

Ultrasonic Measurement

Prosonic FMU 860...862

Level and flow measurements with ultrasonics
Simple to start up, easy to use, flexible
Field mounted ultrasonic transmitters



The Prosonic ultrasonic transmitter in the IP 66 protective housing

Applications

Prosonic FMU 860...862 ultrasonic transmitters are for use with the Prosonic FDU 80...86 family of sensors.

The transmitter determines levels in silos and tanks and calculates the volume of solids and liquids they contain.

With the Prosonic 860 ... 862 sensors can be operated which are mounted in explosion hazardous areas according to FM / CSA / ATEX.

When used for applications in fresh and waste-water, Prosonic measures

- flow rates in flumes and weirs
- water levels

and can control screen cleaning and pumps.

Features and Benefits

A customised instrument programme for the specific application.

Choice of transmitters

- For the field or control room
- Single or two-channel versions with three or five relays, also with optional totaliser
- With optional HART interface for remote configuration
- With RS-485 or PROFIBUS-DP interface

Intelligent commissioning, ultrasonic measurement par excellence

- Instrument parameters arranged in a simple matrix
- Various linearisation functions, totalisers, and all common Q/h curves on call
- Quick commissioning and stable measurement thanks to signal pattern recognition by fuzzy logic and the application parameter

Endress + Hauser

The Power of Know How



Measuring System

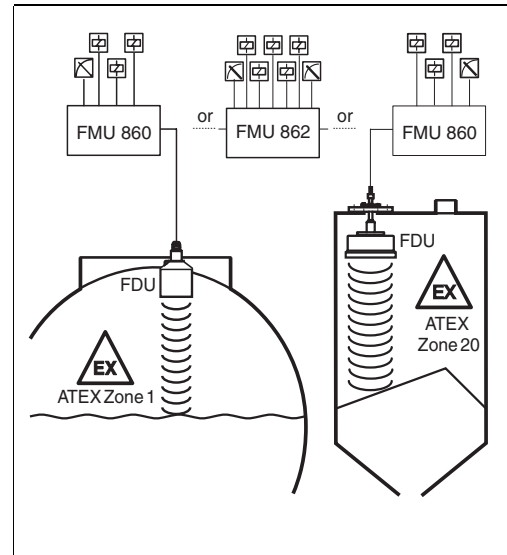
Measuring System

The measuring system consists of the Prosonic transmitter with a Prosonic sensor chosen according to the application at hand. The two-channel version is for differential measurement or for controlling two measuring points. The certified sensor ensures that the measuring system can be used in explosion hazardous areas.

Other units can be connected to the Prosonic transmitter for special applications:

- separate temperature sensor, e.g. if the ultrasonic sensor is heated
- separate external limit detector.

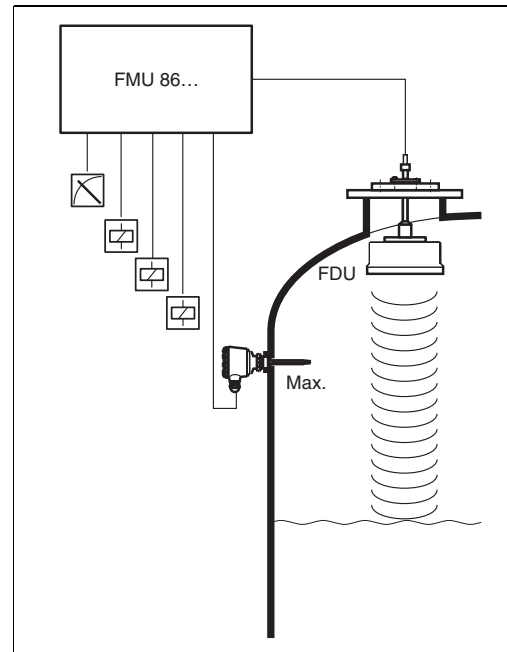
The Prosonic transmitter can be integrated into automation systems using the RS-485 or PRO-FIBUS-DP interface



Overspill protection

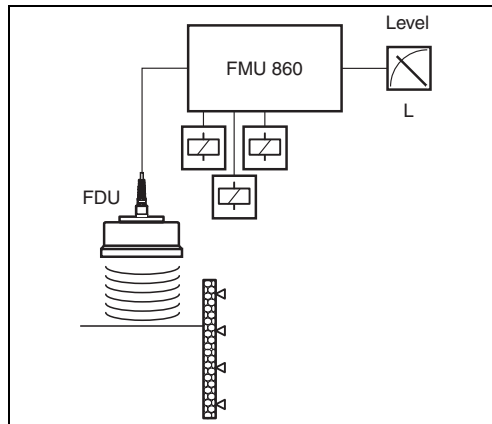
Double protection against overflow:

- All Prosonic transmitters have an additional connection for an external limit detector.
- Even when the level moves within the blocking distance of the sensor, this is promptly indicated by the display, the signal output and relays.

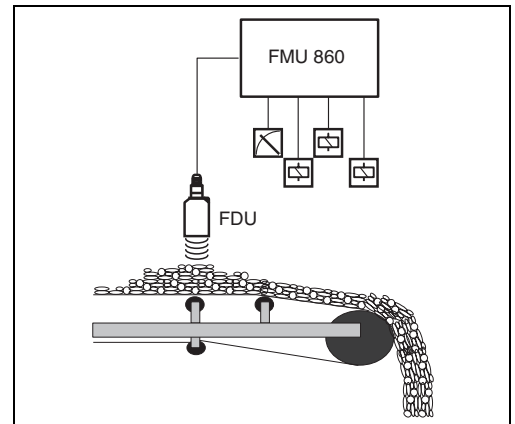


Applications

Prosonic FMU 860



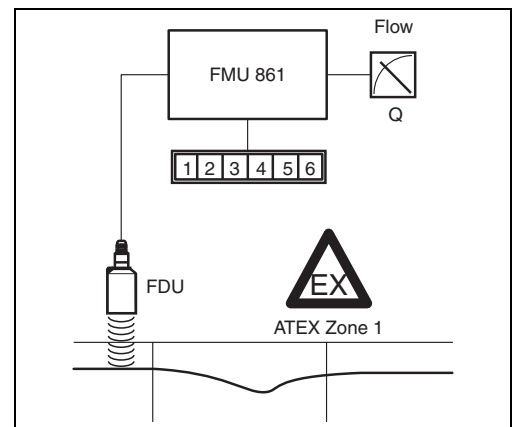
- Continuous level and volumetric measurement of liquids and solids in tanks and silos.
- Pump control in up to 5 steps
- Alternating pump control
- Adjustable switch delay



- Conveyor belts
rapid changes in load height are easily dealt with by the Prosonic FMU 860.

