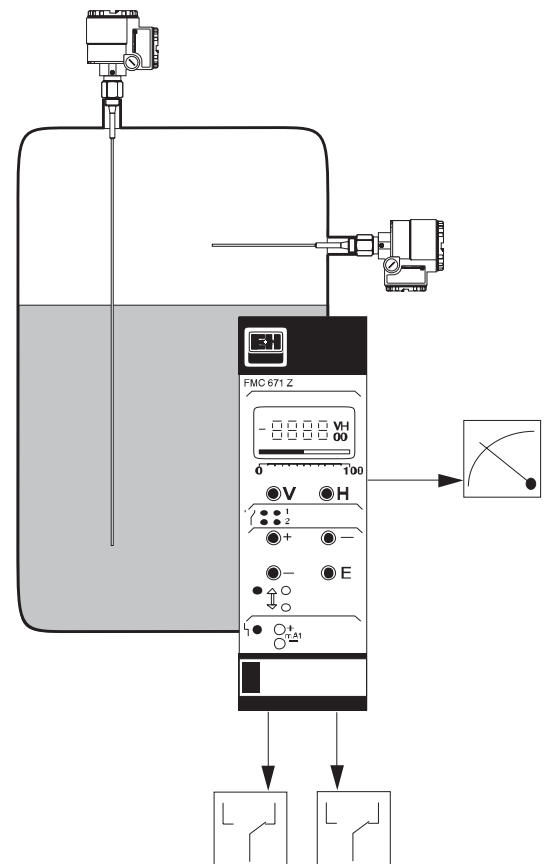
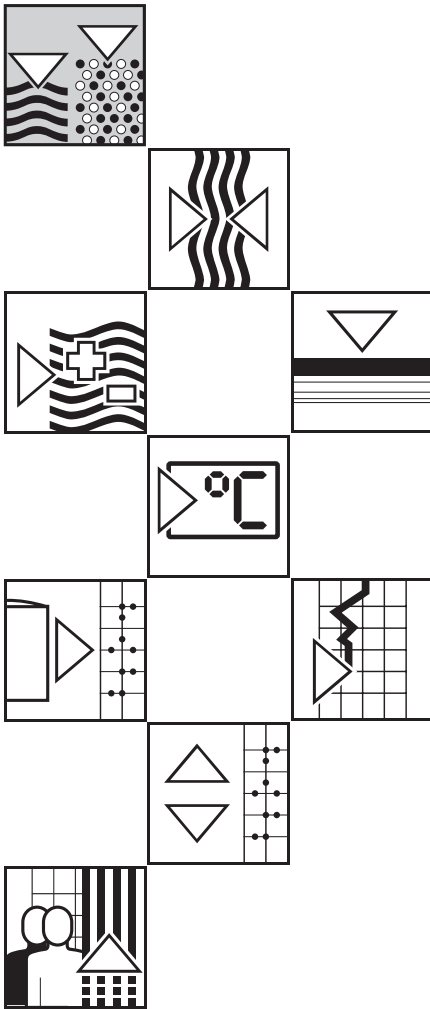


silometer FMC 671 Z/676 Z Level Measurement

Operating Instruction

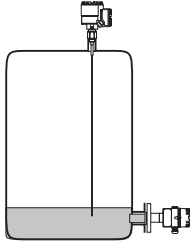
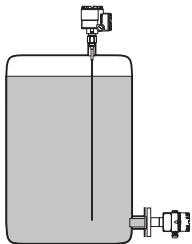
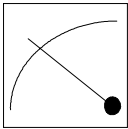
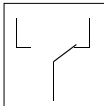
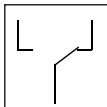


