prosonic T
FMU 130, 131, 230, 231, 232

Ultrasonic Level Measurement
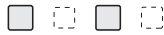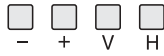
Operating Manual

Endress+Hauser

The Power of Know How
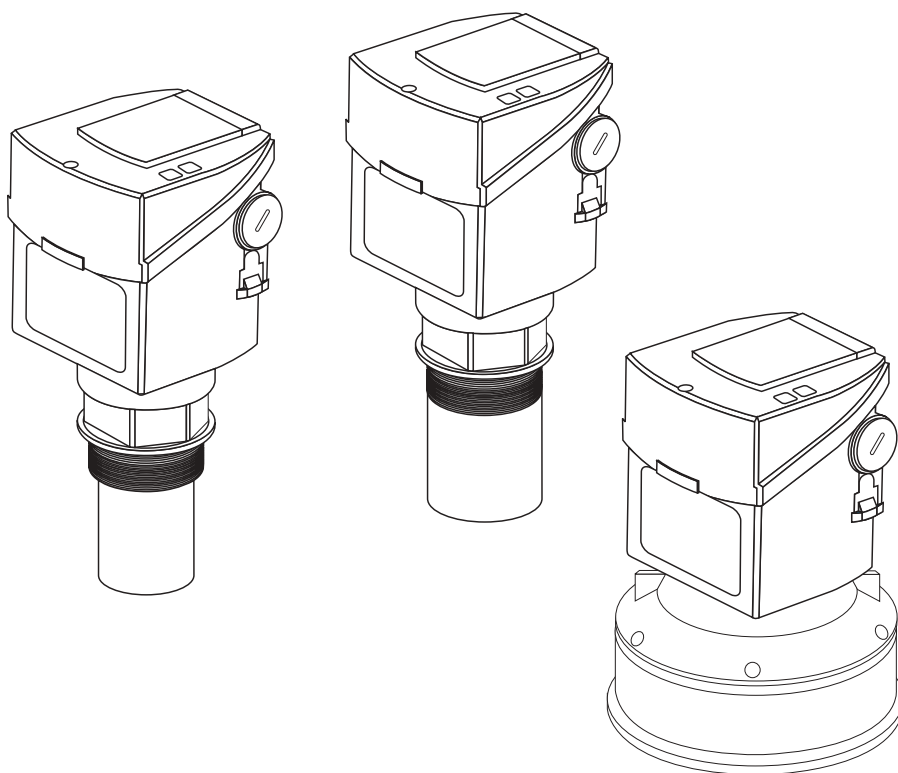
Quick reference guide: calibration

quick and easy without display

more information
page 17

− + V H

0% 4 mA

100% 20 mA

BD
Full **F**
E
F
Empty **E**
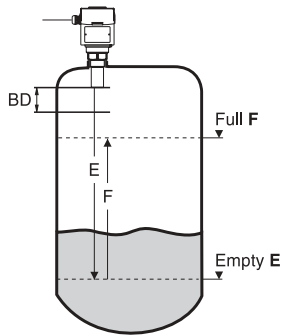
more functions with plugged-in display

more information
page 20 upwards

1. Reset instrument V9H5
   − Input: **333**
2. Select length unit V8H2
   − Input: **0:** m
     1: ft

3. Empty calibration V0H1
   − Input: **E (m/ft)**
4. Full calibration V0H2
   − Input: **F (m/ft)**
5. Applications V0H3
   − Input:
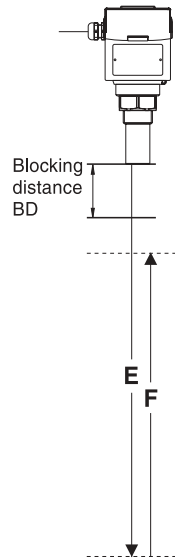
0: Liquid

1: Rapid level change

2: Dome cover

3: Bulk solids

4: Conveyor belt

Blocking distance BD

E
F

Table of Contents

Notes on Safety

The compact transmitters Prosonic T FMU have been designed to operate safely in accordance with current technical and safety standards and must be installed by qualified personnel according to the instructions in this manual. The manufacturer accepts no responsibility for any damage arising from incorrect use, installation or operation of the equipment. Changes or modifications to the equipment not expressly approved in the operating instructions or by the bodies responsible for compliance may make the user's authority to use the equipment null and void. Damaged instruments which may be a safety hazard must not be operated and are to be marked as defective.

Use in Hazardous Areas

When used in explosion hazardous areas, the equipment must be installed in accordance with local regulations as well as with the technical and safety requirements on the

			FMU 130/FMU 131 2-wire Ex	FMU 230/FMU 231 2-wire and 4-wire non Ex	FMU 232 4-wire Dust-Ex
A	Standard			X	X
J	FM, Class I, Division 1, Groups A-G [1]		X		
M	FM, Class II, Division 1, Groups E-G				X
Q	CSA, Class I, Division 1, Groups A-G [1]		X		
R	CSA, Class II, Division 1, Groups E-G				X
N	CSA General Purpose			X	X
F	Dust-Ex Zone 10				X

FMU X3X – □□□□

1) for version FMU X3X **A only**

measuring point as specified in the accompanying certificates.

Installation and Commissioning

Installation, electrical connection, commissioning, operation and maintenance may only be carried out by trained and authorized personnel. The personnel must read and understand these operating instructions before carrying them out.

Operation

The instruments may only be operated by trained personnel authorized by the plant operator. The instructions given in this manual are to be followed exactly.

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.

Explosion Protection

Symbol	Meaning
	Device certified for use in explosion hazardous area If the Prosonic T has this symbol embossed on its nameplate, 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 still require a certificate if their outputs run into explosion hazardous areas.

Electrical Symbols

Symbol	Meaning
	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.

Function

An ultrasonic emitter (sensor) mounted above the product is electronically activated and directs an ultrasonic pulse through the air towards the product. This pulse is reflected back from the surface of the product. The echoes partially reflected are detected by the same sensor, now acting as a receiver, and converted back into an electrical signal. The time taken between transmission and reception of the pulse – *time-of-flight* – is directly proportional to the distance between the sensor and the product surface.
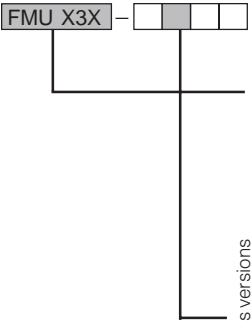
Application and Measuring Ranges

The Prosonic T is a compact ultrasonic transmitter for continuous non-contact level measurement in liquids and in coarse-grained or pelleted solids (grain size from 0.16 inches/4 mm). It has an integrated temperature sensor for time-of-flight compensation. The Prosonic T series consists of three transmitters, which can be equipped with one of several electronics modules, with graduated measuring ranges from 0.82 feet (0.25 m) upwards.

2-Wire, 4 to 20 mA "Loop-Powered"

FMU X3X –

Sensor / Process connection **Measuring ranges** liquid: solid:	FMU 130 1½″ ft (m) 0.8-13.1 (0.25-4) 0.8-6.5 (0.25-2)	**FMU 131** 2″ ft/m 1.3-23 (0.4-7) 1.3-11.5(0.4-3.5)	FMU 230 1½″ ft/m 0.8-13.1 (0.25-4) 0.8-6.5 (0.25-2)	**FMU 231** 2″ ft/m 1.3-23 (0.4-7) 1.3-11.5 (0.4-3.5)	**FMU 232** 4″ ft/m 2-49.2 (0.6-15) 2-23 (0.6-7)
Without Communication	F	F	A	A	—
HART	B	B	C	C	—
INTENSOR	A	A	B	B	—
PROFIBUS PA	P	P	P	P	P

4-Wire, Including Power Supply

FMU X3X –

Sensor / Process connection **Measuring ranges** liquid: solid:	**FMU 230** 1½″ ft/m 0.8 -16.4 (0.25-5) 0.8-6.5 (0.25-2)			**FMU 231** 2″ ft/m 1.3-26 (0.4-8) 1.3-11.5 (0.4-3.5)			**FMU 232** 4″ ft/m 2-49 (0.6-15) 2-23 (0.6-7)		
Power Supply	180 to 250 V AC	90 to 127 V AC	18 to 36 V DC	180 to 250 V AC	90 to 127 V AC	18 to 36 V DC	180 to 250 V AC	90 to 127 V AC	18 to 36 V DC
Without Communication	F	J	D	F	J	D	F	J	D
HART	G	K	E	G	K	E	G	K	E
PROFIBUS-PA (2-wire)	P	P	P	P	P	P	P	P	P

Measuring System

Operating procedures:
* Access to basic functions on site via four push-button on the electronic insert
* Matrix operation via plug-in display
* Matrix operation, communication and integration into process control systems

2-Wire, "Loop-Powered"

① Power supply: via the transmitter power pack e.g. PLC, with FMU 130, 131 connection via the Ex isolator (Zener barrier),
operation: via handheld terminal,
protocols: INTENSOR or HART

② FXN 671: operation via Rackbus or handheld terminal,
protocol: INTENSOR

③ Silometer FMX 770: operation via Commutec transmitter,
protocol: INTENSOR

④ FMU 130, FMU 131 only: connection to PROFIBUS-PA bus for up to 10 transmitters, operated by a PC

⑤ Commubox: Interface to a PC for Smart transmitters, operated by a PC or protocol HART
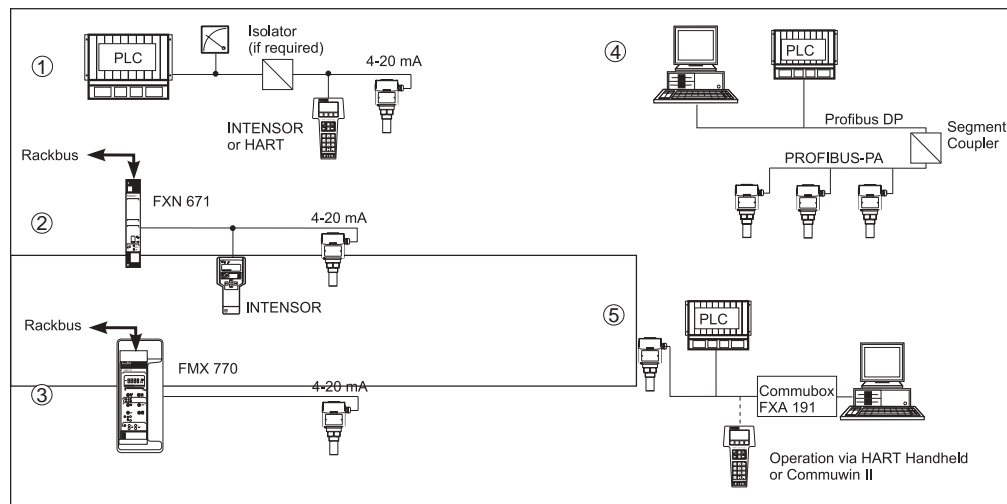
4-Wire, Separate Power Supply

