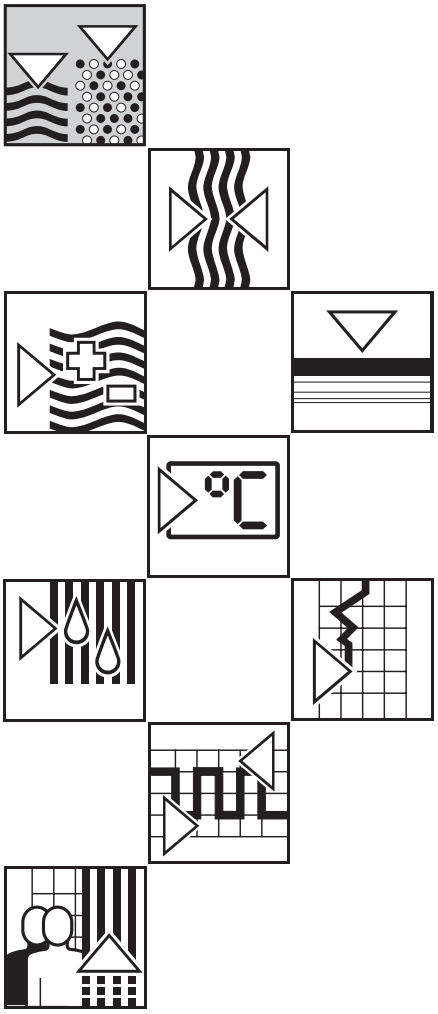
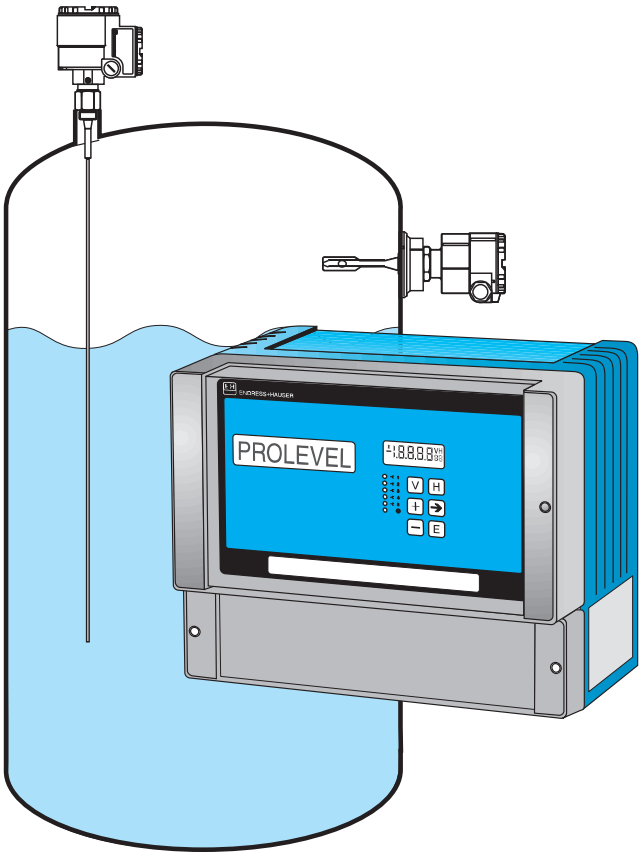
BA 142F/00/en/07.98a
016562-1000
valid for Software 1.x

prolevel
FMC 661
Level Measurement

Operating Instructions



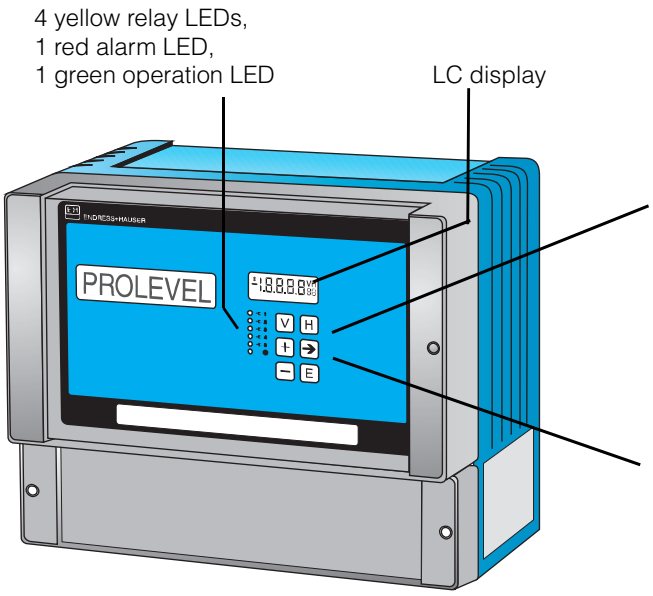


Endress+Hauser

Nothing beats know-how

Short Instructions

Operation



V	Selects vertical matrix position
H	Selects horizontal matrix position
V + H	Select position V0H0
→	Selects next digit
→ + +	Move decimal point
+	Increases value of digit
−	Decreases value of digit
E	Registers entry

Quick configuration for level measurement

Function	Matrix	Action
1 Reset transmitter	V9H5	● Enter 671 Press »E« to register entry - Omit if commissioned as in Section 4.1
2 »Empty« calibration*	V0H1	● Fill vessel 0…40% full (probe covered) Enter level in %, m, ft, etc. Press »E« to register entry
3 »Full« calibration*	V0H2	● Fill vessel 60…100% full Enter level in %, m, ft, etc. Press »E« to register entry
4 0/4 mA signal	V0H3 V0H5 V0H6	● 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 Relays 1a and 1b	V1H0 V1H1	● Enter level for switching in calibration units Press »E« to register entry ● Enter fail-safe mode: 0 = minimum, 1 = maximum Press »E« to register
6 Relays 2a and 2b	V1H5 V1H6 V1H9	● Enter level for switching in calibration units Press »E« to register entry ● Enter fail-safe mode: 0 = minimum, 1 = maximum Press »E« to register ● Enter 1 = Relay 2 assigned to channel 1 Press »E« to register entry

* Can be performed in reverse order

Table of Contents

Notes on Safety

Approved usage

The Prolevel FMC 661 is a field transmitter for level measurement which can be used with a variety of capacitance probes and 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 reponsible for compliance may void the user's authority to operate the equipment.

Certificates

The Prolevel FMC 661 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
Certificate of Conformity PTB No. Ex-96.D.2074	Prolevel FMC 661	[EEx ia] IIC, install outside Ex-area
CSA LR 53988-81	FMC 661	Class I, II, III Div. I Groups A-G
FM J.I. 0Z2A7.AX	FMC 661	Class I, II, III Div. I Groups A-G
PTB Certificate of Conformity PTB Ex 93.C.2171 X ZE 104F/00/d for Germany ZE 103F/00/d, e, f for foreign countries PTB Nr. Ex-93.C.2062 X ZE 097F/00/d	Capacitance probes Multicap DC 11, DC 16, DC 21, DC 26 with electronic insert EC 37 Z or EC 47 Z	EEx ia IIC T4…T6 suitable for installation on Channel 1 of Prolevel FMC 661
Certificate of Conformity PTB Nr. Ex-96.D.2017 X	DB 50…53 with FEB 17 or FEB 17 P	EEx ia IIC T4…T6
KEMA No. Ex-92.C.8494 ZE 076F/00/d, e, f for foreign countries	Liquiphant FDL 30, 31, 35, 36	EEx ib IIC T6 suitable for installation on Channel 2 of Prolevel FMC 661
Type approval BVS 93.4.8004 B	Capacitance probes 11 450 S; 21265 S with electronic insert EC 17 Z	Dust-Ex, Zone 10 (Germany) suitable for installation on Channel 2 of Prolevel FMC 661
German Lloyd No. 97517 HH	Prolevel FMC 661 Capacitance probes Insert EC 37 Z or EC 47 Z Insert EC 17 Z	Level indication on channel 1 (EC 37 Z or EC 47 Z) Level limit detection on channel 2 (EC 17 Z) Suitable for unlimited use within the Rules
German Lloyd No. 99350-97HH	DB 50, 50 L, 52, 53 with FEB 17 or FEB 17 B	

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 FMC 661 field transmitter measures level with hydrostatic pressure sensors or capacitance probes. 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: Level Measurement with Limit Switch;
  describes the automatic calibration correction and other operating modes of the Prolevel FMC 661.
- 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, probe 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, 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

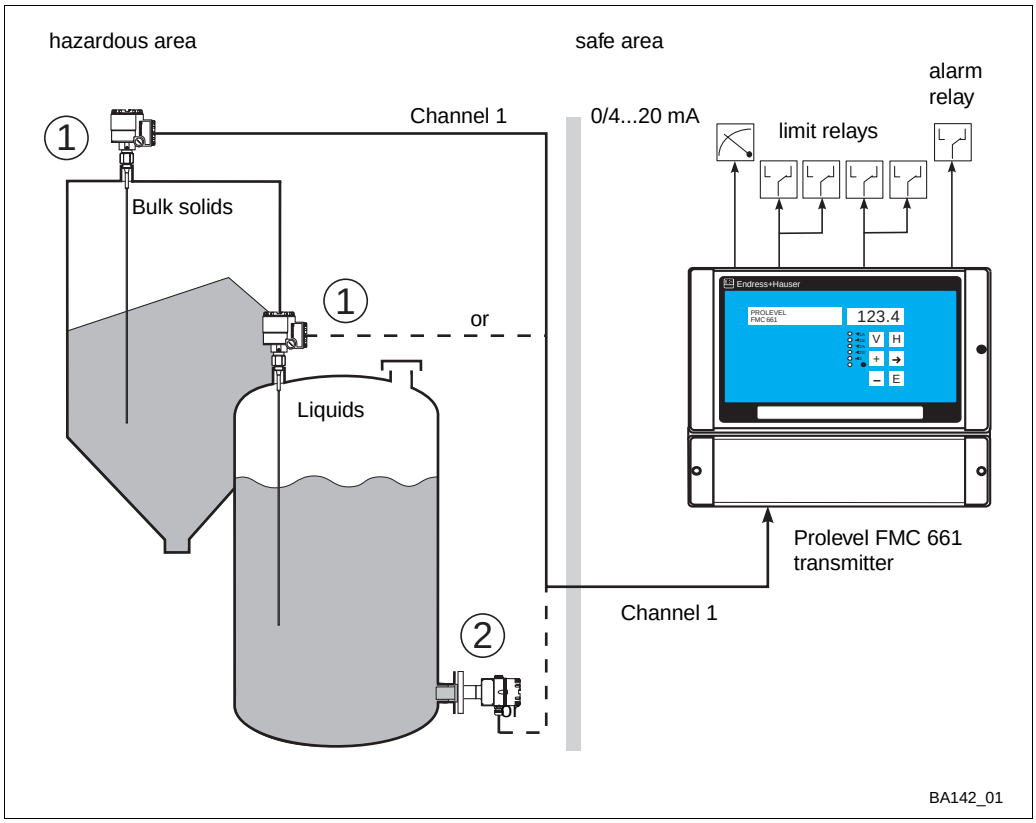
In addition to this manual, the following publications provide information on configuration of the Prolevel FMC 661.

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

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

1.1 Application

Fig. 1.1: Standard application showing Prolevel FMC 661 controlling level measurement
① Capacitance probe
② Hydrostatic probe



The Prolevel FMC 661 is designed for level measurement with a capacitance probe or hydrostatic pressure sensor. A second channel allows level limit detection with a vibration sensor, i.e. Liquiphant or Soliphant, or capacitance probe. The applications described in this manual are as follows:

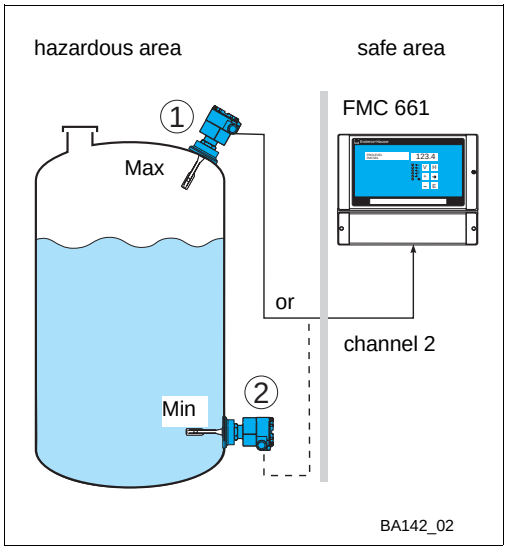
- Level or volume measurement …Chapter 4
- Level limit detection …Chapter 5
- Level measurement with automatic calibration correction …Chapter 5.

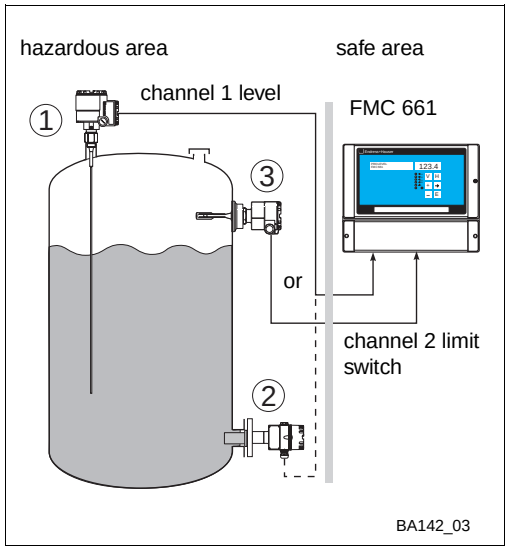
Prolevel transmitters may also be used for applications in explosion hazardous areas and possess intrinsically-safe sensor circuits conforming to EEx ia IIC. A list of certificated combinations is to be found in »Notes on Safety« preceding this chapter.

