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
- Linearisation (up to 32 points, freely configurable)
- Linearisation 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/13.11
71132600

Endress+Hauser
People for Process Automation

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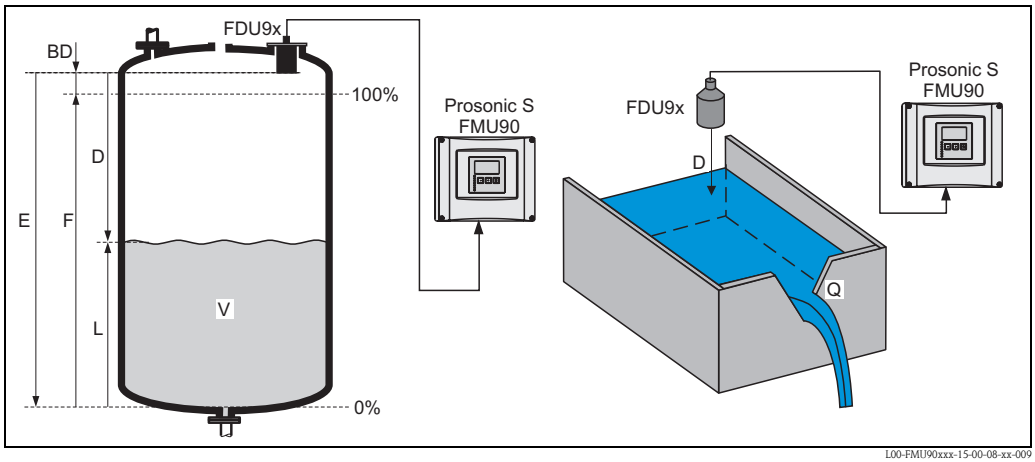
Function and system design

Measuring principle



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 FDU 90/91/91F/92/93/95/96
- TI00189F for the sensors FDU 80/80F/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 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

Linearisation

Pre-programmed linearisation 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 linearisation curves are calculated on-line.

Linearisation 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.

Linearisation table

consisting of up to 32 linearisation 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

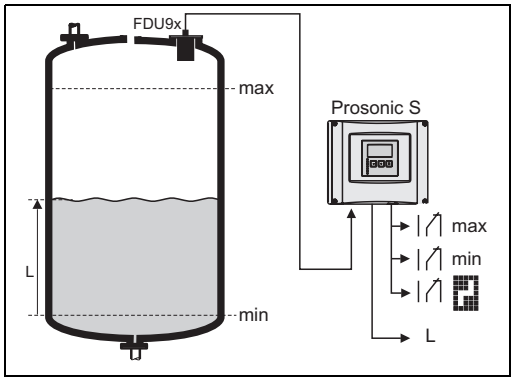
Datalog functions

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

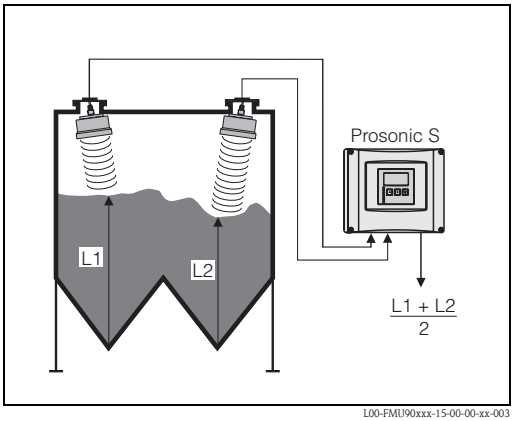
Application examples for level measurements

Level measurement with limit detection and alarm output



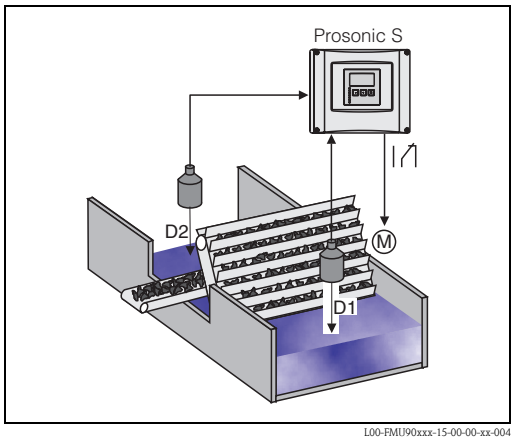
*Order code e.g.: FMU90 - *1***131****
(1 input, 3 relays, 1 outputs)

Average level measurement



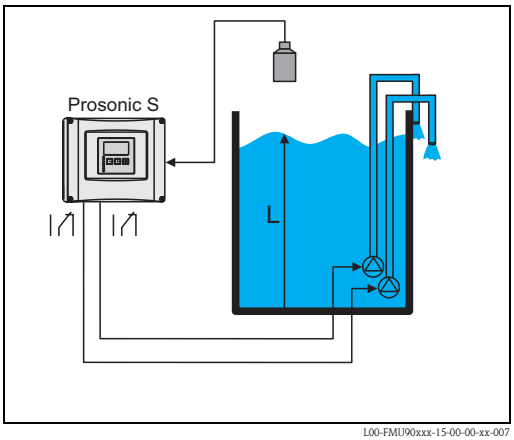
*Order code e.g.: FMU90 - *1***212****
(2 inputs, 2 outputs)

Rake control (differential measurement)



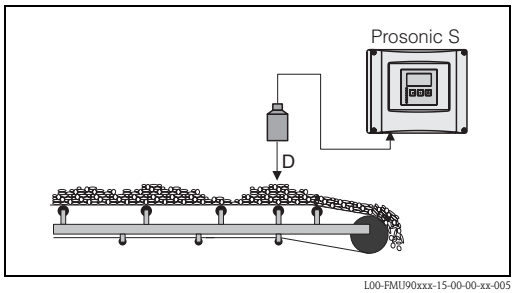
*Order code e.g.: FMU90 - *1***212****
(2 inputs, 1 relay, 2 outputs)

Alternating pump control (up to 6 pumps)



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

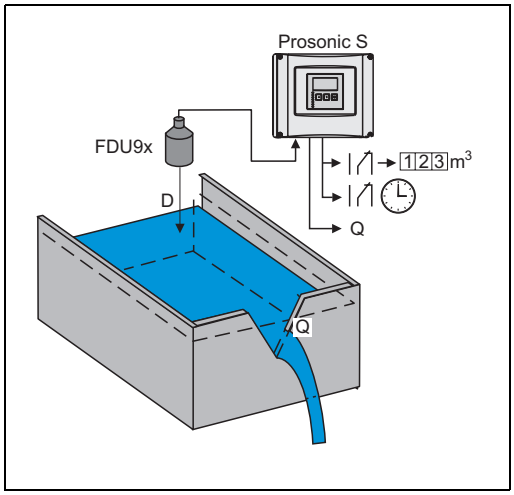
Conveyor belt



*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)

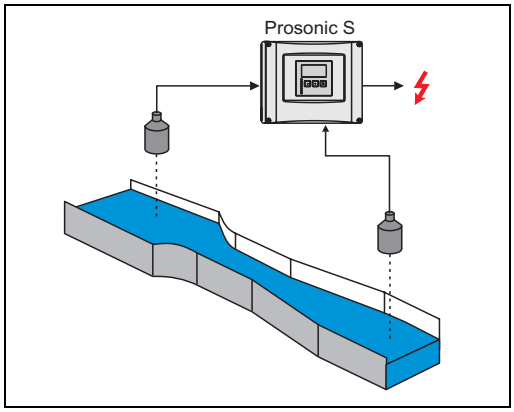


L00-FMU90xxx-15-00-00-xx-011

*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.

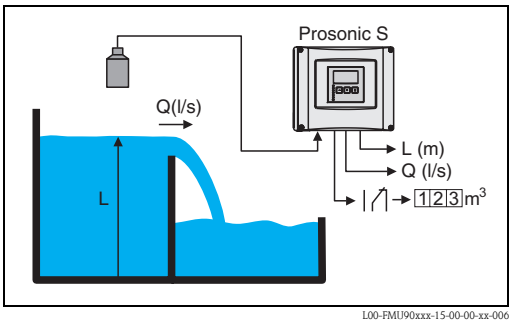


L00-FMU90xxx-15-00-00-xx-008

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

Stormwater overflow bassin

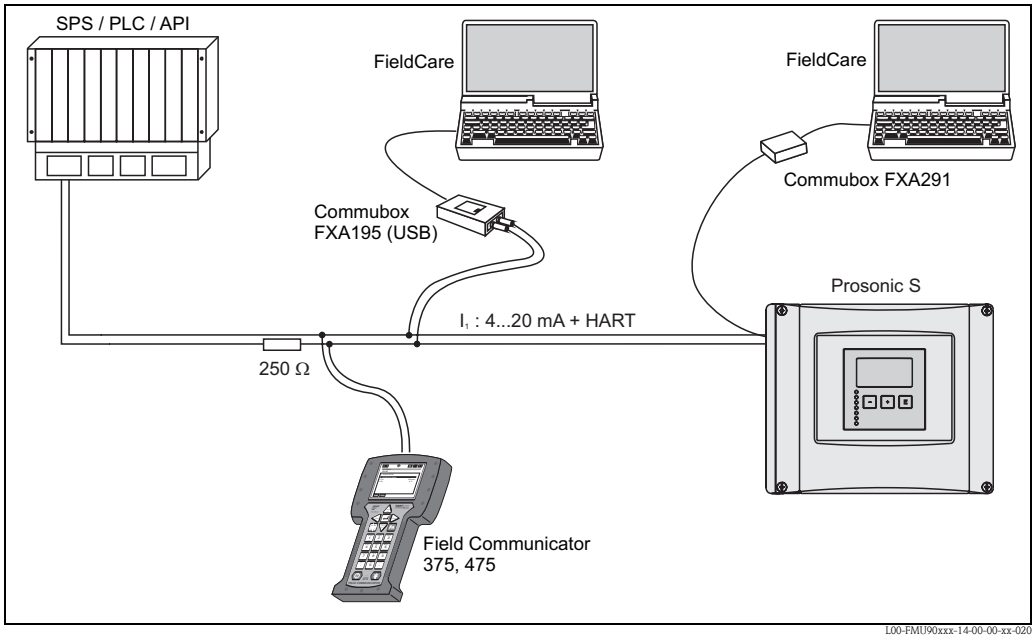
Simultaneous measurement of level L and flow Q with 1 sensor.



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

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

System integration HART

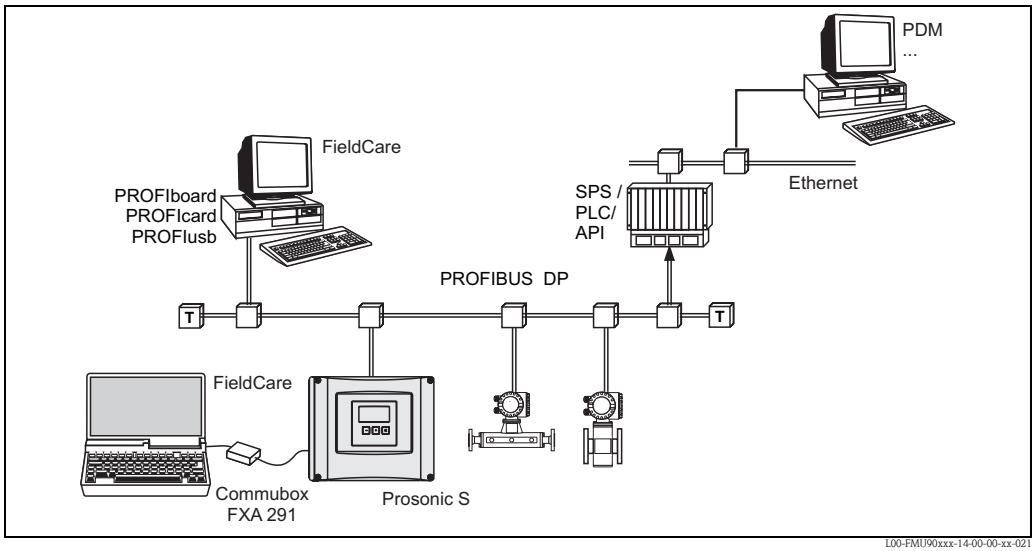


In the standard version a HART signal is superimposed onto the first output current. In order to use the HART communication, the circuit must contain a communication resistor of 250Ω.

Operating options

- via the operating and display module at the Prosonic S (if present)
- via the service interface of the Prosonic S with the Commubox FXA291 and the operating program FieldCare
- via the HART protocol, e.g. with the Commubox FXA195 and the operating program FieldCare
- via the field communicator 375, 475

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 or Proficard 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 189F, 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	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: – -10% (3,6 mA) – 110% (22 mA) – HOLD (last current value is held) – user specific ■ for setting 0 to 20 mA: – 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, 100 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.

Auxiliary energy

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

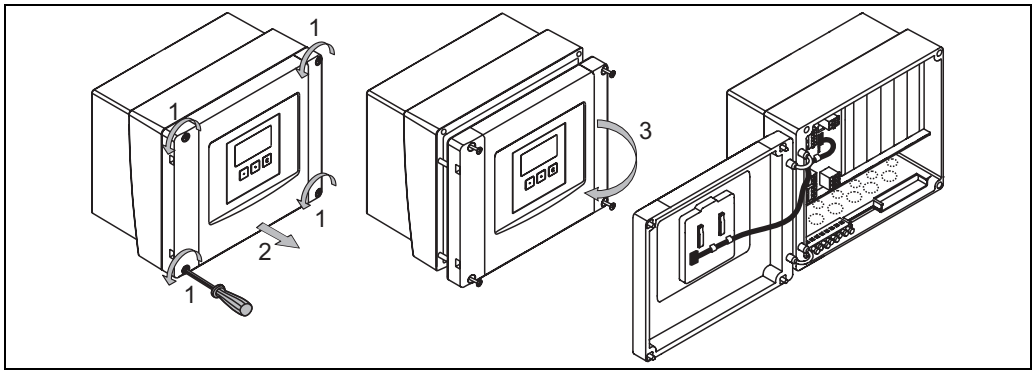
- 2 A T /DC
- 400 mA T /AC

accesible in the terminal compartment

Electrical connection

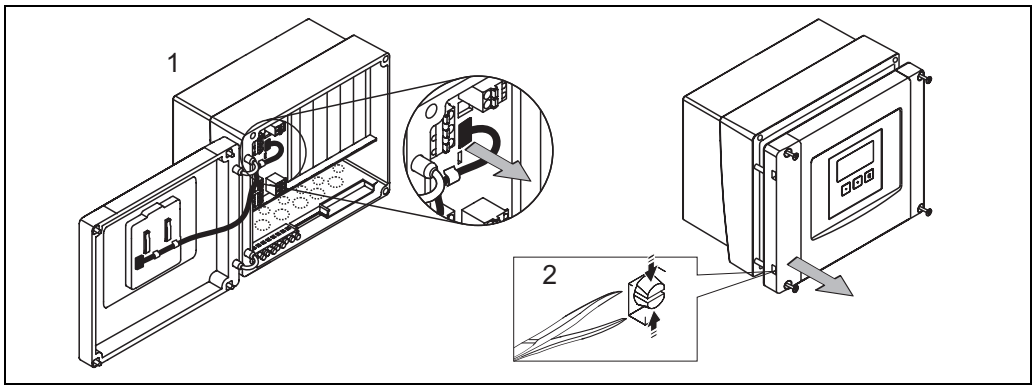
Terminal compartment of the field housing

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 (1) and loosening the hinges (2):



L00-FMU90xxx-04-00-00-xx-009

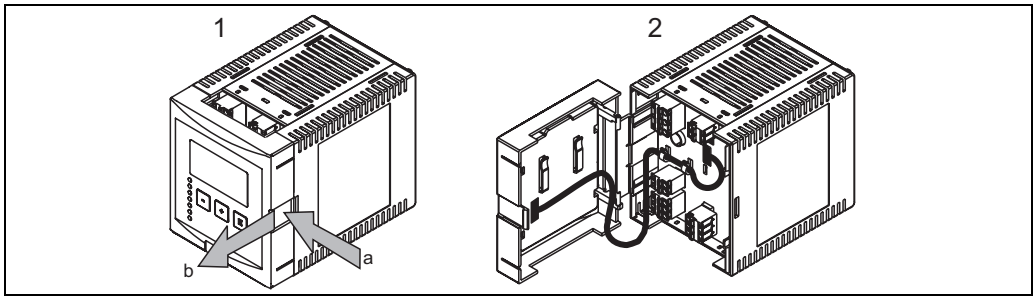
Cable entries of the field housing

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

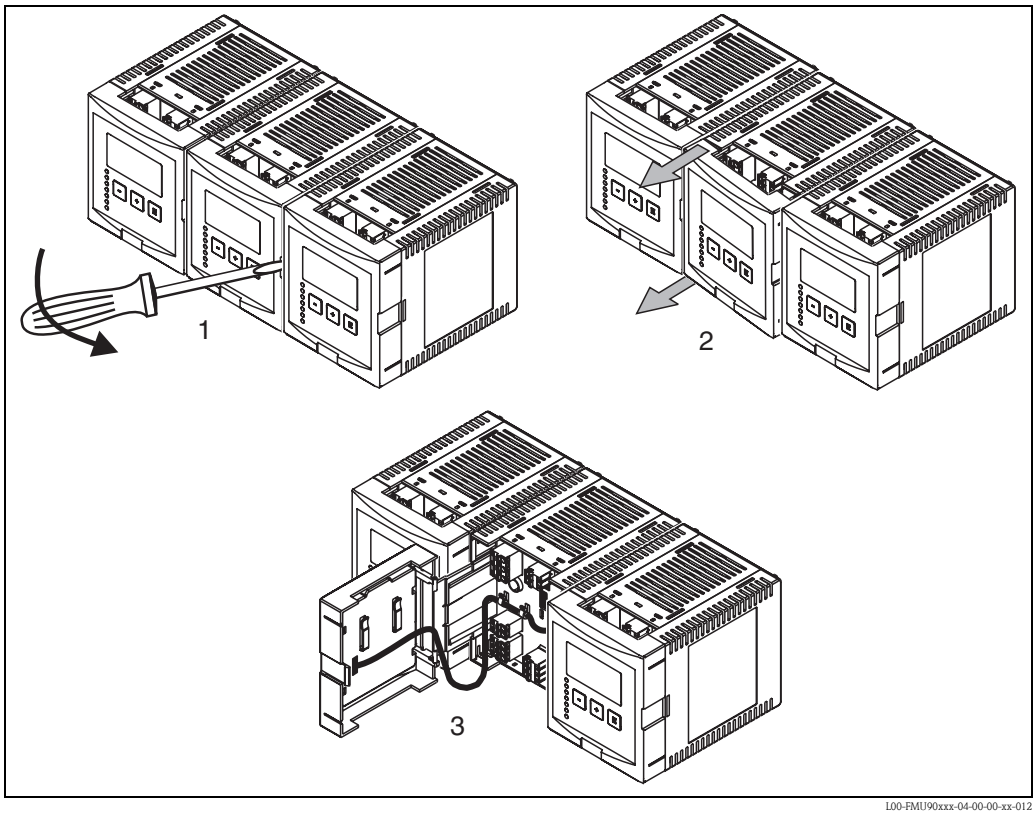
Single instrument



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 instrumentsmounted 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. 2 cm (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").

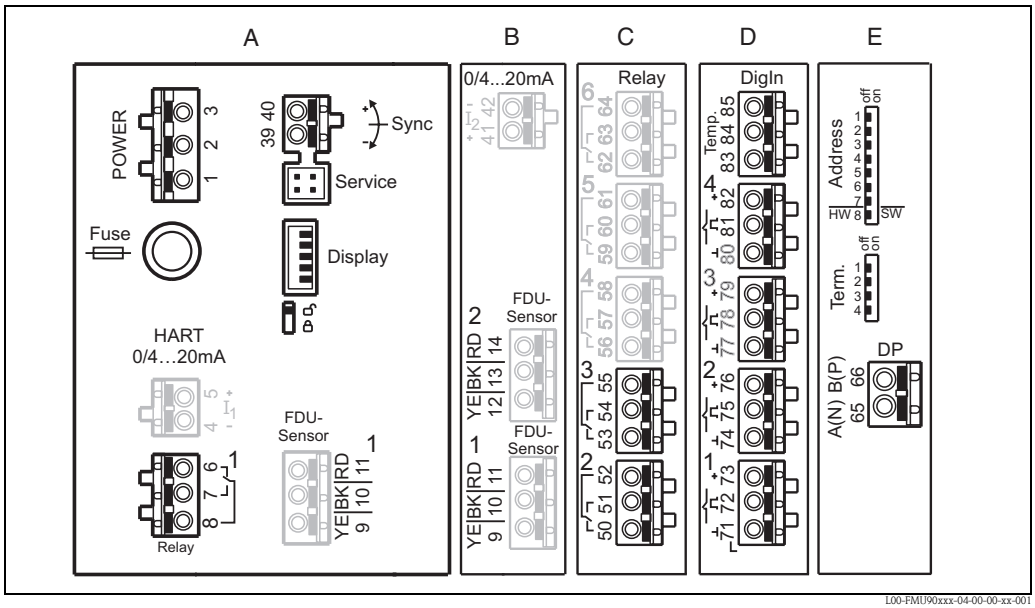
Terminal assignment

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.

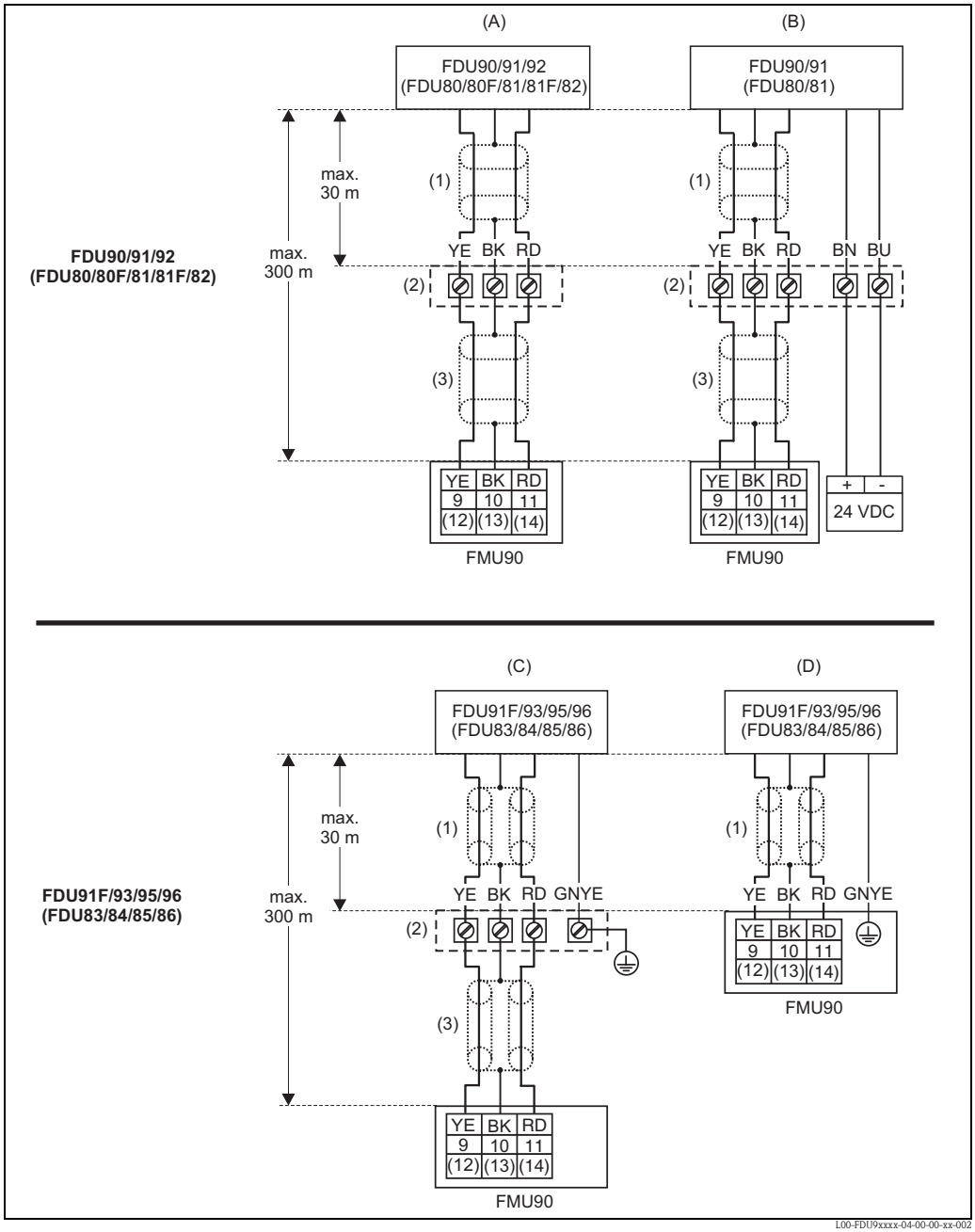
Warning!
When using the public supply mains, an easily accesible power switch must be installed in the proximity of the device. The power switch must be marked as a disconnector for the device (IEC/EN 61010).

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



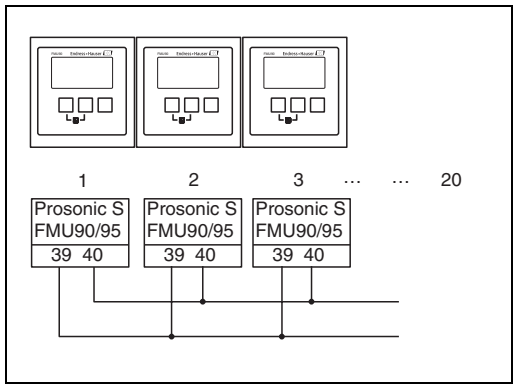
L00-FDU9xxxx-04-00-00-xx-002

(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

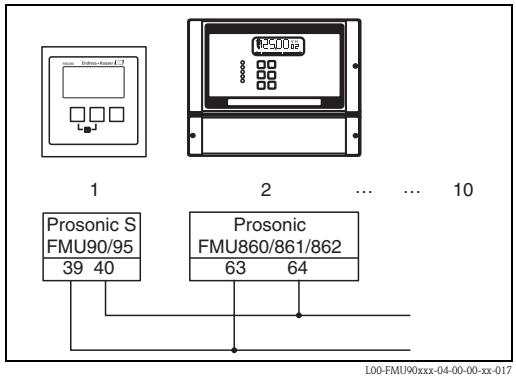
For details refer to Technical Information TI00396F (FDU9x) or TI00189F (FDU8x).

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 causes the evaluation units FMU9x to send the pulses simultaneously. Only after all sensors have received their signal, new simultaneous pulses are sent. 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, 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.

