KA 042F/00/a3/05.00 016810-0000 Software 2.2

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

e Ultrasonic Level Measurement



Quick reference guide: calibration



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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 measuring point as specified in the accompanying certificates.

	FMU >	(3X)-	FMU 130/FMU 131 2-wire Ex	FMU 230/FMU 231 2-wire and 4-wire non Ex	FMU 232 4-wire Dust-Ex
	А	Standard		х	х
	В	EEx ia IIC, Zone 1 / Atex II 2 G	х		
	J	FM, Class I, Division 1 Groups A-D 1)	х		
	М	FM, Class II, Division 1 Groups E-G			х
	Q	CSA, Class I, Division 1, Groups A-D 1)	х		
	R	CSA, Class II, Division 1, Groups E-G			х
	Ν	CSA General Purpose		х	х
	F	BVS/DMT (St-Ex) Zone 10 / ATEX II 1/3 D			×

1) for version FMU X3X A only

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.

Symbol	Meaning
(Ex)	Device certified for use in explosion hazardous areas If the Porsonic T has this symbol embossed on its name plate it can be installed in an explosion hazardous area.
<u> </u>	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.
Ex	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.
	Direct voltage A terminal to which or from which a direct current or voltage may be applied or supplied.
\sim	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.
\forall	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.

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

Electrical Symbols

Function

Application and Measuring Ranges

FML

2-Wire, 4...20 mA »Loop-Powered«

An ultrasonic emitter (sensor) mounted above the product is electrically excited 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 – the *time-of-flight* – is directly proportional to the distance between the sensor and the product surface.

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 4 mm/0.16 in). 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 electronic modules, with graduated measuring ranges from 0.25 m (0.82 ft) upwards.

X3X			Sensor / Process connection Measuring ranges liquid: solid:	FMU 130 1 ¹ /2" m/ft 0.25-4/0.8-13 0.25-2/0.8-6.6	FMU 131 2" m/ft 0.4-7/1.3-23 0.4-3.5/1.3-11.5	FMU 230 1 ¹ /2" m/ft 0.25-4/0.8-13.1 0.25-2/0.8-6.6	FMU 231 2" m/ft 0.4-7/1.3-23 0.4-3.5/1.3-11.5	FMU 232 4" m/ft 0.6-15/2-49 0.6-7/2-23
		sions	without communication	F	F	А	А	—
		ver	HART	В	В	С	С	—
		onic	INTENSOR	А	A	В	В	—
s Power Sup	ply	Electr	PROFIBUS-PA	Ρ	Р	Ρ	Р	Р

4-Wire, Including Mains Power Supply

FMU X3X –	

	Sensor / Process connection Measuring ranges liquid: solid:	0.2 0.1	FMU 230 1 ¹ /2" m/ft 25-5/0.8-1 25-2/0.8-6	6.4 5.6	0 0.4	FMU 231 2" m/ft .4-8/1.3-2 -3.5/1.3-1	6 1.5	0	FMU 232 4" m/ft 0.6-15/2-4 0.6-7/2-23	9
	power supply	180 250 V _{AC}	90 127 V _{AC}	18 36 V _{DC}	180 250 V _{AC}	90 127 V _{AC}	18 36 V _{DC}	180 250 V _{AC}	90 127 V _{AC}	18 36 V _{DC}
	without communication	F	J	D	F	J	D	F	J	D
1	HART	G	К	E	G	К	E	G	К	E
	PROFIBUS-PA (2-wire)	Ρ	Р	Р	Ρ	Р	Ρ	Р	Р	Р

Operating procedures:

- Access to basic functions on site via four pushbuttons on the electronic insert
- Matrix operation via plug-in display
- Matrix operation, communication and integration into process control systems





Measuring System

2-Wire, "Loop-Powered"

 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
- Silometer FMX 770: operation via Commutec transmitter, protocol INTENSOR
- FMU 130, FMU 131 only: connection to PROFIBUS-PA bus for up to 10 transmitters, operated by a PC
 Commutox:
- 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 in a vessel because the instruments may not function correctly.
- Do not mount the sensor in the centre 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 5...9 mm (0.2...0.35 in)
- Sleeves for connection thread G 1/2; 1/2 NPT or M 20x1.5 supplied.