Fig. 1.2: Left: Prolevel FMC 661 with Liquiphant limit switch
① Maximum fail-safe mode
② Minumum fail-safe mode

Right: Prolevel FMC 661 with simultaneous level measurement and limit switching
① Capacitance level probe
② Hydrostatic level sensor
③ Limit switch

The same arrangement is used for automatic calibration correction





1.2 Measuring system

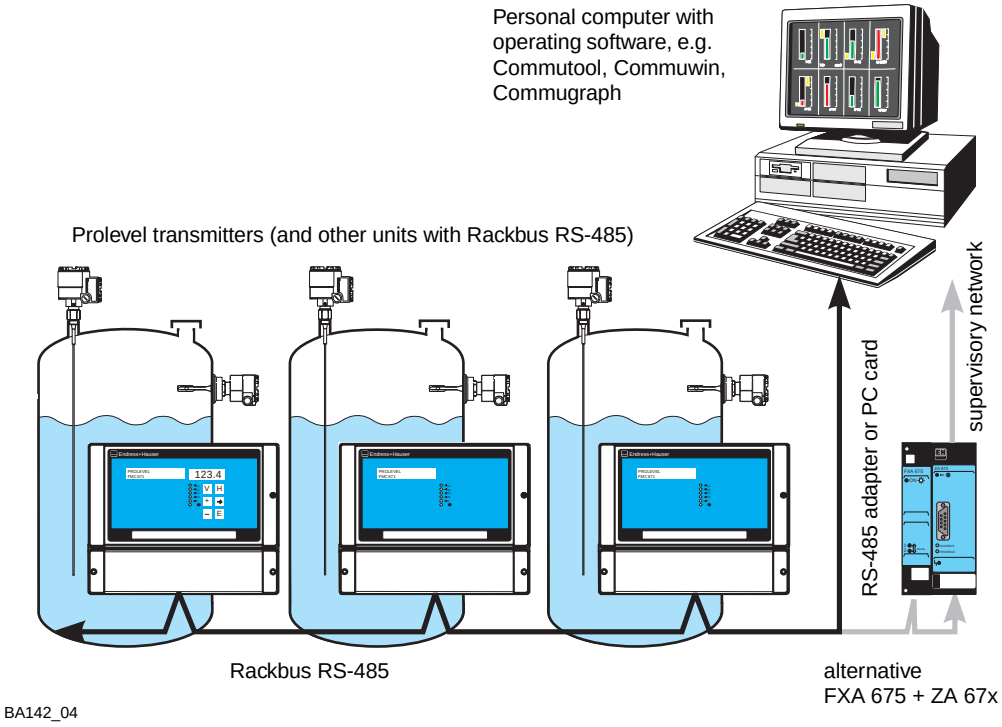


Fig. 1.3:
The Prolevel FMC 661 can be used as a stand-alone unit, see Figs 1.1 and 1.2 or as part of an operating system.
A RS-485 adapter or PC card allows direct connection to a personal computer, the FXA 675 and gateway ZA 67x connection to a supervisory system using the Modbus, Profibus or FIP protocol

A working system for level measurement comprises:

- Prolevel FMC 661 transmitter,
- Capacitance probe or hydrostatic sensor for level measurement with appropriate electronic insert, see Chapter 2
- If required, vibration sensor or capacitance probe for level limit detection or automatic calibration correction.

The Prolevel may operate as a stand alone unit with standard 0/4…20 mA output; two sets of two relays, freely assignable to channel 1 or 2, can be used to control pumps, valves, annuciators 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 FMC 661 measures level on the basis of the capacitance and hydrostatic measurement principles. In both cases the measured value is processed by the electronic insert and passed on as a frequency signal.

Capacitance measurement

The probe and vessel form the two plates of a capacitor, the total capacitance of which can then be calculated from the formula:

$$C_{tot} = C1 + \frac{2\pi\varepsilon_0\varepsilon_r \times L \quad pF}{\ln (D/d)} \qquad (1)$$

whereby

- C_{tot} = total capacitance
- C_1 = capacitance of feed through
- ε_0 = dielectric constant of air (8.85)
- ε_r = rel. dielectric constant of product
- D = diameter of vessel
- d = diameter of probe
- L = length of probe immersed in product in meters

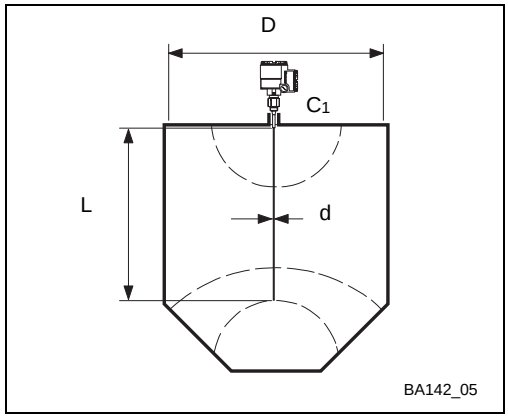


Fig. 1.4:
Capacitance measurement principle

Measurement in conducting media

If the product conducts, the capacitance is now determined by the thickness and properties of the insulating material surrounding the probe. Equation (1) applies, whereby the variable D is now the diameter of the probe with insulation. In this case the capacitance varies by approx. 300 pF/m.

Measurement is independent of dielectric constant and not affected by changes in this variable.

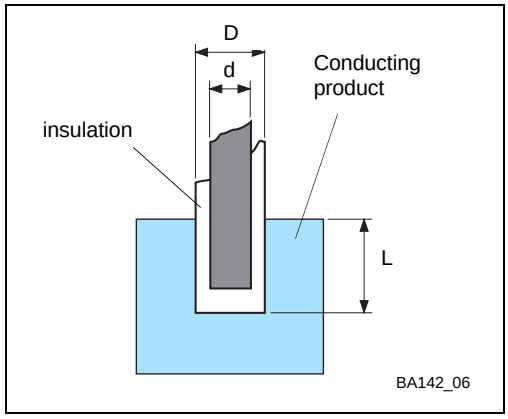


Fig. 1.5:
Measurement in conducting media

Hydrostatic measurement

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:

$$p_1 = \rho \times g \times h \qquad (2)$$

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.

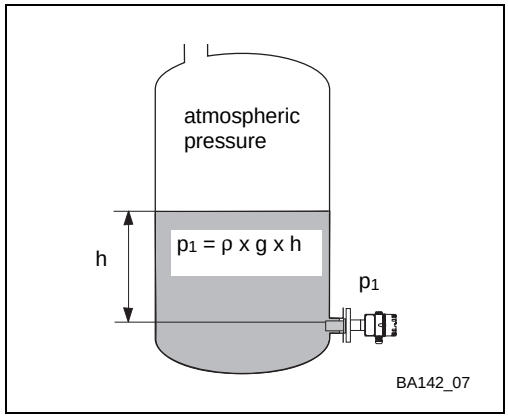


Fig. 1.6:
Hydrostatic measurement principle

1.4 Functional description

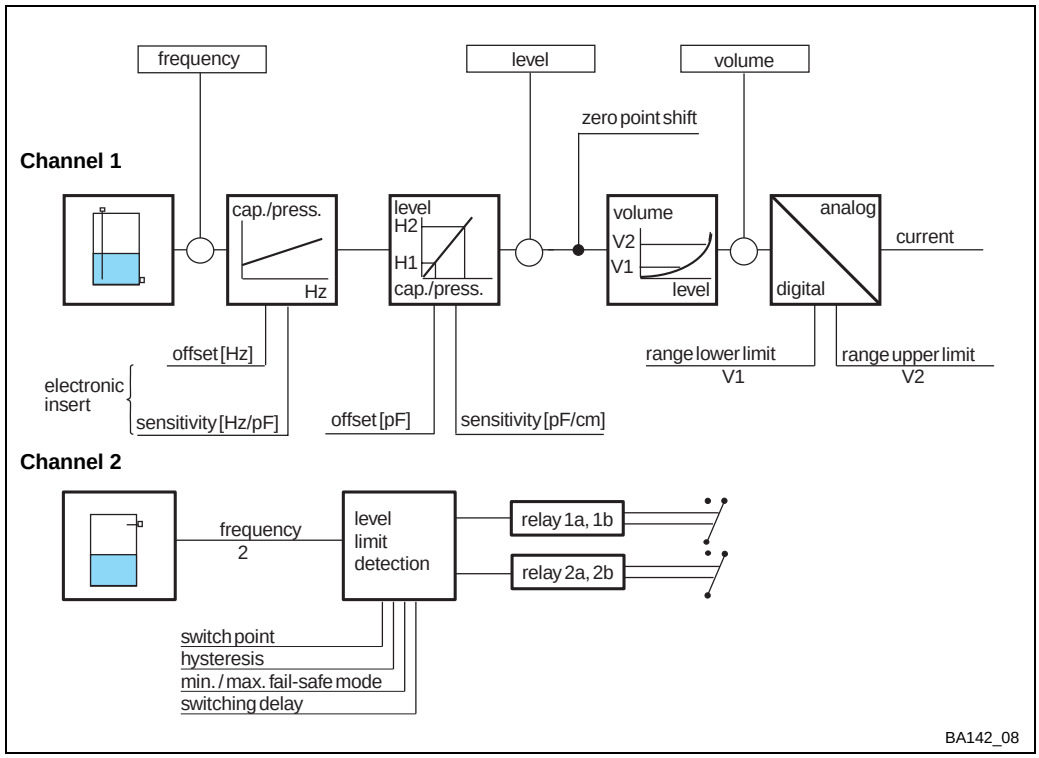


Fig. 1.7: Signal processing in the Prolevel FMC 661 for single channel operation (level and/or limit switching)

Fig. 1.7 is a block diagram of the Prolevel FMC 661. The transmitter supplies the power to the sensor. The capacitance or pressure measured by the sensor is converted into a frequency signal by the electronic insert located in its head and transmitted to the Prolevel over a two-core cable. The signal is then processed to provide six operating modes.

Table 1.1: Prolevel FMC 661 operating modes

Mode in V8H0	Function
0	Simultaneous level measurement and limit detection on channels 1 and 2
1	Level measurement on channel 1 only
2	Limit detection on channel 2 only
5	Corrected level measurement — the level measurement at channel 1 is corrected when the product covers the limit switch at channel 2
6	Simulation of level, volume or current at channel 1
7	Simulation of limit detection 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 mode 5, the measured value at channel 1 is then corrected. 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 FMC 661
Function:	Transmitter for level measurement with capacitance and hydrostatic probes as well as level limit detection with capacitance and vibration 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, channel 1	
Signal:	Pulse frequency modulated signal from connected probe or sensor
Explosion protection:	PTB [EEx ia] IIC, FM, CSA, intrinsically safe signal circuits separated from each other and rest of the electronics
Probe or sensor:	Multicap or other capacitance probe with EC 37 Z or EC 47 Z electronic insert Deltapilot S hydrostatic sensor with FEB 17/FEB 17 P
Switch input, channel 2	
Signal :	Pulse frequency modulated signal from connected probe or sensor
Limit switch:	Multicap probe with EC 16 Z or EC 17 Z electronic insert other capacitance probe with EC 17 Z electronic insert Liquiphant FDL 30 / FDL 31 / FDL 35 / FDL 36 Soliphant DM 90 Z / DM 91 Z / DM 92 Z

Output characteristics

Analog output	
Output:	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

Output characteristics (continued)

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
Interfaces:	0/4…20 mA, Rackbus RS 485 (option)
Reference conditions:	to IEC 770 (T_U = 25°C) or as specified
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: Direct voltage:	230 V / 115 V / 110 V (85...253 V), 50/60 Hz or 24 V / 48 V (20...55V), 50/60 Hz or 24 V (16...60V), residual ripple max. 2 V_{pp} within tolerance
Power consumption:	max. 7 W, switch-on current 880 mA
Safe isolation:	between power supply and signal outputs, CPU, Rackbus RS-485, switch-on current 880 mA 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, FM, CSA 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 ABS (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 each in bottom and rear of terminal compartment 4 pre-stamped cable entries Pg 13.5 in bottom

2 Installation

This Chapter describes:

- Probes and sensors for the Prolevel FMC 661
- Installation of the Prolevel FMC 661
- Transmitter wiring
- Sensor connection.
- Hardware configuration for Rackbus RS-485 option.

Fig 2.1 shows the structure of the chapter.

Technicians and fitters

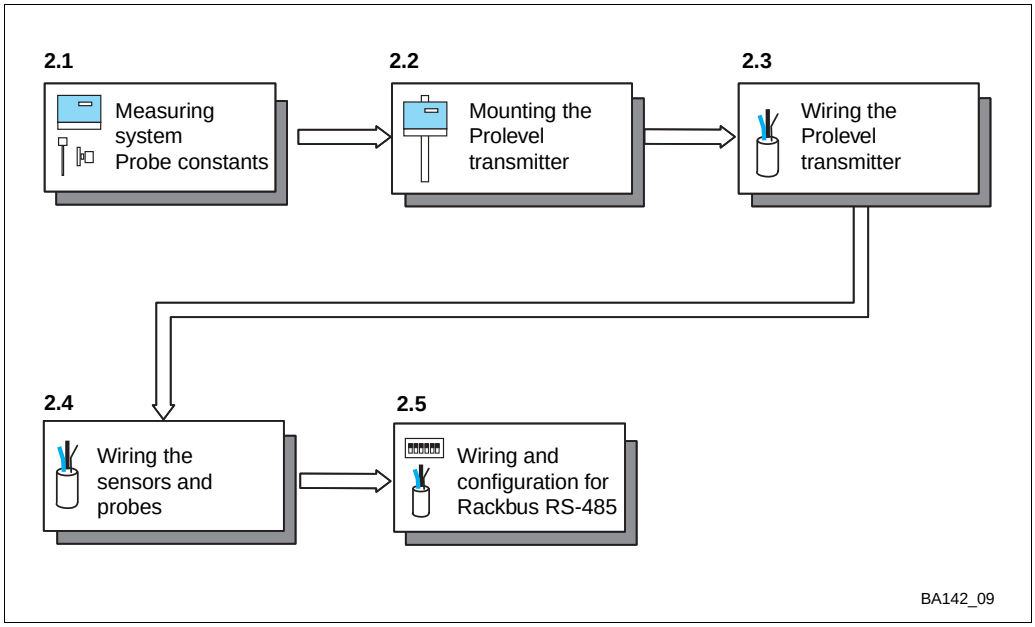
It is assumed that suitably qualified personnel are to be used for the installation and electrical connection of the system components. This is particularly important when the sensors are to be installed in hazardous areas. Please note the following:


Warning!

Warning!

- The Prolevel FMC 661 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 Probes and sensors

Table 2.1 lists the sensors most frequently used with the Prolevel FMC 661 transmitter. In addition to those listed, all probes which can be used with an EC 17 Z, EC 37 Z or EC 47 Z electronic insert can be connected to the transmitter. Installation hints can be taken from the appropriate Technical Information Sheet.

Principle	Channel 1			Channel 2		
	Probe	**TI sheet**	**Insert**	**Probe**	**TI sheet**	**Insert**
Capacitance	DC 11 DC 16 DC 21 DC 26 11 322 Z 11 500 Z 21 211 Multicap TE, TA, E, A	TI 169F TI 096F TI 208F TI 209F E 11.81.03 TI 161F E 10.73.18 TI 239, 240, 242, 243	EC 37 Z EC 47 Z	DC 11 DC 16 DC 21 DC 26 11 450 (Z/St) 11 961 (Z) 21 262 (Z/St) 21 265 (Z/St) Multicap TE, TA, E, A	TI 169F TI 096F TI 208F TI 209F TI 197 E 04.77.04 TI 227 TI 195	EC 17 Z EC 16 Z FEC 22
Hydrostatic pressure	Deltapilot S DB 50, 50 L, 51, 52, 53	TI 257	FEB17 FEB 17P	Not suitable		
Vibration	Not suitable			Liquiphant DL 17 Z FDL 30/31/35/36 Soliphant DM 90 Z…92 Z	 013154-0008 TI 185F TI 124F BA042	EL 17 Z EM 17 Z

Table 2.1: Selection of probes suitable for use with the Prolevel FMC 661

Sensor constants

Deltapilot S hydrostatic pressure sensors and EC 37 Z/47 Z inserts are supplied with the sensor constants zero frequency »fo« and sensitivity »Δf« or »S«, see Fig. 2.2. For Deltapilot S sensors the constants depend on the measuring range, see Table 2.2. Note these constants and enter them into fields V3H5 and V3H6 during commissioning, Section 4.1. This dispenses with the need for a recalibration of the transmitter on replacement of the sensor or insert.