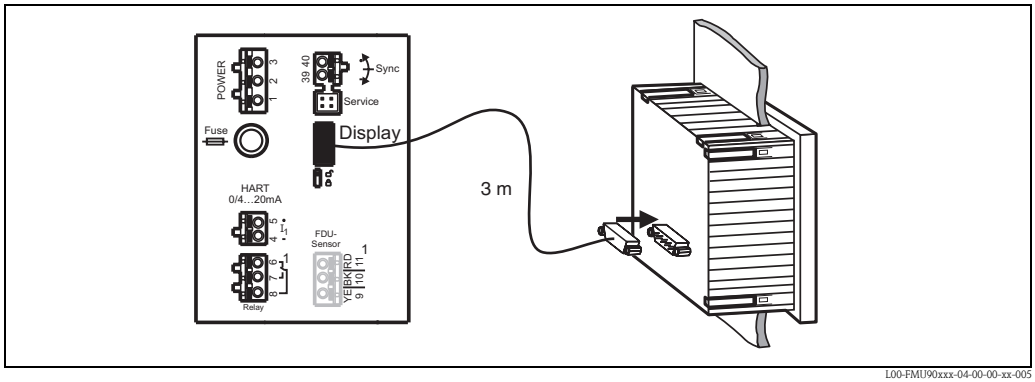


L00-FMU90xxx-04-00-00-xx-004



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

Connection of the separate display and operating module

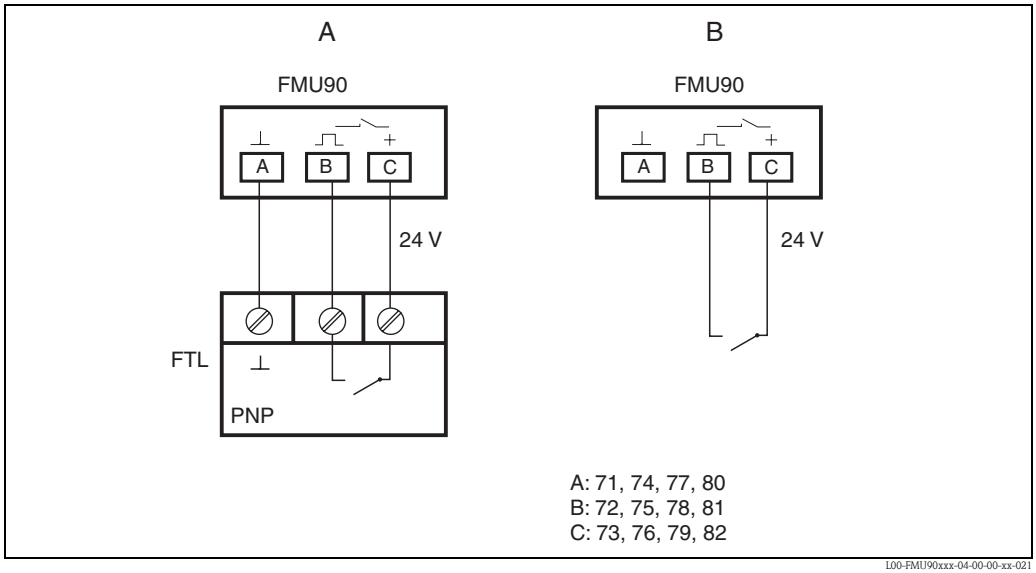


L00-FMU90xxx-04-00-00-xx-005

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: 2 cm (0.79 in)

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



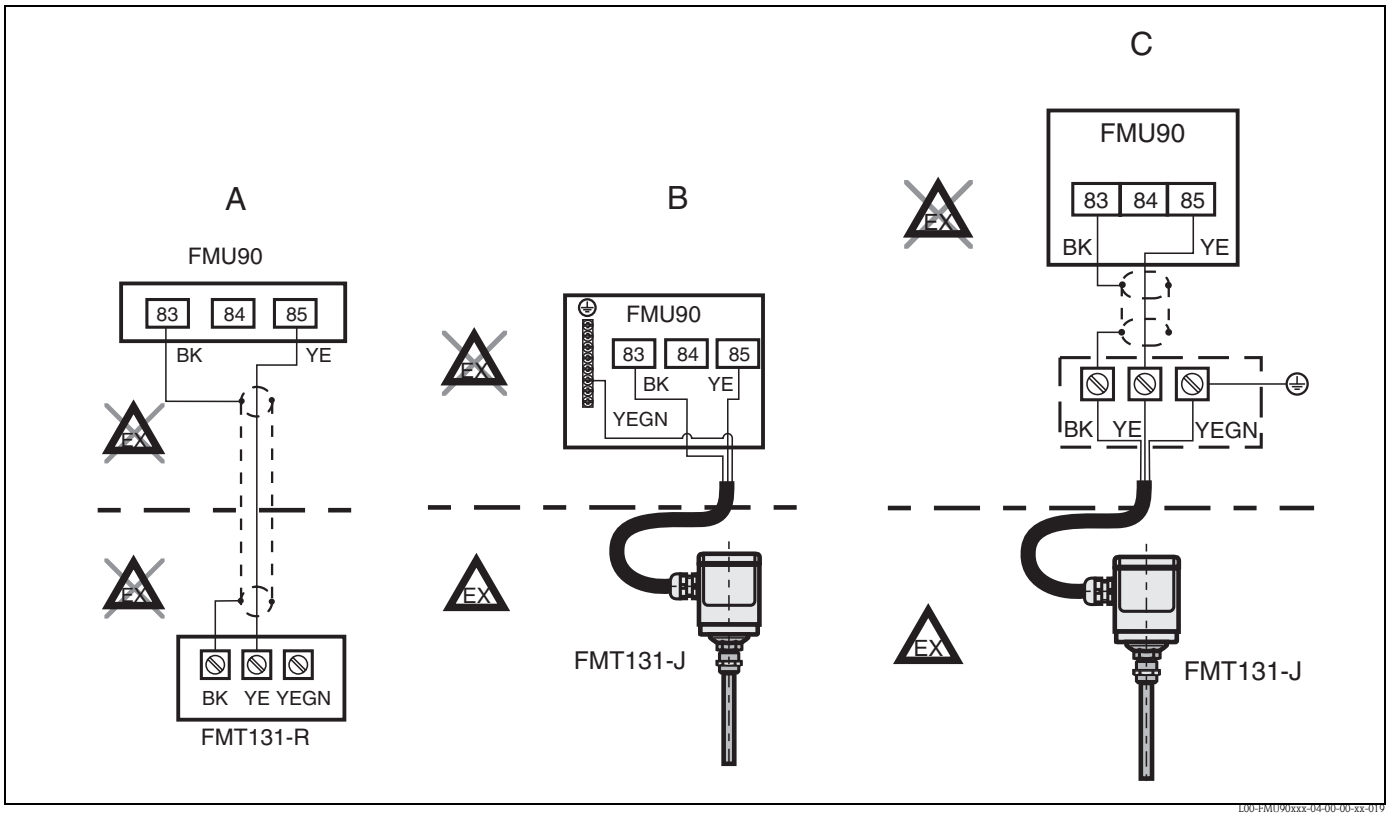
The maximum short-circuit current at 24 V is 20 mA.

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.

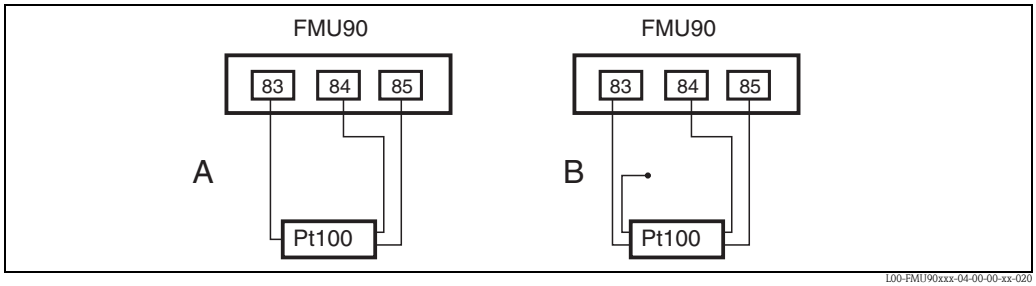
FMT131 (Endress+Hauser)
(connectable to FMU90-******B***)**



A: *Non-Ex area (FMT131-R);* **B:** *Ex area (FMT131-J) with grounding in the FMU90;*
C: *Ex area (FMT131-J) with crounding 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

Measuring uncertainty[5)]

±0,2 % of the maximum span of the sensor

Typical accuracy[6)]

±2 mm (0.08 in) + 0,17 % of the measured distance

Measured value resolution

1 mm (0.04 in) with 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 NAMUR EN 61298-2
6) after calibration

Operating conditions: Environment

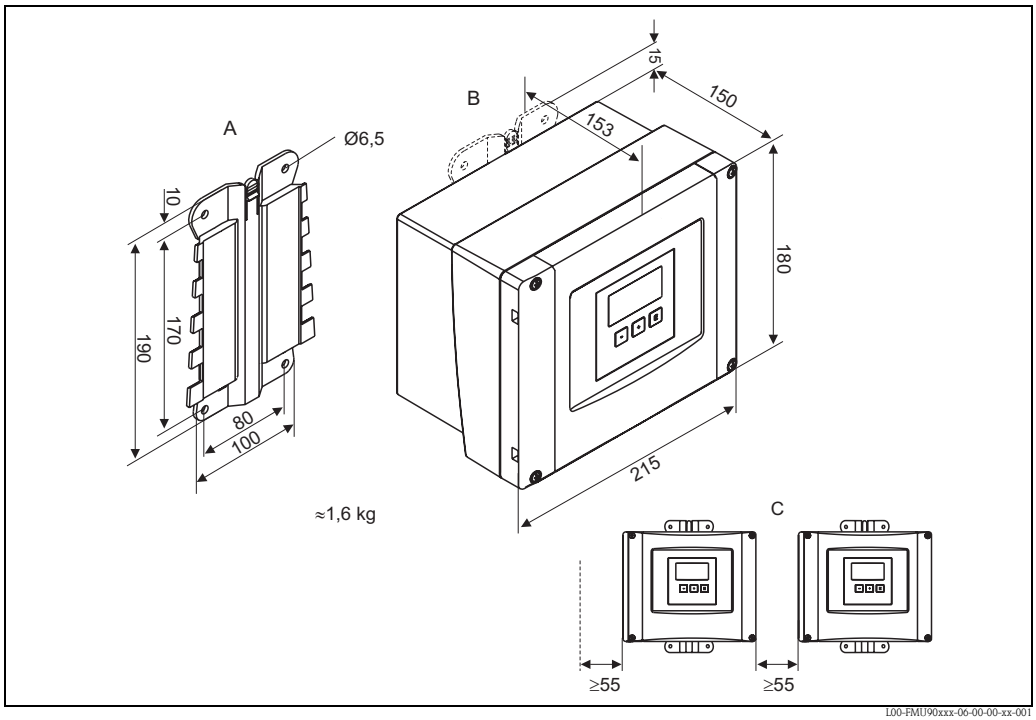
Ambient temperature	-40 to 60 °C (-40 to 140 °F) The functionality of the LC display becomes restricted at T_U < -20 °C (T_U < -4 °F). If the device is operated outdoors in strong sunlight, a protective cover should be used (→ 🖹 29).
Storage temperature	-40 to 60 °C (-40 to 140 °F)
Climate class	■ **Field 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
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.

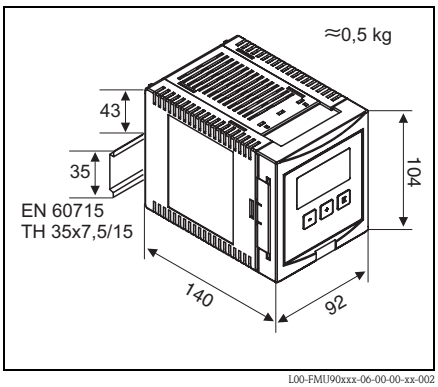
	10	20	30	40	50	**60**	**70**	**80**	**90**	100	110	120
FMU90 -												

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 =	

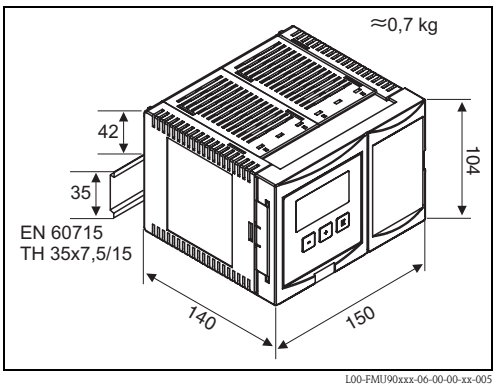
3. The appropriate dimensions are given in the following diagram:

Sum = 0
(only basic terminal area)



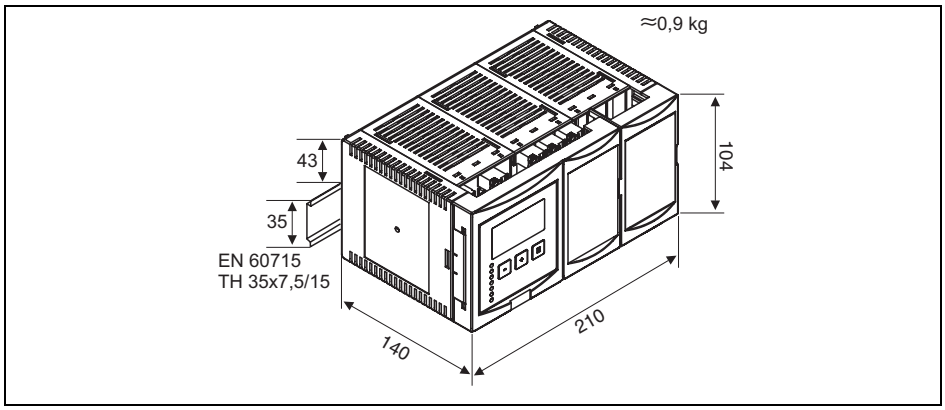
Dimensions in mm

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



Dimensions in mm

Sum = 4
(4 optional terminal areas)



Dimensions in mm

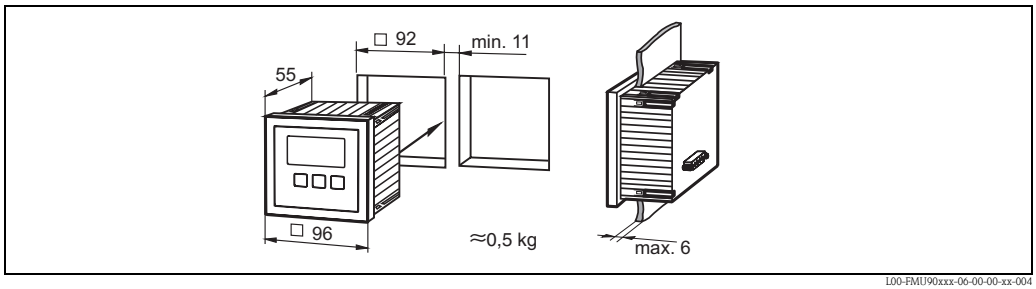
Example

	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

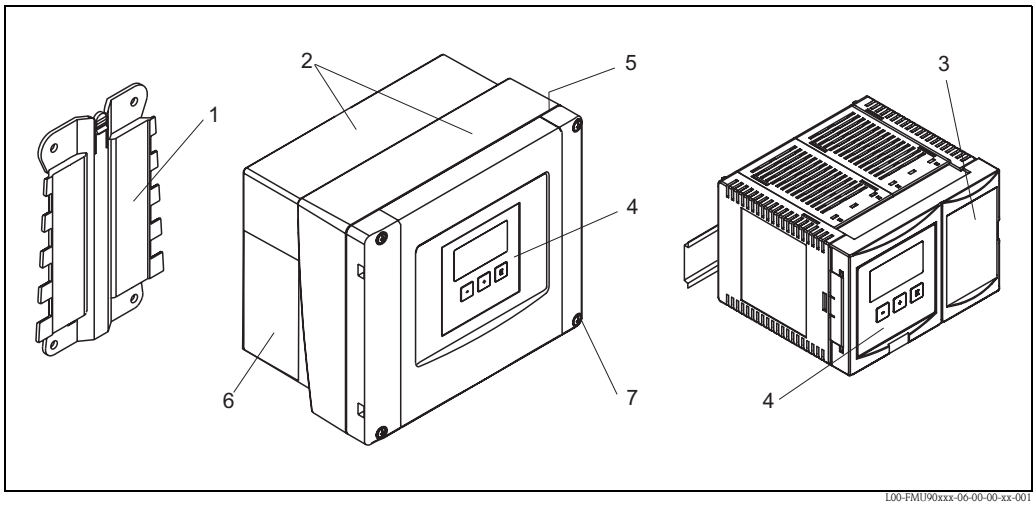


Dimensions in mm

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. 1.10 to 1.54 kg (1.10 ... 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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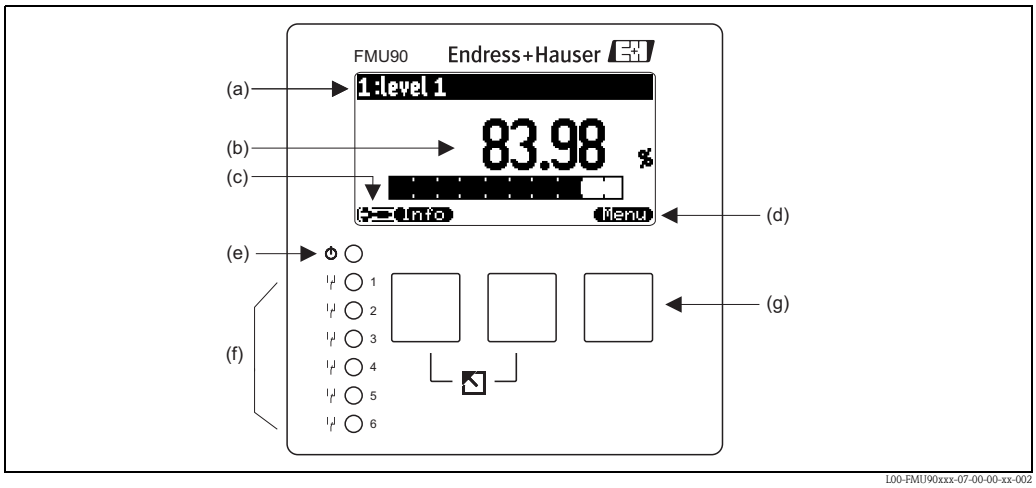
Pos.	Part	Material
1	Housing bracket	PC-FR
2	Field housing	PC-FR
3	Housing for DIN rail	PBT-GF
4	Separate display and operating module	PC
5	Sealing	PUR foam
6	Nameplate	Polyester
7	Screws	A4 (1.4578)

Human interface

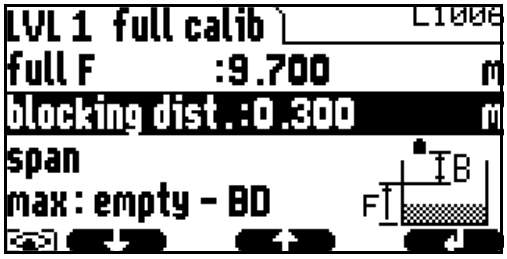
Display and operating module



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

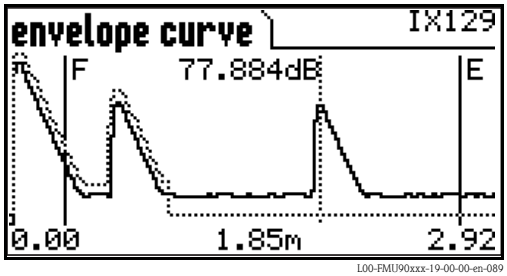
(a): *name of the parameter;* **(b):** *value of the parameter, including unit;* **(c):** *display symbols;* **(d):** *softkey symbol;* **(e):** *LED indicating the operating state;* **(f):** *LEDs indicating the switching states of the relays;* **(g):** *keys*

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)

Illuminated 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-hazarous 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 (in preparation)
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, "Additional documentation")
- for certified instrument versions: Safety Instructions (XAs) or Control Drawings (ZDs)→ 35, "Additional documentation"
- field housing units for flow measurement FMU90-*21********* are delivered with 2 screws for plombing the device

Accessories

Commubox FXA195 HART

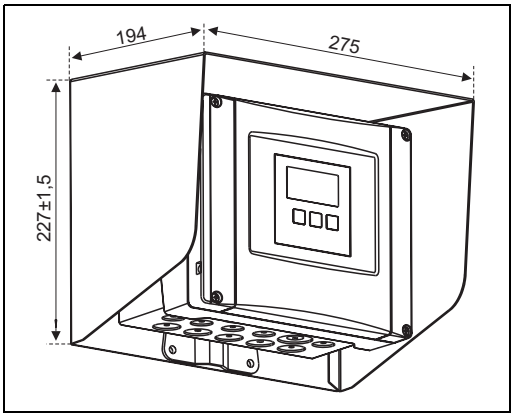
For intrinsically safe communication with FieldCare via the USB interface. For details refer to TI00404F/00/EN.

Commubox FXA291

The Commubox FXA291 connects Endress+Hauser field instruments with CDI interface (= Endress+Hauser Common Data 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

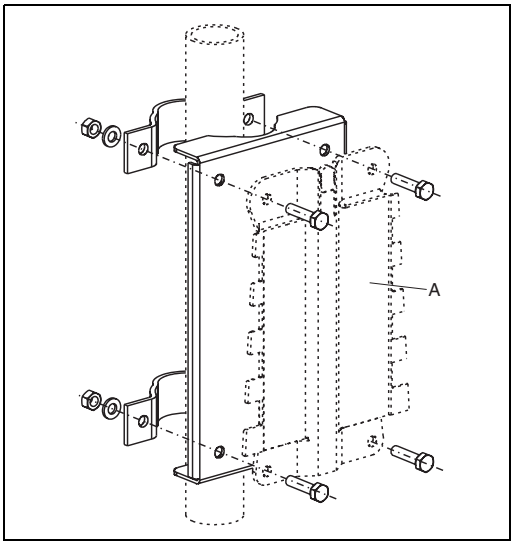
- Material: 316Ti (1.4571)
- is mounted by the mounting help of the Prosonic S
- Order-Code: 52024477



L00-FMU90xxx-06-00-00-xx-003

Mounting plate for the field housing

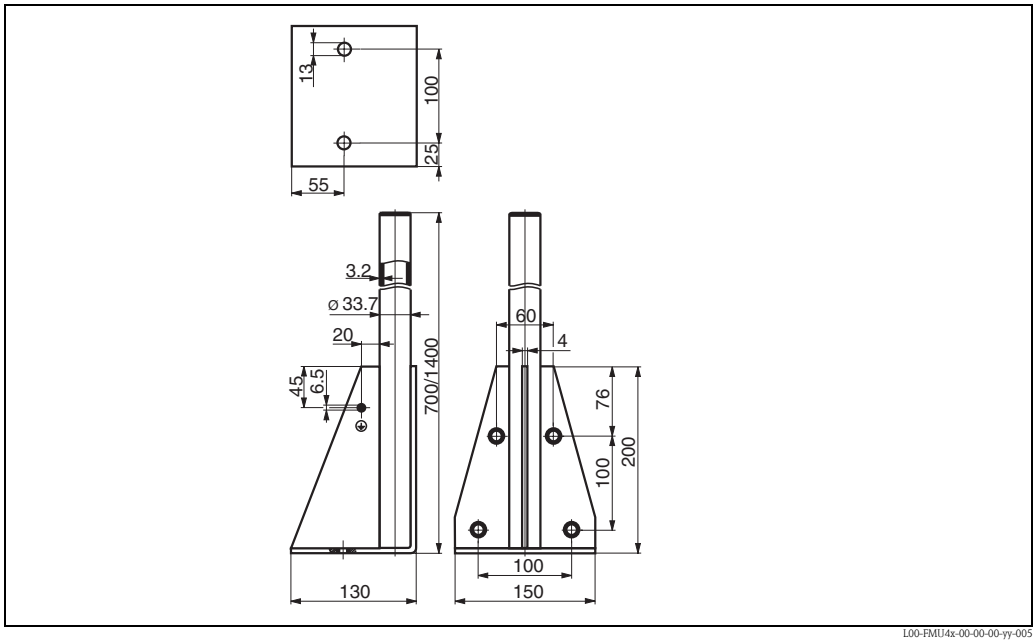
- suited for the mounting help of the Prosonic S
- for 1" - 2" tubes
- Dimensions: 210 mm x 110 mm (8.27 x 4.33 in)
- Material: 316Ti (1.4571)
- fixing clips, screws and nuts are supplied
- Order code: 52024478



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

A: *mounting help of the field housing*

Mounting bracket



L00-FMU4x-00-00-00-yy-005

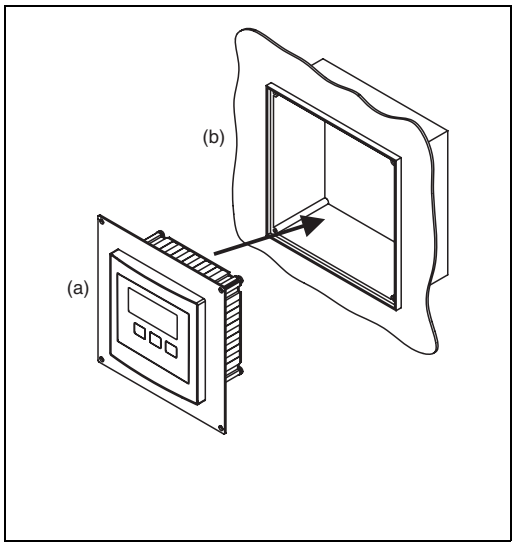
Height mm (in)	Material	Order Code
700 (27.6)	galv. steel	919791-0000
700 (27.6)	316Ti (1.4571)	919791-0001
1400 (55.1)	galv. steel	919791-0002
1400 (55.16)	316Ti (1.4571)	919791-0003

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).



