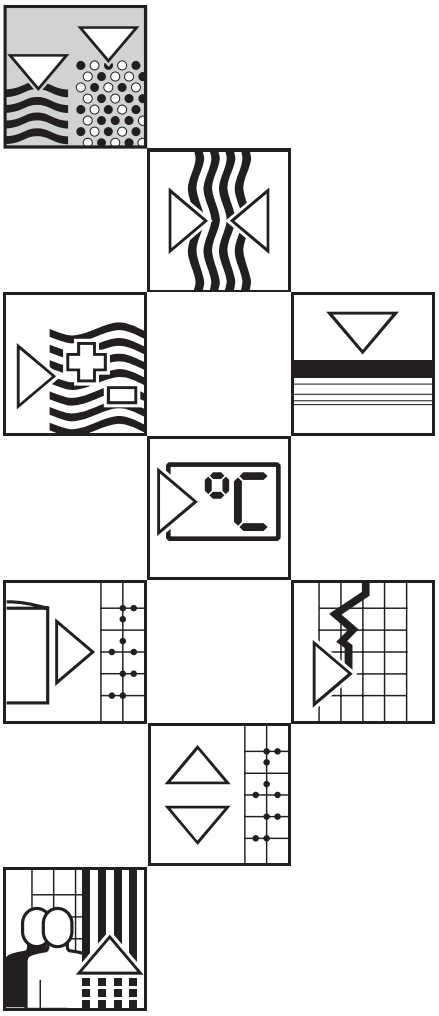
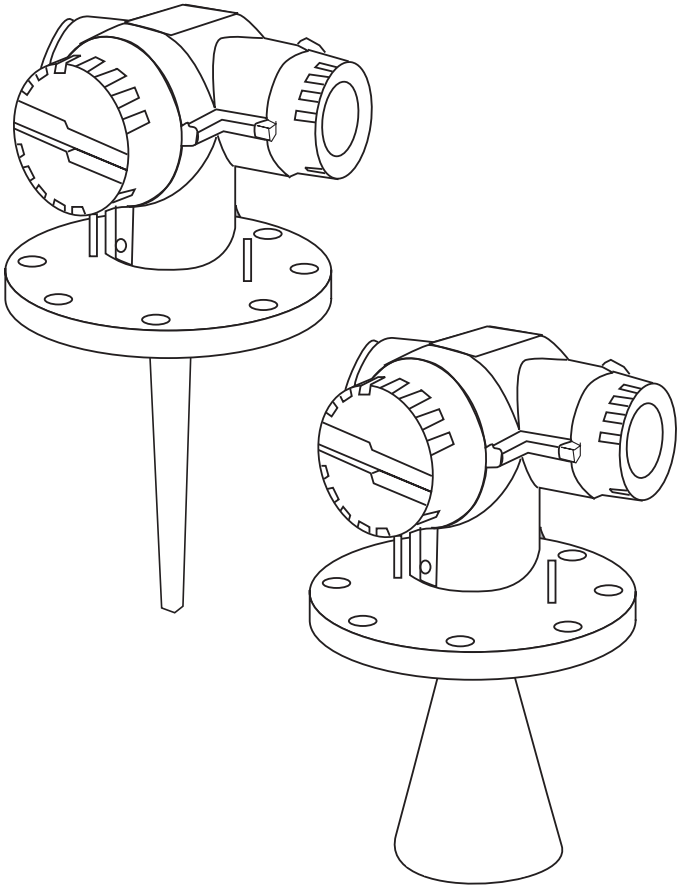
BA 108F/00/en/06.03
Software Version 2.x
Part No. 016329-1000

Micropilot
FMR 130, 131
Microwave Level Measurement

Operating Instructions





Endress+Hauser

The Power of Know How

Quick Guide to Configuration

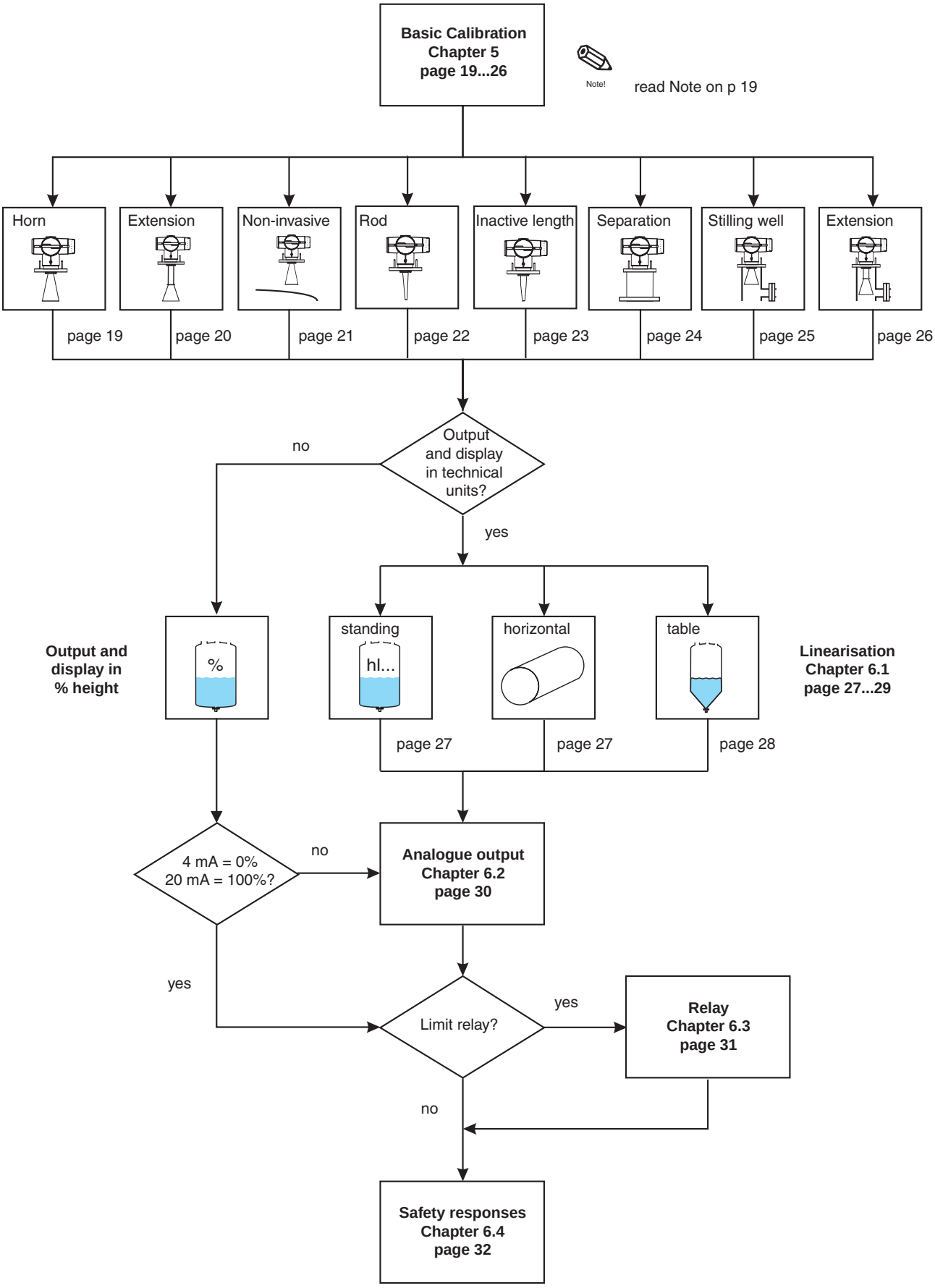


Table of Contents

See opposite, Quick Guide to Configuration

Software Revisions

Version/date	Revisions	Changes
1.5 / 03.96	– new defaults for application parameter – Commuwin II: service matrix matrix can be addressed HART: up-/download possible	no effect on operation
2.0/07.97	– Default evaluation mode changed from FAC to FAC+TDT – New application parameters – Revised TDT recording – V2H5 function expanded – V2H6 new: decimal point – V2H7 new: download – Locking via keys	– Basic calibration, record TDT – Trouble-shooting – Trouble-shooting – Linearisation – Additional settings – Additional settings – Additional settings Basic calibration now includes: – Rod antenna with inactive length – Stilling well with extension Trouble-shooting extended

Note!

Note!
Normally, up and download between different versions is not possible unless special service tools are used.

Notes on Safety

Approved usage

The Micropilot FMR 13x is a Smart field transmitter designed for continuous level measurement in storage, buffer and process tanks which operates according to the microwave pulsed time-of-flight principle. The normal operating frequency of 5.8 GHz lies in the frequency band assigned for industrial, scientific and medical applications. Its low beam energy of 1 µW ERP allows safe installation in metallic and non-metallic vessels, with no risk to humans or the environment.

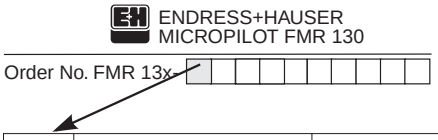
Installation, commissioning and operation

The Micropilot has been designed to operate safely in accordance with current technical, safety and EU standards. If installed incorrectly or used for applications for which it is not intended, however, it is possible that application-related dangers may arise, e.g. product overflow due to incorrect calibration. For this reason the instrument must be installed, connected, operated and maintained according to the instructions in this manual: personnel must be authorised and suitably qualified. Changes or modifications to the equipment which are not expressly approved in this manual or by the bodies responsible for compliance may void the user's authority to operate the equipment.

Explosion hazardous areas

The Micropilot can be supplied with certificates of conformity which allow its use in explosion hazardous areas. The certificate can be identified from the first letter of the order code stamped on the nameplate. When installing in hazardous areas:

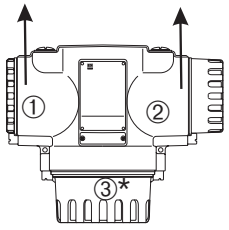
- Ensure that all personnel are suitably qualified.
- Observe the specifications in the certificate as well as national and local regulations.
- Do not open EEx e or Ex d compartments when the power is on. For Ex d wait 30 min. after switching off power before opening the compartment.



Code	Certificate	Explosion protection	Compart. ①	Compart. ②
R	BZT approval	None		
A	FMR 130: PTB 98 ATEX 2122 X (XA 005F) FMR 131: PTB 98 ATEX 2125 X (XA 006F)	ATEX II 1/2 G EEx de [ia] IIC T6 ATEX II 1/2 G EEx de [ia] IIC T4 with FHV 160	EEx e	EEx ia or EEx [ia]
G	FMR 131: PTB 98 ATEX 2125 X (XA 006F)	ATEX II 2 G EEx de [ia] IIC T6 ATEX II 2 G EEx de [ia] IIC T4 with FHV 160		
5	FCC approval	None		
O	FM (+ FCC)	Class I, Div. 1&2, Group A,B,C,D	Ex d	Ex IS
P	FM (+ BZT)	Class I, Div. 1&2, Group A,B,C,D	Ex d	Ex IS
U	CSA GP	None		
S	CSA	Class I, Div. 1&2, Group A,B,C,D	Ex d	Ex IS

Table S.1 Certificates for instruments suitable for use in explosion hazardous areas

[1] Version with FCC approval operate at 6.3 GHz



*Compartment ③ is EEx d/Ex d

Safety Conventions and Symbols

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

Safety conventions

Symbol	Meaning
 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 highlights actions or procedures which, if not performed correctly, may lead to personal injury or incorrect functioning of the instrument
 Warning!	**Warning!** A warning highlights actions or procedures which, if not performed correctly, will lead to personal injury, a safety hazard or destruction of the instrument

Explosion protection

	**Device certified for use in explosion hazardous area** If the Micropilot has this symbol embossed on its name plate it can be installed in an explosion hazardous area
	**Explosion hazardous area** Symbol used in drawings to indicate explosion hazardous areas. Devices located in and wiring entering areas with the designation “explosion hazardous areas” must conform with the stated type of protection
	**Safe area (non-explosion hazardous area)** Symbol used in drawings to indicate, if necessary, non-explosion hazardous areas. Devices located in safe areas stiill require a certificate if their outputs run into explosion hazardous areas.

Electrical symbols

	**Direct voltage** A terminal to which or from which a direct current or voltage may be applied or supplied
	**Alternating voltage** A terminal to which or from which an alternating (sine-wave) current or voltage may be applied or supplied
	**Grounded terminal** A grounded terminal, which as far as the operator is concerned, is already grounded by means of an earth grounding system
	**Protective grounding (earth) terminal** A terminal which must be connected to earth ground prior to making any other connection to the equipment
	**Equipotential connection (earth bonding)** A connection made to the plant grounding system which may be of type e.g. neutral star or equipotential line according to national or company practice

1 Introduction

Application

The Micropilot FMR 130 microwave transmitter is designed for continuous, non-contact level measurement of liquids, pastes and slurries. It finds particular use in storage, buffer and process tanks as well as in applications where high temperatures, high pressures, inert gas blankets, or vapour are present.

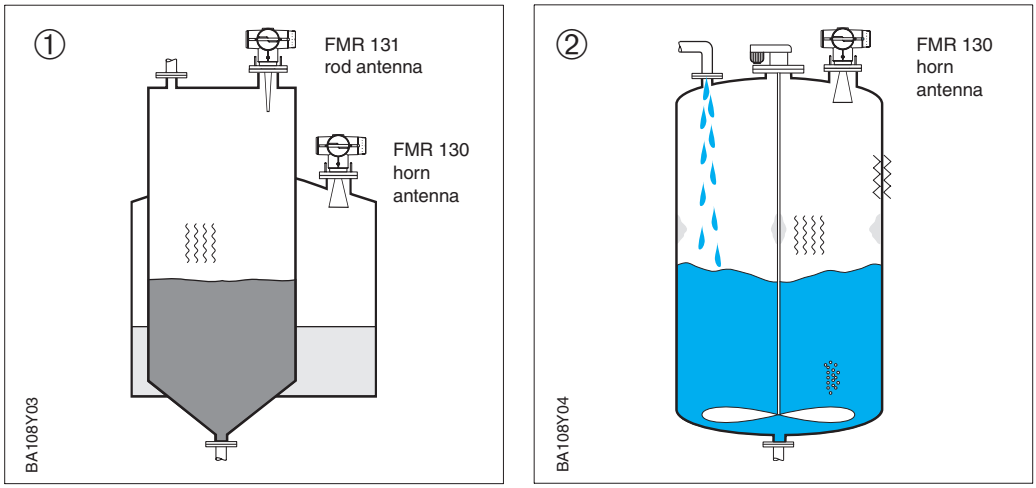


Fig. 1.1
① *Measurement in storage and buffer tanks using the horn or rod antenna*
② *Measurement in process tanks using the horn antenna*

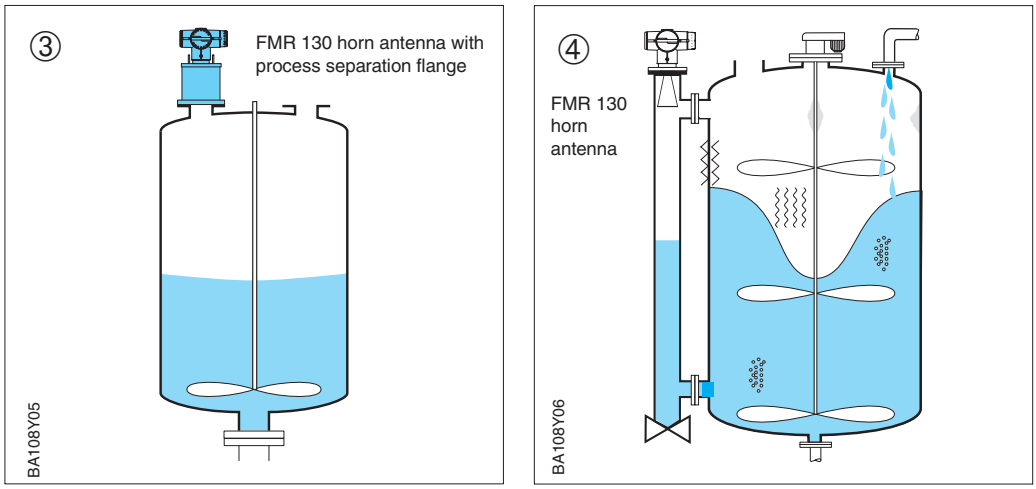


Fig. 1.2
③ *Non-invasive measurement, e.g. with process separation flange*
④ *Measurement in by-pass pipes using the horn antenna*

Operating instructions

There are four basic applications which are described in this manual:

- Measurement in storage, buffer or process tanks using the horn antenna
- Measurement in storage, buffer or process tanks using the rod antenna
- Non-invasive measurements in process or storage tanks using the horn antenna or process separation flange
- Measurement in by-pass pipes or stilling wells using the horn antenna

The differences lie in the installation and calibration of the Micropilot and are described in the associated chapters. Electrical connection, measurement in technical units and configuration of the 4...20 mA signal output are identical for all applications and Micropilot versions.

Depending upon the communication interface, operation is by means of the Endress+Hauser matrix or HART menu. Both possibilities are briefly described in the “Operation” chapter.

1.1 Measurement principle

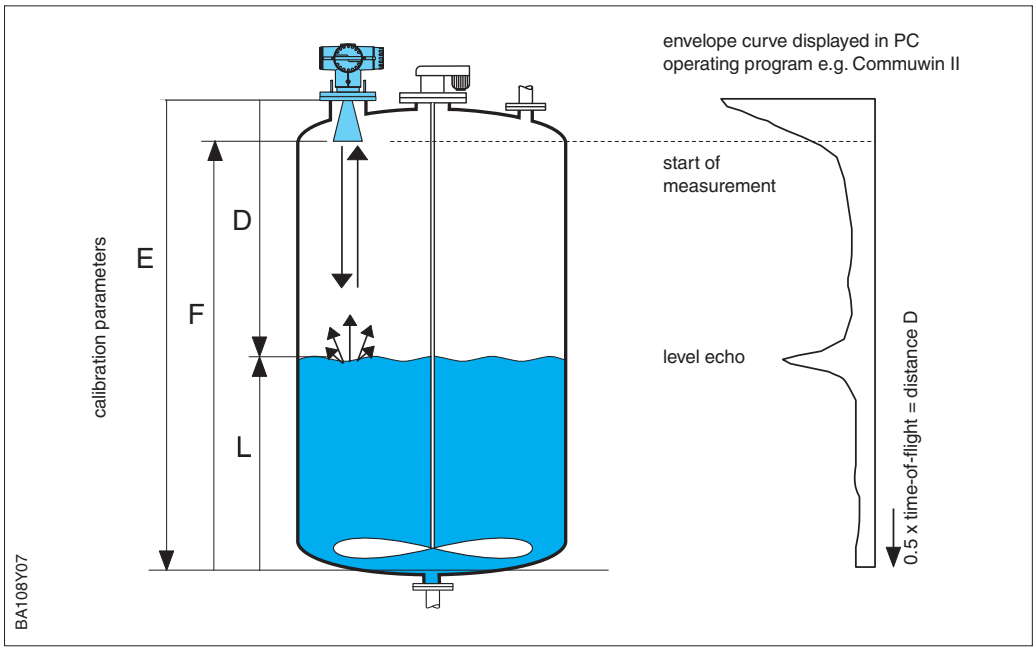


Fig. 1.3
Microwave measurement principle
When the Micropilot is operated by a personal computer the envelope curve can be displayed

Short microwave pulses are beamed by the antenna towards the product, reflected by its surface and detected as a temporal record of the echoes – the envelope curve – by the same arrangement. The distance to the product surface is proportional to the time-of-flight of the microwave pulse:

$$D = c \bullet t/2$$

D= distance sensor - product surface, c= velocity of light, t= time-of-flight.

Evaluation

The Micropilot is calibrated by entering the empty distance E, the full distance F and an application parameter A, which automatically tunes the instrument to the measuring conditions. In order to correctly identify the level echo, two evaluation algorithms can be used. Normally, both are activated:

- The Floating Average Curve (FAC) – this is particularly good for suppressing interference echoes due to tank filling and product agitation.
- The Time Dependent Threshold (TDT) – this suppresses interference echoes from tank fittings (fixed targets).

For non-invasive measurements or when build-up forms near to the antenna, it is also possible to suppress measurements in the affected range (near-field suppression).

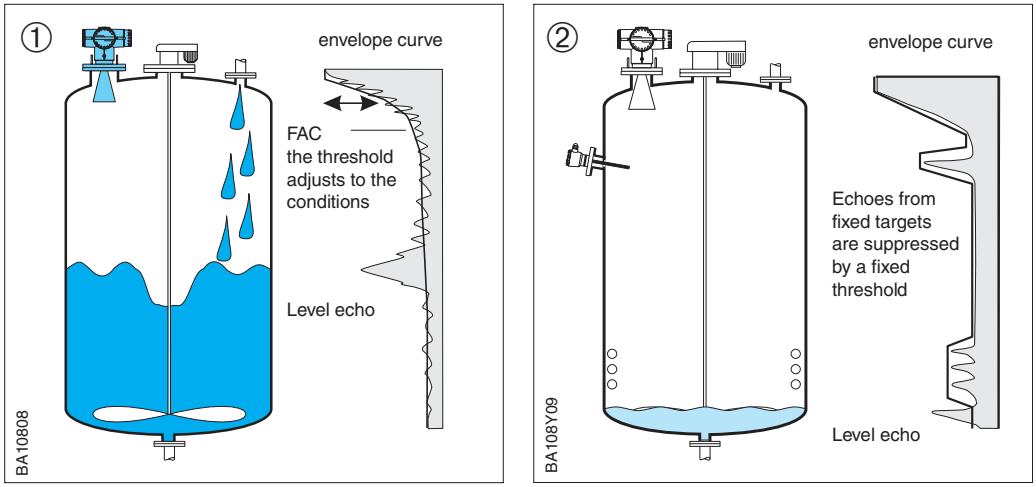


Fig. 1.4
① A floating average curve adjusts to the conditions in the tank
② For fixed target suppression, a fixed, time-dependent threshold (TDT) is imposed upon the envelope curve

Measuring range

The measuring range depends upon the antenna type, the conditions in the tank and the medium to be measured. Table 1.1 describes the product classes, Tables 1.2 and 1.3 the measuring range as a function of the antenna type and measuring conditions. In general, the use of a stilling well or by-pass pipe allows measurement to almost maximum range irrespective of product.

