

Technical Information

Proline Prosonic Flow 93P

Ultrasonic flow measuring system
Volume flow measurement of liquids in
chemical or process applications



Applications

The sensors are perfectly suited for the non-contact measurement of pure or slightly contaminated liquids, regardless of the pressure or electrical conductivity.

- Suitable for pipe diameters from DN 15 to 4000 (½ to 160")
- Suitable for fluid temperatures ranging from -40 to +170 °C (-40 to +338 °F)
- Can be used with all metal and plastic pipes lined or unlined and with composite pipes
- Ideal solution for applications with chemicals, solvents, liquid hydrocarbons, acids and alkalis
- Particularly suitable for corrosive, hazardous or ultrapure fluids thanks to non-contact measurement concept
- Interface for easy integration into all common distributed control systems:
 - HART
 - PROFIBUS DP/PA
 - FOUNDATION Fieldbus
- Approval for use in hazardous area Zone 1 (ATEX, FM, CSA) available as standard

Features and benefits

The Prosonic Flow ultrasonic clamp-on system allows accurate and cost-effective flow measurement from outside the pipe and without the need to interrupt the process. The flow measurement is bidirectional and causes no pressure loss.

- Easy, safe and menu-guided sensor mounting ensures precise measuring results
- Long-term system integrity thanks to robust sensor and industrial mounting kit design
- Automatic frequency scan for optimized installation and maximum measuring performance
- Remote configuration using Endress+Hauser's FieldCare software

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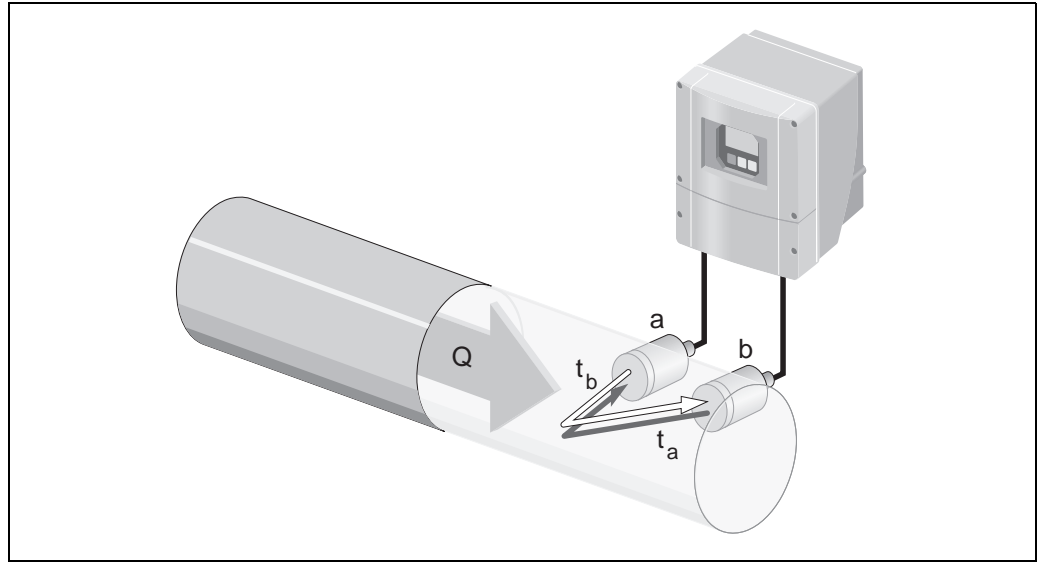
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Function and system design

Measuring principle

The measuring system operates on the principle of transit time difference. In this measurement method, acoustic (ultrasonic) signals are transmitted between two sensors. The signals are sent in both directions, i.e. the sensor in question works as both a sound transmitter and a sound receiver.

As the propagation velocity of the waves is less when the waves travel against the direction of flow than along the direction of flow, a transit time difference occurs. This transit time difference is directly proportional to the flow velocity.



Principle of the transit time difference measurement method

$$Q = v \cdot A$$

a Sensor

b Sensor

Q Volume flow

v Flow velocity ($v \sim \Delta t$)

Δt Transit time difference ($\Delta t = t_a - t_b$)

A Pipe cross-sectional area

The measuring system calculates the volume flow of the fluid from the measured transit time difference and the pipe cross-sectional area. In addition to measuring the transit time difference, the system simultaneously measures the sound velocity of the fluid. This additional measured variable can be used to distinguish different fluids or as a measure of product quality.

The measuring device can be configured onsite to suit the specific application using Quick Setup menus.

Measuring system

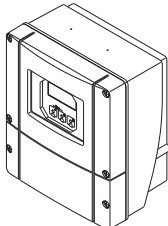
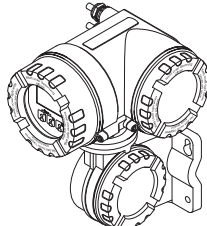
The measuring system consists of one transmitter and two sensors.

The transmitter is used both to control the sensors and to prepare, process and evaluate the measuring signals, and to convert the signals to a desired output variable.

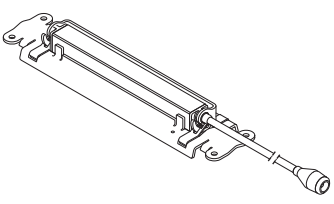
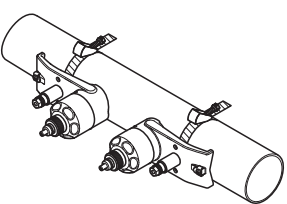
The transmitter is optionally equipped for two-channel operation → 5.

The sensors work as sound transmitters and sound receivers. Depending on the application and version, the sensors can be arranged for measurement via one or two traverses → 5.

Transmitter

Prosonic Flow 93 wall-mount housing	Prosonic Flow 93 field housing
For mounting in non-hazardous zone, Ex Zone 2	For mounting in Ex Zone 1
	
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Sensor

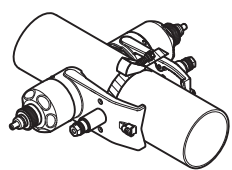
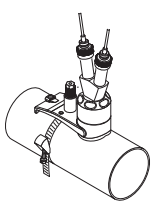
Prosonic Flow P	Prosonic Flow P
DN 15 to 65 (½ to 2½")	DN 50 to 4000 (2 to 160")
	
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Mounting accessories

The requisite mounting distances must be determined for the sensors. Information on the fluid, the pipe material used and the exact pipe dimensions is needed to determine these values. The values for the sound velocity of the following fluids, pipe materials and lining materials are stored in the transmitter:

Fluid	Pipe material	Lining
<ul style="list-style-type: none"> ■ Water ■ Sea water ■ Distilled water ■ Ammonia ■ Alcohol ■ Benzene ■ Bromide ■ Ethanol ■ Glycol ■ Kerosene ■ Milk ■ Methanol ■ Toluene ■ Lube oil ■ Diesel ■ Gasoline 	<ul style="list-style-type: none"> ■ Carbon steel ■ Ductile iron ■ Stainless steel ■ Alloy C ■ PVC ■ PE ■ LDPE ■ HDPE ■ GRP ■ PVDF ■ PA ■ PP ■ PTFE ■ Glass pyrex ■ Asbestos cement ■ Copper 	<ul style="list-style-type: none"> ■ Mortar ■ Rubber ■ Tar Epoxy

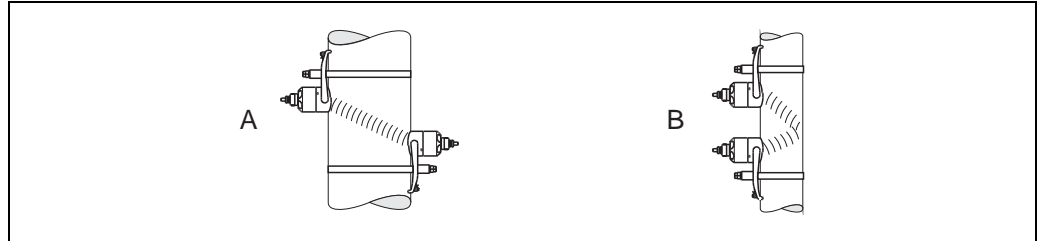
If you are using fluids, pipe materials or lining materials other than those listed in the table, and you do not have the corresponding sound velocities for these fluids/materials, you can use the DDU18 and DDU19 sensors to determine the values.

