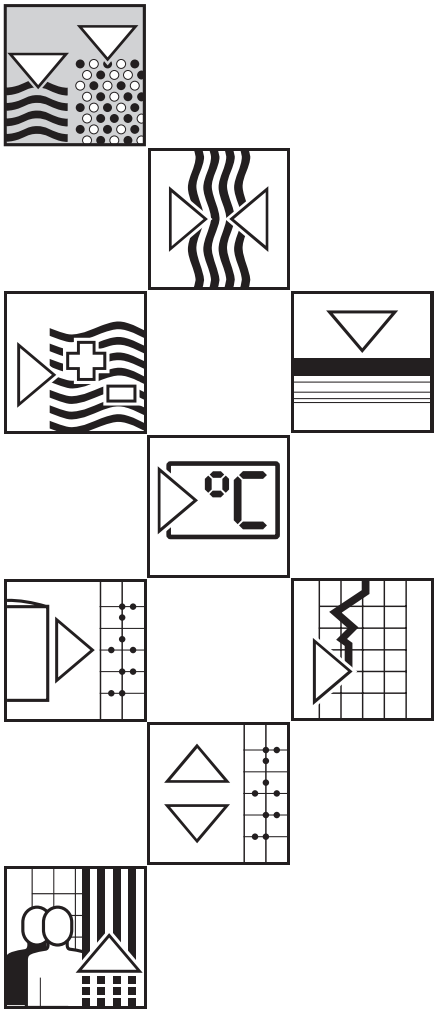
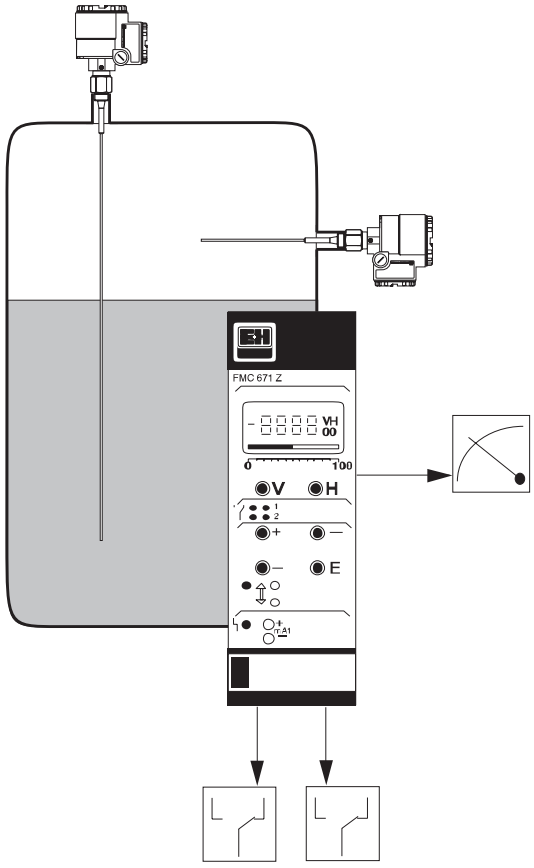
BA 063F/00/en/06.03
015577-1000
Software Version 3.x

silometer
FMC 671 Z/676 Z
Level Measurement

Operating Instruction

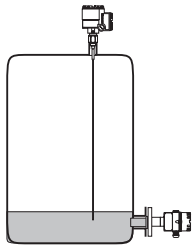
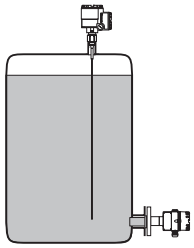
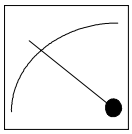
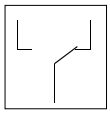
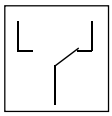




Endress+Hauser

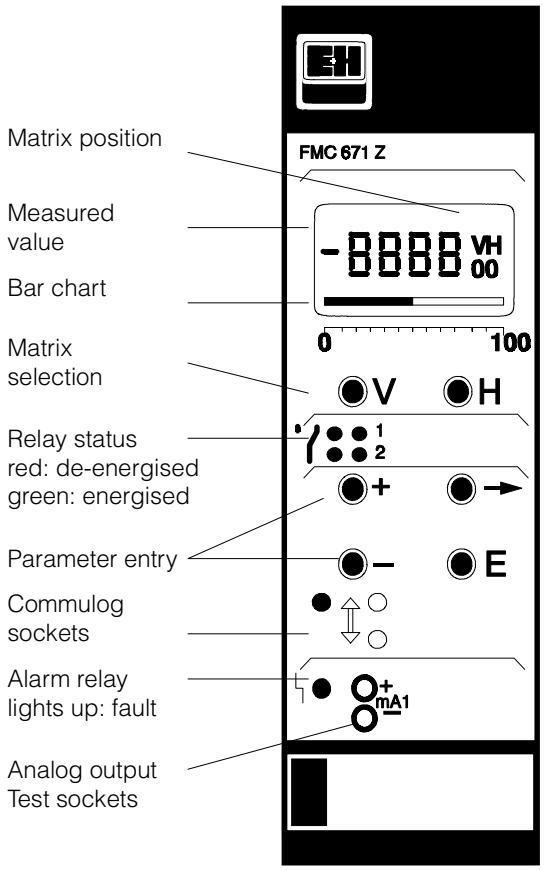
The Power of Know How

Measurement at a Glance

Function	Matrix	Action
1 Reset transmitter	**V9H5**	● Enter 671: »+« and »–« keys, ⇒ changes digit 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 (probe covered) 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 Relay 1 	**V1H0** **V1H1**	● Enter level for switching in calibration units, Relay 1 Press »E« to register entry ● Enter fail-safe mode: 0 = minimum, 1 = maximum Press »E« to register entry
6 Relay 2 	**V1H5** **V1H6** **V1H9**	● Enter level for switching in calibration units, Relay 2 Press »E« to register entry ● Enter fail-safe mode: 0 = minimum, 1 = maximum Press »E« to register entry ● Enter 1 = Relay 2 assigned to channel 1 Press »E« to register entry

*Can be performed in reverse order

FMC 671 Z



V — Selects vertical matrix position

H — Selects horizontal matrix position

V + H — Select position V0H0

→ — Selects next digit

→ + + — Move decimal point

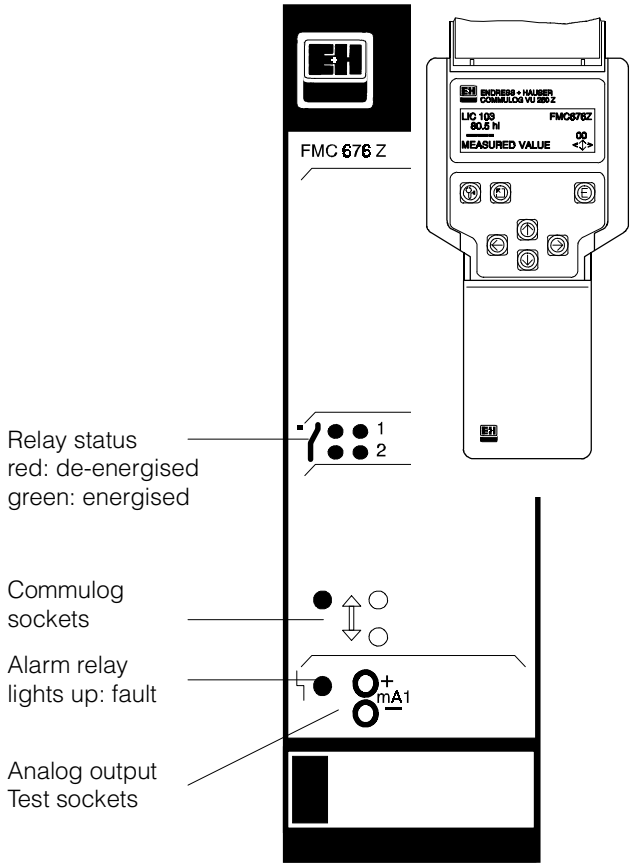
\+ — Increases value of digit +1

– — Decreases value of digit –1

E — Register entry

For operating elements, see chapter 3

FMC 676 Z/Commulog VU 260 Z



→ ↑ ← ↓ — Select matrix position

↖ — Selects position V0H0

Calls error diagnosis

E — Calls entry mode

← → — Select next digit

↑ ↓ — Increase and decrease value

← + ↑ — Move decimal point to left

→ + ↑ — Move decimal point to right

E — Registers entry and quits mode

↖ — Breaks off entry without storing value

Table of Contents

1 Introduction 5
1.1 Application 6
1.2 Measuring system 7
1.3 Measuring principle 8
1.4 Functional description 9

2 Installation 10
2.1 Probes 10
2.2 Silometer installation 11
2.3 Transmitter wiring 13
2.4 Probe connection 15
2.5 Hardware configuration 17
2.6 Technical data: Silometer FMC 671 Z/676 Z transmitter 18

3 Operating elements 19
3.1 Commutec operating matrix 19
3.2 Operating elements: Silometer FMC 671 Z . . 20
3.3 Operating elements: Silometer FMC 676 Z . . 21

4 Calibration and Operation 22
4.1 Commissioning of the transmitter 22
4.2 Empty/full calibration for level measurement . 23
4.3 Empty/full calibration for volume measurement 24
4.4 Level offset value 25
4.5 Measured value display 26
4.6 Locking the parameter matrix 26

5 Linearization 27
5.1 Linearization for a horizontal cylindrical tank . 28
5.2 Linearization for a tank with conical outlet . . 29
5.3 Other modes 32

6 Analogue Outputs 33
6.1 Configuration 34

7 Limit Switches 36
7.1 Relay settings 37
7.2 Applications 38

8 Other Applications 41
8.1 »Dry calibration« for continuous level measurement with Deltapilot probes 41
8.2 Level limit switching 43
8.3 Continuous level measurement with separate level limit detection 46
8.4 Level measurement with automatic calibration correction 47

9 Trouble-Shooting 50
9.1 Faults and warnings 50
9.2 Simulation 53
9.3 Exchanging transmitters or probes 54
9.4 Repairs 55

10 Quick programming guide 56
10.1 Level measurement with separate level switching, capacitance probes 56
10.2 Continuous volume measurement (linearization) 57
10.3 Level limit switching 58
10.4 Level measurement with automatic calibration correction: two capacitance probes 59

Notes on Safety

The Silometer FMC 671 Z/676 Z is used for continuous level measurement. The measuring system must be installed by qualified personnel only, and in accordance with the instructions in this manual. When using the measuring system in potentially explosive areas, relevant local standards must be observed. Measuring specifications and safety directives concerning the measuring points must be observed at all times.

The following table shows available sensors and probes and their applications.

Certificates

Certificate	Transmitter	Notes
TÜV 00 ATEX 1640	Silometer FMC 671 Z/676 Z	CE ⟨Ex⟩ II (1) GD, [EEx ia] IIC/IIB, install outside Ex-area
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
PTB 98 ATEX 2094	DB 50, DB 50 L, DB 51, DB 52, DB 53	CE ⟨Ex⟩ II 1/2 G, II 2 G, EEx ia IIC T4…T6
Z-65.13-107	DC 12 TE, DC .. TE ., DC .. E ., DC .. Capacitance probes 11500 Z, 11961 Z, 21561 Z with electronic insert EC 37/47 Z, FEC 12, HMC 37/47 Z FMC 470, FMC 671/672 Z, FMX 570 Z, FMX 770, SIF 100/110	Continuous level measurement for overspill protection in stationary vessels (for storage of non-combustible, water-polluting liquids)
DiBT No. Z-65.11-29	Silometer FMC 671 Z electronic insert FEB 17 DB 50...52	Continuous level measurement for overspill protection in stationary vessels (for storage of non-combustible, water-polluting liquids)
German Lloyd GL No. 97517 HH	Silometer FMC 671 Z Capacitance probes electronic insert EC 37 or EC 47 electronic 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 GL No. 97510 HH	Liquiphant DL 17 Z	Level indication on channel 1. Suitable for unlimited use within the rules
German Lloyd GL No. 99350 HH	DB 50, 50 L, 52, 53 with electronic insert FEB 17 / 17 P	

Notes on Safety

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

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

Quick Operating Guides

The front cover contains short instructions for the standard set-up, continuous level measurement with capacitance probes, which is used in 80% of applications.

For Users familiar with the operating matrix of Endress+Hauser Commutec transmitters in general and the Silometer FMC 671 Z/676 Z in particular, a Quick Operating Guide for the most important operating modes is to be found in Chapter 10.

In this manual

Users unfamiliar with the Silometer FMC 671 Z/676 Z must read the operating instructions. 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 8. The 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 for the plug-in card.
- Chapter 3: Controls;
  describes operation with the front panel keys, Commulog VU 260 Z and ZA 672.
- Chapter 4: Calibration and Operation;
  tells you how to commission the Silometer for the standard application.
- Chapter 5: Linearization;
  tells you how to calibrate the Silometer to measure volume in a horizontal cylindrical tank or a tank with a conical outlet.
- Chapter 6: Analogue Outputs;
  describes in detail the setting of the 0/4…20 mA signal line.
- Chapter 7: Relays;
  describes in detail the setting of the limit switches.
- Chapter 8: Other Applications;
  describes the configuration of the Silometer for further applications not covered in Chapter 4.
- Chapter 9: 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 10: Quick Programming Guide;
  provides configuration flowcharts for the principle applications.
- Chapter 11: Index;
  lists key words to help you find information quickly.

Further documentation

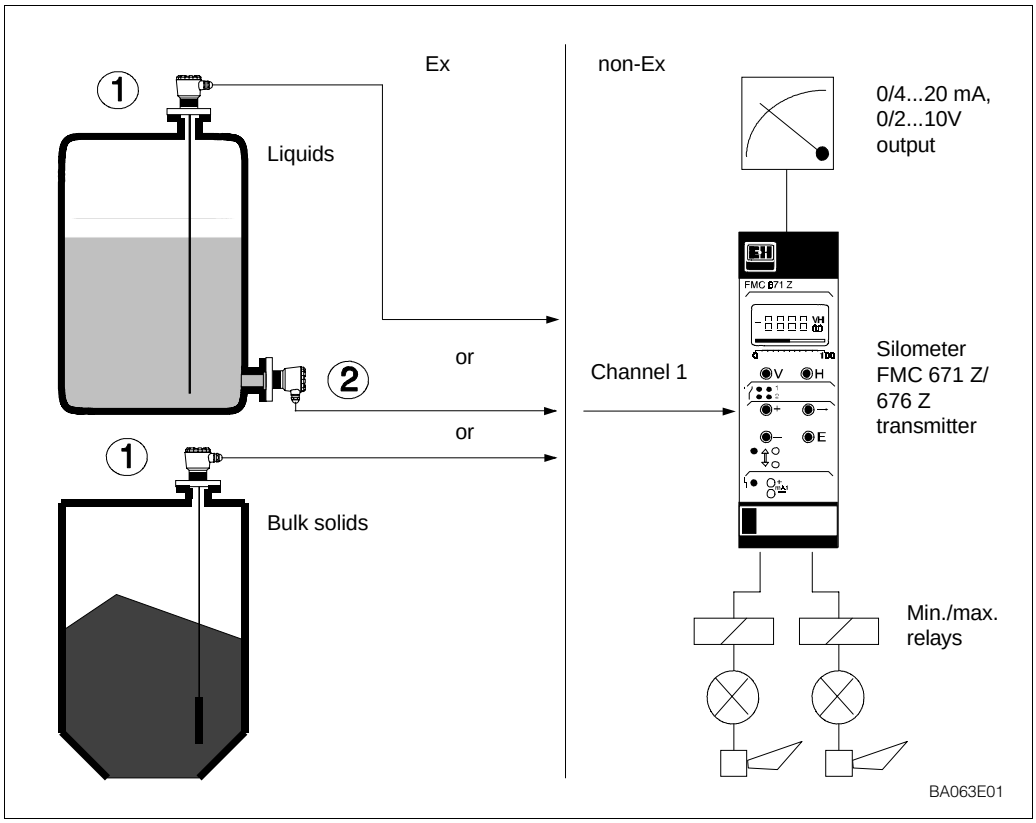
In addition to this manual, the following publications provide information on configuration of the Silometer FMC 671 Z/676 Z.

- BA 028 Commulog VU 260 Z handheld terminal
- BA 054 ZA 672 Modbus Gateway

Installation of the probes, electronic inserts and accessories are 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 with Silometer FMC 671 Z/676 Z
① Capacitance probe
② Deltapilot S



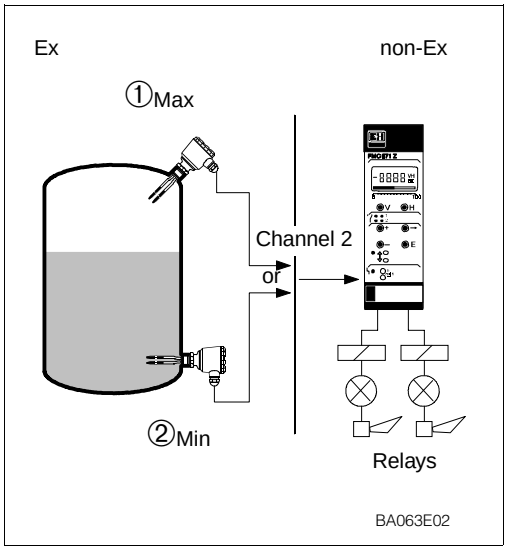
The Silometer FMC 671 Z/676 Z is designed for level measurement with a capacitance, impedance or hydrostatic pressure probe. A second channel allows level limit detection with a capacitance/impedance probe or vibration sensor. The applications described in this manual are as follows:

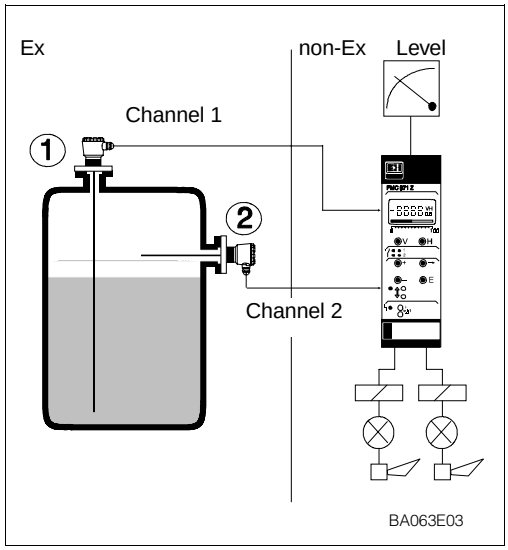
- Continuous level measurement …Chapter 4
- Volume measurement in horizontal or conical tanks …Chapter 5
- Level limit detection …Chapter 8
- Continuous level measurement with automatic correction …Chapter 8.

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

Fig. 1.2:
Left:
Silometer FMC 671 Z with limit switch
① Maximum fail-safe
② Minumum fail-safe

Right:
Silometer FMC 671 Z with continuous level measurement and limit switching
① Level measurement
② Limit switch





1.2 Measuring system

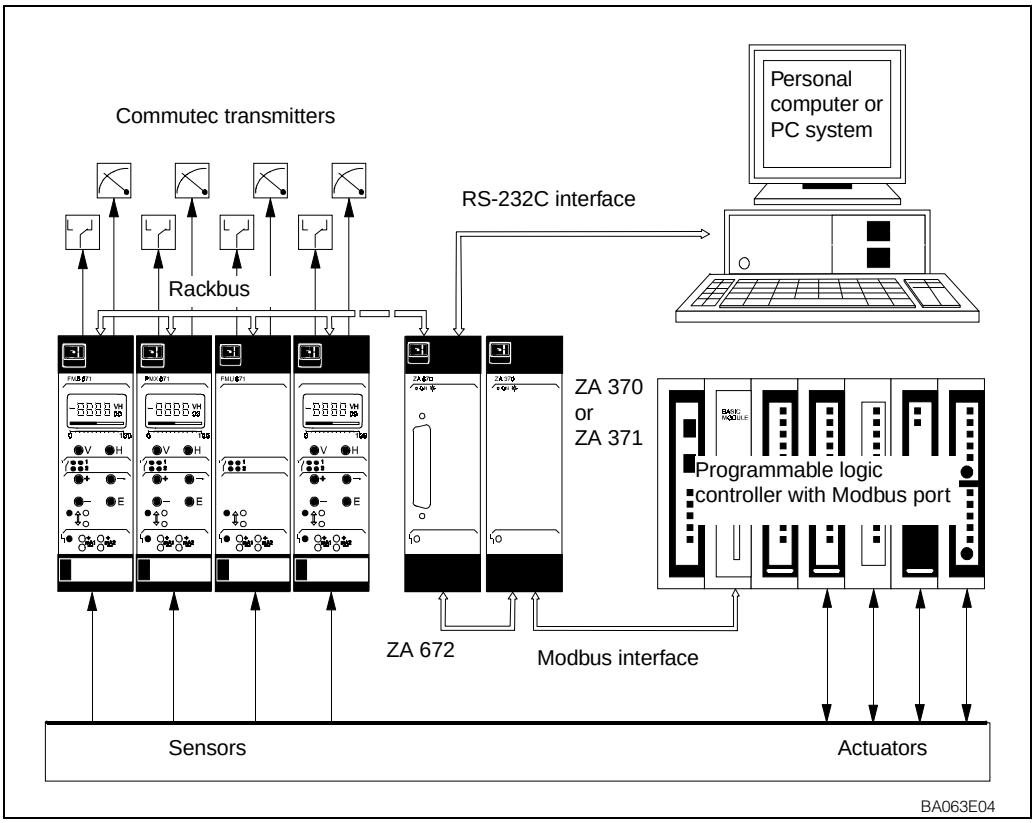


Fig. 1.3
The Silometer 671 Z/676 Z can be used as a stand-alone unit, or as part of a process control system.