Table 1.1
Selection of product class

Product-class	Examples
A	Non-conducting liquids, e.g. liquefied gases etc. Dielectric constant ε_r less than 1.9
B	Non-conducting liquids, petrochemicals, benzene, oil, toluol, etc. Dielectric constant ε_r ca. 1.9...4
C	Concentrated acids, organic solvents, analine, esters, alcohol, acetone, etc. oil/water mixtures, Dielectric constant ε_r ca. 4...10
D	Conducting liquids, aqueous solutions, dilute acids and alkalis, Dielectric constant ε_r > 10 or electrical conductivity σ > 10 mS/cm

Table 1.2
Measuring range as a function of product, antenna type and conditions within the tank
① max. accuracy (±10 mm)
② max. range (accuracy ±20 mm)

— use stilling well or bypass pipe
 # not for rod antenna
**with extended range, version*

FMR 130- | | | | | | | | B | | |

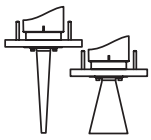
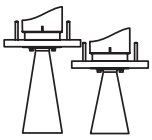
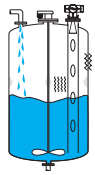
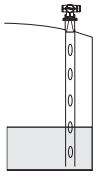
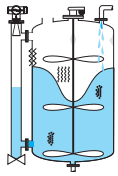
Conditions in tank / Antenna type	Class	Calm ①	Calm ②	Stirred ①	Stirred ②	Turbulent ①	Turbulent ②
Horn or long rod DN 150/6" 	A	—	—	—	—	—	—
	B	5.0 m	10.0 m	2.0 m	5.0 m	—	2.5 m#
	C	10.0 m	15.0 m	4.0 m	8.0 m	1.0 m	4.0 m
	D	15.0 m	20.0 m	7.0 m	12.0 m	2.5 m	6.0 m
Horn DN 200/8" DN 250/10" 	A	—	6.0m	—	—	—	—
	B	11.0 m	16.0 m	4.0 m	10.0 m	—	3.5 m
	C	20.0 m	29.0 m*	7.5 m	12.0 m	—	7.0 m
	D	30.0 m*	35.0 m*	11.0 m	28.0 m*	3.0	10.0 m

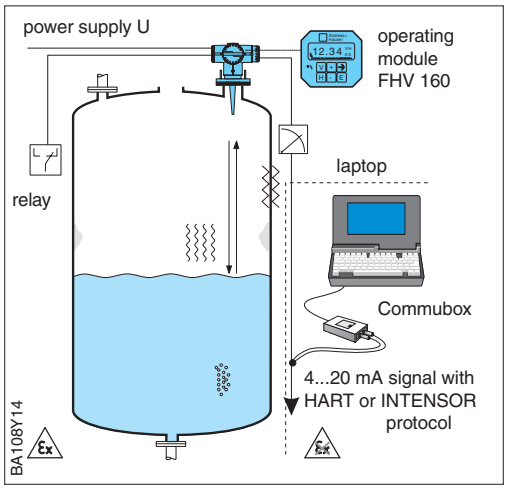
Table 1.3
Measuring range as a function of product and antenna type for stilling wells and by-pass pipes

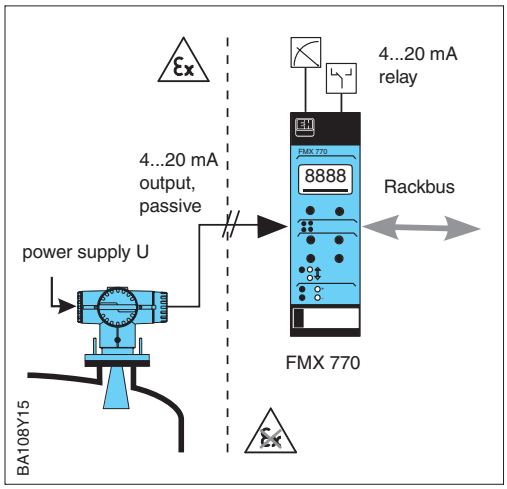
**with extended range, version*

FMR 130- | | | | | | | | B | | |

Type of measurement / Antenna type	Class	Stilling well, slot width < 1/4 ID DN 80/3" 	Stilling well slot width < 1/3 ID ≥ DN 100/4" 	By-pass pipes 1-vent stilling well DN 80/3" 	By-pass pipes 1-vent stilling well ≥ DN 100/4"
Horn DN 80/3" DN 100/4" 	A	10.0 m	18.0 m	33.0* m	18.0 m	33.0 m*
	B					
	C					
	D					

1.2 Measuring system





Single measuring point

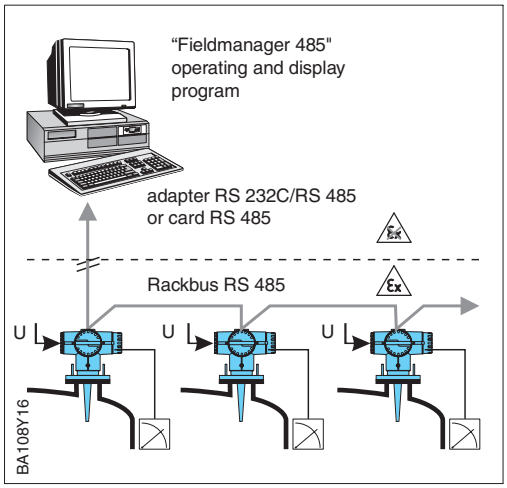
Used as a compact transmitter, the Micropilot FMR 13x is equipped with:

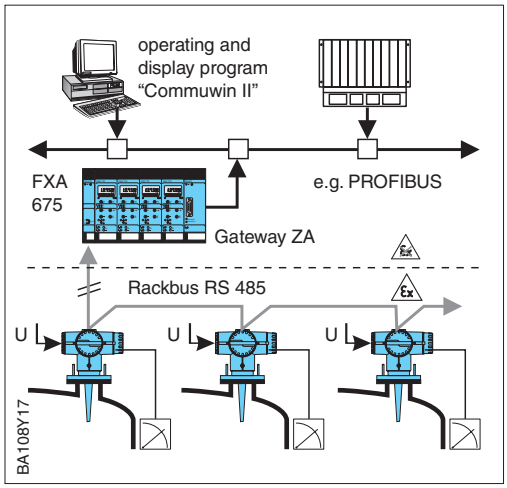
- FHV 160 operating and display module for local operation as well as INTENSOR or HART protocol
- Remote operation is possible by hand-held terminal or Commubox plus laptop

The 4…20 mA output is either *active* for powering follow-up devices or passive for connection to powered lines. A relay with potential-free changeover contact signals transmitter faults or level limits.

A **Silometer FMX 770** transmitter mounted in a Monorack housing or 19" assemby rack connected to a Micropilot with *passive INTENSOR* output provides:

- a single measuring point and/or
- Rackbus connection to a ZA gateway and process control system.



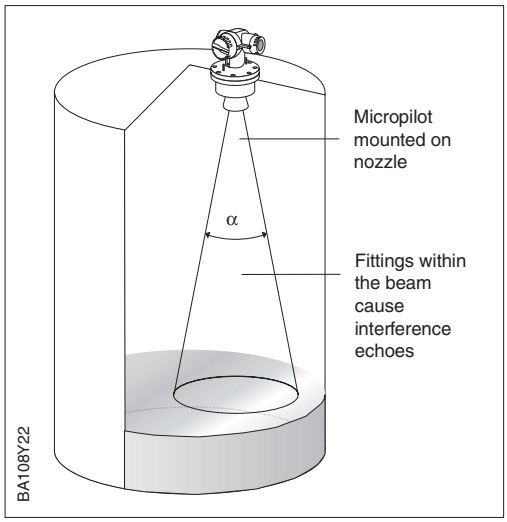


Micropilot with interface Rackbus RS-485

The **Rackbus RS-485 interface** option allows several Micropilots or other Rackbus RS-485 transmitters to be connected together on a bus and to be operated directly from a personal computer. The connection is made with an RS-485 computer card or an RS-485/RS-232C adapter.

The **FXA 675 interface card** allows several Micropilot transmitters to be connected to the Rackbus. A ZA Gateway is used to connect the Rackbus to a supervisory process control system.

2 Installation



General information

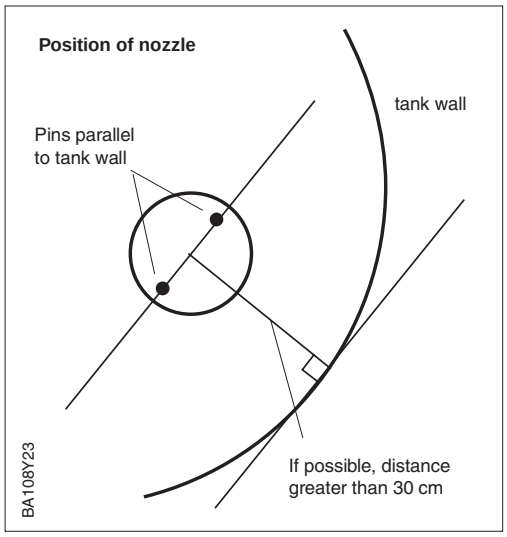
The microwaves should arrive unhindered at the product surface.

- Every object within the beam gives an echo. The nearer the object, the stronger the echo.
- Strong echoes which cannot be avoided by chosing a more suitable nozzle position interfere with the measurement and must be suppressed during the basic calibration

Half-power beam angle

Type	DN 150/6"*	DN 200/8"	DN 250/10"
Angle α	23°	19°	15°

* for all rod antennas also

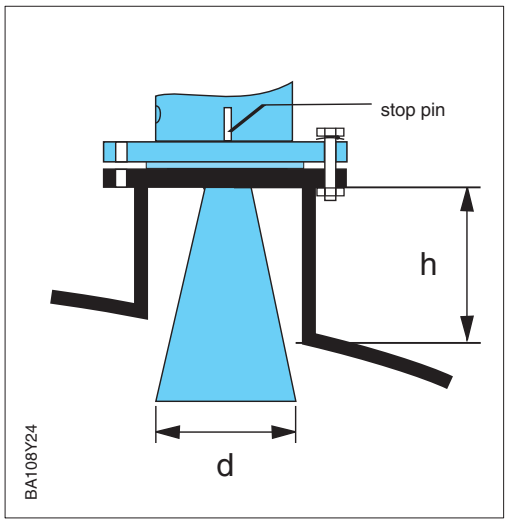


Nozzle position

If the Micropilot is to be mounted on a nozzle, its position should be chosen as follows:

- At least 30 cm from tank wall, but not in the middle of the tank
- Not positioned over the filling curtain, the centre of a vortex or above a baffle
- As few fittings as possible in the microwave beam.

During installation check that the two stop pins on the flange are aligned parallel to the tank wall.



Standard installation, FMR 130 horn antenna

Mount the Micropilot on the nozzle as follows:

- with horn perpendicular to product surface
- stop pins parallel to tank wall
- not positioned above the filling curtain or the centre of a vortex
- nozzle dimensions, see below
- horn protrudes into tank.

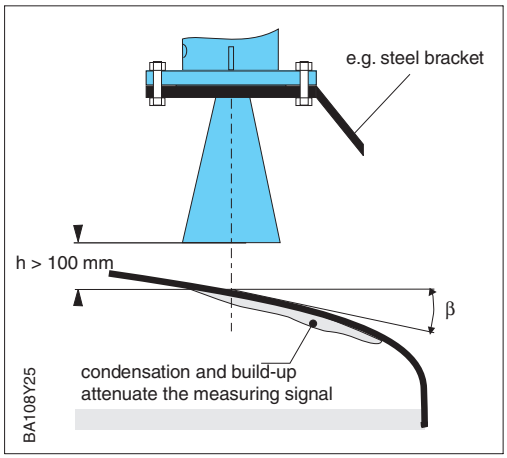
Nozzle dimensions

Antenna	150/6"	200/8"	250/10"
d mm	146	191	241
h mm	< 205	< 290	< 380

Non-invasive measurement

The conditions for nozzle mounting and standard installation apply, in addition:

- stop pins parallel to tank wall
- distance h greater than 100 mm
- angle β 10°...15°
- tank material with small dieletric constant ε_r, e.g. polypropylene, PVC, glass-fibre
- if possible, avoid positions where condensation or build-up collect on the tank roof.

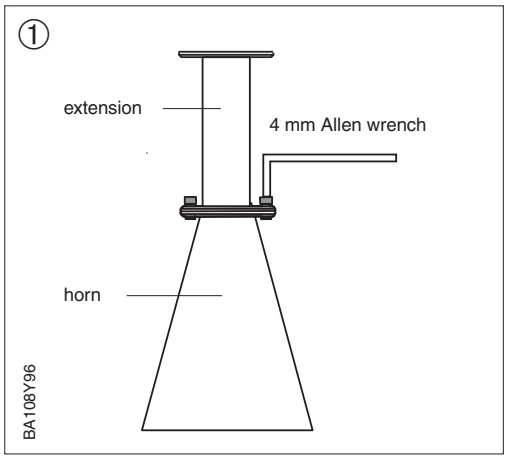


Antenna extension FAR 10

The conditions for nozzle mounting and standard installation apply**.**

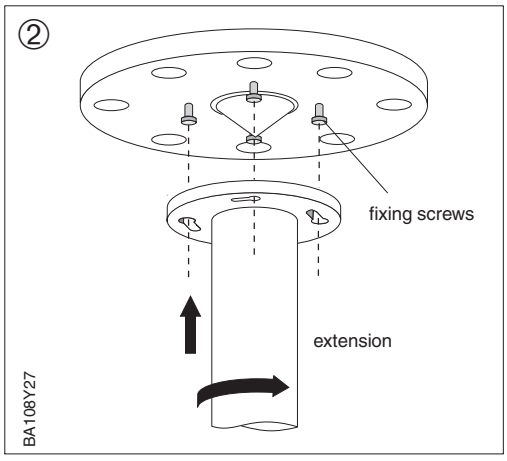
Case 1: Horn fits into the nozzle

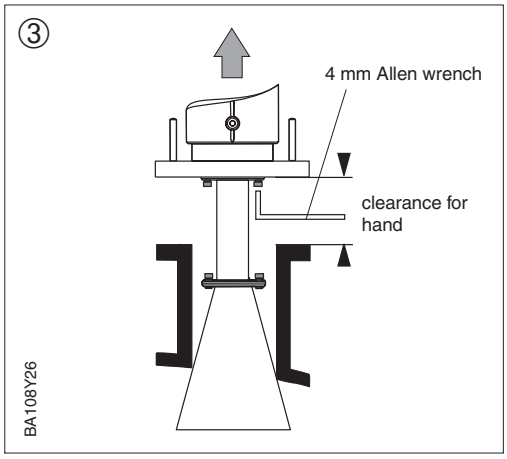
- Screw the extension tube and horn together ①.
- Insert the antenna fixing screws into the process connection and screw in two or three turns.
- Slide the flange over the fixing screws and turn clockwise ②.
- Secure the fixing screws.
- Bolt the Micropilot onto the nozzle.



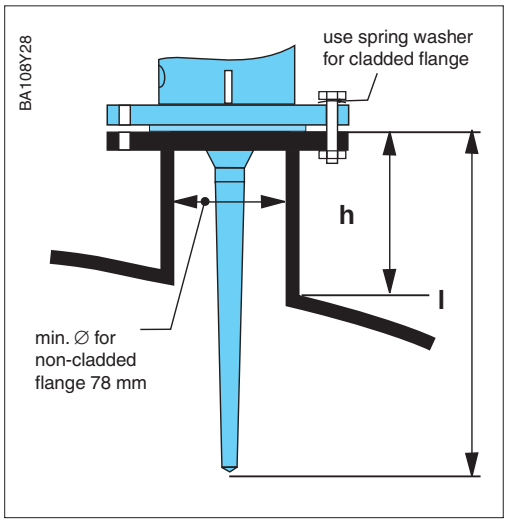
Case 2: Horn is larger than nozzle

- Screw the extension tube and horn together ①.
- Insert the antenna fixing screws into the process connection and screw in two or three turns.
- Position the Micropilot on the nozzle.
- From the inside of the tank, slide the flange over the fixing screws and turn clockwise ②. The extension tube now hangs from the process connection.
- From the outside of the tank, lift the Micropilot and secure the fixing screws using a 4 mm Allen wrench ③.
- Bolt the Micropilot onto the nozzle.
- Attach name plate to FMR 130 to enable external identification.





Rod antenna FMR 131



The antenna and housing with flange are supplied separated.

- Screw the antenna (with cladding) firmly into the flange:
- Transport the device by holding the flange or housing, **not** the antenna.
- When positioning the device: always lift the device before aligning or turn clockwise on the counterflange - this avoids accidental unscrewing or loosening of the antenna.

Note!

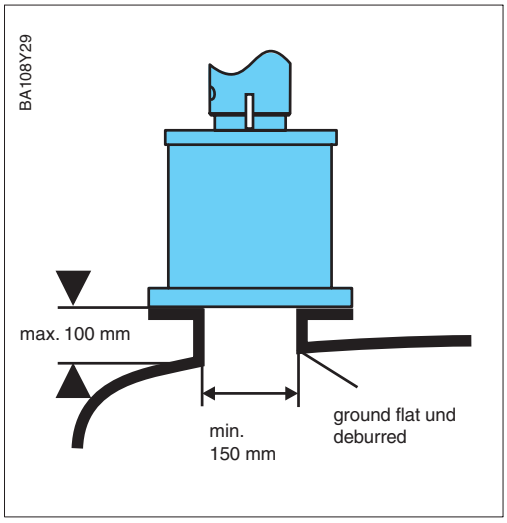
Installation hints

The instructions for nozzle mounting and horn antenna apply, see page 9.

- Note maximum nozzle dimensions.
- Install antenna perpendicular to the product surface.
- Avoid vibration, direct pressure cleaning and lateral loads.

Length l	Max. nozzle length
285 mm	h = 100 mm
445 mm	h = 200 mm
100 mm inactive length	h = 100 mm
250 mm inactive length	h = 250 mm

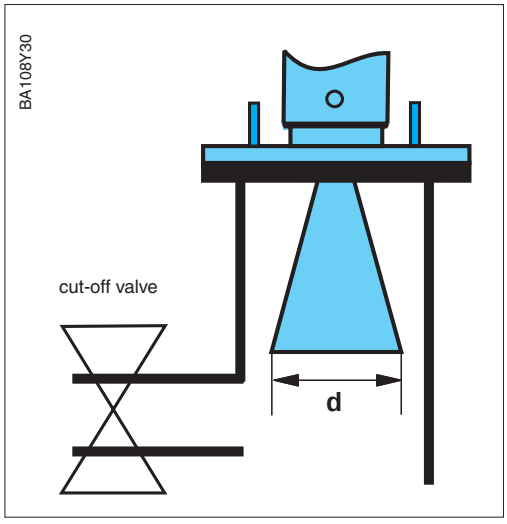
Process separation flange FMR 130



The instructions for nozzle mounting and the horn antenna apply.

- The nozzle should be as short as possible.
- Grind welding seams flat and deburr.
- Process pressures from -1 to 2 bar are permissible provided the process temperature does not exceed 100°C.

Measurement in by-pass pipes and stilling wells with FMR 130



The DN 80 and DN 100 versions (ANSI 3" and 4") are designed for measurement in *metallic* by-pass pipes and stilling wells.

- All welding seams and burr in the by-pass pipe should be ground as flat as possible
- For horn diameters, see below
- Stilling wells: install with stop pins at right-angles to the well slots
- Bypass pipes: install with stop pins parallel to the inlet nozzle.

Antenna type	d mm
DN 80/3"	78
DN 100/4"	96

3 Connection

General information

Please note the following before connecting up:

- The power supply rating must correspond to that on the nameplate.
- Turn off the power before connecting up.
- Connect the earth bonding or potential equalisation line to the ground terminal on the outside of the housing.

Explosion hazardous areas

If the Micropilot is to be installed in an explosion hazardous area, observe the specifications on the certificate as well as any national and local regulations.

Warning!

