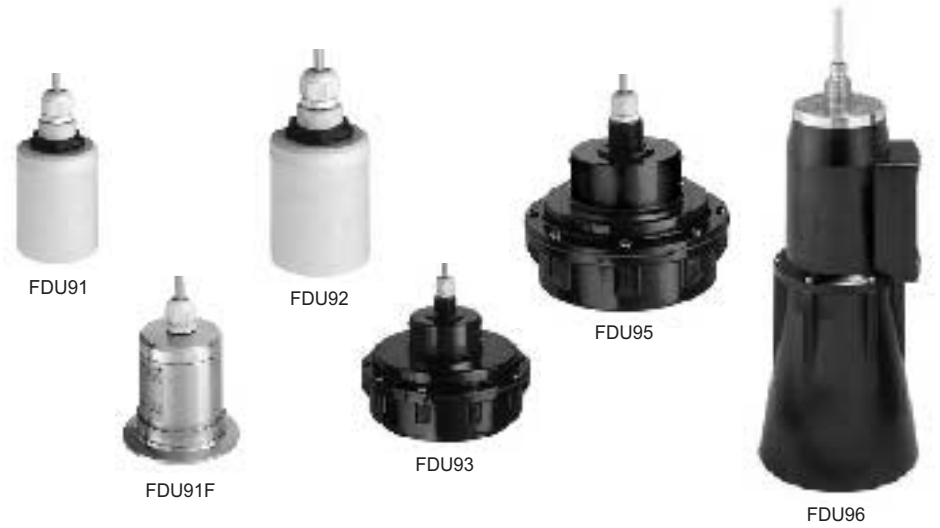
Level | Pressure | Flow | Temperature | Liquid Analysis | Registration | Systems Components | Services | Solutions

Technical Information

Prosonic S
FDU91/91F/92/93/95/96

Ultrasonic sensors for non-contact continuous level and flow measurement; for connection to the transmitter FMU90



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
  - FDU91/FDU91F:
    10 m in fluids
    5 m in bulk materials
  - FDU92:
    20 m in fluids
    10 m in bulk materials
  - FDU93:
    25 m in fluids
    15 m in bulk materials
  - FDU95:
    45 m in bulk materials
  - FDU96:
    70 m 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 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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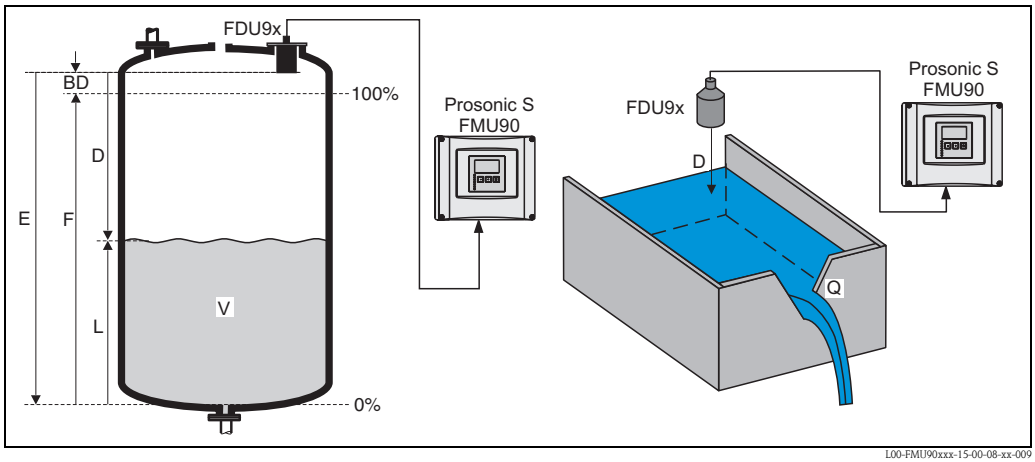
Function and system design

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

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:

Type of sensor	Blocking distance (BD)
FDU91/FDU91F	0,3 m
FDU92	0,4 m
FDU93	0,6 m
FDU95 - *1*** (low temperature version)	0,7 m
FDU95 - *2*** (high temperature version)	0,9 m
FDU96	1,6 m

Transmitter

The sensors can be connected to the transmitter FMU90. 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.

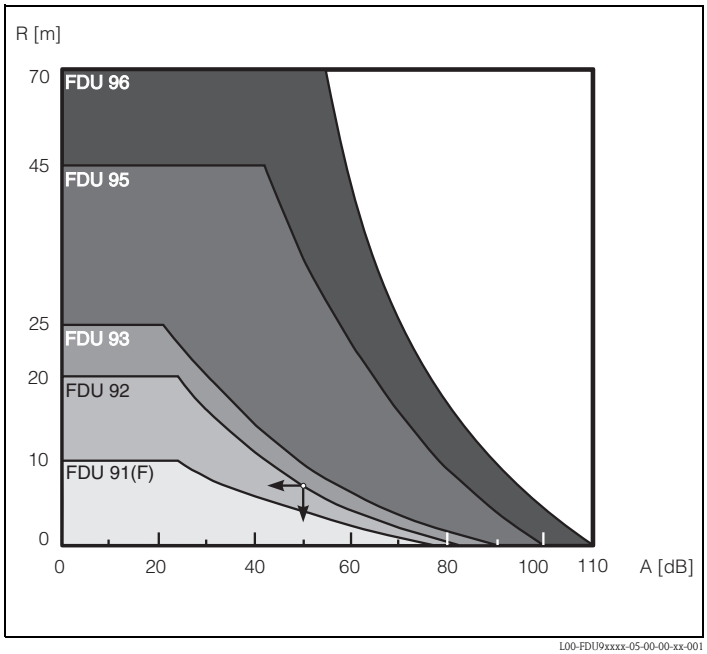
Fluid surface	**Attenuation**
calm	0 dB
waves	5 ... 10 dB
strong turbulence (e.g. stirrers)	10 ... 20 dB
foaming	ask Endress+Hauser

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

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

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

Temperature difference between sensor and product surface	**Attenuation**
to 20 °C	0 dB
to 40 °C	5 ... 10 dB
to 80 °C	10 ... 20 dB



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

Example

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

total: ~ 50dB

=> Range approx. 8 m for FDU92

Operating frequency

Sensor	Operating frequency
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 FDU91 sensor is 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

