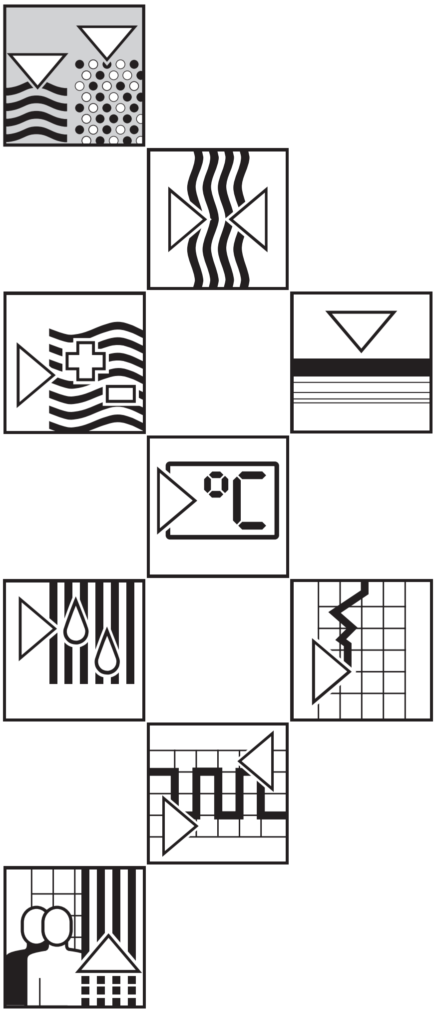
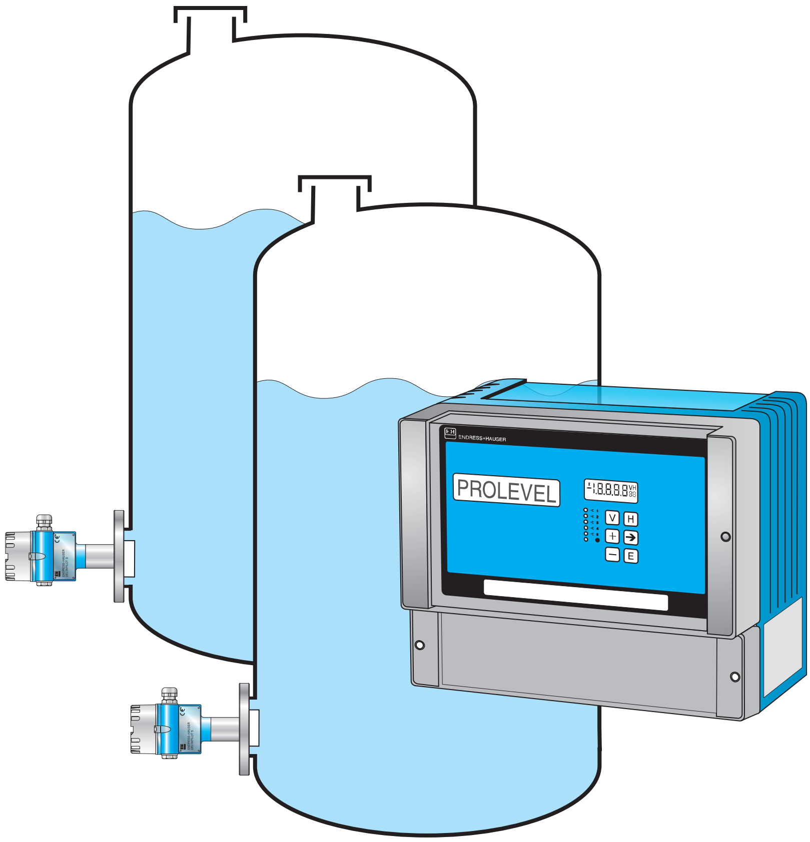
BA 144F/00/en/04.98
valid for Software 1.x
016564-1000

prolevel
FMB 662
Hydrostatic Level Measurement

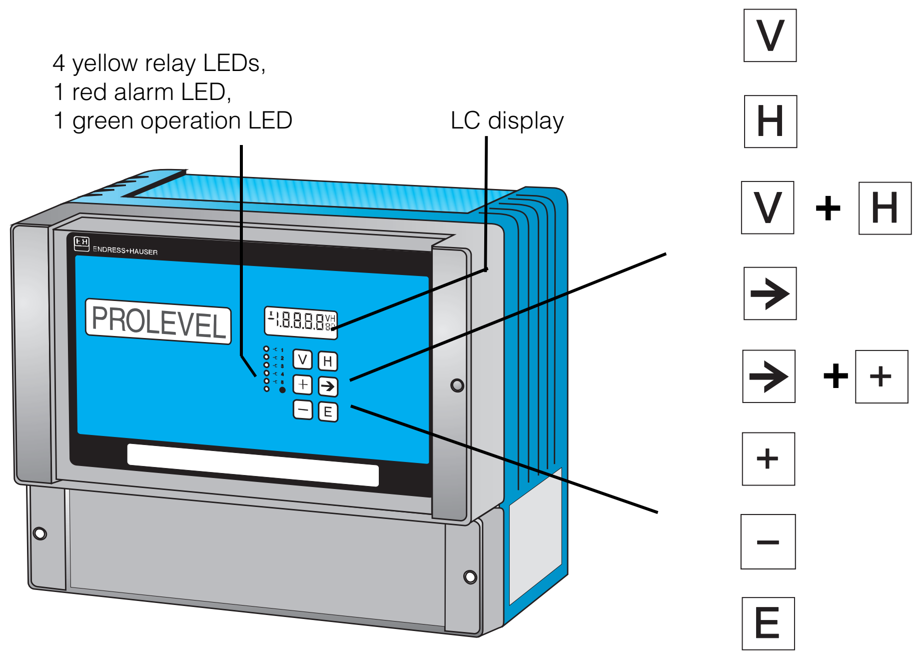
Installation and Operating Instructions



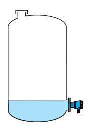
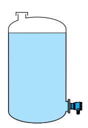
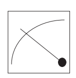
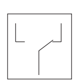


Endress+Hauser
Nothing beats know-how

Short Instructions



Quick configuration for level measurement

	Function	Matrix Ch 1	Ch 2	Action
	**1** Reset transmitter Operating mode	V9H5 V8H0		● Enter 672, press »E« to register entry - *Omit if commissioned as in Section 4.1* •●Enter 0 = channels 1+2, 1 = channel 1, 2 = channel 2 Press »E« to register entry
	2 »Empty« calibration*	V0H1	V4H1	● Fill vessel 0…40% full (probe covered) Enter level in %, m, ft, etc. Press »E« to register entry
	**3** »Full« calibration*	V0H2	V4H2	● Fill vessel 60…100% full Enter level in %, m, ft, etc. Press »E« to register entry
	**4** 0/4 mA signal	V0H3 V0H5 V0H6	V4H3 V4H5 V4H6	● Enter 0 for 0…20 mA signal, 1 for 4…20 mA signal Press »E« to register entry ● Enter level for 0/4 mA signal (if not 0) Press »E« to register entry ● Enter level for 20 mA signal (if not 100) Press »E« to register entry
	**5** Channel 1 Relays 1a and 1b Channel 2 Relays 2a and 2b	V1H0 V1H1	V5H0 V5H1	● Enter level for switching in calibration units Press »E« to register entry ● Enter fail-safe mode: 0 = minimum, 1 = maximum Press »E« to register

* Can be performed in reverse order

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Notes on Safety

Approved usage

The Prolevel FMB 662 is a field transmitter for level measurement which can be used with a variety of hydrostatic sensors. It has 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 manual or by the bodies responsible for compliance may void the user's authority to operate the equipment.

Certificates

The Prolevel FMB 662 transmitter is available with certificate of conformity for use with probes and sensors operating in hazardous areas. The table below indicates the combinations available and conditions for installation. Full details can be taken from the certificates. Please note that where quoted technical data differs from that listed in Section 1.5, that in the certificate applies.

Certificate	Instruments	Notes
PTB No. Ex-96.D.2074	Prolevel FMB 662	[EEx ia] IIC, install outside Ex-area
FM J.I.0Z2A7.AX	Prolevel FMB 662	AIS; Class I-III, Div. 1, Group A-G
CSA LR 53988-81	Prolevel FMB 662	Class I-III, Group A-G
PTB No. Ex-96.D.2071X	Deltapilot S DB50, 50L, 51, 52, 53 with FEB 17 or FEB 17P	EEx ia IIC T4...T6
German Lloyd NO. 99 350-97HH	Deltapilot S DB50, 50L, 51, 52, 53 with FEB 17 or FEB 17P	Suitable for unlimited use within the Rules

Safety conventions

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

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 indicates actions or procedures which, if not performed correctly, may lead to personal injury or incorrect functioning of the instrument.

Warning!

Warning!

- A warning indicates actions or procedures which, if not performed correctly, will lead to personal injury, a safety hazard or destruction of the instrument.

1 Introduction

The Prolevel FMB 662 is a field transmitter for level measurement with hydrostatic pressure sensors. It may be installed, commissioned and maintained by authorised personnel only. The operating manual must have been read and understood before the equipment is installed: instructions are to be followed exactly.

In this manual

Since it is not possible to describe all applications in detail, the standard application, continuous level measurement, has been used as the basis for the functional description. Other applications as listed in Section 1.1 are described in Chapter 5. The operating instructions are structured as follows:

- Chapter 1: Introduction; contains general information including application, measurement principle, functional description and technical data.
- Chapter 2: Installation; contains hardware configuration, installation instructions and connection diagrams.
- Chapter 3: Controls; describes operation with the front panel keys, Commulog VU 260 Z, and via the Rackbus RS-485 interface.
- Chapter 4: Calibration and Operation; tells you how to commission the Prolevel for the standard application including calibration, linearisation, analogue outputs, relays and locking the parameter matrix.
- Chapter 5: Other Operating Modes; describes the measurement of level in a pressurised tank, differential level measurement, and density corrected level measurement.
- Chapter 6: Trouble-Shooting; contains a description of the self-checking system with error messages, the simulation feature as well as instructions for configuration on replacement of the transmitter, sensor or electronic insert.
- Appendix: Contains a flowchart for calibration and linearisation using volume units.
- Index: lists key words to help you find information quickly.

Short instructions

Short instructions for the standard set-up, continuous level measurement in vented tanks, which is used in 80% of applications, are to be found in the front cover. We advise you to commission as described in Section 4.1. before using this procedure as this ensures that probes can be exchanged without the need for re-calibration.

Further documentation

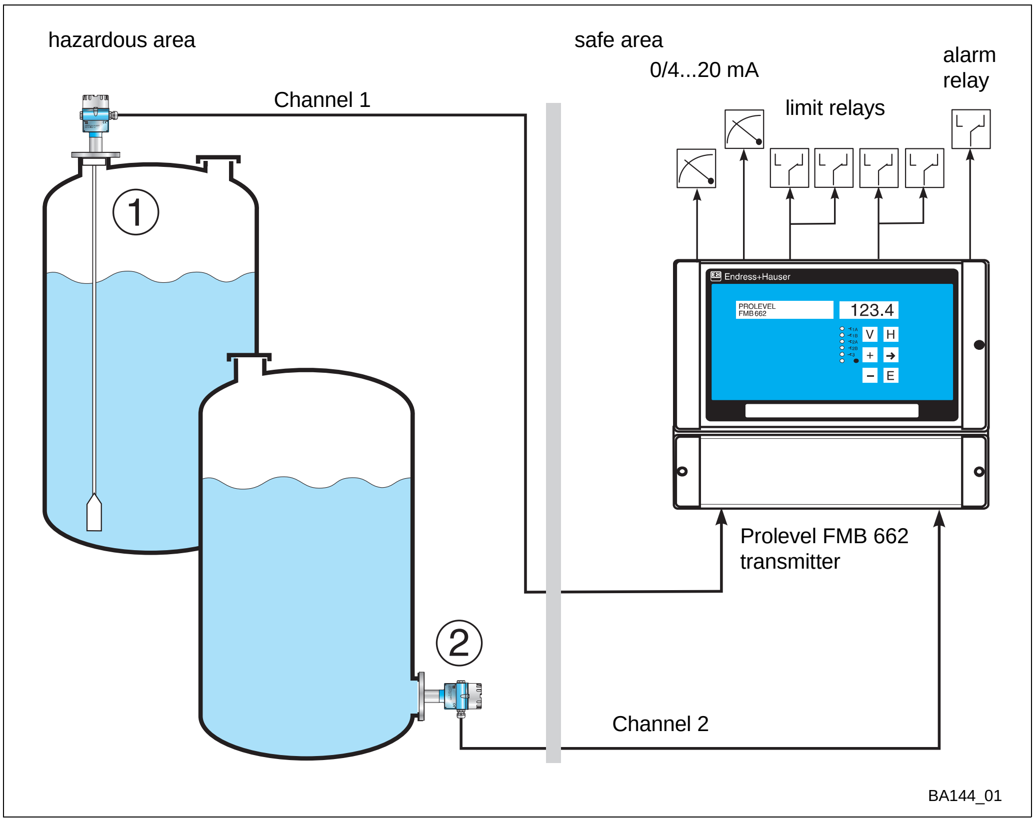
In addition to this manual, the following publications provide information on configuration of the Prolevel FMB 662.

- BA 028F Commulog VU 260 Z handheld terminal
- BA 134F Rackbus RS-485

The installation of the sensors, electronic inserts and accessories is described in the documentation accompanying these articles - see text for references. When installing sensors in explosion hazardous areas the instructions included in the accompanying sensor certification must also be observed.

1.1 Application

Fig. 1.1:
Standard application showing Prolevel FMB 662 controlling level measurement in open tanks
① Deltapilot S rope probe
② Deltapilot S



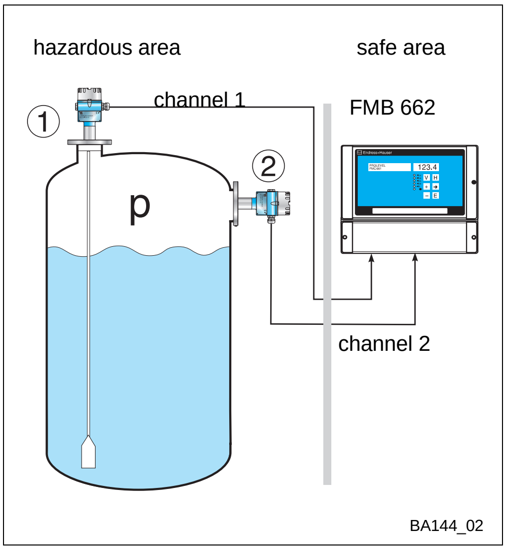
The Prolevel FMB 662 is designed for level measurement on one or two channels with an hydrostatic pressure sensor. The applications described in this manual are as follows:

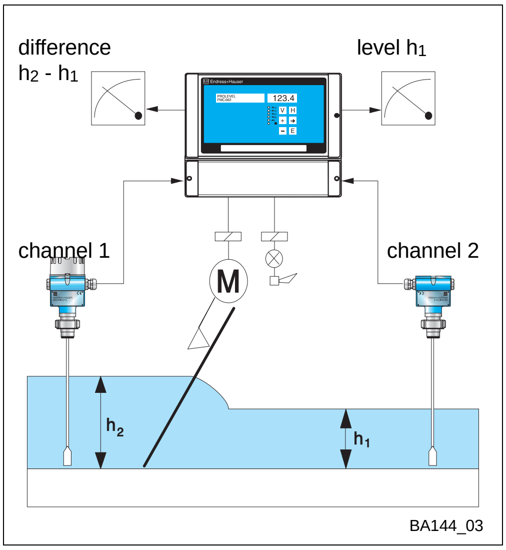
- Level or volume measurement in open vessels …Chapter 4
- Level measurement in pressurised vessels …Chapter 5
- Differential level measurement …Chapter 5
- Density corrected level measurement …Chapter 5

Prolevel transmitters may also be used for applications in explosion hazardous areas and possess intrinsically-safe sensor circuits conforming to EEx ia IIC. A list of certificated combinations is to be found in »Notes on Safety« preceding this chapter.

Fig. 1.2:
Left:
Prolevel FMB 662 measuring level in a closed tank with two Deltapilot S sensors
① level measurement
② measurement of overpressure or vacuum

Right:
Screen control using the Prolevel FMB 662 in the differential level mode





1.2 Measuring system

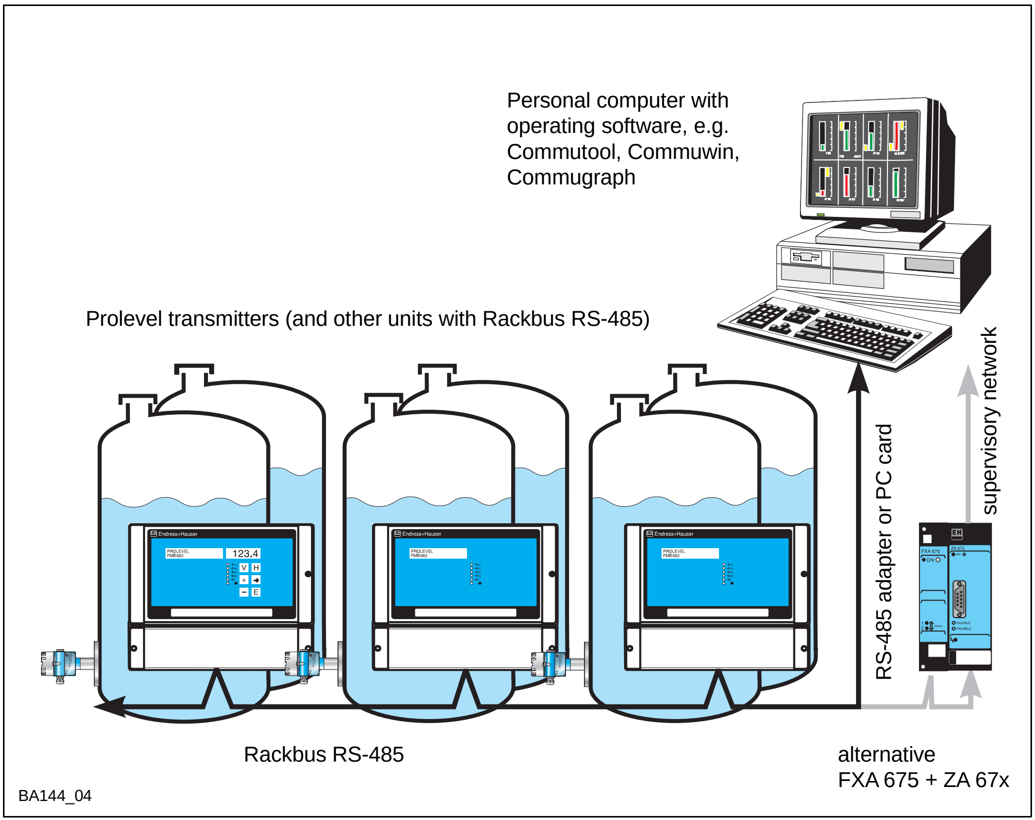


Fig. 1.3:
The Prolevel FMB 662 can be used as a stand-alone unit, see Figs 1.1 and 1.2 or as part of an operating system.
A RS-485 adapter or PC card allows direct connection to a personal computer, the FXA 675 and gateway ZA 67x connection to a supervisory system using the Modbus, Profibus or FIP protocol

A working system for level measurement comprises:

- Prolevel FMB 662 transmitter
- One or two Deltapilot S hydrostatic sensors DB 50…53
- Electronic insert: FEB 17/FEB 17 P.

The Prolevel may operate as a stand alone unit with standard 0/4…20 mA outputs; two sets of two relays, freely assignable to channel 1 or 2, can be used to control pumps, valves, annunciators etc.. Alternatively, the Prolevel may be operated remotely over the optional Rackbus RS-485 interface, either direct from a personal computer or as part of a process control system. Connection to Modbus, Profibus or FIP networks can be realised through the gateways ZA 672, ZA 673 or ZA 674 respectively.

Versions

The Prolevel is available in two versions:

- With display and front panel controls,
- Without display and front panel controls — in this case the transmitter must be configured by the Commulog VU 260 Z handheld terminal or over the optional Rackbus RS-485 interface.

In all other respects, the two versions are identical. More details on controls and operation can be found in Chapter 3.

1.3 Measuring principle

The Prolevel FMB 662 measures level using the hydrostatic measurement principle.

Open vessel

In an open vessel, the level is derived from the hydrostatic pressure exerted by a column of liquid on a probe placed at its foot. The pressure exerted is:

$$p_1 = \rho \times g \times h \qquad (1)$$

whereby

p_1	=	hydrostatic pressure
ρ	=	density of the liquid
g	=	acceleration due to gravity
h	=	height of the liquid column.

Assuming a constant density, the level of the liquid can be calculated from the pressure measured by the Deltapilot S.

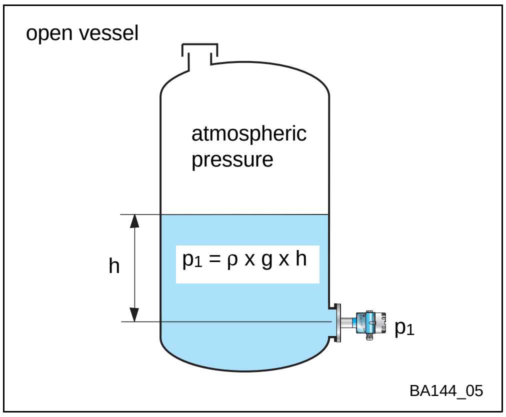


Fig. 1.4:
Hydrostatic measurement principle

Pressurised vessel

For a pressurised vessel, the pressure above the liquid will vary according to whether the level rises or falls, or whether the vessel is deliberately pressurized or evacuated. In this case a second Deltapilot S is required if the level is to be measured correctly. The pressure exerted is:

$$p_{tot} = p_2 + \rho \times g \times h \qquad (2)$$

whereby

p_{tot}	=	total pressure
p_2	=	pressure above liquid
ρ	=	density of the liquid
g	=	acceleration due to gravity
h	=	height of the liquid column.

