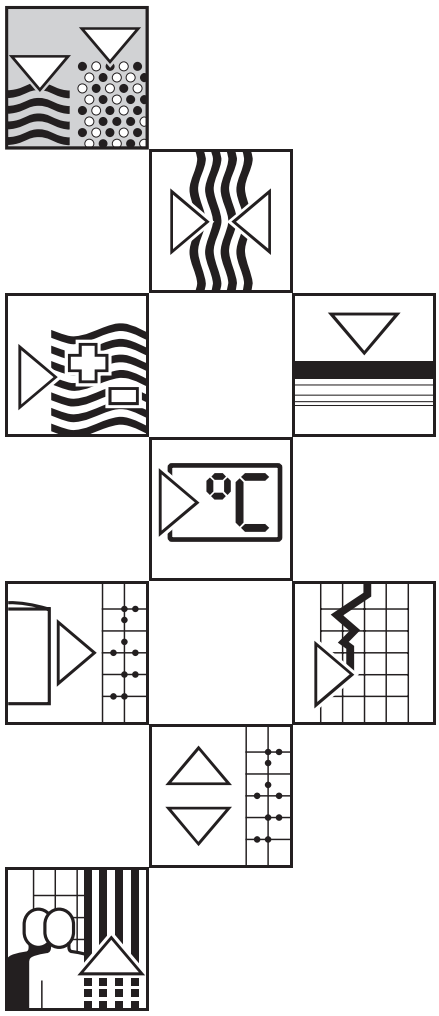
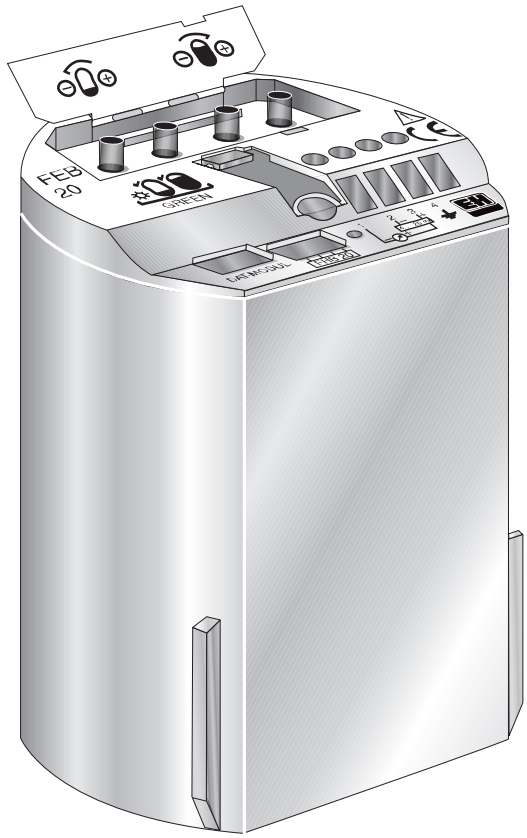
BA 152F/00/en/10.99
Software Version from 2.0
016837-1001

Electronic insert
FEB 20 with INTENSOR Protocol
FEB 22 with HART Protocol

Operating Instructions





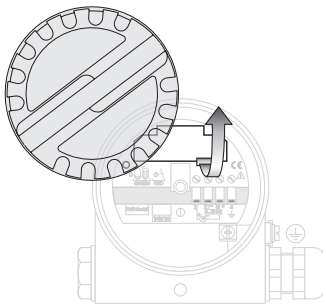
Endress+Hauser

The Power of Know How

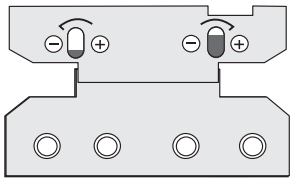
Quick Reference Guide

This quick reference guide enables trained personnel to quickly carry out a standard calibration:
① without the display and operating module
② with the FHB 20 display and operating module plugged in

Warning!
This quick reference guide may only be used by trained personnel who are thoroughly familiar with the BA152F installation and operating instructions.



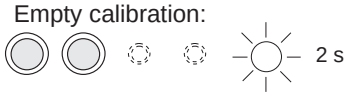
① Operation without display
Key operation



Reset:

Empty and full calibration

Empty calibration:

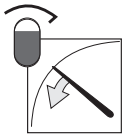


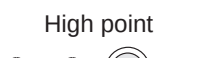
Full calibration:

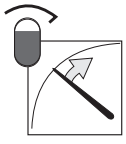
Calibrating a partially filled vessel with an ammeter

Low point

High point



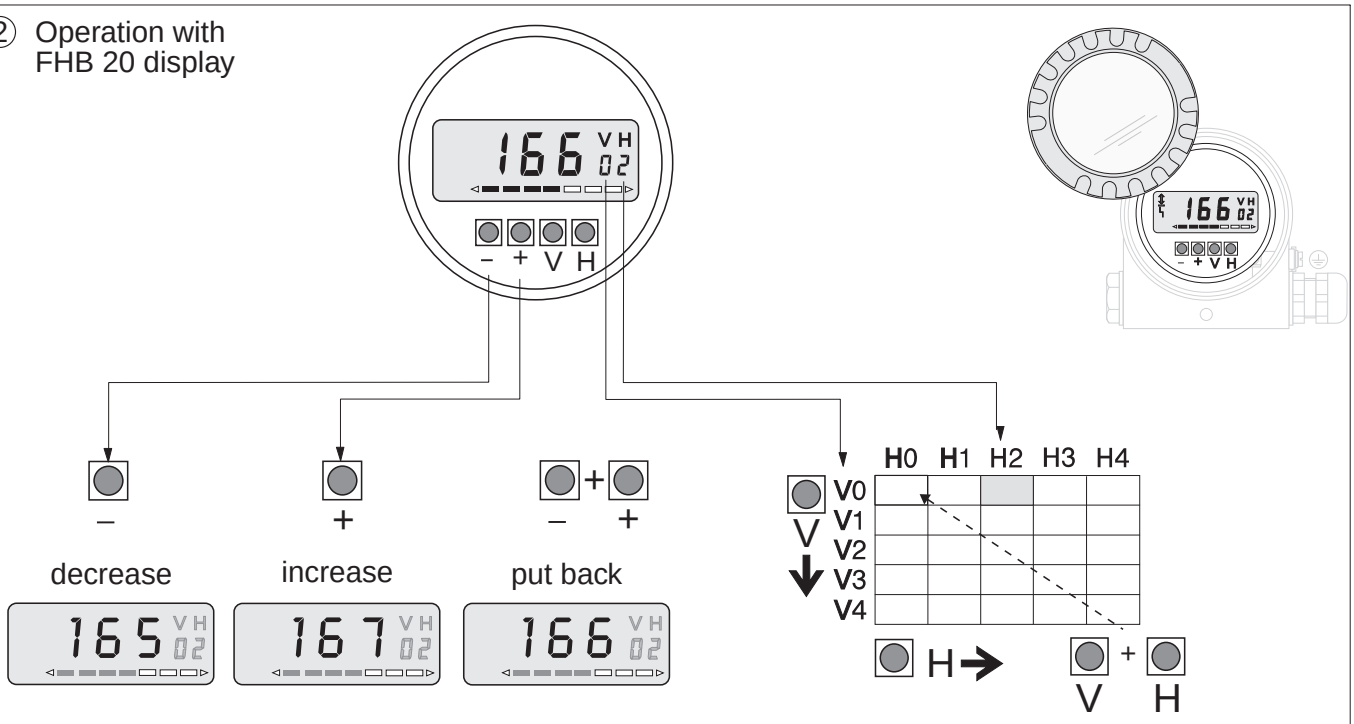




Lock parameters

Unlock parameters

② Operation with FHB 20 display



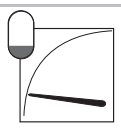
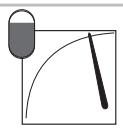
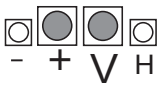
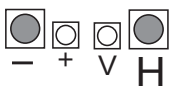
	Keys	Matrix	Input	Confirms entry
Reset:		V9H5	333	V or H
Calibration:		V3H0	Selects calibration mode 0 … level	V or H
		V0H1	 Empty calibration	V or H
		V0H2	 Full calibration	V or H
Current output:		V0H5	 4 mA	V or H
		V0H6	 20 mA	V or H
Lock matrix:		V9H9	≠ 333	V or H
Unlock matrix:		V9H9	 333	V or H

Table of Contents

Software Development

FEB 20 with VU 260 Z

Software version and BA version			Modifications	Remarks
FEB 20	**Instrument and Software No.**	**VU 260 Z**		
1.1	7811	1.7	No changes in documentation.	No up/download between SW 1.x and SW 2.x possible
1.3	7813	1.7		
1.4	7814	1.7		
2.0	7820	1.8	Operating without display: – Calibration via pushbuttons affects matrix field V0H1 »Empty calibration«, V0H2 «Full calibration« and V0H5 »Value for 4 mA«, V0H6 »Value for 20 mA« Operating with matrix: – V0H5/V0H6: Current output can be inverted – V3H7: »Bias pressure« supplemented – V3H6: »Display before bias« supplemented – V0H8: changed to »Display after bias«	

FEB 22 with DXR 275

Software version und BA version			Modifications	Remarks
FEB 22	**Instrument and Software No.**	**DXR 275**		
1.1	7911	Device Revision: 1 DD- Revision: 1	No changes in documentation.	No up/download between SW 1.x and SW 2.x possible
1.3	7913			
1.4	7914			
2.0	7920	Device Revision: 2 DD- Revision: 1	Operating without display: Calibration via pushbuttons affects – »Calibration«: »Empty calibration«, »Full calibration« and »Value for 4 mA«, »Value for 20 mA« Operating with matrix: – »Calibration«: Current output can be inverted – »Extended calibration«: »Bias« supplemented, that's why – »Calibration«: Display before bias« supplemented – »Extended Calibration« »Display after bias« supplemented	

Notes on Safety

Approved usage

The FEB 20 and FEB 22 electronic inserts may be used for continuous hydrostatic level measurement in connection with the hydrostatic probes DB 50, DB 50 L, DB 51, DB 52 and DB 53.
The electronic inserts have been designed to operate safely in accordance with current technical and safety standards and must be installed by qualified personnel according to the instructions in this manual. The manufacturer accepts no responsibility for any damage arising from incorrect use, installation or operation of the equipment. Changes or modifications to the equipment not expressly approved in the operating instructions or by the bodies responsible for compliance may make the user´s authority to use the equipment null and void. Damaged instruments which may be a safety hazard must not be operated and are to be marked as defective.

Use in hazardous areas

When used in explosion hazardous areas, the equipment must be installed in accordance with local regulations as well as with the technical and safety requirements on the measuring point as specified in the accompanying certificates.

Installation and commissioning

Installation, electrical connection, commissioning, operation and maintenance may only be carried out by trained and authorised personnel. The personnel must read and understand these operating instructions before carrying them out.