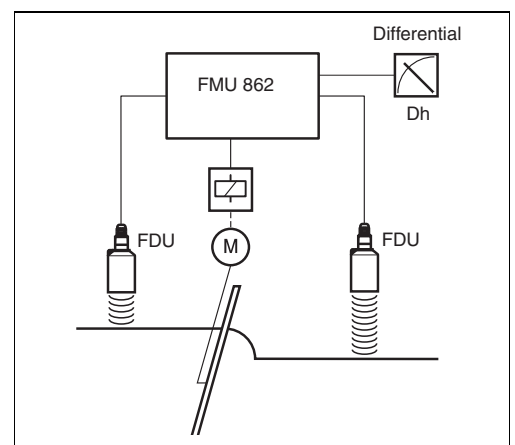
Prosonic FMU 861

- Flow rate measurement in flumes or weirs
- Millimeter accuracy for the flow level
- The linearisation curves of all common standard flumes and weirs are preset and can be called up as required.
- For the version with IP 66 housing, the amount flowing through is summated and displayed by the totaliser
- Low-flow cut-off
- Separate display of floodwater on external counters
- Sample control using a quantity or time function



Prosonic FMU 862

- Two channel version
- Flow or level measurement in channel 1; level measurement in channel 2
 - Differential and average value measurement (FMU 862 D for distance measurement with two sensors)
 - E.g. controlling the screen cleaning process as a function of clogging (s. fig.)
 - Superimposed interval timer
 - Trend indication
 - Back water alarm (Back water in weirs is detected, signalled and the flowrate automatically adjusted)



Operation and Signal Processing

Principle of Operation

An ultrasonic pulse emitted from the sensor is reflected back by the surface of the material or liquid and is received by the same sensor as an echo signal. The product height or water level is then calculated from the run time of the ultrasonic signal (echo level determination).

Simple Start-Up

The time required for start-up is minimised by using preset operating parameter values. Selecting just one parameter automatically sets the measuring line to one of five typical applications:

- liquid
- vessels with rapid changes of liquid
- fine-grained bulk solids
- coarse-grained bulk solids
- conveyor belts

Intelligent Software with Fuzzy Logic Elements

The Prosonic transmitter is based on state-of-the-art evaluation methods including fuzzy logic elements for intelligent echo analysis. No other special procedures are required as this method enables the true level echo to be clearly distinguished from:

- sporadic reflections (e.g. from agitator blades),
- interference echoes and noise (e.g. from filling) or
- multiple reflections (e.g. with closed tanks).

Even with almost unfavorable mounting points, the advantages of continuous, non-contact ultrasonic measurement can be used by activating a special fixed target suppression mode or filtering factor.

Complete Functionality

For level measurement

The characteristic curve is already programmed for volumetric measurement in a horizontal cylinder. The linearisation curve of any vessel can be easily entered (maximum 32 points).

The Prosonic FMU 862 also has the following modes

- **Differential measurement:**

$$\text{Value1} - \text{Value2}$$

- **Average value measurement:**

$$\frac{\text{Value1} + \text{Value2}}{2}$$

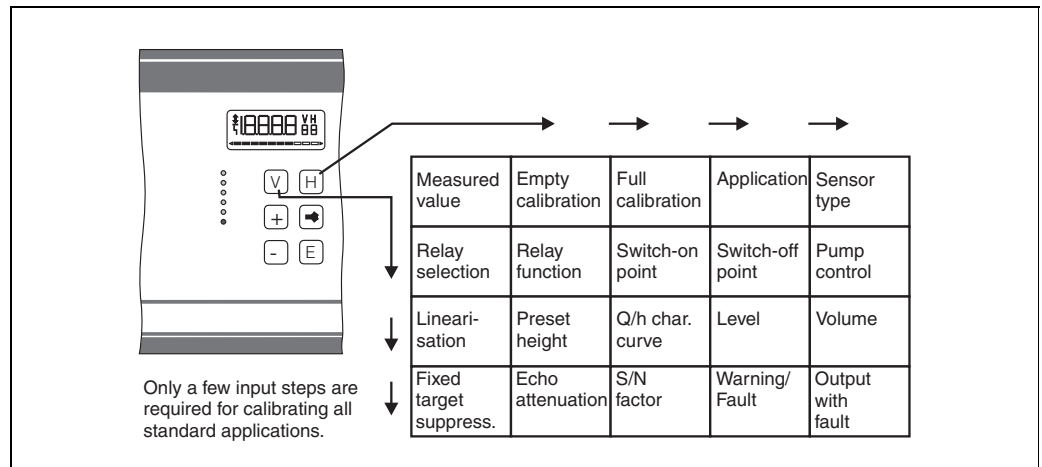
For flow rate measurement

All common Q/h characteristic curves for measuring flow rates with flumes and weirs are stored in the Prosonic. Other Q/h curves can be entered (up to a maximum of 32 points).

Three different programmable counting pulses for totalising can be sent to the relay outputs for controlling external counters. The transmitter itself has a resettable software counter: a non-resettable totaliser is available as an option.

On-site operation

Keys and display on the front cover

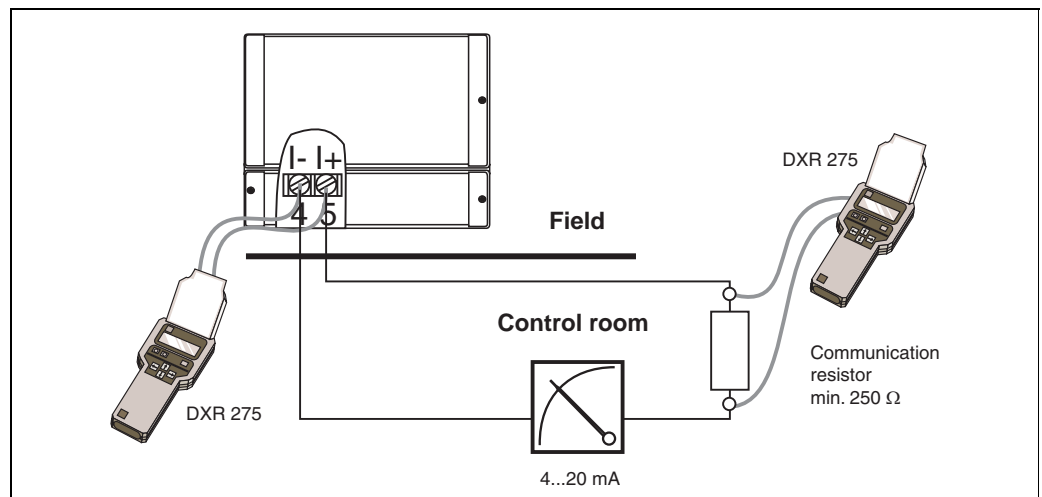


The keypad on the front panel is used to configure the transmitter and call up parameters, which are shown on a 4 1/2 character display.

