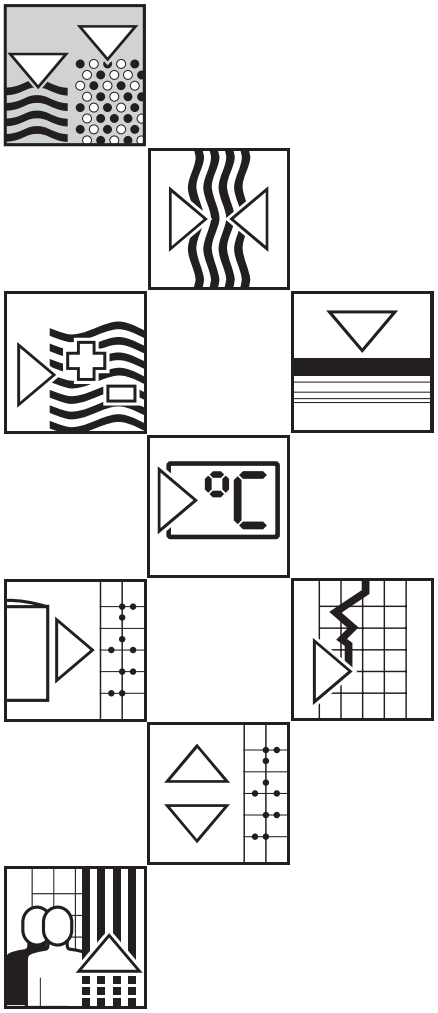
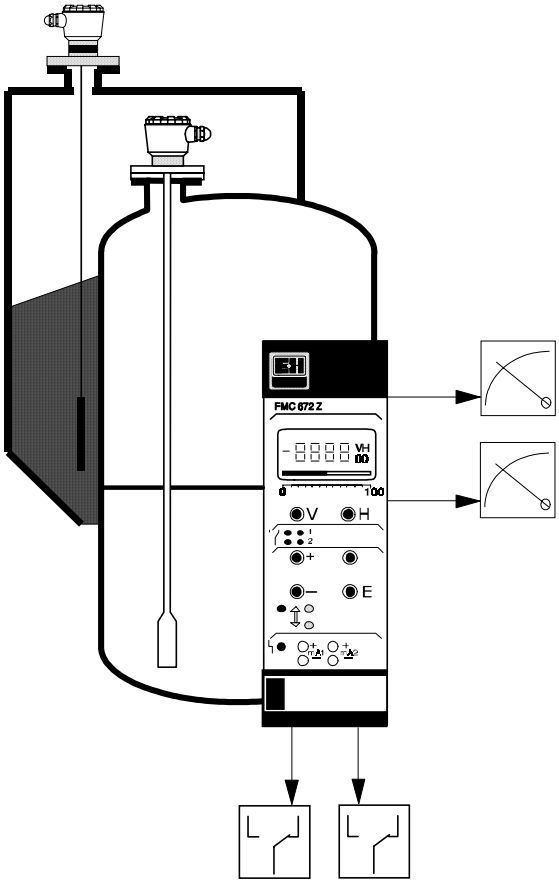
BA 064/00/en/06.03
015576-1000
Software 3.x

silometer
FMC 672 Z/677 Z
Level Measurement

Installation and Operating Instructions

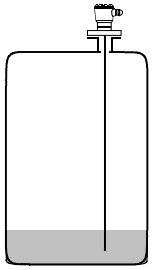
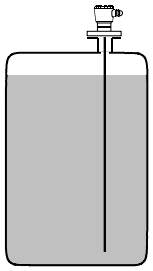
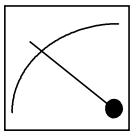
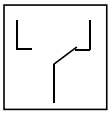




Endress+Hauser

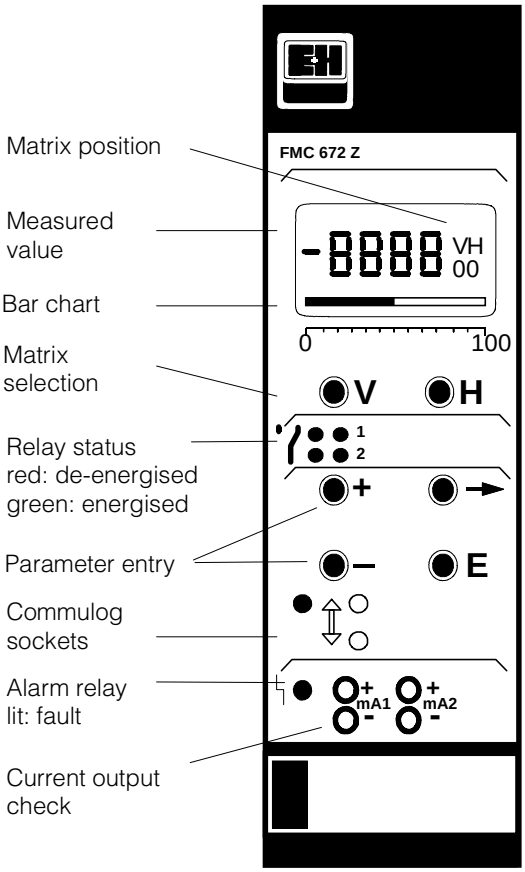
The Power of Know How

Procedure

Function	Channel 1	Channel 2	Action
1 Reset transmitter	**V9H5**		● Enter 671: Use »+« and »-« keys, ⇒ changes digit Press »E« to register entry - Omit for second channel and if commissioned as in Section 4.1
2 »Empty« calibration* 	**V0H1**	**V4H1**	● Fill vessel 0…40% full (probe covered) Enter level in %, m, ft, etc. Press »E« to register entry
3 »Full« calibration* 	**V0H2**	**V4H2**	● Fill vessel 60…100% full Enter level in %, m, ft, etc. Press »E« to register entry
4 0/4 mA signal 	**V0H3** **V0H5** **V0H6**	**V4H3** **V4H5** **V4H6**	● Enter 0 for 0…20 mA, 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**	**V5H0** **V5H1**	● Enter level for switching in calibration units Press »E« to register entry ● Enter fail-safe mode: 0 = minimum 1 = maximum Press »E« to register

*Can be performed in reverse order

FMC 672 Z



V Selects vertical matrix position

H Selects horizontal matrix position

V + H Select positon V0H0

→ Selects next digit

→ + + Move decimal point

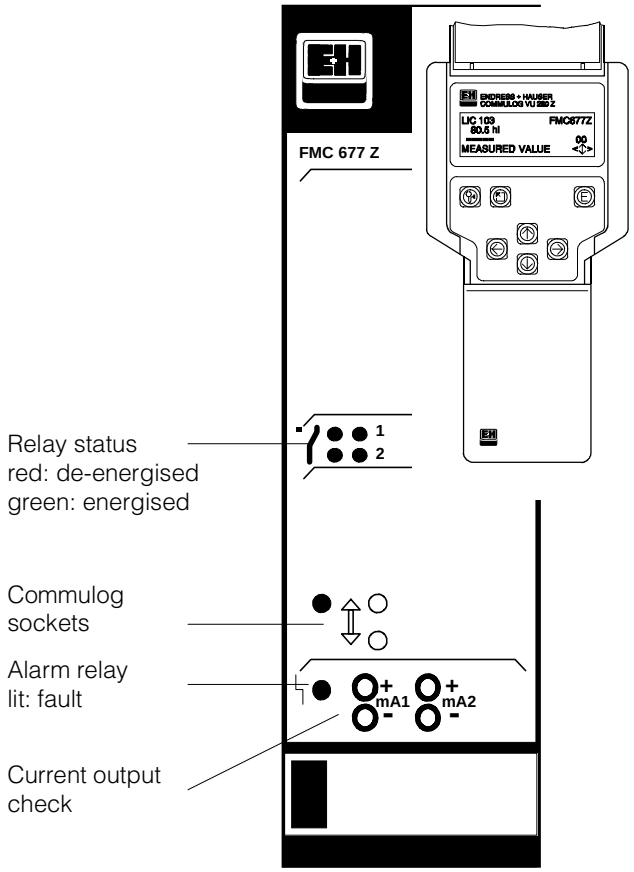
\+ Increases value of digit

– Decreases value of digit

E Registers entry

See also »Controls«, Chapter 3

FMC 677 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

Notes on Safety

The Silometer FMC 672 Z/677 Z is a level measurement transmitter which can be used with a variety of probes and sensors. It must be installed by qualified personnel according to the instructions in this manual.

Certificates

The Silometer FMC 672 Z/677 Z transmitter is available with certificate. The Table below indicates the combinations available and conditions for installation. Full details can be taken from the certificates. Please note that where quoted technical data differs from that listed in Section 2.6, that in the certificate applies.

Certificate	Instruments	Notes
PTB 02 ATEX 2203 X	Silometer FMC 672 Z/677 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) 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 electronic insert EC 17/37/47 Z, FEC 12	CE Ex II 1 G, EEx ia IIC/IIB T6
Z-65.13-107	DC 12 TE, DC .. TE ., DC .. E ., DC .. Capacitance probes 11500 Z, 11961 Z, 21561 Z 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)
German Lloyd GL No. 97517 HH	Silometer FMC 672 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

Safety conventions

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

Note!
- 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 672 Z/677 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 672 Z/677 Z must read the operating instructions. Since it is not possible to describe all applications in detail, the standard application used in 80% of all applications, 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 of continuous level measurement.
- 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: Limit Switches;
  describes in detail the setting of the relays.
- 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

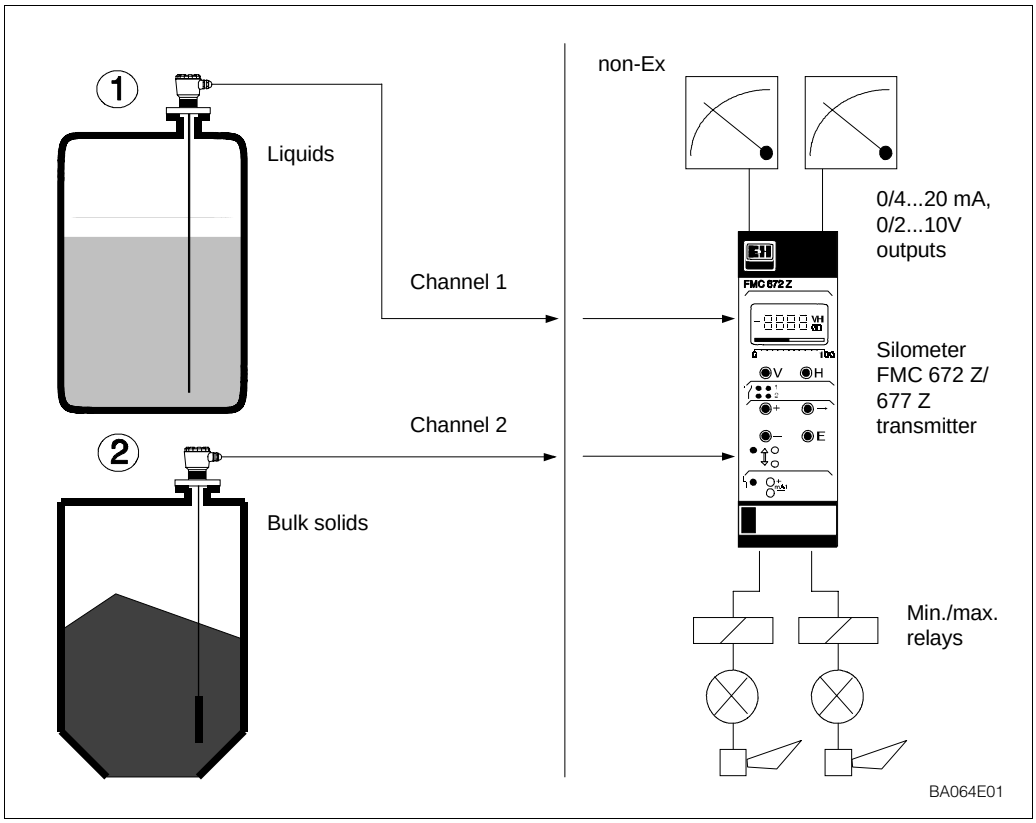
In addition to this manual, the following publications provide information on configuration of the Silometer FMC 672 Z/677 Z.

- 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 showing Silometer FMC 672 Z controlling level measurement
① in liquids
② in bulk solids



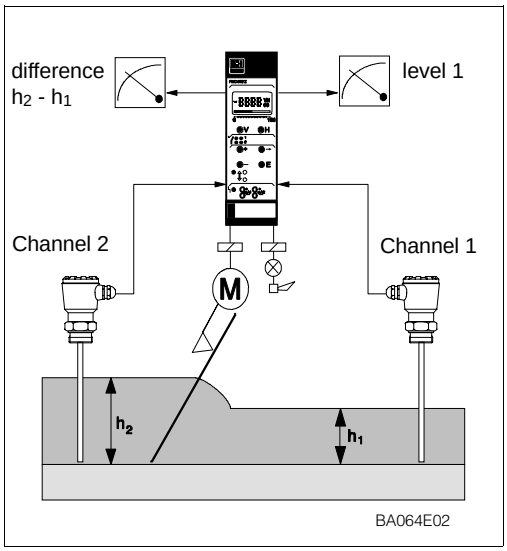
The Silometer FMC 672 Z/677 Z is designed for level measurement on one or two channels with a capacitance or impedance probe. The applications described in this manual are as follows:

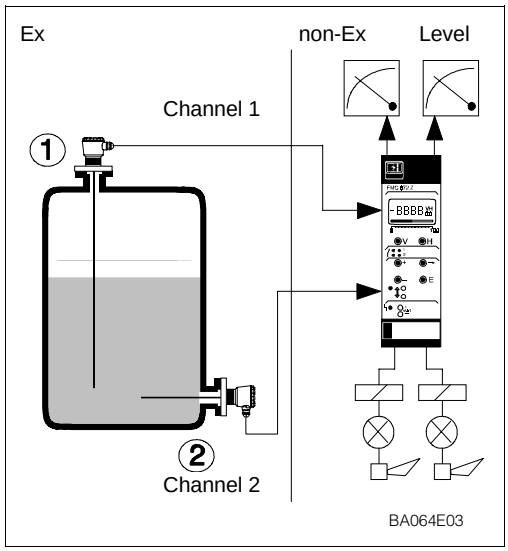
- Continuous level measurement (Chapter 4)
- Volume measurement in horizontal or conical tanks (Chapter 5)
- Differential level measurement (Chapter 8)
- Continuous level measurement with reference probe (Chapter 8).

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:
Level difference measurement with rake control by Silometer FMC 672

Right:
Silometer FMC 672 Z used for continuous level measurement with reference probe
① Measuring probe
② Reference probe





1.2 Measuring system

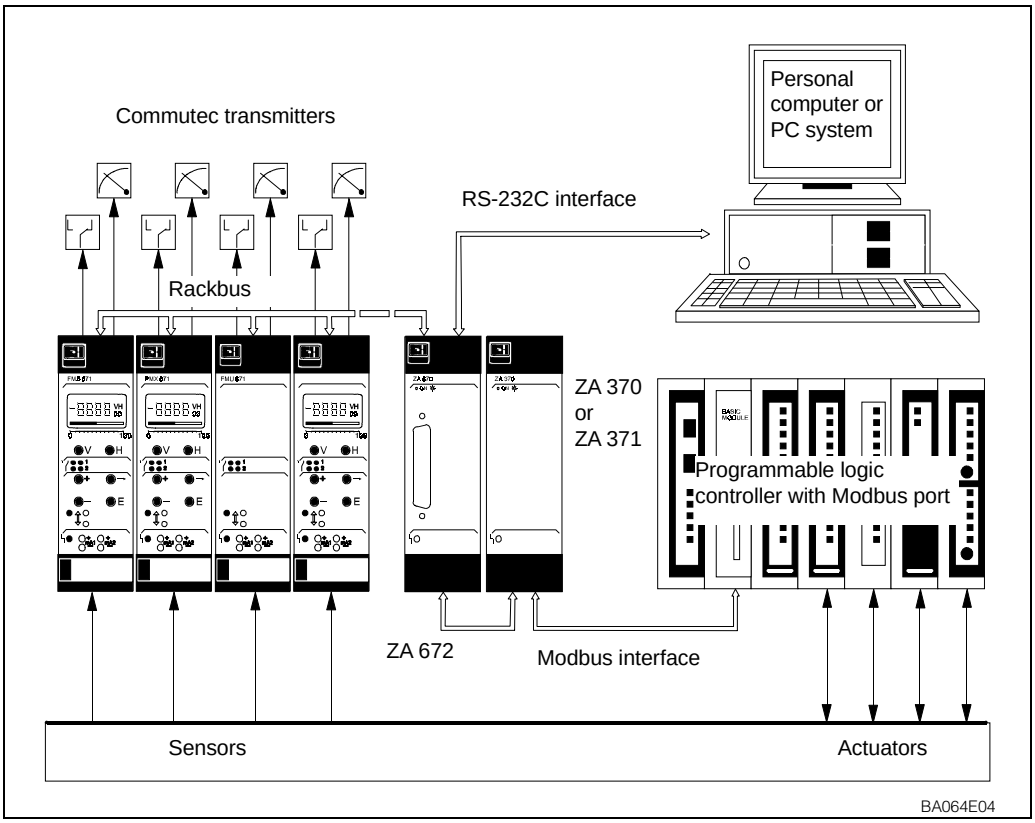


Fig. 1.3
The Silometer FMC 672 Z/677 Z can be used as a stand-alone unit or as part of a process control system

A working system for level measurement comprises:

- Silometer FMC 672 Z/677 Z transmitter,
- Capacitance or impedance probe
- Electronic insert EC 37 Z or EC 47 Z.

The Silometer may operate as a stand alone unit with standard 0/4…20 mA and 0/2…10 V outputs. Two relays, freely assignable to channel 1 or 2, can be used to control pumps, valves, annuciators etc.. An alarm relay monitors the correct functioning of the measurement point and trips on fault condition. If controlled remotely with other Commutec transmitters within a process control system, the Silometer is addressed by the Rackbus. 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:

- FMC 672 Z with display and front panel controls, with remote configuration facilities,
- FMC 677 Z for remote configuration by Commulog VU 260 Z handheld terminal or via ZA 67…/672 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 672 Z/677 Z measures level on the basis of the capacitance/ impedance measurement principle. The measured value processed by the electronic insert and passed on as a frequency signal.