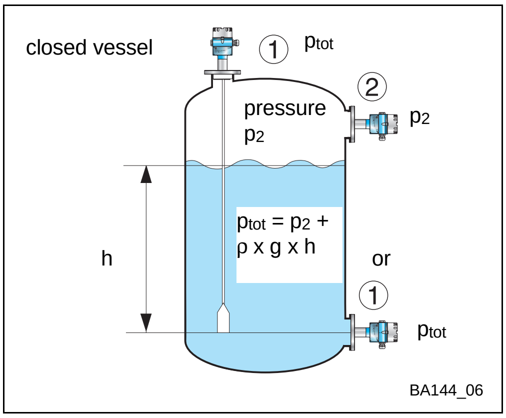


Fig. 1.5:
Hydrostatic measurement in a closed vessel

By taking the difference between the total pressure measured by Deltapilot S 1 and the vessel pressure measured by Deltapilot S 2, the level (and pressure) can be measured.

Density measurement

If the distance between two Deltapilot S sensors is known and both are covered by the same column of liquid, then it is also possible to calculate the density of a liquid as follows:

$$\rho = \Delta p/(g \times \Delta h) \qquad (3)$$

whereby

ρ	=	density of the liquid
Δp	=	difference in pressures measured by Deltapilot S
Δh	=	difference in height

The density can be measured in both a closed and open vessel. If however, level is to be corrected by the measured density, the measurement can be made in open vessels only.

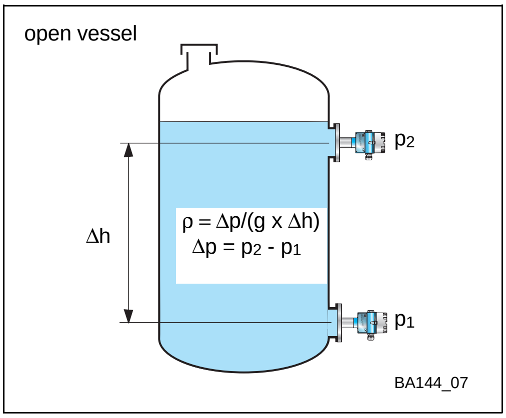


Fig. 1.6:
Hydrostatic measurement principle

1.4 Functional description

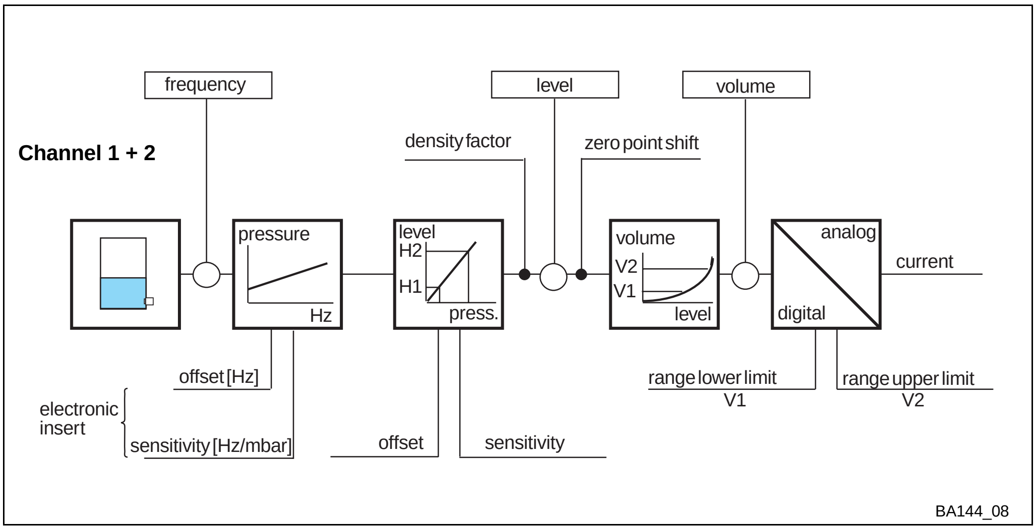


Fig. 1.7: Signal processing in the Prolevel FMB 662 for single and twin channel level measurement, operating modes 0, 1 and 2

Fig. 1.7 is a block diagram of the Prolevel FMB 662. The transmitter supplies the power to the sensor. The pressure measured by the sensor is converted into a frequency signal by the electronic insert located in its head and is transmitted to the Prolevel over a two-core cable. The signal is then processed to provide seven operating modes.

Table 1.1: Prolevel FMB 662 operating modes

Mode in V8H0	Function
0	Simultaneous level measurement on channels 1 and 2
1	Level measurement on channel 1 only
2	Level measurement on channel 2 only
3	Differential level measurement — the measured value measured at channel 2 is subtracted from that measured at channel 1
4	Density corrected level measurement — the level measurement at channel 1 is corrected when the product covers the sensor, installed at a known height, at channel 2
6	Simulation of frequency, level, volume or current at channel 1
7	Simulation of frequency, level, volume or current at channel 2

Signal processing

By calibrating at two levels, »empty« and »full«, the frequency signal is converted to a level measurement in the units entered during calibration. In modes 3 and 4, the measured value at channel 1 is then modified according to the measurement at channel 2. For non-linear volume/level relationships, volume can be calculated from level via the vessel characteristic which describes the shape of the vessel.

The signal resulting from the calibration and linearisation provides a standard 0/4...20 mA output, proportional to level or volume. Any portion of the measuring range can be taken to provide a scaled output. The two sets of two relays can be assigned to either measuring channel to provide level control by switching pumps on and off.

All measured values and the complete configuration can be accessed via the optional Rackbus RS-485 interface.

Fail-safe operation

If a fault condition is detected, e.g. a break in sensor - transmitter cable, the analogue signal switches to -10 % or +110 % level or holds the last measured value. The alarm relay de-energises and the red LED on the front panel lights. In addition, each set of relays can be set to switch on or off as required.

1.5 Technical data

General specifications

Manufacturer:	Endress+Hauser GmbH+Co.
Designation:	Prolevel FMB 662
Function:	Transmitter for level and differential level measurement with hydrostatic probes
Input signal:	Level proportional PFM signal
Interfaces:	0/4…20 mA, Rackbus RS 485 (option)
Reference conditions:	to IEC 770 (T_U = 25°C) or as specified
Miscellaneous:	CE mark

Input characteristics

Signal input, channels 1 and 2	
Signal:	Pulse frequency modulated signal from connected sensor
Explosion protection:	PTB [EEx ia IIC], CSA and FM, intrinsically safe signal circuits separated from the rest of the electronics
Sensor:	Deltapilot S with FEB 17/FEB 17 P

Output characteristics

Analogue output	
Output:	2 outputs, one per channel, 0... 20 mA, switchable to 4... 20 mA
Signal underflow:	-2 mA
Signal overflow:	+ 22 ± 0.2 mA
Output on alarm:	selectable +110%, -10% or hold
Current limitation:	23 mA
Temperature coefficient:	0.3%/10 K of range end value
RFI (E = 10 V/m)	1 %
Warm-up time:	1 s
Output damping:	0 to 100 s, selectable
Max. load:	600 Ω
Load effect:	negligible
Relays	
Type:	5 relays with potential-free changeover contacts
Function:	2 pairs of two limit relays with freely selectable switch points and hysteresis for operation in min. or max. fail-safe mode 1 alarm relay (de-energises on fault condition)
Switching capacity:	6 A, 250 VAC ; 750 VA at cos φ = 0.7, 1500 VA at cos φ = 1 6 A, 250 VDC; 200 W
Display and keyboard	
Display (LCD):	4 digit measured value display with optional lighting, segmented current display in 10% steps, various indicators (communication, signal underflow, overflow)
Light emitting diodes:	1 yellow status LED for every limit relay (lit = relay energised) 1 red alarm LED, lit = alarm — relay de-energised; flashing = warning — relay remains energised 1 green LED to indicate power on
Keyboard:	6 keys for parameter entry, option available without keys

Output characteristics (continued)

Communication interface	
Commulog VU 260 Z:	2 communication sockets in terminal compartment
Rackbus RS 485:	optional interface for direct connection to a personal computer via adapter or interface card, or to Rackbus via FXA 675 interface card Rackbus address via 6-gang DIP-switch in terminal compartment Bus termination via 4-gang switch in terminal compartment

Power supply

Alternating voltage:	230 V / 115 V / 110 V (85...253 V), 50/60 Hz or 24 V / 48 V (20...55V), 50/60 Hz or
Direct voltage:	24 V (16...60V), residual ripple max. 2 V_{pp} within tolerance
Power consumption:	max. 7 W
Start-up current	880 mA (Sicherung 1.6 A)
Safe isolation:	between power supply and signal outputs, CPU, Rackbus RS-485 and electronics

Environment

Operating temperature: Limiting temperature: Storage temperature:	0°C…60°C -20°C…60°C -40°C…80°C
Climatic class:	to Table 10, Class R, DIN 40 040, instrument outdoors, average annual humidity 95%, dew permissible
Ingress protection:	IP 66 with closed housing and corresponding cable glands IP 40 with open housing IP 20 with open terminal compartment
Electromagnetic compatibility:	Emission to EN 50 081-2, industrial use, Immunity to EN 50 082-2 and NAMUR industrial standard, at 10 V/m
Vibration resistance:	to Table 6, Class W, DIN 40 040
Explosion protection:	[EEx ia] IIC, see also "Notes on Safety"

Mechanical specifications

Housing:	for wall- or post-mounting
Dimensions (l x b x h)	292 mm x 176 mm x 253 mm, see Fig. 2.3
Weight:	2.6 kg
Materials:	body ASB (acrylnitrilbutadenestyrol)/PC (polycarbonate), RAL 5012 (blue) transparent cover, polycarbonate front panel, blue with white field for labelling
Electrical connection	
Cable entries:	5 pre-stamped cable entries Pg 16 in bottom and 4 in rear of terminal compartment 4 pre-stamped cable entries Pg 13.5 in bottom
Connection:	screw terminals for cable cross-sections 0.5 mm^2…2.5 mm^2
Cable:	2-core, unscreened cable, max. 25 Ω per core for both channels, see also p. 16

2 Installation

This Chapter describes:

- Probes and sensors for the Prolevel FMB 662
- Installation of the Prolevel FMB 662
- Transmitter wiring
- Sensor connection.
- Hardware configuration for Rackbus RS-485 option.

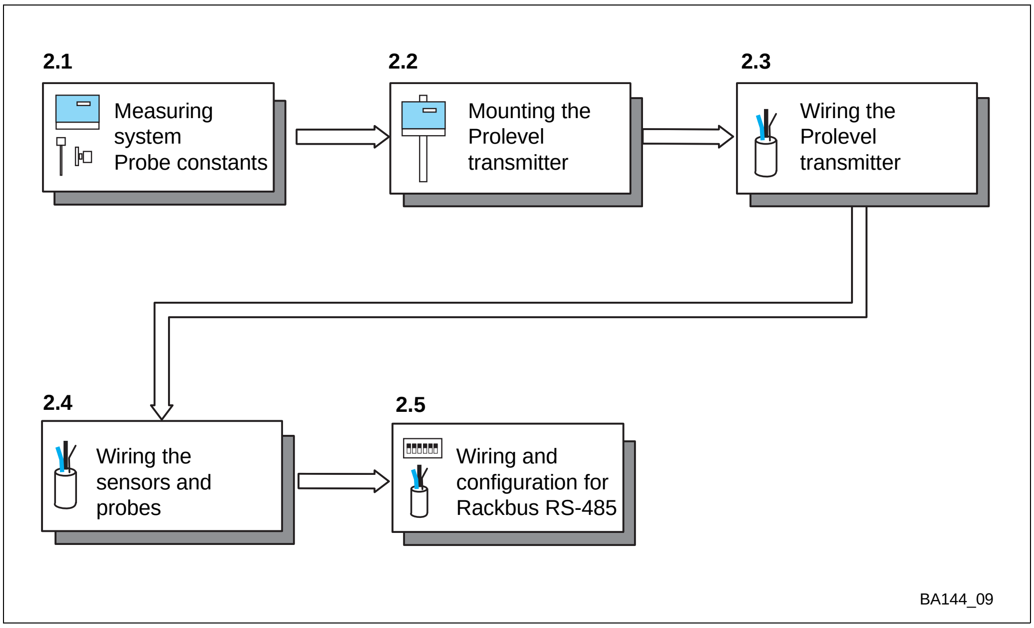
Fig 2.1 shows the structure of the chapter.

Technicians and fitters

It is assumed that suitably qualified personnel are to be used for the installation and electrical connection of the system components. This is particularly important when the sensors are to be installed in hazardous areas. Please note the following:

Warning!
- The Prolevel FMB 662 transmitter must be installed outside explosion hazardous areas.
- Observe the specifications in the certificates as well as local regulations when mounting the sensors in hazardous areas

Fig. 2.1: Structure of Chapter 2, Installation



2.1 Sensors

Table 2.1 lists the sensors which can be used with the Prolevel FMB 662 transmitter, Tables 2.2 and 2.3 the measuring ranges available. Installation hints can be taken from the Technical Information Sheet delivered with the sensor.

Application	Electronic insert	Probes	
• Level and volume in open vessels and pressurised tanks • Gauge pressure and differential pressure	FEB 17/FEB 17 P Cell Bx...	DB 50...53	TI 257
• Level and volume in closed vessels with vacuum, overpressure or fluctuating gauge pressure • Vacuum and differential pressure between 0.1…5 bar abs.	FEB 17/FEB 17 P Cell Dx...	DB 50...52	TI 257

Table 2.1:
Sensors, electronic inserts and applications for Prolevel FMB 662

Sensor constants

Deltapilot S hydrostatic pressure sensors are supplied with the sensor constants zero frequency »fo« and sensitivity »Δf«, see Table 2.2 below.

Note these constants and enter them into fields V3H5 and V3H6 for channel 1 and V7H5 and V7H6 for channel 2 during commissioning, Section 4.1. This dispenses with the need for a recalibration of the transmitter on replacement of the sensor or insert.

- Zero frequency f_o_____ and sensitivity Δf _____ of the probe on channel 1
- Zero frequency f_o_____ and sensitivity Δf _____ of the probe on channel 2

Cell type	Electronic insert FEB 17/FEB 17 P							
	Range		f_0	Δf	Range		f_0	Δf
0.1 bar	BA	0…100 mbar	200	10	DA	-100…100 mbar	200	5
0.4 bar	BB	0…400 mbar	200	2.5	DB	-400…400 mbar	200	1.25
1.2 bar	BC	0…1200 mbar	200	0.833	DC	-900…1200 mbar	200	0.476
4.0 bar	BD	0…4000 mbar	200	0.25	DD	-900…4000 mbar	200	0.204

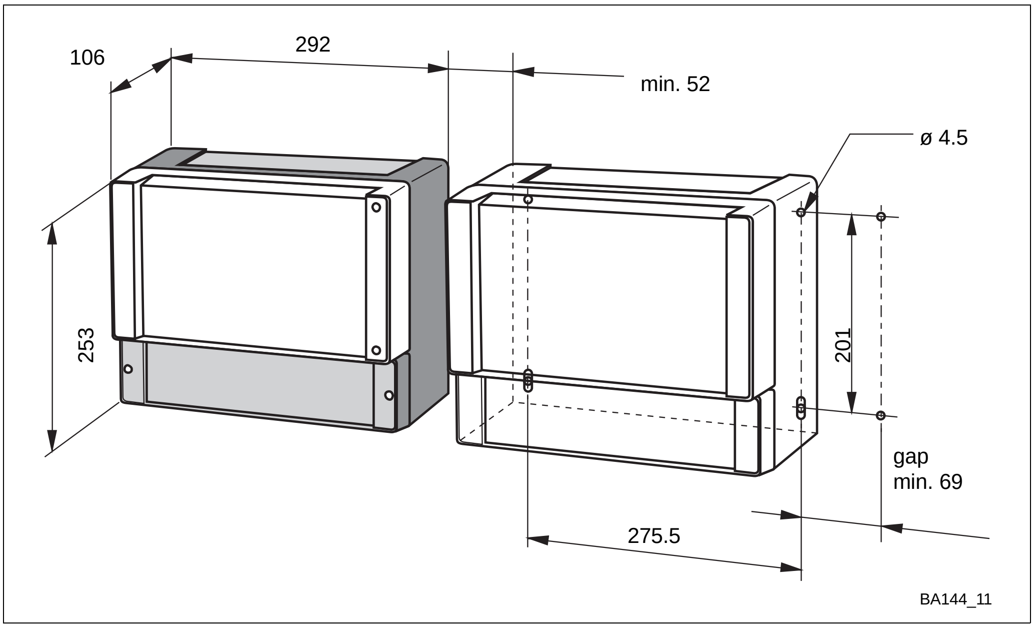
Table 2.2:
Measuring ranges and sensor constants of Deltapilot S S DB 5x

Note!
- If the Prolevel FMB 662 is to be connected to earlier Deltapilot models with EB 17Z, or EB 27Z electronic inserts, the zero frequency and sensitivity are to be found on the label in the sensor housing.

Note!

2.2 Prolevel FMB 662 installation

Fig. 2.2:
Dimensions in mm of Prolevel FMB 662 housing
1" = 25.4 mm



Location

Where possible, find a shady, protected spot in which to mount the Prolevel transmitter:

- Nominal operating temperature: 0°C…+60°C

Use a protective hood or provide cooling if the ambient temperature exceeds +60°C. For temperatures below -20°C insulate the instrument.

Mounting

The Prolevel FMB 662, with IP 66 protective housing, can be mounted on a wall or post outdoors or in the control room. Fig. 2.3 gives details for wall mounting.

Fig. 2.3 shows how the Prolevel can be post-mounted with the all-weather cover. The fastenings (nuts and bolts) for both post mounting and all-weather cover are supplied with the units.

- *Post mounting*:
  Material: galvanised steel
  (for 2" post Order No. 919 566-0000;
  for 1" post: 919 566-1000);
  stainless steel 1.4301 (≅ SS 304 H)
  (for 2" post Order No. 919 566-0001;
  for 1" post: 919 566-1001);
  Weight: 1 kg

- *Prolevel all-weather cover:*
  Material: Aluminium, blue paint-finish;
  Order No. 919567-000
  Material: Steel 1.4301 (≅SS 304 H),
  blue paint-finish; Order No. 919567-001

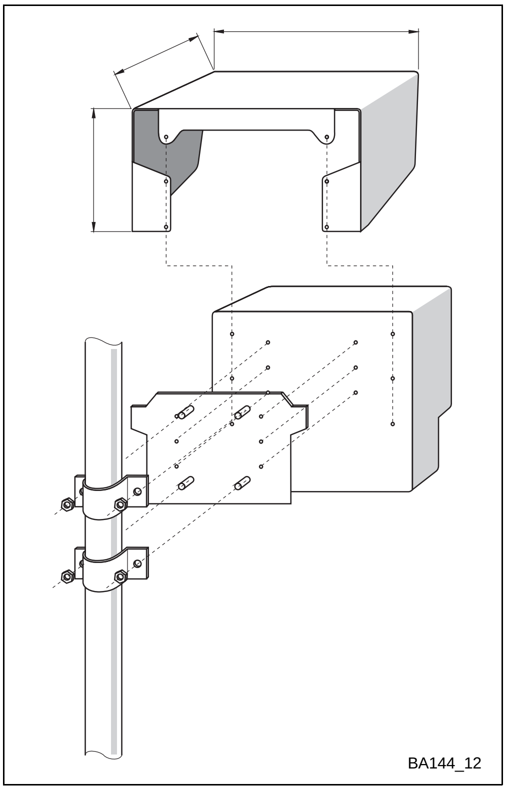


Fig. 2.3:
Post-mounting with all-weather cover

2.3 Transmitter wiring

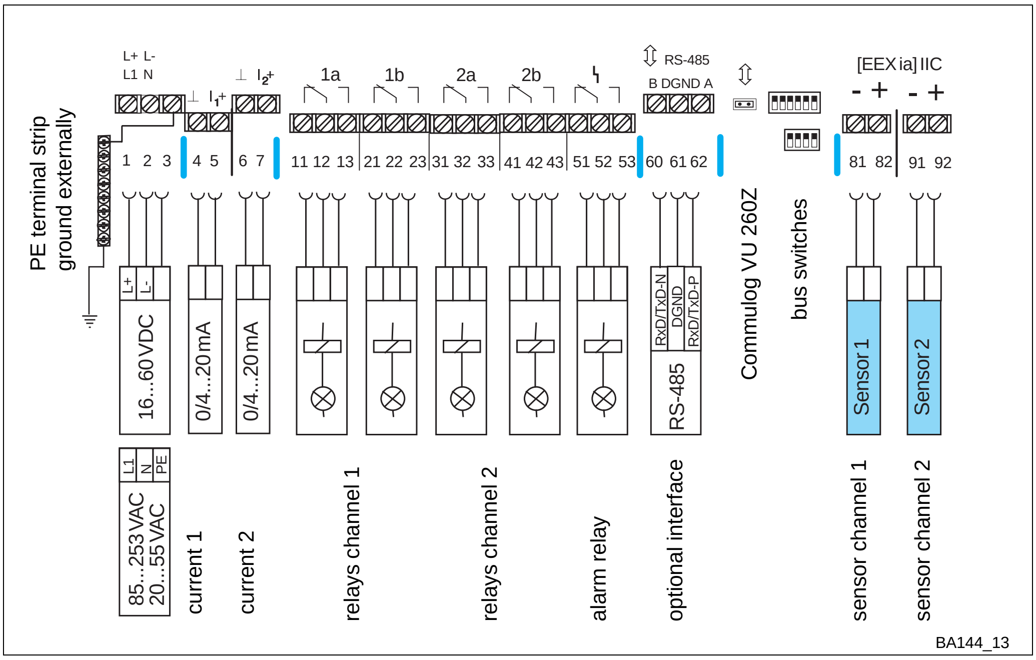


Fig. 2.4:
Terminal assignments for Prolevel FMB 662

Warning!
- Make electrical connections with the power supply switched off!
- The PE terminal strip must be grounded externally (contact protection)!
- When wiring up sensors in explosion hazardous areas, observe the instructions on the certificate and other local regulations.

Terminal strip

The terminal strip for cable cross-sections up to 2.5 mm^2 is located in a separate connection compartment. Fig. 2.4 shows the wiring diagram for the Prolevel FMB 662 (Terminal 3 is reserved for the internal protective ground):

- Remove the plastic cover from the front of the connection compartment
- Press out the pre-stamped cable entries as required
  bottom: 5 x Pg 16, 4 x Pg 13.5; rear: 4 x Pg 16.

Power

The power requirements are printed on the nameplate at the right-hand side of the nameplate, see also Section 1.5, "Technical Data".

- If the specifications on the nameplate do not correspond to those of your power supply, do not connect up - you may damage the instrument!
- Connect the protective ground to the metallic terminal strip provided at the left — this ensures safe isolation and contact protection.
- Current output, relay outputs, power connection and sensor input are all electrically isolated from one another. The analogue outputs share a negative line.