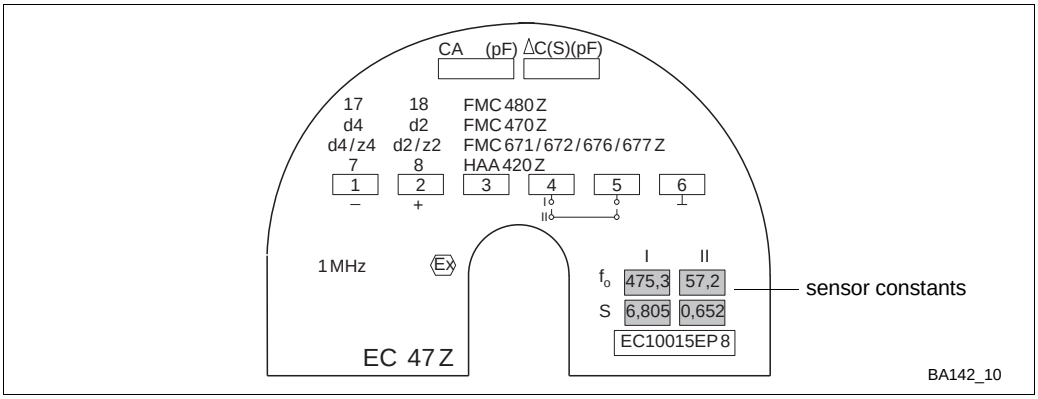


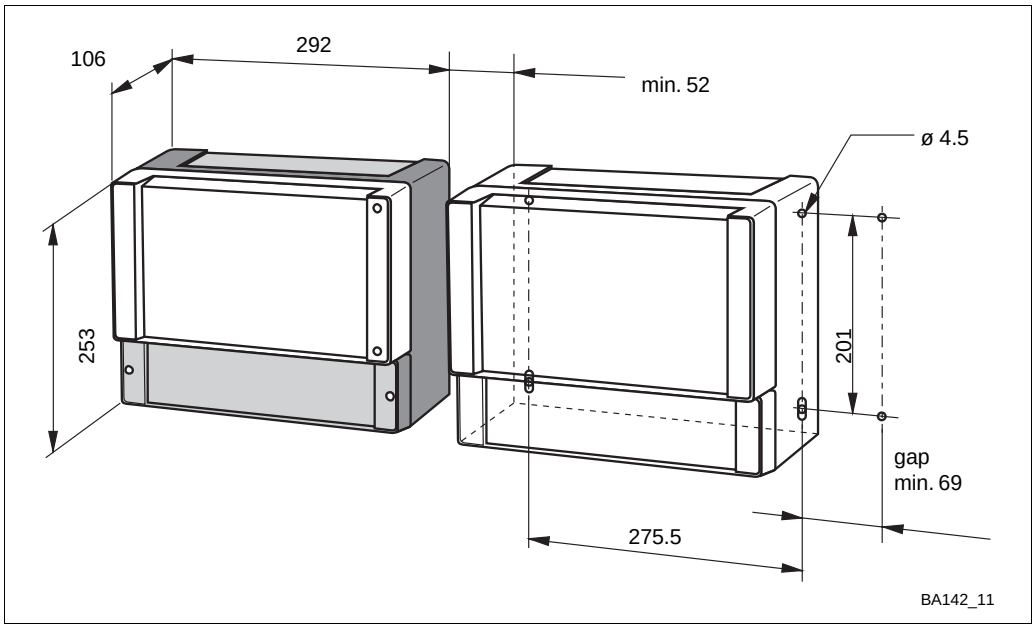
Fig. 2.2: Location of sensor constants on EC 37 Z/47 Z electronic insert and Deltapilot S DB 4x housing

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 DB 5x

2.2 Prolevel FMC 661 installation

Fig. 2.3:
Dimensions in mm of Prolevel FMC 661 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 FMC 661, 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. 2.4 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

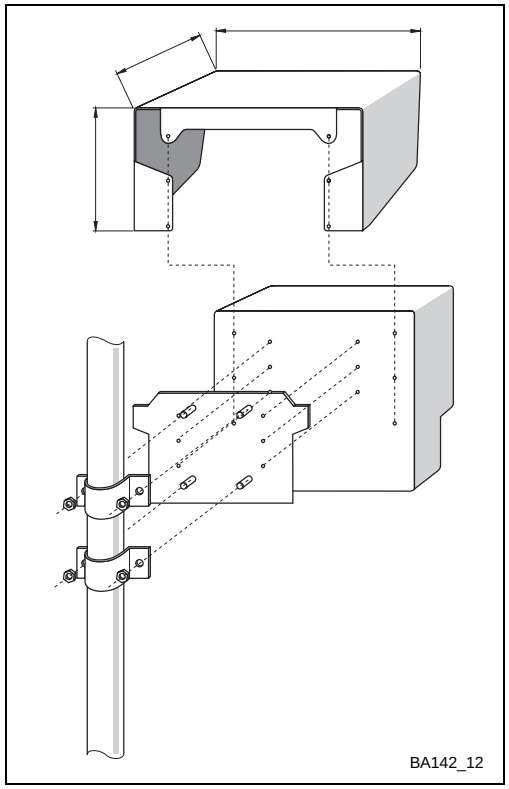


Fig. 2.4:
Post-mounting with all-weather cover

2.3 Transmitter wiring

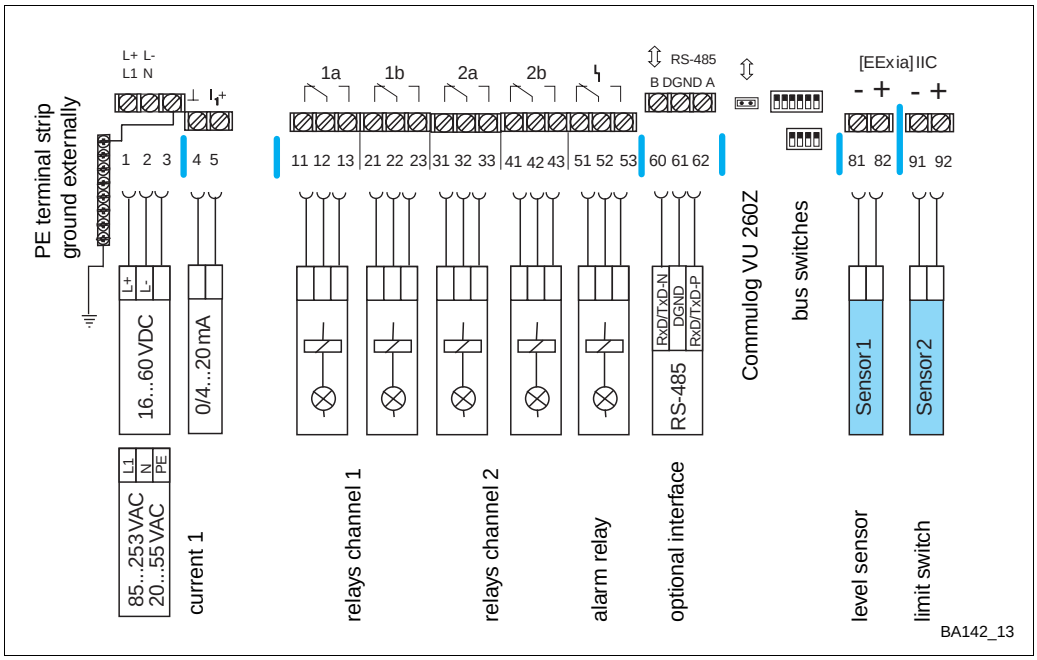


Fig. 2.5: Terminal assignments for Prolevel FMC 661

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

Terminal strip

The terminal strip for cable diameters up to 2.5 mm^2 is located in a separate connection compartment. Fig. 2.5 shows the wiring diagram for the Prolevel FMC 661 (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.

Analogue outputs

Only one non-floating device can be connected to the current output.

- 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.

Level probes and sensors, channel 1

The Prolevel FMC 661 can be operated with a variety of sensor types, each requiring a different electronic insert. For Channel 1, continuous level measurement:

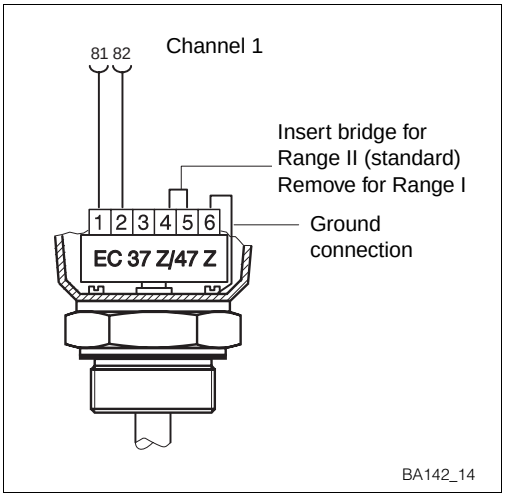
- EC 37 Z or EC 47 Z for capacitance and Multicap probes
  EB 17 or EB 27 P for Deltapilots S

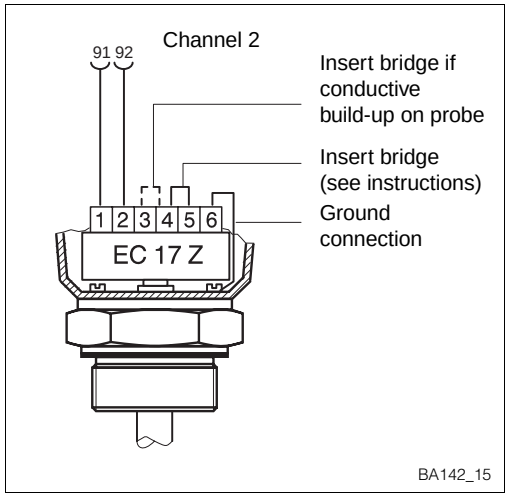
Level limit switch, channel 2:

The level limit switch may be a vibration probe — Liquiphant (liquids) or Soliphant (solids) — or a capacitance probe, with electronic insert

- EC 16 Z/EC 17 Z for Multicap probes
  EC 17 Z for other capacitance probes
- EL 17 Z for Liquiphant probes
  EM 17 Z for Soliphant probes

Fig. 2.6: Connection diagram for electronic inserts
Left: Capacitance/Multicap EC 37 Z/EC 47 Z
Right: Capacitance/Multicap EC 17 Z





EC 37 Z and EC 47 Z

The electronic inserts EC 37 Z and EC 47 Z have two measuring ranges which can be selected by inserting a bridge between terminals 4 and 5 of the insert, see Fig 2.6. Full instructions on selection of the insert are to be found in Publication E 07.80.06/1c.

- Note the zero frequency f_o____ and sensitivity S_____on the insert for the range you have selected.

EC 17 Z

The EC 17 Z electronic insert can be used at Channel 2 with capacitance and Multicap probes for limit level switching. The connection diagram is shown in Fig. 2.6. Technical information is given in Publication E 11.84.04/1a.

EC 16 Z

The EC 16 Z electronic insert is for use on channel 2 with the Multicap probes with active build-up compensation. Wire it up as described in the Technical Information Sheet TI 170F delivered with the insert.

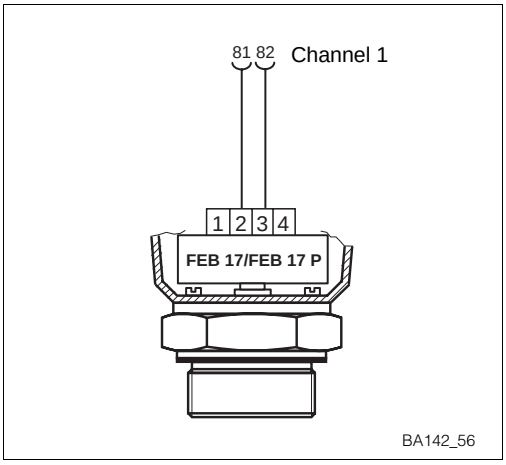


Fig. 2.7:
Connection diagram for Deltapilot S with FEB 17/FEB 17 P electronic insert

FEB 17 and FEB 17 P

The FEB 17/FEB 17 P electronic insert can be used at Channel 1 with Deltapilot S DB 5x... sensors to measure level and volume in open vessels. The sensor constants are listed in Tabel 2.2.

- Note the zero frequency f_o_____ and sensitivity Δf _____ of the probe

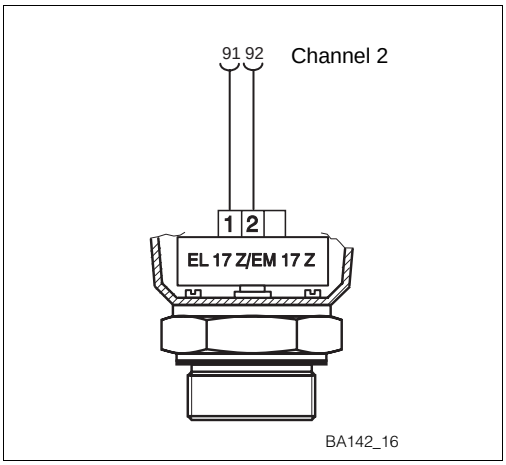


Fig. 2.8:
Connection diagram for Liquiphant/Soliphant electronic inserts EL 17 Z/EM 17 Z

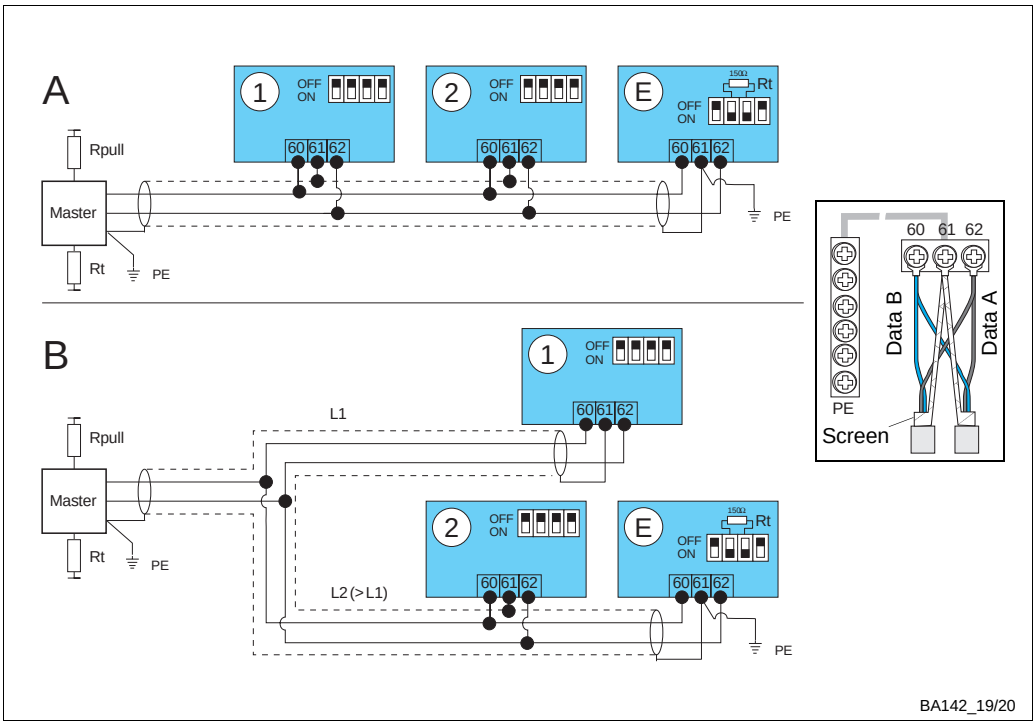
EL 17 Z and EM 17 Z

The EL 17 Z electronic inserts can be used at Channel 2 with Liquiphant sensors for limit level switching. For Soliphant sensors the EM 17 Z insert is used. Publications 013154-0008 and BA 042 (014897-0002) contain full installation instructions.

