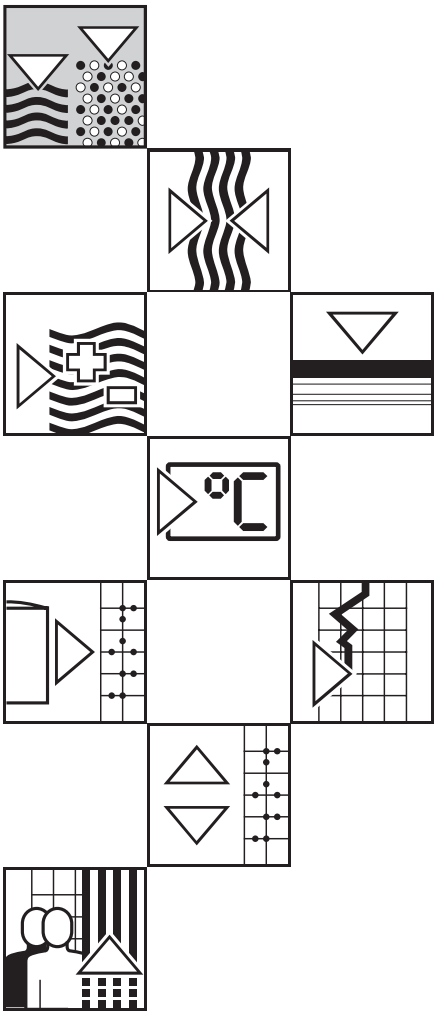
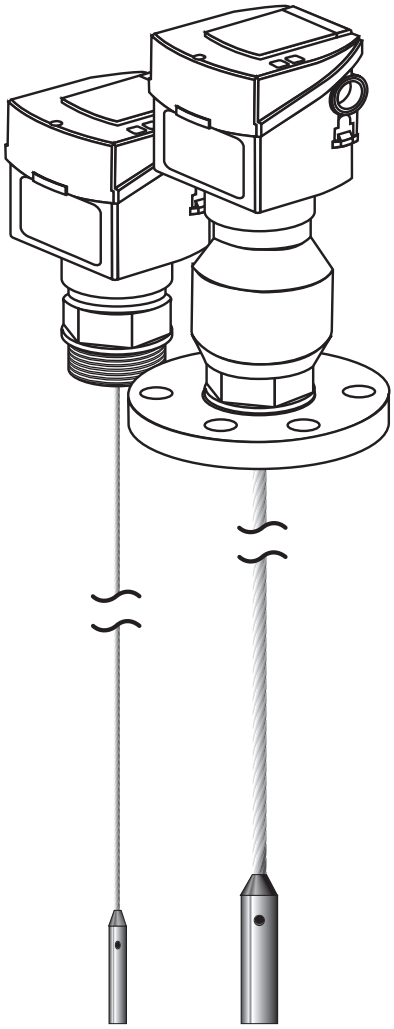
BA 199F/00/en/12.00
Software Version 2.x
52000584

Levelflex
FMP 232 E, 332 E
Microimpuls
Level Measurement

Operating Instructions





Endress + Hauser

The Power of Know How

Levelflex - Quick Setup

The Levelflex is delivered with a factory calibration so that, in general, the instrument operates without requiring further calibration. A calibration / modification to the application is required if:

1.) The probe is mounted in a nozzle which is > 100 mm high and / or ∅ > 100 mm
2.) The probe is shortened
3.) Distance from probe to internals > 400 mm

Calibration for internals with an empty silo

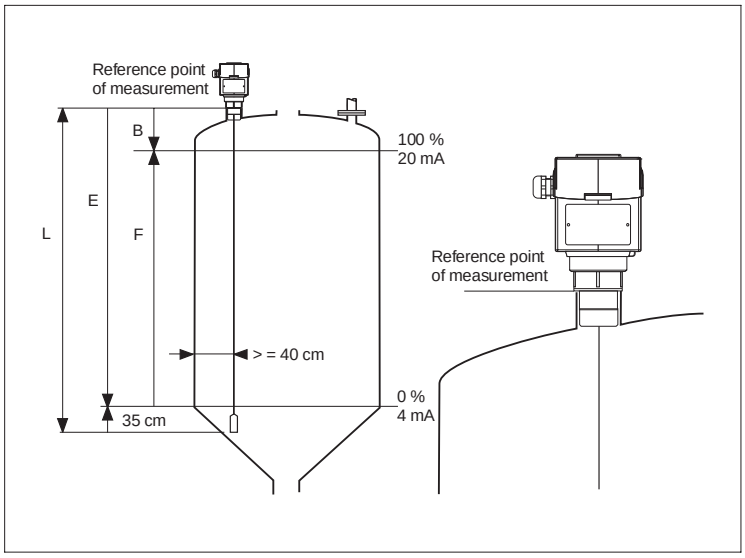
1. Without display or display removed, probe not shortened !

1.) Reset to default values:

press till red LED lights up, wait till red LED goes out (approx 30-60 s)

2.) Calibration

press till red LED lights up, wait till red LED goes out (approx 30-60 s)



L: Probe lenght ordered
E: Empty distance = zero (V3H5)
B: Blocking distance, min.: 30 cm (V3H8)
F: Full distance = span (V0H2)

2. With display and probe shortened

Entries into "matrix fields",
Move around the matrix with [V] and [H] Keys
Entering values with [+] or [–] Keys

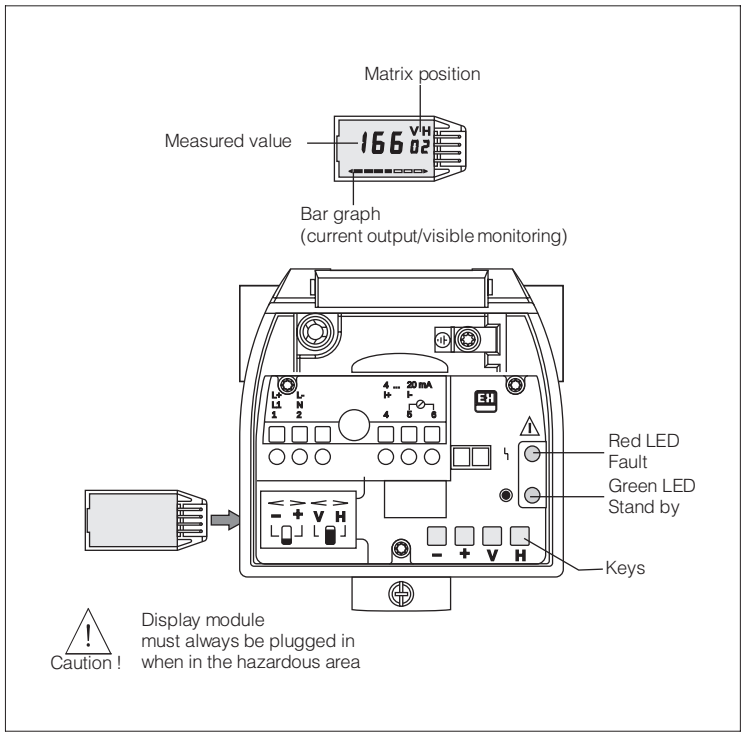
Activate function so that the display flashes, by pressing the [+] and [–] keys!

1.) Go to field **V9H5**
- Enter "333" while keeping the [+] key pressed down, (reset to default values)
- [V] and [H] press simultaneously

2.) Go to field **V3H0** (3x [V] press)
- Enter "**1**" (complete calibration for the whole length of the probe)
- Press [H] key

3.) Enter "**1**" in field **V3H1**

4.) Go to field **V3H5** (4x [H] press)
- Enter length of probe in m, otherwise value already entered: Press [+] or [–] key
- [V] and [H] press simultaneously, the Setup is now evaluated
- Wait until the bar graph no longer flashes, approx 30 - 60 s



If the length of the probe has been changed:

5.) Go to field **V3H5**
- Read off value for lower range-value

6.) Go to field **V0H1**
- Enter value from **V3H5** (zero adjustment)
- Press [H] key

7.) Enter measuring range (span) in m in field **V0H2**, (min. distance to process connection: 300 mm) Check value in field **V3 H8**

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Software History

Software version	Manual edition	Device and software no.	Software changes	Manual Changes
1.0	12.97 02.98	8010	Original software operable via Commuwin II software version 1.41 HART handheld DXR 275 software version 1.11 with DD version 1.0	
2.x	12.98	802x	Probe end detection for devices with ballast weight. Automatic setting of zero 350 mm above the top of the ballast weight. Lost signal detection Default F = 0.9 x E Adjustable blocking distance Persistence factor DD version 2.0 required for remote operation Upload/download between different versions not possible	Measuring length set in V3H5 E641 and delay time in V8H3 Earlier versions to 30 cm from top thread V3H8 V3H9

Notes on Safety

Approved usage

Levelflex FMP 232/332 is a top-mounted, compact four-wire level transmitter for the measurement of bulk solids. It meets FCC requirements for non-intentional radiators.

Before Levelflex is commissioned, it should be checked whether the silo can be filled beyond the the measuring range of the device, since the level is not correctly displayed above this point. If there is a danger of overfilling, then it is recommended that an overspill protection switch, e.g. Soliphant be also installed in the silo.

Installation, commissioning, operation

Levelflex 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 installation or 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. The manual must have been read and understood, and the instructions followed. Modifications and repairs to the device are permissible only when they are expressly approved in the manual.

Explosion hazardous areas

If the device is to be installed in an explosion hazardous area, then the specifications in the certificate as well as all national and local regulations must be observed. The instrument can be delivered with the certificates listed in the table below. The certificate can be identified from the first letter of the order code stamped on the nameplate.

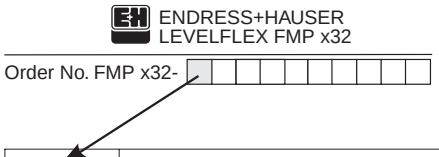
- Ensure that all personnel are suitably qualified
- Observe the specifications in the certificate as well as national and local regulations.

Warning!

- The Levelflex with a Dust-Ex approval is equipped either with a display or the display connector is covered. Neither the display not the cover may be removed when the device is installed in an explosion hazardous ares, otherwise there is a danger of explosion!!

Display module

Warning!



Code	Certificate	Explosion protection
A	none	none
F	BVS	Dust-Ex, Zone 10, ATEX II 1/3 D
M	FM DIP	Class II, Div. 1, Group E,F,G Non-incendive Class 1, Div. 2, Group A,B,C,D
U	CSA GP	none
S	CSA DIP	Class II, Div. 1, Group G and coal dust Non-incendive Class 1, Div. 2, Group A,B,C,D
T	TIIS	Dust-Ex

Table S.1
Certificates for applications in hazardous areas (in preparation)

Safety conventions

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 device 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

Levelflex FMP 232 E/332 E is designed for the continuous measurement of fine and powdery bulk solids with grain size up to 20 mm.

- e.g. sands, minerals, plastics, agricultural products, foodstuffs, pharmaceuticals and solid fuels.

For reliable measurement, the dielectric constant of the bulk solid ε_r must be 1.8 or more. The measurement is independent of the moisure content of the bulk solid or a change in product. Silo geometry, angled material surfaces and bulk solid properties also have no effect on the measurement under normal measuring conditions.

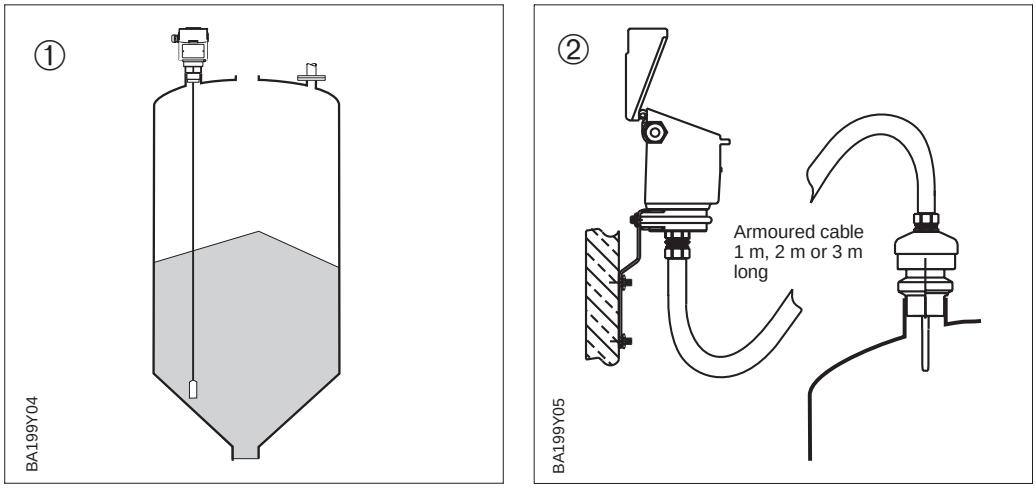


Fig. 1.1
① *Compact version, mounted in silo*
② *Version with remote electronics*

Versions

Levelflex is supplied in two versions: **FMP 232 E with 4 mm rope** and the **FMP 332 E with 8 mm rope**. These are available in the following variations:

Feature	Variations
Certificate	Non-hazardous areas or Dust-Ex
Transmitter type	Compact device Option: Electronic 1 m, 2 m, or 3 m connecting cable.
Housing	Plastic housing: PC/ABS, cable entry Pg 16, ½ NPT, M20x1.5 or ½ BSP (G ½ A)
User interface	With or without plug-in display
Power supply	18 – 36 VDC, 90 – 127 VAC or 180 – 250 VAC, Dust-Ex see p. 17
Output (active)	4...20 mA or 4...20 mA with HART
Process connection	1½ BSP (G 1½) or 1½ NPT – with corresponding threaded flange, if ordered.
Probe length	Up to 10 m for FMP 232 or 20 m for FMP 332
Probe material	Stainless steel for standard applications or carbon steel rope with abrasion-resistant coating
Probe end	Ballast weight or tie-down loop

The version at hand can be determined by checking the identification code on the transmitter nameplate against the product structure in Section 8.3.

Operation

Depending upon the output and the presence of the display, the transmitter is operated via keys, Endress+Hauser matrix or HART menu guidance. All possibilities are briefly described in the "Operation" chapter

1.1 Measurement principle

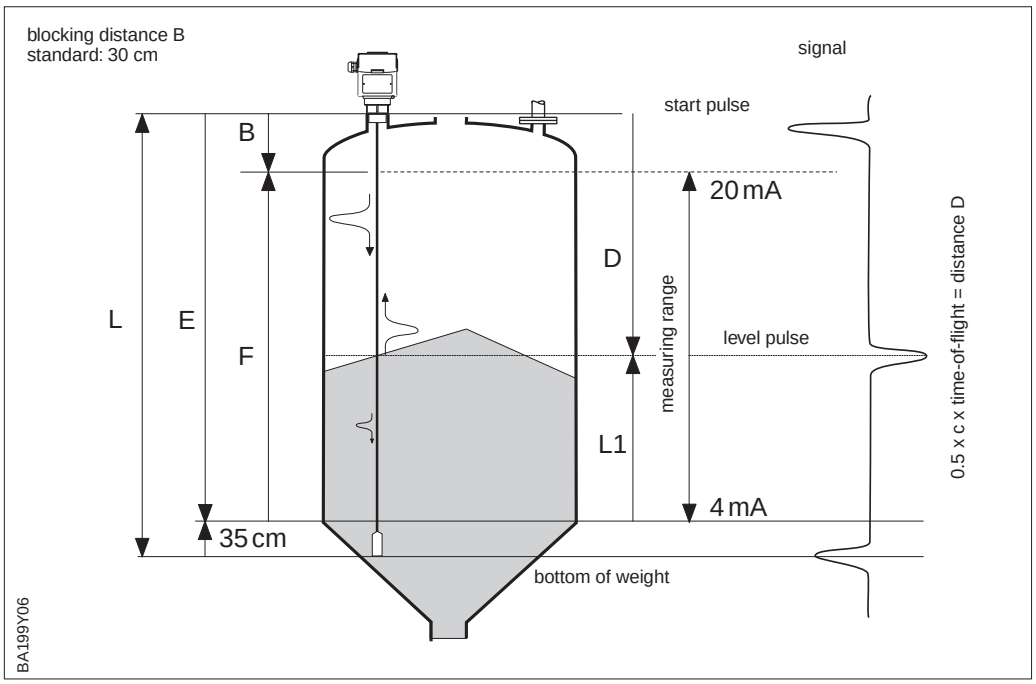


Fig. 1.2
Measuring principle and signal processing of Levelflex FMP 232 E/332 E.
All values are default settings

Levelflex is a "downward-looking" time-of-flight system, which measures the distance from the probe mounting (top of silo) to the material level. An electrical pulse is launched and guided down the probe rope, which acts as a surface wave transmission line.

When the surface wave meets a sudden change in dielectric constant, it is partially reflected. The reflected pulse travels back up the probe to the pulse sampler where it is detected and timed.

Input

Each point along the probe is sampled for its pulse reflection behaviour. The information accumulated over the sampling cycle is captured and passed onto the signal processing, which identifies the signal produced by the change in dielectric constant at the air/product interface. The distance D to the surface of the product is proportional to the time of flight of the pulse t:

$$D = c \bullet t/2,$$ whereby c= approx. velocity of light.

Since the empty distance E is known to the system, it is a simple matter to calculate the level L1.

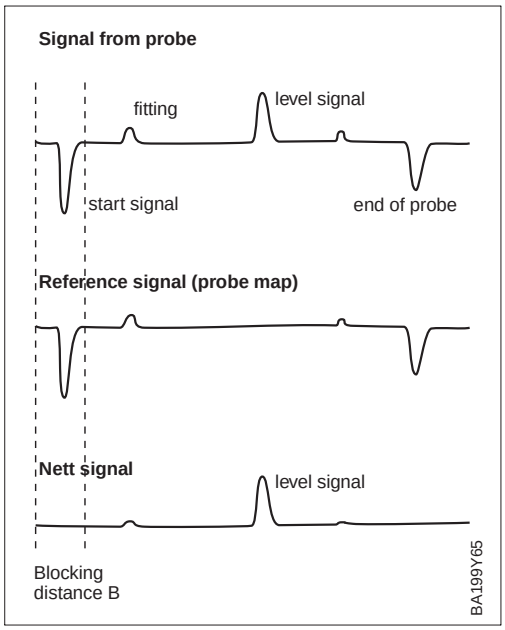
$$L1 = E - D$$

Output

Levelflex leaves the factory pre-calibrated:

- Default zero is set 35 cm above the bottom of ballast weight or tie-down loop. The distance from the top thread of the process connection to the zero point is the default empty distance E (zero).
- Default span F (span) is normally 90% of the empty distance, however, it may not extend into the blocking distance B. If this is the case, the default span is set to E – B, where B is min. 30 cm as standard. The blocking distance is the zone where the pulse is launched and level signals cannot be detected

For versions with current output these points correspond to 4 mA and 20 mA respectively, for digital outputs and the display, 0% and 100% level. The range and units may be re-adjusted locally at the display or remotely via the communications interface.