Analogue outputs

Only one non-floating device can be connected to each of the current outputs.

- There is no limit to the number of floating devices, other than that imposed by considerations of the maximum load of 600 Ω.

Relays

For the switching capacity of the relays see the technical data in Section 1.5.

- Relays 1a and 1b are normally assigned to channel 1
- Relays 2a and 2b are normally assigned to channel 2.

The assignment can be changed by software, see Section 4.4.

2.4 Sensor connection

Sensor cable

Use commercial 2-core installation cable, max. line resistance 25 Ω/core, for the sensor/ transmitter cable — the Prolevel satisfies the quoted EMC standards with this cable. The connection diagram is shown in Fig 2.5.

Electronic insert FEB 17/FEB 17 P

Depending upon version, the FEB 17/FEB 17 P measures overpressure, hydrostatic pressure or vacuum, see Table 2.2 (page 13).

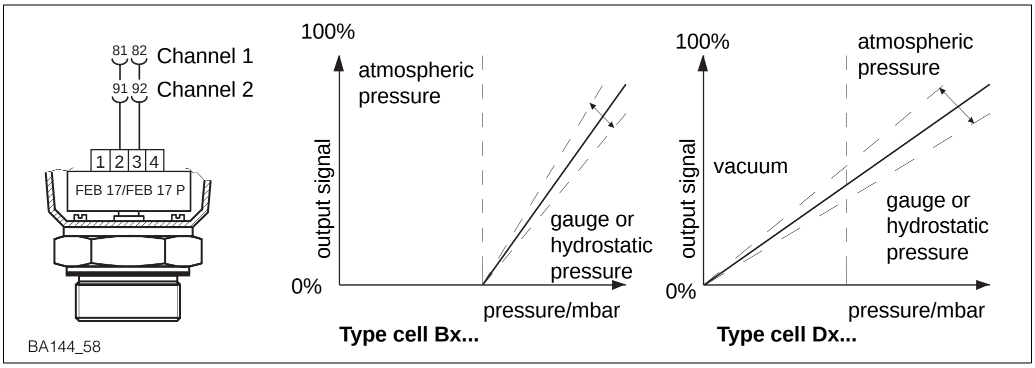


Fig. 2.5: Connection diagram for electronic insert FEB 17/FEB 17 P with output characteristics

2.5 Rackbus RS-485 option

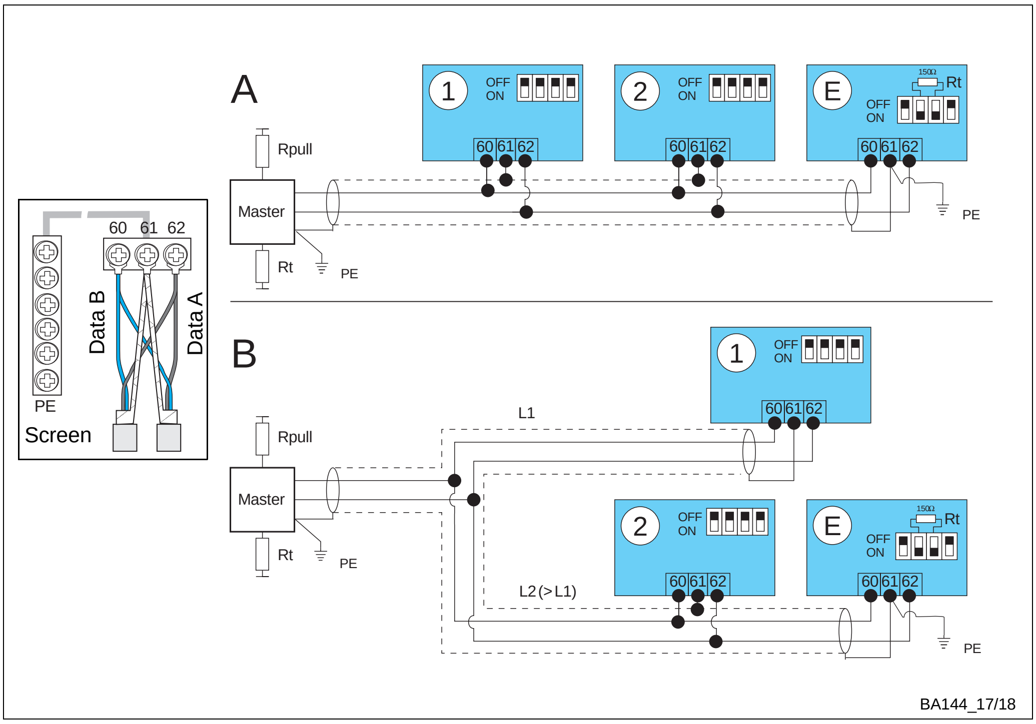
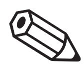


Fig. 2.6:
Rackbus RS-485 topologies showing setting of bus termination resistance

Inset:
Suggestion for wiring the bus

Wiring the bus

Up to 25 Prolevel FMB 662 transmitters can be connected to the Rackbus RS-485. Instructions for wiring and grounding the bus are to be found in Operating Instructions BA 134F which is delivered with Prolevel instruments having the Rackbus RS-485 option. The Prolevel can be wired as indicated in the inset in Fig. 2.6.



Note!

Note!
- Terminal 62 is connected internally to the PE ground terminal strip
- The screening must be grounded and have electrical continuity throughout — read BA 134F for grounding instructions

Bus address and termination

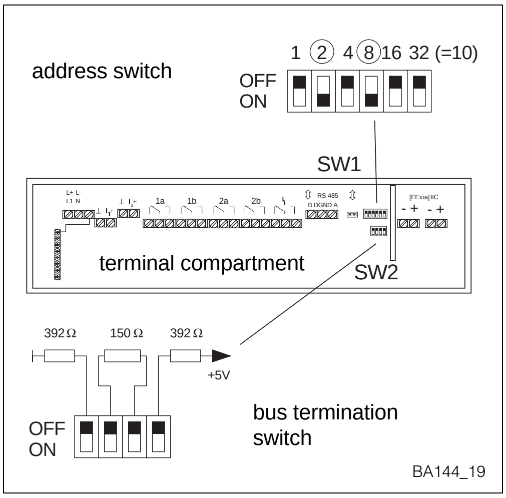


Fig. 2.7:
DIP-switches for bus address and termination

Fig. 2.7 shows the configuration elements for remote operation of the Prolevel FMB 662. Every transmitter must have a unique bus address:

- Switch off power, loosen screws and open the terminal compartment
- Set the address at DIP-switch SW1 (Example: 2 + 8 = 10)

For the last transmitter on the bus, i.e. furthest away from the computer:

- Switch in the terminal resistance at DIP-switch SW2: OFF; ON; ON; OFF
- Close front panel, tighten screws.

3 Controls

This Chapter describes how the Prolevel FMB 662 transmitter is operated. It is divided into the following sections:

- Operating matrix
- Keyboard and display
- Commulog VU 260 Z handheld terminal
- Rackbus RS-485

3.1 Operating matrix

All functions, including the analogue outputs and relay switch points are configured via the operating matrix, see Figs 3.1 and 3.2:

- Each field in the matrix is accessed by a vertical (V) and horizontal (H) position which can be entered at the front panel of the Prolevel FMB 662, by the Commulog VU 260 Z or for the Rackbus RS-485 from a personal computer.

A matrix card, reproduced at the back of this manual, is delivered with the Prolevel FMB 662 transmitter.

Fig. 3.1: Prolevel FMB 662 Parameter matrix operation with function of V and H keys. The complete matrix has 10 x 10 fields, although not all are used

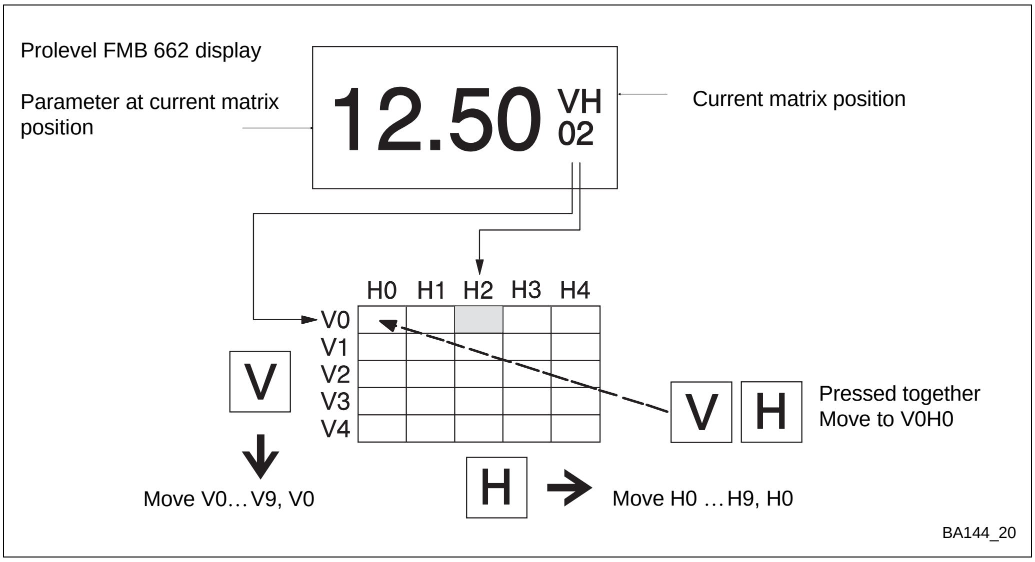
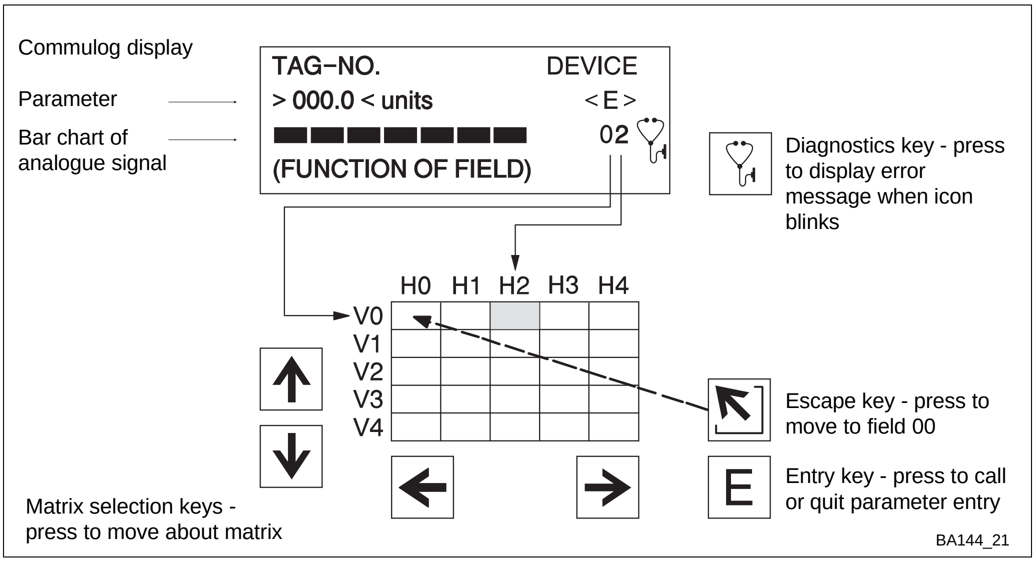


Fig. 3.2: Commulog VU 260 Z display and key functions

The Tag No. and measurement units are entered in the VA level which can be accessed by the Commulog or via the Rackbus RS-485 interface only



3.2 Keyboard and display

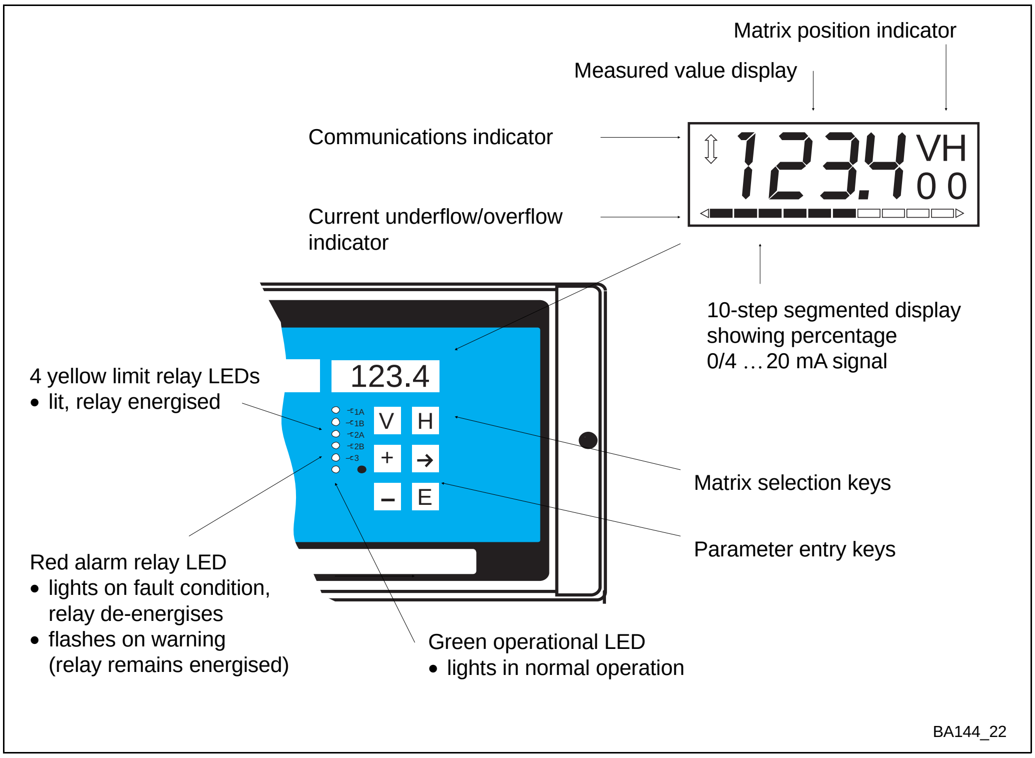


Fig. 3.3:
Front panel of the Prolevel FMB 662 transmitter

The transmitter is also available without the keyboard

Fig. 3.1 shows the LC-display with matrix of the Prolevel FMB 662, Fig. 3.3 its front panel. Table 3.1 below describes the function of the operating keys.

- Changes are not possible if the matrix has been locked (Section 4.6).
- Non-flashing parameters are either read-only indications or locked entry fields.

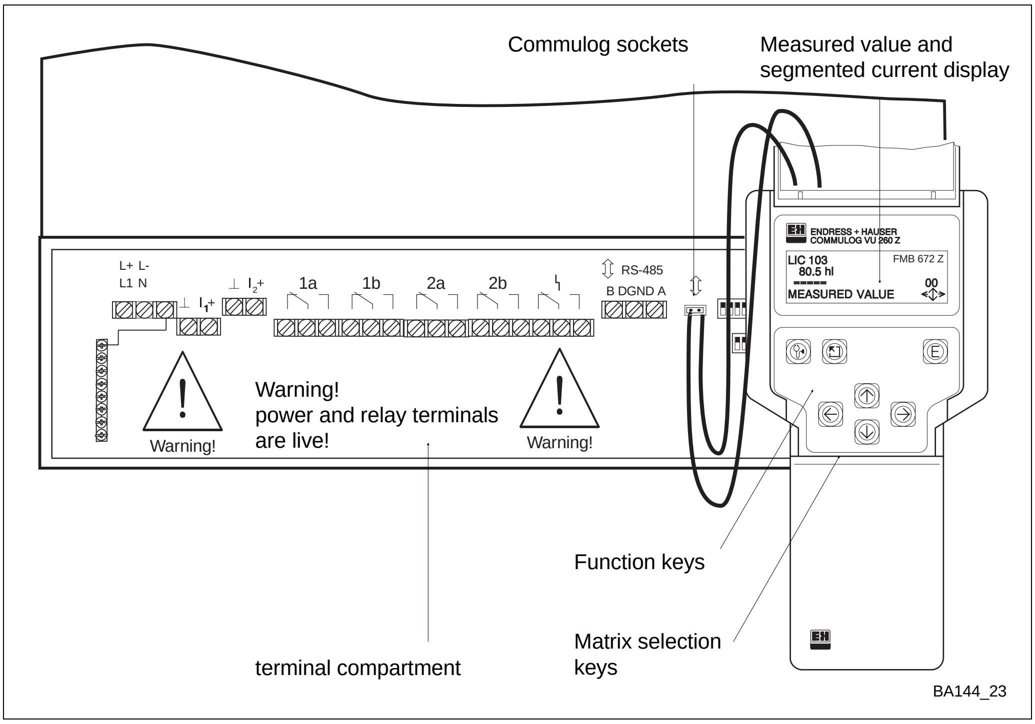
Table 3.1:
Prolevel FMB 662
Parameter entry and display keys

Keys	Function
Matrix selection	
V	• Press V to select the vertical position.
H	• Press H to select the horizontal position
V + H	• Press simultaneously to select the measured value field, V0H0
Parameter entry	
→	• Select the digit to be changed. The digit at the extreme left is selected and flashes. • Move to the next digit by pressing »⇒« again. When the last digit is reached »⇒« selects the leftmost digit again.
+ + →	• To change the position of the *decimal point*, press down both »⇒« and »+«. The decimal point moves 1 space to the right.
+	• Increases the value of the flashing digit
–	• Decreases the value of the flashing digit • To enter a *negative number* decrease the leftmost digit until a minus sign appears in front of it
E	• Press »E« to register entry. • Unregistered entries remain ineffective and the instrument will operate with the old value.

3.3 Commulog VU 260 Z

Fig. 3.4:
Configuration with handheld terminal Commulog VU 260 Z

The Prolevel FMB 662 appears as device FMB 672 Z



Warning!
The power and relay terminals in the terminal compartment are live!

The Prolevel FMB 662 without keyboard can be configured with the Commulog VU 260 Z handheld terminal, Figs 3.2 and 3.4. A full description of Commulog operation is to be found in Operation Instructions BA 028. Table 3.2 summarizes the key functions.

Table 3.2:
Prolevel FMB 662
Parameter entry and display keys for Commulog VU 260 Z

Keys	Function
Matrix selection	
← ↑ → ↓	• Select matrix position
↖ (Escape)	• »Escape key«, selects the position V0H0
(Diagnostics)	• Displays error message if diagnostics icon flashes • Press »Escape« to reset fault alarm and return to last position
Parameter entry	
E	• Calls the parameter entry mode • Quits parameter entry mode and registers the entered value
← →	• Select the digit to be changed: the selected digit flashes.
↑ ↓	• Enter the desired value: If the parameter is alphanumeric: - The ⇑ key scans through all characters starting from "-" through: 0,1,..,9,.,/,+, space, Z,Y,X,W,.. - The ⇓ key scans through all characters starting from "-" through: A,B,..,Y,Z, space,+,/,.,9,8,...
← + ↑ → + ↑	• Move the decimal point: - ⇐ and ⇑ together to move left or - ⇒ and ⇑ together to move right.
↖ (Escape)	• Restores original value and quits entry mode. The Commulog stays at the selected matrix field.

3.4 Rackbus RS-485 (option)

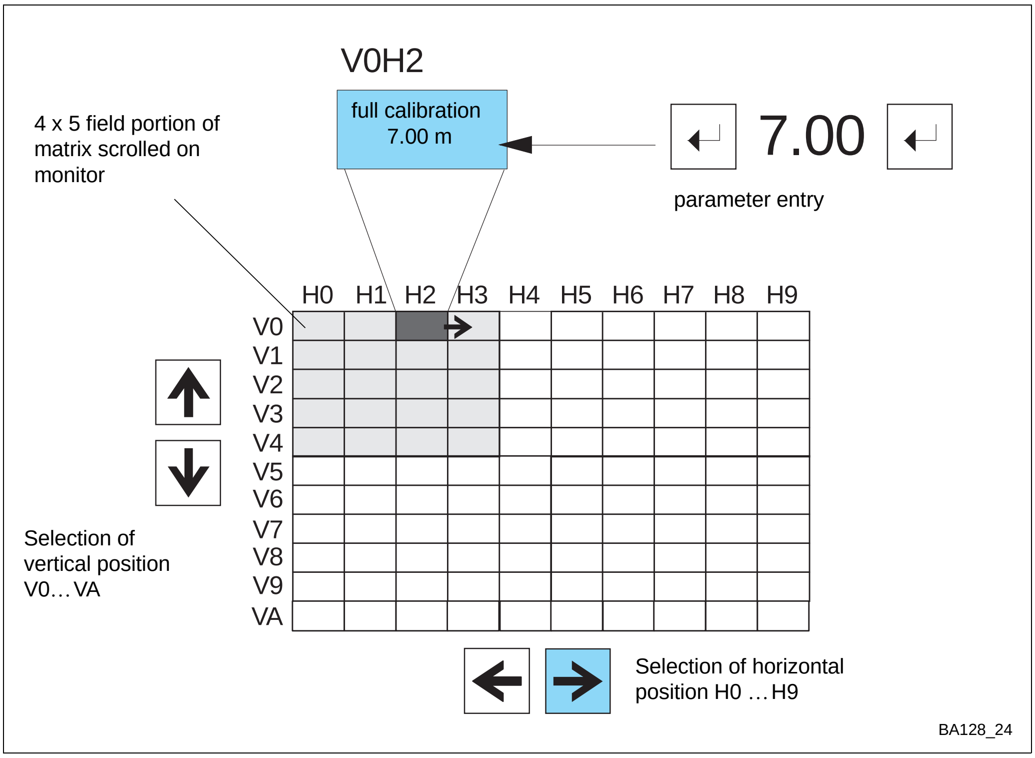


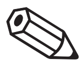
Fig. 3.5: Parameter entry in configuration software

Prolevel FMB 662 transmitters with Rackbus RS-485 interface can be configured from a personal computer using one of the Endress+Hauser operating programs:

- Fieldmanager 485 Version 5.0 and Commugraph 485 if connected to the computer via a RS-485/RS-232C converter or RS-485 card.
- Commuwin, Commutec operating program, Commutool if connected via the FXA 675 and gateway ZA 67x.

The operation corresponds to that of the keyboard version. Full details of the programs can be taken from, e.g. Operating Instructions BA 134F, which is delivered with all Prolevel transmitters with Rackbus RS-485 interface.

Note!
- The Prolevel appears in all programs with the designation "FMB 672 Z"

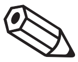

Note!