The input dialogue is based on the standard Endress+Hauser operating matrix in which every input field is quickly and easily selected using the "V" (vertical) and "H" (horizontal) keys. Parameters are simply entered using the three keys »-«, »+«, »→« and are registered and stored once the "E" key has been pressed.

HART communication protocol

Handheld Terminal DXR 275



Operation

For devices with HART interface all values can be entered using a handheld terminal. The user has comprehensive and detailed information on inputs both on-site and in the control room. The measurement remains totally unaffected during the interactive input.

Electrical Connection

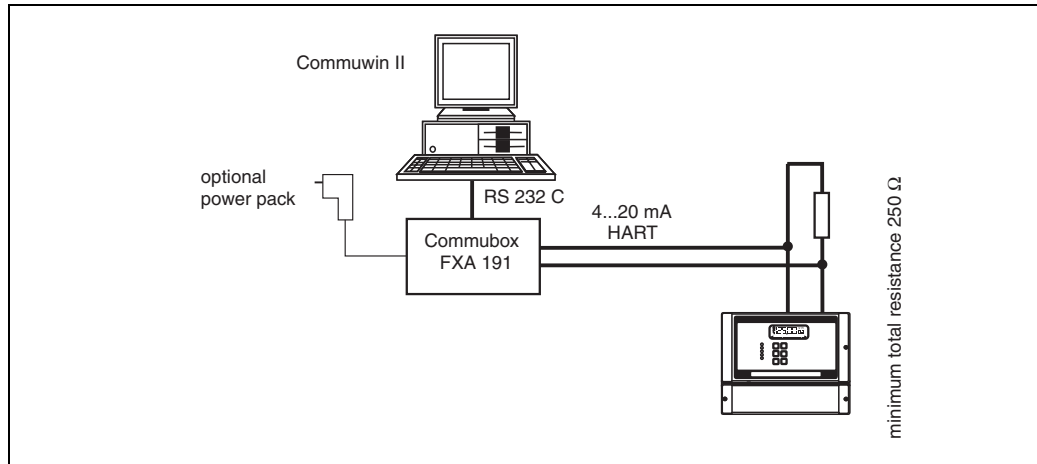
The handheld terminal is connected either

- directly to current output 1 of the transmitter or
- to a communications resistor.

In general: The handheld terminal can be connected anywhere in the signal circuit as long as there is a resistance between its terminals which is larger than the minimum communications resistor (250 Ω).

Screened cable is recommended, maximum capacitance 100 nF.

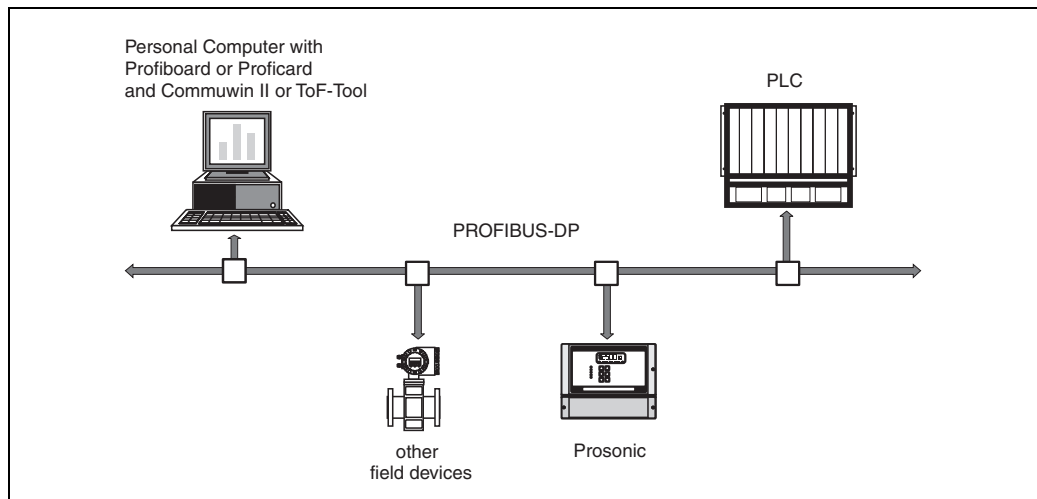
Operation via Commuwin II



The Commubox FXA 191 connects HART transmitters to the RS 232 C serial interface of a personal computer. This enables the transmitter to be remotely operated with the Endress+Hauser Commuwin II operating program.

PROFIBUS-DP interface

System integration



The version with PROFIBUS-DP interface can be integrated as a slave into a PROFIBUS-DP segment. In order to connect a Personal Computer to the bus, PROFIBOARD or PROFICARD can be used.

Operation

The following operation programs are available:

- Commuwin II
- ToF Tool (limited functionality)

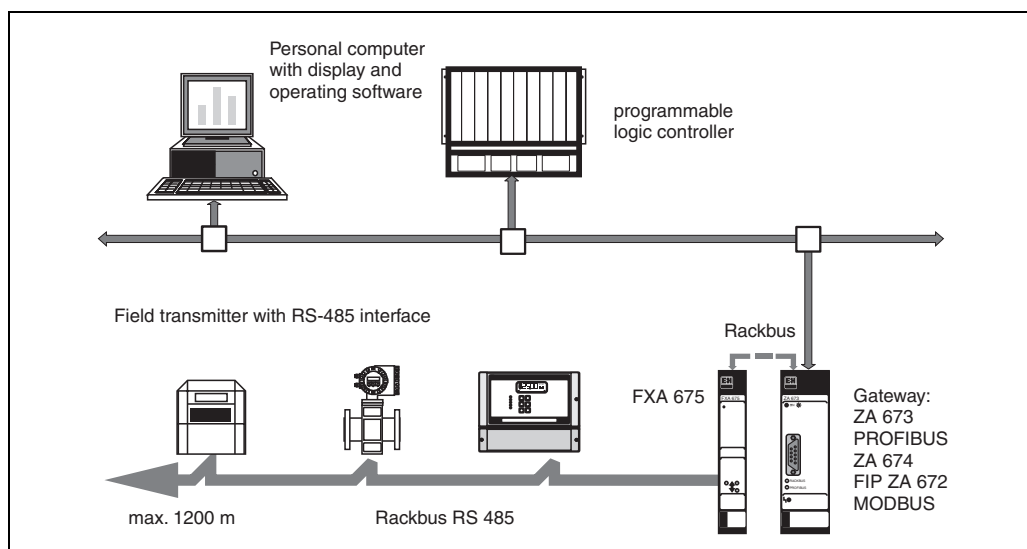
RS-485 Interface

Connecting a Personal Computer

Instruments with RS-485 interface can be connected to a Personal Computer in one of the following ways.