A working system for level measurement comprises:

- Silometer FMC 671 Z/676 Z transmitter,
- Capacitance, impedance or Deltapilot S probe (hydrostatic pressure sensor)
- Electronic insert

For limit switching a capacitance, impedance or vibration probe is used.

The Silometer may operate as a stand alone unit with standard 0/4…20 mA and 0/2…10 V output. Two relays, freely assignable to channel 1 or 2, can be used to control pumps, valves, annuciators etc.. Alternatively, the Silometer may be controlled remotely with other Commutec transmitters via the Rackbus as part of a process control system. In this case, communication is controlled by a ZA 672 Modbus Gateway, see Fig 1.3, or any other ZA 67… Gateway.

Versions

The Silometer is available in two versions:

- Silometer FMC 671 Z with display and operation via the front panel, and via the handheld terminal Commulog VU 260 Z and Gateway ZA 67...
- FMC 676 Z for remote configuration by Commulog VU 260 Z handheld terminal or via ZA 67… 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 Silometer FMC 671 Z/676 Z 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

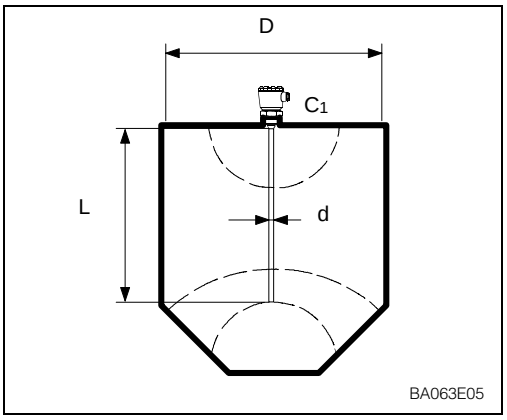


Fig. 1.4
Capacitance measurement principle

For vessels with a diameter greater than 1 m, the capacitance varies by approx. 12 pF per meter of covered probe.

Measurement in conducting media

If the product conducts, the capacitance is 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.

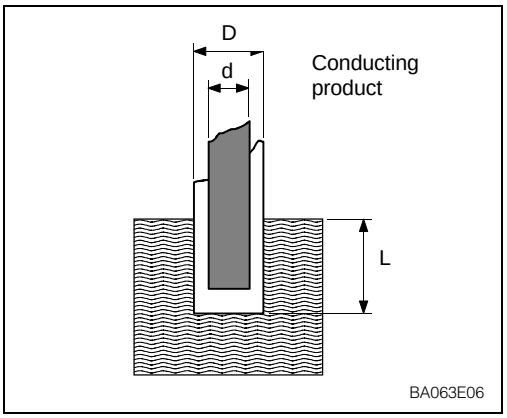


Fig. 1.5
Measurement in conducting media

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:

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

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

At a constant density, the level is proportional to the hydrostatic pressure.

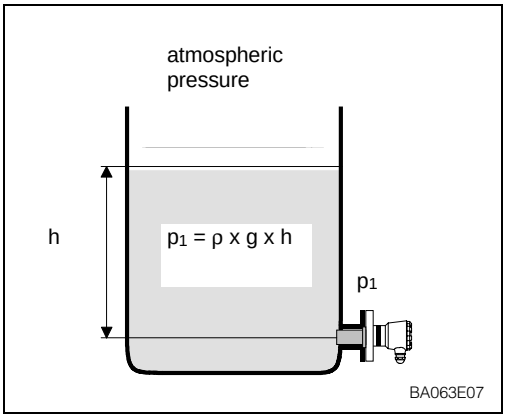


Fig. 1.6
Hydrostatic measurement principle

1.4 Functional description

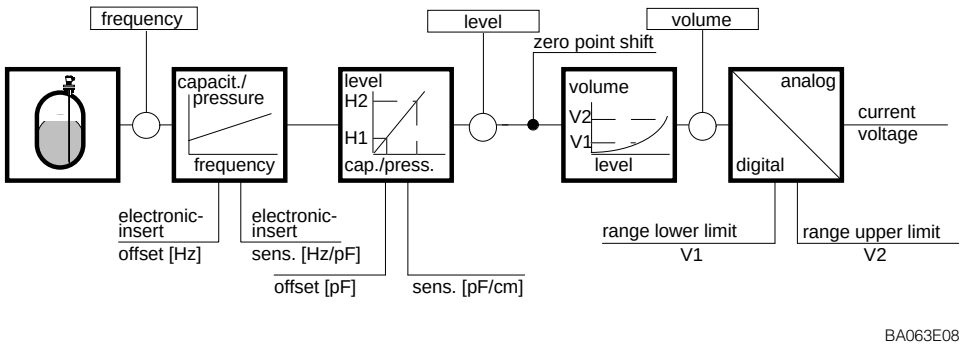


Fig. 1.7
Signal processing in the Silometer FMC 671 Z/676 Z for single channel operation

The capacitance or pressure measured by the sensor is converted into a frequency signal by the electronic insert located in its head. The Silometer FMC 671 Z/676 Z supplies the power and receives a level-proportional frequency signal over a two-core cable. The signal is then processed to provide the following functions:

Silometer functions

- *Level measurement*
  By calibrating at two levels, »empty« and »full«, level measurement can be made in the units entered during calibration.
- *Volume measurement*
  For non-linear volume/level relationships, volume can be calculated from level via the vessel characteristic which describes the shape of the vessel. This function is described under »Linearization« in Chapter 5.
- *Level limit switching*
  Channel 2 of the Silometer can be used as a level limit switch in conjunction with a vibration or capacitance/impedance probe.
- *Level measurement with automatic calibration correction*
  If the dielectric constant or density of the liquid changes or is unknown, the Silometer can be configured to provide a corrected level measurement on channel 1 by using a level switching probe at channel 2.
- *Analogue output*
  The signal resulting from the calibration and linearisation provides a standard 0/4...20 mA and 0/2...10 V output, proportional to level or volume. Any portion of the measuring range can be taken to provide a scaled output, see Chapter 6.
- *Relay control*
  The two relays can be assigned to either measuring channel to provide level control by switching pumps on and off, see Chapter 7.
- *Rackbus signal*
  The measured values and complete configuration can be read by the ZA 672 Modbus Gateway (and ZA 67… computer interface) for integration into process control systems and visualisation on personal computers.
- *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. In addition, each relay can be individually set to switch on or off as required.

2 Installation

This Chapter describes:

- The probes for use with the Silometer FMC 671 Z/676 Z
- Silometer installation in a rack or Monorack housing
- Electrical connections for the Silometer and sensors
- Hardware configuration for Commulog VU 260 Z or ZA 67… operation
- Technical data.

Warning!

Warning!
- The Silometer FMC 671 Z/676 Z transmitter must be installed outside explosion hazardous areas.

2.1 Probes

Table 2.1 lists the sensors most frequently used with the Silometer FMC 671 Z/676 Z 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.

Sensor constants

Deltapilot probes and EC 37 Z/47 Z inserts are supplied with the sensor constants zero frequency »fo« and sensitivity »Df« or »S«. The constants for Deltapilot S probes are in the table on page 55; for electronic inserts, they are printed on the nameplate, see Fig. 9.1, Section 9.3.

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.

Table 2.1 Selection of probes suitable for use with the Silometer FMC 671 Z/676 Z

Principle	Channel 1			Channel 2		
	Probe	**TI sheet**	**Insert**	**Probe**	**TI sheet**	**Insert**
Capacitance, Multicap	DC 11 DC 16 DC 21 DC 26 11 322 Z 11 500 Z 21 211 TA TE E A	TI 169F TI 096F TI 208F TI 209F E 11.81.03 TI 161F E 10.73.18 TI 239F TI 240F TI 242F TI 243F	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)	TI 169F TI 096F TI 208F TI 209F TI 197F E 04.77.04 TI 227F TI 195F	EC 17 Z EC 16 Z
Hydrostatic pressure	Deltapilot DB 50...53	 TI 257F	FEB 17 (P)	Not suitable		
Vibration	Not suitable			Liquiphant DL 17 Z FDL 30 FDL 31 Soliphant DM 90 Z…92 Z	 013154-0008 TI 185F TI 185F TI 124F BA 042F	 EL 17 Z FEL 37 EM 17 Z

2.2 Silometer installation

There are three possibilities for installing Silometer transmitters:

- Assembly rack for max. 12 transmitters,
- Field housing, ingress protection 65, for max.6 transmitters,
- Monorack housing for individual or series installation.

Rack installation

A Racksyst system can be ordered fully wired, in which case the sensors and the external power supply only need to be wired. Planning hints can be found in Publication SD 041/00/en, »Racksyst Assembly Racks« .

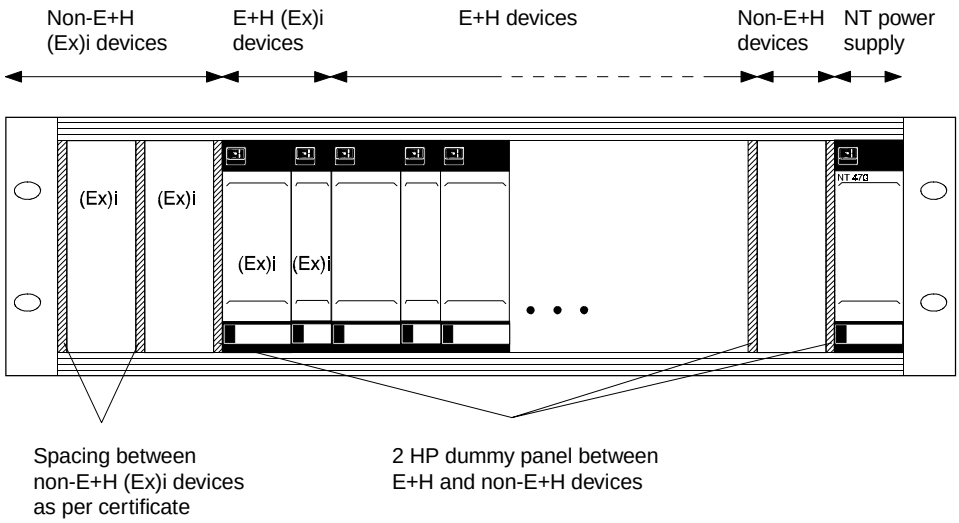


Fig. 2.1: Recommended arrangement for Racksyst rack assemblies

When installing in your assembly rack, or when installing with cards from other manufacturers, fill the rack as follows (see also Fig. 2.1):

Rack arrangement

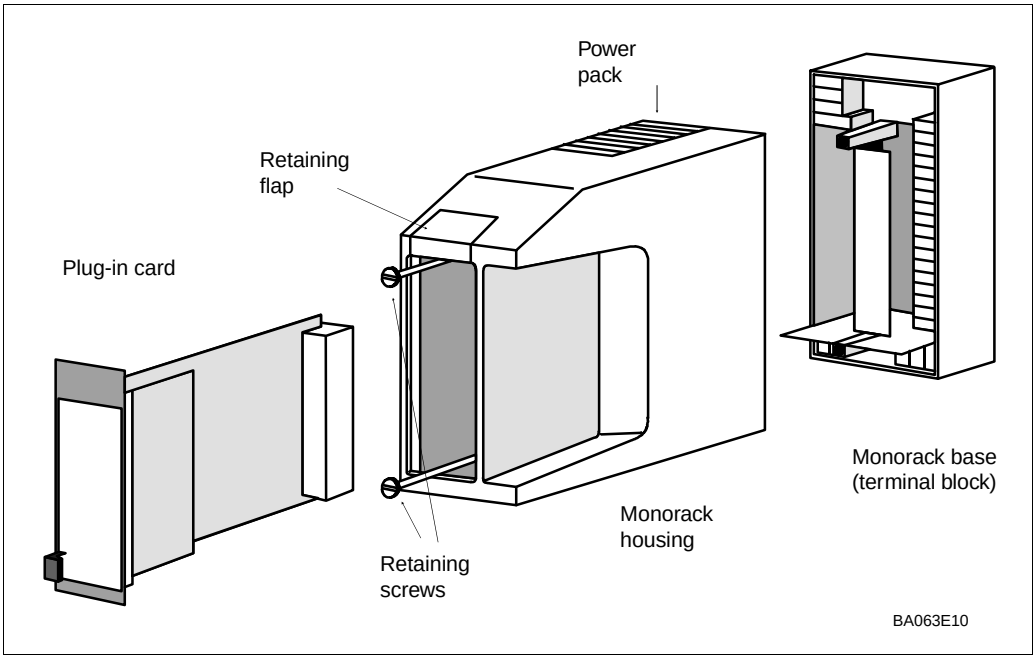
Step	Procedure
1	Allocate the power supply (NT 470) at the rightmost position. - If two NT 470s are used, install a 2 HP dummy panel between them.
2	Install non-intrinsically safe transmitters next to the power supply. - Install a 2 HP dummy panel between all foreign transmitters and between Racksyst cards and foreign transmitters
3	Install intrinsically safe transmitters to the left of the rack. - Install foreign cards first. - Install dummy panels between all foreign transmitters and between Racksyst cards and foreign transmitters in accordance with the instructions on the Ex-Certificate. - No spacer is required between Racksyst cards.

Racksyst field housing

Instructions for installing Commutec transmitters in the Racksyst field housing with half 19" rack are to be found in Publication PI 003.

- Check that the field housing is not installed in direct sunlight.
  - If appropriate fit a protective sun cover.
- The maximum permissible ambient temperature for the field housing varies between +50…+60°C according to the power consumption of the cards (0…20 W).

Fig. 2.2:
Assembly and disassembly of the Monorack housing



Monorack housing

The Silometer FMC 671 Z/676 Z transmitter and Monorack housing are supplied separately. The system must be assembled as shown in Fig. 2.2 before use.

- The Monorack is prepared for wall- or rail-mounting, degree of protection IP 40 or IP 30 respectively.
- The site must be chosen such that the operating temperature of –20°C…+60°C for one Monorack and –20°C…+50°C for Monorack banks is not exceeded.

Full details of the Monorack installation procedure can be taken from the manual supplied with it.

Monorack protective housing

If the Silometer FMC 671 Z/676 Z transmitter and Monorack housing are to be mounted at an exposed site, then it is recommended that they be installed in the protective housing, degree of protection IP 55, which is available as an accessory.

- The protective housing accomodates two Silometer FMC 671 Z/676 Z transmitters.
- The permissible ambient temperature is –20°C…+50°C for one Monorack and –20°C…+40°C for two.

Dimensions and instructions for installation are to be found in the Technical Information sheet TI 099/00/en.

Fig. 2.3:
Monorack protective housing

2.3 Transmitter wiring

Warning!

Warning!
- Make electrical connections with the power supply switched off!
- When wiring up probes and sensors in explosion hazardous areas, observe the instructions on the certificate and other appropriate regulations.

Rack wiring

Fig. 2.4 is a pin assignment diagram for the Silometer FMC 671 Z/676 Z.

- Terminals z 30, b 14, d 14 and b 10 are connected internally
- Inputs d2, d4 and z2, z4 are electrically isolated from the circuit and each other.
- The circuit zero of the unit (⊥) is connected to the negative terminal of the supply voltage.

Note!

Note!
- Two indexing pins, at positions 1 and 22 in the rack connector ensure that Silometer FMC 671 Z/676 Z transmitters only can be inserted at these points. The pins must be inserted if the rack is not custom built by Endress+Hauser.

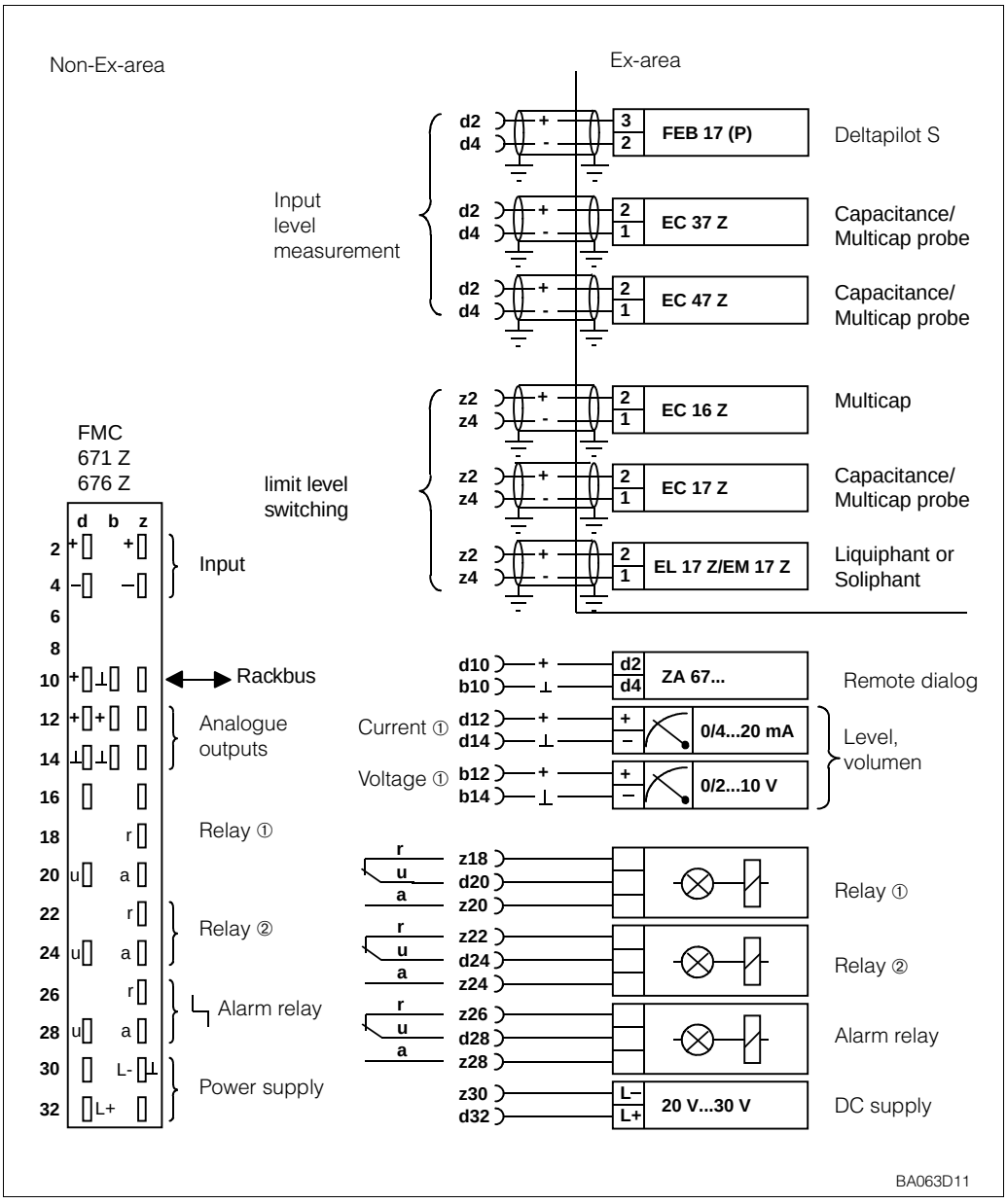
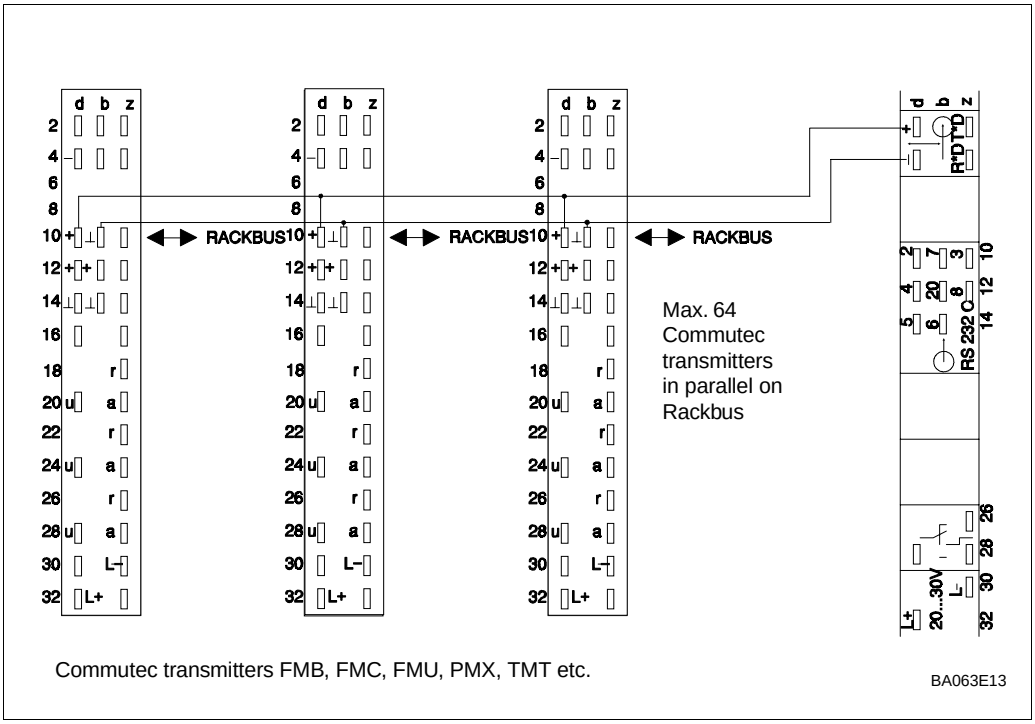


Fig. 2.4:
Pin assignment diagram for Silometer FMC 671 Z/676 Z

Fig. 2.5:
Rackbus wiring diagram



Rackbus

For system use, wire the Rackbus as shown in Fig. 2.5.