Capacitance/impedance 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

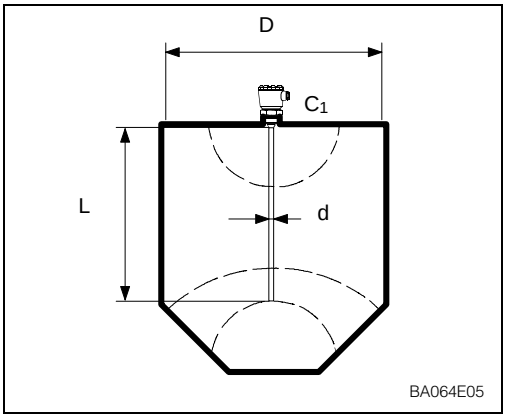


Fig. 1.4
Capacitance measurement principle

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

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

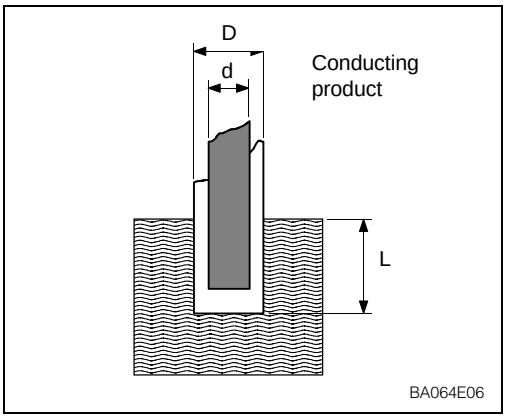


Fig. 1.5
Measurement in conducting media

1.4 Functional description

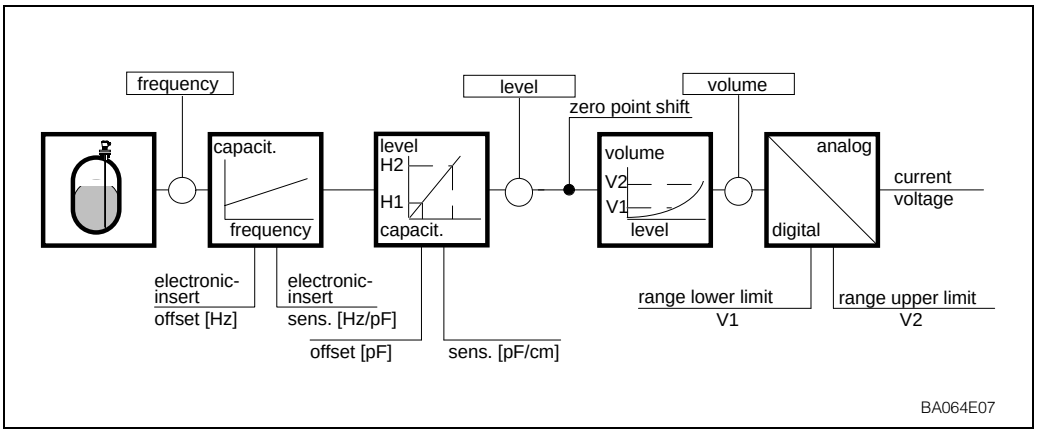


Fig. 1.6
Signal processing in the Silometer FMC 672 Z/677 Z for single channel operation

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 672 Z/677 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 or weight 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. If this function is invoked, volume is indicated at field V0H0 on the LC-display and level at V0H9.
- *Differential level measurement*
  By using two probes and subtracting the measured levels, the Silometer can provide a differential level measurement.
- *Level measurement with reference probe*
  When the dielectric constant of the liquid changes or is unknown, the Silometer can be configured to provide a corrected level measurement on channel 1 by using a reference probe connected to 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.
- *Relay control*
  The two relays can be assigned to either measuring channel to provide level control by switching pumps on and off.
- *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 672 Z/677 Z
- Silometer installation in a rack or Monorack housing
- Transmitter wiring
- Sensor connection.
- Hardware configuration for Commulog VU 260 Z or ZA 67… operation
- Technical data.

Warning!

Warning!
- The Silometer FMC 672 Z/677 Z transmitter must be installed outside explosion hazardous areas.

2.1 Probes and sensors

Table 2.1 lists the sensors most frequently used with the Silometer FMC 672 Z/677 Z transmitter. In addition to those listed, all special probes which can be used with an EC 37 Z or EC 47 Z electronic insert can be connected to the transmitter. Installation hints can be taken from the appropriate Technical Information Sheet.

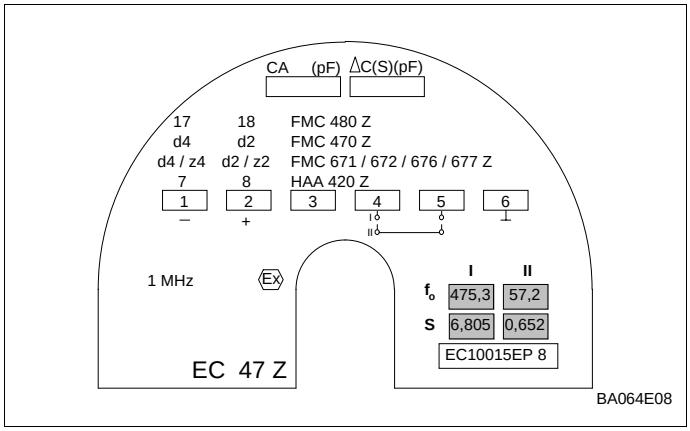
Table 2.1 Selection of probes suitable for use with the Silometer FMC 672 Z/677 Z

Principle	Probe	TI sheet	Insert
Capacitance E 09.83.02	11 302 (Z) 11 303 Z 11 356 11 400 11 322 Z 21 110 21 111 21 211 21 310 (Z) 21 315 (Z)	E 02.78.01 TI 072 E 02.78.03 E 10.73.15 E 11.81.03 E 10.73.19 E 10.73.17 E 10.73.18 E 10.73.20 E 10.73.21	EC 37 Z EC 47 Z
Impedance	Multicap DC 11, DC 16		EC 37 Z EC 47 Z

Sensor contants

EC 37 Z/47 Z inserts are supplied with the sensor constants zero frequency »f_O« and sensitivity»S« printed on the name plate. Note these constants and enter them into fields V3H5/V3H6 and V7H5/V7H6 during commissioning, Section 4.1. This dispenses with the need for a recalibration of the transmitter on replacement of the sensor or insert.

Fig. 2.1: Electronic insert EC 37 Z/ EC 47 Z showing position of sensor constants



2.2 Silometer installation

There are three possibilities for installing Silometer transmitters:

- Standard 19" rack with space for 12 7HP cards,
- Field housing with space for up to 6 7HP cards,
- Monorack housings for single transmitters.

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 E.05.84.05/1 c, »Racksyst Assembly Racks«.

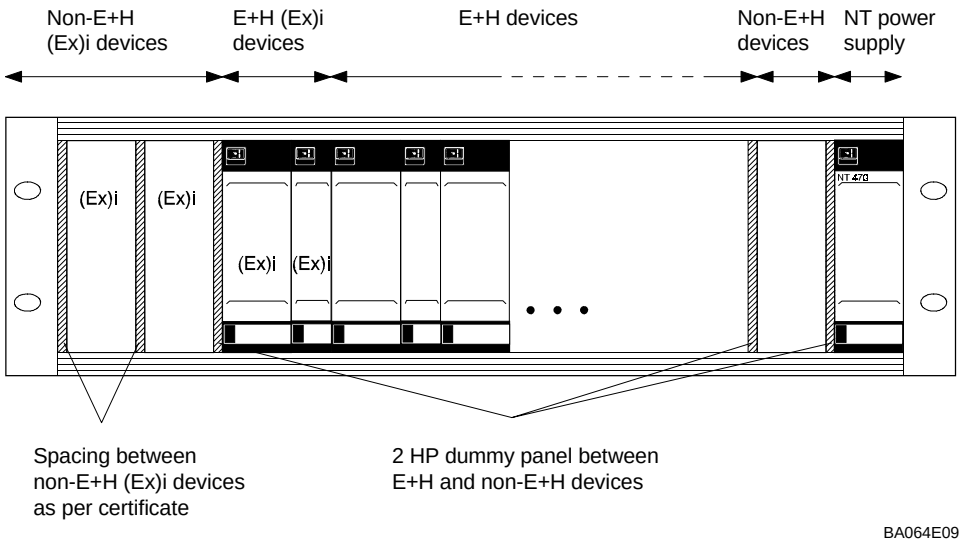


Fig. 2.2: Recommended arrangement for Racksyst rack assemblies

For non-Racksyst installations and for installations including non-Racksyst cards, fill the rack as follows (see also Fig. 2.2):

Rack arrangement

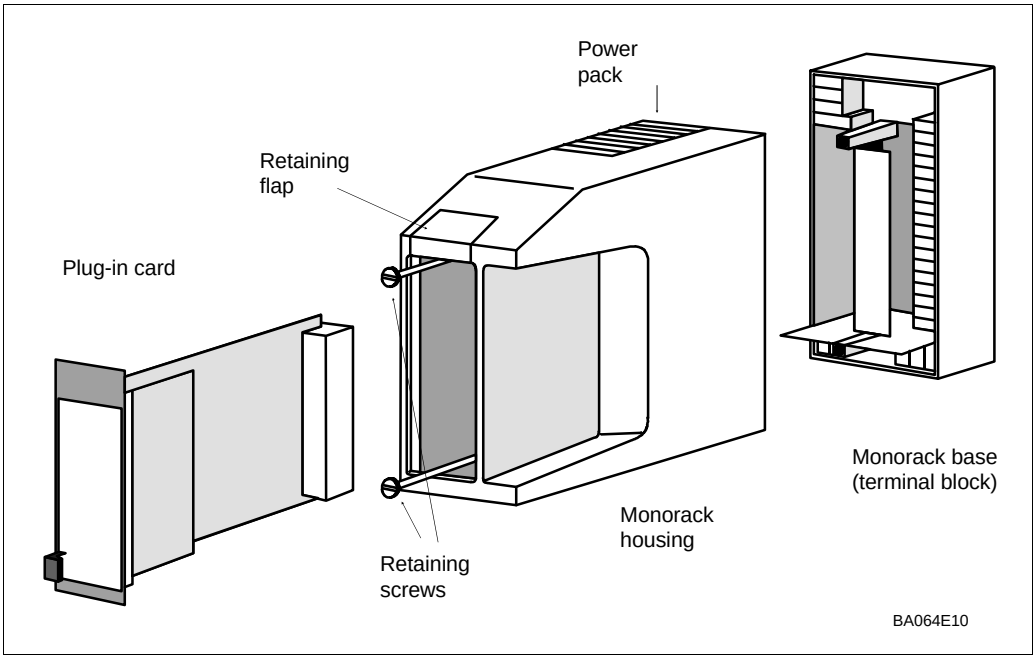
Step	Procedure
1	Allocate the power supply (NT 470) at the rightmost position. - If two NT 470s are used, install a 2 HP dummy panel between them.
2	Install non-intrinsically safe transmitters next to the power supply. - Install a 2 HP dummy panel between all foreign transmitters and between Racksyst 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. 2.3:
Assembly and disassembly of the Monorack housing



Monorack housing

The Silometer FMC 672 Z/677 Z transmitter and Monorack housing are supplied separately. The system must be assembled as shown in Fig. 2.3 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 672 Z/677 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 672 Z/677 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/e.

Fig. 2.4:
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. 2.5 is a pin assignment diagram for the Silometer FMC 672 Z/677 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 23 in the rack connector ensure that Silometer FMC 672 Z/677 Z transmitters only can be inserted at these points. The pins must be inserted if the rack is not custom built by Endress+Hauser.

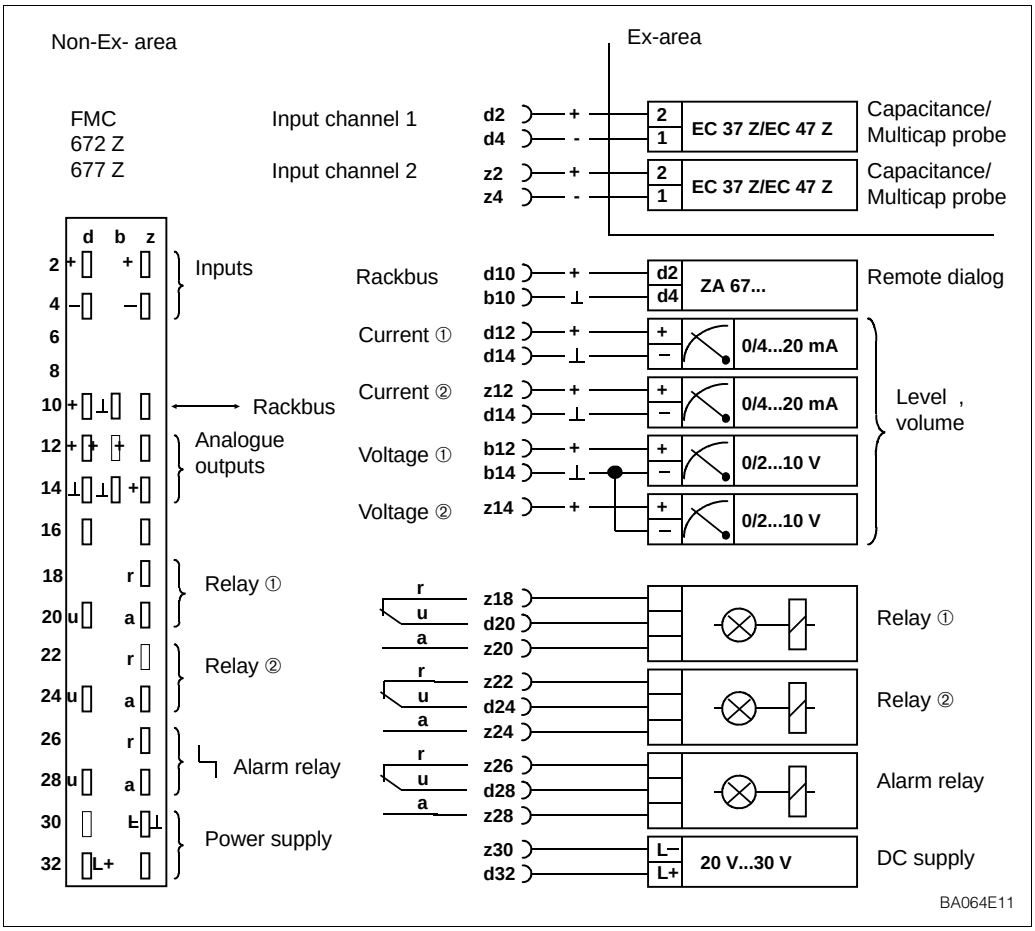
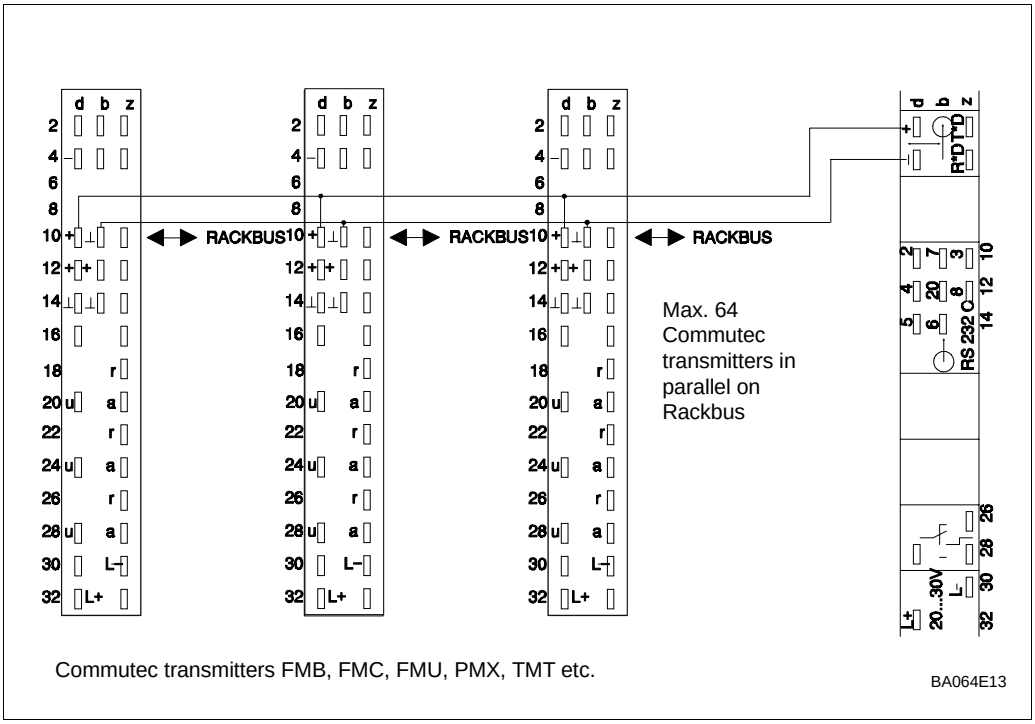


Fig. 2.5:
Pin assignment diagram for Silometer FMC 672 Z/677 Z with capacitance probes.

Fig. 2.6:
Rackbus wiring diagram



Rackbus

For system use, wire the Rackbus as shown in Fig. 2.6.

- For ZA 672 - Computer/PLC wiring see Operating Instructions BA 054E.
- 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

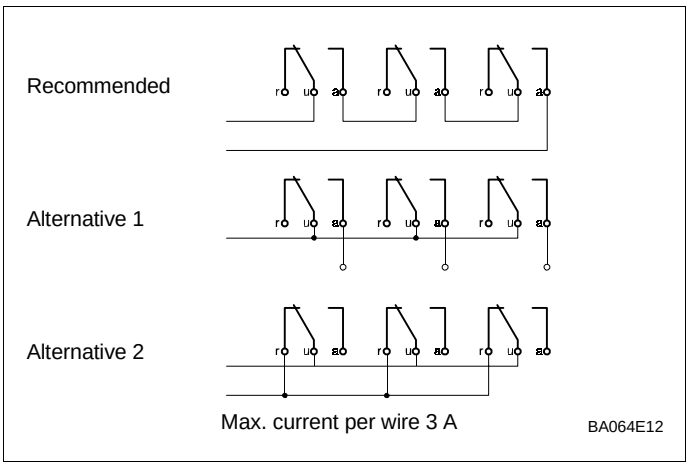
The negative terminal of the current output, of the voltage output and of the supply voltage are connected to the circuit zero of the Silometer FMC 672 Z/677 Z module.

- 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.

Alarms and limit switch relays can be connected as shown in Fig. 2.7.

- Max. current per wire 3A : for switching capacity see Section 2.6.