Operation via HART protocol: point-to-point using handheld terminal or PC (Commubox)
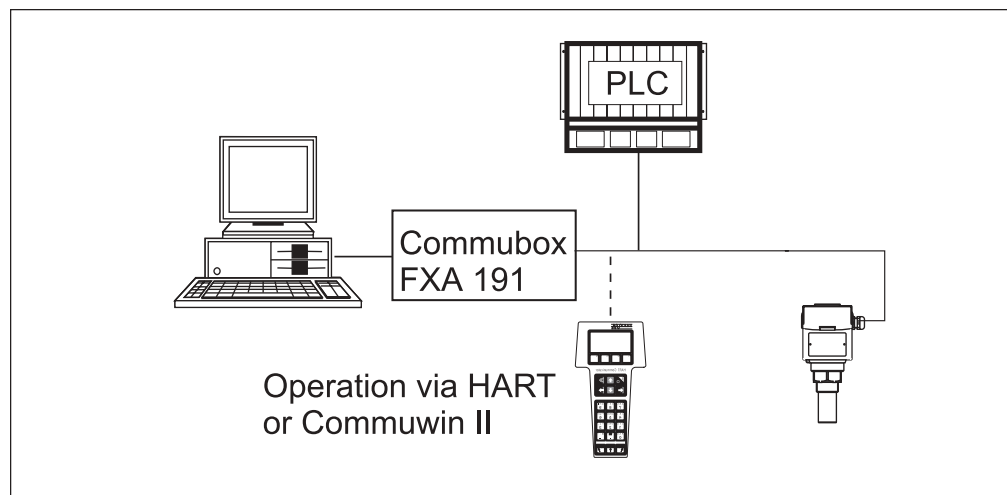
Installation

Blocking Distance

Due to the ringing time of the sensor, there is a zone immediately below it in which returning echoes cannot be detected. This so-called blocking distance is very important to the correct function of the Prosonic T. It determines the minimum distance between the sensor and the maximum level.

- Mount the sensor such that the distance between it and the maximum product level exceeds the blocking distance. Please note that if product enters the blocking distance, the device will not measure correctly.
- Never mount two Prosonic T's in a vessel because the instruments may not function correctly.
- Do not mount the sensor in the center of the vessel roof.
- Install the transmitter at right angles to the surface of the material.
- Do not measure through the filling curtain.

Housing

- Cable entry Pg 16
  Break the cable entry in the housing before mounting.
- Cable diameter 0.2 to 0.35 inches (5 to 9 mm)
- Sleeves for connection thread
  G ½; ½ NPT or M 20x1.5 supplied

Blocking Distance (BD)	
Sensor FMU	BD ft (m)
130 / 230	0.82 (0.25)
131 / 231	1.3 (0.4)
232	2 (0.6)

FMU 130, 230

FMU 131, 231

dimensions in inches (mm)

Protective Hood
Order No.: 942665-0000

Housing
Rotatable housing.
Can be repositioned after mounting.

60 mm wrench (2.36")

Max. torque 11.1 - 14.8 ft-lbs
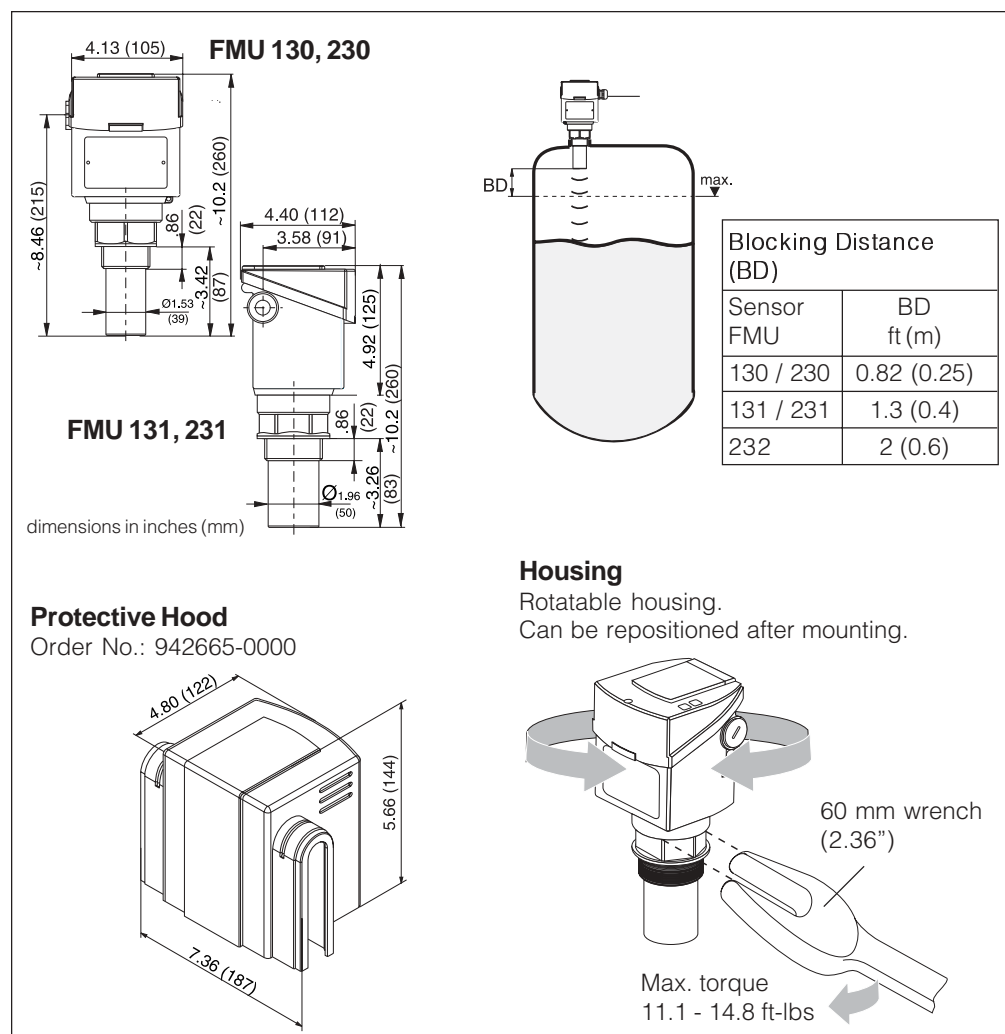
Mounting FMU 130, 131, 230, 231
With Counter Nut or Welded Sleeve

Thread Versions:
- Prosonic T FMU 130, 230 with G 1½ or 1½ NPT
- Prosonic T FMU 131, 231 with G 2 or 2 NPT

Standard Mounting

Mounting with Counter Nut

Mounting with Welded Sleeve

counter nut

welded sleeve

welded sleeve
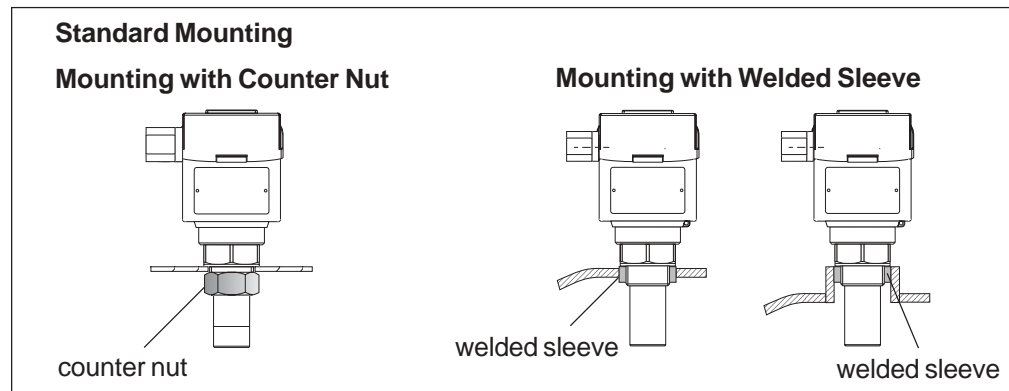
Mounting on a Nozzle
If the maximum level to be measured falls within the blocking distance, the transmitter must be mounted on a nozzle. Please note that if product enters the blocking distance, the device will not measure correctly.

- No buildup should form in the nozzle.
- The recommend nozzle dimensions are limits, within which the nozzle can vary. Select **as big a nozzle diameter as possible**, but keep **the height as small as possible**
- The inner surface of the nozzle should be as smooth as possible (no edges or welding seams).
- Interference echoes caused by the nozzle can be suppressed by the echo suppression function when a display is used for operation (see page 25).

Mounting on a Nozzle

Operation without Display
FMU 130, 131, 230, 231, 232
D_{min}=3.93 in. (100 mm)
L_{max}=5.90 in. (150 mm)

Operation with Display or Commuwin II
Please use the possibilities of echo suppression (see page 25)

Nozzle:	Height and Diameter	
Sensor FMU	D_{min} In. (mm)	L_{max} In. (mm)
130 / 230	1.96 (50)	5.90 (150)
130 / 230	3.14 (80)	9.44 (240)
130 / 230	3.93 (100)	15.0 (380)
131 / 231	3.14 (80)	9.44 (240)
131 / 231	3.93 (100)	15.0 (380)
232	3.93 (100)	11.8 (300)

L

L

L

D

D

deburr edges

Mounting FMU 130, 131, 230, 231
With Mounting Bracket or Adapter Flange

Mounting with Mounting Bracket

15.7 (400)

G

A

9.84 (250)

0.11 (3)

4.72 (120)

0.62 (16) dia.

4.72 (120)

1.18 (30)

- G 1½: A = 2.16" (55 mm)
  Order No.: 942669-0000
- G 2: A = 2.59" (66 mm)
  Order No.: 942669-0001
- Material: 304 SS
- Suited for NPT 1½" and 2" as well

Dimensions in inches (mm)
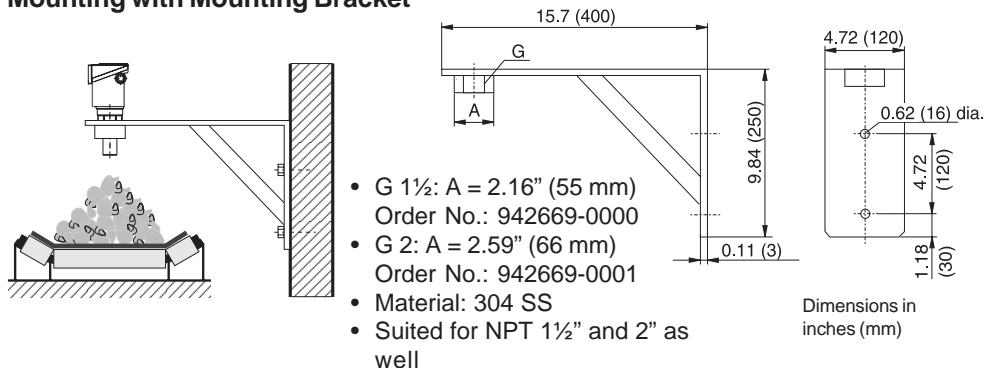
Mounting with Adapter Flange FAU 70 E (parallel thread)

