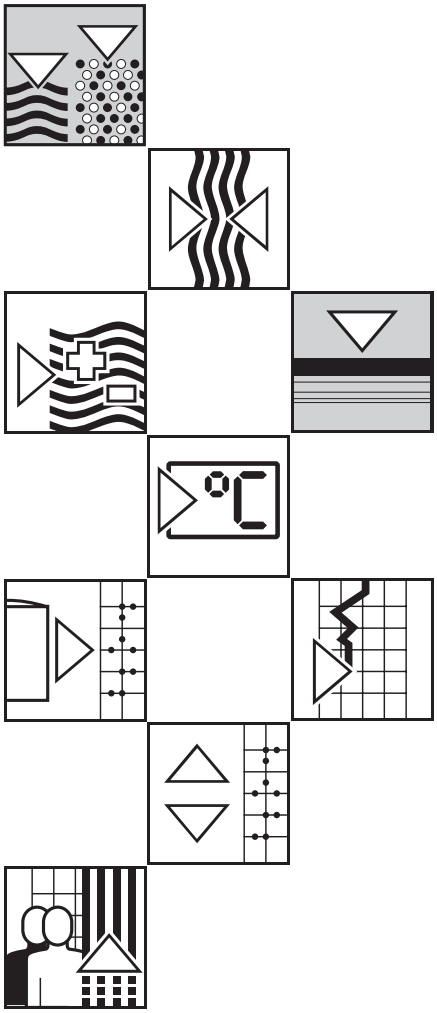
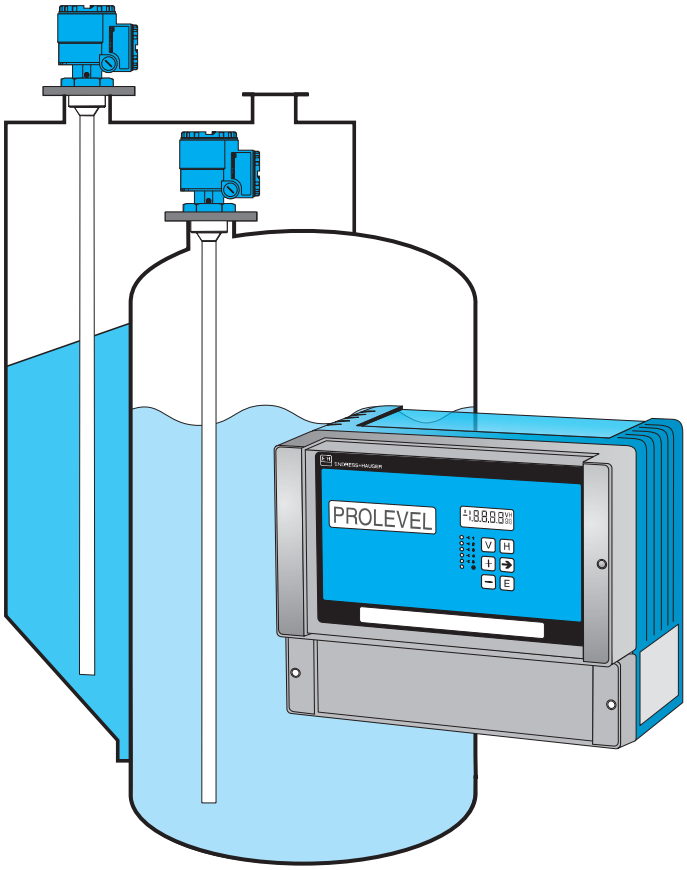
BA 143F/00/en/06.03
016563-1000
valid for Software 1.x

prolevel
FMC 662
Capacitance Level Measurement

Installation and Operating Instructions



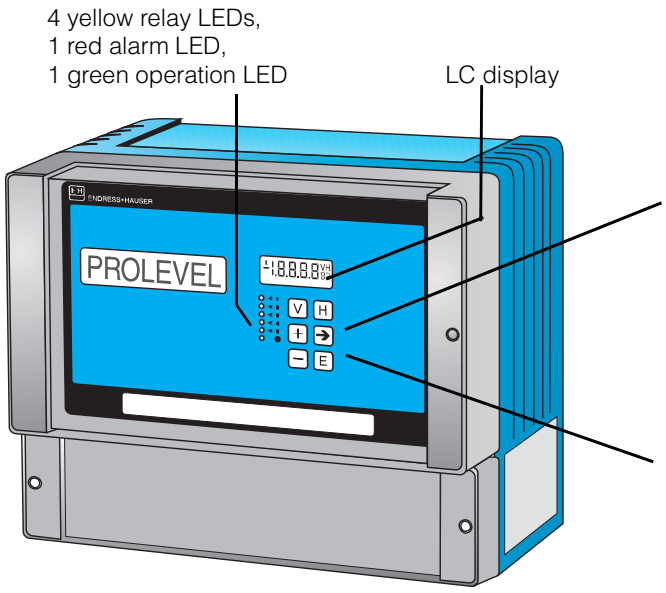


Endress+Hauser

The Power of 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 Ch 1	Matrix Ch 2	Action
	1 Reset transmitter	V9H5		● Enter 672, press »E« to register entry - *Omit if commissioned as in Section 4.1*
	Operating mode	V8H0		● 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	V4H3	● Enter 0 for 0…20 mA signal, 1 for 4…20 mA signal Press »E« to register entry
		V0H5	V4H5	● Enter level for 0/4 mA signal (if not 0) Press »E« to register entry
		V0H6	V4H6	● Enter level for 20 mA signal (if not 100) Press »E« to register entry
	5 Channel 1 Relays 1a and 1b	V1H0	V5H0	● Enter level for switching in calibration units Press »E« to register entry
	Channel 2 Relays 2a and 2b	V1H1	V5H1	● Enter fail-safe mode: 0 = minimum, 1 = maximum Press »E« to register

* Can be performed in reverse order

Table of Contents

Notes on Safety

Approved usage

The Prolevel FMC 662 is a field transmitter for level measurement which can be used with a variety of capacitance probes. 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 662 transmitter is available with certificate of conformity for use with probes installed 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 99 ATEX 2090	Prolevel FMC 661/662, FMB 662	CE Ex II (1) GD, [EEx ia] IIC, install outside Ex-area
CSA LR 53988-81	FMC 662	Class I, II, III Div. I Groups A-G
FM J.I. 0Z2A7.AX	FMC 662	Class I, II, III Div. I Groups A-G
PTB 98 ATEX 2215 X	DC 12 TE, DC .. TE ., DC .. E ., DC .. Capacitance probes 11500 Z(M), 11961 (Z), 21561 (Z) with electronic insert EC 16/17/27/37/47 Z, FEC 12, HTC 16/17/27 Z, HTC 10 E, HMC 37/47 Z	CE Ex II 1/2 G, II 2 G, EEx ia IIC/IIB T6
PTB 98 ATEX 2215 X	DC 12 TE, DC .. TE ., DC .. E ., DC .. Capacitance probes 11500 Z(M), 11961 Z, 21561 Z with electronic insert EC 17/37/47 Z, FEC 12	CE Ex II 1 G, EEx ia IIC/IIB T6

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 662 is a field transmitter for level measurement with 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 on channels 1 and 2, 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 and functional description.
- Chapter 2: Installation;
  contains hardware configuration, installation instructions, connection diagrams and technical data.
- 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 differential level measurement and level measurement with a reference probe
- 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.
- Chapter 7: 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

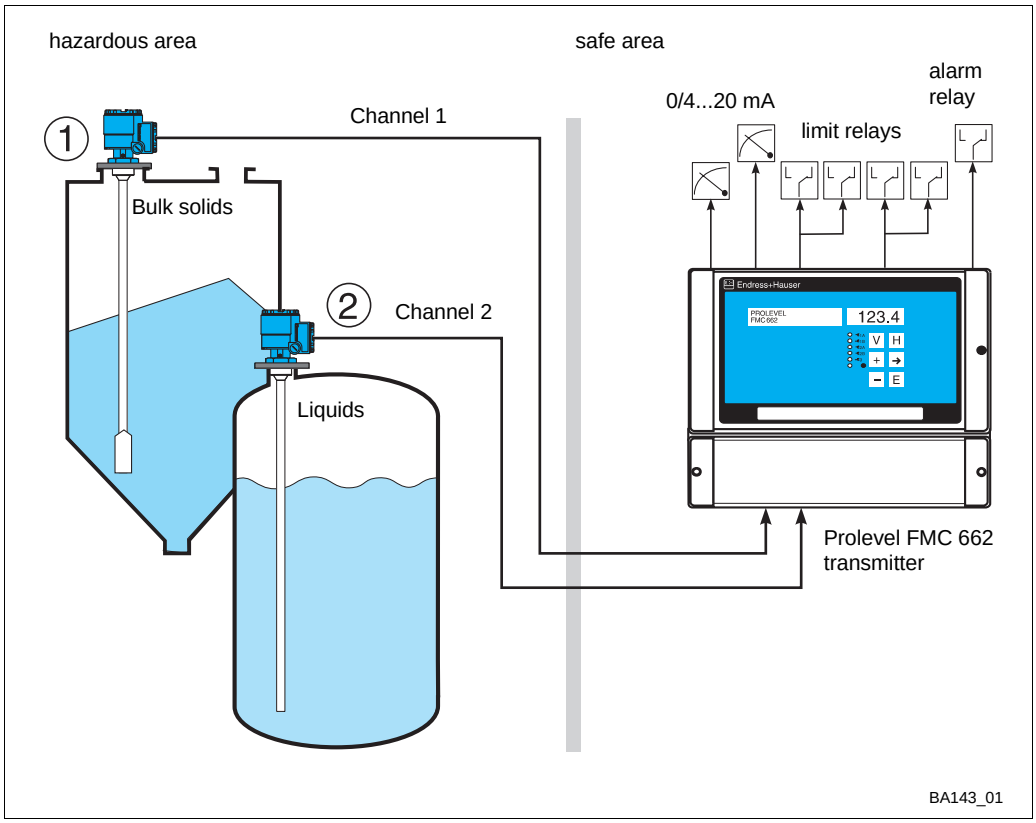
In addition to this manual, the following publications provide information on configuration of the Prolevel FMC 662.

- 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 662 controlling level measurement
① in bulk solids
② in liquids



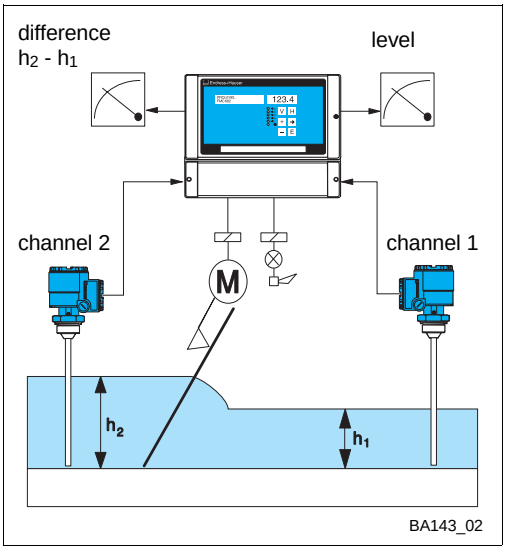
The Prolevel FMC 662 is designed for level measurement on one or two channels with a capacitance probe. The applications described in this manual are as follows:

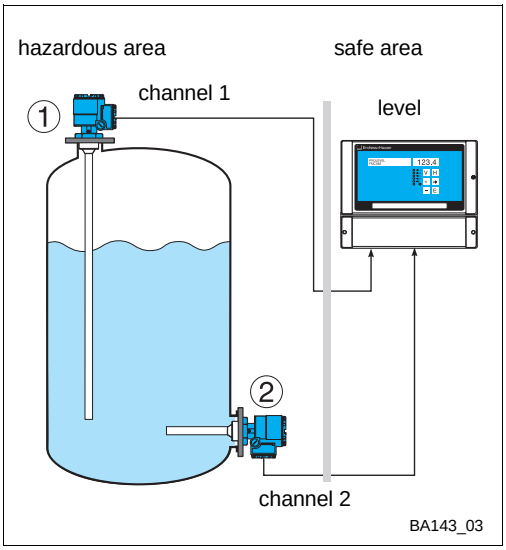
- Level or volume measurement …Chapter 4
- Differential level measurement …Chapter 5
- Level measurement with a reference probe …Chapter 5.