Fig. 2.7:
Suggestions for wiring together relays and alarms



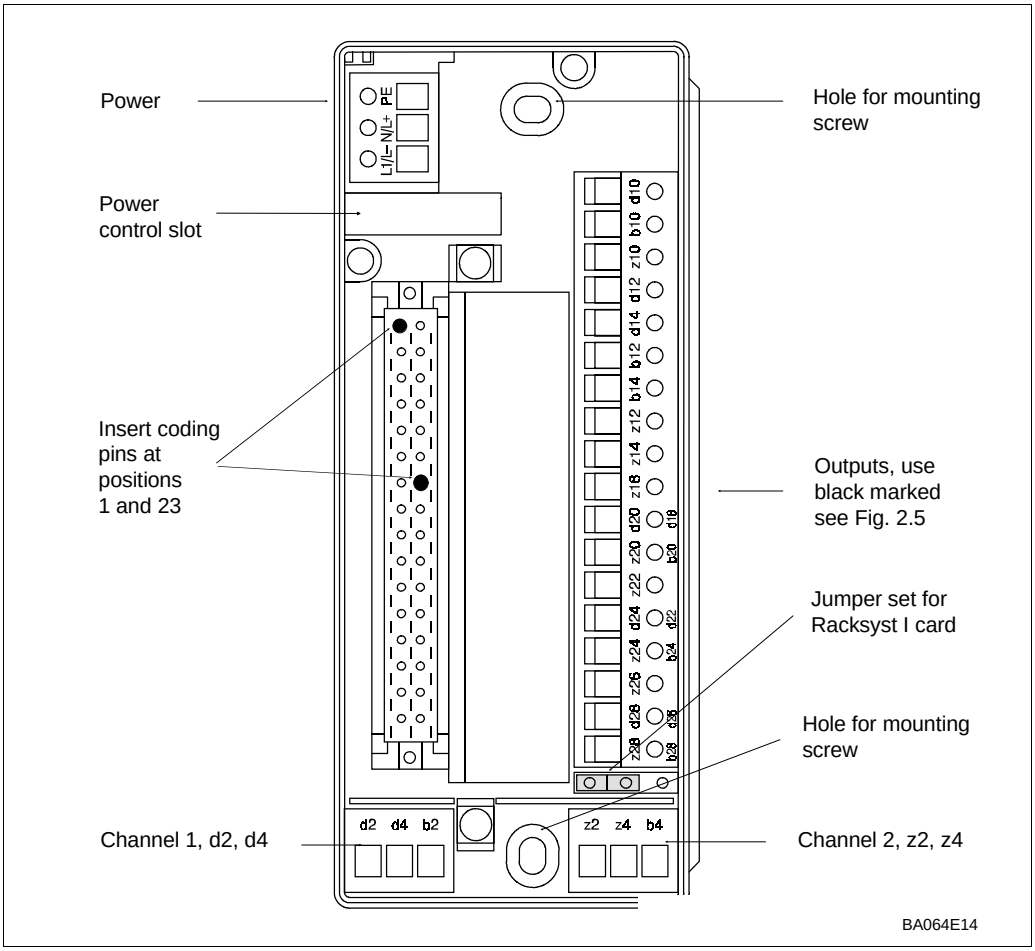


Fig. 2.8:
Layout of Monorack II terminal blocks

Monorack wiring

Fig 2.8 shows the terminals in the base of the Monorack II housing, the pin assignments correspond to those in Fig. 2.5. When connecting together several Monoracks, follow the instructions supplied with the housing.

- Set the jumper to the position "Racksyst I".
- Insert the coding pins supplied at positions 1 and 23 in the female connector in the base of the housing.
- The pin designation printed in black are valid for Silometer FMB cards.

If you are installing the Silometer FMB in a Monorack I housing, please note that there is no jumper switch. In addition, for the 24 V version, the dummy card in the power control slot must be replaced by the 24 V card suppied.

2.4 Sensor connection

The Silometer FMC 672 Z/677 Z can be operated with a variety of sensor types, each requiring an electronic insert:

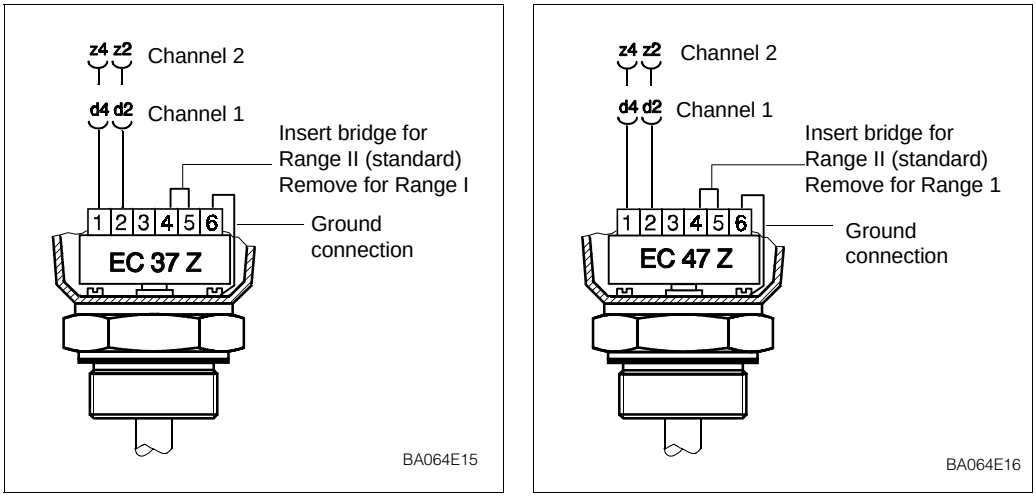
- EC 37 Z or EC 47 Z for capacitance and impedance probes

Sensor cable

Use commercial 2-core installation cable, max. line resistance 25 Ω/core, for the sensor/transmitter cable. If electromagnetic interference is to be expected, we recommend

- that the PFM negative line be grounded at the sensor (check Ex-regulations)
- for heavy interference that shielded cable be used, grounded at both ends.

Fig. 2.9: Connection diagram for electronic inserts
Left: EC 37 Z
Right: EC 47 Z



EC 37 Z and EC 47 Z

The electronic inserts EC 37 Z and EC 47 Z have two measuring ranges which can be selected by inserting a bridge between terminals 4 and 5 of the insert, see Figs 2.9. Full instructions on selection of the insert are to be found in Publication E 07.80.06/1c.

- Note the zero frequency f_o____ and sensitivity S_____on insert, channel 1.
- Note the zero frequency f_o____ and sensitivity S_____on insert, channel 2.

2.5 Hardware configuration

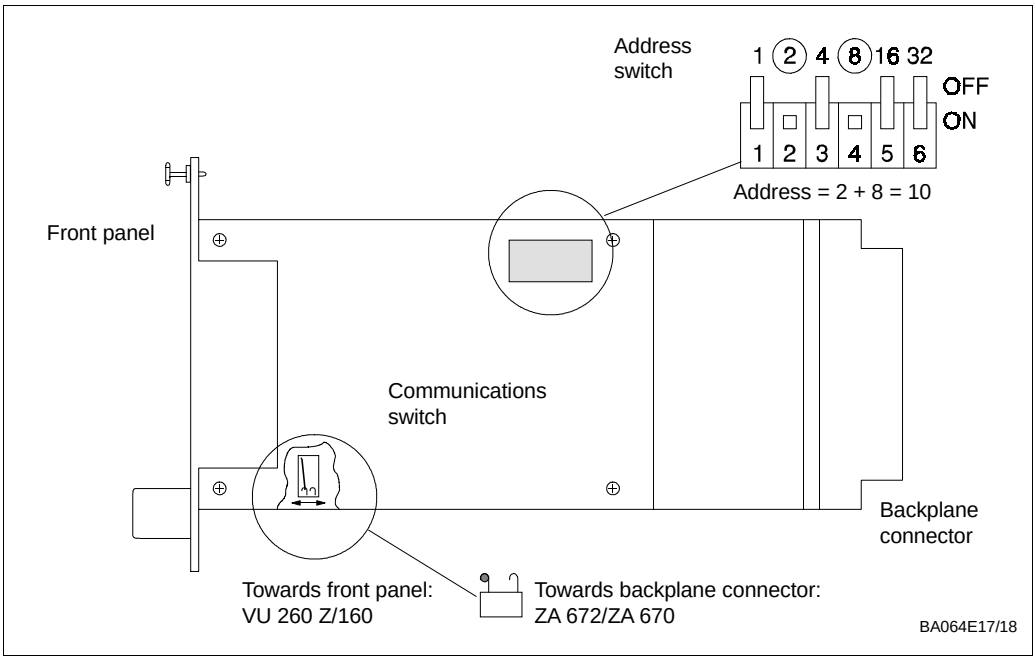


Fig. 2.10: Configuration elements of Silometer FMC 672 Z/677 Z

Fig. 2.10 shows the configuration elements for remote operation of the Silometer FMC 672 Z/677 Z transmitter.

Commulog VU 260 Z/ VU 160

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

ZA 672 Modbus gateway

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.

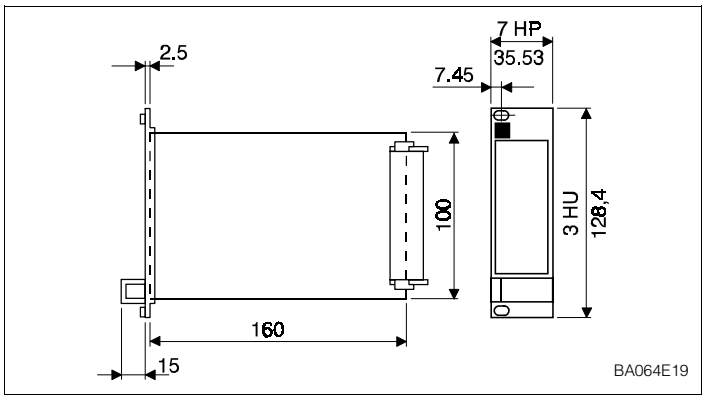
A full description of ZA 672 operation is to be found in Publication BA 054E.

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 672 Z/677 Z transmitter

Fig. 2.11
Silometer FMB 672 Z/677Z
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) Coding pins in positions 1 and 23
	• Power supply:	24 V DC (+6V…-4V); residual ripple 2V, within tolerance
	• Supply current:	approx. 90 mA, max. 125 mA
	• Signal inputs:	Electrically isolated from the rest of the circuitry. Protection [EEx ia] IIC or IIB
	• Probes:	Capitance probes, impedance probes with EC 37 Z or EC 47 Z electronic insert
	• 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, fail-safe mode maximum or minimum selectable Third relay for fault indication Max. switching capacity: 2.5 A, 250 VAC, 300 VA at cos φ > 0.7 *or* 100 VDC, 90 W
Indication and configuration	• FMC 672 Z	LCD and 6 buttons on front panel. 6 LEDs for function control, also configurable via Commulog handheld terminal or ZA 672/ZA 67…
	• FMC 677 Z	6 LEDs for function control, configuration using Commulog handheld terminal or ZA 672/ZA 67… interface.
Certificates	• FMC 672 Z/677 Z	Intrinsically safe circuit to [EEx ia] IIC and IIB (PTB No. Ex-88.B.2050 X) see also »Safety Notes«.

3 Controls

This Chapter describes how the Silometer FMC 672 Z/677 Z transmitters are operated. It is divided into the following sections:

- Commutec operating matrix
- Configuration and display: Silometer FMC 672 Z
- Configuration and display: Silometer FMC 677 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 672 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 054E and Technical Information sheet »Commutec Operating Program« TI 113.

A matrix card, reproduced at the back of this manual, is delivered with the Silometer FMC 672 Z/677 Z transmitter.

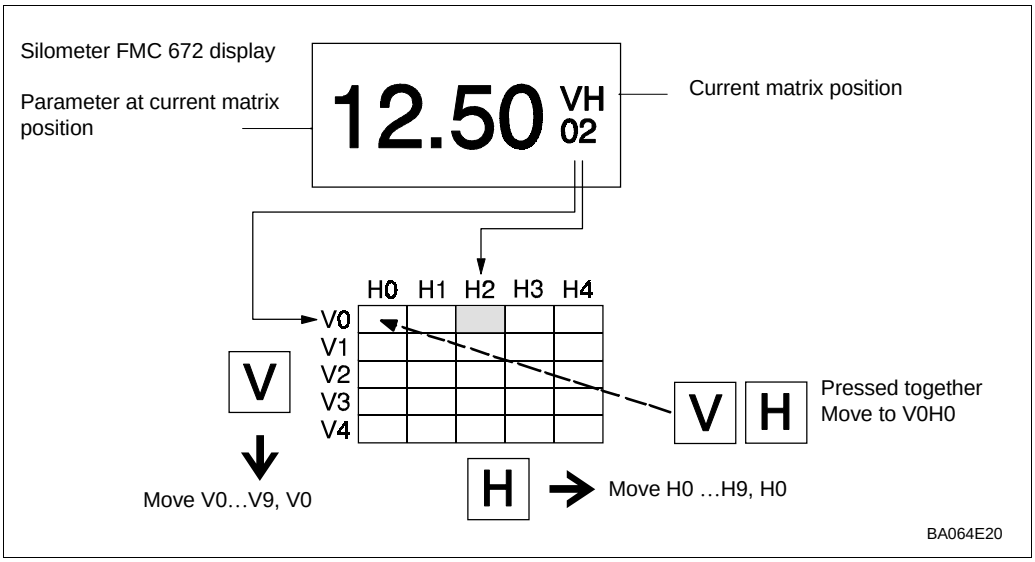


Fig. 3.1:
Silometer FMC 672 Z
Parameter matrix operation with function of V and H keys.
The complete matrix has 10 x 10 fields, although not all are used

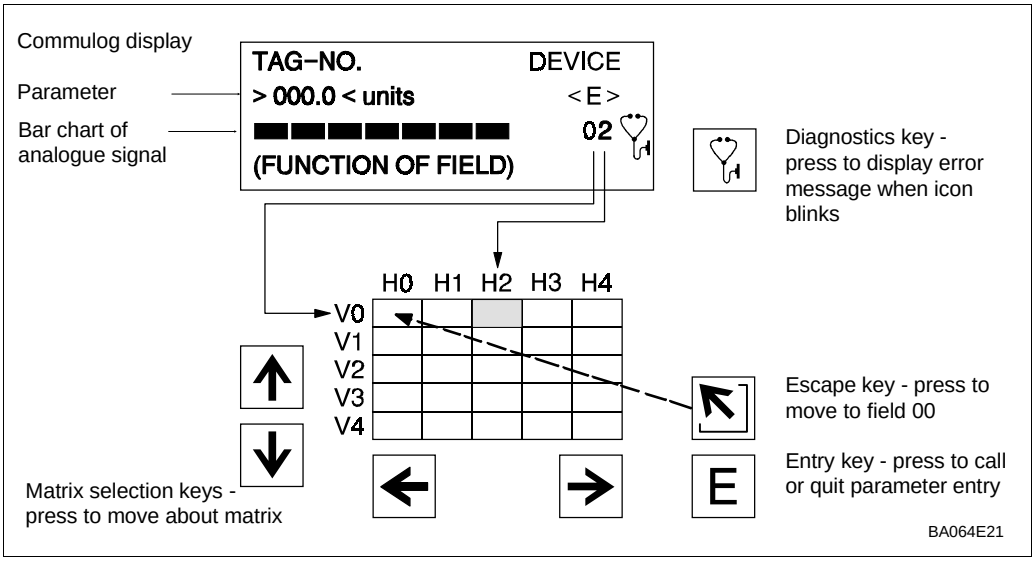


Fig. 3.2:
Silometer FMC 6772 /672 Z
Commulog display and key functions.
The Tag No. and measurement units are entered in the VA level which can be accessed by the Commulog or ZA 67… interface only

3.2 Configuration and display: Silometer FMC 672 Z

Fig. 3.3: Front panel of the Silometer FMC 672 Z transmitter

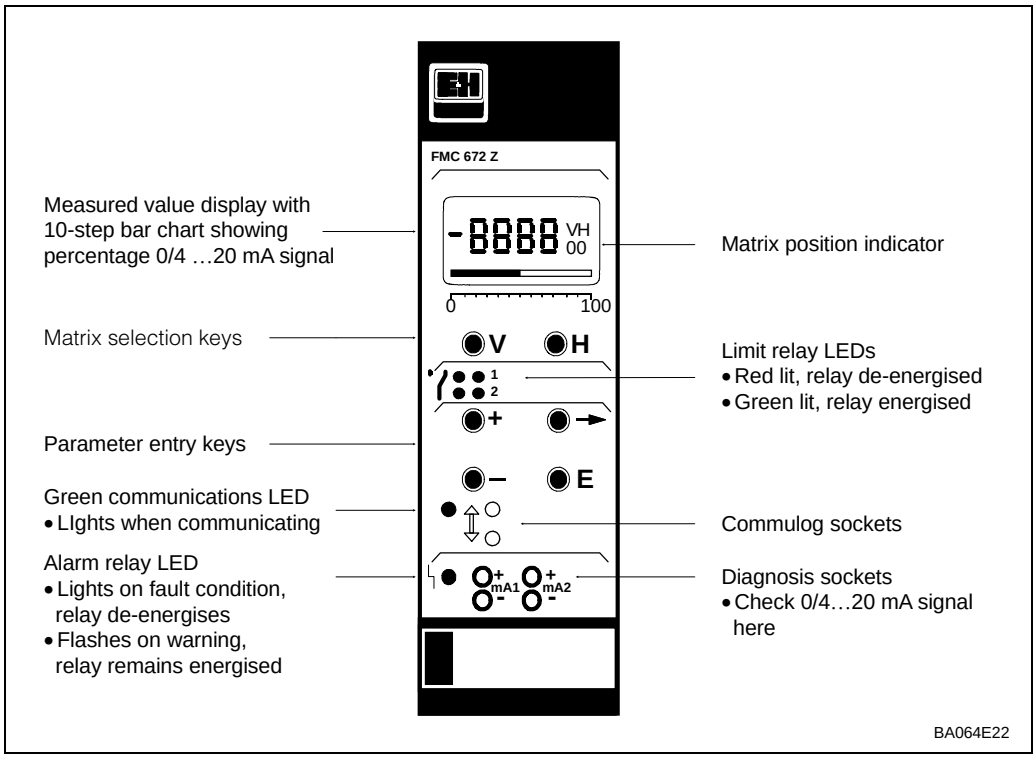


Fig. 3.1 shows the LC-display with matrix of the Silometer FMC 672 Z, Fig. 3.3 its front panel. Table 3.1 below describes the function of the operating keys.

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

Table 3.1: Silometer FMC 672 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	
→	• Select the digit to be changed. The digit at the extreme left is selected and flashes. • Move to the next digit by pressing »⇒« again. When the last digit is reached »⇒« selects the leftmost digit again.
+ + →	• To change the position of the *decimal point*, press down both »⇒« and »+«. The decimal point moves 1 space to the right.
+	• Increases the value of the flashing digit
–	• Decreases the value of the flashing digit • To enter a *negative number* decrease the leftmost digit until a minus sign appears in front of it
E	• Press »E« to register entry. • Unregistered entries remain ineffective and the instrument will operate with the old value.