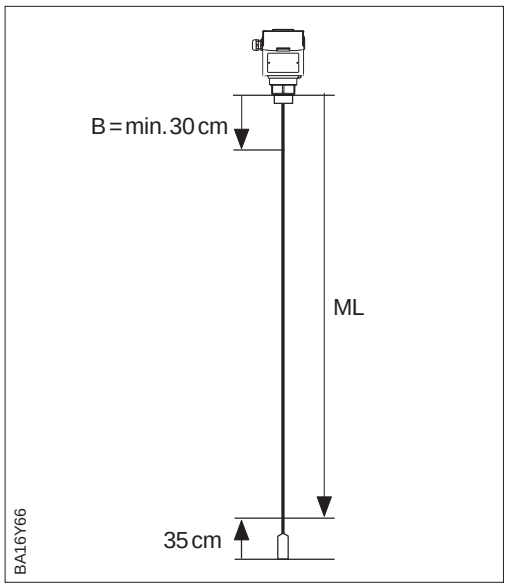
Probe mapping

Levelflex senses discontinuities not only within its surroundings but also within the probe itself. This means that each probe has a characteristic signal spectrum, even when it is operating under ideal conditions. This spectrum is recorded before delivery and stored as a reference signal, the so-called factory probe map.

The factory probe map is used for signal evaluation in plug and play operation. The user can, however, record his own map to adapt the probe to the silo:

- A customer map is made in the empty silo and records over the entire length of the probe.
- A partial map records only to the distance entered, then uses the factory map for the rest of the probe.

Levelflex takes the signal from the probe and subtracts from it the probe map. The resulting signal is used to identify the level signal, see figure.



Measuring length

The distance from the top thread to the end of the zone in which signals can be reliably detected is the measuring length ML. This is automatically calculated when a probe map is made by subtracting 35 cm from the position of the end of probe signal. When delivered from the factory, the empty distance E is set equal to ML.

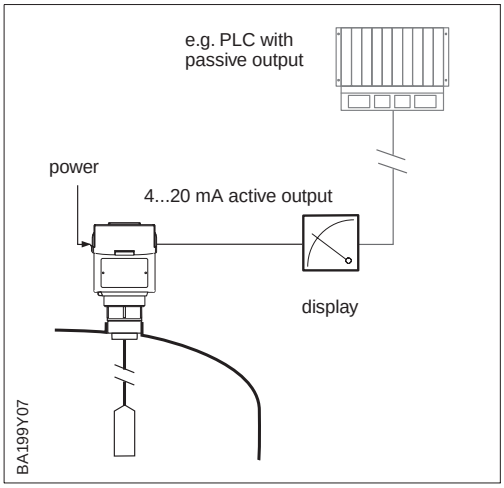
- If a signal is found beyond the measuring length in the vicinity of the probe end, it is interpreted as the end of the probe. Levelflex displays zero level in V0H0.

The measuring length is displayed in V3H5. It can also be manually reduced, e.g. after a customer probe map for probes with tie-downs or when the probe has been shortened.

1.2 Measuring System

4...20 mA output

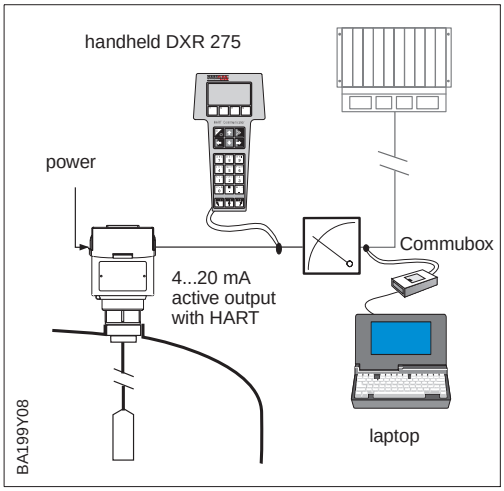
Version with active current output and on-site operation.



4...20 mA with HART

Version with active 4...20 mA current output and superimposed HART digital signal.

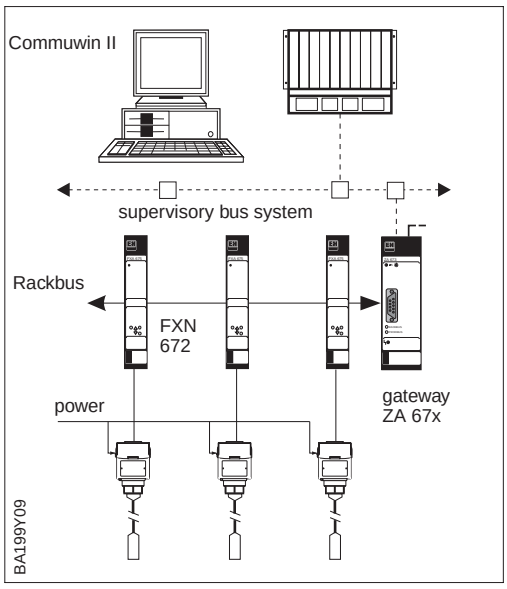
- Can be operated either on-site or remotely with the HART handheld DXR 275.
- Alternatively, a personal computer, Commuwin II and Commubox FXA 191 can be used.



System integration via HART

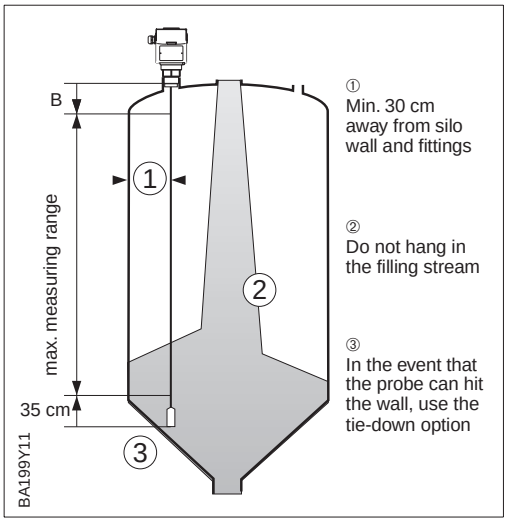
Several Levelflex transmitters (or other devices) with HART interface can be individually connected to the Rackbus via an FXN 672 interface module. The link to a supervisory bus system or a personal computer is then made by a gateway.

- Gateways are available for MODBUS, PROFIBUS, INTERBUS, CONTROLNET etc.
- Both on-site and remote operation are possible.



2 Installation

2.1 Mounting position

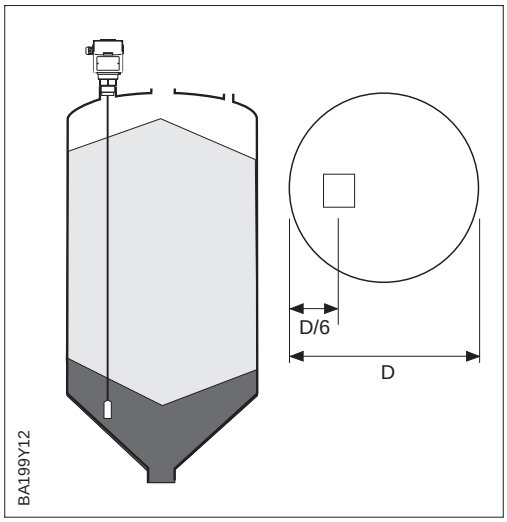


General notes

Levelflex is mounted at the top of the silo, ideally in a 1½" socket. It requires that the probe rope is hung, *fully extended*, across the entire distance where level measurement readings are desired.

- Check that the silo roof and probe can withstand all forces generated at the chosen position, see Chapter 9.2.
- Hang the probe at least 30 cm away from the silo wall or any structural element.
- For concrete silos, the distance from the wall must be at least 40 cm.
- Do not hang it in the filling stream.

In the event that the probe can only be installed near to a wall (<30 cm), then the tie-down loop option is recommended.



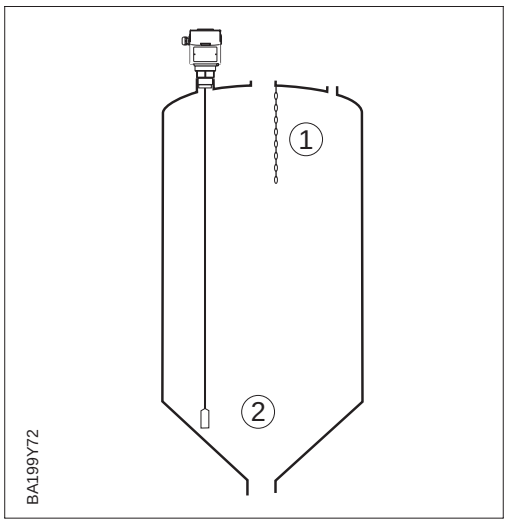
Mounting position

In order to measure level as accurately as possible despite material mounds and funnels, a mounting position roughly 1/6 of the silo diameter, but no closer than 30 cm away from the wall is recommended.

Since high lateral forces may occur at this position, particular attention must be paid to the pull forces acting, see Chapter 9.2.

Caution!

- For technical reasons, a position in the dead centre of the silo is not recommended for metallic tanks.



Electrostatic discharge

- For applications subject to heavy electrostatic discharges it is recommended that a short grounding chain ① be hung in the filling stream.
- If electrostatic discharges still influence the measurement, the persistence filter can be increased, see Chapter 7.5.
- See also trouble-shooting in Chapter 7.3

2.2 Mounting requirements

After a suitable mounting position has been selected, it should be checked whether the following requirements are satisfied at the mounting point:

- The silo roof or mounting point can withstand the maximum load on the probe (= breaking strength of the probe rope).

FMP 232 E – 1.4301	FMP 232 E – coated	FMP 332 E – 1.4301	FMP 332 E – coated
10.5 kN	12.5 kN	40.0 kN	43.5 kN

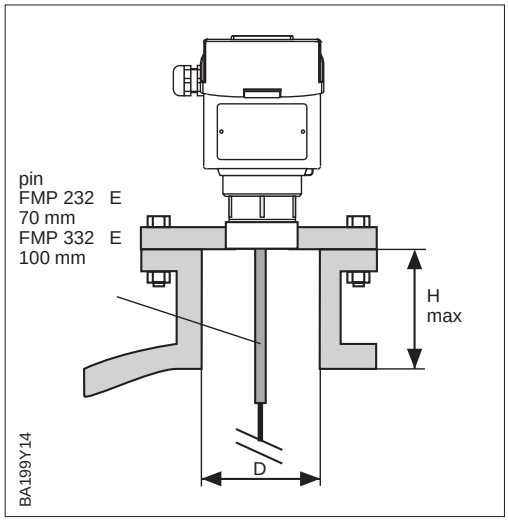
- The probe rope can withstand the forces generated by the product, e.g. during filling and emptying, see Chapter 9.4.
- The temperature requirements at the mounting point and pressure requirements on the process connection are met, see below and Chapter 9.5.
- The probe cannot contact any fittings during measurment.

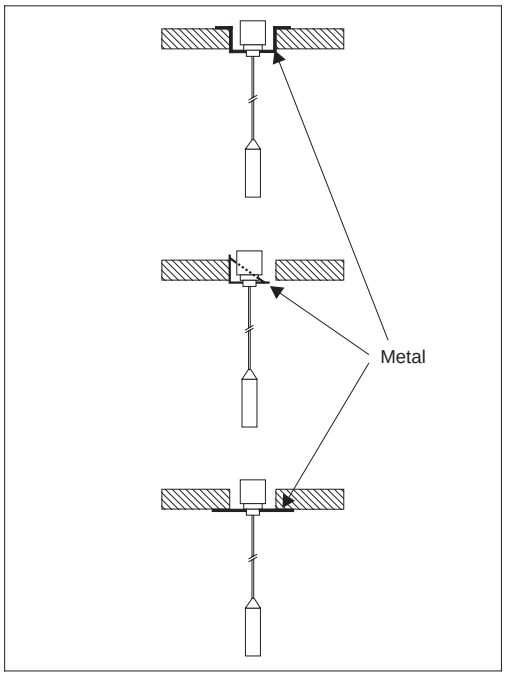
Nozzle mounting

The ideal mount is a 1½" socket, but a nozzle may also be used, provided the following conditions are met.

D	50 mm	80 mm	100 mm
H_{max}	≤ 50 mm	≤ 80 mm	≤ 100 mm

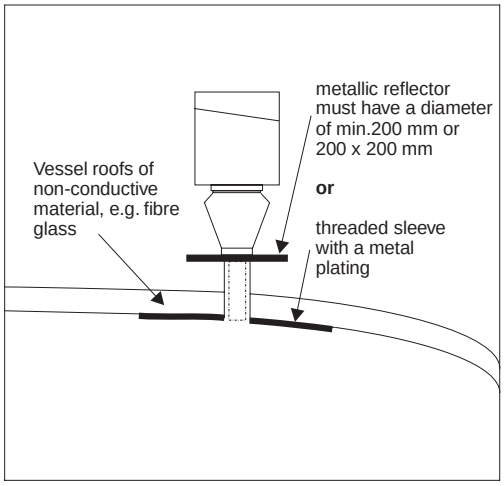
To prevent the probe from touching the side wall of the nozzle, the bolt at the beginning of the rope must project into the vessel.





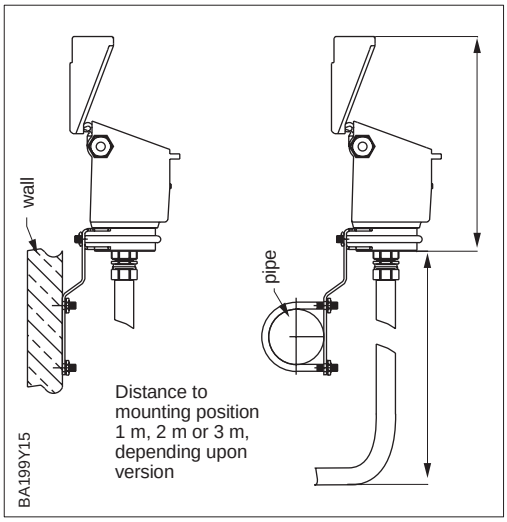
Installation in Concrete Bunkers

If the Levelflex is to be installed in a thick concrete bunker, for example, then the front face of the process connection should be flush with the inside of the bunker roof.
The figure shows installation examples.



Installation in plastic or wood silos

The sensor must be installed in a metal part to act as a reflector when it is installed in a plastic or wood silo. This can be a flange from DN 100mm/4" or larger, or a reflector similar to that shown in the following picture:



Ambient temperature

The ambient temperature at the probe head may not exceed +70 °C. For the Dust-Ex version the limit is +60 °C (check the certificate)

- For higher ambient temperatures, the remote mount option allows the head to positioned at a cooler location up to 3 m away.
- This option should also be used for process temperatures above 90 °C at the process connection.
- For exposed or sunny locations a protective hood is recommended. Order No. 942665-0000

Process temperature

The temperature of the process at the mounting position may not exceed +120 °C.

2.3 Shortening probes with a ballast weight

The rope can be easily shortened as follows:

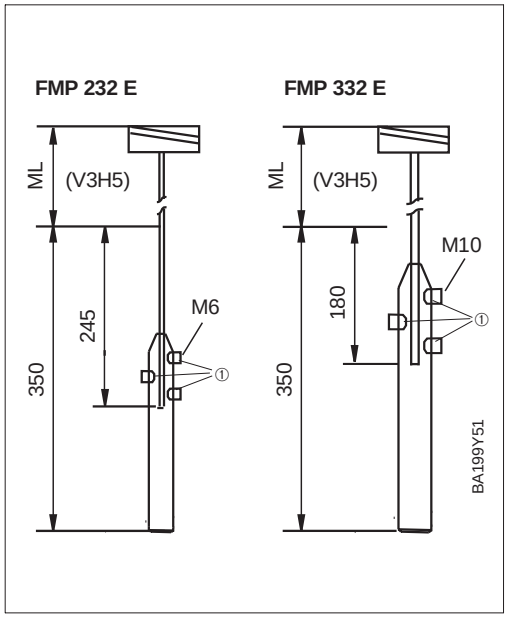

Caution!

Caution!
- The Levelflex must be recalibrated once the probe rope has been shortened.
- For instruments with no display or which are not remotely operated, then they must be calibrated for internals after mounting when the silo is empty.
- For greatest accuracy, a calibration is carried out for internals for instruments with a display or which are remotely operated. The length in V3H5 can otherwise be reduced. The values in V0H1 (zero point) and V0H2 (span) must then also be adjusted.

Rope with weight

Shorten the probe rope as follows:

- Loosen set screws ① and withdraw rope from weight – if necessary, use hot air to loosen the loctite screw safety
- Calculate and mark off the new length: Rope length = meas. length (ML) + X, where X = 245 mm for FMP 232 E
  180 mm for FMP 332 E
- Wrap adhesive tape around the cutting point to prevent splicing
- Neatly *saw* off excess rope (don't clip)
- Fully insert rope into weight bore – check against bore mark
- Apply Loctite screw safety (e.g. Loctite 243) to set screws
- Tighten set screws, top first
- Wait a 1 hour then tighten off: FMP 232 E: 5 Nm, FMP 332 E: 15 Nm
- Install probe, see Chapters 2.4 or 2.5.
- Reconfigure probe, see Chapter 5.2/6.3.



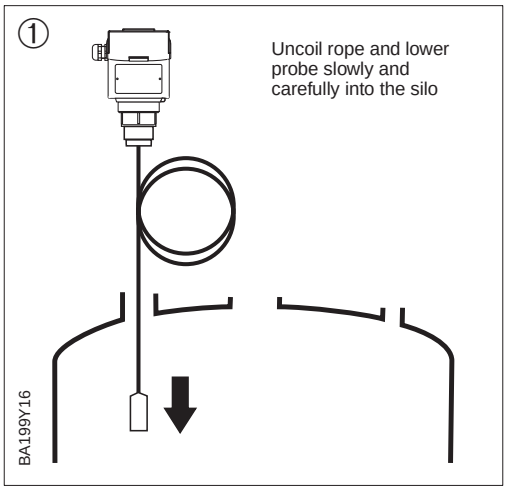
2.4 Mounting probes with ballast weight in an empty silo

Caution!

- If there is a risk of electrostatic discharge from the product, then both process connection and rope must be earthed before the probe is lowered into the silo.


Caution!