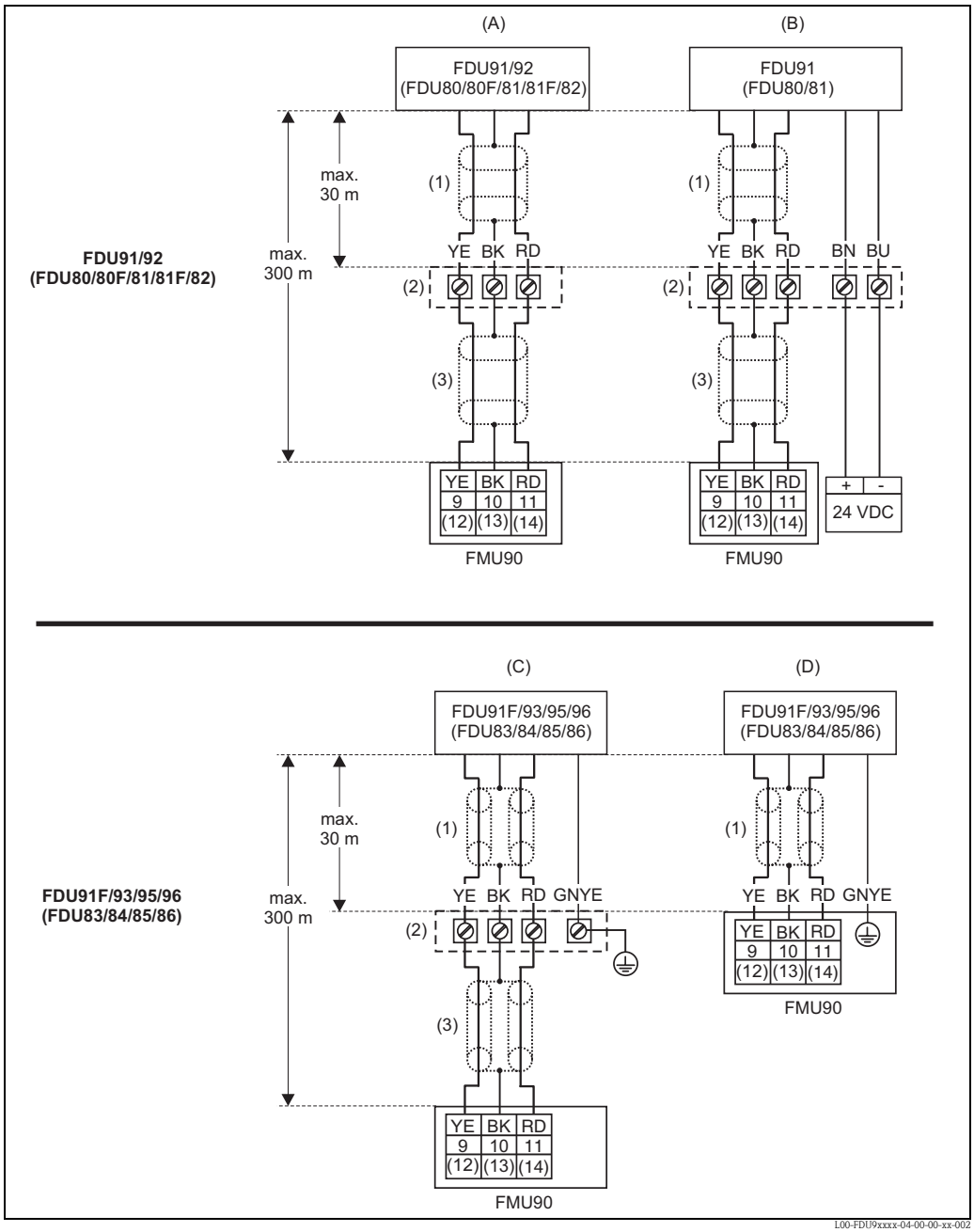
- 24 VDC ±10%; residual ripple < 100 mV
- 250 mA per sensor

Note!
For the FDU91 with sensor heater, the integrated temperature sensor can not be used. Instead, an external temperature sensor (Pt100 or FMT131 from Endress+Hauser) must be applied. The transmitter FMU90 is available in a version with an input for the external temperature sensor. For details refer to Technical Information TI397F.

Note!
The power for the sensor heater can be supplied by the power supply RNB130 from Endress+Hauser (see chapter "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.

Caution!
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.

Warning!
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**. 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).

Note!
For easier mounting it is advisable to use the sensors FDU91/92 and FDU80/80F/81/81F/82 with a maximum cable length of 30 m as well. For longer distances an extension cable with a terminal box should be used.

Connection of the sensor heater (for FDU91F)

The FDU91 sensor is 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

Extenxion cables for the sensors

For distances up to 30 m 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.

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 (s. chapter "Accessories")
Alternatively, cables with the following properties can be used:

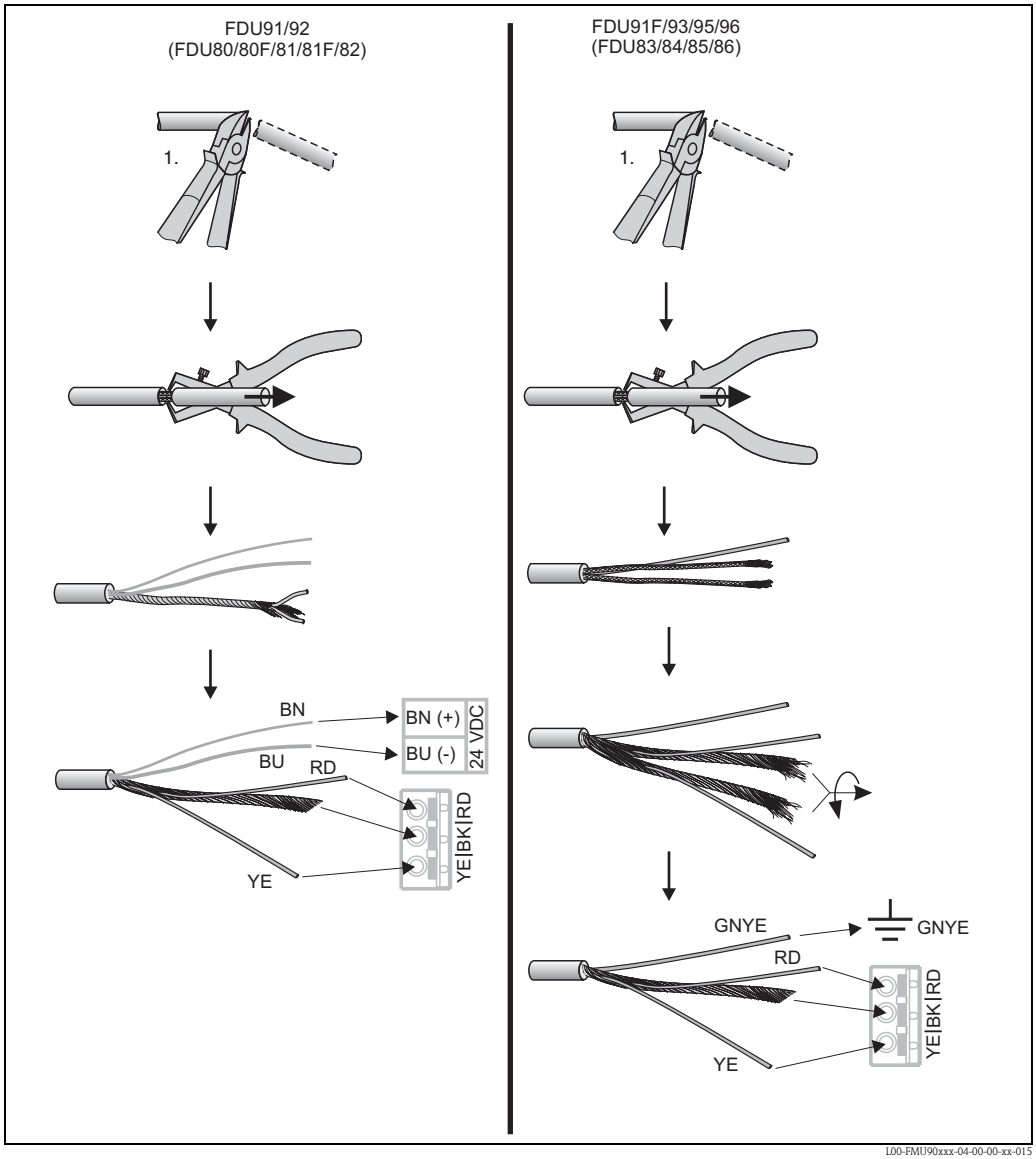
- Number of cores according to the connection diagram (see above)
- braided wire screen for the yellow (YE) and red (RD) core (no foil screen)
- Length: up to 300 m (sensor cable + extension cable)
- Cross section: 0,75 mm^2 to 2,5 mm^2
- up to 6 Ω per core
- max. 60 nF
- for FDU91F/93/95/96 and FDU 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.