FAU 70 E - X X X X

Process Connection
- **12** 2" (DN 50/PN 16)
- **14** 3" (DN 80/PN 16)
- **15** 4" (DN 100/PN 16

Sensor Connection
- **3** G 1½ ISO 228
- **4** G 2 ISO 228

Material
- **2** 1.4435 (AISI 316L)
- **7** PPs (polypropylene)
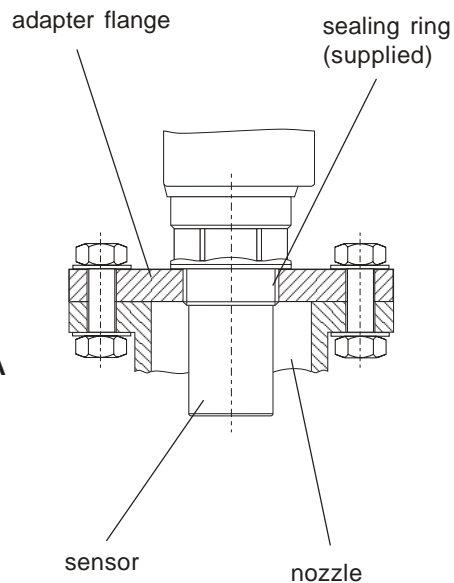
Mounting with Adapter Flange FAU 70 A (conical thread)

FAU 70 A - X X X X

Process Connection
- **22** 2" 150 psi
- **44** 3" 150 psi
- **25** 4" 150 psi

Sensor Connection
- **5** NPT 1½ - 11.5
- **6** NPT 2 - 11.5

Material
- **2** 1.4435 (AISI 316L)
- **7** PPs (polypropylene)

adapter flange

sealing ring (supplied)

sensor

nozzle

Mounting FMU 232
With Mounting Bracket or Slip-On Flange

Mounting with Mounting Bracket
- Order No.: 942666-0000
- Material: 304 SS

4.68 (119)

.98 (25)

4.72 (120)

~4.84 (123)

.07 (2)

.98 (25)

.43 (11)

Dimensions in inches (mm)

2 x M 8x12 and 2 x springs supplied
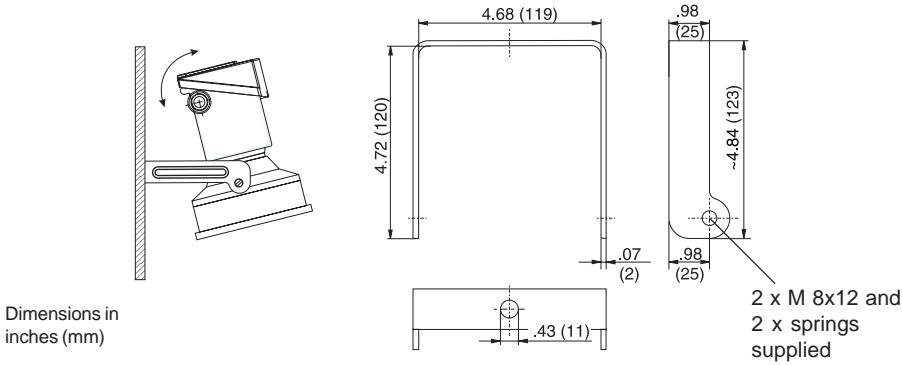
Mounting with Slip-On Flange for FMU 232

slip-on flange

sensor

nozzle

Order No.: FAU 60-X0X

Process Connection
D   4" (DN 100/PN 16)
A   ANSI 4" 150 psi
J   JIS 16 K 100

Material
P   PP
S   Steel painted
R   1.4571 (AISI 316L)

Housing

M8 internal

~8.46 (215)

6.22 (158)

Dimensions in inches (mm)
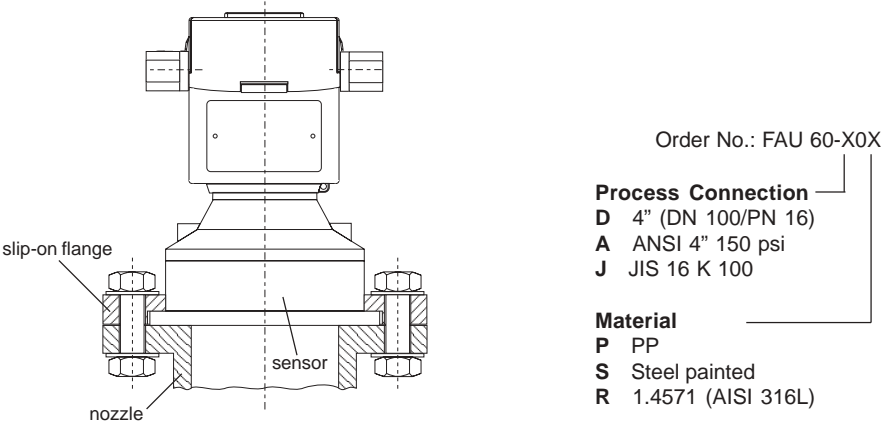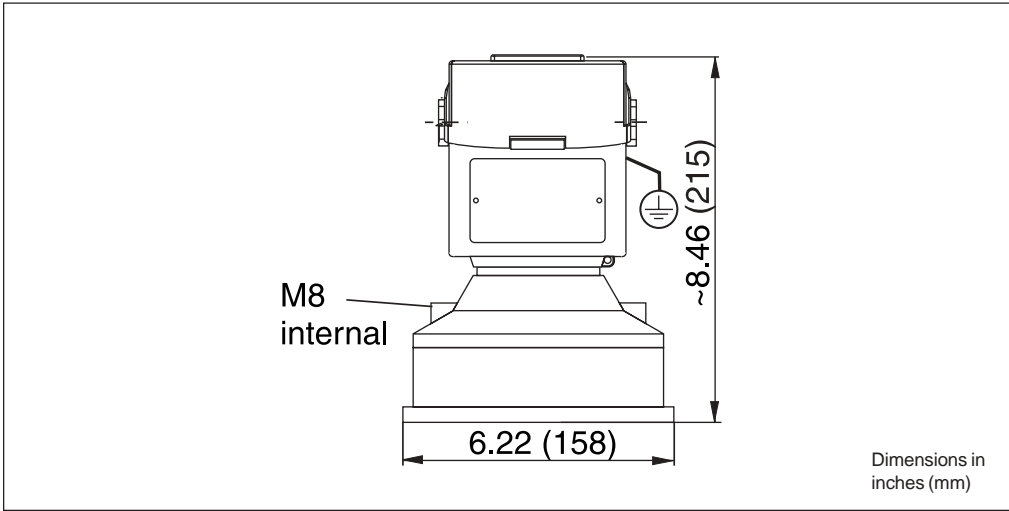
Electrical Connection

Cabling

Use shielded two-core instrumentation cable for the current output of the FMU 130, 131, 230 and 231. For optimal protection against electromagnetic interference, the shield should be grounded in the control room or the nearest earthing point. A good connection to ground is essential to good shielding.

Under certain circumstances, the digital communication signal may be affected if unshielded cable is used.

Connection Diagrams

① FMU 130, 131, 230, 231: 2-wire "loop-powered"
② FMU 230, 231: 4-wire, including main power supply
③ FMU 232: 4-wire, including power supply
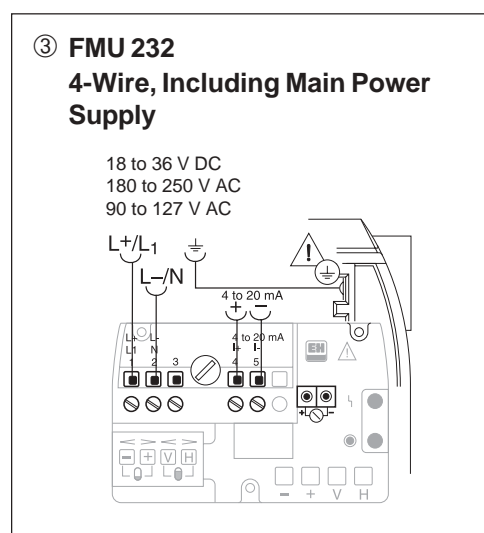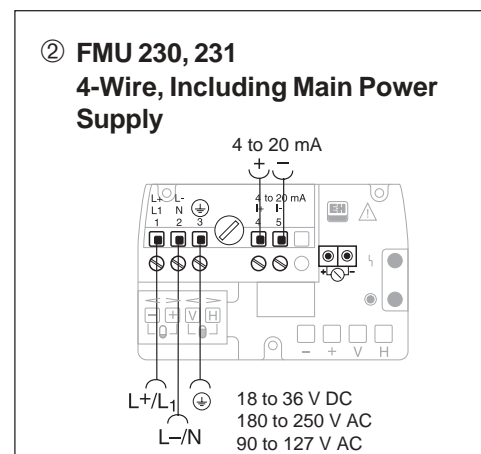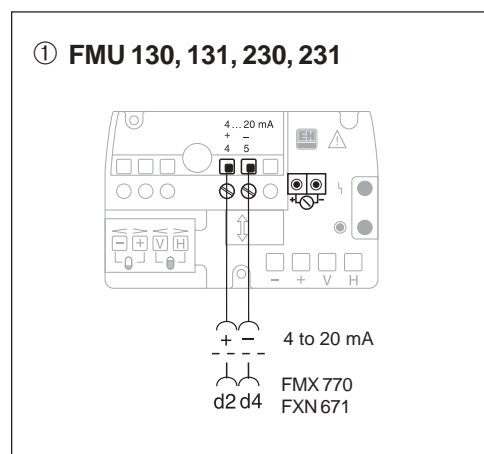
④ FMU 130, 131: 2-wire, communication: PROFIBUS-PA

