Level | Pressure | Flow | Temperature | Liquid Analysis | Registration | Systems Components | Services | Solutions

Technical Information

Prosonic S FMU90

Transmitter in housing for field or top-hat rail mounting for the ultrasonic sensors FDU90/91/91F/92/93/95/96



Application for level measurement

- Continuous, non-contact level measurement of fluids, pastes, sludge and powdery to coarse bulk materials with 1 or 2 ultrasonic sensors
- Measuring range up to 70 m (230 ft) (depending on sensor and material measured)
- Level limit detection (up to 6 relays)
- Pump control (alternating); rake control
- Option: additional pump control functions (pump function test, ...)
- Calculations: average, difference, sum

Application for flow measurement

- Flow measurement in open channels and measuring weirs with 1 or 2 ultrasonic sensors
- Simultaneous measurement of level and flow in a stormwater overflow basin with only 1 sensor
- Flow measurement with back water detection (2 sensors) or sludge detection
- Up to 3 totalizers and 3 (resettable) counters; optionally resettable via digital inputs
- Counting or time pulse output for control of external units

Your benefits

- Simple, menu-guided operation with 6-line plain text display; 15 languages selectable
- Envelope curves on the display for quick and simple diagnosis
- Easy operation, diagnosis and measuring point documentation with the supplied Endress+Hauser operating program "FieldCare".
- Option: four digital inputs (e.g. for pump feedback) and one external temperature input
- Time-of-flight correction via integrated or external temperature sensors
- Linearization (up to 32 points, freely configurable)
- Linearization tables for the most common flumes and weirs pre-programmed and selectable
- Online calculation of the flume-/weir-flows via integrated flow curves
- Pre-programmed pump control routines
- System integration via HART or PROFIBUS DP
- Automatic detection of the sensors FDU9x
- The sensors of the series FDU8x can be connected (for certificates see note → 8)

TI00397F/00/EN/15.12
71209374

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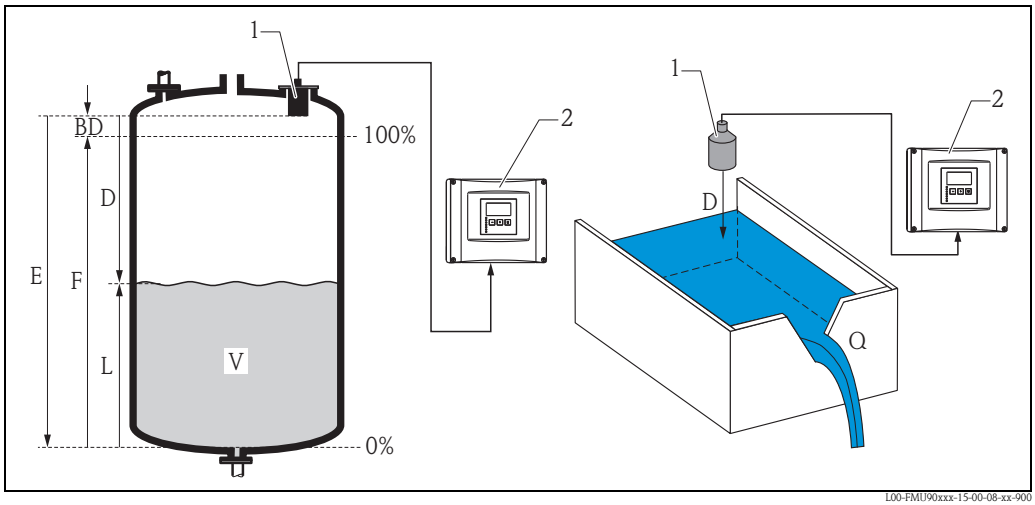
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Function and system design

Measuring principle



1 FDU9x
2 Prosonic S FMU90
BD: *blocking distance,* **D:** *distance from sensor membrane to fluid surface,* **E:** *empty distance* **F:** *span (full distance),* **L:** *level,* **V:** *volume (or mass),* **Q:** *flow*

The sensor transmits ultrasonic pulses in the direction of the product surface. There, they are reflected back and received by the sensor. The transmitter Prosonic S measures the time t between pulse transmission and reception. From t (and the velocity of sound c) it calculates the distance D from the sensor membrane to the product surface:

$D = c \cdot t/2$

From D results the desired measuring value:
- Level L
- Volume V
- Flow Q across measuring weirs or open channels

Blocking distance

The span F may not extend into the blocking distance BD. Level echos within the blocking distance can not be evaluated due to the transient characteristics of the sensor. The blocking distances of the individual sensors are given in the following documents:

- TI00396F for the sensors FDU90/91/91F/92/93/95/96
- TI00189F for the sensors FDU80/80F/81/81F/82/83/84/85/86

Time-of-flight correction

In order to compensate for temperature dependent time-of-flight changes, a temperature sensor (NTC) is integrated in the ultrasonic sensors.
Optionally, the Prosonic S FMU90 has an input for an external temperature sensor (FMU90-********B***). The following sensor can be connected:
- Pt100
- FMT131 from Endress+Hauser

The external sensor mus be used for the heated version of the ulstrasonic sensors FDU90 and FDU91.

Interference echo suppression

The interference echo suppression feature of the Prosonic S ensures that interference echos (e.g. from edges, welded joints and installations) are not interpreted as a level echo.

Pump control

individaully configurable for each pump:
- pump switching delay, e.g. to prevent overlaod of the power supply system
- backlash time and backlash interval, e.g. for complete draining of shafts or channels
- crust reduction at pump shaft walls by fine adjustment of the switch point

Linearization

Pre-programmed linearization curves

Types of vessels

- horizontal, cylindrical tank
- spherical tank
- tank with pyramidal bottom
- tank with conical bottom
- tank with flat, inclined bottom

Flow curves for flumes and weirs[1)]

- Khafagi-Venturi flume
- ISO-Venturi flume
- BST[2)]-Venturi flume
- Parshall flume
- Palmer-Bowlus flume
- Rectangular weir
- Rectangular constricted weir
- NFX[3)] rectangular weir
- NFX[3] rectangular constricted weir
- Trapezoidal weir
- V-notch weir
- BST[2] V-notch wier
- NFX[3] V-notch weir

The pre-programmed linearization curves are calculated on-line.

Linearization formula for flow measurements[1]

$Q = C (h^{\alpha} + \gamma h^{\beta})$
"h" is the upstream level. The parameters α, β, γ and C can be freely programmed by the user.

Linearization table

consisting of up to 32 linearization points; to be entered manually or half-automatically.

Special functions

- limit detection
- rake control
- alternating pump control or control according to pump rate (standard)
- option: additional pump control functions[4)]:
  - Alternation accordint to runtime or starts
  - pump feedback via the optional digital inputs; stand-by pump configurable
  - pump function test after resting time
  - storm function to prevent unnecessary pump running times
  - flush control for regular pump shaft cleaning
  - pump control according to tariff times via digital input
  - output of operating hours alarm or pump alarm
  - recording of pump data (operating hours, number of starts, last running time)
- totalising of the flow volume with (resettable) counters and (non-resettable) totalisers[1]
- triggering of a sampler by time or quantity pulses[1]
- low flow cut off[1]
- backwater detection in flumes[1]
- sludge detection in flumes[1]
- trend detection

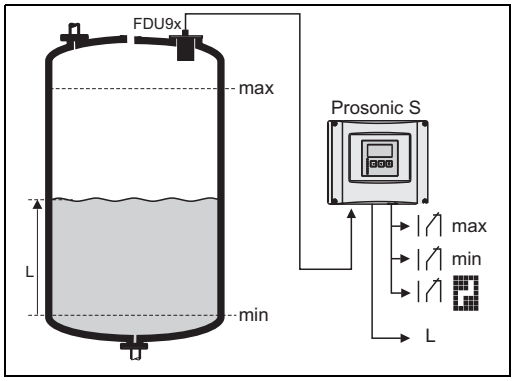
Datalog functions

- Peak hold indicator of the min./max. levels or flows and the min./max. temperatures at the sensors
- Recording of the last 10 alarms
- Indication of the operating status
- Trend indication of the outputs on the on-site display
- Indication of the operating hours

1) for instrument versions with flow software (FMU90 - *2********** or FMU90-*4**********)
2) BST: British Standard
3) French standard NFX 10-311
4) for instruments with software for additional pump control (FMU90-*3********** or FMU90-*4**********)

Application examples for level measurements

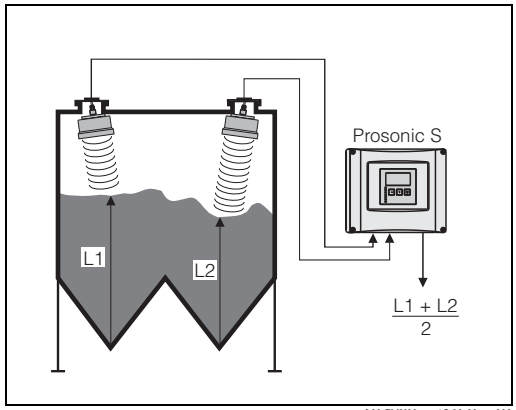
Level measurement with limit detection and alarm output



L00-FMU90xxx-15-00-00-xx-010

*Order code e.g.: FMU90 - *1***131****
(1 input, 3 relays, 1 outputs)

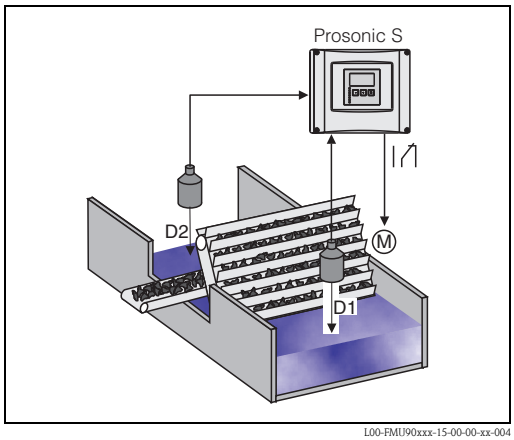
Average level measurement



L00-FMU90xxx-15-00-00-xx-003

*Order code e.g.: FMU90 - *1***212****
(2 inputs, 2 outputs)

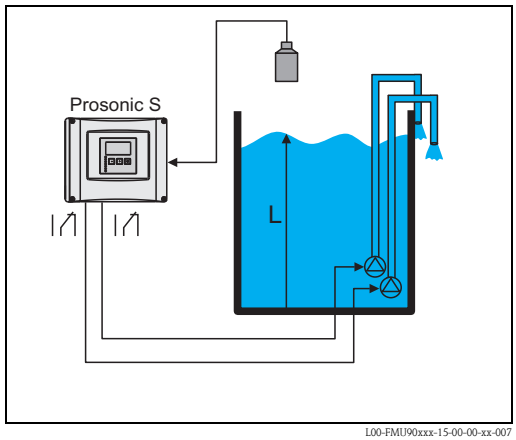
Rake control (differential measurement)



L00-FMU90xxx-15-00-00-xx-004

*Order code e.g.: FMU90 - *1***212****
(2 inputs, 1 relay, 2 outputs)

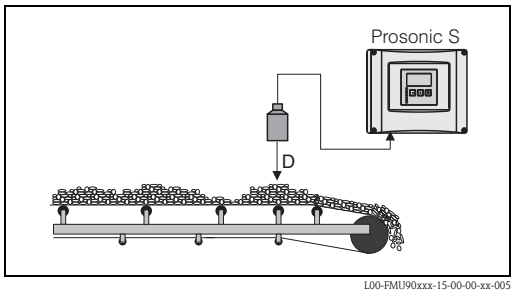
Alternating pump control (up to 6 pumps)



L00-FMU90xxx-15-00-00-xx-007

*Order code e.g.: FMU90 - *1***131****
(1 input, 3 relays)

Conveyor belt

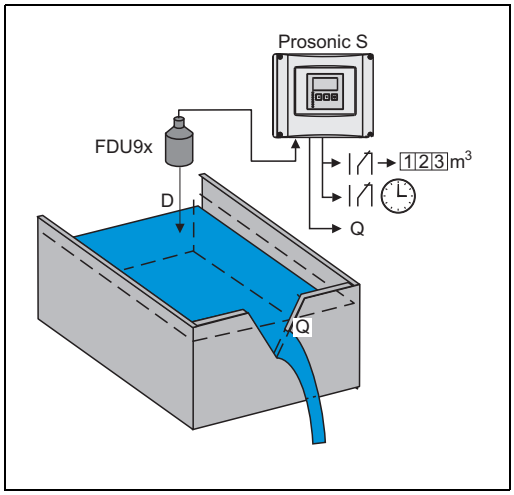


L00-FMU90xxx-15-00-00-xx-005

*Order code e.g.: FMU90 - *1***111****
(1 input, 1 output)

Application examples for flow measurements

Pulses for volume counter + time pulses (e.g. for sampler)

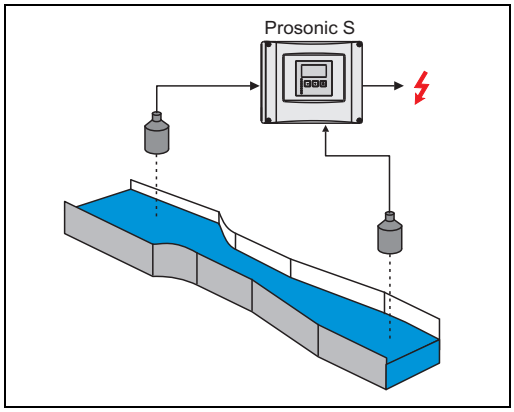


L00-FMU90xxx-15-00-00-xx-011

*Order code e.g.: FMU90 - *2***131****
(1 input, 3 relays, 1 output)*

Flow measurement with backwater alarm or sludge detection

If the ratio "downstream level:upstream level" rises above or falls below a critical value, an alarm will be generated.