- Compartments ① and ③ are rated EEx e/Ex d and Ex d respectively: always switch off the power before opening them. For Ex d rated compartments 30 min. must elapse between switching off the power and opening the compartment

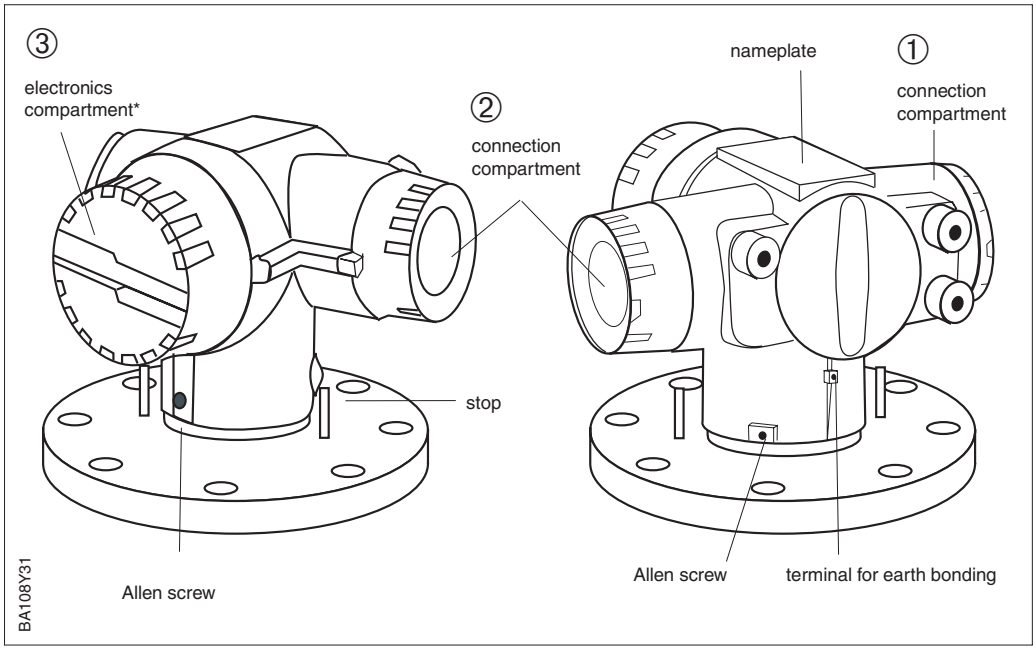


Fig. 3.1
Micropilot housing
① Connection compartment
② Connection compartment
*③ Electronics compartment**

Warning!

**To avoid damage to the antenna cable when screwing on the compartment lid, check that the electronics board is pushed in as far as possible on its guide rail*

The Micropilot has two separate connection compartments ① and ② as well as a separate electronics compartment ③: for versions with certificate this is rated (E)Ex d.

- The transmitter housing can be turned through 85° to facilitate connection by loosening the 4 mm Allen screws.
- All data relating to the version and electrical connection are printed on the nameplate, see Fig. 3.2.

Cable

The recommended cable types can be taken from the table below:

Function	Cable
Power and relays	Standard installation cable
4...20 mA line (standard)	Separate, screened two-wire cable, where possible screen grounded at both ends
4...20 mA line (explosion hazardous areas)	Separate, screened two-wire cable, screen grounded at sensor end. For cable rating see certifcate.
RS-485 data line	Separate, screened twisted pairs, e.g. Beldon 8761 or 9841, where possible screen grounded at both ends, see BA 134F for further information.
EEx d/Ex d	Armoured cable with special cable glands

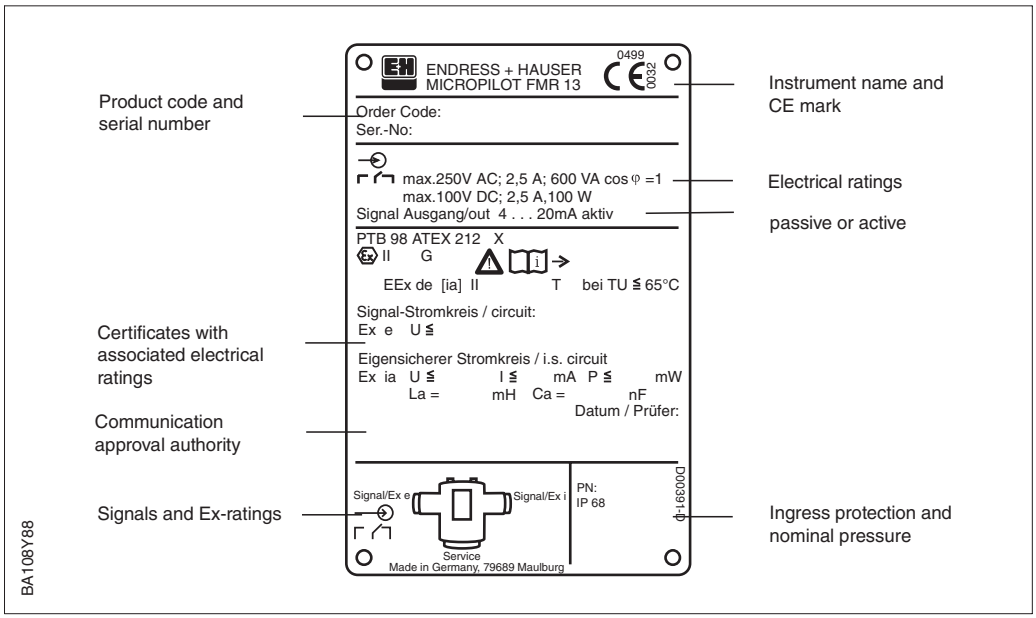


Fig. 3.2
Information on Micropilot nameplate

Connection compartment

The terminal block in compartment ① may be of various designs, see Fig. 3.3.

- For versions with certificate (EEx e/EEx ia or Ex d/Ex IS) the 4...20 mA line can be run from either connection compartment, the choice determining the explosion protection type. The standard version also incorperates this feature.
- Normally compartment ① is active (EEx e or Ex d): compartment ② is activated by changing the plug position in the electronics compartment ③. Warning: Ex d!
- For versions with Rackbus RS-485 interface a unique bus address (0...63) must be set at SW1 in the electronics compartment
  – for the last Micropilot on the bus, SW2 must be set to OFF ON ON OFF

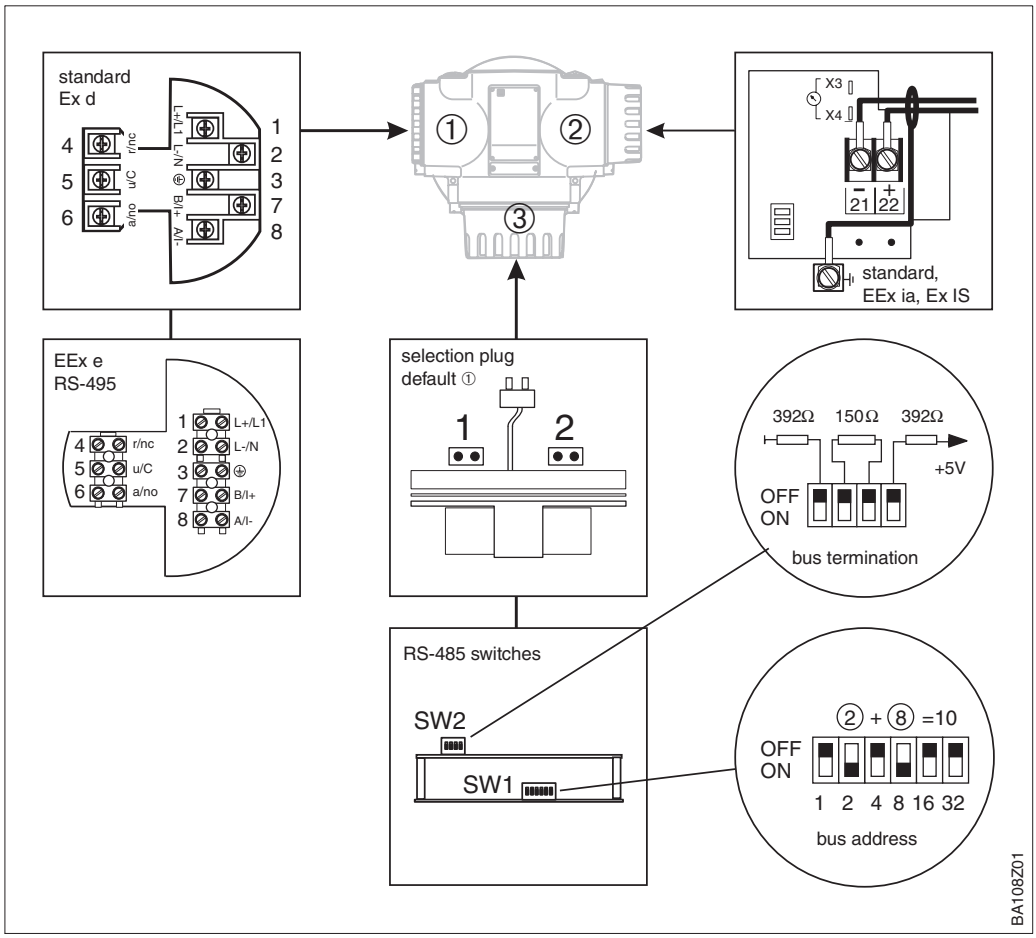


Fig. 3.3
Terminal block designs for the various Micropilot versions – the following combinations are possible:
– Standard/Standard
– EEx e/EEx ia
– Ex d/Ex IS
– RS-485/standard
– RS-485/EEx ia or EX IS

3.1 Wiring examples

The following three pages show examples of wiring for three sets of applications:

- Measuring point for non-hazardous area
- Measuring point for hazardous area
- Measuring points with remote configuration from handheld terminal or via Rackbus RS-485 interface

Non-hazardous areas

Fig. 3.4. shows three examples of wiring for non-hazardous areas:

- A) Standard version with active output driving analogue display
  – the optional PLC has a passive I/O card
- B) Standard version with passive output ②
  – the analogue display is driven by an active power supply or PLC
- C) Standard version with passive output and Silometer FMX 770
  – the 4...20 mA can be passed on to a passive PLC I/O card.

The standard version, can also be wired from the alternate terminals 21 and 22 when these are activated by changing the plug in the electronics compartment.

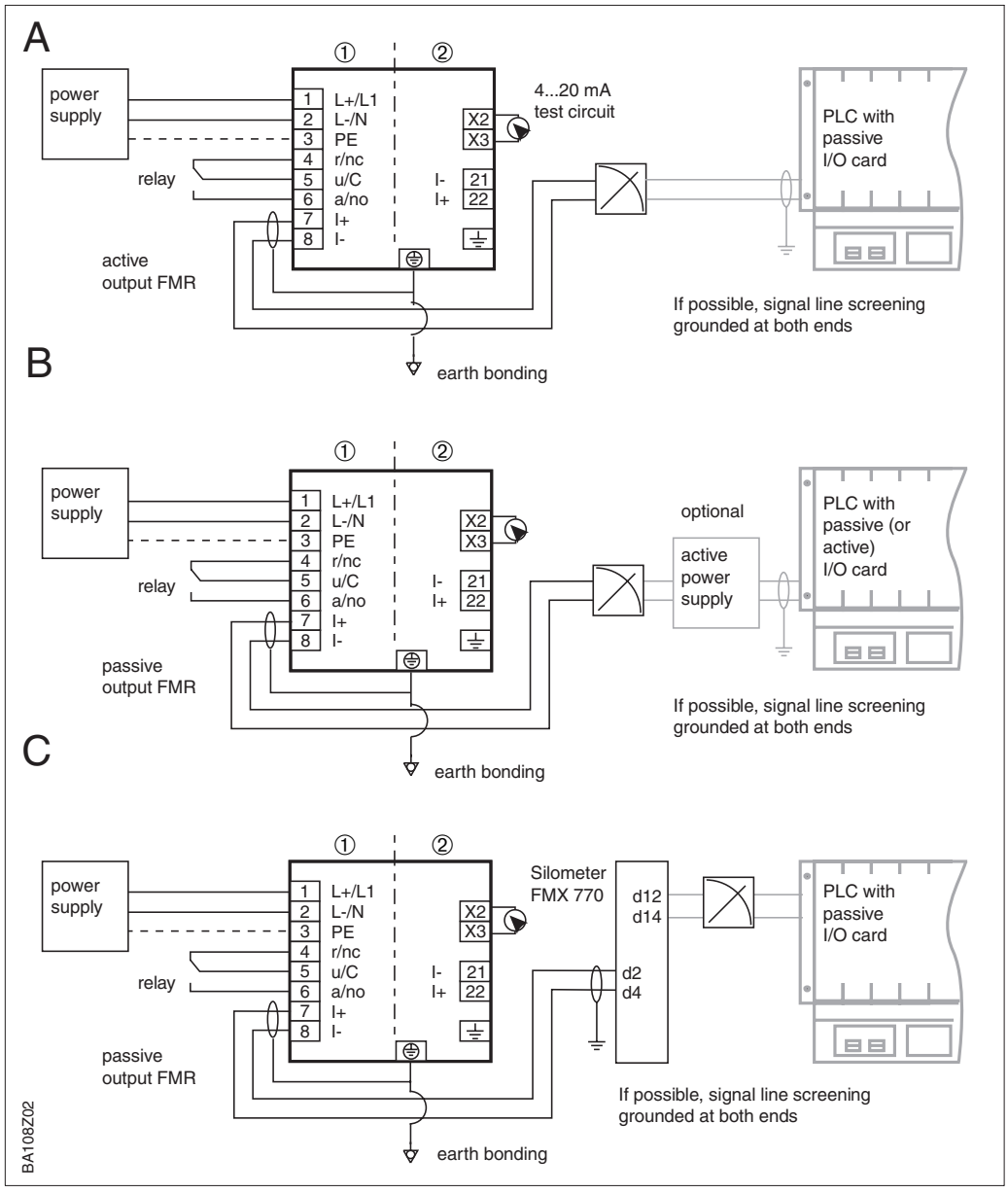


Fig. 3.4
Examples for connection of standard version
A with active output
B with passive output
C with passive output and Silometer FMX 770

Explosion hazardous areas

Fig. 3.5 shows three examples of wiring to EEx e (or Exd) and EEx ia (or Ex IS) in explosion hazardous areas.

- A) EEx e or EEx ia with active output driving analogue display
  – EEx ia: the plug in the electronics compartment must be changed to position 2
  – The barrier is required for EEx ia (Ex IS) only
- B) EEx ia with passive output
  – analogue display driven by external power supply or PLC via a barrier
  – EEx ia: the plug in the electronics compartment must be changed to position 2
- C) EEx e with active output
- D) EEx e with passive output

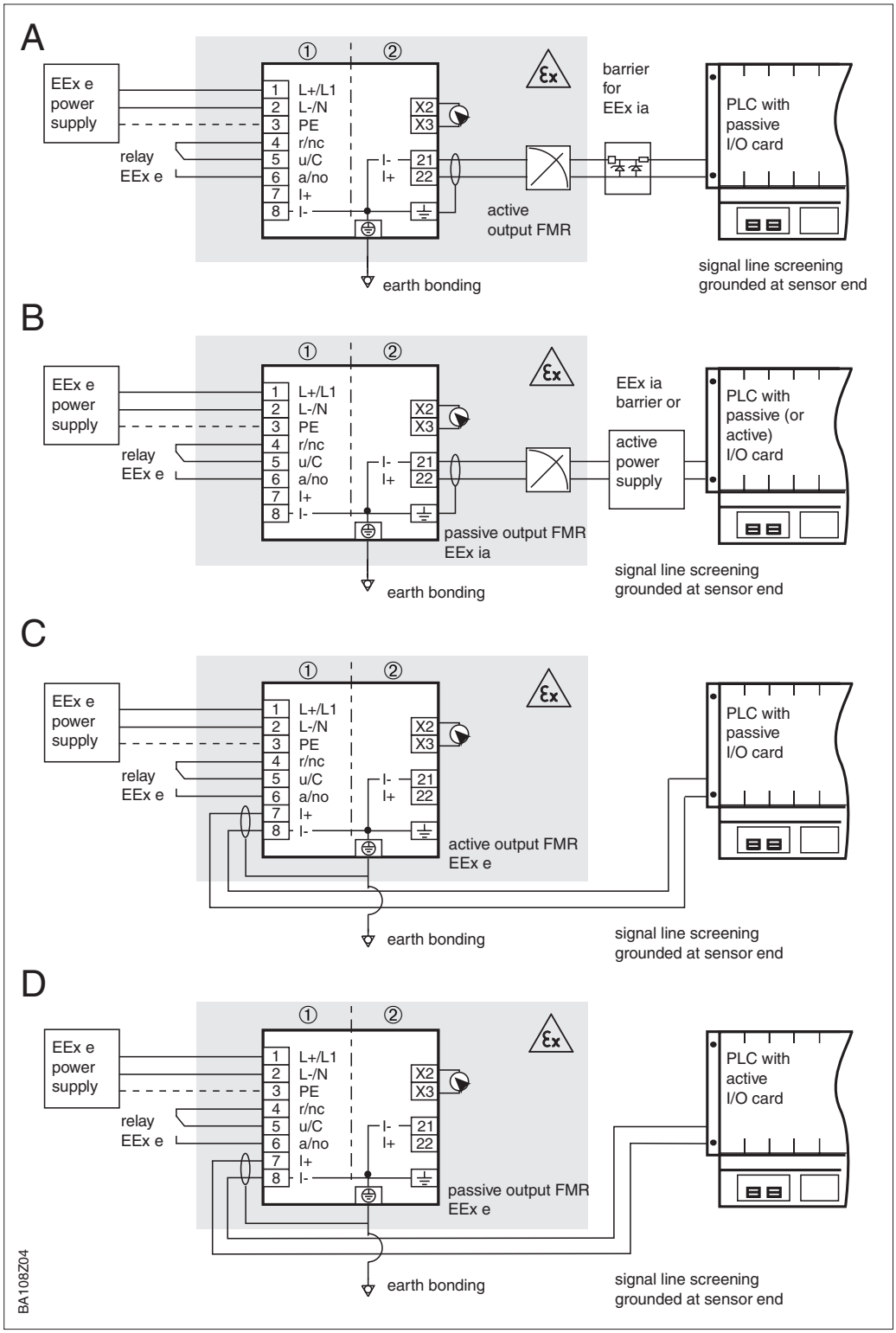


Fig. 3.5
Examples for connection to a PLC, Micropilot operating from explosion hazardous area
A EEx ia with active output
B EEx ia with passive output
C EEx e with active output
D EEx e with passive output

Remote configuration

Figs 3.6 to 3.8 show the wiring of the Micropilot for auxiliary equipment from Endress+Hauser:

- EEx ia wiring to Silometer FMX 770 and Rackbus
  – EEx ia: the plug in the electronics compartment must be changed to position 2
  – for additional Rackbus connections see BA 136F
- Connection to handheld or laptop computer
  – see Technical Data for maximum load
  – the barrier is not required if the Micropilot is operating in a non-hazardous area
- Connection to Rackbus RS-485
  – for version with certificate: output EEx ia or Ex IS
  – barrier required for applications in hazardous areas.

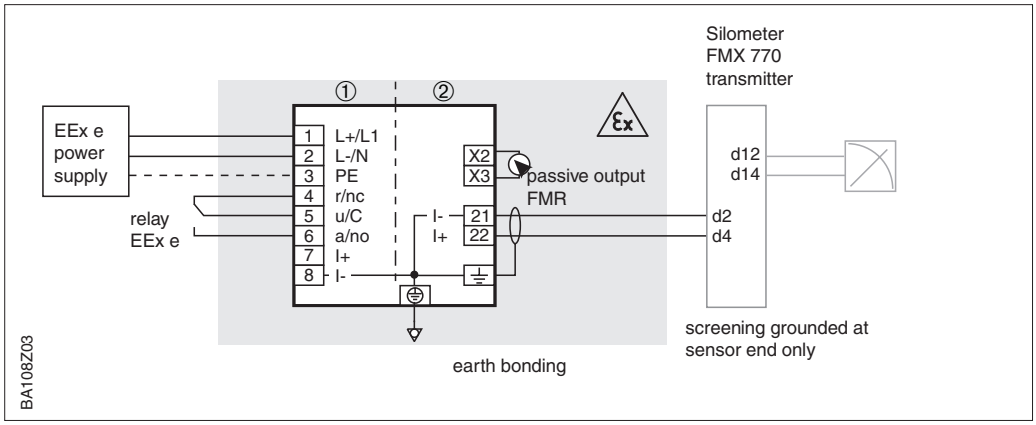


Fig. 3.6
Example for the connection to a Silometer FMX transmitter

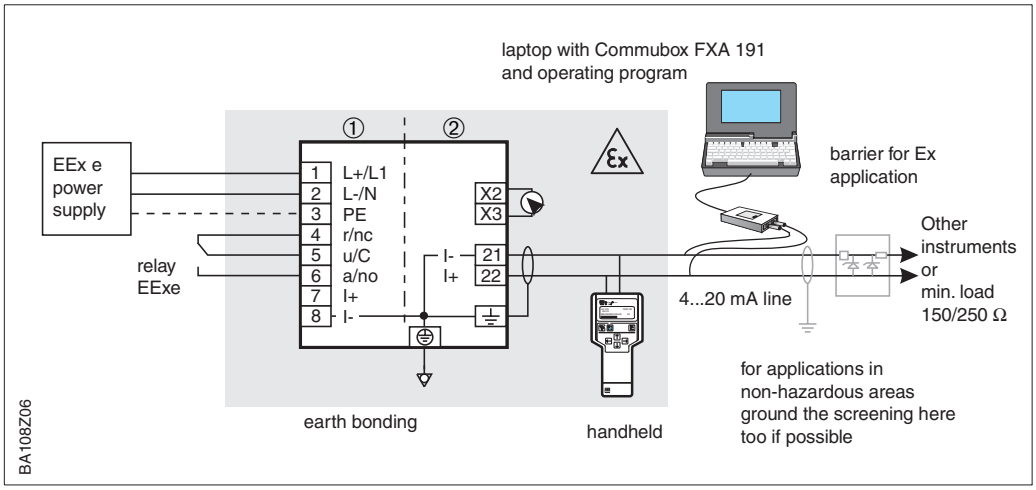


Fig. 3.7
Example of connection of a handheld terminal or laptop computer

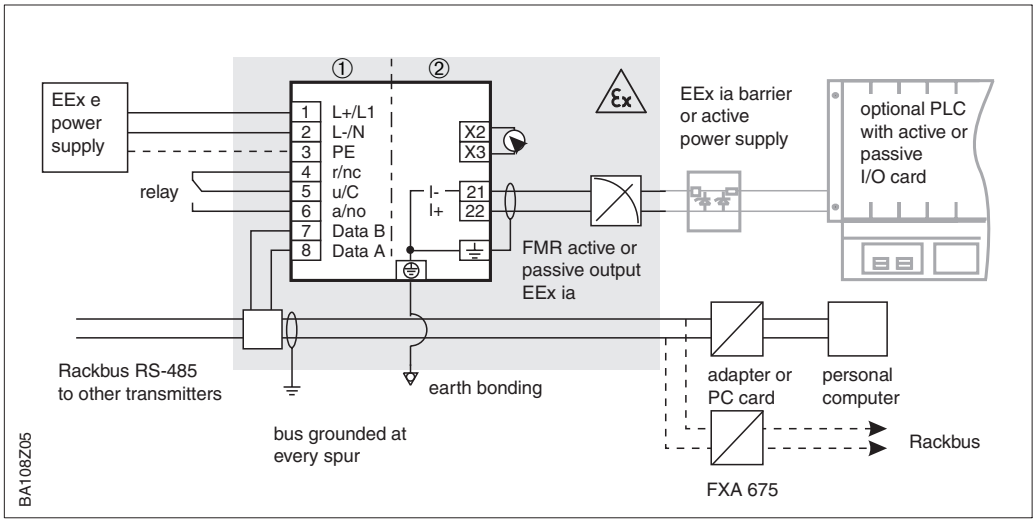


Fig. 3.8
Example for the connection to Rackbus RS-485

4 Operation

Operating matrix

The Micropilot FMR 130/131 is operated by means of a 10 x 10 matrix which can be locked against unauthorised entries, see page 30.