Current consumption: FMU 130, 131, 230, 231: 12 mA ±1 mA

FMU 232: 16 mA ±1 mA

– Connection and operation of PROFIBUS-PA, refer also to BA 166F

⑤ Connecting the Commubox

④ **FMU 130, 131, 230, 231, 232**
PROFIBUS-PA

Every instrument has a unique address

$②+⑧=10$

off: Hardware address
on: Software address

9 to 32 V DC

⑤ **Connecting the Commubox**

Commuwin II

power supply

optional
power pack

Commubox

4 to 20 mA

total resistance
250 Ω

⑥ Connecting the handheld terminal

⑥ **Connecting the handheld terminal**   total resistance 250 Ω

OR

Connecting the handheld terminal anywhere along the 4 to 20 mA cable or directly on the compact echo transmitter.
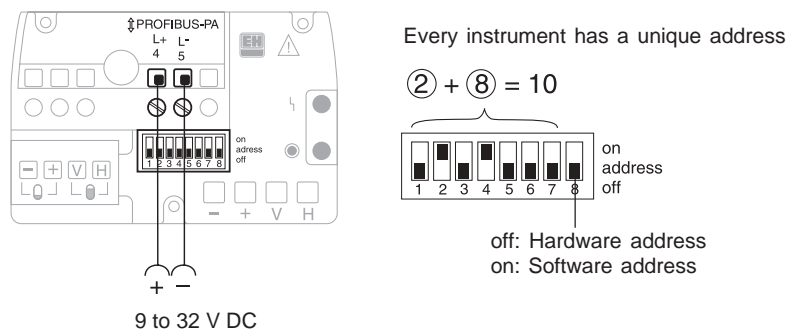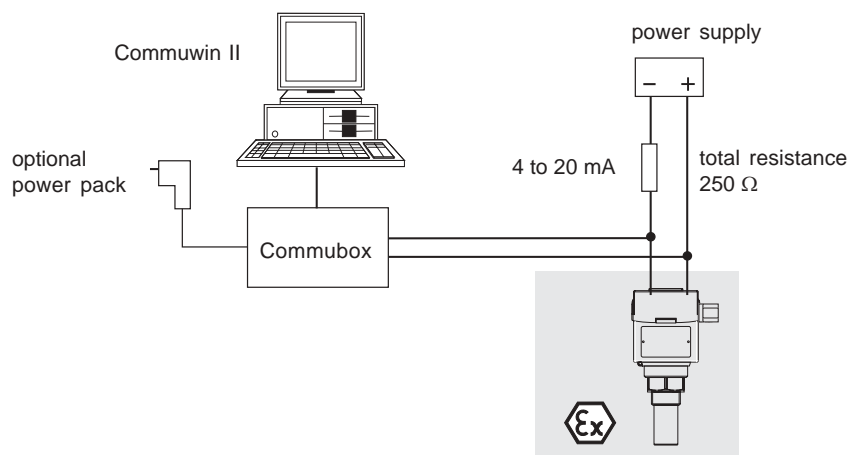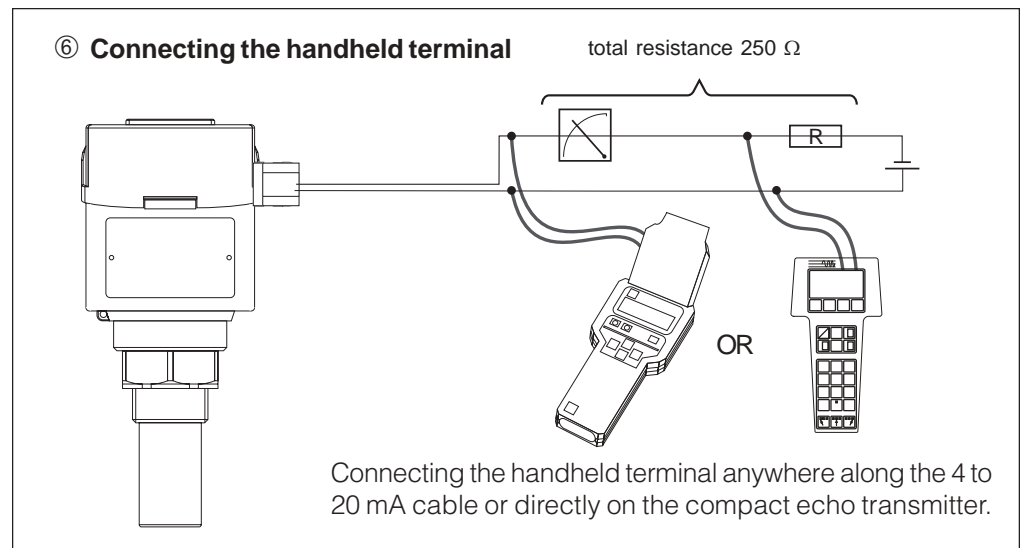
Functional Display

Prosonic T differentiates between the operational faults **alarm** and **warning**.
(See also "Information on the measuring point", page 28.)

2-Wire
If the Prosonic T Identifies an Alarm
- the bargraph flashes, if the display is plugged
- the current output adopts a preselected value (−10% = 3.8 mA, +110%, HOLD)
- an error code is output in V9H0

If the Prosonic T Identifies a Warning
- the instrument continues to measure
- an error code is output in V9H0

4-Wire
If the Prosonic T Identifies an Alarm
- the bargraph flashes, if the display is plugged
- the red LED lights up
- the current output adopts a preselected value (−10% = 2.4 mA, +110%, HOLD)
- an error code is output in V9H0

If the Prosonic T Identifies a Warning
- the red LED flashes
- the instrument continues to measure
- an error code is output in V9H0
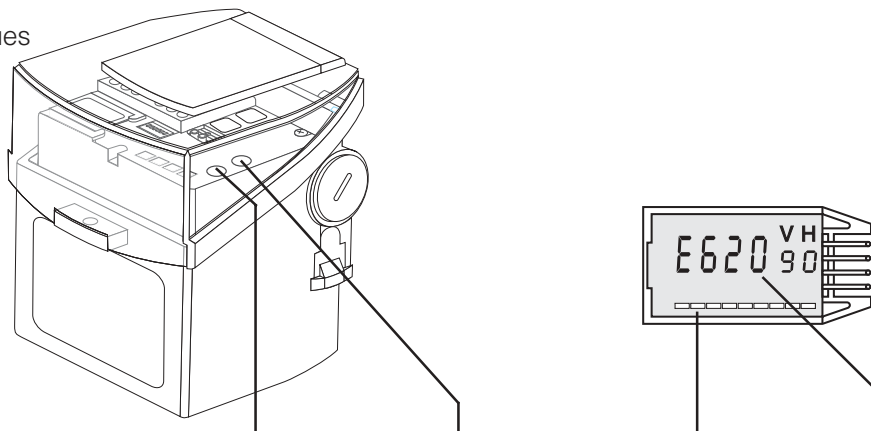
Function	Green LED	Red LED	Bar graph in display	Error Code in V9H0?
Caution 2-wire versions: The green LED is not used to display operational status due to power consumption. There is no red LED.				
2-Wire Entry completed				
Error status – Alarm				YES
– Warning				YES
4-Wire Entry completed				
Error status – Alarm				YES
– Warning				YES

————→ ○ LED off   ▮ →☼ LED on

Summary of Operating Procedures

Caution 2-wire!

After start the instrument needs approx. 50 s for test and initializing. During this time error E641 is shown in V9H0 and 9999 is shown in V0H0.
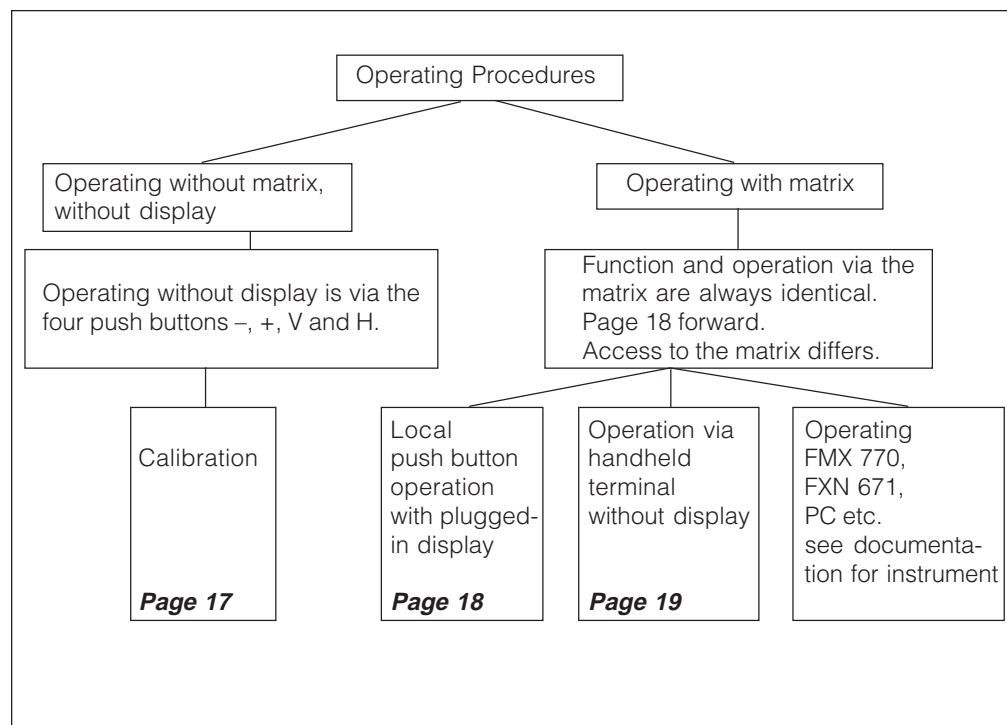
Key Operation without Display, without Matrix

The configuration can be made either with the device mounted in the vessel or with it pointed at a flat wall.

Example:
① Configuration in the vessel.
② Configuration against a flat wall.
  The level is detected over the distance between Prosonic T and the wall.
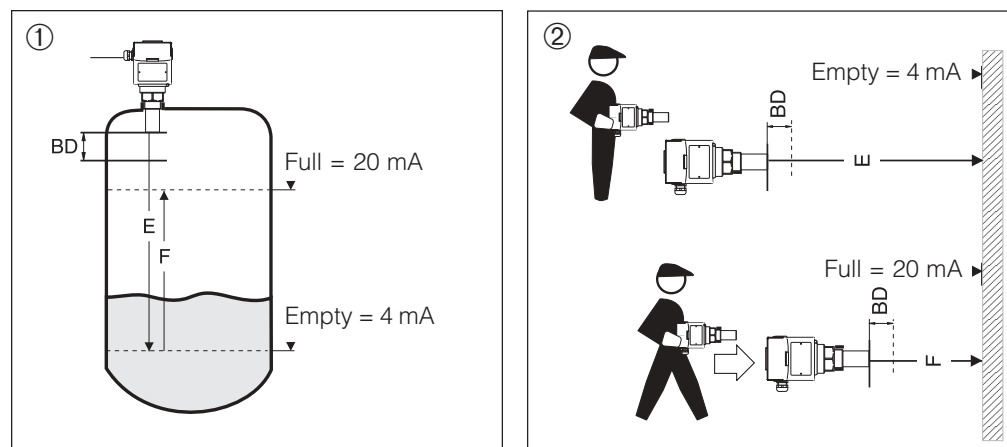
Operation without Matrix

Reset

A reset causes most of the instrument settings to return to the factory settings.
The following parameters are not affected by a reset:

- all linearization parameters
- the Tag number (VAH0)
- the m/ft selection (V8H2)

① **Reset**

③ **Locking**
Protects the entries against unwanted and unauthorized changes.
- simultaneously press ⊞ **and** Ⓥ

④ **Unlocking**
- simultaneously press ⊟ **and** Ⓗ

② **Calibration**
In order to obtain a steady measured value, a short time must elapse before the empty and full calibration.
- 2-wire: approx. 35 s
- 4-wire: approx. 20 s

- Empty calibration 0%
  – fill tank to "empty" point
  – simultaneously press ⊟ **and** ⊞
- Full calibration 100%
  – fill tank to "full" point
  – simultaneously press Ⓥ **and** Ⓗ