3.3 Configuration and display: Silometer FMC 677 Z

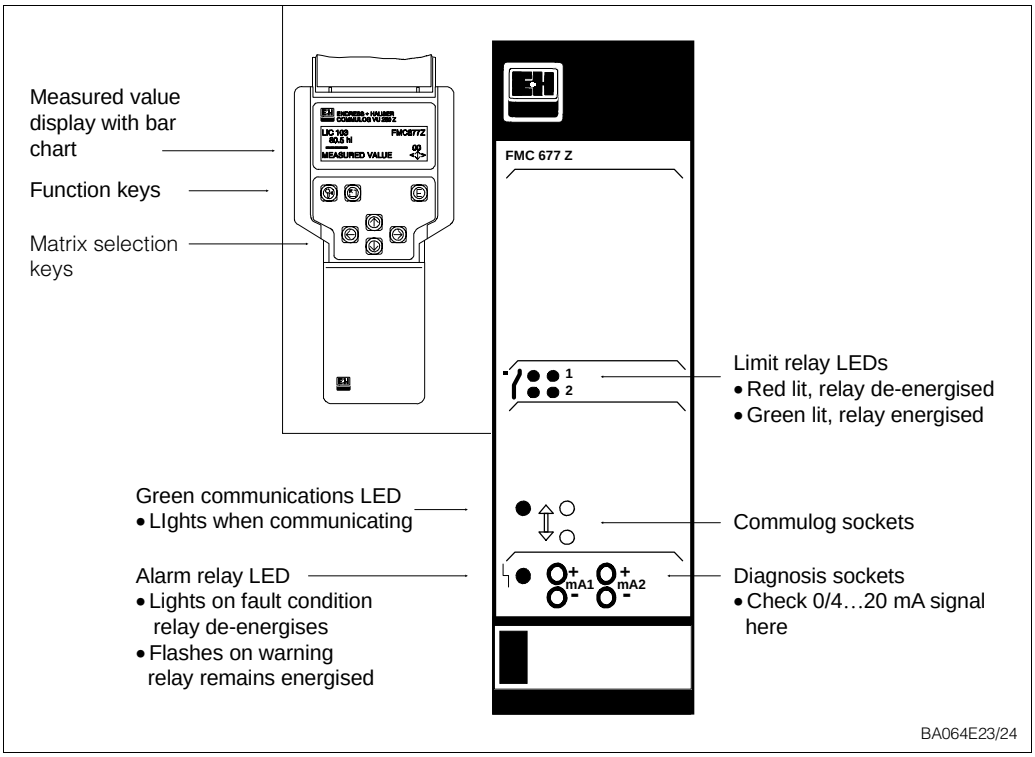


Fig. 3.4: Silometer FMC 677 Z Showing front panel and Commulog VU 260 Z key functions

The Silometer FMC 677 Z is configured with the Commulog VU 260 Z/ VU 160 handheld terminal shown in Figs 3.2 and 3.4. A full description of Commulog operation is to be found in Operation Instructions BA 028, Table 3.2 summarizes the key functions.

- 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 677 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 672 Z/677 Z which allow it to operate with the capacitance probes. The principle sections describe:

- Commissioning
- Calibration of the Silometer FMC 672 Z/677 Z for standard application
- Level offset
- Display of measured values
- Locking the parameter matrix.

The Silometer FMC 672 Z/677 Z controls are described in Chapter 3, linearization in Chapter 5 and the setting of the analogue outputs and relays in Chapter 6 and 7.

Note your settings!

Note your parameters in the tables provided in the back cover. Should the transmitter be exchanged at a later date, simply reenter all the parameters and the system is ready to run - no recalibration is necessary!

4.1 Commissioning

The commissioning comprises two steps:

- Transmitter reset
- Entry of sensor constants from the electronic insert

Transmitter reset

A transmitter reset enters the factory based parameters, see Table in back cover, into the operating matrix. It is made by entering a number between 670 and 679 at V9H5.

Sensor constants

Enter the sensor constants, »f_o« and »S« printed on the electronic insert, see Chapter 2, Section 2.1, at fields V3H5/ V3H6 for channel 1 and V7H5/V7H6 for channel 2. This ensures that there is no need for recalibration if the sensor has to be replaced.

Step	Matrix	Entry	Significance
1	V9H5	e.g. 672	Enter any number 670…679 to reset transmitter
2	-	»E«	Registers entry
3	V3H5	e.g. 99.5	Enter »f_o« value for sensor 1
4	-	»E»	Register entry
5	V3H6	e.g. 1.02	Enter »S« value for sensor 1
6	-	»E«	Registers entry
7	V7H5/V7H6	…	Repeat Steps 3 to 6 for sensor 2.

Operating mode

After commissioning the operating mode is entered at V8H0 and the transmitter calibrated. Turn to the appropriate Section for details:

- 0 = level measurement on both channels (default), Section 4.2, 4.3
- 1, 2 = level measurement on channel 1 or 2 only, Section 4.2, 4.3
- 3 = differential measurement, Chapter 8, Section 8.1
- 5 = level measurement with reference probe, Chapter 8, Section 8.2
- 6, 7 = simulation channel 1 or 2, see Chapter 9, Section 9.2.

Step	Matrix	Entry	Significance
1	V8H0	e.g. 0	Operating mode 0 = default, measures on both channels
2	-	»E«	Registers entry

4.2 Calibration: level measurement

The calibration for operating mode 0 requires the determination of two parameters, in any order, for each measurement channel:

- an »empty« level: at V0H1 for channel 1 and V4H1 for channel 2,
- a »full« level: at V0H2 for channel 1 and V4H2 for channel 2.

For modes 1 and 2, the parameters for the selected channel only are entered.

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

After calibration

- % level is displayed at V0H0/channel 1 and V4H0/channel 2
- The 0/4…20 mA signal range corresponds to 0…100%
- The limit relays trip at 90% (maximum fail-safe)
- The parameters »offset« and »sensitivity« are calculated and stored at V3H1/V3H2 for channel 1 and V7H1/V7H2 for channel 2.

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

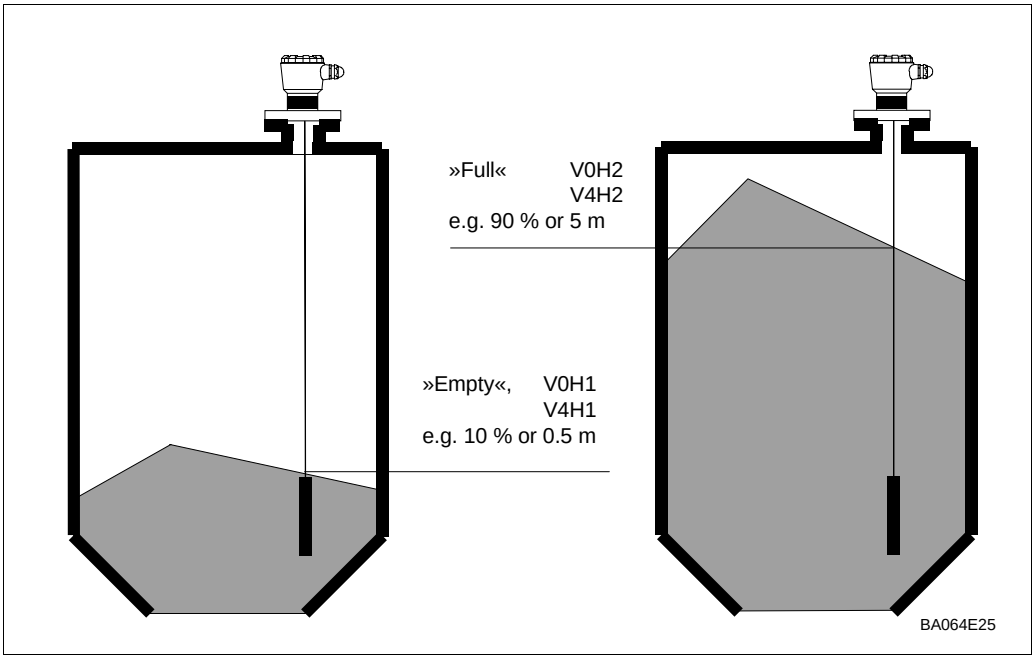


Fig. 4.1:
Parameters required for calibration of the Silometer FMC 672 Z/677 Z for level measurement.
In the case of bulk solids any filling mound or emptying depression can be accounted for by the parameters entered

Procedure

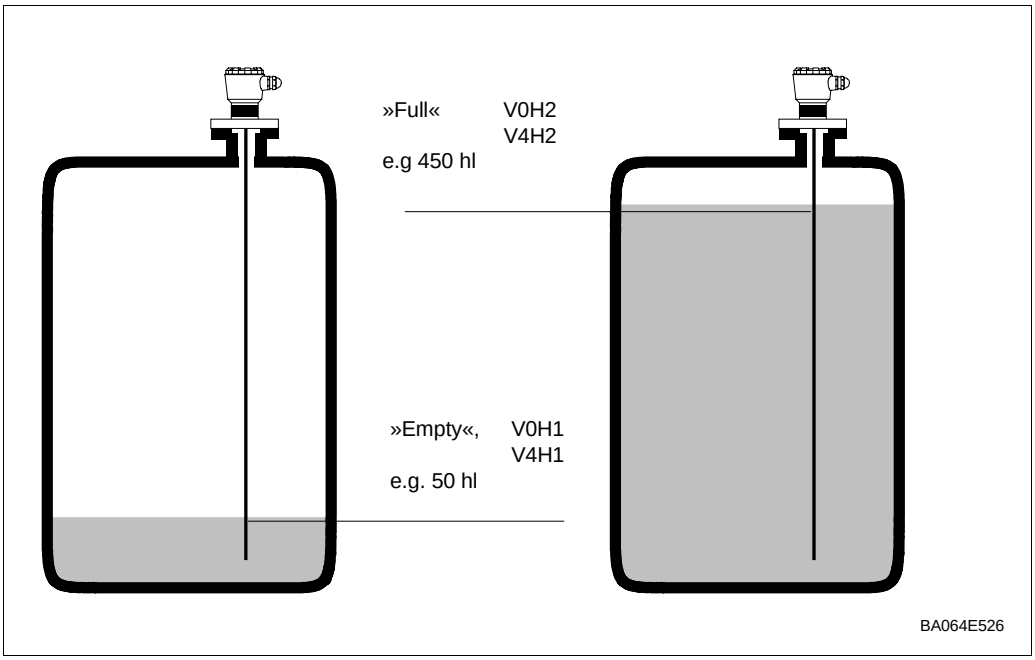
Step	Matrix	Entry	Significance
1	V0H1	e.g. 10%	Fill the vessel until the sensor is covered (0…40%) and enter the level you wish to have displayed,
2	-	»E«	Register entry
3	V0H2	e.g. 90%	Fill the vessel (60…100%) and enter the level
4	-	»E«	Register entry
5	V4H1/V4H2	…	Repeat steps 1 and 2 for channel 2
6	V0H0/V4H0	…	The measured value is shown in the units selected.

Note!
- The calibration can be made in the reverse order.
- For bulk solids, the probe measures the depth of emersion in the product only. Any filling mound or emptying depression is accounted for by the parameters entered.

Note!

4.3 Calibration: volume measurement

Fig. 4.2: Parameters required for calibration of the Silometer FMC 672 Z/677 Z for volume measurements



The Silometer FMC 672 Z/677 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/V4H0. The analogue outputs and limit relays must be set in the same units as described in Chapters 6 or 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 sensor is just covered (0…40%) and enter the volume (or weight) you wish to have displayed,
2	-	»E«	Register entry
3	V0H2	e.g. 450 hl	Fill the vessel as far as possible (60…100%) and enter the level or volume
4	-	»E«	Register entry
5	V4H1/V4H1		If appropriate, repeat procedure for channel 2
6	V0H0/V4H0		The measured value is shown in the units selected.

Note!

Note!
- The »empty« and »full« calibration can be performed in the reverse order.
- Once selected the units cannot 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

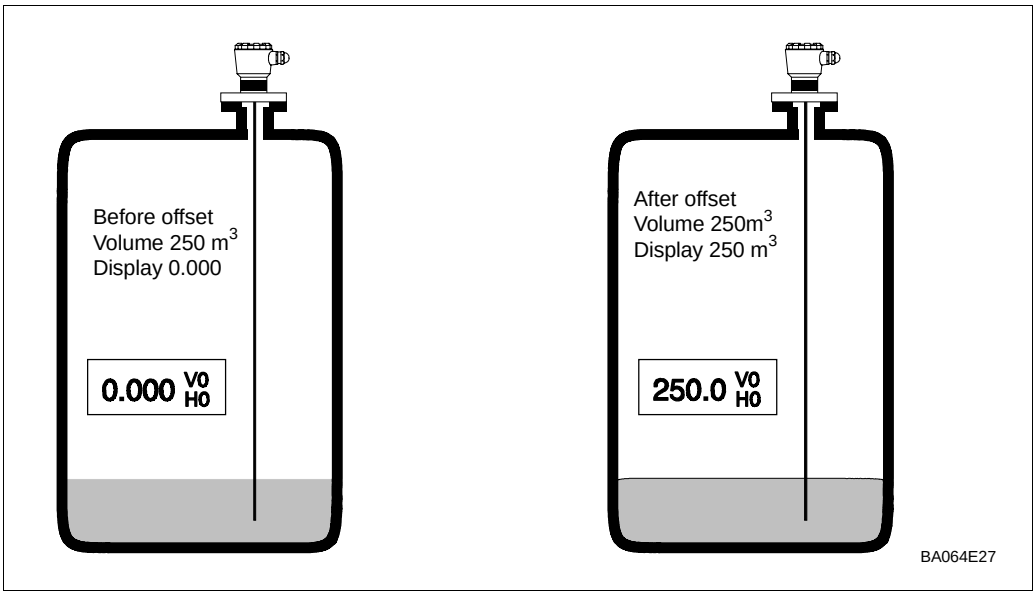


Fig. 4.3:
Effect of level offset on display at V0H0/V4H0

Level offset

The calibration (or linearization) determines the level displayed at V0H0/V4H0 for a particular head of liquid. By entering a level offset at V3H4 for channel 1 or V7H4 for channel 2 the displayed value can be corrected by the value entered.

- The offset is *subtracted* from the 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 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 m^3. The value -250 is entered:

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 or linearisation - for channel 2 enter value at V7H4
2	-	»E«	Registers entry
3	V0H0/V4H0	...	The corrected value is displayed(i.e. +250)

Note!

- The offset can also be used to correct the zero point of a linearization. In this case the offset is first subtracted from the »level« displayed at V0H9/V4H9 and the result converted to the volume displayed at V0H0/V4H0.

Note!

4.5 Measured value display

During normal operation the measured value can be read at V0H0 for channel 1 and V4H0 for channel 2. In addition to this, several other fields contain system information which might be needed, e.g., for trouble-shooting etc.. Table 4.1 summarizes the measured value displays.

Table 4.1: Matrix positions of measured value displays

Channel 1	Channel 2	Measured value	Remarks
V0H0	V4H0	Level or volume	Display in %, m, ft, hl, m^3, ft^3, t etc. according to calibration and/or linearization. The entries for the 0/4 mA and 20 mA value at V0H5/V4H5 and V0H6/V4H6 control the 10-step LCD bar diagram.
V0H8	V4H8	Actual measuring frequency	Displays the frequency which is actually measured by the probe. Can be used as a fault check (must change as level changes)
V0H9	V4H9	Measured value before linearization	Indicates level in the units used for before linearization
V2H6	V6H6	Number of factory set linearization	If display > 0, a factory set linearization is stored in the instrument
V8H7		Correction factor for reference operation	Indicates the factor used for calibration correction in operating mode 5
V9H0		Current error	When red fault LED flashes, the error code can be read here
V9H1		Last error code	The previous error can be read and deleted here - press »E«
V9H3		Software version with instrument code	The first two figures indicate the instrument, the last, the software version; 10 = Version 1.0
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…7) the matrix can be locked by entering a code number.

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

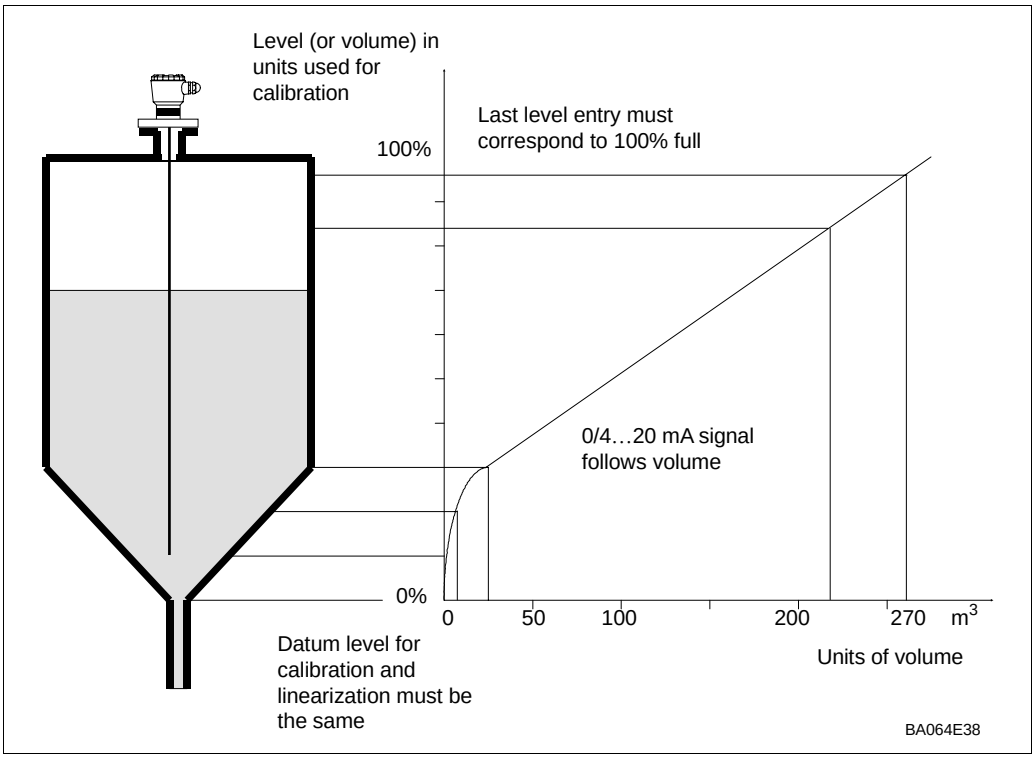


Fig. 5.1:
Linearization for a vessel with a conical outlet

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 at fields V2H0…V2H8 for channel 1 and V6H0…V6H8 for channel 2. In addition the field V3H0/V7H0 determines whether the associated calibration is to be performed in level or volume units (0 = level, default, 1 = volume). For simplicity, the fields for channel 1 only are used in the procedures. The following linearization modes can be entered at V2H0/V6H0:

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 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 during calibration
- The levels for calibration and linearization must be referenced to the same datum point.

After linearization

After linearization:

- The volume of liquid currently in the tank can be read from V0H0/V4H0.
- The level before linearization can be read from V0H9/V4H9.
- The 0/4…20 mA signal range must be set in the volume units entered.
- The relay switch points must be set in the volume units entered.