- Each row is allocated to a particular function,
- Each field sets or displays one parameter.

The same matrix is used, no matter whether the Micropilot is configured with an operating and display module FHV 160, a Silometer FMX 770 transmitter, a handheld terminal Commulog VU 260 Z or via the operating programs Fieldmanager 485 and Commuwin II. It is to be found in Chapter 9. Devices with the HART protocol are operated by a menu which is derived from this matrix (see page 44).

This Chapter briefly describes the operation by means of the operating and display module, and handheld terminal. A description of the operating programs Fieldmanager 485 and Commuwin II, which also allow display of envelope curves, is to be found in BA 134F and BA 124F respectively.

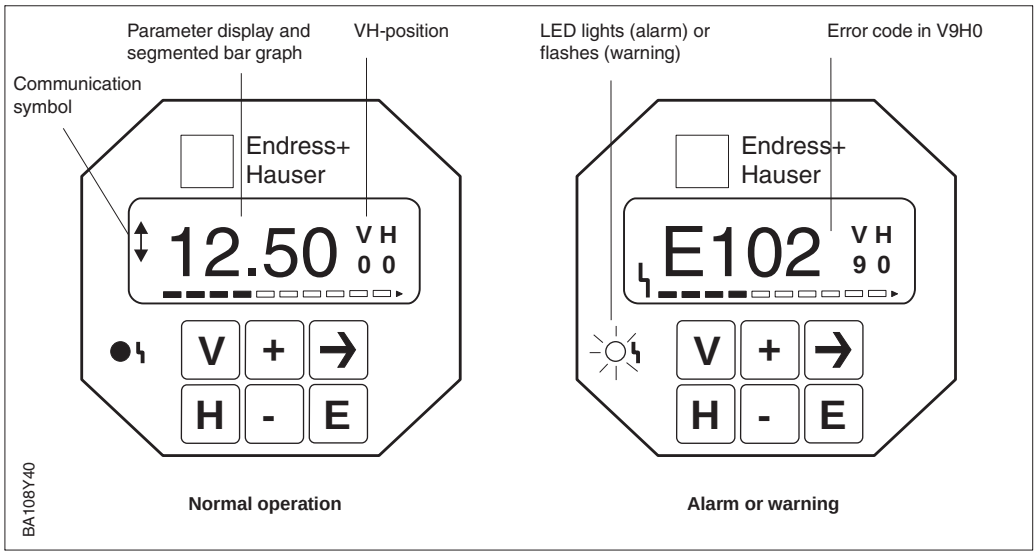
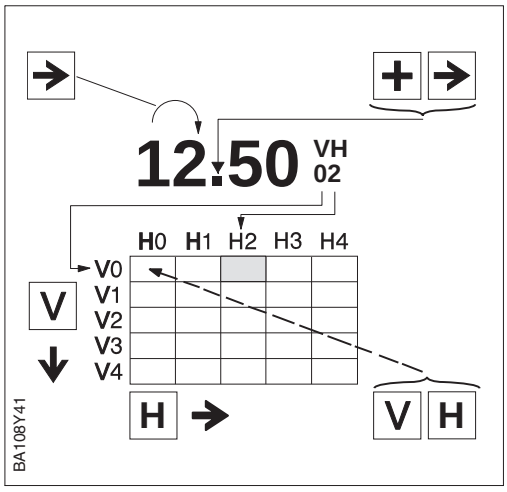


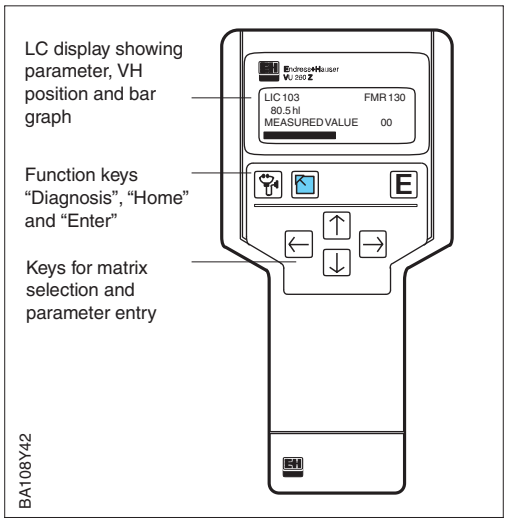
Fig. 4.1
Operating elements of the operating and display module FHV 160

Operating and display module FHV 160



If ordered, the operating and display module is stowed away in connection compartment ②. It functions as follows:

- Select the matrix field with V and H.
- Enter parameters with +, –, →
- Register entries with E.
- Change the decimal point by pressing + and → simultaneously.
- Change digit with →.
  - The LED lights on an alarm and flashes on a warning.
    An error code appears in V9H0 see Chapter 7, Trouble-Shooting.
  - Further codes can be displayed by pressing + and –.
- If the communication symbol lights, the Micropilot is talking to another device.
  No entries can be made at the FHV 160.



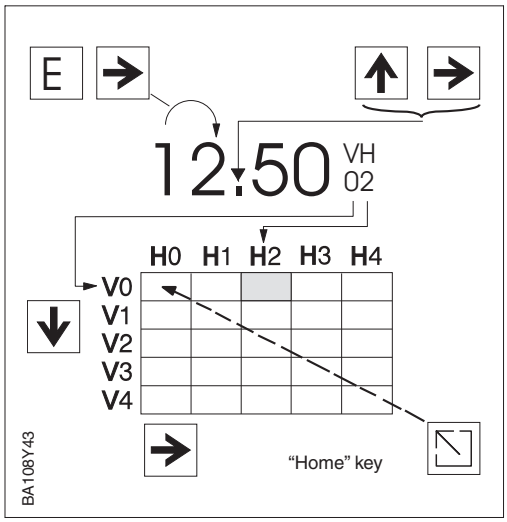


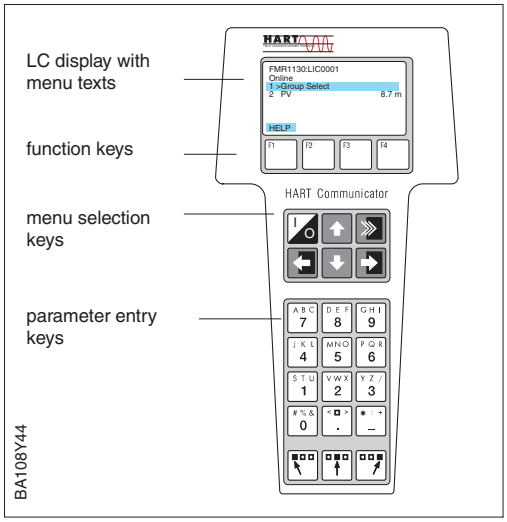
Fig. 4.2
Operating elements and key functions of the handheld Commulog VU 260

Commulog VU 260 Z

Micropilots with INTENSOR protocol can be operated with the handheld terminal Commulog VU 260 Z (from Version 1.4), see also Operating Instructions BA 028F.

- Select matrix fields with ↑, ↓, →, ←.
- Call entry mode with E.
- Enter parameters with ↑, ↓, →, ←.
- Press E to register entry and return to parameter selection mode.
- On alarm, ↯ calls up error messages in plain text.

In the procedures which follow, the Commulog texts appear in the “Text” column.



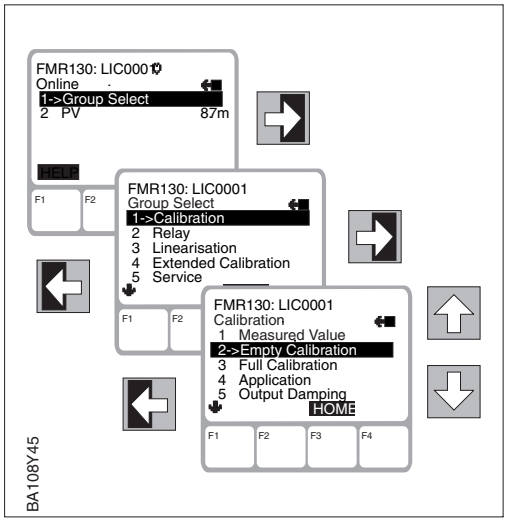


Fig. 4.3
Operating elements and key functions of the HART handheld DXR 275

HART handheld terminal DXR 275

Micropilots with HART protocol can be operated with the universal HART-handheld terminal DXR 275, see accompanying Operating Instructions.

- The Matrix Group Select menu calls the matrix: the rows are the menu headers.
- Parameters are set in the roll-down menus, see Chapter 9.
- Keys ↑, ↓ move up and down the menu list
- Keys →, ← scroll the roll-down menus or return to the previous menu
- Enter parameters with the parameter entry keys
- Keys F1…F4 perform the indicated function, e.g. HOME

In the procedures which follow, the DXR 275 menu lines appear in the “Text” column.

5 Basic Calibration

General information

The basic calibration is made in metres (change in V8H5: 0 = m, 1 = ft). After calibration the Micropilot measures level in % (V0H0) or metres (V0H9) and the values for 4 mA and 20 mA are automatically set to 0% and 100%. Technical units are set later during a linearisation. Please note your parameters in the table on page 38.

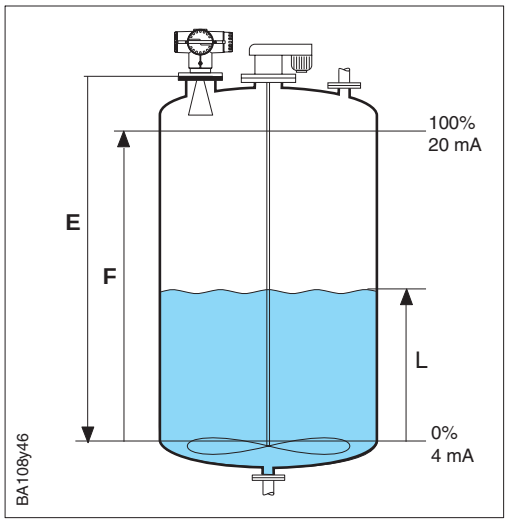
Note!

5.1 Horn antenna

Standard calibration (no extension tube)

After resetting the Micropilot to the factory settings (to produce a defined device status), enter the following parameters:

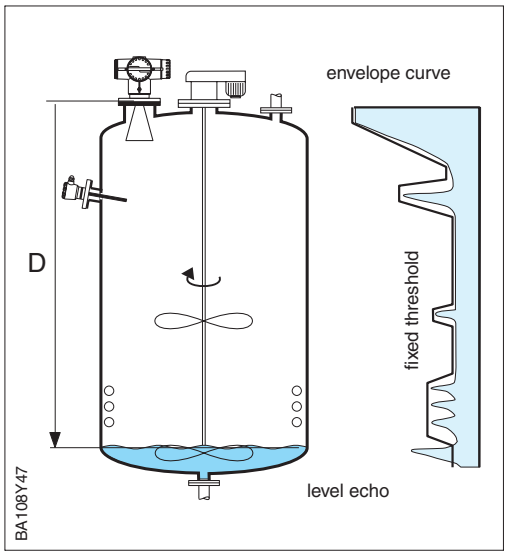
- Empty distance E, full distance F and application parameter A.



#	VH	Entry		Text
1	V9H5	**130**	E	Reset
2	V0H1	**E (m/ft)**	E	Empty calibration
3	V0H2	**F (m/ft)**	E	Full calibration
4	V0H3	**A (00...10)**	E	Application 0: factory setting 1: no stirrer in tank 2: stirrer in tank 3 tank E < 1.5 m 10:solids
5	V0H0 V0H9			Measured value L % or L m/ft

Fixed target suppression

The default evaluation mode uses the floating average curve (FAC) and factory TDT. It is recommended that a “photo” is made of the fittings in the empty tank (customer TDT), so that the fixed target suppression is exactly matched to the operating conditions.



#	VH	Entry		Text
1	Empty vessel as far as possible, where appropriate switch on stirrer			
2	V0H8	D?		Note distance
3	V3H0	**5** or **6**	E	Record TDT 5: if V0H8 = D 6: if V0H8 < D
4	V3H1	—	E	Confirm with E
5	Wait until distance reappears (ca. 60 s)			
6	V3H0 = 6: repeat steps 2 - 5 until V0H8 = D			

Note!

- To re-record TDT, e.g. in new tank: V9H5 = 111, then as above
- Further information: pages 6 and 40.

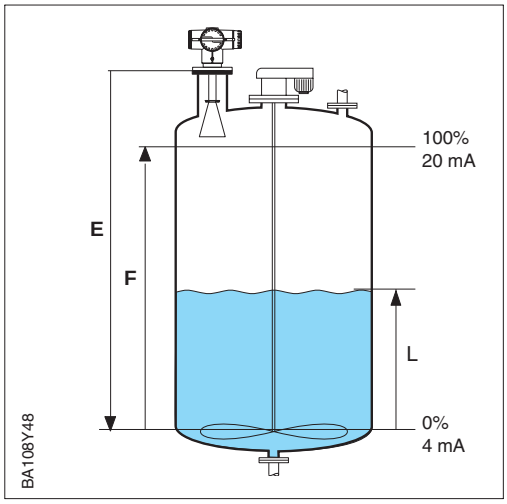
Note!

5.2 Horn antenna with extension tube

If an antenna extension tube is used, an offset factor must also be entered as part of the standard calibration. The factor is dependent upon the diameter and length of the extension tube, see Table below.

- OFF (m) = –0.508 * length l (m) for Ø 40 mm (FAR 10)
- OFF (m) = –0.34 * length l (m) for Ø 46 mm (special design)

#	VH	Entry		Text
1	V9H5	**130**	E	Reset
2	V3H9	**OFF (m/ft)**	E	Offset
3	V0H1	**E (m/ft)**	E	Empty calibration
4	V0H2	**F (m/ft)**	E	Full calibration
5	V0H3	**A (00...10)**	E	Application 0: factory setting 1: no stirrer in tank 2: stirrer in tank 3 tank E < 1.5 m
6	V0H0 V0H9			Measured value L % or L m/ft



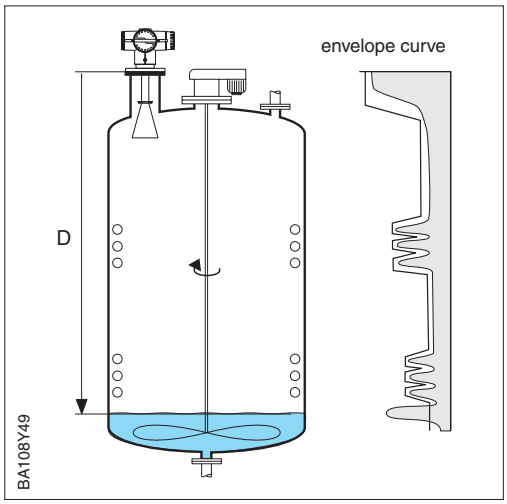
Offset (m)

Ø mm	length of extension tube mm			
	100	**200**	**300**	**400**
40	–0.0508	–0.1016	–0.1524	–0.2032
46	–0.034	–0.068	–0.102	–0.136

Fixed target suppression

The default evaluation mode uses the floating average curve (FAC) and factory TDT. It is recommended that a “photo” is made of the fittings in the empty tank (customer TDT), so that the fixed target suppression is exactly matched to the operating conditions.

#	VH	Entry		Text
1	Empty vessel as far as possible, where appropriate switch on stirrer			
2	V0H8	D?		Note distance
3	V3H0	**5 or 6**	E	Record TDT 5: if V0H8 = D 6: if V0H8 < D
4	V3H1	—	E	Confirm with E
5	Wait until distance reappears (ca. 60 s)			
6	V3H0 = 6: repeat steps 2 - 5 until V0H8 = D			



Note!

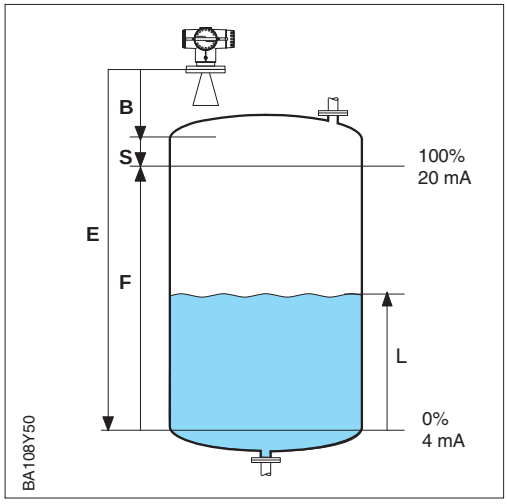
Note!

- To re-record TDT, e.g. in new tank: V9H5 = 111, then as above
- Further information: pages 6 and 40.

5.3 Non-invasive measurement with horn antenna

For non-invasive measurement through the tank roof, in addition to E, F and A, the following parameters must be entered during calibration:

- A near-field suppression distance B (greater than 0.1 m) in V3H2, in order to cut out echoes from the roof — the Micropilot does not measure in this range.
- A safety distance S to the range B in V8H7— if product enters this range, a warning is output which indicates that product is approaching the range B.
- The required response from the device if product enters the safety distance S in V8H6.



#	VH	Entry		Text
1	V9H5	**130**	E	Reset
2	V0H1	**E (m/ft)**	E	Empty calibration
3	V0H2	**F (m/ft)**	E	Full calibration
4	V0H3	**A (00...10)**	E	Application 0: factory setting 1: no stirrer in tank 2: stirrer in tank 3 tank E < 1.5 m
5	V3H2	**B (m/ft)**	E	Near-field suppression
6	V8H6	**0...3**	E	Product in safety distance 0: warning 1: alarm 2: hold alarm 3: clear alarm 2
7	V8H7	**S (m/ft)**	E	Safety distance
8	V0H0 V0H9			Measured value L % or L m/ft

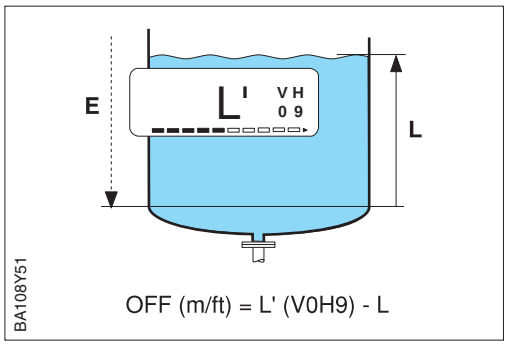
Fixed target suppression

The default evaluation mode uses the floating average curve (FAC) and factory TDT. It is recommended that a “photo” is made of the fittings in the empty tank (customer TDT), so that the fixed target suppression is exactly matched to the operating conditions. For procedure see page 19.

Level offset

If the measured distance in V0H9 differs from the actual level in the tank, a level offset must be entered in V3H9, whereby:

- OFF (m/ft) = L’ (V0H9) - L (actual level)



#	VH	Entry		Text
1	Measure actual distance L			
2	V0H9			Level L’ (m/ft)
3	V3H9	**OFF (m/ft)**	E	Offset (–)
4	V0H0 V0H9			Corrected measured value L % or L m/ft

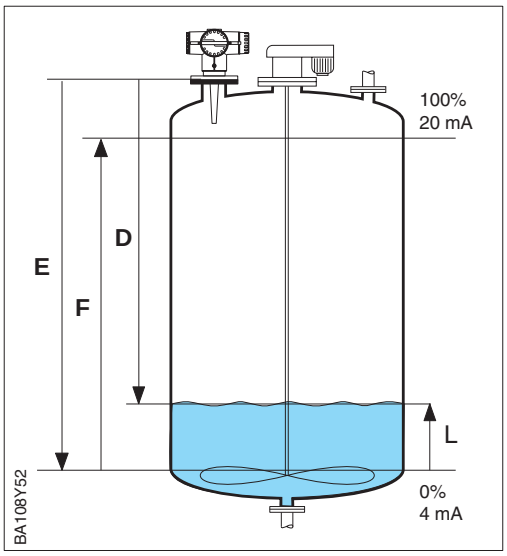
5.4 Rod antenna

Standard calibration (with fixed target suppression)

The standard calibration must be made with an empty or near empty tank and, where appropriate and possible, with stirrer switched on. After resetting the Micropilot to the factory settings (to produce a defined device status), enter the following parameters:

- Empty distance E, full distance F, application parameter A and distance to product surface D.