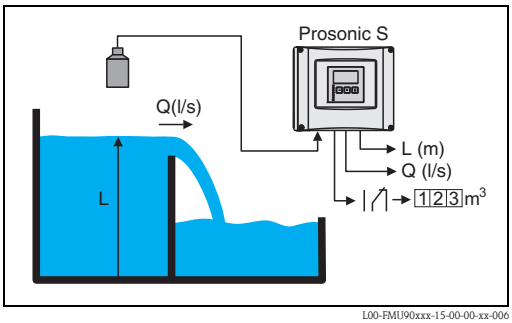


L00-FMU90xxx-15-00-00-xx-008

*Order code e.g.: FMU90 - *2***212****
(2 inputs, 1 relay, 2 outputs)*

Stormwater overflow bassin

Simultaneous measurement of level L and flow Q with 1 sensor.



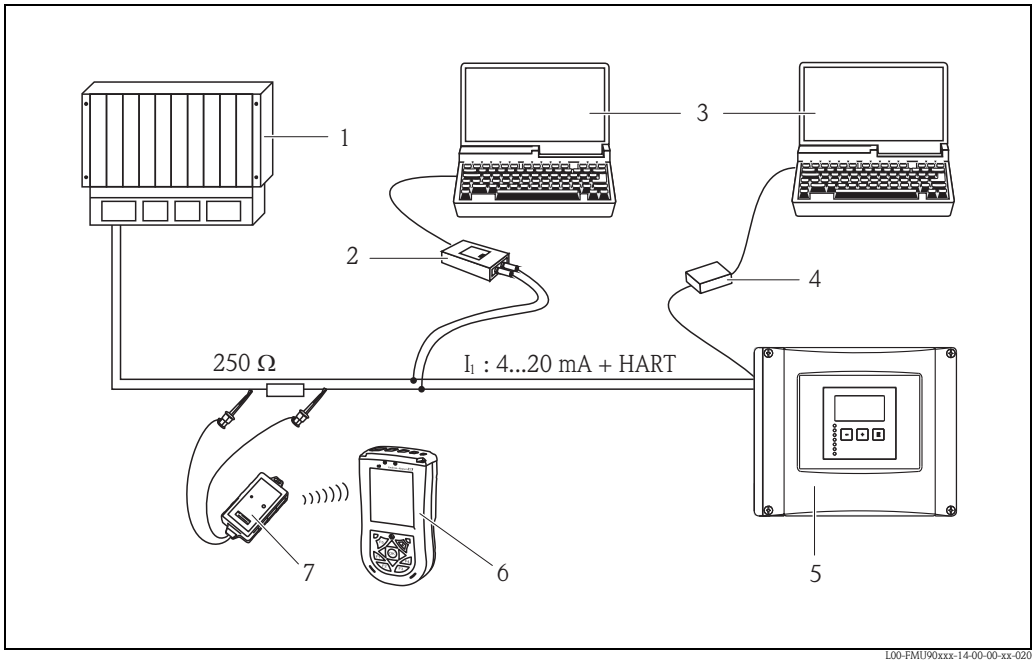
L00-FMU90xxx-15-00-00-xx-006

*Order code e.g.: FMU90 - *2***112****
(1 input, 2 outputs)*

System integration HART

Operating options

In the standard version a HART signal is superimposed onto the first output current. In order to use the HART communication, the circuit must contain a communication resistor of 250Ω.

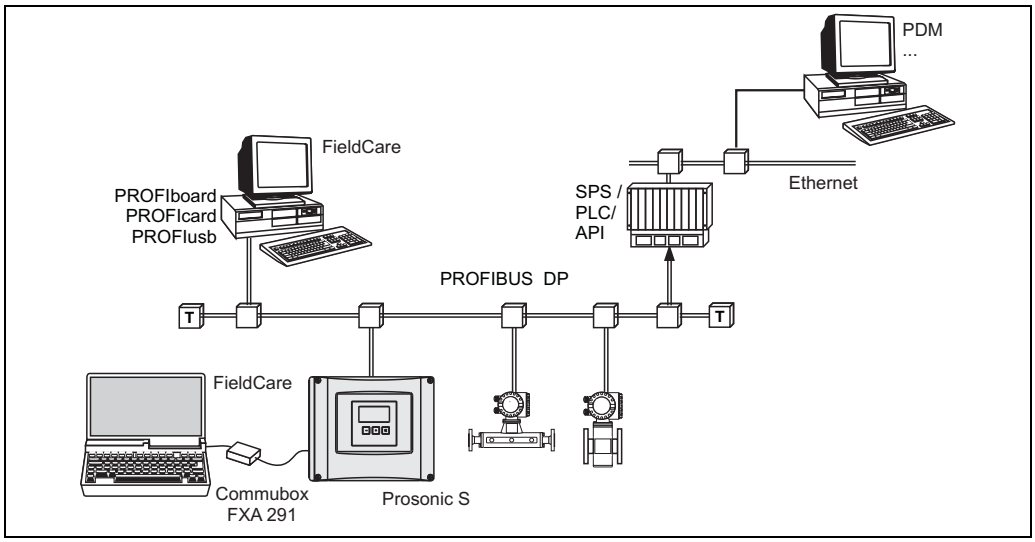


1 SPS, PLC, API
2 Commubox FXA195 (USB), HART-Protocol
3 FieldCare
4 Commubox FXA291 (service interface)
5 Operating and display module at the Prosonic S (if present)
6 Field Xpert SFX100
7 VIATOR Bluetooth-Modem with connection cable

System integration PROFIBUS DP

Operating options

- via the display and operating module at the Prosonic S
- via the service interface with the Commubox FXA291 and the operating program FieldCare
- via PROFIBUS DP with PROFIboard, PROFIcard or PROFIusb and the operating program FieldCare



Input

Sensor inputs

Depending on the instrument version, 1 or 2 of the sensors FDU90, FDU91, FDU91F, FDU92, FDU93, FDU95 and FDU96 can be connected. The Prosonic S identifies these sensors automatically.

Sensor	FDU90	FDU91 FDU91F	FDU92	FDU93	FDU95	FDU96
max. range[1)] in liquids	3 (9.8)	10 (33)	20 (66)	25 (82)	-	-
max. range[1] in solids	1.2 (3.9)	5 (16)	10 (33)	15 (49)	45 (148)	70 (230)

m (ft)

1) This table gives the maximum range. The range depends on the measuring conditions. For an estimation see Technical Information TI00396F, chapter "Input".

In order to support existing installations, the sensors of the series FDU8x can be connected as well. The type of sensor must be entered manually.

Sensor	FDU80 FDU80F	FDU81 FDU81F	FDU82	FDU83	FDU84	FDU85	FDU86
max. range[1)] in liquids	5 (16)	10 (33)	20 (66)	25 (82)	-	-	-
max. range[1] in solids	2 (6.6)	5 (16)	10 (33)	15 (49)	25 (82)	45 (148)	70 (230)

m (ft)

1) This table gives the maximum range. The range depends on the measuring conditions. For an estimation see Technical Information TI 00189F, chapter "Planning Recommendations".

Warning!
The sensors FDU83, FDU84, FDU85 and FDU86 with an ATEX, FM or CSA certificate are not certified for connection to the transmitter FMU90.

External limit switches (option)

Optionally, the Prosonic S FMU90 has four inputs for external limit switches (FMU90-********B***).

Switching options
- external passive limit switch (NC/NO switch)
- 0: < 8 V; 1: > 16 V

Usage (examples)
- pump feedback (for FMU90-*3******B***) and FMU90-*4******B***)
- pump tariff control (for FMU90-*3******B***) and FMU90-*4******B***)
- start/stop/reset of daily counters (for flow measurements) (for FMU90-*2******B*** and FMU90-*4******B***)
- min/max level detection, e.g. by Liquiphant

External temperature sensor

Optionally, the Prosonic S FMU90 has an input for an external temperature sensor (FMU90-********B***).

Connectable sensors
- Pt100 (3-wire or 4-wire connection)
  A Pt100 with 2-wire connection may not be used due to its insufficient accuracy.
- FMT131 (from Endress+Hauser) → 29, "Accessories"

Usage (example)
- Time-of-flight correction for a heated sensor (FDU90-***B*, FDU91-***B*).

Output

Analogue outputs

Number	1 or 2, depending on instrument version
Output signal	active current output output values configurable at the instrument: ■ 4 to 20 mA with HART[1)] ■ 0 to 20 mA without HART
Signal on alarm	■ for setting 4 to 20 mA, selectable: – MIN: -10 % (3,6 mA) – MAX: 110 % (22 mA) – HOLD (last current value is held) – user specific ■ for setting 0 to 20 mA: – MIN: 110 % (21,6 mA) – HOLD (last current value is held) – user specific
Output damping	freely selectable, 0 to 1000 s
Load	max. 600 Ω, influence negligible
max. ripple	U_{SS} = 200 mV at 47 to 125 Hz (measured at 500Ω)
max. noise	U_{eff} = 2,2 mV at 500 Hzto 10 kHz (measured at 500Ω)

1) The HART signal is assigned to the first analogue output. The second analogue output does not carry a HART signal.

Relay outputs

Number	1, 3 or 6; depending on the instrument version
Type	potential-free relay, SPDT, can be inverted
Assignable functions	■ limit (inband, out-of-band, trend, level limit) ■ counting pulse[1] for flow counting (max. frequency 2 Hz; pulse width adjustable) ■ time pulse[1] (max. frequency 2 Hz; pulse width adjustable) ■ alarm/diagnosis (e.g. indication of backwater[1)], sludge[1], echo loss etc.) ■ pump control (alternating/fixed limit/pump rate) ■ for FMU90-*3********** and FMU90-*4**********): additional pump control (standby pump, storm function to avoid unnecessary run times of the pumps, pump function test, flush control to clean pump shafts, operating hours alarm, pump alarm) ■ rake control (difference or relative measurement) ■ fieldbus relay (to be switched direclty from the PROFIBUS DP-bus)
Switching power	■ DC voltage: 35 V_{DC}, 100 W ■ AC voltage: 4 A, 250 V, 1000 VA at cosφ = 0,7
State on error	selectable: ■ HOLD (last value is held) ■ energized ■ de-energized ■ present value is used
Behaviour after power failure	switch-on delay selectable
LEDs[2)]	A yellow LED on the front panel is allocated to each relay, which lights if the relay is energized. The LED of an alarm relay lights during normal operation. The LED for a pulse relay briefly flashes at every pulse.

1) for instrument versions with flow software (FMU90 - *2**********)

2) for instrument versions with display and operating module

PROFIBUS DP interface

Profile	3.0
Transmittable values	■ main value (level or flow, depending on the instrument version) ■ distances ■ counters ■ temperatures ■ average/difference/sum ■ relay states ■ rake control ■ pump control
Function blocks	■ 10 Analog Input Blocks (AI) ■ 10 Digital Input Blocks (DI) ■ 10 Digital Output Blocks (DO)
Supported baud rates	■ 9.6 kbaud ■ 19.2 kbaud ■ 45,45 kbaud ■ 93.75 kbaud ■ 187.5 kbaud ■ 500 kbaud ■ 1.5 Mbaud ■ 3 Mbaud ■ 6 Mbaud ■ 12 Mbaud
Service Access Points (SAPs)	1
ID number 1540 (hex)	1540 (hex) = 5440 (dec)
GSD file	EH3x1540.gsd
Addressing	Via dip switches at the instrument or via software (e.g. FieldCare). Default address: 126 per software
Termination	Can be activated/deactivated in the instrument.
Locking	The device can be locked by hardware or software.