Levelflex can be screwed into a threaded socket or flange. Proceed as follows:



Insert cable

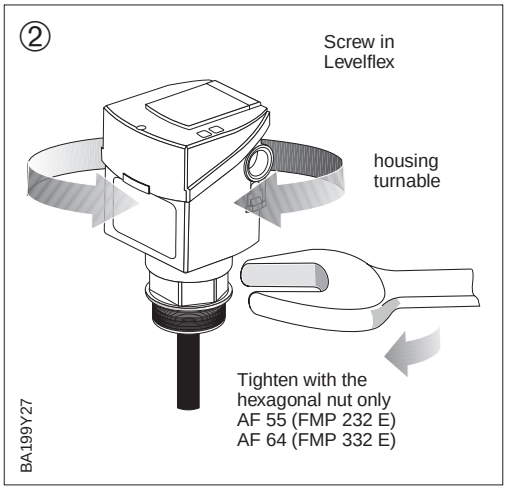
Uncoil rope and lower it slowly and carefully into the silo.

- **Do not kink the rope**
- Avoid any backlash, since this might damage the probe or the silo fittings.

Note!

- Flanges: bolt the flange in position before inserting the cable into the silo.
- For flange mounting: if a seal is used, be sure to use unpainted metal bolts to ensure good electrical contact between probe flange and process flange.


Note!



Screw down

Screw the Levelflex into the process connection or to flange.

- Turn with the hexagonal nut only: torque 10...20 Nm
- Levelflex functions in metal, concrete and plastic silos. When installing in metal silos, take care to ensure good metallic contact between the process connection and silo.

2.5 Mounting probes with ballast weight in a partially full silo

It is not always possible to empty a silo which is already in operation.
Because the probe can be turned in the threaded boss, it can also be mounted when the silo is only partially filled.
In order to avoid problems when Levelflex is mounted into a partially full silo, the following measures should be taken:

- Mount when the silo is as empty as if possible : *there must be at least 1 metres clearance between the mounting point and the product surface.*

After mounting, a partial probe map must be made, Chapter 6.1, should the installation conditions require it. This can be done on-site with the display module or remotely using Commuwin II or the HART handheld. It is not possible to make a partial map with the keys alone.

Caution!

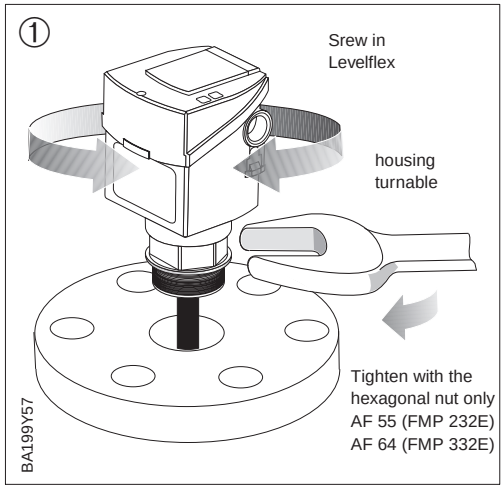
Caution!
- If there is a risk of electrostatic discharge from the product, then both process connection and rope must be earthed before the probe is lowered into the silo.

Screw into flange

If appropriate, screw the Levelflex into the threaded flange.

- Turn with the hexagonal nut only: torque 10...20 Nm
- For flange mounting: if a seal is used, be sure to use unpainted metal bolts to ensure good electrical contact between probe flange and process flange.

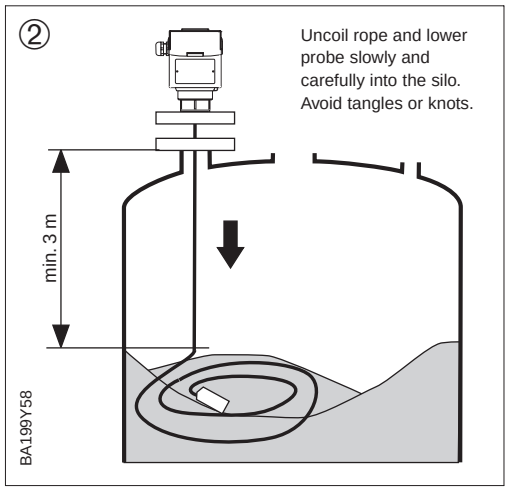
When installing in metal silos, take care to ensure good metallic contact between the process connection and silo.



Insert cable

Uncoil rope and lower it slowly and carefully into the silo.

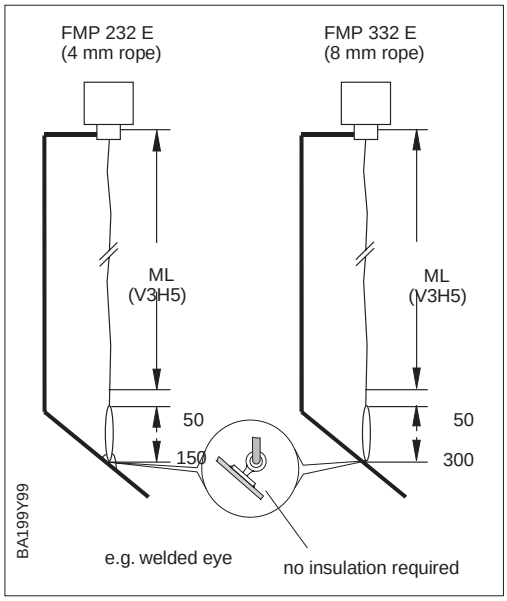
- Avoid any backlash, since this might damage the probe or the silo fittings.
- If possible, make a visual check to see that the rope has not tangled or is lying such that it can knot when the level falls. This is particularly important if a flange was not used. Re-insert the probe if necessary.
- Screw the flange to the counterflange on the nozzle.



Note!

Note!
- This mounting method requires a probe with ballast weight.
- Before full accuracy is obtained, the probe rope must hang, *fully extended*, across the entire distance where level measurement readings are desired.

2.6 Securing probes with loops in empty silos



The probe must be anchored as close as possible to the bottom of the silo, e.g. to a suitably dimensioned welded eye.

Caution!
- Do not anchor to another rope, as this may lead to incorrect measurement.
- Shortening the loop as possible.
- Secure the rope loosely and under no circumstance should it be under any strain otherwise the tensional force will be too high!

Caution!

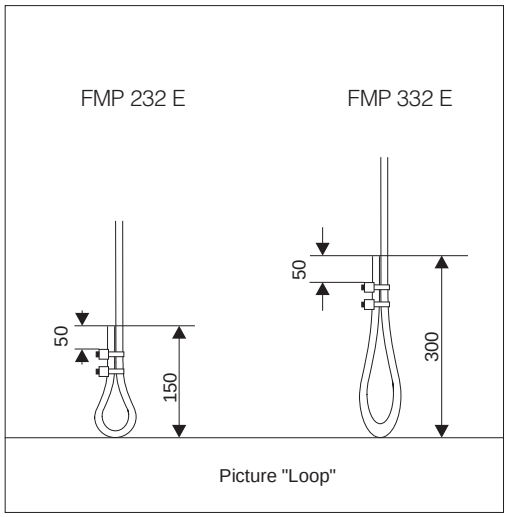
Size of the loop

- max. 150 mm for FMP 232 E or
- max. 300 mm for FMP 332 E.

Mounting

Mount the probe as follows:

- Remove the rope clamps.
- Mount the Levelflex in the process connection. Pull the loose rope through the eye. Do secure it under tension!
- Make the tie-down as small as possible according to the loop shown in the fig..
- Secrure the 2 rope clamps at a distance of 20-30 mm.
- Secure the screws using Loctite screw adhesive (z.B. Loctite 243) apply the following torque:
  FMP 232 E: 2...2.5 Nm,
  FMP 332 E: 5...6 Nm.



Caution

- Tighten up the clamping screws after approx. 1 hour. Cut off the excess rope approx. 50 mm above the upper rope clamp.

Caution!

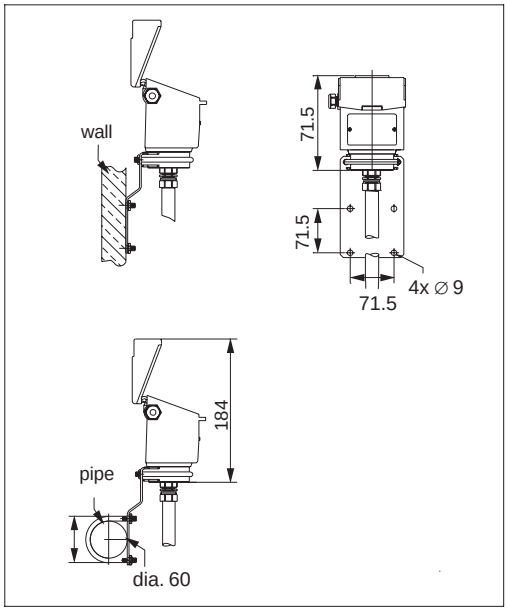
- Measure off the length of the rope that has been cut and write the value in the cover.
- After the electrical connection, the value in matrix fieldV3/H5 must be reduced by this cut length. Then carry out a probe map.

2.7 Mounting the remote version

The remote version comprises the probe and a separate housing with connecting cable. When ordered complete, the components are already connected on delivery.

Mount probe and housing

- Install the probe as described in Chapters 2.3 – 2.6
- Mount the housing on the wall or the pipe as indicated in the figure..



3 Connection

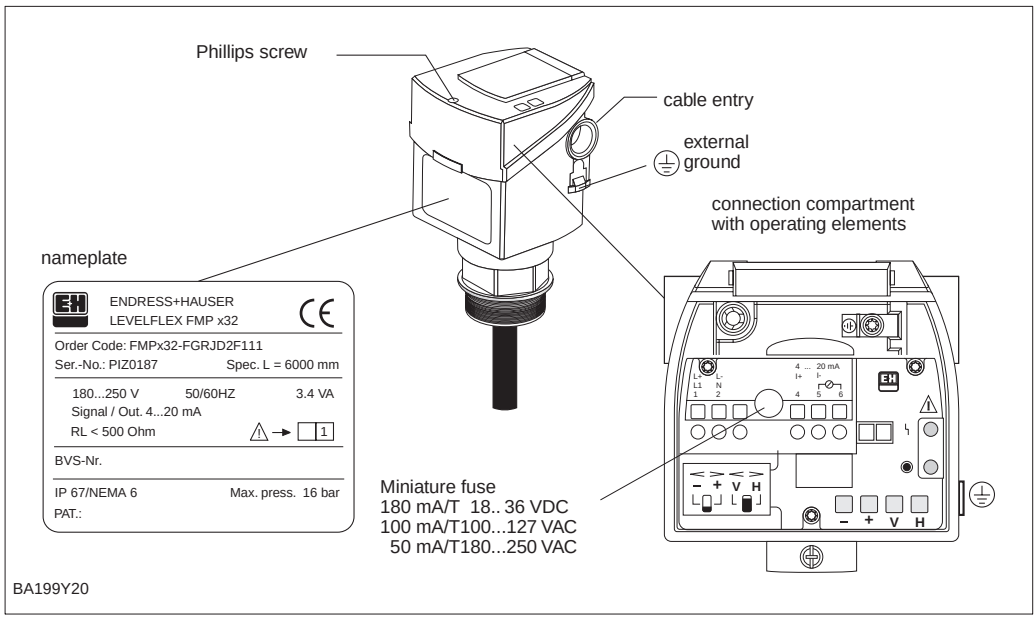


Fig. 3.1
Levelflex terminals and nameplate

General notes

Levelflex is a four-wire transmitter with active 4...20 mA analogue output and optional HART signal. Note the following before connecting up the device:

- Turn off the power.
- Connect the external ground terminal of the transmitter to the plant grounding system.

Caution!

In order to avoid fault currents and the resulting display errors, the power, output and probe circuits are galvanically isolated from one another.

- The power supply rating must correspond to that on the nameplate.
  – For the DC version, the power supply must also be safely isolated.
- The current output may be connected only to devices that have safely isolated power supplies. You can connect:
  – one potential-carrying follow-up device or
  – one or more potential-free devices, provided the load does not exceed 500 Ohm.

Hazardous areas

If the measuring system is to be installed in a hazardous area, local regulations, national guidelines and the specifications in the certificate are to be observed. (look XA 082Fa3)

- The specified cable gland must be used.
- Certified probes can be used in Dust-Ex Zone 10 (or 20) areas, the housings in Dust-Ex Zone 11 (or 22) areas.

Certified transmitters have an intrinsically safe probe circuit. The electronics and current output are galvanically isolated from the probe circuit. Neither safety barriers nor an intrinsically safe power supply are required.

Connection

Connect up the Levelflex as follows:

- Loosen Phillips screw and open housing
- Thread cable through cable gland
- Connect up according to the table below
- Close housing: tighten Phillips screw and cable gland.

3.1 Wiring examples

The following figures show wiring examples for typical applications. In general:

Caution!

- Any screening on the signal line should be grounded at both ends. If this is not possible, ground at the sensor end.
- For applications in hazardous areas, the signal line may be grounded at the sensor end only. Observe the instructions in the certificate.

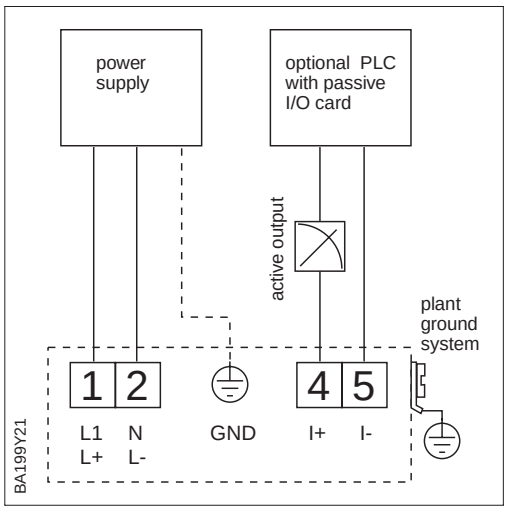
4...20 mA output

Transmitter with active 4...20 mA output.

- Maximum load 500 Ω
- Power supply: 18...36 VDC
  90...127 VAC, Ex: 104...127 VAC or
  180...250 VAC Ex: 207...250 VAC

Use standard installation cable for both power and signal lines.

- Core cross-section max. 2.5 mm^2 with ferrule

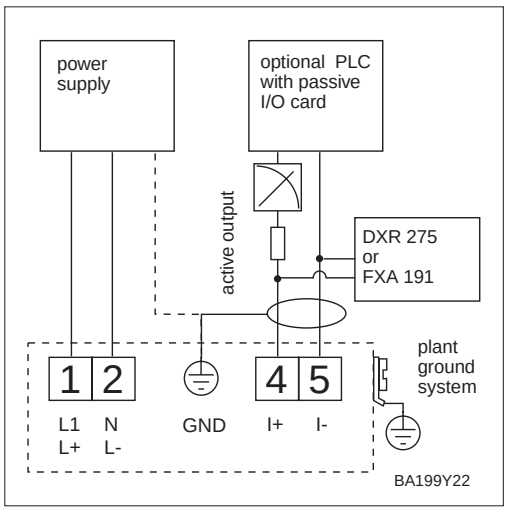


4...20 mA with HART

Transmitter with active 4...20 mA output and superimposed HART digital signal.

- Minimum load 250 Ω
- Maximum load 500 Ω
- Power supply: 18...36 VDC
  90...127 VAC, Ex: 104...127 VAC or
  180...250 VAC Ex: 207...250 VAC

Use standard installation cable for the power line and twisted, screened pairs for the signal line.

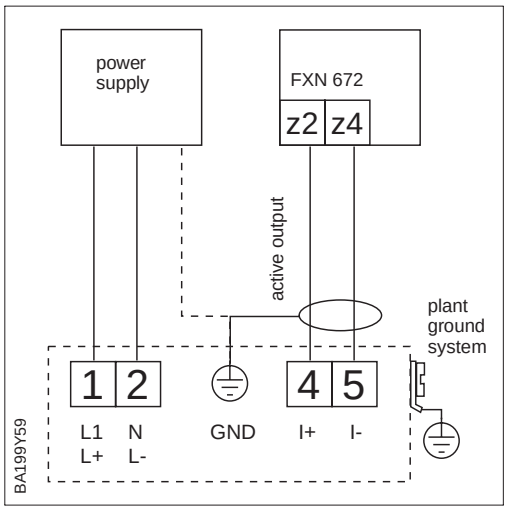


System integration via 4...20 mA with HART

Transmitter with active 4...20 mA output and superimposed HART digital signal. Integration via FXN 672 interface board.

- Minimum load 0 Ω
- Maximum load 200 Ω
- Power supply: 18...36 VDC
  90...127 VAC, Ex: 104...127 VAC or
  180...250 VAC Ex: 207...250 VAC

Use standard installation cable for the power line and twisted, screened pairs for the signal line.



4 Operation

4.1 On-site operation

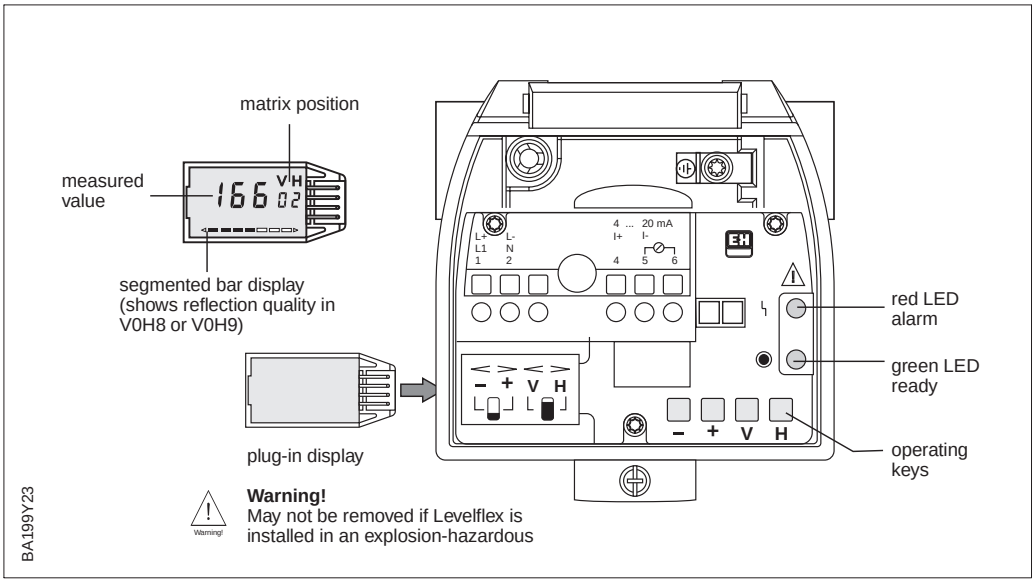


Fig. 4.1
Operating elements of the Levelflex FMP 232 E/332 E

The operating elements are located within the transmitter housing and can be operated when the cover is open. The Levelflex has four keys and two LEDs; the display is optional.