5.1 Linearization for a cylindrical, horizontal tank

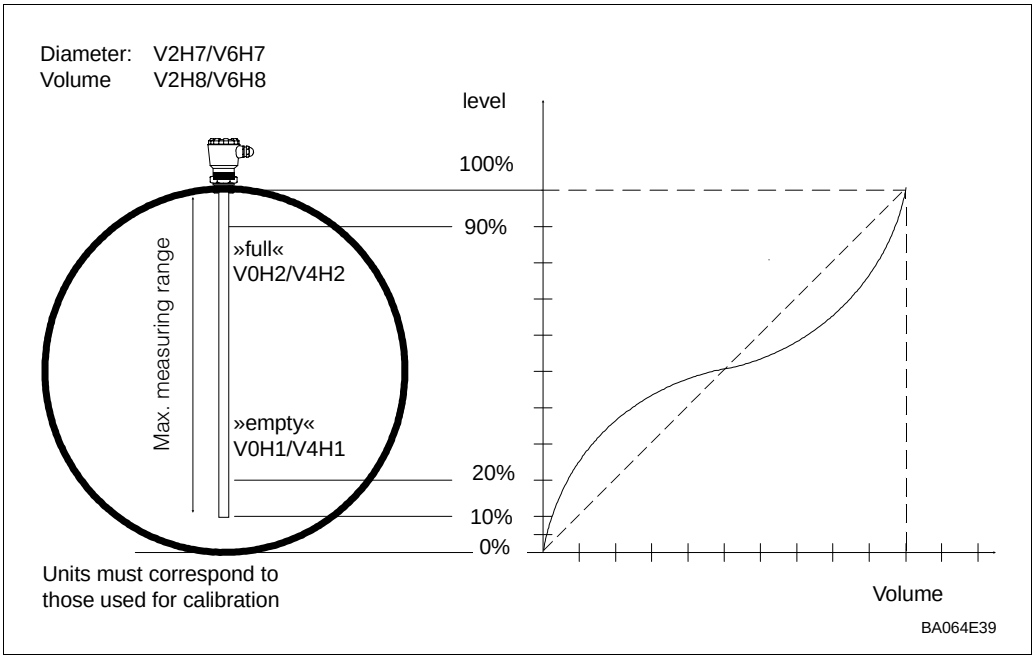


Fig. 5.2: Parameters required for linearization of the Silometer FMC 672 Z/677 Z for a horizontal cylinder

This mode is used when you have a cylindrical tank which lies horizontally: the probe must have a ground tube or the liquid must conduct. The Silometer FMC 672 Z/677 Z transmitter uses a stored linearization table which requires the entry of the tank diameter and tank volume for its calculations.

Procedure

Step	Matrix	Entry	Significance
1	V9H5/V3H5/V3H6		Reset and commission transmitter, see Section 4.1.
2	V3H0	e.g. 0	Select units to be used for calibration, 0 = level, 1 = volume
3	-	»E«	Registers entry
4	V2H7	e.g. 10	Enter tank dia. (for level, in units to be used for calibration)
5	-	»E«	Register entry
6	V2H8	e.g. 200	Enter tank volume in the units you require - If 100 is entered, the system measures in % vol.
7	-	»E«	Register entry
8	V2H0	1	Select horizontal cylinder mode
9	-	»E«	Press »E« to activate linearization
10	V0H1/V0H2	…	Calibrate, as described in Sections 4.2…4.3 or Chapter 8
11	V0H0/V0H9	-	V0H0 indicated volume, V0H9 level before linearization

Note!

Note!
- Omit step 1, transmitter reset, when the second linearization is being entered
- Channel 2 is linearized at V6H7, V6H8 and V6H0 and calibrated at V4H1 and V4H2 respectively; display at V4H0/V4H9, units selection V7H0.
- If the calibration is to be in *volume units* (V3H0/V7H0 = 1), *the sequence of steps must be exactly as shown above*
- When V3H0/V7H0 = 1, the entry at V2H7/V6H7 fixes the end value for the display at V0H9/V4H9.

5.2 Linearization for a tank with conical outlet

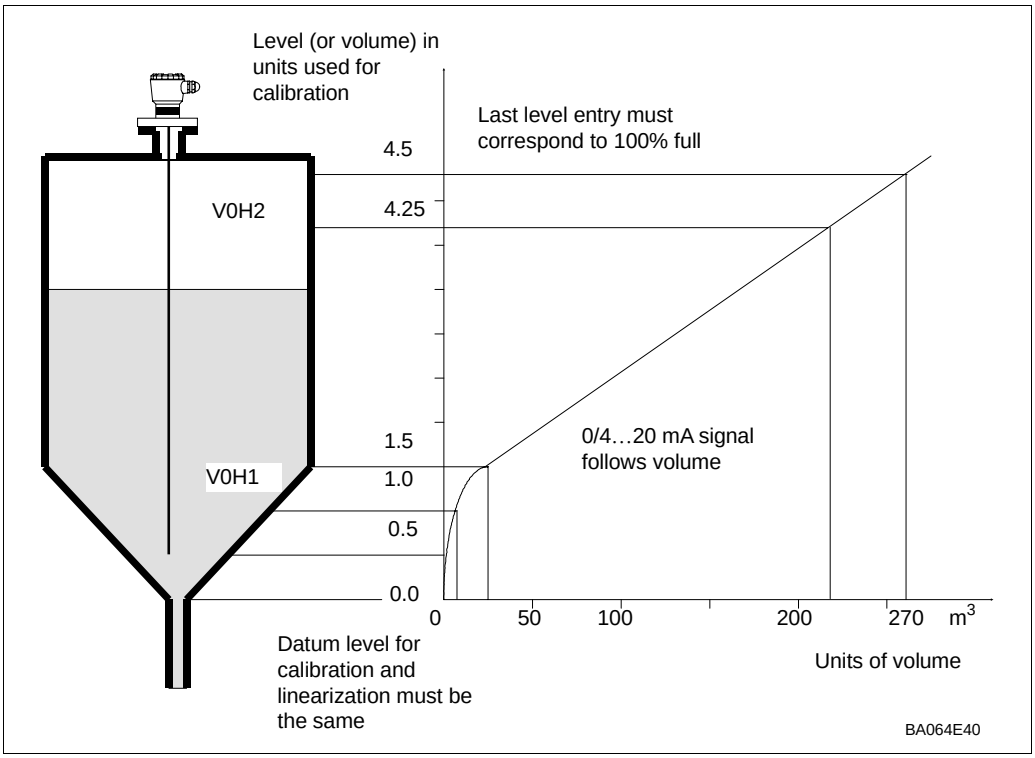


Fig. 5.3:
Linearization for a vessel with a conical outlet

Manual entry
V2H0 = 3, V6H0 = 3

This option allows you to enter your own characteristic, whereby to possibilities exist for entering levels:

- By hand, in this case both level and volume parameters should be entered in a table prior to configuration. A level calibration can always bee performed.
- Automatically: the tank is filled in known volume increments and the measured level is written into V2H4/V6H4 by the system. This method can be used when the volume/level 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/V4H9 have no significance. The entry mode is selected at V2H1/V6H1:

- 0 = manual,
- 1 = automatic.

At the end of the linearization the system measures in the volume units selected, e.g. m^3, ft^3, t, %. Use the Tables overleaf to enter your values.

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 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

Enter you linearization values in the Table below: Channel 1 = V2H2…V2H4, channel 2 = V6H2…V6H4

No. V2H2 V6H2	Volume V2H3 V6H3	Level V2H4 V6H4	No. V2H2 V6H2	Volume V2H3 V6H3	Level V2H4 V6H4
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		

Procedure

Step	Matrix	Entry	Significance
1	V9H5/V3H5/V3H6		Reset and commission transmitter, see Section 4.1
2	V0H1/V0H2	…	Calibrate transmitter, see Sections 4.2…4.3 or Chapter 8
3	V2H0	4	Cancel any previously active linearization table
4	-	»E«	Register entry
5	V2H1	0	Select manual entry of values
6	-	»E«	Register entry
7	V2H2	1…30	Enter table entry number
8	-	»E«	Register entry
9	V2H3	e.g. 0	Enter volume in required units
10	-	»E«	Register entry
11	V2H4	00.00	Enter level in metres or feet
12	-	»E«	Register entry
13	V2H5	2…30	Enter next table entry number
14	-	»E«	Register entry. - The system jumps to V2H3; V2H2 is incremented
15	V2H3		Repeat steps 9 to 14 until all points are entered
16	V2H0	3	Select manual linearization table
17	-	»E«	Press »E« to activate linearization

Note!

Note!
- Omit step 1, transmitter reset, when the second linearization is being entered
- For channel 2 use fields V4H1/V4H2 and V6H0…V6H5.

Manual linearization with automatic level registration

Step	Matrix	Entry	Significance
1	V9H5/V3H5/V3H6		Reset and commission transmitter, see Section 4.1
2	V0H1/V0H2		Calibrate transmitter, see Sections 4.2…4.3 or Chapter 8
3	V2H0	4	Cancel any previously active linearization table
4	-	»E«	Register entry
5	V2H1	1	Select automatic entry of level
6	-	»E«	Register entry
7	V2H2	1…30	Enter table entry number
8	-	»E«	Register entry
9	V2H3	e.g. 0	Fill vessel, enter volume in required units
10	-	»E«	Register entry
11	V2H4	-	Select level entry field
12	-	»E«	Press »E« to write measured level in matrix
13	V2H5	2…30	Enter next table entry number
14	-	»E«	Register entry - The system jumps to V2H3, V2H2 is incremented
15	V2H3		Repeat steps 9 to 14 until all points are entered
16	V2H0	3	Select manual linearization table
17	-	»E«	Press »E« to activate linearization

Note!

Note!
- For this procedure, the tank can be filled for calibration and emptied for linearization.
- Omit step 1, transmitter reset, when the second linearization is being entered
- For channel 2 use fields V4H1/V4H2 and V6H0…V6H5.
- Set analog output and relays in same units as used for linearization.

Corrections to manual linearization

If you make an error during entry, the incorrect entry can be overwritten by selecting the appropriate table number at V2H2 and entering the new value at V2H3 or V2H4.

- A complete entry can be deleted from the list by entering 9999 at V2H3/V6H3.

Step	Matrix	Entry	Significance
1	V2H2	1…30	Enter table entry number where correction is to be made
2	-	»E«	Register entry
3	V2H3/H4	e.g. 10	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 linearization modes

Linear
V2H0 = 0, V6H0 = 0

This mode is the default setting = no linearization. It may be selected when the Silometer FMC 672 Z/677 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 to activate linearization

Factory characteristic
V2H0 = 2, V6H0 = 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 672 Z/677 Z transmitter by viewing matrix position V2H6/V6H6:
  - 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	V2H0	2	Select factory linearization table
2	-	»E«	Press to activate linearization

Cancel current setting
V2H0 = 4, V6H0 = 4

Use this option if you wish to enter an entirely new manual characteristic. All values in the linearization table are cancelled and can be entered anew. The function does not affect the horizontal cylinder characteristic or any factory characteristic stored in the transmitter.

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

Note!

Note!
- For all options, activate at V6H0 for channel 2

6 Analogue Outputs

This Chapter deals with the analogue output settings. The FMC 672 Z/677 Z transmitter is designed for continuous measurement with control of:

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

by the level or volume indications at V0H0 and V4H0. Table 6.1 and Fig. 6.1 summarize the parameters which control the analogue outputs and 10-step LCD display.

Channel 1	Channel 2	Significance	Default value
V0H3	V4H3	Analogue range 0 = 0...20 mA / 0...10 V 1 = 4...20 mA / 2...10 V	0
V0H4	V4H4	Output damping in seconds	1
V0H5	V4H5	0/4 mA value (in units used for calibration or linearization)	0.0
V0H6	V4H6	20 mA value (in units used for calibration or linearization)	100.0
V0H7	V4H7	Output on fault condition (safety alarm) 0 = -10% 1 = +110 % 2 = hold last value	0

Table 6.1: Control parameters for analogue outputs

Units

When defining the analogue range at V0H5/V0H6 or V4H5/V4H6, entries must be made in the units used for calibration or if performed, linearization.

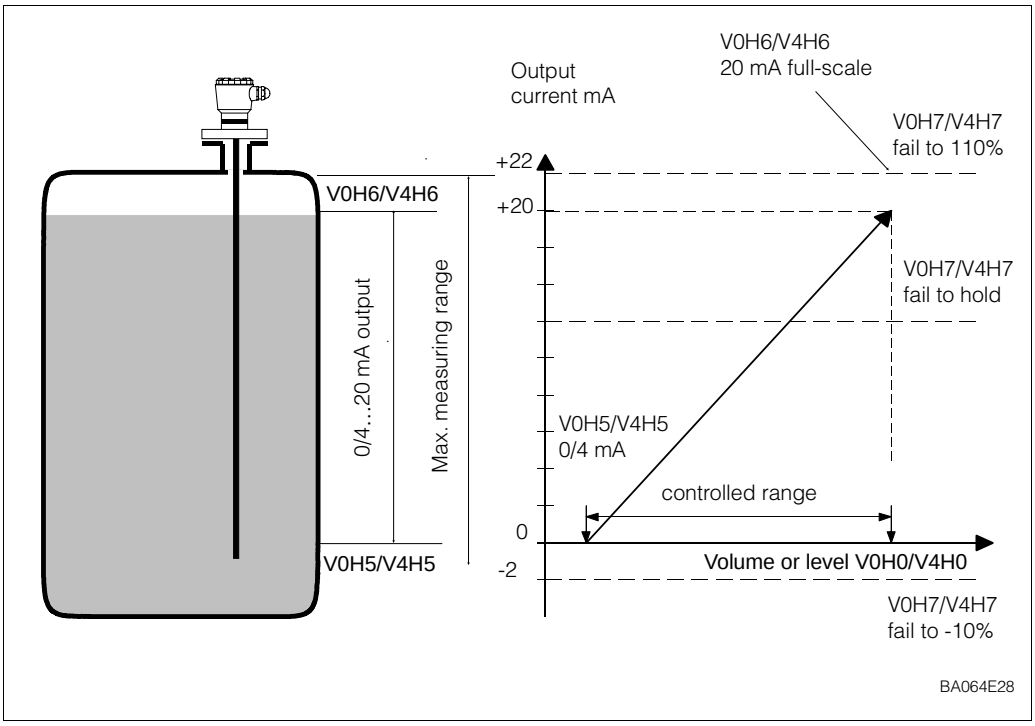


Fig. 6.1: Control parameters for analogue outputs (0…20 mA)

6.1 Analogue output settings

Analogue output range

One of two analogue ranges can be set at V0H3 for channel 1 and V4H3 for channel 2:

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

Current and voltage outputs are switched together.

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

Output damping

A filter, set at V0H4 for channel 1 or V4H4 for channel 2, acts to smooth the analogue output. Using it results in a steady display and analog output less affected by sudden changes in level e.g. due to turbulence. The effect may be modified by changing the integration factor between 0 ... 100s.

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

Step	Matrix	Entry	Significance
1	V0H4	e.g. 5	Sets integration time = 5s
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 and also control the 10-step LCD display. The parameters to be entered are:

- 0/4 mA value: V0H5 for output 1 and V4H5 for output 2
- 20 mA value: V0H6 for output 1 and V4H6 for output 2.

Step	Matrix	Entry	Significance
1	V0H5	e.g. 100	Start-point level or volume for analogue output - V4H5 for output 2
2	-	»E«	Registers entry
3	V0H6	e.g. 1100	Full scale level or volume for analogue output - V4H6 for output 2
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/V4H5> V0H6/V4H6 a warning E 608 appears at V9H0 and the alarm LEDs blink, however, the instrument continuous to operate. The warning and alarm can be eliminated by swapping the values contained in the fields V3H8 and V3H9, D/A calibration, which are normally used for service purposes only. The bar chart, however, still operates in the same direction

0/4…20 mA signal parameters (cont.)

Proceed as follows:

- Enter the smaller value in V0H5, the larger in V0H6
- Select operating mode 6 in field V8H0 (simulation, channel 1). Note the parameters in V3H8 and V3H9
- Enter the V3H8 parameters in V3H9 and vica versa
- Enter previous operating mode in field V8H0

For channel 2, use V4H5, V4H6, V7H8 and V7H9. Select operating mode 7 (simulation, channel 2) at V8H0 to access V7H8 and V8H9.

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 672 Z/677 Z transmitter triggers on finding a fault. The relays follow the analogue output when the value "1" is entered at V1H3 or V5H3. The choice is made at field V0H7 or V4H7, whereby:

- 0 = -10% of full scale ≤ -2 mA, -1V (default value)
- 1 = +110% of full scale ≥ +22 mA, +11V
- 2 = hold = value at fault held

Proceed as follows:

Step	Matrix	Entry	Significance
1	V0H7	e.g. 0	Analogue output drops to -2 mA/-1V on fault
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!

Output 2 assignment

On selection of operating modes 0, 3, and 5 the field V8H2, output 2 assignment, becomes accessible. **Do not** change the values.

7 Limit Switches

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

- Control parameters
- Relay operating modes

Silometer FMC 672 Z/677 Z transmitters have two independent relays, which switch according to the size of the measured value at V0H0/V4H0 on the channel to which they are assigned.

- 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. This determines the point at which the limit switch re-energizes the relay.
- Relay 1 is normally assigned to output 1 and relay 2 to output 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 V5H0 to V5H4 for relay 2. Table 7.1 summarizes their function.

Table 7.1: Relay control parameters

Relay 1	**Relay 2**	**Significance**	**Default**
V1H0	V5H0	Relay switch point	90
V1H1	V5H1	Fail-safe mode 0 = Minimum: relay de-energises when level < switch point 1 = Maximum: relay de-energises when level > switch point On fault condition relay reacts according to V1H3/V5H3 setting see Section 5.2	1
V1H2	V5H2	Relay hysteresis	2.0
V1H3	V5H3	Relay at fault 0 = de-energises 1 = follows analogue output 1/2 according to settings at V0H7 and V4H7	0
V1H4	V5H4	Relay assignment 1 = analogue output 1 2 = analogue output 2	1/2

7.1 Control parameters

Relay assignment

For the Silometer FMC 672 Z/677 Z transmitters, the matrix fields V1H4 and V5H4 assign the relays to the analogue outputs 1 or 2 as required.

Step	Matrix	Entry	Significance
1	V1H4	e.g. 2	Relay 1 is assigned to analogue output 2
2	-	»E«	Register entry

Note!

Note!

- Normally analogue output 2 follows the display at V4H0. It is possible, however, to assign output 2 to channel 1 by entering 1 at V8H2 - see Chapter 6. In this case the output follows V0H0.

Switch point

The switch point is set in the units used for calibration or linearization at V1H0 for relay 1 and V5H0 for relay 2.

Step	Matrix	Entry	Significance
1	V1H0	e.g. 200	Level or volume at which relay 1 triggers
2	-	»E«	Register entry

Fail-safe mode

This function determines whether the relay is to act as a minimum or maximum limit switch, entries are made as V1H1 for relay 1 and V5H1 for relay 2:

- 0 = minimum fail-safe: the relay de-energises if the level or volume drops below the value entered at V1H0/V5H0
- 1 = maximum fail-safe: the relay de-energises if the level or volume rises above the value entered at V1H0/V5H0

Step	Matrix	Entry	Significance
1	V1H1	e.g. 0	Relay 1 de-energises when level drops below 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 hysteresis	Energised	Green on Red off	Drops below hysteresis	Energised	Green on Red off

Table 7.2:
Truth table for minimum and maximum fail-safe mode

Hysteresis

The hysteresis parameter controls the re-energising of the relay after it has tripped, see Fig.7.1 and 7.2. It is expressed as a level or volume and is entered at V1H2 for relay 1 or V5H2 for relay 2:

Step	Matrix	Entry	Significance
1	V1H2	e.g. 400	Sets hysteresis for relay 1 (in our example relay switches on again at 200+400 =600)
2	-	»E«	Register entry

Relay at fault

When the self-monitoring circuit triggers on a fault, the relay adopts the behaviour set at V1H3 for relay 1 and V5H3 for relay 2:

- Setting 0 = de-energised
- Setting 1 = as assigned output 1 or 2, i.e. -10%, +110% or hold depending on entry at V0H7 or V4H7.