Power supply

Supply voltage / Power consumption / Current consumption

Instrument version	Supply voltage	Power consumption	Current consumption
AC voltage (FMU90 - ****A****)	90 to 253 V_{AC} (50/60 Hz)	max. 23 VA	max. 100 mA at 230 V_{AC}
DC voltage (FMU90 - ****B****)	10,5 to 32 V_{DC}	max. 14 W (typically 8 W)	max. 580 mA at 24 V_{DC}

Galvanic isolation

The following terminals are galvanically isolated from each other:
- auxiliary energy
- sensor inputs
- analogue output 1
- analogue output 2
- relay outputs
- bus connection (PROFIBUS DP)

Fuse

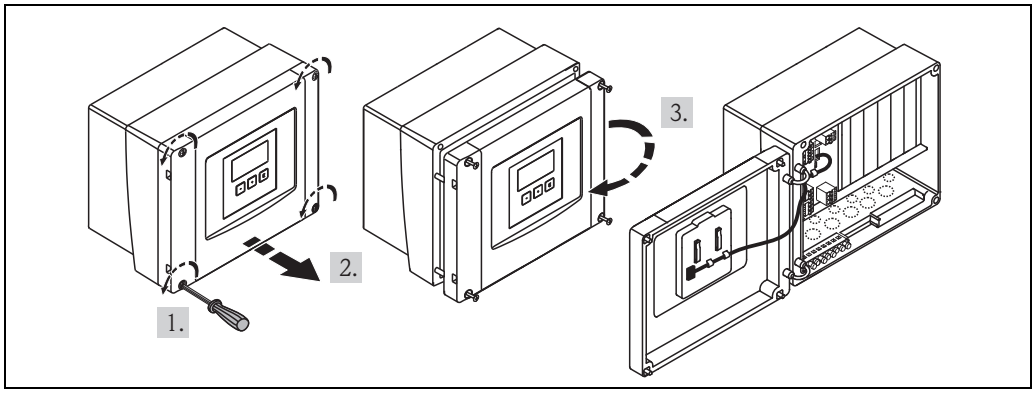
- 2 A T /DC
- 400 mA T /AC

accesible in the terminal compartment

Electrical connection

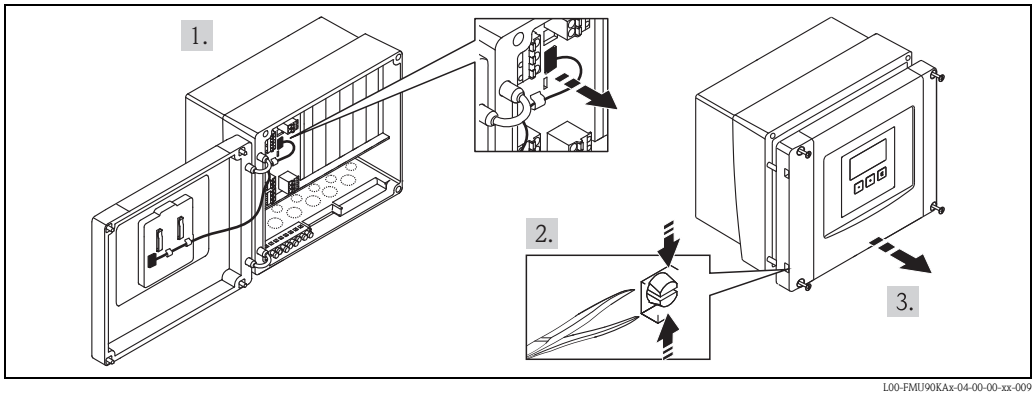
Terminal compartment of the field housing

The field housing has a separate terminal compartment. It can be opened after loosening the four screws of the lid.



L00-FMU90xxx-04-00-00-xx-002

For easier wiring, the lid can be completely removed by unplugging the display plug and loosening the hinges:



L00-FMU90KAx-04-00-00-xx-009

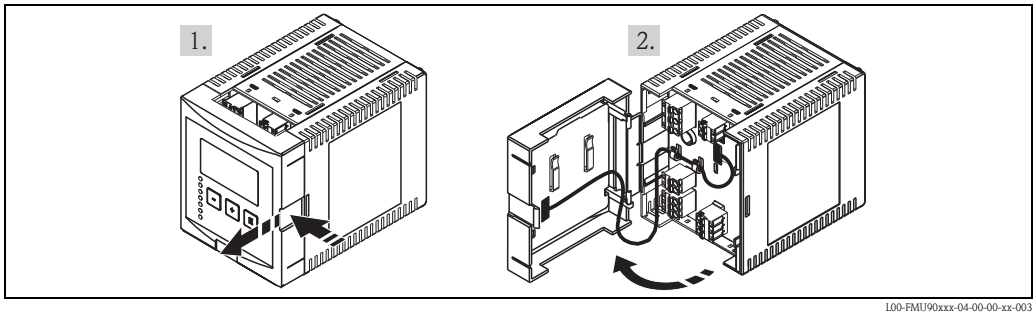
Cable entries of the field housing

On the bottom of the housing the following openings for cable entries are prestamped:
- M20x1.5 (10 openings)
- M16x1.5 (5 openings)
- M25x1.5 (1 opening)

A suitable cutting device must be used for cutting out the openings.

Terminal compartment of the DIN-rail housing

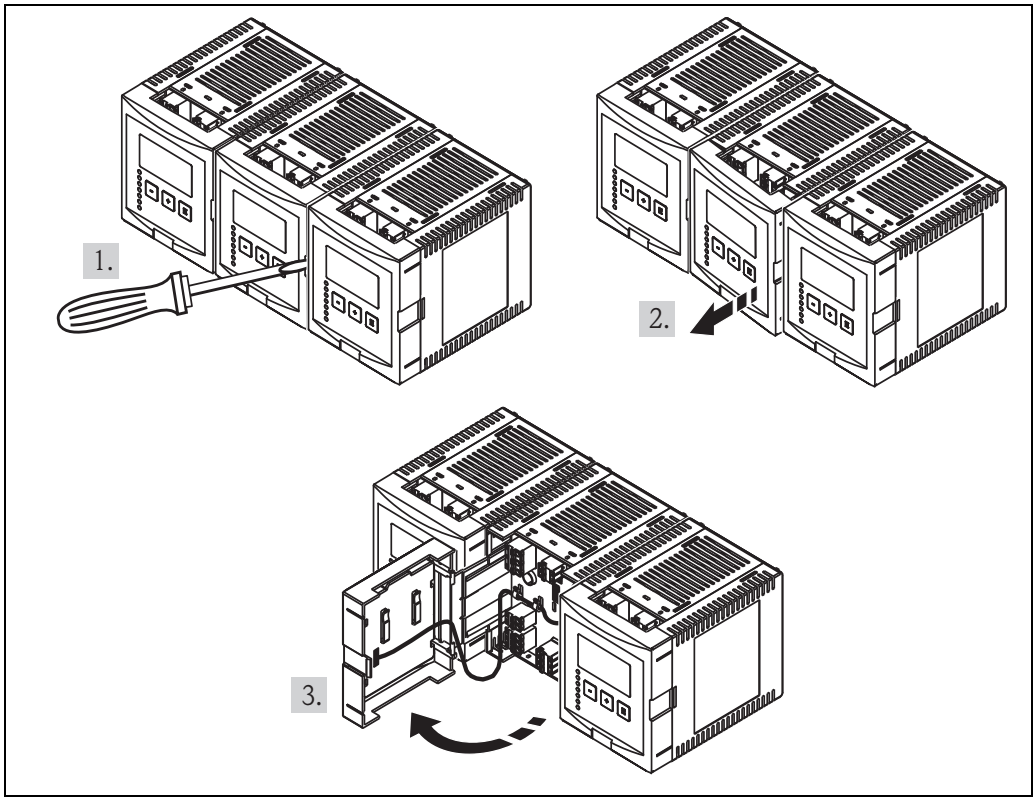
Single instrument



L00-FMU90xxx-04-00-00-xx-003

The catch can be unlocked by slightly pressing onto the clip. Then, the cover of the terminal compartment can be opened.

Several instruments mounted side by side



L00-FMU90xxx-04-00-00-xx-012

1. Open the catch of the cover (e.g. by a screwdriver).
2. Pull the cover out by approx. 20 mm (0.79 in).
3. The cover can now be opened.

Note!
- The cables can be inserted into the housing from above or from below.
- The pictures show the smallest housing version but are valid for the larger versions as well.
- If the instruments are mounted next to each other and if the sensor cables run in parallel, the synchronization terminals (39 and 40) must be interconnected (see sections "Terminal assignment" and Synchronization line").

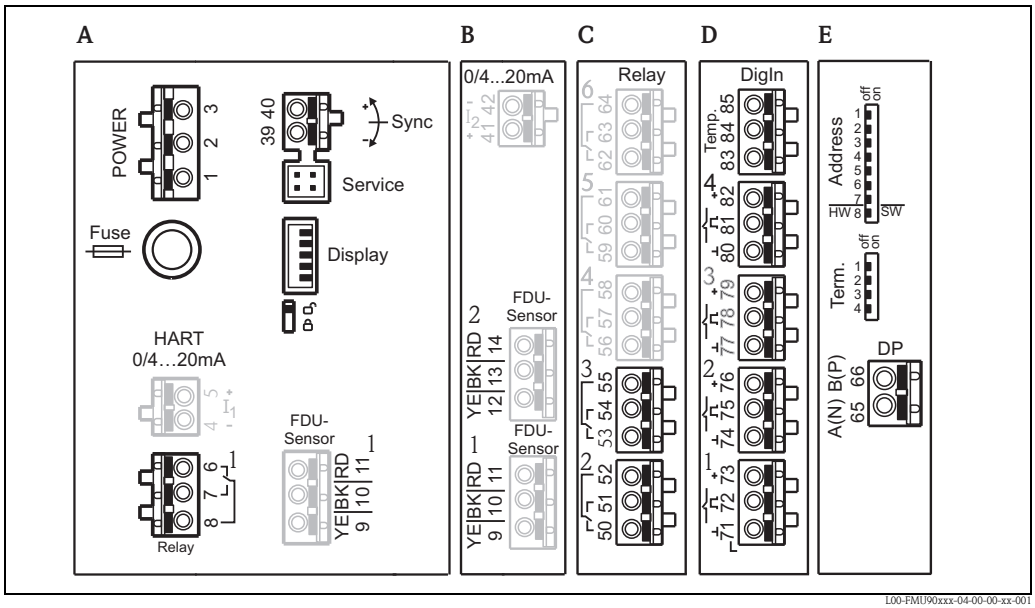
Terminal assignment

Pluggable spring-force terminals for connection of the cables are supplied in the terminal compartment. Rigid conductors or flexible conductors with cable sleeve can directly be inserted and are contacted automatically.

Conductor cross section	0,2 mm² to 2,5 mm² (26 to 14 AWG)
Cable and sleeve cross section	0,25 mm² to 2,5 mm² (24 to 14 AWG)
min. stripping length	10 mm (0.39 in)

The terminal configuration depends on the instrument version ordered. There is a basic terminal area, which is present in every instrument version. Additonal optional terminal areas are only present if the respective option has been selected in the product structure.

Terminal area		**present for the following instrument versions**
Basic area	A	for all versions
Optional areas	B	for instrument versions with 2 sensor inputs and/or 2 analogue outputs (FMU90 – *****2****** and/or FMU90 – *******2****)
	C	for instrument versions with 3 or 6 relays (FMU90 – ******3***** oder FMU90 – ******6*****)
	D	for instruments with external switch inputs and external temperature input (FMU90 – ********B***)
	E	for instrument versions with PROFIBUS DP interface (FMU90 – *******3****)



Terminals of the Prosonic S (the terminals depicted in grey are not present in every instrument version)
A *Basic terminal area*
B-E *Optional terminal areas (present if the respective option has been selected in the product structure)*

Note!
The depicted switching states of the relays refer to the de-energized state.