- The LEDs indicate the operational status:
- The function of the keys depends on whether the display is present or not.

LEDs

Green LED			Red LED			Function
off	**flashes**	**on**	**off**	**flashes**	**on**	
x			x			No power
		x	**x**			**Normal operation**
	x		x			Entry via keys (registered)
		x			x	Probe mapping in progress
		x			x	Instrument alarm. see Chapter 7
		x		x		Instrument warning, see Chapter 7

Operation without display

The key functions are listed in the table below. The two keys must always be pressed simultaneously. They are used as follows:

Keys – + V H	Function
■ □ ■ □	Reset to factory settings, see Chapter 7.7 enter 333
■ ■ □ □	Empty calibration, see Chapter 5
□ □ ■ ■	Full calibration, see Chapter 5
□ ■ □ ■	Probe map, see Chapter 5
□ ■ ■ □	Locking of parameter entry
■ □ □ ■	Unlocking of parameter entry

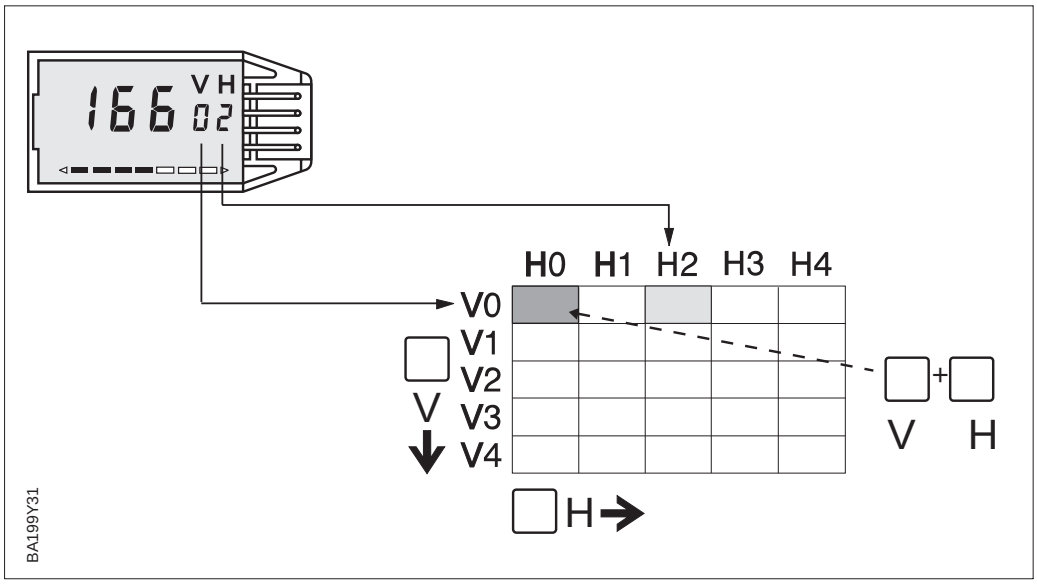


Fig. 4.2
Matrix operation with plugged in display

Operation with display

When the display is plugged in, the full functionality of the Levelflex can be accessed via a 10 x 10 matrix:

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

The same matrix is used for remote and on-site operation with display. Operation is described in Chapter 6, the full matrix is to be found in Chapter 10. If the HART handheld DXR 275 is used, the transmitter is operated by a menu which is derived from this matrix. The table below lists the key functions when the display is in place.

Note!

Note!

- *Before a parameter can be entered, the matrix position must be activated by pressing the ⊞ or ⊟ key: the display flashes.* ***Only when the display flashes, is the parameter registered on leaving the field. This is particularly important, e.g. in probe mapping when suggested parameters must be confirmed.***

Keys	Function
Selection of matrix field	
V	Selection of vertical matrix position
H	Selection of horizontal matrix position
V and H	When V and H are pressed simultaneously the display springs to V0H0
Parameter entry	
⊞ **or** ⊟	**Activates selected matrix position. The selected digit flashes.**
⊞	Changes the value of the flashing digit by +1
⊟	Changes the value of the flashing digit by –1
⊞ and ⊟	Sets the parameter just entered back to its original value, provided it has not already been registered
Registration of the entry	
V or H or V and H	Registration of the entry and quitting of the matrix field Registration of entry and jump to field V0H0
⊞ and V or ⊟ and H	**+** and V lock entries, **–** and H unlock entries, see Section 6.4

4.2 Remote operation

Only Levelflex versions with the communication interface 4...20 mA with HART can be remotely operated. The operation depends on the measuring system.

- For computer operation via Commubox FXA 191 or FXN 672 and gateway, the operating matrix is used, see page 16.
- For operation via handheld, a menu is used.

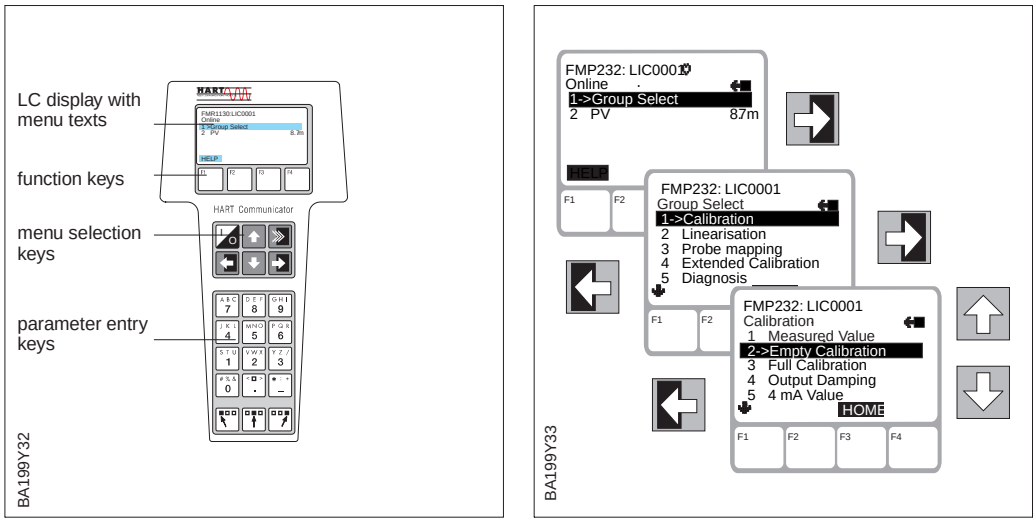


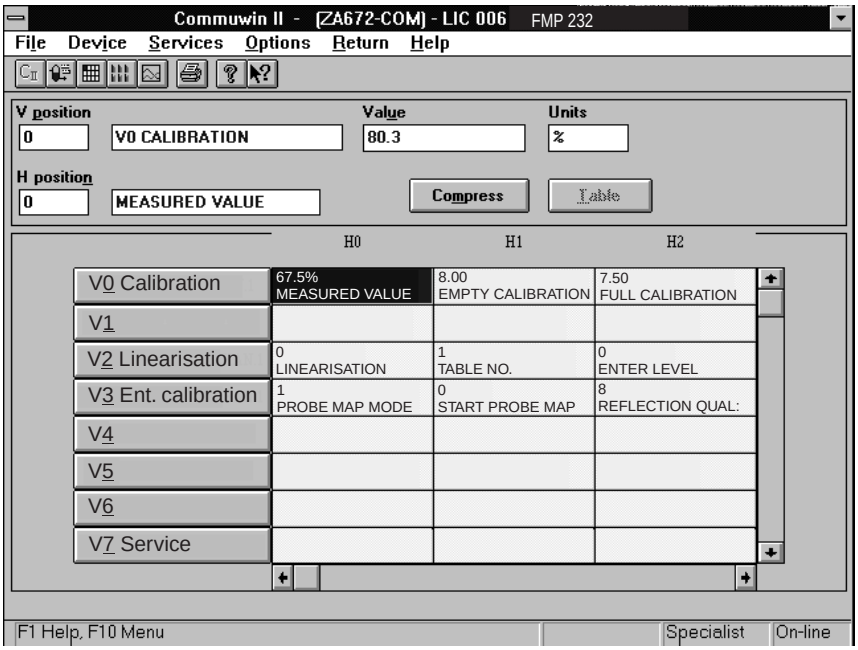
Fig. 4.3
Operating elements and key functions of the HART handheld DXR 275

HART handheld DXR 275

The operation of the HART handheld DXR 275 is described in the manual supplied with it.

- The Group Select menu calls the matrix. The rows are represented by the menu headings.
- Parameters are set in the roll-down menus.
- Keys ↑, ↓ navigate up and down the menu.
- Keys →, ← change to the previous or to the following menu.
- Parameters are entered by the corresponding keys
  – SEND registers the parameter.
- Keys F1 - F4 call the displayed functions, e.g. HOME.

In the procedures described in this manual, the DXR 275 menu lines appear in the "text" column. Chapter 10 contains a listing of menu positions with corresponding matrix fields.



BA199E34

Fig. 4.4
Device parameter menu in Commuwin II

Commuwin II

A full description of the operating programm Commuwin II is to be found in operating instructions BA 124F. All Commuwin II functions are supported except the display of the probe map. The transmitter is configured in the Device Menu either via the operating matrix or the graphic interface templates. The HART menu structure described on p. 15 is not used.

Connections

The connections to Commuwin II are summarised in the table below:

Interface	Hardware	Server	Live list
HART	Commubox 191 set to HART Computer with RS-232C port	HART	Connected device only
	FXN 672 interface module Gateway for MODBUS, PROFIBUS, INTERBUS, FIP etc. Computer with RS-232C port or PROFIBUS card	ZA 673 for PROFIBUS ZA 672 for others	List of all connected Rackbus devices – select the FXN 672 via its bus address

Note!

Note!

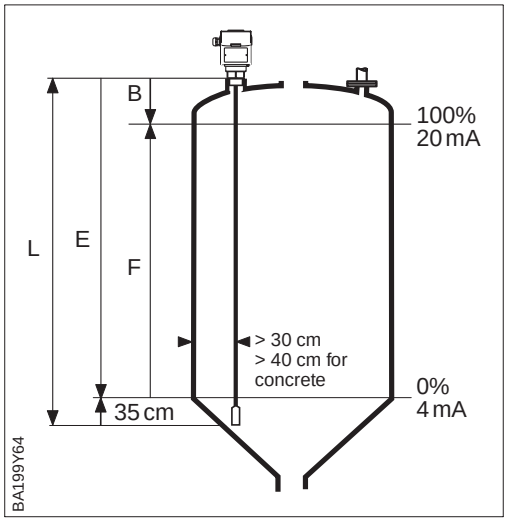
- Levelflex transmitters with HART interface can also be configured on site via the keys. If the keys have been used to lock configuration, the transmitter cannot be remotely configured, but the parameters can be displayed.

5 On-Site Calibration without Display

Probes with a ballast weight can be commissioned by the device keys. If the probe has a tie-down, however, a display or remote operation device (Commuwin II or HART handheld) is required. This type of calibration is described in Chapter 6.

5.1 Mount and measure

Every Levelflex is precalibrated in the factory. If the probe rope has not been shortened, it is often possible that the device measures immediately without further calibration.



- Mount and connect the probe as indicated in Chapters 2 and 3.
- Use a 1½" socket or nozzle with dimensions corresponding to the table on page 10.
- Measurements are then only correctly made when the probe has once hung freely in the silo over its entire lenght.
- Zero (E): Probe length L– 35 cm
- Span (F): Smaller of 90% E or E – B where B = min. 30 cm

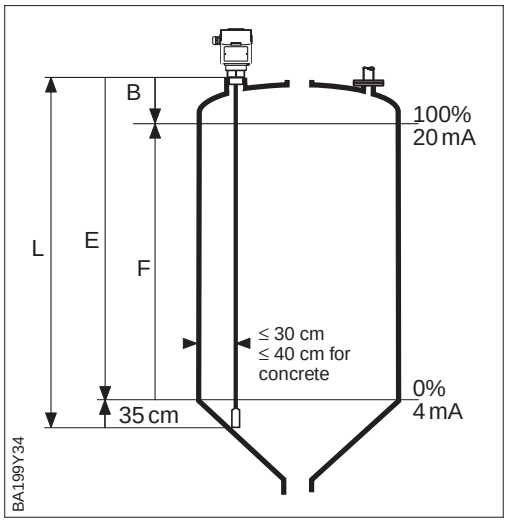
No further action is required on the part of the user unless re-ranging is required or the probe was shortened

5.2 Probe map

A probe map must be made if:

- installation clearances cannot be maintained, e.g. a narrow nozzle or fittings within 30 cm of the rope (in concrete silos the wall distance it must be 40 cm)
- the rope has been shortened.

The silo must be empty! The keys are in the housing.



- Mount and connect the probe as indicated in Chapters 2 and 3.
- Zero (E): Probe length L – 35 cm
- Span (F): Smaller of 90% E or E – B where B = 30 cm

#	Keys – + V H	Significance
1	Empty silo: probe is completely uncovered	
2	□ ⬚ □ ⬚	Reset (on commissioning only)
3	⬚ □ ⬚ □	Probe map Press until red LED lights Wait until red LED goes out
4	If the probe rope was shortened, repeat Step 3 a further three times. Afterwards re-range as described in Chapter 5.3.	

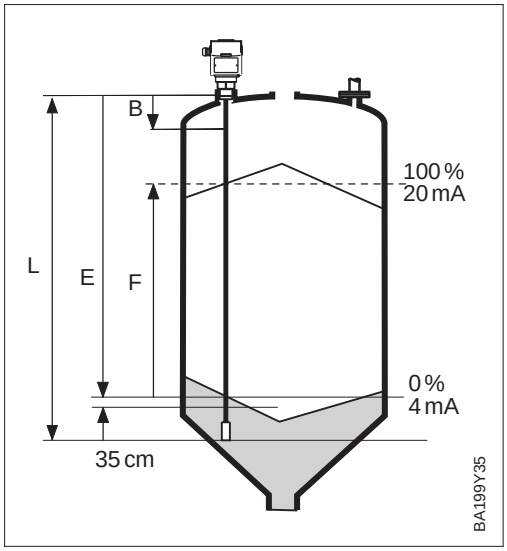
5.3 Re-ranging

Re-ranging requires a so-called empty and full calibration, in which the silo is emptied and filled to the desired level. It must be performed if:

- another measuring range is required
- the rope has been shortened

It is not recommended to set the empty level E below the default value, since probe always signals 0% from this point downwards.

- Set zero, span or both in any order.
- Default E = probe length L – 35 cm
- Max. span = E – B
  where B = 30 cm



#	Keys – + V H	Significance
1	If necessary, make a probe map, p 21	
2	Empty silo to desired "empty" level	
3	□ ■ ⬚ ⬚	Empty calibration (4 mA) = zero
4	Fill silo to desired "full" level	
5	⬚ ⬚ ■ ■	Full calibration (20 mA) = span

After re-ranging

- "Empty" level = 4 mA
- "Full" level = 20 mA

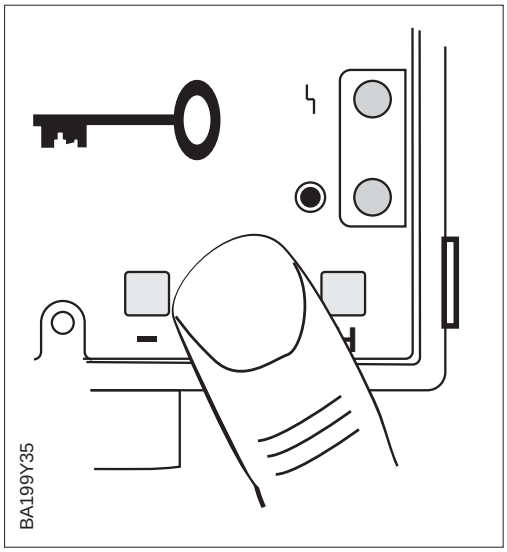
5.4 Lock entry

In order to avoid accidental or unauthorised changing of the settings, the keys can be locked against new entries.

#	Keys – + V H	Significance
1	⬚ ■ ■ ⬚	"Locked"
2	■ ⬚ ⬚ ■	"Unlocked"

After the keys have been locked:

- No more entries can be made on-site or via the operating matrix. The contents of the matrix fields can still be read with display or communication.
- Entries can only be unlocked by using the appropriate key combination, see above.



Note!

Note!

- After configuration, close the housing cover and tighten the locking screw.

6 Calibration with Display/Remote Calibration

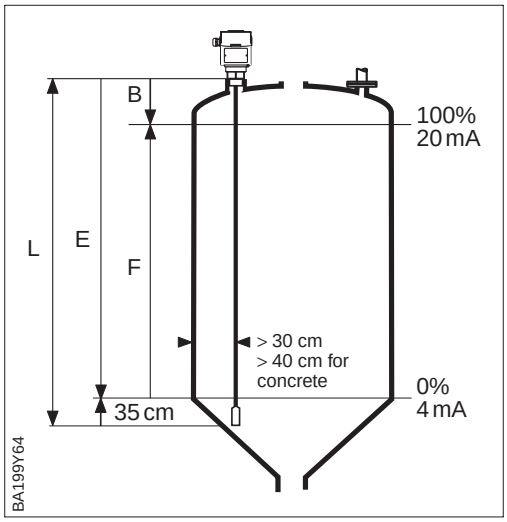
The chapter describes the basic calibration and other functions that can be set via the operating matrix. The matrix can be accessed via:

- the display module (plugged in) and keys
- the HART handheld DXR 275 (is displayed as a menu)
- the operating program Commuwin II.

The chapter primarily describes matrix operation using the keys or Commuwin II matrix. The current menu for the HART handheld is indicated at the start of every procedure, e.g. ➤ Diagnosis: the texts reflect the menu guidance.

6.1 Mount and measure (probe with ballast weight)

The Levelflex leaves the factory in a state which usually allows immediate measurement:



- Mount and connect the probe as indicated in Chapters 2 and 3.
- 1½" socket or nozzle dimensions corresponding to the table on page 10.
- Measurements are then only correctly made when the probe has once hung freely in the silo over its entire lenght.
- Zero (E): Probe length L – 35 cm
- Span (F): Smaller of 90% E or E– B
  Default B = 30 cm
- Check that reflection quality ≥ 3 in V3H2 (or V0H8 with bargraph) when the probe is covered.

No further action is required on the part of the user unless the probe was shortened or re-ranging is required, see note.