2.5 Rackbus RS-485 option

Fig. 2.9:
Rackbus RS-485 topologies showing setting of bus termination resistance

Inset:
Suggestion for wiring the bus



Wiring the bus

Up to 25 Prolevel FMC 661 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. 2.9.

Note!

Note!

- Terminal 61 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. 2.10 shows the configuration elements for remote operation of the Prolevel FMC 661. 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.

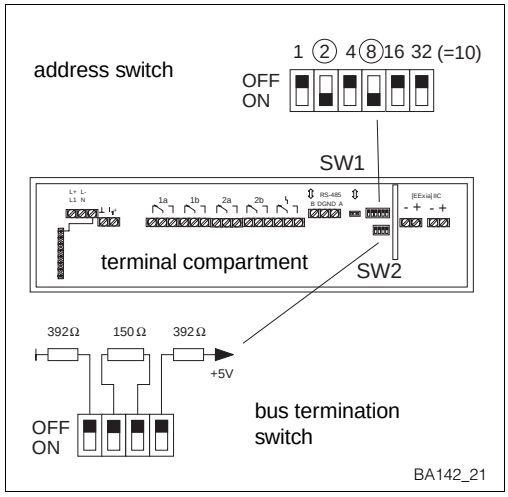


Fig. 2.10:
DIP-switches for bus address and termination

3 Controls

This Chapter describes how the Prolevel FMC 661 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 FMC 661, 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 FMC 661 transmitter.

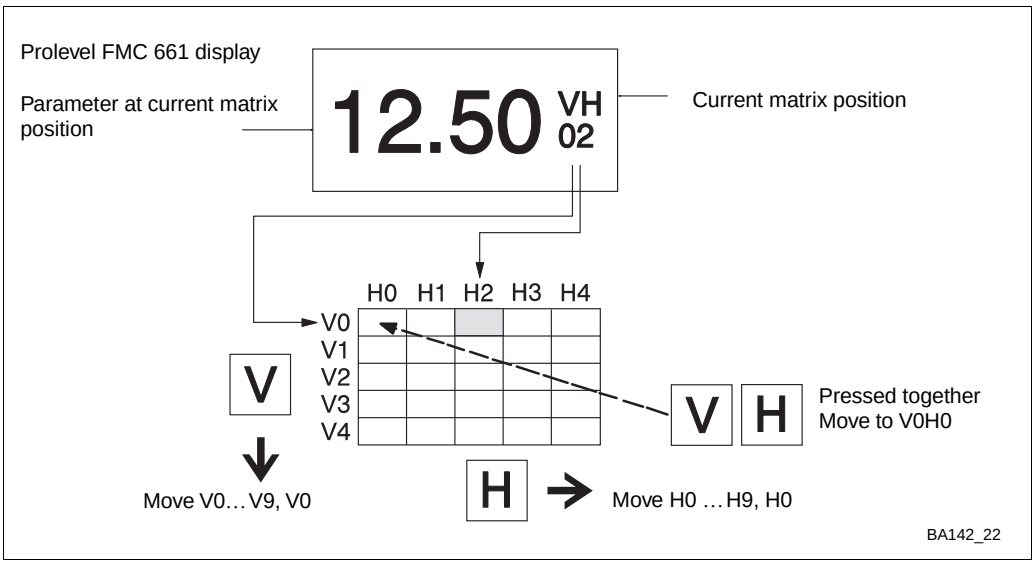


Fig. 3.1:
Prolevel FMC 661
Parameter matrix operation with function of V and H keys.
The complete matrix has 10 x 10 fields, although not all are used

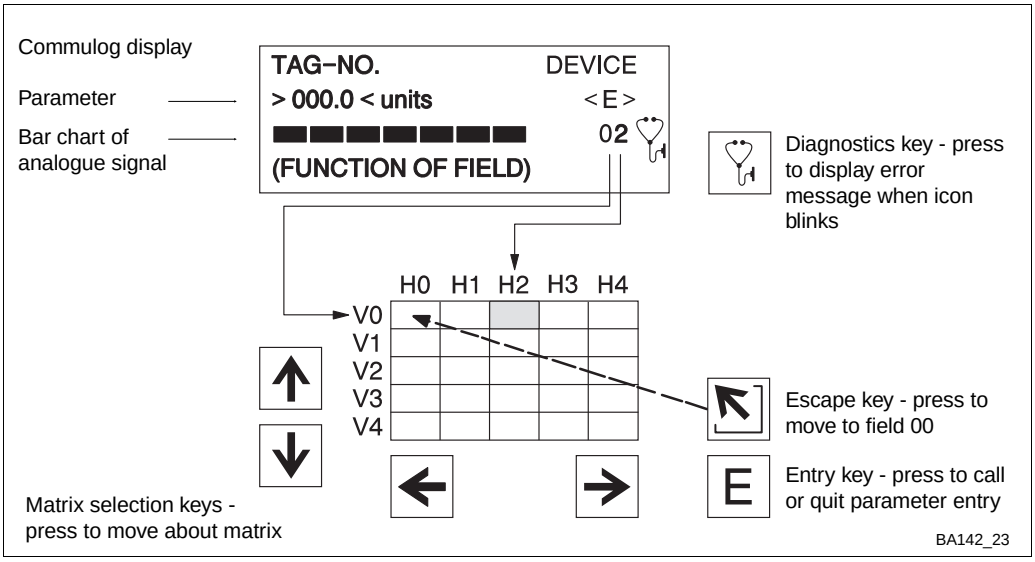


Fig. 3.2:
Commulog VU 260 Z display and key functions

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 FMC 661 transmitter

The transmitter is also available without the keyboard

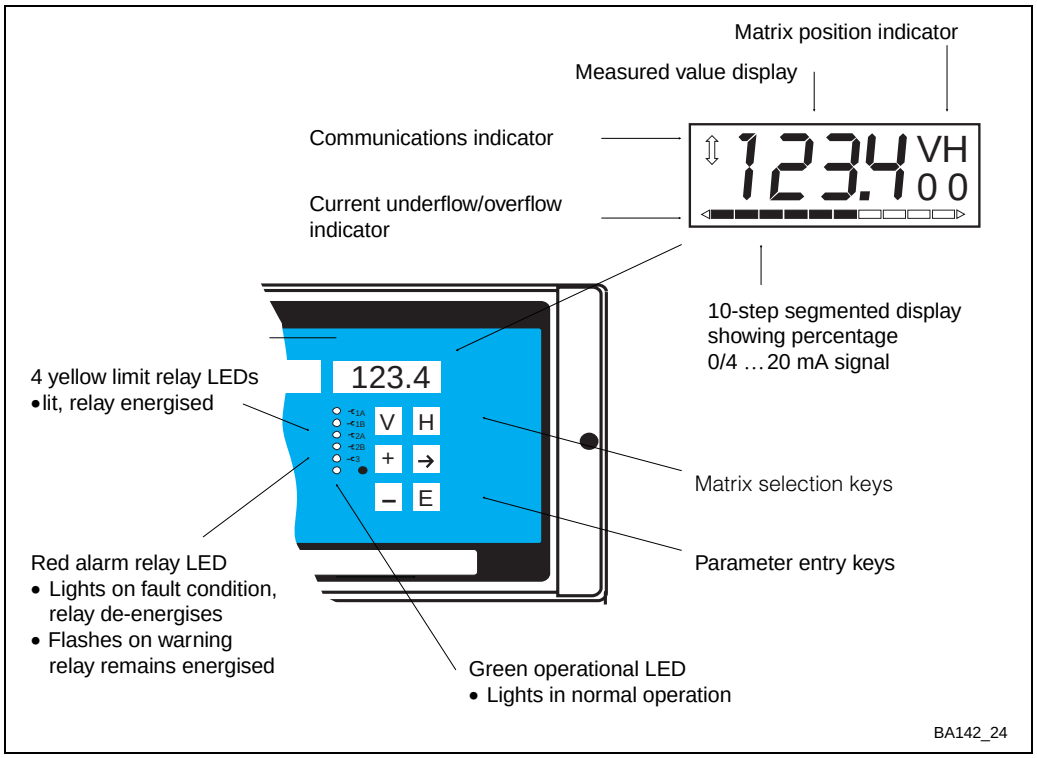


Fig. 3.1 shows the LC-display with matrix of the Prolevel FMC 661, Fig. 3.3 its front panel. Table 3.1 below describes the function of the operating keys.

- 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 FMC 661
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

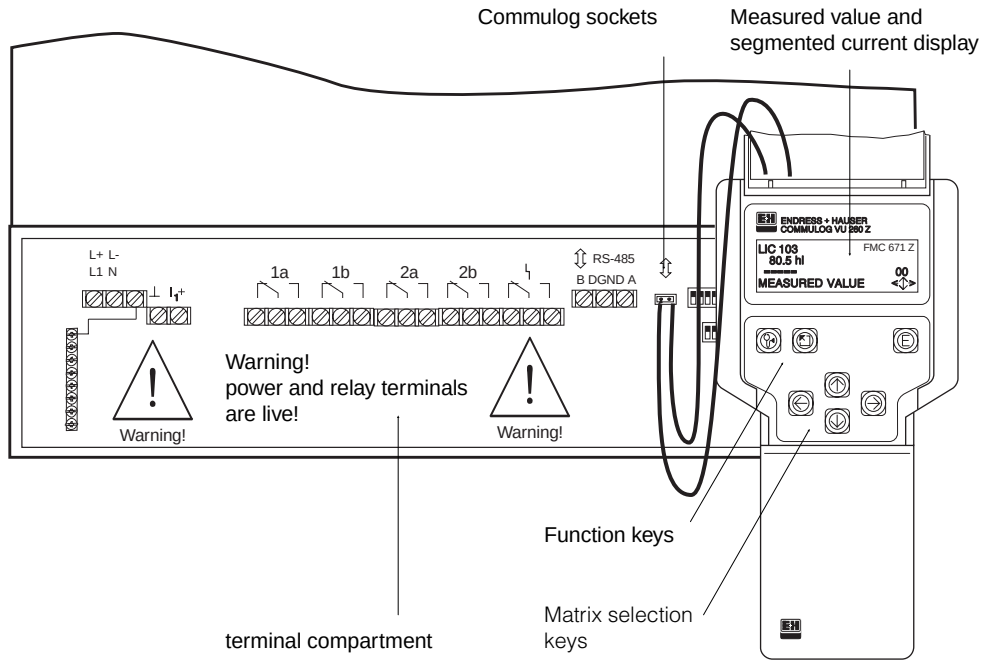


Fig. 3.4: Configuration with handheld terminal Commulog VU 260 Z

The Prolevel FMC 661 appears as device FMC 671 Z

The Prolevel FMC 661 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.

Warning!

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

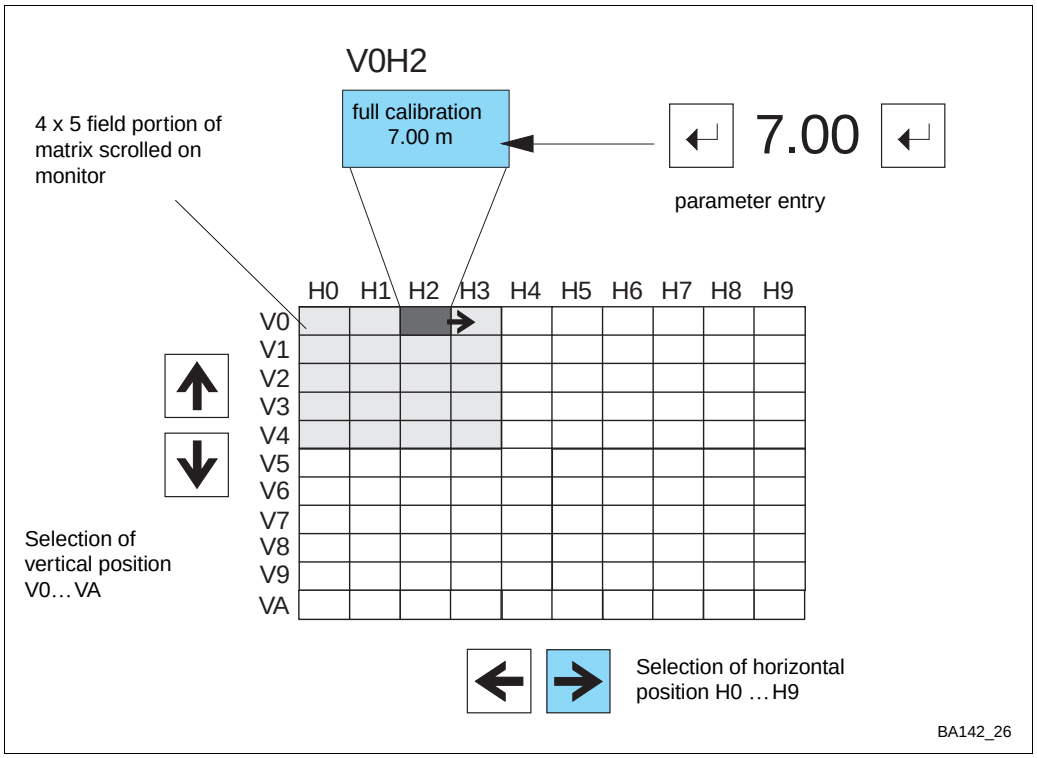
Warning!

Table 3.2: Prolevel FMC 661 Parameter entry and display keys for Commulog VU 260 Z

Keys	Function
Matrix selection	
← ↑ → ↓	• Select matrix position
↖	• »Escape key«, selects the position V0H0
♡	• 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.
↖	• 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 FMC 661 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!

Note!

- The Prolevel appears in all programs with the designation "FMC 671 Z"

4 Level Measurement

This chapter is concerned with the level measurement functions (operating mode 1 in V8H0, default) of the Prolevel FMC 661; 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.

With the exception of the dry calibration, the configuration procedure is independent of whether a hydrostatic pressure sensor or capacitance probe is connected to the Prolevel.