Operation

The instruments may only be operated by trained personnel authorised by the plant operator. The instructions given in this manual are to be followed exactly.

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.

Electrical symbols

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, will 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.

Safety conventions

	**Device certified for use in explosion hazardous area** If the Deltapilot S 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 areas)** 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.

Explosion protection

	**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

1.1 Application

The FEB 20 and FEB 22 electronic inserts serve as transmitters for the hydrostatic probes Deltapilot S DB 50, DB 50 L, DB 51, DB 52, DB 53. The Deltapilot S family is used for continuous level measurement of liquids and pastes in the chemical, pharmaceutical and food industries as well as in the treatment of water and wastewater.

1.2 Operating Principle

The hydrostatic pressure generated by a column of liquid enables level to be measured continuously with a suitable pressure probe. The Deltapilot S converts the pressure acting on its process diaphragm into an electrical signal: the electronic insert takes this signal and makes it available as a standard 4…20 mA current signal, e.g. for connection to a PLC. In addition, the Smart electronic insert, superimposes a digital communication signal onto the current signal, allowing bi-directional data transfer with a suitable partner. This may be a handheld terminal, the Commutec transmitter Silometer FMX 770, the power unit FXN 671 with connection to a PC via Rackbus or a Commubox FXA 191 with PC and operating program.
Two communication protocols are used (FEB 20 INTENSOR, FEB 22 HART).

1.3 Measuring System

The complete measuring system in its simplest form consists of a Deltapilot S with the Smart FEB 20 or FEB 22 electronic insert.
The overwiew shows all operation possibilities.

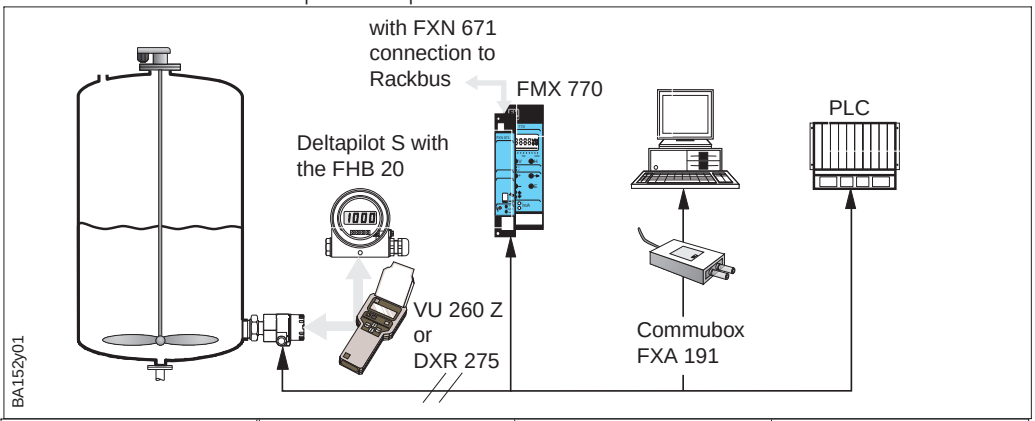


Fig. 1
Operating the Deltapilot S
– Operating directly at the measuring point, optional with display and operating module FHB 20
– Remote operation with handheld terminal
– Operating via the transmitters Silometer FMX 770 or FXN 671 (power unit and transmitter on the Rackbus)
– Operating via Commubox and PC
– Operating via a PLC

Operating mode	Instrument	Documentation	Features
Local **without display** (using the pushbuttons on the electronic insert)		This manual Section 3 Page 10 onwards	– Reset – Empty and full calibration – Locking and unlocking
Local **with display**	FHB 20 display and operating module	Section 4 Page 13 onwards	Full matrix operation – Empty and full calibration – Dry calibration – Linearisation – Adjusting the current output – Zero offset value – Full-scale indication – Locking and unlocking – Simulation
Operation **via communication** (with or without display)	FEB 20: handheld terminal VU 260 Z	BA 028/00/a3	
	FEB 22: Universal HART Communicator	Documentation DXR 275	
	Silometer FMX 770	BA 136F/00/en	
	Rackbus interface card FXN 671	TI 236F/00/en	
	Commubox FXA 191	TI 237F/00/en	

2 Installation

This section describes the electrical connection of the electronic inserts, and gives information regarding the mechanical and technical features required for commissioning and operating the instruments.

2.1 Electrical Connection

Power supply

- Unscrew the cover.
- Remove the FHB 20 display and operating module.
  (If ordered, the display and operating module is supplied already plugged in. This can be prised out to the left using a little pressure.)
- Insert the power cable through the cable entry.
- Connect the cable as shown in the connection diagram.

Screening

- Use screened two-wire installation cable!
- Under certain circumstances the communication signal may be affected if unscreened cabling is used.
- For non-hazardous applications, screening is most effective if grounded at both ends.
- For hazardous applications the screening is to be grounded at one end, preferably at the Deltapilot S probe.

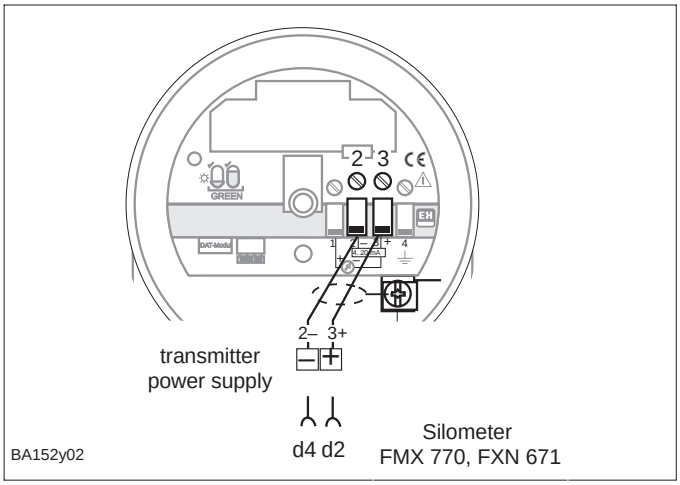


Fig. 2
Electrical connection

FHB 20 display and operating module

- Plug in the connector of the display and operating module – the indexing on the socket ensures correct connection.
- Plug in the display at the desired orientation (steps of 90° are allowed).

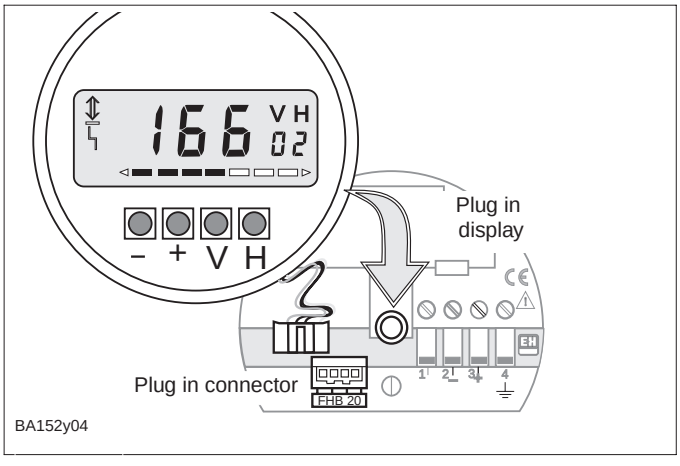


Fig. 3
Mounting the FHB 20 display

DAT module

All non-volatile data concerning the measuring cell are stored in the DAT module. The DAT module is supplied ready-mounted. It is permanently connected to the Deltapilot S housing and cannot be lost.

- If the DAT module has to be exchanged, loosen the looped wire and remove it from electronic insert.
- Plug the new DAT onto the electronic insert and secure the looped wire.

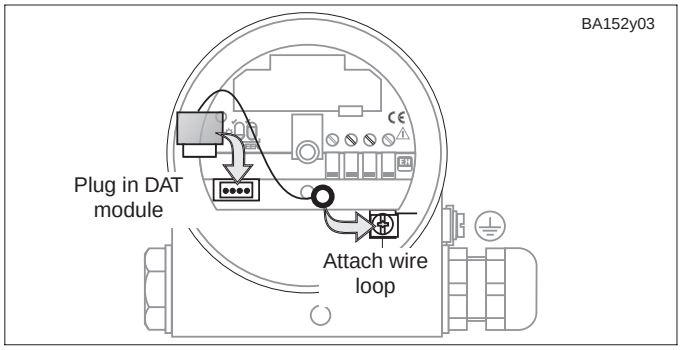


Fig. 4
Replacing the DAT module. The wire loop prevents the DAT from being lost.

Handheld terminals

Connections: – directly to the electronic insert
– at any point in the signal cabling

Caution!

Caution!
There must be a minimum resistance between the connection points and the power supply for error-free transmission of the communication signal.

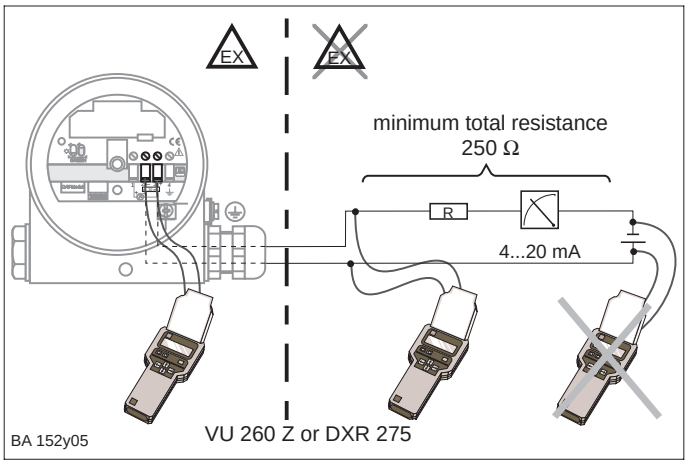


Fig. 5
Connecting a handheld terminal. For Ex applications a suitable power supply or barrier must be used.