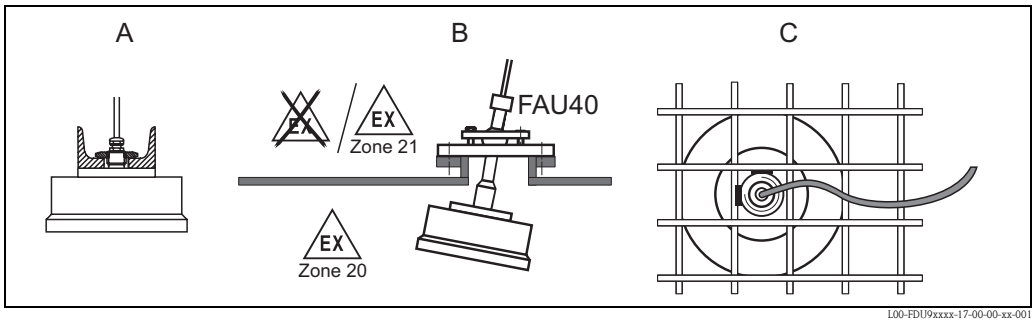


Colours of the strands: YE = yellow; BK = black; RD = red; BU = blue; BN = brown; GNYE = green-yellow

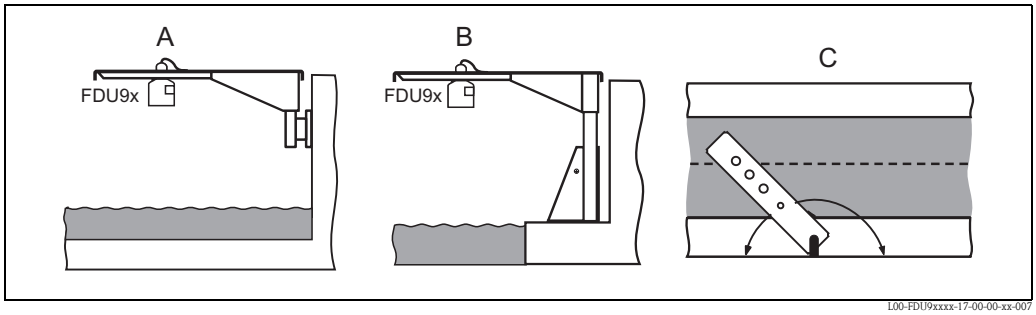
Note!
The blue (BU) and brown (BN) strands are only present for sensors with heater.

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*

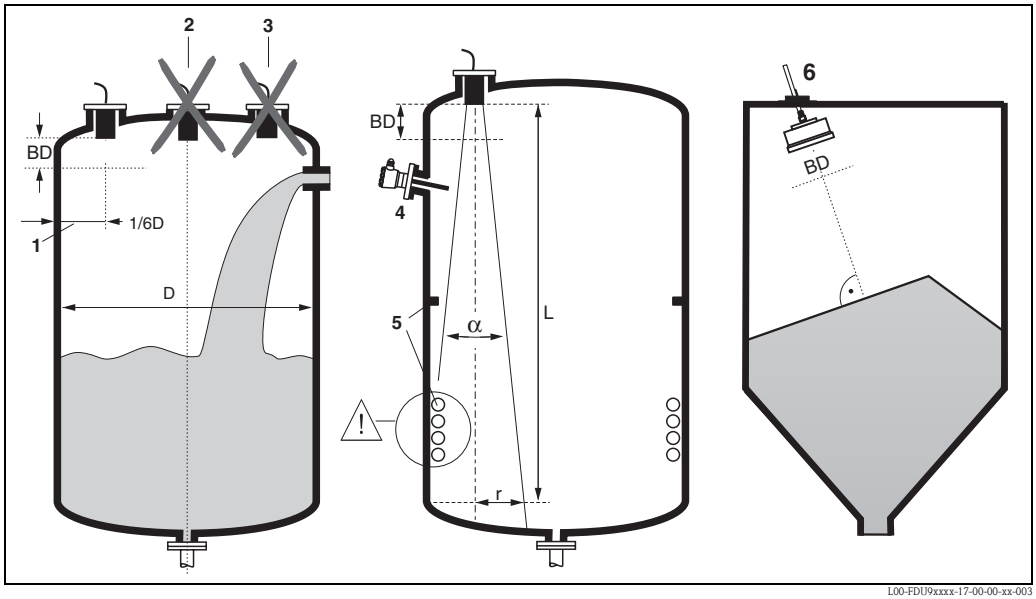


A: *Installation with cantilever and wall bracket;* **B:** *Installation with cantilever and mounting frame;* **C:** *The cantilever can be turned in order to position the sensor over the centre of the flume.*
Cantilever, wall bracket and mounting frame are available as accessories (see chapter "Accessories").

Caution!
The cable of the sensors is not designed as a supporting cable. Do not use it as a suspension wire.

Caution!
The sensor membrane is part of the measuring system and must not be damaged during installation.

Installation conditions for level measurements



- 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 (see chapter "Accessories").
- If the two-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:

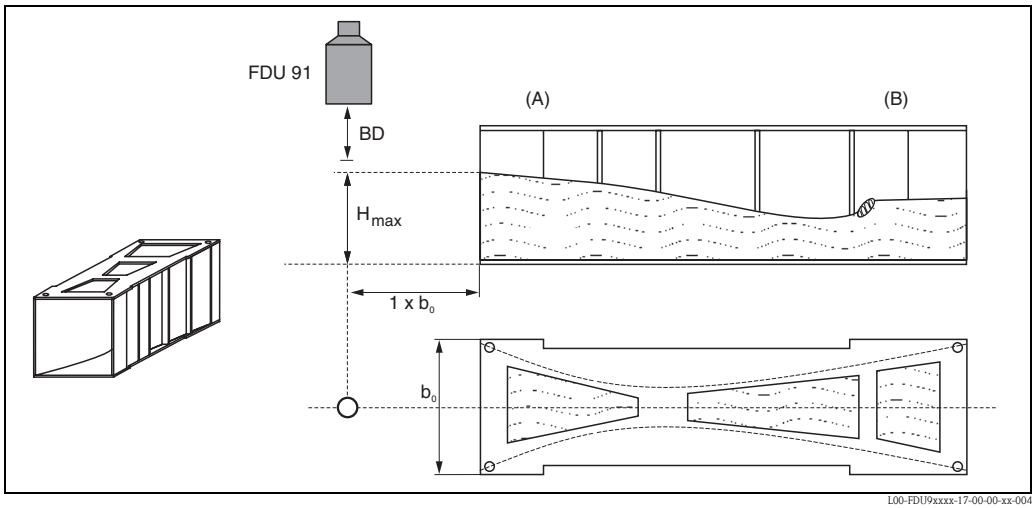
Sensor	Blocking distance BD	α (typically)	Application	L (max)	r (max)
FDU91	0,3 m	9°	fluids	10 m	0,79 m
			bulk materials	5 m	0,39 m
FDU91F	0,3 m	12°	fluids	10 m	1,05 m
			bulk materials	5 m	0,53 m
FDU92	0,4 m	11°	fluids	20 m	1,92 m
			bulk materials	10 m	0,96 m
FDU93	0,6 m	4°	fluids	25 m	0,87 m
			bulk materials	15 m	0,52 m
FDU95	▪ 0,7 m (low temperature version) ▪ 0,9 m (high temperature version)	5°	bulk materials	45 m	1,96 m
FDU96	1, 6 m	6°	bulk materials	70 m	3,6 m