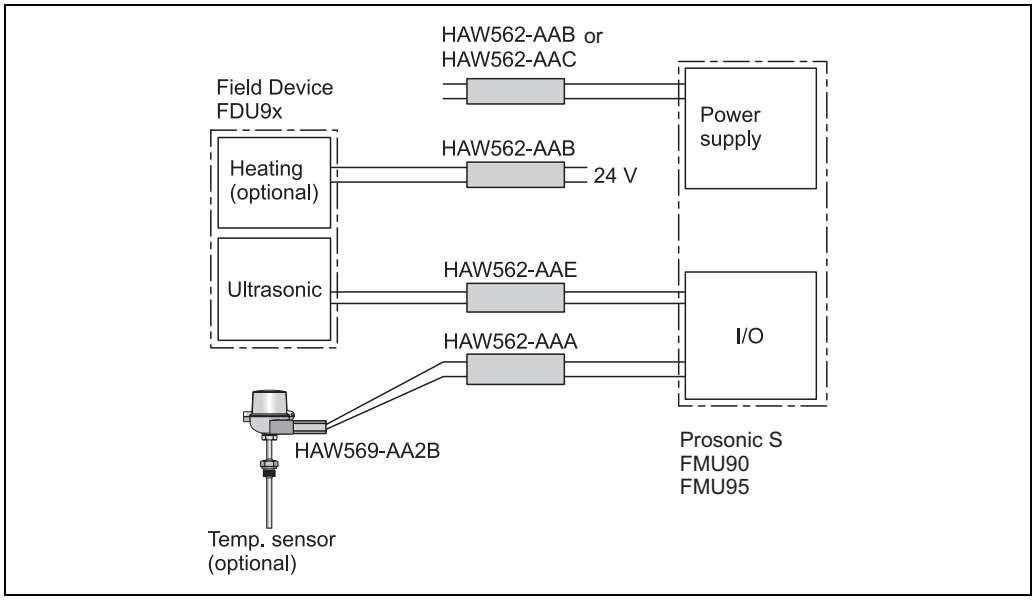
L00-FMU90xxx-00-00-00-xx-001

(a): *remote display of the Prosonic S with adaption plate;*
(b): *opening of the remote display FMU860/861/862*

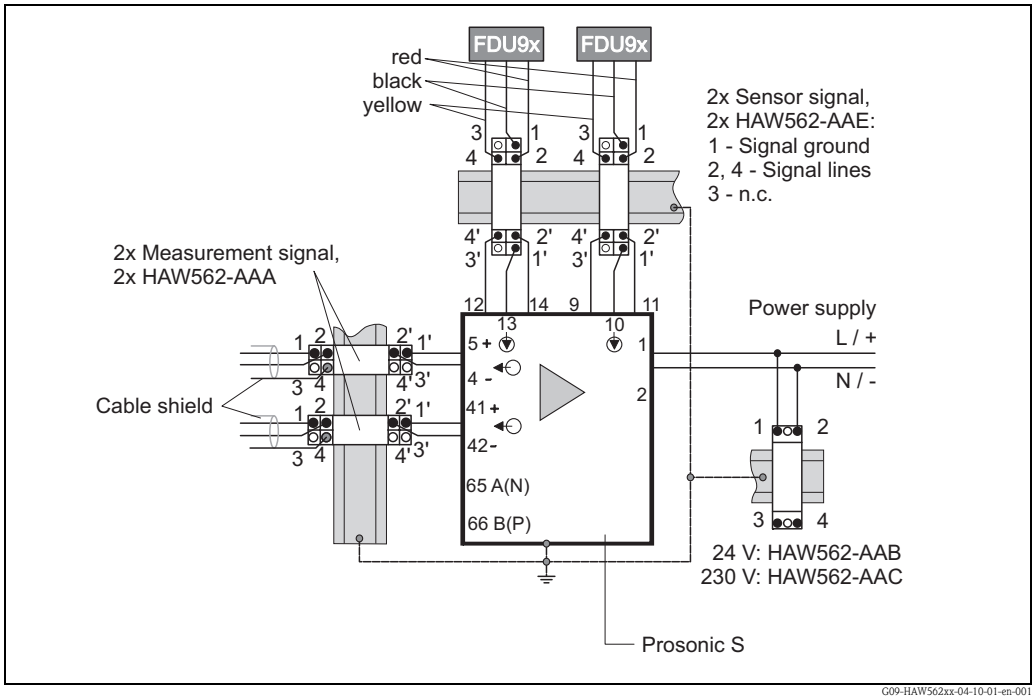
Option:
- Adaption plate 160x160 mm (6.3 x 6.3 in), thickness 3mm (0.12 in) , aluminum, opening 92x92 mm (3.62 x 3.62 in) for remote display of the FMU90 (size of the display: 96 x 96 mm (3.78 x 3.78 in)).
- Can be used to replace the FMU86x remote display or DMU2160/2260.
- Order Code: TSPFU 0390
-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

Overvoltage protection HAW562

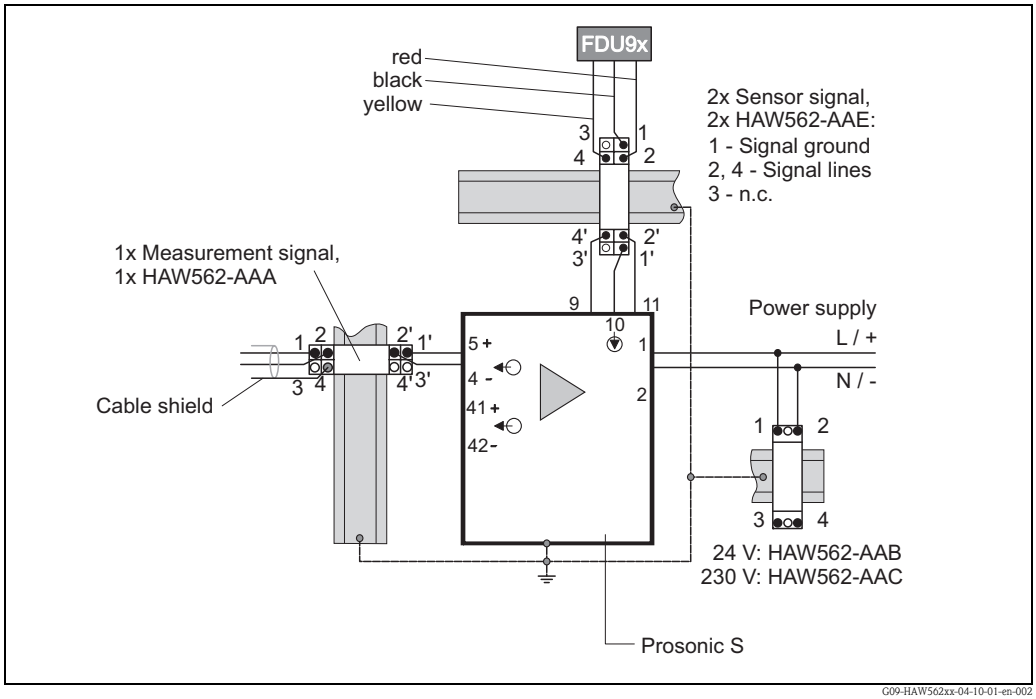
System principle



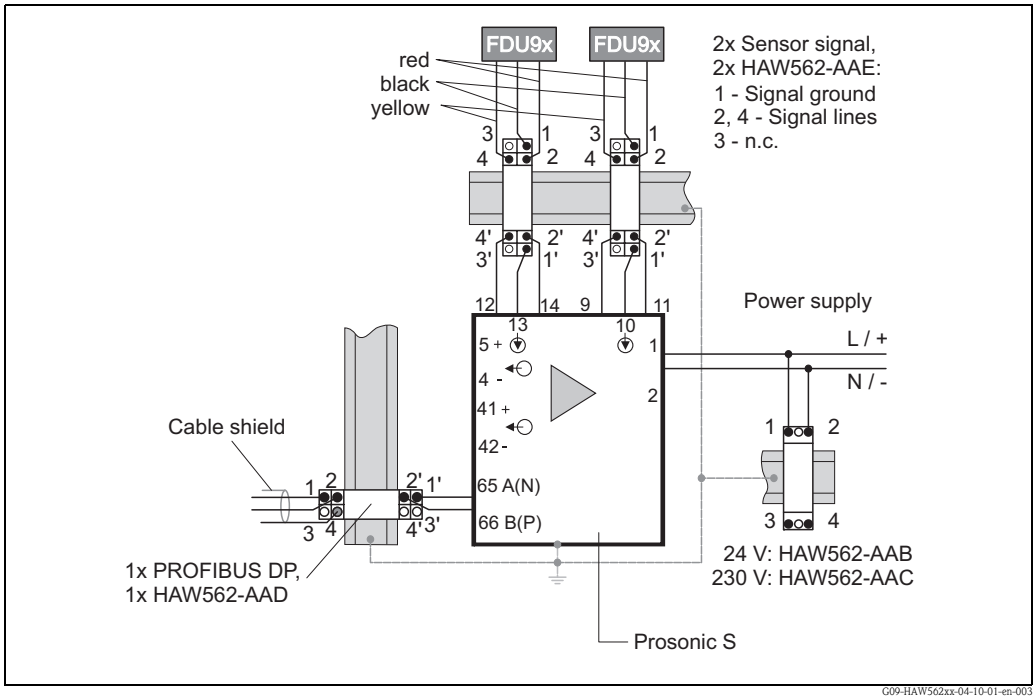
Application examples



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

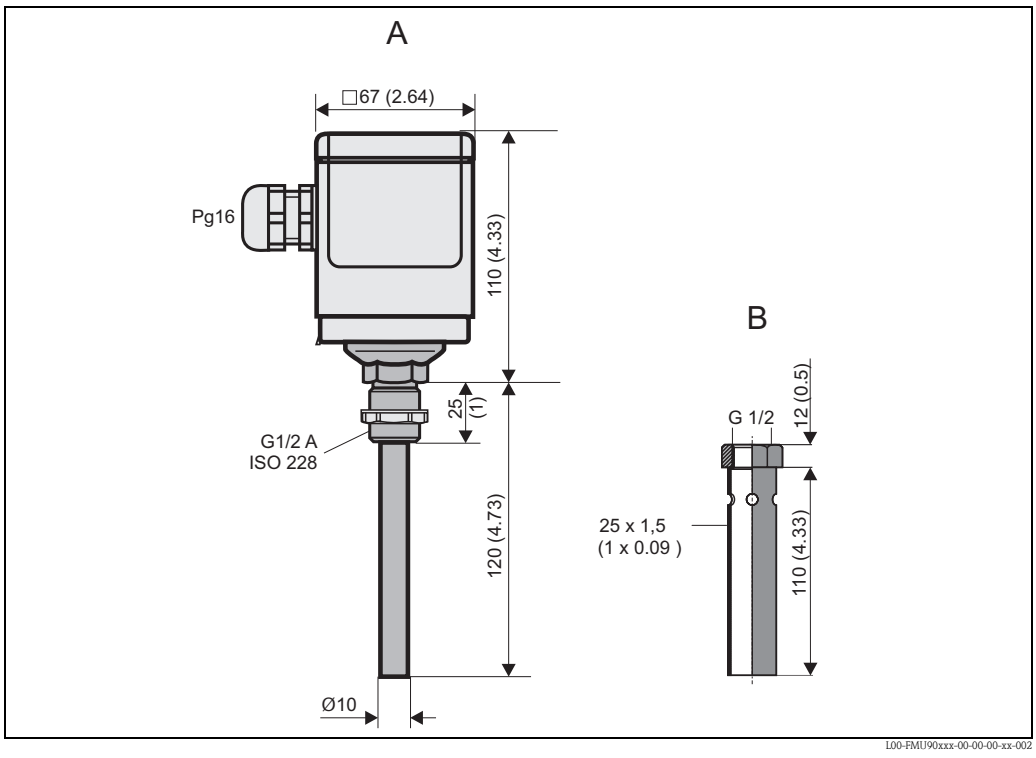
Ordering information

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.

Additional documentation

Innovation booklet

IN00003

Ultrasonic measurement – the solution for your application

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

Instruments International

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Endress+Hauser

People for Process Automation

TI00397F/00/EN/13.11
71132600
FM+SGML 6.0 ProMoDo

71132600

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

Technical Information

Prosonic S FMU95

Transmitter in housing for field or top-hat rail mounting for up to 10 ultrasonic sensors FDU90/91/91F/92/93/95/96

Application

- Continuous, non-contact level measurement of fluids, pastes, sludge and powdery to coarse bulk materials with up to 5 or 10 ultrasonic sensors
- Measuring range up to 70 m (depending on sensor and material measured)
- Calculation of average values or sums

Your benefits

- Simple, menu-guided operation with 6-line plain text display
- Envelope curves on the display for quick and simple diagnosis
- Easy operation, diagnosis and measuring point documentation with the supplied "ToF-Tool - FieldTool Package" or "FieldCare" operating program.
- Temperature dependent time-of-flight correction via the integrated temperature measurement in the sensors
- Linearisation (up to 32 points, freely configurable)
- System integration via PROFIBUS DP with up to 20 measured values
- Automatic detection of the sensors FDU90/91(F)/92/93/95/96
- The sensors of the former series FDU8x can be connected (for certificates see note on page 5)
- adjustable to the individual requirements via product structure

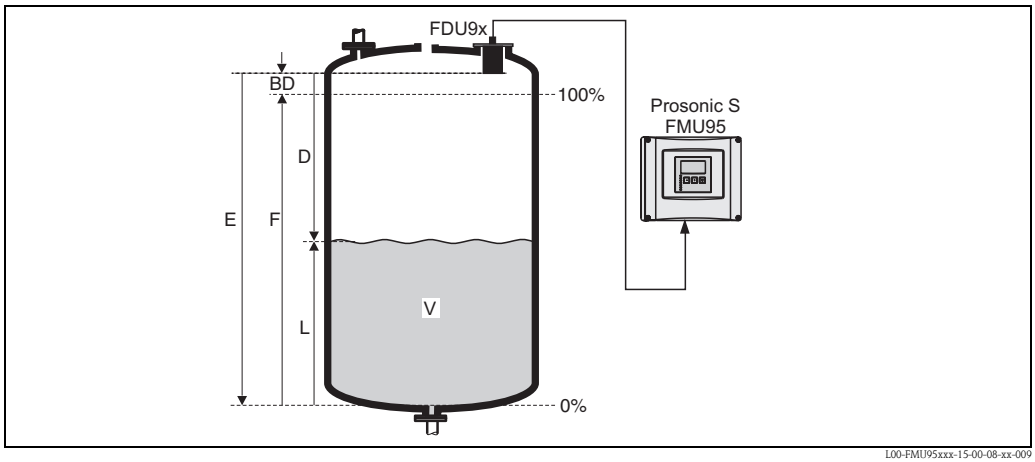
TI398F/00/en/07.09
71100143

Endress+Hauser
People for Process Automation

Table of Contents

Function and system design

Measuring principle



BD: *blocking distance;* **D:** *distance from sensor membrane to fluid surface;* **E:** *empty distance* **F:** *span (full distance);* **L:** *level;* **V:** *volume (or mass)*

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

Blocking distance

The span F may not extend into the blocking distance BD. Level echos from 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:

- TI 396F for the sensors FDU 90/91/91F/92/93/95/96
- TI 189F for the sensors FDU 80/80F/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 is integrated in the ultrasonic sensors.

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.

Linearisation

Pre-programmed linearisation curves for specific types of vessels

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

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

Linearisation table

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

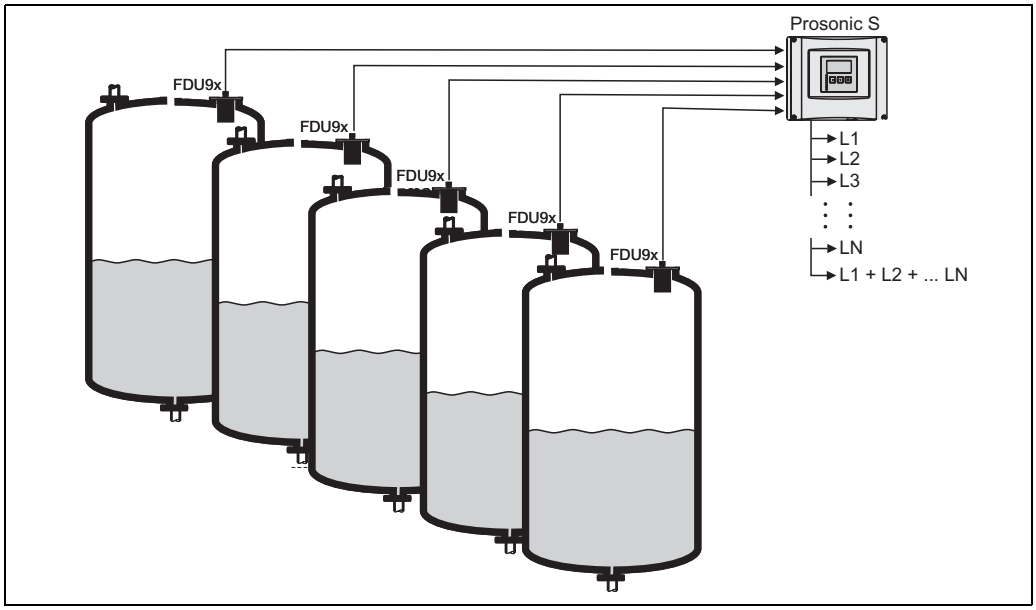
Datalog functions

Basic version

- Peak hold indicator of the min./max. levels and the min./max. temperatures at the sensors
- Recording of the last 10 alarms
- Indication of the operating status
- Indication of the operating hours

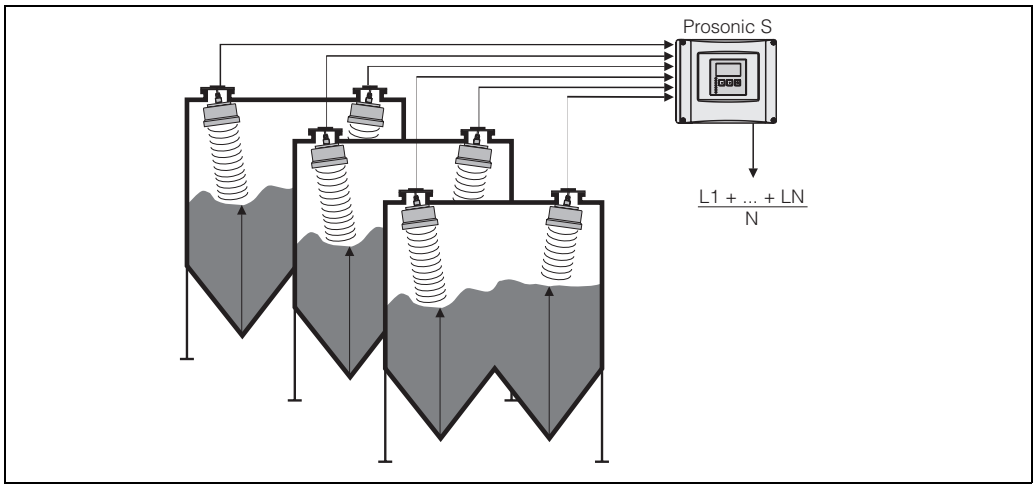
Application examples

Multi-channel level measurement with sum calculation



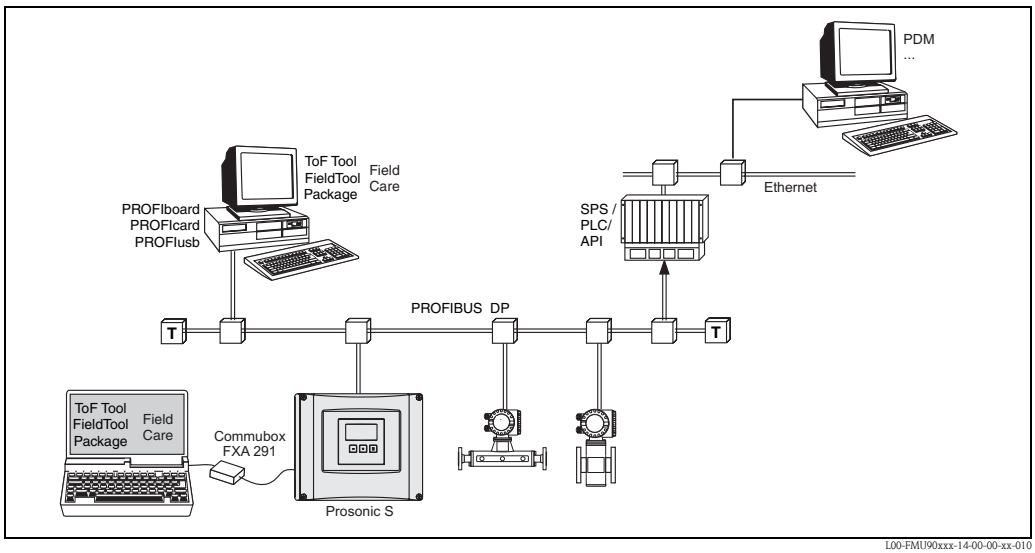
L00-FMU95xxx-15-00-00-xx-010

Multi-channel level measurement with average calculation



L00-FMU95xxx-15-00-00-xx-003

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 "ToF Tool - FieldTool Package" or "FieldCare"
- via PROFIBUS DP with Profiboard or Proficard and the operating program "ToF Fool - FieldTool Package" or "FieldCare"

Input

Sensor inputs

Depending on the instrument version, up to 5 or up to 10 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 m	10 m	20 m	25 m	-	-
max. range[1] in solids	1.2 m	5 m	10 m	15 m	45 m	70 m

1) This table gives the maximum range. The range depends on the measuring conditions. For an estimation see Technical Information TI 396F, chapter "Input".

In order to support existing installations, the sensors of the former 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 m	9 m	20 m	25 m	-	-	-
max. range[1] in solids	2 m	5 m	10 m	15 m	25 m	45 m	70 m

1) This table gives the maximum range. The range depends on the measuring conditions. For an estimation see Technical Information TI 189F, 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 FMU95.

Output

PROFIBUS DP interface

Profile	3.0
Transmittable values	■ main value (level 1 to level 10 ■ distances ■ temperatures ■ averages/sums
Function blocks	■ 20 Analog Input Blocks (AI)
Supported baud rates	■ 9.6 kbaud ■ 19.2 kbaud ■ 45,45 kbuad ■ 93.75 kbaud ■ 187.5 kbaud ■ 500 kbaud ■ 1.5 Mbaud ■ 3 Mbaud ■ 6 Mbaud ■ 12 Mbaud
Service Access Points (SAPs)	2
ID number	154E (hex) = 5454 (dec)
GSD file	EH3x154E.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.

Auxiliary energy

Supply voltage/ Power consumption/ Current consumption

Instrument version	Supply voltage	Power consumption	Current consumption
AC voltage (FMU95 - ****A****)	90 ... 253 V_{AC} (50/60 Hz)	max. 23 VA	max. 100 mA at 230 V_{AC}
DC voltage (FMU95 - ****B****)	10,5 ... 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
- bus connection (PROFIBUS DP)

Fuse

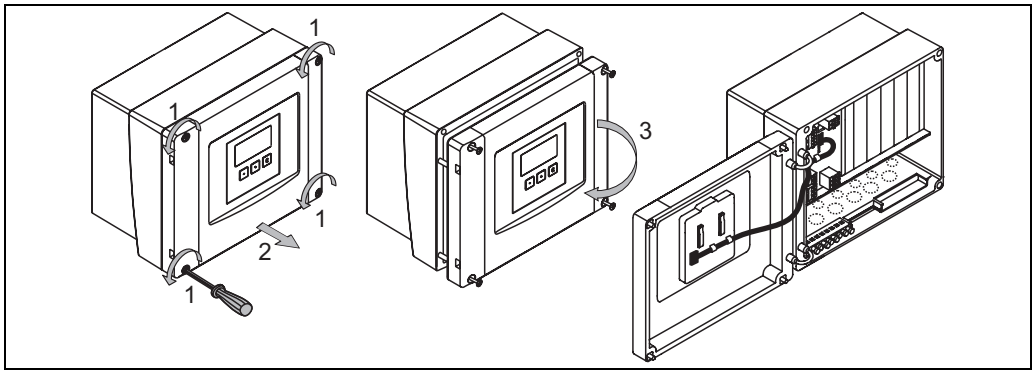
- 2 A T /DC
- 400 mA T /AC

accesible in the terminal compartment

Electrical connection

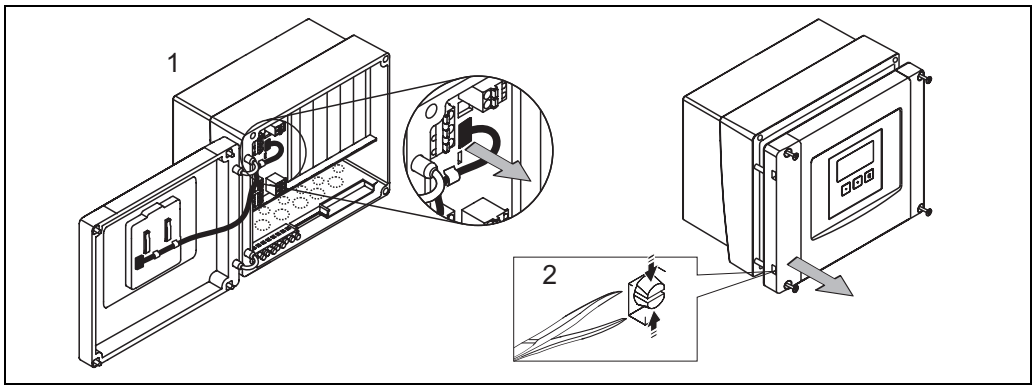
Terminal compartment of the field housing

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 (1) and loosening the hinges (2):



L00-FMU90xxx-04-00-00-xx-009

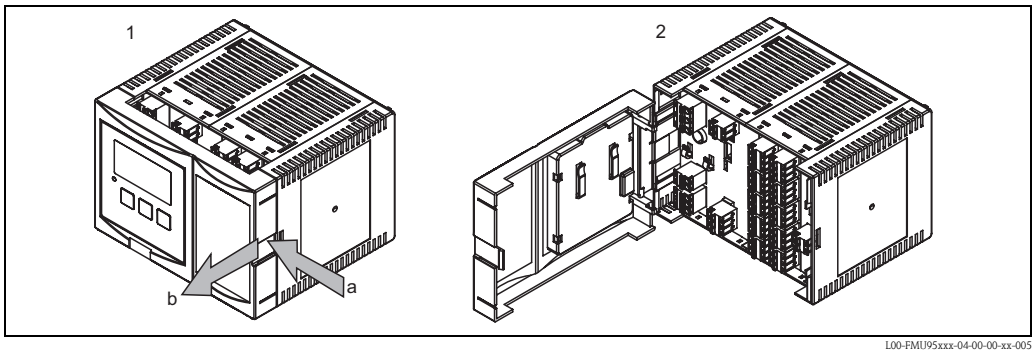
Cable entries of the field housing

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

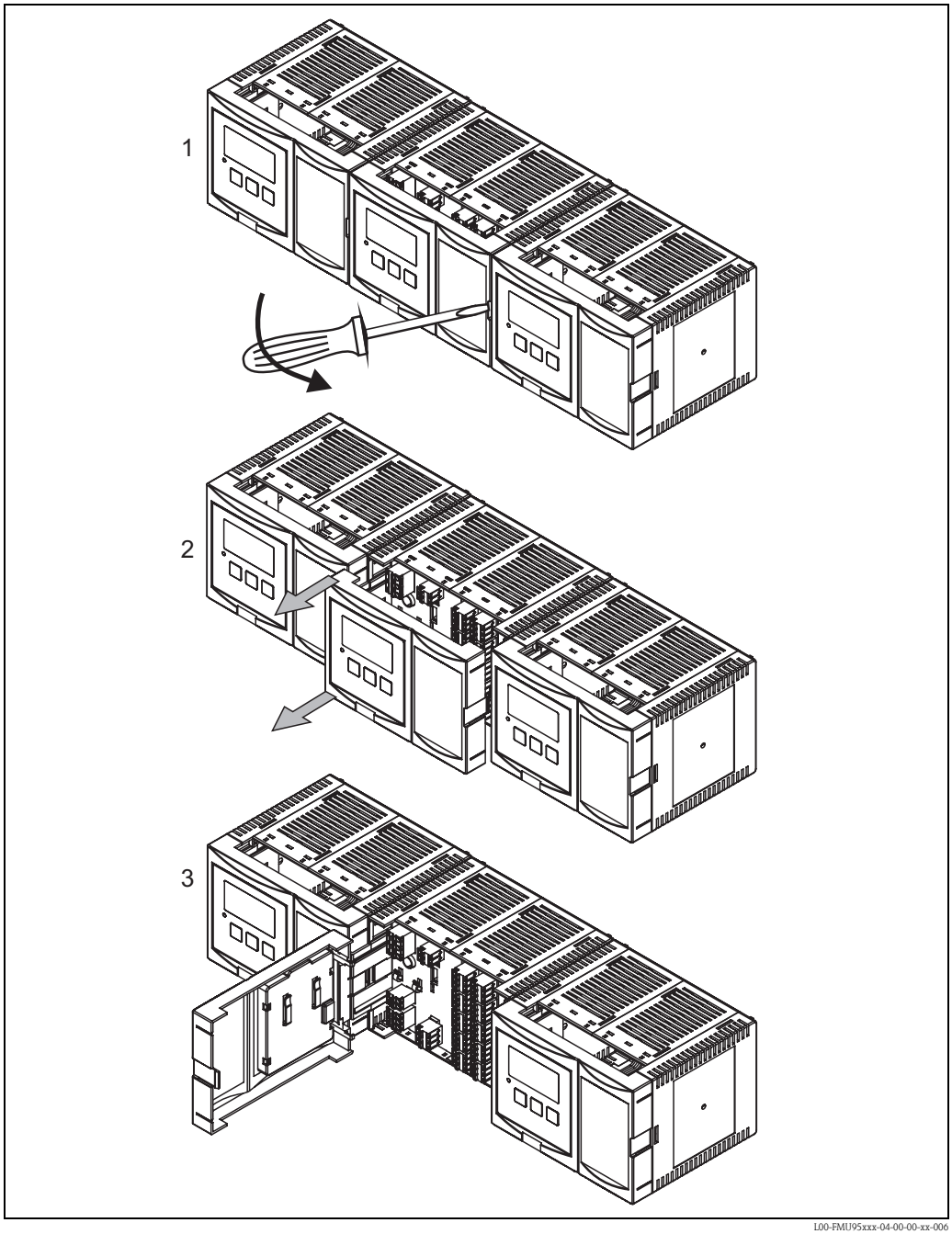
Single instrument



L00-FMU95xxx-04-00-00-xx-005

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-FMU95xxx-04-00-00-xx-006

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

Note!
The cables can be inserted into the housing from above or from below.