Dimensions

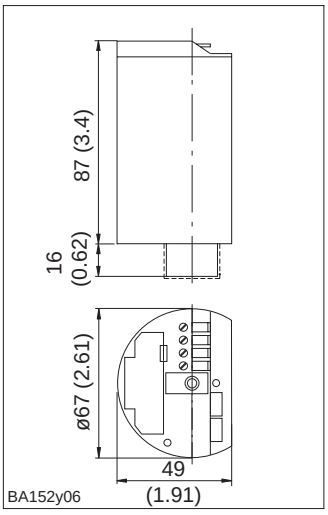


Fig. 6
Dimensions of the FEB 20 and FEB 22 electronic inserts

Dimensions
All dimensions are in mm. Dimensions in brackets are in inch.
1 in = 25.4 mm
1 mm = 0.039 in

2.2 Technical Data

General specifications

Manufacturer	Endress+Hauser
Instrument designation	FEB 20 electronic insert (INTENSOR), FEB 22 (HART)

Input variables

Measured variable	Level using hydrostatic pressure of a column of liquid
Measuring ranges	0…100 mbar (0…1.5 psi) –100…100 mbar (–1.5…1.5 psi) 0…400 mbar (0…6.0 psi) –400…400 mbar (–6.0…6.0 psi) 0…1200 mbar (0…15.0 psi) –900…1200 mbar (–13.0…15.0 psi) 0…4000 mbar (0…60.0 psi) –900…4000 mbar (–13.0…60.0 psi)

Output variables

Output signal	2-wire: 4…20 mA with superimposed digital communication signal
Communication resistance	250 Ω
Load With comm.: Without comm.:	FEB 20 (INTENSOR) 680 Ω, FEB 22 (HART) U_B=30 V, max. 818 Ω U_B=30 V, max. 818 Ω
Overrange signal	Response of the current output: optional 3.6 mA, 22 mA or Hold
Turndown	Calibration range of measuring span 10:1
Zero offset value	90% of measuring range
Integration time	0…99 s, factory setting: 0 s
Integrated overvoltage protection	Protective diodes gas discharger: 230 V Nominal surge current: 10 kA

Measuring accuracy

Reference conditions	25°C
Linearity	Conformity error 0.2% of set measuring range (two-point method to DIN 16086), optional 0.1%
Effect of ambient temperature	0.01% FS/10 K (to DIN 16086)
Hysteresis	± 0.1% FS (to DIN 16086)
Long-term stability	0.1% FS for 6 months (to DIN 16086)

Application conditions
(for Deltapilot probes with integrated electronic insert)

Product temperature range	DB 50, DB 50 L: –10…+100°C (–53…212°F); 135°C (275°F) max. 30 min DB 51, DB 52, DB 53: –10°C…80°C (–53…176°F)
Ambient temperature range	–20…+60°C (–4…140°F) with remote electronics –20…+80°C (–4…176°F)
Limiting temperature range	–40…+85°C (–40…185°F)
Storage temperature range	–40…+85°C (–40…185°F)
Electromagnetic compatibility	Interference immunity to EN 50082–2 and industrial standard NAMUR with 10 V/m, Interference emission to EN 50081–2
Ingress protection	IP 20

Construction

Material	ABS plastic housing, potted electronics
Dimensions	See 2.1 Dimensions

User interface

FHB 20 display and operating module	Four-character LCD, with segment display of current and signal for error indication and communication signal, optional for local display and operation, plug-in unit
Operation	Using four pushbuttons –, +, V, H on the FHB 20 display
Operation without display	Calibration and basic functions using four pushbuttons 0%: –, + and 100%: –, + on the electronic insert
Communication interfaces	Handheld terminal: Connection directly at the current output or any point in the signal line, communication resistance 250 Ω

Power supply

Power supply	11.5…30 V_{DC}
Ripple (Smart devices) Ripple for non-smart devices (within permissible voltage range)	INTENSOR max. ripple (measured at 500 Ω) 0…500 kHz: $U_{pp} \leq 30$ mV HART max. ripple (measured at 500 Ω) 47 Hz…125 Hz: $U_{pp} \leq 200$ mV max. noise (measured at 500 Ω) 500 Hz…10 kHz: $U_{eff.} \leq 2.2$ mV In range 1 Hz…100 kHz max. interference level $U_{pp} \leq 1$ V

3 Operation without Display

This section describes the operation of the Deltapilot S without the FHB 20 display and operating module and without communication. The electronic insert is operated by four pushbuttons. The following entries are possible:
- Reset to factory settings
- Empty and full calibration
- Calibration with a partially filled vessel using an ammeter
- Protecting entries by locking

3.1 Operating Elements

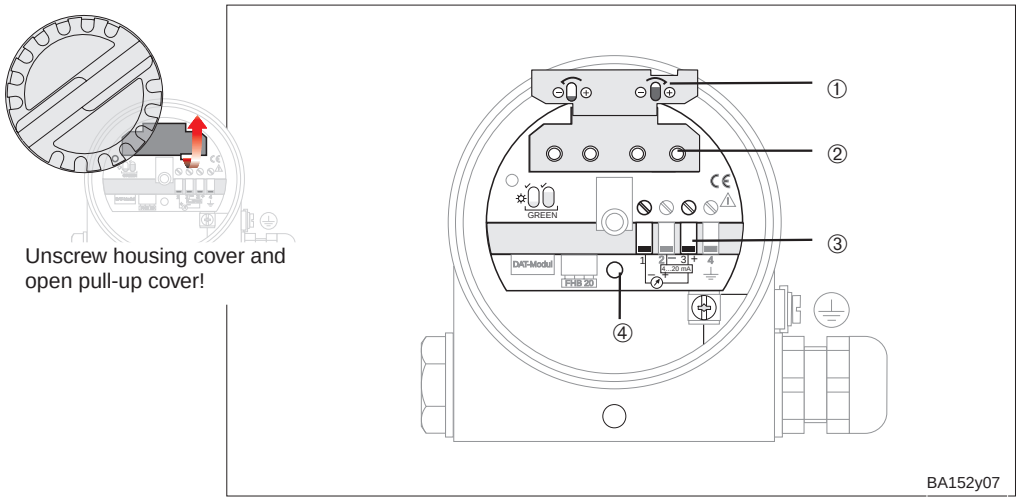


Fig. 7
Operating elements
① Pull-up cover showing pushbutton functions
② Pushbuttons on the electronic insert
③ Connection for ammeter and power supply
④ Green LED flashes to confirm entries

3.2 Reset to Factory Settings

A reset causes the settings of the electronic insert to revert to those set at the factory.

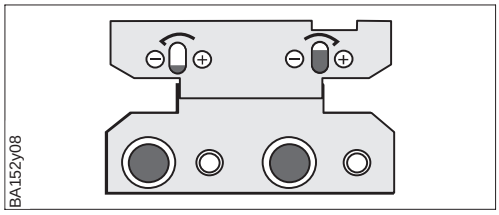


Fig. 8
Pushbutton combination for reset

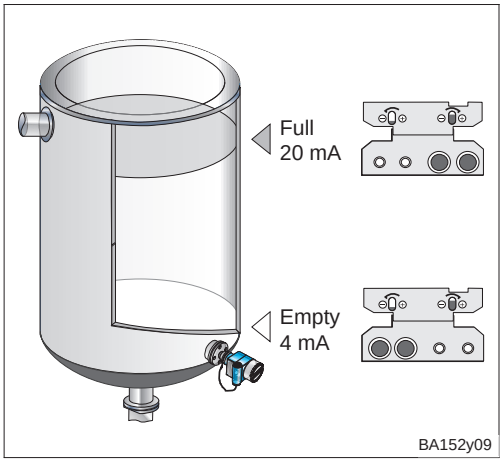
Procedure
- Press the pushbuttons **0%: – and 100%** simultaneously.
- The green LED flashes to confirm the reset.

3.3 Empty and Full Calibration

This calibration mode accurately assigns the 4 mA (0%) and 20 mA (100%) values to the minimum and maximum levels used for calibration.

Preconditions

- The Deltapilot S is in position on the tank.
- The vessel can be filled.



Procedure
Empty calibration

- Fill the vessel exactly to the "empty" calibration point required.
- Press the pushbuttons **0%: – and +** simultaneously.
- The green LED flashes to confirm that the value has been registered.

Full calibration

- Fill the vessel exactly to the "full" calibration point.
- Press the pushbuttons **100%: – and +** simultaneously.
- The green LED flashes to confirm that the value has been registered.

Fig. 9
Empty and full calibration

Result

- A current of 4 mA is assigned to the "empty" calibration point (minimum level).
- A current of 20 mA is assigned to the "full" calibration point (maximum level).

Effects on the matrix

The calibration points are entered in the following matrix fields:
- »Empty calibration« (V0H1) and »Full calibration« (V0H2)
- »Value for 4 mA« and »Value for 20 mA«

3.4 Calibrating a Partially Filled Vessel Using an Ammeter

If the level at two points of a partially filled vessel is known exactly, the electronic insert can be calibrated indirectly using an ammeter.

Preconditions

- The Deltapilot S is in position on the tank.
- The ammeter is connected as shown in Fig. 10.
- The vessel is filled to any known level.
- The corresponding current value is calculated for the particular level.

$$\text{Current value for the particular level} = 4\ \text{mA} + \frac{16\ \text{mA} \cdot \text{particular level}}{\text{maximum level}}$$

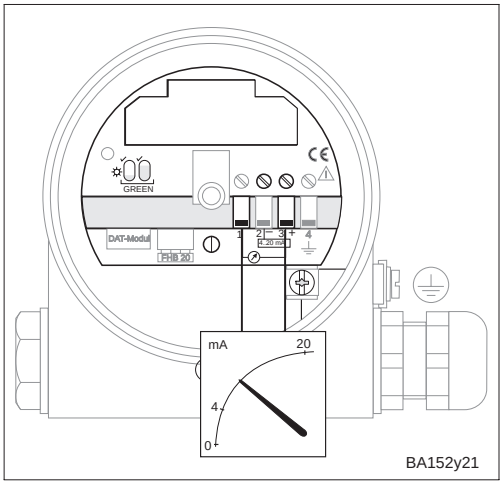


Fig. 10
Connecting the ammeter

Procedure

Example: At the first calibration point the vessel is 20% full. The corresponding current is 7.2 mA.

$$I = 4\,mA + \frac{16\,mA \cdot 20\,\%}{100\,\%} = 7,2\,mA$$

At the second calibration point the vessel is 80% full.
The corresponding current is 16.8 mA.

- Fill the vessel to 20%.
  Set the current exactly to 7.2 mA with the pushbuttons **0%: + or –**.
- Fill the vessel to 80%.
  Set the current exactly to 16.8 mA with the pushbuttons **100%: + or –**.

Note!

Note!
The green LED does **not** flash to confirm your entries during a calibration with a partially filled vessel.

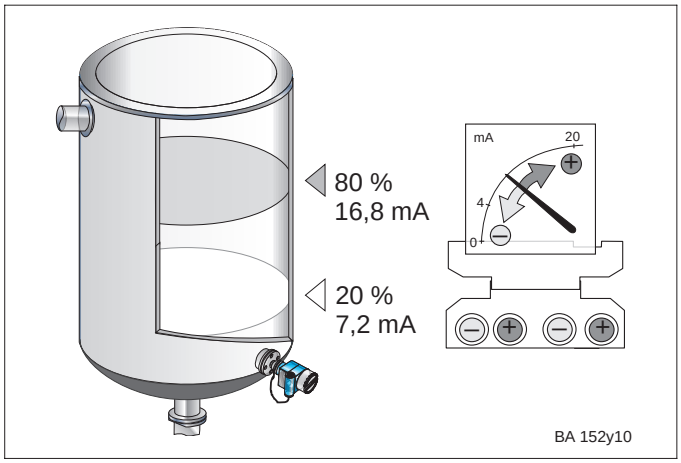


Fig. 11
Calibrating a partially filled vessel

Result

- A current of 4 mA is assigned to the "empty" calibration point (minimum level).
- A current of 20 mA is assigned to the "full" calibration point (maximum level).