- RS 485 card for PC (for the Fieldmanager and Commugraph programs)
- Adapter RS 232 C/RS 485 (for the Fieldmanager and Commugraph programs)
- Commubox FXA 192 (for the graphical program Commuwin II)
- FXA 675 with a Gateway ZA 67x with serial interface

Connecting to Process Control Systems



The Prosonic FMU 86... can be easily linked to existing process control systems via the RS-485 interface.

The FXA 675 interface card (or the Monorack II RS-485) connects two individual Rackbus RS-485 networks with up to 25 transmitters via the Rackbus. A second card (Gateway) serves as the bus connection for standard networks such as PROFIBUS, FIP or MODBUS.

The Prosonic P level measurement system also enables a number of widely distributed ultrasonic measuring points to be controlled by a personal computer.

Operating programs

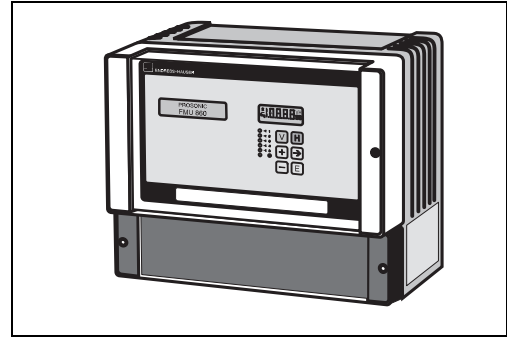
- Operating program "Fieldmanager" (MS-DOS)
- Visualisation program "Commugraph" (MS-DOS)
- Graphical operating program "Commuwin II" (Windows 3.1/3.11, Windows 95, Windows 98, Windows NT)

Housing Versions

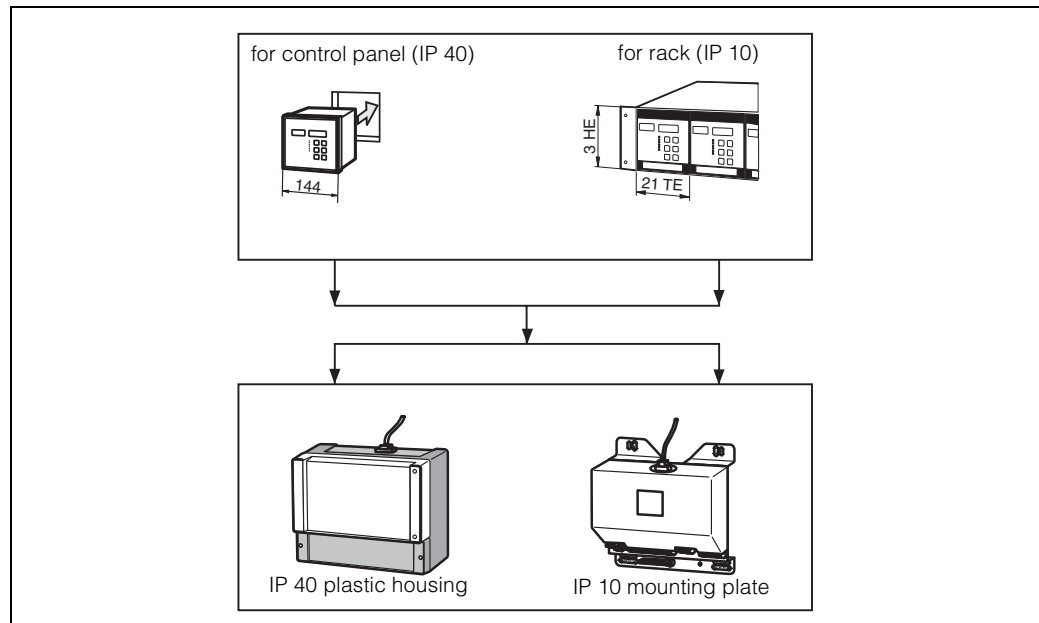
Field housing (Operation in the field)

In this version the transmitter electronics are built into an IP 66 housing. The transmitter is parametrised via an operating unit with a keyboard and display or - by using an additional serial interface - with a handheld terminal.

An external totaliser can also be connected to the Prosonic FMU 861.



Separate transmitter electronics (Control room operation)



With this version, the operating unit is separated from the transmitter electronics. The operating unit is available for mounting in a control cabinet (144 mm x 144 mm) or for mounting in an assembly rack (21 HP). The transmitter electronics are mounted in an IP 40 housing or else are on an IP 10 mounting panel in the control cabinet.



Note!

The versions with separate electronics are **not** available together with the digital interfaces RS-485 or PROFIBUS-DP.

Explosion hazardous areas

Standard Version and CSA General Purpose version

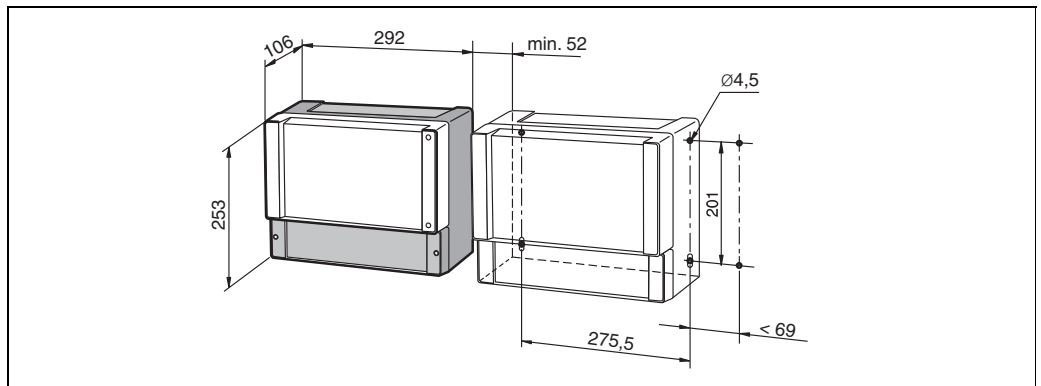
For these transmitter versions, the sensor only may be installed in the explosion hazardous area. The transmitter must be installed in a safe area. All local regulations concerning installation must be observed.