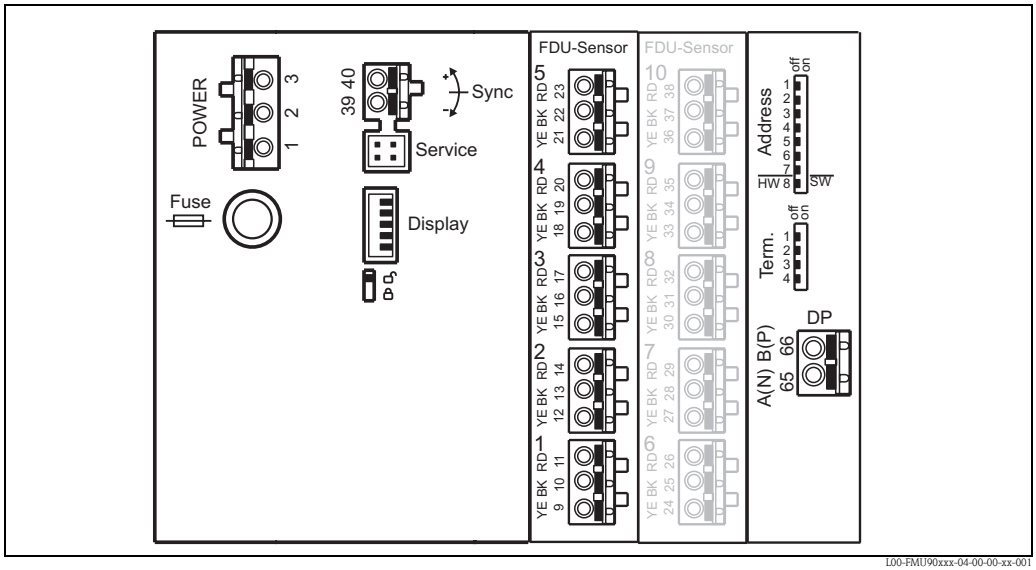
Note!
If the instruments are mounted next to each other and if the sensor cables run in parallel, the synchronization terminals (39 and 40) must be interconnected (see sections "Terminal assignment" and "Synchronization line").

Terminals

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

Conductor cross section	0,2 mm^2 - 2,5 mm^2
Cable and sleeve cross section	0,25 mm^2 - 2,5 mm^2
min. stripping length	10 mm

Terminal assignment



Terminals of the Prosonic S FMU95; the terminals depicted in grey are not present in every instrument version.

Terminals	Meaning	Remarks
Auxiliary energy		
1	■ L (for AC version) ■ L+ (for DC version)	depending on instrument version: ■ 90 ... 253 V_{AC} ■ 10,5 ... 32 V_{DC}
2	■ N (for AC version) ■ L- (for DC version)	
3	Potential equalization	
Fuse		depending on instrument version: ■ 400 mA T (for AC) ■ 2 A T (for DC)
Bus communication		
65	PROFIBUS A (RxT/TxD - N)	
66	PROFIBUS B (RxT/TxD - P)	
Synchronization		
39, 40	Synchronization	see section "Synchronization line"
Level inputs		
09,10,11	Sensor 1 (FDU8x/9x)	YE: yellow strand BK: black strand RD: red strand
12, 13, 14	Sensor 2 (FDU8x/9x)	
15, 16, 17	Sensor 3 (FDU8x/9x)	
18, 19, 20	Sensor 4 (FDU8x/9x)	
21, 22, 23	Sensor 5 (FDU8x/9x)	
24, 25, 26	Sensor 6 (FDU8x/9x)	only available for the version with 10 sensor inputs YE: yellow strand BK: black strand RD: red strand
27, 28, 29	Sensor 7 (FDU8x/9x)	
30, 31, 32	Sensor 8 (FDU8x/9x)	
33, 34, 35	Sensor 9 (FDU8x/9x)	
36, 37, 38	Sensor 10 (FDU8x/9x)	

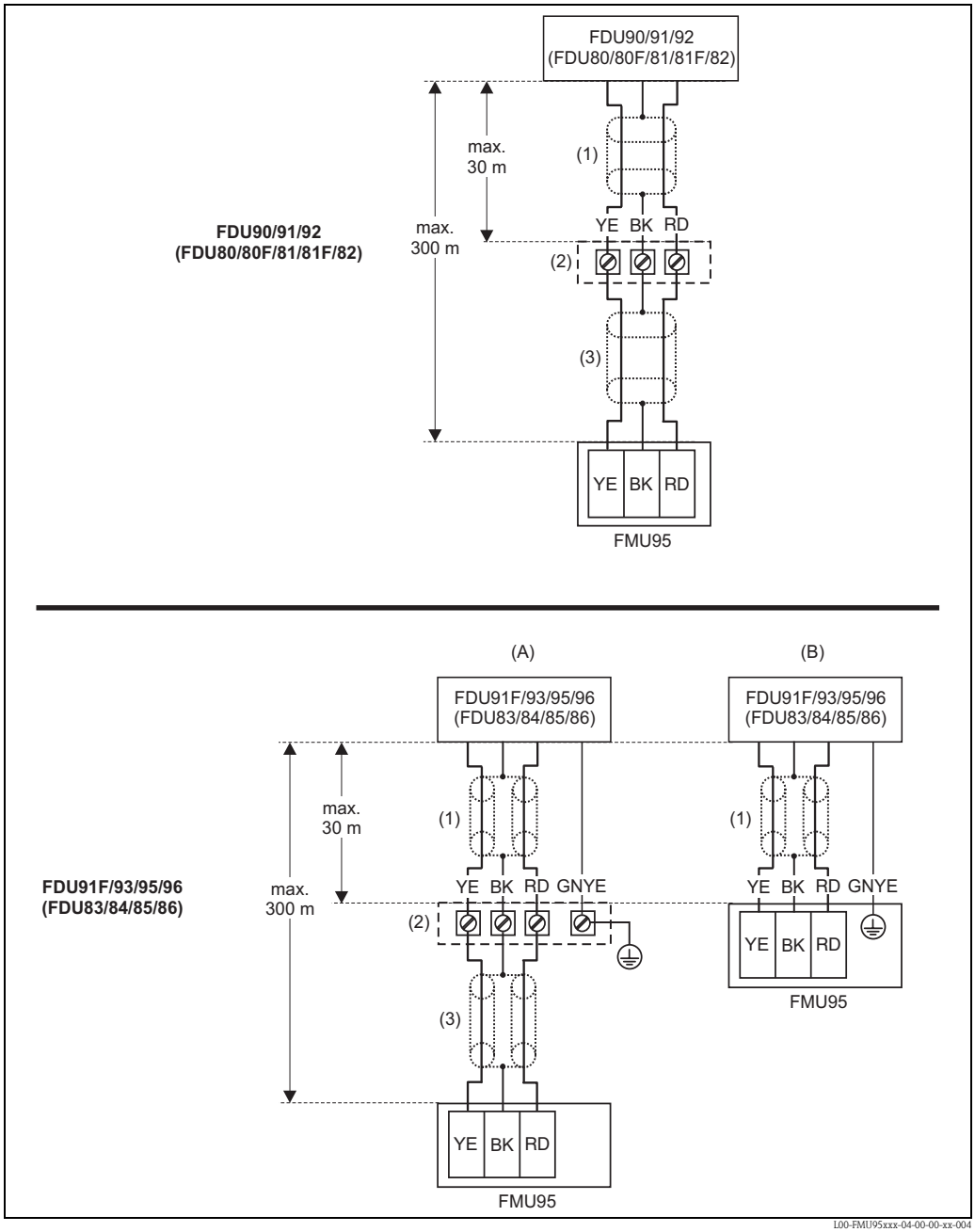
Warning!
When using the public supply mains, an easily accesible power switch must be installed in the proximity of the device. The power switch must be marked as a disconnector for the device (IEC/EN 61010)

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 frequnecy 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 (see chap. 4.7)
Service	Service interface for connection of a PC/Notebook via Commubox FXA291 (see chap. 5.1)
	Locking switch, see chap. 5.5.3
Term.	Bus termination
Address	Bus address

Connection of the sensors FDU9x

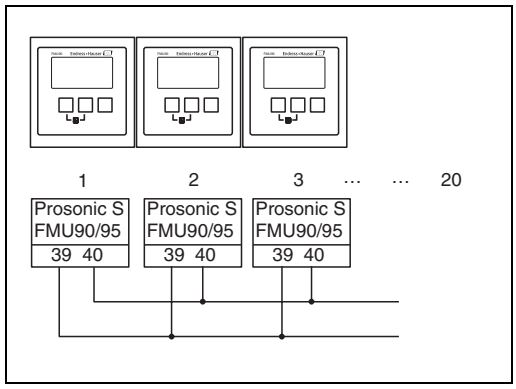


(A): *grounding at the terminal box;*
(B): *grounding at the transmitter FMU95;*
(1): *screen of the sensor cable;*
(2): *terminal box;*
(3): *screen of the extension cable;*
Colours of the strands: YE = yellow; BK = black; RD = : red; BU = blue; BN = brown; GNYE = green-yellow

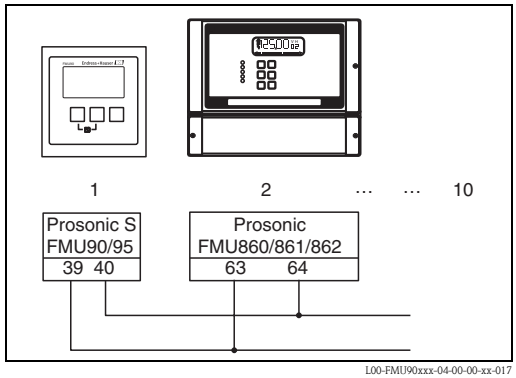
For details on the sensor connection refer to Technical Information TI 396F (FDU9x) or TI189F (FDU8x).

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.
- 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 between the individual instruments
  - cross section: 2 x (0.75 - 2.5 mm^2)
  - for lengths up to 1 m, an unscreened cable can be used; for lenghts exceeding 1 m, 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.

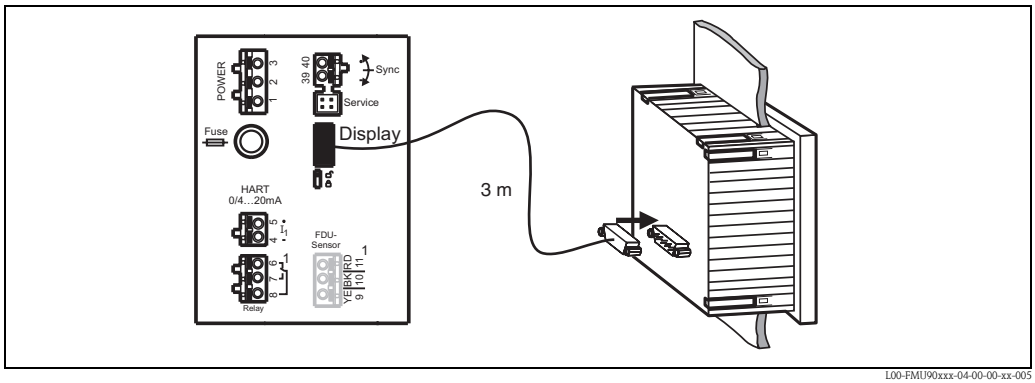


L00-FMU90xxx-04-00-00-xx-004



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

Connection of the separate display and operating module



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

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

Note!
Minimum diameter for cable bushing: 2 cm

Performance characteristics

Reference operating conditions

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

Measuring uncertainty[1)]

±0,2 % of the maximum span of the sensor

Typical accuracy[2)]

±2 mm + 0,17 % of the measured distance

Measured value resolution

1 mm with FDU91

Measuring frequency

- 0,2 Hz (with 5 sensors)
- 0,1 Hz (with 10 sensors)

The exact value depends on the settings of the application parameters and the instrument version (5 sensors or 10 sensors).

Note!
If unused sensor inputs are switched off (in the "sensor management" menu), the measuring frequency increases. The Prosonic S measures with one sensor per second.

Ambient conditions

Ambient temperature

-40 ... 60 °C
The functionality of the LC display becomes restricted at T_U < -20 °C.
If the device is operated outdoors in strong sunlight, a protective cover should be used (s. chapter "Accessories").

Storage temperature

-40 ... 60 °C

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 600068-2-64 / IEC 68-2-64; 20 ... 2000 Hz; 0,5 $(m/s^2)^2/Hz$
- Field housing: DIN EN 600068-2-64 / IEC 68-2-64; 20 ... 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)

- Interference emmission to EN 61326; Equipment class A
- Interference immunity to EN 61326; Annex A (Industrial) and NAMUR recommendation EMC (NE21)

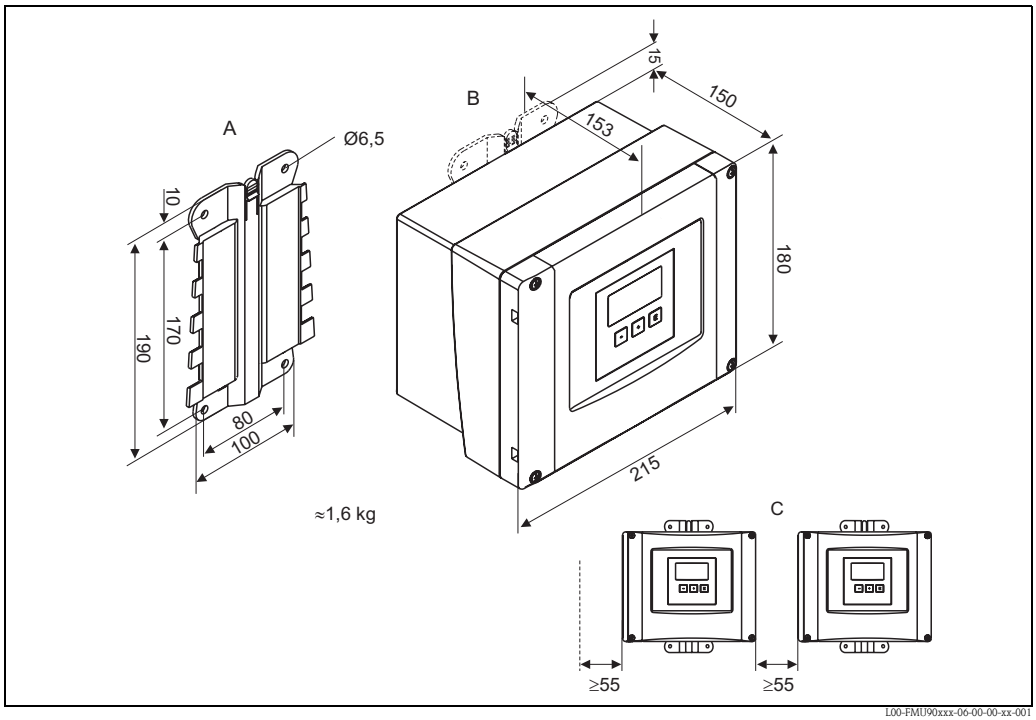
1) according to NAMUR EN 61298-2
2) after calibration

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

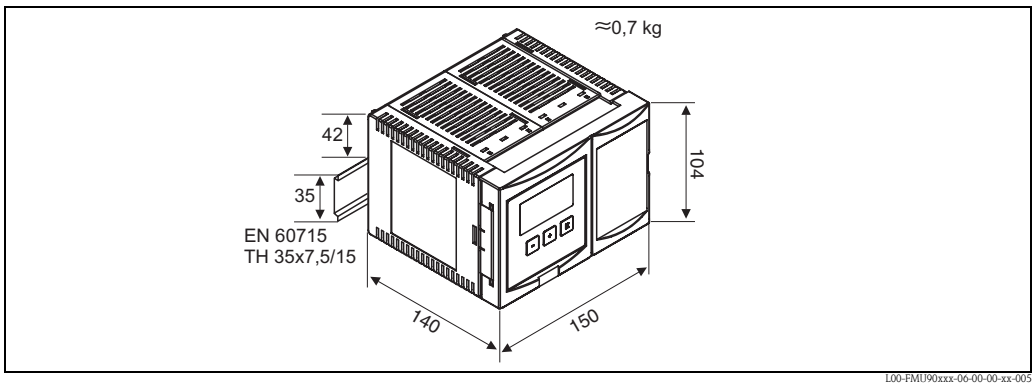


Dimensions in mm
A: *Mounting help (supplied); can also be used as drilling template ;* **B:** *Field housing;* **C:** *minimum mounting distance*

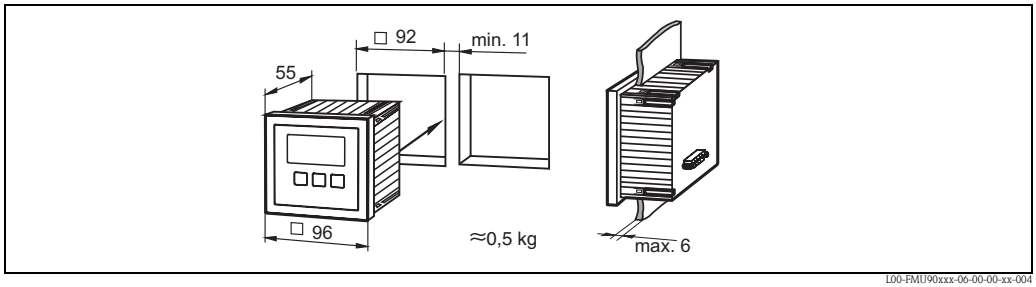
The dimensions of the field housing are the same for all instrument versions.
To open the housing, a minimum mounting distance of 55 mm is required on the left.

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



Dimensions of the separate display and operating module



Dimensions in mm

Weight

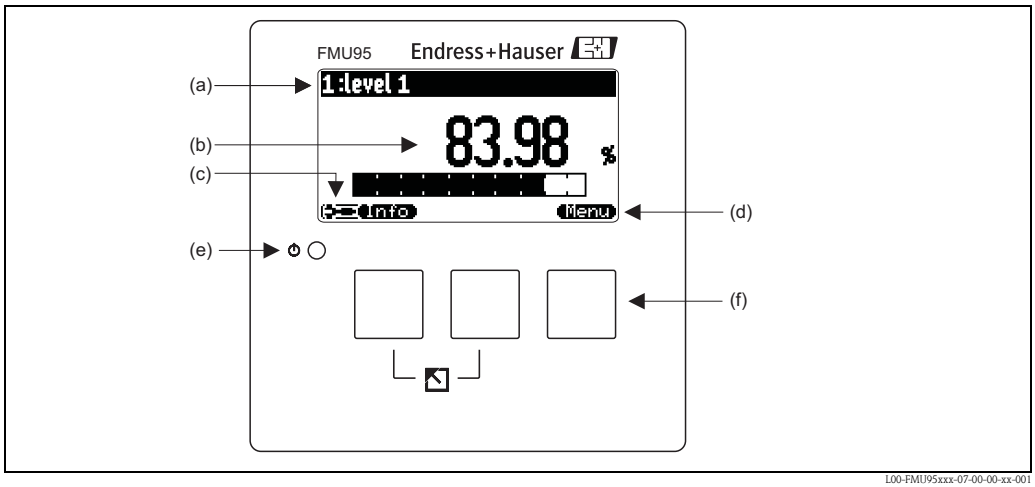
Housing version	Weight
Field housing	approx.. 1,6 ... 1,8 kg; depending on instrument version
Housing for DIN rail	approx. 0,7 kg;
separate display and operating module	approx. 0,5 kg

Materials

- Field housing: PC
- Housing for DIN rail: PBT

Human interface

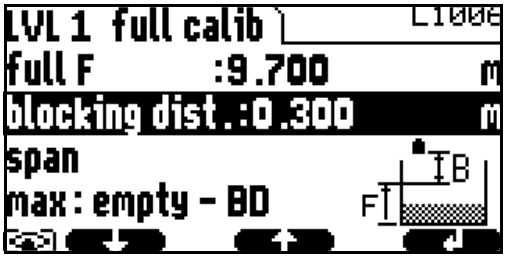
Display and operating module



L00-FMU95xxx-07-00-00-xx-001

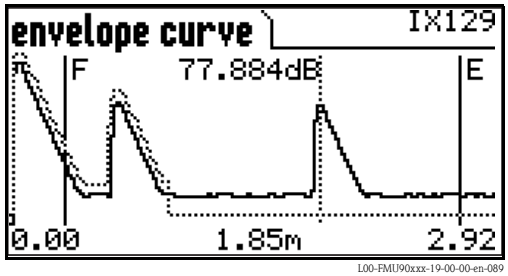
(a): *name of the parameter;* **(b):** *value of the parameter, including unit;* **(c):** *display symbols;* **(d):** *softkey symbol;* **(e):** *LED indicating the operating state;* **(f):** *keys*

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.

LED

The LED (a) indicates the operating state ("normal operation", "alarm" or "warning")

Illuminated display

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

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 a basic setup for easy commissioning of the connected sensors. The basic setup guides 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. "ToF Tool" or "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).
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.

Warning!
For FM approvals:
Unauthorized substitution of components may impair the suitability for Division 1 or Division 2.

Warning!
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.

Note!
Sensors FDU9x with Ex-approval can be connected to the transmitter FMU95 without Ex-approval.

External standards and guidelines

EN 60529

Protection class of housing (IP code)

EN 61326

Electromagnetic compatibility (EMC requirements)

NAMUR

Standards committee for measurement and control in the chemical industry

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

10	**Approval**										
	R	Non-hazarous area									
	J	ATEX II 3D									
	N	CSA General Purpose									
20		**Application**									
		1	Level								
30			**Housing, material**								
			1	Field mounting PC, IP66 NEMA 4x							
			2	DIN rail mounting PBT, IP20							
40				**Operation**							
				C	Illuminated display + keypad						
				E	Illuminated display + keypad, 96x96, panel mounting, front IP65						
				K	w/o display, via communication						
50					**Power supply**						
					A	90-253 VAC					
					B	10,5-32 VDC					
60						**Level input**					
						A	5x sensor FDU9x/8x				
						B	10x sensor FDU9x/8x				
80							**Output**				
							3	PROFIBUS DP			
110								**Language (*)**			
								1	de, en, nl, fr, es, it, pt		
								2	en, ru, pl, cs		
								3	en, zh, ja, ko, th, id		
120									**Additional option**		
									A	Basic version	
FMU95 -											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: "ToF Tool – FieldTool Package" or "FieldCare"
- Operating Instructions (depending on communication version, see chapter "Supplementary documentation")
- for certified instrument versions: Safety Instructions (XAs) or Control Drawings (ZDs) (s. chapter "Supplementary documentation")

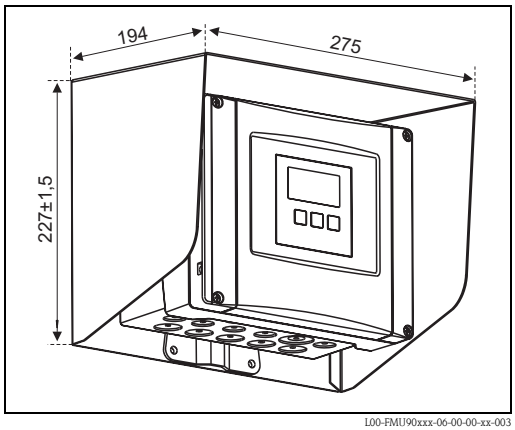
Accessories

Commubox FXA291

For intrinsically safe communication with ToF Tool/FieldCare via the service interface (IPC) of the instrument and the USB interface of a PC/Notebook.
Ordering Code: 51516983

Protection cover for the field housing

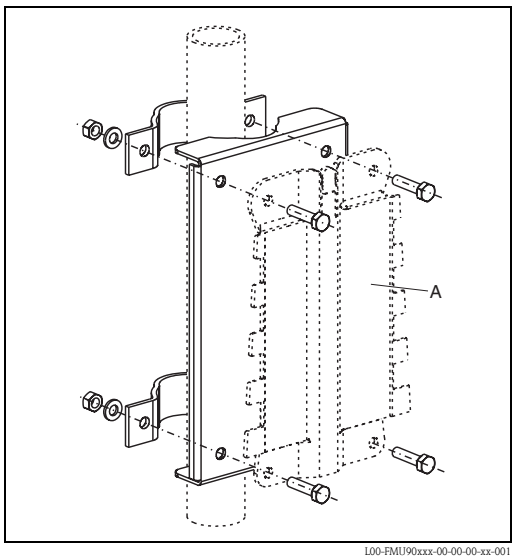
- Material: 316Ti/1.4571
- is mounted by the mounting help of the Prosonic S
- Order-Code: 52024477



L00-FMU90xxx-06-00-00-xx-003

Mounting plate for the field housing

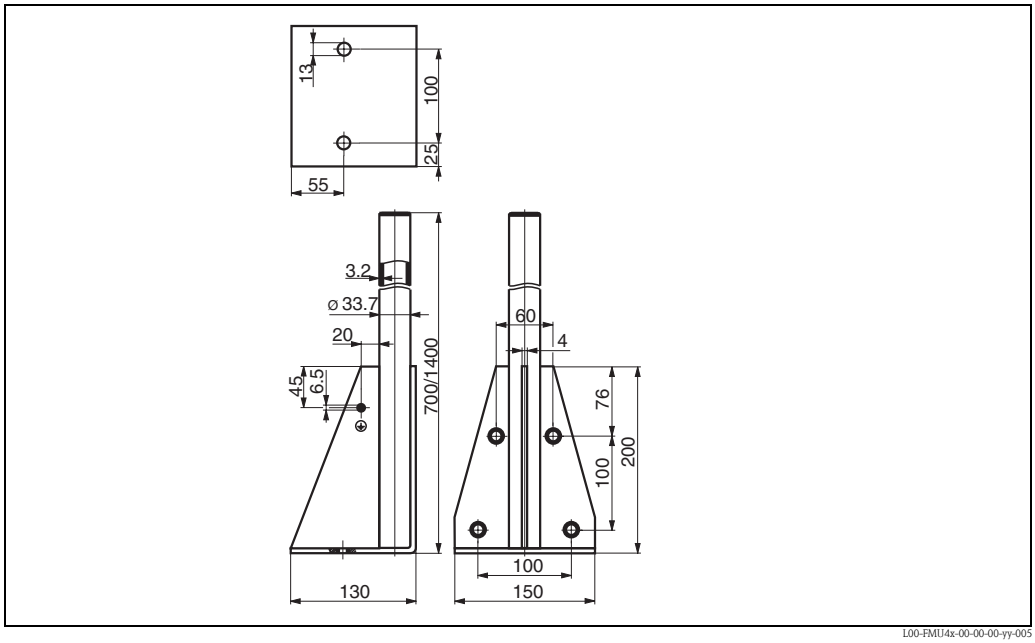
- suited for the mounting help of the Prosonic S
- for 1" - 2" tubes
- Dimensions: 210 mm x 110 mm
- Material: 316Ti/1.4571
- fixing clips, screws and nuts are supplied
- Order code: 52024478



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

A: *mounting help of the field housing*

Mounting bracket



L00-FMU4x-00-00-00-yy-005

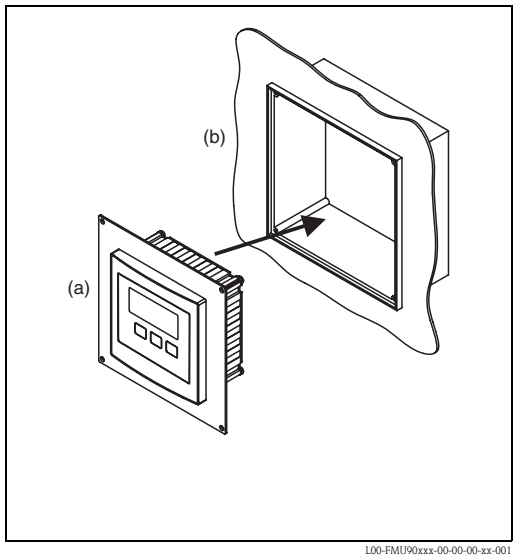
Height	Material	Order Code
700 mm	galv. steel	919791-0000
700 mm	316 Ti	919791-0001
1400 mm	galv. steel	919791-0002
1400 mm	316 Ti	919791-0003

Adaption plate for remote display

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

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.