#	VH	Entry		Text
1	V9H5	**130**	E	Reset
2	V0H1	**E (m/ft)**	E	Empty calibration
3	V0H2	**F (m/ft)**	E	Full calibration
4	V0H3	**A (00...10)**	E	Application 0: factory setting 1: no stirrer in tank 2: stirrer in tank 3 tank E < 1.5 m
5	Empty vessel as far as possible, if possible turn on stirrer			
6	V0H8	D?		Note distance
7	V3H0	**5 or 6**	E	Record TDT 5: if V0H8 = D 6: if V0H8 < D
8	V3H1	—	E	Confirm with E
9	Wait until distance reappears (ca. 60 s)			
10	V3H0 = 6: repeat steps 6 - 9 until V0H8 = D			
11	V0H0 V0H9			Measured value L % or L m/ft



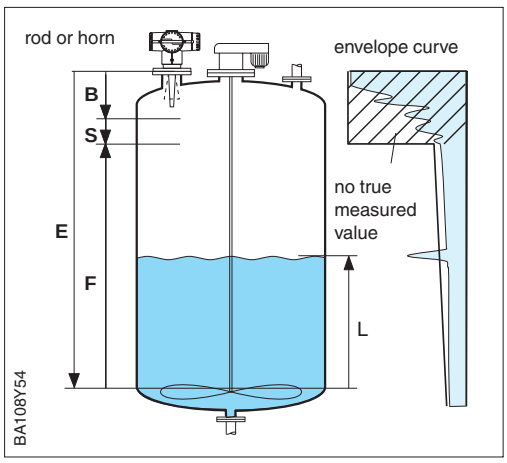
Note!

Note!
- To re-record TDT, e.g. in new tank: V9H5 = 111, then as above
- Further information: pages 6 and 40.

Near-field suppression (rod and horn antenna)

In the case of strong reflections near to and/or heavy build-up on the antenna, fittings close by or welds in the nozzle – see Trouble-Shooting, page 35, for symptoms – measurements must be cut out by entering a near-field suppression range B. Depending on the setting in V8H6 a warning or alarm is given should the product enter the safety distance S.

#	VH	Entry		Text
1	V3H2	**B (m/ft)**	E	Near-field suppression
2	V8H6	**0...3**	E	Product in safety distance 0: warning 1: alarm 2: hold alarm 3: clear alarm 2
3	V8H7	**S (m/ft)**		Safety distance



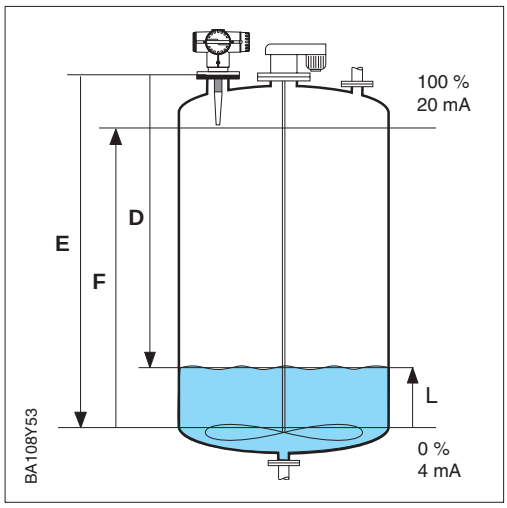
5.5 Rod antenna with inactive length

Standard calibration (with fixed target suppression)

In this version of the rod antenna, the microwaves are launched after the inactive length or 100 mm/250 mm. Build-up, condensation or fittings within the inactive length have no influence on the measurement.

Standard calibration must be made with an empty or near empty tank and, where appropriate and possible, with stirrer switched on. After resetting the Micropilot to the factory settings (to produce a defined device status), enter the following parameters:

- Empty distance E, full distance F, application parameter A and distance to product surface D.



#	VH	Entry		Text
1	V9H5	130	E	Reset
2	V0H1	**E (m/ft)**	E	Empty calibration
3	V0H2	**F (m/ft)**	E	Full calibration
4	V0H3	**A (00...10)**	E	Application 0: factory setting 1: no stirrer in tank 2: stirrer in tank 3 tank E < 1.5 m
5	Empty vessel as far as possible; if possible switch on stirrer			
6	V0H8	D?		Note distance
7	V3H0	**5** or **6**	E	Record TDT 5: if V0H8 = D 6: if V0H8 < D
8	V3H1	—	E	Confirm with E
9	Wait until distance reappears (ca. 60 s)			
10	V3H0 = 6: repeat steps 6 - 9 until V0H8 = D			
11	V0H0 V0H9			measured value L % or L m/ft

Note!
- To re-record TDT, e.g. in new tank: V9H5 = 111, then as above
- Further information: pages 6 and 40.

Note!

Near-field suppression

Near-field suppression is necessary only when strong echoes are received from fittings directly below the inactive length. The suppression is referenced to the lower face of the flange. For procedure see page 22.

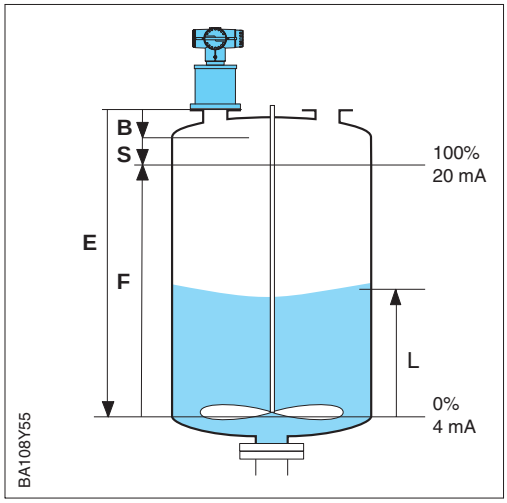
5.6 Process separation flange

Standard calibration

After resetting the Micropilot to the factory settings (to produce a defined device status), the following parameters must be entered during the standard calibration:

- Empty distance E, full distance F and application parameter A
- A near-field suppression distance B (greater than 0.1 m) in V3H2, — the Micropilot does not measure in this range.
- A safety distance S to the range B in V8H7— if product enters this range, a warning is output which indicates that product is approaching the range B.
- The required response from the device if product enters the safety distance S in V8H6.

#	VH	Entry		Text
1	V9H5	**130**	E	Reset
2	V0H1	**E (m/ft)**	E	Empty calibration
3	V0H2	**F (m/ft)**	E	Full calibration
4	V0H3	**A (00...10)**	E	Application 0: factory setting 1: no stirrer in tank 2: stirrer in tank 3 tank E < 1.5 m
5	V3H2	**B (m/ft)**	E	Near-field suppression
6	V8H6	**0...3**	E	Product within safety distance 0: warning 1: alarm 2: hold alarm 3: clear alarm 2
7	V8H7	**S (m/ft)**		Safety distance
8	V0H0 V0H9			Measured value L % or L m/ft



Fixed target suppression

The default evaluation mode uses the floating average curve (FAC) and factory TDT. It is recommended that a “photo” is made of the fittings in the empty tank (customer TDT), so that the fixed target suppression is exactly matched to the operating conditions. For procedure see page 19.

5.7 Bypass pipes and stilling wells

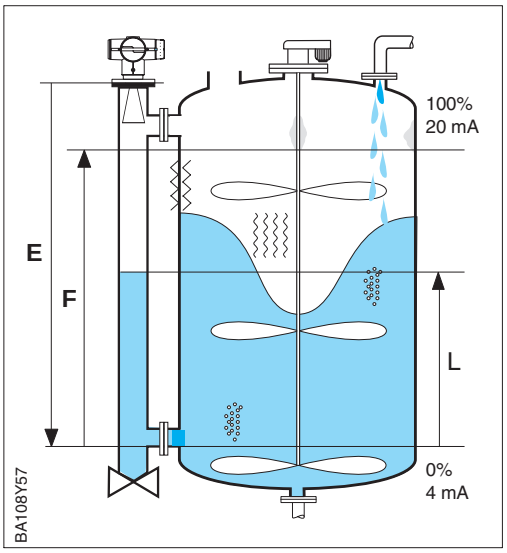
Standard calibration

After resetting the Micropilot to the factory settings (to produce a defined device status), the following parameters must be entered during the standard calibration:

- Empty distance E, full distance F and application parameter A
- A microwave factor MF, which is independent of the calibration units, whereby:

$$MF = + \sqrt{1 - (917.5 / d^2)},$$

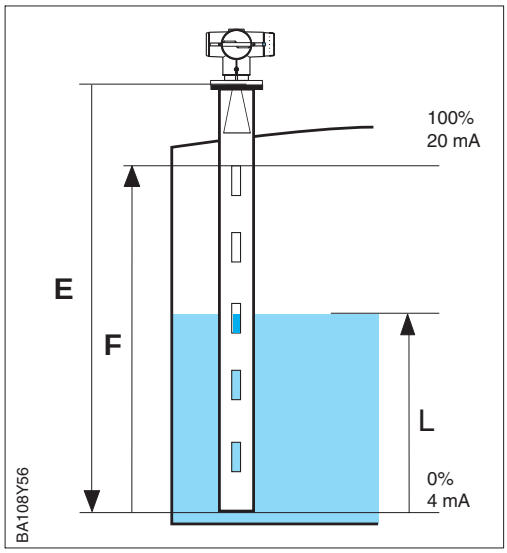
d = diameter of by-pass pipe or stilling well in mm



#	VH	Entry		Text
1	V9H5	**130**	E	Reset
2	V0H1	**E (m/ft)**	E	Empty calibration
3	V0H2	**F (m/ft)**	E	Full calibration
4	V0H3	**5**	E	Application 5: bypass pipe/ stilling well
5	V3H3	**MF**	E	Microwave factor
6	V0H0 V0H9			Measured value L % or L m/ft

Microwave factors

DN (ID) mm	80 (80.8)	100 (105.5)
Factor MF	0.9271	0.9577



Fixed target suppression

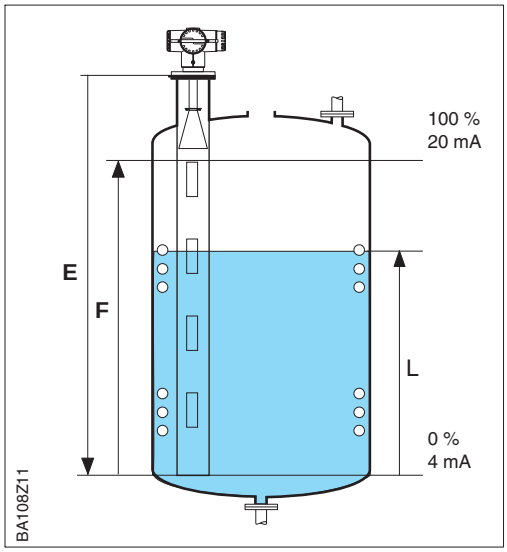
The default evaluation mode uses the floating average curve (FAC) and factory TDT. It is recommended that a "photo" is made of the fittings in the empty tank (customer TDT), so that the fixed target suppression is exactly matched to the operating conditions. For procedure see page 26.

5.8 Horn antenna with extension in bypass pipe/stilling well

The following parameters must be entered during standard calibration:

- Empty distance E, full distance F and application parameter A.
- Microwave factor MF
  MF = + $\sqrt{1\ (917.5\ /d^2)}$, d = ID of stilling well/bypass pipe in mm.
- Offset factor OFF, which is dependent upon the diameter and length of the extension tube, see Table below.
  OFF (m) = –0.508 * length l (m) für Ø 40 mm (type FAR 10)
  OFF (m) = –0.34 * length l (m) für Ø 46 mm (special version)

#	VH	Entry		Text
1	V9H5	**130**	E	Reset
2	V0H1	**E (m/ft)**	E	Empty calibration
3	V0H2	**F (m/ft)**	E	Full calibration
4	V0H3	**5**	E	Application 5: bypass pipe/ stilling well
5	V3H3	**MF**	E	Microwave factor
6	V3H9	**OFF (m/ft)**	E	Offset
7	V0H0 V0H9			measured value **L % or m/ft**



Microwave factor

Antenna	DN 80 (80.8)	DN 100 (105.5)
Factor MF	0,9271	0,9577

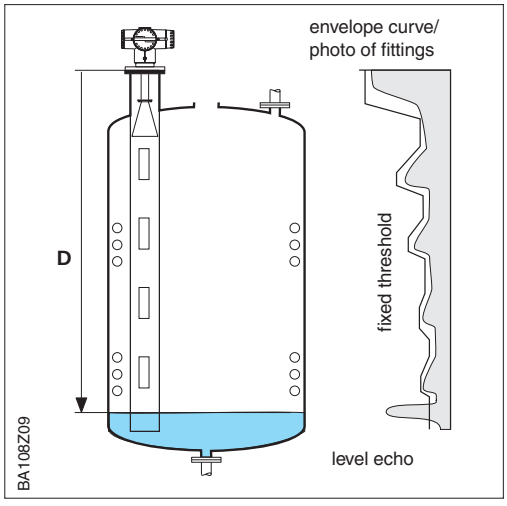
Offset (m)

Ø mm	Length l of extension mm			
	100	200	300	400
40	–0,0508	–0,1016	–0,1524	–0,2032
46	–0,034	–0,068	–0,102	–0,136

Fixed target suppression

The default evaluation mode uses the floating average curve (FAC) and factory TDT. It is recommended that a “photo” is made of the fittings in the empty tank (customer TDT), so that the fixed target suppression is exactly matched to the operating conditions.

#	VH	Entry		Text
1	Empty vessel as far as possible, where appropriate switch on stirrer			
2	V0H8	D?		Note distance
3	V3H0	**5 or 6**	E	Record TDT 5: if V0H8 = D 6: if V0H8 < D
4	V3H1	—	E	Confirm with E
5	Wait until distance reappears (ca. 60 s)			
6	V3H0 = 6: repeat steps 2 - 5 until V0H8 = D			



Note!

Note!

- To re-record TDT, e.g. in new tank: V9H5 = 111, then as above
- Further information: pages 6 and 40.

6 Additional Settings

6.1 Linearisation

General information

A linearisation determines the relationship between level and tank volume/weight and also allows measurement in technical units, e.g. m, ft, hl, gals or t. Afterwards the measured value is displayed in V0H0 in the selected units, and the analogue output changes in direct proportion to it. Either the entry in V2H5 or the highest table value is automatically taken as the 20 mA value (V0H6). There are four linearisation procedures:

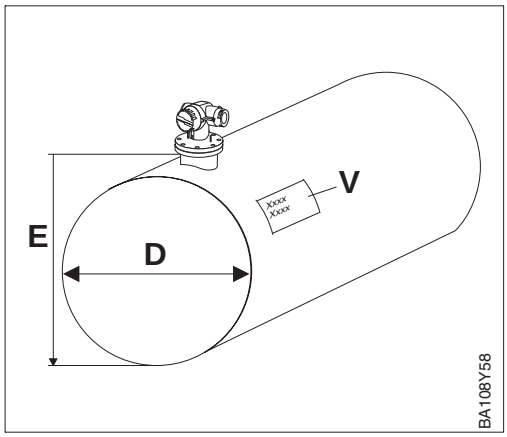
Note!

- horizontal cylinder
- manual entry of a table for standing cylinder
- manual entry of a table for tanks with a conical outlet
- semi-automatic entry of a table.

Horizontal cylinder

For horizontal cylinders, the Micropilot uses a pre-set linearisation table, whereby the following parameters must be entered:

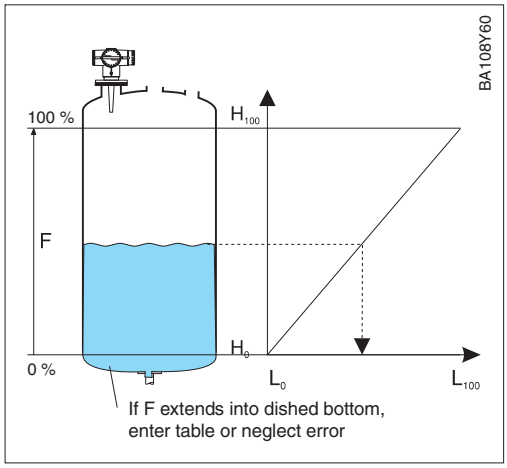
- tank diameter D, in the units (m/ft) used for the basic calibration (V0H1/V0H2)
- tank volume V (or weight) in the required technical units.



#	VH	Entry		Text
1	If no basic calibration made, turn to Chapter 5			
2	V2H4	**D (m/ft)**	E	Diameter
3	V2H5	**V (hl/gal...)**	E	Volume (weight)
4	V2H0	**1**	E	Linearisation 1: cylinder V0H6 = V2H5
5	V0H0 V0H9			Measured value Volume or level

Standing cylinder

For a standing cylinder, simply enter the height, volume or weight ($L_{100\%}$) in V2H5, which corresponds to a level of 100% (= F m/ft):



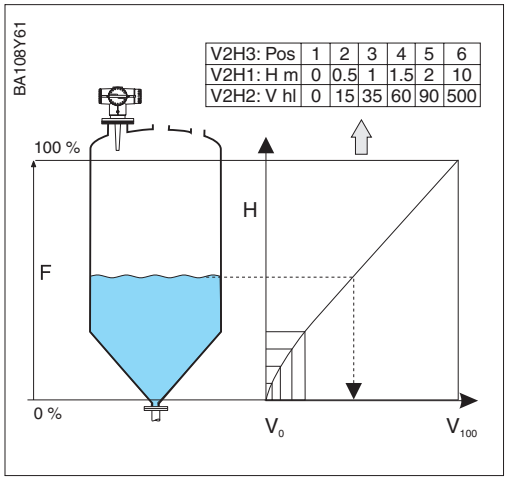
#	VH	Entry		Text
1	If no basic calibration made, turn to Chapter 5			
2	V2H5	$L_{100\ \%}$ (...)	E	Level/volume/ weight
3	V2H0	2	E	Linearisation 2: manual V0H6 = V2H5
4	V0H0			Measured value in technical units

Linearisation table for tank with conical outlet

For tanks, e.g. with a conical outlet, a linearisation table must be entered. This type of linearisation requires:

- up to 32 pairs of values, which rise or fall steadily, H in the units of the basic calibration, V in the required technical units.
- Last value pair: H = F m/ft and V = V_{max}.

#	VH	Entry		Text
1	If no basic calibration made, turn to Chapter 5			
2	V2H1	$H_{1...32}$ (m/ft)	E	Level
3	V2H2	$V_{1..32}$ (hl/kg)	E	Volume (weight)
4	V2H3	2 (...32)	E	Table No.
5	Repeat steps 2 to 4, until all values entered			
6	V2H0	**2**	E	Linearisation 2: manual V0H6 = V_{max}
7	V0H0 V0H9			Measured value volume or level



Note!

Note!

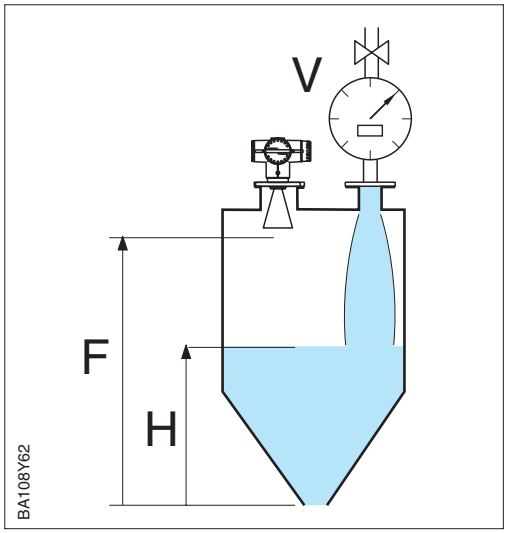
- The sequence is different for HART devices. After the table has been entered, the “sort” function must be activated.

Semi-automatic entry of a table

If the tank amount of liquid entering the tank can be metered, it is possible to automise the entry of the linearisation table:

- the level H is displayed in V2H1
- the associated volume or weight V is entered in V2H2.
- the highest volume/weight is set in V0H6

#	VH	Entry		Text
1	If no basic calibration made, turn to Chapter 5			
2	V2H0	**3**	E	Linearisation 3 = automatic
3	V2H1	$H_{1...32}$		Level (display)
4	V2H2	$V_{1..32}$ (hl/gal...)	E	Volume (weight)
5	V2H3	2 (...32)	E	Table No.
6	Repeat steps 3 to 5, until all value entered			
7	V2H0	**2**	E	Linearisation 2: activate V0H6 = V_{max}
8	V0H0 V0H9			Measured value volume or level



Correction of the table

If error code E602 appears after activation in V2H0 - Table does not increase or decrease monotonically - correct the table and re-activate the linearisation in V2H0. The incorrect pair of values is automatically selected.

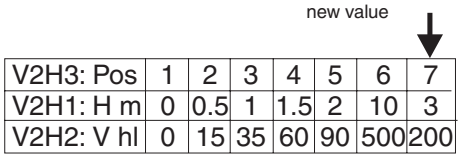
#	VH	Entry		Text
1	V2H3	n	E	Table No.
2	V2H1	H_n	E	Level
3	V2H2	V_n	E	Volume (weight)
4	V2H0	2	E	Linearisation 2: manual

Addition of value pairs

A table can be extended by entering the next number in V2H3 followed by the value pair in V2H1 and V2H2. After the table has been activated it is re-sorted

Note!

The sequence differs for HART devices: after entry of the value pair the Sort function must be activated.