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 662 used for level difference measurement with screen control

Right: Prolevel FMC 662 used for level measurement with reference probe
① Measuring probe
② Reference probe





1.2 Measuring system

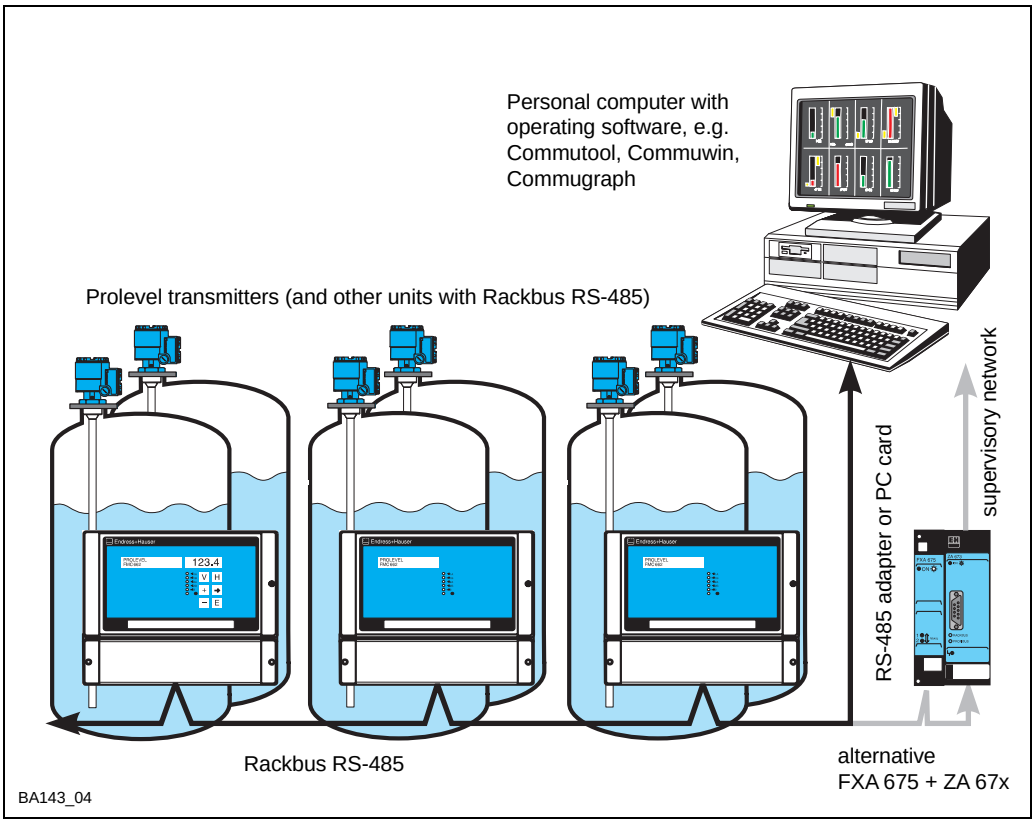


Fig. 1.3:
The Prolevel FMC 662 can be used as a stand-alone unit, see Figs 1.1 and 1.2 or as part of an operating system.
An RS-485 adapter or PC card allows direct connection to a personal computer, the FXA 675 and gateway ZA 67x connection to a supervisory system using the Modbus, Profibus or FIP protocol

A working system for level measurement comprises:

- Prolevel FMC 662 transmitter,
- Capacitance probe for level measurement
- Electronic insert EC 37 Z or EC 47 Z

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, 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 FMC 662 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:

$$C_{tot} = C_1 + \frac{2\pi\varepsilon_0\varepsilon_r \times L}{\ln (D/d)} \quad pF \quad (1)$$

whereby

C_{tot} = total capacitance
C_1= capacitance or 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

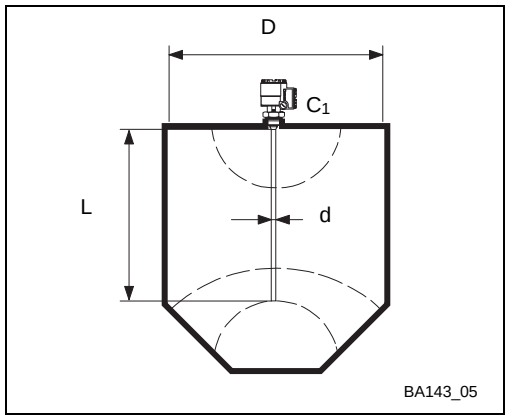


Fig. 1.4:
Capacitance measurement principle

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.

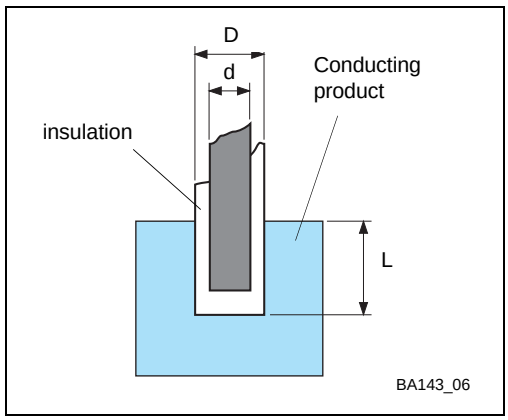


Fig. 1.5:
Measurement in conducting media

1.4 Functional description

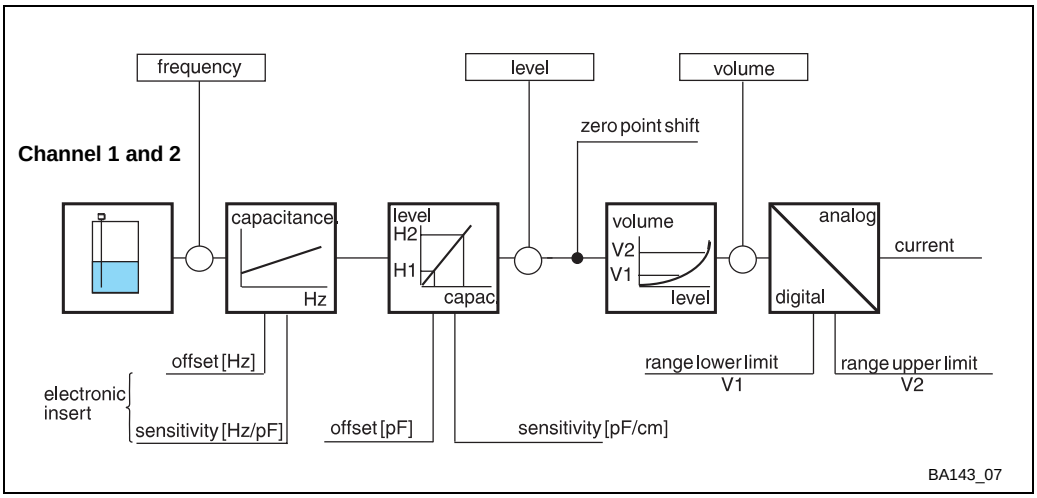


Fig. 1.6: Signal processing in the Prolevel FMC 662 for single and twin channel operation

Fig. 1.6 is a block diagram of the Prolevel FMC 662. The transmitter supplies the power to the probe. The capacitance measured by the probe 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 the following functions:

Table 1.1: Prolevel FMC 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
5	Level measurement with reference probe— the level measurement at channel 1 is corrected by the measurement 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«, level measurement can be made in the units entered during calibration. In modes 3 and 5, the measured value on 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 FMC 662
Function:	Transmitter for level and differential level measurement with capacitance 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:	ATEX II (1) GD [EEx ia] IIC, CSA and FM, intrinsically safe signal circuits separated from the rest of the electronics
Sensor:	Capacitance probes with EC 37 Z or EC 47 Z electronic insert

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
Interfaces:	0/4…20 mA, Rackbus RS 485 (option)
Reference conditions:	to IEC 770 (T_U = 25°C) or as specified

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
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:	Interference Emission to EN 61326; Electrical Equipment Class A Interference Immunity to EN 61326; Annex A (Industrial)
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 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 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 for the Prolevel FMC 662
- Installation of the Prolevel FMC 662
- Transmitter wiring
- Probe connection.
- Hardware configuration for Rackbus RS-485 option
- Technical data.

Fig 2.1 shows the structure of the chapter.

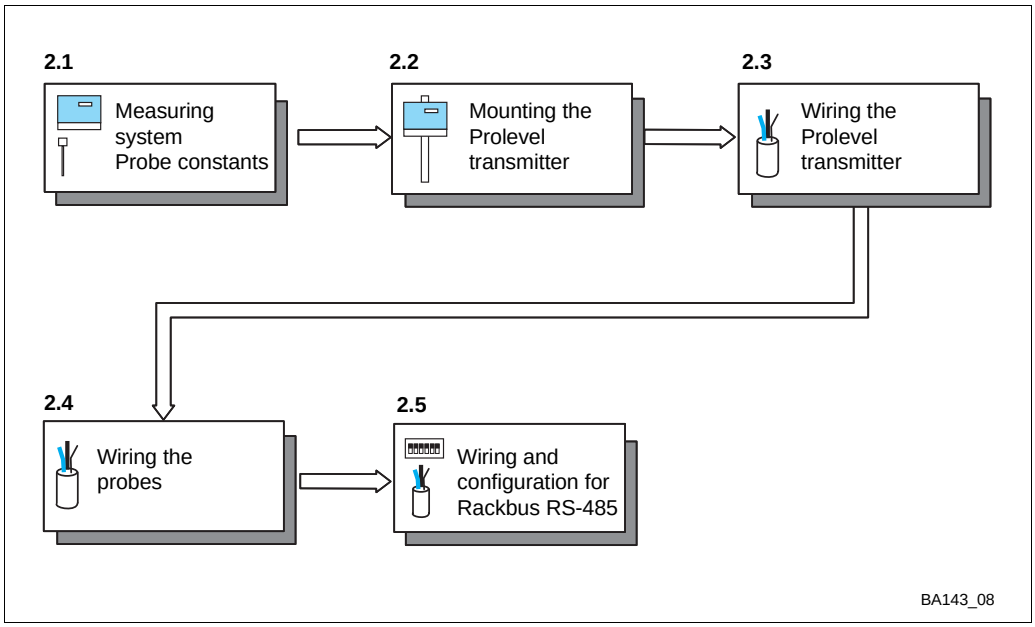
Technicians and fitters

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 FMC 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 Probes

Table 2.1 lists the probes most frequently used with the Prolevel FMC 662 transmitter. In addition to those listed, all probes which can be used with an 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 or Channel 2		
	Probe	**TI sheet**	**Insert**
Capacitance	DC 11	TI 169F	EC 37 Z
	DC 16	TI 096F	EC 47 Z
	DC 21	TI 208F	
	DC 26	TI 209F	
	11 322 Z	E 11.81.03	
	11 500 Z	TI 161F	
	21 211	E 10.73.18	
	Multicap TE	TI 239	
	Multicap TA	TI 240	
	Multicap E	TI 242	
	Multicap A	TI 243	

Table 2.1
Selection of probes suitable for use with the Prolevel FMC 662

Probe constants

EC 37 Z/47 Z inserts are supplied with the probe constants zero frequency »fo« and sensitivity »S«, see Fig. 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.

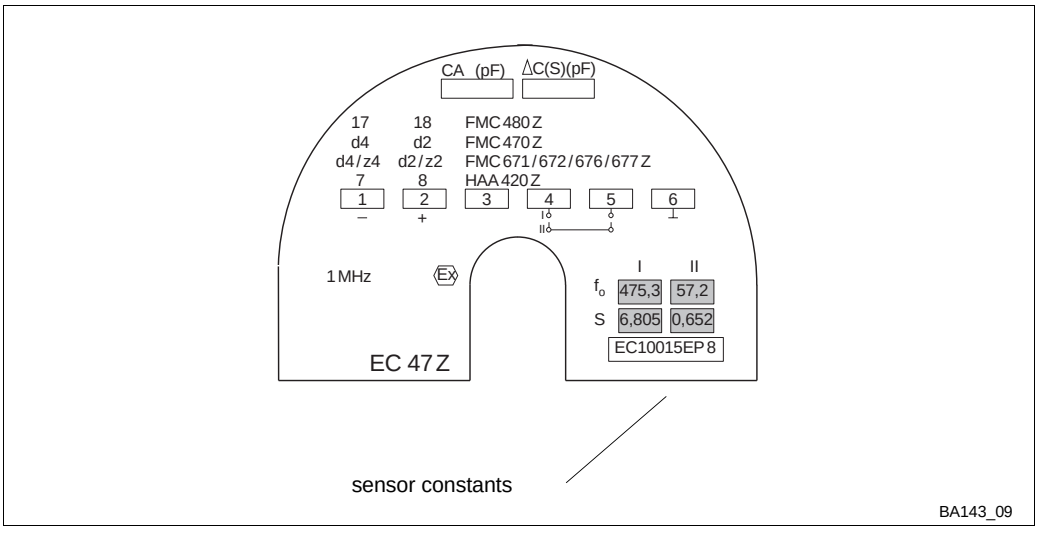


Fig. 2.2:
Location of probe constants on EC 37 Z/47 Z electronic insert

2.2 Prolevel FMC 662 installation

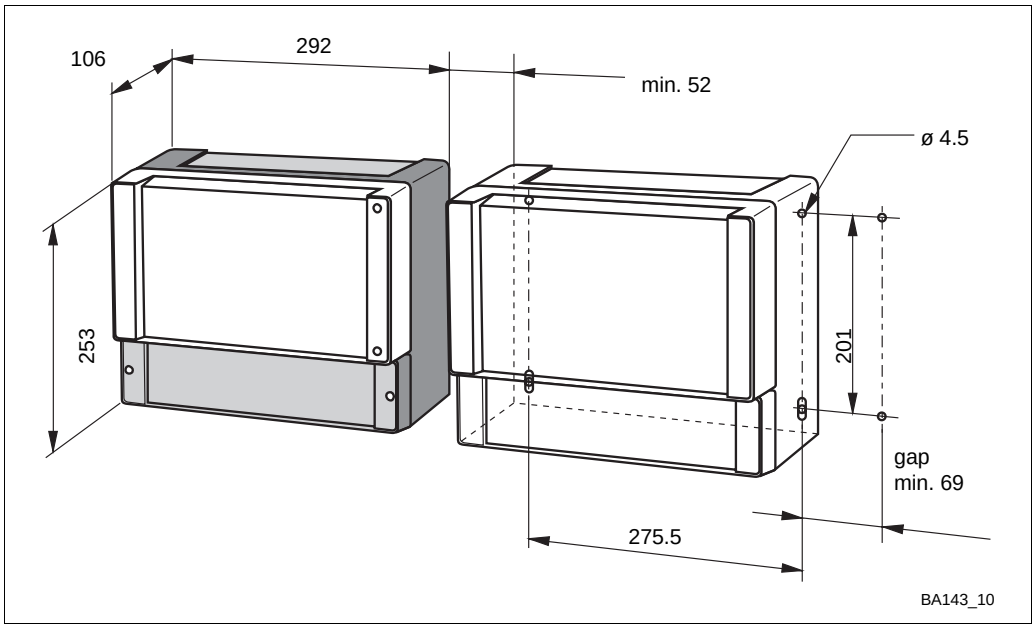


Fig. 2.3: Dimensions in mm of Prolevel FMC 662 housing 1" = 25.4 mm

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 FMC 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. 2.4 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