Step	Matrix	Entry	Significance
1	V1H3	e.g. 0	The relay de-energises when the self-monitoring circuit triggers.
2	-	»E«	Register entry

When option 1 is entered, the relay assumes the status dictated by the analog signal. Table 7.3 summarizes the possibilities

Table 7.3: Relay response on fault condition.

Setting at V0H7/V4H7	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 Relay operating modes

Depending on the hysteresis settings, several operating modes are possible:

- as a limit switch
- as a two-point control with one relay (Fig. 7.1, 7.2)
- as a two-point control with two relays (Fig. 7.3)

Limit switch

If the relay is to act as a limit switch only:

- Set the hysteresis at V1H3 or V5H3 low or to 0

The relay trips when the level of volume drops below or rises above the set pressure. When the level or volume returns to normal, the relay energises immediately.

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

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

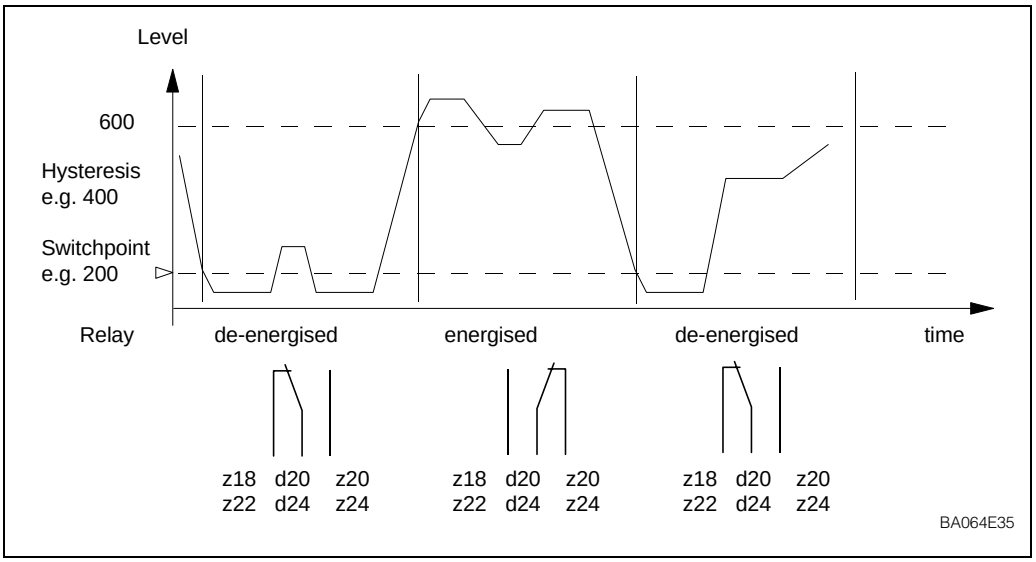


Fig. 7.1: Two-point operation with minimum fail-safe mode

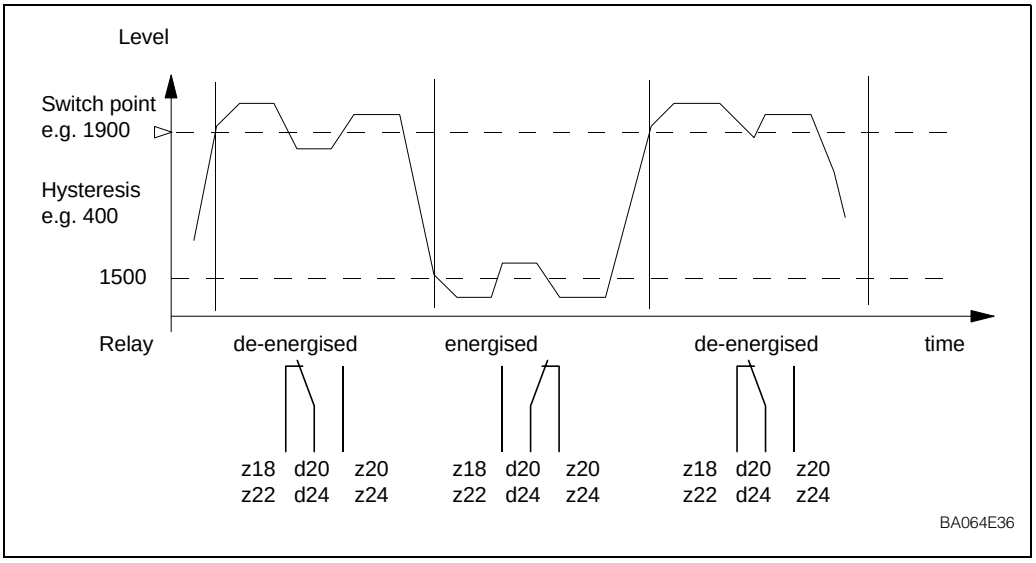


Fig. 7.2: Two-point operation with maximum fail-safe mode

Two-point operation with two relays

This mode of operation is achieved by setting the hysteresis of the two relays (operating on the same channel) such that:

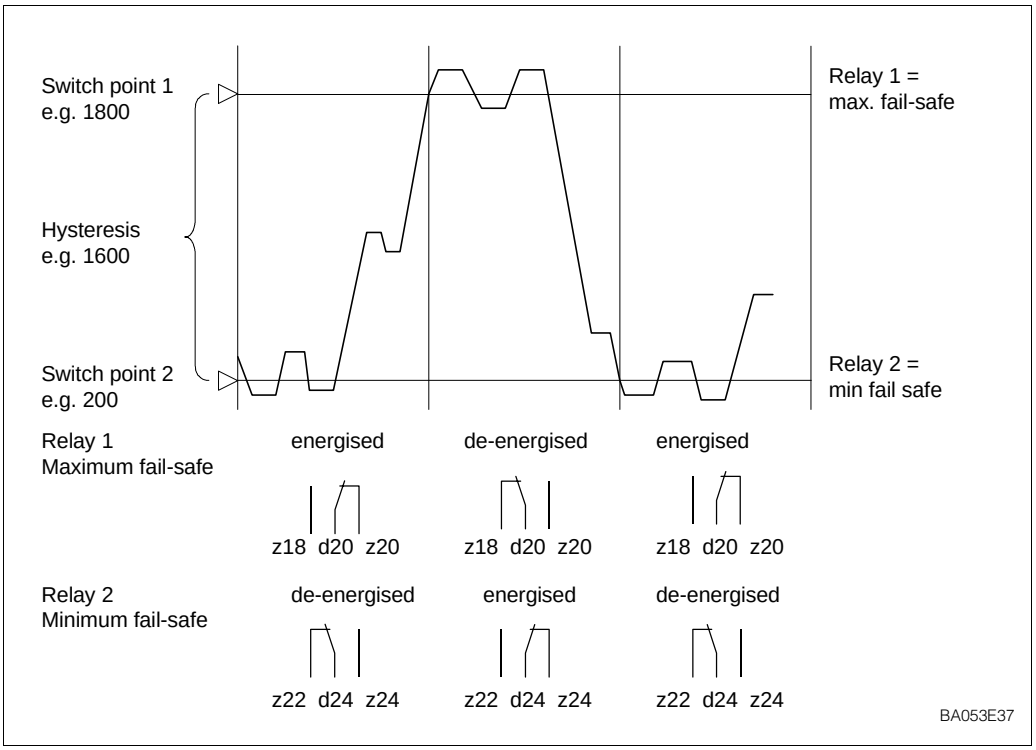
- minimum level/volume + hysteresis = maximum level/volume
- maximum level/volume - hysteresis = minimum level/volume

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	V5H4	1	Assign relay 2 to output 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	V5H0	e.g. 200	Switch point, relay 2 = 200
10	-	»E«	Register entry
11	V5H1	0	Minimum fail-safe mode
12	-	»E«	Register entry
13	V5H2	e.g. 1600	Hysteresis = 1600, the relay energises again at 1800
14	-	»E«	Register entry

Fig. 7.3: Pump control with two pumps



8 Other Applications

This chapter describes the configuration of the Silometer FMC 672 Z/677 Z for operating modes 3 and 5. Density measurement, mode 4, is not described as Deltapilot sensors are required, see BA 060, Silometer FMB 672 Z/677 Z. The applications described are:

- Differential level measurement
- Level measurement with a reference probe

Operating mode 3

Differential level measurements are carried out in operating mode 3. A schematic diagram of the signal processing in this mode is shown in Fig. 8.1.

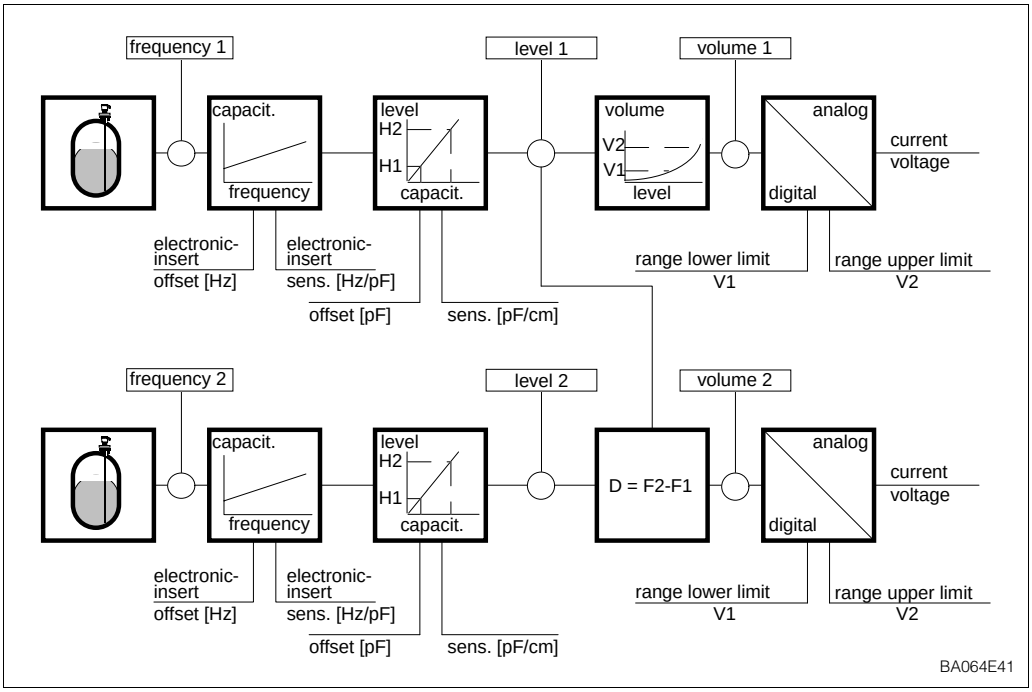


Fig. 8.1:
Schematic diagram of differential level measurement

Operating mode 5

Operating mode 5, see Fig. 8.2, provides a reference measurement at channel 2 which is used to correct the level measurement at channel 1.

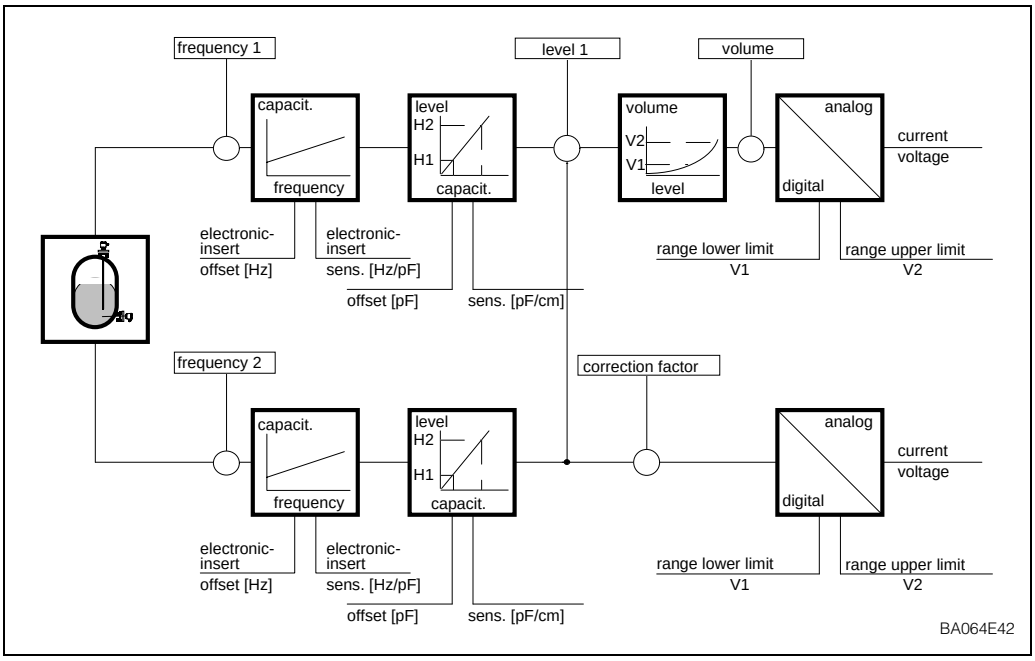


Fig. 8.2:
Schematic diagram of level measurement with reference probe

8.1 Differential level measurement

Fig. 8.3: Example for differential level measurement: level regulation through motorized rake.

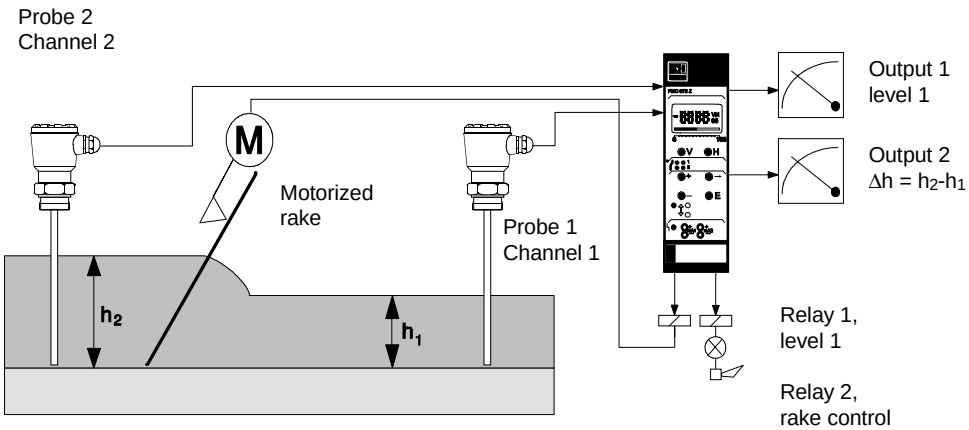


Fig 8.1 shows the Silometer differential level measurement function, Fig. 8.3 a typical application taken from wastewater management. The two capacitance probes measure the difference in levels h_2 - h_1, Δh, which is used to control the inclination of the rake. A continuous display of level h_1 is provided at output 1 and of Δh at output 2. The level measurement at output 1 can be used to provide a flow measurement when an appropriate linearization table is entered for channel 1. When probe 1 is located downstream of probe 2, the level difference is indicated as a positive value

Calibration

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

- Sensor constants »f_o« and »S« from the electronic insert - see Section 2.1.
- Regulation of level to give minimum and maximum for both probes.

Preliminaries

Step	Matrix	Entry	Significance
1	V9H5	671	Reset transmitter
2	-	»E«	Register entry
3	V8H0	3	Select operating mode 3, »differential measurement«
4	-	»E«	Register entry

Sensor adjustment

Step	Matrix	Entry	Significance
1	V3H5	e.g. 99.5	Enter zero frequency »f_o« for probe 1 (channel 1)
2	-	»E«	Register entry
3	V3H6	e.g. 1.056	Enter »S« value of probe 1
4	-	»E«	Register entry
5	V7H5	e.g. 98.8	Enter zero frequency »f_o« for probe 2 (channel 2)
6	-	»E«	Register entry
7	V7H6	e.g. 1.056	Enter »S« value of probe 2
8	-	»E«	Register entry

Level calibration probe 1

Step	Matrix	Entry	Significance
1	V0H1	e.g. 0.5 m	With level at minimum, enter level in %, m, ft etc
2	-	»E«	Register entry
3	V0H2	e.g. 3 m	With level at maximum, enter level in %, m, ft etc.
4	-	»E«	Register entry

Level calibration probe 2

Step	Matrix	Entry	Significance
1	V4H1	e.g. 2 m	With level at minimum, enter level in same units as used for probe 1
2	-	»E«	Register entry
3	V4H2	e.g. 5 m	With level at maximum, enter level in same units as used for probe 2
4	-	»E«	Register entry
5	V0H0	…	Indicates level measured by probe 1
	V4H0	…	Indicates level difference $h_2 - h_1$

Note!
- The »empty« and «full« calibrations can be carried out in any order.
- Configure analogue outputs, see Chapter 6.
  - Output 1 measures level h_1 measured by probe 1
  - Output 2 measures differential level $h_2 - h_1$
- Configure limit switches, see Chapter 7.

Note!

8.2 Level measurement with reference probe

Fig. 8.4: Level measurement with reference probe. Top: Reference probe installed laterally below the measuring probe Bottom: Reference probe installed vertically with active length below the end of the measuring probe

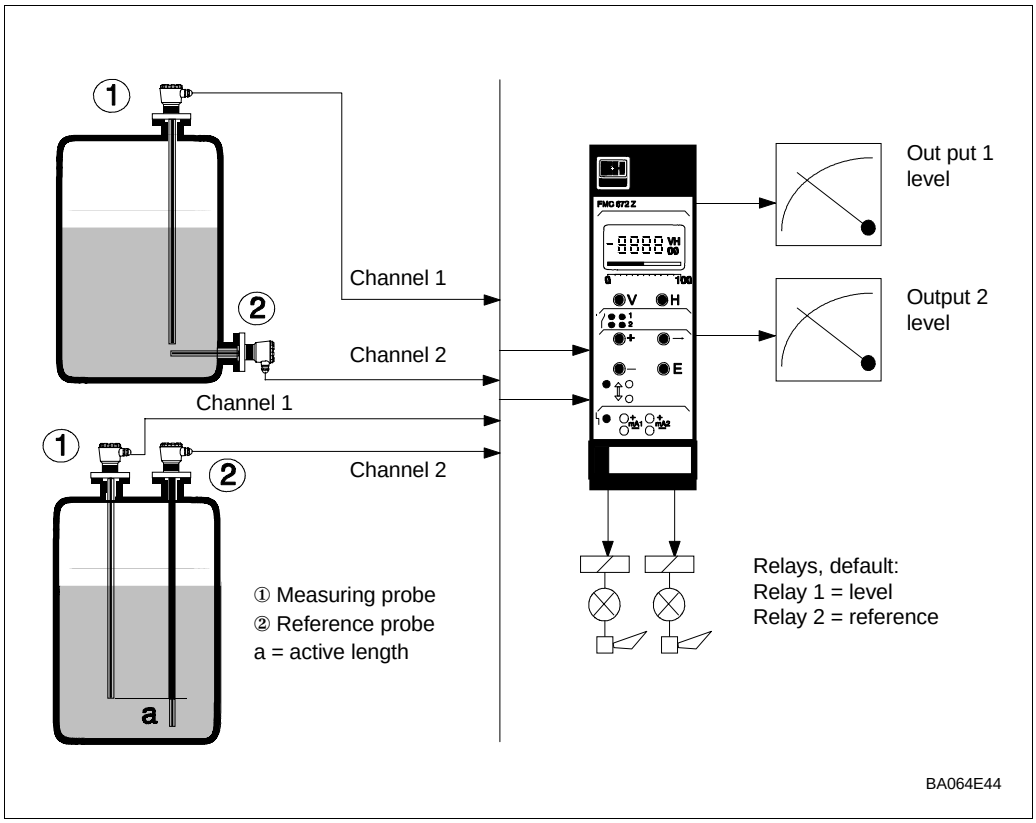


Fig. 8.4 shows two arrangements for level measurement with a reference probe. Under defined conditions, a continuous level measurement on channel 1 can be compensated for the effects of changing products or electrical properties by using a reference probe at channel 2.