Terminals	Meaning	Terminal area	Remarks
Auxiliary energy			
1, 2	■ L (für AC version) ■ L+ (for DC version)	A	depending on instrument version: ■ 90 to 253 V_{AC} ■ 10,5 to 32 V_{DC}
2	■ N (for AC version) ■ L- (for DC version)	A	
3	Potential equalization	A	
Fuse		A	depending on instrument version: ■ 400 mA T (for AC) ■ 2 A T (for DC)
Analog outputs (not available for PROFIBUS DP instruments)			
4, 5	Analog output 1; 4 to 20 mA with HART/ 0 to 20 mA w/o HART	A	**not** present for the PROFIBUS DP version
41, 42	Analog output 2 (optional); 4 to 20 mA/ 0 to 20 mA	B	only for the version with two analog outputs; no HART signal at this output
Relay outputs			
6, 7, 8	Relay 1	A	
50, 51, 52	Relay 2 (optional)	C	only for the versions with 3 or 6 relays
53, 54, 55	Relay 3 (optional)	C	only for the versions with 3 or 6 relays
56, 57, 58	Relay 4 (optional)	C	only for the version with 6 relays
59, 60, 61	Relay 5 (optional)	C	only for the version with 6 relays
62, 63, 64	Relay 6 (optional)	C	only for the version with 6 relays
Bus communication (only available for PROFIBUS DP instruments)			
65	PROFIBUS A (RxT/TxD - N)	D	only for the PROFIBUS DP version
66	PROFIBUS B (RxT/TxD - P)	D	
Synchronization			
39, 40	Synchronization	A	see section 4.6, "Synchronization line"
Level inputs			
9 (YE), 10 (BK), 11 (RD)	Sensor 1 (FDU8x/9x) YE: yellow strand BK: black strand RD: red strand	■ A: for versions with 1 sensor input ■ B: for versions with 2 sensor inputs[1)]	
12 (YE), 13 (BK), 14 (RD)	Sensor 2 (FDU8x/9x) (optional) YE: yellow strand BK: black strand RD: red strand	B	only for the version with 2 sensor inputs
external switch inputs			
71, 72, 73	external switch input 1	D	0: < 8 V or 72 and 73 interconnected 1: > 16 V or 72 and 73 not interconnected
74, 75, 76	external switch input 2	D	0: < 8 V or 75 and 76 interconnected 1: > 16 V or 75 and 76 not interconnected
77, 78, 79	external switch input 3	D	0: < 8 V or 78 and 79 interconnected 1: > 16 V or 78 and 79 not interconnected
80, 81, 82	external switch input 4	D	0: < 8 V or 81 and 82 interconnected 1: > 16 V or 81 and 82 not interconnected
temperature input			
83, 84, 85	temperature input: ■ PT100 ■ FMT131 (Endress+Hauser)	D	see section "Connection of a temperature sensor"

1) In this case, terminals 9/10/11 are not present on terminal area A.

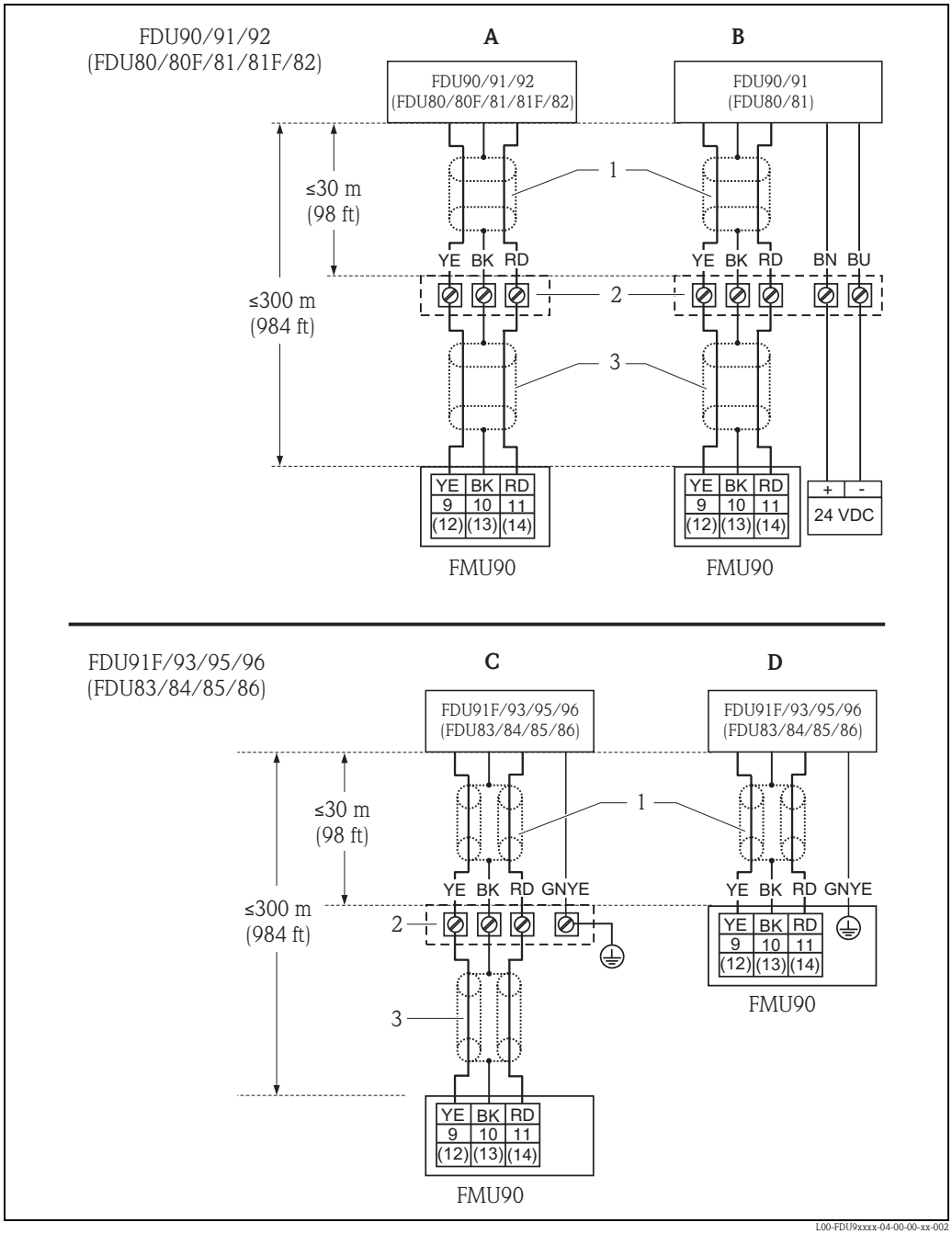
Warning!
When using the public supply mains, an easily accesible power switch must be installed in the proximity of the device. The power switch must be marked as a disconnector for the device (IEC/EN 61010).

Note!
- In order to avoid interference signals, the sensor cables should not be laid parallel to high voltage or electric power lines.
- The cables may not be laid in the proximity to frequency converters.

Additional elements on the terminal areas

Designation	Meaning/Remarks
Fuse	Fuse: 2 A T /DC or 400 mA T/AC
Display	Connection of the display or the remote display and operating module
Service	Service interface for connection of a PC/Notebook via Commubox FXA291
	Locking switch
Term.	Bus termination (only applicable for instruments with PROFIBUS interface)
Address	Bus address (only applicable for instruments with PROFIBUS interface)

Connection of the sensors FDU9x



A *Without sensor heater*
B *With sensor heater*
C *Grounding at the terminal box*
D *Grounding at the transmitter FMU90*

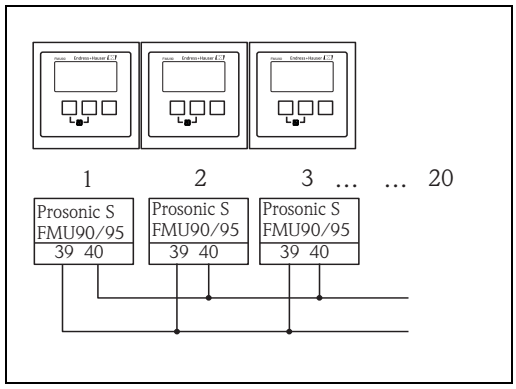
1 Screen of the sensor cable
2 Terminal box
3 Screen of the extension cable

Colours of the strands: YE = yellow; BK = black; RD = red; BU = blue; BN = brown; GNYE = green-yellow

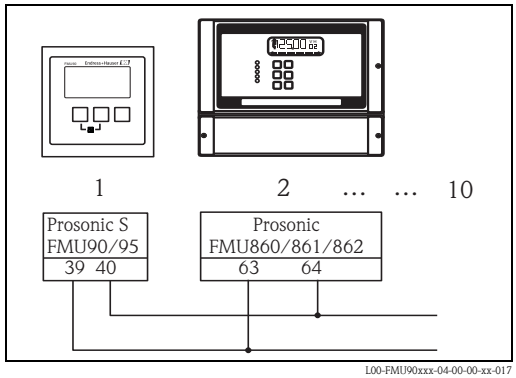
For details refer to Technical Information TI00396F/00/EN (FDU9x) or TI00189F/00/EN (FDU8x).

Synchronization line

- If wiring several Prosonic S (FMU90/FMU95) which are mounted in a common cabinet and if the sensor cables run in parallel, the synchronization terminals (39 and 40) must be interconnected.
- Up to 20 instruments can be synchronized in this way.
- The synchronization prevents an evaluation unit from receiving a signal while a different evaluation unit is emitting a signal.
  This prevents pulses in the sensor cable of one sensor from influencing the received signal on the cable of a different sensor.
- If there are more than 20 instruments, groups must be formed, each containing a maximum of 20 instruments. For the instruments within each group, the sensor cables may run in parallel. The sensor cables of different groups must be seperated from each other.
- Usual commercial screened cable can be used for synchronization
  – max. length: 10 m (33 ft) between the individual instruments
  – cross section: 2 x (0.75 to 2.5 mm^2 (18 to 14 AWG))
  – for lengths up to 1 m (3.3 ft), an unscreened cable can be used; for lenghts exceeding 1 m (3.3 ft), screening is required. The screen must be connected to ground
- Instruments of the Prosonic FMU86x family can be connected to the synchronization line as well. In this case a maximum of 10 instruments can be connected to each synchronisation line.

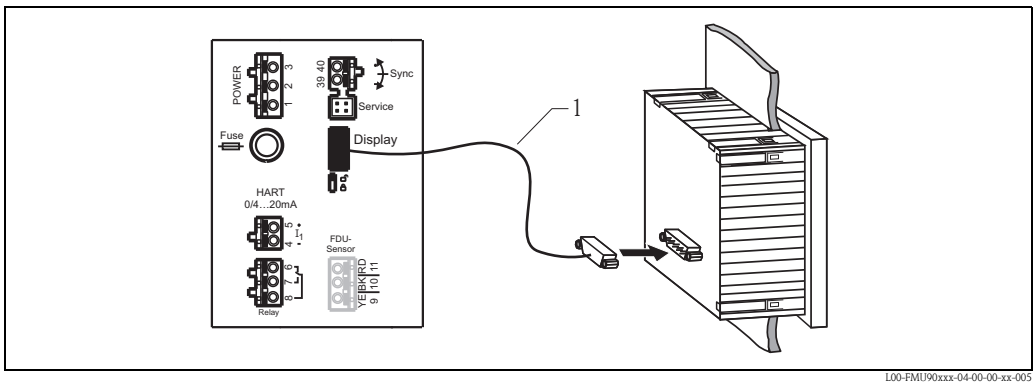


L00-FMU90xxx-04-00-00-xx-004



L00-FMU90xxx-04-00-00-xx-017

Connection of the separate display and operating module



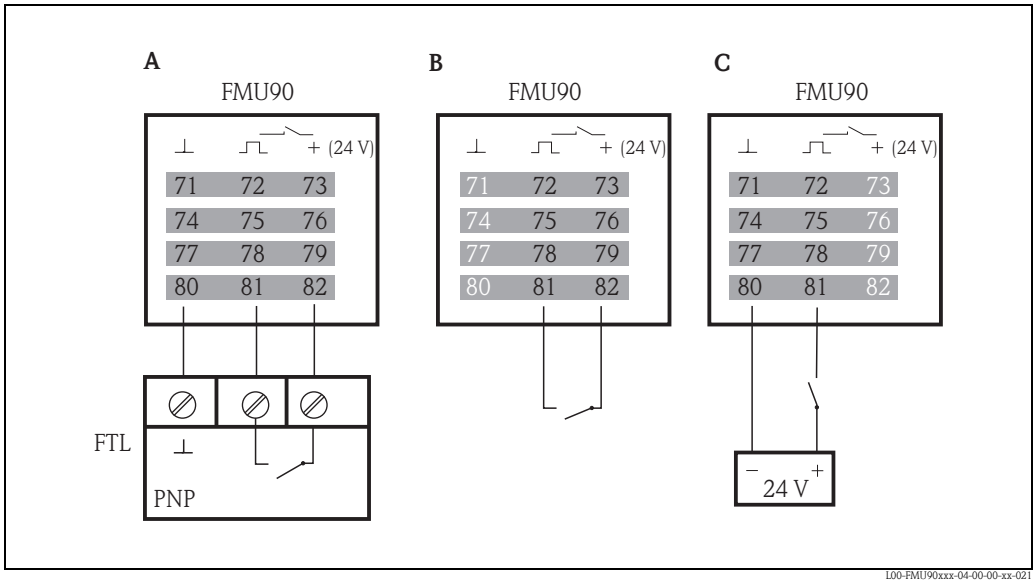
L00-FMU90xxx-04-00-00-xx-005

1 Connection of the display plug with the cable (3 m (9.8 ft))

For the version of the Prosonic S with a separate display for panel mounting, a pre-assembled connecting cable (3 m (9.8 ft)) is supplied. The cable must be connected to the display plug of the Prosonic S.