4 Level Measurement

This chapter is concerned with the standard level measurement functions (operating mode 0, default, 1 or 2) of the Prolevel FMB 662; the principle sections describe:

- Commissioning
- Calibration:— for upright cylindrical tanks
  — for horizontal cylindrical tanks
  — for tanks with conical outlet
  — dry calibration for hydrostatic sensors
- Analogue outputs
- Relays
- Display of measured values
- Locking the parameter matrix.

Fig. 4.1 indicates the sequence of configuration.

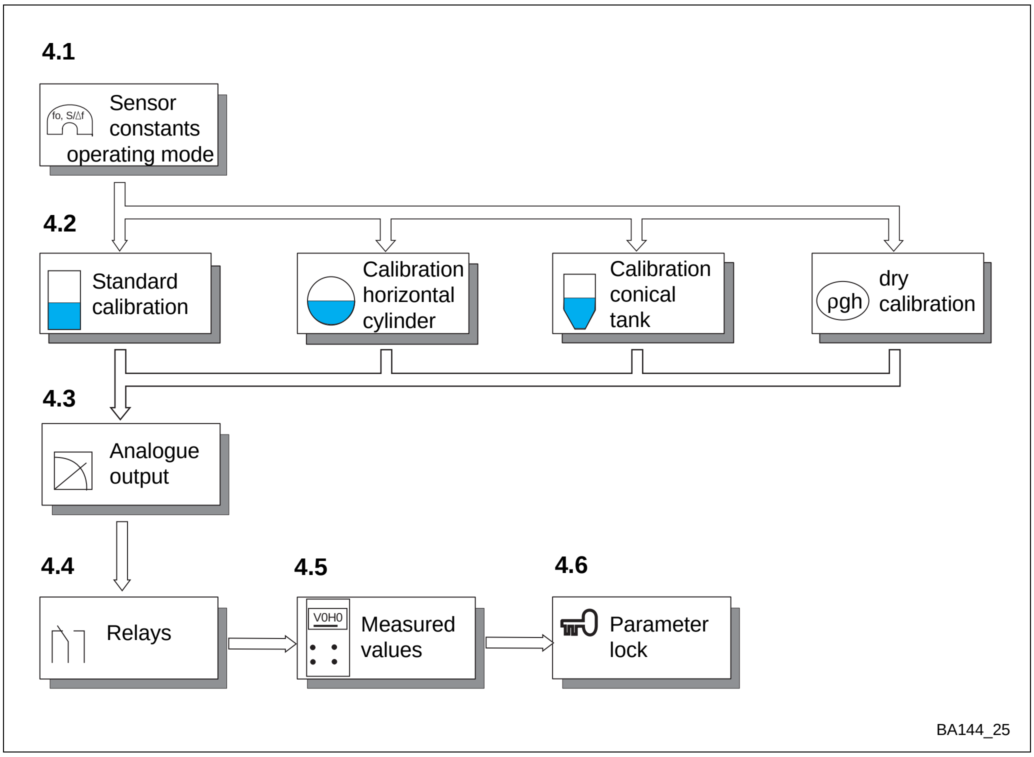


Note!

Note!

- For clarity, practically all examples in this chapter refer to the configuration of channel 1 using the matrix fields V0V0…V3H9.
- Channel 2 can be configured in exactly the same manner using the equivalent fields V4H0…V7H9
  — If the procedure specifies V0H1, channel 2 is configured in V4H1, i.e. just add 4 to the V-position of the channel 1 matrix field.

Fig. 4.1: Procedure: calibration and operation for level measurement



4.1 Commissioning

When programming the Prolevel for the first time, reset the module to the factory based parameters, see Table in back cover. Then enter the sensor constants f_o and Δf for the channels to be used. This ensures that the FEB 17(P) electronic insert or sensor can be replaced without the need for recalibration, see Section 6.4.

Sensor constants

Step	Matrix	Entry	Significance
1	V9H5	e.g. 672	Enter any number 670…679 to reset transmitter
2	-	»E«	Register entry
3	V3H5	e.g. 101.2	Enter zero frequency f_o (offset) of electronic insert connected to channel 1
4	-	»E«	Register entry
5	V3H6	e.g. 1.012	Enter sensitivity, Δf of electronic insert connected to channel 1
6	-	»E«	Register entry
7	V7H5	e.g. 100.1	Enter zero frequency f_o (offset) of electronic insert connected to channel 2
8	-	»E«	Register entry
9	V7H6	e.g. 0.998	Enter sensitivity, Δf of electronic insert connected to channel 2
10	-	»E«	Register entry

Operating mode

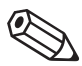
There are three standard level modes for measurement in open vessels as described in this chapter (measurement in closed vessels is described in Chapter 5):

- Operating mode 0: level measurement on both channels
- Operating mode 1: level measurement on channel 1 only
- Operating mode 2: level measurement on channel 2 only

After a reset, mode 0 is automatically selected. If mode 1 or 2 is required, its number must now be entered in V8H0 — the other operating modes 3 and 4 are described in Chapter 5.

Step	Matrix	Entry	Significance
1	V8H0	e.g. 1	1: standard level measurement on channel 1 only
2	-	»E«	Register entry

Note!
- If you use the default value 0 but only have one probe connected, the instrument will respond with alarm E 401 or E 402 — correct by entering the appropriate operating mode in V8H0.


Note!

Next step…

Calibration and if required, linearisation:

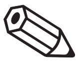
- upright cylinder, p. 24 *or*
- horizontal cylinder, p. 25 *or*
- tank with conical outlet, p. 26, 27.
- dry calibration, p. 28

4.2 Calibration

This section describes three methods of calibration which require the tank or silo to be filled and the entry of:

- an »empty« level at V0H1 (channel 1) and V4H1 (channel 2)
- a »full« level at V0H2 (channel 1) and V4H2 (channel 2).

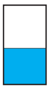
The fourth method can be used to make a »dry« calibration. For horizontal cylinders and tanks with conical outlet, users requiring a volume or weight measurement can activate the linearisation procedure.



Note!

Note!
Prolevel is not bound to specific level units: during calibration it merely assigns the numbers entered to the measured frequencies for »empty« and »full«.

1) Standard calibration for upright cylinders



Channel 2
V4H1
⇓
V4H2
⇓
V4H0

#	Matrix	Entry	Remarks
1	V0H1	**E**	Tank empty, current level in your units
2	-	»E«	Register entry
3	V0H2	**F**	Tank full, current level in your units
4	-	»E«	Register entry
5	V0H0	Level	Measured value in the units selected.

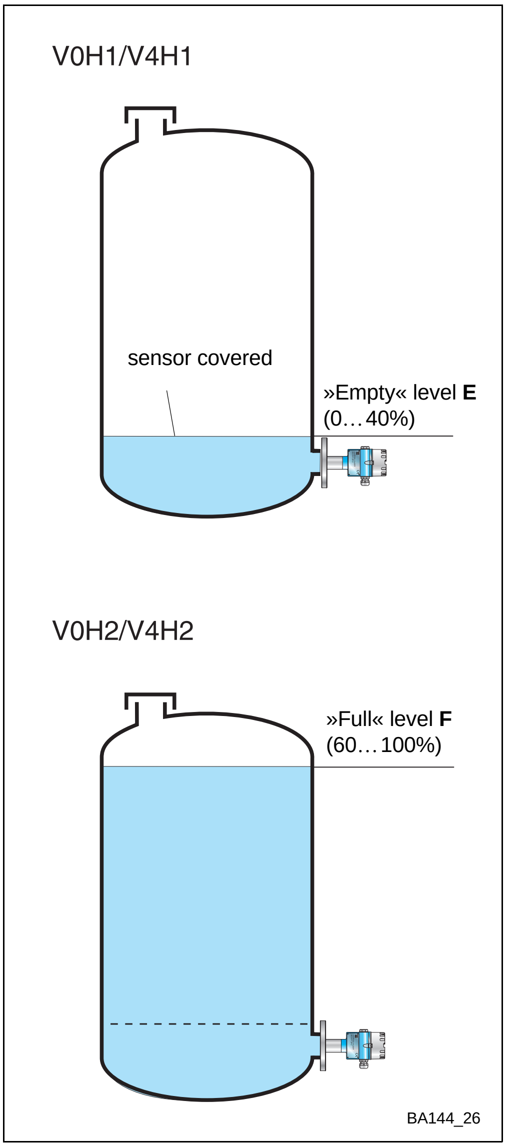


Fig. 4.2:
Parameters for standard calibration in open vessel

Note!

Note!
- The calibration can be performed in reverse order.
- Density correction, see p. 29.

After calibration

If the product level is entered in %:

- % level is displayed at V0H0/V4H0
- the 0/4…20 mA signal range corresponds to 0…100% level
- relays 1a and 1b, channel 1, switch at 90% in maximum fail-safe mode.
- relays 2a and 2b, channel 2, switch at 90% in maximum fail-safe mode.

Next step…

If the level is entered in length, volume or weight units, the analogue output and relays must be set, see p. 30…33.

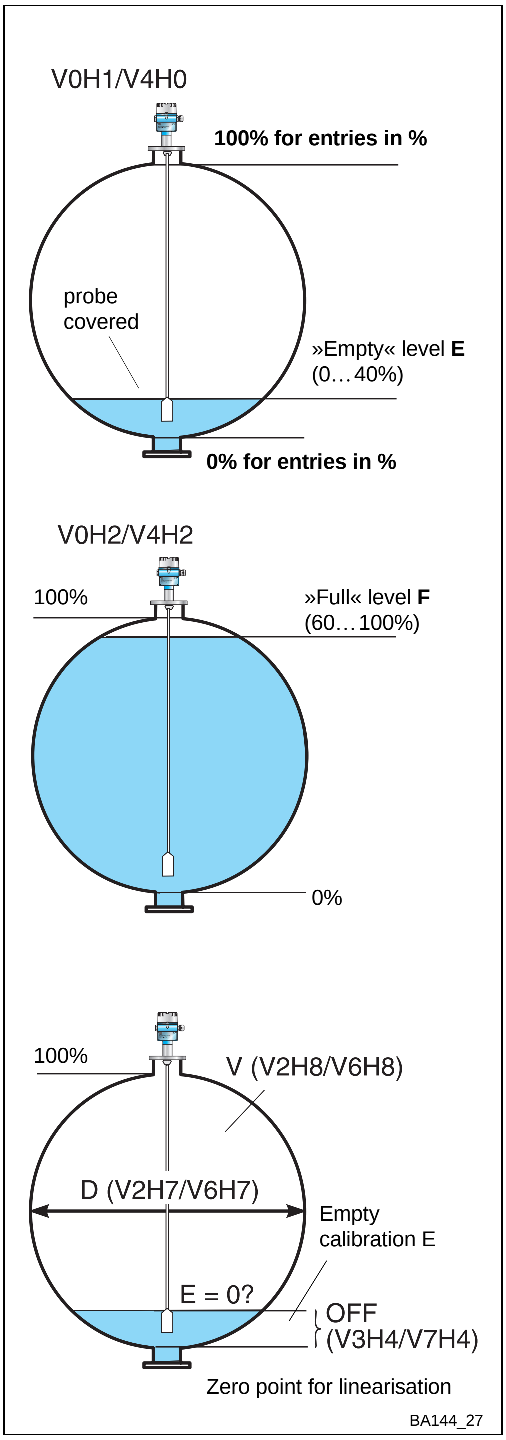


Fig. 4.3:
Parameters for calibration and linearisation in a horizontal cylinder

2) Calibration for horizontal cylinders

#	Matrix	Entry	Remarks
1	V0H1	E	Tank empty, current level in %, m, ft
2	-	»E«	Register entry
3	V0H2	F	Tank full, current level in %, m, ft
4	-	»E«	Register entry

Channel 2: V4H1, V4H2

Level %: refer E% and F% to the bottom (0%) and the top (100%) of the tank! D is then 100%

After calibration the level can be read off at V0H0/V4H0 in %, ft or m.

Linearisation, horizontal cylinder

A volume measurement can be made by calling the linearisation table for horizontal cylinders. Two parameters are entered:

- Tank diameter, **D**
- Tank volume, **V**.

#	Matrix	Entry	Remarks
5	V2H7	**D**	Tank diameter, %, m or ft
6	-	»E«	Register entry
7	V2H8	**V**	Tank volume*, hl, gal…
8	-	»E«	Register entry
9	V2H0	1	Activate linearisation
10	-	»E«	Register entry

* If V =100 is entered, % volume is measured

Channel 2
V6H7
⇓
V6H8
⇓
V6H0

Offset

The linearisation starts at the tank bottom. If the zero point of the calibration does not start at the same point you must now enter a *negative* offset in the units of calibration.

#	Matrix	Entry	Remarks
1.	V3H4	–OFF	Offset, m or ft
2	-	»E«	Register entry

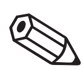
Channel 2
V7H4

After linearisation

- Volume is displayed at V0H0/V4H0
- Level is displayed at V0H9/V4H9

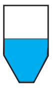
Next step…

Set analogue output and relays in volume units, see p. 30…33.


Note!

Note!
- For linearisation volume => level, see Appendix, p 52.

3) *Calibration for tanks with conical outlet*



Channel 2
V4H1
⇓
V4H2

#	Matrix	Entry	Remarks
1	V0H1	E	Tank empty, current level in %, m, ft
2	-	»E«	Register entry
3	V0H2	F	Tank full, current level in %, m, ft
4	-	»E«	Register entry

After calibration the level can be read off at V0H0 in %, m, or ft. Volume or weight can be measured after a) manual or b) semi-automatic entry of a linearisation table.

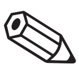
a) Linearisation, manual

You require a linearisation table, H/V or H/G, max. 30 pairs in increasing order

- Level H in %, m or ft
- Volume V or weight G in customer units.

Channel 2
V6H1
⇓
V6H2
⇓
V6H3
⇓
V6H4
⇓
V6H5
⇓
V6H0

#	Matrix	Entry	Remarks
5	V2H1	0	Manual
6	-	»E«	Register entry
7	V2H2	1	Table no.
8	-	»E«	Register entry
9	V2H3	V/G1…30	Volume/weight*
10	-	»E«	Register entry
11	V2H4	H1…30	Level m or ft*
12	-	»E«	Register entry
13	V2H5	**»E«**	**Next table no.*** — springs to V2H3
***Repeat #9…13 until all values entered**			
13	V2H0	3	Activate "manual"
14	-	»E«	Register entry



Note!

Note!
- First pair ~ 0 % level, in %, m, ft. last pair ~ 100 % level, in %, m, ft.
- On error E602…E604, correct table. Re-activate linearisation in V2H0/V6H0.
- For linearisation volume => level, see Appendix, p. 53.

After linearisation

- Volume/weight is displayed at V0H0/V4H0
- Level is displayed at V0H9/V4H9

Next step…

Set analogue output and relays in volume or weight units, p. 30…33.

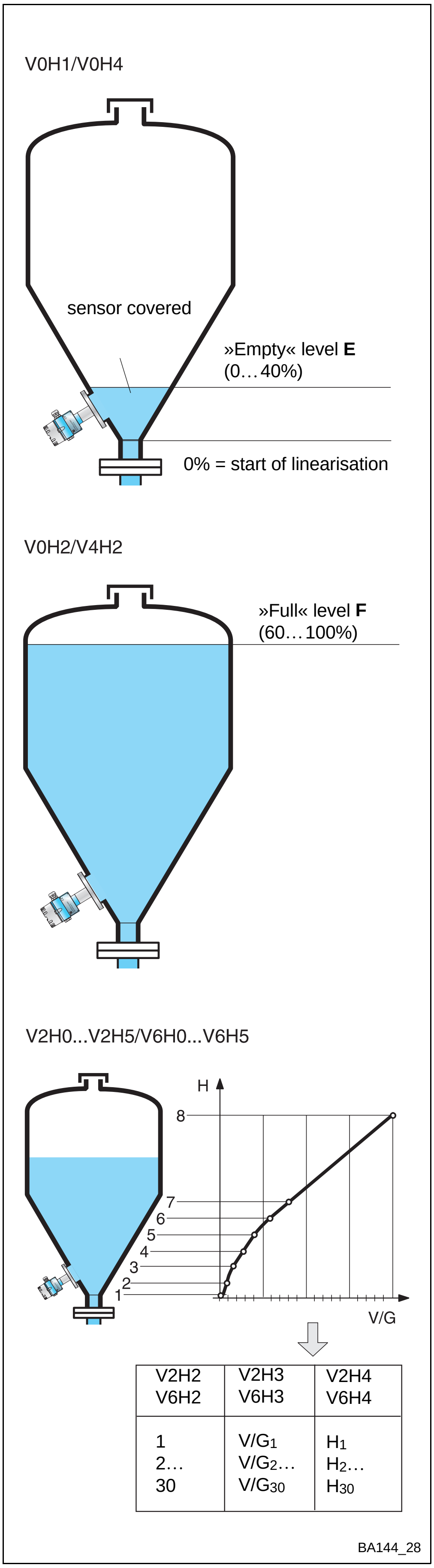


Fig. 4.4:
Parameters for calibration and linearisation in a tank with conical outlet

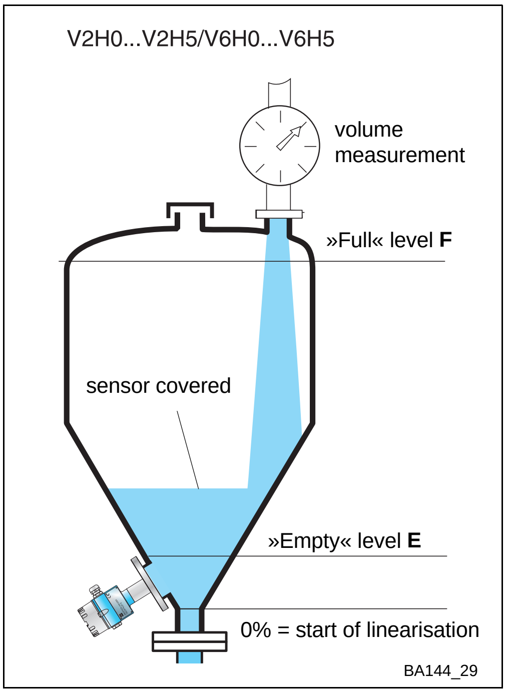


Fig. 4.5:
Parameters for calibration and semi-automatic linearisation in a tank with conical outlet

b) Semi-automatic linearisation

After calibration, p. 26, the semi-automatic linearisation can be made:

- Enter known volume V/weight G in V2H3/V6H3
- Level is displayed in V2H4/V6H4

#	Matrix	Entry	Remarks
5	V2H1	1	Semi-automatic
6	-	»E«	Register entry
7	V2H2	1	Table no.
8	-	»E«	Register entry
9	V2H3	$V/G_{1...30}$	Volume/weight*
10	-	»E«	Register entry
11	V2H4	»E«	Register level $H_{1...30}$*
12	V2H5	**»E«**	**Next** table no.* — springs to V2H3
***Repeat #9…12 until all values entered**			
13	V2H0	3	Activate "manual"
14	-	»E«	Register entry

Channel 2
V6H1
⇓
V6H2
⇓
V6H3
⇓
V6H4
⇓
V6H5
⇓
V6H0

Note!

Note!
- On error E602…E604, correct table. Re-activate linearisation in V2H0 or V6H0.

After linearisation

- Volume/weight is displayed at V0H0/V4H0
- Level is displayed at V0H9/V4H9

Next step…

Set analogue output and relays in volume or weight units, p. 30…33.

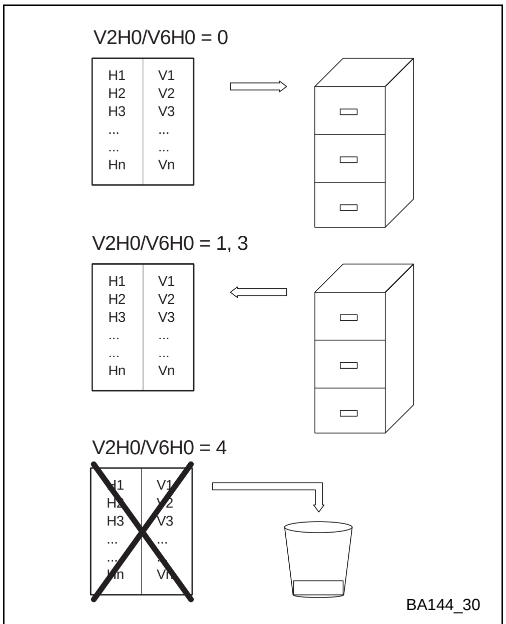


Fig. 4.6:
De-activating a linearisation

Deletion of value pairs

To delete a pair of values:

- Enter table number in V2H2/V6H2
- Enter 9999 in V2H3/V6H3 or V2H4/V6H4

Deletion of linearisation

There are two possibilities for deleting a linearisation:

- Enter "0" in V2H0/V6H0:
  the linearisation is de-activated but the table remains stored
  — Enter 1 (horizontal cylinder) or 3 (linearisation table) to re-activate.
- Enter "4" in V2H0/V6H0:
  the manual or semi-automatic linearisation is deleted, V2H0 = 0
  — The linearisation for horizontal cylinders is deactivated but remains stored.

4) »*Dry calibration*«

ρgh

A dry calibration for hydrostatic sensors requires:

- the »empty« level at which the measurement should start
- the maximum height of the liquid column at »full« level and
- the density of the liquid
- the calculated offset and sensitivity of the display.

Caution!

Caution!
- The sensor constants must have been entered as per Section 4.1.
- Check the calibration during the first filling of the tank! If your calculations are incorrect the levels measured will be incorrect also!