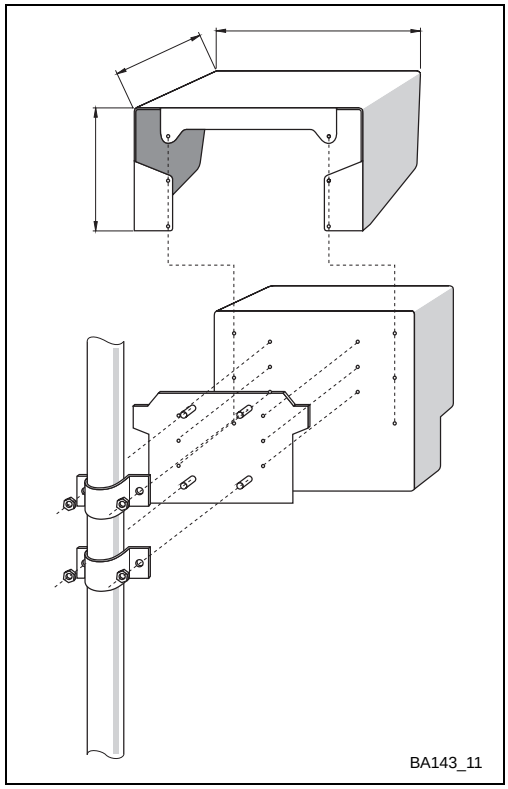


Fig. 2.4: Post-mounting with all-weather cover

2.3 Transmitter wiring

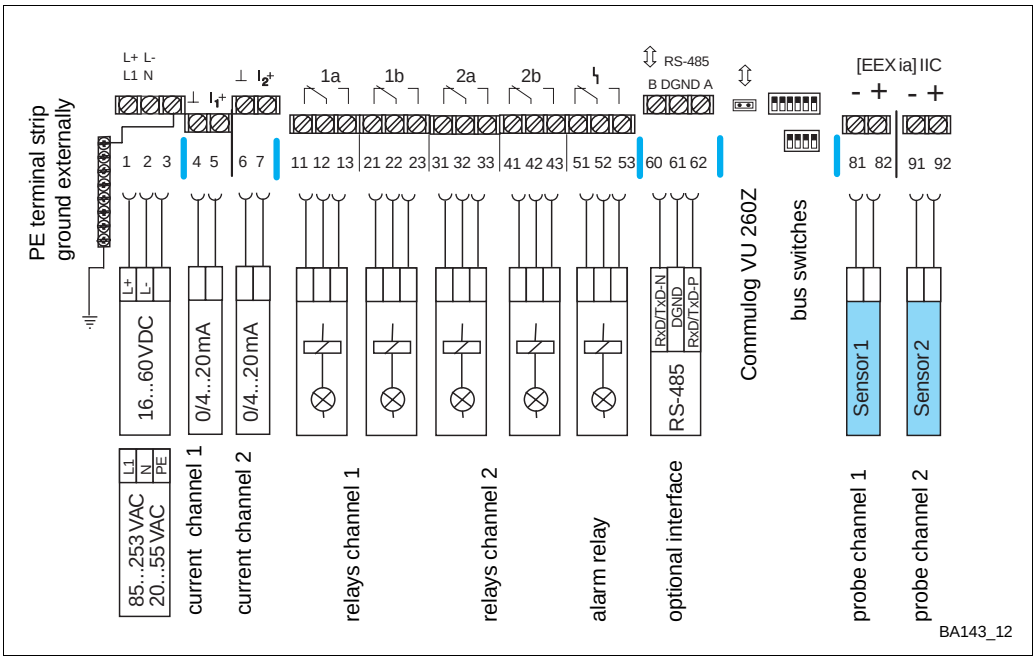


Fig. 2.5: Terminal assignments for Prolevel FMC 662

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 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 2.6, "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 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 2.6.

- 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 Probe connection

Probe cable

Use commercial 2-core installation cable, max. line resistance 25 Ω/core, for the probe/ transmitter cable — the Prolevel satisfies the quoted EMC standards with this cable.

Level probes channels 1 + 2

The Prolevel FMC 662 can be operated with a variety of probe types, each requiring an electronic insert:

- EC 37 Z or EC 47 Z

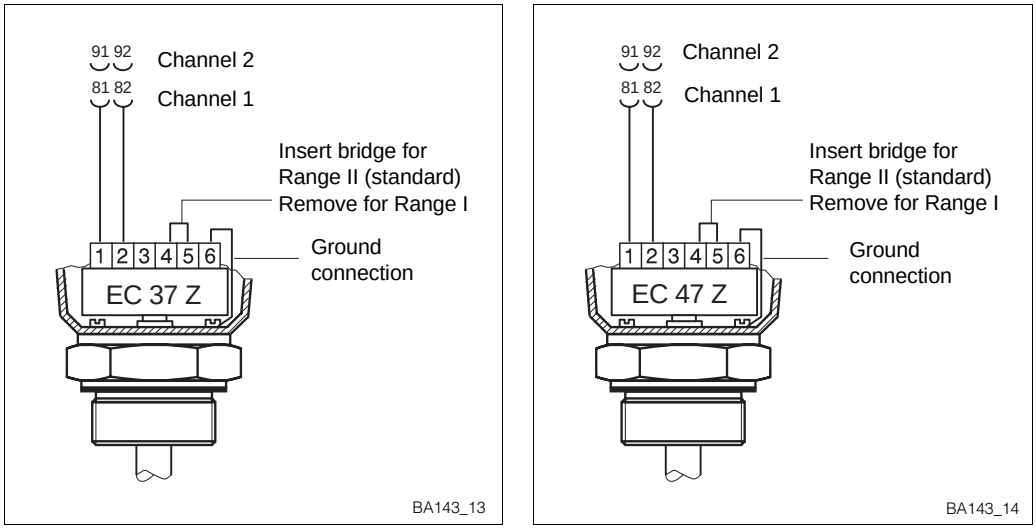


Fig. 2.6: Connection diagram for electronic inserts Left: Capacitance/Multicap EC 37 Z Right: Capacitance/Multicap EC 47 Z

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 for channel 1 the zero frequency f_o____ and sensitivity S_____on the insert for the range you have selected.

- Note for channel 2 the zero frequency f_o____ and sensitivity S_____on the insert for the range you have selected.

2.5 Rackbus RS-485 option

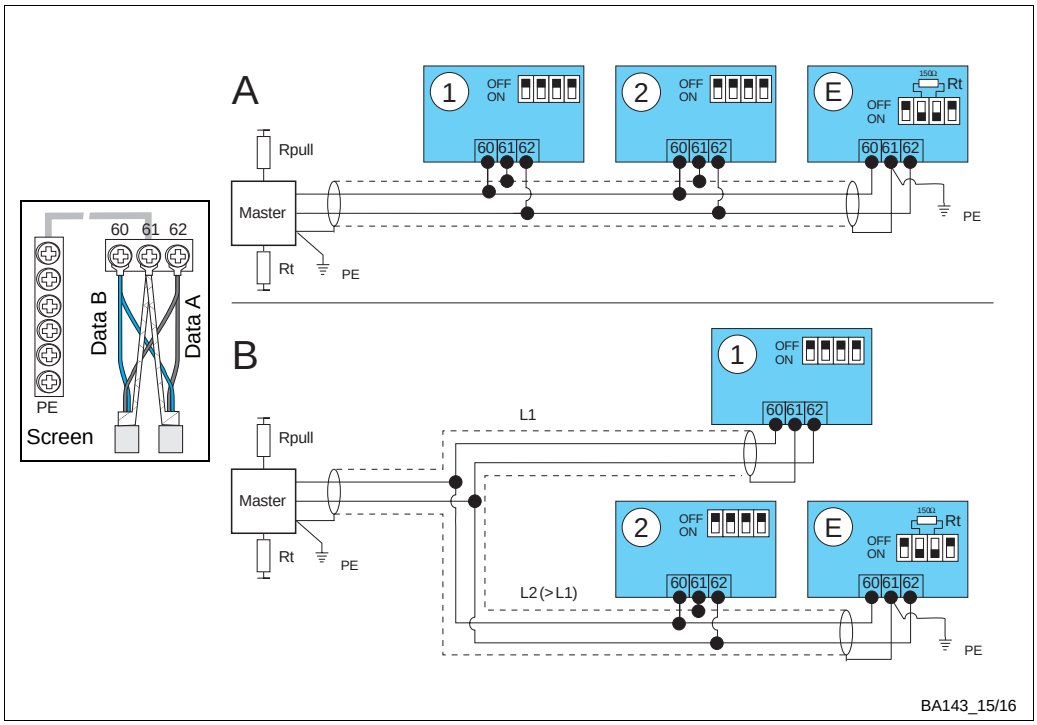


Fig. 2.7:
Rackbus RS-485 topologies showing setting of bus termination resistance

Inset:
Suggestion for wiring the bus

Wiring the bus

Up to 25 Prolevel FMC 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. 2.7.

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

Note!

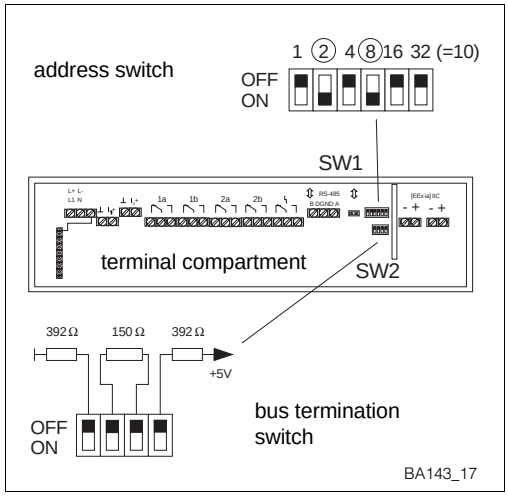


Fig. 2.8:
DIP-switches for bus address and termination

Bus address and termination

Fig. 2.8 shows the configuration elements for remote operation of the Prolevel FMC 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 FMC 662 transmitter is operated. It is divided into the following sections:

- Operating matrix
- Keyboard and display
- Commulog VU 270 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 662 Z, 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 662 transmitter.