- For ZA 672 - Computer/PLC wiring see Operating Instructions BA 054F/00/en.
- Be sure that the system is properly grounded! A difference in ground potential between the Modbus device/personal computer serial connectors and the ZA 672 Modbus Gateway can cause damage to the equipment or loss of module programs.

Analogue and relay outputs

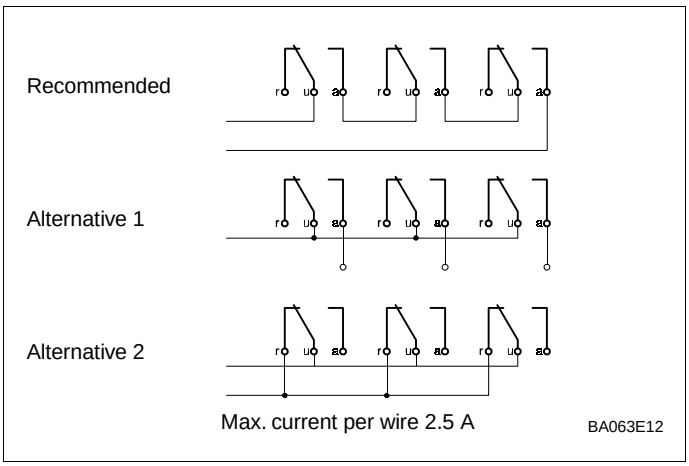
The negative pole of the 24 V DC supply voltage is connected to the negativ terminal of the analog signals (e.g. 4/4...20 mA) and the circuit zero of the FMC 671 Z/676 Z.

- Any number of measurement and control units can be connected in parallel to the voltage output, provided that all potentials are related to negative terminal of the 24 V supply ($R_L \geq 10$ kOhm).
- Only one non-floating device can be connected to each of the current outputs.
- There is no limit to the number of floating devices, apart from that imposed by considerations of maximum or minimum load, see Section 2.6.

Alarms and limit switch relays can be connected as shown in Fig. 2.6.

- Max. current per wire 2.5 A: for switching capacity see Section 2.6.

Fig. 2.6:
Suggestions for wiring together relays and alarms



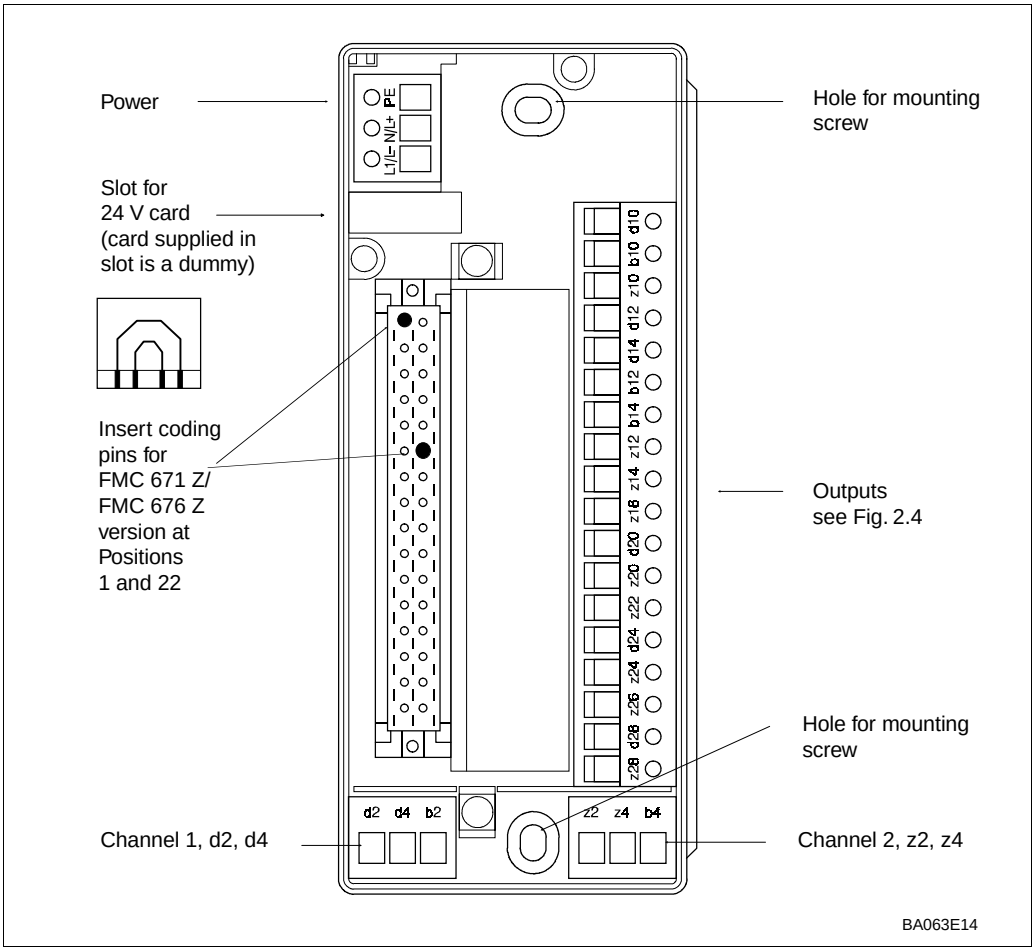


Fig. 2.7:
Layout of Monorack terminal blocks

Monorack wiring

Fig. 2.7 shows the layout in the base of the Monorack housing, the pin assignments correspond to those in Fig. 2.4. When connecting together several Monoracks, follow the instructions supplied with the housing.

- The 24 V version is supplied with a dummy card fitted at the power control slot. Remove this and insert the 24 V card supplied.
- Insert the coding pins supplied at positions 1 and 22 in the female connector at the base of the housing.

2.4 Probe connection

The Silometer FMC 671 Z/676 Z can be operated with a variety of probe 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
  FEB 17 (P) for Deltapilot S probes

For Channel 2, level limit switch:

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

Probe cable

We recommend the use of screened installation cable, max. line resistance 25 Ω/core, for the probe / transmitter cable.

- Ground the screen at both ends (observing local regulations!)
  – If this is not possible, ground the screen at the sensor end only.
  – For more details send for TI 241F/00/en »EMC tests«.
- Observe explosion protection instructions!

EC 37 Z and EC 47 Z

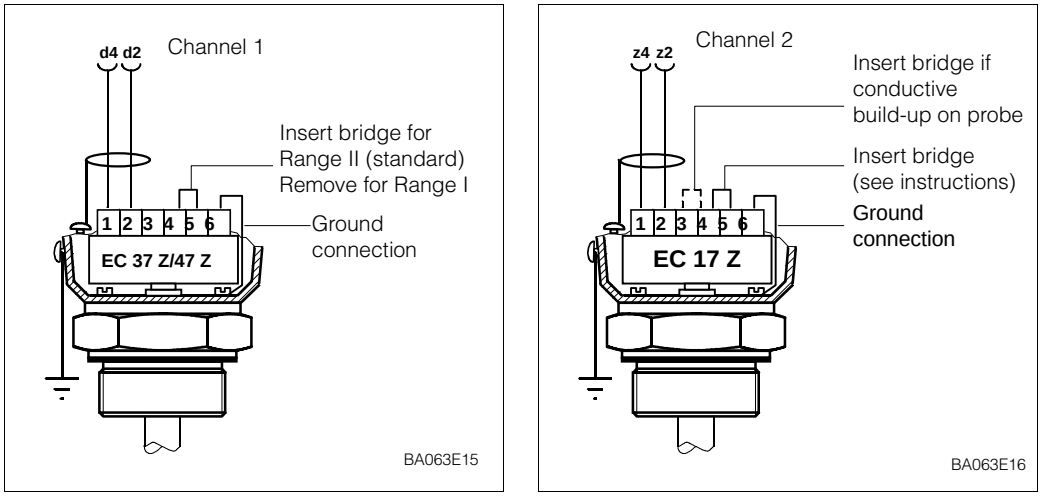
The electronic inserts EC 37 Z and EC 47 Z have two measuring ranges which can be selected by inserting a bridge between terminals 4 and 5 of the insert, see Fig 2.8. Full instructions on selection of the insert are to be found in Publication TI 271F.

- Note the zero frequency f_o____ and sensitivity S_____on the insert.

EC 17 Z

The EC 17 Z electronic insert can be used at Channel 2 with capacitance probes for limit level switching. The connection diagram is shown in Fig. 2.8. Technical information is given in Publication TI 268F.

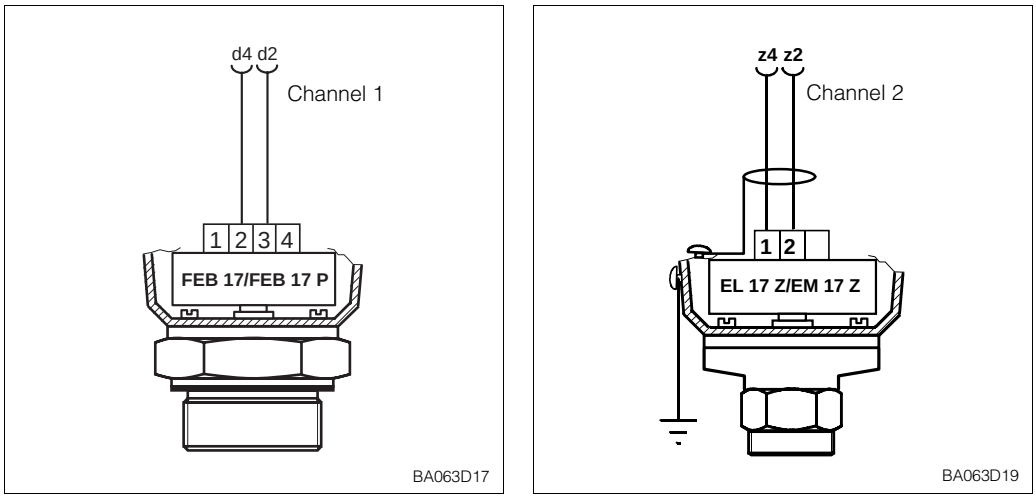
Fig. 2.8: Connection diagram for electronic inserts Left: EC 37 Z/EC 47 Z Right: EC 17 Z



FEB 17 (P)

The FEB 17/FEB 17 P electronic inserts can be used at Channel 1 with Deltapilot S probes to measure level and volume in open vessels. The probe constants are listed in the table on page 55.

Fig. 2.9: Connection diagram for electronic inserts Left: FEB 17 (P) Right: 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 for limit level switching. For Soliphant the EM 17 Z insert is used. Publications BA 039F (013154-0008) and BA 042F (014897-0002) contain full installation instructions.

EC 16 Z

The EC 16 Z electronic insert is for use with the Multicap DC 16 probe with active build-up compensation. Wire it up as the EC 17 Z (see TI 170F).

- The bridges 4 - 5 and 3 - 4 are not required.

2.5 Hardware configuration

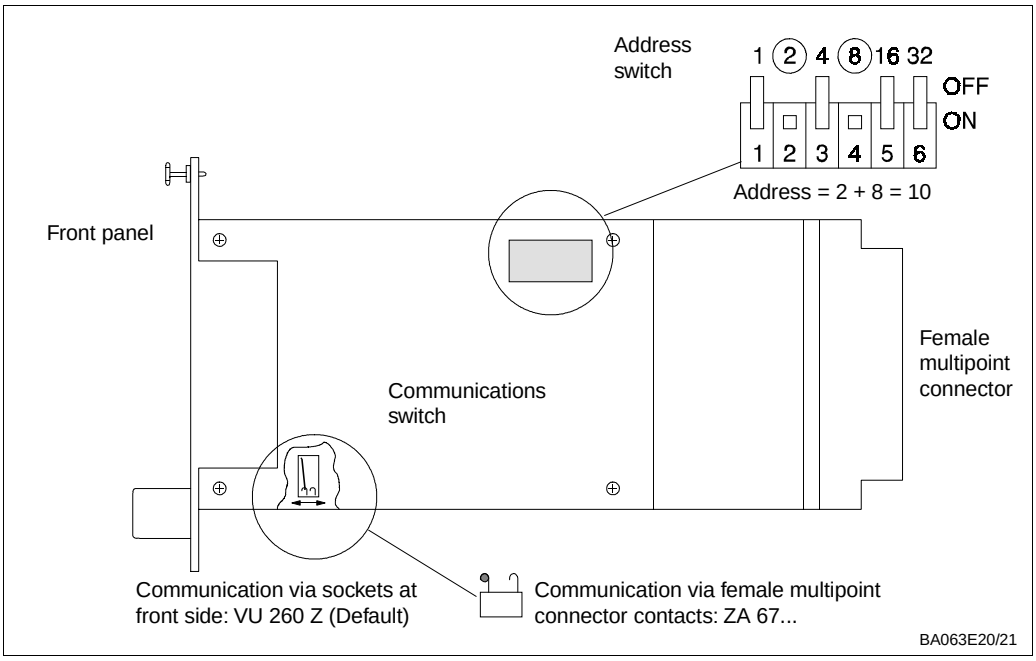


Fig. 2.10: Configuration elements of Silometer FMC 671 Z/676 Z shown for Commulog operation

Fig. 2.10 shows the configuration elements for remote operation of the Silometer FMC 671 Z/676 Z transmitter.

Commulog VU 260 Z

The Silometer is supplied configured for operation with the Commulog handheld terminal, with the hook switch connected to the contact nearest the front panel.

- If the handheld terminal is to be used during computer operation, the card must first be reconfigured for Commulog operation

Gateway ZA 67...

Configure the Silometer card for remote operation via the ZA 672 Modbus gateway (or ZA 67… computer interface) as follows:

- Set the hook switch to ZA 672/ZA 67… operation as indicated (contact nearest the backplane connector).
- Set a unique device address between 0 and 63 at the address switch.
  - When off, each switch has the value 0.
  - When on, each switch is assigned the value shown in Fig. 2.10, inset. In the example the address is 2 + 8 = 10.

A full description of ZA 672 operation is to be found in Publication BA 054F/00/en.

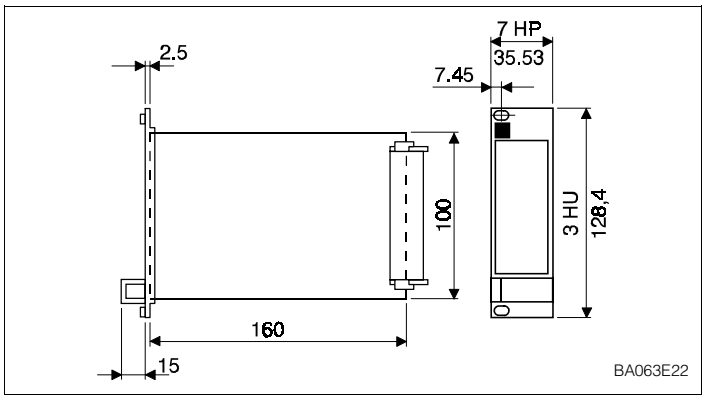
Caution!

Caution!

- Electrostatic discharge can degrade performance or damage electronic modules. Touch a grounded object to rid yourself of charge before handling the modules.

2.6 Technical data: Silometer FMC 671 Z/676 Z transmitter

Fig. 2.11
Silometer FMC 671 Z/676 Z plug-in card



Construction

- Design: 19", 7 HP, plug-in card
- Front panel: black synthetic with blue field inlay, grip and markings, Protection: IP 20 (DIN 40050)
- Dimensions: see diagram
- Weight: approx. 0.3 kg
- Operating temperature: –0°C...+70°C
- Storage temperature: –20°C...+85°C

Electrical connection

- Multipoint plug: conforming to DIN 41612, Part 3, Type F (28-pole)
  - FMC 671 Z/676 Z with coding pins in positions 1 and 22
- Power supply: 24 V DC (–4V…+6V); residual ripple <600 mA, 100 Hz
- Supply current: approx. 90 mA, max. 125 mA, integrated fine-wire fuse
- Signal inputs: Electrically isolated from the rest of the circuitry
  Protection [EEx ia] IIC or IIB
- Probes, Channel 1: Capitance probes with EC 37 Z or EC 47 Z electronic insert
  Deltapilot S DB… with FEB 17 (P) electronic insert
  Channel 2: Capacitance probes with EC 17 Z or EC 16 Z electronic insert
  Liquiphant DL 17 Z or Soliphant DM 90…92 Z.
- Electromagnetic compatibility: Interference Emission to EN 61326; Electrical Equipment Class A
  Interference Immunity to EN 61326

Outputs

- Analogue output: 0...20 mA/4...20 mA selectable, R_L max. 500 Ω
  0...10 V/2...10 V selectable, R_L min. 10 k Ω
- Relays: Two independent relays each with a potential-free change-over contact; freely selectable switching range and hysteresis
  Third relay for fault indication
  Max. switching capacity: 2.5 A, 250 V AC, 300 VA
  at cos φ > 0.7
  or 100 V DC, 90 W
- Fail-safe circuit Minimum or maximum, switchable

Indication and configuration

- FMC 671 Z/676 Z: LCD and 6 buttons on front panel (FMC 671 Z only).
  6 LEDs for function control, also configurable via Commulog handheld terminal or ZA 672/ZA 67…
- FMC 676 Z: 6 LEDs for function control, also configurable via Commulog handheld terminal or ZA 672/ZA 67… interface

Certificates

- Silometer FMC 671 Z/676 Z: TÜV 0 ATEX 1640
  PTB No. Ex-88.B.2048 X

3 Operating elements

This Chapter describes how the Silometer FMC 671 Z/676 Z transmitters are operated. It is divided into the following sections:

- Commutec operating matrix
- Operating and display elements: Silometer FMC 671 Z
- Operating and display elements: Silometer FMC 676 Z

3.1 Commutec 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 FMC 671 Z, by the Commulog VU 260 Z and via a ZA 67… computer gateway.
- For information on ZA 67… operation see the operating manual BA 054F/00/en and Technical Information sheet »Commutec Operating Program« TI 113F.

Operating matrix see page 62, 63.

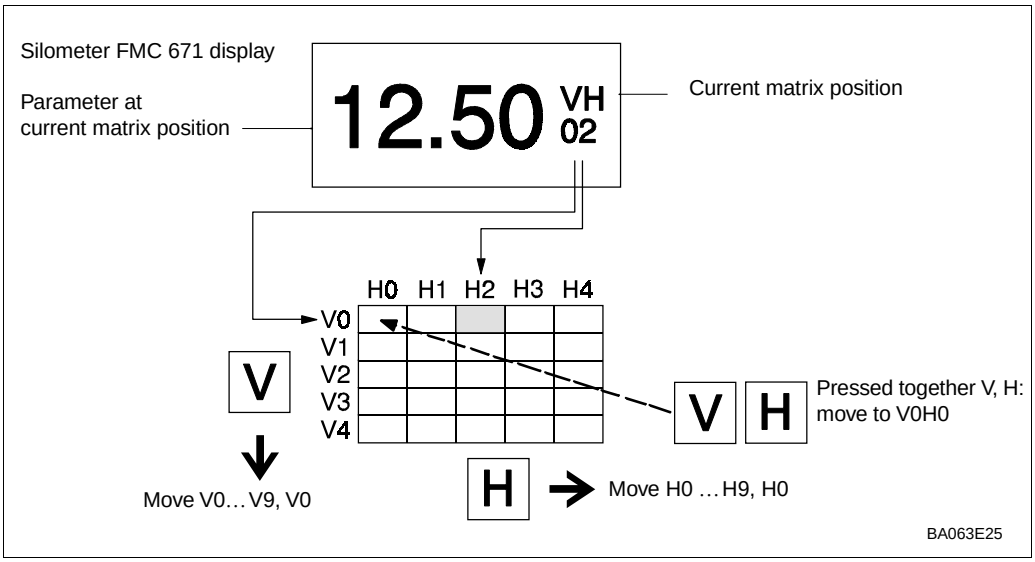


Fig. 3.1:
Silometer FMC 671 Z
Parameter matrix operation with function of V and H keys.
The complete matrix has 10 x 10 fields, although not all are used

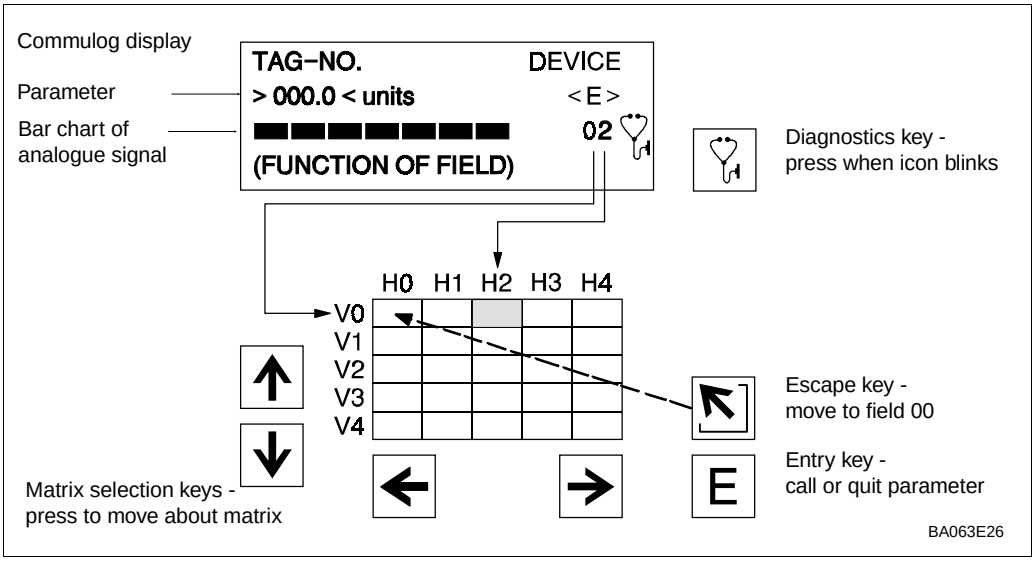


Fig. 3.2:
Commulog display and key functions for the Silometer FMC 671 Z/676 Z

The Tag No. and measurement units are entered in the VA level which can be accessed by the Commulog or ZA 67… interface only

3.2 Operating elements: Silometer FMC 671 Z

Fig. 3.3: Front panel of the Silometer FMC 671 Z transmitter

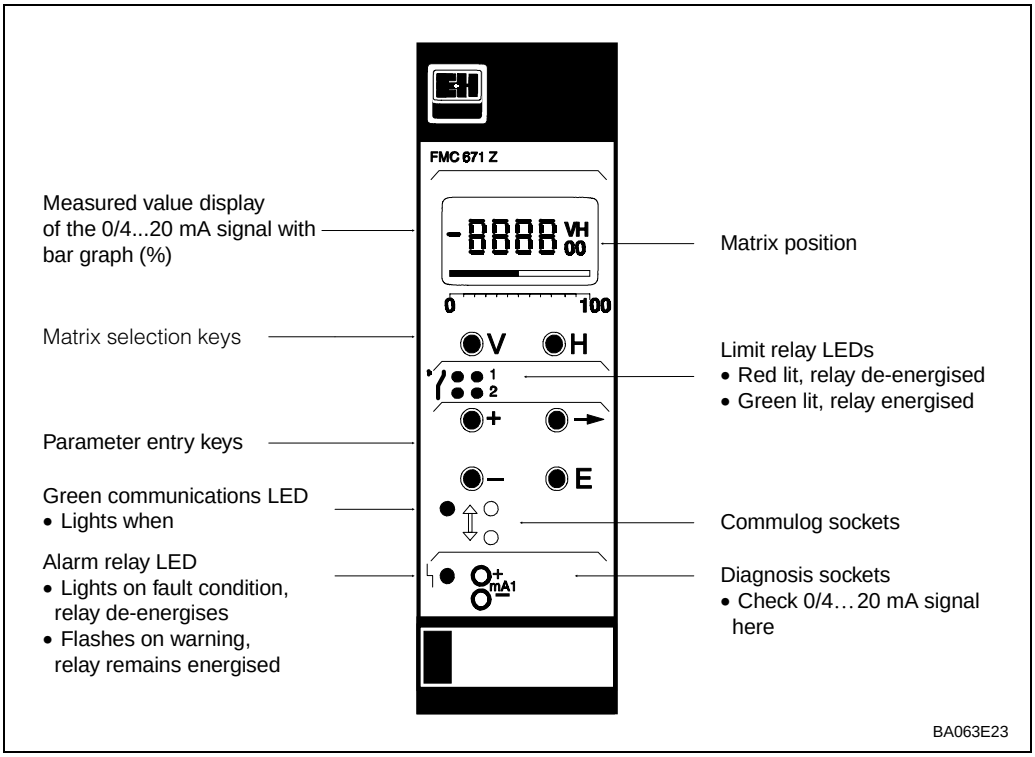


Fig. 3.1 shows the LC-display with matrix of the Silometer FMC 671 Z, Fig. 3.3 its front panel. Table 3.1 below describes the function of the operating keys.