Requirements

Prerequisites for the product to ensure to correct function are:

- The product is homogenous throughout
- No build-up, no crystallization.

The measuring and reference probes can be built into the tank as shown in Fig. 8.4. The active part of the reference probe must always be below the minimum level which can be measured by the measuring probe. Thus any change in capacitance can be attributed to a change in product properties rather than a change in level. This places strict requirements on the probe design:

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

Minimum level

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

Calibration

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

Preliminaries

Step	Matrix	Entry	Significance
1	V9H5	671	Reset transmitter
2	-	»E«	Register entry
3	V8H0	5	Select operating mode 5, »reference measurement«
4	-	»E«	Register entry

Sensor adjustment

Step	Matrix	Entry	Significance
1	V3H5	e.g. 99.5	Enter zero frequency »f_0« of probe 1
2	-	»E«	Register entry
3	V3H6	e.g. 1.056	Enter »S« value of probe 1
4	-	»E«	Register entry
5	V7H5	e.g. 98.8	Enter zero frequency »f_0« of reference probe
6	-	»E«	Register entry
7	V7H6	e.g. 1.056	Enter »S« value of reference probe
8	-	»E«	Register entry

Level calibration

Step	Matrix	Entry	Significance
1	V4H2	100	With tank empty enter 100 (sets correction factor to 1)
2	-	»E«	Register entry
3	V4H1	0.0	With tank empty, enter 0.0 in this field
4	-	»E«	Register entry
5	V0H1	e.g. 0.0	Enter »empty« level
6	-	»E«	Register entry
7	V4H2	100	With tank as full as possible (60…100%) enter 100%
8	-	»E«	Register entry
9	V0H2	e.g. 5 m	Enter »full« level
10	-	»E«	Register entry
11	V8H3	e.g. 0.15m	Enter minimum level for switch-off point
12	-	»E«	Register entry
13	V0H0/V4H0	…	Display compensated level and correction factor

Note!
- If appropriate, perform linearization for channel 1, see Chapter 5.
- Configure analogue outputs, see Chapter 6.
  - Output 2 follows the correction factor at V4H0
- Configure limit switches, see Chapter 7.
  - Default is relay 1 level, relay 2 correction factor
  - Assign relay 2 to output 1 at V5H4 (= 1)

Note!

9 Trouble-Shooting

When the instructions in the manual have been followed correctly, the system must now function. Should this not be the case, the Silometer FMC 672 Z/677 Z transmitter provides a number of aids for setting up and operating the module correctly. This Chapter contains the following:

- Trouble-shooting tables, with error messages, meaning and response
- Description of simulated operating mode for service and commissioning purposes
- Instructions for commissioning replacement electronic inserts, probes and transmitters.
- Repairs

9.1 Trouble-shooting tables

Fault condition

If the FMC 672 Z/677 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/V4H7, i.e. to -10%, +110% of the selected measuring range or last measured value (hold) - see Chapter 6.
- the limit value relays assume fail-safe mode as specified in fields V1H3 and V5H3 - see Chapter 7.

A diagnostic message is given in Field V9H0:

- If the cause of the fault has been rectified, 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

If the FMC 672 Z/677 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. If one fault is on display and a fault of higher priority occurs, the latter will appear at V9H0. The preceding message will be found in V9H1.

Table 9.2, trouble-shooting, indicates possible configuration errors for the Silometer FMC 672 Z/677 Z.

Table 9.1: Error messages

Channel 1	**Channel 2**	Type	**Cause and Remedy**
E 101…106		Alarm	Fault in instrument electronics - Call Endress+Hauser Service
E 107		Alarm	Battery voltage too low - Make back-up of entered parameters immediately - Have battery changed by trained personel or ring for service
E 201/ 202	E 301/ 302	Alarm	Fault in probe on channel 1/2 (f < 35 Hz; f > 3000 Hz) - Check probe and electronic insert
E 400		Alarm	Fault in probe on channels 1 + 2 - Check probe, electronic insert and wiring - Incorrect mode selected (only one probe)
E 401	E 402	Alarm	Fault in probe or wiring, channel 1/2 - Check probe, electronic insert and wiring - Incorrect operating mode
E 403 Modes 3 and 5		Alarm	Difference in measured values Channel 1/2 too large - Check calibration, linearization etc.
E 600	E 601	Warning	PFM transmission internal code check - can be ignored if it appears only briefly
E 602	E 603	Warning	Linearization does not rise monotonously (volume does not increase with level) - Check and re-enter values
E 604	E 605	Warning	Linearization has less than two sets of values - Enter more values
E 606	E 607	Warning	No stored factory linearization (V2H6/V6H6 = 0) - Select another linearisation function at V2H0/V6H0
E 608	E 609	Warning	Value in V0H5 greater than that in V0H6 (V4H5 > V4H6) - Check input
E 610	E 611	Warning	Calibration fault, channel 1 (»empty« level > »full« level) - Repeat calibration
E 613	E 614	Warning	Instrument in simutation mode, channel 1/2 - Switch back when finished

Trouble-shooting table Use the following Table to check for incorrect operation

Table 9.2: Trouble shooting table for incorrect function without error message

Fault	Cause and remedy
Measured value wrong (Modes 0…3)	• Incorrect calibration? Check measured value before linearisation, V0H9 - if not correct, check whether full and empty calibration correct V0H1/V0H2 - If correct, check linearization parameters - Check operating mode, V8H0 • Change in product - recalibrate for new product • Build-up on probe - wire electronic insert for build-up, see Section 2.4 • Probe damaged, bent or pressed to side of vessel - check and remedy • Condensation in connection compartment
Measured value wrong Mode 5, with reference probe	• Product inhomogenous • Build up or crystallisation on both probes • Build-up or crystallisation on reference probe • Probes bent or damaged • Calibration not performed correctly - recalibrate • Reference probe and measuring probe are not matched as required, see Section 8.2 - Check rod diameter, ground pipe or shield, insulating material etc.
0/4…20 mA outputs do not function correctly	• Check all settings - Assignment correct, V8H2 - Start and end values correct, V0H5/V0H6, V4H5/V4H6? - Alarm relay has tripped, fault value • Wiring or loads incorrect, see »Installation«
Relays do not trip correctly	• Incorrect settings, e.g. configured in wrong units - Check correct units used for all relay settings - Check relay assignments, V1H4, V5H4 - Simulate settings in simulation mode - see Section 9.2, if the relays LEDs switch, check wiring • Wiring or load incorrect, see »Installation«
Alarm relay blinks	• For twin channel operation, probe missing on one channel - Switch to mode 1 or 2 • See also Table 9.1
No communication with ZA 67… or Commulog	Check position of hook switch, see Section 2.5

9.2 Simulated operating mode

This function is intended primarily for checking the correct function of the system and is selected and terminated at V8H0:

- Enter 6 to simulate on channel 1
- Enter 7 to simulate on channel 2
- Enter an operating mode to terminate simulation and resume normal measurements.

Start and stop simulation

Step	Matrix	Entry	Significance
1	V8H0	e.g. 6	Selects simulation mode channel 1, fields V9H6…V9H9 can be selected
			or
		e.g. 0	Selects two channel measurement and ends simulation
2	-	»E«	Registers entry

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 and the other 3 simulation values are recalculated. Throughout the simulation the red alarm LED flashes to indicate that the instrument is no longer measuring, the alarm relay does not, however, trip.

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 upon the calibration and linearization, the analogue outputs are fed with a current corresponding to e.g.10 m, 10 ft, 10% level.
2	-	»E«	Registers entry

Volume simulation

Step	Matrix	Entry	Significance
1	V9H8	e.g. 100	Depending upon the calibration and linearization, the analogue outputs are fed with the current corresponding to 100 hl, 100 gallons, 100%
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

9.3 Exchanging transmitters, probes and electronic inserts

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 (for linearization in the correct order) from the old into the new transmitter. The replacement will then measure correctly.

- In the case of level measurement with a reference probe, however, the reference probe must be recalibrated, unless the matrix values are downloaded via the ZA 67… computer interface.

Capacitance probes with EC 37 Z/EC 47 Z

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

- the zero frequency (or offset) f_0 and
- sensitivity S

for the range selected (default Range II) must be entered at V3H5 and V3H6 respectively. Fig. 2.1 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. 101	Enter zero frequency (offset) for probe at channel 1
2	-	»E«	Register entry
3	V3H6	e.g. 1.052	Enter sensitivity for probe at channel 1
4	-	»E«	Register entry
5	V7H5/V7H6	…	For channel 2, repeat steps 1 to 4 at V7H5 and V7H6

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 672 Z/677 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!

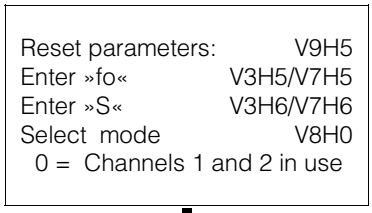
- Special precautions must be observed when sending probes for repair:
  - Remove all visible traces of product from the probe.
  - If the product can impair health, i.e. is corrosive, poisonous, carcinogenic, radioactive etc., please check that the probe is thoroughly decontaminated.
  - If the last 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

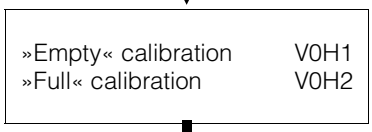
These procedures are intended as a quick guide for users familiar with the Silometer FMC 672 Z/677 Z only.

10.1 Level measurement (2 channels)

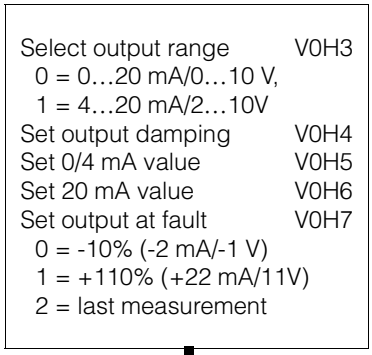
Start
Chapter 4, Section 4.1
- level is displayed at V0H0/V4H0



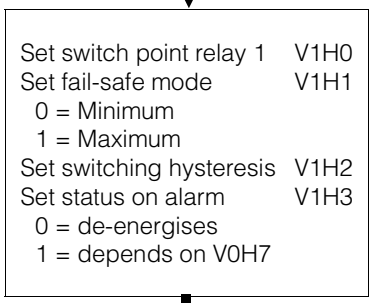
Calibration
Chapter 4, Section 4.2
- After calibration level is displayed at V0H0



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

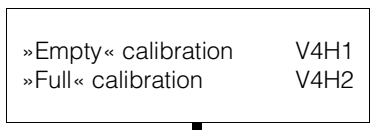


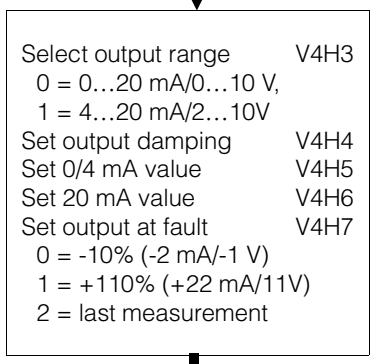
Set relay parameters (optional)
Chapter 7
- Relay 1 can be assigned to channel 2 by entering 2 at V1H4
- Relay 2 can be assigned to channel 1 by entering 1 at V5H4

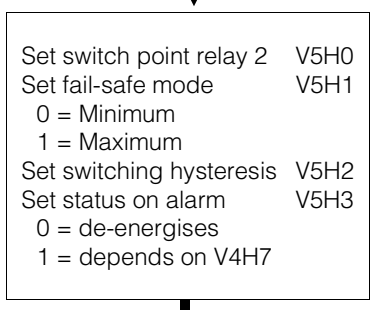


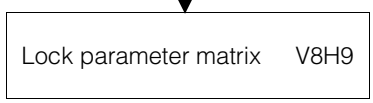
Lock parameter matrix (optional)
Chapter 4, Section 4.6

Set parameters in Channel 2









10.2 Level measurement (Channel 1)

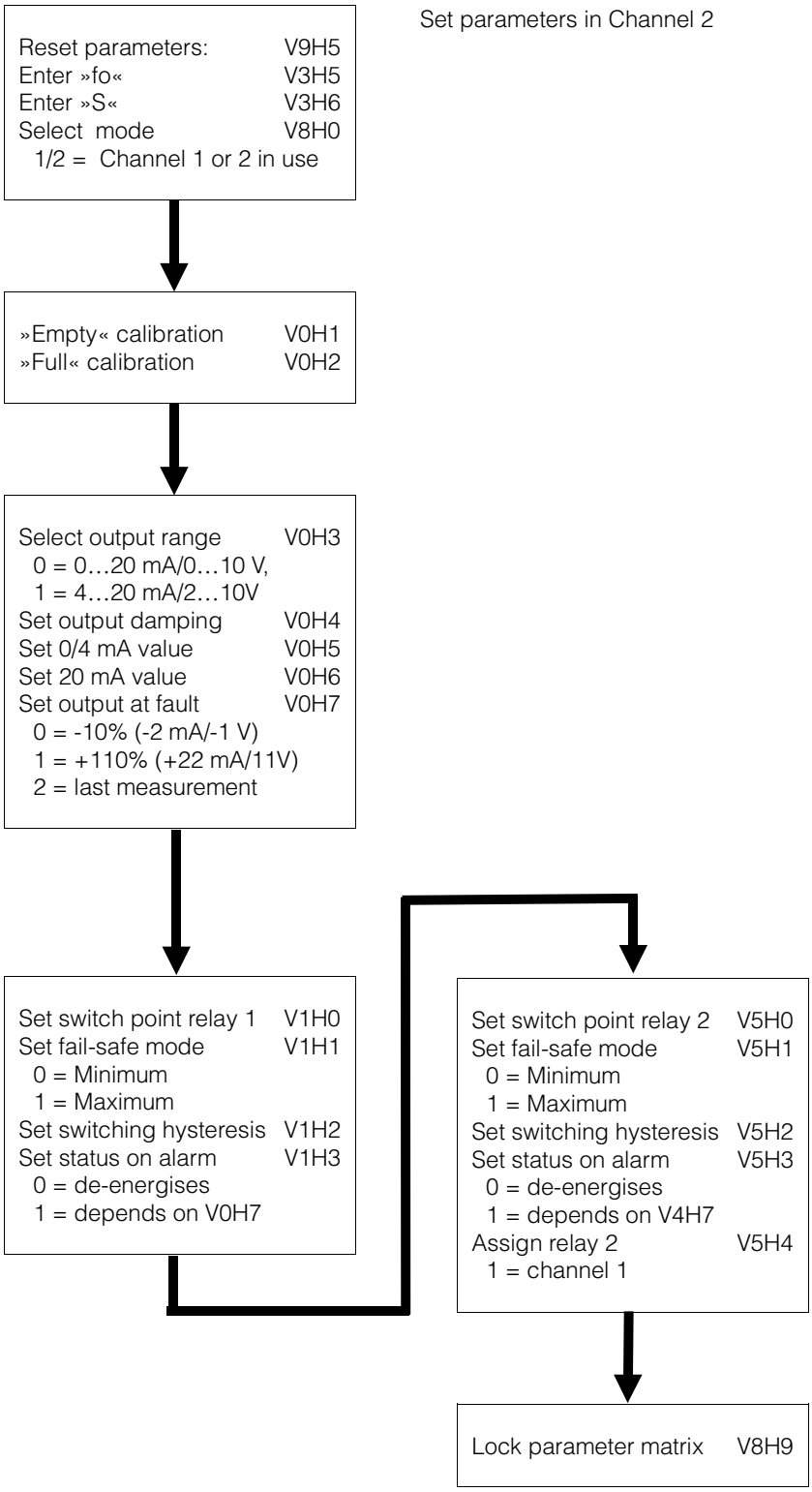
Start
Chapter 4, Section 4.1
- level is displayed at V0H0

Calibration
Chapter 4, Section 4.2
- After calibration level 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

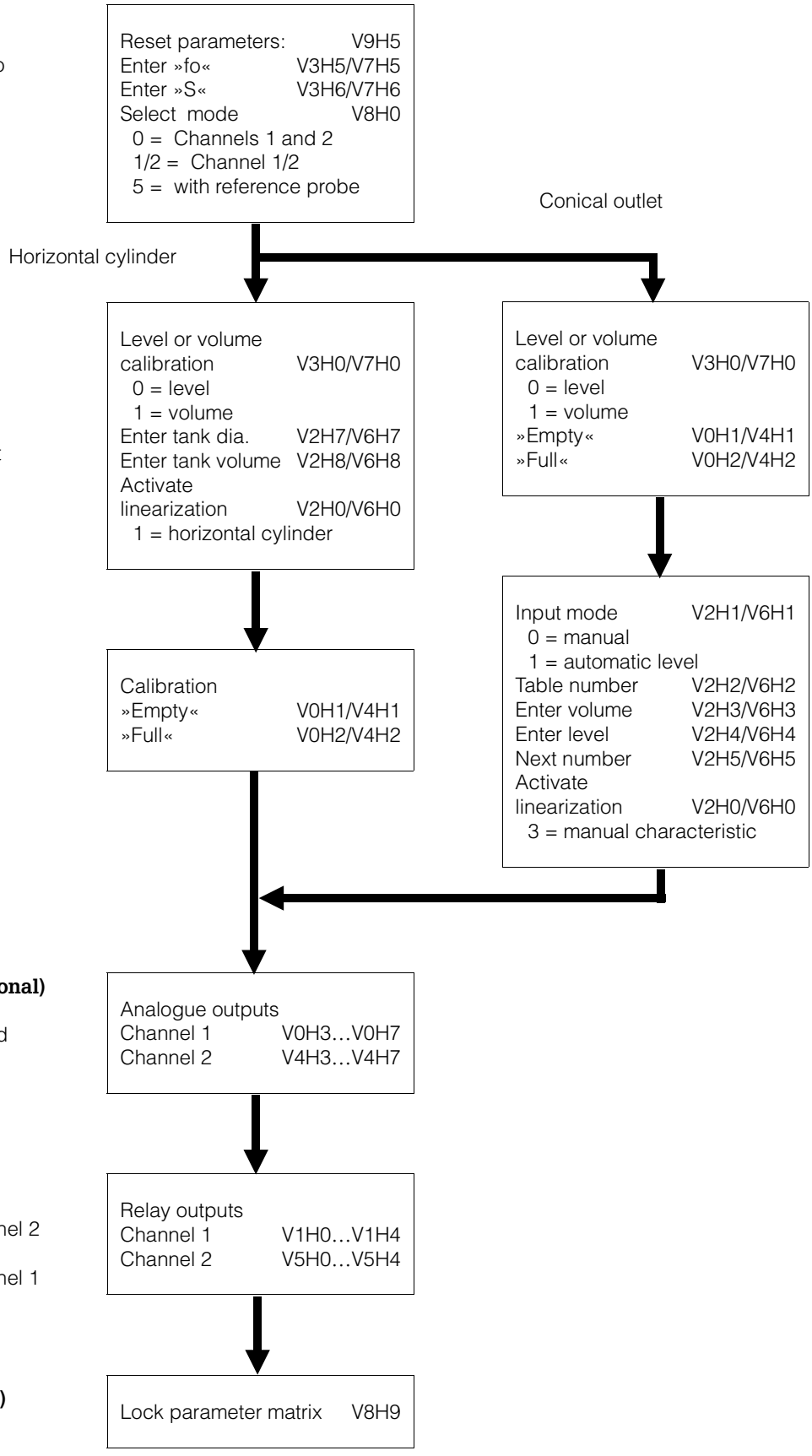
Lock parameter matrix (optional)
Chapter 4, Section 4.6