DDU18 (sound velocity measurement)	DDU19 (wall thickness measurement)
Nominal diameter range: DN 50 to 3000 (2 to 120")	Wall thickness range: <ul style="list-style-type: none"> ■ Steel pipes: 2 to 50 mm (0.08 to 2.0") ■ Plastic pipes: 4 to 15 mm (0.16 to 0.60") (only suitable for PTFE and PE pipes to a certain extent)
	
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Sensor selection and arrangement

The sensors can be arranged in two ways:

- Mounting arrangement for measurement via one traverse:
the sensors are located on opposite sides of the pipe.
- Mounting arrangement for measurement via two traverses:
the sensors are located on the same side of the pipe.



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Sensor mounting arrangement

- A *Mounting arrangement for measurement via one traverse*
 B *Mounting arrangement for measurement via two traverses*

The number of traverses required depends on the sensor type, the nominal diameter and the thickness of the pipe wall. We recommend the following types of mounting:

Sensor Type	Nominal Diameter	Sensor Frequency	Sensor ID	Type of Mounting ¹⁾
Prosonic Flow P	DN 15 to 65 (½ to 2½")	6 MHz	P-CL-6F*	2 traverses ³⁾
	DN 50 to 65 (2 to 2½")	6 MHz (or 2 MHz)	P-CL-6F* P-CL-2F*	2 (or 1) traverses ²⁾
	DN 80 (3")	2 MHz	P-CL-2F*	2 traverses
	DN 100 to 300 (4 to 12")	2 MHz (or 1 MHz)	P-CL-2F* P-CL-1F*	2 traverses
	DN 300 to 600 (12 to 24")	1 MHz (or 2 MHz)	P-CL-1F* P-CL-2F*	2 traverses
	DN 650 to 4000 (26 to 160")	1 MHz	P-CL-1F*	1 traverse

¹⁾ The installation of clamp-on sensors is principally recommended in the 2 traverse type installation. This type of installation allows the easiest and most comfortable type of mounting and means that a system can also be mounted even if the pipe can only be accessed from one side. However, in certain applications a 1 traverse installation may be preferred. These include:

- Certain plastic pipes with wall thickness > 4 mm (0.16")
- Pipes made of composite materials such as GRP
- Lined pipes
- Applications with fluids with high acoustic damping

²⁾ If the pipe nominal diameter is small (DN 65 / 2½" and smaller), the sensor spacing with Prosonic Flow P can be too small for two traverse installation using sensor P-CL-2F*. In this case, the 1 traverse type of installation must be used.

³⁾ 6 MHz sensors for applications where flow velocity ≤ 10 m/s (32.8 ft/s).

Two-channel operation

The transmitter is able to operate two independent measuring channels (measuring channel 1 and measuring channel 2). A pair of sensors is connected per measuring channel. Both measuring channels operate independently of one another and are supported by the transmitter to an equal extent.

Two-channel operation can be used for the following measurements:

- Two-channel measurement = flow measurement at two separate measuring points
- Two-path measurement = redundant flow measurement at one measuring point

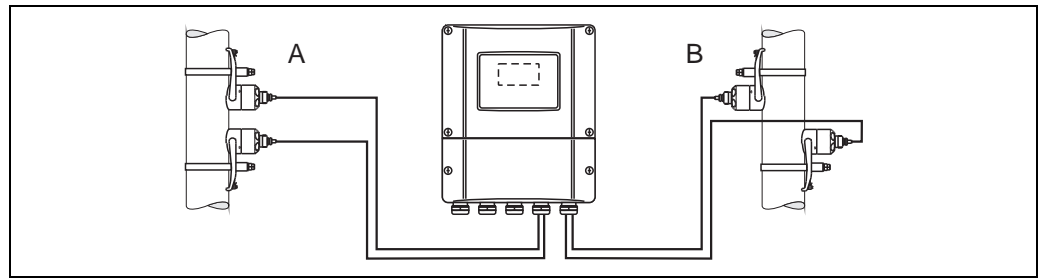
Two-channel measurement

The flow is measured at two separate measuring points in the case of two-channel measurement. The measured values of the two measuring channels can be processed and displayed differently.

The following measured values can be output for two-channel measurement:

- Individual measured values per measuring channel (output independently of one another)
- The difference between the two measured values
- The sum of the two measured values

The two measuring channels can be configured individually. This makes it possible to independently configure and select the display, outputs, sensor type and type of installation.



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Two-channel measurement: example of arranging sensor pairs at two separate measuring points

- A Measuring channel 1: mounting the sensor pair for measurement via two traverses
 B Measuring channel 2: mounting the sensor pair for measurement via one traverse

Two-path measurement

The flow is measured redundantly at one measuring point in the case of two-path measurement. The measured values of the two measuring channels can be processed and displayed differently.

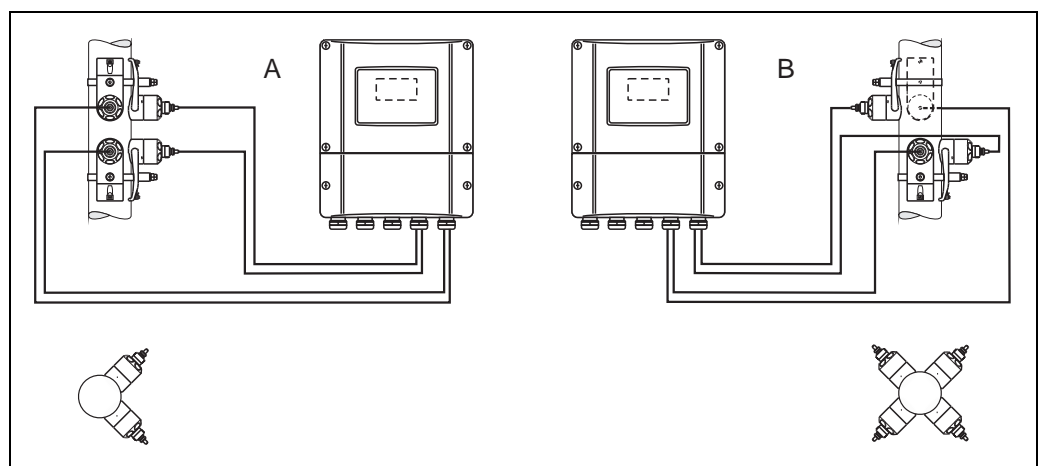
The following measured values can be output for two-path measurement:

- Individual measured values per measuring channel (output independently of one another)
- The average of the two measured values

The "Averaging" function generally provides you with a more stable measured value. The function is thus suitable for measurements under conditions that are not ideal (e.g. short inlet runs).

The two measuring channels can be configured individually. This makes it possible to independently configure and select the display, outputs, sensor type and type of installation.

It is generally not necessary to individually configure the two measuring channels in the case of two-path measurement. However, in certain situations individual channel configuration can be used to balance out application-specific asymmetries.



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Two-path measurement: examples of arranging sensor pairs at one measuring point

- A Measuring channel 1 and measuring channel 2: mounting the sensor pair for measurement via two traverses
 B Measuring channel 1 and measuring channel 2: mounting the sensor pair for measurement via one traverse

Input

Measured variable	Flow velocity (transit time difference proportional to flow velocity)
Measuring range	Typically $v = 0$ to 15 m/s (0 to 50 ft/s)
Operable flow range	Over 150 : 1
Input signal	<p>Status input (auxiliary input)</p> <p>$U = 3$ to 30 V DC, $R_i = 5$ kΩ, galvanically isolated</p> <p>Configurable for: totalizer(s) reset, measured-value suppression, error-message reset</p>