Endress + Hauser

The Power of Know How

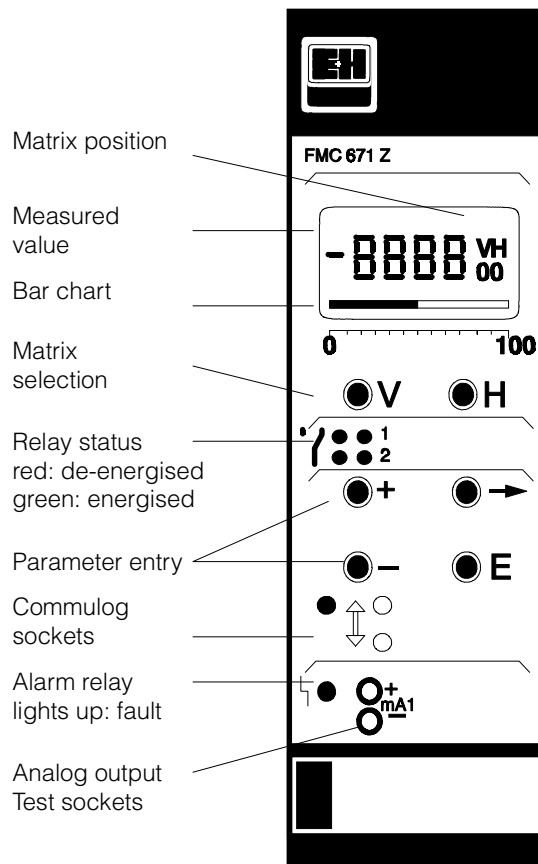


Measurement at a Glance

Function	Matrix	Action
1 Reset transmitter	V9H5	● Enter 671: »+« and »-« keys, ⇒ changes digit - Press »E« to register entry - Omit if commissioned as in Section 4.1
2 »Empty« calibration* 	V0H1	● Fill vessel 0...40% full (probe covered) - Enter level in %, m, ft, etc. - Press »E« to register entry
3 »Full« calibration* 	V0H2	● Fill vessel 60...100% full (probe covered) - Enter level in %, m, ft, etc. - Press »E« to register entry
4 0/4 mA signal 	V0H3 V0H5 V0H6	● Enter 0 for 0...20 mA signal, 1 for 4...20 mA signal - Press »E« to register entry ● Enter level for 0/4 mA signal (if not 0) - Press »E« to register entry ● Enter level for 20 mA signal (if not 100) - Press »E« to register entry
5 Relay 1 	V1H0 V1H1	● Enter level for switching in calibration units, Relay 1 - Press »E« to register entry ● Enter fail-safe mode: 0 = minimum, 1 = maximum - Press »E« to register entry
6 Relay 2 	V1H5 V1H6 V1H9	● Enter level for switching in calibration units, Relay 2 - Press »E« to register entry ● Enter fail-safe mode: 0 = minimum, 1 = maximum - Press »E« to register entry ● Enter 1 = Relay 2 assigned to channel 1 - Press »E« to register entry

*Can be performed in reverse order

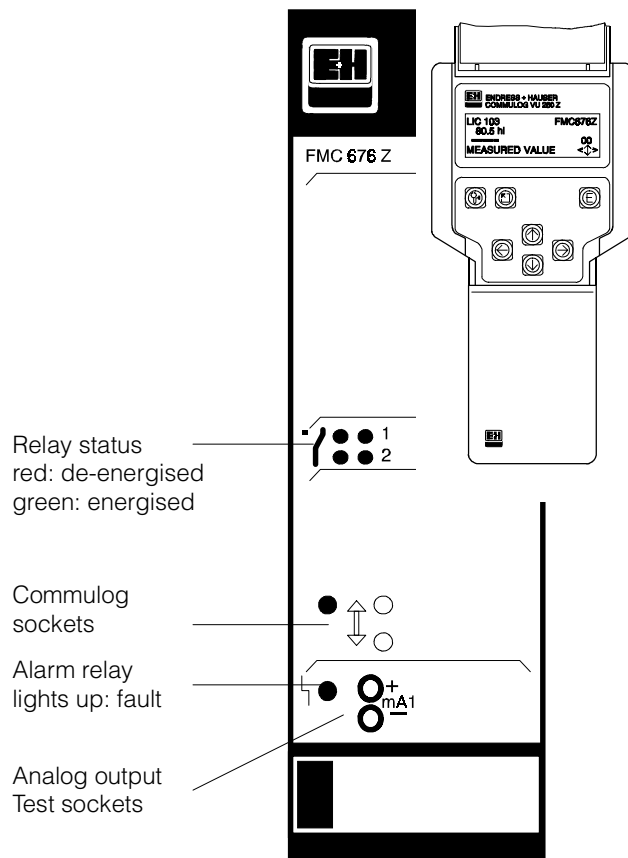
FMC 671 Z



- V** Selects vertical matrix position
- H** Selects horizontal matrix position
- V** + **H** Select position V0H0
- Selects next digit
- + **+** Move decimal point
- +** Increases value of digit +1
- Decreases value of digit -1
- E** Register entry