Caution!
If the parameters are locked by pressing push-button, programming is no longer possible via the display, handheld, etc.
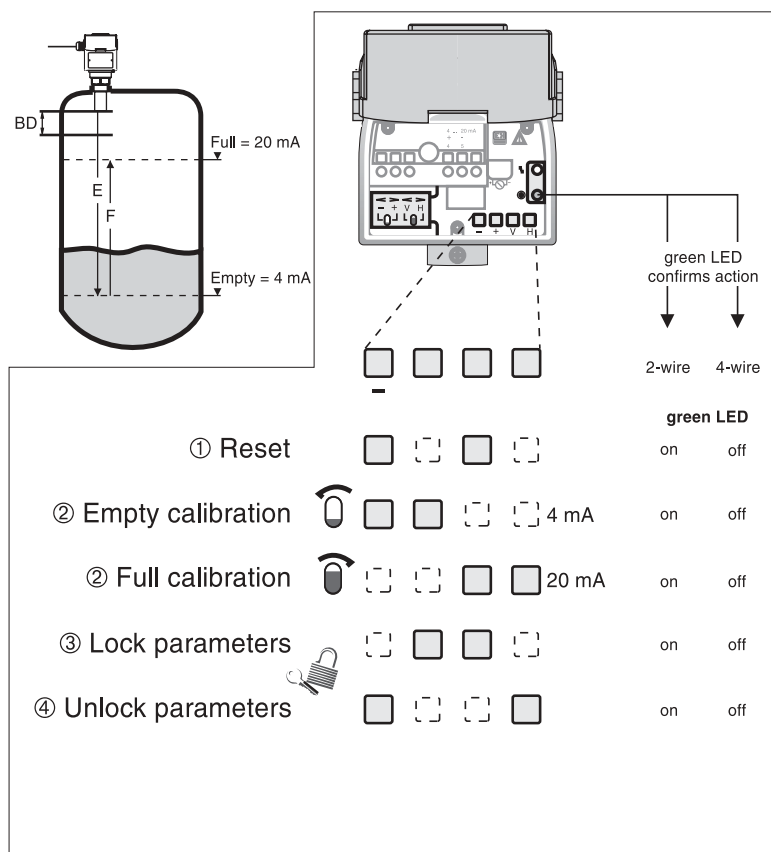
Operating via the Matrix
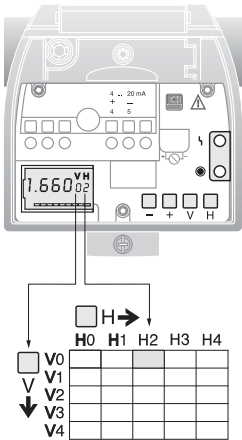
The Prosonic T is calibrated and operated using the 10 x 10 Endress+Hauser user matrix.

The **basic configuration** can be realized in its simplest form over **three matrix fields**.

Configuration and operation are always identical for:
- Local push-button operation with display
- Operation via handheld terminal
- Operation via the Silometer FMX 770 (BA 136F) or FXN 671 (TI 236F)
- Operation via a process bus

Local Push-button Operation with Plug-In Display

Display Elements

VH position

Parameter

Bar display:
– Display: current or echo quality
– flashes on alarm
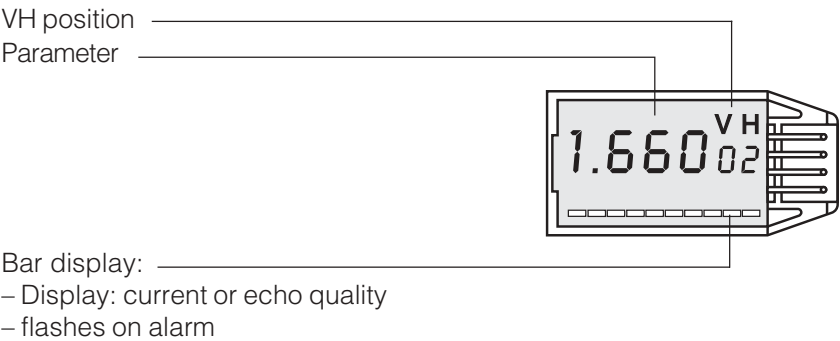
Push Buttons

| Push-button	Function
Selecting the Matrix Field	
V	Selecting the vertical matrix position.
H	Selecting the horizontal matrix position.
V and H	The display jumps to V0H0.
Entering Parameters	
+ or −	Activates the appropriate matrix position. The selected position flashes.
+	Changes the value of the flashing position by +1.
−	Changes the value of the flashing position by −1.
+ and −	Resets the value entered to the original value if it is not yet confirmed with **V** or **H**.
Confirming the Entry	
V or H	Confirms the entry by leaving the matrix field.
Locking/Unlocking the Matrix	
+ and V	Locking matrix, 9999 is shown in V9H9.
− and H	Unlocking matrix, 333 is shown in V9H9.

Operation via Commulog VU 260 Z

Prosonic T with INTENSOR protocol can be set via the Commulog VU 260 Z handheld terminal (from Version 1.7), see also Operating Instructions BA 028F.

- Select the matrix field with ←, →, ↑, ↓

- Call up the input mode with E

- Enter parameters with ←, →, ↑, ↓, E

- On error ↻ calls up the error message in plain text
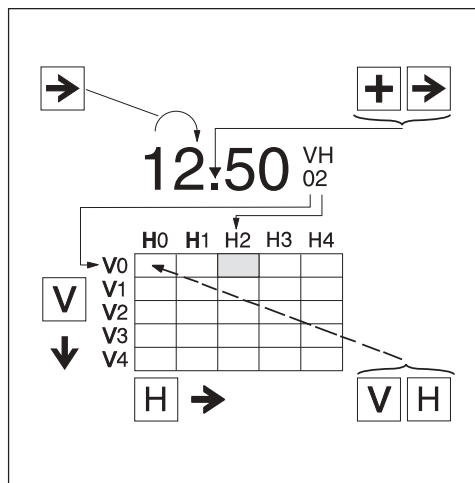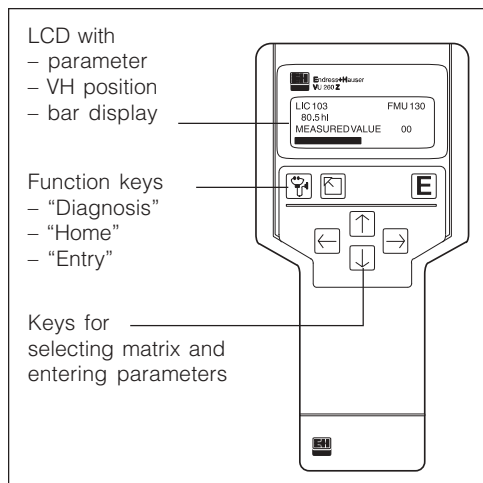
Operation via Universal HART Communicator DXR 275

For the HART protocol an interactive menu is used which is supported by the matrix (see also the operating manual for the handheld terminal).

- The menu "Group Select" calls up the matrix.
- The lines show menu headings.
- Parameters are set using submenus.
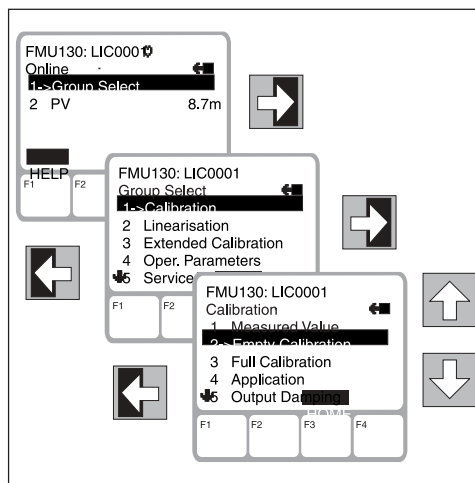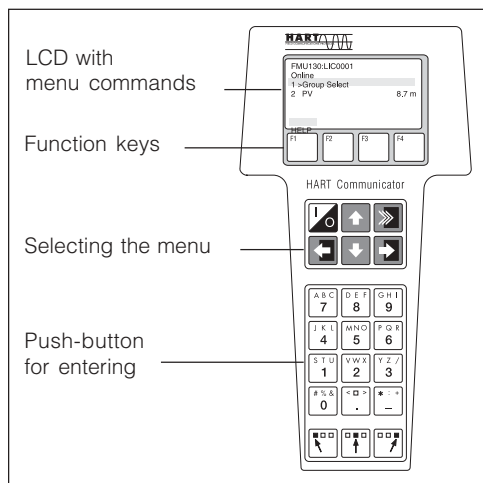
Configuration

Basic Configuration

(21) See page 21

Other Settings

```
                        ┌─────────────────────┐
                        │  Basic Calibration  │
                        │                 (21)│
                        └──────────┬──────────┘
                        ╱─────────────────────╲      no
                       ⟨     Linearization      ⟩──────────────┐
                        ╲                 (22) ╱                │
                        └──────────┬──────────┘                │
                              yes                              │
        ┌──────────┬──────────────┼──────────────┬─────────┐  │
┌───────────────┐┌───────────────┐┌───────────────┐┌─────────────┐
│ Volumetric    ││ Semi-automatic ││ Manual entry of a ││ Exception:  │
│ measurement in││ linearization by ││ linearization ││ cylindrical and │
│ linear vessels││ "emptying"    ││ curve         ││ horizontal tank │
└───────────────┘└───────────────┘└───────────────┘└─────────────┘
        └──────────┴──────────────┬──────────────┴─────────┴──┘
                        ┌─────────────────────┐
                        │  Set current output │
                        │                 (24)│
                        └──────────┬──────────┘
                           ┌───────┴───────┐
                    ┌───────────┐    ┌───────────┐
                    │ Continuous│    │  Switch   │
                    └───────────┘    └───────────┘
```
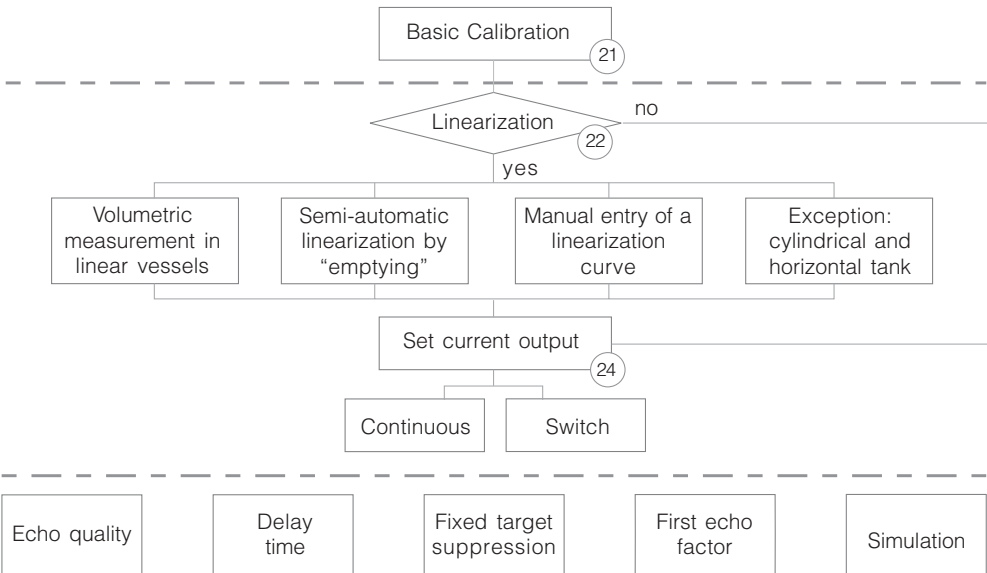
Optimize the Measuring Point

| Echo quality | Delay time | Fixed target suppression | First echo factor | Simulation |

Calling Up Measured Values and Measuring Point Information

Measured Values		Information on the Measuring Point	
Matrix Field	**Display**	**Matrix Field**	**Display**
V0H0	Main measured value	V9H0	Actual error code
V0H8	Measuring distance: distance between sensor and material, bar graph shows echo quality	V9H1	Last error code
V0H9	Height: distance between surface of material and zero point, bar graph shows echo quality	V9H2	Sensor and electronics number
V9H8	Output current value	V9H3	Instrument and software number
V3H5	Temperature		

Calibration

Reset

A reset causes most of the instrument settings to return to the factory settings. The following parameters are not affected by a reset:

- all linearization parameters (V2H0 – V2H3)
- the Tag number (VAH0)
- the m/ft selection (V8H2)

Note V8H2 Units of Length

- Units of length remain unchanged after carrying out a reset.
- They may only be entered directly after a reset. If the units of length are changed at a later date, then all subsequent entries must be repeated.