Output

Output signal	<p>Current output</p> <ul style="list-style-type: none"> ■ Galvanically isolated ■ Active/passive selectable <ul style="list-style-type: none"> – Active: 0/4 to 20 mA, $R_L < 700 \Omega$ (for HART: $R_L \geq 250 \Omega$) – Passive: 4 to 20 mA, max. 30 V DC, $R_i \leq 150 \Omega$ ■ Time constant selectable (0.01 to 100 s) ■ Full scale value adjustable ■ Temperature coefficient: typ. 0.005 % o.r./°C (o.r. = of reading) ■ Resolution: 0.5 μA <p>Pulse/frequency output</p> <ul style="list-style-type: none"> ■ Galvanically isolated ■ Active/passive selectable <ul style="list-style-type: none"> – Active: 24 V DC, 25 mA (max. 250 mA during 20 ms), $R_L > 100 \Omega$ – Passive: open collector, 30 V DC, 250 mA ■ Time constant selectable (0.05 to 100 s) ■ Frequency output <ul style="list-style-type: none"> – End frequency: 2 to 10000 Hz ($f_{max} = 12500$ Hz) – End frequency for EEx ia 2 to 5000 Hz – On/off ratio 1:1, pulse width max. 10 s ■ Pulse output <ul style="list-style-type: none"> – Pulse value and pulse polarity selectable – Max. pulse width adjustable (0.05 to 2000 ms) – As of a frequency of $1 / (2 \times \text{pulse width})$, the on/off ratio is 1:1 <p>PROFIBUS DP interface</p> <ul style="list-style-type: none"> ■ PROFIBUS DP in accordance with EN 50170 Volume 2 ■ Profile version 3.0 ■ Data transmission rate: 9.6 kBaud to 12 MBaud ■ Automatic data transmission rate recognition ■ Signal encoding = NRZ Code ■ Function blocks: 8 \times Analog Input (AI), 3 \times Totalizer ■ Output data: volume flow channel 1 or channel 2, sound velocity channel 1 or channel 2, flow velocity channel 1 or channel 2, average volume flow, average sound velocity, average flow velocity, volume flow sum, volume flow difference, totalizer 1 to 3 ■ Input data: positive zero return (ON/OFF), zero point adjustment, measuring mode, totalizer control ■ Bus address adjustable via miniature switches or local display (optional) at the measuring device ■ Available output combination \rightarrow 9
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PROFIBUS PA interface

- PROFIBUS PA in accordance with EN 50170 Volume 2, IEC 61158-2 (MBP)
- Galvanically isolated
- Data transmission rate, supported baudrate: 31.25 kBit/s
- Current consumption = 11 mA
- Error current FDE (fault disconnection electronic) = 0 mA
- Signal encoding = Manchester II
- Function blocks: 8 × Analog Input (AI), 3 × Totalizer
- Output data: volume flow channel 1 or channel 2, sound velocity channel 1 or channel 2, flow velocity channel 1 or channel 2, average volume flow, average sound velocity, average flow velocity, volume flow sum, volume flow difference, totalizer 1 to 3
- Input data: positive zero return (ON/OFF), operation control, totalizer control, zero point adjustment control, display value
- Bus address can be set via DIP switch on device

FOUNDATION Fieldbus interface

- FOUNDATION Fieldbus H1, IEC 61158-2
- Galvanically isolated
- Data transmission rate, supported baudrate: 31.25 kBit/s
- Current consumption = 12 mA
- Error current FDE (fault disconnection electronic) = 0 mA
- Signal encoding = Manchester II
- Function blocks: 8 × Analog Input (AI), 1 × Discrete Output, 1 × PID
- Output data: volume flow channel 1 or channel 2, sound velocity channel 1 or channel 2, flow velocity channel 1 or channel 2, signal strength channel 1 or 2, average volume flow, average sound velocity, average flow velocity, volume flow sum, difference, volume flow, totalizer 1 to 3
- Input data: positive zero return (ON/OFF), reset totalizer, zero point adjustment control
- Link master function (LAS) is supported

Signal on alarm

- Current output → failsafe mode selectable
- Pulse/frequency output → failsafe mode selectable
- Relay output → "deenergized" in the event of a fault or if the power supply fails

Load

See "Output signal"

Switching output**Relay output**

- NC or NO contact available
Factory setting: relay 1 = NO contact, relay 2 = NC contact
- Max. 30 V / 0.5 A AC; 60 V / 0.1 A DC
- Galvanically isolated
- Configurable for: error messages, flow direction, limit values

Low flow cutoff

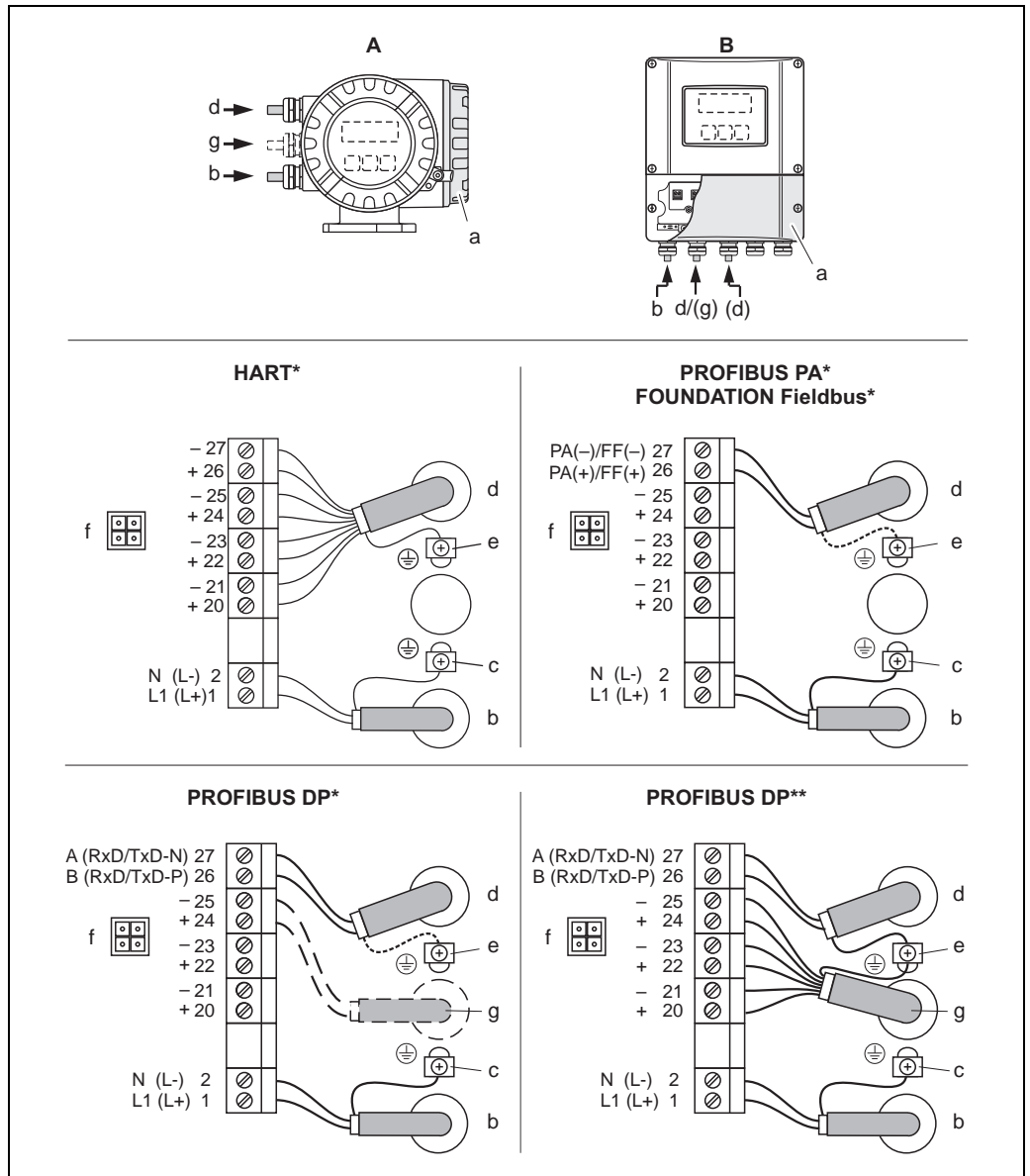
Switch points for low flow are selectable

Galvanic isolation

All circuits for inputs, outputs, and power supply are galvanically isolated from each other.