Mounting on a Nozzle

Operation without Display

 $\begin{array}{l} FMU \; 130, \; 131, \; 230, \; 231, \; 232 \\ D_{min} = 100 \; mm \; (3.9 \; in) \\ L_{max} = 150 \; mm \; (5.9 \; in) \end{array}$



Operation with Display

Please use the possibilities of echo suppression (see page 25)

Nozzle: height and diameter							
Sensor FMU	D _{min} mm (in)	L _{max} mm (in)					
130 / 230	50 (1.9)	150 (5.8)					
130 / 230	80 (3.1)	240 (9.4)					
130 / 230	100 (3.9)	380 (14.8)					
131 / 231	80 (3.1)	240 (9.4)					
131 / 231	100 (3.9)	380 (14.8)					
232	100 (3.9)	300 (11.7)					

Mounting FMU 130, 131, 230, 231 With Counter Nut or Welded Sleeve

Thread Versions:

- Prosonic T FMU 130, 230 with G $1^{1\!\!/}_{2}$ or $1^{1\!\!/}_{2}$ NPT
- Prosonic T FMU 131, 231 with G 2 or 2 NPT

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





Mounting FMU 232 With Mounting Bracket or Slip-On Flange

Housing

- Cable entry Pg 16 Break the cable entry in the housing before mounting.
- Cable diameter 5...9 mm (0.2...0.35 in).



Electrical Connection

Cabling

Use screened two-core instrumentation cable for the current output of the FMU 130, 131, 230 and 231. For optimal protection against electromagnetic interference, the screen should be grounded in the controlroom or the nearest earthing point. A good connection to ground is essential to good screening. Under certain circumstances, the digital communication signal may be affected if unscreened cable is used.

① FMU 130, 131, 230, 231



Connection Diagrams

- FMU 130, 131, 230, 231: 2-wire »loop-powered«
- FMU 230, 231:
 4-wire, including mains power supply
- FMU 232:4-wire, including mains power supply









 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





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

Summary of Operating Procedures

Caution 2-wire!

After start the instrument needs approx. 50 s for test and initialising. 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

\bigcirc 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 t

 Full calibration 100%

 fill tank to "full" point
 - simultaneously press V and H

3 Locking

Protects the entries against unwanted and unauthorized changes

④ Unlocking

- simultaneously press \boxdot and \boxplus

Caution!

If the parameters are locked by pressing pushbuttons, the parametration is no longer possible via the display, handheld etc. e

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 pushbutton 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 Pushbutton Operation with Plug-In Display

VH position Parameter			r	
	ſ	1.68	50°	H
Der diepleur	L			

Bar display:

- Display: current or echo quality

- flashes on alarm

Pushbuttons

Pushbuttons	Function				
Selecting the Matrix Fi	eld				
V	Selecting the vertical matrix position				
н	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 💟	Locking matrix, 9999 is shown in V9H9				
🗖 and Ħ	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 T 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.

е



Calling Up Measured Values and Measuring Point Information

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

#	VH	Entry		Text
1	V9H5	333 H		Reset instrument
2	V8H2	(01) H		Units of length 0: meters 1: feet
3	V0H1	E (m/ft) H		Empty calibration
4	V0H2	F (m/ft)	Н	Full calibration
5	V0H3		н	Application





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. е

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.

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:

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

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 Linerization:

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

4 Types of Measurement

① Volumetric Measurement for Linear Relationship between Level and Volume

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.