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

Installation conditions for flow measurements

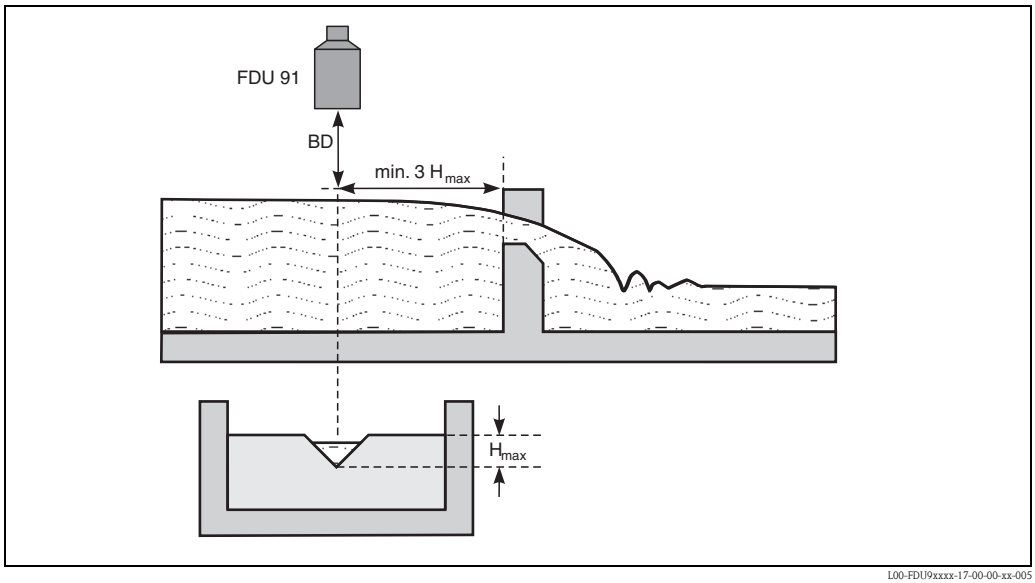
- Install the sensor at the inflow side (A), above the maximum water level H_{max} plus the blocking distance BD.
- Position the sensor in the middle of the channel or weir.
- Align the sensor vertically to the water surface.
- Comply to the installation distance of the channel or weir.[1)]
- Use a protective cover, in order to protect the sensor from direct sun or rain. A protective cover is available for the sensor FDU91 (see chapter "Accessories").

Example: Khafagi-Venturi flume



(A): *inflow side;* **(B):** *outflow side*

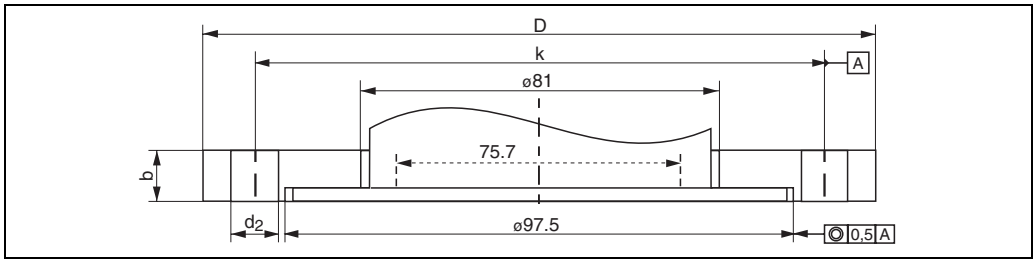
Example: V-notch weir



1) The installation distances of important flumes and weirs are specified in the Operating Instructions BA 289F (FMU90 with HART) and BA 293F (FMU90 with PROFIBUS).

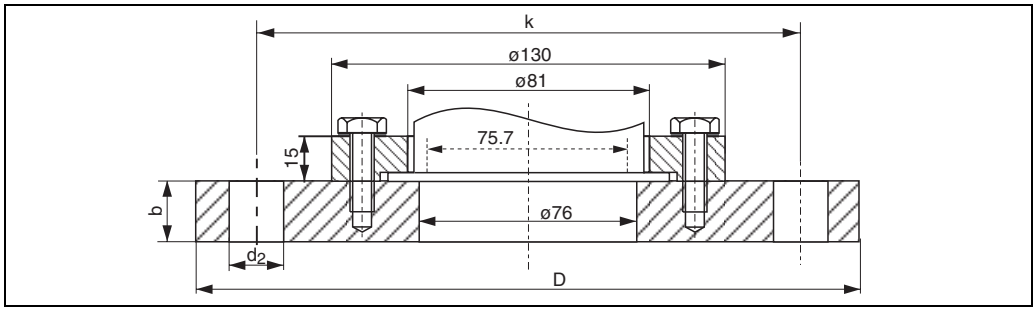
Flush mounting with slip-on flange FAU80

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



L00-FDU9xxxx-17-00-00-xx-009

Order No.	Material	b [mm]	∅D [mm]	∅d2 [mm]	k [mm]	No. d2	Standard
FAU80 - CAP	PPs	20	200	18	160	8	DN80 PN16 (DIN EN 1092-1-E)
FAU80 - CAJ	316L						
FAU80 - AAP	PPs	23,9	190,5	19,1	152,4	4	ANSI 3" 150 psi (ANSI B 16.5)
FAU80 - AAJ	316L						
FAU80 - KAP	PPs	18	185	19	150	8	JIS10 K80 (JIS B 2220)
FAU80 - KAJ	316L						



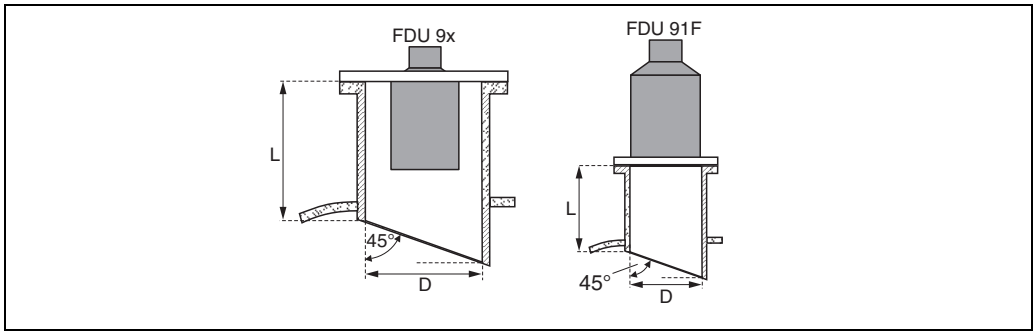
L00-FDU9xxxx-17-00-00-xx-010

Order No.	Material	b [mm]	∅D [mm]	∅d2 [mm]	k [mm]	No. d2	Standard
FAU80 - CHP	PPs	20	220	18	180	8	DN100 PN16 (DIN 2527)
FAU80 - CHJ	316L						
FAU80 - AHP	PPs	23,9	228,6	19,1	190,5	4	ANSI 4" 150 psi (ANSI B 16.5)
FAU80 - AHJ	316L						
FAU80 - KHP	PPs	18	210	19	175	8	JIS10 K100 (JIS B 2220)
FAU80 - KHJ	316L						

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°).

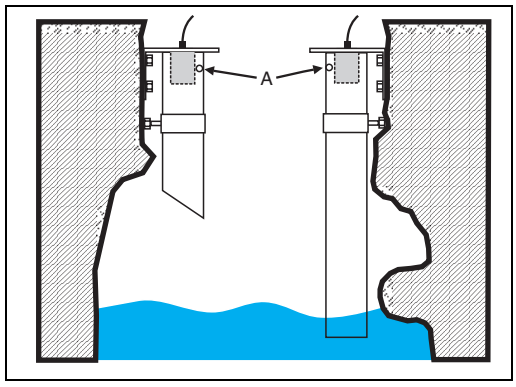


L00-FDU9xxxx-17-00-00-xx-006

Sensor	D [mm]	L [mm]
FDU91	80	< 340
	100	< 390
FDU91F	80	< 250
	100	< 300
FDU92	150	< 400
FDU93	200	< 520
FDU95	250	< 630
FDU96	300	< 800

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 (for FDU91). Make sure that the pipe is not soiled by accumulated dirt. If necessary, clean the pipe at regular intervals.