Set parameters in Channel 2

10.3 Linearization for horizontal cylinder or conical outlet

Start
Chapter 4, Section 4.1
- for mode 5, calibrate according to the instructions in Chapter 8.2



Claibration/Linearization
Chapter 4, Section 4.2…4.4
Chapter 8
Chapter 5
- V0H0 displays volume
- Relays and analogue output must be set in volume units

Set analogue output signal (optional)
Chapter 6
- Enter settings in the units selected during calibration or linearization
- V8H2 assigns output 2

Set relay parameters(optional)
Chapter 7
- Relay 1 can be assigned to channel 2 by entering 2 at V1H4
- Relay 2 can be assigned to channel 1 by entering 1 at V5H4

Lock parameter matrix (optional)
Chapter 4, Section 4.6

10.4 Differential level measurement

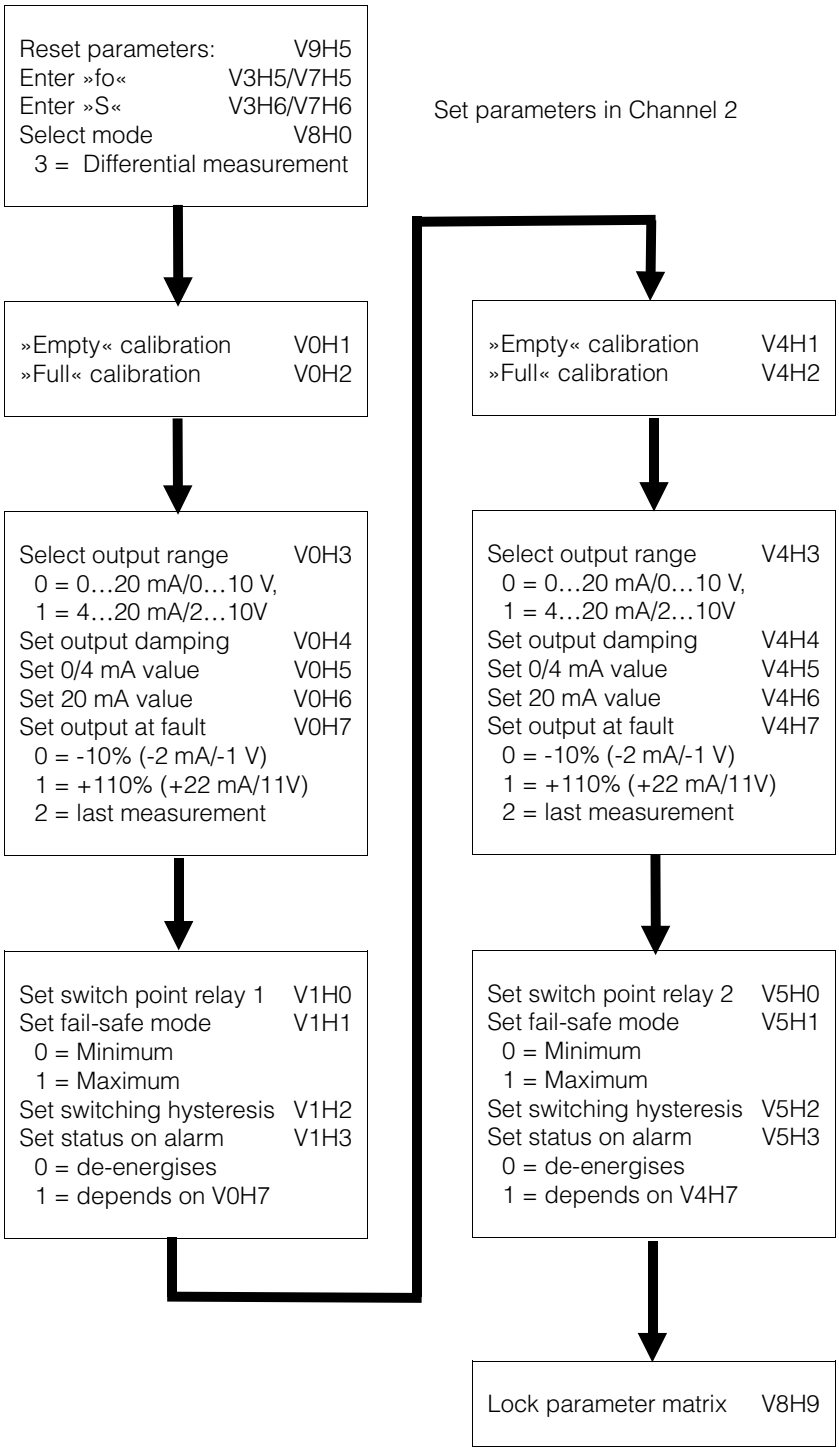
Start
Chapter 8, Section 8.1
- Channel 1 = level, Channel 2 = difference
- level difference is displayed at V4H0
- level probe 1is displayed at V0H0

Calibration
Chapter 8, Section 8.1
- Order of calibration not critical
- A linearization can be performed at channel 1

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

Set relay parameters(optional)
Chapter 7
- Relay 2 can be assigned to channel 1 by entering 1 at V5H4

Lock parameter matrix (optional)
Chapter 4, Section 4.6



10.5 Level measurement with reference probe

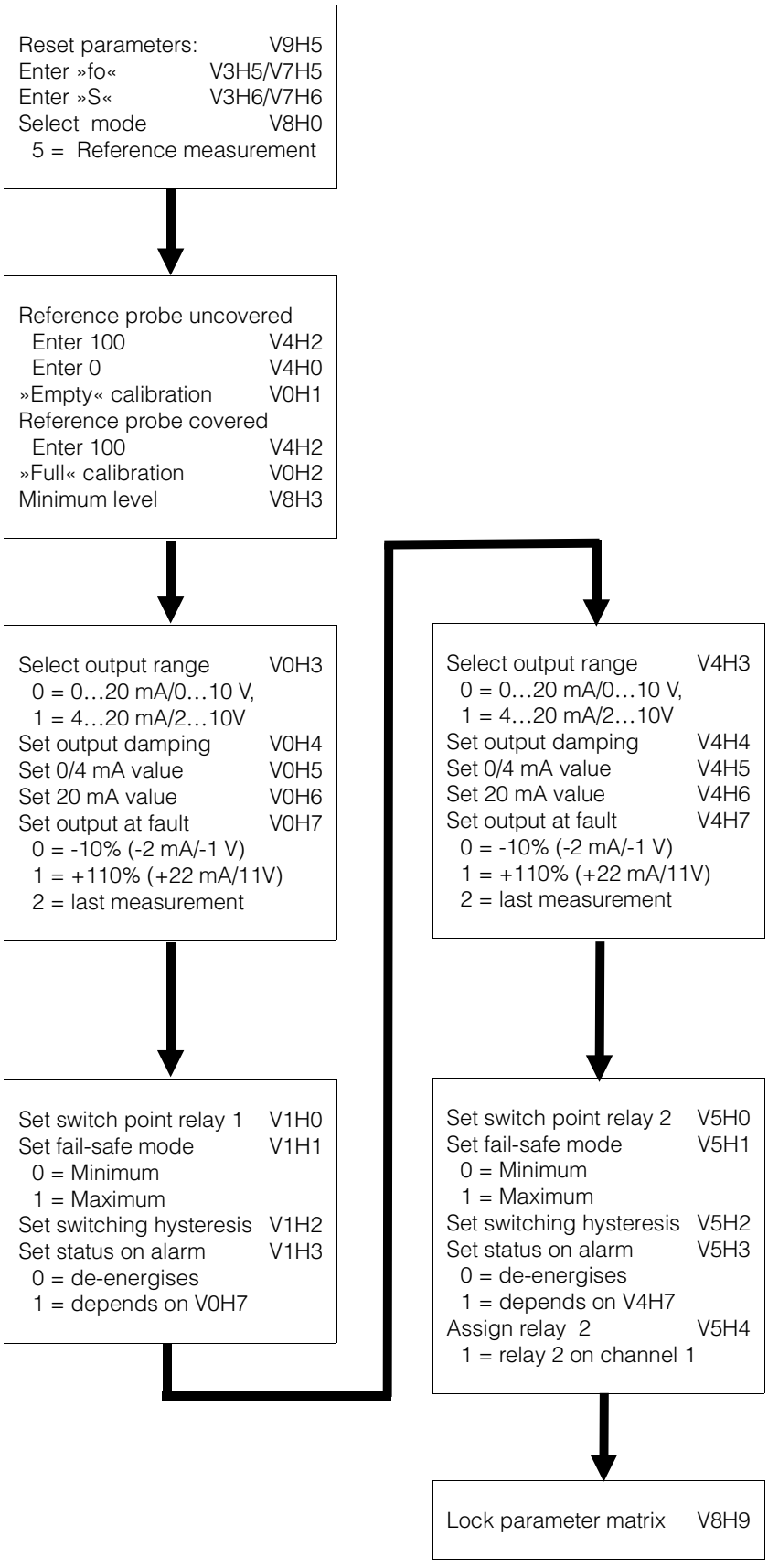
Start
Chapter 8, Section 8.2
- Channel 1 = level, Channel 2 = reference probe
- Level is displayed at V0H0, Correction factor at V4H0

Calibration
Chapter 8, Section 8.2
- After calibration level/volume is displayed at V0H0
- Minimum level = 3% measuring probe length

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

Set relay parameters (optional)
Chapter 7
- Assign relay 2 to channel 1 (level controlled) by entering 1 at V5H4

Lock parameter matrix (optional)
Chapter 4, Section 4.6



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Operating Matrix

Operating and default parameters

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

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

Display field

The default parameters are as indicated below.

	H0	H1	H2	H3	H4	H5	H6	H7	H8	H9
V0		0.0	100.0	0	1	0.0	100.0	1		
V1	90.0	1	2.0	0	1					
V2	0	0	1	0.0	0.0	1		100	100	
V3	0	0.0	10.0	1.000	0.0	0.0	100.0	1		
V4		0.0	100.0	0	1	0.0	100.0			
V5	90.0	1	2.0	0	2					
V6	0	0	1	0.0	0.0	1		100	100	
V7	0	0.0	10.0	1.000	0.0	0.0	100.0	1		
V8	0	9990	2	20.0	0					670
V9				63…		0	0.0	0.0	0.0	0.0

Display field

Parameter Matrix

	H0	H1	H2	H3	H4	H5	H6	H7	H8	H9
V0 Calibration Channel 1	Measured value	Empty calibration	Full calibration	Select current 0=0…20mA 1=4…20mA	Output damping (s)	Value for 0/4 mA	Value for 20 mA	Safety alarm 0 = -10% 1=+110% 2=Hold	Actual measuring frequency	Measured value before linearization
V1 Limit value Channel 1	Relay 1 switching point	Relay 1 fail-safe mode 0 = min. 1 = max.	Relay 1 hysteresis	Relay 1 at alarm 0 = de-energise 1 = as V0/V4H7	Relay 1 1 = channel 1 2 = channel 2					
V2 Linearisation Channel 1	Linearization 0=linear 1= hor. cylinder 2=factory 3=manual 4=clear 3	Level input mode 0=manual 1=auto.	Table No. (1…30)	Input Volume	Input Level	Next Table No.	No. of factory-set character-istic	Diameter for horizontal cylinder	Volume for horizontal cylinder	
V3 Extended Calibration Channel 1	Calibration mode 0=level 1= volume	Offset	Sensitivity		Zero offset value	Offset (device-specific) fo	Sensitivity (device-specific) S		For Service only (0 mA D/A calibration)	For Service only 20 mA D/A calibration)
V4 Calibration Channel 2	Measured value	Empty calibration	Full calibration	Select current 0=0…20mA 1=4…20mA	Output damping (s)	Value for 0/4 mA	Value 20 mA	Safety alarm 0 = -10% 1=+110% 2=Hold	Actual measuring frequency	Measured value before linearization
V5 Limit value Channel 2	Relay 2 switching point	Relay 2 fail-safe mode 0 = min. 1 = max.	Relay 2 hysteresis	Relay 2 at alarm 0 = de-energise 1 = as V4/V0H7	Relay 2 1 = channel 1 2 = channel 2					
V6 Linearisation Channel 2	Linearization 0=linear 1= hor. cylinder 2=factory 3=manual 4=clear 3	Level input mode 0=manual 1=auto.	Table No. (1…30)	Input Volume	Input Level	Next Table No.	Factory curve No.	Diameter for horizontal cylinder	Volume for horizontal cylinder	
V7 Extended Calibration Channel 2	Calibration mode 0=level 1= volume	Offset	Sensitivity		Zero offset value	Offset (device-specific) fo	Sensitivity (device-specific) S		For Service only (0 mA D/A calibration)	For Service only 20 mA D/A calibration)
V8	Operat. mode 0 = 2 channels 1/2= chan.1/2 3 = difference 5 = reference 6/7 = sim.ch1/2	Max. diff with 2 channel operation	Analog output 2 1 = channel1 2 = channel 2	Minimum level Mode 5				Correction factor for reference operation		Security locking < 670 or > 679
V9 Service and Simulation	Current error code	Last but one errorcode E=clear		Instrument and Software version	Rackbus address	Reset to default values 670…679	Simulation frequency	Simulation level	Simulation volume	Simulation current
VA VU 260 Z ZA 672 only	Tag. No. channel 1	Tag No. channel 2	Units measured value channel 1 before linearisation	Units measured value channel 2 after linearisation	Units measured value channel 1 before linearisation	Units measured value channel 2 after linearisation	Text measured value channel 1 before linearisation	Text measured value channel 1 after linearisation	Text measured value channel 2 before linearisation	Text measured value channel 2 after linearisation

Display field

Europe

Austria
❑ Endress+Hauser Ges.m.b.H.
Wien
Tel. (01) 88056-0, Fax (01) 88056-35

Belarus
Belorgsintez
Minsk
Tel. (0172) 508473, Fax (0172) 508583

Belgium / Luxemburg
❑ Endress+Hauser N.V.
Brussels
Tel. (02) 2480600, Fax (02) 2480553

Bulgaria
INTERTECH-AUTOMATION
Sofia
Tel. (02) 664869, Fax (02) 963139

Croatia
❑ Endress+Hauser GmbH+Co.
Zagreb
Tel. (01) 6637785, Fax (01) 663782 3

Cyprus
I+G Electrical Services Co. Ltd.
Nicosia
Tel. (02) 484788, Fax (02) 484690

Czech Republic
❑ Endress+Hauser GmbH+Co.
Praha
Tel. (026) 6784200, Fax (026) 6784179

Denmark
❑ Endress+Hauser A/S
Søborg
Tel. (70) 131132, Fax (70) 132133

Estonia
ELVI-Aqua
Tartu
Tel. (7) 441638, Fax (7) 441582

Finland
❑ Endress+Hauser Oy
Espoo
Tel. (09) 86767440, Fax (09) 86767440

France
❑ Endress+Hauser S.A.
Huningue
Tel. (389) 696768, Fax (389) 694802

Germany
❑ Endress+Hauser Messtechnik GmbH+Co.
Weil am Rhein
Tel. (07621) 975-01, Fax (07621) 975-555

Great Britain
❑ Endress+Hauser Ltd.
Manchester
Tel. (0161) 2865000, Fax (0161) 9981841

Greece
I & G Building Services Automation S.A.
Athens
Tel. (01) 9241500, Fax (01) 9221714

Hungary
Mile Ipari-Elektro
Budapest
Tel. (01) 2615535, Fax (01) 2615535

Iceland
BIL ehf
Reykjavik
Tel. (05) 619616, Fax (05) 619617

Ireland
Flomeaco Company Ltd.
Kildare
Tel. (045) 868615, Fax (045) 868182

Italy
❑ Endress+Hauser S.p.A.
Cernusco s/N Milano
Tel. (02) 92192-1, Fax (02) 92192-362

Latvia
Rino TK
Riga
Tel. (07) 315087, Fax (07) 315084

Lithuania
UAB "Agava"
Kaunas
Tel. (07) 202410, Fax (07) 207414

Netherlands
❑ Endress+Hauser B.V.
Naarden
Tel. (035) 6958611, Fax (035) 6958825

Norway
❑ Endress+Hauser A/S
Tranby
Tel. (032) 859850, Fax (032) 859851

Poland
Endress+Hauser Polska Sp. z o.o.
Warszawy
Tel. (022) 7201090, Fax (022) 7201085

Portugal
Tecnisis - Tecnica de Sistemas Industriais
Linda-a-Velha
Tel. (21) 4267290, Fax (21) 4267299

Romania
Romconseng S.R.L.
Bucharest
Tel. (01) 4101634, Fax (01) 4112501

Russia
Endress+Hauser Moscow Office
Moscow
Tel. (095) 1587564, Fax (095) 1589871

Slovakia
Transcom Technik s.r.o.
Bratislava
Tel. (7) 44886884, Fax (7) 44887112

Slovenia
Endress+Hauser D.O.O.
Ljubljana
Tel. (061) 1592217, Fax (061) 1592298

Spain
❑ Endress+Hauser S.A.
Sant Just Desvern
Tel. (93) 4803366, Fax (93) 4733839

Sweden
❑ Endress+Hauser AB
Sollentuna
Tel. (08) 55511600, Fax (08) 55511655

Switzerland
❑ Endress+Hauser AG
Reinach/BL 1
Tel. (061) 7157575, Fax (061) 7111650

Turkey
Intek Endüstriyel Ölcü ve Kontrol Sistemleri
Istanbul
Tel. (0212) 2751355, Fax (0212) 2662775

Ukraine
Photonika GmbH
Kiev
Tel. (44) 26881, Fax (44) 26908

Yugoslavia Rep.
Meris d.o.o.
Beograd
Tel. (11) 4441966, Fax (11) 4441966

Africa

Egypt
Anasia
Heliopolis/Cairo
Tel. (02) 4179007, Fax (02) 4179008

Morocco
Oussama S.A.
Casablanca
Tel. (02) 241338, Fax (02) 402657

South Africa
❑ Endress+Hauser Pty. Ltd.
Sandton
Tel. (011) 4441386, Fax (011) 444197 7

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