Power supply

Electrical connection,
measuring unit



Connecting the transmitter, cable cross-section max. 2.5 mm² (14 AWG)

A Aluminum field housing

B Wall-mount housing

*) Permanent assignment communication boards

**) Flexible assignment communication boards

a Cover of the connection compartment

b Cable for power supply: 85 to 260 V AC, 20 to 55 V AC, 16 to 62 V DC

Terminal No. 1: L1 for AC, L+ for DC

Terminal No. 1: N for AC, L- for DC

c Ground terminal for protective ground

d Signal cable: see terminal assignment

Fieldbus:

- Terminal 26: DP (B) / PA (+), FF (+) with reverse polarity protection

- Terminal 27: DP (A) / PA (-), FF (-) with reverse polarity protection

e Ground terminal for signal cable / fieldbus cable

f Service connector for connecting service interface FXA 193 (Fieldcheck, FieldCare)

g Signal cable: see terminal assignment

Cable for external termination (only for PROFIBUS DP with permanent assignment communication board)

- Terminal No. 24: +5V

- Terminal No. 25: DGND

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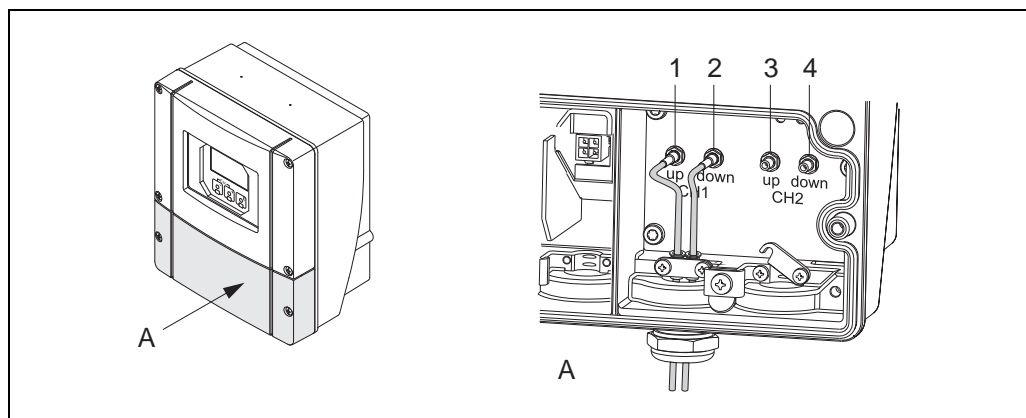
Electrical connection, terminal assignment

The inputs and outputs on the communication board can be either permanently assigned or variable, depending on the version ordered (see table). Replacements for modules which are defective or which have to be replaced can be ordered as accessories.

Order variant	Terminal No. (inputs/outputs)			
	20 (+) / 21 (-)	22 (+) / 23 (-)	24 (+) / 25 (-)	26 (+) / 27 (-)
<i>Fixed communication boards (fixed assignment)</i>				
93***_*****A	–	–	Frequency output	Current output HART
93***_*****B	Relay output 2	Relay output 1	Frequency output	Current output HART
93***_*****F	–	–	–	PROFIBUS PA, Ex i
93***_*****G	–	–	–	FOUNDATION Fieldbus, Ex i
93***_*****H	–	–	–	PROFIBUS PA
93***_*****J	–	–	–	PROFIBUS DP
93***_*****K	–	–	–	FOUNDATION Fieldbus
93***_*****S	–	–	Frequency output, Ex i	Current output, Ex i, passive, HART
93***_*****T	–	–	Frequency output, Ex i	Current output, Ex i, passive, HART
<i>Flexible communication boards</i>				
93***_*****C	Relay output 2	Relay output 1	Frequency output	Current output HART
93***_*****D	Status input	Relay output	Frequency output	Current output HART
93***_*****L	Status input	Relay output 2	Relay output 1	Current output HART
93***_*****M	Status input	Frequency output	Frequency output	Current output HART
93***_*****P	Current output	Frequency output	Status input	PROFIBUS DP
93***_*****V	Relay output 2	Relay output 1	Status input	PROFIBUS DP
93***_*****W	Relay output	Current output	Current output	Current output HART
93***_*****2	Relay output	Current output	Frequency output	Current output HART
93***_*****4	Current input	Relay output	Frequency output	Current output HART
93***_*****6	Relay output	Relay output	Current output	Current output HART

Connecting the connecting cable

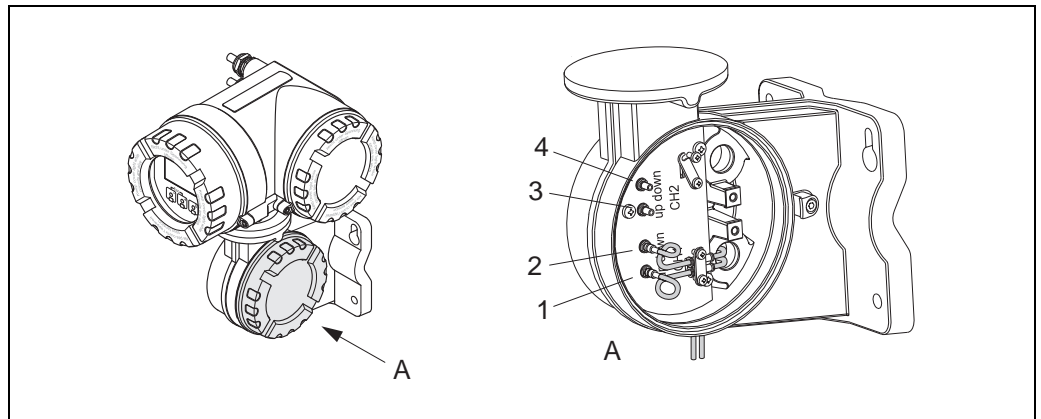
Connecting the wall-mount housing



Connecting the connecting cable, wall-mount housing

- 1 Channel 1 upstream
- 2 Channel 1 downstream
- 3 Channel 2 upstream (only available when ordered)
- 4 Channel 2 downstream (only available when ordered)

Connecting the field housing



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Connecting the connecting cable, field housing

- 1 Channel 1 upstream
- 2 Channel 1 downstream
- 3 Channel 2 upstream (only available when ordered)
- 4 Channel 2 downstream (only available when ordered)

Supply voltage

Transmitter

HART

- 85 to 260 V AC, 45 to 65 Hz
- 20 to 55 V AC, 45 to 65 Hz
- 16 to 62 V DC

PROFIBUS DP/PA

- 9 to 32 V DC

FOUNDATION Fieldbus

- 9 to 32 V DC

Sensor

Powered by the transmitter

Cable entry

Power supply and signal cables (inputs/outputs)

- Cable gland M20 × 1.5
 - Cable gland for cables 8 to 12 mm (0.31 to 0.47")
 - Cable gland for cables 6 to 12 mm (0.24 to 0.47")
- Thread for cable entry ½" NPT, G ½"

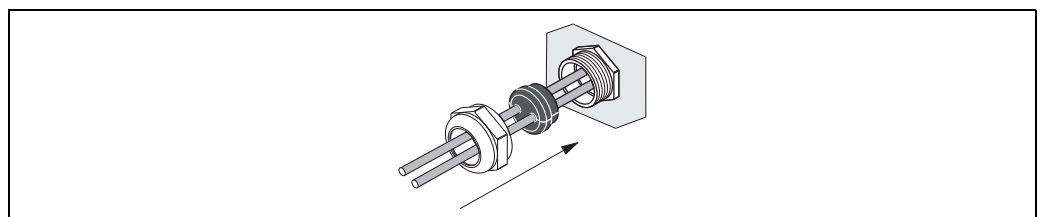
Connecting cable (sensor/transmitter)

Cable gland for one connecting cable per cable entry, 1 × Ø 8 mm (1 × Ø 0.31")

- Cable gland M20 × 1.5
- Thread for cable entry ½" NPT, G ½"

Cable gland for two connecting cables per cable entry, 2 × Ø 4 mm (2 × Ø 0.16")

- Cable gland M20 × 1.5
- Thread for cable entry ½" NPT, G ½"



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Cable gland for two connecting cables per cable entry

Connecting cable (sensor/transmitter)

Only use the connecting cables supplied by Endress+Hauser.

Different versions of the connecting cables are available →  27.

- Cable material:
 - Prosonic Flow 93P (DN 50 to 4000 / 2 to 160"): PVC (standard) or PTFE (for higher temperatures)
 - Prosonic Flow 93P (DN 15 to 65 / ½ to 2½"): TPE-V
- Cable length:
 - For use in a non-hazardous zone: 5 to 60 m (16.4 to 196.8 ft)
 - For use in a hazardous zone: 5 to 30 m (16.4 to 98.4 ft)



Note!