A: *venting hole*

Ambient conditions

Ingress protection	tested according to IP68/NEMA6P (24 h at 6 ft under water surface)
Vibration resistance	DIN EN 600068-2-64; 20 ... 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	■ Interference emission to EN 61326; Equipment class A ■ Interference immunity to EN 61326; Appendix A (Industrial)

Process conditions

Process temperature
Process pressure

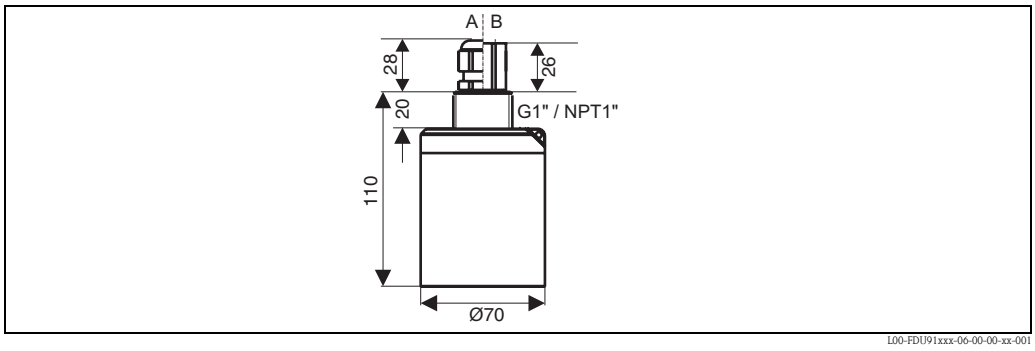
Sensor	Process temperature	Process pressure (abs.)
FDU91	-40 ... +80 °C [1]	0,7 ... 4 bar
FDU91F	-40 ... +105 °C (30 min/135 °C)[2] for Ex instruments: -40 ... +80 °C	0,7 ... 4 bar
FDU92	-40 ... +95 °C for Ex instruments: -40 ... +80 °C	0,7 ... 4 bar
FDU93	-40 ... +95 °C for Ex instruments: -40 ... +80 °C	0,7 ... 3 bar
FDU95 - *1*** (low temperature version)	-40 ... +80 °C	0,7 ... 1,5 bar
FDU95 - *2*** (high temperature version)	-40 ... +150 °C for Dust-Ex versions: -40 ... 130 °C	0,7 ... 1,5 bar
FDU96	-40 ... +150 °C for Dust-Ex or Gas-Ex versions: -40 ... 140 °C	0,7 ... 3 bar

1) In order to avoid ice build-up, the sensor FDU91 is available in a version with integrated sensor heater (see page 5). 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 TI397F.

2) only valid for Tri-clamp and flush mounting

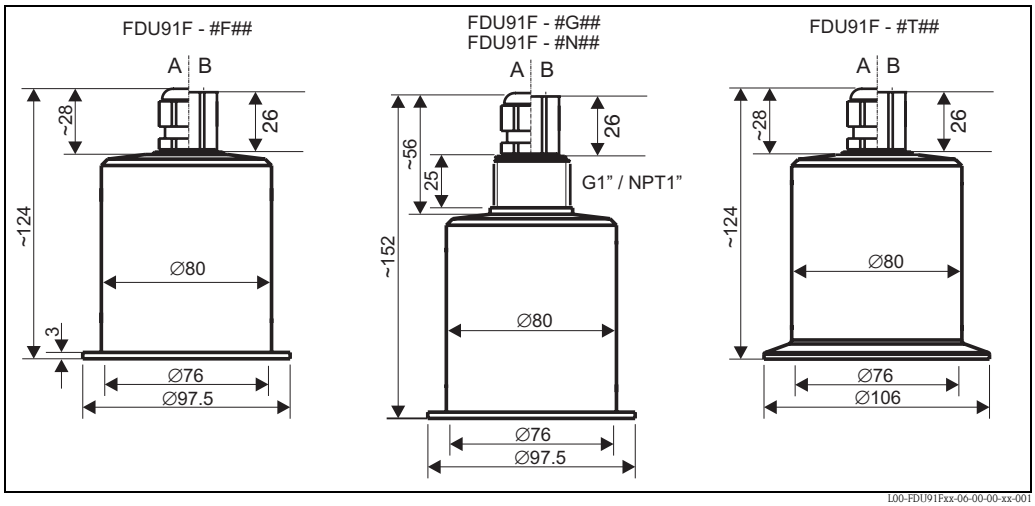
Mechanical construction

Dimensions FDU91



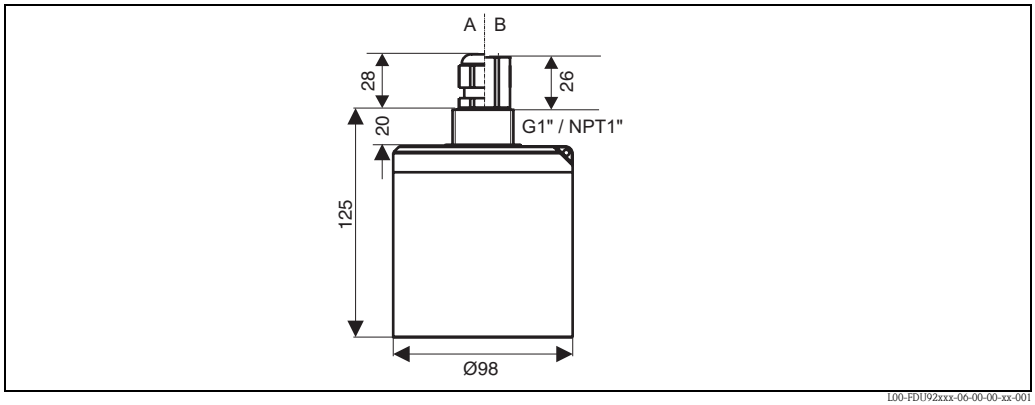
Dimensions in mm
A: *Cable gland for: FDU91-R..., FDU91-J..., FDU91-G..., FDU91-E..., FDU91-H..., FDU91-U...*
B: *Conduit connection NPT 1/2" for: FDU91-S..., FDU91-Q...*
The conduit connection is partly potted (half filled).

Dimensions FDU91F



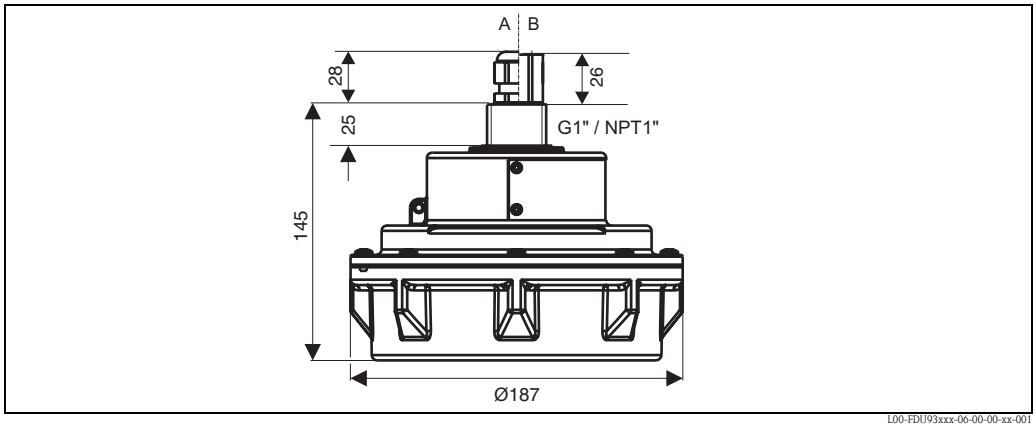
Dimensions in mm
A: *Cable gland for FDU91F-R..., FDU91F-J..., FDU91F-G..., FDU91F-E..., FDU91F-H..., FDU91F-U...*
B: *Conduit connection NPT 1/2" for: FDU91F-S..., FDU91F-Q...*
The conduit connection is partly potted (half filled).