ATEX II 3 D version

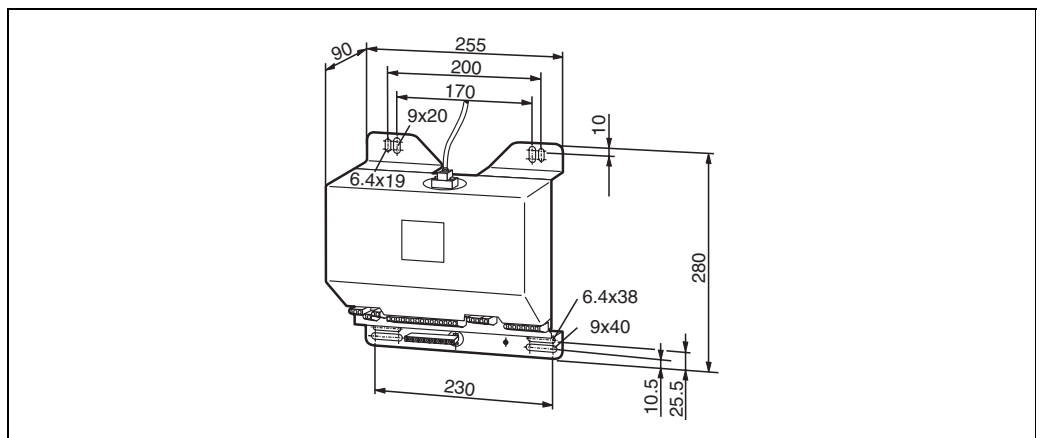
This transmitter version can be installed in explosion hazardous areas of Zone 22.

Dimensions

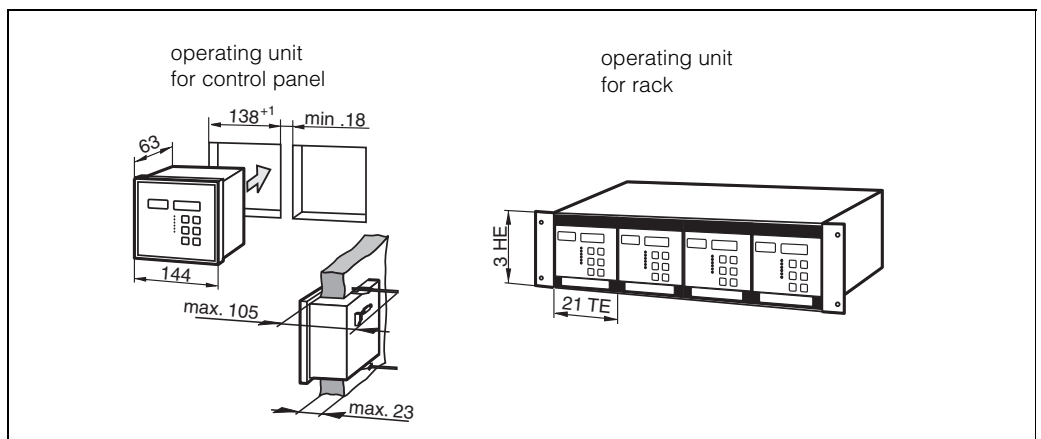
IP 66 field housing resp.
IP 40 plastic housing



IP 10 mounting plate



Seprate operating unit



Accessories

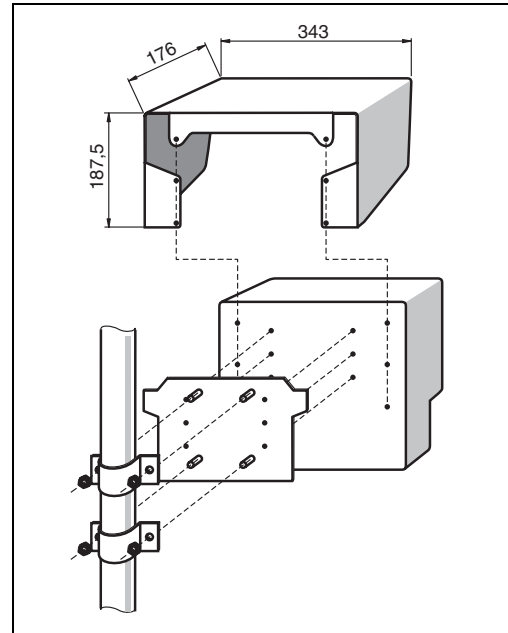
Accessories for the field housing

All-Weather Cover

- Material: aluminium, blue lacquered
Order No. 919567-0000
- Material: stainless steel 1.4301;
Order No. 919567-0001
- Weight: approx. 1 kg
- Mounting screws supplied

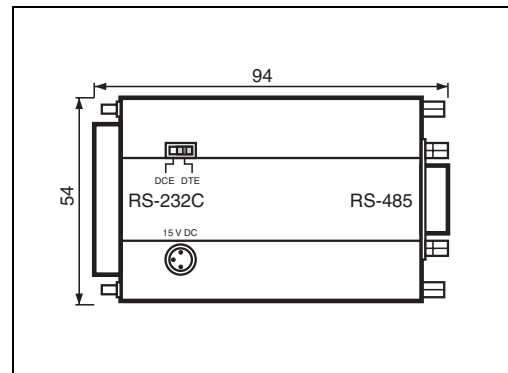
Post mounting

- Material: galvanised steel, Order No.:
for 2"-Post: 919566-0000
for 1"-Post: 919566-1000
- Material: stainless steel 1.4301; Order No.:
for 2"-Post: 919566-0001
for 1"-Post: 919566-1001
- Weight: approx. 1 kg
- Mounting screws and nuts supplied



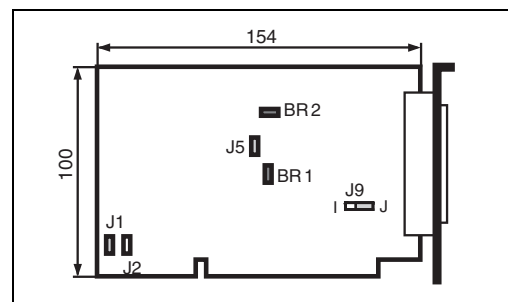
Converter:RS 232C/RS 485 Interface

- Order No.
for 230 V: 016398-0000
for 115 V: 016398-0050
- Connector for PC: 25pin Min-D-plug
- for bus:9-pin Min-D-plug, plug supplied with screw terminals
- Baud rate: 19 200 Bits/s
- RS 485-output electrically isolated,
- Power supply: 15 V DC; power unit 230 V or 115 V, to order
- RS 232C interface, can be configured as DCE/DTE



RS 485 PC Interface Card

- Order No. 016399-0000
- Connector: 25 pin Min-D-plug, plug supplied with screw terminals
- Baud rate: 19 200 Bits/s
- Configuration: supplied configured for COM 3, address 3E8H, with protective ground at Pin 1 or connector, Slot: 8 or 16 bit
- RS 485 output electrically isolated