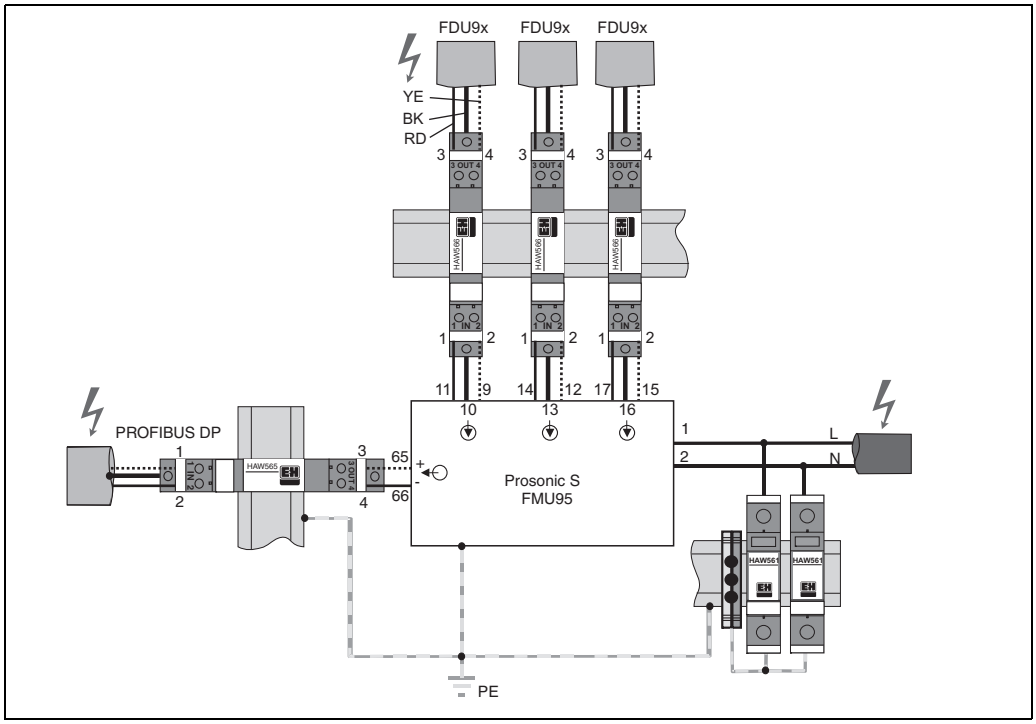
L00-FMU90xxx-00-00-00-xx-001

(a): *remote display of the Prosonic S with adaption plate;*
(b): *opening of the remote display FMU860/861/862*

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

Overvoltage protection HAW56x

Application example

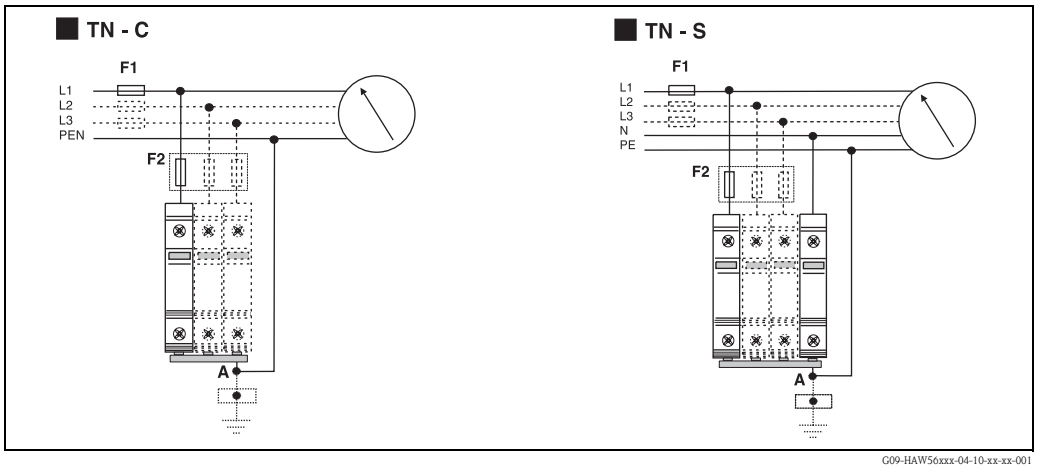


L00-FMU95xxx-04-00-00-xx-012

The following components are required:
- 1 x HAW560+565 for the signal line PROFIBUS DP
- for each sensor: 1 x HAW560+566
- 2 x HAW561 for the power supply of the transmitter

Electrical connection

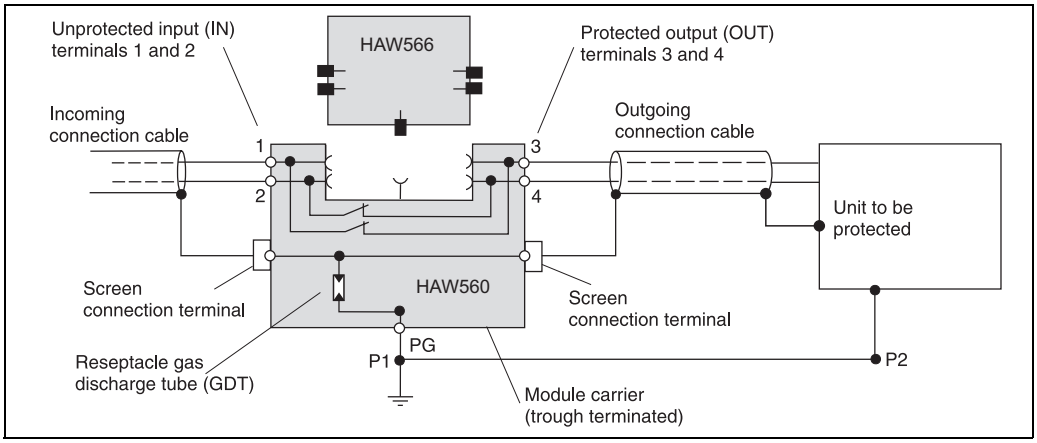
Power supply: HAW561 and 561K



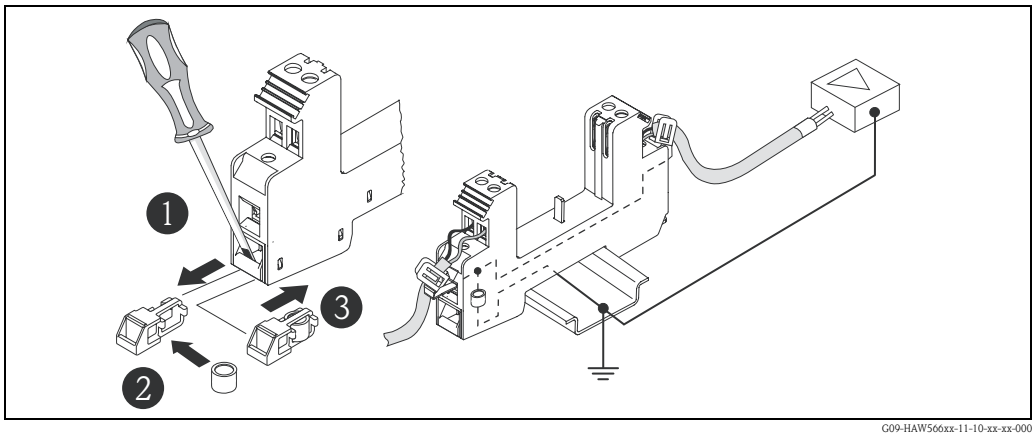
G09-HAW56xxx-04-10-xx-xx-001

A fixed allocation of the phase and ground terminal is not allocated (pole security). The unit is fitted on both ends with a multi function connection terminal. This gives the opportunity to simultaneously connect a cable as well as a fork ferrule from standard busbars.
Connection of the unit is as in the diagram above. Dependent on the cabling, up to four units will be required.

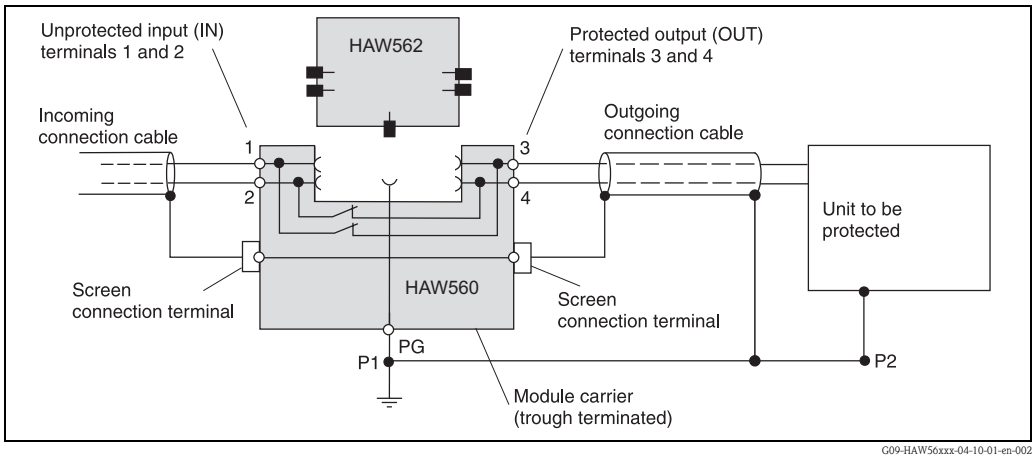
Sensor signal: HAW560 with HAW566



Connection of the unit as in the diagram. The ground connection is made using the DIN rail.
For indirect screening (as required if connecting the Prosonic S signal line to an HAW566) a gas-discharge arrester is supplied. It must be inserted into the provided plug-in bay on the HAW560:



Output signal



Connection of the unit as in the diagram. The ground connection is made using the DIN rail.

Product overview

Oreder code	Unit
51003569	**Surge arrester HAW561K** For low voltage users 24/48V, single pole, requirement class C, basic component with plugged in protection unit, defect display, 18 mm housing width
51003570	**Surge arrester HAW561** For standard voltage users 115/230 V, single pole, requirement class C, basic component with plugged in protection unit, defect display, 18 mm housing width
51003571	**Surge arrester module carrier HAW560** Two pole through terminated for fitting surge arrester modules for units in information technology, 12 mm housing width, colour grey
51003573	**Surge arrester module HAW565** For protection of 2 single lines, e.g. 2 asymmetrical single lines with high frequency signal transmission, e.g.: Profibus DP, RS 485, 12 mm housing width, colour grey
71028875	**Surge arrester module HAW566** Protection for 2 signal inputs, e.g. 2 asymmetrical inputs, e.g. Prosonic S signal 12 mm housing with, colour grey

For details see Technical Information TI093R.

Supplementary documentation

Technical Information

TI 396F

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

Operating Instructions

BA344F

Operating Instructions for Prosonic S FMU95;
This document describes the installation and commissioning of the Prosonic S. It contains those functions from the operating menu which are required fo a standard measuring task. Additional functions are contained in the "Description of Instrument Funcitons", BA345F.

BA345F

Description of Instrument Functions for Prosonc S FMU95

BA346F

Slot-Index tables for the PROFIBS-DP interface of Prosonic S FMU95

Safety Instructions

XA326F

Safety Instructions for ATEX II 3D

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Endress+Hauser

People for Process Automation

TI398F/00/en/07.09
71100143
FM+SGML 6.0 ProMoDo

71100143

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

Technical Information

Prosonic S
FDU90/91/91F/92/93/95/96

Ultrasonic sensors for non-contact continuous level and flow measurement, for connection to the transmitters FMU90 and FMU95

Application

- Continuous, non-contact level measurement of fluids, pastes, sludges and powdery to coarse bulk materials
- Flow measurement in open channels and measuring weirs
- Maximum measuring range
  - FDU90: 3 m (9.8 ft) in fluids
    1.2 m 3.9 ft) in bulk materials
  - FDU91/FDU91F: 10 m (33 ft) in fluids
    5 m (16 ft) in bulk materials
  - FDU92: 20 m (66 ft) in fluids
    10 m (33 ft) in bulk materials
  - FDU93: 25 m (82 ft) in fluids
    15 m (49 ft) in bulk materials
  - FDU95: 45 m (148 ft) in bulk materials
  - FDU96: 70 m (230 ft) in bulk materials
- Suited for explosion hazardous areas

Your benefits

- Non-contact measurement method; minimizes service requirements
- Integrated temperature sensor for time-of-flight correction. Accurate measurements are possible, even if temperature changes are present
- Hermetically welded PVDF sensors FDU91/92 for fluid measurement, for highest chemical resistance
- Integrated automatical sensor detection for transmitters FMU90, simple commissioning
- Can be installed up to 300 m (984 ft) from the transmitter
- Suited for rough ambient conditions thanks to separate installation from the transmitter
- Reduced build-up formation because of the self-cleaning effect
- Integrated heating against a build-up of ice at the sensor (optional), ensures reliable measurement
- Weather resistant and flood-proof (IP68)
- Dust-Ex and Gas-Ex certificats available (ATEX, FM, CSA)

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Endress+Hauser
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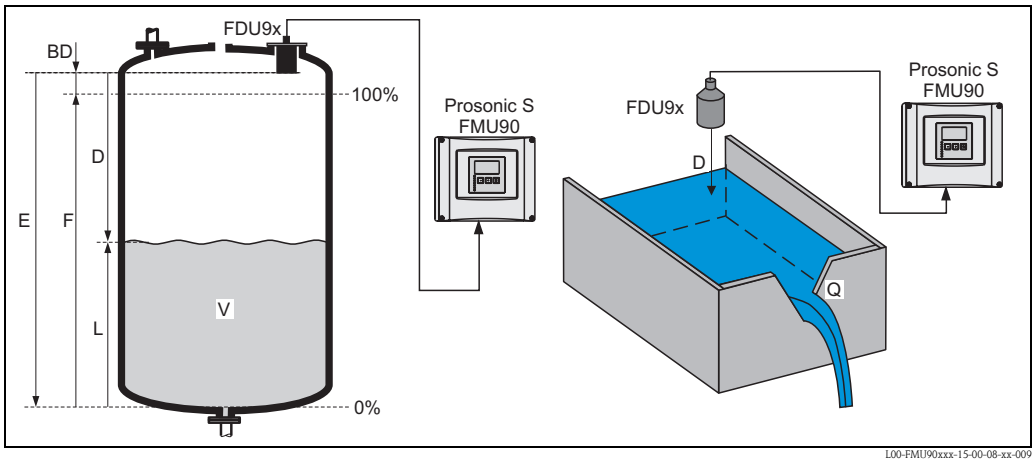
Table of Contents

Function and system design

Measuring principle



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 reference point (see the figure → 4) to the product surface:

$D = c \cdot t/2$

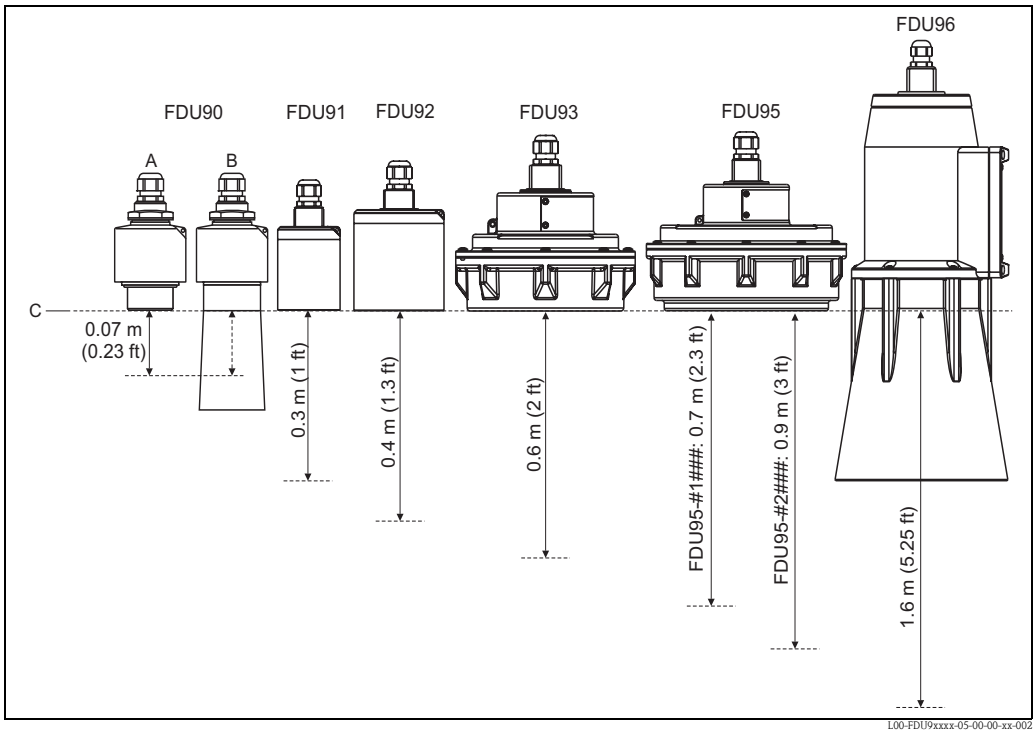
From D results the desired measuring value:
- level L
- volume V
- flow Q across measuring weirs or open channels

Time-of-flight correction

In order to compensate for temperature dependent time-of-flight changes, a temperature sensor is integrated in the ultrasonic sensors.

Blocking distance

The level L may not extend into the blocking distance BD. Level echoes within the blocking distance can not be evaluated due to the transient characteristics of the sensor and thus a reliable measurement is not possible. The blocking distance BD is dependent on the type of sensor:



A: *without flooding protection tube,* **B:** *with flooding protection tube,* **C:** *reference point*

Transmitter

The sensors can be connected to the transmitter FMU90 and FMU95. The transmitter recognizes the type of sensor automatically.

Input

Measuring range

The effective range of the sensors is dependent on the operating conditions. To estimate the range, proceed as follows (see also the example):

1. Determine which of the influences shown in the following table are appropriate for your process.
2. Add the corresponding attenuation values.
3. From the total attenuation, use the diagram to calculate the range.

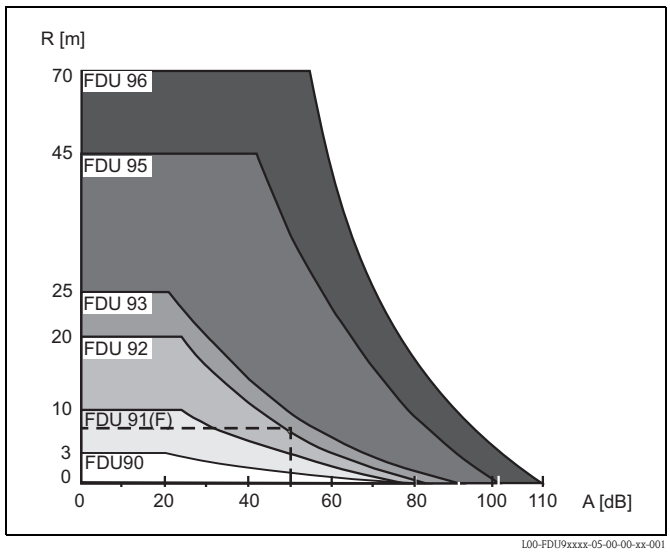
Fluid surface	**Attenuation**
calm	0 dB
waves	5 to 10 dB
strong turbulence (e.g. stirrers)	10 to 20 dB
foaming	Please contact your Endress+Hauser sales representative.

Bulk material surface	**Attenuation**
hard, rough (e.g. rubble)	40 dB
soft (e.g. peat, dust-covered clinker)	40 to 60 dB

Dust	**Attenuation**
no dust formation	0 dB
little dust formation	5 dB
heavy dust formation	5 to 20 dB

Filling curtain in detection range	**Attenuation**
none	0 dB
small quantities	5 dB
large quantities	5 to 20 dB

Temperature difference between sensor and product surface	**Attenuation**
to 20 °C (68 °F)	0 dB
to 40 °C (104 °F)	5 to 10 dB
to 80 °C (176 °F)	10 to 20 dB



A: *Attenuation (dB)*, **R:** *Range (m)*

Example for FDU92

- Silo with rubble: ~ 40dB
- small quantities of filling curtain: ~ 5dB
- little dust: ~ 5dB

total: ~ 50dB

=> Range approx. 8 m (26 ft)

Operating frequency

Sensor	Operating frequency
FDU90	90 kHz
FDU91	43 kHz
FDU91F	42 kHz
FDU92	30 kHz
FDU93	27 kHz
FDU95 - *1*** (low temperature version)	17 kHz
FDU95 - *2*** (high temperature version)	18 kHz
FDU96	11 kHz

Output

Signal transmission

analogue voltages

Auxiliary energy

Power supply

supplied by the transmitter FMU90

Sensor heater (for FDU91)

The FDU90 and FDU91 sensors are available in a version with heater. The power for this heater must be provided by an external power supply unit. The supply voltage is connected to the brown (BN) and blue (BU) strands of the sensor cable.

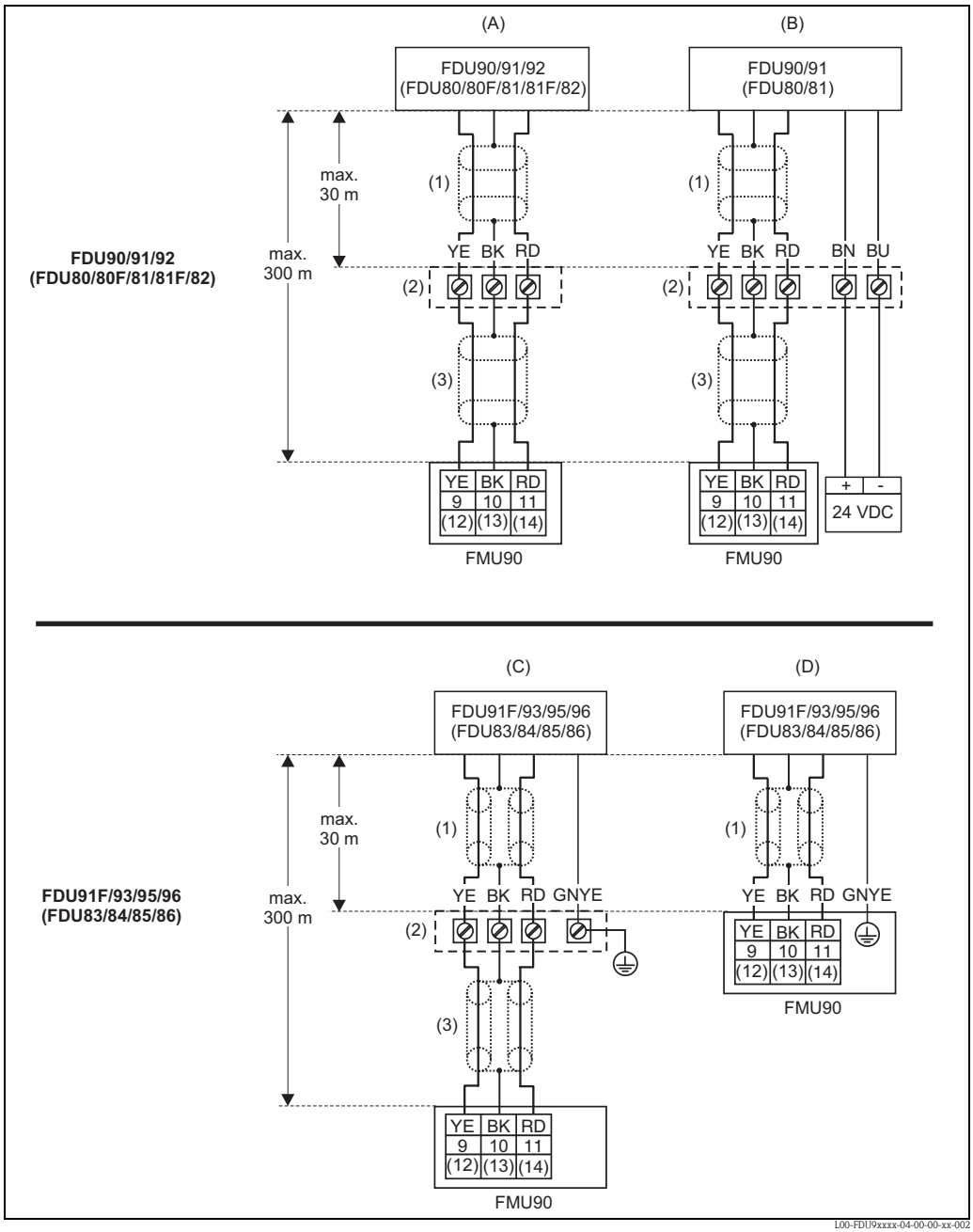
Technical data

- 24 VDC ±10 %; residual ripple < 100 mV
- 250 mA per sensor

Note!
- If the sensor heater is applied, the integrated temperature sensor can not be used. Instead, an external temperature sensor (Pt100 or FMT131 from Endress+Hauser) must be used. The transmitter FMU90 is available in a version with an input for the external temperature sensor. For details refer to Technical Information TI00397F.
- The power for the sensor heater can be supplied by the power supply RNB130 from Endress+Hauser (→ 30 "Accessories").

Electrical connection

Connection diagram



(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

Connection hints

Caution!
- In order to avoid interference signals, the sensor cables should not be laid parallel to high voltage electric power lines. The cables may not be laid in the proximity to frequency converters.
- The cable screen serves as a return cable and must be connected to the transmitter without any electrical break. With the pre-assembled cables, the screen ends in a black strand (BK). With the extension cable, the screen must be twisted together and connected to the "BK" terminal.

Warning!
- The sensors FDU83, FDU84, FDU85 and FDU86 with an ATEX, FM or CSA certificate are not certified for connection to the FMU90 transmitter.
- for the sensors FDU91F/93/95/96 and FDU83/84/85/86:
  The ground lead (GNYE) must be connected to the local potential equalization **after a maximum distance of 30 m (98 ft)**. This can be done either
  – at the terminal box or
  – at the transmitter FMU90 or in the cabinet (if the distance to the sensor does not exceed 30 m (98 ft)).

Note!
For easier mounting it is advisable to use the sensors FDU90/91/92 and FDU80/80F/81/81F/82 with a maximum cable length of 30 m (98 ft) as well. For longer distances an extension cable with a terminal box should be used.

Connection of the sensor heater (for FDU90/FDU91)

The FDU90 and FDU91 sensors are available in a version with heater. The power for this heater must be provided by an external power supply unit. The supply voltage is connected to the brown (BN) and blue (BU) strands of the sensor cable.

Technical Data
- 24 VDC ± 10 %; residual ripple < 100 mV
- 250 mA per sensor

Note!
When using the sensor heater, the temperature compensation of the ultrasonic measurement must be performed with an external temperature probe, which is connecte to the additional temperature input of the FMU90 transmitter (see Technical Information TI00397F).

Extension cables for the sensors

For distances up to 30 m (98 ft) the sensor can be directly connected by the sensor cable. For longer distances, it is recommended to use an extension cable. The extension cable is connected via a terminal box. The total length (sensor cable + extension cable) may be up to 300 m (984 ft).