Dimensions FDU92



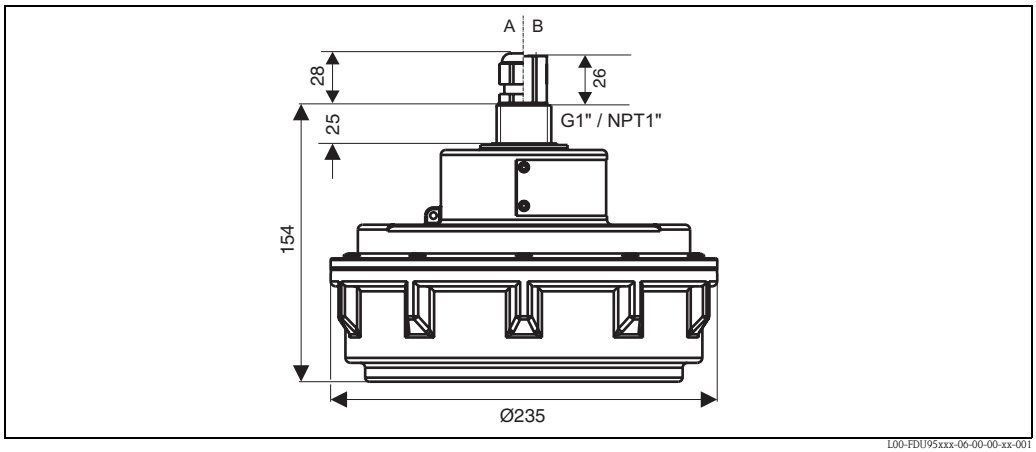
Dimensions in mm
A: *Cable gland for: FDU92-R..., FDU92-J..., FDU92-G..., FDU92-E..., FDU92-H..., FDU92-U...*
B: *Conduit connection NPT 1/2" for: FDU92-S..., FDU92-Q...*
The conduit connection is partly potted (half filled).

Dimensions FDU93



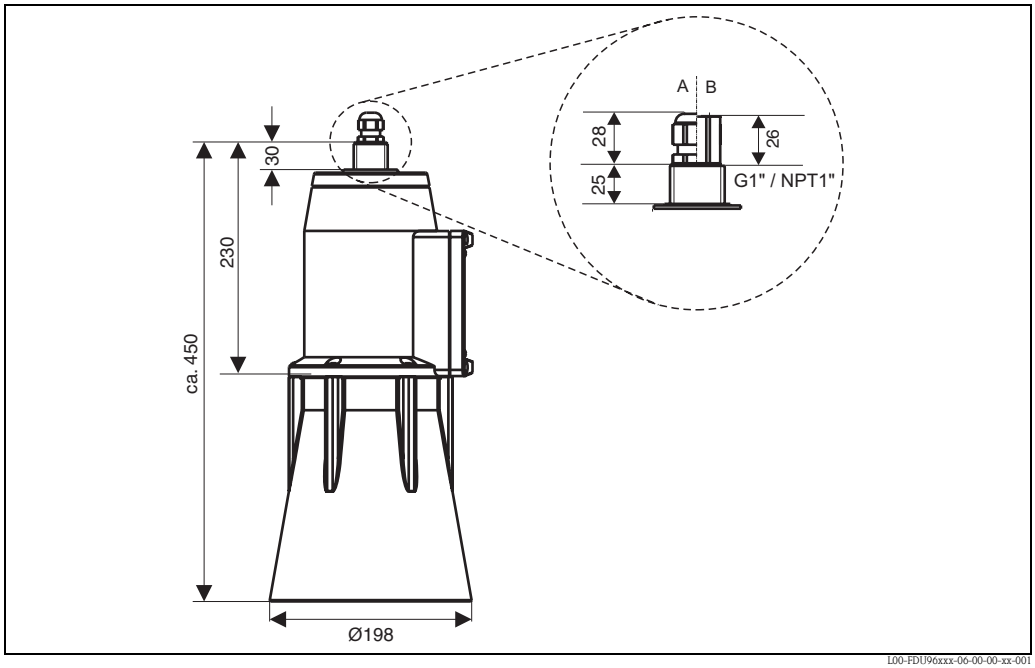
Dimensions in mm
A: *Cable gland for: FDU93-R..., FDU93-J..., FDU93-G..., FDU93-E..., FDU93-H..., FDU93-U...*
B: *Conduit connection NPT 1/2" for: FDU93-T..., FDU93-P...*
The conduit connection is partly potted (half filled).

Dimensions FDU95



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

Dimensions FDU96



Dimensions in mm

A: *Cable gland for: FDU95-R..., FDU95-J..., FDU95-E..., FDU95-H..., FDU95-U...*

B: *Conduit connection NPT 1/2" for: FDU95-P..., FDU95-T...*
The conduit connection is partly potted (half filled).

Weight

Sensor	Weight (including 5 m cable)
FDU91	approx. 1.1 kg
FDU91F	approx. 1.6 kg
FDU92	approx. 2 kg
FDU93	approx. 2.9 kg
FDU95	approx. 4.5 kg
FDU96	approx. 5 kg

Materials

Sensor	Material of sensor	Material of process connection	Material of process seal	Material of cable
FDU91	PVDF counter nut: PA	PVDF	w/o sealing	PVC
FDU91F	316L	316L	w/o sealing	PVC
FDU92	PVDF counter nut: PA	PVDF	w/o sealing	PVC
FDU93	■ housing: UP ■ membrane: Alu/PTFE	UP	silicone	PVC
FDU95 - *1*** (low temperature version)	■ housing: UP ■ membrane coating: 316L/PE	UP	silicone	PVC
FDU95 - *2*** (high temperature version)	■ housing: UP ■ membrane coating: 316L	UP	silicone	silicone
FDU96	■ housing: UP ■ membrane coating: Alu/PTFE	selectable: ■ UP ■ 304	silicone	silicone

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

Connecting cable

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

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.

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

Ordering information

Product structure FDU91

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

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

030						Cable length
			1			5 m
			2			10 m
			3			15 m
			4			20 m
			5			25 m
			6			30 m
			8			... m (variable length, up to 300 m)
			A			... ft (variable length, up to 985 ft)

035						Heater
				A		w/o heater
				B		Connection to 24 VDC

040						Additional option
					A	Basic version

FDU91 -						product designation

Product structure FDU91F

010						Approval
	R					Non-hazardous area
	J					ATEX II 2G EEx ma II T5
	G					ATEX II 3G EEx nA II T6 (in preparation)
	E					ATEX II 1/2 D, ATEX II 2G Ex ma II T6 (in preparation)
	H					ATEX II 3D (in preparation)
	U					CSA General Purpose
	S					CSA Cl.I,II,III Div.1+2 Gr.A-G
	Q					FM Cl.I,II,III Div. 1+2 Gr.A-G
	V					TIIS Ex is IIC T6 (in preparation)

020						Process connection
		G				Thread ISO228 G1, 316L
		N				Thread ANSI NPT1, 316L
		F				Flush mounting; prepared for slip-on flange FAU80, 3A
		T				Tri-Clamp ISO2852 DN80, 316L, 3A

030						Cable length
			1			5 m
			2			10 m
			3			15 m
			4			20 m
			5			25 m
			6			30 m
			8			... m (variable length, up to 300 m)
			A			... ft (variable length, up to 985 ft)

040						Additional option
				A		Basic version

FDU91F -						product designation

Product structure FDU92

010	Approval
R	Non-hazardous area
J	ATEX II 2G EEx m II T6
G	ATEX II 3G EEx nA II T6 (in preparation)
E	ATEX II 1/2 D, ATEX II 2G Ex ma II T6
H	ATEX II 3D (in preparation)
U	CSA General Purpose
S	CSA Cl.I,II,III Div.1+2 Gr.A-G
Q	FM Cl.I,II,III Div. 1+2 Gr.A-G
V	TIIS Ex is IIC T6

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

030	Cable length
1	5 m
2	10 m
3	15 m
4	20 m
5	25 m
6	30 m
8	... m (variable length, up to 300 m)
A	... ft (variable length, up to 985 ft)