Effects on the matrix

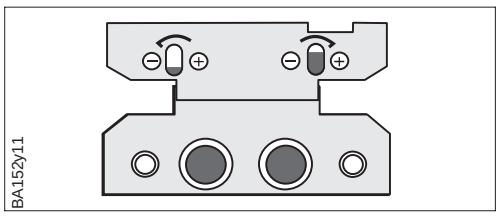
The calibration points are entered in the following matrix fields:

- the level values in »Empty calibration« (V0H1) and »Full calibration« (V0H2)
- the current values in »Value for 4 mA« (V0H5) and »Value for 20 mA« (V0H6)

3.5 Locking / Unlocking

Locking protects your measuring point from unwanted and unauthorised changes to your entries.

Locking



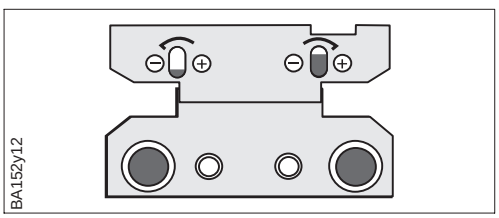
- Press the pushbuttons
  0%: + and 100%: – simultaneously
- The green LED flashes to confirm the locking.

Fig. 12
Pushbutton combination for locking

Caution!

Caution!
If the parameters are locked by simultaneously pressing the pushbuttons at the electronic insert, they can no longer be changed via the communication link. They can be unlocked only at the electronic insert.

Unlocking



- Press the pushbuttons
  0%: – and 100%: + simultaneously.
- The green LED flashes to confirm the unlocking.

Fig. 13
Pushbutton combination for unlocking

4 Operation via the Communication Link

Operating via a communication link is based on a 10 x 10 matrix using the following principles:

- Each row is assigned a function group.
- Each field has one parameter.

The same matrix is used for all settings via:
- FHB 20 display and operating module
- Commulog VU 260 Z handheld terminal (INTENSOR)
- FMX 770 transmitter

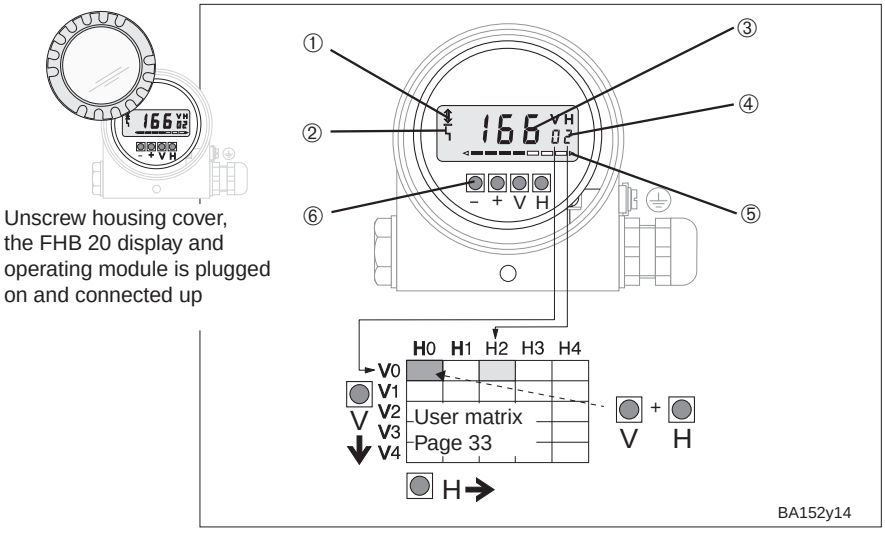
or the Fieldmanager 485 operating program or Commuwin II.

The FEB 22 with the Universal DXR 275 HART Communicator and HART protocol uses an appropriate submenu operated via the matrix.

4.1 Operating Elements

Operation via the FHB 20 is independent of the INTENSOR or HART protocols and is identical for both the FEB 20 and 22 electronic inserts.

Note!
If you have set your transmitter with the FHB 20 display and operating module, then you can remove the display and use it for calibrating other instruments. All entries are saved independently of the display and cannot be lost.

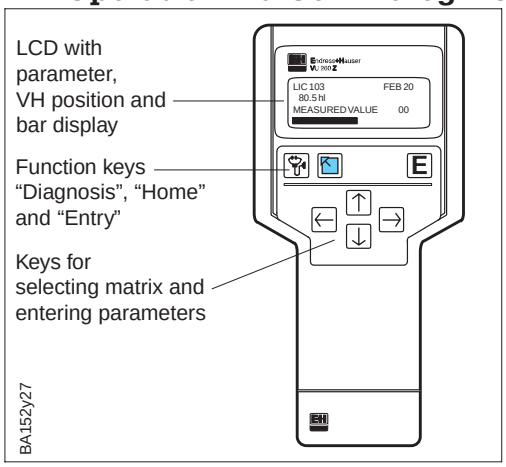


Note!

Fig. 14
User interface of the electronic insert with FHB 20 display and operating module
① Communication signal: lights when the handheld terminals, FMX, FXN etc. are connected
② Signal for error indication
③ Display of measured values and input parameters
④ Actual matrix position
⑤ Bar display of 4…20 mA signal
⑥ Pushbuttons

Pushbuttons	Function
Selecting the matrix field	
V	Selecting the vertical matrix position
H	Selecting the horizontal matrix position
V and H	By simultaneously pressing V and H the display jumps to V0H0
Entering parameters	
+ or –	Activates the appropriate matrix position. The selected position flashes.
+	Changes the value of the flashing position by +1
–	Changes the value of the flashing position by –1
+ and –	Resets the value entered to the original value if it is not yet confirmed.
Confirming the entry	
V or H or V and H	Confirms the entry and leaves the matrix field

4.2 Operation via Commulog VU 260 Z



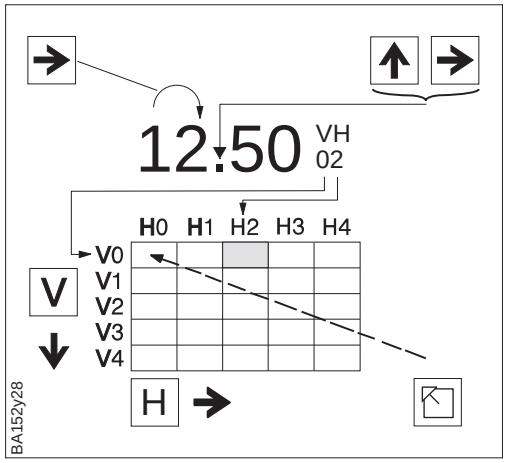
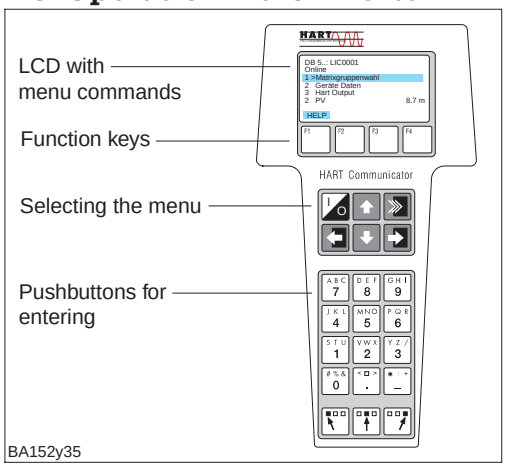


Abb. 15
Operating elements and function keys of the Commulog VU 260 Z handheld terminal

Deltapilot S with an electronic insert FEB 20 (INTENSOR) can be set via the Commulog VU 260 Z handheld terminal (from Version 1.7), see also the Operating Instructions BA 028F.

- Select the matrix field with ↑, ↓, →, ←
- Call up the input mode with E
- Enter parameters with ↑, ↓, →, ←, E
- On error ⚠ calls up the error indication in plain text.

4.3 Operation via Universal HART DXR 275 Communicator



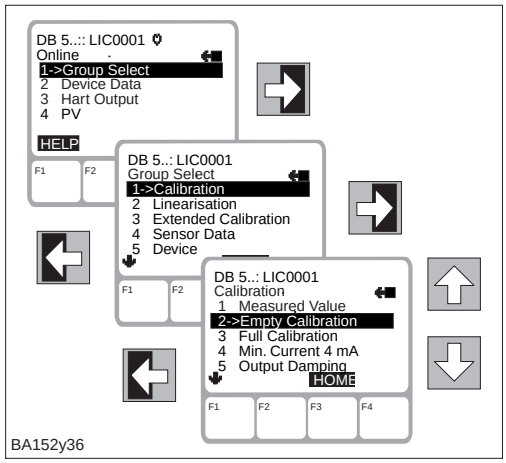


Abb. 16
Operating elements and function keys of the DXR 275 handheld terminal

Deltapilot S probes with the FEB 22 (HART) electronic insert can be set using the DXR 275 HART handheld terminal, see operating instructions supplied.

- The menu "Group Select" calls up the matrix.
- The lines show menu headings.
- Parameters are set using submenus.

4.4 Instructions for Operating via the Handheld Terminal

Information concerning operation via the handheld terminal are indicated by the pictogram on the left.

5 Basic Settings

This section describes settings required for commissioning a Deltapilot S with the FEB 20 or FEB 22 electronic insert.
- Reset to factory settings (Reset)
- Empty and full calibration or dry calibration
- Setting the current output (4…20 mA)

5.1 Position Correction

The position of the sensor can cause the pressure display to show slight shifts at the zero point. The sensor may not indicate a zero but slight pressure (±2 mbar) when the vessel is empty. This inexact reading can be corrected in matrix field V3H7.
The value to be corrected is to be found in matrix field V3H6 (display of sensor pressure before position correction).

Procedure

Step	Matrix	Entry	Significance
1	V3H6		Read value (e.g. 0.23)
2	V3H7	e.g. 0.23	Corrects the pressure value shown by 0.23
3		V or H	Confirms entry

Result

The pressure sensor entered is subtracted from the sensor pressure – the main pressure value is shown as zero.

Measured Values

V0H0: Main measured value
V3H6: Display of sensor pressure before bias pressure
V0H8: Display of sensor pressure after bias pressure

5.2 Reset to Factory Settings (Reset)

When starting up for the first time, all matrix fields should be reset to factory values. The factory settings can be found in the matrix for "Factory Settings" on page 33. Your entries can also be written on this matrix.

Step	Matrix	Entry	Significance
1	V9H5	333	Resets values to factory settings
2		V or H	Confirms entry

Not affected by the reset are:
- linearisation curve
- stored values of the full-scale function
- fields in which technical units have been selected
- Tag-No.

These values can be directly deleted in the matrix field.

5.3 Empty and Full Calibration

Empty and full calibration identify the minimum and maximum level required.

Preconditions

- The Deltapilot S is in position on the tank.
- The vessel can be filled.