Note!

Note!
- 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: Silometer FMC 671 Z 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	
→	• The display jumps to the next digit position in the digital display. The digit count can then be changed. • The selected digit position flashes.
+ + →	• To change the position of the *decimal point*, press down both »⇒« and »+«. The decimal point moves 1 space to the right.
+	• Changes the count of the flashing digit position by +1
–	• Changes the count of the flashing digit position by –1 • 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 Operating elements: Silometer FMC 676 Z

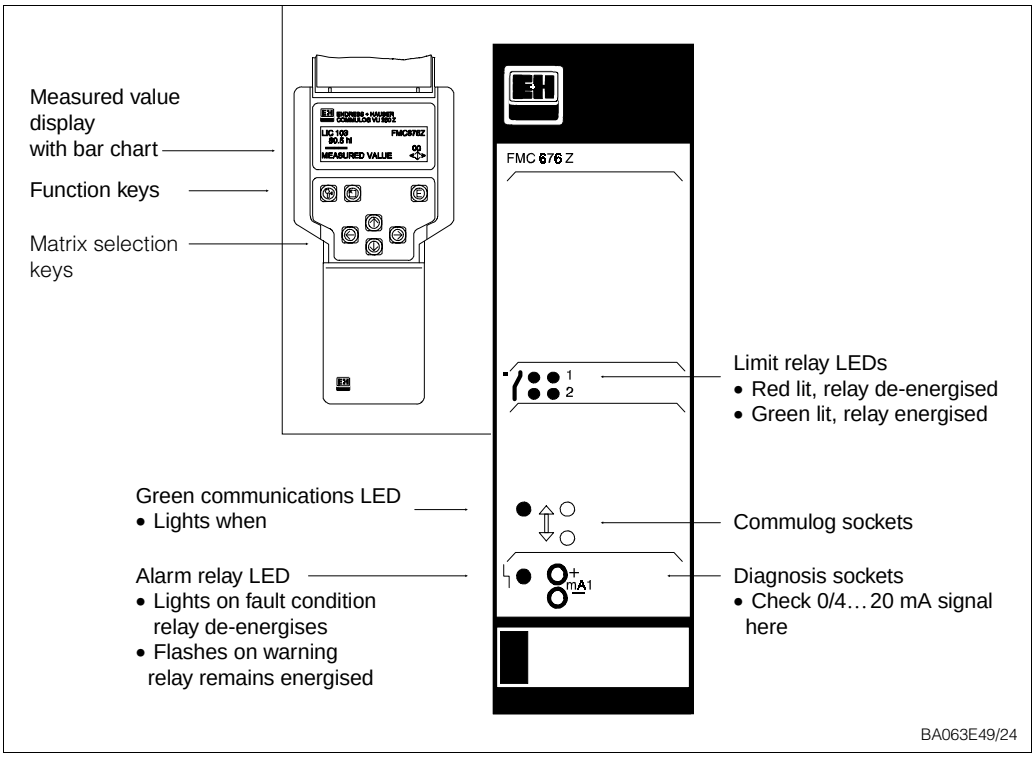


Fig. 3.4: Silometer FMC 676 Z Showing front panel and Commulog VU 260 Z key functions

The Silometer FMC 676 Z is configured with the Commulog VU 260 Z handheld terminal shown in Figs 3.2 and 3.4. A full description of Commulog operation is to be found in Operation Instructions BA 028F. Table 3.2 summarizes the key functions.

- The tag numbers for channels 1 and 2, as well as units before and after linearization must be entered by calling up the VA fields in the operating matrix.

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: Silometer FMC 676 Z Parameter entry and display keys for Commulog VU 260 Z

4 Calibration and Operation

This chapter is concerned with the basic settings of the Silometer FMC 671 Z/676 Z which allow it to operate for continuous level measurement. The principle sections describe:

- Commissioning of the transmitter
- Empty/full calibration for level measurement
- Empty/full calibration for volume measurement
- Level offset value
- Display of measured values
- Locking the parameter matrix.

The linearization for volume or weight measurements is described in Chapter 5, the setting of the analogue outputs and relays in Chapter 6 and 7.

Note!

Note!
- When configuring note your parameters in the Table in the rear cover.
- If the transmitter is ever replaced, these parameters can be entered at the front panel, with the FMC 671 Z, Commulog VU 260 Z or via the ZA 67… Gateway. For level measurements, the transmitter will then measure correctly without the need for another calibration, see Section 9.3.

4.1 Commissioning of the transmitter

If programming the module for the first time, reset the module to the factory based parameters, see Table in back cover. Then enter the probe constants f_o and S (Δf). This ensures that the EC 37 Z/EC 47 Z electronic insert or Deltapilot can be replaced without the need for recalibration, see Section 9.3.

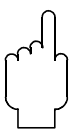
Step	Matrix	Entry	Significance
1	V9H5	e.g. 672	Enter any number 670…679 to reset transmitter
2	-	»E«	Register entry
3	V3H5	e.g. 475.3	Enter zero frequency f_o (offset) of electronic insert with probe
4	-	»E«	Register entry
5	V3H6	e.g. 0.652	Enter sensitivity, S or Δf, of electronic insert with probe
6	-	»E«	Register entry

Operating mode

Now select the operating mode at V8H0:

- 0 = continuous level measurement on channel 1 together with level limit switching on channel 2, see Chapter 8, Section 8.3
- 1 = continuous level measurement on channel 1, Sections 4.2, 4.3
- 2 = level limit switching on channel 2, see Chapter 8, Sections 8.2
- 5 = measurement with calibration correction, see Chapter 8, Section 8.4
- 6, 7 = simulation channel 1 or 2, see Chapter 9, Section 9.2.

Step	Matrix	Entry	Significance
1	V8H0	e.g. 1	Mode 1, continuous level measurement (default)
2	-	»E«	Register entry



Note!

Note!
- The default settings for the Silometer are for % level measurement in operating

mode 1. This corresponds to the calibration described in Section 4.2.

4.2 Empty/full calibration for level measurement

This calibration requires the determination of two parameters,

- an »empty« level at V0H1,
- a »full« level at V0H2.

If the level is entered in %, after the calibration:

After calibration

- % level is displayed at V0H0
- The 0/4…20 mA signal range corresponds to 0…100% level
- Limit relay 1 trips at 90% (maximum fail-safe)
- the parameters »offset« and »sensitivity« are calculated and stored at V3H1/V3H2.

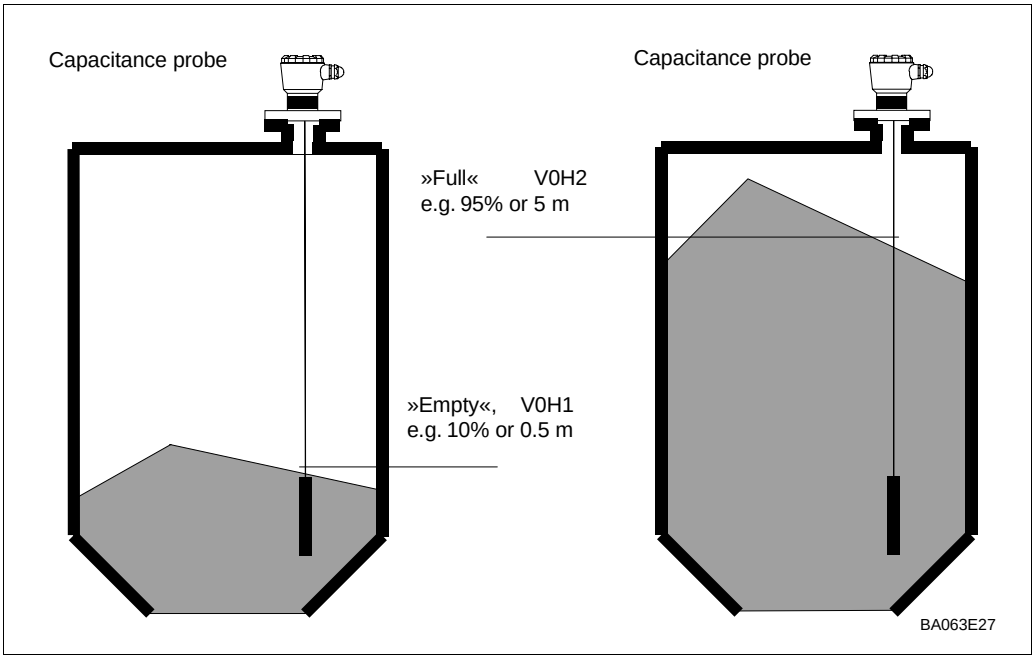


Fig. 4.1:
Parameters required for calibration of the Silometer FMC 671 Z/676 Z for level measurement shown for bulk solid measurement.
Any filling mound or outflow depression can be accounted for by the parameters entered.

If the level is entered in m, ft. etc. the analogue outputs and relay switching points must be set in the same units, see Chapters 6 and 7.

Procedure

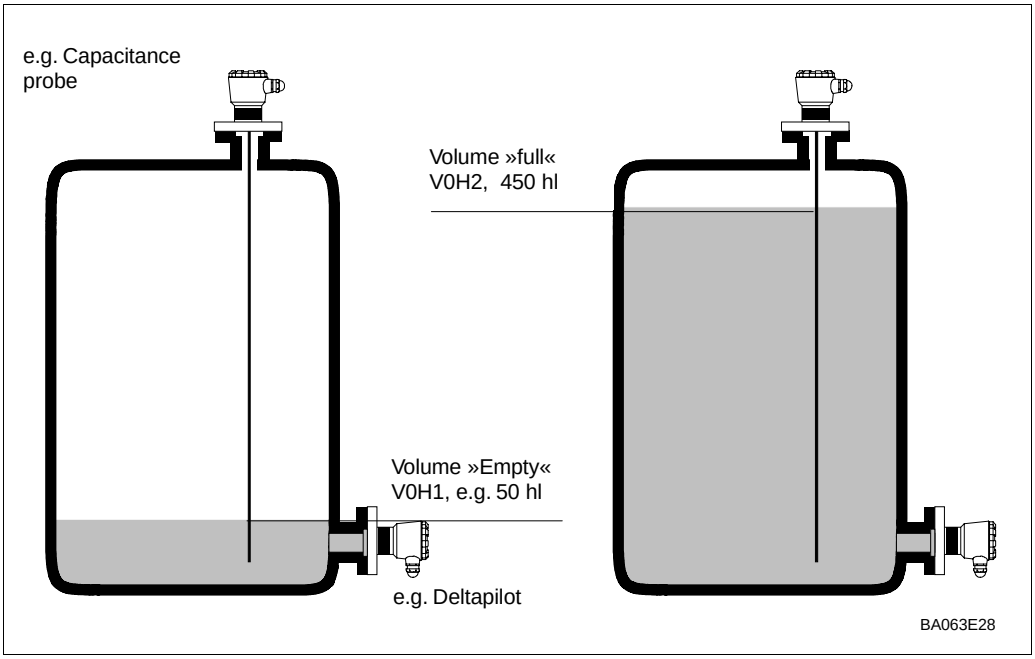
Step	Matrix	Entry	Significance
1	V0H1	e.g. 10%	Fill the vessel until the probe is covered (0…40%) and enter the level you wish to have displayed.
2	-	»E«	Register entry
3	V0H2	e.g. 95%	Fill the vessel as far as possible (60…100%) and enter the level you wish to have displayed.
4	-	»E«	Register entry
5	V0H0		The measured value is shown in the units selected.

Note!

Note!
- The calibration can be performed in reverse order
- For bulk solids, the probe measures the depth of emersion in the product only. Account for any filling mound or outflow depression by the entered levels.

• For the Deltapilot (liquids only), a »dry calibration« can be made on the basis of the sensor characteristics, see Chapter 8, Section 8.1.

Fig. 4.2: Parameters required for calibration of the Silometer FMC 671 Z/676 Z. Example for volume measurement of liquids with capacitance probe or hydrostatic pressure sensor



• If appropriate, a linearization can now be carried out, see Chapter 5.

4.3 Empty/full calibration for volume measurement

The Silometer FMC 671 Z/676 Z can also be calibrated in volume or weight units, e.g. in litres, hectolitres, gallons, %vol, tonnes or kg. After calibration volume (or weight) is displayed at V0H0. The analogue outputs and relays must be set in the same units as described in Chapters 6 and 7.

If the level/volume relationship is not linear, i.e. the tank is a horizontal cylinder or has a conical outlet, the volume calibration is performed as part of the linearization procedure. In this case, turn to Chapter 5, Section 5.1 or 5.2 to determine the correct order of parameter entry before proceding further.

Procedure

Step	Matrix	Entry	Significance
1	V0H1	e.g. 50 hl	Fill the vessel until the probe is covered (0…40%) and enter the volume you wish to have displayed.
2	-	»E«	Register entry
3	V0H2	e.g. 450%	Fill the vessel as far as possible (60…100%) and enter the volume you wish to have displayed.
4	-	»E«	Register entry
5	V0H0		The measured value is shown in the units selected.

Note!

Note!
• The »empty« and »full« calibration can be performed in any order.
• Once selected, units may not be changed unless the Silometer is reconfigured.
• If the level/volume relationship for the vessel is not linear, first see Chapter 5.

4.4 Level offset value

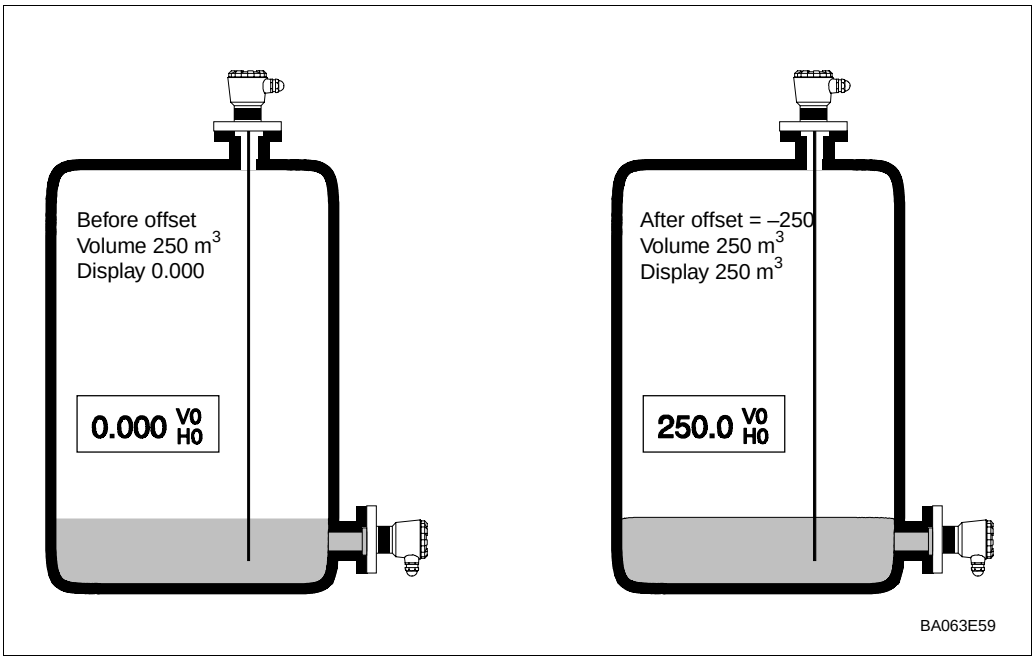


Fig. 4.3:
Effect of level offset value on display at V0H0 for level measurement

The calibration determines the level displayed at V0H0 for a particular head of liquid. By entering a level offset at V3H4 the displayed value can be corrected by the value entered.

- The offset is *subtracted* from the true measured value
- It must be entered in the units you have used for calibration
- All values, including analog signals and relay settings must be changed to follow the corrected measurement.

For example, after a dry calibration, see Section 8.1, it is decided that the true volume measured from the bottom of the tank is to be measured, i.e. when the liquid reaches the calibrated zero level, the display must indicate say 250 m3. The zero shift corresponds to 250 m^3.

Step	Matrix	Entry	Significance
1	V3H4	e.g 250	Enter amount by which the display is to be corrected in the units used for calibration
2	-	»E«	Register entry
3	V0H0	…	The corrected value is displayed (+250 instead of 0 at 0)

Note!
- The offset cannot be used if a linearization has been performed. In this case, the offset is first subtracted from the »level« displayed at V0H9 and the result converted to the volume to be displayed at V0H0.

4.5 Measured value display

During normal operation 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. Table 4.1 summarizes the measured value displays.

Table 4.1: 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 linearization
V0H8	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	Measured value before linearization	Indicates level in the units used for calibration or before linearization
V2H6	Number of factory set calibration	If display > 0, a factory set linearization is stored in the instrument
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
V8H8	Current measuring frequency	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 address set at DIP-switches on card

4.6 Locking the parameter matrix

When all parameter entries have been made (see also Chapters 5 and 6) the matrix can be locked.

Step	Matrix	Entry	Significance
1	V8H9	e.g. 888	Enter any code from 100 - 669 or from 680 - 999
2	-	»E«	Register entry

In this mode, all entries can be displayed but not changed.

- The lock is released when a number between 670 and 679, e.g. 672, is entered into the matrix at the same position.

5 Linearization

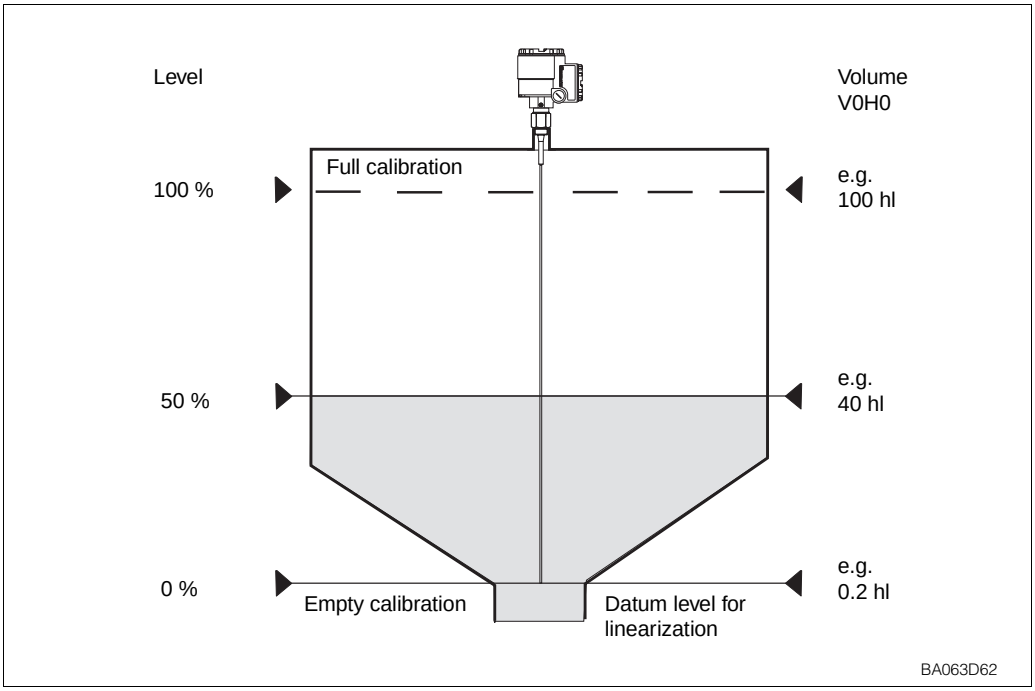


Fig. 5.1:
Linearisation for a vessel with a conical outlet

For tanks in which volume is not directly proportional to level, e.g. for horizontal cylinders or tanks with conical outlets, the linearization converts the level measurement into a measurement of capacity.