040	Additional option
A	Basic version

FDU92 -	product designation

Product structure FDU93

010	Approval
R	Non-hazardous area
J	ATEX II 2G EEx m II T6, ATEX II 1/2D
G	ATEX II 3G EEx nA II T6 (in preparation)
E	ATEX II 1/2 D
H	ATEX II 3D (in preparation)
U	CSA General Purpose
T	CSA Cl.I,II,III Div.1 Gr.E-G
P	FM Cl.I,II,III Div. 1+2 Gr.A-G
W	TIIS dust-Ex DP12 (in preparation)

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

030	Cable length
1	5 m
2	10 m
3	15 m
4	20 m
5	25 m
6	30 m
8	... m (variable length, up to 300 m)
A	... ft (variable length, up to 985 ft)

040	Additional option
A	Basic version

FDU93 -	product designation

Product structure FDU95

010	Approval
R	Non-hazardous area
J	ATEX II 2G Ex ma II T6, ATEX II 1/D
E	ATEX II 1/2 D
H	ATEX II 3D (in preparation)
P	FM Cl.II Div.1 Gr.E-G
U	CSA General Purpose
T	CSA Cl.II Div.1 Gr.E-G
W	TIIS dust-Ex DP12 (in preparation)

015	Temperature; blocking distance; material
1	-40 ... +80 °C; 70 cm; membrane: 316L; surface: PE
2	-40 ... 150 °C; 90 cm; membrane: 316L

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

030	Cable length
1	5 m
2	10 m
3	15 m
4	20 m
5	25 m
6	30 m
8	... m (variable length, up to 300 m)
A	... ft (variable length, up to 985 ft)

040	Additional option
A	Basic version

FDU95 -	product designation

Product structure FDU96

010	Approval
R	Non-hazardous area
J	ATEX II 2G EEx ma II T6, ATEX II 1/2D
E	ATEX II 1/2 D, -40 ... +140 °C
F	ATEX II 1/2 D, -40 ... +80 °C
H	ATEX II 3D (in preparation)
U	CSA General Purpose
L	CSA Cl.I,II,III Div.1 Gr.E-G; LT; Ambient temperature: -40 ... +80 °C (176 °F)
T	CSA Cl.I,II,III Div.1 Gr.E-G; HT; Ambient temperature: -40 ... +140 °C (284 °F)
P	FM Cl.I,II,III Div. 1+2 Gr.A-G; HT; Ambient temperature: -40 ... +140 °C (284 °F)
K	FM Cl.I,II,III Div. 1+2 Gr.A-G; LT; Ambient temperature: -40 ... +80 °C (176 °F)
W	TIIS dust-Ex DP12 (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
2	10 m
3	15 m
4	20 m
5	25 m
6	30 m
8	... m (variable length, up to 300 m)
A	... ft (variable length, up to 985 ft)

040	Additional options
A	Basic version

FDU96 -	product designation

Scope of delivery

- Instrument according to the version ordered
- This Technical Information TI396F (serves as installation and operating instruction)
- for certified instrument versions: Safety Instructions (XA) or Control Drawings (ZD)
- for FDU91 with sensor heater: terminal module, to be mounted in the field housing of the transmitter FMU90
- for FDU91/91F/92 with G1" process connection: counter nut (PA) + seal (EPDM)
- for FDU 93/95/96 with Ex-certificate: process seal (silicone)

Accessories

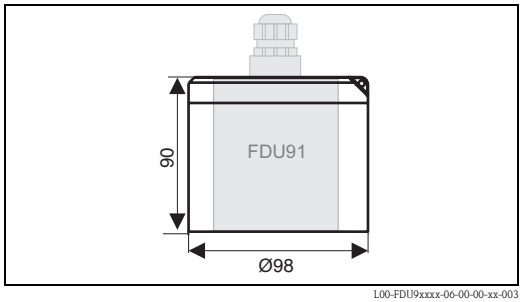
Extension cable for sensors

for Sensor	Material	Cable type	Order code
■ FDU91 ■ FDU92	PVC	LiYCY/CUL 2x(0,75)	71027742
■ FDU91F ■ FDU93 ■ FDU95	PVC (-40 ... +105 °C)	LIYY/CUL 2x(0,75)D+1x0,75#	71027743
■ FDU95 ■ FDU96	Silicone (-40 ... +150 °C)	Li2G2G 2x(0,75)D+1x0,75#	71027745
■ FDU91 with heater	PVC	LIYY/CUL 2x(0,75)D+2x0,75#	71027746

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

Protective cover for FDU91

- Material: PVDF
- Order code: 52025686



Dimensions in mm

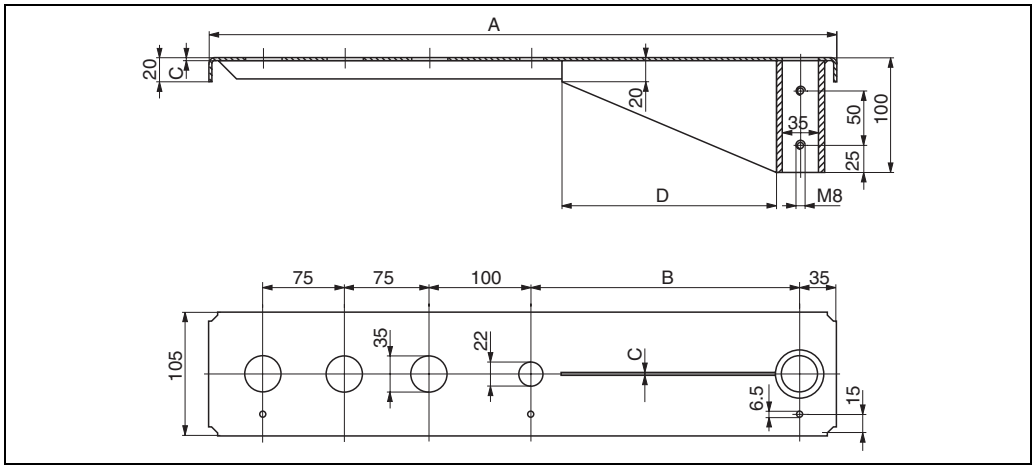
Flanges

Version	Material	Order code
DIN B DN80/PN16	PP-FR	919789-0000
DIN B DN100/PN16	PP-FR	919789-0002
DIN B DN150/PN16	PP-FR	919789-0004
DIN B DN200/PN16	PP-FR	919789-0006
DIN B DN250/PN16	PP-FR	919789-0008

All flanges have a central G1" thread (also suited for NPT 1"). The maximum operating pressure of the sensor is always valid.
Other flanges on request.

Cantilever

The cantilever is used to mount the sensor FDU91 above open channels for example.



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

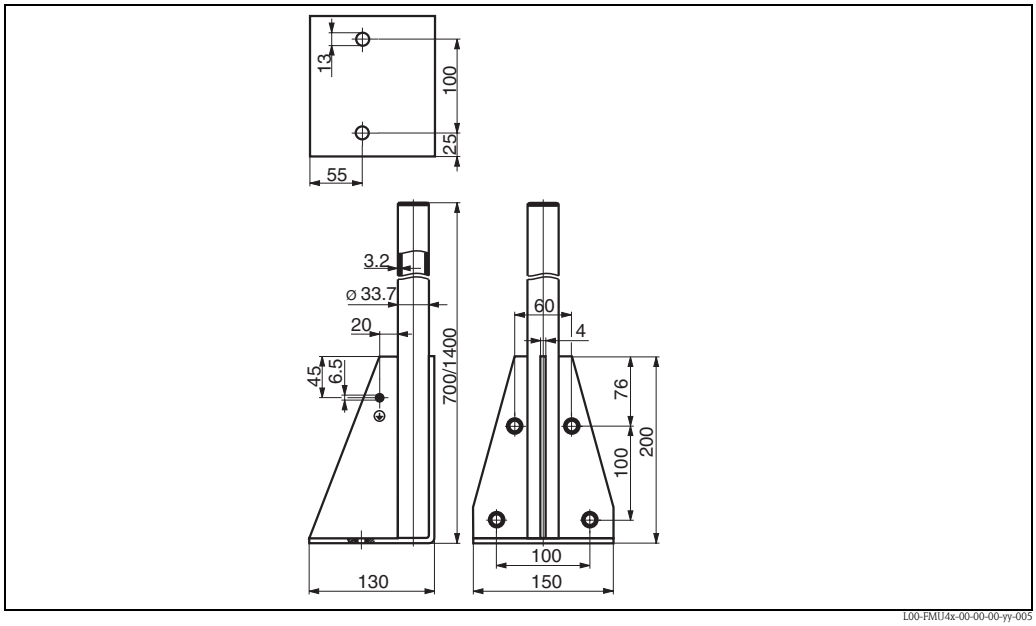
A	B	C	D	Material	Order code
585 mm	250 mm	2 mm	200 mm	galvanised steel	919790-0000
				316Ti/1.4571	919790-0001
1085 mm	750 mm	3 mm	300 mm	galvanised steel	919790-0002
				316Ti/1.4571	919790-0003