HART-Communicator DXR 275

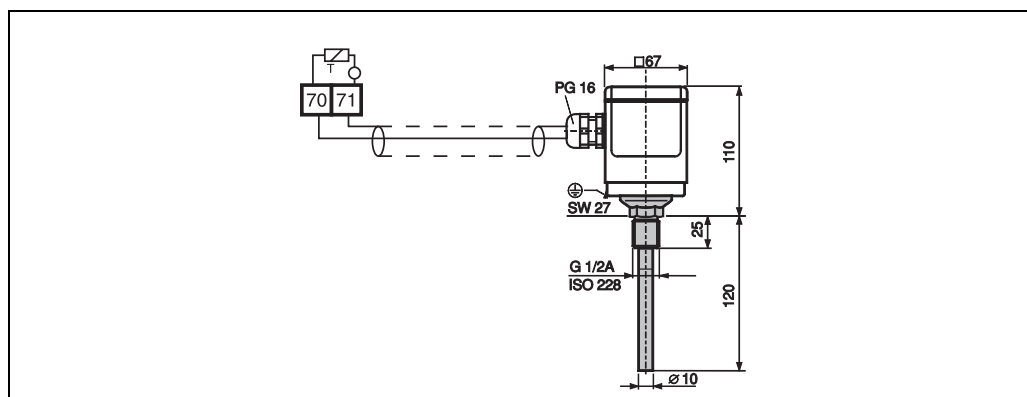
Handheld for instruments with HART interface (siehe Operating Instructions 139F/00/en).

PC Interfaces for PROFIBUS-DP

- PROFICARD (PCMCIA card); Order No. 016570-5200
- PROFIBOARD (PCI-Board); Order No. 52005721

Temperature sensor

An external temperature sensor FMT 131 can be connected.

**Spare Sensor Cable**

Connection from the Prosonic FMU 86... transmitters to the sensors

- FDU 80, FDU 80 F, FDU 81, FDU 81 F, FDU 82; Order-No. 938278-0120
- FDU 83, FDU 84, FDU 85; Order No. 938278-1021
- FDU 86 Order No. 52000261

Overvoltage protection in IP 66 protective housing

Overvoltage protection unit for power supply

- Order No. 215095-0001
- Dimensions: s. page 9 (IP 66 housing)

Overvoltage protection and power supply Unit for Sensor heating in IP 66 Protective Cover

Power supply unit (24V DC) for sensor heating of up to 2 sensors with integrated overvoltage protection for power supply

- Order No. 215095-0000
- Power supply: 230 V (+15%/-20%)
- Dimensions: s. page 9 (IP 66 housing)

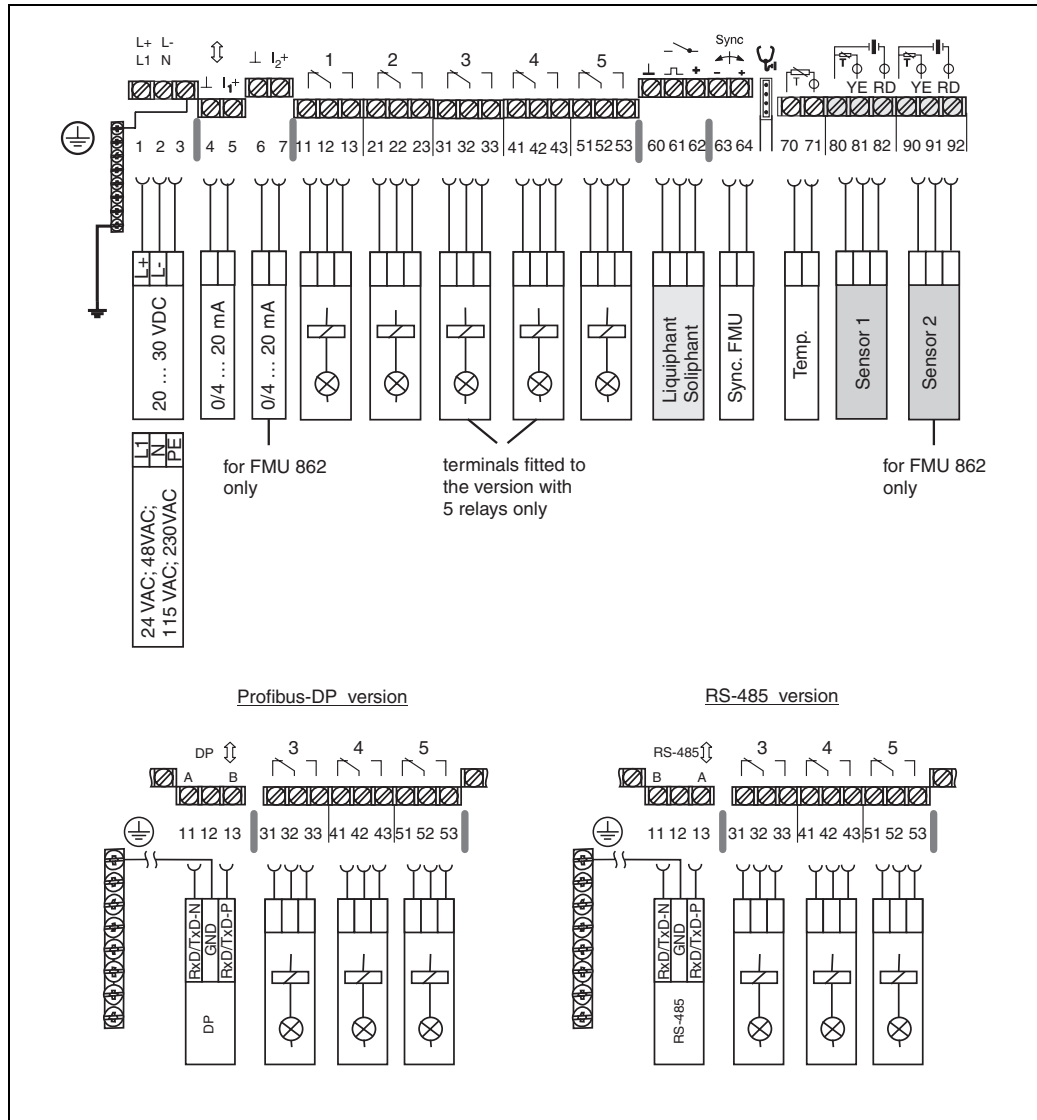
Power supply unit for Sensor Heating in IP 66 Protective Housing

Power supply unit (24 VDC) for Sensor Heating of up to 2 sensors

- Order No. 215095-0002
- Power supply 230 V (+15%/-20%)
- Dimensions: s. page 9 (IP 66 housing)

Electrical Connection

Terminal Strip



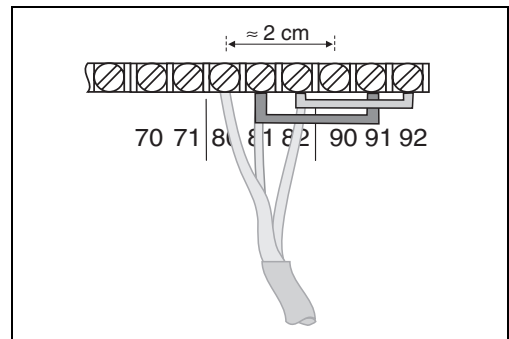
The terminal strip for cable diameters up to 2.5 mm² is in a separate connection chamber. The cable entries are prestamped for easy removal.