Caution!
If the terminal box is installed in explosion hazardous areas, all applicable national guidelines must be observed.
Suitable extension cables can be obtained from Endress+Hauser (→ 🖹 30 "Accessories")
Alternatively, cables with the following properties can be used:

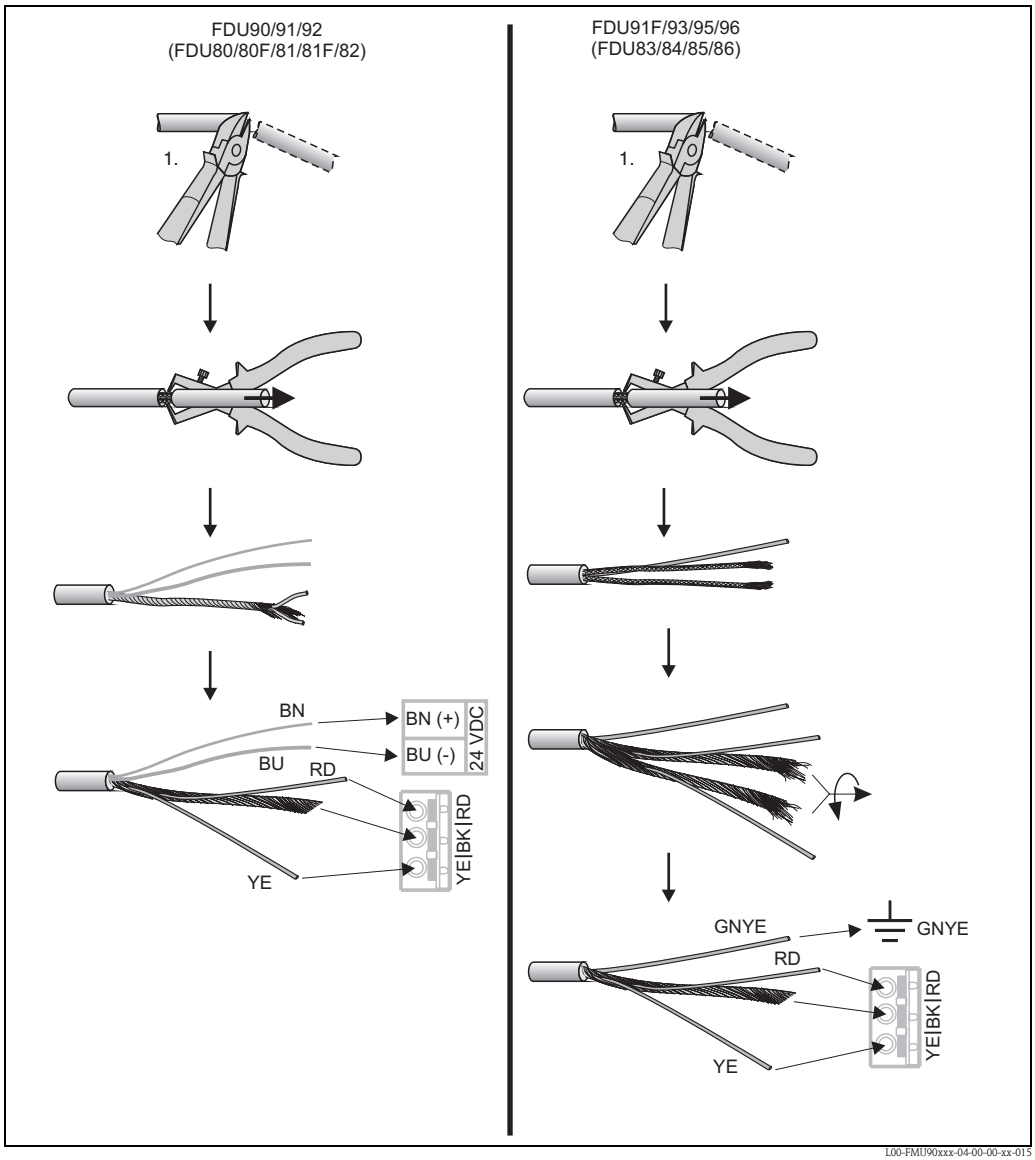
- Number of cores according to the connection diagram (→ 🖹 7 "Connection diagram")
- braided wire screen for the yellow (YE) and red (RD) core (no foil screen)
- Length: up to 300 m (984 ft), sensor cable + extension cable
- Cross section: 0.75 mm^2 to 2.5 mm^2 (18 to 14 AWG)
- up to 6 Ω per core
- max. 60 nF
- for FDU91F/93/95/96 and FDU 83/84/85/86: The earth lead must not be within the screening.

Shortening the sensor cable

If required, the sensor cable can be shortened. Please note:

- Do not damage the cores when removing the insulation.
- The cable is shielded by a metallic braiding. This shielding serves as a return cable and corresponds to the black (BK) strand of the unshortened cable. After shortening the cable, loosen the metallic braiding, twist it together securely and connect it to the "BK" terminal.

Caution!
The protective earth conductor (GNYE), which is present in some of the sensor cables, may not be electrically connected to the cable shield.

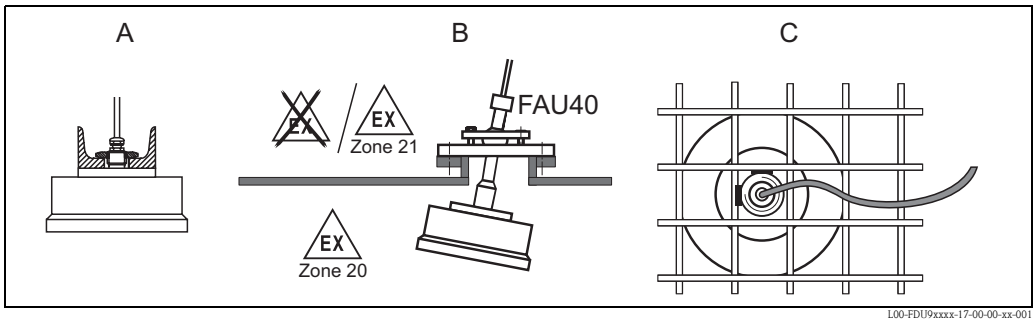


Colours of the strands: YE = yellow; BK = black; RD = red; BU = blue; BN = brown; GNYE = green-yellow

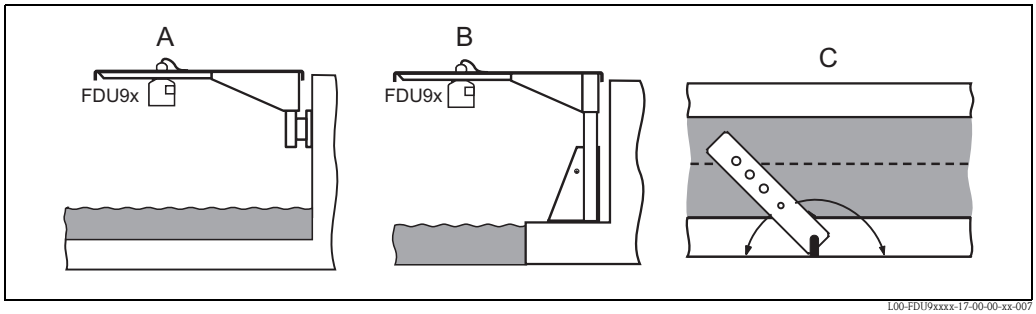
Note!
The blue (BU) and brown (BN) strands is only present for sensors with heater.

Installation conditions

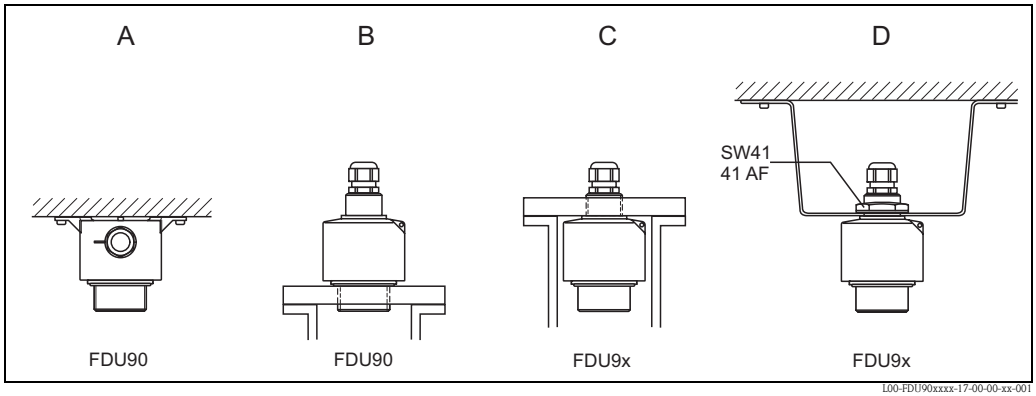
Installation options (Examples)



A: *at girder or angle bracket,* **B:** *with alignment unit FAU40, in ATEX Zone 20 the alignment unit can be used for zone separation,* **C:** *with a 1" sleeve welded to a grating*



A: *Installation with cantilever and wall bracket,* **B:** *Installation with cantilever and mounting frame,* **C:** *The cantilever can be turned in order to position the sensor over the centre of the flume.*
Cantilever, wall bracket and mounting frame are available as accessories (→ 🖹 30).

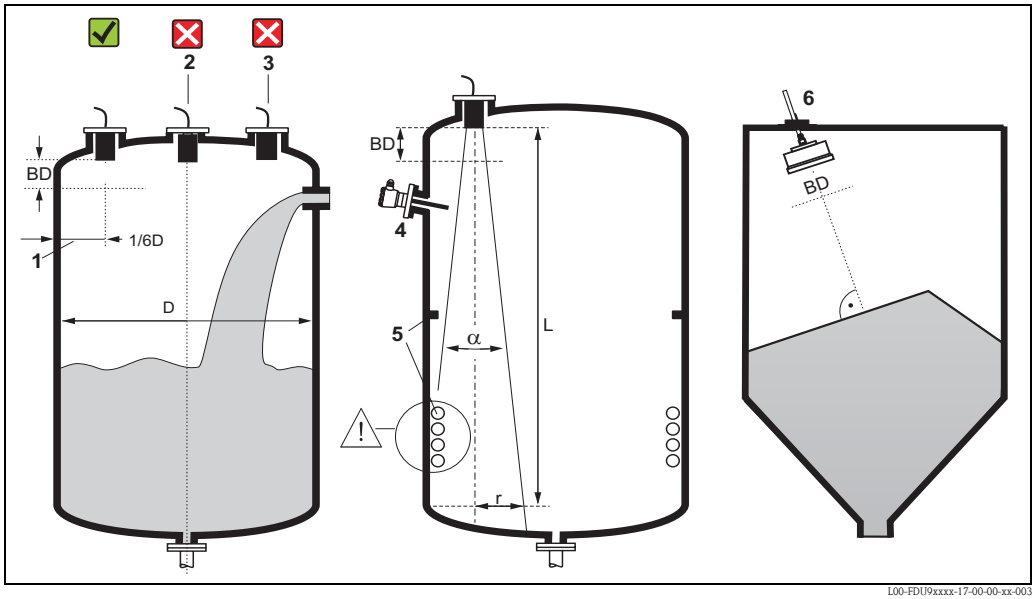


A: *FDU90: Ceiling mounting*
B: *FDU90: Mounted at front thread (G1-1/2 or NPT1-1/2)*
C: *FDU9x: Mounted at rear thread (G1 or NPT1)*
D: *FDU90, FDU91, FDU92: Mounting with G1 counter nut[1]; 42AF*

Caution!
- The cable of the sensors is not designed as a supporting cable. Do not use it as a suspension wire.
- The sensor membrane is part of the measuring system and must not be damaged during installation.

1) The counter nut with gasket is supplied for the sensors FDU90, FDU91 and FDU92 with a metric thread G1 at the process connection.

Installation conditions for level measurements



L00-FDU9xxxx-17-00-00-xx-003

- If possible, install the sensor so that its lower edge projects into the vessel.
- Make sure, that the maximum level does not reach into the blocking distance (BD, see table).
- Do not install the sensor in the middle of the tank (2). We recommend leaving a distance (1) between the sensor and the tank wall measuring 1/6 of the tank diameter.
- Avoid measurements through the filling curtain (3).
- Make sure that equipment (4) such as limit switches, temperature sensors, baffles etc. are not located within the emitting angle α. Emitting angles of the individual sensors are given in the table below. In particular, symmetrical equipment (5) such as heating coils etc. can influence the measurement.
- Align the sensor vertically to the product surface (6). An alignment unit (FAU40) is available as an accessory (→ 🖹 30).
- If the two-channel version of the transmitter FMU90 or the multi-channel version of the transmitter FMU90 is used, both sensors can be mounted in one vessel.
- To estimate the detection range, use the 3 dB emitting angle α:

Sensor	α (typically)	L (max)	r (max)
FDU90	12°	3 (9.8)	0.31 (1.0)
FDU91	9°	10 (33)	0.79 (2.6)
FDU91F	12°	10 (33)	1.05 (3.4)
FDU92	11°	20 (66)	1.92 (6.3)
FDU93	4°	25 (82)	0.87 (2.9)
FDU95	5°	45 (148)	1.96 (6.4)
FDU96	6°	70 (230)	3.6 (12)

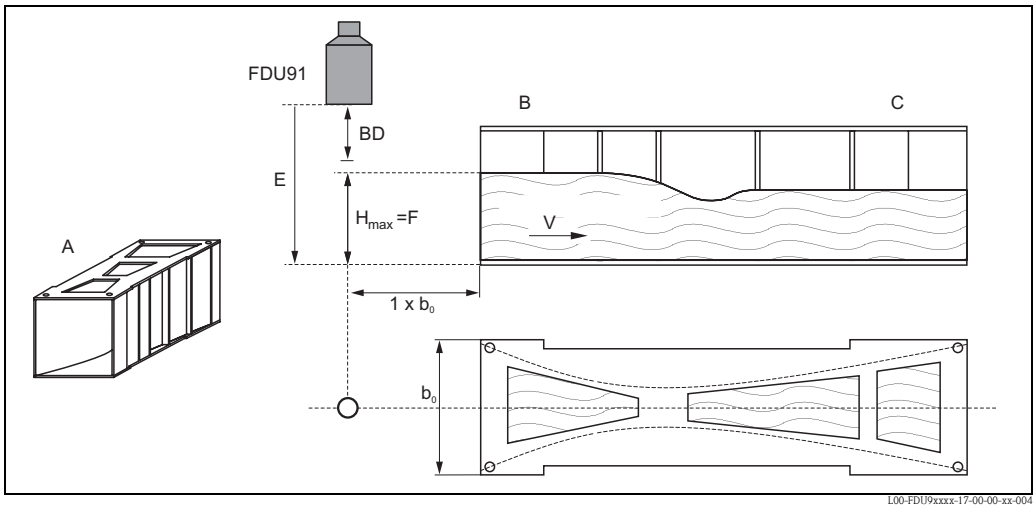
m (ft)

Warning!
All national guidelines applicable must be observed in explosion hazardous areas.

Installation conditions for flow measurements

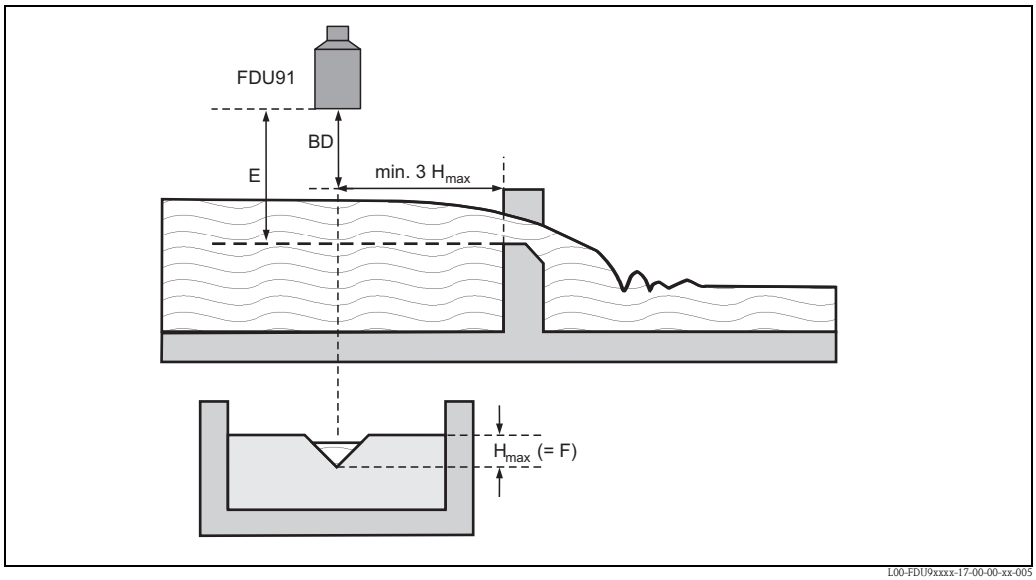
- Install the sensor at the inflow side (B), above the maximum water level H_{max} (=F) plus the blocking distance BD.
- Position the sensor in the middle of the channel or weir.
- Align the sensor vertically to the water surface.
- Comply to the installation distance of the channel or weir.[2)]
- Use a protective cover, in order to protect the sensor from direct sun or rain. A protective cover is available for the sensors FDU90 and FDU91 (→ 🖹 30).

Example: Khafagi-Venturi flume



A: *Khafagi-Venturi flume,* **B:** *inflow,* **C:** *outflow,* **BD:** *blocking distance,* **E:** *empty calibration,* **F:** *full calibration,* **V:** *direction of flow*

Example: V-notch weir

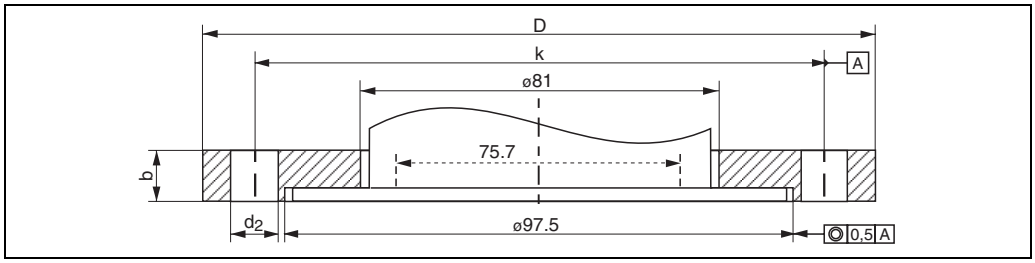


BD: *blocking distance,* **E:** *empty calibration*, **F:** *full calibration*

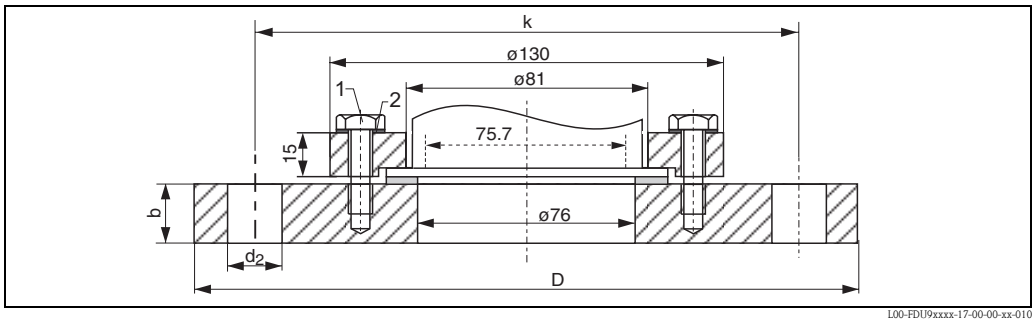
2) The installation distances of important flumes and weirs are specified in the Operating Instructions BA00289F (FMU90 with HART) and BA00293F (FMU90 with PROFIBUS).

Flush mounting with slip-on flange FAU80

The FDU91F sensor can be flush mounted using a FAU80 slip-on flange. Flanges in polypropylene (PP-FR) should only be used with pressures up to 1.5 bar_{abs} (22 psi abs), flanges in 316L also above.



Order code	Material	b [mm (in)]	øD [mm (in)]	ød2 [mm (in)]	k [mm (in)]	No. d2	Standard
FAU80 - CAP	PP-FR	20 (0.79)	200 (7.87)	18 (0.71)	160 (6.3)	8	DN80 PN16 A (DIN EN 1092-1 (DIN2527 B))
FAU80 - CAJ	316L (1.4435)						
FAU80 - AAP	PP-FR	23.9 (0.94)	190.5 (7.5)	19.1 (0.75)	152.4 (6.0)	4	ANSI 3" 150 lbs FF (ANSI B 16.5)
FAU80 - AAJ	316L (1.4435)						
FAU80 - KAP	PP-FR	18 (0.71)	185 (7.28)	19 (0.75)	150 (5.9)	8	JIS 10K 80A FF (JIS B 2220)
FAU80 - KAJ	316L (1.4435)						



The adapter flange is included in the delivery

Position	Part	Material
1	Screws	V2A
2	Washer	PP-FR or 316/316L (1.4435)

Order code	Material	b [mm]	øD [mm]	ød2 [mm]	k [mm]	No. d2	Standard
FAU80 - CHP	PP-FR	20 (0.79)	220 (8.66)	18 (0.71)	180 (7.09)	8	DN100 PN16 A (DIN EN 1092-1 (DIN2527 B))
FAU80 - CHJ	316L (1.4435)						
FAU80 - AHP	PP-FR	23.9 (0.94)	228.6 (9.0)	19.1 (0.75)	190.5 (7.5)	4	ANSI 4" 150 lbs FF (ANSI B 16.5)
FAU80 - AHJ	316L (1.4435)						
FAU80 - KHP	PP-FR	18 (0.71)	210 (8.27)	19 (0.75)	175 (6.89)	8	JIS 10K 100A FF (JIS B 2220)
FAU80 - KHJ	316L (1.4435)						

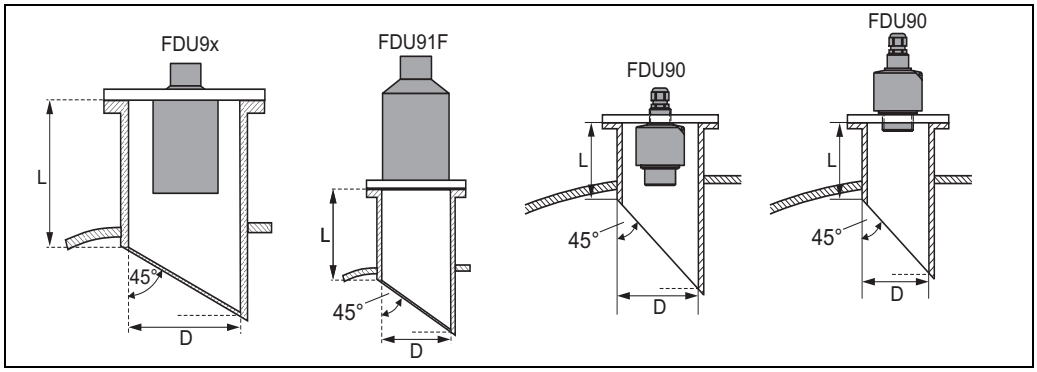
Note!
- The process seal is not included in the delivery.

- Endress+Hauser supplies DIN/EN flanges made of stainless steel AISI 316L with the material number 1.4404 or 1.4435. With regard to their temperature stability properties, the materials 1.4404 and 1.4435 are grouped under 13E0 in EN 1092-1 Tab. 18. The chemical composition of the two materials can be identical.

Caution!
For 3A applications:
The internal diameter of the nozzle should be selected according to the valid allowable limits for 3A applications. Usually, the internal diameter of the nozzle should be larger than or equal to the internal diameter of the sensor.

Nozzle installation

Install the sensor at a height so that the blocking distance BD is not undershot, even at maximum fill level. Use a pipe nozzle if you cannot maintain the blocking distance in any other way. The interior of the nozzle must be smooth and may not contain any edges or welded joints. In particular, there should be no burr on the inside of the tank side nozzle end. Note the specified limits for nozzle diameter and length. To minimise disturbing factors, we recommend an angled socket edge (ideally 45°).



	Maximum nozzle length [mm (in)]							
Nozzle diameter	**FDU90[1)]**	**FDU90[2)]**	**FDU91**	**FDU91F**	**FDU92**	**FDU93**	**FDU95**	**FDU96**
DN50/2"		50 (1.97)						
DN80/3"	340 (13.4)	250 (9.84)	340 (13.4)	250 (9.84)[3)]				
DN100/4"	390 (15.4)	300 (11.8)	390 (15.4)	300 (11.8)[3]				
DN150/6"	400 (15.7)	300 (11.8)	400 (15.7)	300(11.8)[3]	400 (15.7)			
DN200/8"	400 (15.7)	300 (11.8)	400 (15.7)	300(11.8)[3]	400 (15.7)	520 (20.5)		
DN250/10"	400 (15.7)	300 (11.8)	400 (15.7)	300(11.8)[3]	400 (15.7)	520 (20.5)	630 (24.8)	
DN300/12"	400 (15.7)	300 (11.8)	400 (15.7)	300(11.8)[3]	400 (15.7)	520 (20.5)	630 (24.8)	800 (31.5)
Sensor characteristics								
Emission angle α	12°	12°	9°	12°	11°	4°	5°	6°
Blocking distance [m (ft)]	0.07 (0.2)	0.07 (0.2)	0.3 (1)	0.3 (1)	0.4 (1.3)	0.6 (2)	0.7 (2.3)	1.6 (5.2)
Max. measuring range [m (ft)) in liquids	3 (9.8)	3 (9.8)	10 (33)	10 (33)	20 (66)	25 (82)		
Max. measuring range [m] in solids	1.2 (3.9)	1.2 (3.9)	5 (16)	5 (16)	10 (33)	15 (49)	45 (148)	70 (230)

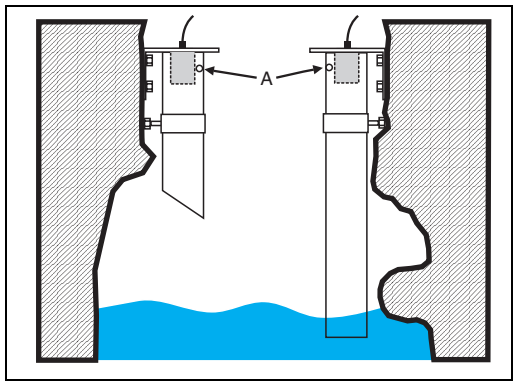
1) mounted at the rear side thread

2) mounted at the front side thread (flush mounting)

3) Valid for flush mounting; for mounting with G/NPT1" and DN100 or higher see FDU91F.

Ultrasound guide pipe

In narrow shafts with strong interference echoes, we recommend using an ultrasound guide pipe (e.g. PE or PVC wastewater pipe) with a minimum diameter of 100 mm (3.94 in), for FDU91. Make sure that the pipe is not soiled by accumulated dirt. If necessary, clean the pipe at regular intervals.



A: *venting hole*

Operating conditions: Environment

Ingress protection	tested according to IP68/NEMA6P (24 h at 6 ft under water surface)
Vibration resistance	DIN EN 600068-2-64; 20 to 2000 Hz; 1 $(m/s^2)^2$/Hz; 3x100 min.
Storage temperature	identical to process temperature, see below
Thermal shock resistance	according to DIN EN 60068-2-14; examination to min/max process temperature; 0.5 K/min; 1000 h
Electromagnetic compatibility	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"!

Operating conditions: Process

Process temperature
Process pressure

Sensor	Process temperature	Process pressure (abs.)
FDU90	-40 to +80 °C (-40 to +176 °F)[1]	0.7 to 4 bar (10.15 to 58 psi)
FDU91	-40 to +80 °C (-40 to +176 °F)[1)]	0.7 to 4 bar (10.15 to 58 psi)
FDU91F	-40 to +105 °C (-40 to +221 °F) (30 min/135 °C (275 °F))[2)] for Ex instruments: -40 to +80 °C (-40 to +176 °F)	0.7 to 4 bar (10.15 to 58 psi)
FDU92	-40 to +95 °C (-40 to+203 °F) for Ex instruments: -40 to +80 °C (-40 to +176 °F)	0.7 to 4 bar (10.15 to 58 psi)
FDU93	-40 to +95 °C (-40 to +203 °F) for Ex instruments: -40 to +80 °C (-40 to +176 °F)	0.7 to 3 bar (10.15 to 43.5 psi)
FDU95 - *1*** (low temperature version)	-40 to +80 °C (-40 to +176 °F)	0.7 to 1.5 bar (10.15 to 22 psi)
FDU95 - *2*** (high temperature version)	-40 to +150 °C (-40 to +302 °F) for Dust-Ex versions: -40 to +130 °C	0.7 to 1.5 bar (10.15 to 22 psi)
FDU96	-40 to +150 °C (-40 to +302 °F) for Dust-Ex or Gas-Ex versions: -40 to 140 °C (-40 to +284 °F)	0.7 to 3 bar (10.15 to 43.5 psi)

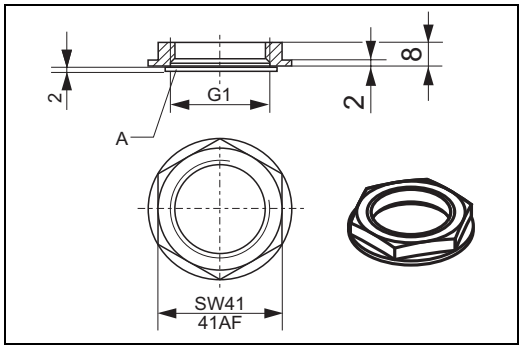
1) In order to avoid ice build-up, the sensors FDU90 and FDU91 are available in a version with integrated sensor heater (see page 6). If this heater is used, an external temperature sensor has to be applied for time-of-flight correction. The transmitter FMU90 is available in a version with an input for the external temperature sensor. For details refer to Technical Information TI00397F.