Example: display in %; display for p_{zero} = 0

Calculate the pressure in mbar acting at the sensor for the desired »empty« level and the span (»full« - »empty«):

$p_{mbar} = 10 \times \rho\ (kg/dm^3) \times g\ (m/s^2) \times \Delta h\ (m)$

For 0.45 m water, display = 0%,
For 10.45 m water, display = 100%
Span (0%…100%) = 10 m

- p_{zero} = 10 x 1.0 x 9.807 x 0.45
  = 44.13 mbar
  p_{span} = 10 x 1.0 x 9.807 x 10.00
  = 980.7 mbar
- Offset = p_{zero} = **44.13 mbar**
  Sensitivity = p_{span}/span = 980.7/100
  9.807 mbar/%

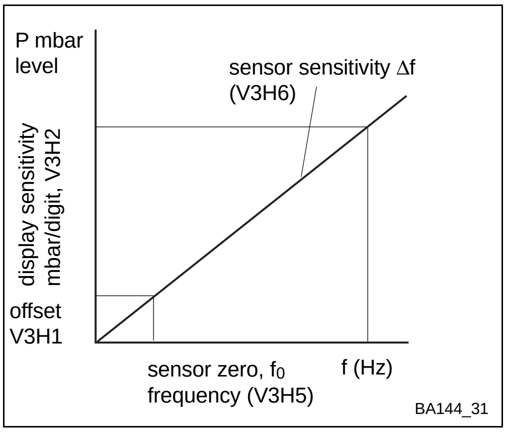


Fig. 4.7:
Offset and sensitivities for dry calibration

Sensor calibration

Channel 2
V4H2
⇓
V7H1
⇓
V7H2
⇓
V4H0

#	Matrix	Entry	Remarks
1	V0H2	e.g. 100	Full level (100%)
2	-	»E«	Register entry
3	V3H1	e.g. 44.13	Offset in mbar
4	-	»E«	Register entry
5	V3H2	e.g. 9.807	Sensitivity mbar/%
6	-	»E«	Register entry
5	V0H0	**.**	Measured value %

The Prolevel now measures 0 at 44.13 mbar

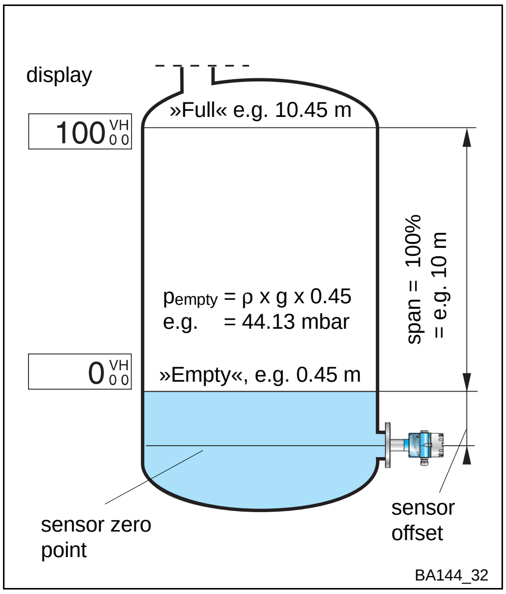


Fig. 4.8:
Parameters for dry calibration, display in %

Next step…

Set analogue outputs and relays in %, see p. 30…33.

Example: display in hl display for $p_{zero} \neq 0$

Calculate the pressure in mbar acting at the sensor for the desired »empty« level and the span (»full« - »empty«):

$$p_{mbar} = 10 \times \rho\ (kg/dm^3) \times g\ (m/s^2) \times \Delta h\ (m)$$

For 0.0 m water, display = 50 hl
For 10.0 m water, display = 2000 hl
Span (50…2000 = 1950) = 10 m

- p_{zero} = 10 x 1.0 x 9.807 x 0.0 = 0.0 mbar
  p_{1950} = p_{span} = 10 x 1.0 x 9.807 x 10.00 = 980.7 mbar
- Offset = p_{zero} = **= 0.0 mbar**
  Sensitivity = p_{span}/span = 980.7/1950 **= 0.5029 mbar/hl**

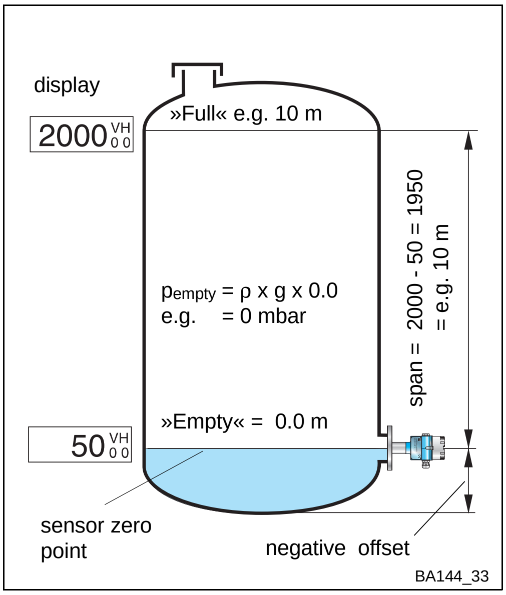


Fig. 4.9:
Parameters for dry calibration, display in hl

Sensor calibration

#	Matrix	Entry	Remarks
1	V0H2	e.g. 2000	Full level (100%)
2	-	»E«	Register entry
3	V3H1	0.0	Offset in mbar
4	-	»E«	Register entry
5	V3H2	e.g. 0.5029	Sensitivity mbar/hl
6	-	»E«	Register entry
The Prolevel now measures 0 at 0 mbar — a negative level offset must be entered, p. 25			
7	V3H4	e.g. -50	Level offset
8	-	»E«	Register entry

Channel 2
V4H2
⇓
V7H1
⇓
V7H2
⇓
V7H4

Next step…

Set analogue outputs and relays in the units used for calibration, e.g. hl, see p. 30…33.

Density correction

If the product changes after calibration, the measurement can be corrected by entering a density factor at V3H3 for channel 1 or V7H3 for channel 2:

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

The measured value is divided by the factor before display.

Note!
- For an automatic density correction using a second sensor see »Calibration Correction« in Chapter 5

Note!

4.3 Analogue Outputs

This section describes the setting of the analogue outputs. The following parameters can be entered or changed:

- Analogue signal range
- Output damping
- Value for 0/4 mA and 20 mA
- Output at fault
- Output 2 assignment

Analogue signal range

Two settings are possible: :

- 0 = 0...20 mA (default)
- 1 = 4...20 mA

Depending on the level values entered at V0H5/V4H5 and V0H6/V4H6 for the start and end of the range, it is possible that signals below 0/4 mA and above 20 mA can be generated in normal operation.

V0H3 V4H3	Range	Current limits
0	0...20 mA	-2.0…22.0 mA
1	4...20 mA	-2.0…22.0 mA

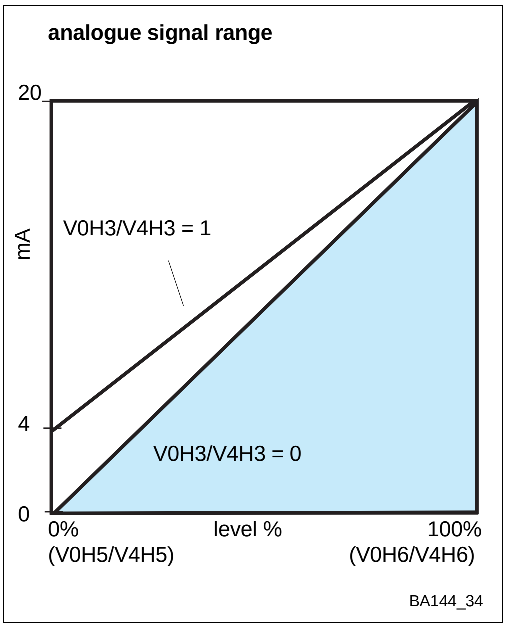


Fig. 4.10:
Selection of analogue signal range, V0H3/V4H3

Example:
4…20 mA

Channel 2
V4H3

#	Matrix	Entry	Remarks
1	V0H3	1	4…20 mA
2	-	»E«	Register entry

Output damping

This parameter sets the degree of damping of the analogue output: on a sudden change in level, 63% of the new value is attained in the set time (0...100 s).

Example:
Output damping

Channel 2
V4H4

#	Matrix	Entry	Remarks
1	V0H4	20	Damping 20 s
2	-	»E«	Register entry

The digital values at V0H0/V4H0, V0H8/V4H8 and V0H9/V4H9 are also influenced by the output damping.

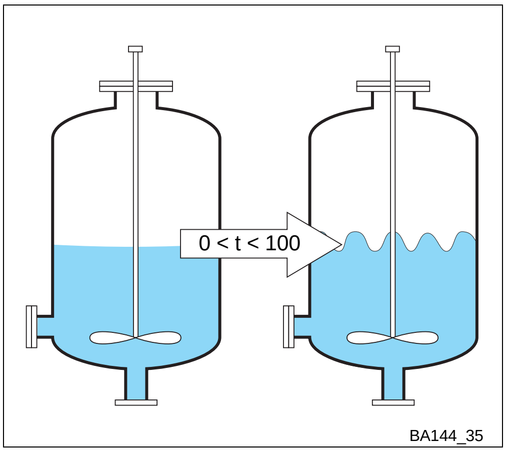


Fig. 4.11:
Output damping, V0H4/V4H4

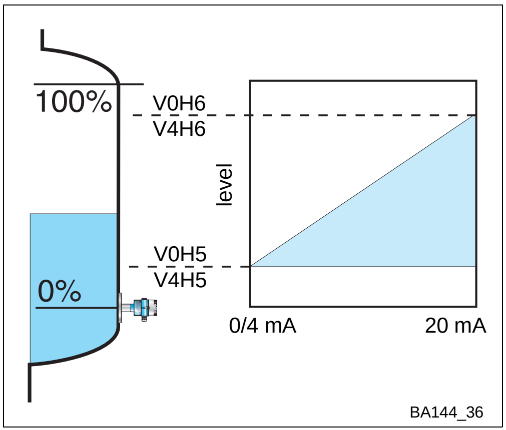


Fig. 4.12:
Value for 4 mA and 20 mA, V0H5/V4H5 and V0H6/V4H6

Value for 4 mA and 20 mA

The 4mA (V0H5/V4H5) and 20 mA (V0H6/V4H6) values, default values 0% and 100%, determine the levels at which the analogue signal range begins and ends.

#	Matrix	Entry	Remarks
1	V0H5	20	4mA value, 20 %
2	-	»E«	Register entry
3	V0H6	80	20 mA value, 80%
4	-	»E«	Register entry

Example:
4 mA = 20%,
20 mA = 80%

Channel 2
V4H5
⇓
V4H6

Note!
- Set in calibration/linearisation units
- When V0H3/V4H3 = 0, then V0H5/V4H5 = 0 mA value

Note!

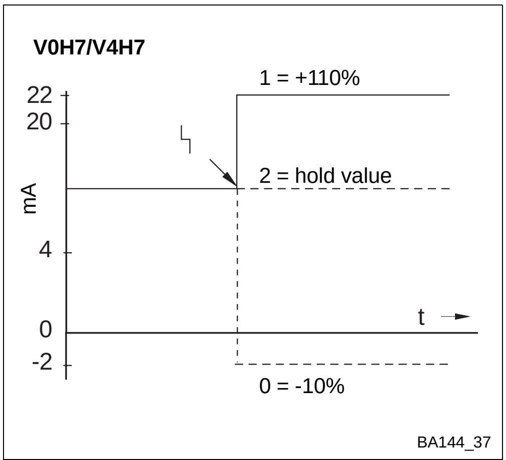


Fig. 4.13:
Output on alarm, V0H7/V4H7

Output on alarm

The analogue outputs can be set such that they take on distinctive values when a fault with alarm is detected. Depending on the setting in V1H3/V5H3, the relays may also follow them. The entry is made in V0H7/V4H7:

- 0 = -10% of signal range
- 1 = +110% of signal range (default)
- 2 = last value is held

#	Matrix	Entry	Remarks
1	V0H7	0	-10% on alarm
2	-	»E«	Register entry

Example:
Output -10 % on alarm

Channel 2
V4H7

The current values set on an alarm are shown in the table

V0H3/V4H3 =	Current on alarm when V0H7/V4H7 =		
	0: (-10%)	1: (+110%)	2: hold
0: 0…20 mA	≤ -2 mA	≥ 22.0 mA	last value
1: 4…20 mA	≤ -2 mA	≥ 22.0 mA	last value

Caution!
- If setting 2 is chosen, the fault recognition system on the 0/4…20 mA signal line is effectively deactivated. Although the transmitter recognises a fault, i.e. the alarm relay de-energises and the associated LED lights, the signal output to any follow-up instrumentation appears to indicate a correct measured value.

Note!

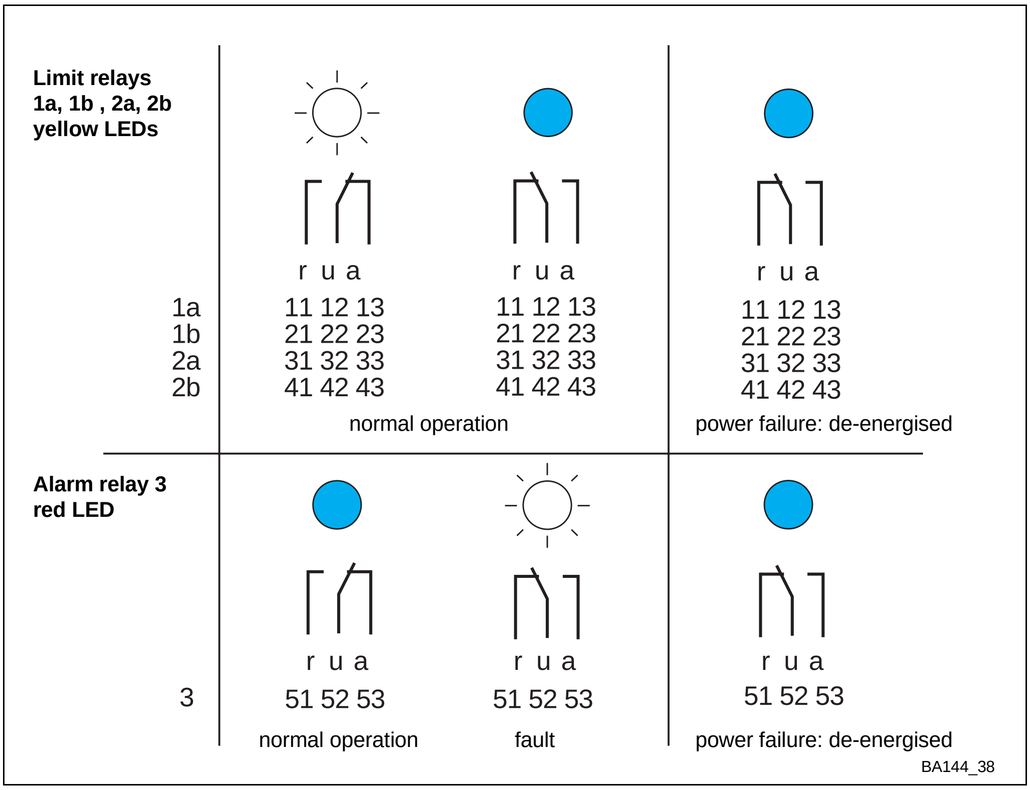
Output 2 assignment (operating mode 3)

By entering 1 in V8H2, it is possible to assign analogue output 2 to channel 1 in operating mode 3. It can be re-assigned to channel 2 by entering 2 at the same matrix position.

#	Matrix	Entry	Remarks
1	V8H2	1	Analogue output 2 assigned to channel 1
2	-	»E«	Register entry

4.4 Relays

Fig. 4.14: Relay LEDs as a function of relay status: limit relay: lit, energised out, de-energised alarm relay (default setting): lit, de-energised out or flashing, energised



Operating modes

The Prolevel FMB 662 has five independent relays with potential-free changeover contacts. Relays 1a, 1b, 2a and 2b are limit relays, relay 3 is an alarm relay which always de-energises on fault condition. Relays 1a and 1b are set together, as are 2a and 2b. Five parameters set the limit relays, Table 4.1 summarises their function:

Table 4.1: Parameters for setting limit relays

Parameter	Matrix position for relays		Entry/Function
	1a, 1b	2a, 2b	
Switch point	V1H0	V5H0	Relay switch point in calibration/linearisation units
Fail-safe mode	V1H1	V5H1	0: minimum fail-safe mode: — the relay de-energises when the level drops below the switch point, see Fig. 4.12. 1: maximum fail-safe mode — the relay de-energises when the level rises above the switch point, see Fig 4.13.
Hysteresis	V1H2	V5H2	Range at end of which the relay energises again
Relay on alarm	V1H3	V5H3	0: de-energised 1: as analogue output: see Table 4.2.
Relay assignment	V1H4	V5H4	1: channel 1 2: channel 2

Relay on alarm

The limit relays respond to an alarm according to the entry at V1H3/V5H3. Table 4.2 indicates their response when the analogue output option is chosen.

Table 4.2: Relay response on fault condition when V1H3/V5H3 = 1.

Setting at V0H7/V4H7	Minimum fail-safe mode	Maximum fail-safe mode
0 = -10% (≤ -2 mA)	Relay de-energises	Relay energises
1 = +110% (≥ +22 mA)	Relay energises	Relay de-energises

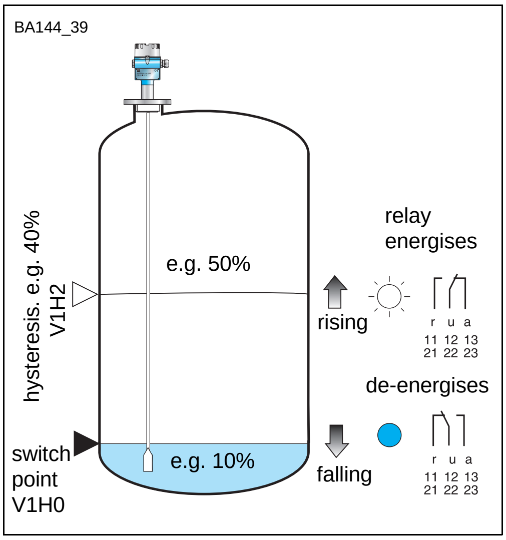


Fig. 4.15:
Limit value relay: example for minimum fail-safe mode on channel 1

#	Matrix	Entry	Remarks
1	V1H0	e.g. 10	Switch point
2	-	»E«	Register entry
3	V1H1	0	Min. fail-safe mode
4	-	»E«	Register entry
5	V1H2	e.g. 40	Hysteresis — relay energises at 50
6	-	»E«	Register entry
7	V1H3	0	De-energise on alarm
8	-	»E«	Register entry
9	V1H4	1	Assign to channel 1
10	-	»E«	Register entry

Example channel 1:
min. fail-safe mode,
relays 1a, 1b:
switch point 10%,
hysteresis 40%
relay de-energises on alarm

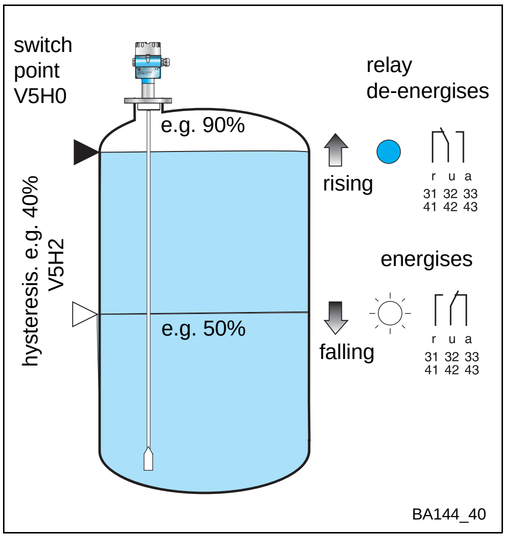
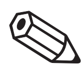


Fig. 4.16:
Limit value relay: example for maximum fail-safe mode on channel 2

#	Matrix	Entry	Remarks
1	V5H0	e.g. 90	Switch point
2	-	»E«	Register entry
3	V5H1	1	Max. fail-safe mode
4	-	»E«	Register entry
5	V5H2	e.g. 40	Hysteresis — relay energises at 50
6	-	»E«	Register entry
7	V5H3	1	Follow outputs
8	-	»E«	Register entry
9	V5H4	2	Assign to channel 2
10	-	»E«	Register entry

Example channel 2:
max. fail-safe mode,
relay 2a, 2b
switch point 90%
hysteresis 40%
relay follows analogue output

Note!
- The switch point and hysteresis are always entered in the units of calibration or linearisation
- A small hysteresis prevents faulty switching due to turbulence
- A large hysteresis allows two-point control of a pump with one relay
- If both pairs of relays are assigned to channel 1, the hystereses of each can be set such that one relay pair de-energises just as the other energises.



4.5 Measured value display

The measured values can be read from V0H0 and V4H0. In addition to this, several other fields contain system information which might be needed, e.g., for trouble-shooting etc.. Table 4.3 summarises the displays.

Table 4.3: Matrix positions of measured value displays

Channel 1	Channel 2	Measured value	Remarks
V0H0	V4H0	Level or volume	Display in %, m, ft, hl, m^3, ft^3, t etc. according to calibration and/or linearisation. The entries for the 0/4 mA and 20 mA value at V0H5/V4H5 and V0H6/V4H6 control the 10-step LCD bar diagram. For mode 3, V0H0 shows differential level, V4H0 the value measured by sensor 2 and analogue output 2, depending on the setting in V8H2
V0H8	V4H8	Current measuring frequency	Displays the frequency which is actually measured by the probe. Can be used as a fault check (must change as level changes)
V0H9	V4H9	Measured value before linearisation	Indicates level before linearisation in the units used for calibration
V8H8		Display difference	Displays the difference in display in mode 3 and 4
V9H0		Current error code	Error code of fault with highest priority appears on fault condition, alarm LED lights or blinks
V9H1		Last error code	The previous error can be read and deleted here - press »E« to delete
V9H3		Software version with instrument code	The first two figures indicate the instrument, the last, the software version; 33 = Version 3.3
V9H4		Rackbus address	Indicates RS-485 address set at DIP-switches

4.6 Parameter locking

When all parameter entries have been made, the matrix can be locked by entering any code number less that 670 or greater than 679 in V8H9.

Step	Matrix	Entry	Remarks
1	V8H9	e.g. 888	Enter any code from 000 - 669 or from 680 - 999
2	-	»E«	Register entry

After locking, all entries can be displayed but not changed.

- The lock is released when a number between 670 and 679 is entered at V8H9.

Note your parameters!

The instrument is now configured. Note your parameters in the table at the back of the manual - if you have to replace the transmitter, these can be simply entered in the replacement Prolevel FMB 662. There is no need to recalibrate.

5 Other Operating Modes

This chapter describes the configuration of the Prolevel FMB 662 for:

- Level measurement in a pressurised vessel
  - with pressurisation of the vessel
  - without pressurisation of the vessel
  - dry calibration
- Differential level measurement for screen control
- Density-compensated level measurement
  - density known
  - density unknown

Fig. 5.1 summarises the configuration sequence


Note!

Note!
For the following applications we recommend the use of high-accuracy, chromium-nickel resistive cells. All calculations of measurement uncertainty are based on the technical data for these cells.