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

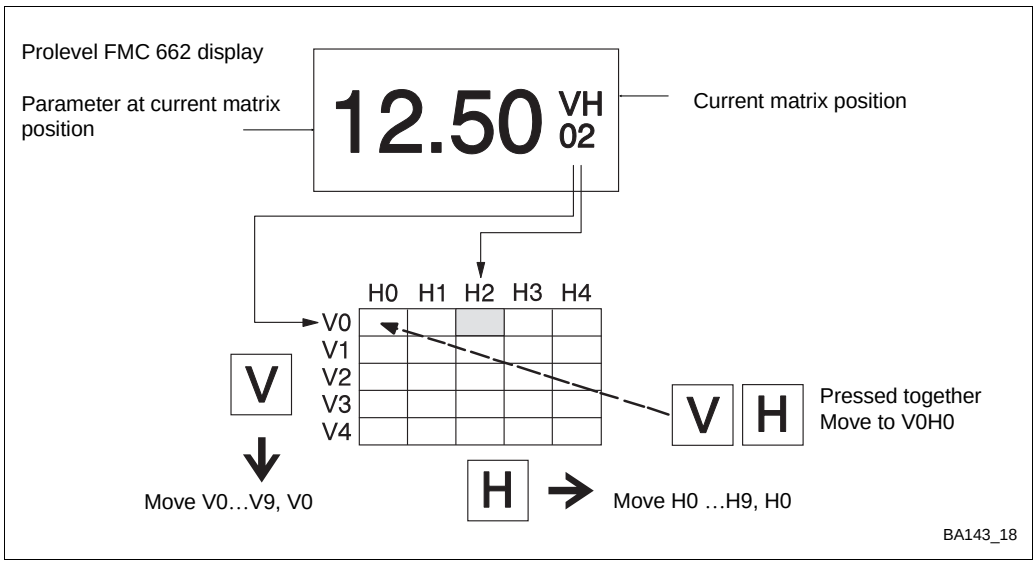
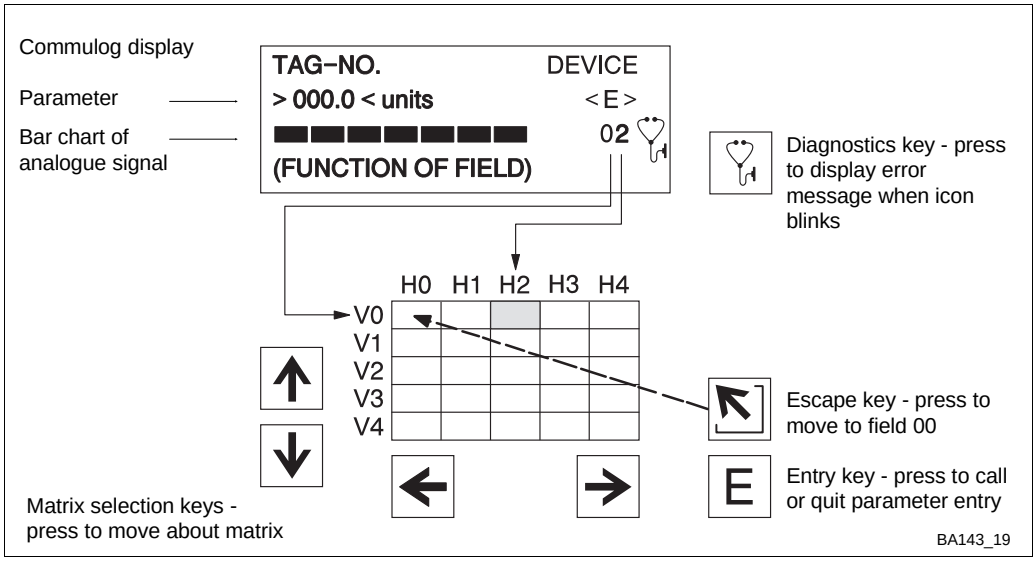


Fig. 3.2: Commulog VU 260 Z display and key functions

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

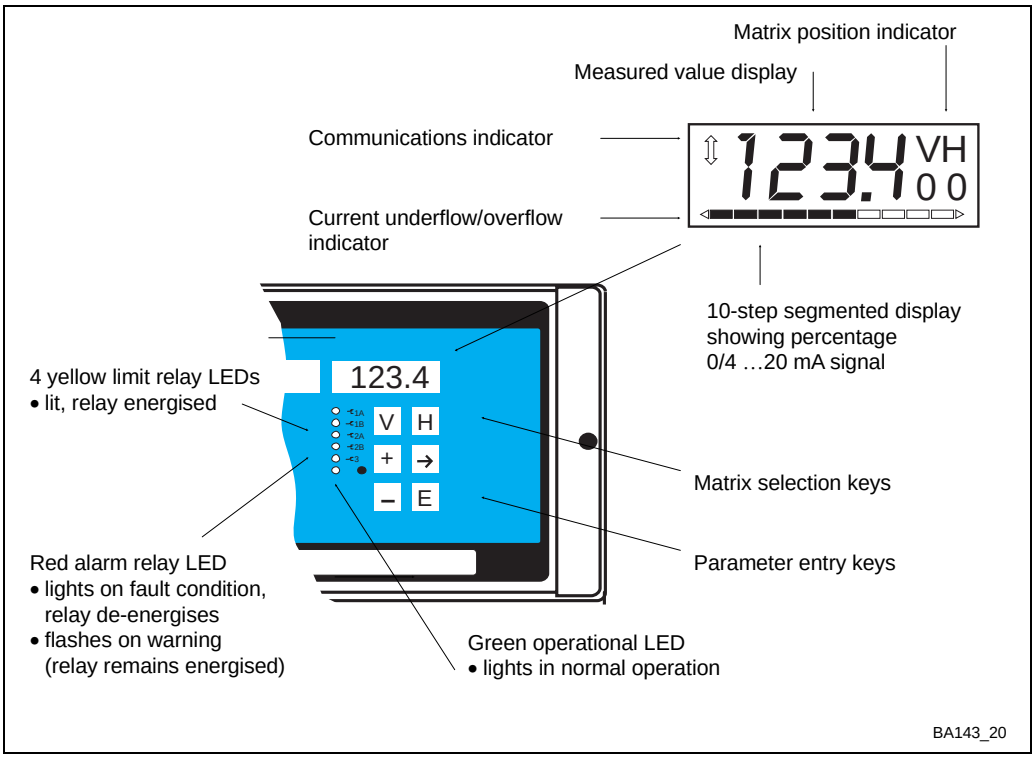


Fig. 3.3:
Front panel of the Prolevel FMC 662 transmitter

The transmitter is also available without the keyboard

Fig. 3.1 shows the LC-display with matrix of the Prolevel FMC 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.

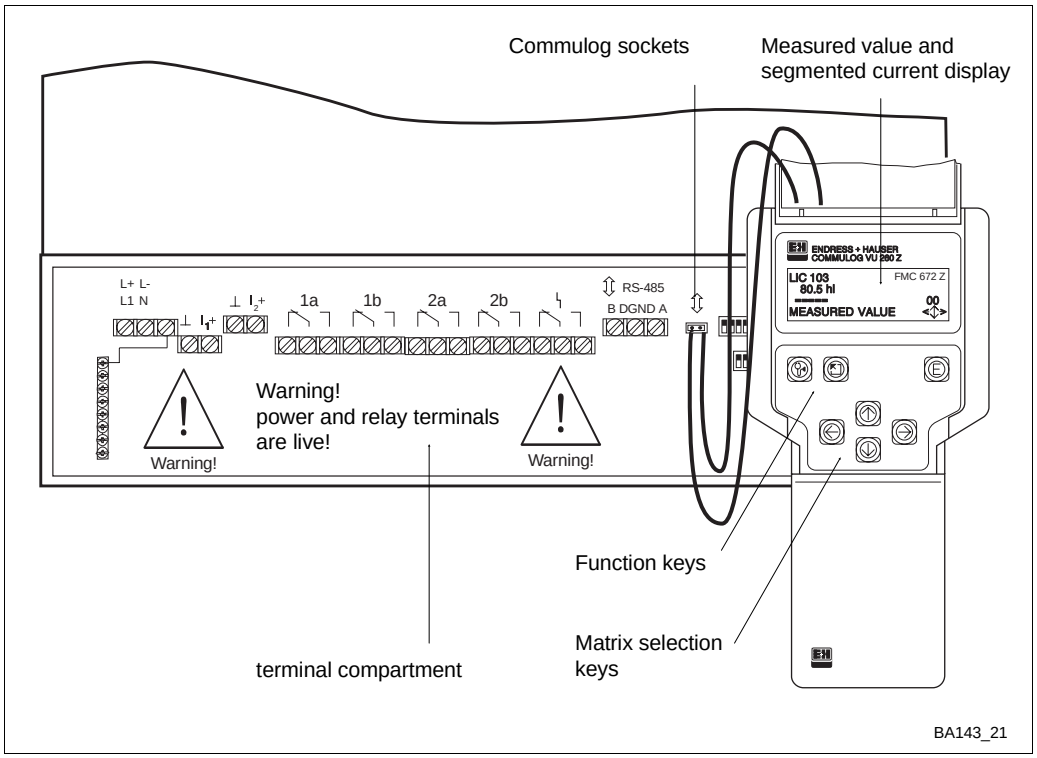
Keys	Function
Matrix selection	
V	• Press V to select the vertical position.
H	• Press H to select the horizontal position
V + H	• Press simultaneously to select the measured value field, V0H0
Parameter entry	
→	• Select the digit to be changed. The digit at the extreme left is selected and flashes. • 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.

Table 3.1:
Prolevel FMC 662
Parameter entry and display keys

3.3 Commulog VU 260 Z

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

The Prolevel FMC 662 appears as device FMC 672 Z



The Prolevel FMC 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.

Warning!

Warning!

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

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 V0H0
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.

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

3.4 Rackbus RS-485 (option)

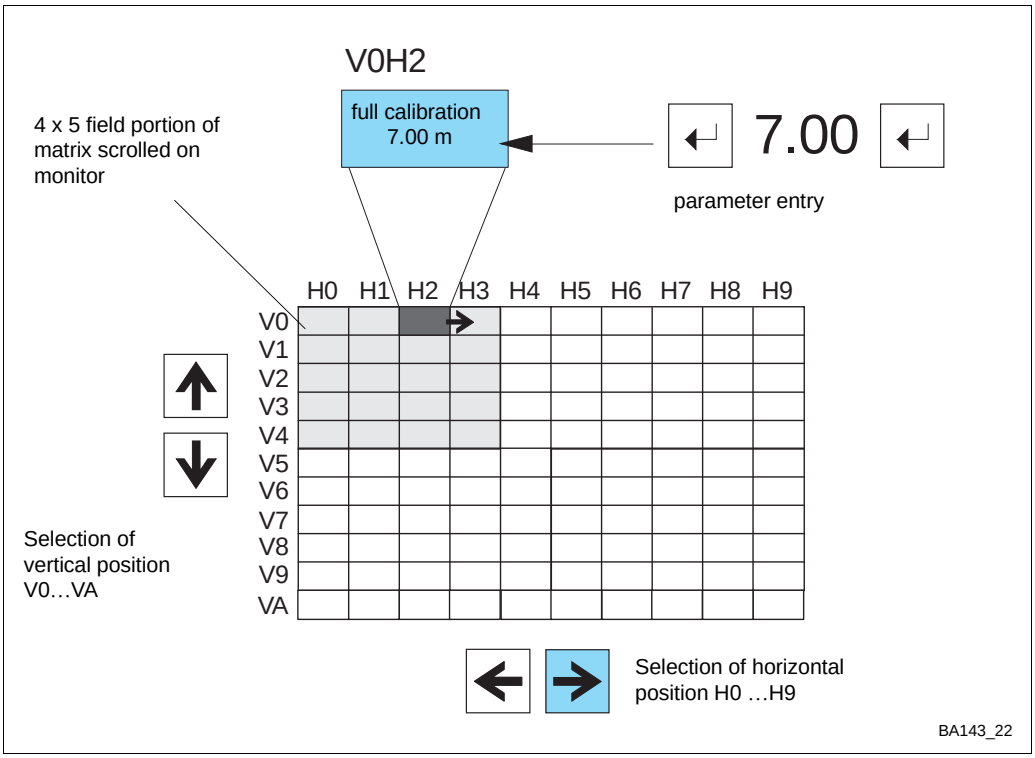


Fig. 3.5:
Parameter entry in configuration software

Prolevel FMC 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 standard Rackbus and gateway.

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 "FMC 672 Z"

Note!

4 Level Measurement

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

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

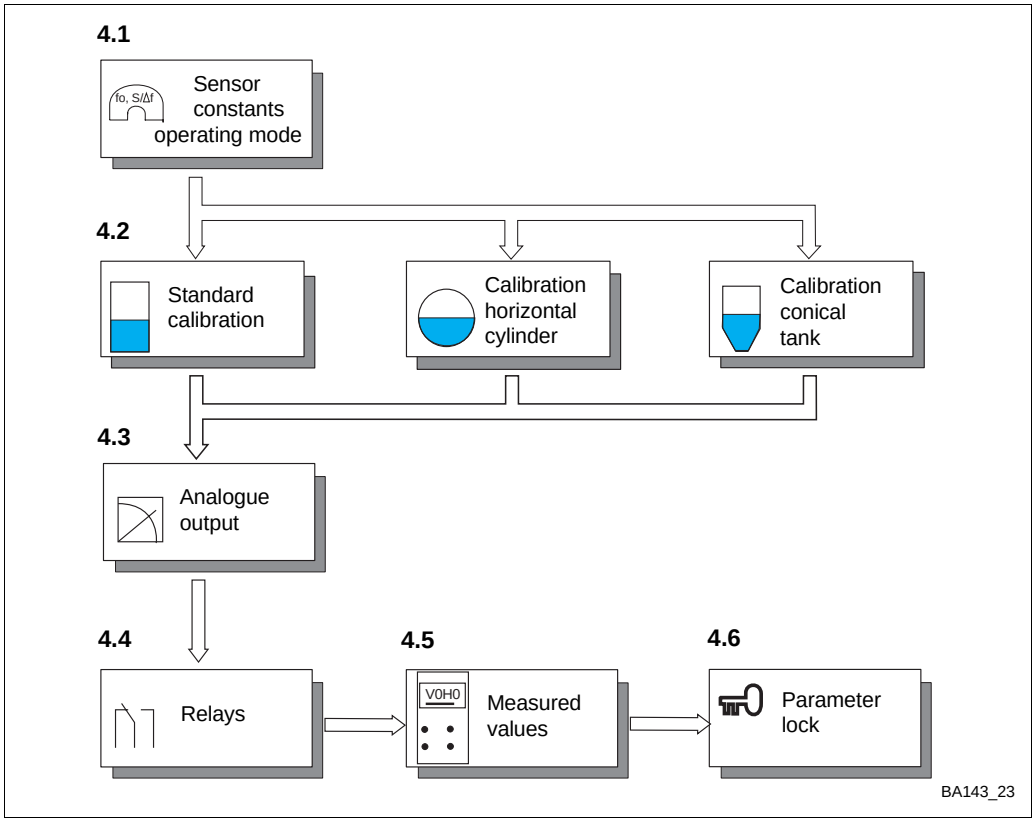
Fig. 4.1 indicates the sequence of configuration.