6.2 Probe map (probe with ballast weight)

A probe map must be made if:

- installation clearances cannot be maintained, e.g. there are fittings within 30 cm of the rope (in concrete silos the wall distance it must be 40 cm)
- the rope has been shortened and maximum accuracy is required (otherwise reduce the measuring length in V3H5 the zero point in V0H1 and the span in V0H2 be changed).
- the electronics have been retrofitted into a separate housing.

There are two possibilities for recording a probe map:

- Customer probe map: made with the silo empty.
- Partial probe map: made when the silo is partially full.

More details on probe mapping are to be found in Chapter 1.2.

Note!

Note!
- During the recording of a customer or partial map, Levelflex switches to alarm status for about 30 s and error code E642 is displayed.

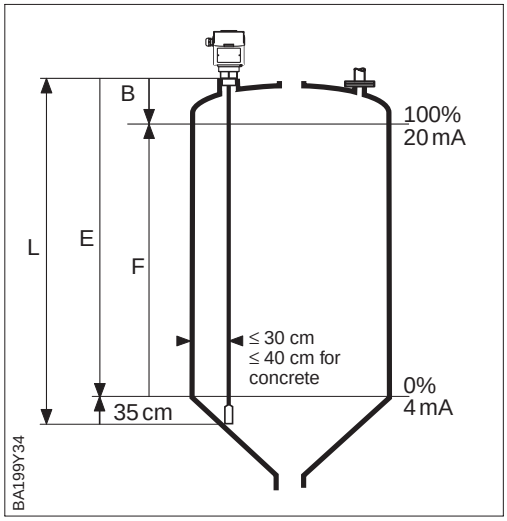
Customer map

Make a customer map only when the silo is empty.

Note!

Note!
- For standard Levelflex versions, the simplest way to make a probe map in an empty silo is to remove the display module and proceed as described in Chapter 5.2.
- For Dust-Ex versions, the procedure below must be followed (display module may not be removed).

- Mount and connect the probe as indicated in Chapters 2 and 3.
- Empty the silo!
- Zero (E): Probe length L – 35 cm
- Span (F): Smaller of 90% E or E – B
  Default B = 30 cm



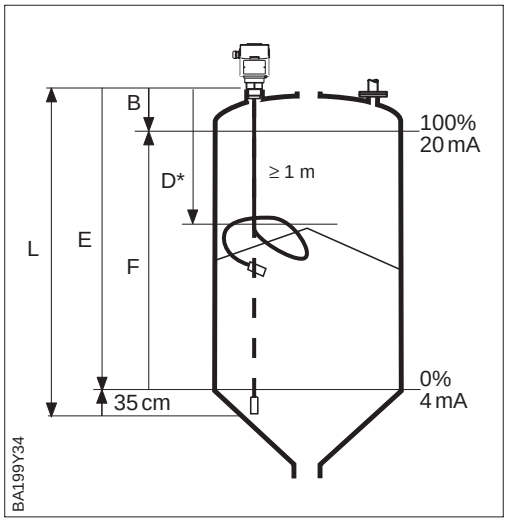
#	VH	Entry		Text
	➤ Diagnosis			
1	V9H5	333	**VH**	Reset (only on commissioning)
	➤ Mapping			
2	V3H0	1	**H**	Customer map
3	V3H1	1	**H**	Activate mapping
4	V3H5	e.g. 10 m	**+H**	Measuring length Enter length of probe
5	Wait until bargraph stops flashing red LED extinguishes			
6	V3H5 now displays the measuring length determined from the end of probe signal.			

Note!

Note!
- If the rope was shortened, the probe must now be re-ranged, see Chapter 6.4.
- Check teh quality of the reflection when the probe is covered. The Display in V3H2 should be > =3.

Partial map

Make a partial map when a probe map is necessary and cannot be performed in an empty silo. The product must be at least 1 metres below the process connection, and the probe should hang straight in the range entered (D*).



- Mount and connect the probe as indicated in Chapters 2 and 3.
- Zero (E): Probe length L – 35 cm
- Span (F): Smaller of 90% E or E– B
  Default B = 30 cm
- Distance D* = distance to product surface less 1 m

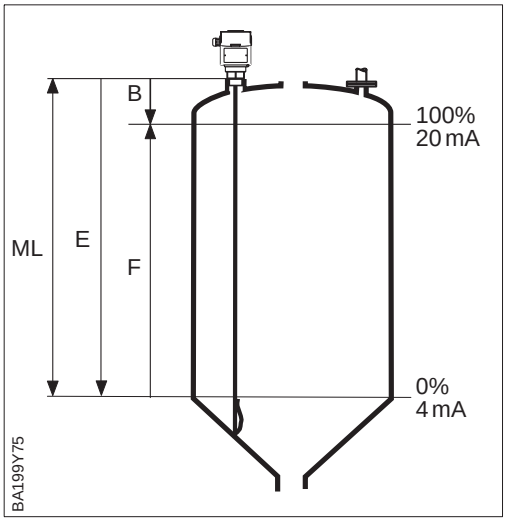
#	VH	Entry		Text
	➤ Diagnosis			
1	V9H5	333	**VH**	Reset (only on commssioning)
	➤ Mapping			
2	V3H0	2	**H**	Partial map
3	V3H1	1	**H**	Activate mapping
4	V3H5	D* - 0,3 m	**VH**	See above
5	Wait until bargraph stops flashing/ red LED extinguishes			
6	V3H5 now displays the default measuring measuring length from the factory map.			

Note!
- If the rope was shortened, now reduce V3H5 (= new length – 35 cm) and re-range.
- Before full accuracy is obtained, the probe rope must hang, *fully extended*, across the entire distance where level measurement readings are desired.


Note!

6.3 Reconfiguration of probes with tie-down

Probes with a tie-down must be reconfigured and mapped by entering the measuring length ML determined during installation, see Chapter 2.6.



- Mount and connect the probe as indicated in Chapters 2 and 3.
- Silo empty!
- Zero (Empty distance E): ML (or less)
- Span (Full distance F):
  Maximum smaller of 90% E or E – B
  Default B = 30 cm (or less)

#	VH	Entry		Text
	➤ Diagnosis			
1	V9H5	333	**VH**	Reset
	➤ Mapping			
2	V3H0	1	**H**	Customer map
3	V3H1	1	**H**	Activate mapping
4	V3H5	ML	**+H**	Measuring length
5	Wait until bargraph stops flashing red LED extinguishes			
6	V3H5	ML	**+H**	Measuring length
	➤ Basic calibration			
8	V0H1	E (m/ft)	**H**	Empty distance
9	V0H2	F (m/ft)	**VH**	Full distance

- Check the quality of the reflection when the probe is covered. The display in V3H2 should be > = 3.

6.4 Re-ranging and technical units

Re-ranging is necessary if:

- another measuring range is required
- the probe rope has been shortened (probe with ballast weight).

Levelflex is re-ranged using the display or digital communication *without changing the level in the silo.* The empty level E and/or the full level F are entered.

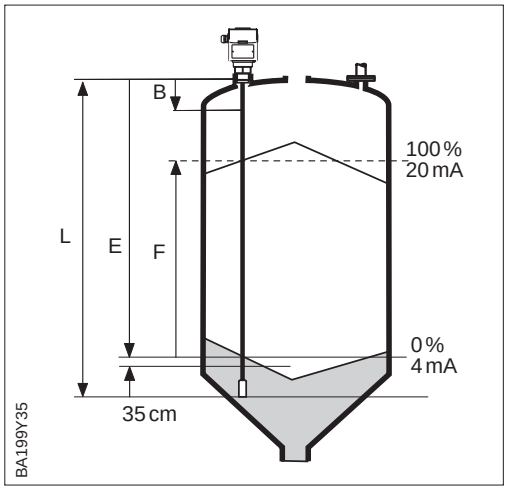
Re-ranging

- Emax = measuring length (V3H5)
- Fmax = E – B
  Default B = 30 cm

#	VH	Entry		Text
1	If necessary, make probe map			
	➤ Basic calibration			
2	V0H1	E (m/ft)	**H**	Empty distance
3	V0H2	F (m/ft)	**VH**	Full distance
4	V0H0			Measured value %

Result

- Lower range-value (E) = 0% (4 mA)
- Upper range-value (F) = 100 % (20 mA)



Note!

Note!

- Calibration units are defined in V8H2: 0 = metres (default), 1 = feet
- An empty distance E greater than the measuring length (V3H5) can also be entered. The measured value and current output assume the values 0% and 4 mA respectively, however, when the level falls below the measuring length.

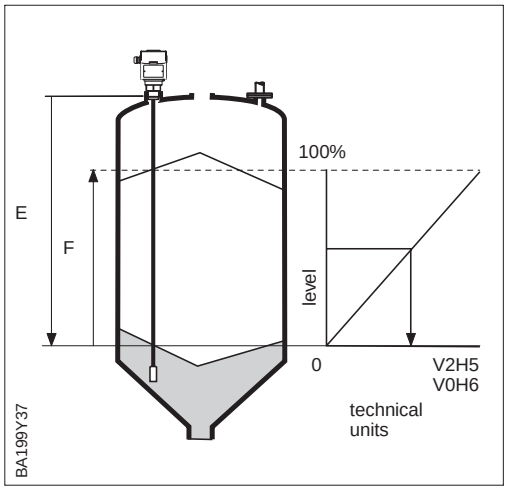
Technical units

If volume or weight is proportional to level within the set measuring range, then technical units can be set as follows:

#	VH	Entry		Text
	➤ Linearisation			
1	V2H0	5	**H**	Linear
2	V2H5	e.g. 500 kg	**VH**	Max. volumen Volumen/weight at level F
	➤ Basic calibration			
3	V0H6	e.g. 500 kg	**VH**	Value for 20 mA Volumen/weight at level F
4	V0H0			Measured value kg

Result, e.g.

- Lower range-value (E) = 0 kg (4 mA)
- Upper range-value (F) = 500 kg (20 mA)

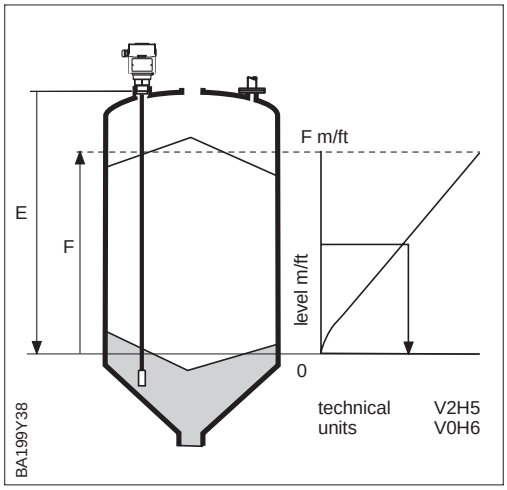


6.5 Linearisation

Linearisation table

If volume or weight is not proportional to level within the set measuring range, then a linearisation table can be entered in order to display the measured value in technical units and produce a volume-proportional output. The prerequisites are as follows:

- the max. 11 value pairs for the linearisation curve are known
- the linearisation curve rises continuously: points are entered in increasing order
- the levels for the first and last points should correspond to those of the empty and full calibration (E and F)
- the level points are entered in the units of calibration.



#	VH	Entry		Text
1	If no calibration yet, see Chapter 6.1			
	➤ Linearisation			
2	V2H0	4	**VH**	Delete existing curve
3	V2H0	2	**H**	Linearisation mode "table"
4	V2H1	e.g. 1	**H**	1st value pair
5	V2H2	e.g. 0	**H**	Level point 1
6	V2H3	e.g. 6 kg	**H**	Volume/weight point 1
7	Repeat steps 4...6 for up to 10 more value pairs			
8	V2H0	1	**H**	Activate linearisation table
	➤ Basic calibration			
9	V0H6	e.g. 600 kg	**VH**	Value for 20 mA Volumen/weight at level F
11	V0H0 V0H9			Measured value TU Level in m/ft

Result:

- Measurement in technical units
- Current output proportional to volume/ weight etc.

Note!
During entry of the table, an error message is generated and the red LED indicates an alarm.


Note!

6.6 Analogue output

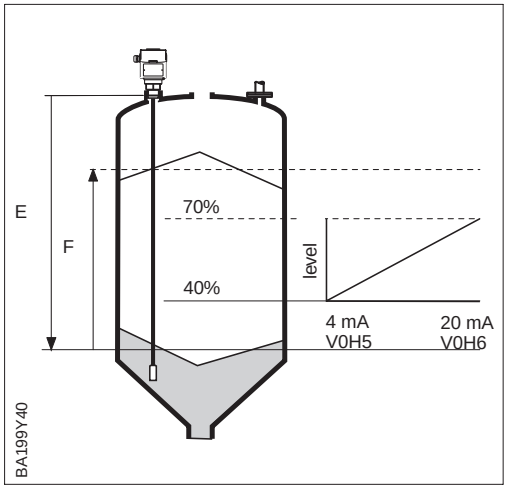
The analogue output can be configured as a standard current output or as a two-point switch. Turndown and inversion can be set in V0H5 and V0H6.

Settings

Field	Parameter	Significance
V8H1	Assign current output mode 0: 4...20 mA 1: 4...20 mA with 4 mA limit 2: 4 / 20 mA binary 3: 8 / 16 mA binary	Sets behaviour of analogue output. Default = 0. 0: 4...20 mA continuous output 1: as above, but 4 mA limit in normal operation 2: 4 or 20 mA two-point operation 3: 8 or 16 mA two-point operation
V0H4	Output damping τ 0...255 s	Influences the time it takes for the current output to react to a sudden change in level (63% of steady-state value). Default 5 s. Increasing the value damps the effect of e.g. rapid level changes on the measured value.
V0H5 V0H6	4 mA value 20 mA value	Lower range-value Upper range-value Entry in % or after a linearisation in technical units
V0H7	Safety alarm (Output on alarm) 0: MIN (-10%) 1: MAX (+110%) 2: HOLD (last value)	In order to signal an alarm, the measured value assumes the selected value. MIN = 2.4 mA; MAX = 22 mA
V8H3	Delay on signal loss	Delay in seconds between loss of signal (E641) and alarm response of Levelflex

Example: turndown

#	VH	Entry		Text
	➤ Operating mode			
1	V8H1	e.g. 1	**H**	0: 4...20 mA 1: with 4 mA limit
	➤ Basic calibration			
2	V0H4	e.g. 60	**H**	Output damping
3	V0H5	e.g. 40%	**H**	Value for 4 mA
4	V0H6	e.g. 70%	**H**	Value for 20 mA
5	V0H7	e.g. 0	**H**	Safety alarm 0 = MIN (–10%) 1 = MAX (+110%) 2 = HOLD
6	V8H3	e.g. 10 s	**VH**	Delay time

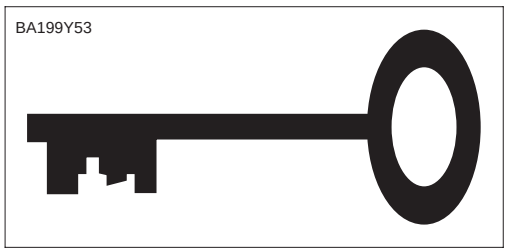


6.7 Locking/Unlocking the Matrix

After all parameters have been entered, the matrix can be locked.

- on-site via the keys, see Chapter 5, or
- via the matrix by entering a three digit code number ≠ 333 in V9H9
  (333 is the code to unlock the measuring point)

The measuring point is then protected against accidental or unauthorised entries.



#	VH	Entry		Text
	➤ Simulation			
Lock				
1	V9H9	e.g. 100	**VH**	Matrix locked (except V9H9)
Unlock				
2	V9H9	333	**VH**	Matrix unlocked

Note!

- If the Levelflex is locked by means of the keys **+** and **V** , then the entire matrix including V9H9 is locked. No parameters can be changed, not even via the communication interface. The matrix can only be unlocked by using the keys **–** and **H** on the Levelflex.


Note!

6.8 Measuring point information

The following information about the measuring point can be read:

Matrix field	Display or entry
Measured value	
V0H0	Principle measured value
V0H8	Distance from product surface
V0H9	Level before linearisation
Sensor data	
V3H2	Signal quality 0...10, uncritical > = 3
V3H5	Max. measuring value
Measuring point information	
V9H3	xxyy: Device (xx) and software number (yy) (yy = 10 = Software 1.0, yy = 20 = Softwareversion 2.0
Behaviour on alarm	
V9H0	Current diagnostic code
V9H1	Last diagnostic code

Communication level

The matrix row "VA communication" can only be accessed via the HART handheld DXR 275 or Commuwin II.

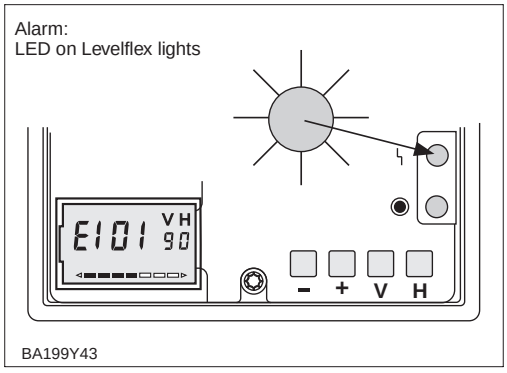
VAH0	Tag No. An 8-figure measuring point designation can be entered here.

7 Trouble-Shooting

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

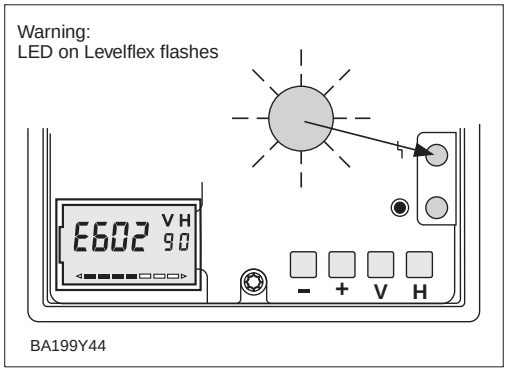
7.1 Self-monitoring

The self-monitoring system of the Levelflex differentiates between alarms and warnings.



On an alarm

- The red fault LED lights.
- Levelflex no longer measures.
- The analogue output responds according to the settings in V0H7
- An error code is displayed at matrix position V9H0 to help locate the fault, see page 30.



On a warning

- The red fault LED flashes.
- Levelflex continues to measure.
- An error code is displayed at matrix position V9H0 to help locate the fault, see page 30.

During probe mapping

- The red fault LED lights.
- Levelflex no measures.
- On completion of the probe map the red LED goes out.
- If the red LED remains lit, the mapping was unsuccessful – repeat the procedure.

7.2 Error messages

The current error code is displayed in V9H0.

- The last error code is displayed in V9H1.

Table 7 lists the error codes with the corresponding messages.