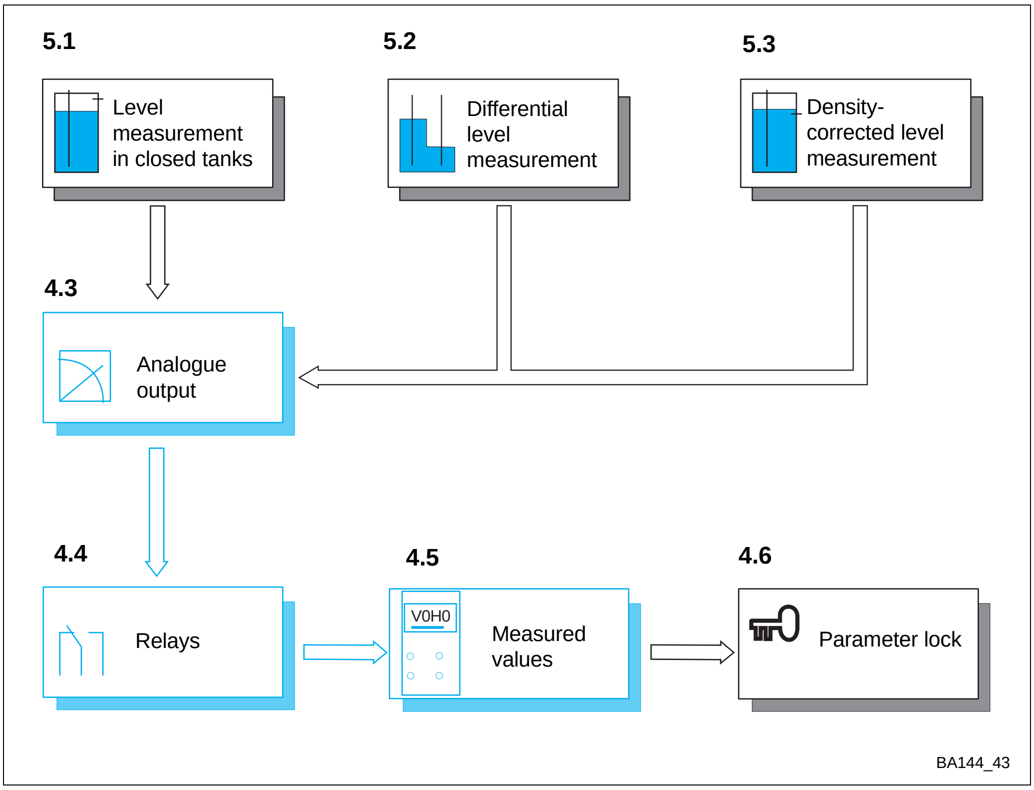
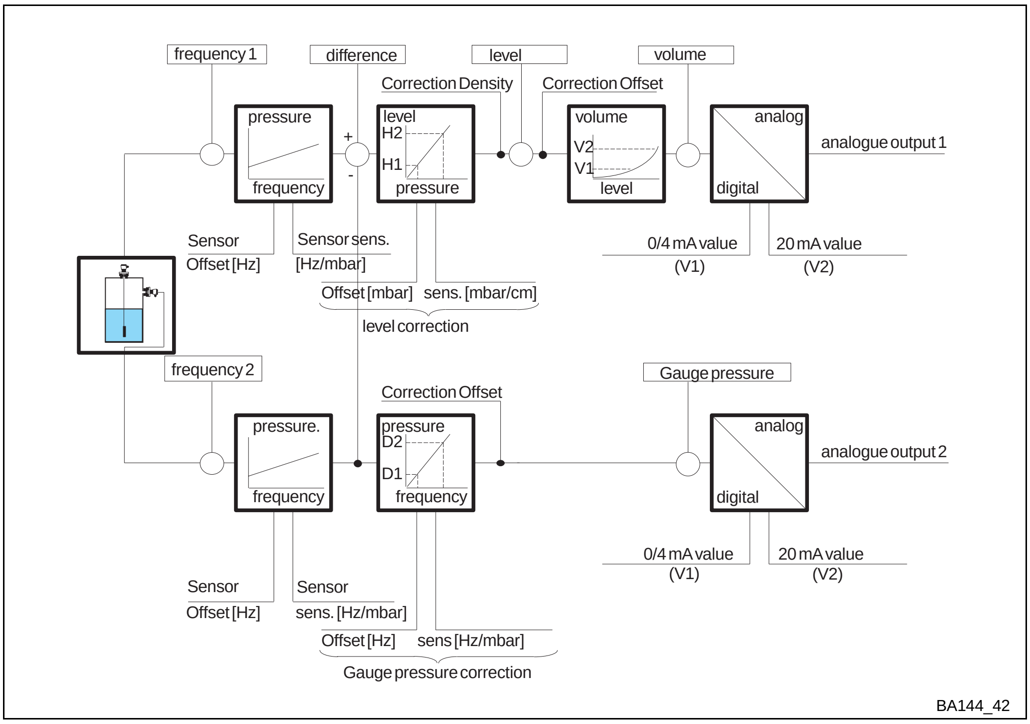


Fig. 5.1: Configuration sequence of applications modes described in Chapter 5

5.1 Level measurement in pressurised vessels

Fig. 5.2: Block diagram of pressure-compensated level measurement



Operating mode 3

Pressure-compensated and differential level measurements are carried out in operating mode 3, see Fig 5.2, whereby the signal from channel 2 is subtracted from that of channel 1. In closed tanks the second Deltapilot S is used as a pressure gauge and can as a consequence be subject to vacuum or overpressure according to application. The electronic insert chosen determines the measuring range, see Table 2.2 (page 13).

Measured error

Since two measuring cells are required, the measured error must be calculated in detail:

$$\text{Measured error} = \sqrt{L_f^2 + T_f^2 + H_f^2}$$

where:

L_f = linearity error	≤	linearity x measured value
T_f = temperature error	≤	T_K x ΔT x nominal measuring range
H_f = hysteresis error	≤	hysteresis x nominal measuring range

Example, see Fig. 5.3

The hydrostatic cell must be chosen according to the pressure acting on it, e.g. for: *tank height 18 m; pressure 0.5…1 bar gauge; temperature 2°…8°C; density 1.0 kg/dm³;* the hydrostatic pressure at Deltapilot S 1 is ca. 1.8 bar, i.e.:

$$p_{tot} = 1 \text{ bar} + 1.8 \text{ bar} = 2.8 \text{ bar}$$

For 2.8 bar total pressure, the 4 bar cell must be used

L_{f1}	≤	0.2% x 2.8 bar	= 5.6 mbar
L_{f2}	≤	0.2% x 1 bar	= 2.0 mbar
T_{f1}	≤	0.01% x 6K x 4 bar	= 2.4 mbar
T_{f2}	≤	0.01% x 6K x 1.2 bar	= 0.72 mbar
H_{f1}	≤	0.1% x 4 bar	= 4 mbar
H_{f2}	≤	0.1% x 1.2 bar	= 1.2 mbar

$$\text{Measured error} \leq \sqrt{5.6^2 + 2^2 + 2.4^2 + 0.72^2 + 4^2 + 1.2^2} = 7.68 \text{ mbar}$$

referred to a measured value of 18 m or 1.8 bar ≤ 0.427%

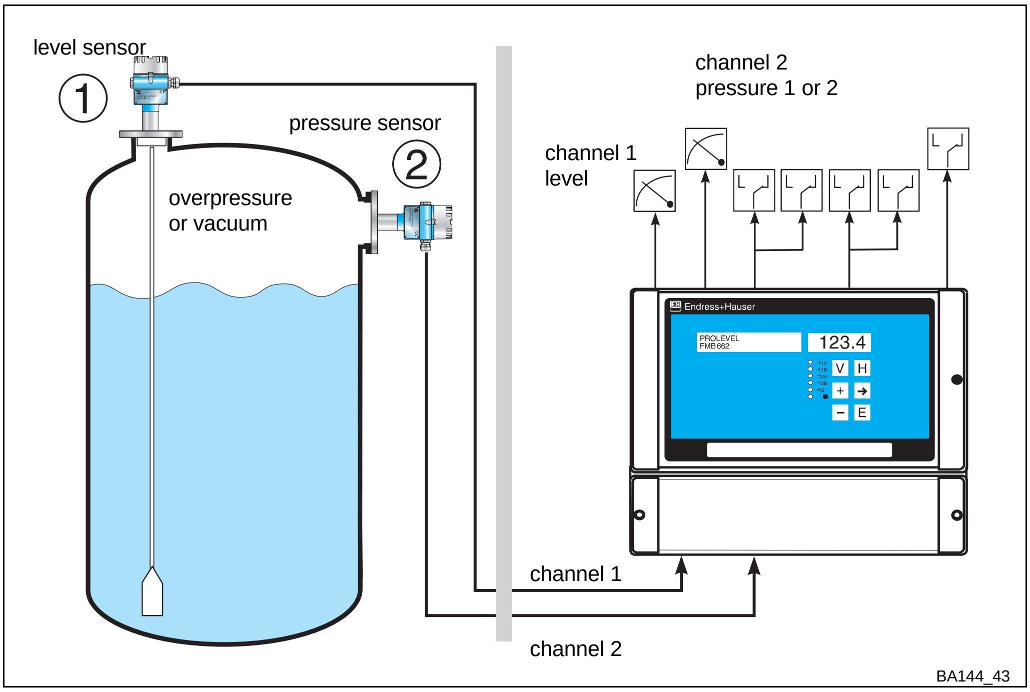


Fig. 5.3:
Measuring system for level measurement in closed tanks
① measurement of total hydrostatic pressure
② measurement of overpressure or vacuum

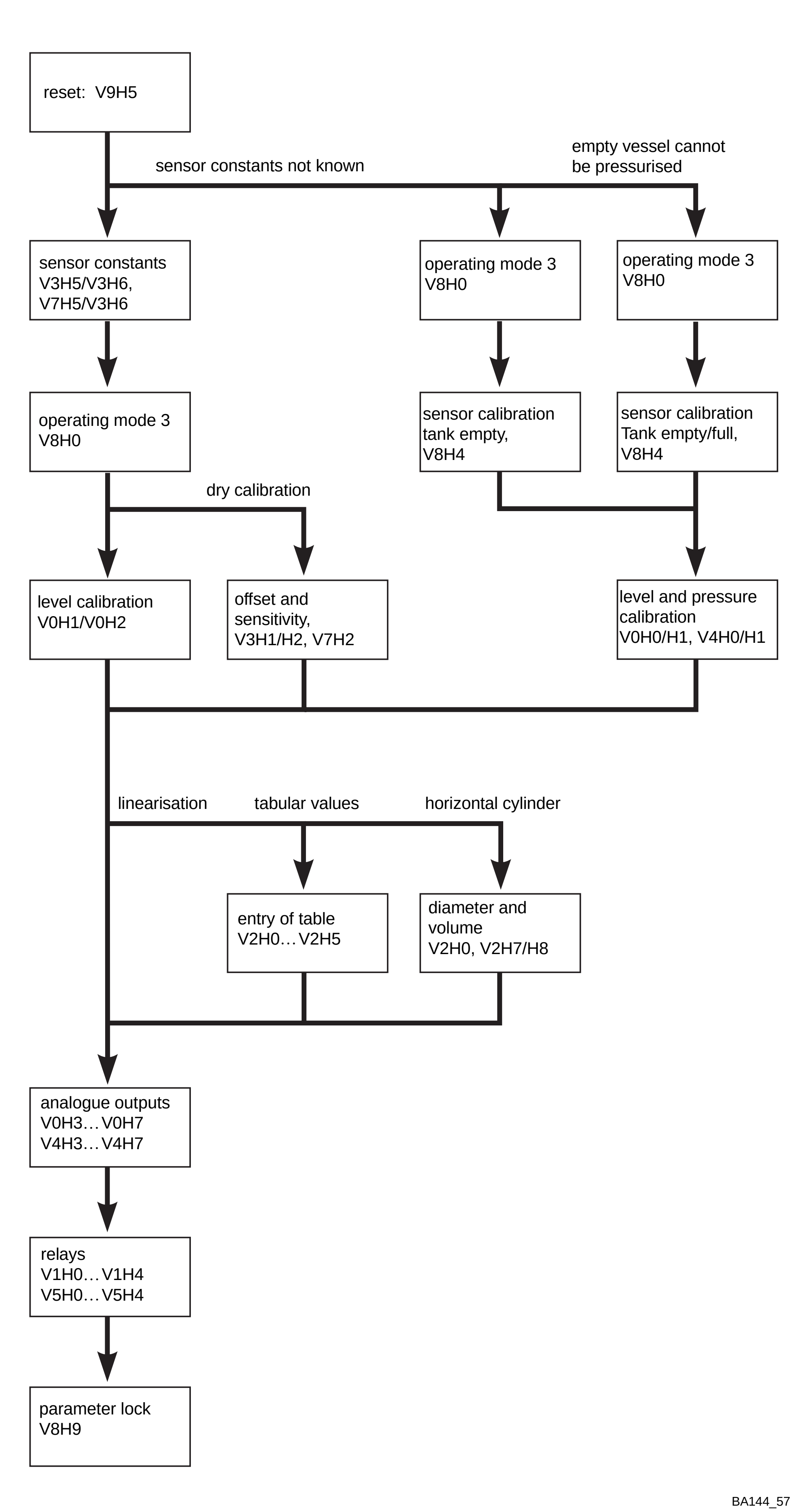
System requirements

Fig. 5.3 is a schematic diagram of the measuring system, whereby the pressure above the liquid column may fluctuate between overpressure and vacuum. The Deltapilot S measuring pressure must be positioned above the maximum liquid level. There are three possibilies to calibrate:

- *standard calibration, p. 39*
  this can be used when the sensor constants are known and the empty vessel can be pressurised
- *sensor and level calibration, p.40*
  this can be used if the sensor constants have not been noted and the sensors are already in position. There is also no need to pressurise the empty vessel with this method.
- *a dry calibration, p. 41*
  this can be used when the sensor constants are known but it is not possible to empty and fill the tank.

Fig. 5.4 overleaf shows the full calibration procedure.

Fig. 5.4:
Block diagram of calibration methods for pressure-compensated level measurement



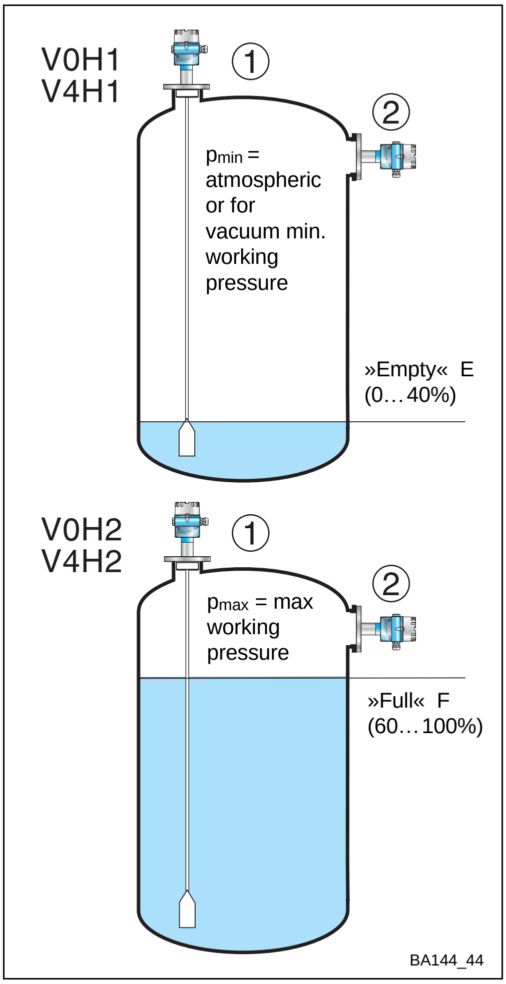
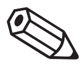


Fig. 5.5:
Parameters for level measurement in closed tank

1) Standard calibration tank pressurised

#	Matrix	Entry	Remarks
1	V9H5/V3H5/V3H6 V7H5/V7H6		Commission as in Section 4.1
2	V8H0	**3**	Differential level
3	-	»E«	Register entry
5	V0H1	**E**	Tank empty, p = min.
6	-	»E«	Register entry
7	V4H1	$\mathbf{p_{min}}$	Pressure sensor 2
8	-	»E«	Register entry
9	V0H2	**F**	Tank full, p = max.
10	-	»E«	Register entry
11	V4H2	$\mathbf{p_{max}}$	Pressure sensor 2
12	-	»E«	Register entry


Note!

Note!
- Use any level and pressure units
- If volume units are to be used and a linearisation other than by tabular values is required, omit steps #5 and #9, and proceed from step #7 of the linearisation procedure described on p. 52 or 53.

After calibration

- V0H0 = level,
  V4H0 = pressure channel 2..

Next step…

If necessary linearisation channel 1, p. 25…, analogue outputs and relays, p. 30…33

2) Sensor and level calibration, empty tank unpressurised

#	Matrix	Entry	Remarks
1	V9H5…	672	Reset
2	-	»E«	Register entry
3	V8H0	3	Differential level«
4	-	»E«	Register entry
5	V8H4	0	Tank empty, p_{min}.
6	-	»E«	Register entry
7	V8H4	1	Tank full. p_{atm}
8	-	»E«	Register entry
9	V8H4	2	Tank full, p_{max}
10	-	»E«	Register entry
11	V0H2	**F**	Level, tank full, p_{max}
12	-	»E«	Register entry
13	V4H2	$\mathbf{p_{max}}$	Tank full, p_{max}
14	-	»E«	Register entry
15	V0H1	**E**	Level , tank empty, p_{min}
16	-	»E«	Register entry
17	V4H1	$\mathbf{p_{min.}}$	Tank empty, p_{min}
18	-	»E«	Register entry

Note!

Note!
- Use the level and pressure units of your choice
- If the empty tank can be pressurised:
  — leave out # 7, 8
  — # 9, 10: with empty tank and p_{max}, V8H4 = 2
- If volume units are to be used and a linearisation other than by tabular values is required, omit steps #11 and #15, and proceed from step #7 of the linearisation procedure described on p. 52 or 53.

After calibration

- V0H0 = level,
  V4H0 = pressure on channel 2.

Next step…

If necessary, 1inearisation on channel 1 p 25…, analogue outputs and relays, p. 30…33.

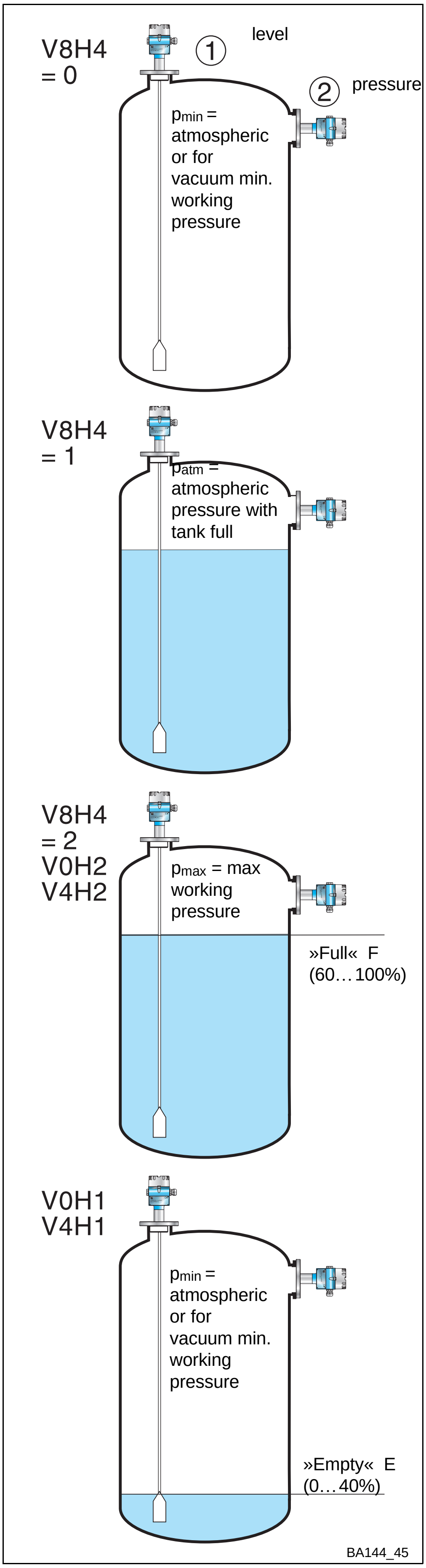


Fig. 5.6:
Parameters for level measurement in closed tank

3) »Dry calibration« pressurised vessel

A theoretical calibration can be performed by using the sensor constants zero frequency »f_0« and sensitivity »Δf«. A dry calibration, see also p. 28 and 29, requires:

- the »empty« level at which the measurement should start
- the maximum height of the liquid column at »full« level
- the density of the liquid
- the calculated offset and sensitivity of the display
- the pressure display sensitivity — 1 for mbar, 1000 for bar

Caution!
- Check the calibration during the first filling of the tank! If your calculations are incorrect the levels measured will be incorrect also!


Caution!