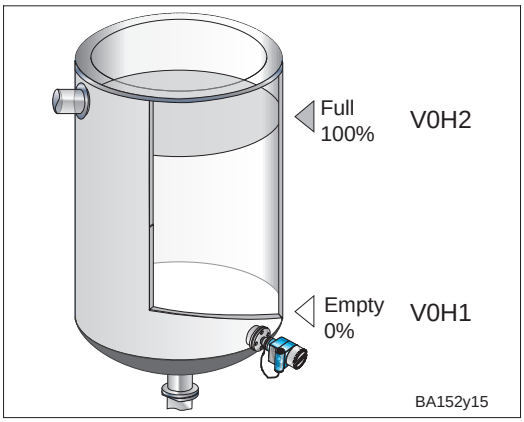


Fig. 17
Empty and full calibration

Procedure

Step	Matrix	Entry	Significance
1	V3H0	0	Selects calibration mode "level"
2		V or H	Confirms entry
3	V0H1	e.g. 0	The vessel is empty. The actual level (e.g. 0%) corresponds to the "empty" calibration point.
4		V or H	Confirms entry
5	V0H2	e.g. 100	The vessel is filled. The actual level (e.g. 100%) corresponds to the calibration point "full".
6		V or H	Confirms entry

Result

- The measured value is shown in matrix field V0H0 in the units of the calibration.
- All other entries, e.g. current output, linearisation etc. must be in the same units as the calibration (e.g. in m).

When operating via the handheld terminal, the units of the calibration are shown in the display if they have first been selected in matrix field VAH2.

Zero offset value

The calibration point "empty" can be shifted by entering an offset. The measured value in V0H0 is corrected by the value entered.

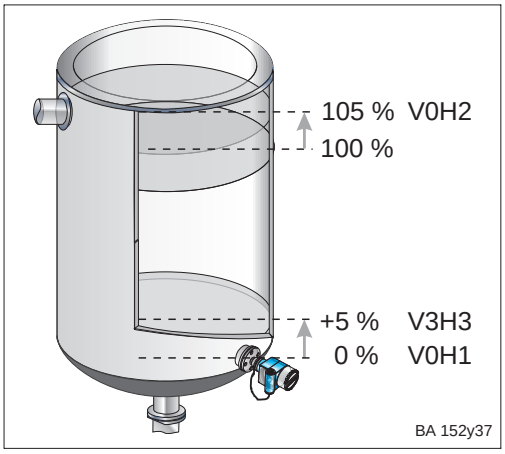


Fig. 18
Example
The display should read 0% about 5% above the original point of empty calibration. The difference of +5% is entered as a zero offset value in V3H3. +5% is now substracted from the measurement and the result displayed in V0H0.
Note: The position of the 100% point is also shifted by +5% – this should be taken into account when selecting the full calibration point.

Step	Matrix	Entry	Significance
1	V3H3	5	Calibration point "empty" in V0H1 is shifted by +5%. Make the full calibration at a point +5% more than actually required.
2		V or H	Confirms entry

Note!
- The zero offset value is in the same units as the calibration
- Further entries relate to the zero offset value

Note!

5.4 Density Correction

If the calibration is carried out with water or the product changes, then correct your calibration values by simply entering a density factor.

$$\text{Density factor} = \text{actual factor} \cdot \frac{\text{new density}}{\text{old density}}$$

Determination of the density factor

Example: A vessel is filled with water and calibrated. The density of water (previous density) is 1 g/cm³. The vessel is then later used as a storage tank and filled with a new product to be measured. The new density is now 1.2 g/cm³.
The factory setting of 1 g/cm³ is still stored in V3H2, i.e. the actual factor is 1 g/cm³.

$$\text{Density factor} = 1\,\text{g/cm}^3 \cdot \frac{1{,}2\,\text{kg/cm}^3}{1\,\text{kg/cm}^3} = 1{,}2\,\text{kg/cm}^3$$

Procedure

Step	Matrix	Entry	Significance
1	V3H2	1,2	Calibrated values are adjusted to the new product.
2		V or H	Confirms entry

Result

The measured value in V0H0 is divided by the density factor and the level measured correctly for the new product.
A density factor is entered for level measurement.
If you want to measure the volume using a linearisation curve, first enter the density factor and then the linearisation curve.

5.5 Dry Calibration

Dry calibration is a theoretical calibration which can be carried out using Deltapilot S not mounted or using an empty vessel.
The calibration point "empty" is always at the mounting point of the probe. It does not need to be entered. A zero offset value can be carried out if the measurement begins at another height.

Preconditions

- The level for the calibration point "full" is known.
- The density factor is known.

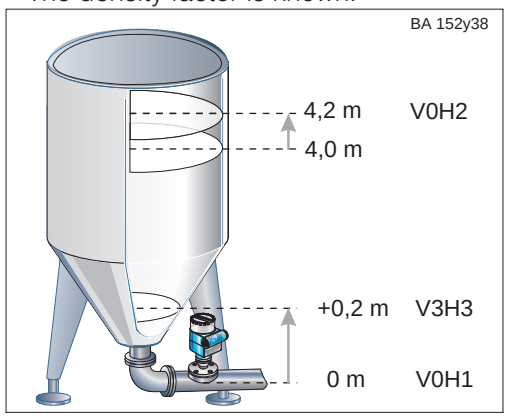


Fig. 19
Example
Dry calibration with zero offset value when Deltapilot S mounted at the tank outlet:
The display should read 0 m about 0.2 m above the original point of empty calibration. The difference of +0.2 m is entered as a zero offset value in V3H3. +0.2 m is now substracted from the measurement and the result displayed in V0H0.
Note: The position of the 100% (=4 m) point is also shifted by +0.2 m – this is taken into account when selecting the full calibration point (= 4.2 m), i.e. span = 4.0 m.

Two calibration modes are possible:
– Measured value in technical units selected or measured value in %

Procedure

Step	Matrix	Entry	Significance
1	V3H0		Selects calibration mode "dry calibration":
		1	Display shows technical units selected
2		V or H	Confirms entry
3	V3H1	e.g. 0	Units for the dry calibration e.g. m
4		V or H	Confirms entry
5	V3H2	e.g. 1.2	Enters density factor e.g. 1.2 for 1.2 kg/m3
6		V or H	Confirms entry
7	V3H3	0.2	The calibration point "empty" set by the installation point of the probe is shifted by 0.2 m.
8		V or H	Confirms entry
9	V0H2	e.g. 4.2	Entry maximum level "full" e.g. 4.2 m The value takes into account the subsequent zero offset value
10		V or H	Confirms entry

If the correction mode "Level" (V3H0 - setting 0) is switched to "Dry Calibration H" (V3H0 - setting 1) or "Dry Calibration %" (V3H2 - setting 2), then the matrix fields "Density Factor" (V3H2) and "Zero Offset Value" (V3H3) are reset.

Zero offset value

Note!

Note!
The values of the zero offset value and the maximum level are always entered in the selected length units.
All other entries are then related to this zero offset value.

Correcting the dry calibration after mounting

After a dry calibration, initial filling of the vessel should be supervised in all cases to immediately identify any errors or inaccuracies.
By using the "normal calibration" mode V3H0: 0, you can correct entries or fine tune them. Any corrections must be in the same technical units of the calibration.

Step	Matrix	Entry	Significance
1	V3H0	0	Calibration mode "level"
2		V or H	Confirms entry
3	V0H2	e.g. 4.5	The vessel is filled to 4.5 m.
4		V or H	Confirms entry

5.6 Setting the Current Output

The FEB 20 has a 4…20 mA current output which can be assigned to any value to be displayed in V0H0. The following entries are possible for setting the current output:

Matrix	Entry	Significance or other information
V0H5	4 mA value in the units of the calibration *Factory setting: 0*	*Measuring range spread (turndown)* Any 4 mA and 20 mA within the calibrated range can be set, i.e. turndowns are possible. *Inverse (inverted current output)* The current output can also be inverted, whereby the signal current decreases with increasing measured values.
V0H6	20 mA value in the units of the calibration *Factory setting: 100*	
V0H3	4 mA threshold 0: off (3,8…20 mA) 1: on (4…20 mA) *Factory setting: 0*	This sets the minimum value of the current output which is permissible under normal operating conditions. A value of 3.8…20 mA is useful for e.g. unsteady displays or a measuring range spread. In this case the current can fall slightly below the 4 mA threshold without causing an error.
V0H4	Output damping (0…99 s) *Factory setting: 0*	The integration time affects the speed at which the current output and the display V0H0; V0H8; V0H9 react to changes in level. By increasing the integration time, the effects of agitated liquids on the display (V0H0, V0H8, V0H9) and the full-scale functions can be dampened.
V0H7	Output on fault 0: Min. = 3.6 mA 1: Max. = 22 mA 2: Hold (last valid current value held) *Factory setting: 1*	The current output adopts the value selected by the user for indicating an error.

Procedure

Step	Matrix	Entry	Significance
1	V0H5	e.g. 0	Enters the level for 4 mA (e.g. 0%)
2		V or H	Confirms entry
3	V0H6	e.g. 100	Enters the level for 20 mA (e.g. 100%)
4		V or H	Confirms entry
5	V0H4	e.g. 30	The integration time should be 30 s, e.g. with very agitated liquids.
6		V or H	Confirms entry
7	V0H7	1	On error the current goes to 22 mA.
8		V or H	Confirms entry

Result

- A current of 4 mA is assigned to the calibration point "empty" (minimum level)
- A current of 20 mA is assigned to the calibration point "full" (maximum level)
- If you want to enter a linearisation curve after the basic settings, the entries must be made before the current output is set.

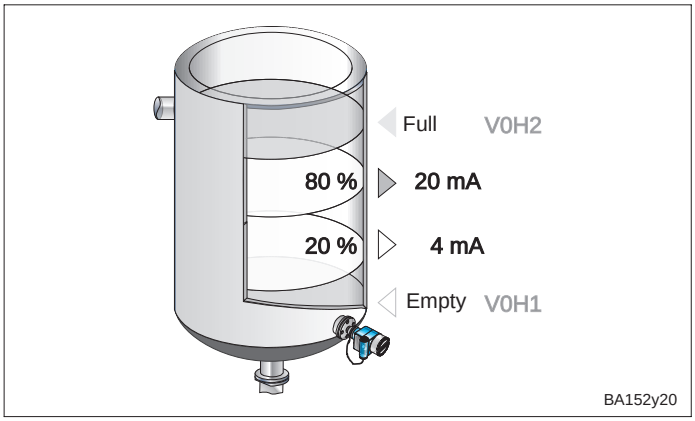


Fig. 20
Setting the current output
Measuring range spread:
The 4 and 20 mA can also be assigned to part of the measurement range.

6 Other Settings

This section describes the functions of the FEB 20 and FEB 22 electronic inserts which may be used in basic operation but are not necessary for all applications.
- Linearisation
- Pressure and differential pressure measurement
- Locking

6.1 Linearisation

For tanks and vessels in which the volume is not directly proportional to the level, the volume can be determined from the level by using a linearisation curve.