Note!
Minimum diameter for cable bushing: 20 mm (0.79 in)

Connection of external switches (for FMU90-******B***)**



A *Liquiphant*
B *External switch*
C *External switch with external supply voltage*

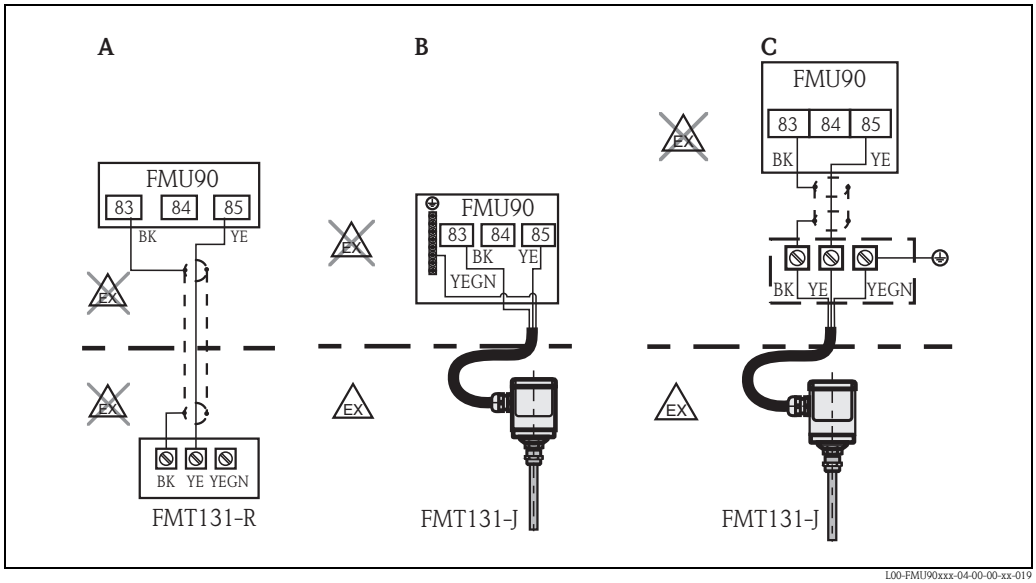
The maximum short-circuit current at 24 V is 20 mA.

Connection of a temperature sensor

The Prosonic S FMU90 transmitter has an optional input for an external temperature probe (in the product structure: feature 90 "Additional input", option B, → 28). The following probes can be connected:
- a FMT131 temperature probe from Endress+Hauser
- a Pt100 temperature probe

Note!
- After connecting an external temperature sensor, the following is required:
  1. The type of the connected sensor (Pt100 or FMT131) must be selected in "sensor management/ext. temp. sensor" in the "sensor type" parameter.
  2. The external temperature sensor must be assigned to an ultrasonic sensor in "sensor management/FDU sensor/US sensor N" in the "temp. measurement" parameter.
- If the option "alarm" has been selected for the case of an error in external temperature sensor, this alarm is indicated by the alarm relay.

FMT131 (Endress+Hauser) (connectable to FMU90-******B***)**

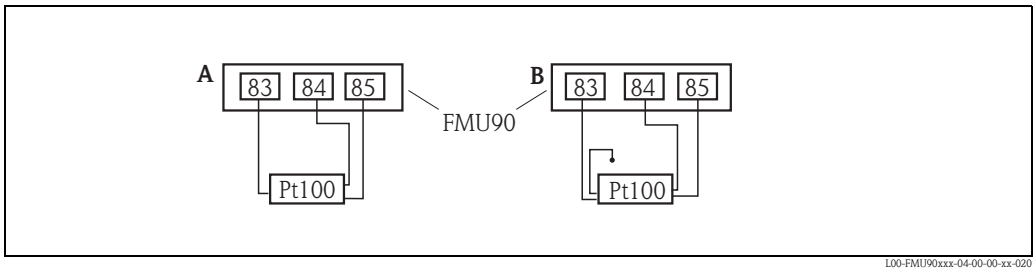


A *Non-Ex area (FMT131-R)*
B *Ex area (FMT131-J) with grounding in the FMU90*
C *Ex area (FMT131-J) with grounding at a terminal box*

BK black
YE yellow
YEGN yellow-green

Note!
For details refer to the Operating Instructions KA00019F.

Pt100 (connectable to FMU90-******B***)**



A *Pt100 with 3-wire connection*
B *Pt100 with 4-wire connection (one connector remains unused)*

Note!
A Pt100 with 2-wire connection may not be used due to its insufficient measuring accuracy.

Warning!
A Pt100 may not be connected in explosion hazardous areas. A FMT131 must be used instead.

Performance characteristics

Reference operating conditions

- Temperature = 24±5 °C (75±9 °F)
- Pressure = 960±100 mbar (14±1.45 psi)
- Relative humidity = 60±15 %
- Ideally reflecting surface, sensor vertically aligned (e.g. calm, plane liquid surface of 1 m^2 (10.76 ft^2))
- No interference echoes within the signal beam
- Settings of the application parameters:
  - tank shape = flat ceiling
  - medium property = liquid
  - process condition = calm surface

Maximum measuring error[5) 6)]

±0.2 % of the maximum span of the sensor

Typical measuring error[6)]

Include linearity, repeatability, and hysteresis
Better than ±2 mm (0.08 in) + 0.17 % of the measured distance

Measured value resolution

1 mm (0.04 in) with FDU90/FDU91

Measuring frequency

Max. 3 Hz
The exact value depends on the settings of the application parameters and the instrument version.

Note!
The maximum measuring frequency is obtained for "empty E" ≤ 2 m (≤ 6.6 ft) and "process condition" = "test: no filter".

Influence of the vapor pressure

The vapor pressure at 20 °C (68 °F) gives a hint on the accuracy of the ultrasonic level measurement. If the vapor pressure at 20 °C (68 °F) is below 50 mbar (1 psi), ultrasonic level measurement is possible with a very high accuracy. This is valid for water, aqueous solutions, water-solid-solutions, dilute acids (hydrochloric acid, sulfuric acid, ...), dilute bases (caustic soda, ...), oils, greases, slurries, pastes, ...
High vapor pressures or outgassing media (ethanol, acetone, ammonia, ...) can influence the accuracy. If conditions like these are present, please contact your Endress+Hauser sales representative.

5) according to EN 61298-2
6) with reference operating conditions

Environment

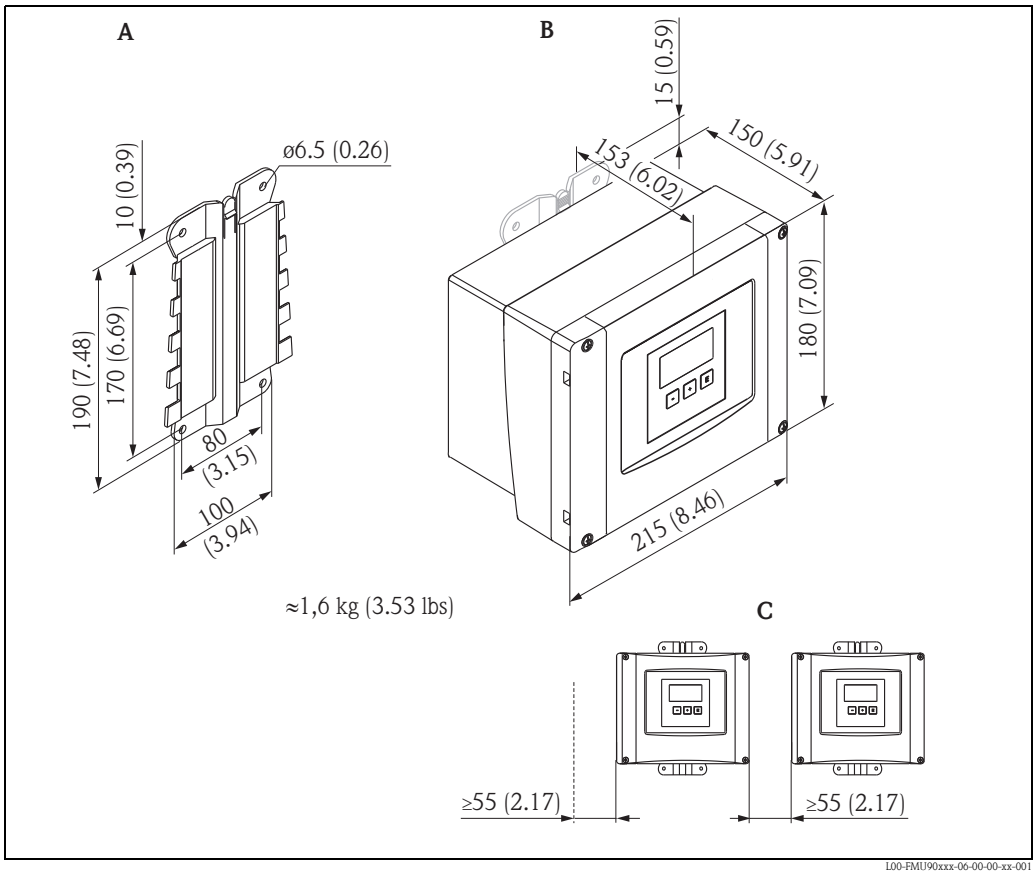
Ambient temperature	–40 to 60 °C (–40 to 140 °F) The functionality of the LC display becomes restricted at T_U < –20 °C (T_U < –4 °F). If the device is operated outdoors in strong sunlight, a protective cover should be used (→ 🖹 29).
Storage temperature	–40 to 60 °C (–40 to 140 °F)
Climate class	■ **Field housing:** according to DIN EN 60721-3 4K2/4K5/4K6/4Z2/4Z5/4C3/4S4/4M2 (DIN 60721-3 4K2 corresponds to DIN 60654-1 D1) ■ **Housing for DIN rail mounting:** according to DIN EN 60721-3 3K3/3Z2/3Z5/3B1/3C2/3S3/3M1 (DIN 60721-3 3K3 corresponds to DIN 60654-1 B2)
Vibration resistance	■ Housing for DIN rail: DIN EN 60068-2-64 / IEC 68-2-64; 20 to 2000 Hz; 0,5 $(m/s^2)^2/Hz$ ■ Field housing: DIN EN 60068-2-64 / IEC 68-2-64; 20 to 2000 Hz; 1,0 $(m/s^2)^2/Hz$
Ingress protection	■ Field housing: IP66 / NEMA 4x ■ Housing for DIN rail: IP20 ■ Separate display: – IP65 / NEMA 4 (front panel, if mounted in cabinet door) – IP20 (rear panel, if mounted in cabinet door)
Electromagnetic compatibility (EMC)	Electromagnetic compatibility according to all relevant requirements of the EN 61326- series and NAMUR recommendation EMC (NE21). For details see declaration of conformity. With respect to interference emission the devices meet the requirements of class A and are only provided for use in an "industrial environment"!

Mechanical construction

Housing versions

- Field housing; optionally with integrated display and operating module
- Housing for top-hat rail mounting; optionally with intergrated display and operating module
- Housing for top-hat rail mounting with separated display and operating module for cabinet door mounting

Dimensions of the field housing



Dimensions in mm (in)
A *Mounting help (supplied); can also be used as drilling template*
B *Field housing*
C *Minimum mounting distance*

The dimensions of the field housing are the same for all instrument versions.
To open the housing, a minimum mounting distance of 55 mm (2.17 in) is required on the left.

Note!
The mounting help must be mounted on a plane surface and must not become bent. Otherwise the mounting of the field housing may be difficult or impossible.

Dimensions of the DIN-rail housing

The dimensions of the DIN-rail housing depend on the instrument version. The version determines, which terminal areas the Prosonic S contains. The dimensions are influenced by the following features of the product structure (see chapter 2.3):

- 60: Level Input
- 70: Switch Output
- 80: Output

In order to determine the dimensions of a specific version, perform the following steps (see the example → 📄 24):

1. Using the product structure, determine the options of the features 60, 70 and 80 of the instrument version in question.