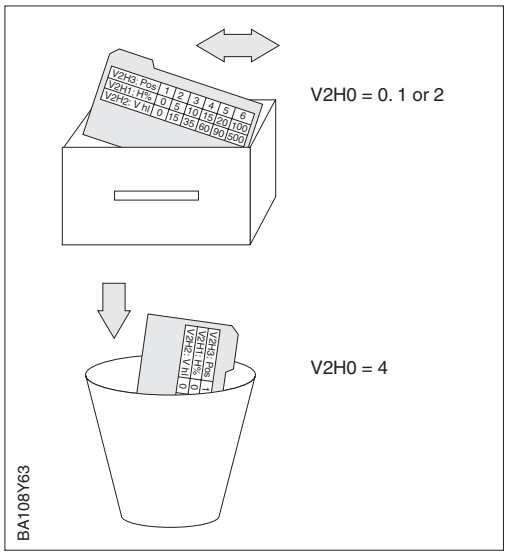
V2H3: Pos	1	2	3	4	5	6	7
V2H1: H m	0	0.5	1	1.5	2	10	3
V2H2: V hl	0	15	35	60	90	500	200

#	VH	Entry		Text
1	V2H3	n	E	Table No.
2	V2H1	H_n	E	Level
3	V2H2	V_n	E	Volume (weight)
4	V2H0	2	E	Linearisation 2: manual

De-activate linearisation

There are two possibilities for de-activating a linearisation table.

- Enter ‘0’ in V2H0 - the linearisation is de-activated, but the linearisation table is not deleted. The table is re-activated by entering ‘1’ or ‘2’ in V2H0.
- Enter ‘4’ in V2H0 to delete the customer linearisation table - the table for horizontal cylinder is not affected by this action.



#	VH	Entry		Text
1	De-activate			
2	V2H0	**0**	E	Linearisation 0: linear
3	Re-activate			
4	V2H0	e.g. 2	E	Linearisation 1: cylinder 2: table
5	Delete			
6	V2H0	**4**	E	Linearisation 4: clear

6.2 Analogue output

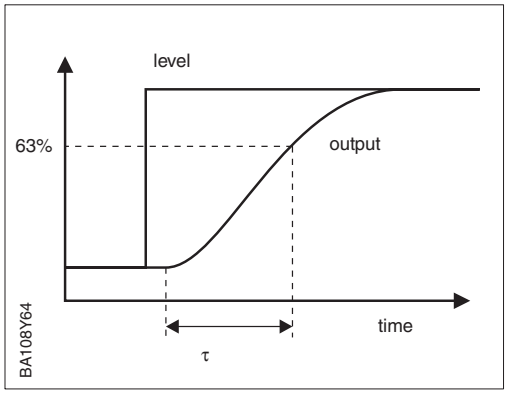
The analogue output is set as follows:

- V0H4 determines the output damping
- V0H5 and V0H6 determine the values for 4 mA and 20 mA.

Output damping τ

The output damping regulates the settling time of the analogue output. On a sudden change in level, 63% of the new value is attained in the time set (t = 0...300 s).

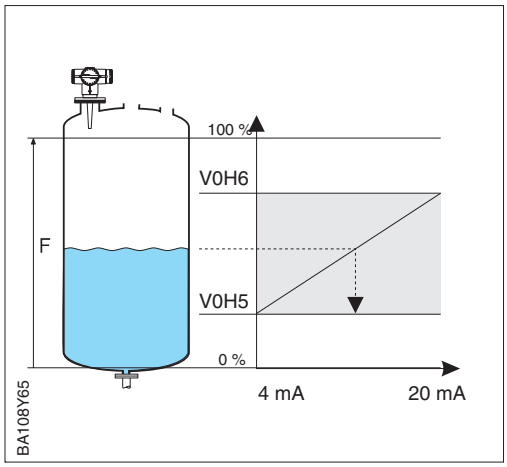
#	VH	Entry		Text
1	V0H4	0...300 s	E	Output damping



4 mA and 20 mA values

The 4 mA and 20 mA values determine the levels at which the analogue signal range begins and ends. The factory settings are 0% and 100%. After a linearisation, V0H6 is set automatically to either the value entered in V2H5 or the highest value entered in the linearisation table. Any range can be set, provided it lies within the full calibration range F (V0H2).

#	VH	Entry		Text
1	V0H5	± 19999 (%, m, hl...)	E	Value for 4 mA
2	V0H6	± 19999 (%, m, hl...)	E	Value for 20 mA



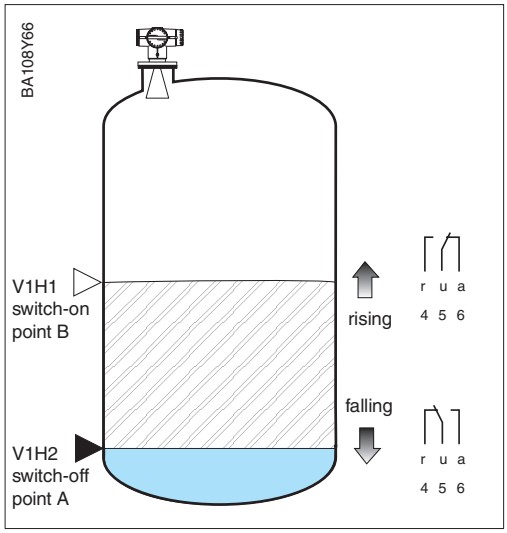
6.3 Relay

If required, the alarm relay can be set as a limit relay (V1H0 = 1), which operates in either minimum or maximum fail-safe mode. The units correspond to those used for the analogue output.

Minimum fail-safe mode

In minimum fail-safe mode the relay switches (de-activates) as soon as the product level falls below the set limit (switch-off point). The relay re-energises when the product level exceeds the switch-on point, i.e.:

- Switch-on point (V1H1) > switch-off point (V1H2).

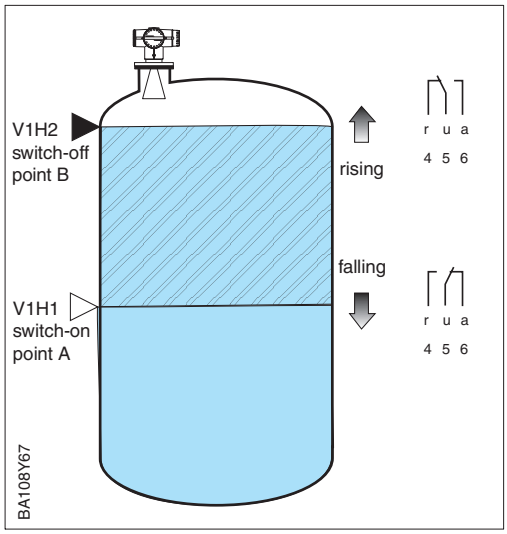


#	VH	Entry		Text
1	V1H0	**1**	E	Relay function 0: alarm relay 1: limit relay
2	V1H1	B (%, hl...)	E	Switch-on point
3	V1H2	A (%, hl...)	E	Switch-off point

Maximum fail-safe mode

In maximum fail-safe mode the relay switches (de-activates) as soon as the product level rises above the set limit (switch-off point). The relay re-energises when the product level drops below the switch-on point, i.e.:

- Switch-on point (V1H1) < switch-off point (V1H2).



#	VH	Entry		Text
1	V1H0	**1**	E	Relay function 0: alarm relay 1: limit relay
2	V1H1	A (%, hl...)	E	Switch-on point
3	V1H2	B (%, hl...)	E	Switch-off point

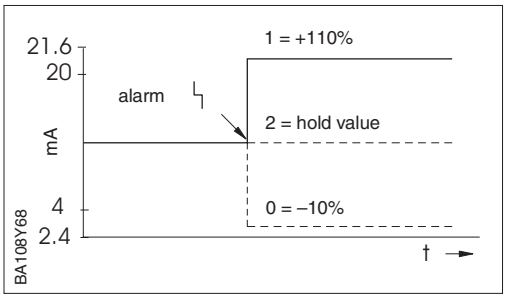
6.4 Safety responses

The safety responses *(default)* define the behaviour of the Micropilot on the appearance of a warning or alarm, see also Chapter 7.

Output on alarm

The analogue output can be set such that it takes on a distinctive value on an alarm. If the relay is set for limit detection (V1H0 = 1), it switches according to the settings in V1H1 and V1H2, see Chapter 7.

#	VH	Entry		Text
1	V8H1	e.g. 0	E	Output on alarm 0: -10% *1: +110%* 2: hold value

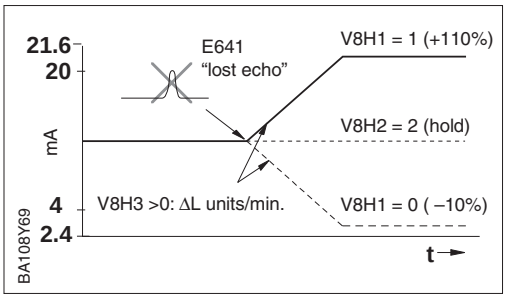


On lost echo – E641

If the level echo is lost, error E641 appears. The field V8H2 determines whether this situation is handled as an alarm or warning. If the warning option is chosen, the behaviour of the analogue output - hold value or rate of rising/falling - must be set in V8H3 in addition.

#	VH	Entry		Text
1	V8H2	e.g. 0	E	On lost echo *0: warning* 1: alarm (as V8H1) 2: hold value 3: clear hold (2)
2	V8H3	e.g. 10	E	Output on warning *0: hold value* >0: ΔL%/min*.

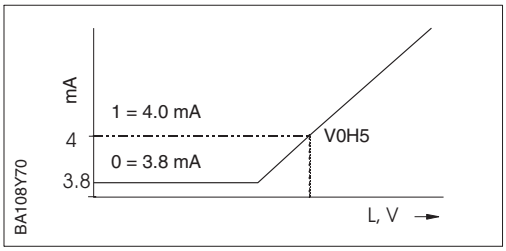
*the response time of the analogue output depends on the values set for 4 mA and 20 mA (V0H5/H6)



4 mA threshold

The 4 mA threshold is activated as standard and ensures that the analogue signal value does not fall below 4 mA under normal operating conditions. It can be de-activated in V8H4.

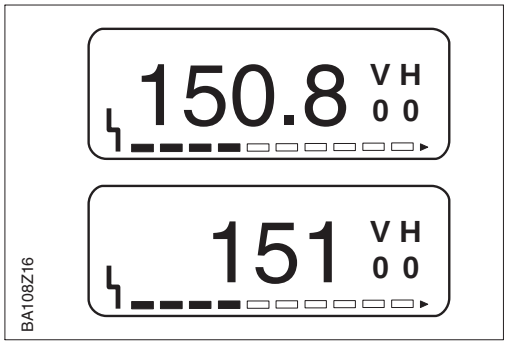
#	VH	Entry		Text
1	V8H4	e.g. 0	E	4 mA threshold 0: off *1: on*



6.5 Other functions

Number of decimal figures

By entering a number between 0 and 4 in V2H6, the number of decimal figures displayed in V0H0 can be varied between 0 and 4. The factory setting is 1.



#	VH	Entry		Text
1	V2H6	e.g. 0	E	No. decimal figures 0: 0 *1: 1* 2: 2 3: 3 4: 4

Download

Field V2H7 controls which data are accepted by the device during a download, e.g. from Commuwin II:

- 0 = matrix data only (default setting)
- 1 = matrix data and customer TDT
- 2 = matrix data, customer TDT and factory TDT.

The acceptance of a TDT only makes sense when the data concerned originated from the same device in the same application.

6.6 Parameter lock

Locking via keys

In order to prevent accidental or unauthorised changing of the configuration, the device can be locked on-site with the operating and display module FHV 160.

- Locking :
  - Press keys V and E simultaneously
  - P—- appears for ca. 2 s as confirmation
  - 9999 appears in field V8H9
  - Parameters cannot be changed on-site or via communcation (or download)
  - if an upload from a locked Micropilot is stored and then downloaded to another device, the new device is not locked.
- Unlocking
  - Press keys H and → simultaneously
  - F—— appears for ca. 2 s as confirmation
  - The unlocking code appears in field V8H9.

Locking via matrix

The parameter matrix can be locked and unlocked by entering a code in V8H9. Locking via keys hasa precedence over locking via matrix.

#	VH	Entry		Text
1	V8H9	e.g.1230	E	Security locking ≠ 130 locks *= 130 unlocks*

6.7 Measured value display

Measuring point

Field	Significance
V0H0	Level in percent or, after a linearisation, in technical units
V0H5/V0H6	Lower range-value and upper range-value of analogue output
V0H8	Measured distance in m/ft from sensor to product surface
V0H9	Level of product in m/ft
V1H0	Relay function: 0 = alarm, 1 = limit value
V8H9	Parameter lock: 9999 via keys, ≠ 130 locked, = 130 unlocked
V9H0	Error code: 0 = measurement OK, ≠ 0 instrument alarm or warning
V9H1	Last error code
V9H2	Last but one error code
V9H3	Device type and software version XXYY: XX = device type 80 HART, 41 INTENSOR, 66 RS-485 Y.Y = software version
V9H4	RS-485 address (if equipped with RS-485 interface)
VAH0	Measuring point designation (only accessible with communication interface)

Parameters

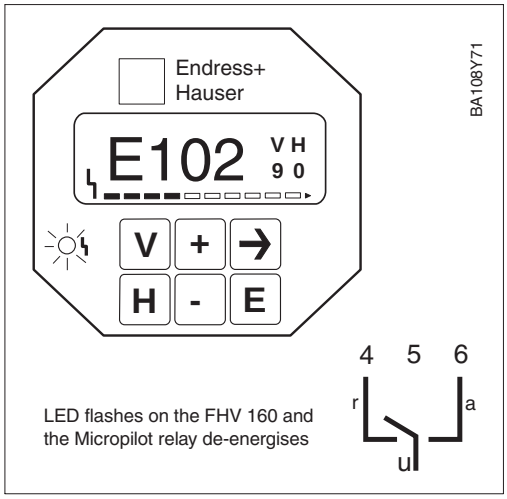
Field	Significance
V0H1/V0H2	Empty and full calibration
V0H3	Application parameter, see page 39 00 factory setting with tank bottom recognition 01 tank with no stirrer 02 process tank with stirrer (turbulence) 03 small tanks (E < 1.5 m/5 ft) 04 reserved 05 stilling well or bypass pipe 06 optimisation 01 07 optimisation 02 08 optimisation 03 09 reserved for service 10 bulk solids
V0H4	Output damping
V0H7	Echo damping: the lower the better
V3H0	Evaluation mode: 0: Factory TDT 1: FAC only 2: Customer TDT only 3: FAC + TDT
V7H1	xyyzz x = measuring range, 0 = 20 m, 1 = 35 m yy = echo damping in dB zz = signal to noise ratio (the higher the better)
V8H0	Operating mode 0 = level, 7 = simulation
V8H5	Length units: 0 = m, 1 = ft

7 Trouble-Shooting

When the instructions in the manual have been followed correctly, the system must now function. Should this not be the case, the Micropilot provides a number of possibilities for analysing and correcting faults.

7.1 Fault monitoring

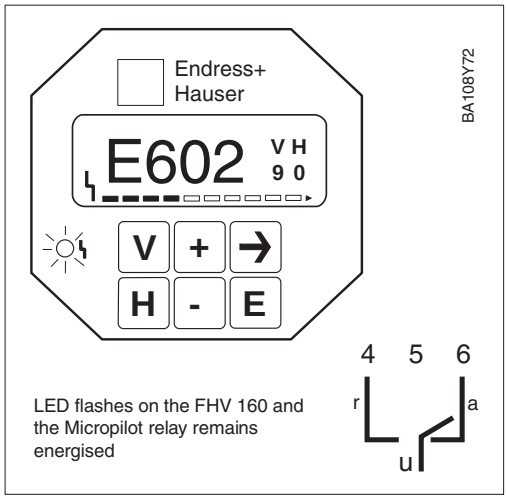
The self-monitoring system makes a distinction between alarms and warnings.



On an alarm

- The fault indicator appears at the operating and display module FHV 160.
- The red fault LED on the operating and display module FHV 160 lights.
- The alarm relay de-energises (V1H0 = 0), the Micropilot stops measuring.
- The analogue output responds according to the settings in V8H1...V8H6, see Table below.

An error code is displayed at matrix position V9H0 to help locate the fault.



On a warning

- The fault indicator appears and flashes.
- The red fault LED flashes.
- The alarm relay remains activated and the Micropilot continues measuring.
- The analogue output responds according to the settings in V8H1 and V8H3.

An error code is displayed at matrix position V9H0 to help locate the fault.

Limit relay

If the relay is set as a limit relay, its response depends upon the settings of the analogue output (V8H1) and the selected fail-safe mode (V1H1/V1H2) The table below lists possible switching states.

Relay status for...	V8H1 = 0 (–10%)	V8H1 = 1 (+110%)	V8H1 = 2 (hold)
Min. fail-safe mode	relay de-energises	relay energises	hold status
Max. fail-safe mode	realy energises	relay de-energises	hold status

7.2 Error messages

The current error code is displayed in V9H0.

- The last two error codes are displayed in V9H1 and V9H2 respectively.
- If present, further error codes can be read at the operating and display module FHV 160 by pressing the ⊞ and ⊟ keys; the display sequence corresponds to the priority of the faults.
- Key E clears the error codes displayed in V9H1/V9H2.

Table 7.1 lists the error codes with the corresponding messages.

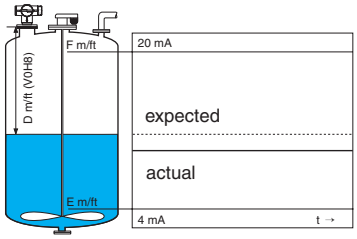
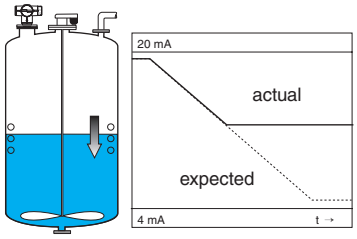
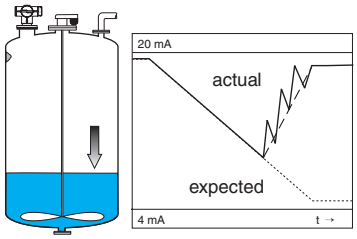
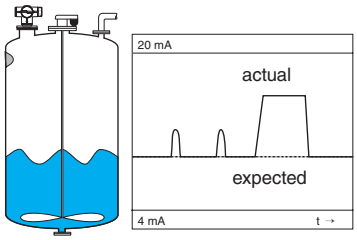
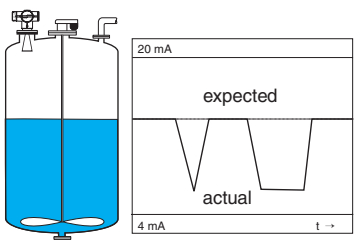
Table 7.1
Diagnostic messages

Code	Type	Significance	Response
E111... E124	Alarm	Instrument fault	☎ Call Service
E231	Alarm	No sensor signal	☎ Call Service
E233	Alarm	Fault in electronics	☎ Call Service
E501	Warning	No antenna type	☎ Call Service
E511	Warning	No factory TDT	☎ Call Service
E512	Warning	Ready to record TDT	Record TDT, 4 (full) or 5 (partial) in V3H0 - message disappears when evaluation mode is set to 0...3 in V3H0
E520	Warning	Transmission calibration	For service purposes only
E602	Warning	Error in linearisation – values do not rise or fall monotonically, (saddle point in curve)	Enter the incorrect value pairs again, see page 28 - **caution**, the values are now sorted according to size
E613	Warning	Simulation or sensor optimisation mode	Message disappears after the operating mode 'level' is selected again (V8H0 = 0)
E621	Warning	Measurement stopped for service	Appears during reading of envelope curve by a PC operating program
E641	Warning Alarm	Lost echo The message type is selected in V8H2, see 'Safety functions'	For response see trouble-shooting table, page 38
E643	Warning Alarm	Product inside safety distance, danger of overspill Message type is selected in V8H6, see 'Safety functions'	Disappears as soon as level falls or alarm is cleared (V8H3 = 3)
E651	Warning	Faulty antenna signal	☎ Call Service

7.3 Trouble-shooting

Table 7.2 lists the most common measuring errors with possible remedies. If a remedy works, the others are not necessary.

Note!