Entry V2H0	Linearisation mode	Significance
0	Linear (factory setting)	The vessel is linear, e.g. standing cylindrical tank. If calibration is to be carried out in volumetric units, then the measured value can be read off in volumetric units without any further entries.
2	Manual entry	For a linearisation curve, enter max 11 pairs of values for a particular level and its corresponding volume.
3	Semi-automatic entry of a linearisation curve	With semi-automatic entry of a linearisation curve, the tank is filled or emptied during calibration. The Deltapilot S automatically determines the level via the hydrostatic pressure and the appropriate volume is then entered.
V2H0 also offers the functions:		
1	Activate table	A linearisation table which has been entered is only effective if it is also activated!
4	Delete table	Any existing table must first be deleted before entering another linearisation table. The linearisation mode then jumps automatically to »Linear«.

1. Manual Entry of a Linearisation Curve

Preconditions

- Pairs of values for points on the linearisation curve are known.
- The linearisation curve must rise continuously.
- The first and last points of the linearisation curve must correspond to empty and full calibration levels.
- The linearisation curve is entered out in the units of the basic calibration.

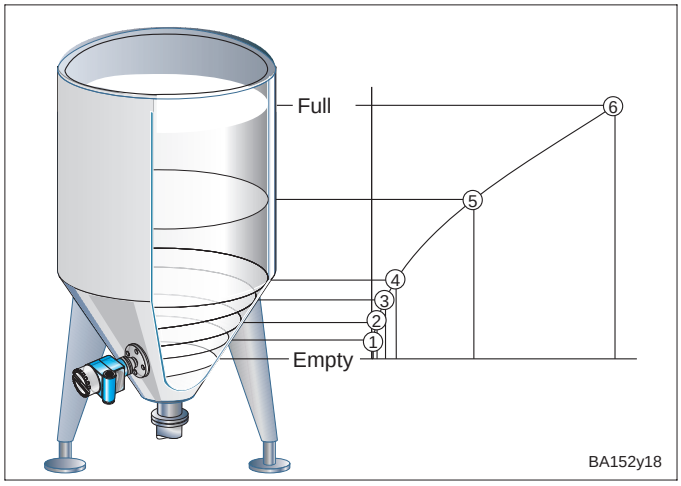


Fig. 21
Entering a linearisation curve for a vertical cylindrical tank with conical outlet.
Please note!
– A maximum of 11 points may be entered.
– The first point should be at the same height as the probe. This corresponds to empty calibration.
– The last point should be at the same height as the maximum level. This corresponds to full calibration.

Procedure

Step	Matrix	Entry	Significance
1	V2H0	4	Existing linearisation curve is deleted.
2		V or H	Confirms entry
3	V2H0	2	Selects linearisation mode»manual«
4		V or H	Confirms entry
5	V2H1	1	First pair of values of the linearisation curve
6		V or H	Confirms entry
7	V2H2	e.g. 0	Level for Point 1 (e.g. 0 m = empty calibration)
8		V or H	Confirms entry
9	V2H3	e.g. 0.6	Volume for Point 1 of the linearisation curve e.g. 0.6 m^3
10		V or H	Confirms entry
11	V2H1	2	Second pair of values of the linearisation curve
12	V2H2	…	…
	After entering all pairs of values		
44	V2H0	1	Activates table
	Set current output see 5.6 Setting Current Output		

Result

- The volume is given in V0H0.
- The level can be read in V0H9.

When operating via the handheld terminal, the units of linearisation are shown in the display if they are first selected in matrix field VAH3.

Note!

- If a manual linearisation is carried out and set in "Level" V3H0 (setting 0), then the values entered in m are adopted. If there is a switch over to "Dry Calibration H" V3H0 (setting 1), and the units changed in V3H1, then the value entered is converted into the new units.
  If linearisation is immediately carried out in, e.g. cm, then the units must first be defined in V3H1. The matrix field V3H1 is, however, only opened in the "Dry Calibration H" mode V3H0 (setting 1).
- For "Dry Calibration H" V3H0 (setting 1) or for manual linearisation V2H0 (setting 2) the values in V0H2 or V2H2 refer to the units selected in V3H1. If the setting 0 "Level" is entered in V3H0 with manual linearisation, then the value is shown in % in V2H2 and V0H0.

Note!

Warnings:

When entering vessel characteristics, the symbol for error indication lights up and the current output indicates an error.

- **E 605:** Manual linearisation incomplete.
  When vessel characteristic curve is activated the error indication disappears .

After entering values, the linearisation curve is checked for plausibility.
The following warnings may occur:

- **W 602:** The linearisation curve does not rise continuously.
  The number of the last correct pair of values is shown in V2H1. All value pairs from this value must be reentered.
- **W 604:** The linearisation curve consists of less than two pairs of values.
  Increase the number of pairs of values.

2. Example:
Linearisation Curve for a Horizontal Cylindrical Tank

By using the example, it is possible to calculate a linearisation curve for any horizontal cylindrical tank.

Procedure

- With an empty tank the level is 0%, with a completely filled tank the level is 100%.
- The level is entered in 10% steps.
- The volume for the completely filled tank is 100%.
  The percentage entries for the volume are assigned to each 10% step.
  – Calculate the corresponding volume for each 10% step using a completely filled tank.

$$\text{Volume for x\% level} = \frac{\text{Totalvolume} \cdot \text{Volume(\%)}}{100}$$

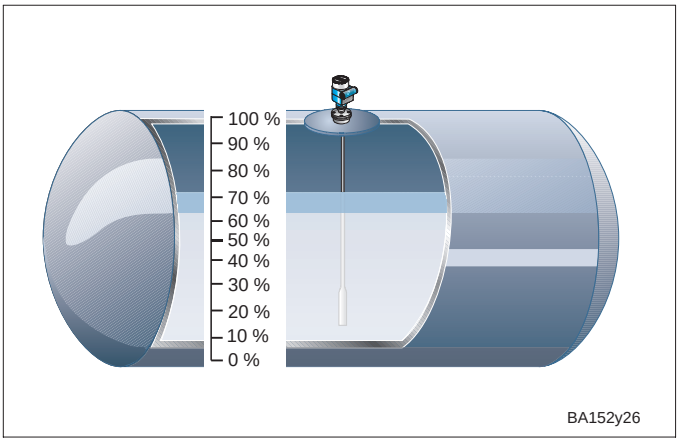


Fig. 22
Entering a linearisation curve for a horizontal cylindrical tank. The first point (0%) and the last point (100%) refer to the floor and the roof of the tank.

Line No.	Level V2H2		Volume V2H3	
V2H1	%	User value	%	User value
1	0		0	
2	10		5.20	
3	20		14.24	
4	30		25.23	
5	40		37.35	
6	50		50.00	
7	60		62.65	
8	70		74.77	
9	80		85.76	
10	90		94.79	
11	100		100	

3. Semi-Automatic Linearisation Curve

The vessel can be filled e.g. for calibration and empired step-by-step for linearisation. The level is automatically determined via the hydrostatic pressure and the corresponding volume entered.

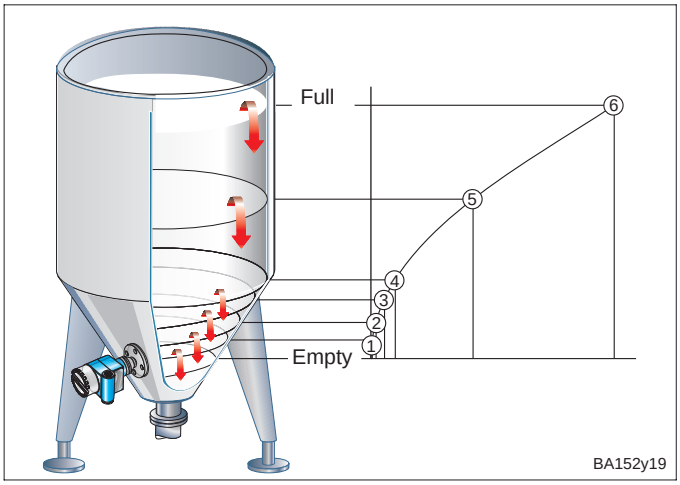


Fig. 23
Semi-automatic entry of a linearisation curve

Procedure

Step	Matrix	Entry	Significance
1	V2H0	4	Existing linearisation curve is deleted.
2		V or H	Confirms entry
3	V2H0	3	Linearisation mode "semi-automatic" is selected
4		V or H	Confirms entry
5	V2H1	6	Selects first pair of values of the linearisation curve
6		V or H	Confirms entry
7	V2H2	8	The level of Point 6 is automatically determined by hydrostatic pressure. (e.g. 8 m = full calibration)
8	V2H3	32	The volume for Point 6 is entered. This is e.g. 32 m^3.
9		V or H	Confirms entry
10	V2H1	5	Second pair of values of the linearisation curve
		V or H	Confirms entry
11	V2H2	…	…
	After entering all pairs of values e.g. 6…1		
38	V2H0	1	Activates table
	Set current output see 5.6 Setting Current Output		

Result

- The volume is shown in V0H0.
- The level before linearisation is shown in V0H9.

Note!

When operating with the HART handheld, the current level cannot be read from the »Enter level« field in the linearisation menu. The message »Parameter invalid« appears.
Despite this error message, the linearisation is correct. The level can be checked by selecting the »Level« hidd in the basic calibration menu (= matrix field V0H9).

Note!

6.2 Pressure and Differential Pressure Measurement

In the calibration pressure mode, the pressure acting on the Deltapilot S is shown in V0H0. The differential pressure at filters, for example, can be measured in pressurised tanks using two Deltapilot S probes.

Note!

Note!
The calibration for the "pressure" mode is carried out without a reference pressure. The calibration points "empty" (4 mA) and "full" (20 mA) are entered.

Pressure Measurement

Preconditions

- The Deltapilot is mounted.
- The following units of pressure can be selected in V3H4:

0: mbar	4: psi	8: MPa	12: g / cm^2
1: bar	5: ft H_2O	9: hPa	13: kg / cm^2
2: m H_2O	6: in H_2O	10: mm Hg	14: lb / ft^2
3: mm H_2O	7: Pa	11: in Hg	15: kgf / cm^2

Procedure

Step	Matrix	Entry	Significance
1	V3H0	3	Select the calibration mode "pressure"
2		V or H	Confirms entry
3	V3H4	e.g. 2	Select a unit of pressure e.g. m H2O
4		V or H	Confirms entry
5	V0H5	e.g. 0	Enter minimum pressure (=4 mA)
6		V or H	Confirms entry
7	V0H6	e.g. 20	Enter maximum pressure (=20 mA)
8		V or H	Confirms entry

Result

- The pressure is shown in V0H0.

Note!

Note!
If the units of pressure in V3H4 are changed after the calibration, the electronic insert calculates all values in the new units. Recalibration is thus not required.