- underside 5 x Pg 16 und 4 x Pg 13.5 (M20x1,5)
- rear 5 x Pg 16

The electrically isolated areas are separated by thick lines in the figure above.

Simultaneous level and flow measurement with one sensor

With the FMU 862 it is possible to measure level and flow simultaneously with one sensor only. For this purpose it is necessary to position the sensor above the basin. Then the sensor has to be connected parallelly to both channels of the FMU 862. To connect the sensor to both channels, the terminals 81 to 91 and 82 to 92 have to be bridged according to the figure. Then, it is possible, for example, to configure channel 1 for flow measurement and channel 2 for level measurement.



Sensor Cable

Connection is with the cable supplied or by using an extension via a terminal box with commercial, two-core screened cabling (also available from E+H). Maximum values: up to 6 Ω per core, maximum 60 nF.

\varnothing mm ²	0,5	0,75	1
max. length in m	150	250	300

Electrical Isolation

Current output, relay outputs, power connection and sensor input are all electrically isolated from one another.

With the FMU 862, the two current outputs are electrically connected to one another, as are the two sensor inputs.

Power Supply**Alternating voltage**

180...253 V	+10% / -15%	50/60 Hz
90...132 V	+15% / -22%	50/60 Hz
38...55 V	+15% / -20%	50/60 Hz
19...28 V	+15% / -20%	50/60 Hz

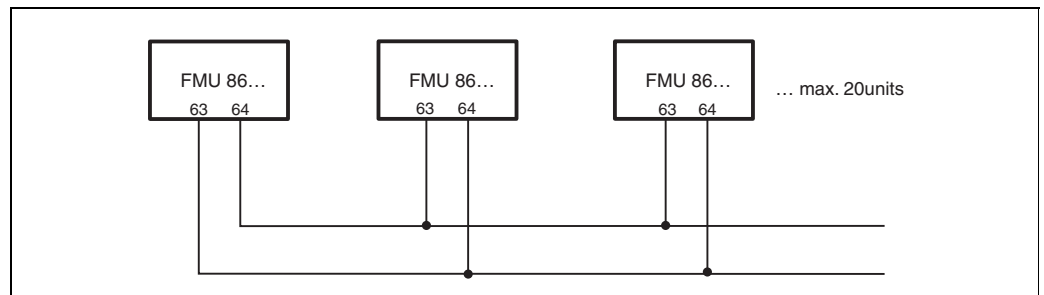
Power consumption: maximum 15 VA

Current consumption: maximum 65 mA at 230 V_{AC}

Direct voltage

20...30 V (residual ripple within tolerance), integrated reverse connection protection.

Power consumption: maximum 12 W (typically 8 W), maximum 500 mA at 24 V_{DC}

Synchronisation line

In order to avoid cross-talk between parallel routed sensor lines connect the transmitters (max. 20) to a synchronisation line. The sensors are then scanned in sequence. If more devices are present, groups of 20 transmitters should be used. The cables within one group can be in parallel. The cables of different groups must be separated. Common screened cable can be used.

Technical Data

General Information

Manufacturer	Endress+Hauser GmbH+Co. KG
Instrument	Ultrasonic transmitter
Designation	Prosonic FMU 860, 861, 862
Technical Documentation Version Technical Data	TI 190F/00/en 08.02 to DIN 19259

Application

Non contact, continuous level measurement in liquids and solids, for determining flowrates in open channels and weirs, water levels or for controlling screens and pumps

Function and System Design

Measuring principle	Ultrasonic echo, time of flight measurement
Modularity	<ul style="list-style-type: none"> - FMU 860: One signal input for level measurement - FMU 861: One signal input for flow measurement - FMU 862: Two signal inputs for differential level measurement

Operation and system design

Transmitter	<ul style="list-style-type: none"> - IP 66 field housing for post and wall mounting - Separate operating unit (keyboard and display) for control panel mounting or for rack mounting; 3 m connecting cable supplied - IP 40 plastic housing with electronics for connecting a separate operating unit - IP 10 mounting plate for connecting a separate operating unit
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Input

Measured variable	Time of flight measurement of the ultrasonic pulse using ultrasonic sensors
Measuring range	2...70 m depending on the ultrasonic sensor, s. TI 189F
Ultrasonic sensors	FDU 80, 80F, 81, 81F, 82, 83, 84, 85, 86
Separate switch input	external passive limit switch (NO contact or NC contact) or PNP switch, 24 V, maximum short circuit current 20 mA
Separate temperature sensor	to compensate for temperature effects on time of flight in open channels, NTC version

Analogue output

Output signal	<ul style="list-style-type: none"> - 4 ... 20 mA, switchable to 0 ... 20 mA (can be inverted), superposed digital communications signal HART - FMU 862: same values for second signal output, simultaneous switchover of Channel 1 to 0 ... 20 mA - with plug-in module and also serial interface - 4mA level for coupling
Output on error	<ul style="list-style-type: none"> - 0...20 mA: -10 % (-2 mA), +110 % (22 mA), HOLD (last current value is held) - 4...20 mA: -10 % (2,4 mA), +110 % (21,6 mA), HOLD (last current value is held)
Current limit	24 mA
Integration time	0...300 s
Load	max. 600 Ω
Effect of load	negligible

Relay output

Version	optional three or five independent relays each with one potential-free change-contact always three relays only with RS-485- or PROFIBUS-DP interface
Functions	<ul style="list-style-type: none"> - limit value - alarm relay - trend - time pulses(FMU 861 and FMU 862 only) max. counting frequency 2 Hz, pulse width 200 ms - time pulses (FMU 861 only) - back-up (FMU 862 only)
switching power	AC: 4 A, 250 V, 1000 VA at $\cos \varphi = 0,7$, DC: 4 A, 35 V and 100 W

Accuracy

Measured error (sum of linearity, hysteresis and reproducibility)	typical 0,2 % for maximum measurement span with smooth surface
Max. resolution	1 mm for FDU 80
Effect of load	negligible within permissible range

Ambient conditions

Ambient temperature	-20...+60 °C
Storage temperature	-40...+80 °C
Shock resistance	2 g (10...55 Hz) and 15 g for 11 ms (DIN 40040, Typ W)
Climatic class	DIN 40040 Type R Relative air humidity 95% in yearly average, condensation permissible
Ingress protection	DIN 40050: <ul style="list-style-type: none"> - Field housing: IP 66 with closed housing and cable entry of identical protection - IP 40: plastic housing with cable entry of identical protection - IP 10: plate for mounting in control cabinet - IP 40: separate operating unit for control panel - IP 10: separate operating unit for rack
Electromagnetic compatibility (EMC)	<ul style="list-style-type: none"> - AC power supply: Interference emission to EN 61326 ; Electrical equipment class B Interference immunity to EN 61326 ; Annex A (Industrial) - DC power supply: Interference emission to EN 61326 ; Electrical equipment class A Interference immunity to EN 61326 ; Annex A (Industrial) - for PROFIBUS-DP instruments Interference emission to EN 61326, Electrical equipment class A Interference immunity to EN 61326