Fault	Analogue output	Possible cause	Remedy
Measured value incorrect		Distance D (V0H8) correct? → no yes Linearisation correct? → no yes 4 mA and 20 mA settings correct? → no yes	① Incorrect calibration? Check parameters E (V0H1) and F (V0H2), if necessary enter new application parameter in V0H3 ② Antenna extension in use? Re-enter offset parameter, see Basic Calibration, page 20 or 26 ③ By-pass or stilling pipe? Check microwave factor, see Basic Calibration, page 25 or 26 ① Check parameters, e.g. with simulation, page 39, if necessary re-enter table, page 29 ① Re-enter values in V0H5 and V0H6, page 30 ① ☎ Call Service
Measured value remains constant when tank is emptied (No Warning E 641)		Fittings at displayed level causing strong echoes → yes no	① Record TDT, see page 40
Display springs to higher values when tank is emptied		Build-up on or near antenna causes weak echoes → yes no	① Activate near-field suppression, see Basic Calibration – Near-field suppression, page 22 ② Carefully clean antenna
Measured value jumps sporadically when level constant, but product surface turbulent		Signal attenuated by turbulent surface - interference echo is temporarily stronger → yes	① Try application parameter 8 (V0H3) ② Activate near-field suppression, p. 22 ③ Increase output damping, page 30 ④ Activate fixed target suppression page 40 ⑤ Check Micropilot position, page 9, if possible mount on better placed nozzle ⑥ Fit larger antenna, ☎ Call Service
Display springs to lower value when level stationary		Multiple echoes → yes	① Try “optimisation” application parameter (V0H3), page 39 06: no stirrer in tank 07: stirrer in tank 08: tank E < 1.5 m ② If necessary, reposition Micropilot at less central point in tank

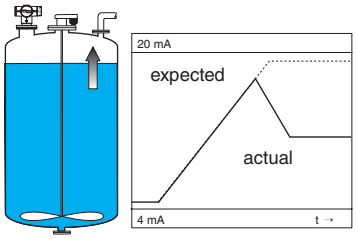
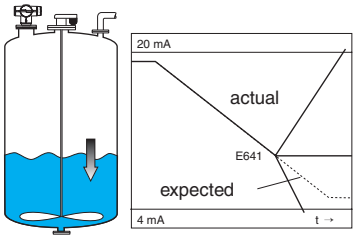
Fault	Analogue output	Possible cause	Remedy
Display springs to lower value as 100% mark is neared		Multiple echoes →	① For process separation flange or non-invasive measurement, near-field suppression distance too small, Change parameter B, see Basic Calibration, page 21 or 24 ② Level over 100% mark, if necessary change E and F values, see Basic Calibration. page 19...26
E641 appears when tank being filled or emptied or during process when stirrer switched on		Echo too weak to be detected →	① Try “optimisation” application parameter (V0H3), page 39 06: no stirrer in tank* 07: stirrer in tank* 08: tank E < 1.5 m *In these cases activate FAC only (V3H0 = 1) ② Check Micropilot position, page 9, if possible mount on better placed nozzle ③ Use larger antenna, ☎ Call Service
No current output		Plug in wrong socket → yes no ↓ Incorrectly wired or line interrupted → yes no ↓ No power supply for device with passive output → yes no ↓ Faulty electronics →	① Check plug position in electronics compartment, see Connection, page 13 ① Check wiring ① Connect power supply ☎ Service
No Smart communication		Incorrectly wired → yes no ↓ Electromagnetic interference →	① Check wiring and necessary/ permissible load, see Technical Data, page 41 ① Check screening, see Connection page 14...16
No RS-485 communication		Incorrectly wired → yes no ↓ Two or more instruments with same address → no ↓ Bus termination set at more than one instrument - required only at the last one on the bus →	① Check data lines and screening, see Connection page 13, 16 and BA 134F ① Change address, see Connection page 13 ① Check instruments, See Connection page 13

Table 7.2
Trouble-shooting

7.4 Application parameter

In the majority of cases, the use of the factory set application parameter will provide an accurate and reliable measurement. Where this is not the case, or where special requirements are placed on the measurement, a more exact adaptation to the operating conditions is necessary. Table 7.3 summarises the application parameters available to the user.

Code	Application	Description
00	Factory setting	Standard settings for measurement of liquids. With tank bottom recognition for tanks with dished bottoms.
01	No stirrer in tank (storage tank)	Adapted to the measurement in calm liquids with slow level changes. Without tank bottom recognition
02	Stirrer in tank (process tank)	Adapted to the measurement of turbulent liquids, e.g. in tanks with stirrers. With tank bottom recognition for tanks with dished bottoms.
03	Small tanks (E < 1.5 m)	Adapted to measurement of rapidly changing levels, e.g. as found in small tanks. With tank bottom recognition for tanks with dished bottoms.
04	Reserved	Reserved
05	Stilling well/bypass pipe	Adapted to measurement in stillling wells and bypass pipes. Without tank bottom recognition
06	Optimisation 01	Alternative to application parameter 01 when alarm E641 appears frequently. Also for liquids with low dielectric constant.
07	Optimisation 02	Alternative to application parameter 02 when alarm E641 appears frequently. With tank bottom recognition for tanks with dished bottoms.
08	Optimisation 03	Alternative to application parameter 03 when alarm E641 appears frequently. The greater sensitivity means a slower, possibly less steady, measurement
09	Service mode	For service purposes only
10	Solids	Adapted to the measurement of bulk solids

Table 7.3
Application parameters

Tank bottom recognition

The tank bottom recognition function ensures reliable measurement in the following cases:

- The tank has a dished bottom. If microwaves are reflected from the tank bottom, e.g. when the tank is completely empty, then the curvature causes them to be deflected towards the tank wall. This results in an increase in the time of flight, and hence of the apparent distance to the level echo. A negative level would be displayed. The tank bottom recognition function recognises this state of affairs and displays the level 0.
- The liquid has a low dielectric constant and the surface is calm. Under these conditions, a portion of the microwaves penetrate the surface. When the tank is almost empty, it is possible that these microwaves are reflected from the bottom of the tank to produce a strong, somewhat delayed, echo. A negative level would be displayed. The tank bottom recognition function recognises this state of affairs and displays the true level (optimisation 01, code 06)

7.5 Evaluation mode and echo suppression

Evaluation mode

Normally, evaluation mode 3, FAC + TDT, is used for measurement. A change of evaluation mode is necessary only if the measurement is too slow.

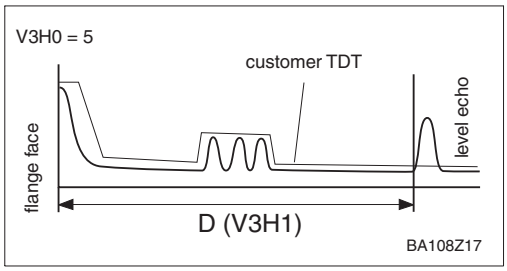
Evaluation mode	Signifcance
0 = factory TDT	Recorded in the factory to a maximum distance of 5 m. Suppresses echoes which might appear on standard mounting in a nozzle.
1 = FAC only	Fuzzy logic algorithm which matches the echo suppression to the prevailing noise threshold. If interference echoes are no problem, a faster measurement than in mode 3 is possible.
2 = customer TDT only	Is recorded by customer, see below, preferrably when vessel is empty. Suppresses all interference (fixed) echoes within the entered distance. If filling noise and turbulence is no problem, it is faster and has more signal reserve than mode 3. If no customer TDT is recorded, the factory TDT is used
3 = FAC + TDT	Default setting with both evaluation modes, which allows a reliable measurement independent of operating conditions.

Echo suppression

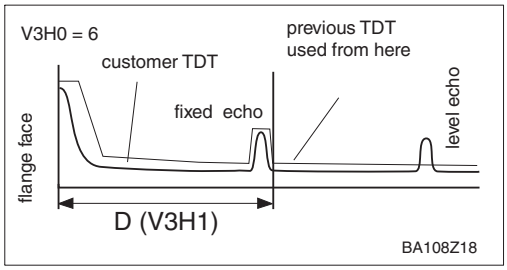
The customer has two possibilities to suppress interference echoes:

- Mode 5, empty echo: the tank is as empty as possible, V0H8 is correct (distance to product surface). All echos up to the distance D are suppressed.
- Mode 6, interference echo: the measured value remains constant during emptying, see Trouble-shooting. By confirming the value in V3H1 (approx. V0H8), the fixed echos are successively suppressed until the true level is displayed.

#	VH	Entry		Text
1	V3H0	**5**	E	Recording mode 5: empty echo
2	V3H1	—	E	Distance to product surface
3	V3H0	**3**		Evaluation mode 3: FAC + TDT set automatically



#	VH	Entry		Text
1	V3H0	**6**	E	Recording mode 6: fixed echo
2	V3H1	D (m/ft)	E	Confirm with E
3	Repeat steps 1 +2 until V0H8 = true distance			
4	V3H0	**3**		Evaluation mode 3: FAC + TDT set automatically



Recording mode	Significance
4 = service	For service only. Recording stops exactly at the specified distance. A previous TDT is retained from this point onwards. Requires an envelope curve display
5 = level echo	Records from flange to selected echo. The device assumes that the measured echo is the true level and does not suppress it. The previous TDT is retained from the selected echo to the end of range.
6 = fixed echo	Records from flange up to and including the selected echo. The device assumes that the selected echo is an interference echo and supresses it. The previous TDT is retained from the end of the selected echo to the end of range.

7.6 Simulation

Simulation

Where appropriate, the simulation function allows the linearisation, analogue output and relay to be tested. The following possibilities exist:

- Simulation of level in V9H7: fields V0H0, V0H9, V9H8, V9H9 and the analogue output (with limit relay) follow the value entered
- Simulation of volume in V9H8: fields V0H9, V9H9 and the analogue output (with limit relay) follow the value entered
- Simulation of analogue current in V9H9: the analogue output (with limit relay) follow the value entered.

Enter the value to be simulated in the appropriate field. During simulation, warning E613 appears in V9H0.

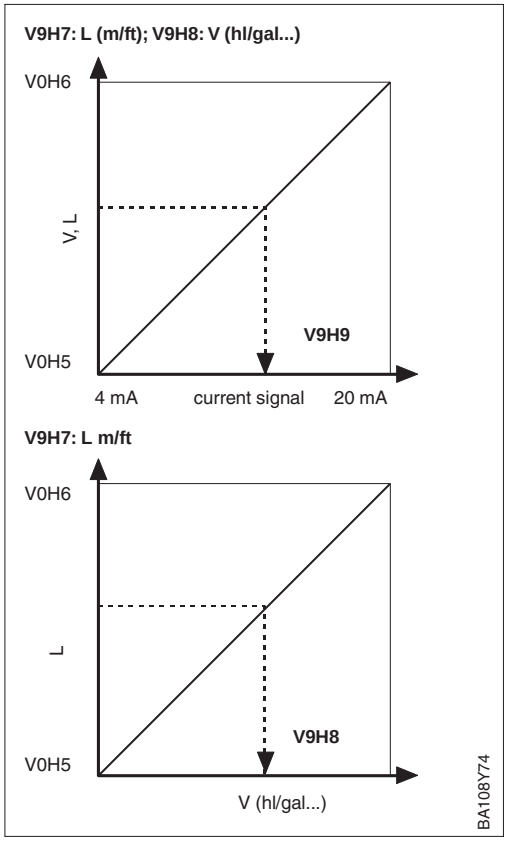


Fig. 7.1
Simulation of level and current signal

#	VH	Entry		Text
1	V8H0	**7**	E	Operating mode 7: Simulation
2	V9H7	L (m/ft)		Level
	V9H8	V (hl/gal...)		Volume
	V9H9	4...20 mA		Current
3	V8H0	**1**	E	Operating mode 0: level

7.7 Maintenance

Exchanging complete Micropilots

It is usually sufficient to enter all the matrix parameters from the old into the new transmitter (or to download from the computer). The replacement will then measure correctly without the need for renewed calibration.

- If necessary, re-activate linearisation in V2H0
- If necessary, re-record TDT.

Exchanging the antenna or electronics

Ask for appropriate Service Information sheet.

Factory settings

On a general reset (V9H5 = 130) the factory settings [in brackets] are recalled. The grey fields remain unaffected.

Table 7.4 Customer settings – factory settings in brackets, grey fields are unaffected by a reset

	H0	H1	H2	H3	H4	H5	H6	H7	H8	H9
V0		[20/35]	[20/35]	[0]	[0]	[0]	[100]			
V1	[0]	[0]	[100]							
V2	[0]						[1]	[0]		
V3	[3]			[1.0]					[0]	[0]
V4...V7										
V8	[0]	[1]	[0]	[0]	[1]		[0]		[0.1]	[130]
V9										

Maintenance

Check the condition of the transmitter during regular inspections. If necessary, free the horn or rod from build-up. When cleaning the antenna, handle with care.

Repairs

Should the transmitter need to be repaired by Endress+Hauser, please send it to your nearest service station with a note containing the following information:

- An exact description of the application for which it was used
- The chemical and physical properties of the product measured
- A short description of the fault.

Special precautions must be observed when sending the transmitters for repair:

- Remove all traces of product.
- This is particularly important if the product can impair health, i.e. is corrosive, poisonous, carcinogenic, radioactive etc..
- 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 transmitter for repair.

8 Technical Data

General specifications

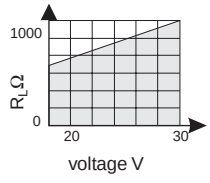
Manufacturer	Endress+Hauser
Designation	Micropilot FMR 130 (horn antenna), Micropilot FMR 131 (rod antenna)
Function	Smart transmitter for level measurement by pulsed time-of-flight (FTOF) microwave measurement
Operating frequency	approx 6 GHz ultra wide band system
Beam angle	Half-power beam angle: DN 150/6" and rod 23°; DN 200/8" 19°; DN 250/10" 15°
Pulse power	1 µW ERP
Reference conditions	as per IEC 770 (T_U = 25°C) or as specified
Other	CE Mark

Input characteristics

Signal	Time-of-flight of microwave pulse from antenna to medium and back again
Evaluation	Sampled envelope curve, 44 curves/s, with interference echo suppression by floating average curve and/or fixed target suppression
Update time	≥ 0.3 s depending upon software evaluation mode
Measuring range	max. 20 m (67 ft), with extended range max. 35 m (117 ft), see page 7 Accuracy – see tables, page 7 – max. accuracy ±1 cm; max. range ±2 cm; Digital resolution: 1 mm, see also analogue output Reproducibility: ± 3 mm Temperature coefficient: 0.02%/10 K of upper range-value for rod antenna negligible for horn antenna Process pressure: 1 bar 16 bar 40 bar (depends on 20°C 0% –0.4% –1.0% of value physics) 200°C 0% –0.2% –0.7% of value

Output characteristics

Analogue output

Output	4...20 mA, active or passive Signal under and overflow: min. 3.8 mA or max. 21.6 mA
On alarm	–10% (2.6 mA), +110% (22 mA) or last value, selectable
Electrical isolation	Electrically isolated from other circuits For versions with Ex-certificate the negative output terminal is connected to ground
Charateristics	Resolution: better than 0.1% (13 µA) Temperature drift: ± 0.1%/10 K of upper range-value (20 mA) Linearity: ≤ 0.1% of upper range-value (20 mA) Load dependency: ± 0.3%/100 Ω of upper range-value (20 mA)
Load (passive output)  	HART RS 485 active 250*...600 Ω 0...600 Ω active, EEx [ia] 250*...400 Ω 0...400 Ω passive R_K*..... (R_L – R_K*) passive, EEx ia R_K*..... (R_L– R_K* –R_{ISB}) R_K = HART = 250 Ω; RS 485 = 0 Ω and R_L = Load, see figure, R_{ISB} = impedance of any safety barrier * 0 Ω if Smart communication not used

Output characteristics (continued)

Local operation	Operating and display module FHV 160 Six keys, LC display, 4 ½-digit with VH-position and bar graph, Polycarbonate housing, IP 44, EEx ia IIC T4
Remote operation (options)	HART: with DXR 275 handheld terminal, or Commubox/laptop RS 485 interface: with adapter/PC card or interface FXA 675

Relay

Type	1 relay with potential-free changeover contact
Function	Selectable, alarm relay or limit relay For limit relay, maximum or minimum fail-safe mode selectable through swtich-on and switch-off points
On alarm	Alarm relay de-energises
Switching capacity	AC: 2.5 A, 250 V, 600 VA at cos φ = 1; 300 VA at cos φ ≥ 0.7 DC: 2.5 A, 100 V, 100 W,

Power supply

Versions	230 V (184...250 V), 50/60 Hz; 115 V (90...138 V), 50/60 Hz: 48 V (38...58 V), 50/60 Hz; 24 V (19...29 V), 50/60 Hz 24 VDC (18...30 V), residual ripple 1 V_{pp} within tolerances
Power consumption	AC: approx. 10 VA, approx. 20 VA with heating DC: approx. 6 W, approx.16 W with heating

Environmental conditions

Temperature ratings	Nominal range: -20…+70°C; with heating: -40…+70°C with certificate -20…+65°C; with heating: -40…+65°C Limiting range: -25 (-40)…+80°C; Storage: -40…+85°C Max. Temperature at antenna/counterflange: see figure page 45 for polypropylene 80°C
Process pressure	Dependent upon flange version and temperature, see Figure, page 45
Electromagnetic compatibility	Interference Emission to EN 61326, Electrical Equipment Class B Interference Immunity to EN 61326, Annex A (Industrial) and NAMUR Recommendation NE 21 (EMC) A standard installation cable is sufficient if only the analogue signal is used. Use a screened cable when working with a superimposed communications signal (HART).
Postal approval	R&TTE, FCC No. LCG FMR 13x
Explosion protection	EEx de [ia] IIC T2...T6/T2...T4 with FHV 160, see Notes on Safety, page 3 FM/CSA: Class I, Div. 1 & 2, Group A-D
Marine approvals	GL 96695 – 95 HH, Cat. G
Climatic class	Housing Class C, DIN 400 40, IEC 68
Ingress protection	Housing and antenna IP 68, DIN 40 050 for Pg16 version Housing: Salt spray test: 3 weeks to DIN 50 021
Vibration resistance	IEC 68 2-6/6.1990

Mechanical construction

Antenna	Dimensions: see Figures page 46 and 47, Horn antenna: Material: stainless steel 1.4571 or special coating Rod antenna: Material PTFE or approved sanitary plastic
Housing	Dimensions see Figures page 46 and 47 Material: Aluminium, sea-water resistant, chromated, powder-coated Weight: ca. 6 kg + flange
Flange	Standards: DIN, ANSI and JIS, material as horn antenna

Antenna extension tube FAR 10

Dimensions	see Figure 8.6, standard lengths = 100, 200, 300 and 400 mm
Material	stainless steel 1.4571, Hastelloy B4 2.4617 or C2 2.4610

8.1 Process connection

Pressure and temperature

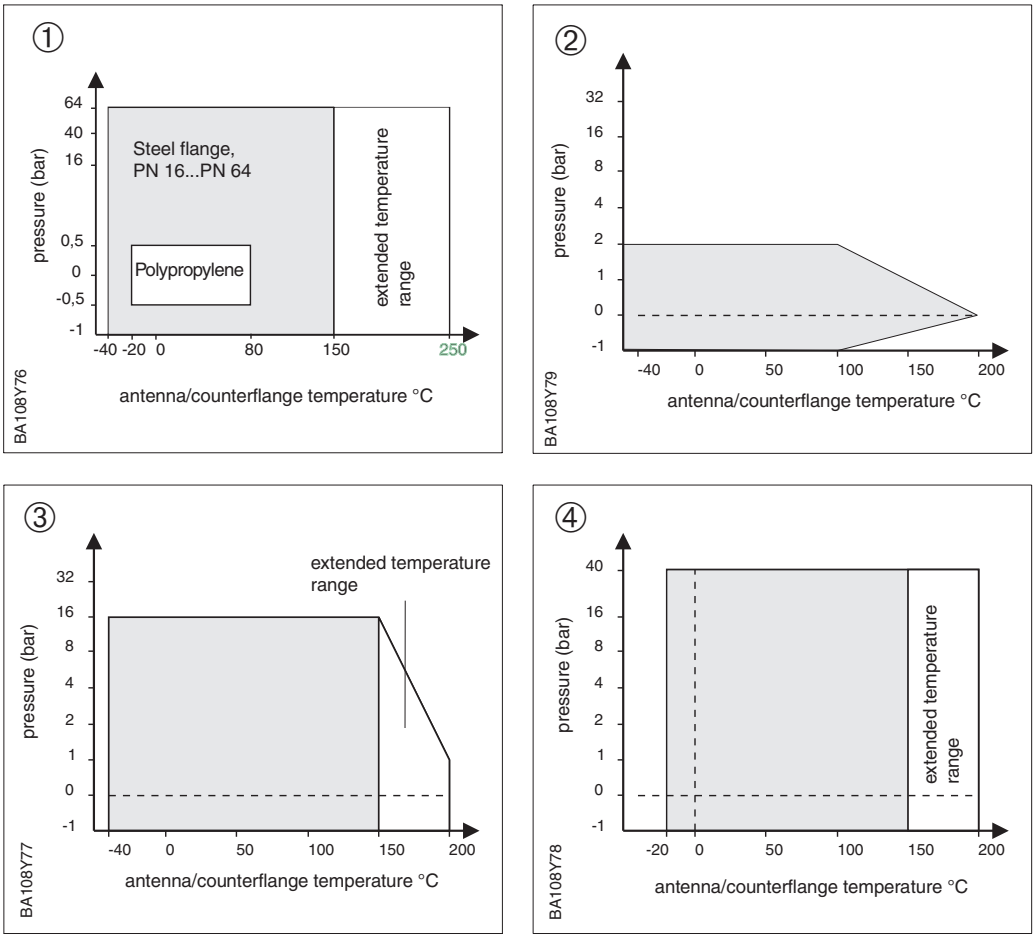
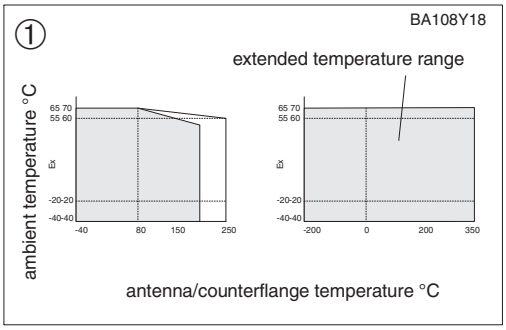


Fig. 8.1
Permissible process pressure as a function of flange version and antenna type
① *Horn antenna*
② *Process separation flange*
③ *Rod antenna, sanitary version*
④ *Rod antenna, standard version and with inactive length*

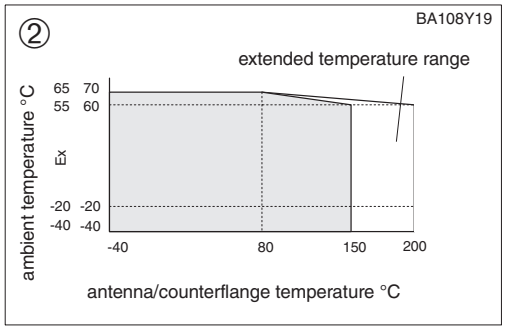
Ambient and antenna/counterflange temperature



The permissible temperature range for the antenna and counterflange is dependent upon the material of the antenna O-ring:

- Viton: –20°C...+150°C
- Kalrez: 0°C...+250 °C
- EPDM: –40°C...+150°C

Please enquire about applications above 150°C with high heat transfer rates to the flange, e.g. super- heated steam.