Differential Pressure Measurement

Preconditions

- Two Deltapilot S probes must be mounted
  - Probe ① measures the total pressure (hydrostatic pressure and head pressure).
  - Probe ② measures only the head pressure.
- The ratio of hydrostatic pressure and head pressure should be a maximum 1:6.

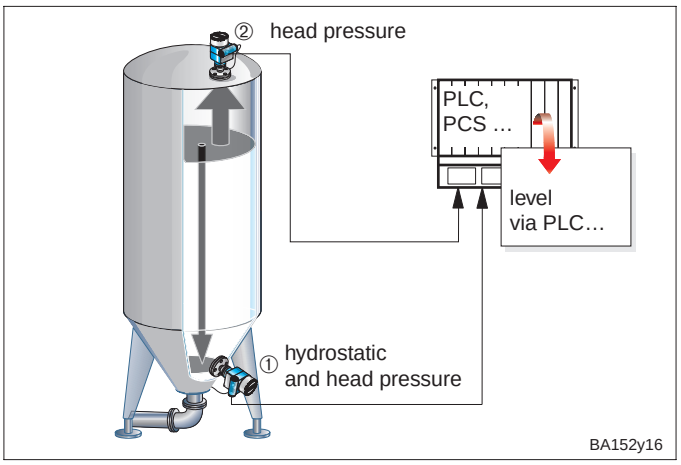


Fig. 24
Differential pressure measurement in a pressurised tank

Caution!

- The measuring diaphragm of Probe ② may not be immersed as this creates an additional hydrostatic pressure which falsifies measurement.

1. Calibration probe ① (hydrostatic pressure and head pressure)

Procedure

Step	Matrix	Entry	Significance
1	V3H0	3	Selects calibration mode "pressure"
2		V or H	Confirms entry
3	V3H4	e.g. 0	Selects units of pressure e.g. mbar
4		V or H	Confirms entry
5	V0H5	e.g. 0	Enter minimum pressure (=4 mA)
6		V or H	Confirms entry
7	V0H6	e.g. 1500	Enter maximum pressure (=20 mA) Maximum head pressure 1000 mbar + 500 mbar hydrostatic pressure at approx. 5 m water column
8		V or H	Confirms entry

2. Calibration probe ② (head pressure)

Caution!
The current output of both Deltapilot probes must be assigned the same pressure range.
This means that although the maximum head pressure is 1000 mbar, 1500 mbar must still be assigned to the 20 mA value as for Probe ①.


Caution!

Step	Matrix	Entry	Significance
1	V3H0	3	Selects calibration mode pressure
2		V or H	Confirms entry
3	V3H4	e.g. 0	Selects a unit of pressure e.g. mbar
4		V or H	Confirms entry
5	V0H5	e.g. 0	Enter minimum pressure e.g. 0 mbar (=4 mA)
6		V or H	Confirms entry
7	V0H6	e.g. 1500	Enters the maximum pressure e.g. 1500 mbar (=20 mA)
8		V or H	Confirms entry

Result

- The difference between the total pressure and the head pressure is calculated for the entire system resulting in the level.
- The pressure acting directly on the each of the Deltapilot S probes can be read in V0H0 (Deltapilot ①: hydrostatic pressure and head pressure; Deltapilot ②: head pressure).

6.3 Locking / Unlocking

The matrix can be locked after all parameters have been entered:
- via the keyboard on the display and operating module FHB 20 or
- via the matrix by entering a three character code number ≠ 333
  (333 is the code number for unlocking the measuring point)

The measuring point is thus protected from unwanted and unauthorised changes to your entries.

1. Locking via the keyboard

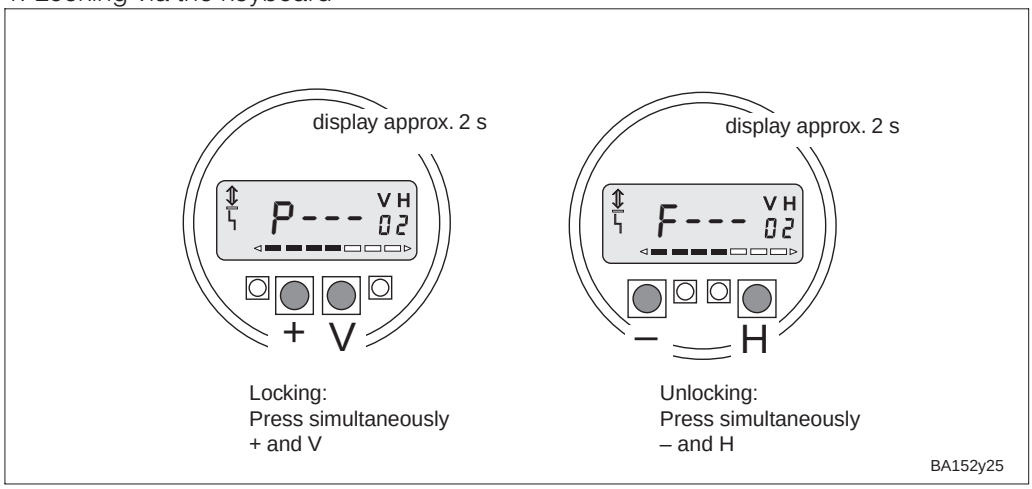


Fig. 25
Locking via the keyboard

2. Locking and unlocking via the matrix

Locking

Step	Matrix	Entry	Significance
1	V9H9	e.g. 332	All matrix fields except for V9H9 are locked.
2		V or H	Confirms entry Entries can be read but not changed.
	9999 is shown in V9H9		

Unlocking

Step	Matrix	Entry	Significance
1	V9H9	333	Cancels locking
2		V or H	Confirms entry Locking of the matrix field is cancelled.
	333 is shown in V9H9		

Note!

Note!
If the FEB 20 without display is locked with the pushbutton combination **0%: + and 100%: –**, then the all matrix operations and Field V9H9 is locked. This can only then be cancelled without the display by the pushbutton combination **0%: – and 100%: +**; or with the display by **– and H**. (See also 3.5 Locking without Display.)

7 Information on the Measuring Point

The following information can be called up:

Measured values

Matrix field	Display or entry
V0H0	Main measured value Unit selectable: if V2H0=1 in VAH3, if V2H0=0 and V3H0=0 in VAH2, if V2H0=0 and V3H0=1 in V3H1)
V0H8	Sensor pressure (units selectable in V3H4)
V3H6	Sensor pressure before bias (units selectable in V3H4)
V0H9	Level before linearisation (Unit selectable: if V3H0=0 in VAH2, if V3H0=1 in V3H1)
V9H8	Output current (mA)

Sensor data

V7H0	Lower measuring limit of the sensor (units selectable in V3H4)
V7H1	Upper measuring limit of the sensor (units selectable in V3H4)
V7H3	Actual sensor temperature (units selectable in V3H5)

Information about the measuring point

V9H3	Instrument and software numbers

Error responses

V9H0	Actual diagnostic code number
V9H1	Last diagnostic code number

Full-scale function

The full-scale function enables the largest pressure or temperature measured to be date to be called.

Matrix field	Display
V7H2	Maximum pressure (units selectable in V3H4)
V7H4	Maximum temperature (units selectable in V3H5)

Note!
The units of pressure and temperature are selected in matrix fields V3H4 and V3H5. Note that a change in the units in matrix field V3H4 affects all entries for pressure.

Note!

The values of the full-scale function are not effected on reset. They can, however, be reset to the current value in matrix field V7H2 and V7H4.

Step	Matrix	Entry	Significance
1	V7H2	Vor H	Resets maximum pressure to actual value

Step	Matrix	Entry	Significance
1	V7H4	Vor H	Resets maximum temperature to actual value

Special interrogation using a handheld terminal FMX 770, FXN 671 etc.

The matrix line "VA Communication" can only be called up and calibrated via the communication procedure (handheld terminal, FMX 770, FXN 671 etc.).

VAH0	Measuring point tag. The measuring point can be specified by a max. 8-character (ASCII) tag.
VAH2	Selects units before linearisation
VAH3	Selects units after linearisation
VAH5	Serial number of the instrument
VAH6	Sensor pressure at empty calibration (unit selectable in V3H4)
VAH7	Density factor at empty calibration
VAH8	Sensor pressure at full calibration (unit selectable in V3H4)
VAH9	Density factor at full calibration

7.1 Diagnosis and Troubleshooting

Error

If the FEB 20 or FEB 22 identifies a fault, then:
- the error signal on the display lights up.
- the current output assumes the value selected for error indication (min: 3.6 mA, max.: 22 mA or hold – the last valid measured value is held).
- the last error code can be read in V9H1, the actual error code can be read in V9H0.

Warning

If the FEB 20 or FEB 22 identifies a warning:
- the error signal flashes on the display, the electronic insert continues to measure.
- the last error code can be read in V9H1, the actual error code can be read in V9H0.

Error codes

- The actual error code can be read in V9H0.
- The last error code can be read in V9H1.

Code	Type	Cause and remedy
E 101 **E 114** **E 117** **E 121**	Error	Electronic instrument error – Contact Endress+Hauser Service.
E 106	Error	Up-Download activated – Wait until the procedure is complete.
E 110	Error	Transmitter data not saved – Carry out reset.
E 112	Error	Connection with DAT module faulty – Check whether the sensor and the DAT module are correctly connected.
E 116	Error	Download error – Carry out either another download with corrected data or else a reset. (Please observe the notes on resetting on page 17)
E 122	Error	Control signal cabling broken – Check the sensor connection. If the error remains, then contact Endress+Hauser Service.
E 125	Error	Signal transmission or understepping – Check the sensor connection. If the error remains, then contact Endress+Hauser Service.
E 605	Error	Manual linearisation curve incomplete (shown when entering the table) – Activate the linearisation curve after entering all points.
E 610	Error	Calibration error, same pressure value for V0H1 and V0H2 – Check calibration.
W 102	Warning	Error with maximum indicator – Reset the device (Please observe the notes on resetting on page 17)
W103	Warning	Initialisation in progress, lasts approx. 6 s – If error remains, the initialisation cannot be started.
W 602	Warning	Vessel characteristic does not rise continuously – Check the plausibility of the manual characteristic curve. Does the volume rise with level?
W 604	Warning	Vessel characteristic curve consists of less than 2 reference points. – Check the manual characteristic curve.
W 613	Warning	Instrument in simulation mode – Switch again to the calibration mode required after the simulation procedure.
W 620	Warning	Current output is outside the set range (3.8…20 mA or 4…20 mA) – Check calibration and settings of the current output.

7.2 Simulation

The simulation mode allows functions of the electronic insert to be simulated and checked.
The following modes are possible:
- Simulation of current
- Simulation of pressure
- Simulation of level
- Simulation of volume (after linearisation only)


Note!

- If the simulation mode is activated then the error signal flashes in the display and warning W 613 is shown in V9H0.
  This status remains while simulation is in progress.
- Return to normal operation mode once simulation has been completed. Simulation off: V9H6: 0

Simulation of current

Step	Matrix	Entry	Significance
1	V9H6	1	Selects "simulation of current"
2		V or H	Confirms entry
3	V9H7	e.g. 14	Enters current value required e.g. 14 mA

The current value is given in V9H8 and is shown at the current output.