To ensure correct measuring results, route the connecting cable well clear of electrical machines and switching elements.

Power consumption

AC: < 18 VA (incl. sensor)

DC: < 10 W (incl. sensor)

Switch-on current

- max. 13.5 A (< 50 ms) at 24 V DC
- max. 3 A (< 5 ms) at 260 V AC

Power supply failure

Lasting min. 1 power cycle

HistoROM/T-DAT save measuring system data if the power supply fails

Potential equalization

For potential equalization, no special measures are necessary.

Performance characteristics

Reference operating conditions

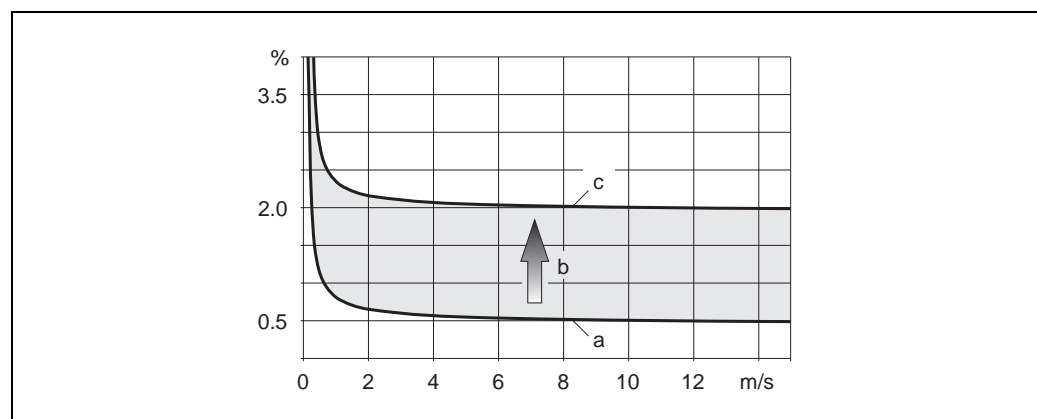
- Fluid temperature: +20 to +30 °C
- Ambient temperature: +22 °C ± 2 K
- Warm-up period: 30 minutes
- Sensors and transmitter are grounded
- The measuring sensors are correctly installed

Maximum measured error

The measured error depends on a number of factors. A distinction is made between the measured error of the device (Prosonic Flow 93 = 0.5 % of the measured value) and an additional installation-specific measured error (typically 1.5 % of the measured value) that is independent of the device.

The installation-specific measured error depends on the installation conditions on site, such as the nominal diameter, wall thickness, real pipe geometry, fluid, etc.

The sum of the two measured errors is the measured error at the measuring point.



Example of the measured error in a pipe with a nominal diameter DN > 200 (8")

- a Measured error of the device (0.5 % o.r. ± 3 mm/s)
- b Measured error due to installation conditions (typically 1.5 % o.r.)
- c Measured error at the measuring point: 0.5 % o.r. ± 3 mm/s + 1.5 % o.r. = 2 % o.r. ± 3 mm/s

Measured error at the measuring point

The measured error at the measuring point is made up of the measured error of the device (0.5 % o.r.) and the measured error resulting from the installation conditions on site. Given a flow velocity > 0.3 m/s (1 ft/s) and a Reynolds number > 10000, the following are typical error limits:

Nominal diameter	Device error limits	+	Installation-specific error limits (typical)	→	Error limits at the measuring point (typical)
DN 15 (½")	±0.5 % o.r. ± 5 mm/s	+	±2.5 % o.r.	→	±3 % o.r. ± 5 mm/s
DN 25 to 200 (1 to 8")	±0.5 % o.r. ± 7.5 mm/s	+	±1.5 % o.r.	→	±2 % o.r. ± 7.5 mm/s
> DN 200 (8")	±0.5 % o.r. ± 3 mm/s	+	±1.5 % o.r.	→	±2 % o.r. ± 3 mm/s

o.r. = of reading

Measurement Report

If required, the device can be supplied with a factory measurement report. To certify the performance of the device, a measurement is performed under reference conditions. Here, the sensors are mounted on a pipe with a nominal diameter of DN 15 (½"), DN 25 (1"), DN 40 (1½"), DN 50 (2") or DN 100 (4") respectively.

The measurement report guarantees the following error limits of the device [at a flow velocity > 0.3 m/s (1 ft/s) and a Reynolds number > 10000]:

Nominal diameter	Guaranteed error limits of the device
DN 15 (½"), DN 25 (1"), DN 40 (1½"), DN 50 (2")	±0.5 % o.r. ± 5 mm/s
DN 100 (4")	±0.5 % o.r. ± 7.5 mm/s

o.r. = of reading

Repeatability ±0.3 % for flow velocities > 0.3 m/s (1 ft/s)

Operating conditions: installation

Installation instructions

Mounting location

Correct flow measurement is possible only if the pipe is full. It is preferable to install the sensors in a riser.

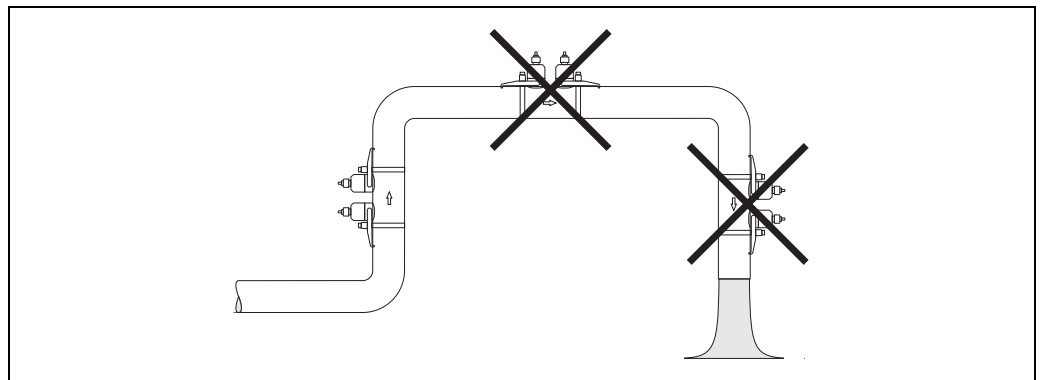


Note!

Entrained air or gas bubbles in the measuring tube can result in an increase in measuring errors.

For this reason, **avoid** the following mounting locations:

- Highest point of a pipeline. Risk of air accumulating.
- Directly upstream of a free pipe outlet in a vertical pipe. Risk of partial pipe filling.



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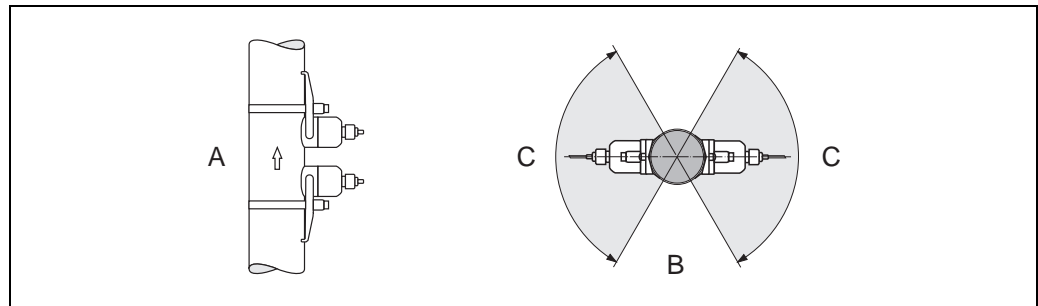
Orientation

Vertical

Recommended orientation with upward direction of flow (View A). With this orientation, entrained solids will sink and gases will rise away from the sensor when the fluid is stagnant. The piping can be completely drained and protected against solids buildup.