For operating elements, see chapter 3

FMC 676 Z/Commulog VU 260 Z



- **↑** **←** **↓** Select matrix position
- ↖** Selects position V0H0
- 🩺** Calls error diagnosis
- E** Calls entry mode
- ←** **→** Select next digit
- ↑** **↓** Increase and decrease value
- ←** + **↑** Move decimal point to left
- + **↑** Move decimal point to right
- E** Registers entry and quits mode
- ↖** Breaks off entry without storing value

Table of Contents

1	Introduction	5	7	Limit Switches	36
1.1	Application	6	7.1	Relay settings	37
1.2	Measuring system	7	7.2	Applications	38
1.3	Measuring principle	8			
1.4	Functional description	9	8	Other Applications	41
2	Installation	10	8.1	»Dry calibration« for continuous level measurement with Deltapilot probes	41
2.1	Probes	10	8.2	Level limit switching	43
2.2	Silometer installation	11	8.3	Continuous level measurement with separate level limit detection	46
2.3	Transmitter wiring	13	8.4	Level measurement with automatic calibration correction	47
2.4	Probe connection	15			
2.5	Hardware configuration	17	9	Trouble-Shooting	50
2.6	Technical data: Silometer FMC 671 Z/676 Z transmitter	18	9.1	Faults and warnings	50
3	Operating elements	19	9.2	Simulation	53
3.1	Commute operating matrix	19	9.3	Exchanging transmitters or probes	54
3.2	Operating elements: Silometer FMC 671 Z	20	9.4	Repairs	55
3.3	Operating elements: Silometer FMC 676 Z	21	10	Quick programming guide	56
4	Calibration and Operation	22	10.1	Level measurement with separate level switching, capacitance probes	56
4.1	Commissioning of the transmitter	22	10.2	Continuous volume measurement (linearization)	57
4.2	Empty/full calibration for level measurement	23	10.3	Level limit switching	58
4.3	Empty/full calibration for volume measurement	24	10.4	Level measurement with automatic calibration correction: two capacitance probes	59
4.4	Level offset value	25			
4.5	Measured value display	26			
4.6	Locking the parameter matrix	26			
5	Linearization	27			
5.1	Linearization for a horizontal cylindrical tank	28			
5.2	Linearization for a tank with conical outlet	29			
5.3	Other modes	32			
6	Analogue Outputs	33			
6.1	Configuration	34			

Notes on Safety

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

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

Certificates

Certificate	Transmitter	Notes
TÜV 00 ATEX 1640	Silometer FMC 671 Z/676 Z	  II (1) GD, [EEx ia] IIC/IIB, install outside Ex-area
PTB 98 ATEX 2215 X	DC 12 TE, DC .. TE .., DC .. E .., DC .. Capacitance probes 11500 Z(M), 11961 (Z), 21561 (Z) with electronic insert EC 16/17/27/37/47 Z, FEC 12, HTC 16/17/27 Z, HTC 10 E, HMC 37/47 Z	  II 1/2 G, II 2 G, EEx ia IIC/IIB T6
PTB 98 ATEX 2215 X	DC 12 TE, DC .. TE .., DC .. E .., DC .. Capacitance probes 11500 Z(M), 11961 Z, 21561 Z with electronic insert EC 17/37/47 Z, FEC 12	  II 1 G, EEx ia IIC/IIB T6
PTB 98 ATEX 2094	DB 50, DB 50 L, DB 51, DB 52, DB 53	  II 1/2 G, II 2 G, EEx ia IIC T4...T6
Z-65.13-107	DC 12 TE, DC .. TE .., DC .. E .., DC .. Capacitance probes 11500 Z, 11961 Z, 21561 Z with electronic insert EC 37/47 Z, FEC 12, HMC 37/47 Z FMC 470, FMC 671/672 Z, FMX 570 Z, FMX 770, SIF 100/110	Continuous level measurement for overspill protection in stationary vessels (for storage of non-combustible, water-polluting liquids)
DiBT No. Z-65.11-29	Silometer FMC 671 Z electronic insert FEB 17 DB 50...52	Continuous level measurement for overspill protection in stationary vessels (for storage of non-combustible, water-polluting liquids)
German Lloyd GL No. 97517 HH	Silometer FMC 671 Z Capacitance probes electronic insert EC 37 or EC 47 electronic insert EC 17 Z	Level indication on channel 1 (EC 37 Z or EC 47 Z) Level limit detection on channel 2 (EC 17 Z) Suitable for unlimited use within the rules
German Lloyd GL No. 97510 HH	Liquiphant DL 17 Z	Level indication on channel 1. Suitable for unlimited use within the rules
German Lloyd GL No. 99350 HH	DB 50, 50 L, 52, 53 with electronic insert FEB 17 / 17 P	

Notes on Safety

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



Note!