Table 7.1
Error messages

Code	Message	Significance	Remedy
E101	Alarm	Invalid checksum	Appears shortly during start-up, if displayed permanently ✎ Call Service
E102	Warning	Invalid checksum	Appears shortly during start-up, if displayed permanently ✎ Call Service
E103	Warning	E2PROM update active	Appears shortly during start-up, if displayed permanently ✎ Call Service
E106	Alarm	Download of data to Levelflex	Appears during download from computer, measurements cannot be made during this period
E110... E115	Alarm	Device fault	✎ Call Service
E116	Alarm	Download error	Appears if download cannot be started or completed Restart download
E121	Alarm	Invalid checksum	✎ Call Service
E602	Warning	Linearisation error – curve does not rise or fall continuously	Re-enter incorrect value - caution
E604	Warning	No. of linearisation points < 2	Enter more points
E605	Alarm	No linearisation curve	Enter curve or deactivate linearisation
E613	Warning	Simulation mode	Message disappears when simulation mode deactivated (V9H6 = 0)
E620	Warning	Current outside limits	Can appear when analogue output operating with turndown
E641	Alarm	Loss of signal, signal too weak, e.g. – product has intruded into the blocking distance or – dielectric constant of the material is less than 1.8	– Device functions again when product level falls – ✎ Call Service
E642	Alarm	Probe map being recorded	Disappears as soon as probe mapping has finished

7.3 Fault analysis

Table 7.2 lists the most common measuring errors with possible remedies. If the first measure is successful, the remaining steps are not required.

Table 7.2 Trouble-shooting

Sequence	Display	Possible cause	Remedy
1	**No output signal**	Fuse?	– Check fuse, check specifications
		Incorrectly wired or broken line?	– Check wiring
		Condensation in housing?	– Dry out and check gland
2	**Incorrect measured value or current**	Calibration in wrong units?	– Check V8H2, recalibrate
		Incorrect calibration?	– Check E (V0H1) and F (V0H2), recalibrate
		Linearisation correct?	– Check parameters, with simulation if necessary
		4/20 mA settings wrong?	– Re-enter values in V0H5 und V0H6
		Value entered in V3H5 for partial map too large: level signal suppressed	– New partial map with smaller value
		Customer map with partially full silo: level signal suppressed	– Empty silo and repeat customer map or reset 111 (V9H5) then make partial map
		Product within blocking distance	– Set F below blocking distance, S.37
		Electrostatic charge on probe rope	– Power reset (check grounding of probe)
		Error not found	– Enter current level in V3H3 in m (or ft) till incorrect? ☎ Call Service!
3	**Reading erratic**	Reflecting signal too weak (<3). Check in V3H2	– Record new probe map with empty silo
			– Material not suitable. Dielectric constant too small
		Signal intermittent e.g. sporadic interference	– Increase persistence filter index (V3H9) No effect? ☎ Call Service!
		Signal jumps to higher values because interference stronger than signal	– Increase blocking distance (V3H8)
		Ambient temperature too high	– Use protective hood or remote housing
		Probe mounted in filling stream	– Reposition
		Voltage variations (reading drops to zero)	– Check power supply
		EMC problems	– Install screened signal cables or check grounding
		Probe rope frayed or abraded	– Reposition probe or check if a non-contact ultrasonics system should be used
4	**Reading locks during emptying**	Fittings or nozzle too near probe	– Record probe map Increase blocking distance
		E set below end of rope V3H5	– Normal operation: Zero is shown until measurement returns within range, otherwise re-enter “E” and “F”
		ML not reduced, e.g. for tie-down	– Reduce V3H5, see page 27
		Rope touching wall (reflection signal very high)	– Use tie-down
		Build-up on rope	– Either clean rope or remap probe and increase blocking distance
		Rope or weight torn off	– Install new probe
		Tie-down loose	– Empty silo and re-tie
5	**Total breakdown, components damaged**	Destroyed due to static discharges at extremely high energies	– ☎ Call Service Return instrument, replacement with special electronics
6	**No Smart-communication**	Incorrectly wired	– Check screening, wiring and load
		Residual ripple too high (HART)	– Check power supply

7.4 Simulation

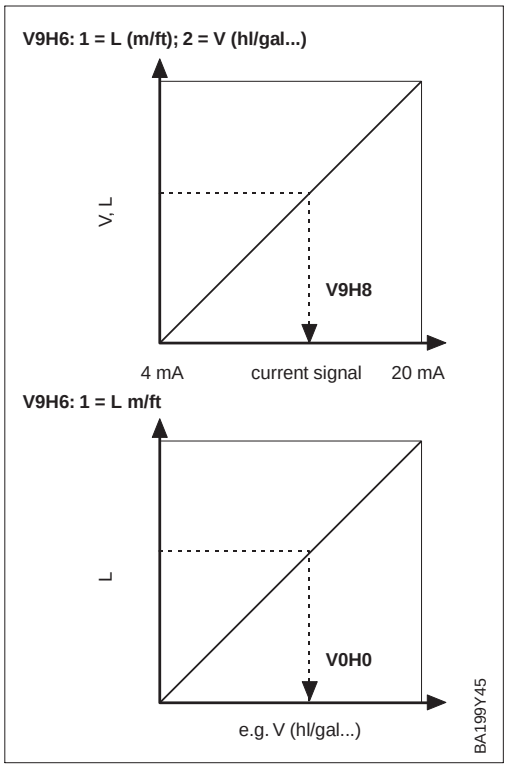
Simulation

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

- Simulation of level in V9H6: fields V0H0, V0H9 and V9H8 follow the set values.
- Simulation of volume in V9H6: fields V0H0, V0H9 and V9H8 follow the set values.
- Simulation of current in V9H6: field V9H8 follows the set values.

Depending upon requirement, enter a value in V9H7: Warning E613 appears in V9H0 during simulation.

#	VH	Entry		Text
	➤ Simulation			
	Simulation level			
1	V9H6	**1**	**H**	Simulation level
	V9H7	****	**H**	Level value
	V9H8	——	**VH**	Current
	V0H0	——		Level/volume
	Simulation volume			
2	V9H6	**2**	**H**	Simulation volume
	V9H7	****	**H**	Volume value
	V9H8	——	**VH**	Current
	V0H0	——		Volume
	Simulation current			
3	V9H6	**3**	**H**	Simulation current
	V9H7	****	**H**	Current value
	V9H8	——	**VH**	Current
	V0H0	——		Level/volume
	End simulation			
4	V9H6	**0**	**H**	Simulation off



7.5 Persistence filter

The persistence filter allows reliable measurement when interference e.g. caused by intermittant external influences such as electrostatic discharge appear in the signal. In order to avoid that these are interpreted as the level signal, each new level value is compared to a certain number of its predecessors. If the value is plausible, it is output.

The filter index determines the depth of comparison: the higher the index, the deeper the comparison.

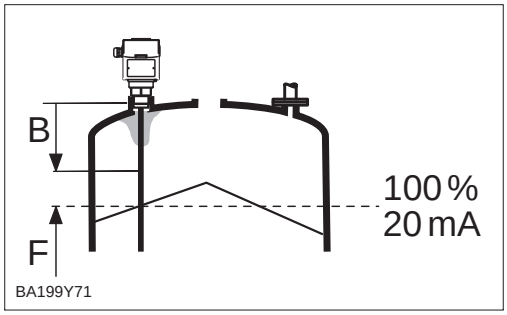
#	VH	Entry		Text
	➤ Probe map			
1	V3H9	e.g. 5	**H**	Persistence filter

Enter values from 2 to 10 here. If you set a value of more than 2 for the stability filter, also check the setting for delay in field V8H3. This value must be 4 times higher than the value in V3H9.

7.6 Blocking distance

The blocking distance is a zone immediately below the process connection in which no signals can be detected. It is set at the factory to min. 30 cm.

In order to eliminate the effects of build-up in a nozzle or strong interference in close proximity to the process connection, the blocking distance can be changed as follows:



#	VH	Entry		Text
	➤ Probe map			
1	V3H8	B	**H**	Blocking distance
	➤ Basic calibration			
2	V0H2	F	**H**	Full distance

Note!
- The full distance "F" may not encroach into the blocking distance "B"
-

Note!

Blocking distance: Default values for factory calibration in cm:

1 m	2 m	3 m	3,5 m	4 m	5 m	7,5 m	10 m	15 m	20 m
30	30	30	31	33	38	51	63	88	113

Formula: **B= [(L - 35) x 0,1 - 30] / 2 + 30**
however min. 30 cm

7.7 Reset to factory settings

Levelflex allows a reset to be made to factory settings:

- Code 333: Reset of all parameters to factory settings, with the exception of linearisation curve, units and tag. no.
  – is also invoked by the key reset without display
- Code 111: Overwrites a customer or partial probe map with the factory map and sets V3H0 = 0.

	H0	H1	H2	H3	H4	H5	H6	H7	H8	H9
V0		[Probe length – 0.35]	[0.9 x E]		[5]	[0]	[100]	[1]		
V2	[5]									
V3	[0]	[0]			[0]	[length l]			[30]	
V8		[3]		[5]						
V9							[0]			[333]

Table 7.3
Factory settings in brackets, grey field are unaffected by reset

On reset to factory parameters (Code 333), the values in [brackets] are assumed. The values in the (grey fields) are retained.

8 Maintenance and Repair

8.1 Maintenance

Exchange of complete Levelflex

For devices with a communication interface, it is usually sufficient to enter all the matrix parameters from the old into the new transmitter. The replacement will then measure correctly without the need for renewed calibration,

- If necessary, re-activate linearisation in V2H0
- If necessary, record a new probe map, see basic calibration.

	H0	H1	H2	H3	H4	H5	H6	H7	H8	H9
V0										
V2										
V3										
V8										
V9										

Table 8.1
Customer settings
– enter you settings here

Maintenance

Check the condition of the transmitter during regular inspections. If necessary, free the probe from build-up. When cleaning the Levelflex, handle with care.

Repairs

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

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

Warning!

Warning!
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.

8.2 Spare parts

Warning!
- If the electronics are changed, take care that the probe is not left mounted in the silo without electronics and grounding for any length of time, since there is a risk that it will charge up.


Warning!

Installation instructions are packed with the spare part.

Modification nameplate (in preparation)

When spare parts which are part of the product structure (Chapter 8.3) are ordered, it must be checked whether the type designation on the nameplate is still valid, e.g. for

- a display module
- an electronics module.

If the type designation changes, a modification nameplate must be purchased. The specifications of the new transmitter must then be transferred to the modification nameplate, which must then be fastened to the transmitter. See instructions packed with nameplate.

Caution!
- It is not possible to transform a standard device into a device suitable for hazardous areas by exchanging the parts.
- Parts on devices certified for explosion hazardous areas may be exchange on a "like for like" basis only. The device must be returned to its "original" state after repair.
- Repairs on devices certified for explosion hazardous areas must be done by suitably qualified personnel in accordance with local and national regulations.


Caution!

Spare parts concept

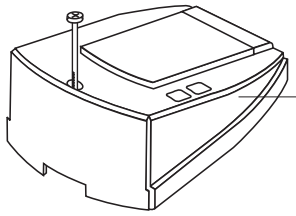
The spare parts concept offers the following possibilities:

- The customer exchanges the part himself
- E+H Service exchanges the part on-site
- The device is sent to an E+H Service Centre for the part to be exchanged there.

Part/Problem	Exchange by			Remarks
	Cust.	Service	E+H	
Probe complete with threaded connection	maybe	**yes**	yes	All parts can be exchanged but it might be that a new gland is cheaper
Ballast weight	**yes**	yes	yes	
Rope clamps	**yes**	yes	yes	
Probe adapter	maybe	**yes**	yes	Belongs to housing
Housing (complete)	maybe	**yes**	yes	With probe adapter, flat seal and O-ring
Housing cover	**yes**	yes	yes	
Cover plate complete	**yes**	yes	yes	
Electronics	yes	**yes**	yes	Exchange (operation with new customer or partial probe map)
Operating unit complete	**yes**	yes	yes	with key contact strip
LC display module	**yes**	yes	yes	
Cable glands	**yes**	yes	yes	
Adapter for remote gland	**yes**	yes	yes	For remote version only

yes: preferred solution
maybe: when customer has equipment and trained technicians

Standard probe



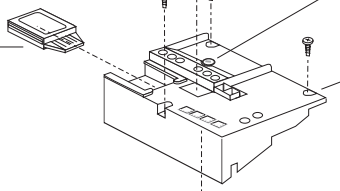
Housing lid complete 542 651 - 0000
(incl. fixing screw, window and hinge)

Miniature fuse for FMP 232/332
50 mA/T = 014 737 - 0000 (180...250 V AC)
100 mA/T = 016 086 - 0000 (90...127 V AC)
160 mA/T = 016 189 - 0000 (18... 36 V DC)

Cover

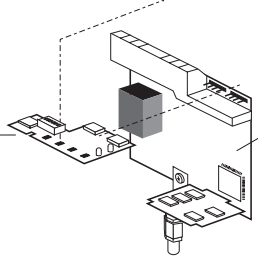
3 fixing screws

LC display module
942 663 - 0000



Cover plate complete. 542 653 - 0117
(incl. cover HART and neutral,
terminal strip and 3 screws

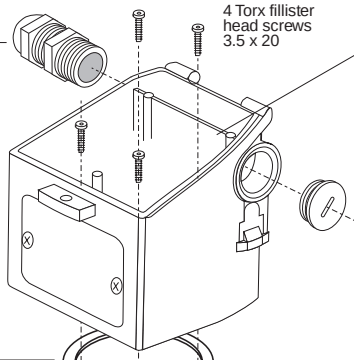
Contact strip



Electronics module, see table on page 42

Operating unit complete
with contact strip
528 297 - 3000

4 Torx fillister
head screws
3.5 x 20



Pg16 entry with
adapter for Pg13.5 016 908 - 0000
Adapter Pg16 to ½ NPT 919 253 - 1000
Adapter Pg16 to M20 919 253 - 0000
Adapter Pg16 to ½ BSP (G ½) 919 253 - 2000
The version with NPT thread must be secured with Loctite when screwed into the housing!

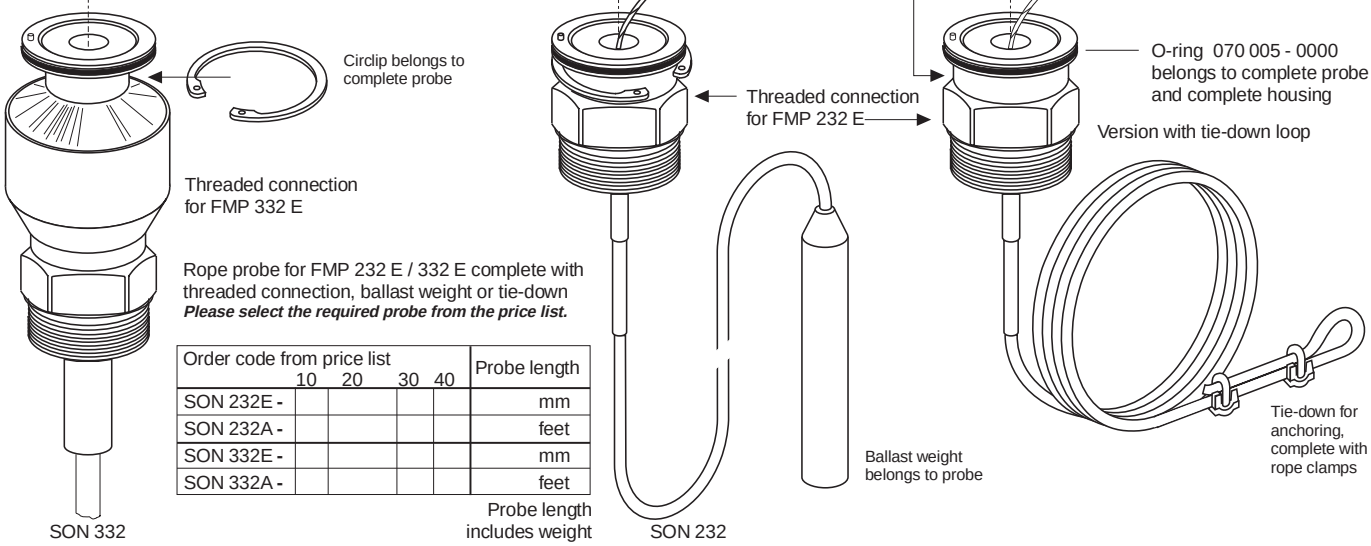
Housing F9 complete, pre-mounted 542 650 - 0117
(incl. ground terminal, Teflon filter, 2 Philips screws
to fix nameplate, stop, 4 Torx fillister-head screws,
probe adapter with circlip, flat seal and O-ring for
probe head)
Please order the cable gland separately!

Stop 015 565 - 0000
contained in housing
The version with NPT thread must be secured with Loctite when screwed into the housing!

Flat seal 65 x 73 x 3
contained in complete
housing

Probe adapter
(plastic) belongs to
complete housing

Circlip belongs to complete probe
and complete housing



Circlip belongs to
complete probe

Threaded connection
for FMP 232 E

Threaded connection
for FMP 332 E

O-ring 070 005 - 0000
belongs to complete probe
and complete housing

Version with tie-down loop

Rope probe for FMP 232 E / 332 E complete with
threaded connection, ballast weight or tie-down
Please select the required probe from the price list.

Order code from price list	10	20	30	40	Probe length
SON 232E -					mm
SON 232A -					feet
SON 332E -					mm
SON 332A -					feet

Ballast weight
belongs to probe

Tie-down for
anchoring,
complete with
rope clamps

SON 332

Probe length
includes weight

SON 232

Part numbers

Electronics module

- Each electronic module is calibrated to to the corresponding maximum rope length.
- When fitting to a coated probe, field V3H6 must be set to probe type "1".
- When fitting a 115 VAC unit, the fuse and jumpers must be changed: the 100 mA/T fuse is supplied.
- When fitting a unit into an American version system (FMP x32**A**), V8H2 should be changed to 1 (= feet).