Horizontal

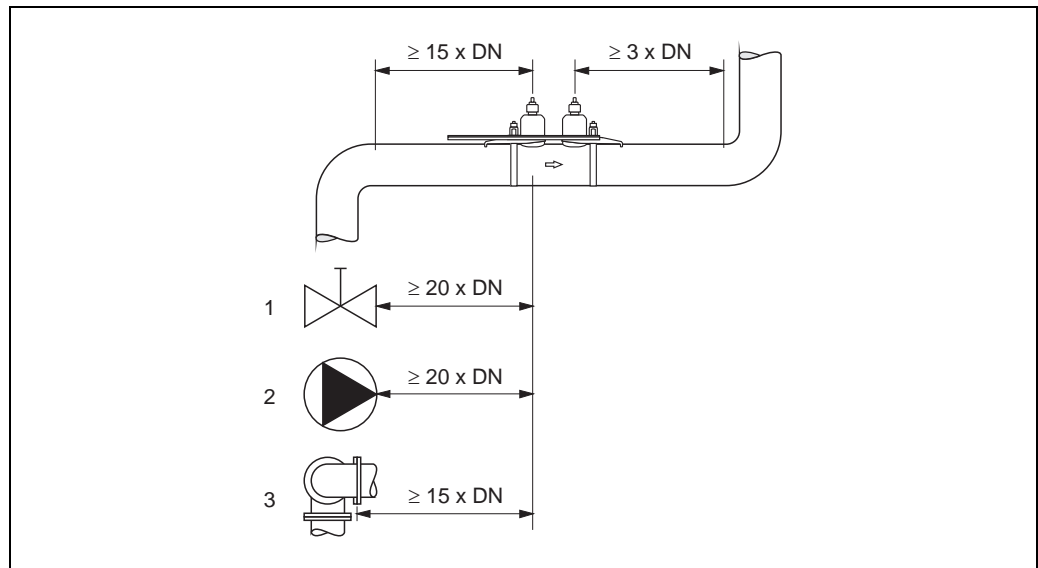
In the recommended installation range in a horizontal installation position (View B), gas and air collections at the pipe cover and problematic deposits at the bottom of the pipe have a smaller influence on measurement.



- A Recommended orientation with upward direction of flow
 B Recommended installation range with horizontal orientation
 C Recommended installation range max. 120°

Inlet and outlet runs


If possible, install the sensor well clear of fittings such as valves, T-pieces, elbows, etc. Compliance with the following inlet and outlet runs is required in order to ensure measuring accuracy.



Inlet and outlet runs (top view)

- 1 Valve (2/3 open)
 2 Pump
 3 Two pipe bends in different directions

Operating conditions: environment

Ambient temperature range	<p>Transmitter</p> <ul style="list-style-type: none"> ■ Standard: -20 to +60 °C (-4 to +140 °F) ■ Optional: -40 to +60 °C (-40 to +140 °F) <p>Prosonic Flow P sensor</p> <p>Prosonic Flow P (DN 15 to 65 / ½ to 2½")</p> <ul style="list-style-type: none"> ■ Standard: -40 to +100 °C (-40 to +212 °F) ■ Optional: -40 to +150 °C (-40 to +302 °F) <p>Prosonic Flow P (DN 50 to 4000 / 2 to 160")</p> <ul style="list-style-type: none"> ■ Standard: -40 to +80 °C (-40 to +176 °F) ■ Optional: 0 to +170 °C (+32 to +338 °F) <p>DDU18 sensor (accessories: sound velocity measurement)</p> <ul style="list-style-type: none"> ■ Standard: -40 to +80 °C (-40 to +176 °F) ■ Optional: 0 to +170 °C (+32 to +338 °F) <p>DDU19 sensor (accessories: wall thickness measurement)</p> <p>-20 to +60 °C (-4 to +140 °F)</p> <p>Connecting cable (sensor/transmitter)</p> <p>Prosonic Flow 93P (DN 15 to 65 / ½ to 2½"):</p> <ul style="list-style-type: none"> ■ Standard (TPE-V): -40 to +80 °C (-40 to +176 °F) <p>Prosonic Flow 93P (DN 50 to 4000 / 2 to 160"):</p> <ul style="list-style-type: none"> ■ Standard (PVC): -20 to +70 °C (-4 to +158 °F) ■ Optional (PTFE): -40 to +170 °C (-40 to +338 °F) <p> Note!</p> <ul style="list-style-type: none"> ■ It is permitted to insulate the sensors mounted on the pipe. ■ Mount the transmitter in a shady location and avoid direct sunlight, particularly in warm climatic regions.
Storage temperature	The storage temperature corresponds to the ambient temperature range.
Degree of protection	<p>Transmitter</p> <p>IP 67 (NEMA 4X)</p> <p>Sensor</p> <p>IP 68 (NEMA 6P)</p> <p>DDU18 sensor (accessories: sound velocity measurement)</p> <p>IP 68 (NEMA 6P)</p> <p>DDU19 sensor (accessories: wall thickness measurement)</p> <p>IP 67 (NEMA 4X)</p>
Shock and vibration resistance	According to IEC 68-2-6
Electromagnetic compatibility (EMC)	Electromagnetic compatibility (EMC requirements) according to IEC/EN 61326 "Emission to class A requirements" and NAMUR Recommendation NE 21 and NE 43.

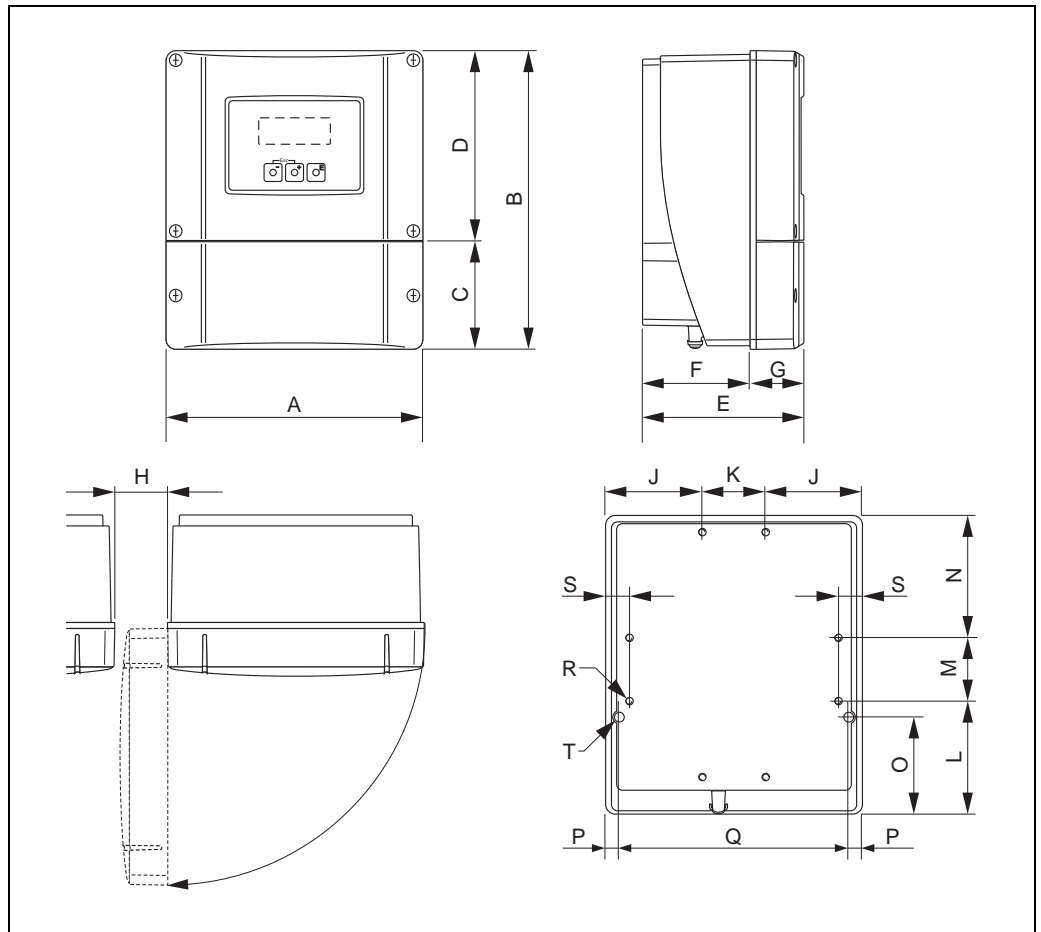
Operating conditions: process

Medium temperature range	<p>Prosonic Flow P sensor</p> <p>Prosonic Flow P (DN 15 to 65)</p> <ul style="list-style-type: none">■ Standard: -40 to +100 °C (-40 to +212 °F)■ Optional: -40 to +150 °C (-40 to +302 °F) <p>Prosonic Flow P (DN 50 to 4000)</p> <ul style="list-style-type: none">■ Standard: -40 to +80 °C (-40 to +176 °F)■ Optional: 0 to +170 °C (+32 to +338 °F) <p>DDU18 sensor (accessories: sound velocity measurement)</p> <ul style="list-style-type: none">■ Standard: -40 to +80 °C (-40 to +176 °F)■ Optional: 0 to +170 °C (+32 to +338 °F) <p>DDU19 sensor (accessories: wall thickness measurement)</p> <p>-20 to +60 °C (-4 to +140 °F)</p>
Medium pressure range (nominal pressure)	No pressure limitation, however perfect measurement requires that the static fluid pressure is higher than vapor pressure.
Pressure loss	There is no pressure loss.