Note!

- A note highlights actions or procedures which, if not performed correctly, may indirectly affect operation or may lead to an instrument response which is not planned.



Caution!

Caution!

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



Warning!

Warning!

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

1 Introduction

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

Quick Operating Guides

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

Users unfamiliar with the Silometer FMC 671 Z/676 Z must read the operating instructions. Since it is not possible to describe all applications in detail, the standard application, continuous level measurement, has been used as the basis for the functional description. Other applications as listed in Section 1.1 are described in Chapter 8. The instructions are structured as follows:

In this manual

- Chapter 1: Introduction;
contains general information including application, measurement principle and functional description.
- Chapter 2: Installation;
contains hardware configuration, installation instructions, connection diagrams and technical data for the plug-in card.
- Chapter 3: Controls;
describes operation with the front panel keys, Commulog VU 260 Z and ZA 672.
- Chapter 4: Calibration and Operation;
tells you how to commission the Silometer for the standard application.
- Chapter 5: Linearization;
tells you how to calibrate the Silometer to measure volume in a horizontal cylindrical tank or a tank with a conical outlet.
- Chapter 6: Analogue Outputs;
describes in detail the setting of the 0/4...20 mA signal line.
- Chapter 7: Relays;
describes in detail the setting of the limit switches.
- Chapter 8: Other Applications;
describes the configuration of the Silometer for further applications not covered in Chapter 4.
- Chapter 9: Trouble-Shooting;
contains a description of the self-checking system with error messages, the simulation feature as well as instructions for configuration on replacement of the transmitter, probe or electronic insert.
- Chapter 10: Quick Programming Guide;
provides configuration flowcharts for the principle applications.
- Chapter 11: Index;
lists key words to help you find information quickly.

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

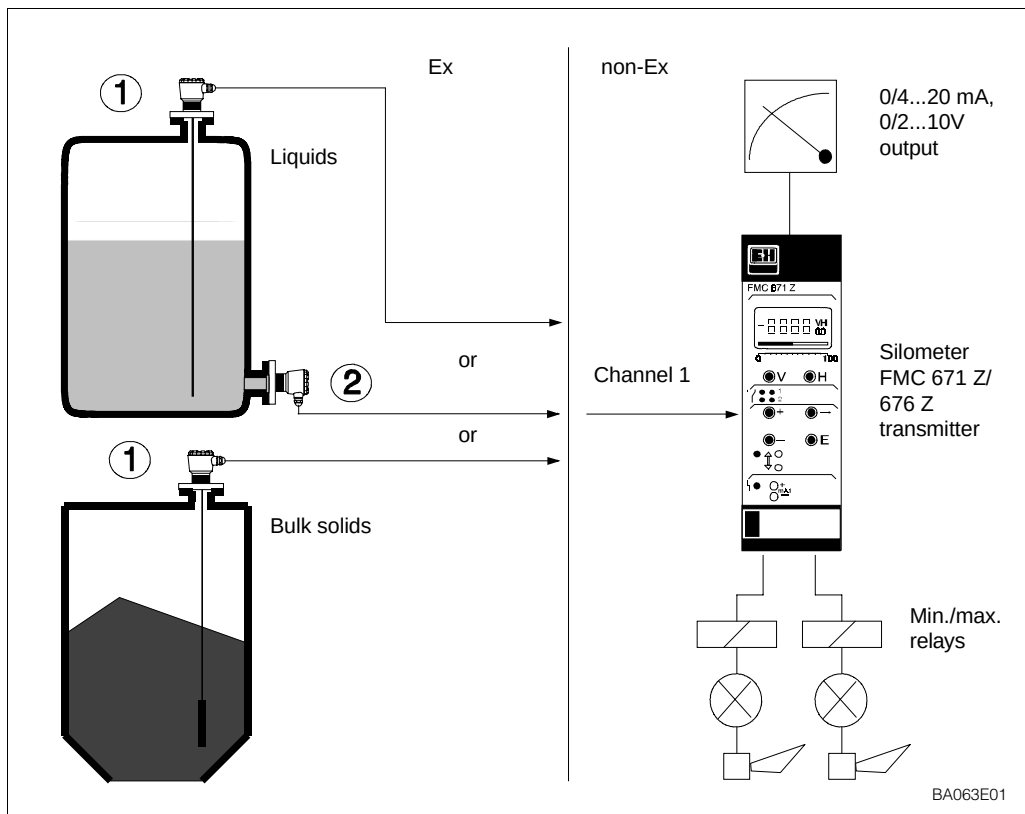
Further documentation

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

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

1.1 Application

Fig. 1.1:
Standard application with
Silometer FMC 671 Z/676 Z
① Capacitance probe
② Deltapilot S