Electronics Version E	**Supply voltage**	**Part No.**
FMP 232 E	18...36 V DC, 4...20 mA	52001061
	90...127 V AC, 4...20 mA 180...250 V AC, 4...20 mA	52001062
	18...36 V DC, 4...20 mA HART	571 013–2011
	90...127 V AC, 4...20 mA HART 180...250 V AC, 4...20 mA HART	571 013–2013
	18...36 V DC, Dust-Ex, 4...20 mA	52001063
	104...127 V AC, Dust-Ex 4...20 mA	52001064
	207...250 V AC, Dust-Ex, 4...20 mA	52001065
	18...36 V DC, Dust-Ex, 4...20 mA HART	52000844
	104...127 V AC, Dust-Ex 4...20 mA HART	52000842
	207...250 V AC, Dust-Ex, 4...20 mA HART	52000843
FMP 332 E	18...36 V DC, 4...20 mA	52001066
	90...127 V AC, 4...20 mA 180...250 V AC, 4...20 mA	52001067
	18...36 V DC, 4...20 mA HART	571 013–3011
	90...127 V AC, 4...20 mA HART 180...250 V AC, 4...20 mA HART	571 013–3013
	18...36 V DC, Dust-Ex, 4...20 mA	52001068
	104...127 V AC, Dust-Ex 4...20 mA	52001069
	207...250 V AC, Dust-Ex, 4...20 mA	52001070
	18...36 V DC, Dust-Ex, 4...20 mA HART	52000932
	104...127 V AC, Dust-Ex 4...20 mA HART	52000930
	207...250 V AC, Dust-Ex, 4...20 mA HART	52000931

8.3 Product structure

10 Certificates / Approvals

A Non-hazardous area
F Dust-Ex, Zone 10 (BVS)– for uncoated stainless steel ropes only
G ATEX II 1/3 D
T Dust-Ex (TIIS) – for uncoated stainless steel ropes only
Y other approvals, see Technical Data

20 Process Connection

GR1 Thread 1 ½ BSP (G 1 ½), steel
GRJ Thread 1 ½ BSP (G 1 ½), 1.4435 (SS 316L)
GN1 Thread 1 ½ NPT, steel
GNJ Thread 1 ½ NPT, 1.4435 (SS 316L)

30 Probe Length (L)* and Material

FMP 232 E (specify in product designation)

A 1,500 mm ... 10,000 mm wire rope to order (4 mm diameter), carbon steel, with polyamide coating*
B 1,500 mm ... 10,000 mm wire rope to order (4 mm diameter), stainless steel 1.4301(SS 304)
C 6,000 mm wire rope (4 mm diameter), carbon steel, with polyamide coating
D 6,000 mm wire rope (4 mm diameter), stainless steel, 1.4301(SS 304)
E 10,000 mm wire rope (4 mm diameter), carbon steel, with polyamide coating
F 10,000 mm wire rope (4 mm diameter), stainless steel, 1.4301(SS 304)

FMP 332 E (specify in product designation)

A 2,000 mm ... 20,000 mm wire rope to order (8 mm diameter), carbon steel, with polyamide coating*
B 2,000 mm ... 20,000 mm wire rope to order (8 mm diameter), stainless steel, 1.4401(SS 306)*
C 6,000 mm wire rope (8 mm diameter), carbon steel, with polyamide coating
D 6,000 mm wire rope (8 mm diameter), stainless steel, 1.4401(SS 306)
G 12,000 mm wire rope (8 mm diameter), carbon steel, with polyamide coating
H 12,000 mm wire rope (8 mm diameter), stainless steel, 1.4401(SS 306)
L 20,000 mm wire rope (8 mm diameter), carbon steel, with polyamide coating
M 20,000 mm wire rope (8 mm diameter), stainless steel, 1.4401(SS 306)

40 Probe End

1 Probe with 2 cable clamps for tie down
2 Probe with ballast weight
Y others

50 Power Supply / Communication_

D 18 - 36 VDC / 4 ... 20 mA current signal
E 18 - 36 VDC / HART via 4 .. 20 mA current signal
F 180 - 253 VAC, 50/60Hz / 4 ... 20 mA current signal
207 - 250 VAC Dust-Ex
G 180 - 253 VAC, 50/60Hz / HART via 4 .. 20 mA current signalp.
207 - 250 VAC Dust-Ex
J 90 - 127 VAC, 50/60Hz / 4 ... 20 mA current signal
104 - 127 VAC Dust-Ex
K 90 - 127 VAC, 50/60Hz / HART via 4 .. 20 mA current signal
104 - 127 VAC Dust-Ex
Y Other

60 Housing, Cable Entry

1 Polyester F9 housing IP 67, Pg16
2 Polyester F9 housing NEMA 6, NPT 1/2
3 Polyester F9 housing IP 67, M 20x1.5
4 Polyester F9 housing IP 67, ½ BSP (G ½)
9 Other

70 Display

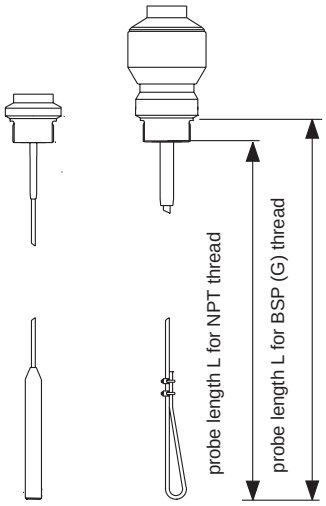
1 without display
2 with display installed

80 Remote Kit

1 Compact unit
2 1 m remote
3 2 m remote
4 3 m remote

complete order-No.:

FMP232 E -	complete Product designation	**Length L =**
FMP332 E -	complete Produkt designation	**Lenght L =**



9 Technical Data

General specifications

Manufacturer	Endress+Hauser
Instrument designation	Levelflex FMP 232 E/332 E

Application

Continuous level measurement of powdery to coarse-grained solids using contact-type probe

Function and system design

Measurement principle	Guided time-of-flight via microimpulse time domain reflectometry
Modularity	Compact four-wire instrument comprising transmitter and integrated probe. Optional remoted electronics version, with pipe or wall mounting kit. Optional display.
Signal transmission	4...20 mA with HART protocol as option

Input

Measured variable	Level, determined by the time-of-flight of a guided microwave pulse from transmitter to product surface and back
Measuring range	FMP 232 E: 0.3 – 10 m; freely adjustable zero and span FMP 332 E: 0.3 – 20 m; freely adjustable zero and span

Output

Versions	Analogue 4...20 mA output Analogue 4...20 mA output with superimposed HART digital signal
Output signal	Analogue: useable output current range 3.8 mA...20.5 mA Digital: –9 999 to +9 999
Output resolution	10 bit (equivalent to 0.1% FS or microamps)
Load	Analogue: max. 500 Ω; HART: 250 Ω to 500 Ω
Signal on alarm	Adjustable: MIN, MAX or HOLD Analogue: MIN = 2.4 mA, MAX = 22.0 mA Digital: MIN = –9 999, MAX = +9 999
Output damping	Adjustable: 0...250 s
Turndown	Max. 10:1

Accuracy

Reference conditions	Reflection from a flat surface of 3 mm grains, temperature +20 °C; output scaled to 90% of probe length, probe fully extended
Measured error	± 1% FS
Resolution	0.2% of probe length
Repeatability	0.2% FS
Hysteresis	better than 0.5% FS
Settling time	≤ 2 s
Warm-up time	30 s
Ambient temperature effect	± 0.01% FS/K
Process temperature effect	± 0.02% FS/K
Linearity	± 1% FS (independent linearity)

Operating conditions

Installation

Orientation	Vertical: top-mounted, minimum 30 cm from wall or structural element (in Concrete silos 40 cm)
Silo geometry effects	No influence on measurement by silo shape or materials or probe movement within above limits

Environment

Operating conditions (cont.)

Operating temperature	–20 °C...+70 °C; Dust-Ex version –20 °C...+60 °C, see certificate
Limiting temperature	–40 °C...+80 °C; Dust-Ex version –40 °C...+60 °C, see certificate
Storage temperature	–40 °C...+80 °C
Ingress protection	Housing: IP 67 (open IP 20) Probe: IP 68
Climate class	DIN/IEC 68 Part 2-30 Db, 4K2 per EN 60 721-3.4 (1995)
Thermal shock rating	DIN/IEC 68 Part 2-14 NB (1K/min across temperature range)
Vibrational resistance	DIN/IEC 68 Part 1-6 (2g)
Electromagnetic compatibility	EN 61326-1, EN 50 081-1, EN 50 082-2 The device is suitable for use in industrial environments

Medium

Process temperature	–40 °C...+120 °C; Dust-Ex version see certificate
Process pressure	vacuum ... 16 bar
Properties and effects of medium	Min. relative dielectric constant of 1.8, grain size ≤ 20 mm No influence on measurement by density, particle size, moisture content

Housing

Mechanical construction

Material	PC/ABS flame retardant; Seal and O-rings: EPDM
Cable entry	M 20x1,5 Pg 16 (gland supplied), ½ NPT, G ½ (BSPP)
Cable	see chapter 3 "Electrical connection"

Process connection

Type	Threaded connection 1½ NPT bzw. 1½ BSP (G 1½), installation in all flanges 1½" nominal (or 40 mm)
Seal	EPDM O-rings
Wetted parts	FMP 232: PPS FMP 332: PTFE and steel, or stainless steel 1.4435

Probe

Dimensions	see page 44
Material rope/weight	FMP 232 E: Rope and weight Steel of 1.4301, or rope of steel with PA 12 and weight of steel
Material rope/weight	FMP 332 E: Rope and weight Steel of 1.4401, or rope of steel with PA 12 and weight of steel
Wire rope diameter	FMP 232 E: 4 mm; 6 mm coated FMP 332: 8mm; 11 mm coated
Max. rope load	FMP 232 E: 10.5 kN; 12.5 kN coated FMP 332: 40.0 kN; 43.5 kN coated
Weight rope/housing	FMP 232 E: 4.8 kg + 0.08 kg/m FMP 332: 5.6 kg + 0.3 kg/m

Keypad	4 rubberised keys for matrix navigation, data entry and system security
Indication (ext. visible)	Green and red LEDs indicate system status
Display	Optional, four digit LCD (parameter) with matrix field indication
Digital communication	None, HART or Rackbus RS-485, depending upon version

User interface

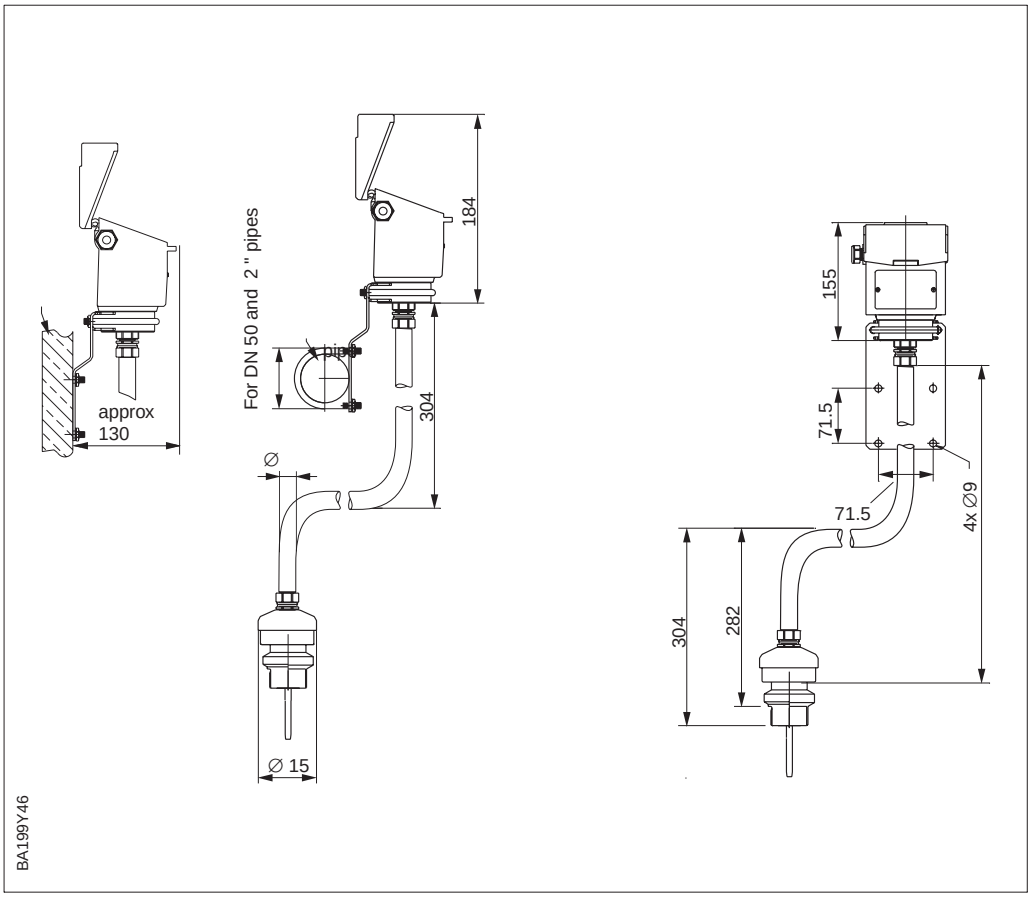
Supply voltage	AC version: Standard: 90 V – 127 V or 180 V – 250 V; 50/60 Hz, 3.5 VA Dust-Ex: 104V – 127 V or 207V – 250 V DC version: 18 V – 36 V; 1.5 W
HART (at 500 Ω)	Ripple: 47–125 Hz, U_{pp} = 200 mV Noise: 500 Hz–10 kHz: Urms = 2.2 mV

Power

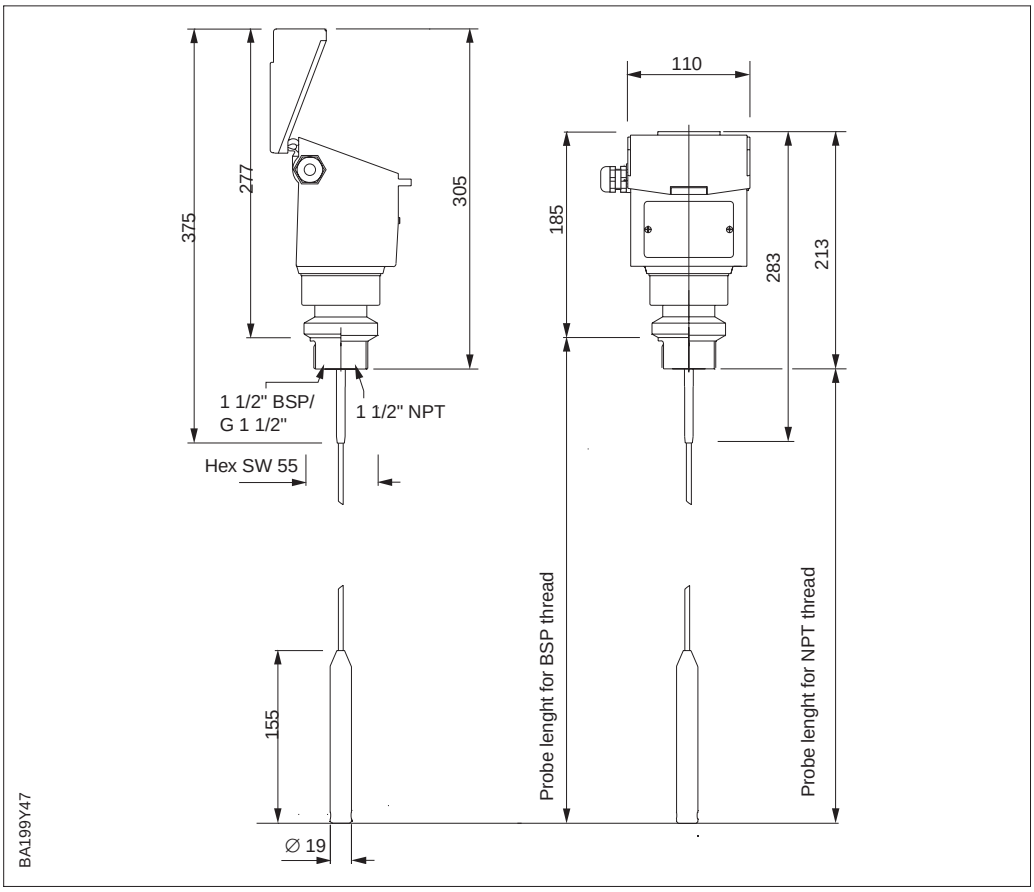
Explosion protection	See Note on Safety, page 3
Telecommunications	Meets FCC requirement for unintentional radiator
CE mark	In attaching the CE Mark, Endress+Hauser confirms that the Levelflex conforms to all relevant EU directives