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 probe constants fo and S for the channels to be used. This ensures that the EC 37 Z/EC 47 Z electronic insert can be replaced without the need for recalibration, see Section 6.4.

Probe 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. 475.3	Enter zero frequency f_O (offset) of electronic insert connected to channel 1
4	-	»E«	Register entry
5	V3H6	e.g. 0.652	Enter sensitivity, S of electronic insert connected to channel 1
6	-	»E«	Register entry
7	V7H5	e.g. 457.8	Enter zero frequency f_O (offset) of electronic insert connected to channel 2
8	-	»E«	Register entry
9	V7H6	e.g. 0.597	Enter sensitivity, S of electronic insert connected to channel 2
10	-	»E«	Register entry

Operating mode

There are three standard level modes as described in this chapter:

- 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 5 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.

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).

For horizontal cylinders and tanks with conical outlet, users requiring a volume or weight measurement can activate the linearisation procedure.

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.

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.

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. 28...31.

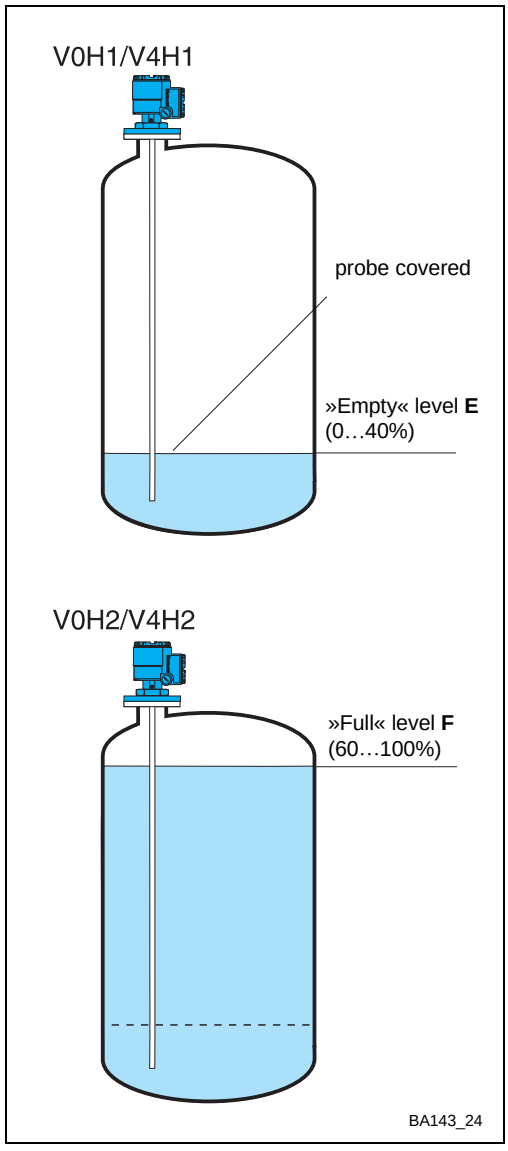


Fig. 4.2:
Parameters for standard calibration

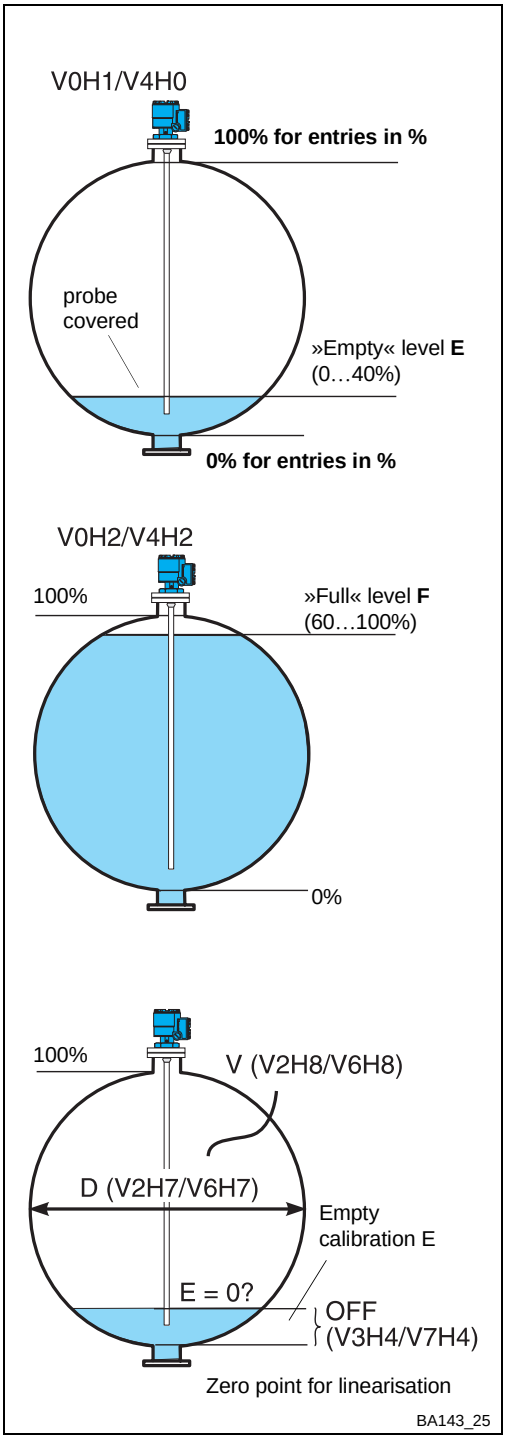


Fig. 4.3:
Parameters for calibration and linearisation in a horizontal cylinder

#	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

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

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

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

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

Set analogue output and relays in volume units, see p. 28**…**31.

Note!
- For linearisation volume => level, see Appendix, p 42.

2) Calibration for horizontal cylinders

Channel 2: V4H1, V4H2

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

Linearisation, horizontal cylinder

Channel 2
V6H7
⇓
V6H8
⇓
V6H0

Offset

Channel 2
V7H4

After linearisation

Next step…

Note!

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	$V/G_{1...30}$	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…E604, correct table.
  Re-activate linearisation in V2H0/V6H0.
- For linearisation volume => level,
  see Appendix, p. 42.

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. 28…31.

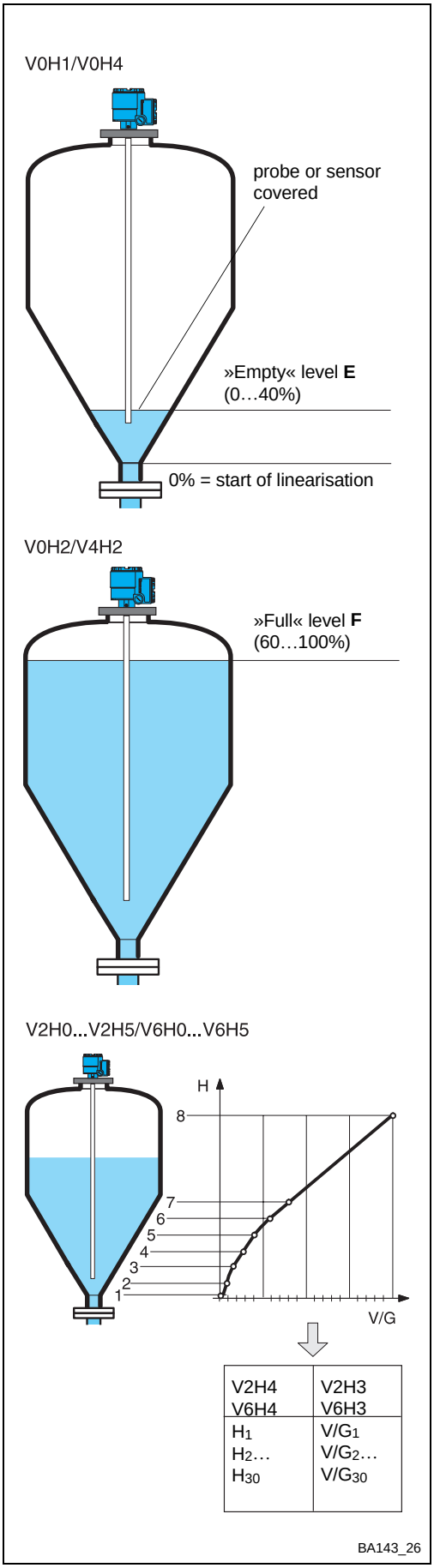


Fig. 4.4:
Parameters for calibration and linearisation in a tank with conical outlet

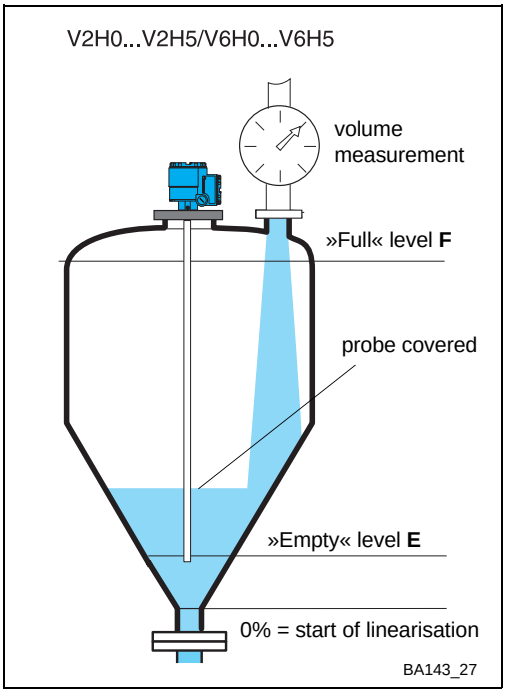


Fig. 4.5:
Parameters for calibration and semi-automatic linearisation in a tank with conical outlet

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

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

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

b) Semi-automatic linearisation

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

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

Note!

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

After linearisation

Set analogue output and relays in volume or weight units, p. 28…31.

Next step…

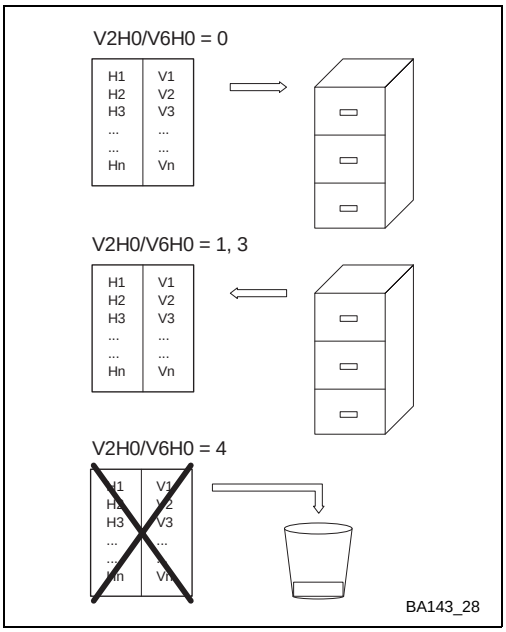


Fig. 4.6:
De-activating a linearisation

To delete a pair of values:

Deletion of value pairs

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

There are two possibilities for deleting a linearisation:

Deletion of 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.

4.3 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 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 4 mA and above 20 mA can be generated in normal operation.

V0H3 V4H3	Range	Current limits
0	0...20 mA	-2…+22 mA
1	4...20 mA	-2…+22 mA

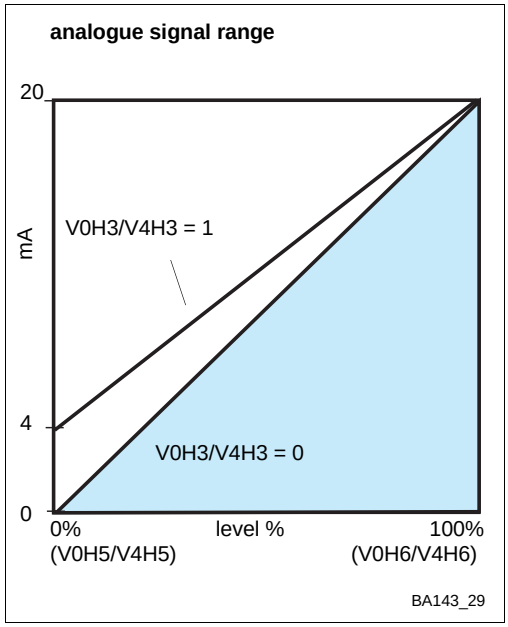


Fig. 4.7:
Selection of analogue signal range, V0H3/V4H3

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, V0H8 and V0H4 (V4H0, V4H8 and V4H9 for channel 2) are also influenced by the output damping.