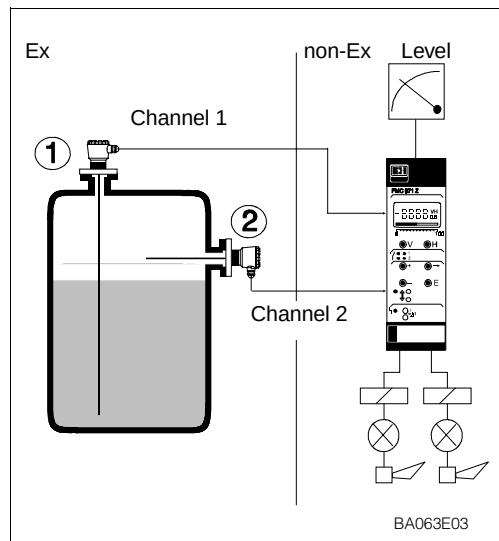
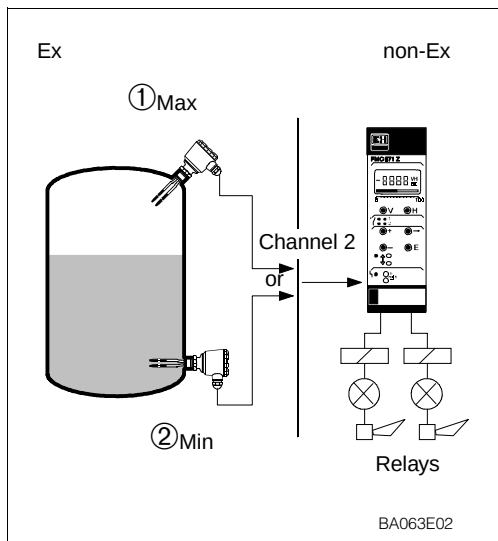


The Silometer FMC 671 Z/676 Z is designed for level measurement with a capacitance, impedance or hydrostatic pressure probe. A second channel allows level limit detection with a capacitance/impedance probe or vibration sensor. The applications described in this manual are as follows:

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

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

Fig. 1.2:
Left:
Silometer FMC 671 Z with
limit switch
① Maximum fail-safe
② Minimum fail-safe
Right:
Silometer FMC 671 Z with
continuous level measurement
and limit switching
① Level measurement
② Limit switch