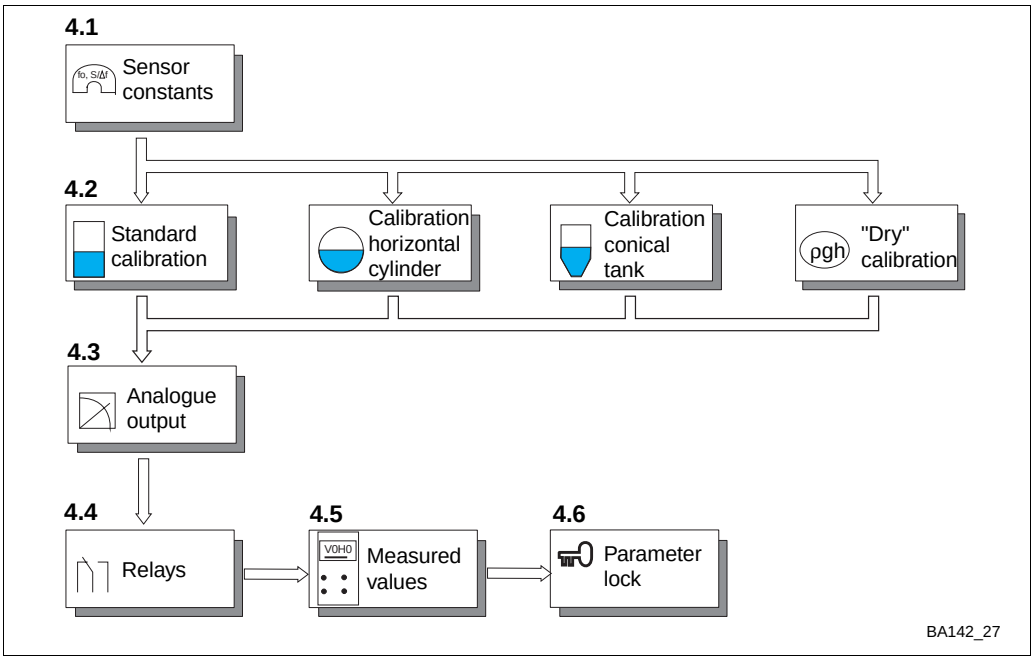


Fig. 4.1: Procedure: calibration and operation for level measurement

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 probe constants fo and S (Δf) — measured at 25°C. This ensures that the EC 37 Z/EC 47 Z electronic insert or Deltapilot can be replaced without the need for recalibration, see Section 6.4.

Step	Matrix	Entry	Significance
1	V9H5	e.g. 671	Enter any number 670…679 to reset transmitter
2	-	»E«	Register entry
3	V3H5	e.g. 475.3	Enter zero frequency f_o (offset) of electronic insert or sensor
4	-	»E«	Register entry
5	V3H6	e.g. 6.805	Enter sensitivity, S or Δf, of electronic insert or sensor
6	-	»E«	Register entry

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 and
- a »full« level at V0H2.

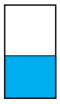
The fourth method can be used to make a »dry« calibration for hydrostatic sensors. For horizontal cylinders and tanks with conical outlet, users requiring a volume or weight measurement can activate the linearisation procedure.

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



#	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.

Note!

Note!

- The calibration can be performed in reverse order.
- For bulk solids (capacitance probes!), the probe measures the depth of emersion in the product only. Account for any filling mound or outflow depression by the entered levels.
- Density correction, see p. 29.

After calibration

If the product level is entered in %:

- % level is displayed at V0H0
- the 0/4…20 mA signal range corresponds to 0…100% level
- relays 1a and 1b 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.

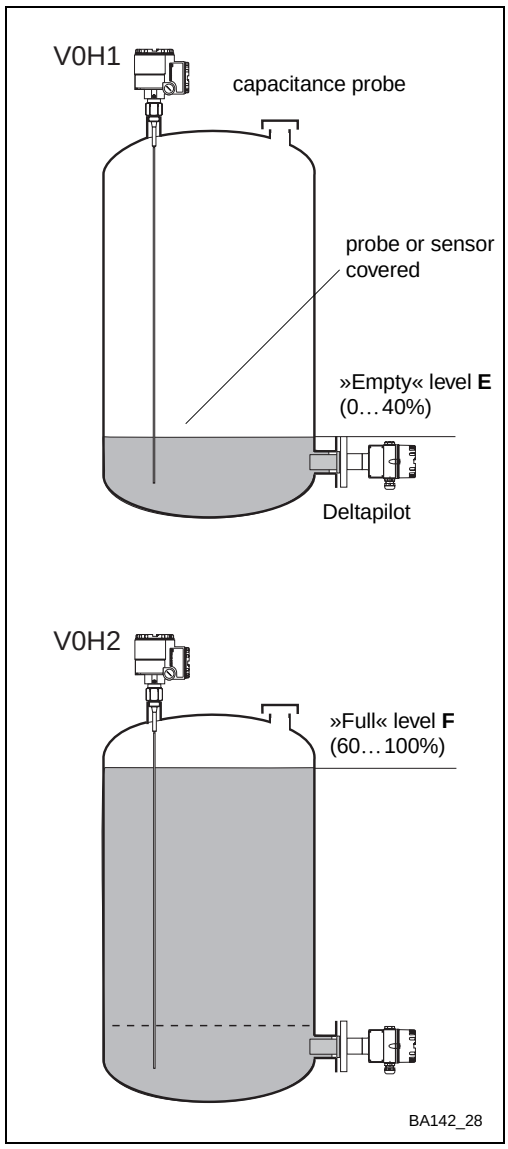


Fig. 4.2:
Parameters for standard calibration

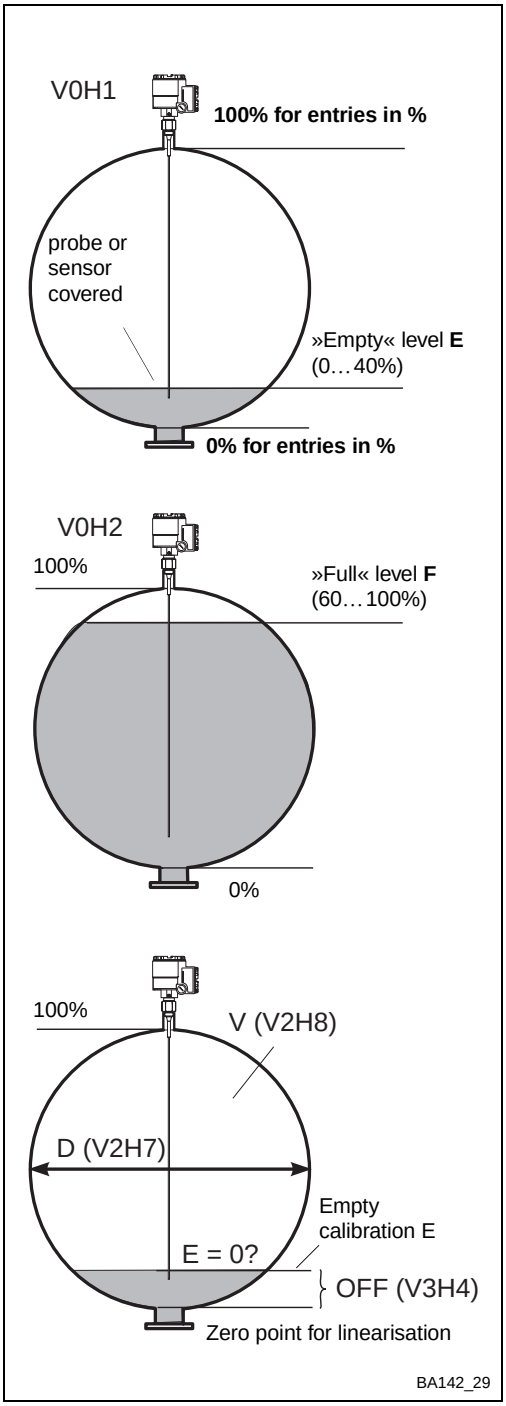


Fig. 4.3:
Parameters for calibration and linearisation in a horizontal cylinder

#	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

2) Calibration for horizontal cylinders

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 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

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

After linearisation

- Volume is displayed at V0H0
- Level is displayed at V0H9
- Density correction, p. 29.

Next step…

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

Note!

- For linearisation volume => level, see Appendix, p 46.

Note!

3) Calibration for tanks with conical outlet

#	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.

#	Matrix	Entry	Remarks
5	V2H1	0	Manual
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	$H_{1...30}$	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 or E604, correct table.
  Re-activate linearisation in V2H0.
- For linearisation volume => level, see Appendix, p. 47.

After linearisation

- Volume/weight is displayed at V0H0
- Level is displayed at V0H9
- Density correction, p. 29.

Next step…

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

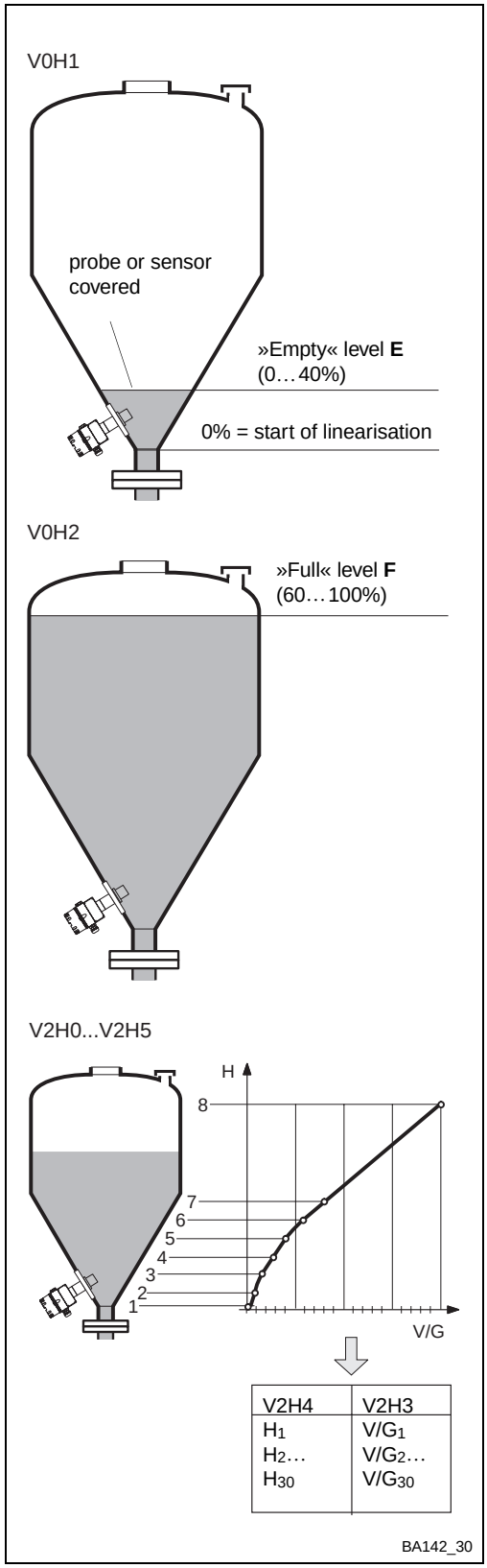


Fig. 4.4:
Parameters for calibration and linearisation in a tank with conical outlet

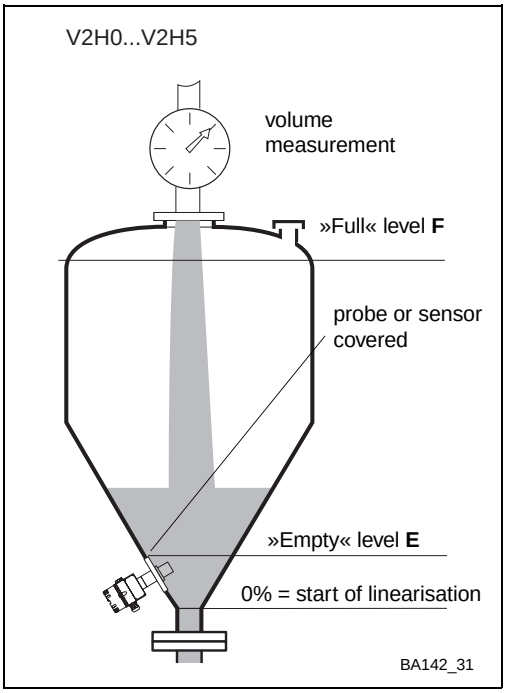


Fig. 4.5:
Parameters for calibration and semi-automatic linearisation in a tank with conical outlet

b) Semi-automatic linearisation

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

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

No.	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

Note!

- On error E602 or E604, correct table. Re-activate linearisation in V2H0.

Note!

After linearisation

- Volume/weight is displayed at V0H0
- Level is displayed at V0H9
- Density correction, p. 29.

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

Next step…

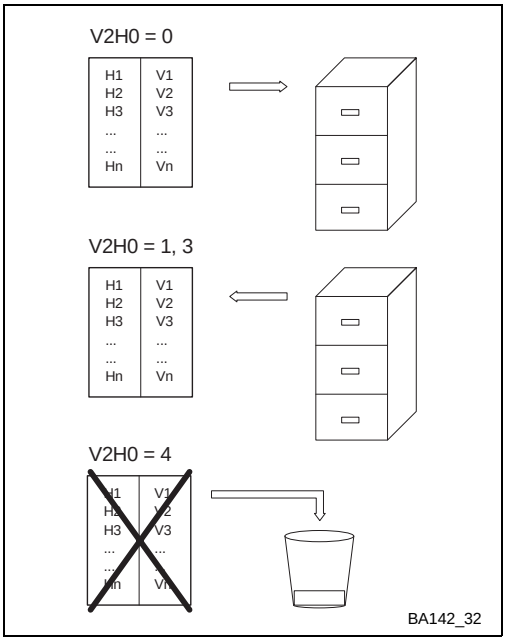


Fig. 4.6:
De-activating a linearisation

To delete a pair of values:

Deletion of value pairs

- Enter table number in V2H2
- Enter 9999 in V2H3 or V2H4

There are two possibilities for deleting a linearisation:

Deletion of linearisation

- Enter "0" in V2H0: 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: 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 x ρ (kg/dm^3) x g (m/s^2) x Δh (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/%

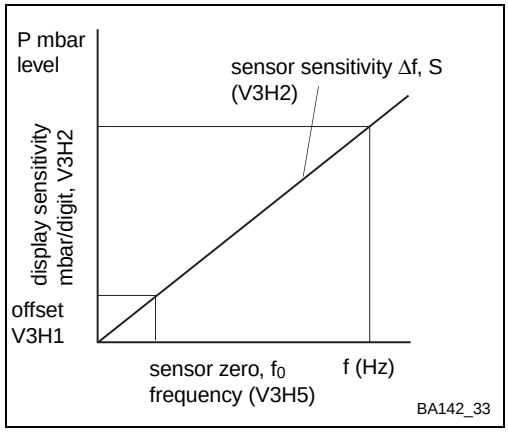


Fig. 4.7:
Offset and sensitivities for dry calibration

Sensor calibration

#	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
7	V0H0	**.**	Measured value %

The Prolevel now measures 0 at 44.13 mbar

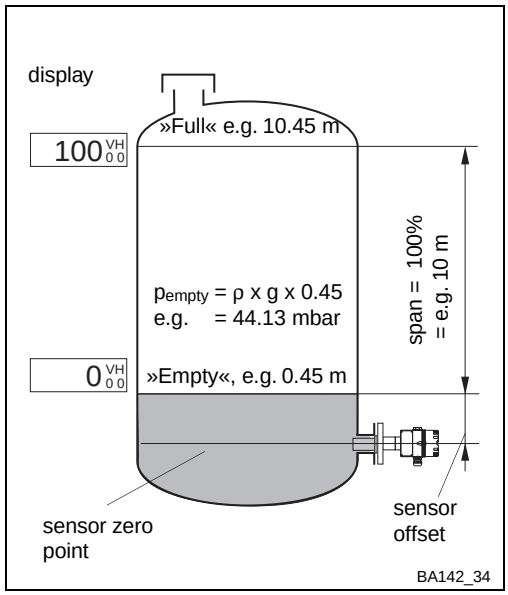


Fig. 4.8:
Parameters for dry calibration, display in %

Next step...