Simulation of pressure

Step	Matrix	Entry	Significance
1	V9H6	2	Selects "simulation of pressure"
2		V or H	Confirms entry
3	V3H4	e.g. 0	Enters units of pressure required e.g. mbar
4		V or H	Confirms entry
5	V9H7	e.g. 200	Enters pressure value required e.g. 200 mbar

Bei Simulation Druck wird immer der lagekorrigierte Druck (V0H8) simuliert.
The current value is given in V9H8 and shown at the current output.
The volume (after linearisation) or the level (without linearisation) is shown in V0H0.
The level is shown in V0H9.

Simulation of level

Step	Matrix	Entry	Significance
1	V9H6	3	Selects "simulation of level"
2		V or H	Confirms entry
3	V9H7	e.g. 5	Enters the level required in the units of the calibration e.g. 5 m

The current value is given in V9H8 and is shown at the current output.
The level is shown in V0H0.

Simulation of volume

Step	Matrix	Entry	Significance
1	V9H6	4	Selects "simulation of volume"
2		V or H	Confirms entry
3	V9H7	e.g. 17	Enters the volume in the units of the linearisation e.g. 17 m^3

The current value is given in V9H8 and is shown at the current output.
The volume is shown in V0H0. If no linearisation curve is entered, then the volume corresponds to the level.


Caution!

Caution!
The instrument automatically returns to normal operating mode on power failure.

7.3 Repairs

If a FEB 20 electronic insert or a complete Deltapilot S has to be sent in to Endress+Hauser for repair, then please enclose a note containing the following information:
- An exact description of the application for which it was used.
- The chemical and physical properties of the product.
- A brief description of the fault.

Special precautions must be observed when sending in a probe for repair:
- Remove all visible traces of product from the probe.
  This is especially important if the product can impair health, e.g. corrosive, poisonous, carcinogenic, radioactive, etc.
- Please do not send the probe for repair if the last traces of danger products cannot be removed, e.g. the product has penetrated into fissures or diffused into plastic parts.

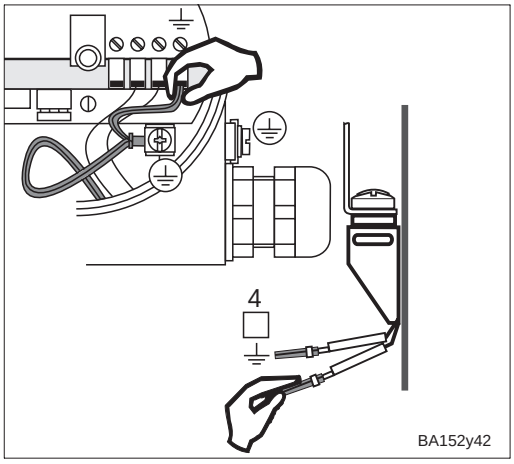
7.4 Replacing the Electronic Insert

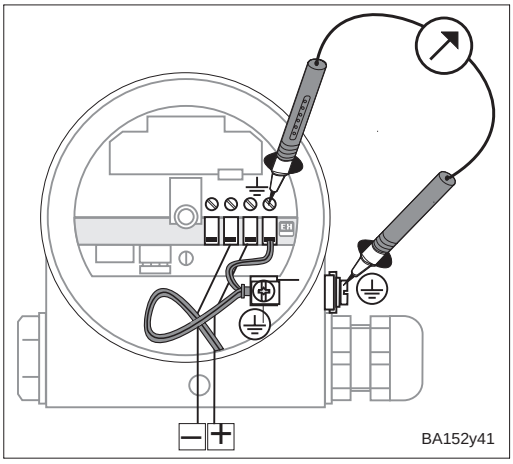
If the electronic inset has to be replaced, then all data specific to the measuring point can be loaded into the new electronic insert with the DAT module.
Replacing the electronic insert and the electrical connection are described in section 2.1 Connection on page 9. Calibration and settings must be repeated after replacement.


Caution!

Caution!
After replacing the electronic insert, check that the ground cable is firmly connected:
- to the internal ground terminal of the housing
- to terminal 4.

Also check the resistance between terminal 4 and the external ground. It must never be more than 0.1 Ω.





7.5 Replacing the Measuring Cell


Note!

If the measuring cell is exchanged, the calibration values are automatically corrected using the new cell data continued in the DAT module.
A new DAT module is supplied with every replacement cell. It is installed and connected as described in section 2.1 Connection on page 10.
It lost individual DAT modules can be ordered from Endress+Hauser. Please specify the serial number, which is to be found in the housing or on measuring cell itself.

Matrix INTENSOR

	H0	H1	H2	H3	H4	H5	H6	H7	H8	H9
V0 Calibration	Measured value	Empty calibration	Full calibration	4 mA threshold off: 0 on: 1	Output damping 0…99 s	Value for 4 mA	Value for 20 mA	Safety alarm min: 0 max: 1 hold: 2	Sensor pressure after correction	Measured level before linearisation
V1										
V2 Linearisation	Lin. mode linear: 0 activate table: 1 manual: 2 semiaut.:3 clear: 4	Line No. (1…11)	Input level	Input volume						
V3 Extended Calibration	Calibration mode Level %: 0 Dry cal. H: 1 Dry cal. %: 2 Pressure:3	Select unit dry calibration m: 0 cm: 1 ft: 2 inch: 3	Density factor	Zero offset value	Pressure unit mbar: 0 bar: 1 m H_2O: 2 . . .	Temperature unit °C: 0 °F: 1	Sensor pressure before position correction	Position correction		
V4… V6										
V7 Transmitter Info	Low sensor limit	High sensor limit	Max. Pressure	Temperature	Max. Temperature					
V8										
V9 Service + Simulation	Actual diagnostic code	Last diagnostic code		Instrument/ Software No.		Reset »333«	Simulation off: 0 Current: 1 Pressure:2 Level: 3 Volume: 4	Simulation Value	Current	Locking: ≠ 333 Unlocking: »333«
VA Communication	Tag No.		Unit befor linearisation	Unit after linearisation		Serial number	Pressure at empty calibration	Density factor at empty cal.	Pressure at full calibration	Density factor at full cal.

Display field

This matrix gives an summary of factory settings.
Your values can be entered here.

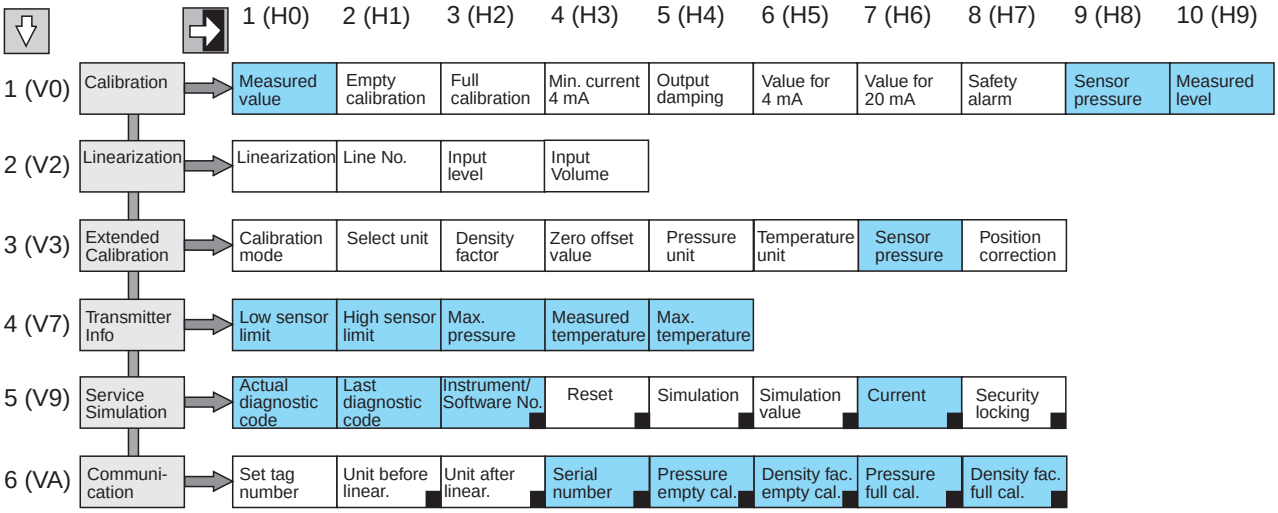
	H0	H1	H2	H3	H4	H5	H6	H7	H8	H9
V0		0.000	100.0	0	0	0.000	100.0	1		
V1										
V2	0	1	0.000	0,.000						
V3	0	0	1.000	0.000	0	0		0		
V4										
V7										
V8										
V9			0	7820		0	0	0.000		333
VA	———		0	0						

Display field

Matrix HART

Online

1. Group Select



2. Device Data

3. HART Output

Conversion HART/INTENSOR

Matrix	HART menu	Matrix	HART menu	Matrix	HART menu
	1 Basic calibration		**3 Extend. calibration**		**5 Service/Simulation**
V0H0	1 Measured value	V3H0	1 Calibration mode	V9H0	1 Actual diagn. code
V0H1 *1	2 Calibration "empty"	V3H1 *3	2 Units for dry calib.	V9H1	2 Last diagn. code
V0H2 *2	3 Calibration "full"	V3H2	3 Density factor	V9H3	3 Instr. and software No.
V0H3	4 Current min. 4 mA	V3H3	4 Zero offset value	V9H5	4 Reset
V0H4	5 Output damping	V3H4	5 Units of pressure	V9H6	5 Simulation
V0H5	6 Value for 4 mA	V3H5	6 Temperature unit	V9H7 *4	6 Simulation value
V0H6	7 Value for 20 mA	V3H6	7 Sensor pressure before correction	V9H8	7 Current
V0H7	8 Output on error	V3H7	8 Position correction	V9H9	8 Locking/Unlocking
V0H8	9 Display of sensor pressure		**4 Sensor data**		**6 Communication**
V0H9 *2	10 Level	V7H0	1 Lower meas. limit	VAH0	1 Tag-No.
	2 Linearisation	V7H1	2 Upper meas. limit	VAH2	2 Units before linear.
V2H0 *2	1 Type of linearisation	V7H2	3 Maximum pressure	VAH3	3 Units after linear.
V2H1 *2	2 Line number	V7H3	4 Temperature	VAH5	4 Serial No.
V2H2 *2	3 Enter level	V7H4	5 Max. Temperature	VAH6	5 Pressure at empty cal.
V2H3 *2	4 Entry volume			VAH7	6 Density fac. empty cal.
				VAH8	7 Pressure at full cal.
				VAH9	8 Density fac. full cal.

The presence of the marked parameters depends upon the calibration mode:
*1 level only
*2 level/dry calibration only
*3 dry calibration only
*4 simulation only
If a parameter is missing, all following parameters are automaticaly moved forward.

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