Display:

V0H0:   Level in %
V0H8:   Distance in meters/feet
V0H9:   Level in meters/feet

Caution!

All entries which follow (linearization, current output, fixed target suppression) must be in the same units as those of the calibration.

#	VH	Entry		Text
1	V9H5	**333**	H	Reset instrument
2	V8H2	**(0 to 1)**	H	Units of length **0**: meter 1: feet
3	V0H1	**E (m/ft)**	H	Empty calibration
4	V0H2	**F (m/ft)**	H	Full calibration
5	V0H3		H	Application
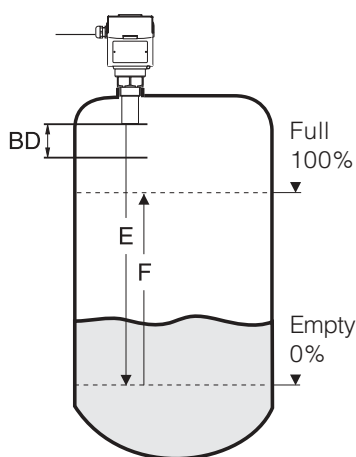
V0H3 Applications	
	0: Liquid including automatic stirrer suppression
	1: Rapid level change The height changes quickly.
	2: Liquid / dome cover including automatic stirrer suppression. The instrument is mounted under a dome cover. The maximum initial echo factor is entered as standard.
	3. Coarse bulk solids (grain size from 0.16″ / 4 mm)
	4. Conveyor belt

Linearization

Entry of a Linearization Curve
- The linearization curve must be entered in the same units as the calibration.
- Before entering another linearization curve, delete any other curve present with V2H0: 4.
- A linearization curve can have a maximum of 11 points.
- The linearization curve must **always** rise continuously.
- After entering all pairs of values activate the linearization curve with V2H0: 1.
- Points on the linearization curve can be individually changed by simply entering new pairs of values. The corrected curve must also rise continuously.

#	VH	Entry		Text
1	V2H1	**1**	H	Line No. 1
2	V2H2			Select level entry field
3	V2H2		H	Field activated digit flashes
4	V2H2	**e.g. 0.000**		Enter value
5	V2H2		H	Register entry by leaving the field

Caution!
First Point of the Linearization Curve
The level and volume values for the first point of the linearization must also be registered. The procedure is as follows:

Setting the Current Output
After a linearization, the current output must be set in the unit of linearization, e.g. volume.

Reset
The values entered in the fields V2H0 – V2H3 are **not** affected by a reset.

Errors and Warnings in V9H0
When entering a linearization curve the current output assumes an error and the instrument stops measuring. The following error messages may be shown.
- **E605**: Display when entering the linearization curve. The error message disappears when the linearization curve is activated.
- **E602**: The linearization curve rise not continuously. The number of the last correct pair of values is automatically shown in V2H1. Enter the new values in the next line in V2H2 and V2H3.
- **E604**: The linearization curve has less than two pairs of values. Enter more pairs of values.

Display after Linearization:
V0H0: Display in user-specific units
V0H8: Distance in meters/feet
V0H9: Height in meters/feet

Four Types of Measurement
① **Volumetric Measurement for Linear Relationship between Level and Volume**

#	VH	Entry		Text
1	V2H0	**4**	H	Delete
1	V2H0	**5**	H	Linear
2	V2H5	**e.g. 528 gal. = 2000 l**	H	Maximum volume $V_{100\%}$ (e.g. 2000 l = 528 gal.)

The measured value in V0H0 can be shown in any units of volume.
- The maximum volume at the "full" calibration point is entered.

Note!
The max. volume in V2H5 is automatically assigned to the "full" calibration point.

② **Entering a Linearization Table by "Emptying" a Vessel**

The vessel is gradually filled or emptied.
- The known volume is entered.
- The level is determined automatically.

#	VH	Entry		Text
1	V2H0	**4**	H	Delete
2	V2H0	**3**	H	Semi-automatic
3	V2H1	**7**	H	Line No.
4	V2H2	**e.g. 13.1 ft. (4.000 m)**	H	Level
5	V2H3	**e.g. 1320 gal. (5000 l)**	H	Volume input
6	V2H1	**6**	H	Line No.
After entering all pairs of values				
	V2H0	**1**	H	Activate table

③ **Manually Entering a Linearization Table**

A max. 11 pairs of values for level and volume are to be entered for a linearization curve.

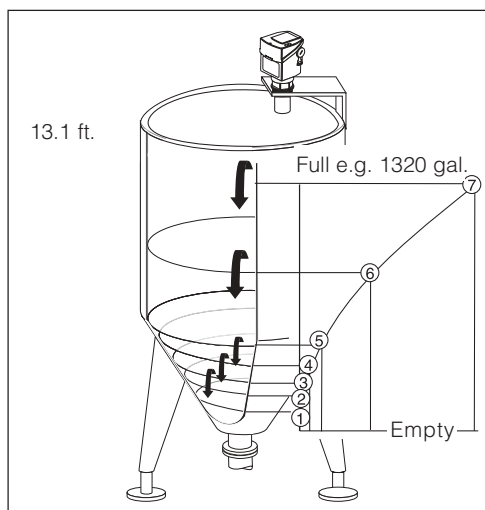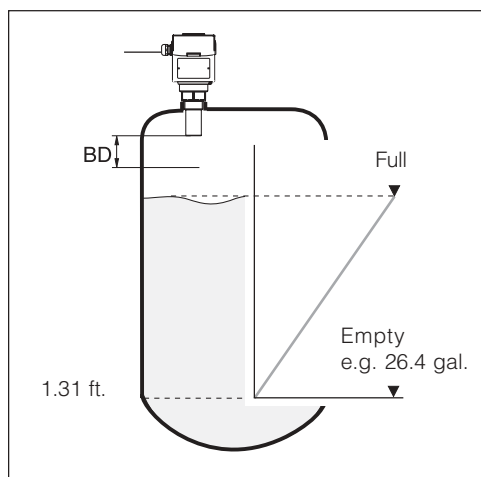| #	VH	Entry		Text
1	V2H0	**4**	H	Delete
2	V2H0	**2**	H	Manual
3	V2H1	**1**	H	Line No.
4	V2H2	**e.g. 1.31 ft (0.400 m)**	H	Level input
5	V2H3	**e.g. 26.4 gal. (100 l)**	H	Volume input
6	V2H1	**2**	H	Line No.
After entering all pairs of values				
	V2H0	**1**	H	Activate table

④ **Exception: a Cylindrical Horizontal Tank**

By using the example of a tank having a diameter of 1, the linearization curve can be calculated for any cylindrical horizontal tank.

$$V_{level} \ x \ \% = \frac{V_{all} \cdot V \%}{100}$$
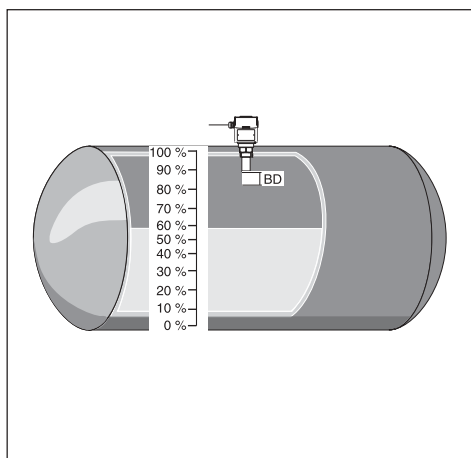
Line No. V2H1	Level V2H2		Volume V2H3	
	%	User Unit	%	User Unit
1	0		0	
2	10		5.20	
3	20		14.24	
4	30		25.23	
5	40		37.35	
6	50		50.00	
7	60		62.64	
8	70		74.77	
9	80		85.76	
10	90		94.79	
11	100		100	

Set Current Output

Notes on Current Output:
- The current output must be set in % or in the units of linearization.
- **Measuring Range Spread**: The beginning and end of the current range can be set as required with partial ranges of the total span also being assigned.
- The **current output** can also be **inverted** so that the value in V0H5 is greater than that in V0H6. An increased measured value will decrease the signal current.
- **Output Damping**: The effect of the output damping is to attenuate the analog output and the measuring indication on the display of the Prosonic T. When the liquid surface is not steady, a steady reading can be obtained with the aid of the output damping.
  0 s = without damping
  1 to 255 s = with damping
- Current on Fault (V0H7)

	4-wire	2-wire
	4 to 20 mA, 4/20 mA, 8/16 mA	
-10%	2.4 mA	3.8 mA
+110%	22 mA	22 mA

- **4 mA Threshold**:
  The 4 mA threshold ensures that no value falls below this during measurement.
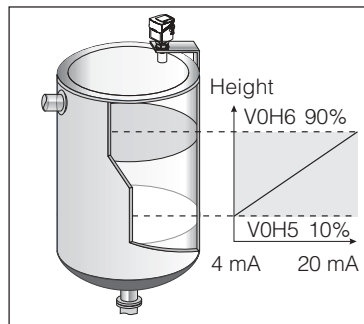
Errors and Warnings in V9H0
- **E620**: The current output is outside the set range (smaller than 3.8 mA, greater 20.5 mA). Check the calibration and settings of the current output.

Two Types of Measurement
① Continuous Current Output
The current from 4 to 20 mA is assigned to a measuring range.