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

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

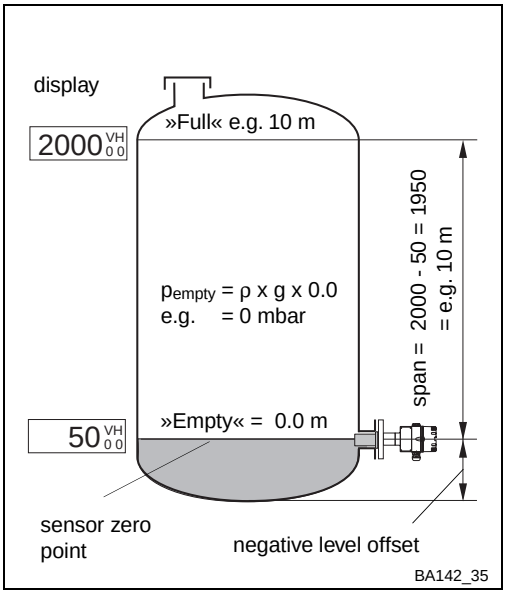
Calculate the pressure in mbar acting at the sensor for the desired »empty« level and the span (»full« - »empty«):

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

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**

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. .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

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

Next step...

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

Density correction for hydrostatic sensor

If the product changes after calibration, the measurement can be corrected by entering a density factor at V8H7:

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

The measured value is divided by the factor before display.


Note!

Note!

- For an automatic density correction using an additional external limit switch see »Calibration Correction« in Chapter 5

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

Analogue signal range

Two settings are possible:

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

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

V0H3	Range	Current limits
0	0...20 mA	-2…22 mA
1	4...20 mA	-2…22 mA

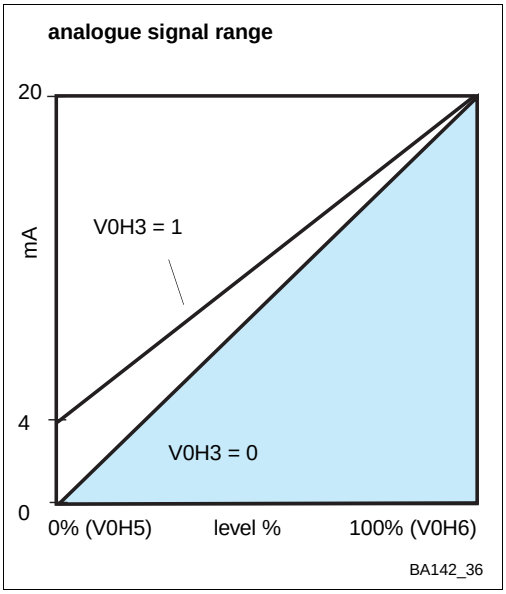


Fig. 4.10:
Selection of analogue signal range, V0H3

Example:
4…20 mA

#	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

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

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

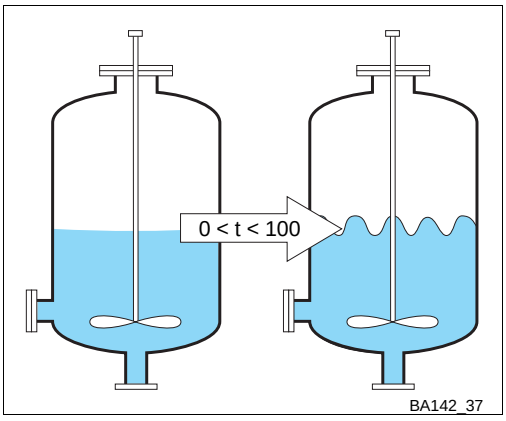


Fig. 4.11:
Output damping, V0H4

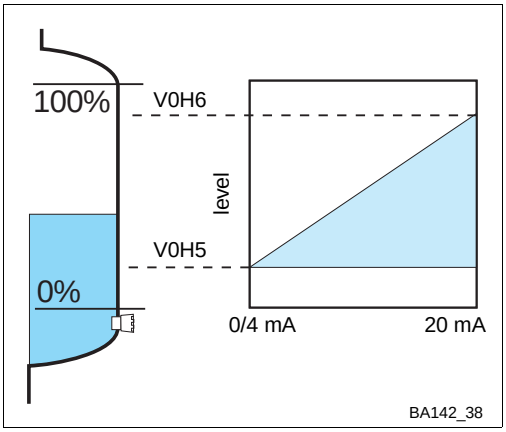


Fig. 4.12:
Value for 4 mA and 20 mA, V0H5 and V0H6

Value for 4 mA and 20 mA

The 4mA (V0H5) and 20 mA (V0H6) 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%

Note!

- Set in calibration/linearisation units
- When V0H3 = 0, V0H5 = 0 mA value

Note!

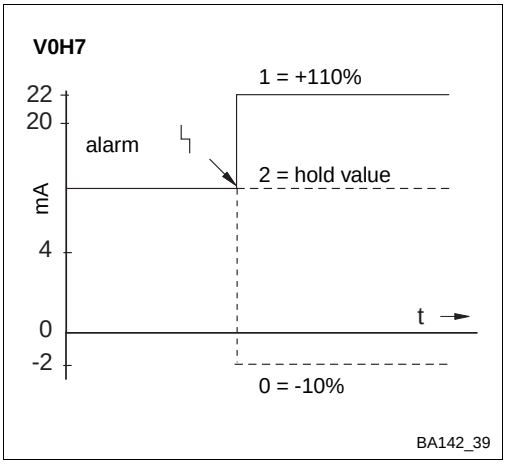


Fig. 4.13:
Output on alarm, V0H7

Output on alarm

The analogue output can be set such that it takes on distinctive values when a fault with alarm is detected. Depending on the setting in V1H3/V1H8, the relays may also follow the analogue output. The entry is made in V0H7:

- 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

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

V0H3 =	**Current on alarm when V0H7 =**		
	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.

Caution!

4.4 Relays

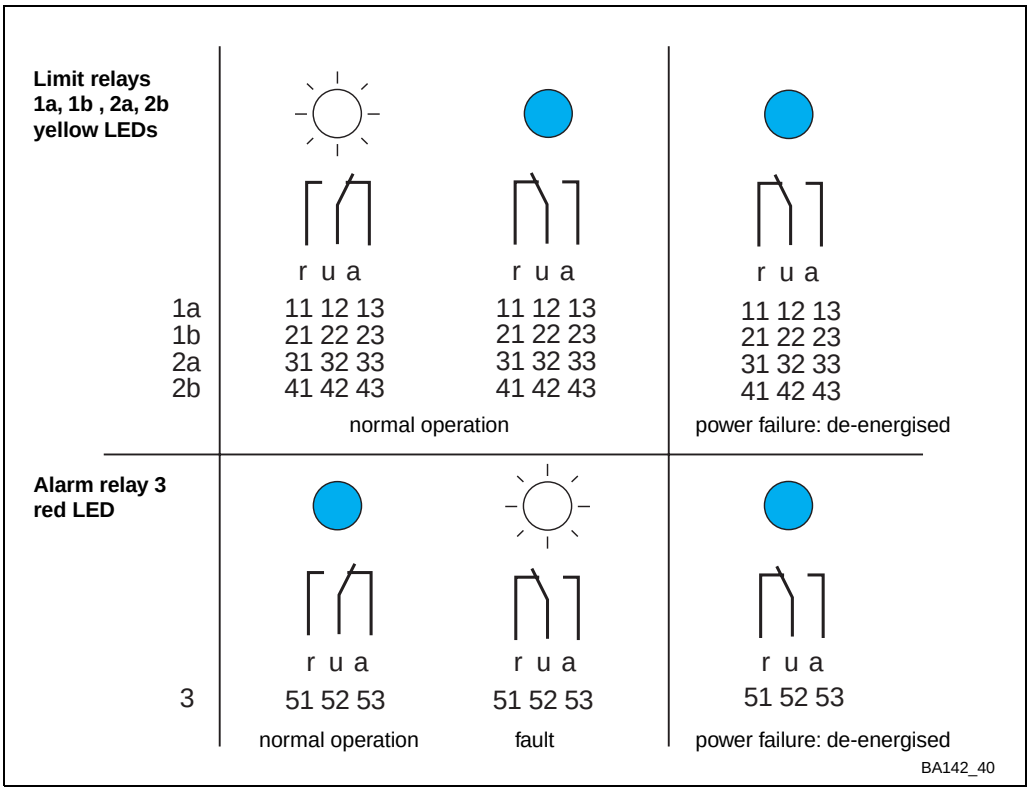


Fig. 4.14: Relay LEDs as a function of relay status: limit relay: lit, energised out, de-energised alarm relay (default setting): lit, de-energised out, energised

Operating modes

The Prolevel FMC 661 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	V1H5	Relay switch point in calibration/linearisation units
Fail-safe mode	V1H1	V1H6	0: minimum fail-safe mode: — the relay de-energises when the level drops below the switch point, see Fig. 4.15. 1: maximum fail-safe mode — the relay de-energises when the level rises above the switch point, see Fig 4.16.
Hysteresis	V1H2	V1H7	Range at end of which the relay energises again
Relay on alarm	V1H3	V1H8	0: de-energised 1: as analogue output: see Table 4.2.
Relay assignment	V1H4	V1H9	1: channel 1 2: channel 2

Relay on alarm

The limit relays respond to an alarm according to the entry at V1H3/V1H8 (0 = de-energise, 1 = as Table 4.2). When the relays are assigned to the external limit switch (see Chapter 5) they always de-energises on alarm.

Table 4.2: Relay response on fault condition when V1H3/V1H8 = 1.

Setting at V0H7	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

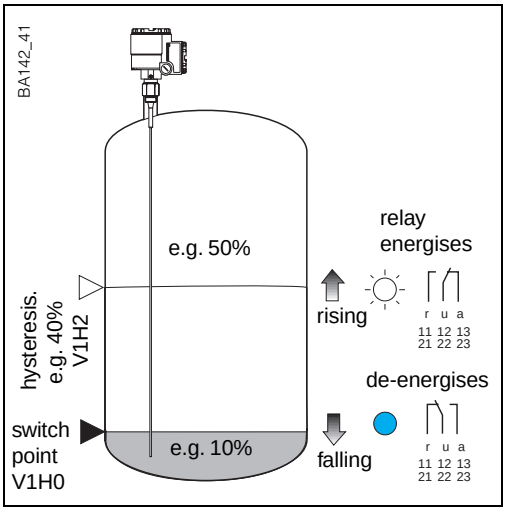


Fig. 4.15:
Limit value relay: example for minimum fail-safe mode

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

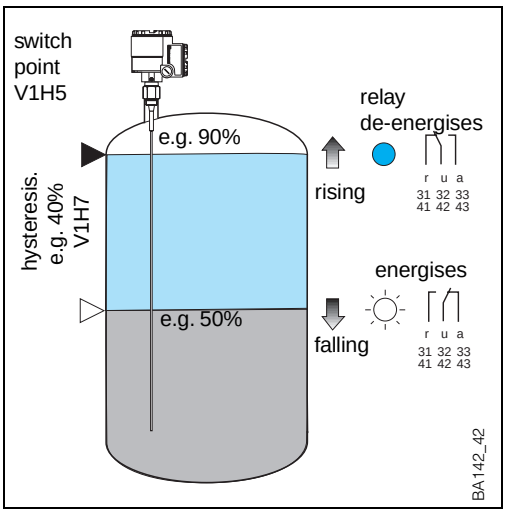


Fig. 4.16:
Limit value relay: example for maximum fail-safe mode

#	Matrix	Entry	Remarks
1	V1H5	e.g. 90	Switch point
2	-	»E«	Register entry
3	V1H6	1	Max. fail-safe mode
4	-	»E«	Register entry
5	V1H7	e.g. 40	Hysteresis —— relay energises at 50
6	-	»E«	Register entry
7	V1H8	1	Follow outputs
8	-	»E«	Register entry
9	V1H9	1	Assign to channel 2
10	-	»E«	Register entry

Example:
max. fail-safe mode,
relay 2a, 2b
switch point 90%
hysteresis 40%
relay follows analogue output
assigned to channel 1

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
- For two pairs of relays on channel 1, the hystereses can set such that one pair of relays de-energises just as the other energises.

Note!

4.5 Measured value display

The measured value can be read at V0H0. 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	Measured value	Remarks
V0H0	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 and V0H6 control the 10-step LCD bar diagram.
V0H8	Current measuring frequency channel 1	Displays the frequency which is actually measured by the probe. Can be used as a fault check (must change as level changes)
V0H9	Measured value before linearisation	Indicates level before linearisation in the units used for calibration
V8H7	Factor for calibration correction	For operating mode 5, displays correction factor used in calibration. Can also be used to enter a density factor when used with a Deltapilot S
V8H8	Current measuring frequency channel 2	Displays measuring frequency for Channel 2 when operating modes 0, 2 and 5 are selected.
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 FMC 661. For level probes on channel 1 there is no need to recalibrate.

5 Level Measurement with Limit Switch

This chapter describes the configuration of the Prolevel FMC 661 operating with an external limit switch for:

- Level measurement with automatic calibration correction

The external limit switch can also be used for:

- Level measurement on channel 1 with level switching on channel 2
- Level limit switching on channel 2 only

The setting of the analogue output, relays, measured value display and parameter upload and locking are described in Chapter 4.