Parameters for linearization are selected and entered at fields V2H0…V2H8. In addition, the field V3H0 determines whether the associated calibration is to be performed in level or volume units (0 = level (=default), 1 = volume). The following linearization modes can be entered at V2H0:

0 = linear, default value
1 = horizontal cylinder
2 = factory set
3 = manual entry
4 = cancel current setting

The most frequently used modes, horizontal cylinder and manual entry for conical outlets are described in Sections 5.1 and 5.2, all others in Section 5.3.

Two important rules must be observed when performing a linearization:

- All level (or volume) entries must be made in the units you have chosen for calibration at V0H1 and V0H2.
- The levels for linearization and calibration must both be referenced to the same zero point.

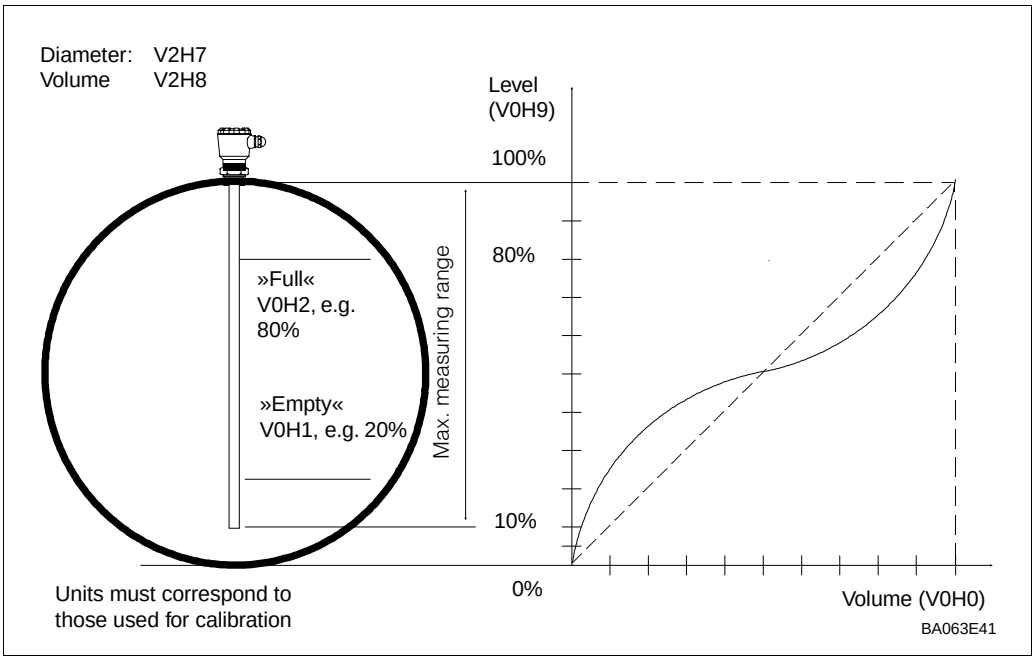
After linearization

After linearization:

- The volume of liquid currently in the tank can be read from V0H0.
- The level before linearization can be read from V0H9.
- The 0/4…20 mA signal range must be set in the volume units entered, see Chapter 6.
- The relay switch points must be set in the volume units entered, see Chapter 7.

5.1 Linearization for a horizontal cylindrical tank

Fig. 5.2: Parameters required for linearization of the Silometer FMC 671 Z/676 Z for a horizontal cylinder



The Silometer FMC 671 Z/676 Z transmitter uses a stored linearization table which requires the entry of the tank diameter, tank volume for its volume calculations.

Procedure

Step	Matrix	Entry	Significance
1	V9H5	e.g. 672	Reset, see Section 4.1 (default = operating mode 1) - Enter probe constants at V3H5 and V3H6
2	-	»E«	Register entry
3	V3H0	e.g. 0	Select units to be used for calibration: 0 = level, 1 = volume
4	-	»E«	Register entry
5	V2H7	e.g. 100	Enter tank dia. (for level, in units to be used for calibration)
6	-	»E«	Register entry
7	V2H8	e.g. 200	Enter tank volume in the units you require - If 100 is entered, the system measures in % volume
8	-	»E«	Register entry
9	V2H0	1	Select horizontal cylinder mode
10	-	»E«	Press »E« to activate linearization
11	V0H1/V0H2	-	Empty/full calibration
12	-	»E«	Register entry
13	V0H0/V0H9	-	V0H0 indicates volume, V0H9 level before linearization

Note!

Note!
- For capacitance or impedance probes a ground tube is necessary or the liquid must be conducting.
- If a level calibration is made, V3H0 = 0, the calibration can preceed the linearization.
- If the calibration is to be in *volume units* (V3H0 = 1), the sequence of steps must be exactly as shown above.
- When V3H0 = 1, the entry at V2H7 fixes the end value for the level display at V0H9.

5.2 Linearization for a tank with conical outlet

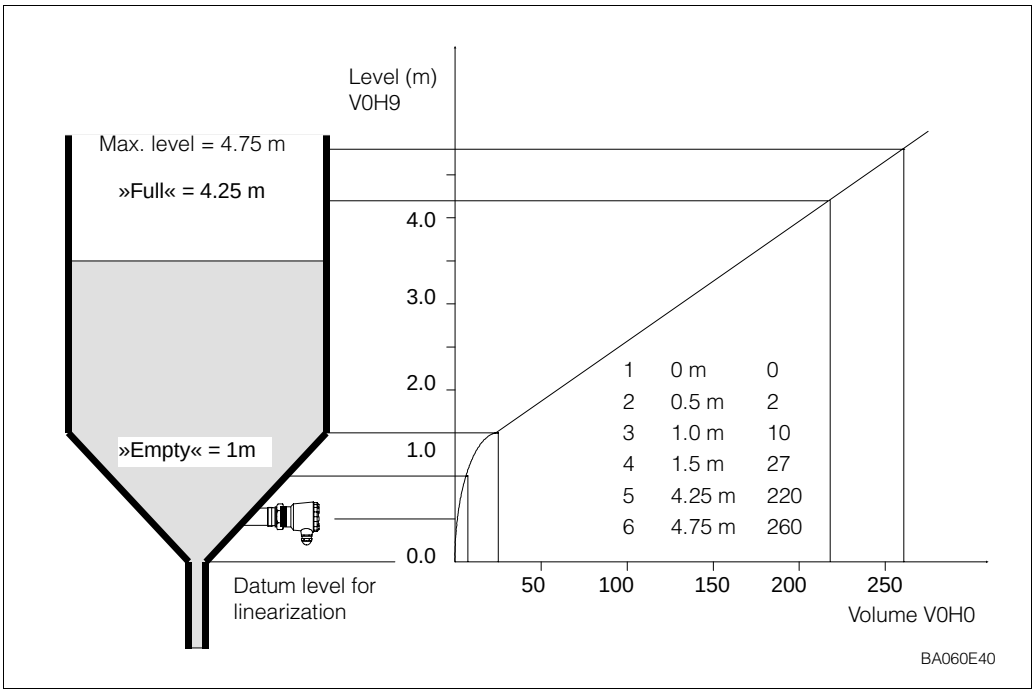


Fig. 5.3: Linearisation for a vessel with a conical outlet

Manual entry V2H0 = 3

This option allows you to enter your own characteristic, whereby two possibilities exist for entering the level values:

- By hand: in this case both level and volume/weight parameters should be calculated and entered in a table prior to configuration. A level calibration can always be performed.
- Automatically: the tank is filled or emptied in known volume increments and the measured level is written into V2H4 by the system. This method can be used when the level/volume relationship is not known.

The automatic mode can also be used if you can calibrate in volume units only: perform the volume calibration first, e.g. when filling the tank, followed by the linearization with »level registration« e.g. when emptying the tank. In this case, however, the »level« values displayed at V0H9 have no significance.

The entry mode is selected at V2H1:

- 0 = manual,
- 1 = automatic.

At the end of the linearization the system measures in the volume/weight units selected, e.g. m^3, ft^3, t, %.

Note!

Note!
- You must enter at least two points:
  - The first level point should be below or at the level of the sensor. If it is not and the level drops below the first point, the linearization will extrapolate back!
  - The last level point should be greater than or equal to the maximum level to be measured.
  - The maximum value for V2H3 and V2H4 is 9998; 9999 cancels the entry.
- The maximum number of points is 30
- When all points have been entered and the linearization is activated, the points are sorted in rising volume and subjected to a plausibility check!

Manual linearization with tabular values

No. V2H2	Volume V2H3	Level V2H4	No. V2H2	Volume V2H3	Level V2H4
1			16		
2			17		
3			18		
4			19		
5			20		
6			21		
7			22		
8			23		
9			24		
10			25		
11			26		
12			27		
13			28		
14			29		
15			30		

Step	Matrix	Entry	Significance
1	V9H5	e.g. 670	Reset transmitter, see Section 4.1 (default = operating mode 1) - Enter probe constants at V3H5 and V3H6
2	V0H1/V0H2	-	Calibrate as described in Section 4.2
3	V2H1	0	Select manual entry of values
4	-	»E«	Register entry
5	V2H2	1…30	Enter table entry number
6	-	»E«	Register entry
7	V2H3	e.g. 0	Enter volume in required units
8	-	»E«	Register entry
9	V2H4	00.00	Enter level for support point number
10	-	»E«	Register entry
11	V2H5	2…30	Second support point number will be displayed
12	-	»E«	Confirm input, the system jumps to V2H3, the support point number is addet automatically
13	V2H3		Repeat steps 7 to 12 until the filling volume and level have been entered for all support points
14	V2H0	3	Select manual linearization table
15	-	»E«	Press »E« to activate linearization
16	V0H0/V0H9	-	Display of volume and level before linearisation

Note!

Note!

- Set analogue output and relay switch point in same units as used for linearization

Manual linearization with automatic level registration

Step	Matrix	Entry	Significance
1	V9H5	e.g. 672	Reset transmitter, see Section 4.1 (default = operating mode 1) - Enter probe constants at V3H5 and V3H6
2	V0H1/V0H2	-	Calibrate as described in Section 4.2
3	V2H1	1	Select automatic entry of values
4	-	»E«	Register entry
5	V2H2	1…30	Enter table entry number
6	-	»E«	Register entry
7	V2H3	e.g. 0	Fill vessel, enter volume in required units
8	-	»E«	Register entry
9	V2H4	-	Display of current level
10	-	»E«	Automatically writes the level to the support point number
11	V2H5	2…30	Second support point number will be displayed
12	-	»E«	Confirm input, the system jumps to V2H3, the support point number is addet automatically
13	V2H3		Repeat steps 7 to 12 until the filling volume and level have been entered for all support points
14	V2H0	3	Select manual linearization table
15	-	»E«	Press »E« to activate linearization
16	V0H0/V0H9	-	Display of volume and level before linearisation

Note!
- For this procedure the tank can be filled for calibration then emptied for linearization.
- Set analogue output and relay switch point in same units as used for linearization

Note!

Corrections to manual linearization

An incorrect entry can be overwritten by selecting the appropriate table number at V2H2 and entering the new value at V2H3 or V2H4.

- If 9999 is entered, the entire point is deleted from the characteristic.
- On activation the linearization is resorted and subjected to a plausibility check.

Step	Matrix	Entry	Significance
1	V2H2	1…30	Enter support point number that is to be corrected
2	-	»E«	Register entry
3	V2H3/V2H4	e.g. 10	Enter correct volume or level
4	-	»E«	Register entry
5	-		Make further correction as in steps 1 to 4
6	V2H0	3	Select manual linearization table
7	-	»E«	Press »E« to activate linearization

5.3 Other modes

Linear
V2H0 = 0

This mode is selected when the Silometer FMC 671 Z/676 Z transmitter is to revert to measurement of level after being used for volume measurement.

- If the volume is proportional to level, e.g. standing cylinder, a volume measurement is obtained by entering the »empty« and »full« volumes at V0H1 and V0H2 respectively, see Section 4.3.

Step	Matrix	Entry	Significance
1	V2H0	0	Select linear characteristic
2	-	»E«	Press »E« to activate linearization

Factory characteristic
V2H0 = 2

Use this option if your tank dimensions were sent to Endress+Hauser for the production of a customer specific linearization table.

- You can check whether a factory linearization is stored in the Silometer FMC 671 Z/676 Z transmitter by viewing matrix position V2H6:
  - A number means a factory linearization is stored.
  - A »0« means there is no factory linearization.
- The measurement units are those agreed on with Endress+Hauser.

Step	Matrix	Entry	Significance
1	V9H5	e.g. 672	Reset transmitter, see Section 4.1 (default = operating mode 1) - Enter probe constants at V3H5 and V3H6
2	V0H1/V0H2	-	Calibrate as described in Section 4.2
3	V2H0	2	Select factory linearization table
4	-	»E«	Press »E« to activate linearization

Cancel current setting
V2H0 = 4

Use this option if you wish to enter an entirely new manual characteristic without a transmitter reset. All values in the linearization table are cancelled and can be entered anew.

Step	Matrix	Entry	Significance
1	V2H0	4	Cancel all previous entries in the manual linearization table
2	-	»E«	Press E to register

Note!

Note!
- The function does not affect the horizontal cylinder characteristic or any factory characteristic stored in the transmitter.

6 Analogue Outputs

This Chapter deals with the analogue output settings. The FMC 671 Z/676 Z transmitter is designed for continuous measurement at channel 1 with control of:

- one voltage output 0/2 ... 10 V
- one current output 0/4 ... 20 mA

by the level or volume indication at V0H0. Table 6.1 and Fig. 6.1 summarize the parameters which control the analog outputs and 10-step LCD display.

When the Silometer is used for limit switching alone, operating mode 2, the analogue output cannot be used.

Units

The analog output signals are based on the measured value displayed in matrix field V0H0!

Matrix	Significance	Default value
V0H3	Analogue range 0 = 0...20 mA / 0...10 V 1 = 4...20 mA / 2...10 V	0
V0H4	Output damping in seconds	1
V0H5	0/4 mA value (in units used for calibration or linearization)	0.0
V0H6	20 mA value (in units used for calibration or linearization)	100.0
V0H7	Output on fault condition 0 = –10% 1 = +110 % 2 = hold	0

Table 6.1: Control parameters for analogue outputs

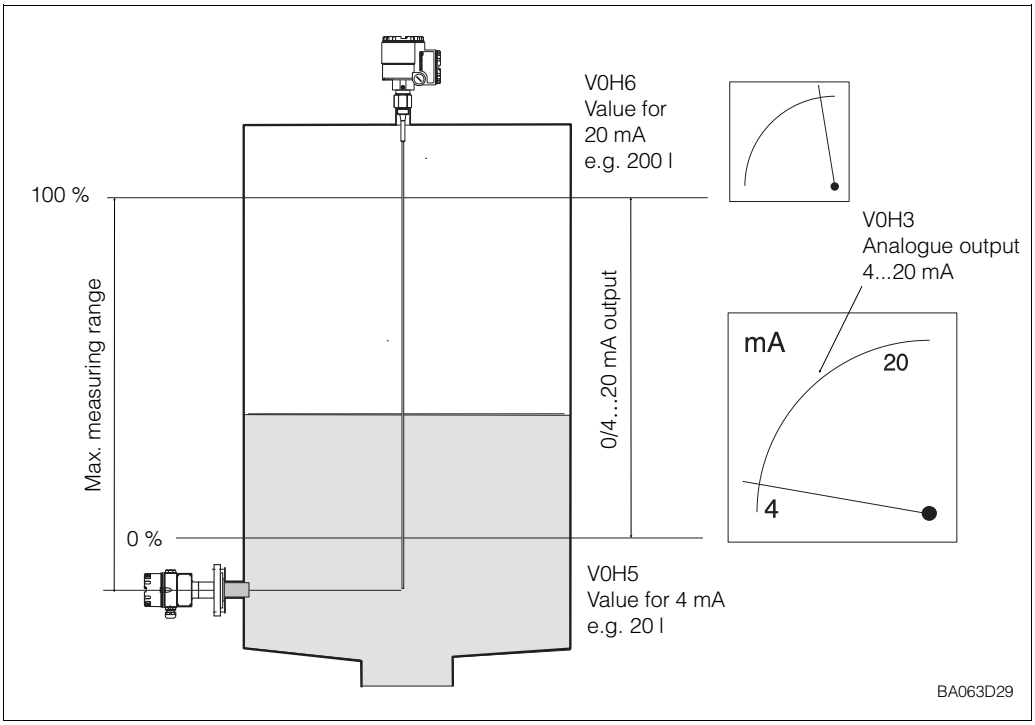


Abb. 6.1: Control parameters for analogue outputs (0… 20 mA)

6.1 Configuration

Analogue output range

One of two analogue ranges can be set:

- 0 = 0 ... 20 mA/ 0...10 V (default)
- 1 = 4 ... 20 mA/ 2...10 V.

Switching the current output to 4...20 mAalso causes the voltage output to switch to 2...10 V.

Step	Matrix	Entry	Significance
1	V0H3	1	Selects 4 ... 20 mA/2 ...10 V range
2	-	»E«	Register entry

Output damping

The output damping causes a damping of the analog outputs and the display. If the fluid's surface is turbulent, output damping may result in a smooth display.

- 0 = without filter.
- 1 = 1…100 = with filter (default 1 s).

Step	Matrix	Entry	Significance
1	V0H4	e.g. 5	Output damping = 5 s
2	-	»E«	Register entry

0/4…20 mA signal parameters

These parameters, entered in the units used for calibration or linearization, indicate the start and end of range values of the analogue signal output.

- 0/4 mA value: V0H5
- 20 mA value: V0H6.

Step	Matrix	Entry	Significance
1	V0H5	e.g. 100	Value for 0/4...20 mA
2	-	»E«	Registers entry
3	V0H6	e.g. 1100	Full scale value for 0/4...20 mA
4	-	»E«	Register entry

Turn-down scale:
Practically any start or end value can be entered, allowing the 0/4…20 mA signal to be assigned to any section of the measuring range.

Reverse scale:
If V0H5 > V0H6 a warning appears at V9H0 and the alarm LED blinks. The instrument, however, continuous to operate. In this case, set V0H5 > V0H6 and read out and take a note of the parameters from V3H8/V3H9. By swapping the values (entering value from V3H8 in V3H9 or value V3H9 in V3H8) the calibration of the D/A converter is inverted and the output signal (voltage and current) reversed. The bar chart, however, still operates in the same direction, i.e. rising from left to right.

Output at fault

The current and voltage outputs can be set to take on distinctive values if the self-monitoring circuit of the Silometer FMC 671 Z/676 Z transmitter triggers on finding a fault. The relays follow the analogue output when the value "1" is entered at field V1H3 or V1H8. The choice is made at V0H7, whereby:

- 0 = –10% of the measuring range
- 1 = +110% of the measuring range
- 2 = last value is recorded

Proceed as follows:

Step	Matrix	Entry	Significance
1	V0H7	e.g. 0	In the event of a fault, display falls to –10%
2	-	»E«	Registers entry

Caution!

- Selecting option 2 effectively disables any fault recognition safeguards on the analogue lines. Although the self-checking system functions, the alarm relay trips and the red alarm LED lights on the transmitter, all analogue devices connected to the Silometer as well as the measured values passed over the Rackbus appear to indicate correct measurements.

Caution!

7 Limit Switches

This Chapter describes the setting of the relay limit switches for continuous level measurement. It is divided into two Sections:

- Relay settings
- Applications

Level measurement

Silometer FMC 671 Z/676 Z transmitters have two independent relays, which switch according to the size of the measured value at V0H0.

- Each limit switch can be operated in minimum or maximum fail-safe mode, i.e. when the level drops below or exceeds the switch point the relay is de-energized.
- The hysteresis of each limit switch is freely selectable.
- Relay 1 is normally assigned to channel 1 and relay 2 to channel 2, however, the assignment can be changed.

The switch points are entered in the units selected during calibration and linearization, i.e:

- No linearization: level units entered
- No linearization, calibration in volume units: volume units entered
- Linearization: volume units entered

The relays are controlled by the matrix fields V1H0 to V1H4 for relay 1 and V1H5 to V1H9 for relay 2. Table 7.1 summarizes their function.

Limit switching

If the Silometer is used as a limit switch only, the relay switch point is fixed by the position of the probe for Liquiphant or Soliphant and at V8H6 for capacitance probes. The hysteresis is set as a switching time delay at V8H3, see Chapter 8, Sections 8.2 and 8.3. By entering »2« in V1H4/V1H9, both relays can be assignet to channel 2, the safety mode can be set in V1H1 and V1H5. The default setting = 0, relays de-energise, is taken for the relay at fault.

Note!

Note!
- If operating mode 1 or 2 is selected and both relays are assigned to channel 2, switch point and hysteresis must be entered in Hz.