#	VH	Entry		Text
1	V8H1	**e.g. 0**	H	Current output 0: linear 4 to 20 mA 1: linear 4 to 20 mA with 4 mA threshold
2	V0H5	**e.g. 10%**	H	Level for 4 mA
3	V0H6	**e.g. 90%**	H	Level for 20 mA
4	V0H4	**e.g. 20 s**	H	Output damping
5	V0H7	**e.g. 1**	H	Output on fault 0: -10% 1: +110% 2: HOLD (holds last measured value)

② Switch Current Output
The current values 4 and 20 mA or 8 and 16 mA are set as switchpoints.
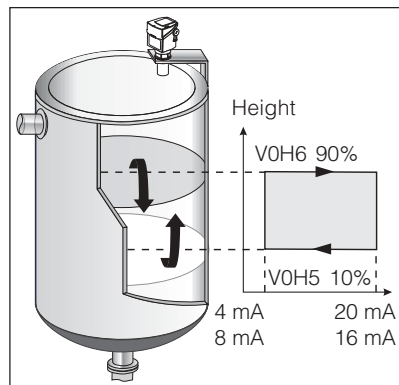
#	VH	Entry		Text
1	V8H1	**e.g. 2**	H	Current output 2: digital 4/20 mA 3: digital 8/16 mA
2	V0H5	**e.g. 10%**	H	Switchpoint min. 4 or 8 mA
3	V0H6	**e.g. 90%**	H	Switchpoint max. 20 or 16 mA
4	V0H4	**e.g. 10 s**	H	Output damping
5	V0H7	**e.g. 1**	H	Output on fault 0: -10% 1: +110% 2: HOLD (holds last measured value)

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Other Possible Entries

Echo Quality

The quality of the ultrasonic echo is shown in matrix fields V0H8 and V0H9 via the bargraph.

- Poor echo quality due to fumes, dust, internal fittings, foam, higher measuring distance etc.:
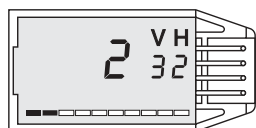
- Smooth liquid surface does not affect the echo:

Positioning the Sensor

When mounting use the bargraph display for echo quality to determine the correct installation point.

Internal fittings which intrude too far into the measuring zone of the sensor reflect the ultrasonic echo. Interfering signals can be eliminated by selecting a different sensor position or activating the fixed target suppression function.

Fixed Target Echo Suppression

The fixed target suppression function is used when the level echo is not detected because a fitting is generating a stronger interference echo. Up to three interference echoes can be suppressed. The suppression should be activated with the tank as empty as possible.
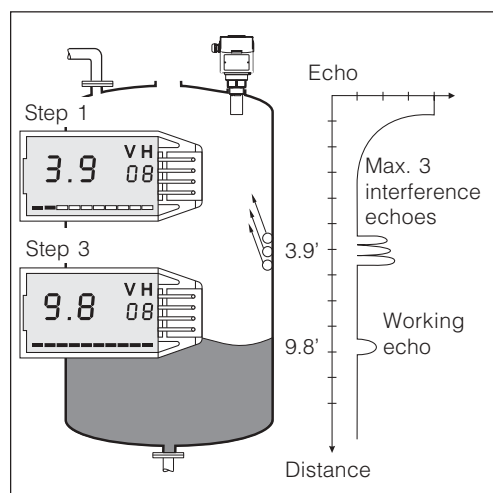
#	VH	Entry		Text
1	V0H8	Determine the measuring distance (e.g. 1.2 m /3.9 ft.) and check echo quality		
Wait until a stable value is displayed				
2	V3H0	**e.g. 3**	H	Known distance from the surface of material (e.g. 3 m /9.8 ft.)
2-wire instruments: wait approx. 40 s				
3	V0H8	Measuring distance approx. 9.8 ft.? YES - suppression completed NO - repeat procedure		

Temperature

The actual temperature at the sensor is shown in V3H5.

Upper Temperature Limit

Exceeding the upper temperature limit of 176°F (80°C) is shown in Field V3H5. Any value above 176°F (80°C) is then stored in this field.
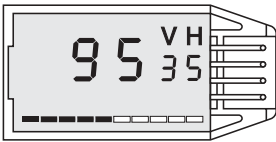
Lost Echo Delay Time

Entering a delay time in V8H3 prevents an alarm response of the measuring point to a short-term lost echo (e.g. caused by foam). For normal level applications, the delay time should not be smaller than 30 s.

#	VH	Entry		Text
1	V8H3	**e.g. 80**	H	
The measuring point reacts to a lost echo only after 80 s and then activates the alarm E 641.				

Factory setting: 60 s
Selectable: 0 to 255 s

Actual Height

Falsifications in height in V0H9 (e.g. by temperature effects) can be corrected by entering the correct height – the actual height – in V3H1. Entering the actual height then automatically corrects empty calibration.

First Echo Factor

Vessels with tightly rounded roofs (dome covers) can cause double echoes giving rise to a display showing a level which is too low. Double echoes can be excluded by increasing the first echo factor to "maximum".

#	VH	Entry		Text
1	V3H4	**2**	H	Maximum first echo factor

Simulation

The simulation mode enables Prosonic T functions to be simulated and checked.

Errors and Warnings in V9H0
- **E613**: Display during simulation.
  Returns to normal operation after simulation.
  Simulation Off: V9H6: 0
- On power failure the instrument automatically returns to normal operation!

Simulation of Height

#	VH	Entry		Text
1	V9H6	**1**	H	Simulation height
2	V9H7	**e.g. 6.600 ft. (2.000)**	H	Simulated height (e.g. 6.6 ft./2 m)
3	V9H8	Display of current (also shown on bargraph)		
	V0H0	Display of height, level or volume		
4	V9H6	**0**	H	Simulation off

Simulation of Current

#	VH	Entry		Text
1	V9H6	**3**	H	Simulation current
2	V9H7	**e.g. 14**	H	Simulated current (e.g. 14 mA)
3	V9H8	Display of current (also shown on bargraph)		
4	V9H6	0	H	Simulation off

Simulation of Volume

#	VH	Entry		Text
1	V9H6	**2**	H	Simulation volume
2	V9H7	**e.g. 26.40 gal. (100.0)**	H	Simulated volume (e.g. 26.4 gal/100 l)
3	V9H8	Display of current (also shown on bargraph)		
	V0H0	Display of volume (if no linearization curve has been entered, the volume corresponds to level).		
4	V9H6	**0**	H	Simulation off

Locking

Locking via the Keyboard

When the instrument is locked via the keyboard, both keyboard and display programming as well as all programming via the handheld terminals FMX 770, FXN 671 etc. are blocked. It can only be unlocked using the keyboard.
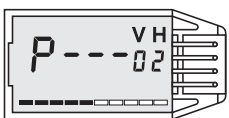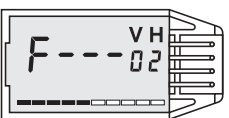
The matrix can again be locked once all parameters have been entered.

- Locking by entering a three-figure code number not equal to 333.

#	VH	Entry		Text
1	V9H9	**e.g. 332**	H	Locking
2	The number 332 is shown in V9H9. All matrix fields are blocked except V9H9.			

#	VH	Entry		Text
1	V9H9	**333**	H	Unlocking
2	The number 333 is shown in V9H9. Matrix fields are no longer blocked.			

- Locking by using the keyboard (see note on locking via the keyboard).

Information on the Measuring Point

Diagnosis and Troubleshooting

Prosonic T distinguishes between the operating faults **alarm** and **warning**.

2-wire

If the Prosonic T Identifies an Alarm
- if the display is plugged in, the bargraph flashes
- the current output adopts a preselected value (–10% = 3.8 mA, +110%, HOLD)
- an error code is output in V9H0

If the Prosonic T Identifies a Warning
- the instrument continues to measure
- an error code is output in V9H0

4-wire

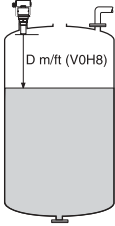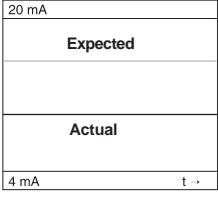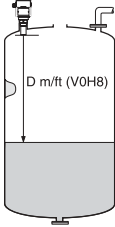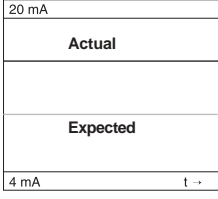**If the Prosonic T Identifies an Alarm**
- the red LED lights up
- if the display is plugged in, the bargraph flashes
- the current output adopts a preselected value (–10% = 2.4 mA, +110%, HOLD)
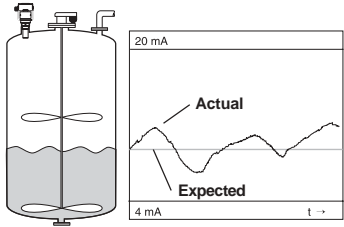- an error code is output in V9H0
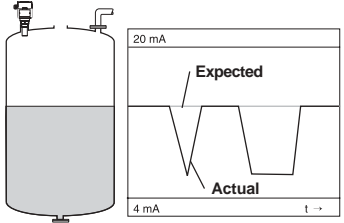
If the Prosonic T Identifies a Warning
- the red LED flashes
- the instrument continues to measure
- an error code is output in V9H0

Code	Type	Cause and Removal
E 101	Alarm	Check sum error EEPROM/FRAM - Contact Endress+Hauser Service.
E 102	Warning	Check sum error EEPROM/FRAM - Contact Endress+Hauser Service.
E 103	Warning	Initialization starting. If error remains, initialization cannot be started.
E 106	Alarm	Download in progress – Wait until completed.
E 110-E 121	Alarm	Reset instrument, if error remains, electronic instrument error. Contact Endress+Hauser Service.
E116	Alarm	Error with download – Carry out reset or restart download with corrected data.
E125	Alarm	Defective sensor – Check sensor connection. Contact Endress+Hauser Service if error remains.
E261	Alarm	Error in temperature sensor – Contact Endress+Hauser Service.
E 501	Alarm	Sensor electronics not recognized – Contact Endress+Hauser Service.
E 602	Warning	Linearization curve is rising continuously – Check manual linearization curve. Does the volume increase with height?
E 604	Warning	Linearization curve has less than 2 points – Check manual linearization curve and enter more points.
E 605	Alarm	Linearization table not available – Appears while entering the linearization curve. Activate the linearization curve after entering all points.
E 613	Warning	Simulation activated – Switch to normal operation after simulation is completed. Simulation off: V9H6: 0
E 620	Warning	Current outside range – Check calibration and settings of the current output.
E 641	Alarm	No usable echo – Due to loss of echo (e.g. foam) or when measuring starts – Check calibration and operating range Contact Endress+Hauser Service if error remains.
E 661	Warning	High Temperature (greater than 176°F/80°C) – Check measuring conditions.