Example: level in ft pressure in mbar

Calculate the pressure in mbar acting at the sensor for the desired »empty« level and the span (»full« - »empty«):

$p_{mbar} = 10 \times \rho\ (kg/dm^3) \times g\ (m/s^2) \times \Delta h\ (m)$

For 0 ft water, display = 2 ft; for 16 ft water, display = 18 ft; span (18 ft - 2 ft) = 16 ft

- p_{empty} = 10 x 1.0 x 9.807 x 0 = 0 mbar
  p_{span} = 10 x 1.0 x 9.807 x (16.00 x 0.3048) = 478.3 mbar
- Offset = p_{empty} = **0 mbar**
  Sensitivity = p_{span}/span = 478.3/16 = **29.89 mbar/ft**

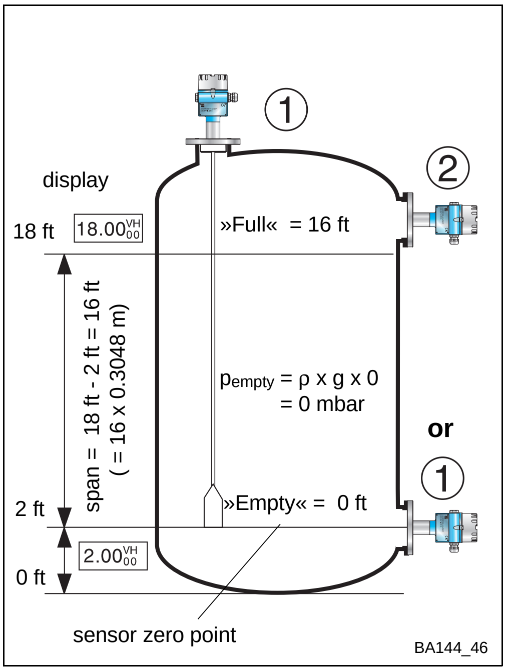


Fig. 5.7:
Parameters for dry calibration, display in ft
① *level measurement*
② *pressure measurement*

Procedure

#	Matrix	Entry	Remarks
1	V9H5/V3H5/V3H6 V7H5/V7H6		Commission as in Section 4.1
2	V8H0	3	Differential level
3	-	»E«	Register entry
4	V0H2	e.g. 18	Full level (100%)
5	-	»E«	Register entry
6	V3H1	e.g. 0	Display offset Ch. 1
7	-	»E«	Register entry
8	V3H2	e.g. 29.89	Disp. sensitivity Ch. 1
9	-	»E«	Register entry
10	V7H2	e.g. 1	Disp. sensitivity Ch. 2 - measures in mbar
11	-	»E«	Register entry
The Prolevel now displays 0 at 0 mbar — a negative level offset must be entered, p.25			
12	V3H4	e.g. -2	Level offset
13	-	»E«	Register entry

Ch. 1 = Channel 1
Ch. 2 = Channel 2

After calibration

- V0H0 = level, V4H0 = pressure Ch. 2.

Next step…

Linearisation on channel 1? p 25…
— must correspond to chosen display, analogue outputs and relays, p. 30…33.

5.2 Differential level measurement

Fig. 5.8: Measuring system for level difference measurement with screen control

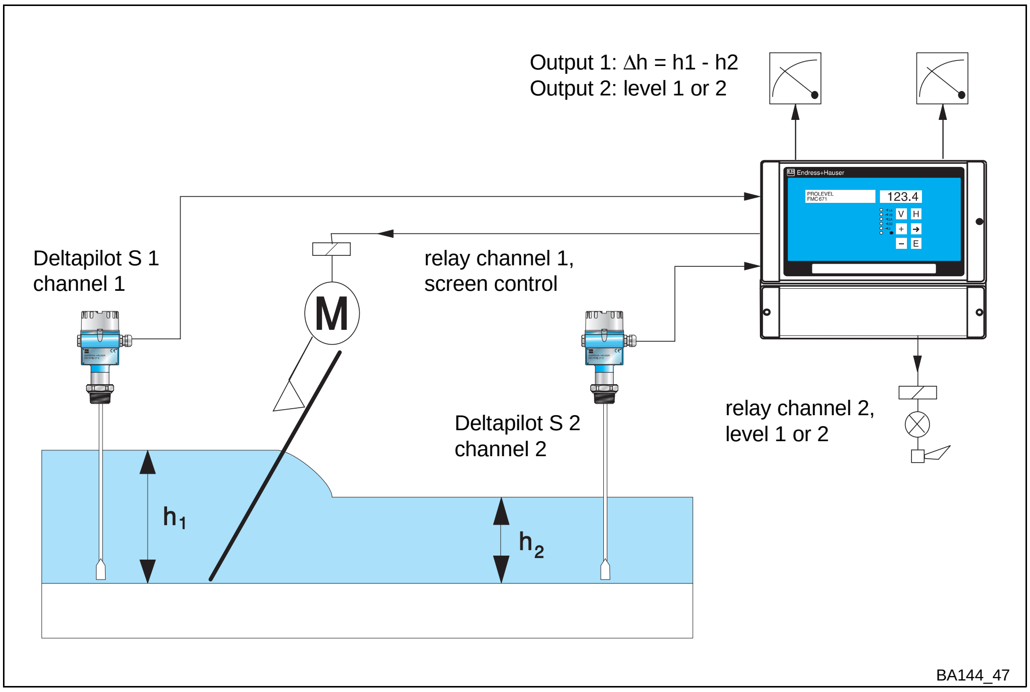


Fig. 5.8 shows a typical application for differential level measurement taken from wastewater management. The two Deltapilot S sensors measure the difference between the levels h_1 and h_2, Δh, which is used to control the inclination of the screen. A continuous display of level h_1 or h_2 is provided by the second output.

Calibration

The system is calibrated on-site. The following parameters required:

- Sensor constants »f_0« and »Δf« from the table, see Section 2.1.
- Deltapilot S pressures at minimum and maximum level difference
- Deltapilot S pressures at minimum and maximum level for level output

The simplest way of producing the required pressures is to move Deltapilot S 2 during the calibration. For maximum difference, lift until the hydrostatic pressure corresponds to the minimum permissible pressure behind the screen, for minimum difference, immerse parallel to Deltapilot S 1 before the screen.

The level measurement sensor is determined by the entry at V8H2:

- 1: Sensor 1
- 2: Sensor 2

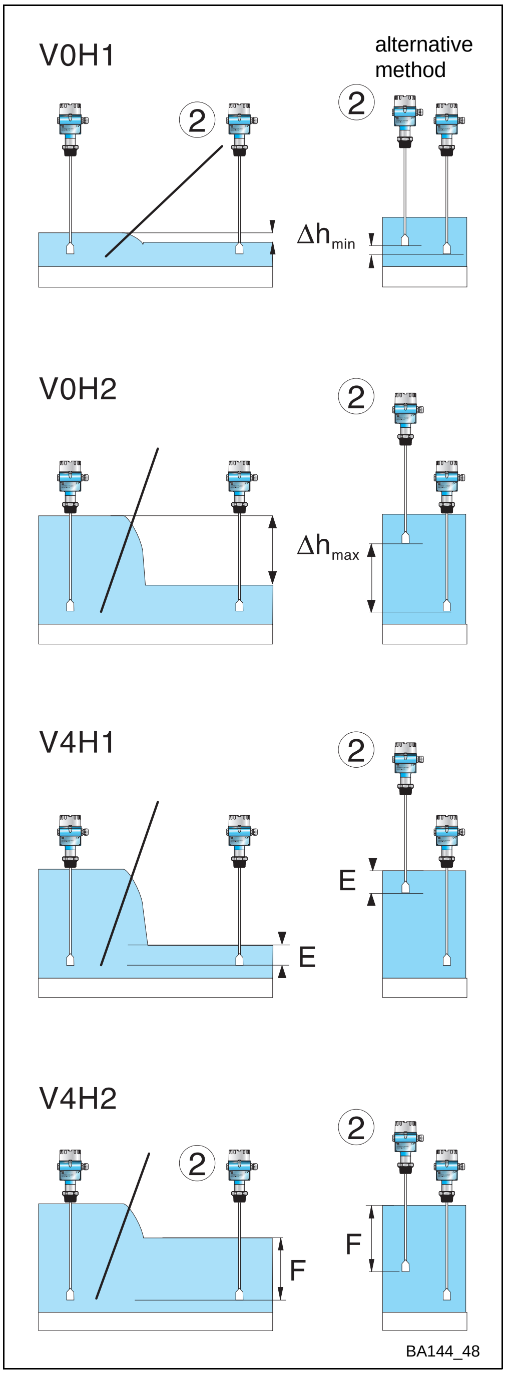


Fig. 5.9:
Parameters for differential level calibration with level measurement from sensor 2

Example:
Differential level
+ level measurement
with sensor 2

#	Matrix	Entry	Remarks
1	V9H5/V3H5/V3H6 V7H5/V7H6		Commission as in Section 4.1
2	V8H0	3	Differential level
3	-	»E«	Register entry
4	V0H1	Δh_{min}	Min. level difference
5	-	»E«	Register entry
6	V0H2	Δh_{max}	Max. level difference
7	-	»E«	Register entry
8	V8H2	2	Assign level output 1 = Deltapilot S 1 2 = Deltapilot S 2
9	-	»E«	Register entry
10	V4H1	E	Min. level sensor 2 If V8H2 = 1, sensor 1
11	-	»E«	Register entry
12	V4H2	F	Max. level sensor 2 If V8H2 = 1, sensor 1
13	-	»E«	Register entry

After calibration

- V0H0 = level difference $\Delta h = h_1 - h_2$
- V4H0 = level sensor 2 (or 1)

Next step…

- Linearisation on channel 1? p. 25…
  — e.g. for flow measurement
- Analogue outputs and relays, p. 30…33
  — Output 1 measures differential level $h_1 - h_2$
  — Output 2 measures level h_1 or h_2 according to entry at V8H2.

5.3 Density compensated level measurement

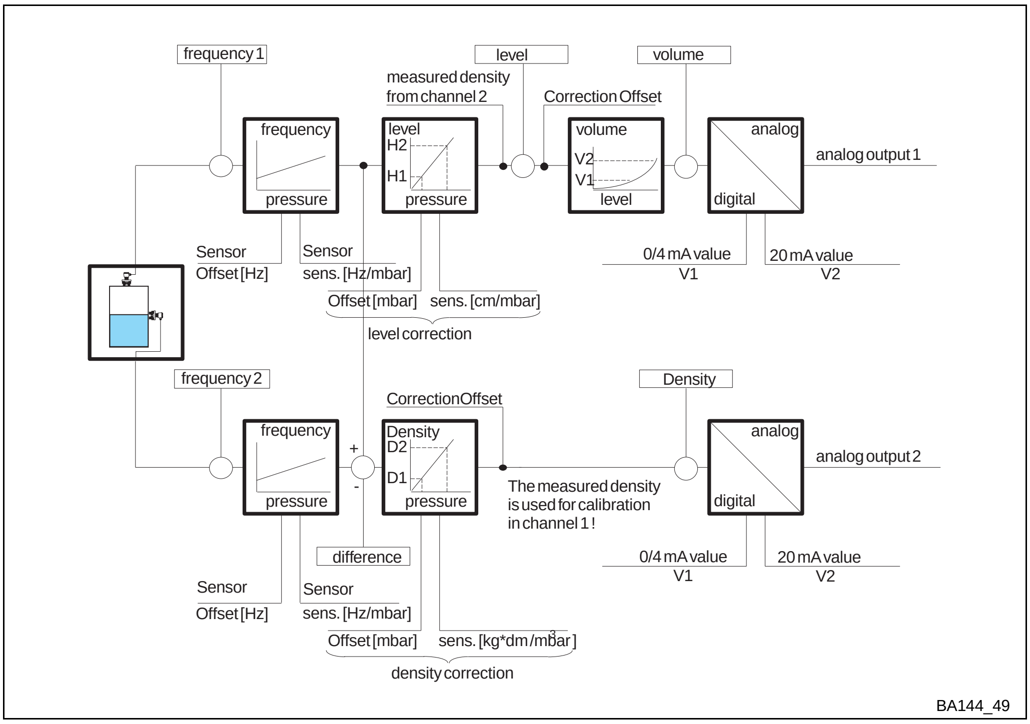


Fig. 5.10: Block diagram of density compensated level measurement

Operating mode 4

Operating mode 4, see Fig. 5.10, provides a density measurement at channel 2 which can be coupled to the level measurement at channel 1 providing a density compensated level measurement.

Measured error for density

The measurement uncertainty is dependent on the distance between the Deltapilot S sensors and the density range to be measured.

$$\text{Measured error} = \sqrt{L_f^2 + T_f^2 + H_f^2}$$

where:

L_f = linearity error ≤ linearity x measured value (= 0.098 x $\Delta\rho$ x Δh)
T_f = temperature error ≤ T_k x ΔT x nominal measuring range
H_f = hysteresis error ≤ hysteresis x nominal measuring range

Deltapilot Spacing

It is important that the two Deltapilot S sensors are separated by as greater distance as possible. This is is particularly important if the density output is to be used as a control variable. For example, for the working conditions: *tank height 6 m; distance between sensors: 2.5 m; temperature: 20°...25°C; density: 1.0...1.5 kg/dm^3*, the measured error is given by:

L_{f1} ≤ 0.2% x (1.5 x 0.6 bar - 1 x 0.6 bar) = 0.6 mbar
L_{f2} ≤ 0.2% x (1.5 x 0.35 bar - 1 x 0.35 bar) = 0.35 mbar
T_{f1} ≤ 0.01% x 5K x 1.2 bar = 0.6 mbar
T_{f2} ≤ 0.01% x 5K x 1.2 bar = 0.6 mbar
H_{f1} ≤ 0.1% x 1.2 bar = 1.2 mbar
H_{f2} ≤ 0.1% x 1.2 bar = 1.2 mbar

$$\text{Measured error} \leq \sqrt{0.6^2 + 0.35^2 + 0.6^2 + 0.6^2 + 1.2^2 + 1.2^2} = 2.02 \text{ mbar}$$

referred to a span of 122.5 mbar ≤ 1.65%

The worst case measured error in the density measurement is less than 1.65 %. The greater the spacing between the Deltapilots, the less the measurement uncertainty.

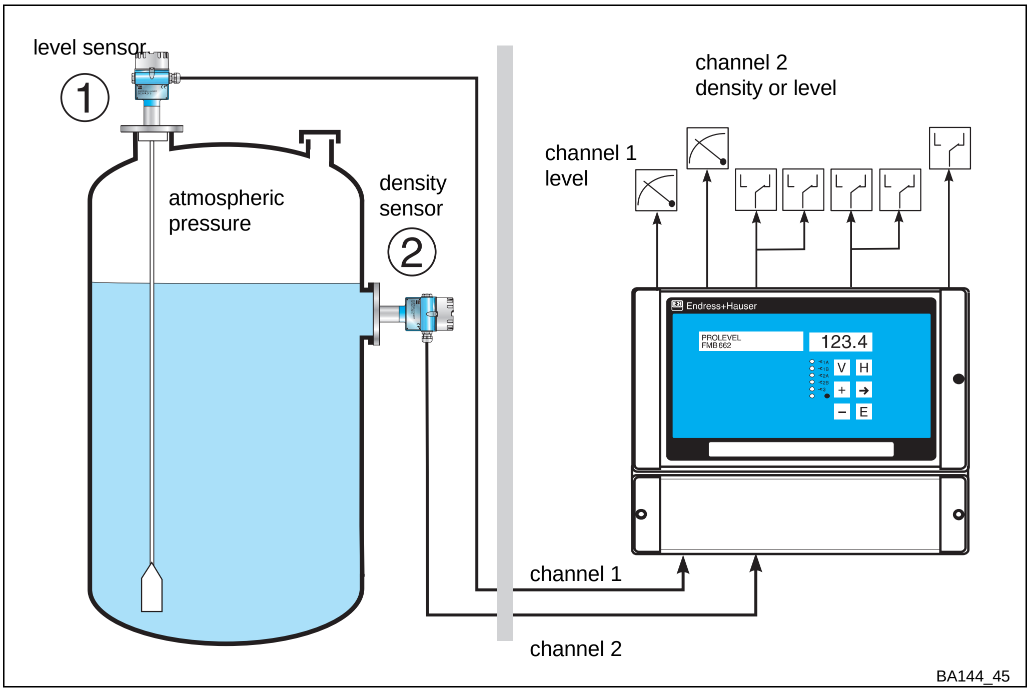


Fig. 5.11:
Measuring system for level measurement with density correction in open tank
① measurement of hydrostatic pressure
② measurement of density

Fig. 5.11 shows a typical application for a density compensated level measurement. This measurement can be made in open vessels only and is used where the density of the product is unknown. This may be because there is a density change during the time the product is stored within the vessel or because the vessel is used for different products.

The density compensation can be made only when the second Deltapilot S is completely covered by product. In the time when the liquid level lies below it, the last density measurement is used for the correction.

Calibration

The calibration for density measurement should be performed on site with the densest product possible. After the entry of the sensor constants »f_0« and »Δf« for both sensors, two possibilities exist:

- The density of the liquid is unknown
- The density of the liquid is known

In both cases the *switch-off level*, i.e. the distance between the sensors, *must be entered in the units of calibration (i.e. %, m, ft, hl, gal...)*. The density compensation operates only as long as the product covers this sensor. If the product drops below this level, the last density measured is used until the sensor is covered again.

Display sensitivity

If the density of the product is unknown, the display sensitivity for density must be entered at V7H2.. This is calculated as follows, whereby the unit factor is taken from the table:

Sensitivity, V7H2 = $\Delta p_{\text{mbar (water)}}$/unit factor
= {98.07 x distance between DBs in m}/unit factor
or = {29.89 x distance between DBs in ft}/unit factor

Unit factor	g/cm^3, kg/dm^3	kg/cm^3	lb/ft^3	lb/in^3
	1	1000	62.44	3.6136 x 10^{-2}

Example 1: distance between Deltapilot S sensors = 3 m; units g/cm^3
density sensitivity = 98.07 x 3 / 1 = 294.1

Example 2: distance between Deltapilot S sensors = 10 ft; units lb/ft^3
density sensitivity = 29.89 x 10 / 62.44 =4.787

Calibration with density known

#	Matrix	Entry	Remarks
1	V9H5/V3H5/V3H6 V7H5/V7H6		Commission as in Section 4.1
2	V8H0	4	Density
3	-	»E«	Register entry
4	V8H3	0	Switch-off level = 0
5	-	»E«	Register entry
6	V4H1	0	Tank empty, density
7	-	»E«	Register entry
8	V0H1	0	Empty level
9	-	»E«	Register entry
10	V4H2	ρ in units	Tank full, density - DB 2 covered
11	-	»E«	Register entry
12	V0H2	F	Full level
13	-	»E«	Register entry
14	V8H3	Δh	Switch-off level
15	-	»E«	Register entry

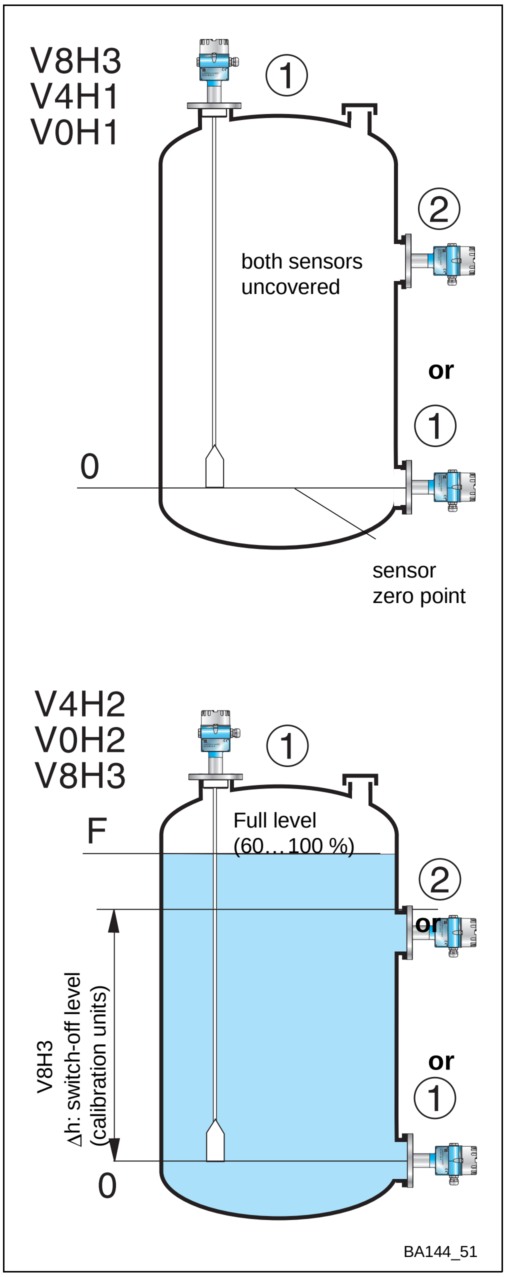


Fig. 5.12:
Parameters for density corrected calibration

Calibration with density unknown

#	Matrix	Entry	Remarks
1	V9H5/V3H5/V3H6 V7H5/V7H6		Commission as in Section 4.1
2	V8H0	4	Density
3	-	»E«	Register entry
4	V8H3	0	Switch off level = 0
5	-	»E«	Register entry
6	V4H1	0	Tank empty, density
7	-	»E«	Register entry
8	V0H1	0	Empty level
9	-	»E«	Register entry
10	V7H2	Sensitivity	Tank full, density - DB 2 covered
11	-	»E«	Register entry
12	V0H2	F	Full level
13	-	»E«	Register entry
14	V8H3	Δh	Switch-off level
15	-	»E«	Register entry

After calibration

- V0H0 = density compensated level
- V4H0 = density

Next step…

- Level offset ? p. 25
- Linearisation on channel 1? p 25…
- Analogue outputs and relays, p. 30…33

6 Trouble-Shooting

The Prolevel FMB 662 provides a number of aids for setting up and operating the module correctly. This Chapter contains the following:

- Fault recognition system
- Error message and trouble-shooting tables
- Simulated operating mode
- Commissioning replacement transmitters and sensors
- Repairs.

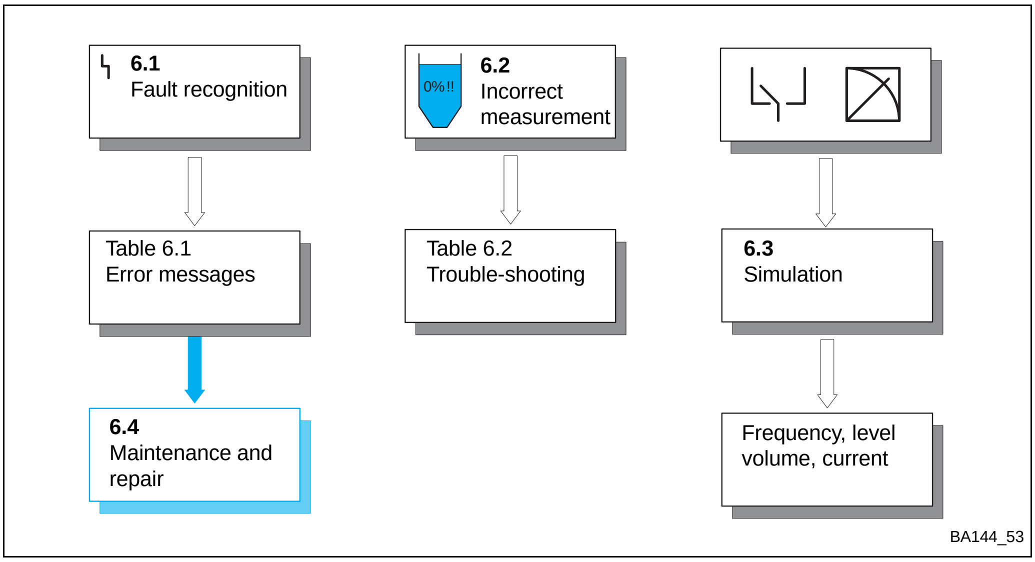


Fig. 6.1: Trouble-shooting and fault elimination for the Prolevel FMB 662

6.1 Fault recognition

Alarms

If the Prolevel FMB 662 transmitter recognizes a fault condition where further measurement is impossible, i.e. an alarm:

- the red alarm LED lights (LED 3) and the alarm relay trips
- the limit value relays assume respond according to the setting in V1H3/V5H3.
- the code for a diagnostic message is to be found in V9H0.