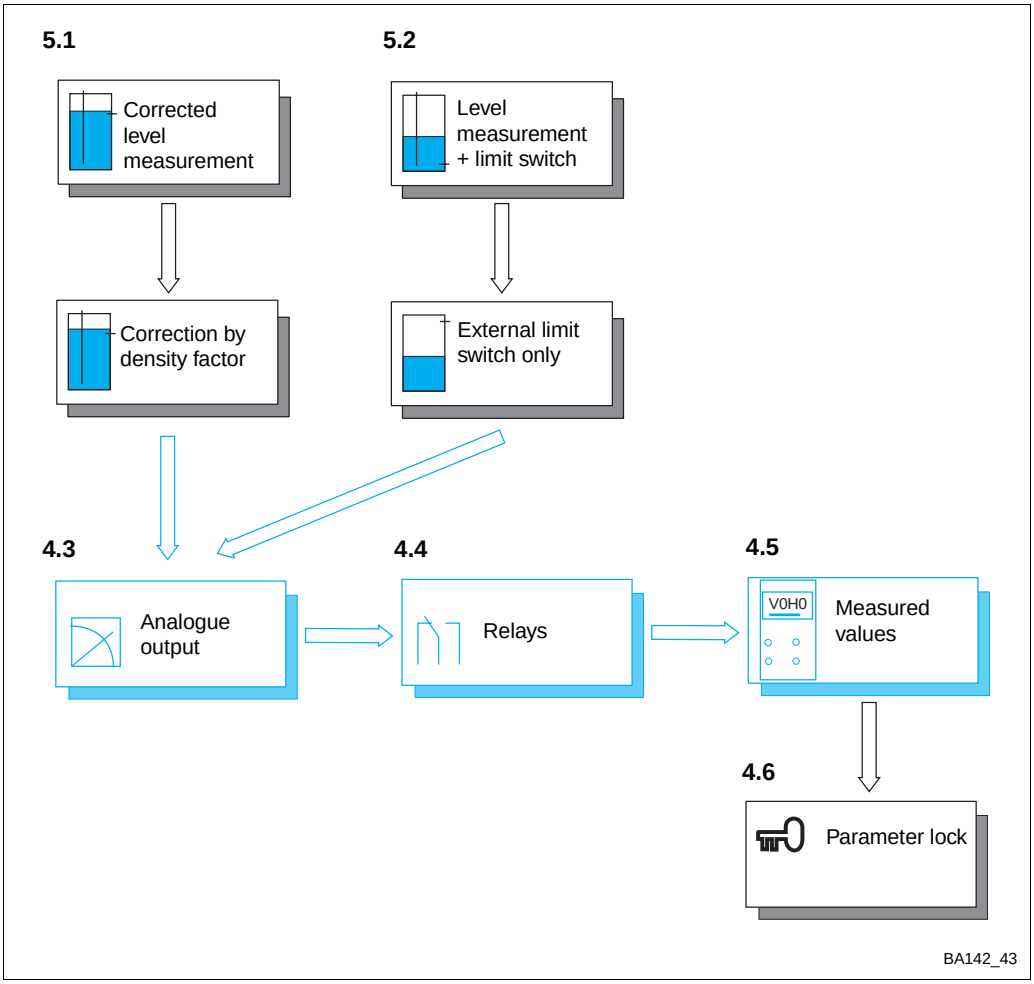
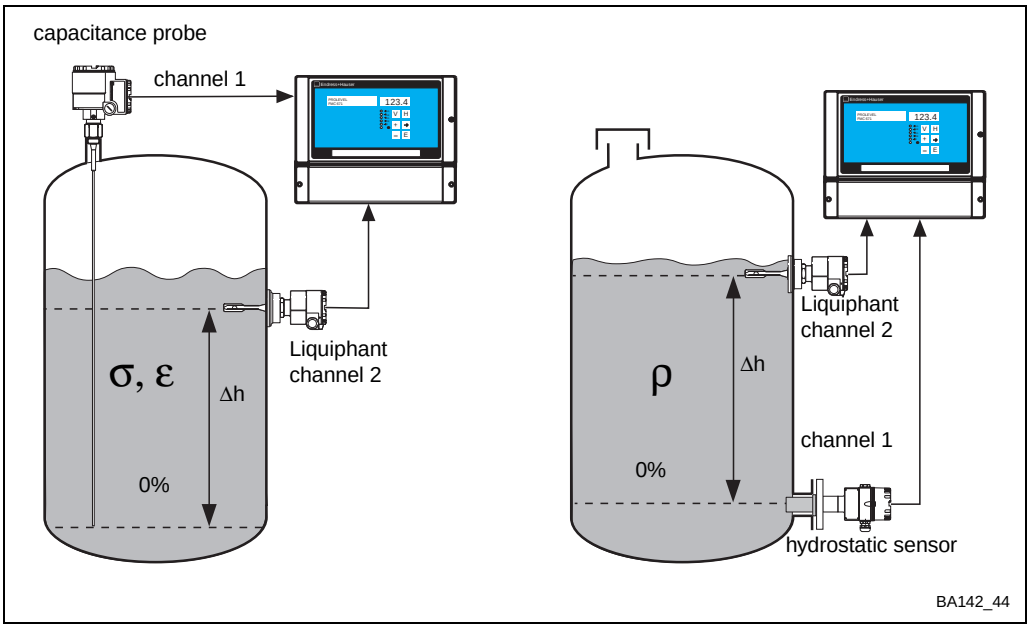


Fig. 5.1: Summary: Corrected level measurement and other applications with an external limit switch

5.1 Level measurement with automatic calibration correction

Fig. 5.2: Level measurement with automatic calibration correction: for dielectric constant with capacitance probes for density with hydrostatic sensors A capacitance probe can be used instead of the Liquiphant (applies to Multicap only)



This level measurement mode employs a Liquiphant or capacitance probe on channel 2 to check the validity of the calibration on channel 1. If a descrepancy is found, e.g. because of a change in dielectric constant for capacitance probes or in density for hydrostatic sensors, the level display is corrected.

The level calibration is corrected every time the product passes the external limit switch, i.e. uncovered ⇒ covered or covered ⇒ uncovered.

- If the measured level is less than the installation height of the external limit switch when this is covered, the value at V8H3 or its volume equivalent is displayed at V0H0 until the next automatic calibration,
- If the measured level is greater than the installation height of the external limit switch when this is uncovered, the value at V8H3 or its volume equivalent is displayed at V0H0 until the next automatic calibration.

Installation hints

Install the external limit switch where:

- it is frequently covered and uncovered (increases frequency of correction)
- as near as possible to 100% (ensures greatest accuracy)
  - we recommend a height between 70…90%.

Note!

Note!

- For Deltapilot S, always use a Liquiphant switch. The use of a capacitance limit switch causes faulty operation.
- Product properties may not change during a filling operation, since there is no means of continuous compensation.
- The external limit switch must operate with all densities (or dielectric constants) encountered.
- If overspill must be avoided at all costs, a separate system must be installed.
- The automatic correction mode is not recommended for use with bulk solids.

Standard method

The standard method can be used for all probes and sensors:

- The switching delay (0…30 s) determines the delay between the covering or uncovering and the switching of the Liquiphant (or capacitance probe).
- The installation height is the height above the 0% level expressed in the same units (%, m, ft, hl, gal, tonnes etc.) as the subsequent calibration step.

The »full« calibration is carried out automatically when the product reaches the external limit switch. Since the default display sensitivity is used during this time, the display at V0H0 may be initially incorrect and analogue signal/relays not function as set.

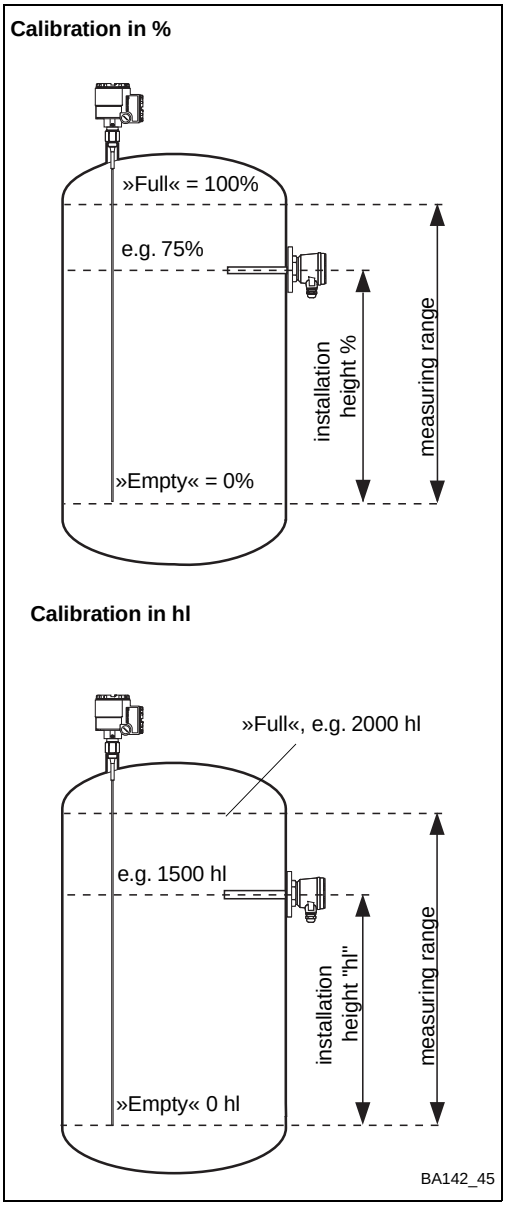


Fig. 5.3:
Parameters for standard calibration, level measurement with automatic calibration correction

Sensor calibration capacitance limit switch + level sensor

#	Matrix	Entry	Remarks
1	V9H5 V3H5/V3H6		Reset, enter probe constants, page 23
2	V8H0	5	Calibration correction
3	-	»E«	Register entry
4	V8H2	e.g. 2 s	Switching delay
5	-	»E«	Register entry
6	V8H3	e.g. 75%	Installation height
7	-	»E«	Register entry
8	V8H4	1	Sensor = Capacit.
9	-	»E«	Register entry
10	V8H5	0	Sensor uncovered
11	-	»E«	Register entry
12	V8H6	e.g. 1	Switch point in Hz
	-	»E«	Register entry

»Empty« calibration

#	Matrix	Entry	Remarks
13	V0H1	0	»Empty« level
14	-	»E«	Register entry

Note!

- The sensor calibration for Liquiphant limit switches is described on p. 38
- If the probe ist covered, V8H5 = 1
- V8H6: if the probe is top-mounted there is an additional delay (Table 5.1, p. 39).

Note!

Next step…

- If appropriate, linearisation, p. 25…27
- If appropriate, level offset, p. 25
- Analogue output and relays, p. 30…33, — assign relays 2a/2b to channel 1.

Calibration with partially filled vessel

If the following calibration is initially carried out with a hydrostatic pressure sensor using water (ρ = 1.0), density can be measured and read off from V8H7.

- If the product changes, the system can be quickly adapted to the new product by entering a its density at V8H7. This ensures that the correct level is measured as the vessel is filled.

Sensor calibration Liquiphant limit switch + level probe

#	Matrix	Entry	Remarks
1	V9H5 V3H5/V3H6		Reset, enter probe constants, page 23
2	V8H0	5	Calibration correction
3	-	»E«	Register entry
4	V8H2	e.g. 2 s	Switching delay
5	-	»E«	Register entry
6	V8H3	e.g. 75%	Installation height
7	-	»E«	Register entry
8	V8H4	0	Sensor = Liquiphant
9	-	»E«	Register entry

Level calibration

#	Matrix	Entry	Remarks
10	V8H7	1	At »empty« level, set corr. factor to 1
11	-	»E«	Register entry
12	V0H1	e.g. 10%	»Empty« level
13	-	»E«	Register entry
14	V8H7	1	At »full« level set corr. factor to 1
15	-	»E«	Register entry
16	V0H2	e.g. 90%	»Full« level
17	-	»E«	Register entry

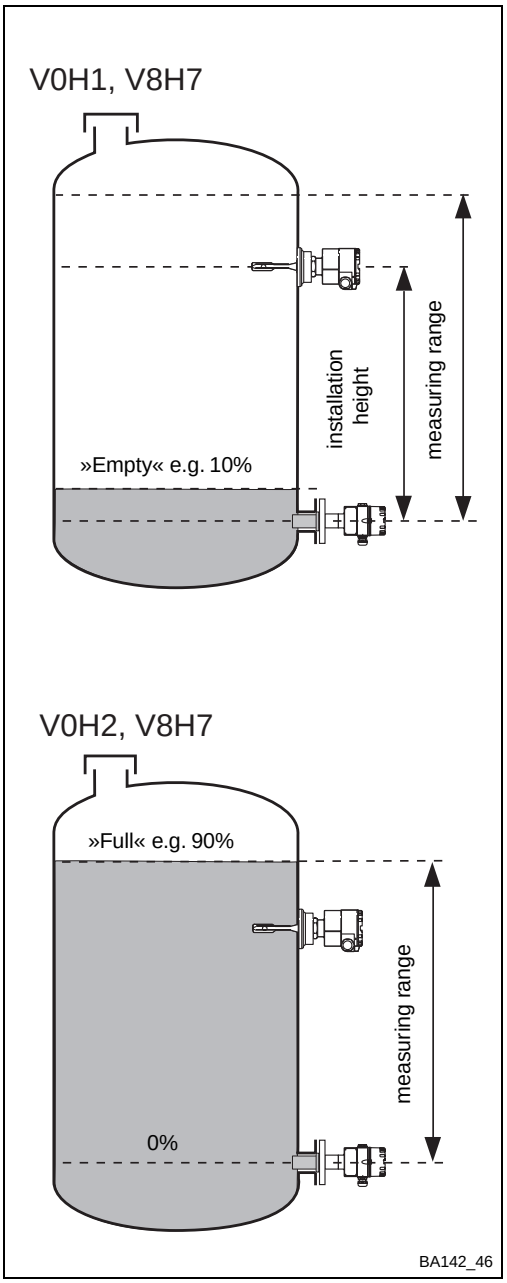


Fig. 5.4:
Parameters for calibration with partially filled vessel

Note!

Note!

- The best accuracy is attained when the difference between »full« and »empty« levels is as great as possible.
- If the operating mode is temporarily quit, the Prolevel measures by using the sensitivity V3H2 x V8H3. The indication remains correct as long as the same product is in the tank.

Next step…

- If appropriate, linearisation, p. 25…27
- Analogue output and relays, p. 30…33 — assign relays 2a/2b to channel 1.

5.2 External limit switch

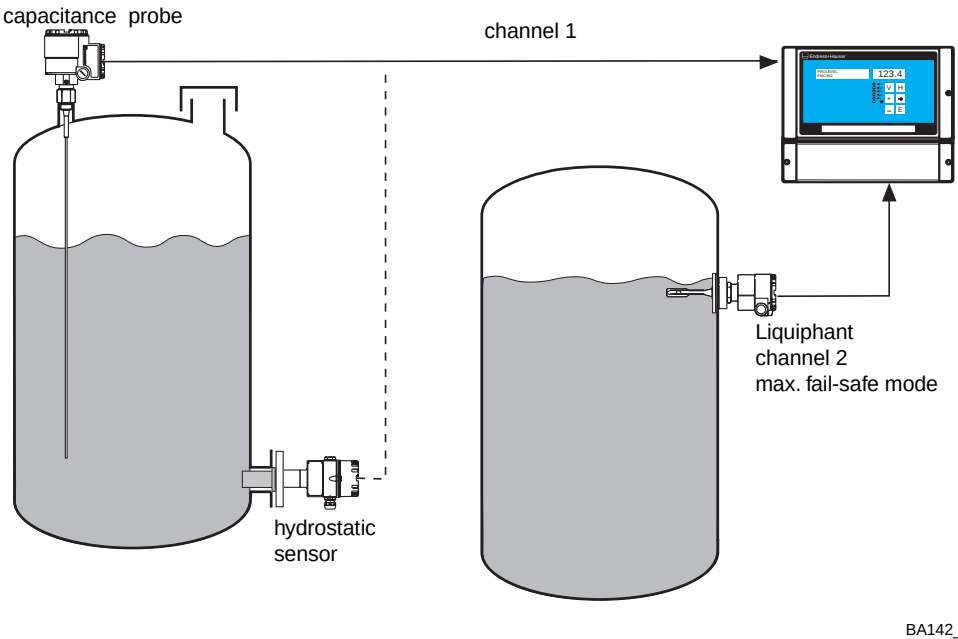


Fig. 5.5: Level measurement and limit switching on separate channels

Level measurement with level switching

Operating mode 0 (V8H0 = 0) of the Prolevel FMC 661 allows level measurement on channel 1 and separate level switching on channel 2:

#	Matrix	Remarks
1	V9H5/V3H5/V3H6	Reset, enter sensor constants
2	V8H0	Select and register operating mode 0 (=0)
3	V0H1…V0H7	Level calibration, analogue output, Chapter 4.
4	V8H2…V8H6	Calibrate limit switch, capacitance p. 37, Liquiphant p 38.
5	V1H0…V1H4, V1H6	Set relays, for limit switch set fail-safe mode only

Level limit switching

Operating mode 2 (V8H0 = 2) provides level limit switching on channel 2 only. The limit switch calibration is as described under "Sensor calibration", capacitance probes p. 37, Liquiphant, p 38. For a top-mounted capacitance switch there is an additional delay, see Table 5.1:

- Set the relay fail-safe mode only
- If V1H4 = 2 (channel 2), copy the values in V1H5/V1H7 to V1H0/V1H2.