Fault Analysis

	Current Output	Possible Cause	Removal
① Bar display flashes.	Response of the current output depends on the setting in V0H7. V0H7 = 0 **-10%** 2.4 mA or 3.8 mA V0H7 = 1 **110%** 22 mA V0H7 = 2 **HOLD** Last value is held	Error code in V9H0. → *yes*	– Which error code? *See page 28.* – Further action depends on the error code.
		E641 in V9H0 Echo too weak or foam on the surface. → *yes*	– Check sensor position. *See pages 8-11, 25.*
② Measured value in V0H0 too small.		Distance D in V0H8 too large? → *yes* ↓ *no* Incorrect linearization? → *yes* ↓ *no* Incorrect current output? → *yes*	Multiple echo? *See ⑤* – Gas layering? Contact E+H Service. – Check sensor position. *See pages 8-11, 25.* – Re-enter linearization curve *See pages 22 – 23.* – Check values in V0H5 and V0H6 and re-enter if necessary. *See page 24.*
③ Measured value in V0H0 too large.		Distance D in V0H8 too small? → *yes* ↓ *no*	Interference from internals in the measuring range? Instrument mounted in nozzle? – Check dimensions of nozzle. *See page 9.* – Check sensor position. *See pages 8-11, 25.* – Select application parameter 0 or 2 in V0H3. *See page 21.* – Carry out interference echo suppression. *See page 25.*
		Incorrect linearization? → *yes* ↓ *no* Incorrect current output? → *yes*	Re-enter linearization curve. *See pages 22-23.* Check values in V0H5 and V0H6 and re-enter if necessary. *See page 24.*

④ Measured value jumps sporadically with constant level and turbulence or agitator blades.		Is the signal affected by turbulence or agitator blades?	*yes*	– Increase output damping *see page 24.* – With agitator blades in measuring range, check sensor position. *see page 8-11, 25.* – Select application parameter 0 or 2 in V0H3. *See page 21.*
⑤ The measured value jumps to a lower value or remains continuously too low with constant level.		Multiple echoes?	*yes*	– Select application parameter 2 in V0H3. *See page 21.* – Select a larger first echo factor 1 or 2 in V3H4. *See page 26.*

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Matrix INTENSOR

	H0	H1	H2	H3	H4	H5	H6	H7	H8	H9
Calibration V0	Measured value User unit	Empty calibration m/ft	Full calibration m/ft	Application fast :1 dome cover :2 coarse bulk solids :3 conveyor belt :4	Output damping 0 - 255 s Seconds	Value for 4 mA Switch point for 4 mA 8 mA User unit	Value for 20 mA Switch point for 20 mA 16 mA User unit	Output on alarm –10% :0 2-wire: 3.8 mA 4-wire: 2.4 mA :1 HOLD :2	Measured distance bargraph= echo quality m/ft	Height bargraph= echo quality m/ft
V1										
Lineari-zation V2	Linearization height :0 activate table :1 manual :2 automatic :3 cancel :4 :5	Linearization table Line number	Linearization table Input level m/ft	Linearization table Input volume m/ft		Volume max. User unit				
Extended Parameter V3	Range for automatic suppression **Default: 0.000**	Actual level **Default: 0.000**	Echo quality 0 - 10		1st echo factor none :0 **medium :1** max. :2	Temperature °C				
V4 - V7										
Operating parameter V8	Current output **linear :0** **4-20 mA** linear 4-20 mA with threshold:1 digit 4/20 mA :2 digit 8/16 mA :3	Select unit **m :0** ft :1	Lost echo delay time 0 - 255 s **Default: 60 s** Seconds							
Service/ Simulation V9	Diagnostic code	Last diagnostic code	Type of sensor/ electronics	Instrument & Software no.	Rackbus-Address (only for RS-485 devices)	Reset device 333	Simulation **off :0** height :1 volume :2 current :3	Simulation value	Current output	Security locking other than 333 locks 333 unlocks
Communi-cation VA	Tag-Number			Unit after lin.						

☐ Display field   ☐ Entry field   Bold type e.g. **Default: 3 s** factory settings

Matrix HART

Group Select

	1 (H0)	2 (H1)	3 (H2)	4 (H3)	5 (H4)	6 (H5)	7 (H6)	8 (H7)	9 (H8)	10 (H9)
1 (V0) Calibration	Measured value	Empty calibration	Full calibration	Application	Output damping	Value for 4 mA	Value for 20 mA	Safety alarm	Measured distance	Measured level
2 (V2) Linearization	Linearization	Line No.	Input level	Input volume	Volume max.					
3 (V3) Extended parameter		Range for aut. suppr.	Actual level	Echo quality	1st echo factor	Measured temperature				
4 (V8) Operating parameter		Assign output	Select unit	Delay time						
5 (V9) Service and Simulation	Diagnostic code	Last diagnostic code	Type of sensor / electronics	Instrument & software No.	Rackbus-address RS-485	Reset 333	Simulation	Simulation value	Current output	Security locking
6 (VA) Communication	Tag-Number	Unit after lin.								Device ID
8 HART Specific	Date	Message	Descriptor	Poll address	Burst mode	Burst options	Universal revision	Device revision	Software revision	Hardware revision

Legend:

- Display field
- With HART only
- Modified H position

Technical Data
(Subject to change without notice)

Input Variables

Frequency	FMU 130, 230: approx. 70 kHz; FMU 131, 231: approx. 55 kHz; FMU 232: approx. 37 kHz
Pulse Frequency	0.5 to 3 Hz, depending on sensor and electronic version

Output Variables

Output Damping (Integration time)	0 - 255 s
Load	Max. 600 Ω

Measuring Accuracy

Measuring Uncertainty	0.25% for max. measuring span (ideal reflection from flat surface at 68°F/20°C)
Resolution	FMU 130, 131, 230, 231 (2-wire): 0.12 in. (3 mm); FMU 230, 231, 232 (4-wire): 0.078 in. (2 mm)

Application Conditions

Medium temperature range	-40 to +176°F (-40 to +80°C) (built-in temperature sensor)
Operating Temperature Range	-4 to +140°F (-20 to +60°C)
Storage Temperature Range	40 to +176°F (-40 to +80°C)
Operating Pressure p_{abs}	Sensors with process connection G 1½ and G 2: 44 psi (3 bar); Sensor DN 100 or 4″: 36 psi (2.5 bar)
Climatic Class	DIN / IEC 68 T2-30 dB
Type of Protection	NEMA 6, with housing cover open; NEMA 1
Vibration Resistance	DIN IEC 68T2-6 Tab. 2.C (10 to 55 Hz)
Electromagnetic Compatibility	Interference emission according to EN 61326; apparatus of class B; interference immunity according to EN 61326, app. A (industrial area) and NAMUR recommendation EMV (NE 21)
Explosion Protection	FMU 130/131 (2-wire Ex): EEx ia IIC T6 (FRG: Zone 1 only) FMU 230/231 (2-wire not Ex and 4-wire): without FMU 232 (4-wire): Dust-Ex Zone 10 (FRG only: BVS) not with open housing cover

Mechanical Design

Material	Housing: PBT (glass reinforced, flame-retardant) Threaded boss and sensor: PVDF, for FMU 232: UP (unsaturated polyester), or 1.4571 (SS316TI) Sensor diaphragm: Stainless steel
Seals	Between threaded boss and sensor, internal: EPDM seal; On threaded boss, external: EPDM seal

Display and Operating Elements

Display (LCD)	4-character display with segment display of current
LEDs	**Red:** Indicates alarm or warning
	Green: Indicates power ON (with four-wire versions only) and entry acknowledgment

[1])Please check with Endress+Hauser before using sensors at higher temperatures and higher pressures. When sensors are subjected to high temperatures and pressures (with limiting conditions), it is recommended that the coupling (process connection) be tightened.

Power Supply

AC Voltage   4-wire: 180 to 250 V AC;
                                90 to 127 V AC; power consumption < 4 VA

DC Voltage   4-wire: 18 to 36 V DC, power consumption
                                         < 2.5 W
                                2-wire: 12 to 36 V DC

Ripple (Smart-devices)   INTENSOR max. ripple (measured at 500 Ω)
                                0 to 100 kHz; V_{pp} = 30 mV
                                HART max. ripple (measured at 500 Ω)
                                 47 Hz to 125 Hz; V_{pp} = 200 mV
                                Max. noise (measured at 500 Ω)
                                500 Hz to 10 kHz: $V_{eff.}$ = 2.2 mV

Electric Isolation   The evaluation electronics is electrically
                                isolated from the power supply terminals
                                with all four-wire versions

Software Development

Software version and BA version			Modifications	Remarks
Prosonic T SW/BA	**Instrument and Software No. V9H3**	**VU 260 Z**		
1.0/from 03.96	7510	1.7	No changes to the documentation	No up-/down-load between SW 1.x and 2.x possible
1.2/from 03.96	7512	1.7		
1.3/from 03.96	7513	1.7		
1.4/from 03.96	7514	1.7		
2.0/from 04.97	7520	from 1.7	Operation simplified. Documentation updated.	
2.2/from 08.99	7522	from 1.7	No changes to the documentation	

Prosonic T SW/BA	**Instrument and Software No. V9H3**	**DXR 275**	**Modifications**	**Remarks**
1.0/from 03.96	7410	Device Revision: 1 DD-Revision: 2	No changes to the documentation	No up-/down-load between SW 1.x and 2.x possible
1.2/from 03.96	7412			
1.3/from 03.96	7413			
1.4/from 03.96	7414			
2.0/from 04.97	7420	Device Revision: 2 DD-Revision: 2	Operation simplified. Documentation updated.	
2.1/from 01.98	7421		Error message E 641 revised.	
2.2/from 08.99	7422		No changes to the documentation	

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Endress+Hauser

IMPORTANT NOTICE
RETURN AUTHORIZATION POLICY

Endress+Hauser must pre-approve and assign a Return Authorization number to any instrument you plan to return. Please identify the Return Authorization number clearly on all shipping cartons and paperwork.

Please note that the issuance of a Return Authorization number does not automatically mean that credit will be issued, or that the return is covered by our warranty. An Endress+Hauser associate will contact you regarding the disposition of your returned equipment.

In order to serve you better, and to protect our employees from any potentially hazardous contaminants, Endress+Hauser must return unopened, at the sender's expense, all items that do not have a Return Authorization number.

To get a Return Authorization number for **credit**, call **888-ENDRESS**

To get a Return Authorization number for **calibration or repair**, call **800-642-8737**

To get a Return Authorization number **in Canada**, call **800-668-3199**

Please be sure to include the following information when requesting a Return Authorization number. This information will help us speed up the repair and return process.

Customer name:
Customer address:
Customer phone number:
Customer contact:
Equipment type:
Original sales order or purchase order number:
Reason for return:
Failure description, if applicable:
Process material(s) to which the equipment has been exposed:

> OSHA Hazard Communication Standard 29CFR 1910.1200 mandates that we take specific steps to protect our employees from exposure to potentially hazardous materials. Therefore, all equipment so exposed must be accompanied by a letter certifying that the equipment has been decontaminated prior to its acceptance by Endress+Hauser.

The employees of Endress+Hauser sincerely appreciate your cooperation in following this policy.

Address your equipment to:

Endress+Hauser
2350 Endress Place
Greenwood, IN 46143
Return Authorization number:

In Canada:

Endress+Hauser
1440 Graham's Lane, #1, Burlington
Ont. Canada L7S 1W3
Return Authorization number:

Effective November 1987

For application and selection assistance,
in the U.S. call 888-ENDRESS

For total support of your installed base, 24 hours a day,
in the U.S. call 800-642-8737

Visit us on our web site, www.us.endress.com

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