- The 35 mm orifices are for the sensors FDU9x.
- The 22 mm 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)

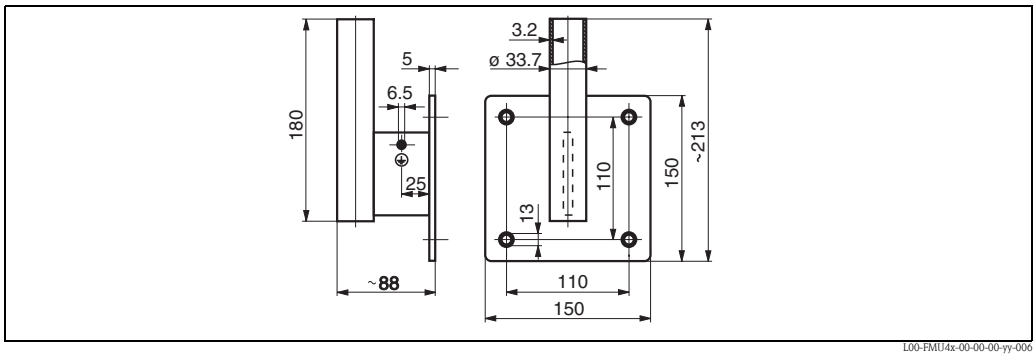
Fixing screws are supplied.

Mounting Frame



Height	Material	Order Code
700 mm	galv. steel	919791-0000
700 mm	1.4301 (AISI 304)	919791-0001
1400 mm	galv. steel	919791-0002
1400 mm	1.4301 (AISI 304)	919791-0003

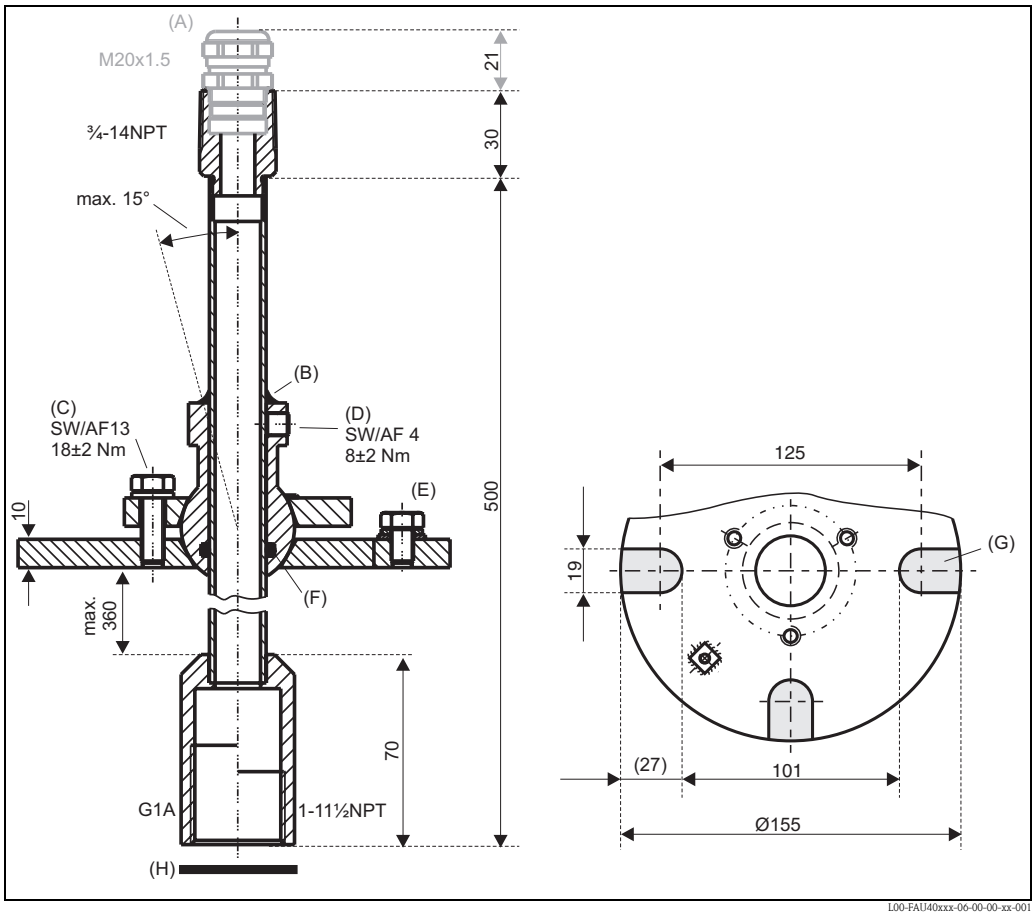
Wall Bracket



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

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 TI 179F.

Product structure

010	**Process connection (Flange)**		
	1		Welding flange, 304/1.4301
	2		UNI flange 2"/DN50/50A, 304, max. 1.5 bar abs./22psia suitable for 2" 150lbs / DN50 PN16 / 10K 50A
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 FDU91sensor 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 TI202R.

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 number: 51002468
For additional information refer to Technical Information TI080R.

Supplementary documentation

Innovation booklet

IN 003

Ultrasonic measurement – the solution for your application

Technical Information

TI 397F

Technical Information for the transmitter Prosonic S FMU90

TI 179F

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
BA 288F	HART	■ level measurement ■ alternating pump control ■ screen and rake control	FMU90 – *******1**** FMU90 – *******2****
BA 289F		■ flow measurement ■ backwater and dirt detection ■ totalizers and counters	FMU90 – *2*****1**** FMU90 – *4*****1**** FMU90 – *2*****2**** FMU90 – *4*****2****
BA 292F	PROFIBUS DP	■ level measurement ■ alternating pump control ■ screen and rake control	FMU90 – *******3****
BA 293F		■ 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" (BA 290F, see below).

Description of Instrument Functions (for transmitter FMU90)

BA290F

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 of the "ToF-Tool – FieldTool Package", which is supplied together with the instrument
- in the internet at "www.endress.com"

Safety Instructions

The following Safety Instructions are supplied with ATEX-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
■ FDU91 – J**** ■ FDU91F – J*** ■ FDU92 – J***	ATEX II 2 G Ex ma II T6 – T1	XA 321F
■ FDU91 – E**** ■ FDU91F – E*** ■ FDU92 – E*** ■ FDU93 – J*** ■ FDU95 – J**** ■ FDU96 – J***	■ ATEX II 2 G Ex ma II T6 – T1 ■ ATEX II 1/2 D	XA322F
■ FDU93 – E*** ■ FDU95 – E**** ■ FDU96 – E*** ■ FDU96 – F***	ATEX II 1/2 D	XA323F

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TI396F/00/en/07.07
52024314
FM+SGML 6.0 ProMoDo

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