Materials/Weight

IP 66 / NEMA 4x field housing	<ul style="list-style-type: none"> - Housing body: PC/ABS - Transparent cover: PC (polycarbonate) - Front plate with tag area - Weight: 2,6 kg
IP 40 plastic housing	<ul style="list-style-type: none"> - PC/ABS - Weight: 1,0 kg
IP 10 mounting plate	<ul style="list-style-type: none"> - Al/PS - Weight: 0,8 kg
IP 40 separate operating unit	<ul style="list-style-type: none"> - PC/ABS - Weight: 0,3 kg

Accessories

Protective cover for field housing	<ul style="list-style-type: none"> - Materials: Aluminium blue lacquered or SS 304 (1.4301) - Weight: approx. 1,0 kg - Mounting screws supplied
Post mounting	<ul style="list-style-type: none"> - Material: galvanised steel or SS 304 (1.4301) - Weight: approx. 1,0 kg - Mounting screws and nuts supplied

Display and Operating Interface

Display (LCD)	<ul style="list-style-type: none"> - 4 ½-character display, optional lighting - with segment display of the current in 10 % steps - Display elements: error, signal overflow or underflow, communication
LEDs	<ul style="list-style-type: none"> - one yellow LED each for indicating the switching status of the relay (lit: relay energised) - one yellow LED error indication (lit = error-free operation) - one green LED indicates error free indication (lit = error-free operation, flashing = warning)
Counter	<ul style="list-style-type: none"> - FMU 861 standard only, FMU 862 optional - Version: six-character, cannot be reset
Software counter	<ul style="list-style-type: none"> - FMU 861 standard only, FMU 862 optional

Communication Interfaces

HART	<ul style="list-style-type: none"> - On-site operation via HART handheld DXR 275 - Connection to PC via Commubox FXA 191 - Remote operation via Commuwin II software
RS 485	<ul style="list-style-type: none"> - via interface card FXA 675 connection to Rackbus-RS 485 networks; Operation via Fieldmanager, visualisation via Commugraph - via Commubox FXA 192 connection to serial interface RS 232C of a PC; operation via Commuwin II
PROFIBUS-DP	<ul style="list-style-type: none"> - Profile Version 3.0 - supported Baudrates: <ul style="list-style-type: none"> 19.2 kBaud 45.45 kBaud 93.75 kBaud 187.5 kBaud 500 kBaud 1.5 MBaud - via PROFIBOARD or PROFICARD connection to PC - Operation via Commuwin II or ToF Tool
Synchronizing connection	Parallel link for up to 20 instruments if several sensor cables are laid together over long distances.

Power supply

AC	180...253 V (50/60 Hz), 90...132 V (50/60 Hz), 38...55 V (50/60 Hz), 19...28 V (50/60 Hz)
DC Power consumption	20...30 V (residual ripple within tolerances) max. 12 W (typical 8 W), max. 500 mA at 24 V DC
Ripple with Smart transmitters	HART max. Ripple (measured to 500 Ω) 47...125 Hz: $U_{SS}=200$ mV max. noise (measured to 500 Ω) 500 Hz...10kHz: $U_{eff}=2,2$ mV
Reliable galvanic isolation	between current output, relay outputs, interfaces, power supply and sensor inputs
Power supply cable	common two wired screened cable Maximum values: to 6 Ω per wire, max 60 nF

Certificates and approvals

Ignition protection	<ul style="list-style-type: none"> - ATEX II 3 D IP66 T 70 °C - CSA General Purpose
CE Mark	By attaching the CE Mark, Endress+Hauser confirms that the instrument fulfils all the requirements of the relevant EC directives.

Supplementary documentation

<p>Technical Information TI 189F/00/en Prosonic Ultrasonic Sensors FDU 80...86</p> <p>Operating Instructions BA 100F/00/en Prosonic FMU 860...862</p> <p>Safety Instructions XA 255F-A (for the ATEX II 3 D version)</p>
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Ordering Information

Product Structure

Prosonic Transmitter FMU 86...									
Instrument Version									
	0	One channel for level measurement							
	1	One channel for flow measurement							
	2	Two channel for flow and/or level measurement, differential measurement							
Certificates *									
	R	Standard (non-certified transmitter, also for all certified sensors)							
	E	ATEX II 3 D IP66 T 70 °C							
	U	CSA General Purpose							
Housing for electronics									
	1	IP 66 protective housing for field mounting and operation							
	2	Plastic housing IP 40 for remote operation							
	7	Mounting plate IP 10 for control panel mounting and remote operation							
Versions for operation/display/totaliser for flow measurement									
	A	Keypad in protective housing / with display / without mechanical totaliser, not for FMU 861							
	B	Keypad in protective housing / with display / with mechanical totaliser, not for FMU 860							
	E	Keypad in protective housing / with illuminated display / without mechanical totaliser, not for FMU 861							
	F	Keypad in protective housing / with illuminated display / with mechanical totaliser, not for FMU 860							
	D	Separate keypad for control panel / with display / without mechanical counter / without RS 485/ without DP							
	H	Separate keypad for control panel / with illuminated display / without mechanical counter / without RS 485/ without DP							
	C	Separate keypad for rack / with display / without mechanical counter / without RS 485/ without DP							
	G	Separate keypad for rack / with illuminated display / without mechanical counter / without RS 485/ without DP							
	K	Without keypad / without display / without mechanical counter, operation via HART, RS 485 or PROFIBUS-DP							
Relays									
	1	Three potential-free change-over contacts							
	2	Five potential-free change-over contacts, not for versions with RS-485 or PROFIBUS-DP							
Power supply									
	A	AC	180...253 V	50/60 Hz					
	B	AC	90...132 V	50/60 Hz					
	C	AC	38...55 V	50/60 Hz					
	D	AC	19...28 V	50/60 Hz					
	E	DC	20...30 V						
Interface/protocol									
	1	Without interface							
	3	Serial interface with HART protocol							
	4	Separate serial Rackbus RS 485 interface							
	5	Separate serial PROFIBUS-DP interface							
FMU 86	-								Product designation

* Shipbuilding approvals:
GL; DNV, LR, ABS, BV, RINA on request

Scope of delivery

- Instrument in the ordered version
- Operating manual BA 100F

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