If several faults occur together, the code for the one with the highest priority is displayed. The others can be called up by pressing the »+« or »-« key when field V9H0 is selected.

If the cause of the fault is rectified, its code is no longer displayed:

- the code for the last fault rectified is retained in V9H1
- this message can be cleared by pressing the »E« key.

If the power fails, all relays de-energise.

Warnings

If the Prolevel FMB 662 transmitter has detected a fault condition where further measurement is possible, i.e. a warning:

- the red alarm LED flashes but the transmitter functions as normal, however, depending on the fault the measured value may be incorrect
- the alarm relay remains energised
- the appropriate code is to be found in V9H0.

The codes and error messages are listed in Table 6.1 in the order of their priority.

Table 6.1: Error messages Prolevel FMB 662

Code	Type	Cause and Remedy
E 101-106	Alarm	Fault in instrument electronics - Call Endress+Hauser Service
E 107	Alarm	Battery voltage too low - Make back-up of entered parameters immediately - Have battery changed at once by trained personel or ring for service
E 201-202	Alarm	Fault in probe on channel 1 (f < 35 Hz; f > 3000 Hz) - Check probe and electronic insert
E 301-302	Alarm	Fault in probe on channel 2 (f < 35 Hz; f > 3000 Hz) - Check probe and electronic insert
E 400	Alarm	Fault in probe on channels 1 + 2 - Check probe, electronic insert and wiring
E 401	Alarm	Fault in probe or wiring, channel 1 - Check probe, electronic insert and wiring - Incorrect operating mode
E 402	Alarm	Fault in probe or wiring, channel 2 - Check probe, electronic insert and wiring - Incorrect operating mode
E 403	Alarm	Difference between values measured at channels 1 and 2 too great - Determine max. possible difference from V8H1 - Check calibration, probes etc.
E 600	Warning	PFM transmission internal code check - can be ignored if it appears only briefly
E 601	Warning	PFM transmission internal code check - can be ignored if it appears only briefly
E 602	Warning	Linearisation channel 1 does not rise monotonously (volume does not increase with level) - Check and re-enter correct values, reactivate linearization
E 603	Warning	Linearisation channel 2 does not rise monotonously (volume does not increase with level) - Check and re-enter correct values, reactivate linearization
E 604	Warning	Linearisation channel 1 has less than two sets of values - Enter more values, reactivate linearization
E 605	Warning	Linearisation channel 2 has less than two sets of values - Enter more values, reactivate linearization
E 608	Warning	Value in V0H5 greater than that in V0H6 - Check input
E 609	Warning	Value in V4H5 greater than that in V4H6 - Check input
E 610	Warning	Calibration fault, channel 1 (»empty« level > »full« level) - Repeat calibration
E 611	Warning	Calibration fault, channel 2 (»empty« level > »full« level) - Repeat calibration
E 613	Warning	Instrument in simulation mode, channel 1 - Switch back when finished
E 614	Warning	Instrument in simulation mode, channel 2 - Switch back when finished

6.2 Incorrect measurements

Trouble-shooting table

Table 6.2 summarises the most common operating errors which lead to incorrect measurement by the Prolevel transmitter.

Table 6.2:
Trouble shooting table for incorrect function without error message

Fault	Cause and remedy
Measured value wrong	• Incorrect calibration? Check measured value before linearisation, V0H9 - if not correct, check whether full and empty calibration correct V0H1/V0H2 or V4H1/V4H2 - If correct, check linearization parameters - Check operating mode, V8H0 • Change in density of product - enter new density factor at V3H3 or V7H3, see p. 29 - recalibrate - use Mode 4? • Sensor damaged - check and remedy
Relays do not trip correctly	• Incorrect settings, e.g. configured in wrong units - Check correct units used for all relay settings - Check relay assignments, V1H4, V5H4 - Simulate settings in simulation mode - see Section 6.3, if the relays LEDs switch, check wiring

6.3 Simulated operating mode

This function is intended primarily for checking the correct function of the system:

- Enter 6 at V8H0 to activate the simulation mode for channel 1
- Enter 7 at V8H0 to activate the simulation mode for channel 2
- Enter 0 (1...4) at V8H0 to terminate simulation and resume normal measurements.

When the simulation mode is activated, the alarm relay flashes (Warning E613 or E614). The following simulations are possible:

Matrix	Entry	Simulated variable
V9H6	Frequency (Hz)	Frequency, level, volume, current
V9H7	Level	Level, volume, current
V9H8	Volume	Volume, current
V9H9	Current (-2…+22 mA)	Current

The level simulation mode takes the last measured value as default value in V9H7.

Example: Simulation of volume and current on channel 1 by entry of level in V9H7

#	Matrix	Entry	Significance
1	V8H0	6	Simulation Ch. 1
2	-	»E«	Register entry
3	V9H7	e.g. 80%	Enter level
4	-	»E«	Register entry
5	V9H8	**.**	Volume for level
6	V9H9	**.**	Current for level
7	V8H0	e.g. 1	Measurement mode
8	-	»E«	Register entry

Example: Simulation of current on channel 2 by entry of volume in V9H8

#	Matrix	Entry	Significance
1	V8H0	7	Simulation Ch. 2
2	-	»E«	Register entry
3	V9H8	e.g. 500	Volume = 500 hl
4	V9H9	**.**	Current for volume
5	V8H0	e.g. 1	Measurement mode
6	-	»E«	Register entry

Example: Simulation of current on channel 1 by entry of current in V9H9

#	Matrix	Entry	Significance
1	V8H0	6	Simulation Ch. 1
2	-	»E«	Register entry
3	V9H9	16	16 mA
4	V8H0	e.g. 0	Measurement mode
5	-	»E«	Register entry

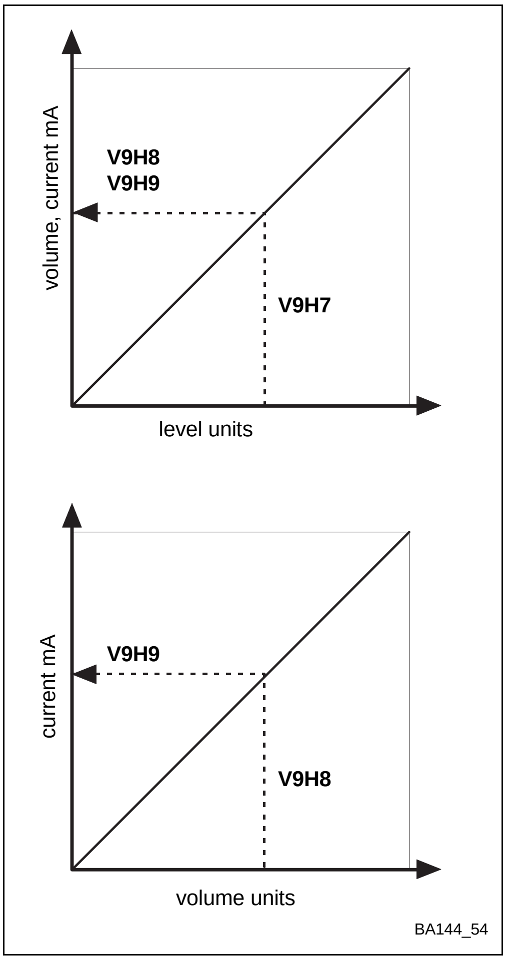


Fig. 6.2:
Simulation mode

6.4 Exchanging transmitters and sensors

FMB 662 transmitter

If the Prolevel FMB 662 has to be exchanged, the replacement need not be recalibrated. Simply enter the settings which you have noted in the Table at the back of the manual. For versions with Rackbus RS-485 interface, the parameters can be downloaded from the computer.

- Sequences requiring a particular order must be re-entered in that order
- Any linearisation must be manually reactivated by entering the mode in V2H0.

Deltapilot S

Provided a »dry« calibration was made or the sensor constants were entered before calibration, it is not necessary to recalibrate the instrument when the electronic insert is replaced. The measurement can be taken up again as soon as the new constants have been entered in the matrix.

- If the old sensor constants were not entered, the system must be recalibrated.

The new sensor constants are to be found in Table 2.2 in Section 2.1. They are entered as below:

- f_0 is the zero frequency (or offset)
- Δf is the sensitivity

Procedure

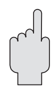
Step	Matrix	Entry	Significance
1	V3H5	e.g. 100.2	Enter zero frequency (offset)
2	-	»E«	Register entry
3	V3H6	e.g. 0.998	Enter sensitivity
4	-	»E«	Register entry

Channel 2
V7H5
⇓
V7H6

6.5 Repairs

Should the Prolevel FMB 662 transmitter or its sensor need to be repaired by Endress+Hauser, please send it to your nearest Service Centre with a note containing the following information:

- An exact description of the application for which it was used.
- The physical and chemical properties of the product measured.
- A short description of the fault.


Caution!

Caution!
- Special precautions must be observed when sending probes for repair:
  - Remove all visible traces of product from the probe.
  - If the product can impair health, i.e. is corrosive, poisonous, carcinogenic, radioactive etc., please check that the probe is thoroughly decontaminated.
  - If the last traces of dangerous products cannot be removed, e.g. product has penetrated into fissures or diffused into plastic parts, we kindly ask you not to send the probe for repair.

7 Appendix

7.1 Calibration and linearisation in volume units

Use the following two procedures if you can calibrate in volume units only but still require a linearisation.

Linearisation, horizontal cylinder

The parameters must be entered in the order below. Two parameters are entered:

- Tank diameter, **D**
- Tank volume, **V**.

#	Matrix	Entry	Remarks
1	V9H5	670	Reset
2	-	»E«	Register entry
3	V3H5	fo	Zero frequency
4	-	»E«	Register entry
5	V3H6	S	Sensitivity
6	-	»E«	Register entry
7	V3H0	1	Volume units
8	-	»E«	Register entry
9	V2H7	**D**	Tank diameter, %, m or ft
10	-	»E«	Register entry
11	V2H8	**V**	Tank volume*, hl, gal…
12	-	»E«	Register entry
13	V2H0	1	Activate linearisation
14	-	»E«	Register entry
15	V0H1	**E**	Tank empty, current volume in hl, gal…
16	-	»E«	Register entry
17	V0H2	**F**	Tank full, current volume in hl, gal…
18	-	»E«	Register entry

Channel 2
V7H5
⇓
V7H6
⇓
V7H0
⇓
V6H7
⇓
V6H8
⇓
V6H0
⇓
V4H1
⇓
V4H2

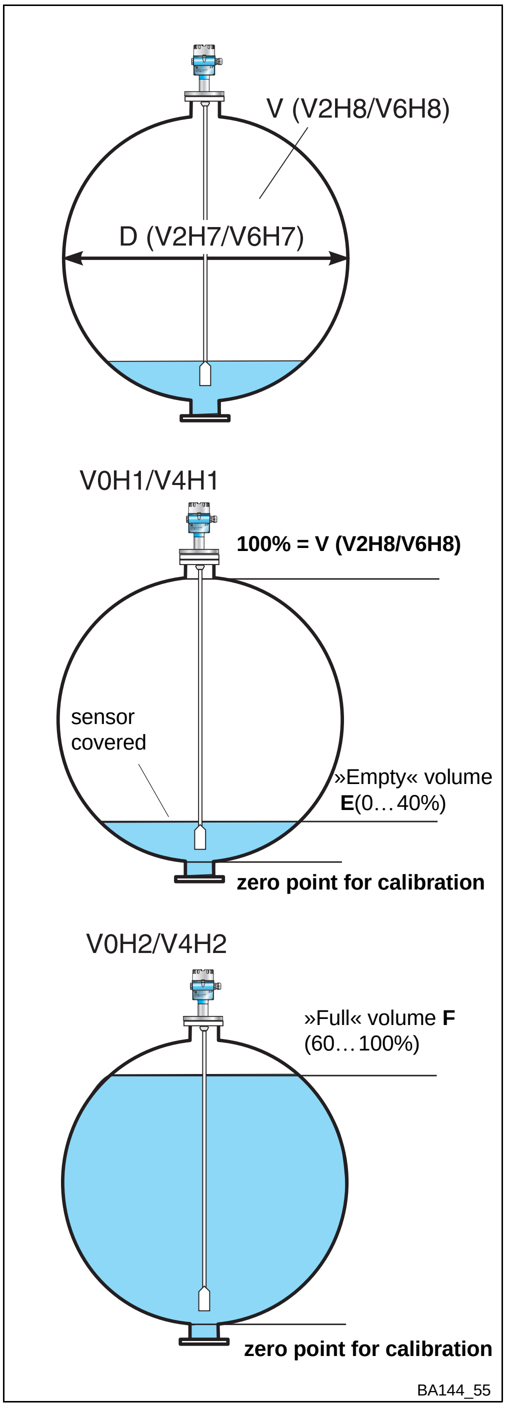


Fig. 7.1:
Parameters for calibration and linearisation in a horizontal cylinder

Note!

Note!
- D determines the level units at V0H9/V4H9
- If V =100 is entered, the calibration must be made in % volume units

After linearisation

- Volume is displayed at V0H0/V4H0
- Level is displayed at V0H9/V4H9

Next step…

Set analogue output and relays in volume units, see p. 30…33.

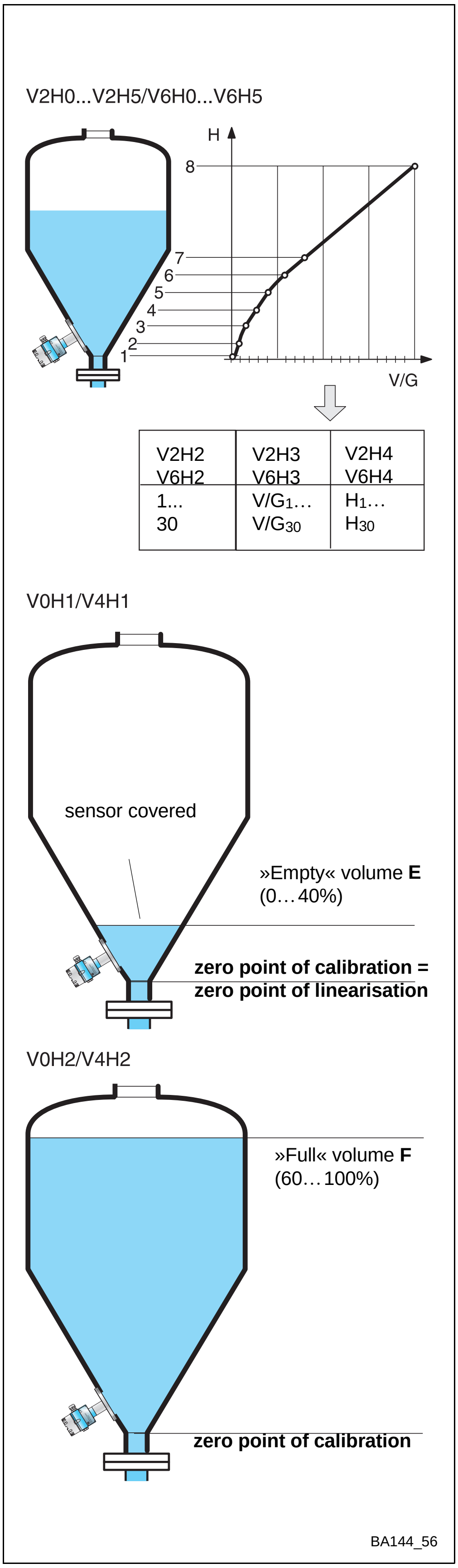


Fig. 7.2:
Parameters for calibration and linearisation in a tank with conical outlet

Linearisation for tanks with conical outlet

You require a linearisation table, H/V or H/G, max. 30 pairs in increasing order

- Level H in %, m or ft
- Volume V or weight G in customer units.

#	Matrix	Entry	Remarks
1	V9H5	670	Reset
2	-	»E«	Register entry
3	V3H5	fo	Zero frequency
4	-	»E«	Register entry
5	V3H6	S	Sensitivity
6	-	»E«	Register entry
7	V3H0	1	Volume units
8	-	»E«	Register entry
9	V2H1	0	Manual
10	-	»E«	Register entry
11	V2H2	1	Table no.
12	-	»E«	Register entry
13	V2H3	$V/G_{1...30}$	Volume/weight*
14	-	»E«	Register entry
15	V2H4	$H_{1...30}$	Level m or ft*
16	-	»E«	Register entry
17	V2H5	**»E«**	**Next** table no.* — springs to V2H3
***Repeat #13…17 until all values entered**			
18	V2H0	3	Activate "manual"
19	-	»E«	Register entry
20	V0H1	**E**	Tank empty, current volume in hl, gal…
21	-	»E«	Register entry
22	V0H2	**F**	Tank full, current volume in hl, gal…
23	-	»E«	Register entry

Channel 2
V7H5
⇓
V7H6
⇓
V7H0
⇓
V6H1
⇓
V6H2
⇓
V6H3
⇓
V6H4
⇓
V6H5
⇓
V6H0
⇓
V4H1
⇓
V4H2

Note!
- First pair ~ 0 % level, in %, m, ft.
  last pair ~ 100 % level, in %, m, ft.
- On error E602…E605, correct table.
  Re-activate linearisation in V2H0/V6H0.

Note!

After linearisation

- Volume/weight is displayed at V0H0/V4H0
- Level is displayed at V0H9/V4H9

Next step…

Set analogue output and relays in volume or weight units, p. 30…33.

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Operating Matrix

Operating and default parameters

Enter your operating parameters in the matrix below, a full matrix is to be found overleaf.

	H0	H1	H2	H3	H4	H5	H6	H7	H8	H9
V0										
V1										
V2										
V3										
V4										
V5										
V6										
V7										
V8										
V9										

Display field

The default parameters are as indicated below.

	H0	H1	H2	H3	H4	H5	H6	H7	H8	H9
V0		0.0	100.0	0	1	0.0	100.0			
V1	90.0	1	2.0	0	1					
V2	0	0	1	0.0	0.0	1		100	100	
V3	0	0.0	10.0	1.000	0.0	0.0	100.0	1		
V4		0.0	100.0	0	1	0.0	100.0			
V5	90.0	1	2.0	0	2					
V6	0	0	1	0.0	0.0	1		100	100	
V7	0	0.0	10.0	1.000	0.0	0.0	100.0	1		
V8	0	9990	2	20.0	0					670
V9				731		0	0.0	0.0	0.0	0.0

Display field

Parameter Matrix

	H0	H1	H2	H3	H4	H5	H6	H7	H8	H9
V0 Calibration Channel 1	Measured value	Empty calibration	Full calibration	Select current 0=0…20mA 1=4…20mA	Output damping (s)	Value for 0/4 mA	Value for 20 mA	Safety alarm 0 = -10% 1=+110% 2=Hold	Actual measuring frequency	Measured value before linearisation
V1 Limit value Channel 1	Relay 1 switching point	Relay 1 fail-safe mode 0 = min. 1 = max.	Relay 1 hysteresis	Relay 1 at alarm 0 = de-energise 1 = as V0/V4H7	Relay 1 1 = channel 1 2 = channel 2					
V2 Linearisation Channel 1	Linearization 0=linear 1= hor. cylinder 3=manual 4=clear 3	Level input mode 0=manual 1=auto.	Table No. (1…30)	Input Volume/ weight	Input Level	Next Table No.		Diameter for horizontal cylinder	Volume for horizontal cylinder	
V3 Extended Calibration Channel 1	Calibration mode 0=level 1= volume	Offset	Sensitivity	Density factor Channel 1	Zero offset value	Offset (device-specific fo	Sensitivity (device-specific) Δf		For Service only (0 mA D/A calibration)	For Service only 20 mA D/A calibration)
V4 Calibration Channel 2	Measured value	Empty calibration	Full calibration	Select current 0=0…20mA 1=4…20mA	Output damping (s)	Value for 0/4 mA	Value 20 mA	Safety alarm 0 = -10% 1=+110% 2=Hold	Actual measuring frequency	Measured value before linearisation
V5 Limit value Channel 2	Relay 2 switching point	Relay 2 fail-safe mode 0 = min. 1 = max.	Relay 2 hysteresis	Relay 2 at alarm 0 = de-energise 1 = as V4/V0H7	Relay 2 1 = channel 1 2 = channel 2					
V6 Linearisation Channel 2	Linearization 0=linear 1= hor. cylinder 3=manual 4=clear 3	Level input mode 0=manual 1=auto.	Table No. (1…30)	Input Volume/ weight	Input Level	Next Table No.		Diameter for horizontal cylinder	Volume for horizontal cylinder	
V7 Extended Calibration Channel 2	Calibration mode 0=level 1= volume	Offset	Sensitivity	Density factor Channel 2	Zero offset value	Offset (device-specific) fo	Sensitivity (device-specific) Δf		For Service only (0 mA D/A calibration)	For Service only 20 mA D/A calibration)
V8 Operating mode	0 = 2 channels 1= chan. 1 only 2 = chan. 2 only 3 = difference 4 = density 6/7 = sim.ch1/2	Max. diff with 2 channel operation	Analog output 2 1 = channel1 2 = channel 2	Minimum level Mode 4	Sensor matching 0 = DBs free (p atm) 1 = level at DB2 2 = vessel full (p nominal)				Display difference in Modes 3 and 4	Security locking < 670 or > 679
V9 Service and Simulation	Current error code	Last errorcode E=clear		Instrument and Software version	Rackbus address	Reset to default values 670…679	Simulation frequency	Simulation level	Simulation volume	Simulation current
VA VU 260 Z ZA 672 only	Tag. No. channel 1	Tag No. channel 2	Units measured value channel 1 before linearisation	Units measured value channel 1 after linearisation	Units measured value channel 2 before linearisation	Units measured value channel 2 after linearisation	Text measured value channel 1 before linearisation	Text measured value channel 1 after linearisation	Text measured value channel 2 before linearisation	Text measured value channel 2 after linearisation

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