Table 7.1: Relay control parameters

Matrix Relay 1	Matrix Relay 2	Significance	Default
V1H0	V1H5	Relay switch point	90.0
V1H1	V1H6	Fail-safe mode 0 = Minimum: relay de-energises when level < switch point 1 = Maximum: relay de-energises when level > switch point At fault relay reacts according to V1H3/V1H8 setting	1
V1H2	V1H7	Relay hysteresis	2.0/0.1
V1H3	V1H8	Relay at fault 0 = de-energises 1 = follows analogue output 1/2 according to setting at V0H7	0
V1H4	V1H9	Relay assignment 1 = Channel 1 2 = Channel 2	1/2

7.1 Relay settings

Relay assignment

In V1H4 and V1H9, relays 1 or 2 can be assigned to the corresponding measuring channel by entering the channel number »1« or »2«.

Step	Matrix	Entry	Significance
1	V1H9	e.g. 1	Relay 2 is assigned to channel 1
2	-	»E«	Register entry

Switch point

The switch point is set at V1H0 for relay 1 and V1H5 for relay 2 in the units used for calibration or linearization.

Step	Matrix	Entry	Significance
1	V1H0	e.g. 200	Switch point for relay 1 (in the unit displayed in field V0H0)
2	-	»E«	Registers entry

Note!

Note!
- If the relays are assigned to channel 2, the switch point is set at V8H6 as described in Chapter 8, Section 8.2 and 8.3.

Fail-safe mode

This function determines whether the relay is to act as a minimum or maximum limit switch, entries are made at V1H1 for relay 1 and V1H6 for relay 2:

- 0 = minimum fail-safe: the relay de-energises if the level or volume drops below the value
- 1 = maximum fail-safe: the relay de-energises if the level or volume rises above the value

Step	Matrix	Entry	Significance
1	V1H1	e.g. 0	Relay 1 de-energises when the product level drops below the switch point
2	-	»E«	Register entry

Minimum fail-safe mode, setting 0			Maximum fail-safe mode, setting 1		
Level	**Relay status**	**LED**	**Level**	**Relay status**	**LED**
Drops below switch point	De-energised	Green off Red on	Rises above switch point	De-energised	Green off Red on
Rises above switch point	Energised	Green on Red off	Drops below switch point	Energised	Green on Red off

Table 7.2: Function of the relays at minimum and maximum fail-safe mode

Hysteresis

The hysteresis determines the level or volume at which the relay re-energises after the trip point has been exceeded or undershot. It is expressed as a level or volume and is entered at V1H2 for relay 1 or V1H7 for relay 2:

Step	Matrix	Entry	Significance
1	V1H2	e.g. 400	Hysteresis for relay 1 (in the unit displayed in field V0H0)
2	-	»E«	Register entry

Relay at fault

When the relays are assigned to channel 1 and the self-monitoring circuit triggers on a fault, relay 1 responds according to the entry at V1H3 and relay 2 to the entry at V1H8:

- 0 = de-energised
- 1 = as analogue output, i.e. –10%, +110% or hold depending on entry at V0H7.

Step	Matrix	Entry	Significance
1	V1H3	e.g. 0	The relay 1 de-energises at fault
2	-	»E«	Register entry

With option 1, the behaviour of the analog output, which was preset in V0H7, determines the reaction of the relay to a fault. Table 7.3 summarizes the possibilities:

Table 7.3: Relay response on fault condition.

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

7.2 Applications

Depending on the hysteresis settings, several operating modes are possible for continuous measurement at channel 1:

- limit switch
- two point operation with one relay
- two point operation with two relays

Limit switch

If the relay is to act as a limit switch only: Set the hysteresis at V1H2 or V1H7 low or to 0. The relay trips when the level of volume drops below or rises above the switch point. When the level or volume returns to normal, the relay energises almost immediately.

Step	Matrix	Entry	Significance
1	V1H0	e.g. 10	Switch point = 10
2	-	»E«	Register entry
3	V1H1	0	Minimum fail-safe mode
4	-	»E«	Register entry
5	V1H2	10	Hysteresis = 10, the relay energises again at level = 20
6	-	»E«	Register entry

Two-point operation with one relay

If a particular level or volume range has to be maintained, this can be achieved by setting an appropriate maximum (or minimum level) and hysteresis. For example, the relay is set to maximum fail-safe mode.

- Set the switch point to maximum permissible volume or level.
- Set the hysteresis to the level or volume difference you want to control.

The level rises until the maximum is exceeded, at which point the relay triggers and the pump is switched off. The relay energises again when the maximum level – hysteresis has been reached.

- Maximum level – hysteresis

The pump switches on again.

Procedure

Step	Matrix	Entry	Significance
1	V1H0	e.g. 1900	Switch point 1 = 1900
2	-	»E«	Register entry
3	V1H1	1	Maximum fail-safe mode
4	-	»E«	Register entry
5	V1H2	e.g. 400	Hysteresis = 400, the relay energises again at level = 1500
6	-	»E«	Register entry

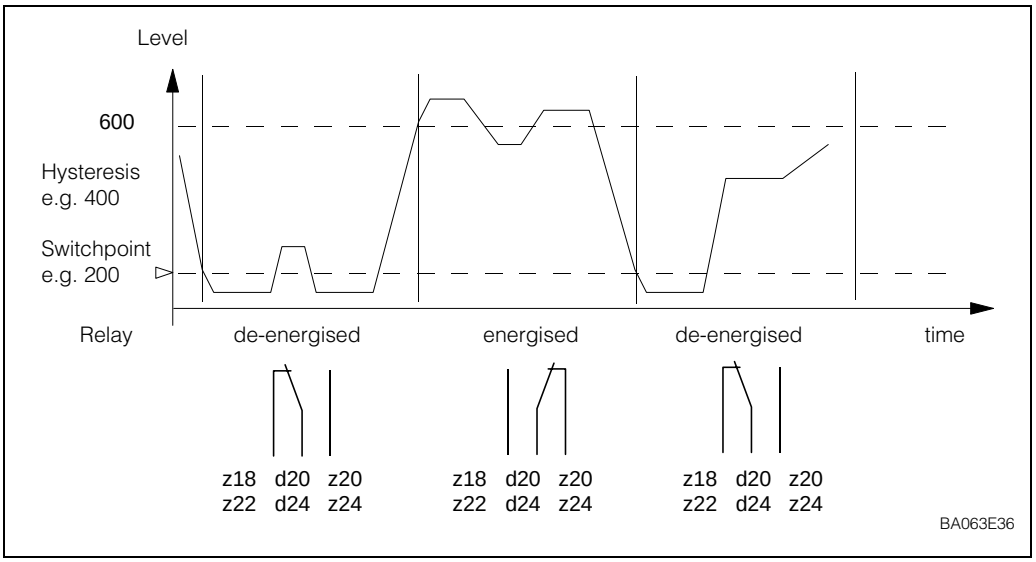


Fig. 7.1:
Range switching with minimum fail-safe mode

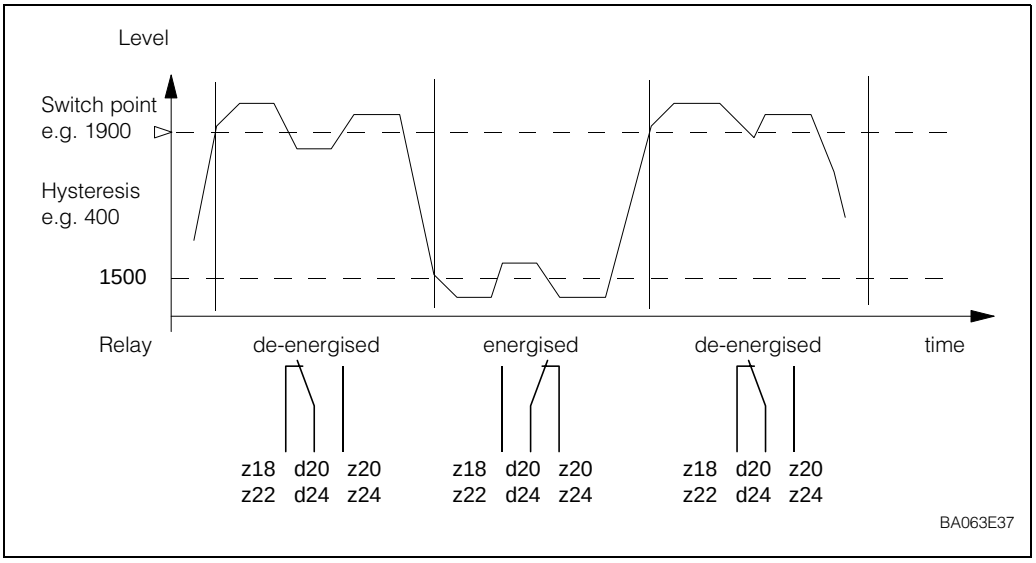


Fig. 7.2:
Range switching with maximum fail-safe mode

Two-point operation with two relays

This mode of operation is achieved by setting the hysteresis of both relays such that:

- minimum level/volume + hysteresis = maximum level/volume
- maximum level/volume – hysteresis = minimum level/volume

Relay 1 is set for maximum and relay 2 for minimum fail-safe mode in the same channel:

- When the level drops below the minimum relay 2 de-energises, relay 1 energises
- When the level rises above the maximum relay 1 de-energises, relay 2 energises.

Step	Matrix	Entry	Significance
1	V1H9	1	Assign relay 2 to channel 1
2	-	»E«	Register entry
3	V1H0	e.g. 1800	Switch point, relay 1 = 1800
4	-	»E«	Register entry
5	V1H1	1	Maximum fail-safe mode
6	-	»E«	Register entry
7	V1H2	e.g. 1600	Hysteresis = 1600, the relay energises again at 200
8	-	»E«	Register entry
9	V1H5	e.g. 200	Switch point, relay 2 = 200
10	-	»E«	Register entry
11	V1H6	0	Minimum fail-safe mode
12	-	»E«	Registers entry
13	V1H7	e.g. 1600	Hysteresis = 1600, the relay energises again at 1800
14	-	»E«	Register entry

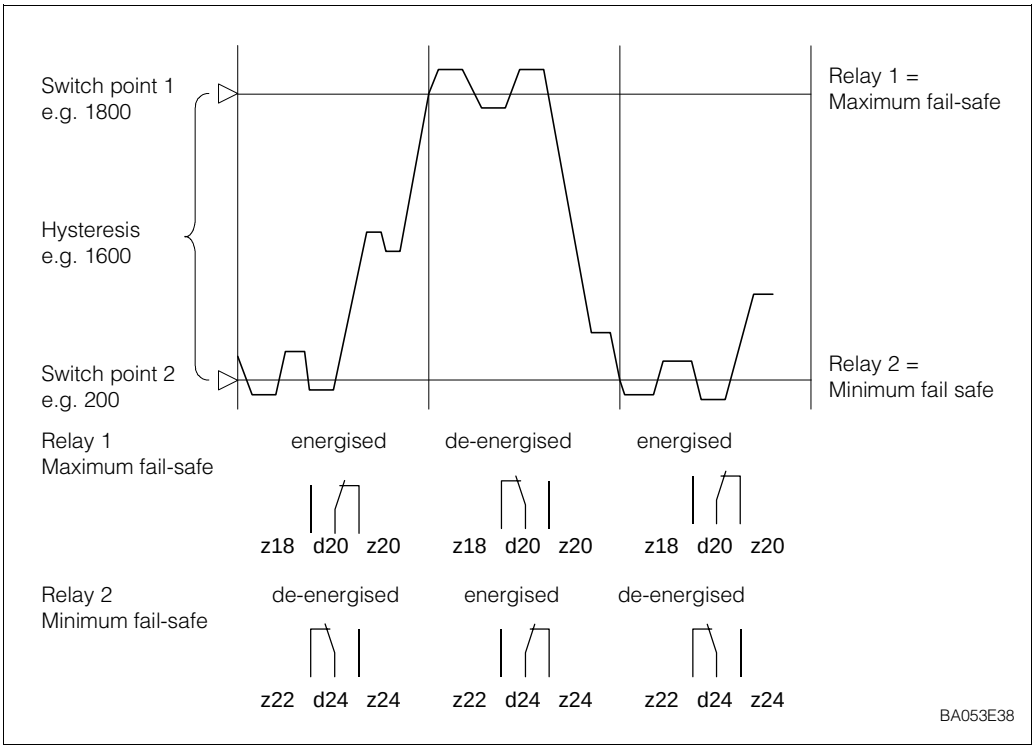


Fig. 7.3: Two-point operation with two relays

8 Other Applications

This chapter describes the configuration of Silometer FMC 671 Z/676 Z for other applications. The applications described are:

- »Dry Calibration« for continuous level measurement with Deltapilot probes
- Level limit switching
- Continuous level measurement with independent level limit detection
- Level measurement with automatic calibration correction

8.1 »Dry calibration« for continuous level measurement with Deltapilot probes

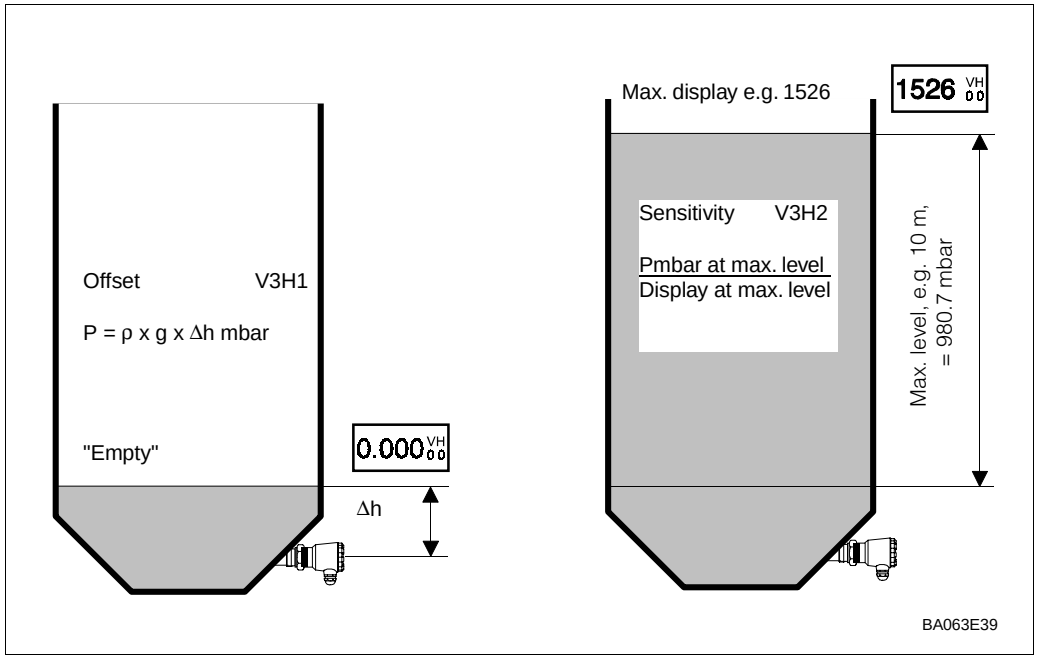


Fig. 8.1: Parameters required for »dry calibration« of the Silometer FMC 671 Z/676 Z, ...

For Deltapilot probes it is possible to calibrate the Silometer FMC 671 Z/676 Z »dry« by using the probe characteristics. For this alternative calibration you need:

- the »zero frequency« and »sensitivity« of the sensors,
- the »empty« level or offset at which the measurement should start
- the maximum height
- the density of the liquid.

The calibration is performed with an empty tank at atmospheric pressure.

Probe constants

The probe constants are listed in table 9.3, page 55:

- The zero frequency is marked »f_O« in Hz. This is the standard frequency of the probe at atmospheric pressure.
  - Provided the sensor is unpressurized, the actual frequency, which takes into account orientation effects, can be read at V0H8.
- The sensitivity is marked »Δf« in Hz/mbar. This is the increase in frequency for every mbar increase in hydrostatic pressure.

These parameters are entered at V3H5 and V3H6 respectively.

Offset level, V3H1

The offset is the hydrostatic pressure in mbar acting on the probe when the vessel is filled to the desired »empty« level. When the value is entered at V3H1, the Silometer will indicate 0 for this level.

- If the default value 0 is used, the zero level is at the point of installation of the Deltapilot probe.

The hydrostatic pressure is calculated from the density and »empty« level:

p_{mbar} = ρ (kg/dm^3) x g (m/s^2) x Δh (m) x 10 mbar

Example
The Silometer must display 0 for an »empty« level of 45 cm water, the offset p_{mbar} is:

p_{mbar} = 1.0 x 9.807 x 0.45 x 10 = 44.13 mbar

Display sensitivity, V3H2

The sensitivity specification in V3H2 determines the increase in the measured value per mbar pressure rise at the Deltapilot S probe.

$Sensitivity_{mbar/digit}$ = p_{max}/required display at V0H0 for p_{max}

Example
The maximum level 10 m corresponds to 1526 m^3

p_{max} = ρ (kg/dm^3) x g (m/s^2) x h (m) x 10 mbar
= 1.0 x 9.807 x 10 x 10
= 980.7 mbar

To display *volume (m^3)*

$Sensitivity_{mbar/digit}$ = 980.7/1526 = 0.64266 mbar/digit

To display *level (m)*

$Sensitivity_{mbar/digit}$ = 980.7/10 = 98.07 mbar/digit

Procedure

The calibration, described here for operating mode 1, should be carried out preferably with an empty tank (probe at bottom, dry and unpressurized). If tank is partially filled, take over f0 from stick-on label.

- Initial filling of the tank should be carried out under close supervision so that the results of a possible calculation error can be recognized in good time.

Step	Matrix	Entry	Significance
1	V9H5	e.g. 672	Reset transmitter
2	-	»E«	Register entry
3	V0H2	e.g. 1526	Enter volume used for sensitivity calculation - for level measurement enter level (e.g. 10 m)
4	-	»E«	Register entry
5	V3H5	e.g. 99.5	Enter frequency »f_O« at V0H8
6	-	»E«	Register entry
7	V3H6	e.g. 1.054	Enter sensitivity »Δf«
8	-	»E«	Register entry
9	V3H1	e.g. 44.13	Enter offset level (V0H0 = 0 for 45 cm water)
10	-	»E«	Register entry
11	V3H2	e.g. .6426	Enter display sensitivity (V0H0 = 1526 for 10 m water) - for level enter e.g. 98.07
12	-	»E«	Register entry

8.2 Level limit switching

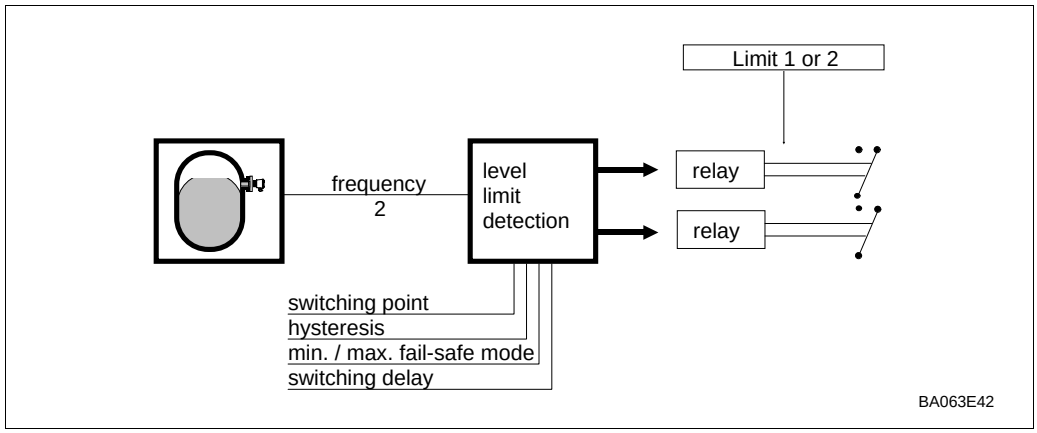


Fig. 8.2:
Schematic diagram, limit level switching
Relay 1 must be assigned to channel 2 at V1H4

Operating mode 2 is used for level limit detection in fluids or bulk solids. To serve as a limit signal transmitter,

- a capacitance probe for liquids or bulk solids or
- a vibration limit switch, Liquiphant for liquids or Soliphant for bulk solids,

can be connected at channel 2.

Relay settings

In operating mode 2, the relay switch points are in Hz. On fault condition, the relays de-energise, fail-safe mode is set at V1H1/V1H6 (default = maximum).

- Enter 2 at V1H4 to switch relay 1 to channel 2
- For capacitive probes, the result of the calibration at V8H5 is written in Hz into field V1H5
- The switching point, and hysteresis for Relais 1 are entered in Hz at V1H0/V1H2 (take values from V1H5/V1H7).

Capacitance probe

Fig. 8.3 shows the set up for limit switching with capacitance probes. The probe can be built in horizontally or vertically. The relay trips as soon as the product exceeds the calibration point set at V8H6. The entry at V8H6 provides build-up compensation by shifting the switch point for vertical probes by the amount indicated in Table 8.1. The default value 1 Hz = approx. 5 pF. A higher value decreases the sensitivity.