2) only valid for Tri-clamp and flush mounting

Mechanical construction

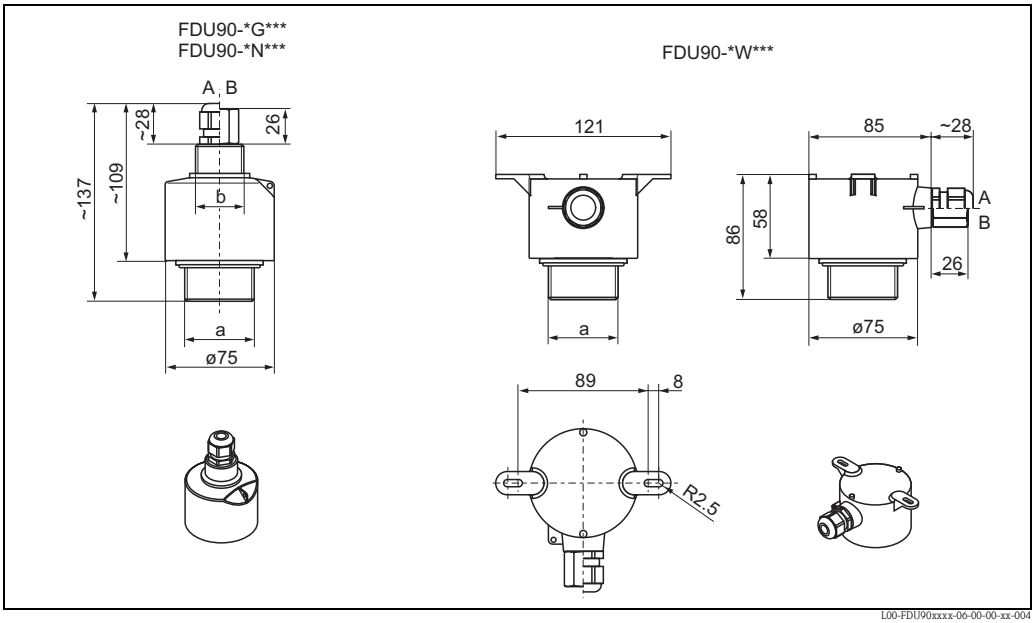
Counter nut G1

- Is supplied for the sensor FDU90, FDU91 and FDU92 with a metric G1 thread.
- Material: PA6.6
- Gasket (EPDM) is supplied



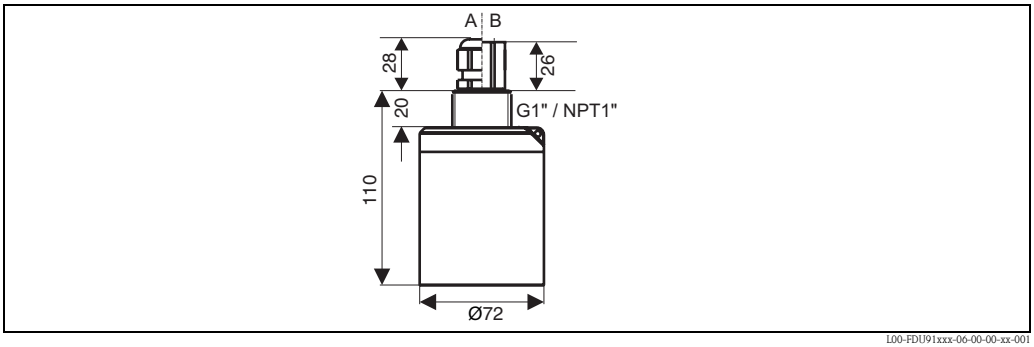
A: *Gasket*

Dimensions FDU90



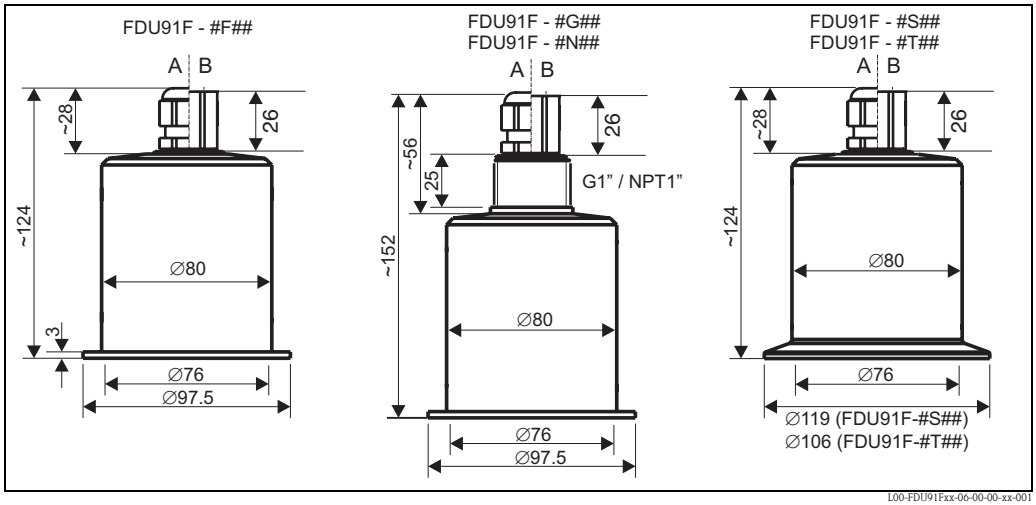
Dimensions in mm
A: *Cable gland for approval versions FDU90-C/D/E/G/H/J/R/U/V/1*
B: *Conduit connection NPT 1/2" for approval versions FDU90-Q/S*
The conduit connection is partly potted (half-filled)
a: *G1-1/2 or NPT1-1/2 (see product structure: 020 "Process connection"* → 🖹 *23)*
b: *G1 or NPT1 (see product structure: 020 "Process connection"* → 🖹 *23)*

Dimensions FDU91



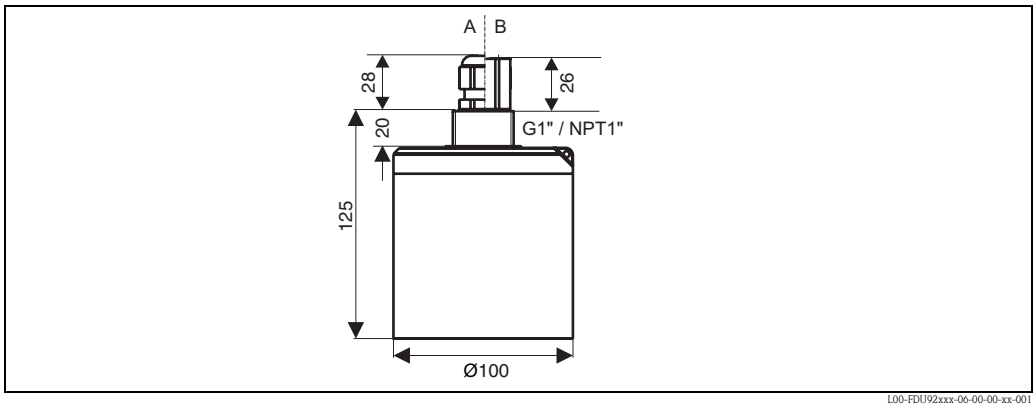
Dimensions in mm
A: *Cable gland for approval versions FDU91-C/D/E/G/H/J/R/U/V/1*
B: *Conduit connection NPT 1/2" for approval versions FDU91-Q/S*
The conduit connection is partly potted (half-filled).

Dimensions FDU91F



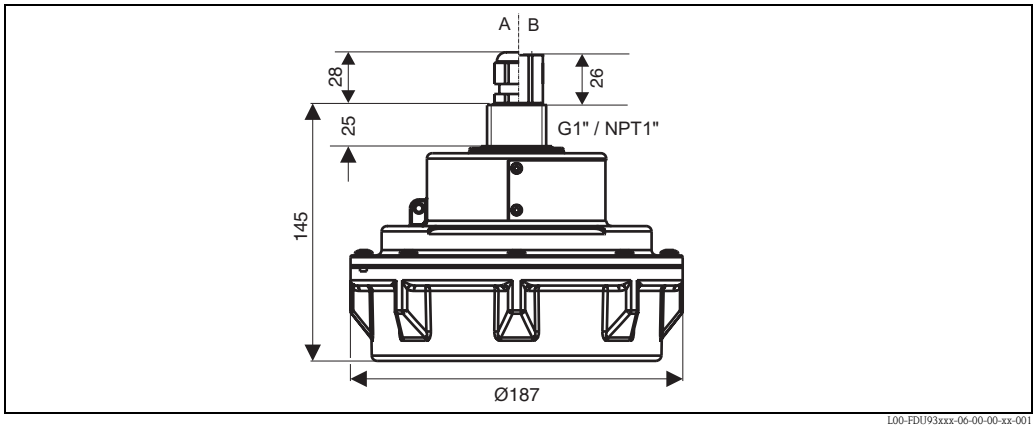
Dimensions in mm
A: *Cable gland for approval versions FDU91F-C/D/E/G/H/J/R/U/V*
B: *Conduit connection NPT 1/2" for approval versions FDU91F-Q/S*
The conduit connection is partly potted (half-filled).

Dimensions FDU92



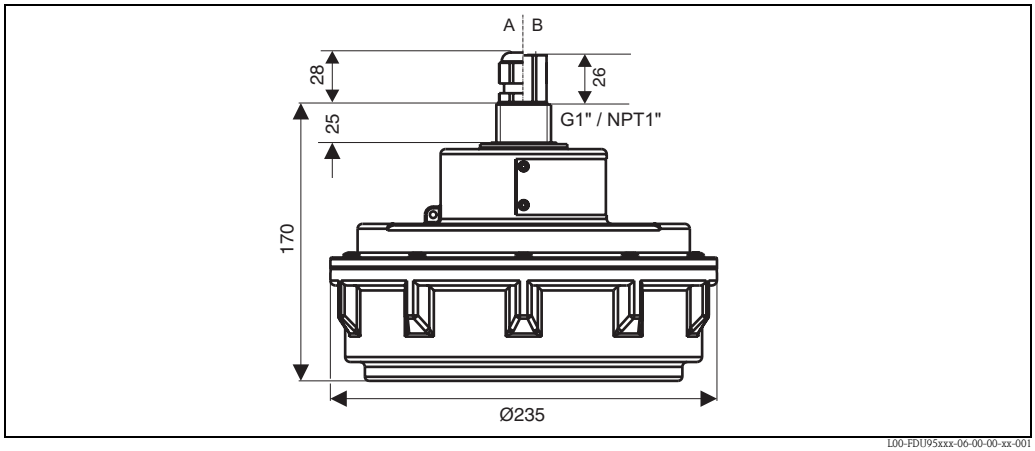
Dimensions in mm
A: *Cable gland for approval versions FDU92-C/D/E/G/H/J/R/U/V/1*
B: *Conduit connection NPT 1/2" for approval versions FDU92-Q/S*
The conduit connection is partly potted (half-filled).

Dimensions FDU93



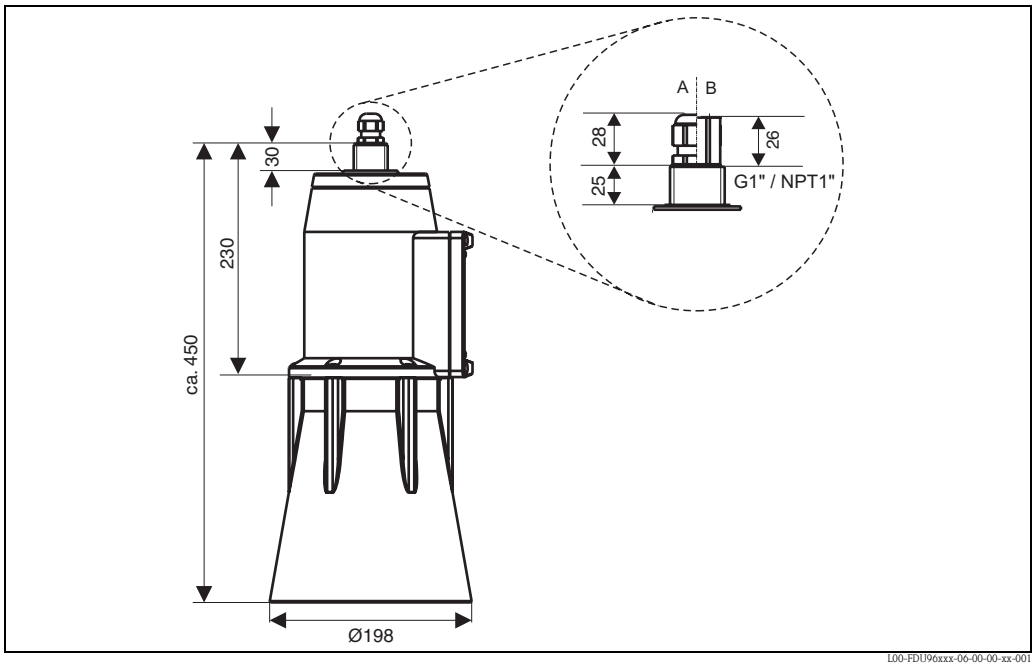
Dimensions in mm
A: *Cable gland for approval version FDU93-C/D/E/G/H/J/R/U/W/1*
B: *Conduit connection NPT 1/2" for approval versions FDU93-P/T*
The conduit connection is partly potted (half-filled).

Dimensions FDU95



Dimensions in mm
A: *Cable gland for approval versions FDU95-C/D/E/H/J/R/U/W/1*
B: *Conduit connection NPT 1/2" for approval versions FDU95-P/T*
The conduit connection is partly potted (half-filled).

Dimensions FDU96

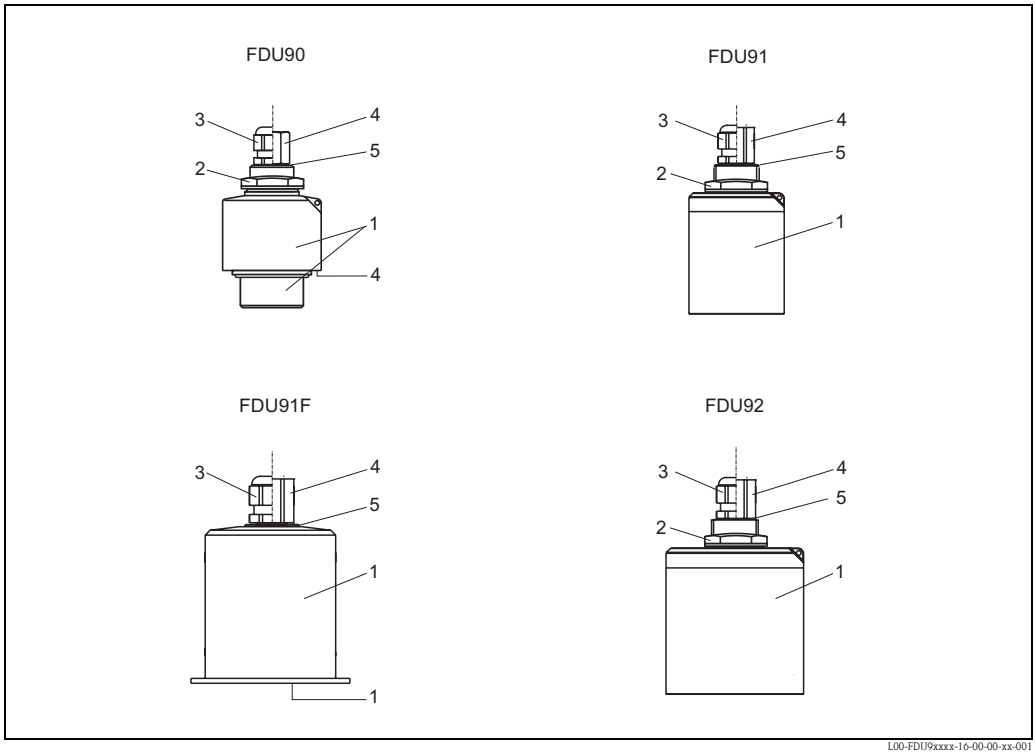


Dimensions in mm
A: *Cable gland for approval versions FDU96-C/D/E/F/H/J/R/W/1*
B: *Conduit connection NPT 1/2" for approval versions FDU96-K/L/P/T*
The conduit connection is partly potted (half filled).

Weight

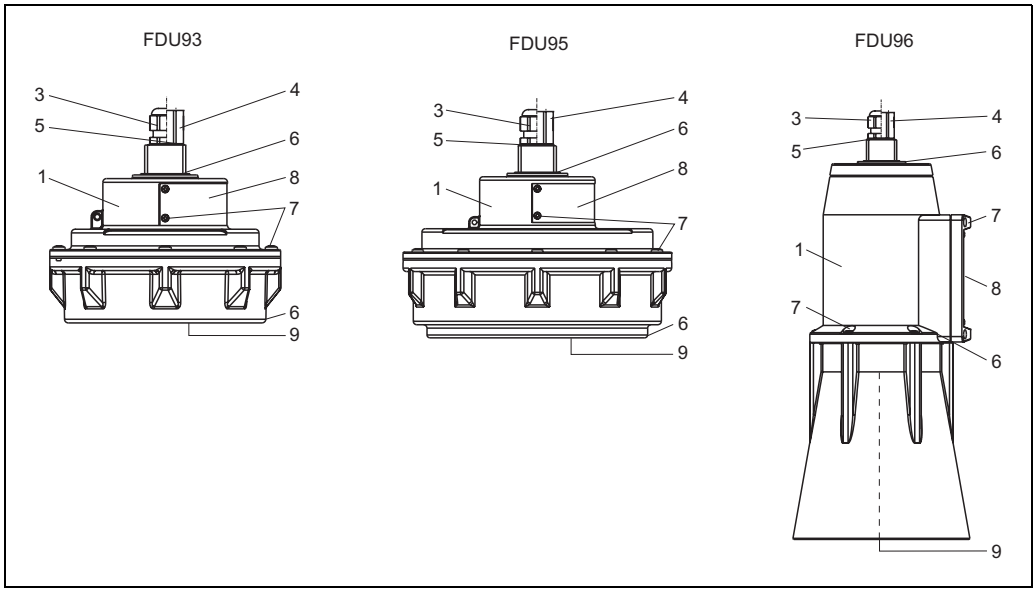
Sensor	Weight (including 5 m (16 ft) cable)
FDU90	▪ approx. 0.9 kg (1.98 lbs) without flooding protection tube ▪ approx. 1.0 kg (2.21 lbs) with flooding protection tube
FDU91	approx. 1.1 kg (2.43 lbs)
FDU91F	approx. 1.6 kg (3.53 lbs)
FDU92	approx. 2 kg (4.41 lbs)
FDU93	approx. 2.9 kg (6.39 lbs)
FDU95	approx. 4.5 kg (9.92 lbs)
FDU96	approx. 5 kg (11.03 lbs)

Materials



Pos.	Part	FDU90	FDU91	FDU91F	FDU92
1	Sensor	PVDF		316 L (1.4404/1.4435)	PVDF
2	Counter nut	PA6.6		–	PA6.6
3	Cable gland	PA			
4	Adpater	CuZn nickel-plated			
5	O-ring	EPDM			
6	Sealing				

Note!
The chemical compatibility of the sensors must be checked before installation with compatibility charts.



Pos.	Part	FDU93	FDU95	FDU96
1	Sensor	UP		
2	Counter nut	PA6.6		
3	Cable gland	PA or CuZn nickel-plated		
4	Adpater	CuZn nickel-plated		
5	O-ring	EPDM		
6	Sealing	VMQ		
7	Screws	V2A		
8	Nameplate	304 (1.4301)		
9	Membrane	ALU or PFA coated	FDU95 - *1*** (low temperature version): 316 L (1.4404) FDU95 - *2*** (high temperature version): 316 L (1.4404) and PE	ALU or PFA coated

Note!
The chemical compatibility of the sensors must be checked before installation with compatibility charts.

Connecting cable

5 to 300 m (16 to 984 ft)
for cable length > 30 m (> 98 ft), an extension cable is recommended.
In this case, the total length (sensor cable + extension cable) must not exceed 300 m (984 ft).

Cable	Material
for FDU90/91/91F/92/93	PVC
for FDU95/96	VMQ

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.

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

Ordering information

Product structure FDU90

010	Approval
C	IEC Ex ta/tb IIIC Da/Db, IEC Ex ma IIC T5 Gb
D	IEC Ex ma IIC T5 Gb
E	ATEX II 1/2D Ex ta/tb IIIC, ATEX II 2G Ex ma IIC T5
G	ATEX II 3G Ex nA II T6 (in preparation)
H	ATEX II 3D (in preparation)
J	ATEX II 2G Ex ma IIC T5
Q	FM Cl.I,II,III Div.1+2 Gr.A-G, zone 1,2,21,22 (in preparation)
R	Non-hazardous area
S	CSA C/US Cl.I,II,III Div.1+2 Gr.A-G, zone 1,2 (in preparation)
U	CSA General Purpose (in preparation)
V	TIIS Ex is IIC T6 (in preparation)
1	NEPSI DIP (in preparation)

020	Process connection (threaded boss)
G	Thread ISO228, PVDF; rear side G1, front side G1-1/2
N	Thread ANSI, PVDF; rear side NPT1, front side NPT1-1/2
W	Ceiling mounting; front side G1-1/2

030	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
8	... m (variable length, up to 300 m)
A	... ft (variable length, up to 985 ft)

035	Heater
A	W/o
B	Connection to 24 VDC Note Technical Information FMU90! (Temperature compensation)

040	Additional option
A	Basic version
B	Flooding protection tube
L	5-point linearity protocol (only to order with FMU9x transmitter + 5-point linearity protocol (in preparation)

895	Marking
Z1	Tagging (TAG)

FDU90 -	product designation

Product structure FDU91

010	Approval
C	IEC Ex ta/tb IIIC Da/Db, IEC Ex ma IIC T6 Gb
D	IEC Ex ma IIC T6 Gb
E	ATEX II 1/2 D Ex ta/tb IIIC, ATEX II 2 G Ex ma IIC T6
G	ATEX II 3G EEx nA II T6 (in preparation)
H	ATEX II 3D (in preparation)
J	ATEX II 2 G Ex ma IIC T6
Q	FM Cl.I,II,III Div. 1+2 Gr.A-G, zone 1,2,21,22
R	Non-hazardous area
S	CSA Cl.I,II,III Div.1+2 Gr.A-G, zone 1,2
U	CSA General Purpose
V	TIIS Ex is IIC T6
1	NEPSI DIP (in preparation)

020		Process connection (threaded boss)
G		Thread ISO228 G1, PVDF
N		Thread ANSI NPT1, PVDF

030			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
8			... m (variable length, up to 300 m)
A			... ft (variable length, up to 985 ft)

035				Heater
A				w/o
B				Connection to 24 VDC Note Technical Information FMU90! (Temperature compensation)

040					Additional option
A					Basic version
L					5-point linearity protocol only to order with FMU9x transmitter + 5-point linearity protocol (in preparation)

995						Marking
1						Tagging (TAG)

FDU91 -							product designation

Product structure FDU91F

010	Approval
C	IEC Ex ta/tb IIIC Da/Db, IEC Ex ma IIC T6 Gb
D	IEC Ex ma IIC T6 Gb
E	ATEX II 1/2 D Ex ta/tb IIIC, ATEX II 2 G Ex ma IIC T6
G	ATEX II 3G EEx nA II T6 (in preparation)
H	ATEX II 3D (in preparation)
J	ATEX II 2G Ex ma II T6
Q	FM Cl.I,II,III Div. 1+2 Gr.A-G, zone 1,2,21,22
R	Non-hazardous area
S	CSA Cl.I,II,III Div.1+2 Gr.A-G, zone 1,2
U	CSA General Purpose
V	TIIS Ex is IIC T6 (in preparation)

020	Process connection
F	for slip-on flange, 316L, accessory FAU80A
G	Thread ISO228 G1, 316L
N	Thread ANSI NPT1, 316L
S	Tri-Clamp ISO2852 DN101,6 (4"), 316L, 3A
T	Tri-Clamp ISO2852 DN88,6 (3½"), 316L, 3A

030	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
8	... m (variable length, up to 300 m)
A	... ft (variable length, up to 985 ft)

040	Additional option
A	Basic version
B	EN10204-3.1 material, wetted parts, (316L wetted parts); inspection certificate
L	5-point linearity protocol (only to order with FMU9x transmitter + 5-point linearity protocol, (in preparation))

995	Marking
1	Tagging (TAG)

FDU91F -	product designation

Product structure FDU92

010	Approval
C	IIEC Ex ta/tb IIIC Da/Db, IEC Ex ma IIC T6 Gb
D	IEC Ex ma IIC T6 Gb
E	ATEX II 1/2 D Ex ta/tb IIIC, ATEX II 2 G Ex ma IIC T6
G	ATEX II 3G EEx nA II T6 (in preparation)
H	ATEX II 3D (in preparation)
J	ATEX II 2G Ex m II T6
Q	FM Cl.I,II,III Div. 1+2 Gr.A-G, zone 1,2,21,22
R	Non-hazardous area
S	CSA Cl.I,II,III Div.1+2 Gr.A-G, zone 1,2
U	CSA General Purpose
V	TIIS Ex is IIC T6
1	NEPSI DIP (in preparation)

020	Process connection (threaded boss)
G	Thread ISO228 G1, PVDF
N	Thread ANSI NPT1, PVDF

030	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
8	... m (variable length, up to 300 m)
A	... ft (variable length, up to 985 ft)

040	Additional option
A	Basic version
L	5-point linearity protocol (only to order with FMU9x transmitter + 5-point linearity protocol, (in preparation))

995	Marking
1	Tagging (TAG)

FDU92 –	product designation

Product structure FDU93

010							Approval
	C						IEC Ex ta/tb IIIC Da/Db
	D						IEC Ex ma IIC T6 Gb, IEC Ex ta/tb IIIC Da/Db
	E						ATEX II 1/2 D Ex ta/tb IIIC
	G						ATEX II 3G EEx nA II T6 (in preparation)
	H						ATEX II 3D (in preparation)
	J						ATEX II 1/2 D Ex ta/tb IIIC, ATEX II 2 G Ex ma IIC T6
	P						FM Cl.I,II,III Div. 1+2 Gr.A-G, zone 2,21,22
	R						Non-hazardous area
	T						CSA Cl.II,III Div.1 Gr.E-G, zone 2
	U						CSA General Purpose
	W						TIIS dust-Ex DP12 (in preparation)
	1						NEPSI DIP (in preparation)

020			Process connection (threaded boss)
		G	Thread ISO228 G1, UP
		N	Thread ANSI NPT1, UP

030				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
			8	... m (variable length, up to 300 m)
			A	... ft (variable length, up to 985 ft)

040					Additional option
				A	Basic version
				L	5-point linearity protocol (only to order with FMU9x transmitter + 5-point linearity protocol, (in preparation))

995						Marking
					1	Tagging (TAG)

FDU93 -							product designation

Product structure FDU95

010	Approval
C	IEC Ex ta/tb IIIC Da/Db
D	IEC Ex ma IIC T6 Gb, IEC Ex ta/tb IIIC Da/Db
E	ATEX II 1/2 D Ex ta/tb IIIC
H	ATEX II 3D (in preparation)
J	ATEX II 1/2 D Ex ta/tb IIIC, ATEX II 2G Ex ma IIC T6
P	FM Cl.II Div.1 Gr.E-G, zone 2,21,22
R	Non-hazardous area
T	CSA Cl.II Div.1 Gr.E-G, zone 2
U	CSA General Purpose
W	TIIS dust-Ex DP12 (in preparation)
1	NEPSI DIP (in preparation)