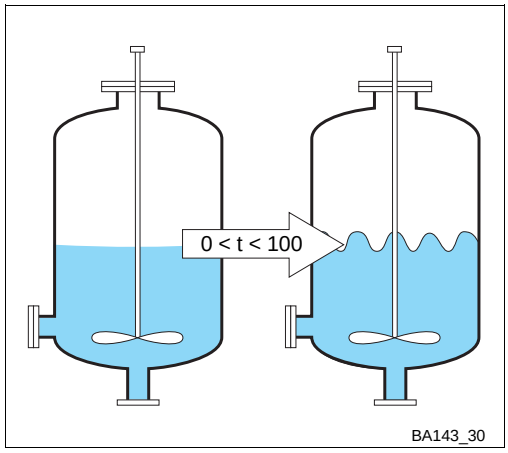


Fig. 4.8:
Output damping, V0H4/V4H4

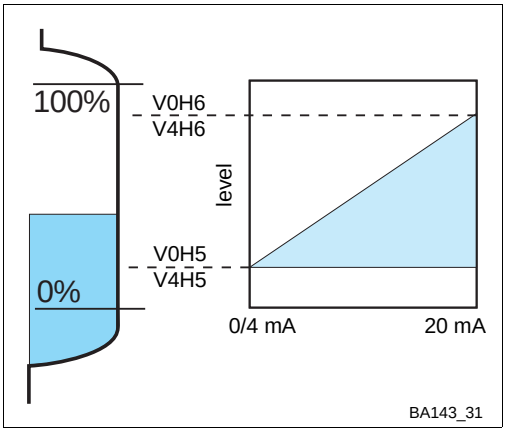


Fig. 4.9:
Value for 4 mA and 20 mA, V0H5/V4H5 and V0H6/V4H6

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!

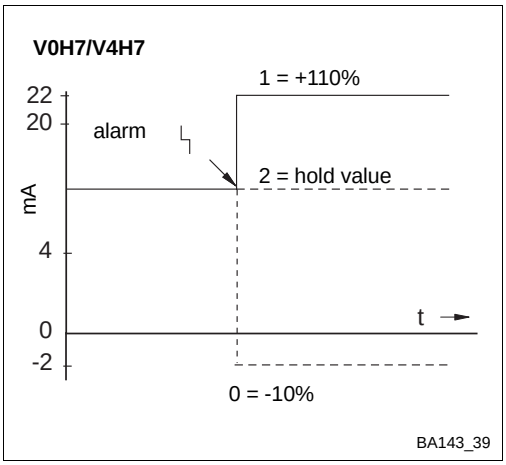


Fig. 4.10:
Output on alarm, V0H7/V4H7

Output on alarm

The analogue outputs can be set such that they take on distinctive values when a fault with alarm is detected. Depending upon 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.

Caution!

Output 2 assignment

Field V8H2 is activated in operating modes 0, 3 and 5. Do not change the settings — the function intended for the field is not required in the applications described in this manual.

4.4 Relays

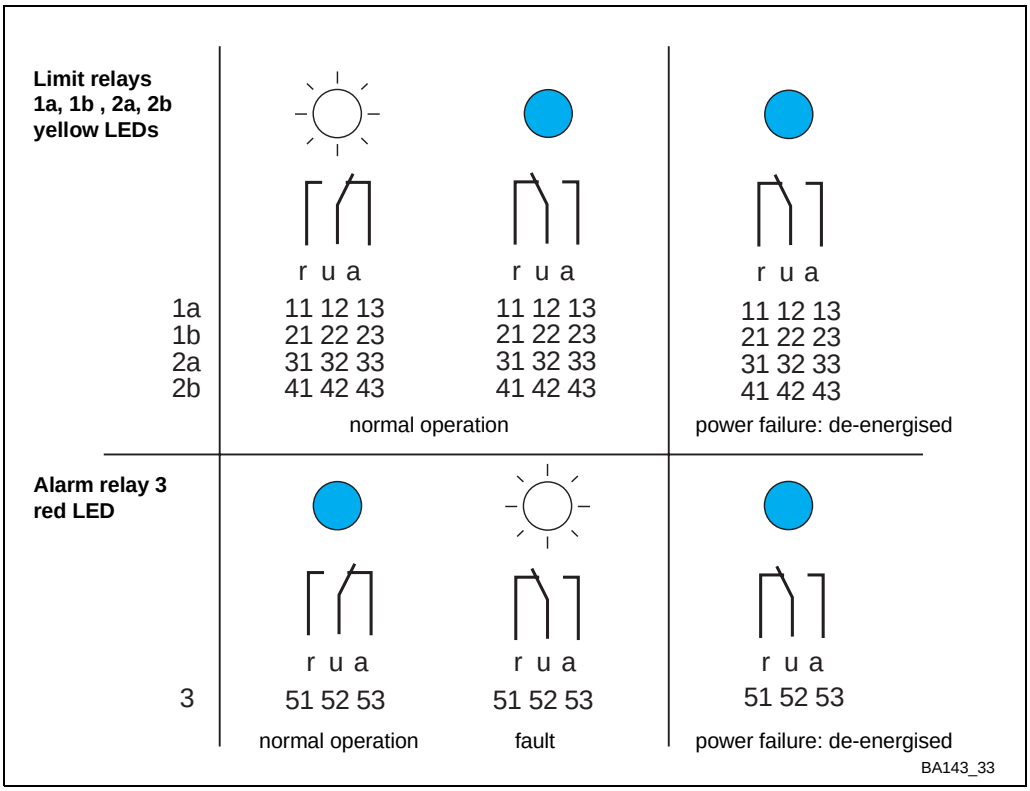


Fig. 4.11: Relay LEDs as a function of relay status: limit relay: lit, energised out, de-energised alarm relay (default setting): lit, de-energised out or flashing, energised

Operating modes

The Prolevel FMC 662 has five 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

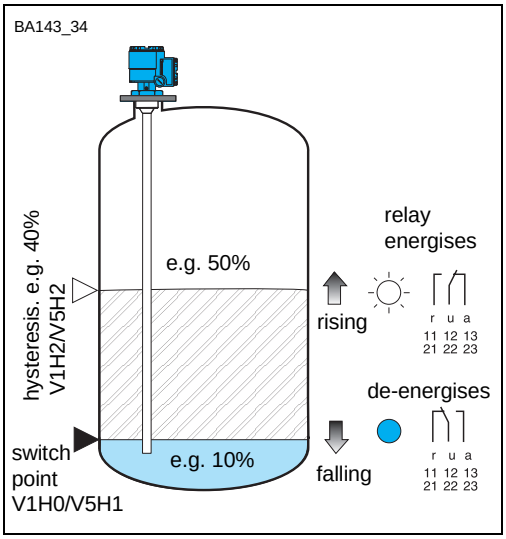
Parameter	Matrix position for relays		Entry/Function
	1a, 1b	2a, 2b	
Switch point	V1H0	V5H0	Relay switch point in calibration/linearisation units
Fail-safe mode	V1H1	V5H1	0: minimum fail-safe mode: — the relay de-energises when the level drops below the switch point, see Fig. 4.12. 1: maximum fail-safe 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 V2H3/V5H3 = 1

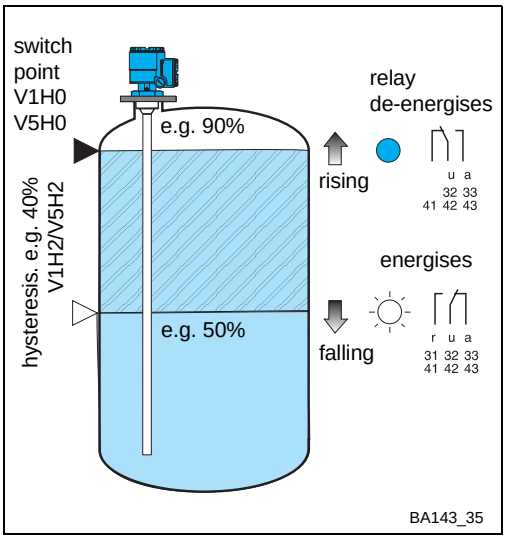
Setting at V0H7/V4H7	Minimum fail-safe mode	Maximum fail-safe mode
0 = -10% (≤ -2 mA/2.4 mA)	Relay de-energises	Relay energises
1 = +110% (≥ +22 mA)	Relay energises	Relay de-energises
2 = hold (last value)	No change	No change



#	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. 4.12:
Limit value relay: example for minimum fail-safe mode



#	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

Fig. 4.13:
Limit value relay: example for maximum fail-safe mode

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
- I both pairs of relays are assigned to channel 1, the hystereses of each can set such that one relay pair de-energises just as the other energises.

Note!

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		Measured value	Remarks
1	2		
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.
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
V8H7		Correction factor for reference mode	For operating mode 5, displays correction factor used in calibration.
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 662. There is no need to recalibrate.

5 Other Operating Modes

This chapter describes the configuration of the Prolevel FMC 662 for

- Differential level measurement, operating mode 3
- Level measurement with a reference probe, operating mode 5.

Density measurement, mode 4, is not described as Deltapilot sensors are required, see BA 144F, Prolevel FMB 662.

Fig. 5.1. indicates the sequence of configuration.

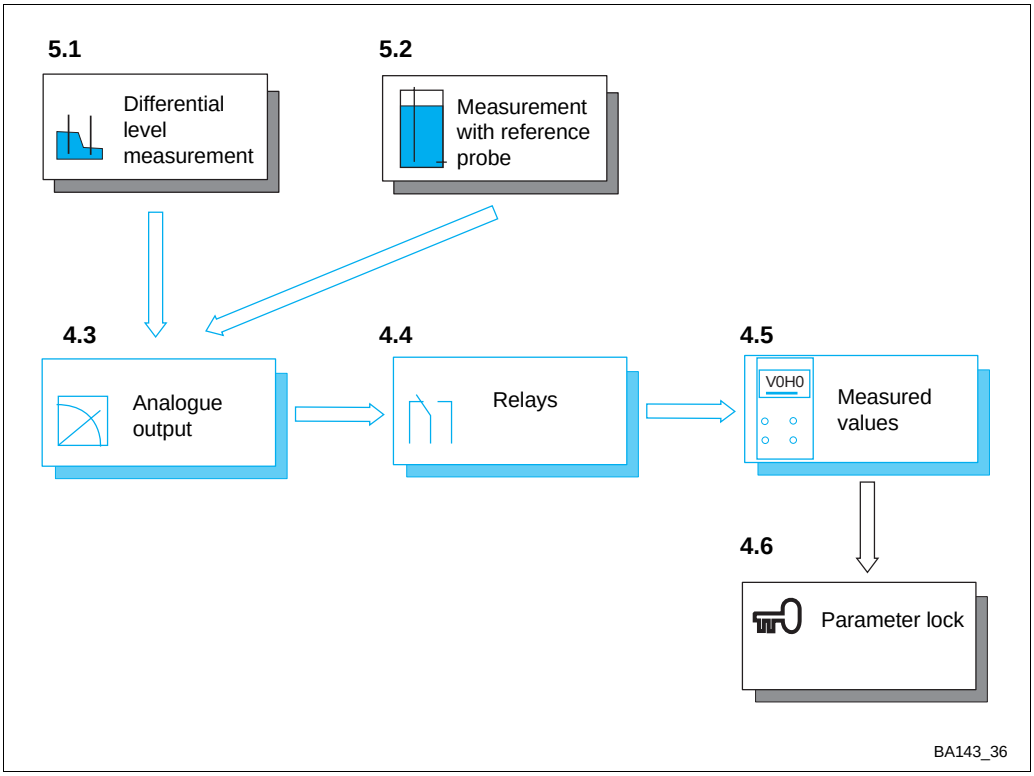
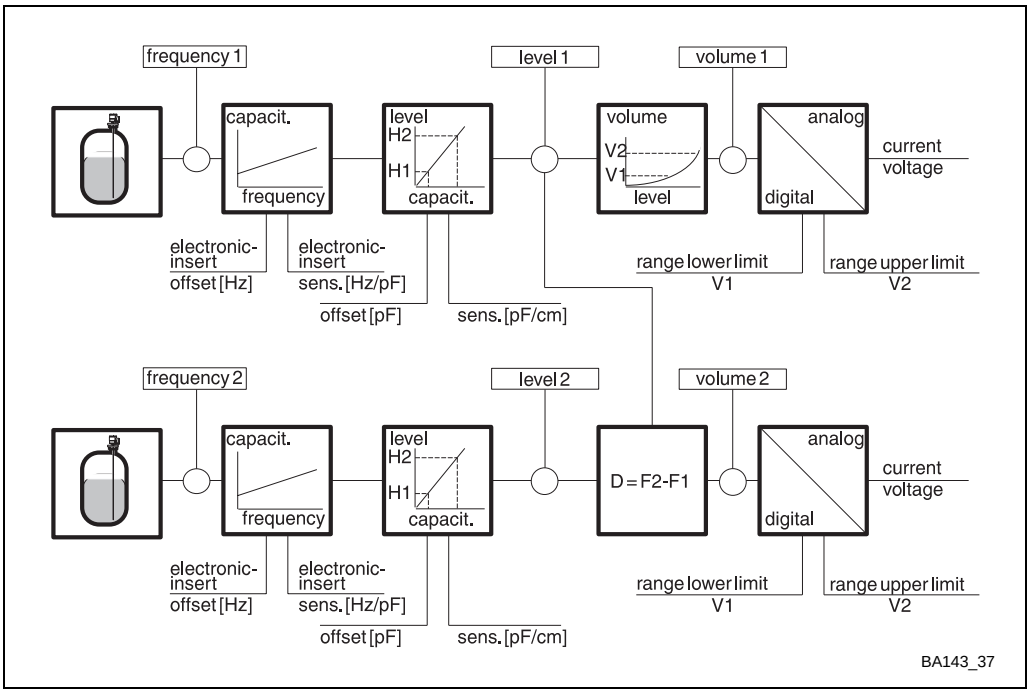


Fig. 5.1: Summary: differential level measurement and level measurement with a reference probe

5.1 Differential level measurement

Fig. 5.2: Schematic diagram of differential level measurement mode



Differential level measurement is carried out in operating mode 3, see Fig. 5.2. The calibration procedure is as below.