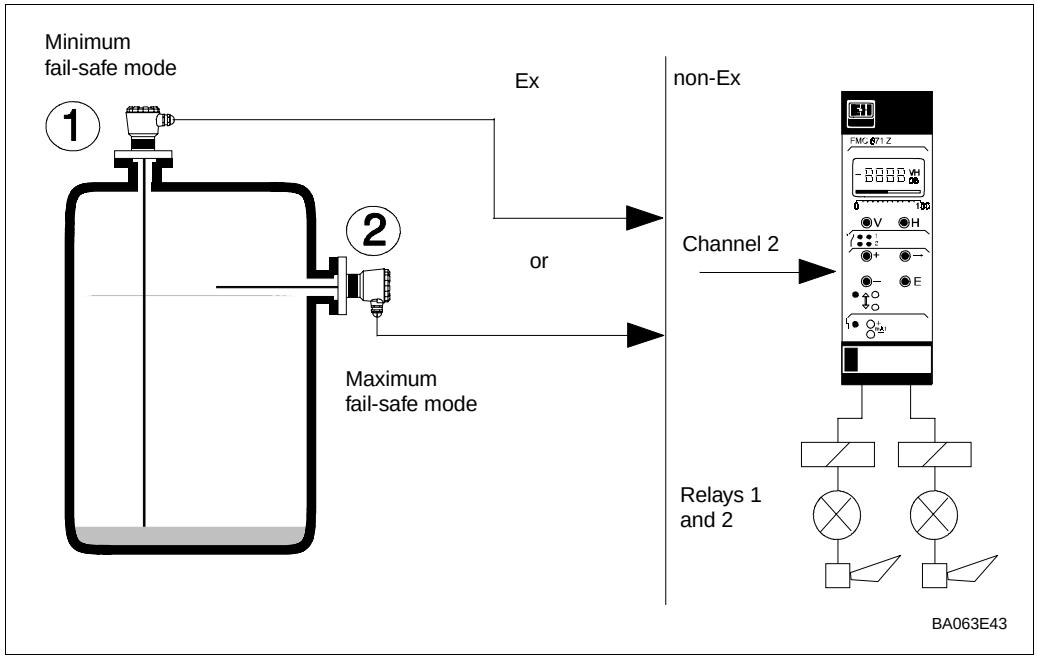


Fig. 8.3:
Schematic diagram, limit level switching with capacitance probes
① Minimum fail-safe
② Maximum fail-safe

Calibration for capacitance probes

Step	Matrix	Entry	Significance
1	V9H5	671	Reset transmitter
2	-	»E«	Register entry
3	V8H0	2	Select level switching mode - If 0 is entered, both level measurement (channel 1) and level switching (channel 2) is possible
4	-	»E«	Register entry
5	V8H4	1	Set sensor type to capacitance probe
6	-	»E«	Register entry
7	V8H6	e.g. 1	Set switching point in Hz (build-up compensation) - 1 Hz ≅ 5 pF, see Table 8.1
8	-	»E«	Register entry
9	V8H5		*Either*
		0	Calibrate with exposed probe
10	-	»E«	Register entry (frequency stored at V1H5)
9	V8H5		*or*
		1	Calibrate with covered probe
10	-	»E«	Register entry (frequency stored at V1H5)
11	V1H4	2	If appropriate, assign relay 1 to channel 2 - Enter same values in V1H0/V1H2 as are to be found at V1H5/V1H7
12	-	»E«	Register entry
13	V1H1/V1H6	e.g. 0	Select fail-safe mode - 1 = maximum (default), 0 = minimum
14	-	»E«	Register entry
15	V8H2	e.g. 2	Set relay switching delay in seconds (default = 1 s)
16	-	»E«	Register entry

Note!

Note!

- At step 9, always press button »E« even if the correct digit has already appeared in the display.
- The value in field V1H7 must be less than that in V8H6 otherwise the relay will not switch correctly

Table 8.1: Switching point adjustment for default value of 1 Hz = 5 pF as a function of product

Product	Dielectric constant εr	Conductivity	Switching 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)
aqueous liquids	>3	high	ca. 30 mm	ca. 30 mm

Liquiphant or Soliphant

Fig. 8.4 shows the arrangement for Liquiphant or Soliphant vibration sensors. The relay trips when the product rises above or drops below the sensor. The default value of 90 Hz for the switching point is correct for this application.

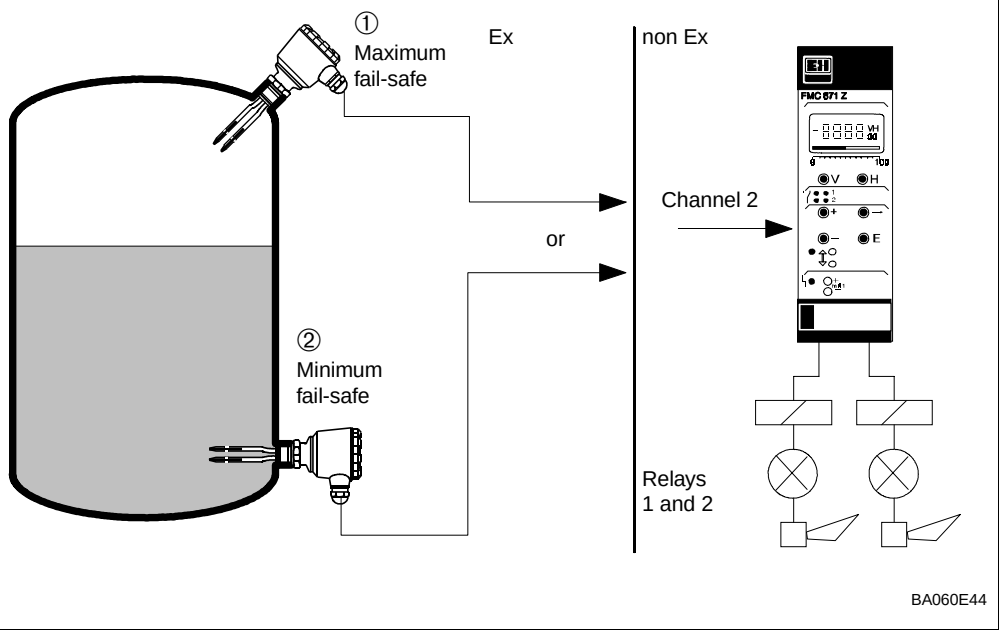


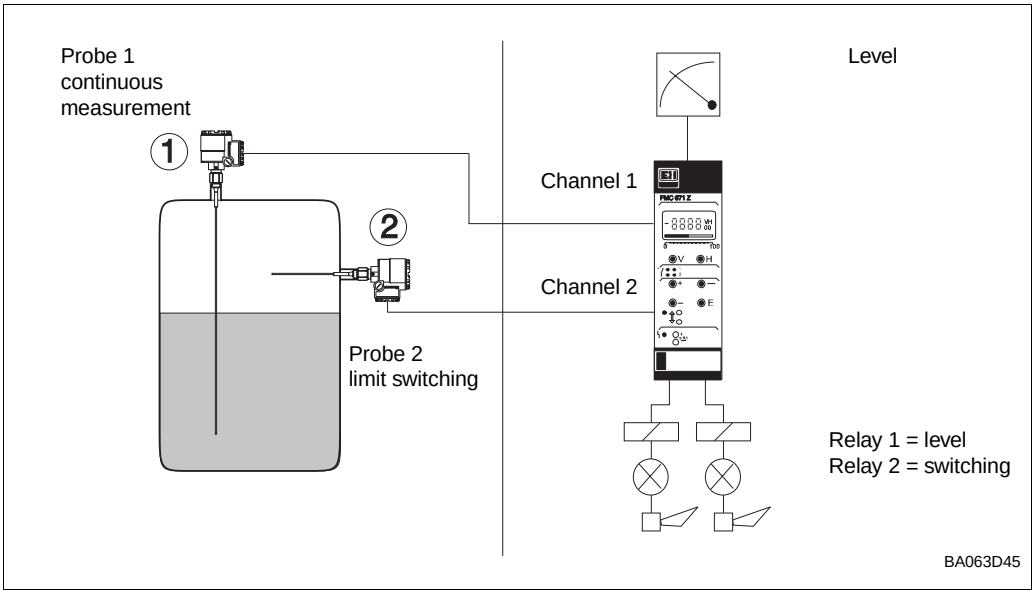
Fig. 8.4: Standard installation for limit switching with vibration sensors

Calibration for vibration sensor

Step	Matrix	Entry	Significance
1	V9H5	e.g. 672	Reset transmitter
2	-	»E«	Register entry
3	V8H0	2	Select level switching mode - if 0 is entered, both level measurement (channel 1) and level switching (channel 2) is possible
4	-	»E«	Register entry
5	V8H4	0	Sensor type = enter vibration probe
6	-	»E«	Register entry
7	V1H4	2	If appropriate, assign relay 1 to channel 2
8	-	»E«	Register entry
9	V1H1/V1H6	e.g. 0	Select fail-safe mode - 1 = maximum (default), 0 = minimum
10	-	»E«	Register entry
11	V8H2	e.g. 2	Set relay switching delay in seconds (default = 1 s)
12	-	»E«	Register entry

8.3 Continuous level measurement with separate level limit detection

Fig. 8.5: Operating mode 0 Continuous level measurement with simultaneous level switching



Operating mode 0 allows level measurement on channel 1 and level switching on channel 2. *If a Deltapilot S is being used, only a Liquiphant can be used as limit switch.* Each channel is assignet to a relay.

- Relay 1 (channel 1) and relay 2 (channel 2) are set as described in Chapter 6 and Section 8.2.
- Calibration for each channel is as described in Chapter 4 and Section 8.2.

For capacitance probes the system can be calibrated as follows:

Level limit probe calibration with empty vessel

Step	Matrix	Entry	Significance
1	V9H5	e.g. 672	Reset transmitter
2	-	»E«	Register entry
3	V8H0	0	Select level switching mode
4	-	»E«	Register entry
5	V8H4	1	Set sensor type to capacitance probe
6	-	»E«	Register entry
7	V8H6	e.g. 1	Set switching point in Hz
8 -		»E«	Register entry
9	V8H5	0	Calibrate with probe uncovered
10	-	»E«	Register entry (must be pressed!!)

Level calibration

Step	Matrix	Entry	Significance
1	V0H1	e.g. 10%	With vessel 0…40% full, enter current level
2	-	»E«	Register entry
3	V0H2	e.g. 90%	With vessel 60…100% full, enter current level
4	-	»E«	Register entry

8.4 Level measurement with automatic calibration correction

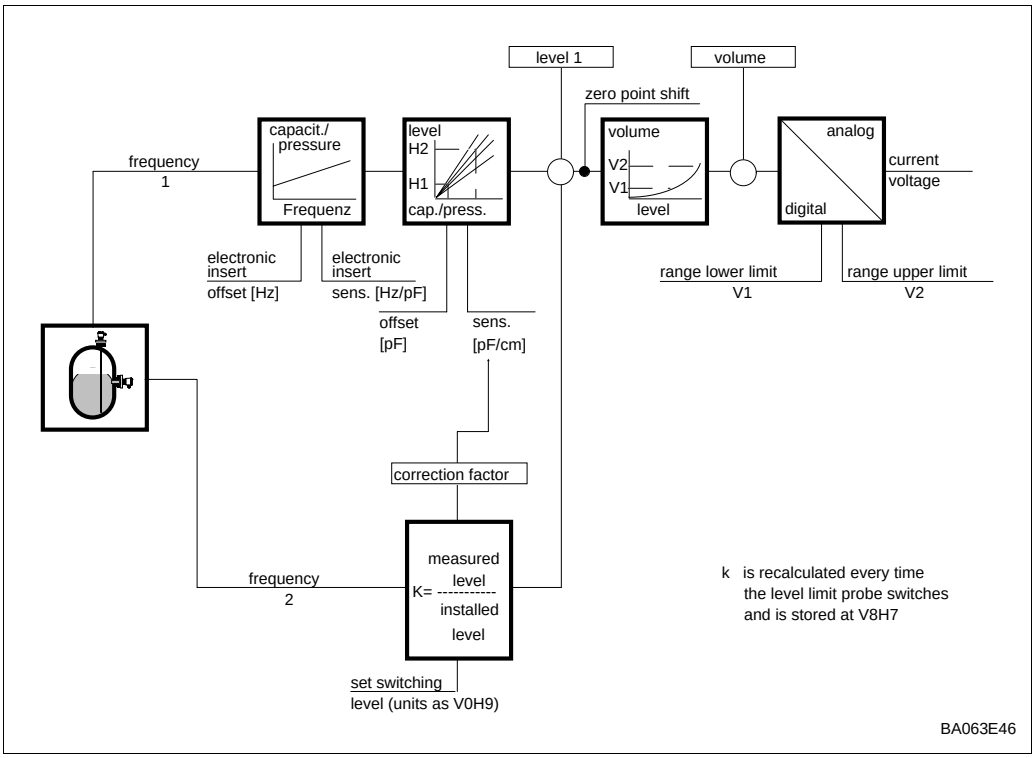


Fig. 8.6:
Schematic diagram of automatic calibration correction

Operating mode 5 employs the limit switch 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 conductivity or dielectric constant for capacitance probes or in density for Deltapilot S, the level displayed at V0H0 is corrected. *If a Deltapilot S is being used, only a Liquiphant can be used as limit switch.*

The calibration at channel 1 is corrected every time the product passes the switching point. A plausibility check prevents

- if the measured level is less than the installation height of the level limit probe when this is covered
- if the measured level is greater than the installation height (V8H3) of the level limit probe when this is uncovered.

Installation hints

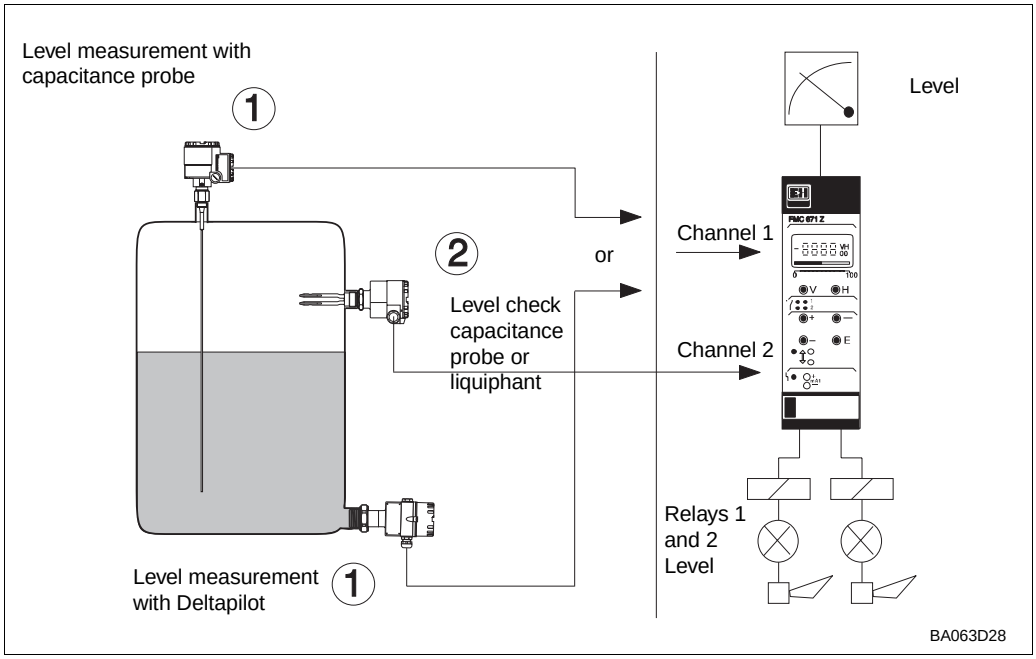
Install the switching probe where:

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

If, for level measurement with capacitance probes, the product is frequently changed, the switching probe must be installed in the side of the vessel or a Liquiphant must be used. For this arrangement, the properties may not change during a filling operation, since there is no means of continuous compensation.

- It is imperative that the limit switch trips even with the smallest dielectric constants (capacitance probe) and across the entire density range (vibration sensor).
- To safely avoid overfilling, it may be necessary to install in separate overspill protection system.
- This operating mode is not recommended for bulk solids.
- When using a capacitive limit level probe, where possible the calibration of the limit switch should only be carried out with the probe free.

Fig. 8.7: Arrangement for continuous level measurement with automatic calibration correction



Sensor calibration with vessel empty

Step	Matrix	Entry	Significance
1	V9H5	e.g. 672	Reset transmitter
2	-	»E«	Register entry
Note! See also Section 4.1 Commissioning, V3H5; V3H6			
3	V8H0	5	Enter operating mode
4	-	»E«	Register entry
5	V8H2	4 s	Set switching delay to min. 4 s
6	-	»E«	Register entry
7	V8H3	e.g. 80%	Enter installation height of limit switch in same unit as level in channel 1
8	-	»E«	Register entry
9	V8H4	0	Enter sensor type: 0 = Liquiphant; 1 =capacitance probe
10	-	»E«	Register entry
11	V8H5	0	only for capacitance probes (channel 2) Perform calibration with exposed probe
12	-	»E«	Register entry
13	V8H6	e.g. 1	only for capacitance probes (channel 2) Set switching point in Hz, **Section 8.2**
14	-	»E«	Register entry
16	V8H7	1	Set correction factor to 1.0
17	-	»E«	Register entry

"Empty" calibration

Step	Matrix	Entry	Significance
1	V0H1	0%	Enter »empty«level of zero
2	-	»E«	Register entry

Note!

Note!

- The »full« calibration is carried out automatically when the product reaches the switching probe. 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.
- Analogue output and relays are set as described in Chapter 6 and 7.

Calibration with partially filled vessel

If the following calibration during the hydrostatic level measurement is carried out with water (density = 1g/cm3), the correction factor indicated in the V8H7 corresponds in each case to the density of the product.

Sensor calibration

Step	Matrix	Entry	Significance
1	V9H5	e.g. 672	Reset transmitter
2	-	»E«	Register entry
Note! See also Section 4.1 Commissioning, V3H5; V3H6			
3	V8H0	5	Enter operating mode
4	-	»E«	Register entry
5	V8H2	4 s	Set switching delay to min. 4 s
6	-	»E«	Register entry
7	V8H3	e.g. 80%	Enter installation height of limit switch in desired unit
8	-	»E«	Register entry
9	V8H4	0	Enter sensor type: 0 = Liquiphant; 1 = capacitance probe
10	-	»E«	Register entry
11	V8H5	0	only for capacitance probes (channel 2) Perform calibration with exposed probe
12	-	»E«	Register entry
13	V8H6	e.g. 1	only for capacitance probes (channel 2) Set switching point in Hz, **Section 8.2**
14	-	»E«	Register entry

Level calibration

Step	Matrix	Entry	Significance
1	V8H7	1	With vessel partially filled (0…40 %), enter density (correction factor)
2	-	»E«	Register entry
3	V0H1	e.g. 10%	Enter »empty« level
4	-	»E«	Register entry
2	V8H7	1	Fill vessel (60…100%) and re-enter density (correction factor)
3	-	»E«	Register entry
3	V0H2	e.g. 90%	Enter »full« level
4	-	»E«	Register entry

Note!

- The best accuracy is attained when the difference between »full« and »empty« levels is as great as possible.
- If operating mode 5 is temporarily quit, the Silometer measures by using the sensitivity V3H2 x V8H7. The indication remains correct as long as the same product is in the tank.
- Analogue output and relays are set as described in Chapter 6 and 7.

Note!

9 Trouble-Shooting

This Chapter contains the following:

- Faults and warnings
- Fault analysis
- Simulation
- Instructions for commissioning replacement probes and transmitters.
- Repairs

9.1 Faults and warnings

Fault condition

When the FMC 671 Z/676 Z transmitter recognizes a fault condition:

- the red fault LED lights and the alarm relay trips.
- the output current reverts to the status selected in field V0H7
- the limit value relays assume fail-safe mode as specified in fields V1H3 and V1H8.

A diagnostic message is given in Field V9H0:

- The last diagnostic message is retained in V9H1.
- This message can be cleared by pressing the »E« key.

If the power fails, all relays de-energise.

Warnings

When the FMC 671 Z/676 Z transmitter has detected a warning:

- the red fault LED flashes but the Silometer continues to measure
- the alarm relay remains energised
- the appropriate message is to be found in V9H0.

The error messages are listed in Table 9.1 in the order of their priority.
Table 9.2, trouble-shooting, indicates possible configuration errors for the Silometer FMC 671 Z/676 Z.

Fault messages and warnings

The fault sequence is priority-based, i.e. if a low-priority fault is present and another fault with higher priority occurs, the fault with the highest priority is displayed. The previous error is shown in V9H1.

Table 9.1: Error messages

Code	Type	Cause and Remedy
E 101-106	Fault	Fault in instrument electronics - Call Endress+Hauser Service
E 107	Fault	Battery voltage too low - Make back-up of entered parameters immediately - Have battery changed at once by trained personel
E 201-202	Fault	Fault in probe on channel 1 (f < 35 Hz; f > 3000 Hz) - Check probe and electronic insert
E 301-302	Fault	Fault in probe on channel 2 (f < 35 Hz; f > 3000 Hz) - Check probe and electronic insert
E 400	Fault	Fault in probe on channels 1 + 2 - Check probe, electronic insert and wiring - Incorrect operating mode selected (only one probe), operating mode V8H0
E 401	Fault	Fault in probe or wiring, channel 1 - Check probe, electronic insert and wiring - Incorrect operating mode
E 402	Fault	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	Linearization does not rise monotonously (volume does not increase with level) - Check and re-enter correct values
E 604	Warning	Linearization has less than two sets of values - Enter more values
E 606	Warning	No stored factory linearization (V2H6 = 0) - Select another linearisation function. The diagnostic code can be eliminated by pressing the »E« button in field 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

Fault analysis

Table 9.2 contains a list of possible faults and their remedies.

Table 9.2: 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 • Build-up - Wire electronic insert for build-up, recalibrate • 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 • Sensor damaged - Check and remedy
Capacitance 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 9.3, if the relays switch, check wiring
Capacitance Channel 2	Does not switch correctly	• Incorrect calibration? - V1H7 ≥ V8H6? - Change in product, build-up • Settings wrong - Check 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 - Clean regularly • Settings wrong - Check type of probe, fail-safe function, switching delay • Probe damaged or bent

9.2 Simulation

Simulation can be used to check the FMC 671 Z/676 Z and external downstream devices. Four modes are possible:

- Simulation of frequency, V9H6
- Simulation of level, V9H7
- Simulation of volume, V9H8
- Simulation of current, V9H9.