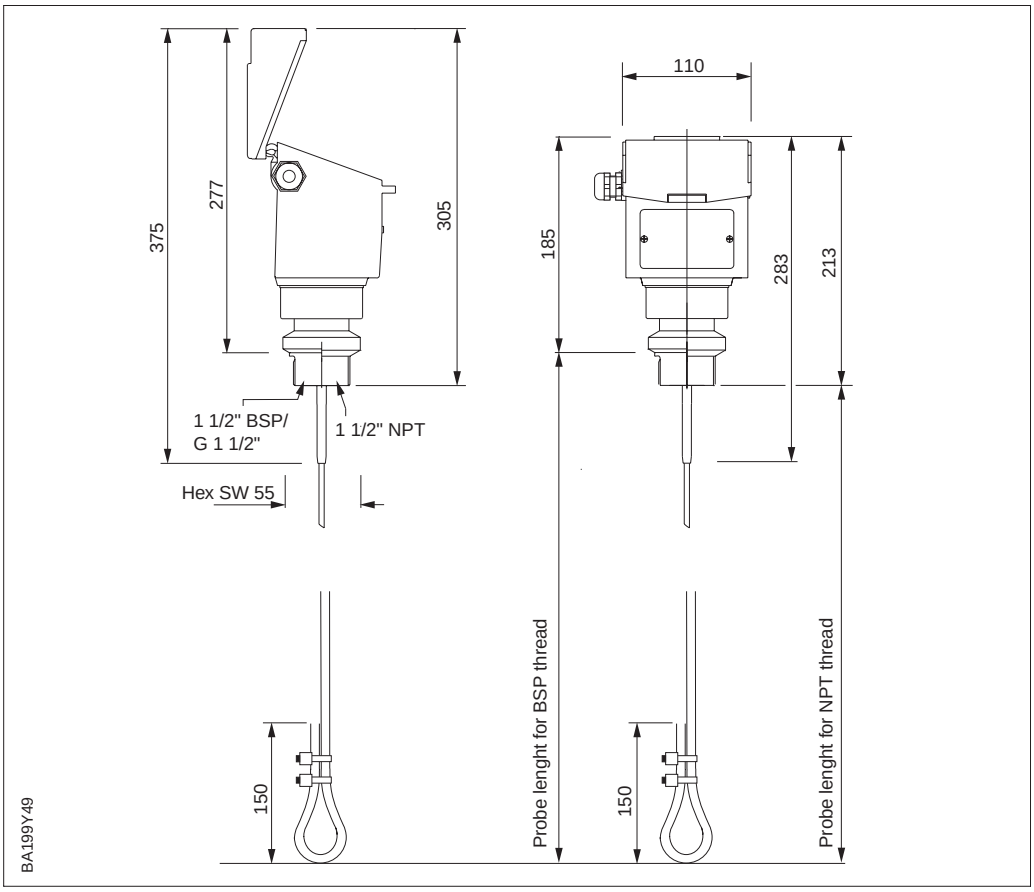
Certificates

9.1 Dimensions of remote housing

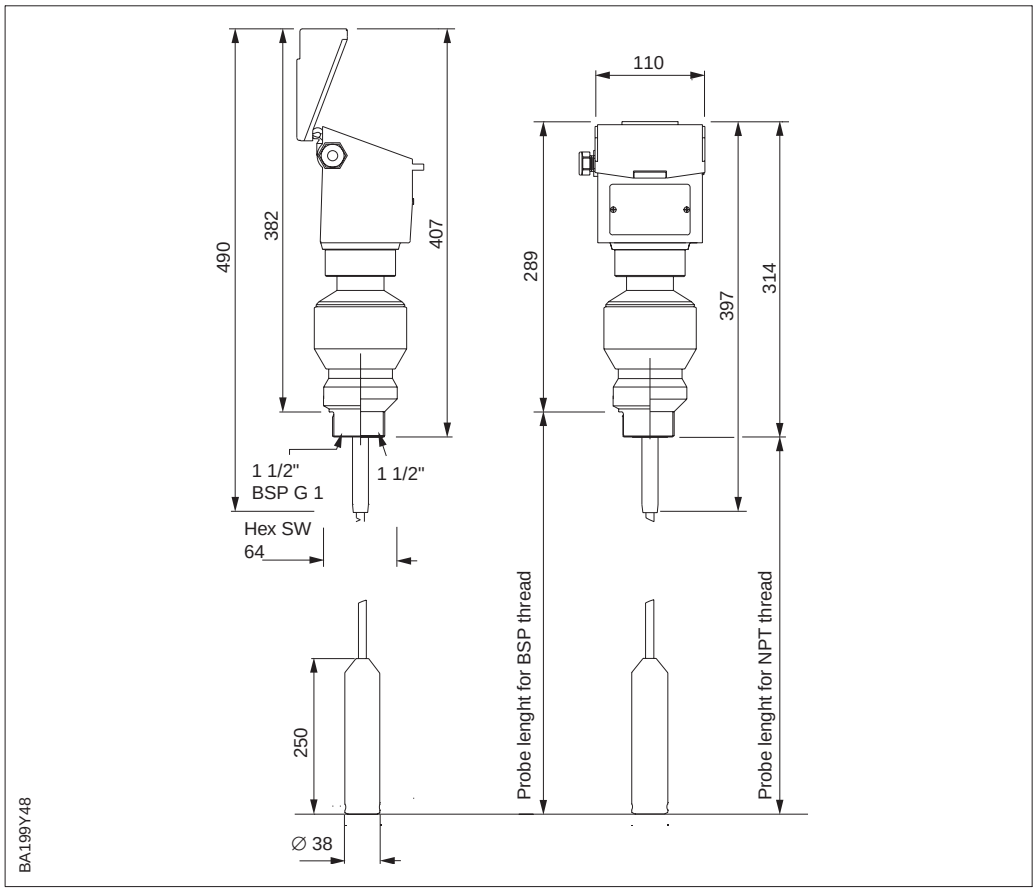


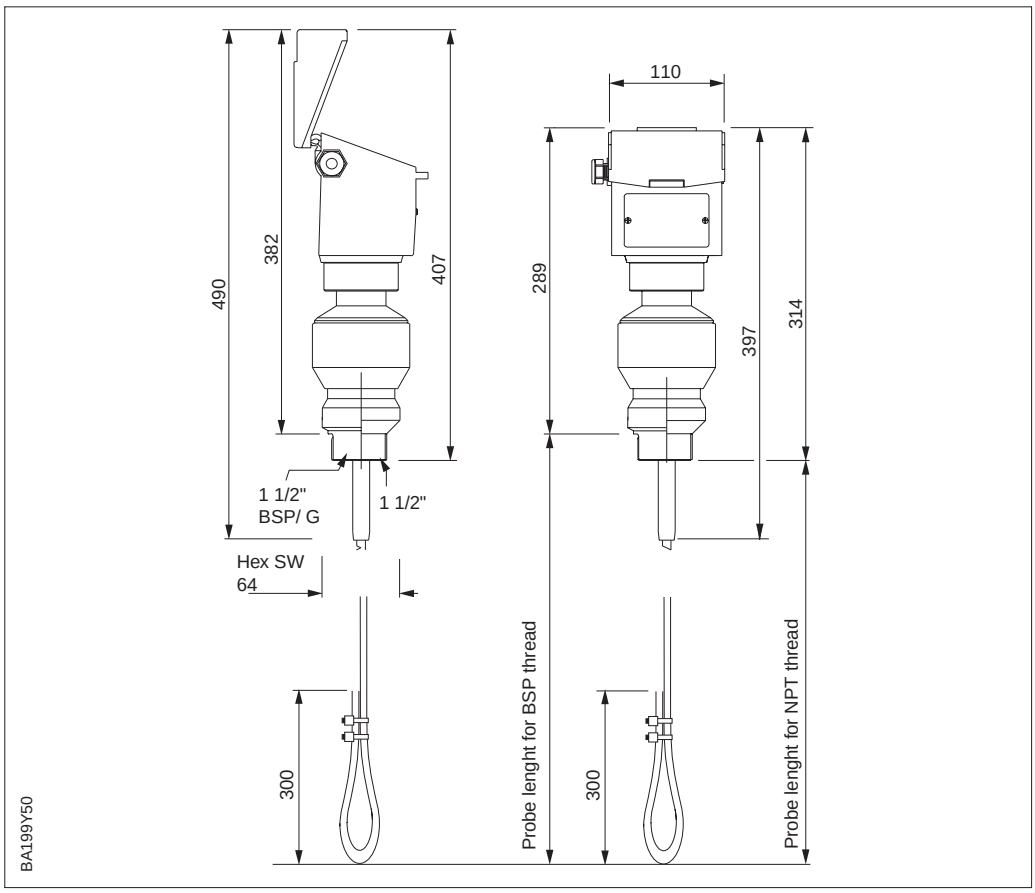
9.2 Dimensions of Levelflex FMP 232 E





9.3 Dimensions of Levelflex FMP 332 E





9.4 Forces on rope

The silo roof and probe rope must be able to withstand the forces generated by the product.

- The silo roof must withstand the maximum possible rope load (= breaking strength of rope)
- The down-pull is dependent upon the bulk density and coefficient of friction of the material, the size of the silo, the position in the silo and the selected probe.

Breaking strength of rope

The table below lists the breaking strengths of the probe rope for the normal and heavy duty versions.

Type	Stainless steel	Steel/PA	Type	Stainless steel	Steel/PA
FMP 232 E	10.5 kN	12.5 kN	FMP 332 E	40.0 kN	43.5 kN

Rope with ballast weight

The table below summarises the pull-down forces and permissible rope lengths for the free-hanging version with ballast weight.

- For silos less than 10 m diameter the full length applies to all the cases described
- The down-pull forces are shown to assist the user in considering safety factors.

Material	FMP 232 E 4 mm uncoated		FMP 232 E 4 mm coated		FMP 332 E 8 mm uncoated		FMP 332 E 8 mm coated	
	L max	pull (kN)	L max	pull (kN)	L max	pull (kN)	L max	pull (kN)
Wheat	10	1	10	1.4	20	5.2	20	7.2
Polypropylene pellets	10	0.7	10	0.9	20	3.6	20	3.6
Gravel	10	4.5	10	6	20	26	*19*	43
Cement	10	6	10	7	20	38	20	39

Pull-down forces as a function of fully buried rope and material for a 12 m diameter silo.
L max = maximum probe length

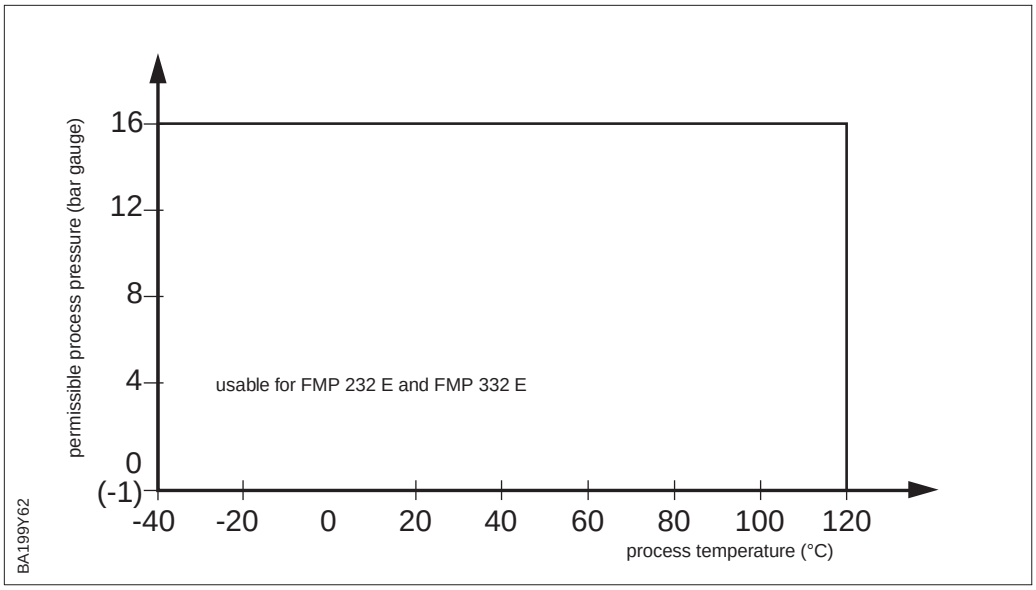
Rope with tie-down loop

Depending upon their position in the silo, the forces on ropes with tie-downs are two to ten times greater than those on ropes with ballast weights.

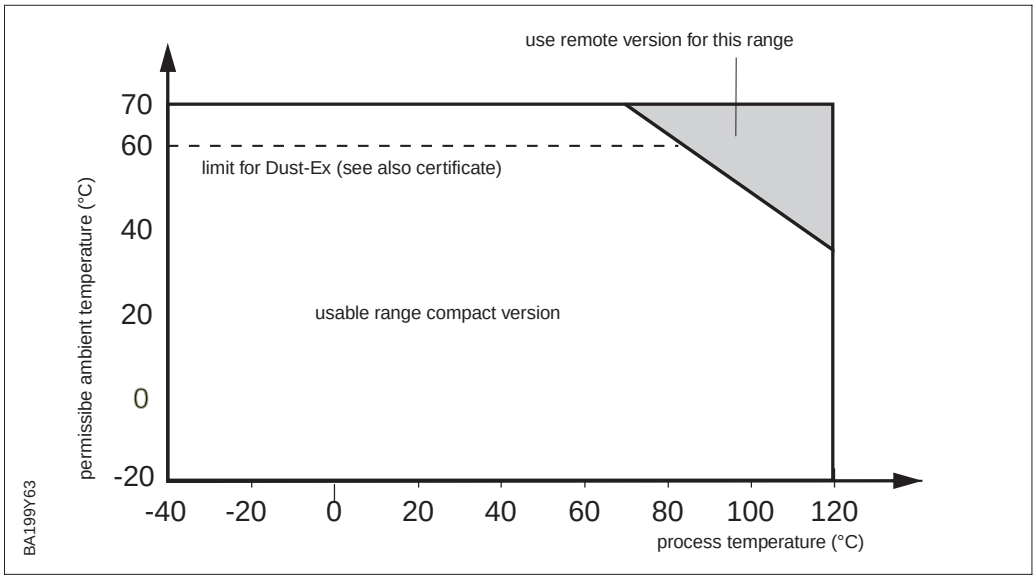
- Forces increase with buried length and silo diameter. Both parameters are of equal importance
- Allow a good safety factor.

9.5 Pressure and temperature diagrams

Permissible process pressure as a function of process temperature



Permissible ambient temperature as a function of process temperature



10 Operating Matrix

10.1 Matrix operation

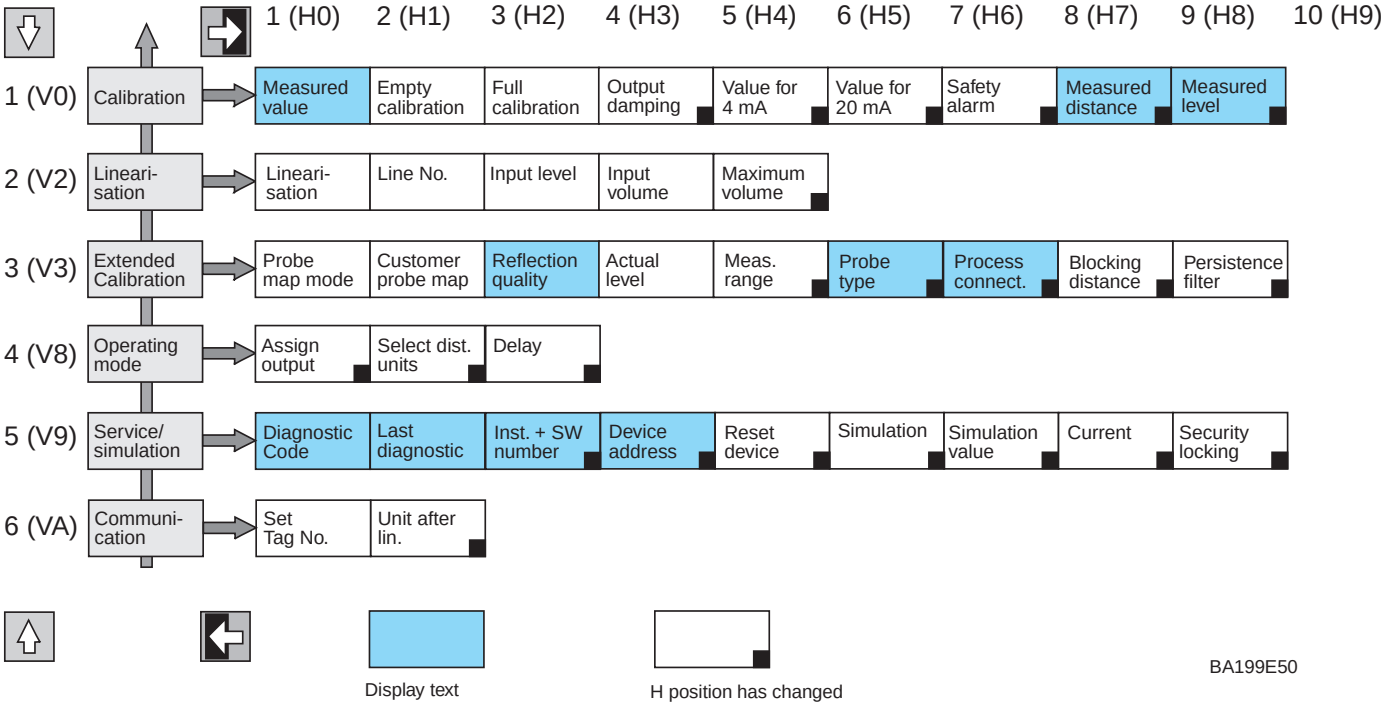
	H0	H1	H2	H3	H4	H5	H6	H7	H8	H9
V0 Basic calibration	Measured value customer unit [%] (26)	Empty calibration [V3H5] (26)	Full calibration [0.9 x E] (26)		Output damping 0...250 s [5] (28)	Value for 4 mA customer units [0] (28)	Value for 20 mA customer units [100] (28)	Safety alarm 0: MIN 1:MAX 2: HOLD [2] (28)	Measured distance (D) Metre/Feet (6)	Level (L1) Metre/Feet (6)
V1										
V2 Linearisation	Linearisation 0: level m/ft 1: activate 2: manual 3: semi-auto 4: clear 5: linear [0] (27)	Table line no. (27)	Enter level Metre/Feet (27)	Enter volume Customer units (27)		Max. volume Customer units (27)				
V3 Extended calibration	Probe map mode 0: factory 1: customer 2: partial [0] (24)	Customer probe map 0: not activated 1: activate (24)	Reflection quality 0...10 (24)	Actual level m/ft (-)		Measuring length (range) 1...10 m 1...20 m (24)	Probe type 0: uncoated 1: coated	Process connection 0: standard	Blocking distance Metre/Feet [0.3/0.6] (35)	Persistance filter 0...100 [5] 34)
V4...V6	not used									
V7 Service	*	*		*	*	*	*	*	*	*
V8 Operating mode		Assign current output mode 0: 4...20 mA 1: 4 mA limit 2: 4 / 20 mA 3: 8 /16 mA [1] (28)	Select distance unit 0: m 1: ft [0] (26)	Delay time on E641 s [100] (28)						
V9 Simulation	Diagnositic code (32)	Last diagnostic code (32		Device and software version (30)	Device address (-)	Reset 333: customer 111: map only (35)	Simulation 0: off 1: lev el 2: volume 3: current [0] (34)	Simulation value (34)	Current output mA (34)	Security lock 333: unlock xxx: lock (29)
VA Remote operation	Tag No.			Units for V0H0 1...12 : %, l, hl m^3, dm, cm qft (= ft^3), kg, t ft, US-gal						

Display field Factory setting

Factory setting [00] (00) see appropriate page in operating manual

10.2 HART

Matrix Group Select



Conversion HART/Operating matrix

Matrix	HART menu	Matrix	HART menu	Matrix	HART menu
	1 Basic calibration		**3 Extended calibration**		**5 Simulation**
V0H0	1 Measured value	V3H0	1 Probe map mode	V9H0	1 Diagnostic code
V0H1	2 Empty calibration	V3H1	2 Customer probe map	V9H1	2 Last diagnostic code
V0H2	3 Full calibration	V3H2	3 Reflection quality	V9H3	3 Software No.
V0H4	4 Output damping	V3H3	4 Actual level	V9H4	4 Device address
V0H5	5 Value for 4 mA	V3H5	5 Measuring range	V9H5	5 Reset
V0H6	6 Value for 20 mA	V3H6	6 Probe type	V9H6	6 Simulation mode
V0H7	7 Safety alarm	V3H7	7 Process connection	V9H7	7 Simulation value
V0H8	8 Measured distance	V3H8	8 Blocking distance	V9H8	8 Output current
V0H9	9 Level	V3H9	9 Persistence filter	V9H9	9 Security lock
	2 Linearisation		**4 Operating mode**	VAH0	**6 Communication**
V2H0	1 Linearisation mode	V8H1	1 Assign output	VAH3	1 Tag No.
V2H1	2 Line No.	V8H2	2 Length units		2 Unit after linearisation
V2H2	3 Enter level	V8H3	3 Delay time		
V2H3	4 Enter volume				
V2H5	5 Max. volume				

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