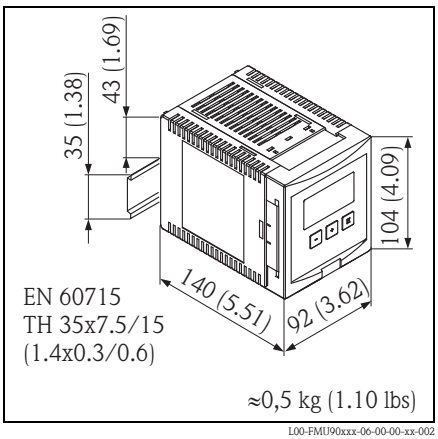
	10	20	30	40	50	**60**	**70**	**80**	**90**	100	110	120
FMU90 -												

2. Using the following table, determine how many optional terminal areas this instrument version contains.

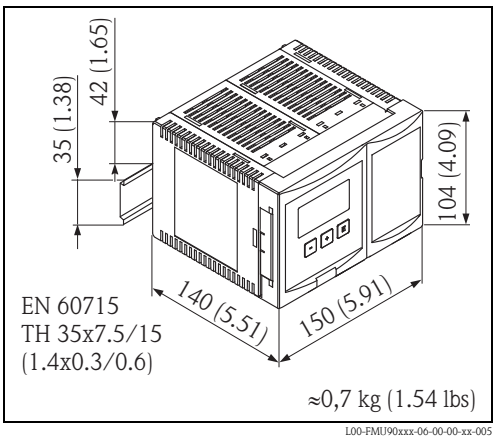
Feature and option of the product structure	**corresponds to the following terminal area**	**present? yes = 1 no = 0**
feature 60; option 2 and/or feature 80, option 2	2 sensor inputs and/or 2 analogue outputs	
feature 70, option 3 or 6	3 o 6 relays	
feature 80, option 3	PROFIBUS DP interface	
feature 90, option B	inputs for external switches and external temperature sensor	
	Sum =	

3. The appropriate dimensions are given in the following diagram:

Sum = 0
(only basic terminal area)

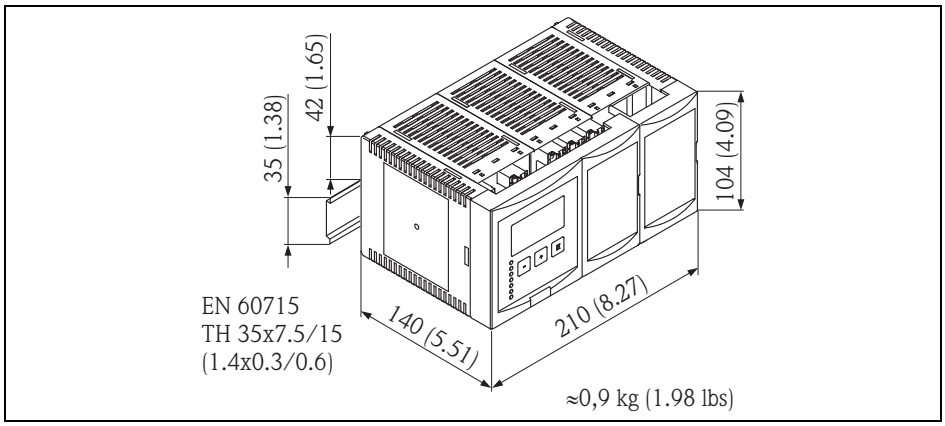


Sum = 1, 2 or 3
(1-3 optional terminal areas)



Dimensions in mm (in)

Sum = 4
(4 optional terminal areas)



Dimensions in mm (in)

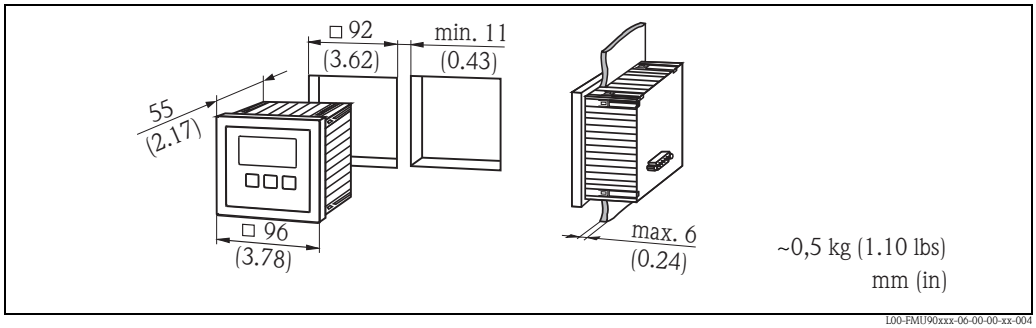
Example

	10	20	30	40	50	**60**	**70**	**80**	**90**	100	110	120
FMU90 -	R	1	2	A	A	2	3	2	A	A	1	A

feature and option of the product structure	**corresponds to the following terminal area**	**present?**
feature 60; option 2 and/or feature 80, option 2	2 sensor inputs and/or 2 analogue outputs	1 (yes)
feature 70, option 3 or 6	3 or 6 relays	1 (yes)
feature 80, option 3	PROFIBUS DP interface	0 (no)
feature 90, option B	inputs for external switches and external temperature sensorr	0 (no)
	Sum =	2

Sum = 2
=> 104 mm x 150 mm x 140 mm (4.09 x 5.91 x 5.51 in)

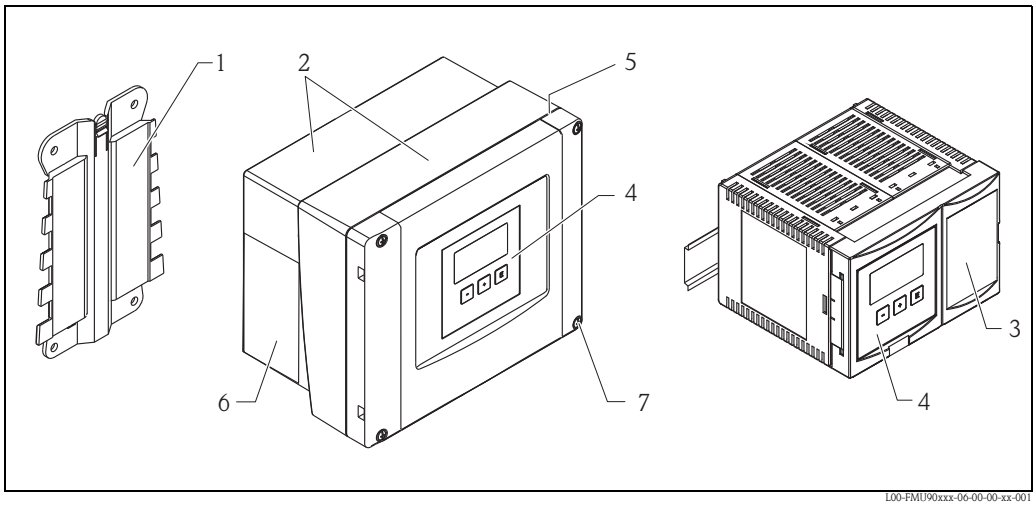
Dimensions of the separate display and operating module



Weight

Housing version	Weight
Field housing	approx. 1.6 to 1.8 kg (3.53 to 3.97 lbs); depending on instrument version
Housing for DIN rail	approx. 0.5 to 0.7 kg (1.10 to 1.54 lbs); depending on instrument version (→ 📄 23 "Dimensions of the DIN-rail housing")
separate display and operating module	approx. 0.5 kg (1.10 lbs)

Materials

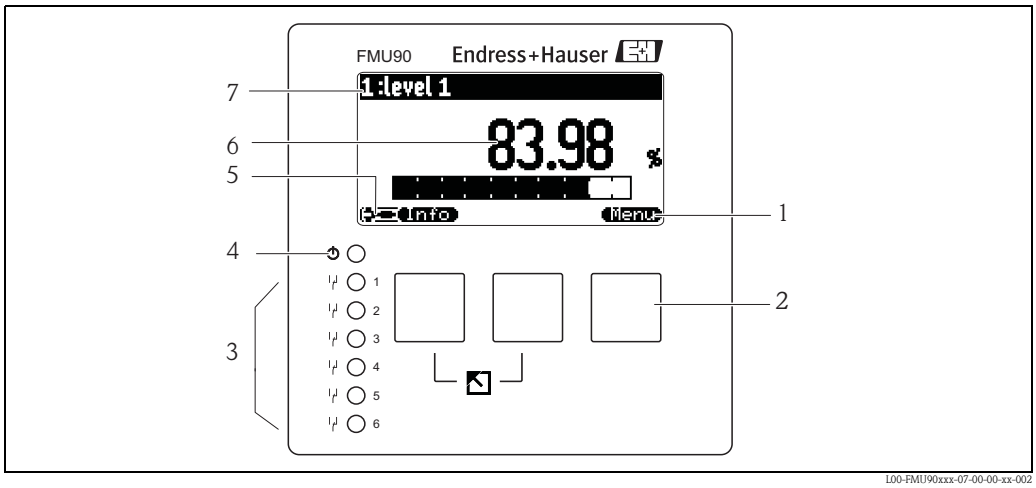


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Pos.	Part	Material
1	Housing bracket	PC-FR
2	Field housing	PC-FR
3	Housing for DIN rail	PBT-GF
4	Separate display and operating module	PC
5	Sealing	PUR foam
6	Nameplate	Polyester
7	Screws	A4 (1.4578)

Operability

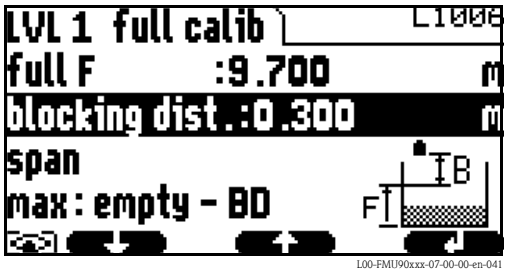
Display and operating module



L00-FMU90xxx-07-00-00-xx-002

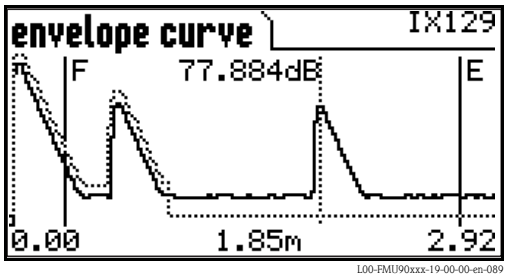
1 Softkey symbol
2 Key
3 LEDs indicating the switching states of the relays
4 LED indicating the operating state
5 Display symbols
6 Value of the parameter, including unit
7 Name of the parameter

Display (Examples)



L00-FMU90xxx-07-00-00-en-041

Display of a function including help text and descriptive graphic



L00-FMU90xxx-19-00-00-en-089

Display of the envelope curve including the mapping. The level echo and the empty distance are marked.

Keys (softkey operation)

The function of the keys depends on the current position within the operating menu (softkey functionality). The key functions are indicated by softkey symbols in the bottom line of the display.

LEDs

- 1 LED (a) indicates the operating state ("normal operation", "alarm" or "warning")
- 6 LEDs (b) indicate the switching state of the relays (LED glows if the respective relay is energised)

Display

An illuminated display is available as an option (s. feature 40 of the product structure → 🗎 28)

Operating menu

The Prosonic S has got a dynamical operating menu. Only those functions are visible which are relevant for the instrument version and installation environment at hand.

Basic setup

The operating menu contains basic setups for easy commissioning of level and flow measurements. The basic setups guide the user through the complete commissioning procedure.

Locking of the instrument

The instrument can be locked against parameter changes in the following ways:
- Locking switch in the terminal compartment
- Key combination at the operating module
- Input of a locking code via software (e.g. "FieldCare")

Certificates and Approvals

CE mark

The measuring system meets the legal requirements of the EC-guidelines. Endress+Hauser confirms the instrument passing the required tests by attaching the CE-mark.

Ex approval

The available certificates are listed in the ordering information. Note the associated safety instructions (XA) and control or installation drawings (ZD).

Warning!
- Measuring systems for use in hazardous environments are accompanied by separate "Ex documentation", which is an integral part of this Operating Manual. Strict compliance with the installation instructions and ratings as stated in this supplementary documentation is mandatory.
  - Ensure that all personnel are suitably qualified.
  - Observe the specifications in the certificate as well as national and local standards and regulations.
- The transmitter may only be installed in suitable areas.
- Sensors with a certificate for hazardous areas may be connected to a transmitter without a certificate.
- For FM approvals:
  Unauthorized substitution of components may impair the suitability for Division 1 or Division 2.
- Do not disconnect equipment unless the area is known to be non-hazardous.