When a value is entered at the appropriate matrix, the analog outputs are fed with the appropriate current and voltage.

Activation

Enter operating mode 6 for channel 1 or 7 for channel 2 in V8H0; the red alarm LED flashes during the simulation.

Step	Matrix	Entry	Significance
1	V8H0	e.g. 6	Operating mode 6, simulation channel 1
2	-	»E«	Registers entry

Frequency simulation

Step	Matrix	Entry	Significance
1	V9H6	e.g. 100	Depending upon the calibration and linearization, a value corresponding to 100 Hz is displayed
2	-	»E«	Registers entry

Level simulation

Step	Matrix	Entry	Significance
1	V9H7	e.g. 10	Depending on the calibration and linearization, the analogue outputs accept values according to the unit in V0V0
2	-	»E«	Registers entry

Volume simulation

Step	Matrix	Entry	Significance
1	V9H8	e.g. 100	Depending on the calibration and linearization, the analogue outputs accept values according to the unit in V0H0
2	-	»E«	Registers entry

Current simulation

Step	Matrix	Entry	Significance
1	V9H9	e.g. 16	The analogue output is fed with a current of 16 mA and the corresponding measured value displayed
2	-	»E«	Registers entry

Deactivation

Step	Matrix	Entry	Significance
1	V8H0	e.g. 0	Operating mode 0, standard measuring
2	-	»E«	Registers entry

9.3 Exchanging transmitters or probes

Transmitter

If the Silometer has to be exchanged, the replacement need not be recalibrated. Instead it is usually sufficient to enter all the matrix values from the old into the new transmitter. The replacement will then measure correctly.

- Where a special order has to be maintained, e.g. activation of linearization after entry of parameters, this should be accounted for during re-entry/down-loading or the steps must be performed separately.
- In the case of level measurement with automatic calibration correction, however, the limit probe must be recalibrated, unless the matrix values are downloaded via the ZA 67… computer interface.

For sensors, the procedure to be followed depends upon the type used.

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 (offset) f_o and
- sensitivity S

for the range selected (default = II) must be entered at V3H5 and V3H6 respectively. Fig. 9.1 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

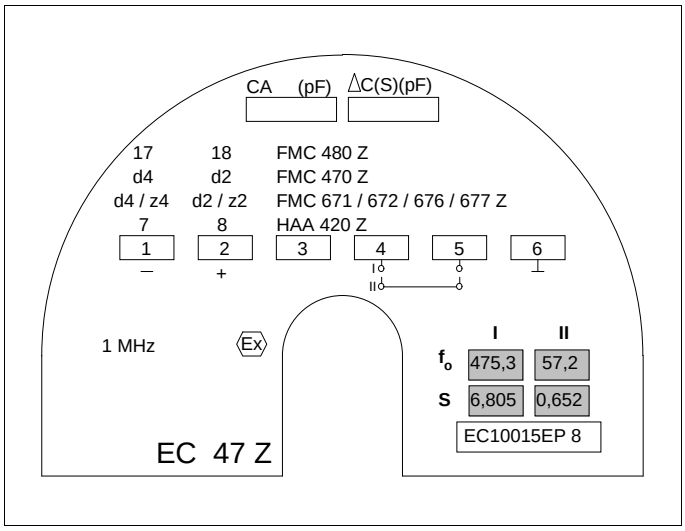


Fig. 9.1: Electronic insert EC 37 Z/ EC 47 Z showing location of probe constants

EC 17 Z insert

If the capacitance probe was used for limit switching, 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 Deltapilot probe constants are dependent on the measuring points.

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

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

Tabelle 9.3: Measuring ranges and probe constants of the Deltapilot S DB 5x

For the Deltapilot, the zero frequency may also be read from V0H8 when the probe is unpressurized. This value gives slightly better accuracy, since it accounts for the orientation of the probe.

Procedure

Step	**Matrix**	**Entry**	**Significance**
1	V3H5	e.g. 101	Enter zero frequency (offset)
2	-	»E«	Register entry
3	V3H6	e.g. 1.052	Enter sensitivity
4	-	»E«	Register entry

Liquiphant/Soliphant

There is no need for calibration when vibration sensors are replaced.

9.4 Repairs

Check the condition of the probes during regular maintenance inspections. If necessary, free them of build-up. Remember that all probes are sensitive instruments and must be treated accordingly.

Should the Silometer FMC 671 Z/676 Z transmitter or its probes 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.

10 Quick programming guide

10.1 Level measurement with separate level switching, capacitance probes

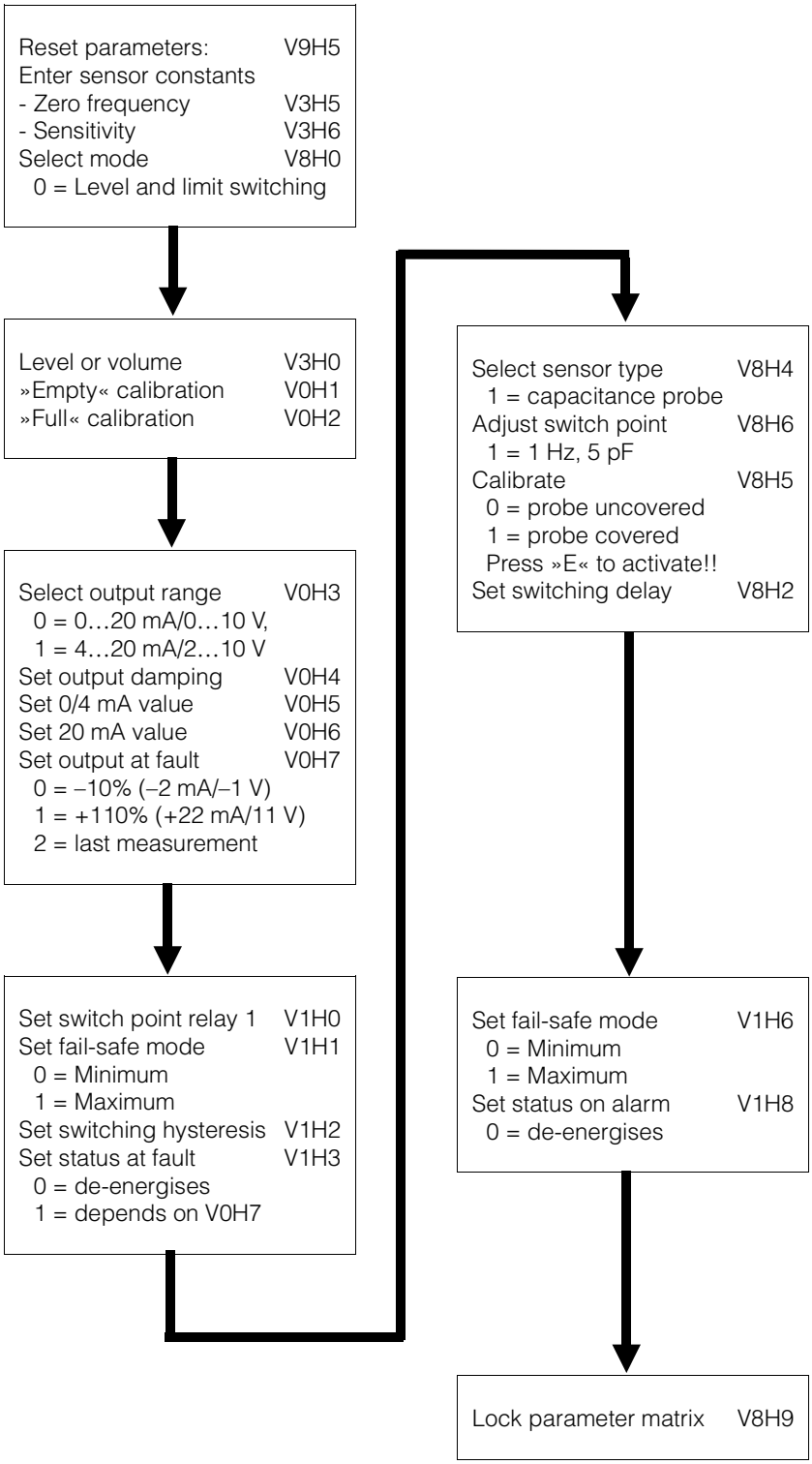
Start
Chapter 4, Section 4.1
- Constants for EC 37 Z/EC 47 Z or EB 17 Z/EB 27 Z
- level is displayed at V0H0

Calibration
Chapter 4, Section 4.2 or 4.3
- After calibration level/volume is displayed at V0H0

Set analogue output signal (optional)
Chapter 6
- Enter settings in the units selected during calibration or linearization

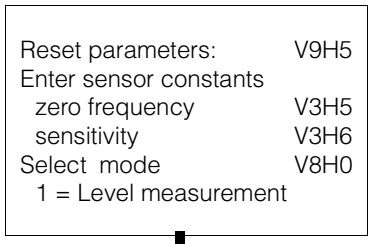
Set relay parameters (optioanal)
Chapter 7

Lock parameter matrix (optional)
Chapter 4, Section 4.6

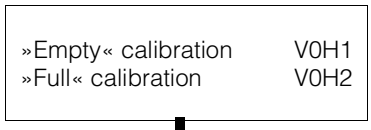


10.2 Continuous volume measurement (linearization)

Start
Chapter 4, Section 4.1
- Constants for EC 37 Z/EC 47 Z or EB 17 Z/EB 27 Z
- level is displayed at V0H0

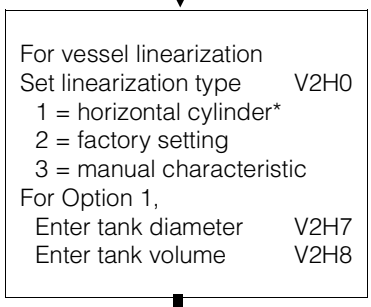


Calibration
Chapter 4, Section 4.3
- After calibration level is displayed at V0H0



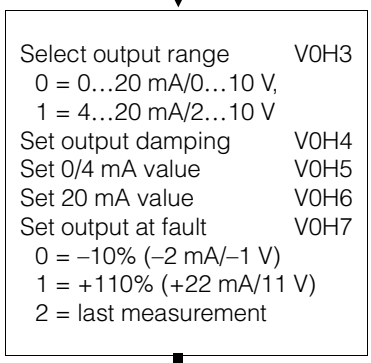
Linearization
Chapter 5
- V0H0 displays volume
- Relays and analogue output must be set in volume units

Level measurement

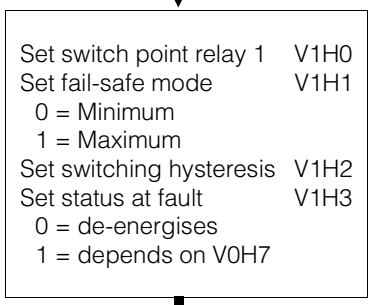


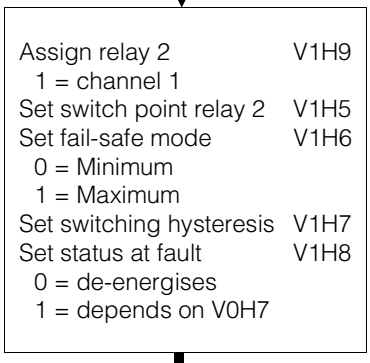
* If the calibration is made in volume units check Section 5.1 for correct linearization/calibration sequence

Set analogue output signal
Chapter 6
- Enter settings in the units selected during calibration or linearization

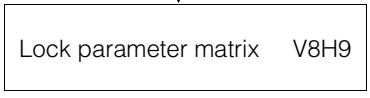


Set relay parameters
Chapter 7
-both relay follow channel 1



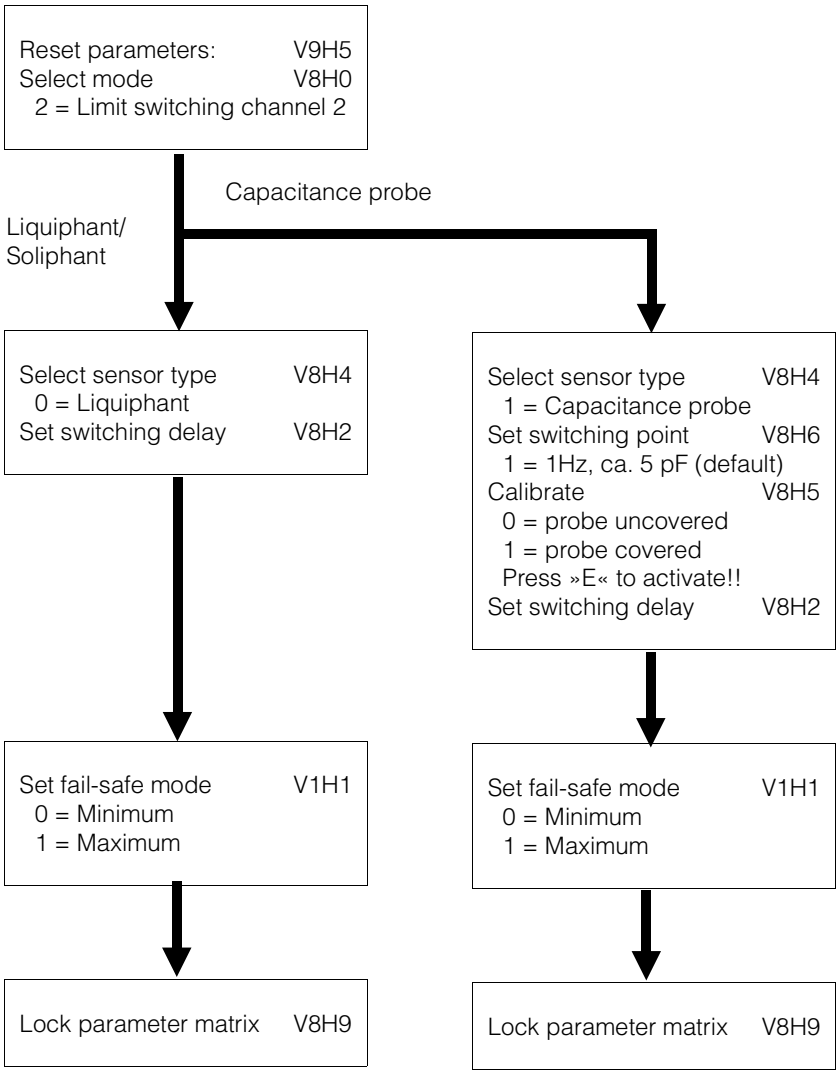


Lock parameter matrix
Chapter 4, Section 4.6



10.3 Level limit switching

Start
Chapter 8, Section 8.2
- Relay responds when the switch point is exceeded or undershot



Calibration
Chapter 8, Section 8.2

Set relay parameters
Section 8.2
- Relay 1 can be assigned to channel 2 by entering = 2 at V1H4

Lock parameter matrix
Chapter 4, Section 4.6

10.4 Level measurement with automatic calibration correction: two capacitance probes

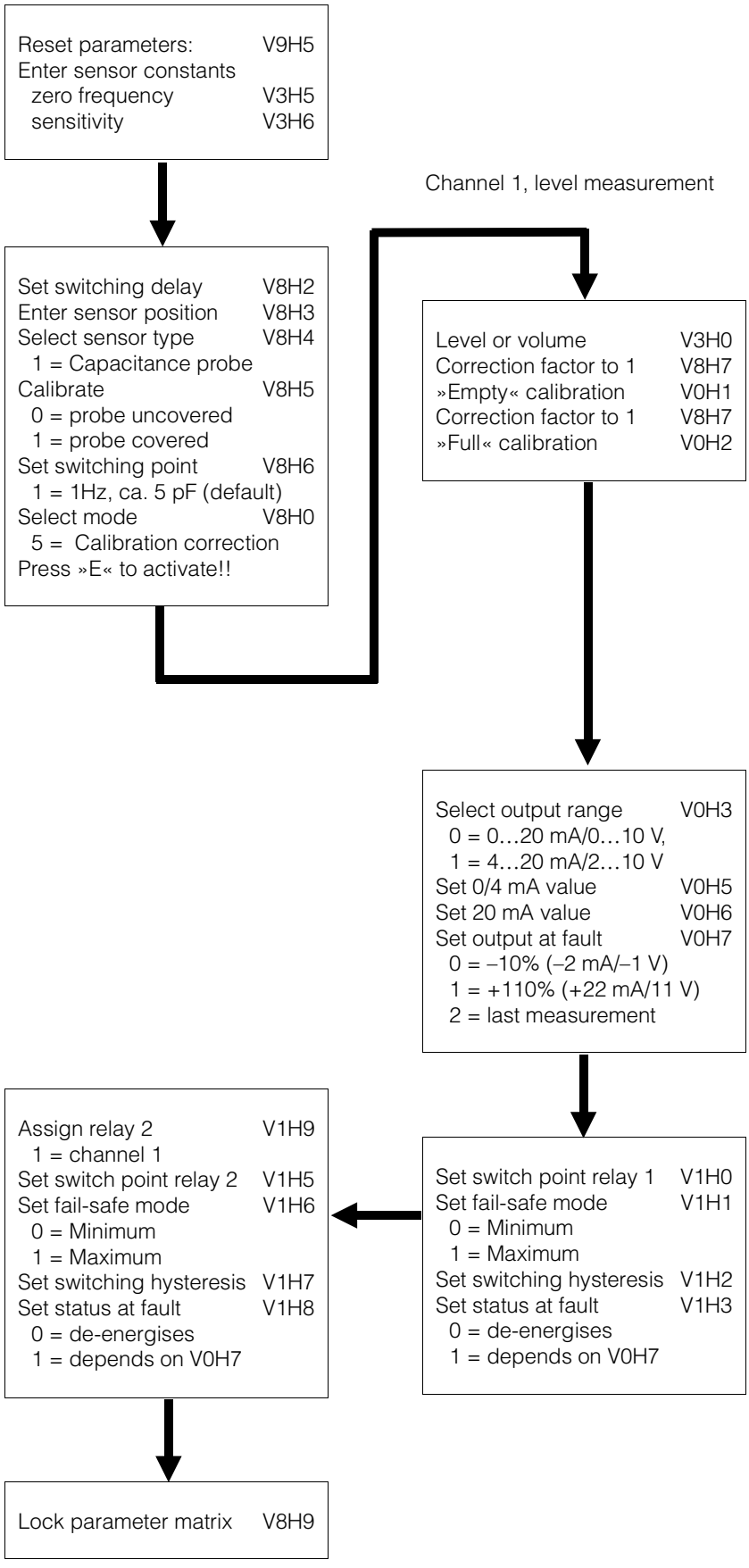
Start
Chapter 4, Section 4.1
- Constants for EC 37 Z/EC 47 Z or EB 17 Z/EB 27 Z
- level is displayed at V0H0

Calibration
Chapter 8, Section 8.4
- After calibration level/volume is displayed at V0H0

Set analogue output signal (optional)
Chapter 6
- Enter settings in the units selected during calibration or linearization

Set relay parameters (optional)
Chapter 7
- Both relays follow channel 1

Lock parameter matrix (optional)
Chapter 4, Section 4.6



Index

A
Analogue outputs 33 - 35
Application 6

C
Calibration
»Dry calibration« for continuous level measurement with Deltapilot probes 41
Level measurement 23
Level limit switching 58
Level limit switching with vibration sensor 45
Level measurement with calibration correction 48 - 49, 59
Level measurement with limit switching 46, 56
Limit level switching for capacitance probes 44, 58
Volume measurement 24, 57
Capacitance probes 54
Certificates 3
Commulog VU 260 Z 17
Configuration
Remote operation 17
Construction 18
Controls 19 - 21

D
Deltapilot sensors 55

E
Electrical connection 18
Electronic inserts 16
Error messages 51

F
Fault 50

I
Indexing pins 13
Indicators 15
Installation 10 - 18

L
Level limit switching
Capacitance probe 43, 58
Vibration sensor 45
Level measurement 36
Level offset 25
Limit level switching 43
Limit switches 36 - 40
Linearization 9, 27 - 32
Cancel settings 32
Horizontal tank 28
Linear characteristic 28, 42
Manual entry of characteristic 32
Tank with conical outlet 29

M
Measured value display 26
Measurement principles 8
Measuring system 7
Monorack protective housing 12
Monorack wiring 15

O
Offset (vessel) 42
Operating matrix 62, 63
Operating mode 22
Operating elements 19 - 21
Output at fault 35
Output damping 34

P
Parameter matrix lock 26
Pin assignment
Monorack housing 15
Silometer FMC 671 Z/676 Z 13
Probes 10

Q
Quick programming guide 56 - 59

R
Rack wiring 13
Rackbus wiring 14
Racksyst installation 11

S
Sensitivity 42
Sensor constants 10, 22, 54
Silometer FMC 671 Z/FMC 676 Z 20, 21
Simulated operation 53
Switch point 37

T
Technical data 18
Transmitter reset 22
Trouble-shooting 50
Two-point relay operation 39 - 40

W
Warnings 4, 50

Z
ZA 67... gateway 17

Operating Matrix

Operating and default matrix

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

This matrix gives an overview of the default values

	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…20 mA 1=4…20 mA	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	Linearization 0=linear 1= hor. cylinder 2=factory 3=manual 4=clear	Level 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	
V3 Extended Calibration Channel 1	Calibration 0=level 1= volume	Offset	Sensitivity		Zero offset value	Offset (electronic insert)	Sensitivity (electronic insert)		D/A calibration 0 mA	D/A calibration 20 mA
V4										
V5										
V6										
V7										
V8	Operat. mode 0 = FMC/FTC 1= only FMC 2 = only FTC 5 = corr. level 6/7 = sim. 1/2		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		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 67...	Tag. No. channel 1	Tag No. channel 2	Units before linearisation	Units after linearisation			Display before linearisation	Display after linearisation		

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