Product	Dielectric constant εr	Conductivity	Switch point	
			with ground tube	without ground tube
Solvents, oil, fuel	<3	low	ca. 150 mm	ca. 500 mm
dry bulk solids	<3	low		ca. 350 mm (cable probe)
moist bulk solids	>3	medium		ca. 150 mm (cable probe)

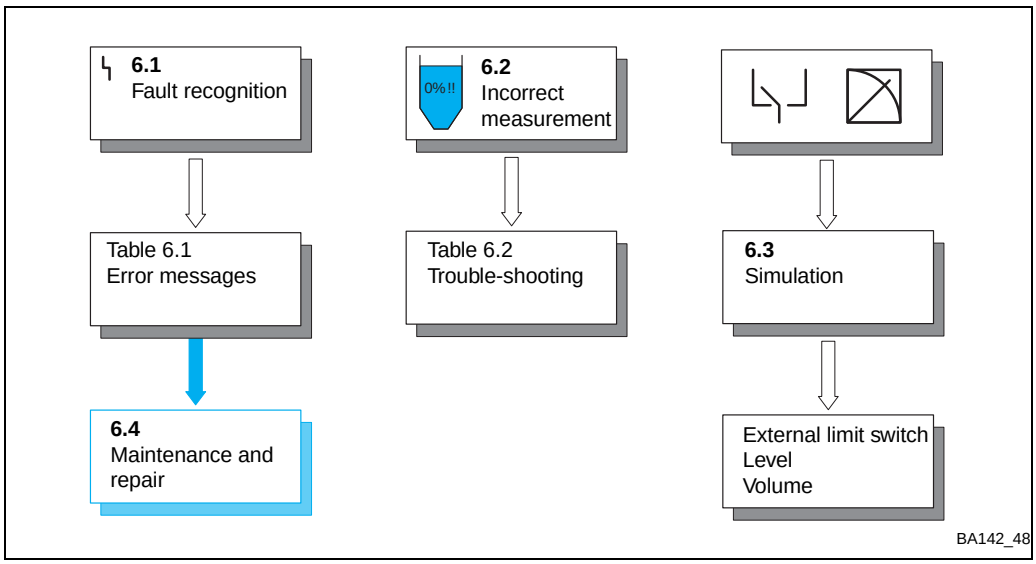
Table 5.1: Switch point deviation as a function of product for top mounted capacitance probes and default value of 1 Hz = 5 pF

6 Trouble-Shooting

The Prolevel FMC 661 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 FMC 661



6.1 Fault recognition

Alarms

If the Prolevel FMC 661 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/V1H8.
- 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 FMC 661 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 FMC 661

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 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 does not rise monotonously (volume does not increase with level) - Check and re-enter correct values, reactivate linearization
E 604	Warning	Linearisation has less than two sets of values - Enter more values, reactivate linearization
E 606	Warning	No stored factory linearization (V2H6 = 0) - Select another linearisation function at V2H0
E 608	Warning	Value in V0H5 greater than that in V0H6 - Check input
E 610	Warning	Calibration fault, channel 1 (»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

Sensor/ channel	Fault	Cause and remedy
Capacitance Channel 1	Measured value wrong	• Incorrect calibration? Check measured value before linearisation, V0H9 - if not correct, check whether full and empty calibration correct V0H1/V0H2 - If correct, check linearization parameters - Check operating mode, V8H0 • Change in product - recalibrate for new product • Probe damaged, bent or pressed to side of vessel - check and remedy • Condensation in connection compartment
Deltapilot S Channel 1	Measured value wrong	• Incorrect calibration? Check measured value before linearisation, V0H9 - if not correct, check whether full and empty calibration correct V0H1/V0H2 - If correct, check linearization parameters - Check operating mode, V8H0 • Change in density of product - recalibrate - for Mode 0, 1, 5, enter new density at V8H7 • Sensor damaged - check and remedy
Capacitance or Deltapilot S Channel 1	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, V1H9 - Simulate settings in simulation mode - see Section 6.3, if the relays LEDs switch, check wiring
Capacitance Channel 2	Does not switch correctly	• Incorrect calibration? - V1H7 ≥ V8H6? - change in product, build-up on probe • Build-up on probe - wire electronic insert for build-up, see Section 2.4 • Settings wrong - type of probe, fail-safe function, switching delay • Probe damaged, bent or pressed to side of wall
Liquiphant Soliphant Channel 2	Does not switch correctly	• Build-up on probe - clean regularly • Settings wrong - type of probe, fail-safe function, switching delay • Probe damaged or bent

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 level measurement
- Enter 7 at V8H0 to activate the simulation mode for level switching
- Enter 0 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 (V8H0 = 7)	0 = switch uncovered 100 = switch covered	External limit switch for Liquiphant values reversed
V9H7 (V8H0 = 6)	Level	Level, current, volume
V9H8 (V8H0 = 6)	Volume	Volume, current
V9H9 (V8H0 = 6)	Current	Current

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

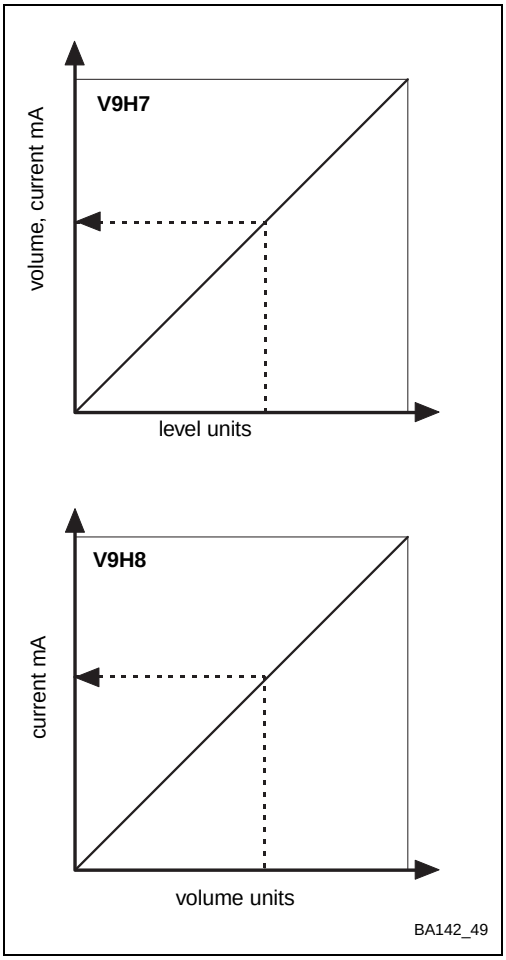


Fig. 6.2:
Simulation mode

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

#	Matrix	Entry	Significance
1	V8H0	6	Select simulation
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 by entry of volume in V9H8

#	Matrix	Entry	Significance
1	V8H0	6	Select simulation
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 covered external limit switch

#	Matrix	Entry	Significance
1	V8H0	7	Select simulation
2	-	»E«	Register entry
3	V9H6	100	Switch covered
4	V8H0	e.g. 0	Measurement mode
5	-	»E«	Register entry

6.4 Exchanging transmitters and sensors

FMC 661 transmitter

If the Prolevel FMC 661 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.

Capacitance probes with EC 37 Z/EC 47 Z

For level measurement, provided the sensor constants were entered before calibration, it is not necessary to recalibrate the instrument when the electronic insert is replaced. On replacement:

- the zero frequency (or offset) f_O and
- sensitivity S

for the range selected (default Range II) must be entered at V3H5 and V3H6 respectively. Fig. 2.2 shows where the information is to be found on the EC 37 Z and EC 47 Z inserts.

- If a different range is selected, the transmitter must be recalibrated.
- If the constants were not entered a recalibration is necessary.

Procedure

Step	Matrix	Entry	Significance
1	V3H5	e.g. 57.2	Enter zero frequency (offset)
2	-	»E«	Register entry
3	V3H6	e.g. 0.652	Enter sensitivity
4	-	»E«	Register entry

EC 17 Z insert

If the capacitance probe was used for limit switching on channel 2, a recalibration is necessary.

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 found in table 2.2., p. 13.

- f_O is the zero frequency (or offset)
  — the zero frequency may also be read from V0H8 when the probe is unpressurised. This value gives slightly better accuracy, since it accounts for the orientation of the probe.
- Δf is the sensitivity

Liquiphant

No recalibration is necessary if the Liquiphant is exchanged.

6.5 Repairs

Should the Prolevel FMC 661 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	Δf	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

Note!

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

After linearisation
- Volume is displayed at V0H0
- Level is displayed at V0H9

Next step…

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

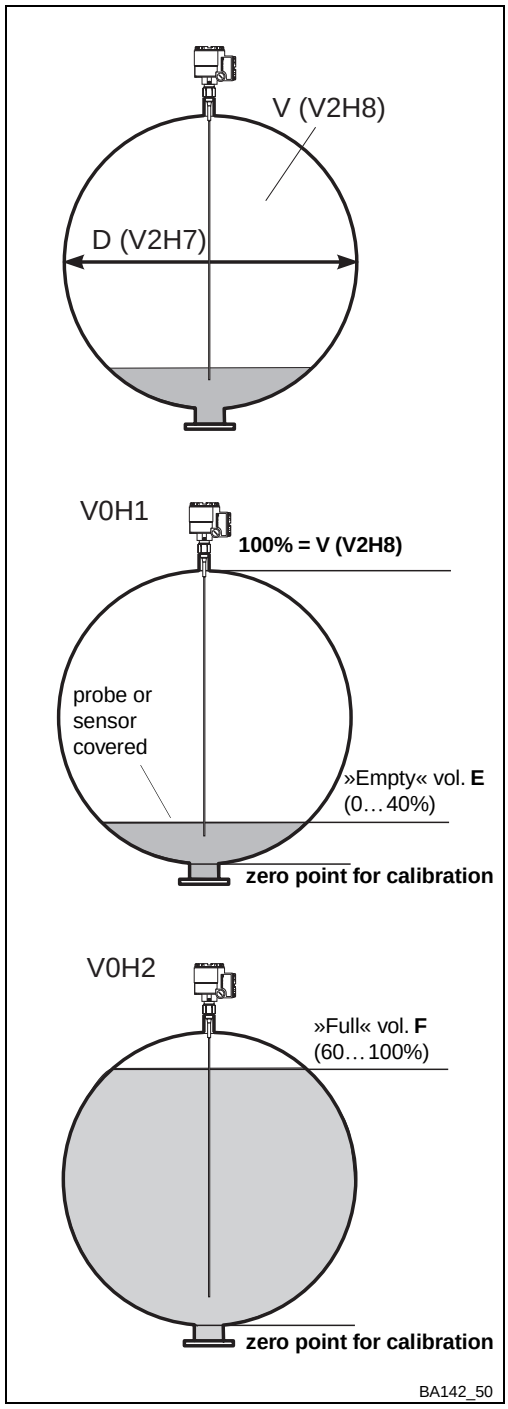


Fig. 7.1:
Parameters for calibration and linearisation in a horizontal cylinder

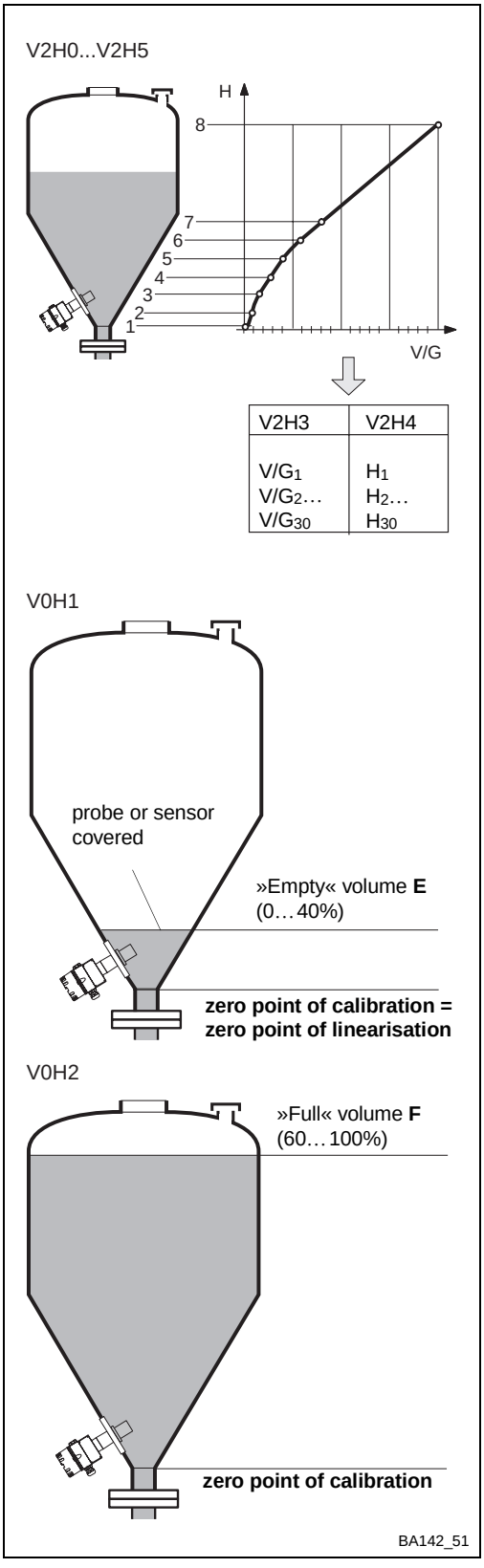


Fig. 7.2:
Parameters for calibration and linearisation in a tank with conical outlet

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	Δf	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

Note!

- First pair ~ 0 % level, in %, m, ft. last pair ~ 100 % level, in %, m, ft.
- On error E602 or E604, correct table. Re-activate linearisation in V2H0.

Note!

After linearisation

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

Next step…

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

Index

Operating Matrix

Operating and default parameters

Enter your operating parameters in the matrix below.

	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	1		
V1	90.0	1	2.0	0	1	90.0	1	0.1	0	2
V2	0	0	1	0.0	0.0	1		100	100	
V3	0	0.0	10.0		0.0	0.0	1.0			
V4										
V5										
V6										
V7										
V8	1		1	90.0	1	0	1.0	1.0		670
V9	E	E		532		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 channel 1	Measured value before linearization
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 V0H7	Select Relay 1 1 = channel 1 2 = 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 V0H7	Select Relay 2 1 = channel 1 2 = channel 2
V2 Linearisation Channel 1	Linearisation 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		Zero offset value	Offset of device (zero frequency)	Sensitivity of device		For Service only (0 mA D/A calibration)	For Service only 20 mA D/A calibration)
V4										
V5										
V6							.			
V7										
V8 Operating mode	0 = level/switch 1= level 2 = switch 5 = corr. level 6 = sim. FMC 7 = sim. FTC		Switch delay time (s)	Sensor position for corr. cal.	Type of sensor 0=DL 17 Z 1=EC 17 Z	Calibration EC 17 Z 0=free 1=covered	Calibration EC 17 Z Switch point 0.1…100 Hz	Factor for calibration correction	Actual frequency measuring channel 2	Security locking < 670 or > 679
V9 Service and Simulation	Current diagnostic code	Last diagnostic code 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 channel 1 before linearisation	Units channel 1 after linearisation			Display channel 1 before linearisation	Display channel 1 after linearisation		

Display field

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