#	VH	Entry		Text
1	V2H0	4	Н	Delete
1	V2H0	5	Н	Linear
2	V2H5	e.g. 2000 l = 528 USgal	Н	Maximum volume V _{100%} (e.g. 2000 l = 528 USgal)



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	Н	Delete
2	V2H0	3	Н	Semi-automatic
3	V2H1	7	Н	Line No.
4	V2H2	e.g. 4.000 m (13.1 ft)	Н	Level
5	V2H3	e.g. 5000 l (1320 USgal)	Н	Volume input
6	V2H1	6	Н	Line No.
After entering all pairs of values				
	V2H0	1	Н	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	Н	Delete
2	V2H0	2	Н	Manual
3	V2H1	1	Н	Line No.
4	V2H2	e.g. 0.400 m (1.31 ft)	Н	Level input
5	V2H3	e.g. 100.0 l (26.4 USgal)	Н	Volume input
6	V2H1	2	Н	Line No.
After entering all pairs of values				
	V2H0	1	Н	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.



Line	Level	V2H2	Volume	e V2H3
No. V2H1	%	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	





е

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 analogue output and the measurand 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...255 s = with damping

• Current on Fault (V0H7)

	4-wire	2-wire
	420 mA, 4/2	0 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.

2 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	Η	Current output 0: linear 420 mA 1: linear 420 mA with 4 mA threshold
2	V0H5	e.g. 10%	Н	Level for 4 mA
3	V0H6	e.g. 90%	Н	Level for 20 mA
4	V0H4	e.g. 20 s	Н	Output damping
5	V0H7	e.g. 1	Η	Output on fault 0: -10% 1:+110% 2: HOLD (holds last measured value)

Height VOH6 90% VOH5 10% 4 mA 20 mA

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	Н	Current output 2: digital 4/20 mA 3: digital 8/16 mA
2	V0H5	e.g. 10%	Н	Switchpoint min. 4 or 8 mA
3	V0H6	e.g. 90%	Н	Switchpoint max. 20 or 16 mA
4	V0H4	e.g. 10 s	Н	Output damping
5	V0H7	e.g. 1	Н	Output on fault 0: -10% 1: +110% 2: HOLD (holds last measured value)



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.



13.010°8

븏

working

echo

3 m

Distance

Other Possible Entries

Temperature

The actual temperature at the sensor is shown in V3H5.

Upper Temperature Limit

Exceeding the upper temperature limit of 80°C is shown in Field V3H5. Any value above 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 losst 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...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	Н	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	Н	Simulation height
2	V9H7	e.g. 2.000 (6.600 ft)	Н	Simulated height (e.g. 2 m / 6.6 ft)
3	V9H8 V0H0	Display of current (also shown on bargraph) Display of height, level or volume		
4	V9H6	0	Н	Simulation off

Simulation of Current

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

Simulation of Volume

Locking

etc. are blocked.

Locking via the Keyboard

When the instrument is locked via the

keyboard, both keyboard and display parametration as well as all parametrations

It can only be unlocked using the keyboard.

1 V9H6 2 H Simulation volume 2 V9H7 e.g. 100.0 (26.40 USgal) H Simulated volume (e.g. 100 I / 26.4 USgal) 3 V9H8 Display of current (also shown on bargraph)	#	VH	VH Entry		Text	
2 V9H7 e.g. 100.0 (26.40 USgal) H Simulated volume (e.g. 100 l / 26.4 USgal) 3 V9H8 Display of current (also shown on bargraph)	1	V9H6	V9H6 2	Н	Simulation volume	
3 V9H8 Display of current (also shown on bargraph)	2	V9H7	V9H7 e.g. 100.0 (26.40 USgal)	н	Simulated volume (e.g. 100 l / 26.4 USgal)	
V0H0 Display of volume (If no linearization curve has been entered then volume corresponds to level.)	3	V9H8 V0H0	V9H8 Display of o bargraph) V0H0 Display of v linearization entered the to level.)	Display of current (also shown on bargraph) Display of volume (If no linearization curve has been entered then volume corresponds to level.)		
4 V9H6 0 H Simulation off	4	V9H6	V9H6 0	Н	Simulation off	

The matrix can be again locked once all parameters have been entered.