015	Temperature; blocking distance; material
1	-40 ... +80°C/176°F; 70 cm/2.3ft; membrane: 316L; PEcoated
2	-40 ... 150°C/302°F; 90 cm/2,9ft; membrane: 316L

020	Process connection (threaded boss)
G	Thread ISO228 G1, UP
N	Thread ANSI NPT1, UP

030	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
8	... m (variable length, up to 300 m)
A	... ft (variable length, up to 985 ft)

040	Additional option
A	Basic version
L	5-point linearity protocol (only to order with FMU9x transmitter + 5-point linearity protocol, (in preparation))

995	Marking
1	Tagging (TAG)

FDU95 -							product designation

Product structure FDU96

010	Approval
C	IEC Ex ta/tb IIIC Da/Db
D	IEC Ex ma IIC T6 Gb, IEC Ex ta/tb IIIC Da/D
E	ATEX II 1/2 D Ex ta/tb IIIC, -40 ... +140 °C
F	ATEX II 1/2 D Ex ta/tb IIIC, -40 ... +80 °C
H	ATEX II 3D (in preparation)
J	ATEX II 1/2 D Ex ta/tb IIIC, ATEX II 2 G Ex ma IIC T6
K	FM Cl.I,II,III Div.1+2 Gr.A-G, LT; Ambient temperature: -40 ... +80 °C (176 °F), zone 2,21,22
L	CSA Cl.II,III Div.1 Gr.E-G, LT; Ambient temperature: -40 ... +80 °C (176 °F), zone 2
P	FM Cl.I,II,III Div.1+2 Gr.A-G, HT; Ambient temperature: -40 ... +140 °C (284 °F), zone 2,21,22
R	Non-hazardous area
T	CSA Cl.II,III Div.1 Gr.E-G, HT; Ambient temperature: -40 ... +140 °C (284 °F), zone 2
U	CSA General Purpose
W	TIIS dust-Ex DP12 (in preparation)
1	NEPSI DIP (in preparation)

020	Process connection (threaded boss)
G	Thread ISO228 G1, UP
S	Thread ISO228 G1, 304
N	Thread ANSI NPT1, UP
V	Thread ANSI NPT1, 304

030	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
8	... m (variable length, up to 300 m)
A	... ft (variable length, up to 985 ft)

040	Additional options
A	Basic version
L	5-point linearity protocol (only to order with FMU9x transmitter + 5-point linearity protocol, (in preparation))

995	Marking
1	Tagging (TAG)

FDU96 -						product designation

Scope of delivery

- Instrument according to the version ordered
- This Technical Information TI00396F (serves as installation and operating instruction)
- For certified instrument versions: Safety Instructions (XA) or Control Drawings (ZD)
- For FDU90/91 with sensor heater: terminal module, to be mounted in the field housing of the transmitter FMU90
- For FDU90/91/92 with G1" process connection: counter nut (PA6.6) + seal (EPDM)
- For FDU 93/95/96 with Ex-certificate: process seal (VMQ)

Accessories

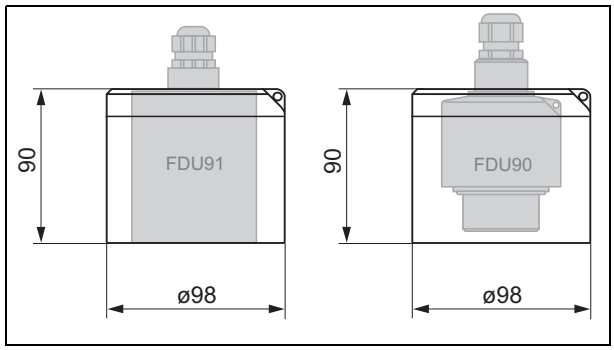
Extension cable for sensors

for Sensor	Material	Cable type	Order code
■ FDU90 ■ FDU91 ■ FDU92	PVC	LiYCY 2x(0.75)	71027742
■ FDU91F ■ FDU93 ■ FDU95	PVC (-40 to +105 °C) (-40 to +221 °F)	LiYY 2x(0.75)D+1x0.75	71027743
■ FDU95 ■ FDU96	Silicone (-40 to +150 °C) (-40 to +302 °F)	Li2G2G 2x(0.75)D+1x0.75	71027745
■ FDU90/FDU91 with heater	PVC	LiYY 2x(0.75)D+2x0.75	71027746

Total length (sensor cable + extension cable): up to 300 m (984 ft)

Protective cover for FDU91

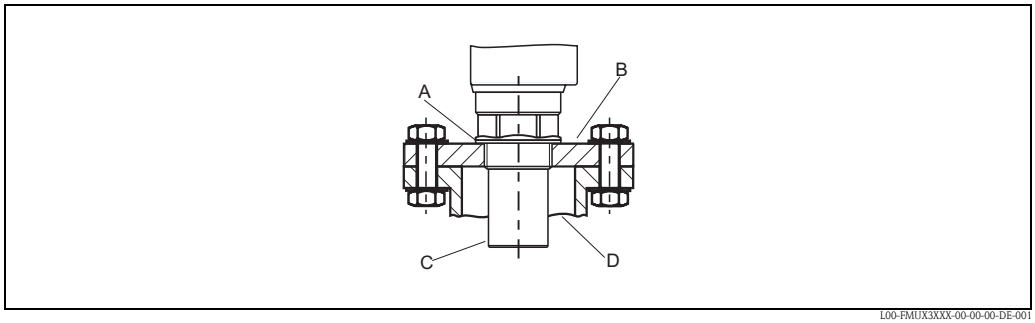
- Material: PVDF
- Order code: 52025686



L00-FDU9xxxx-06-00-00-xx-003

Dimensions in mm

Screw in flange



L00-FMUX3XXX-00-00-00-DE-001

A: *sealing ring EPDM (supplied),* **B:** *screw in flange,* **C:** *sensor,* **D:** *nozzle*

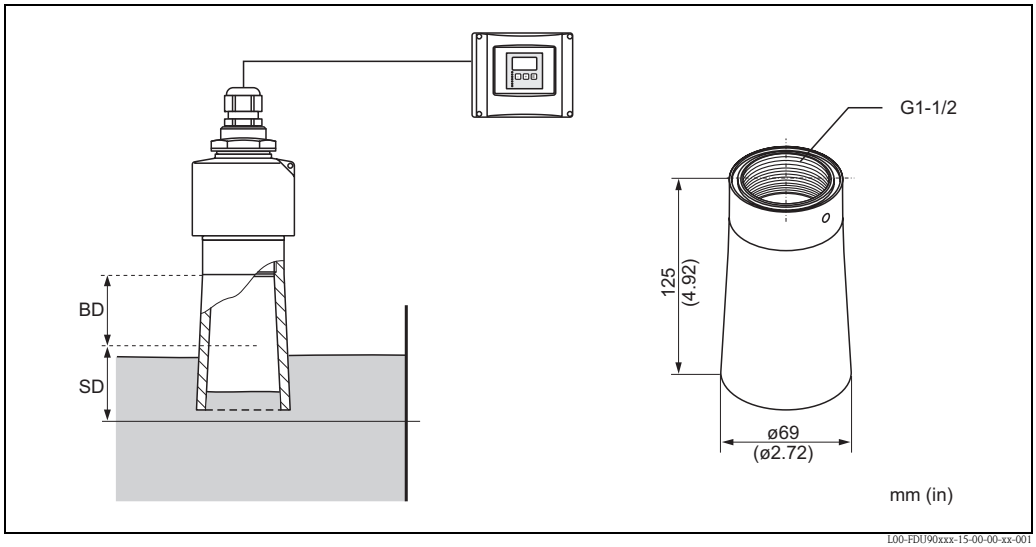
Screw in flange FAX50

015	Material:	
	BR1	DN50 PN10/16 A, steel flange EN1092-1
	BS1	DN80 PN10/16 A, steel flange EN1092-1
	BT1	DN100 PN10/16 A, steel flange EN1092-1
	JF1	2" 150lbs FF, steel flange ANSI B16.5
	JG1	3" 150lbs FF, steel flange ANSI B16.5
	JH1	4" 150lbs FF, steel flange ANSI B16.5
	JK2	8" 150lbs FF, PP max 3bar abs/44psia flange ANSI B16.5
	XIF	UNI flange 2"/DN50/50, PVDF max 4bar abs/58psia, suitable for 2" 150lbs/DN50 PN16/10K 50
	XIG	UNI flange 2"/DN50/50, PP max 4bar abs/58psia, suitable for 2" 150lbs/DN50 PN16/10K 50
	XIJ	UNI flange 2"/DN50/50, 316L max 4bar abs/58psia suitable for 2" 150lbs/DN50 PN16/10K 50
	XJF	UNI flange 3"/DN80/80, max 4bar abs/58psia, suitable for 3" 150lbs/DN80 PN16/10K 80
	XJG	UNI flange 3"/DN80/80, PP max 4bar abs/58psia, suitable for 3" 150lbs/DN80 PN16/10K 80
	XJJ	UNI flange 3"/DN80/80, 316L max 4bar abs/58psia, suitable for 3" 150lbs/DN80 PN16/10K 80
	XKF	UNI flange 4"/DN100/100, PVDF max 4bar abs/58psia, suitable for 4" 150lbs/DN100 PN16/10K 100
	XKG	UNI flange 4"/DN100/100, PP max 4bar abs/58psia, suitable for 4" 150lbs/DN100 PN16/10K 100
	XKJ	UNI flange 4"/DN100/100, 316L max 4bar abs/58psia, suitable for 4" 150lbs/DN100 PN16/10K 100
	XLF	UNI flange 6"/DN150/150, PVDF max 4bar abs/58psia, suitable for 6" 150lbs/DN150 PN16/10K 150
	XLG	UNI flange 6"/DN150/150, PP max 4bar abs/58psia, suitable for 6" 150lbs/DN150 PN16/10K 150
	XLJ	UNI flange 6"/DN150/150, 316L max 4bar abs/58psia, suitable for 6" 150lbs/DN150 PN16/10K 150
	XMG	UNI flange DN200/200, PP max 4bar abs/58psia, suitable for DN200 PN16/10K 200
	XNG	UNI flange DN250/250, PP max 4bar abs/58psia, suitable for DN250 PN16/10K 250
	YYY	Special version

020	Sensor Connection:	
	A	Thread ISO228 G3/4
	B	Thread ISO228 G1
	C	Thread ISO228 G1-1/2
	D	Thread ISO228 G2
	E	Thread ANSI NPT3/4
	F	Thread ANSI NPT1
	G	Thread ANSI NPT1-1/2
	H	Thread ANSI NPT2
	Y	Special version

	015	020
FAX50 -		

Flooding protection tube for FDU90



BD: *Blocking distance,* **SD:** *Safety distance*

Usage

The flooding protection tube prevents the level to rise into the blocking distance of the FDU90 sensor even if the sensor is flooded.
The user can set a safety distance SD in the transmitter FMU90/FMU95 and define that a warning signal is generated as soon as the level rises into the safety distance.

Mounting hints

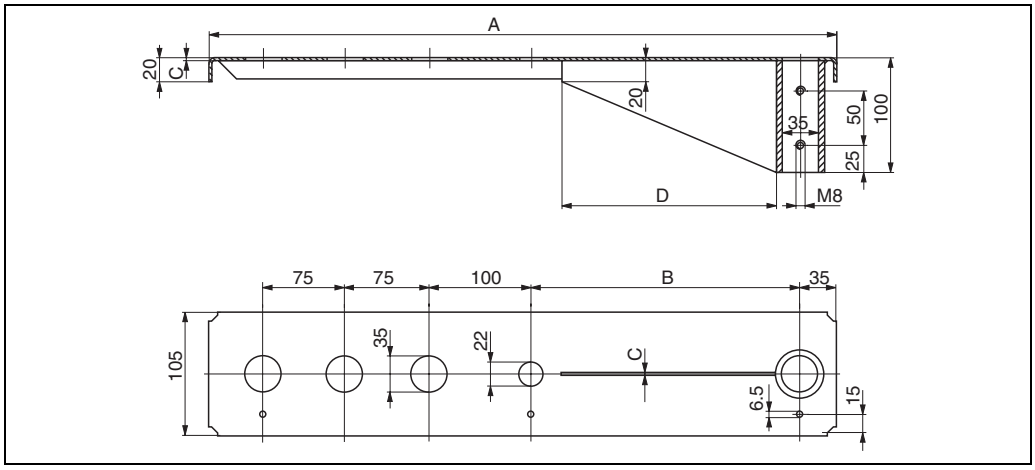
In order to ensure tightness, the supplied gasket has to be applied and the flooding protection tube must be screwed hand tight up to limit stop. When re-equipping the flooding protection tube, repeat the basic setup including the mapping

Note!
- The flooding protection tube has a G1-1/2" thread.
- If it is ordered together with the FDU90 sensor in the product structure, the sensor always has a G1-1/2" thread at its front side, irrespective of the selection in feature 020, "Process connection".
- If the flooding protection tube is ordered as an accessory, it can only be used for sensors with a G1-1/2" thread at the front side.

Material	Weight	Order code
PP	0.12 kg (0.26 lbs)	71091216
Gasket EPDM		

Cantilever

The cantilever is used to mount the sensors FDU90, FDU91 and FDU92 above open channels for example.



L00-FMU4xxxx-06-00-00-yy-005

A	B	C	D	Material	Order code
585 (23)	250 (9.84)	2 (0.08)	200 (7.87)	galvanised steel	919790-0000
				316Ti (1.4571)	919790-0001
1085 (42.7)	750 (29.5)	3 (0.12)	300 (11.8)	galvanised steel	919790-0002
				316Ti (1.4571)	919790-0003

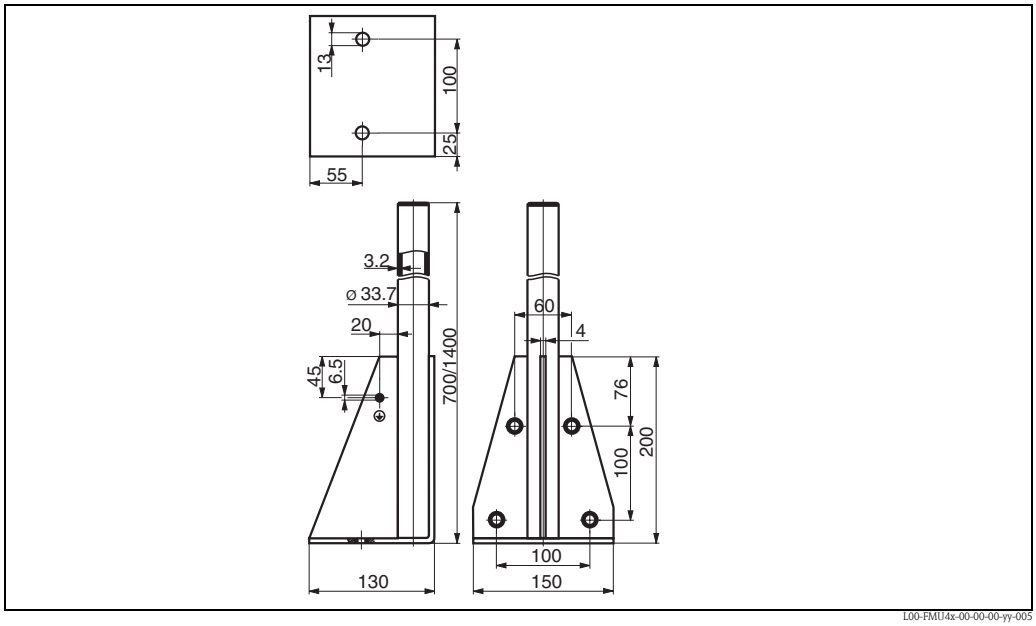
mm (in)

- The 35 mm (1.38 in) orifices are for the sensors FDU9x.
- The 22 mm (0.87 in) orifice may be used for an external temperature sensor (e.g. FMT131).

The cantilever can be mounted in the following ways:
- by a mounting frame (see below)
- by a wall bracket (see below)

Fixing screws are supplied.

Mounting Frame

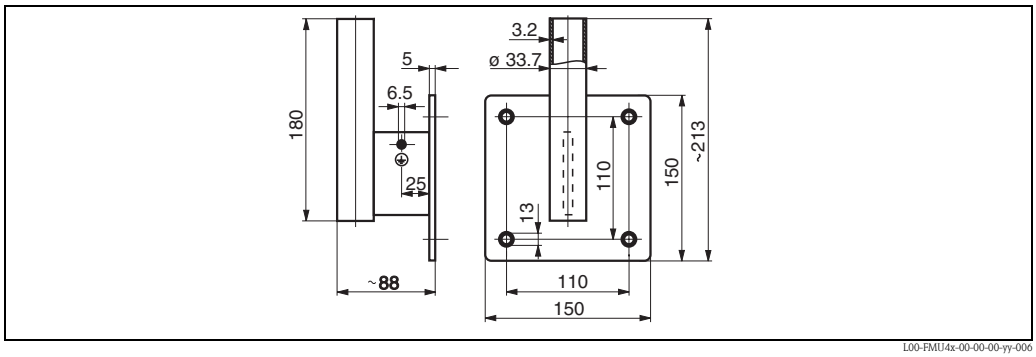


L00-FMU4x-00-00-00-yy-005

Height	Material	Order Code
700 (27.6)	galv. steel	919791-0000
700 (27.6)	316Ti (1.4571)	919791-0001
1400 (55.1)	galv. steel	919791-0002
1400 (55.1)	316Ti (1.4571)	919791-0003

mm (in)

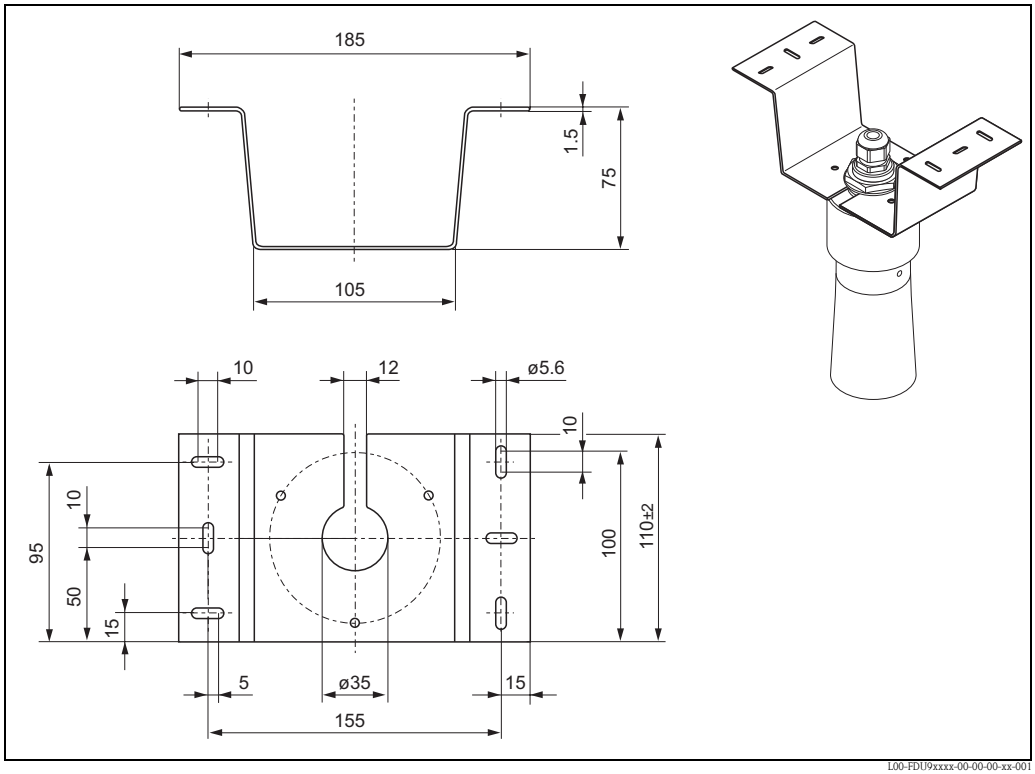
Wall Bracket



L00-FMU4x-00-00-00-yy-006

Material	Order Code
galv. steel	919792-0000
316Ti (1.4571)	919792-0001

Mounting bracket for ceiling mounting

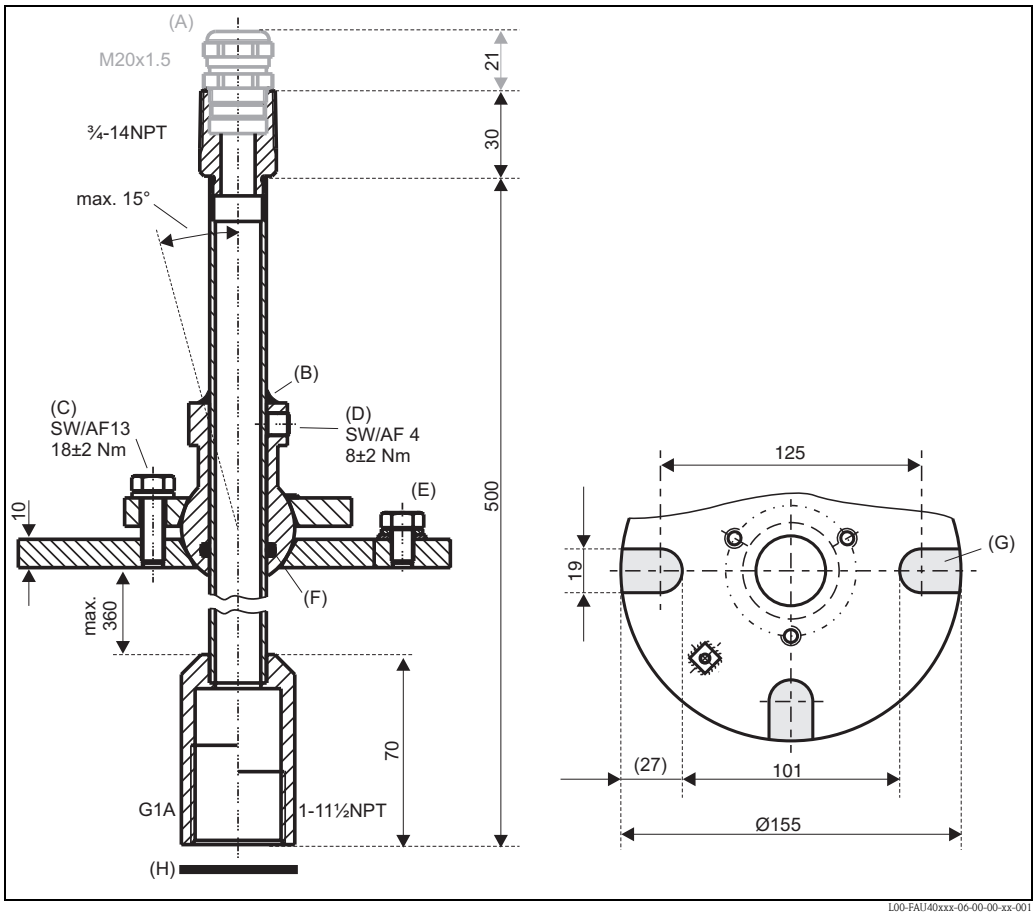


Dimensions in mm

	Material	Order No.
Suited for: FDU90, FDU91, FDU91F, FDU92	316 L (1.4404)	71093130

Alignment unit FAU40

For measurements in solids, usage of the alignment unit FAU40 is recommended. It is designed for simple mounting and alignment of a FDU sensor on the product surface and can be used for zone separation in explosion hazardous areas.



(A): *Cable gland M20x1.5 (present if selected in the product structure),* **(B):** *sealant here,* **(C):** *screw for lateral movement,* **(D):** *two Allen screws for height adjustment,* **(E):** *ground pin,* **(F):** *O-ring,* **(G):** *mounting grooves (present in the UNI flange),* **(H):** *seal supplied with the sensor, must be used for applications in ATEX zone 20*

The alignment unit can be rotated up to 15°.
For further information see Technical Information T00179F.

Product structure

010	**Process connection (Flange)**		
	1		Welding flange, 304/1.4301
	2		UNI flange 2"/DN50/50, 304, max. 1.5 bar abs./22psia suitable for 2" 150lbs / DN50 PN16 / 10K 50
020		**Sensor connection**	
		S	Thread G1, cable gland M20, 304/1.4301
		G	Thread G1, cable gland M20, galvanised steel
		N	Thread NPT1, cable entry3/4, galvanised steel
FAU40 –			product designation

Power supply RNB130 for the FDU90/FDU91 sensor heater

Technical data

- Primary switched-mode power supply
- Input: 100 – 240 V AC
- Output: 24 V DC connection, max. 30 V in the event of a fault
- Connection to monophased a.c. networks or to two phase conductors of three-phase supply networks (TN, TT or IT networks as per VDE 0100 T 300/IEC 364-3) with 100 – 240 V AC nominal voltage

For further information see Technical Information TI00120R.

Product structure

010	**Approvals**				
	A	Non-hazardous area			
020		**Connection**			
		1	Screw strip		
		3	Screw connection, power terminal block		
030			**Version**		
			A	Standard	
RNB130 –					complete product designation

IP66 protective housing for the power supply RNB130

Order code: 51002468
For additional information refer to Technical Information TI00080R.

Additional documentation

Innovation booklet

IN00003F

Ultrasonic measurement – the solution for your application

Technical Information

TI00397F

Technical Information for the transmitter Prosonic S FMU90

TI00179F

Technical Information for the alignment unit FAU40

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 (for transmitter FMU90)

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

The following Safety Instructions are supplied with certified versions of the sensors. If the sensors are used in hazardous areas, comply with all the specifications in these Safety Instructions.

Sensor version	Certificate	Safety Instructions
ATEX		
■ FDU90 - J... ■ FDU91 - J... ■ FDU91F - J... ■ FDU92 - J...	■ II 2 G Ex ma IIC T5 Gb (FDU90) ■ II 2 G Ex ma IIC T6 Gb (FDU91/91F/92)	XA00321F
■ FDU90 - E... ■ FDU91 - E... ■ FDU91F - E... ■ FDU92 - E... ■ FDU93 - J... ■ FDU95 - J... ■ FDU96 - J...	■ II 2 G Ex ma IIC T5 Gb (FDU90) ■ II 2 G Ex ma IIC T6 Gb (FDU91/91F/92/93/95/96) ■ II 1/2 D Ex ta/tb IIIC Txx°C Da/Db IP68 ■ II 2 D Ex tb IIIC Txx°C Db IP68	XA00322F
■ FDU93 - E... ■ FDU95 - E... ■ FDU96 - E...	■ II 1/2 D Ex ta/tb IIIC Txx°C Da/Db IP68 ■ II 2 D Ex tb IIIC Txx°C Db IP68	XA00323F
IEC Ex		
■ FDU90 - C... ■ FDU91 - C... ■ FDU91F - C... ■ FDU92 - C... ■ FDU93 - D... ■ FDU95 - D... ■ FDU96 - D...	■ IEC Ex ma IIC T5 Gb (FDU90) ■ IEC Ex ma IIC T6 Gb (FDU91/91F/92/93/95/96) ■ IEC Ex ta/tb IIIC Txx°C Da/Db IP68 ■ IEC Ex tbIIIC Txx°C DbIP68	XA00481F
■ FDU90 - D... ■ FDU91 - D... ■ FDU91F - D... ■ FDU92 - D...	■ IEC Ex ma IIC T5 Gb (FDU90) ■ IEC Ex ma IIC T6 Gb (FDU91, FDU91F, FDU92)	XA00482F
■ FDU93 - C... ■ FDU95 - C... ■ FDU96 - C...	■ IEC Ex ta/tb IIIC Txx°C Da/Db IP68 ■ IEC Ex tbIIIC Txx°C Db IP68	XA00483F

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