Note!
- The sensor must be installed and used in a way that eliminates any danger. Possible installation positions: in tanks, vessels, silos, over stockpiles, open channels, weirs or other bins.
- Sensors FDU9x with Ex-approval can be connected to the transmitter FMU90 without Ex-approval.

External standards and guidelines

EN 60529

Protection class of housing (IP code)

EN 61326 series

EMC product family standard for electrical equipment for measurement, control and laboratory use

NAMUR

User association for automation technology in process industries

US Standard UL 61010-1

CSA General Purpose Units FMU9x-N********** are tested according to US standard UL 61010-1, 2nd eedition

Ordering information

Product structure

010	**Approval**	
	R	Non-hazardous area
	J	ATEX II 3D
	N	CSA General Purpose
020	**Application**	
	1	Level + pump control, alternating
	2	Flow + totalizer + level + sample control + preprogrammed OCM flow curves
	3	Level + additional pump control
	4	Universal instrument (Level + Flow + Additional pump control)
030	**Housing, material**	
	1	Field mounting PC, IP66 NEMA 4x
	2	DIN rail mounting PBT, IP20
040	**Operation**	
	C	Illuminated display + keypad
	E	Illuminated display + keypad, 96x96, panel mounting, front IP65
	K	w/o display, via communication
050	**Power supply**	
	A	90-253 VAC
	B	10.5-32 VDC
060	**Level input**	
	1	1x sensor FDU9x/8x
	2	2x sensor FDU9x/8x
070	**Switch output**	
	1	1x relay, SPDT
	3	3x relay, SPDT
	6	6x relay, SPDT
080	**Output**	
	1	1x 0/4-20mA HART
	2	2x 0/4-20mA HART
	3	PROFIBUS DP
090	**Additional input**	
	A	w/o additional input
	B	4x limit switch + 1x temperature PT100/FMT131
100	**Datalog function**	
	A	Basic version
110	**Languages**	
	1	de, en, nl, fr, es, it, pt
	2	de, en, ru, pl, cs
	3	en, zh, ja, ko, th, id
120	**Additional option**	
	A	Basic version
	L	5-point linearity protocol only to order with FDU9x sensor + 5-point linearity protocol
995	**Marking**	
	1	Tagging (TAG)
	2	Bus address
FMU90 -		complete product designation

(*): meaning of the language code:
cs: Czech; de: German; en: English; es: Spanish; fr: French; id: Bahasa (Indonesia, Malaysia); it: Italian; ja: Japanese; ko: korean; nl: Dutch; pl: Polish; pt: Portuguese; ru: Russian; th: Thai; zh: Chinese

Scope of delivery

- Instrument according to the version ordered
- Operating program: FieldCare
- Operating Instructions (depending on communication version → 📄 35, "Documentation")
- for certified instrument versions: Safety Instructions (XAs) or Control Drawings (ZDs)→ 📄 35, "Documentation"
- field housing units for flow measurement FMU90-*21********* are delivered with 2 screws for plombing the device

Accessories

Commubox FXA195 HART

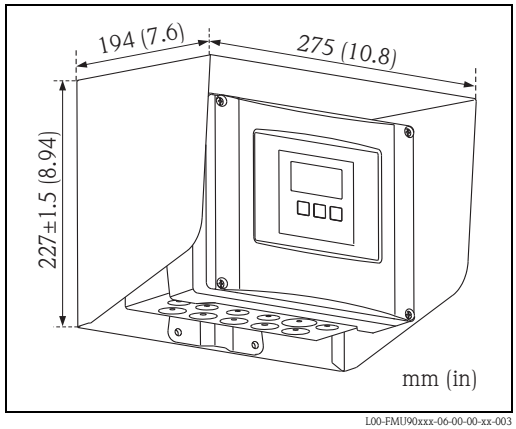
For intrinsically safe communication with FieldCare via the USB interface. For details refer to TI00404F/00/EN.

Commubox FXA291

The Commubox FXA291connects Endress+Hauser field instruments via service interface to the USB interface of a personal computer or a notebook. For details refer to TI00405C/07/EN.

Protection cover for the field housing

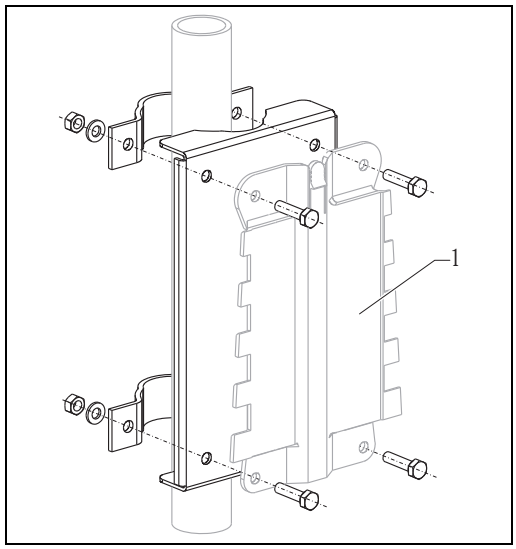
- Material: 316Ti (1.4571)
- is mounted by the mounting help of the Prosonic S
- Order-Code: 52024477



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Mounting plate for the field housing

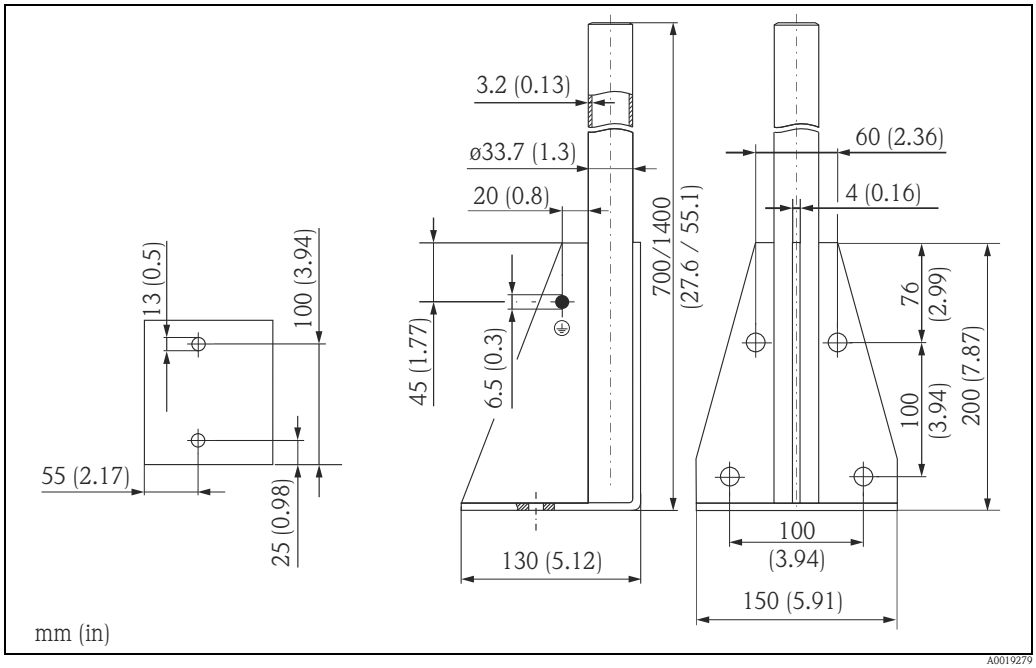
- suited for the mounting help of the Prosonic S
- for 1" - 2" tubes
- Dimensions: 210 mm x 110 mm (8.27 x 4.33 in)
- Material: 316Ti (1.4571)
- fixing clips, screws and nuts are supplied
- Order code: 52024478



L00-FMU90xxx-00-00-00-xx-001

1 Mounting help of the field housing

Mounting bracket



Height	Material	Weight	Order Code
700 (27.6)	galv. steel	3.2 kg (7.06 lbs)	919791-0000
700 (27.6)	316Ti (1.4571)		919791-0001
1400 (55.1)	galv. steel	4.9 kg (10,08 lbs)	919791-0002
1400 (55.1)	316Ti (1.4571)		919791-0003

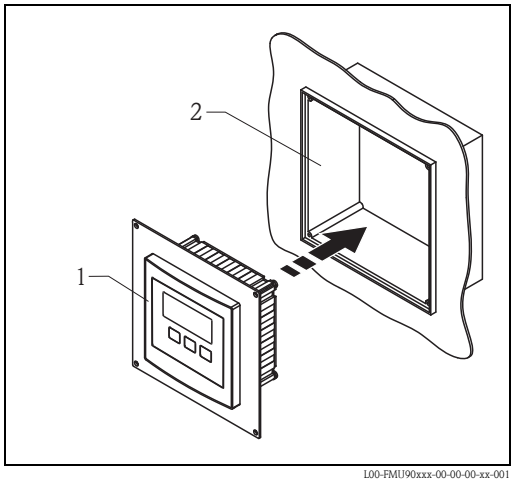
mm (in)

Adaption plate for remote display

Used to mount the remote display into the opening (138 mm x 138 mm (5.43 x 5.43 in)) of the remote display module of the Prosonic FMU860/861/862 (Display size: 144 x 144 mm (5.67 x 5.67 in)).

Order-Code: 52027441

Note!
The adapter plate will be mounted directly in the old remote display of the FMU86x series. The housing of the remote display of FMU860/861/862 is the holder for the adapter plate and the new remote display of the FMU90/95 in the format 96x96 mm (3.78 x 3.78 in).

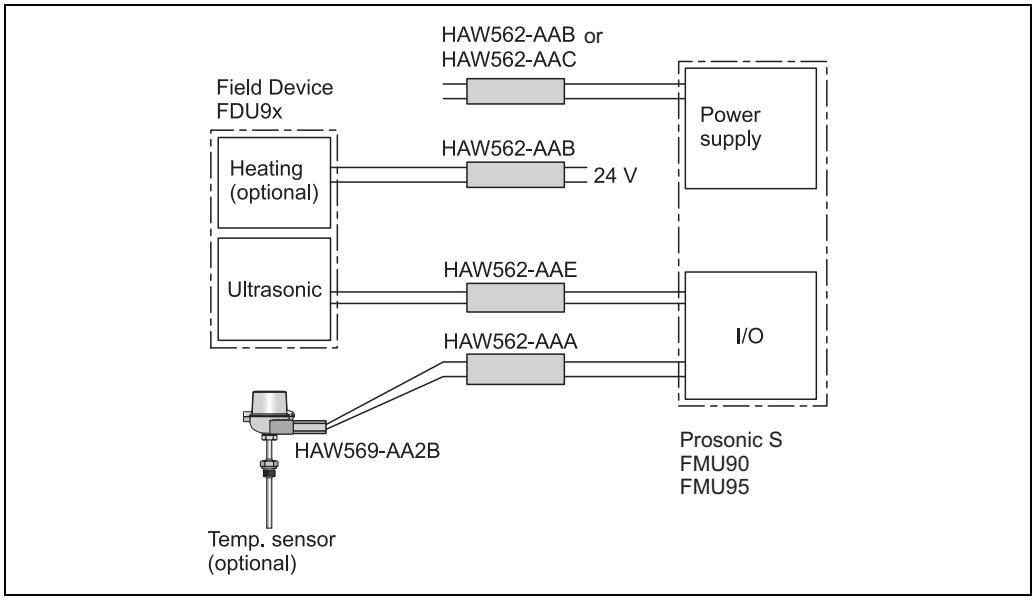


1 Remote display of the Prosonic S with adaption plate
2 Opening of the remote display FMU860/861/862

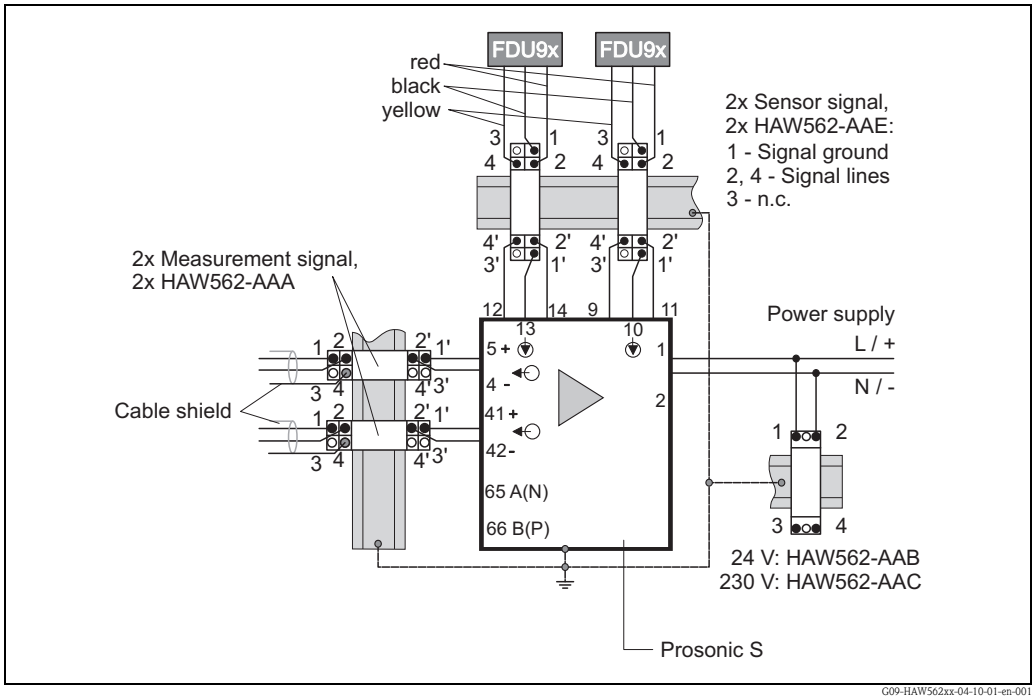
Option:
- Adaption plate 160x160 mm (6.3 x 6.3 in), thickness 3 mm (0.12 in) , aluminum, opening 92x92 mm (3.62 x 3.62 in) for remote display of the FMU90 (size of the display: 96 x 96 mm (3.78 x 3.78 in)).
- Can be used to replace the FMU86x remote display or DMU2160/2260.
- Order Code: TSPFU 0390
- Please contact your Endress+Hauser sales representative.