Calibration

#	Matrix	Entry	Significance
1	V9H5/V3H5/V3H6 V7H5/V7H6		Commission as per Section 4.1
2	V8H0	3	Differential level
3	-	»E«	Register entry
4	V0H1	**E_1**	Empty level probe 1
5	-	»E«	Register entry
6	V0H2	**F_1**	Full level probe 1
7	-	»E«	Register entry
8	V4H1	**E_2**	Empty level probe 2
9	-	»E«	Register entry
10	V4H2	**F_2**	Full level probe 2
11	-	»E«	Register entry

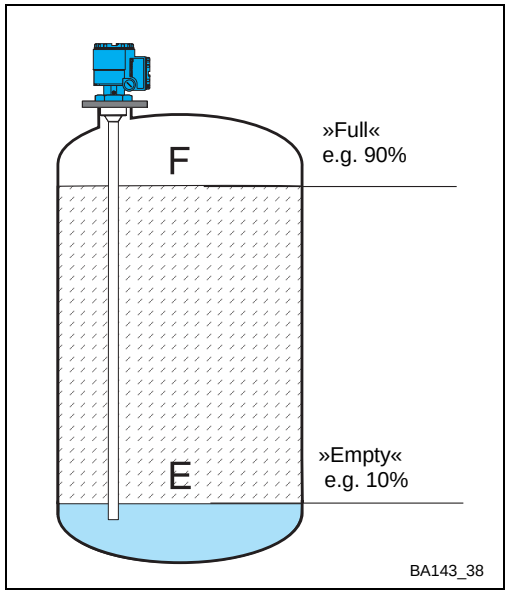


Fig. 5.3: Parameters for calibration of probes 1 and 2

Note!

Note!
- Steps 4…11 can be done in any order.
- Use same units for both probes

After calibration

V0H0 indicates the level measured by probe 1, V4H0 the level difference h_2 - h_1.

Next step…

If required, linearisation (e.g. flowrate for open channel) on channel 1, p. 26. Set analogue outputs and relays in calibration or linearisation units, p. 28…31
- Output 1 follows level h_1 measured by probe 1
- Output 2 follows differential level h_2 - h_1.

5.2 Level measurement with reference probe

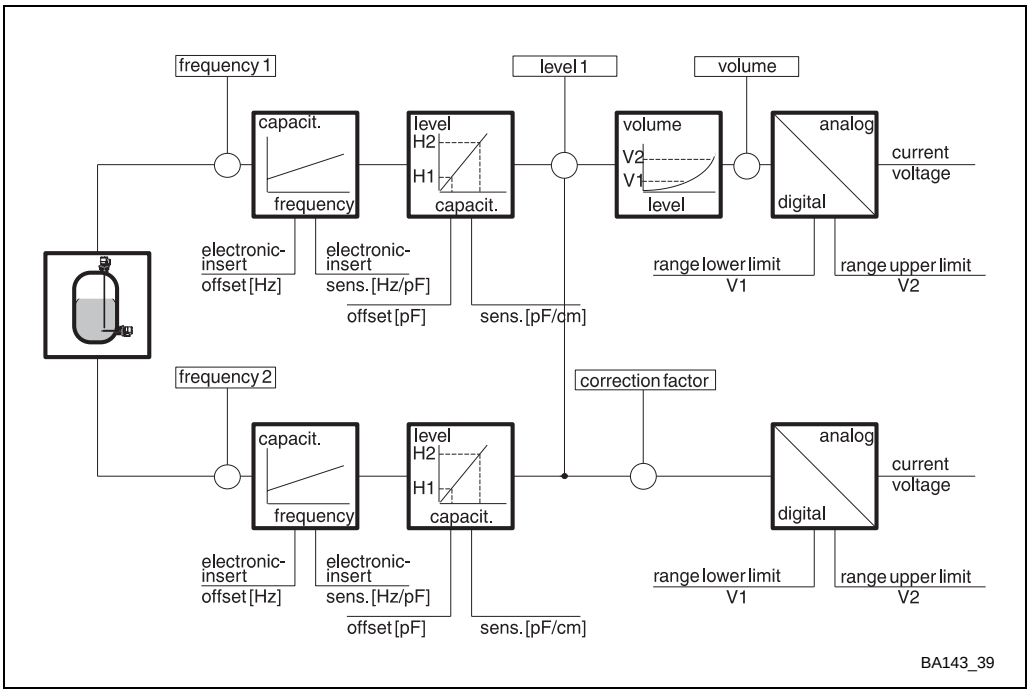


Fig. 5.4: Schematic diagram of level measurement with reference probe

Operating mode 5

Operating mode 5, see Fig. 5.4, provides a reference measurement at channel 2 which is used to correct the level measurement at channel 1. Fig. 5.5 shows two arrangements for level measurement with a reference probe. Under defined conditions, a continuous level measurement on channel 1 can be compensated for the effects of changing products or electrical properties by using a reference probe at channel 2.

Requirements

Prerequisites for the product to ensure to correct function are:

- The product is homogeneous throughout.

The measuring and reference probes can be built into the tank as shown in Fig. 5.5. The active part of the reference probe should if possible be below the minimum level which can be measured by the measuring probe (otherwise the height at which the active part starts must be entered into V8H3). Thus any change in capacitance can be attributed to a change in product properties rather than a change in level. This places strict requirements on the probe design:

- Probe material, rod diameter, type and thickness of insulation must be identical.
- Both probes should be fitted with a perforated ground tube or grid which is exactly the same length as the insulated rod.
- In the case of vertical installation, a reference probe must be chosen with an inactive length screening equal to (or slightly longer than) the length of the measuring probe.
- The same electronic insert and insert range must be used in both probes.

Minimum level, V8H3

To ensure that the calculated correction factor is correct, the reference probe must always be covered with product. For vertically installed reference probes in particular, the Prolevel provides an additional safeguard in the minimum level entry at V8H3. When the level drops below the value entered, the reference function is temporarily disabled until the value is exceeded again. In the meantime, the system measures with the last correction factor.

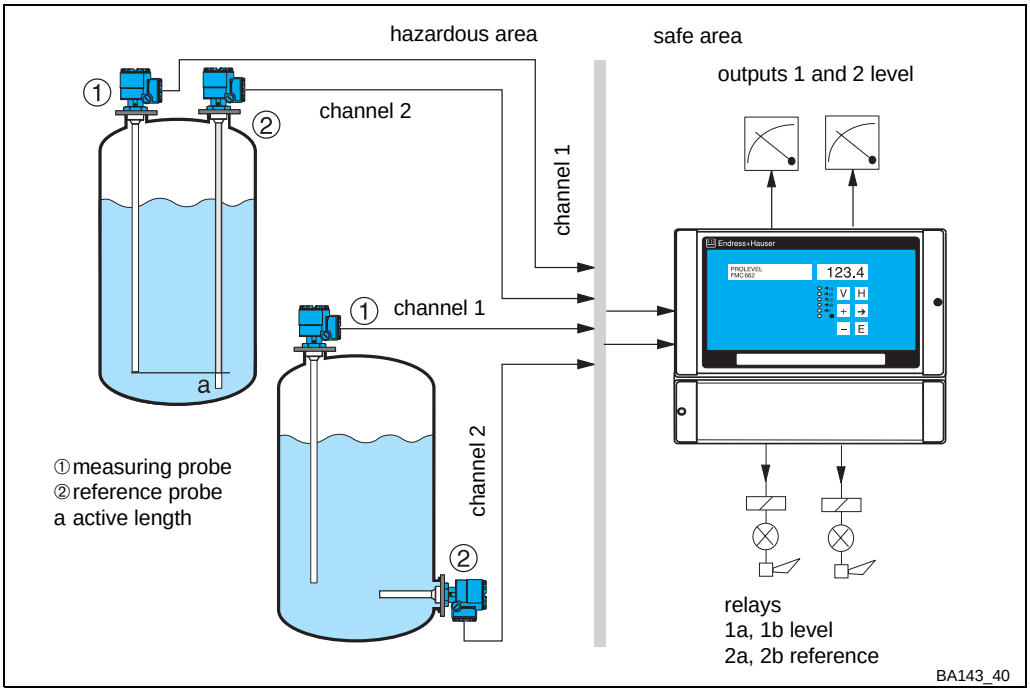


Fig. 5.5: Level measurement with reference probe top: reference probe top-mounted with active length below the end of the measuring probe bottom: reference probe installed laterally below the end of the measuring probe

Calibration

The calibration is carried out with a completely empty then a full tank. The minimum level is chosen to be approx. 3% of the measuring range. This ensures that compensation is not triggered when the probe is temporarily uncovered due to turbulence etc..

Procedure

#	Matrix	Entry	Significance
1	V9H5/V3H5/V3H6 V7H5/V7H6		Commission as described in Section 4.1
2	V8H0	5	Select operating mode 5, »reference measurement«
3	-	»E«	Register entry
4	V4H2	100	With tank empty enter 100 (sets correction factor to 1)
5	- »E«	Register entry	
6	V4H1	0.0	With tank empty, enter 0.0 in this field
7	-	»E«	Register entry
8	V0H1	e.g. 0.0	Enter »empty« level
9	-	»E«	Register entry
10	V4H2	100	With tank as full as possible (60…100%) enter 100%
11	-	»E«	Register entry
9	V0H2	e.g. 5 m	Enter »full« level
10	-	»E«	Register entry
11	V8H3	e.g. 0.15m	Enter minimum level for switch-off point
12	-	»E«	Register entry

After calibration

V0H0 displays compensated level, V4H0 the correction factor

Next step…

If appropriate, perform linearisation for channel 1, p. 26. Set analogue outputs and relays in calibration or linearisation units, p. 28…31

- Output 2 follows the correction factor — assignment to channel 1: V8H2 = 1
- Relay 2 is assigned to output 2 — assignment to output 1: V5H4 = 1

6 Trouble-Shooting

The Prolevel FMC 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 probes.
- Repairs

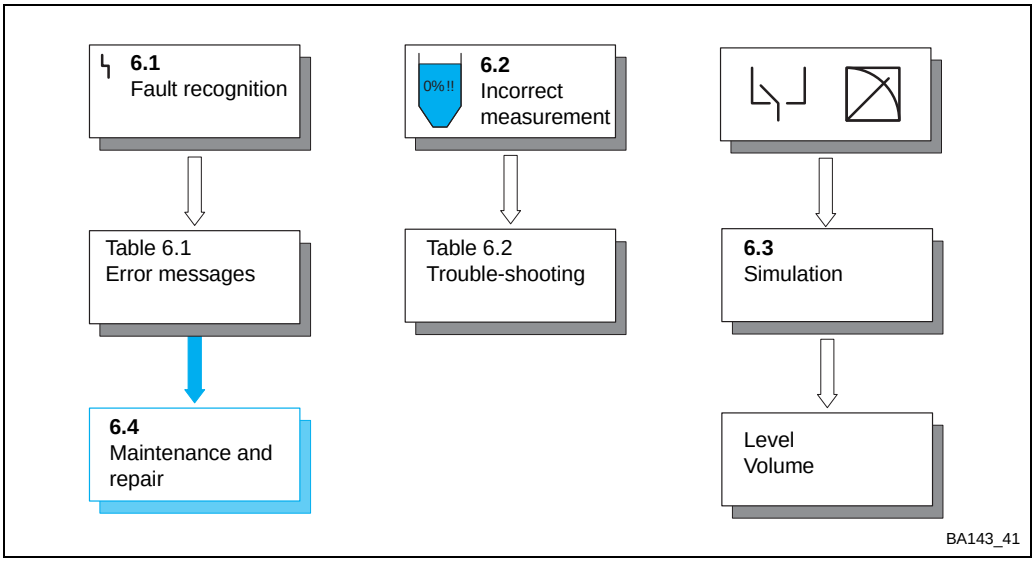


Fig. 6.1: Trouble-shooting and fault elimination for the Prolevel FMC 662

6.1 Fault recognition

Alarms

If the Prolevel FMC 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/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 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 FMC 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 - Incorrect mode selected (only one probe)
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 in measured values between channel 1 and 2 too large (modes 3 and 5 only) - Check calibration and linearisation
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 1does 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

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

Trouble-shooting table

Fault	Cause and remedy
Measured value wrong Modes 0…3	• Incorrect calibration? Check measured value before linearisation, V0H9, V4H9 - if not correct, check whether full and empty calibration correct V0H1/V0H2, V4H1/V4H2 - If correct, check linearization parameters - Check operating mode, V8H0 • Change in product - recalibrate for new product • Build-up on probe - wire electronic insert for build-up, see Section 2.4 • Probe damaged, bent or pressed to side of vessel - check and remedy • Condensation in connection compartment
Measured value wrong Mode 5 with reference probe	• Product inhomogenous • Build-up or crystallisation on both probes • Build-up or crystallisation on reference probes • Probes bent or damaged • Incorrect calibration? - recalibrate • Reference probe and measuring probe are not matched as required, see Section 6.2 - Check rod diameter, ground pipe or shield, insulating material etc.
Analogue outputs do not function correctly	• Check all settings - Assignment correct, V8H2 - Start and end values correct, V0H5/V0H6, V4H5/V4H6 - Alarm relay has tripped, fault value assumed • Incorrect wiring or load
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, V4H4 - Simulate settings in simulation mode - see Section 6.3 if the relays LEDs switch, check wiring • Incorrect wiring or load
Alarm relay flashes in twin channel operation	• Only one probe connected - Select mode 1 or 2 in V8H0 • See Table 6.1

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

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 at V8H0 to terminate simulation and resume normal measurements.