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

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

#	VH	Entry		Text	
1	V9H9	333	Н	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 Trouble-Shooting

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	Туре	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	Initialising starting. If error remains, initialisation cannot be started.
E 106	Alarm	Download in progress – Wait until completed.
E 110 E 121	Alarm	Reset instrument, if error remains longer electronic instrument error – Contact Endress+Hauser Service.
E 116	Alarm	Error with download – Carry out reset or restart download with corrected data.
E 125	Alarm	Defective sensor – Check sensor connection, contact Endress+Hauser Service if error remains.
E 261	Alarm	Error in temperature sensor - Contact Endress+Hauser Service.
E 501	Alarm	Sensor electronics not recognised – 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	Linearisation table not available – Appears while entering the linearization curve. Active 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 voltage. Contact Endress+Hauser Service if error remains.
E 661	Warning	High Temperature (greater than 80°C/176°F) – Check measuring conditions.

Fault Analysis	Analogue output	Possible Cause	Removal
1 Bar display flashes	Response of the current output depends on the setting in V0H7V0H7=0-10 %2,4 mA or 3,8 mAV0H7=1110 %22 mAV0H7=2HOLD last value is held	Error code in V9H0 yes E641 in V9H0 Echo too weak or foam on the surface	 Which error code? see page 28 Further action depends on the error code Check sensor position see pages 811, 25
② Measured value in V0H0 too small	D m/ft (V0H8) 20 mA expected actual 4 mA t →	Distance D in V0H8 too large? yes no Incorrect linearisation? no Incorrect current output? yes	 Multiple echo? see (5) Gas layering? Contact E+H Service Check sensor position see pages 811, 25 Re-enter linearisation curve see pages 2223 Check values in V0H5 and V0H6 and re-enter if necessary see name 24
③ Measured value in V0H0 too large	D m/ft (V0H8) 20 mA actual	Distance D in V0H8 too small? <i>no</i> Continued on page 30	Interference from internals in measuring range? Instrument mounted in nozzle? - Check dimensions of nozzle see page 9 - Check sensor position see pages 811, 25 - Select application parameter 0 or 2 in V0H3 see page 21 - Carry out interference echo suppression see page 25

Continuation of measured value too large		Incorrect linearisation?	yes yes	Reenter linearisation curve see pages 2223 Check values in V0H5 and V0H6 and re-enter it if necessary see page 24
Measured value jumps sporadically with constant level and turbulence or agitator blades	20 mA actual expected 4 mA t →	Is the signal affected by turbulence or agitator blades	yes	 Increase integration time see page 24 With agitator blades in measuring range check sensor position see pages 811, 25 Select application parameter 0 or 2 in V0H3 see page 21
The measured value jumps to a lower value or remains continuously too low with constant level	20 mA 	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

Matrix INTENSOR

	HO	H1	H2	H3	H4	H5	H6	H7	H8	H9
Cali- bration V0	Measured value	Empty calibration	Full calibration	Application liquid :0 fast :1 dome cover :2 coarse bulk solids :3	Output damping 0255 s Default: 3 s	Value for 4 mA Default: 0% Switch point for 4 mA 8 mA	Value for 20 mA Default: 100% Switch point for 20 mA 16 mA	Output on alarm -10% :0 2-wire: 3.8 mA 4-wire: 2.4 mA +110% :1	Measured distance bargraph= echo quality	Height bargraph= echo quality
	User unit	m/ft	m/ft	conveyor belt :4	Seconds	User unit	User unit	HOLD :2	m/ft	m/ft
V1					1	r.	I	r.		
Lineari- sation V2	Linearisation height :0 activate table :1 manual :2 automatic :3	Linearisation table Line No.	Linearisation table Input level	Linearisation table Input volume		Volume max. Default: 100.0				
	cancel :4 linear :5		m/ft	User unit		User unit				
Ext. para- meter V3	Range for automatic suppression Default: 0.000	Actual level Default: 0.000	Echo quality 010		1st echo factornone:0medium:1max.:2	Temperature ℃				
V4V7										
Opera- ting para- meter V8		Current output linear 420mA :0 linear 420mA with threshold :1 digit. 4/20 mA :2 digit. 8/16 mA :3	Select unit m :0 ft :1	Lost echo delay time 0255 s Default: 60 s						
Service/ Simu- lation 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 <>333 locked =333 unlocked
Commu- nication VA	Tag-Number			Unit after lin.						