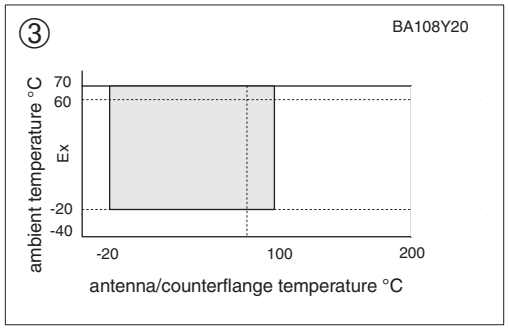
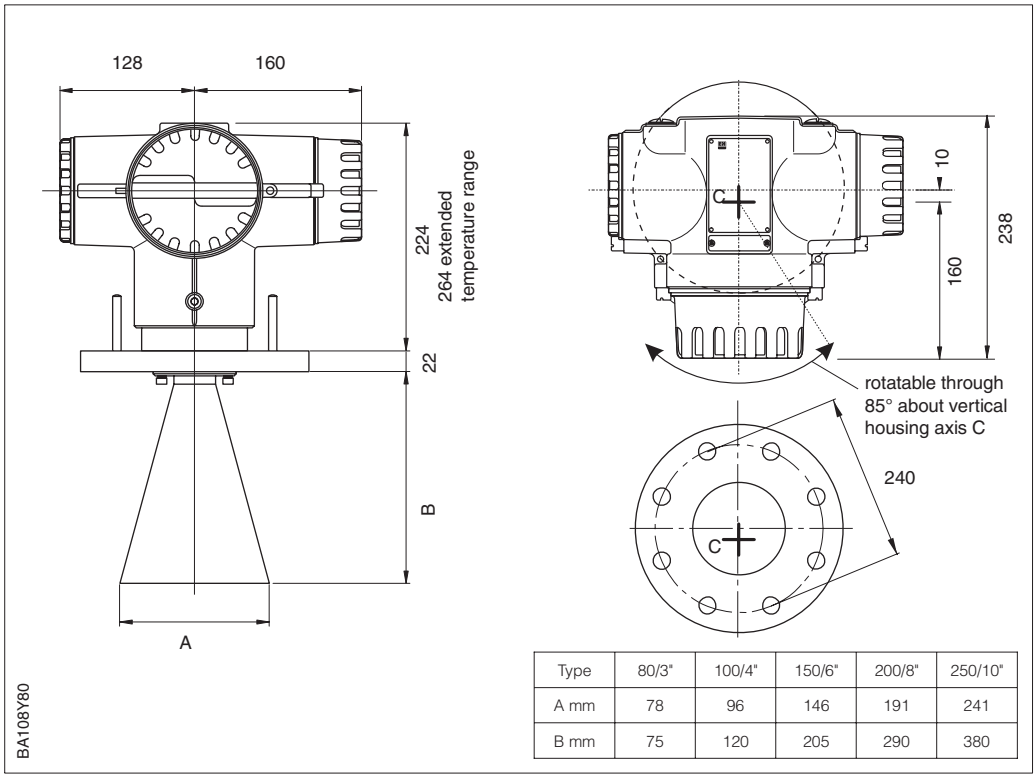


Fig. 8.2
Permissible ambient temperature as a function of antenna temperature
① *Horn antenna with steel flange*
② *Rod antenna*
③ *Polypropylene or process separation flange*

8.2 Dimensions

Horn antenna



Type	80/3"	100/4"	150/6"	200/8"	250/10"
A mm	78	96	146	191	241
B mm	75	120	205	290	380

Fig. 8.3
Dimensions in mm of hornantenna (with flange DN 150)
1" = 25.4 mm

Process separation flange

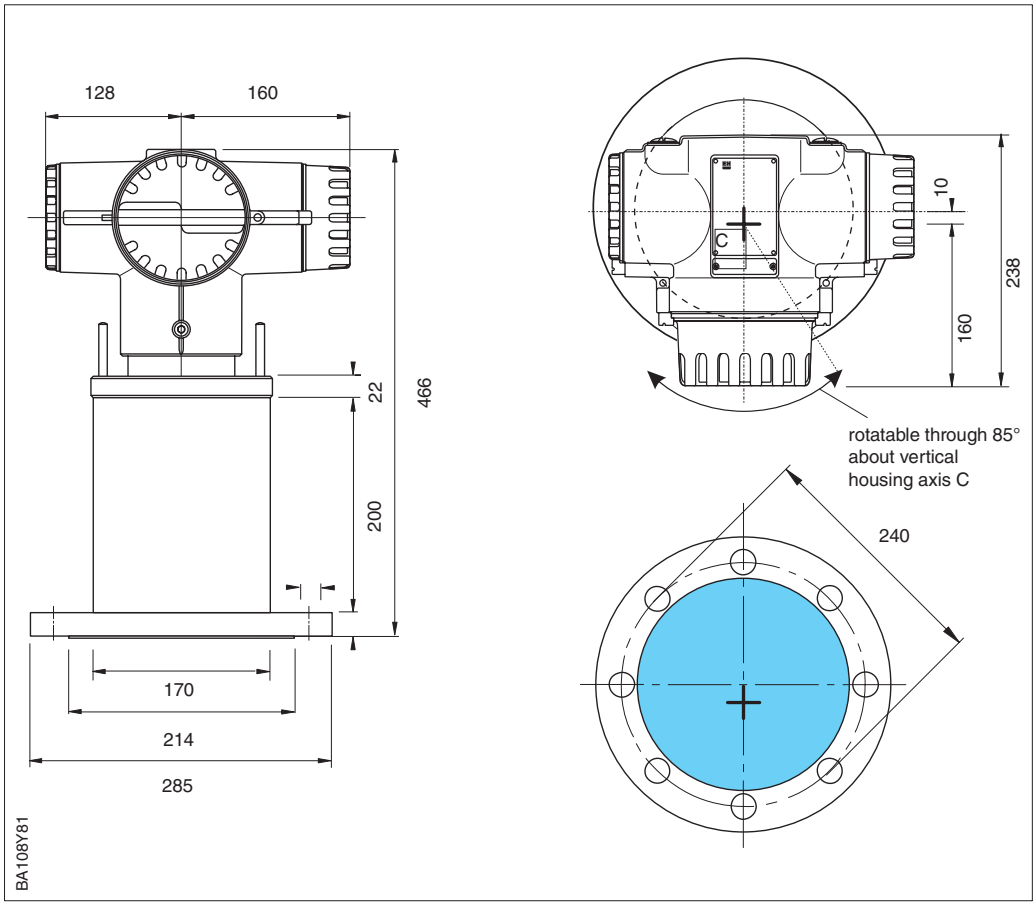


Fig. 8.4
Dimensions in mm, process separation flange
1" = 25.4 mm

Rod antenna

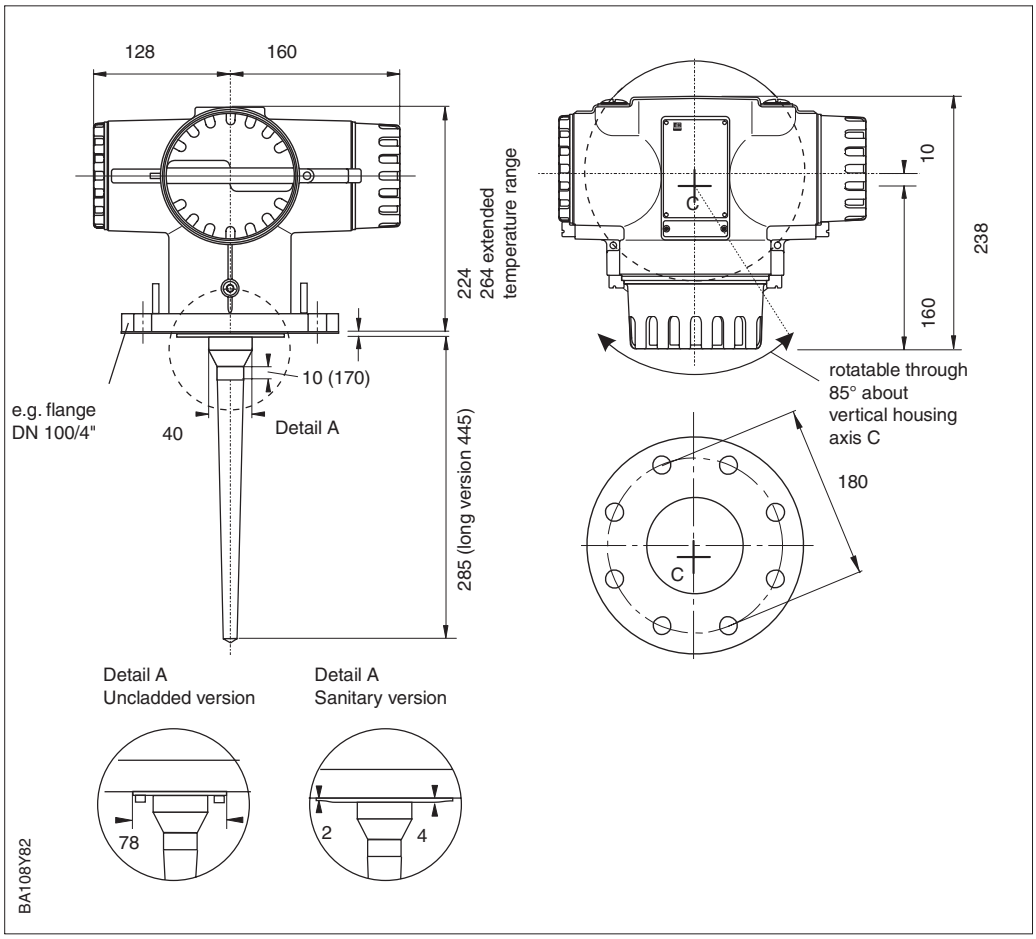


Fig. 8.5
Dimensions in mm of rod antenna (with flange DN 100)
1" = 25.4 mm

Rod antenna with inactive length

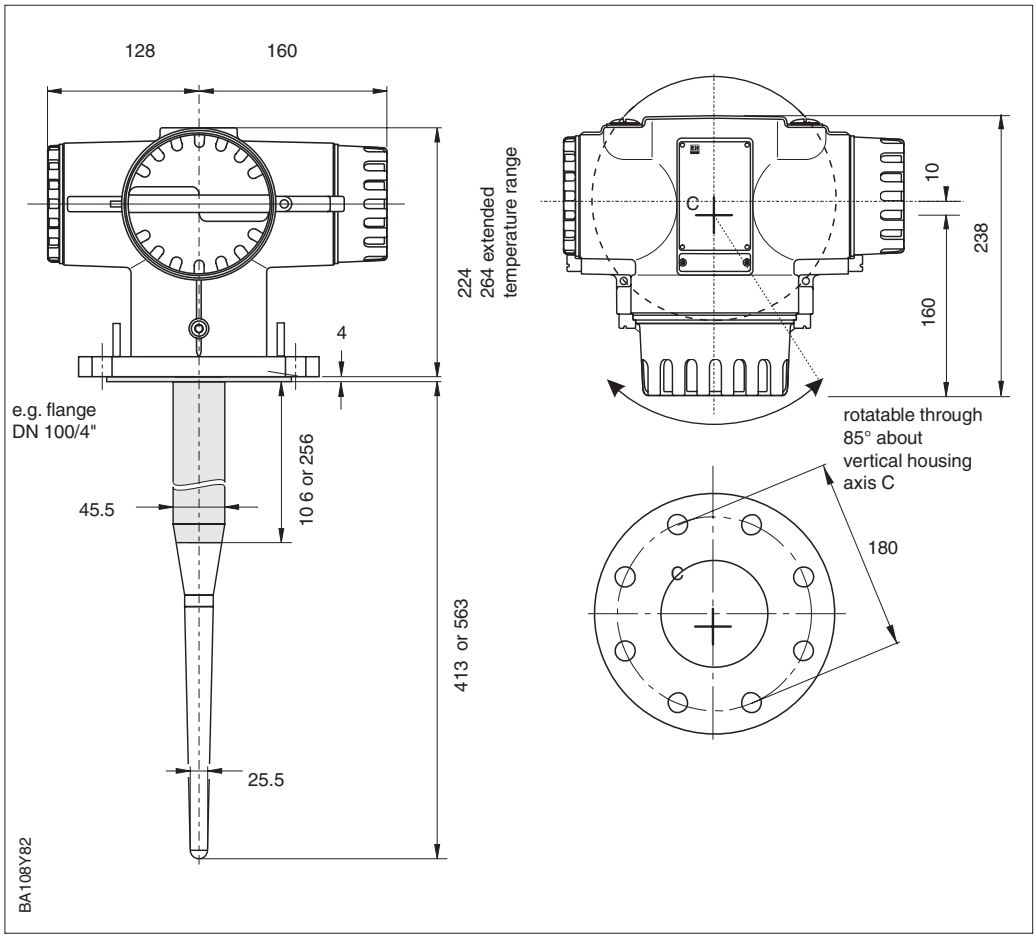


Fig. 8.6
Dimensions in mm of rod antenna (with flange DN 100)
1" = 25.4 mm

9 Operating Matrix

9.1 INTENSOR

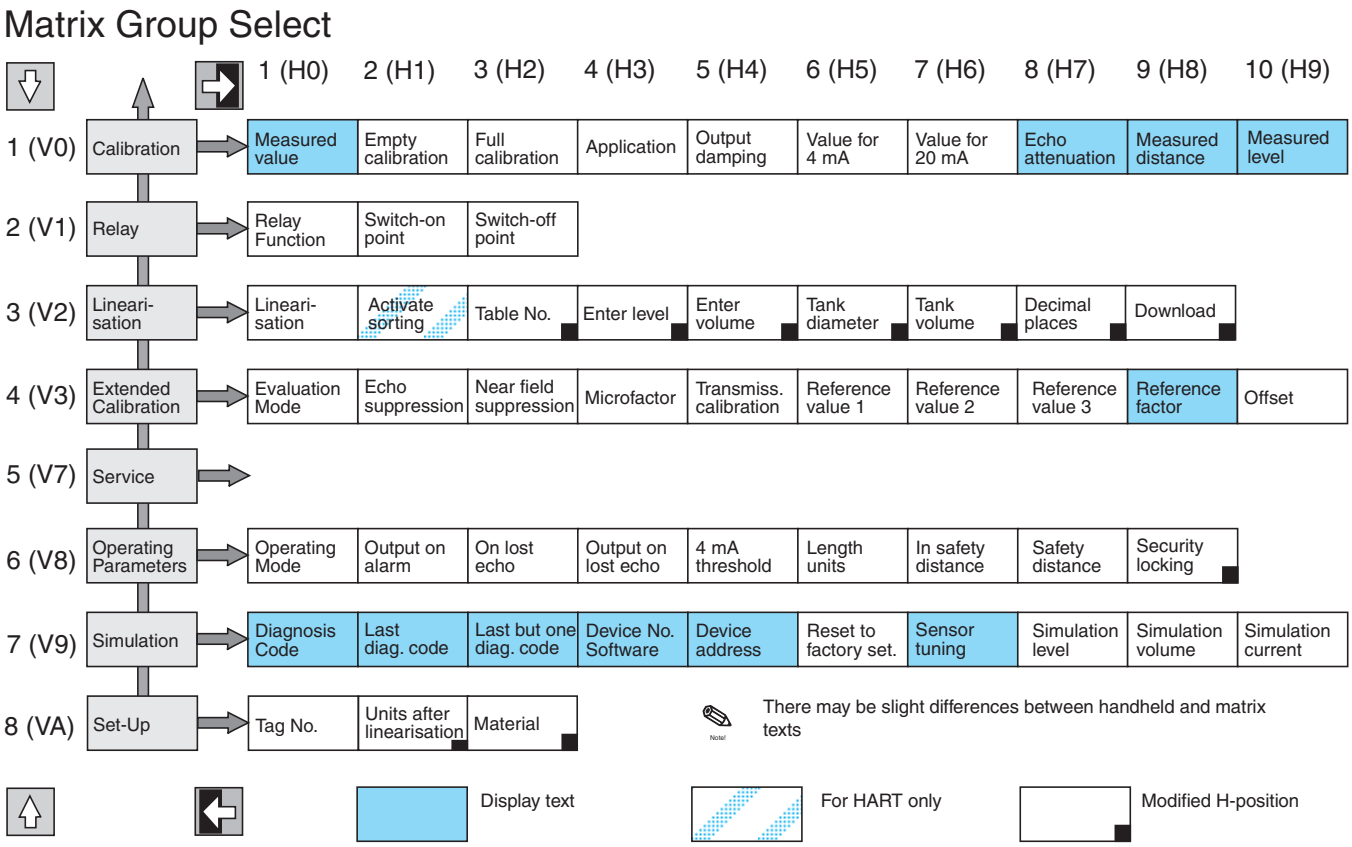
	H0	H1	H2	H3	H4	H5	H6	H7	H8	H9
V0 Calibration	Measured value customer unit (19)	Empty calibration [20/25] (19)	Full calibration [20/25] (19)	Application see p 39 [0] (39)	Output damping seconds [0] (28)	Value for 4 mA customer unit [0] (28)	Value for 20 mA customer unit [100] (28)	Echo attenuation Decibel (34)	Measured distance metre/feet (6)	Level metre/feet (19)
V1 Relay	Relay function 0: alarm 1: limit switch [0] (29)	Switch-on point V1H0 = 1 customer unit [0] (29)	Switch-off point V1H0 = 1 customer unit [100] (29)							
V2 Linear-isation	Linearisation 0: linear 1: cylindrical 2: manual 3: semi-autom. 4: clear [0] (25)	Enter level metre/feet (25)	Enter volume customer unit (25)	Line No. (25)	Tank diameter V2H0 = 1 metre/feet (25)	Tank volume V2H0 = 1 customer unit (25)	Decimal places 0....4 [1] (33)	Download 0: matrix 1: 0 + cust. TDT 2: 1 + fact. TDT [0] (33)		
V3 Extended calibration	Evaluation mode 0: factory TDT 1: FAC on 2: TDT on 3: FAC+TDT 4: service 5: empty echo 6: fixed echo [3] (40)	Echo suppression V3H0 = 4.5 metre/feet (40)	Near-field suppression metre/feet (22)	Micro factor (24)						Offset metre/feet [0] (20)
V4...V6	unused									
V7 Service	*	*	S/N-Ratio*	*	*	*	*	*	*	*
V8 Operating parameters	Operating mode 0: level 1: not used 7: simulation [0] (41)	Output on alarm 0: -10% 1: +110% 2: hold [1] (32)	On lost echo 0: warning 1: alarm 2: hold alarm 3: reset alarm [0] (32)	Output on lost echo V8H2 0: hold >0: L%/min. [0] (32)	4 mA threshold 0: off 1: on [1] (32)	Length units 0: metre 1: feet [0/1] (19)	Within safety distance 0: warning 1: alarm 2: hold alarm 3: reset alarm [0] (22)	Safety distance metre/feet [0.1] (22)		Security locking [130] (33)
V9 Simulation	Diagnosis code (36)	Last diagnosis code E = clear (36)	Last but one diagnosis code E = clear (36)	Device No. and software version (34)	RS-485 address (option) (13)	Reset to factory settings (41)	Service* 	Simulation level V8H0 = 7 metre/feet (41)	Simulation volume V8H0 = 7 customer unit (41)	Simulation current V8H0 = 7 mA (41)
VA Remote operation	Tag. No.			Units for V0H0 1...12: %, l, hl, m^3, dm, cm, qft (= ft^3), kg, t, ft, US-gal	Material			Measured value customer unit		

* For service, not described in this manual

Display field Factory setting

[X] = value of factory setting
(xx) = page where description is to be found

9.2 HART



Matrix	HART menu	Matrix	HART menu	Matrix	HART menu
	1 Calibration		**3 Linearisation**		**6 Operating parameters**
V0H0	1 Measured value	V2H0	1 Linearisation	V8H0	1 Operating mode
V0H1	2 Empty calibration		2 Sort table	V8H1	2 Output on alarm
V0H2	3 Full calibration	V2H3	3 Table No.	V8H2	3 On lost echo
V0H3	4 Application	V2H1	4 Enter level	V8H3	4 Output on lost echo
V0H4	5 Output damping	V2H2	5 Enter volume	V8H4	5 4 mA threshold
V0H5	6 Value for 4 mA	V2H4	6 Cylinder diameter	V8H5	6 Length units
V0H6	7 Value for 20 mA	V2H5	7 Cylinder volume	V8H6	7 Within safety distance
V0H7	8 Echo attenuation	V2H6	8 Decimal places	V8H7	8 Safety distance
V0H8	9 Measured distance	V2H7	9 Download	V8H9	9 Security locking
V0H9	10 Level		**4 Extended calibration**		**7 Simulation**
	2 Relay	V3H0	1 Evaluation mode	V9H0	1 Diagnosis code
V1H0	1 Relay function	V3H1	2 Echo suppression	V9H1	2 Last diagnosis code
V1H1	2 Switch-on point	V3H2	3 Near-field suppression	V9H2	3 Last but one code
V1H2	3 Switch-off point	V3H3	4 Microfactor	V9H3	4 Device/software addr.
		V3H4	5 reserved	V9H4	5 RS-485 address
		V3H5	6 reserved	V9H5	6 Reset
		V3H6	7 reserved	V9H6	7 Sensor tuning
		V3H7	8 reserved	V9H7	8 Simulation level
		V3H8	9 Factor ref. mode	V9H8	9 Simulation volume
		V3H9	10 Offset	V9H9	10 Simulation current

Conversion HART/INTENSOR

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