When the simulation mode is activated, the alarm relay flashes (Warning E613 or E 614). 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. 0	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. 2	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

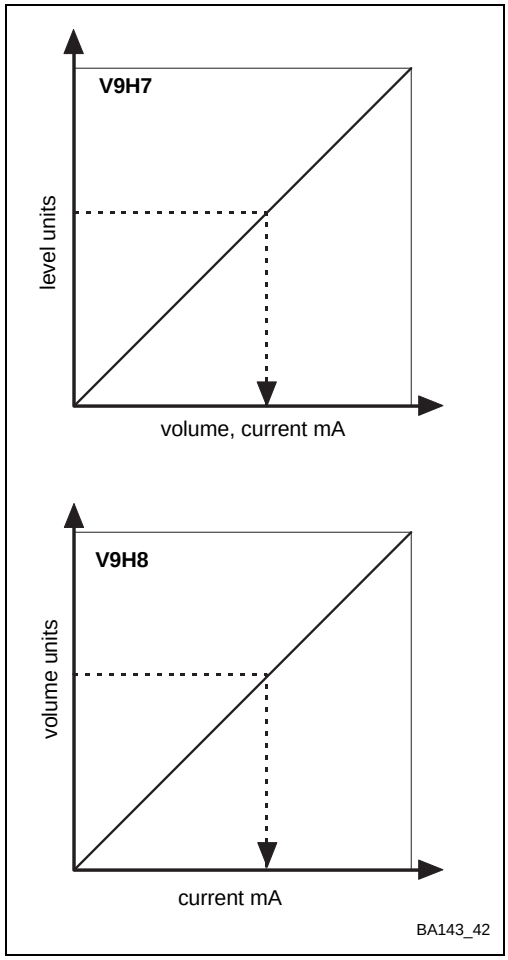


Fig. 6.2:
Simulation mode

6.4 Exchanging transmitters and sensors

FMC 662 transmitter

If the Prolevel FMC 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.

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_0 and
- sensitivity S

for the range selected (default Range II) must be entered at V3H5 and V3H6 for probe 1 or V7H5 and V7H6 for probe 2 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

Channel 2
V7H5
⇓
V7H6

6.5 Repairs

Should the Prolevel FMC 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 Anhang

7.1 Abgleich und Linearisierung in Volumeneinheiten

Benutzen Sie folgende Vorgänge, falls Sie in Volumeneinheiten abgleichen und gleichzeitig eine Linearisierung möchten.

Abgleich für liegende Zylinder

Die Reihenfolge für die Eingabe der Parameter muß unbedingt eingehalten werden. Zwei Parameter müssen eingegeben werden:

- Tankdurchmesser **D**
- Tankvolumen **V**.

#	Matrix	Eingabe	Bemerkungen
1	V9H5	670	Werkseinstellung
2	-	»E«	Eingabe bestätigen
3	V3H5	fo	Nullfrequenz
4	-	»E«	Eingabe bestätigen
5	V3H6	Δf	Empfindlichkeit
6	-	»E«	Eingabe bestätigen
7	V3H0	1	Volumeneinheiten
8	-	»E«	Eingabe bestätigen
9	V2H7	**D**	Tankdurchmesser, %, m oder ft
10	-	»E«	Eingabe bestätigen
11	V2H8	**V**	Tankvolumen*, hl, gal…
12	-	»E«	Eingabe bestätigen
13	V2H0	1	Linearisierung aktivieren
14	-	»E«	Eingabe bestätigen
15	V0H1	E	Tank leer, aktuelles Volumen in hl, gal…
16	-	»E«	Eingabe bestätigen
17	V0H2	F	Tank voll, aktuelles Volumen in hl, gal…
18	-	»E«	Eingabe bestätigen

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

Hinweis!

Hinweis!
- D bestimmt die Füllstandseinheiten in V0H9
- Bei V =100 erfolgt die Eingabe in %Volumen

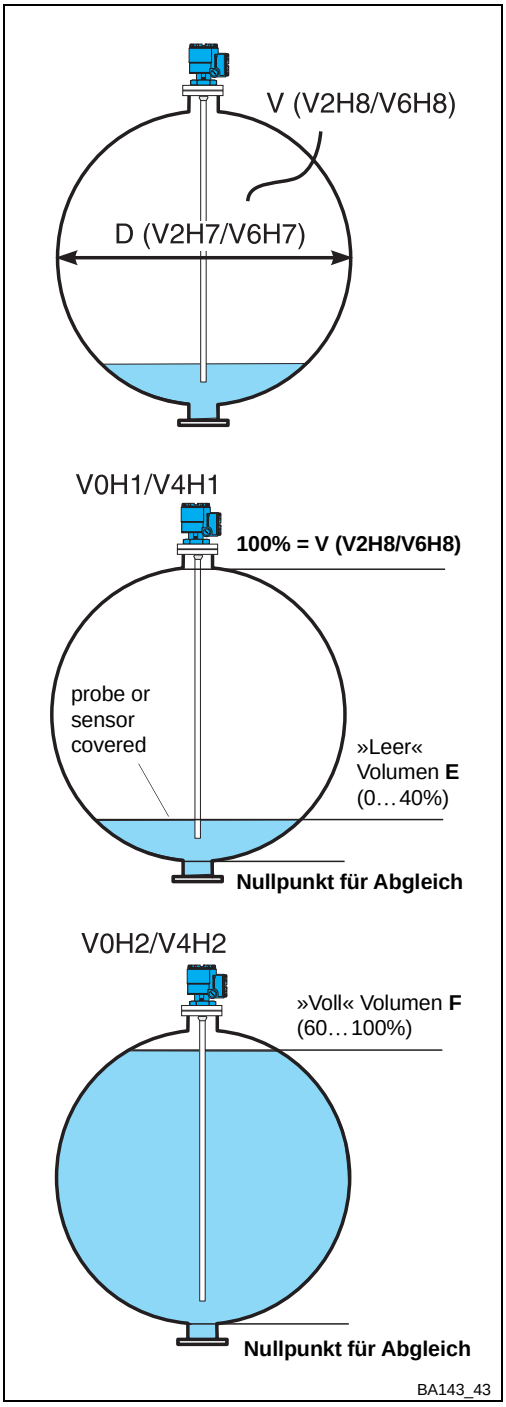


Abb. 7.1:
Parameter für Abgleich und Linearisierung in einem horizontal liegendem Zylinder

Nach der Linearisierung
- Volumen kann in V0H0 abgelesen werden
- Füllstand in V0H9

Nächster Schritt…

Analogausgang und Relais in Volumeneinheiten einstellen, Seite 28…31.

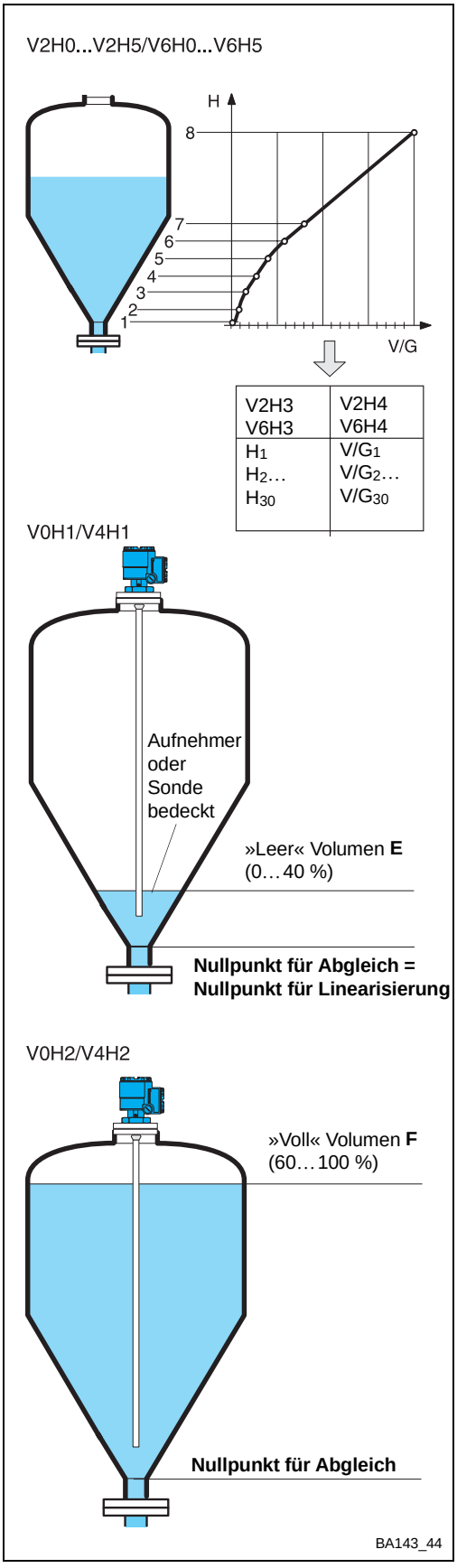


Abb. 7.2:
Parameter für Abgleich und Linearisierung in einem Tank mit konischem Auslauf

Abgleich für Tanks mit konischem Auslauf

Sie brauchen eine monoton steigende Linearisierungstabelle, max. 30 Wertepaare H/V oder H/G

- Füllstand H in %, m oder ft
- Volumen V oder Gewicht G in technischen Einheiten.

#	Matrix	Eingabe	Bemerkungen
1	V9H5	670	Werkseinstellung
2	-	»E«	Eingabe bestätigen
3	V3H5	fo	Nullfrequenz
4	-	»E«	Eingabe bestätigen
5	V3H6	Δf	Empfindlichkeit
6	-	»E«	Eingabe bestätigen
7	V3H0	1	Volumeneinheiten
8	-	»E«	Eingabe bestätigen
9	V2H1	0	Manuelle Eingabe
10	-	»E«	Eingabe bestätigen
11	V2H2	1	Tabelle-Nr.
12	-	»E«	Eingabe bestätigen
13	V2H3	$V/G_{1…30}$	Volumen/Gewicht*
14	-	»E«	Eingabe bestätigen
15	V2H4	$H_{1…30}$	Füllstand m oder ft*
16	-	»E«	Eingabe bestätigen
17	V2H5	**»E«**	**Nächstes Wertepaar* — springt auf V2H3**
***Weiter mit # 13…19 für alle Wertepaare**			
18	V2H0	3	"manuell" aktivieren
19	-	»E«	Eingabe bestätigen
20	V0H1	E	Tank leer, aktuelles Volumen in hl, gal…
21	-	»E«	Eingabe bestätigen
22	V0H2	F	Tank voll, aktuelles Volumen in hl, gal…
23	-	»E«	Eingabe bestätigen

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

Hinweis!

- Erstes Paar ~ 0 % Füllstand, in %, m, ft. Letztes Paar ~ 100 % Füllstand, in %, m, ft.
- Bei Fehler E602 oder E604 Tabelle korrigieren. Linearisierung erneut in V2H0 aktivieren

Hinweis!

Nach der Linearisierung

- Volumen/Gewicht kann in V0H0 abgelesen werden
- Füllstand in V0H9

Nächster Schritt…

Analogausgang und Relais in Volumeneinheiten einstellen (Seite 28…31).

Index

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	1		
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				63…		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 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 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	Input Level	Next Table No.	No. of factory-set character-istic	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 (device-specific) fo	Sensitivity (device-specific) S		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 linearization
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 2=factory 3=manual 4=clear 3	Level input mode 0=manual 1=auto.	Table No. (1…30)	Input Volume	Input Level	Next Table No.	Factory curve No.	Diameter for horizontal cylinder	Volume for horizontal cylinder	
V7 Extended Calibration Channel 2	Calibration mode 0=level 1= volume	Offset	Sensitivity		Zero offset value	Offset (device-specific) fo	Sensitivity (device-specific) S		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 5 = reference 6/7 = sim.ch1/2	Max. diff with 2 channel operation	Analog output 2 1 = channel1 2 = channel 2	Minimum level Mode 5				Correction factor for reference operation		Security locking < 670 or > 679
V9 Service and Simulation	Current error code	Last but one 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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