1.2 Measuring system

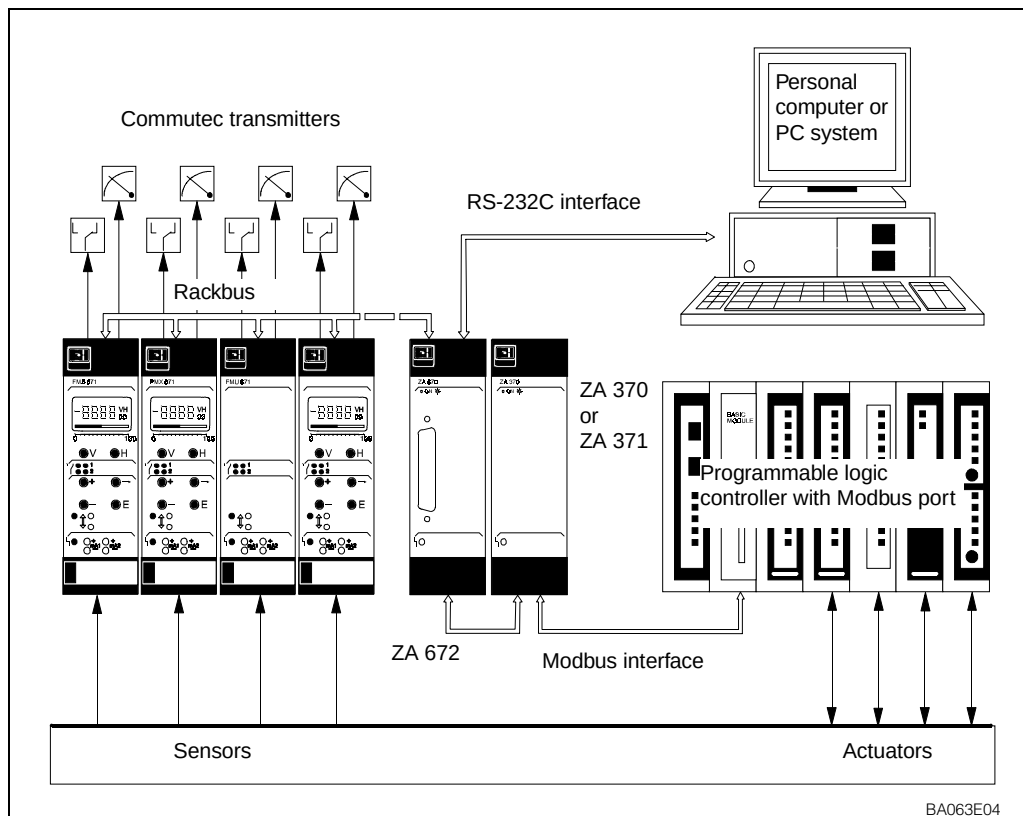


Fig. 1.3
The Silometer 671 Z/676 Z can be used as a stand-alone unit, or as part of a process control system.

A working system for level measurement comprises:

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

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

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

The Silometer is available in two versions:

Versions

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

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

1.3 Measuring principle

The Silometer FMC 671 Z/676 Z measures level on the basis of the capacitance and hydrostatic measurement principles. In both cases the measured value is processed by the electronic insert and passed on as a frequency signal.

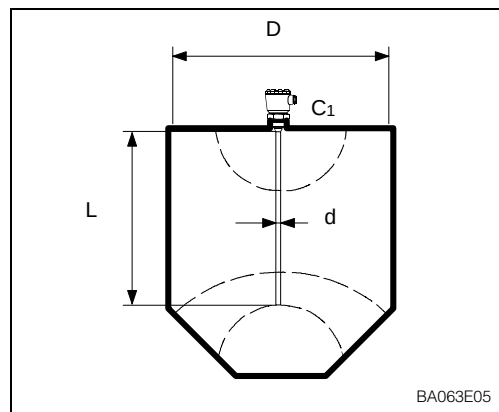
Capacitance measurement

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

$$C_{\text{tot}} = C_1 + \frac{2\pi\epsilon_0\epsilon_r \times L}{\ln(D/d)} \quad \text{pF} \quad (1)$$

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



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Fig. 1.4

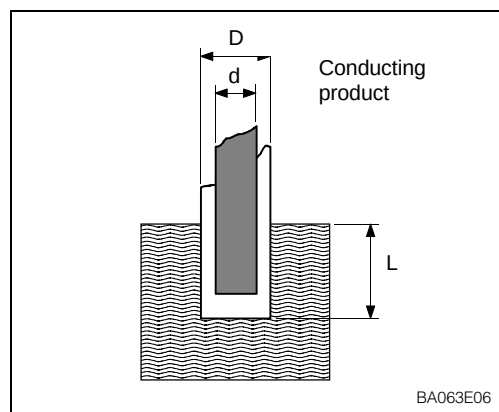
Capacitance measurement principle

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

Measurement in conducting media

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

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



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Fig. 1.5

Measurement in conducting media

Hydrostatic measurement

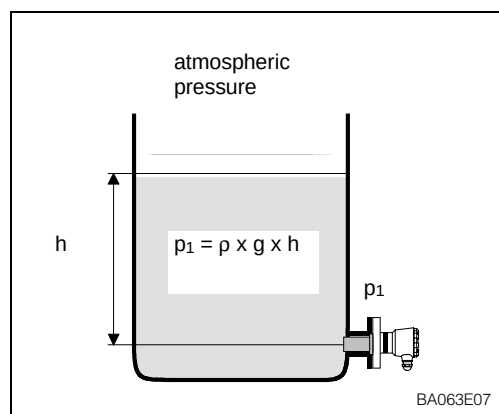
In an open vessel, the level is derived from the hydrostatic pressure exerted by a column of liquid on a probe placed at its foot. The pressure exerted is:

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

whereby

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

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



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Fig. 1.6

Hydrostatic measurement principle

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