Overvoltage protection HAW562

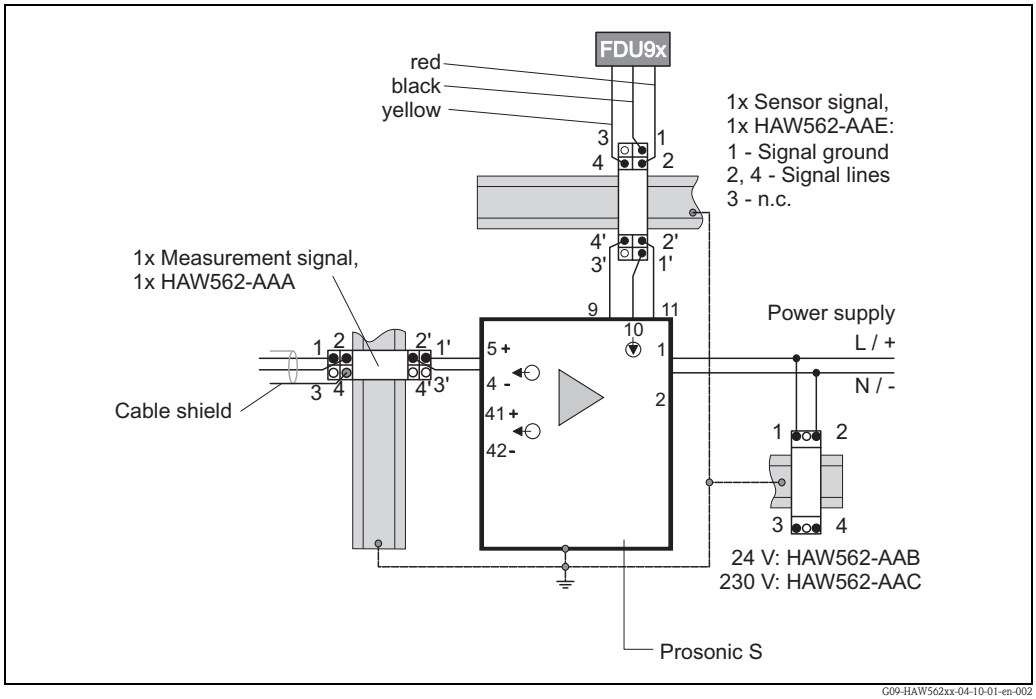
System principle



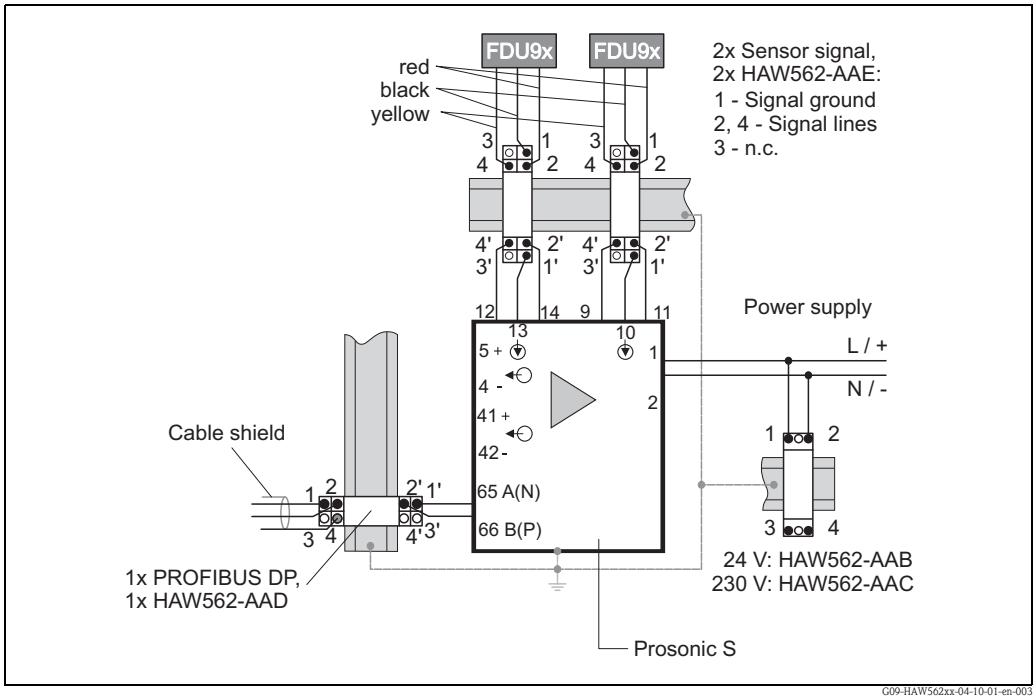
Application examples



Level measurement with 2 Prosonic FDU9x level sensors, version 4 to 20 mA HART



Level measurement with 1 Prosonic FDU9x level sensor, version 4 to 20 mA HART



Level measurement with 2 Prosonic FDU9x level sensors, version PROFIBUS DP

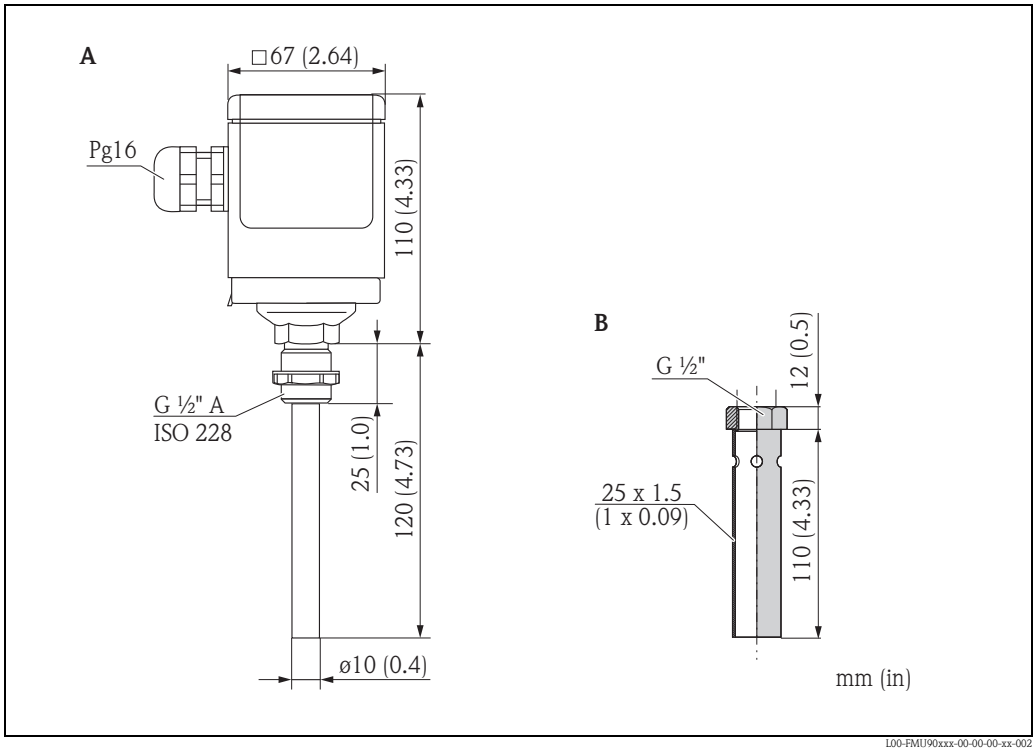
Ordering information

Surge Arrester HAW562, compact device for DINrail installation in signal and power supply lines andcommunication lines protecting field devices and systems against overvoltage and magnetic induction.

Approval							
AA	Non-hazardous area						
8D	ATEX II 2 (1)G Ex ia IIC T6						
	Application						
	A	Measuring signal 0/4-20 mA, PFM, PA, FF					
	B	Supply voltage 10-55 V (+/-20 %)					
	C	Supply voltage 90-230 V (+/-10 %)					
	D	Communication RS485/MOD-Bus/PROFIBUS DP					
	E	Protection module Prosonic FMU90					
		+	**Additional selection (option)**				
				Additional approvals			
				LA	SIL		
					Accessory enclosed		
					PA	Screen grounding terminal	
					PB	Field housing	
					PC	Mounting bracket, wall/pipe	
						Marking	
						Z1	Tagging (TAG), metal
						Z3	Commissioning label, paper
						Z6	Tagging (TAG), by customer
HAW562 -			**+**				complete product designation

For details see Technical Informations TI01012K und TI01013K and the Operating Instruction BA00306K.

Temperature sensor FMT131



A *Temperature sensor FMT131*
B *Weather protector*

Product structure

010	**Approval**		
	R	Non-hazardous area	
	J	ATEX II 2G EEx m II T6/T5	
	Q	FM Cl.I Div. 1 Gr. A-D, zone 1, 2	
	U	CSA General Purpose (in preperation)	
	S	CSA Class I Div. 1	
020		**Cable length**	
		1	5 m/16 ft
		2	10 m/ 32 ft
		3	15 m/49 ft
		4	20 m/65 ft
		5	25 m/82 ft
		6	30 m/98 ft
		7	w/o cable, gland Pg16, IP66
		8	... m
		A	... ft
995			**Marking**
			1 Tagging (TAG)
FMT131 -			complete product designation

Weather protection cover for FMT131
Order code: 942046-0000

Note!
The FMT131 for use in hazardous areas is completely plotted and is always supplied with cable.
The FMT131 version for non-hazardous areas (FMT131-R*) is supplied without cable.

Documentation

Technical Information

TI00396F

Technical Information for the ultrasonic sensors FDU90/FDU91/FDU91F/FDU92/FDU93/FDU95/FDU96

Operating instructions (for transmitter FMU90)

Depending on the instrument version, the following operating instructions are supplied with the Prosonic S FMU90:

Operating instructions	Output	Application	Instrument version
BA00288F	HART	■ level measurement ■ alternating pump control ■ screen and rake control	FMU90 - *******1**** FMU90 - *******2****
BA00289F		■ flow measurement ■ backwater and dirt detection ■ totalizers and counters	FMU90 - *2*****1**** FMU90 - *4*****1**** FMU90 - *2*****2**** FMU90 - *4*****2****
BA00292F	PROFIBUS DP	■ level measurement ■ alternating pump control ■ screen and rake control	FMU90 - *******3****
BA00293F		■ flow measurement ■ backwater and dirt detection ■ totalizers and counters	FMU90 - *2*****3**** FMU90 - *4*****3****

These operating instructions describe installation and commissioning of the respective version of the Prosonic S. It contains those functions from the operating menu, which are required for a standard measuring task. Additional functions are contained in the "Descripiton of Instrument Functions" (BA00290F, see below).

Description of Instrument Functions

BA00290F

contains a detailed description of **all** functions of the Prosonic S and is valid for all instrument versions. A PDF file of this document can be found
- on the CD-ROM, which is supplied together with the instrument
- in the internet at → see: www.en.endress.com → Download

Safety Instructions

XA00326F

Safety Instructions for ATEX II 3D

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People for Process Automation

TI00397F/00/EN/15.12
71209374
FM+SGML 9.0

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