Display field

Entry field

bold type e.g. **Default: 3 s** factory settings е

Matrix HART



display field

with HART only

modified H position

Technical Data					
Input Variables	Frequency	FMU 130, 230: approx. 70 kHz; FMU 131, 231: approx. 55 kHz; FMU 232: approx. 37 kHz			
	Pulse frequency	0.53 Hz, depending on sensor and electronic version			
Output Variables	Switching delay time	0255 s			
	Load	max. 600 Ω			
Measuring Accuracy	Measuring uncertainty	0.25% for max. measuring span (ideal reflection from flat surface at 20°C/68°F)			
	Resolution	FMU 130, 131, 230, 231 (2-wire): 3 mm (0.12 in); FMU 230, 231, 232 (4-wire): 2 mm (0.078 in)			
Application Conditions	Medium temperature range 1)	-40+80°C (-40°F176°F) (built-in temperature sensor)			
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.	Operating temperature range	-20+60°C (-4°F140°F)			
	Storage temperature range	-20+80°C (-4176°F)			
	Operating pressure pabs 1)	Sensors with process connection G 1^{1} / ₂ and G 2: 3 bar (43.5 psi); Sensor DN 100 or 4": 2.5 bar (36.25 p			
	Climatic class	JIN / IEC 68 T2–30 Db			
	Type of protection	IP 67 (NEMA 6), with housing cover open IP 20			
	Vibration resistance	DIN IEC 68T2-6 Tab. 2.C (1055 Hz)			
	Electromagnetic compatibility	Interference immunity to EN 50082–2 and industrial standard NAMUR (field strength 10 V/m), interference emission to EN 50081–1			
	Explosion protection	FMU 130/131 (2-wire Ex): EEx ia IIC T6 (FRG only: Zone 1) 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 Construction	Material	Housing: PBT (glass reinforced, flame-retended) threaded boss and sensor: PVDF, for FMU 232 UP (unsaturated polyester) or 1.4571 (SS 316Ti), sensor diaphragm stainless steel			
	Seals	Between threaded boss and sensor, internal: EPDM seal on threaded boss, external: EPDM seal			
Display and Operating	Display (LCD)	4 character display with segment display of current			
Elements	LEDs	red: indicates alarm or warning green: indicates power on (with four-wire versions only) and entry acknowledgement			
Power Supply	AC voltage	4-wire: 180250 V_{AC} ; 90127 V_{AC} ; power consumption < 4 VA			
	DC voltage	4-wire: 1836 V _{DC} , 2-wire: 1236 V _{DC} ; power consumption < 2.5 W			
	Ripple (Smart-devices)	$\begin{array}{l} \text{INTENSOR max. ripple (measured at 500 Ω) 0100 kHz: $U_{PP}=30 mV \\ \text{HART max. ripple (measured at 500 Ω) 47 Hz125 Hz: $U_{PP}=200 mV \\ \text{max. noise (measured at 500 Ω) 500 Hz10 kHz: $U_{eff}=2.2 mV \\ \end{array}$			
	Electrical isolation	The evaluation electronics is electrically isolated from the power supply terminals with all four-wire versions.			

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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.	
1.2/from 03.96	7512	1.7		No up-/
1.3/from 03.96	7513	1.7		down- load
1.4/from 03.96	7514	1.7		between SW 1.x
2.0/from 04.97	7520	from 1.7	Operation simplified. Documentation updated.	and 2.x possible
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-	No changes to the documentation.						
1.2/from 03.96	7412								
1.3/from 03.96	7413	DD-	DD-	DD-	DD-	DD-	DD-		
1.4/from 03.96	7414	Revision: 2		No up-/ down- load					
2.0/from 04.97	7420	Device- Revision:	Operation simplified. Documentation updated.	between SW 1.x and 2.x					
2.1/from 01.98	7421	DD-	Error message E 641 revised.	possible					
2.2/from 08.99	7422	Revision:	No changes to the documentation.						

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