Mechanical construction

Design, dimensions

Transmitter wall-mount housing



A0001150

Dimensions (SI units)

A	B	C	D	E	F	G	H	J	K
215	250	90.5	159.5	135	90	45	> 50	81	53
L	M	N	O	P	Q	R	S	T ¹⁾	
95	53	102	81.5	11.5	192	8 × M5	20	2 × Ø 6.5	

¹⁾ Securing screw for wall mounting: M6 (screw head max. 10.5 mm)
All dimensions in [mm]

Dimensions (US units)

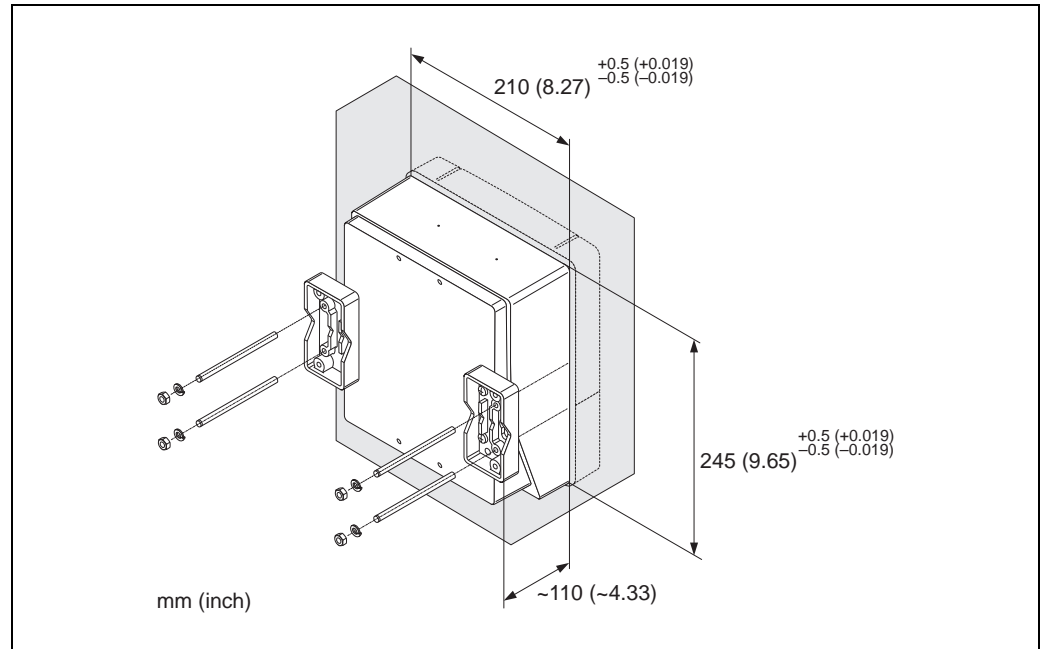
A	B	C	D	E	F	G	H	J	K
8.46	9.84	3.56	6.27	5.31	3.54	1.77	> 1.97	3.18	2.08
L	M	N	O	P	Q	R	S	T ¹⁾	
3.74	2.08	4.01	3.20	0.45	7.55	8 × M5	0.79	2 × Ø 0.26	

¹⁾ Securing screw for wall mounting: M6 (screw head max. 0.41")
All dimensions in [inch]

There is a separate mounting kit for the wall-mounted housing. It can be ordered from Endress+Hauser as an accessory (→ [Fig. 27](#)). The following installation variants are possible:

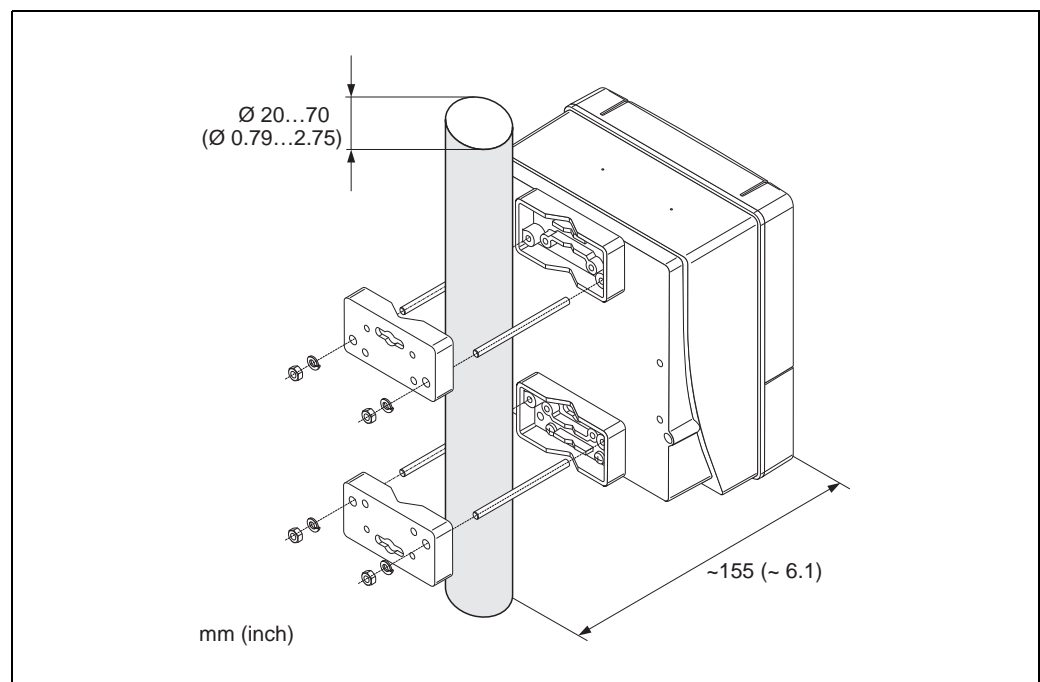
- Panel-mounted installation
- Pipe mounting

Panel-mounted installation



A0001131

Pipe mounting



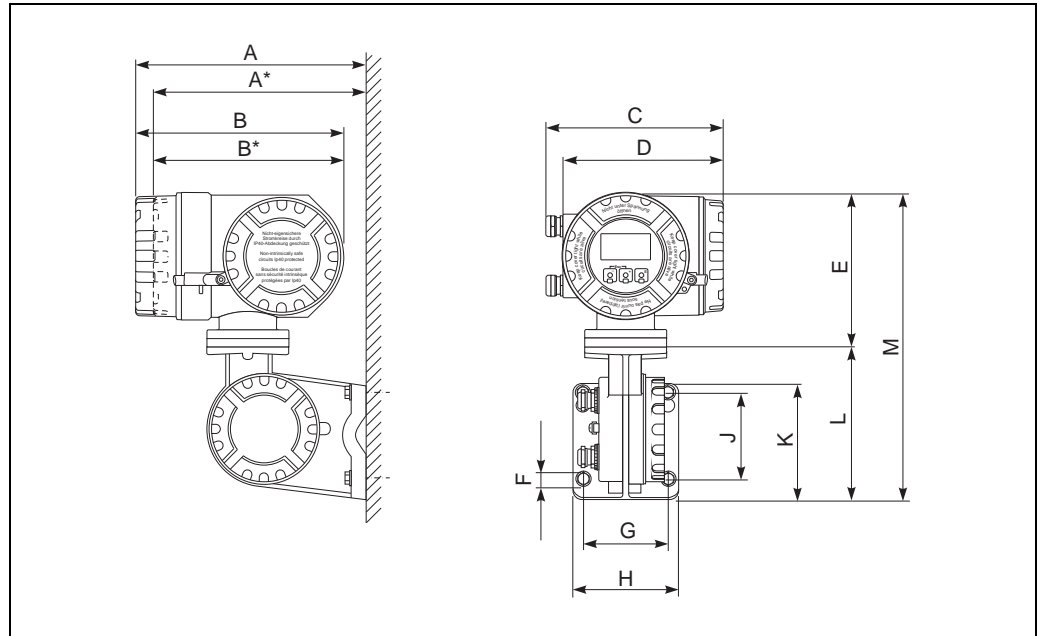
A0001132

Transmitter Field housing

There is a separate mounting kit for the field housing. It can be ordered from Endress+Hauser as an accessory (→ 27). The following installation variants are possible:

- Wall mounting
- Pipe mounting

Wall mounting



A0006999

Dimensions in SI units

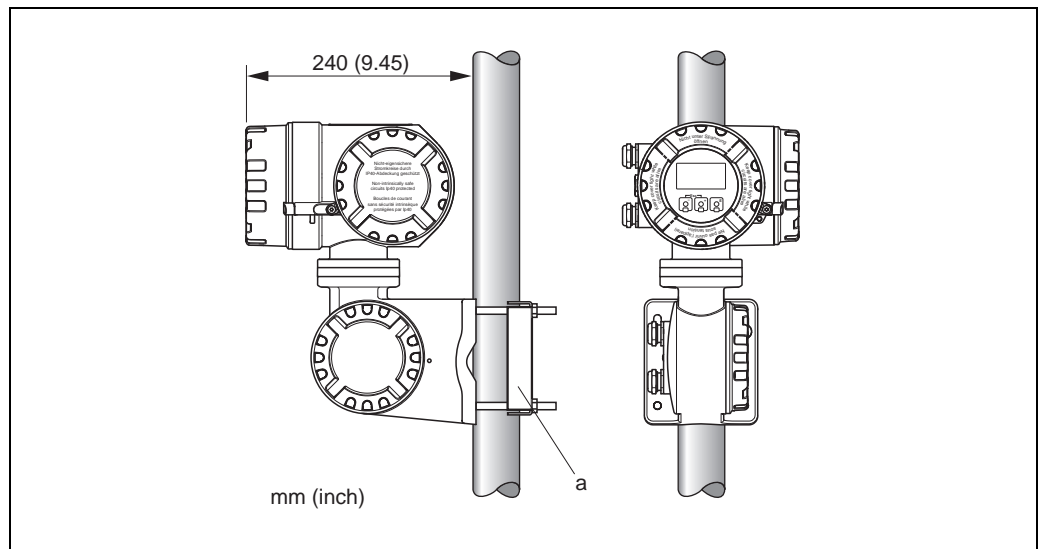
A	A*	B	B*	C	D	E	F	G	H	J	K	L	M
265	242	240	217	206	186	178	∅ 8.6 (M8)	100	130	100	144	170	355

* Blind version (without local display)
All dimensions in [mm]

Dimensions in US units

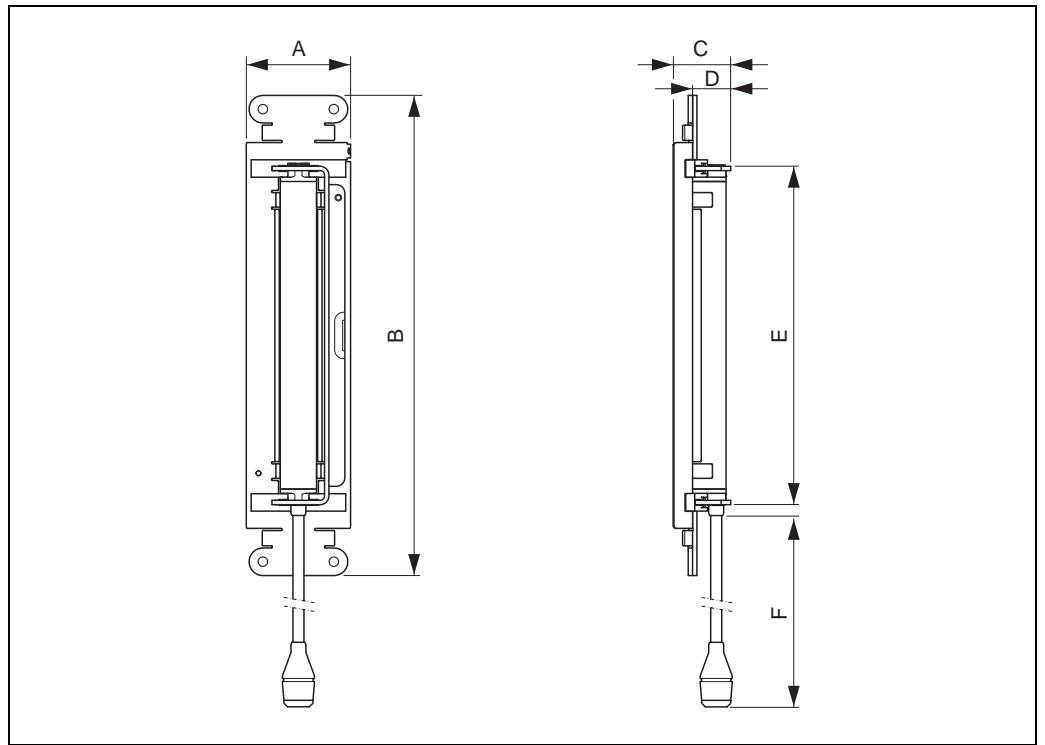
A	A*	B	B*	C	D	E	F	G	H	J	K	L	M
10.4	9.53	9.45	8.54	8.11	7.32	7.01	∅ 8.6 (M8)	3.94	5.12	3.94	5.67	6.69	13.9

* Blind version (without local display)
All dimensions in [inch]

Pipe mounting

a = Pipe mounting (separate mounting set, see accessories → [27](#))

Prosonic Flow P sensor (DN 15 to 65 / ½ to 2½")



A0011502

Dimensions in SI units

A	B	C	D	E	F
72	331	39	28	233	450

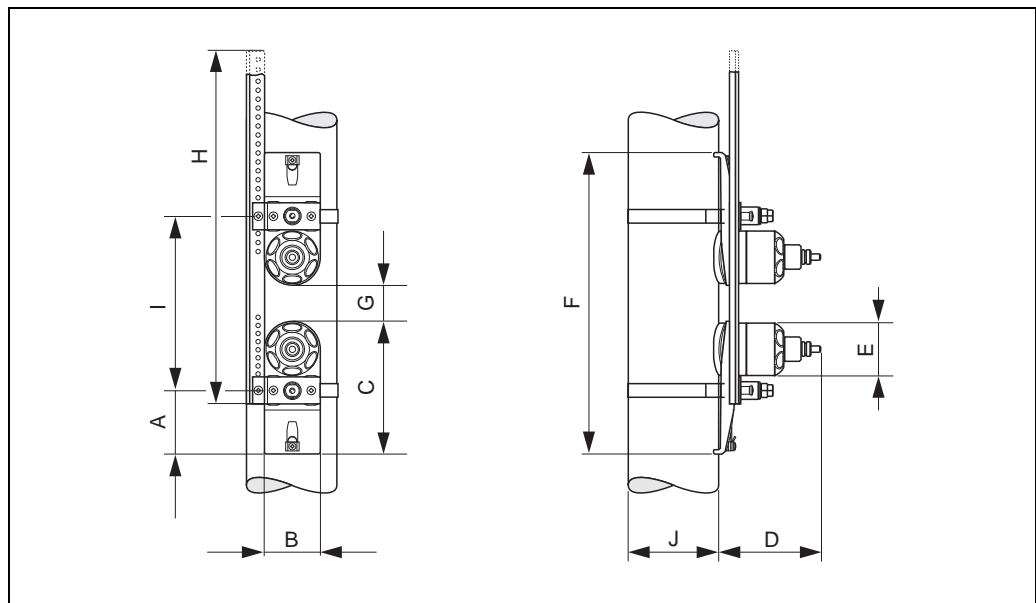
All dimensions in [mm]

Dimensions in US units

A	B	C	D	E	F
2.83	13.03	1.54	1.10	9.17	17.72

All dimensions in [inch]

Prosonic Flow P sensor (DN 50 to 4000 / 2 to 160")



A0001154

Mounting arrangement for measurement via two traverses

Dimensions in SI units

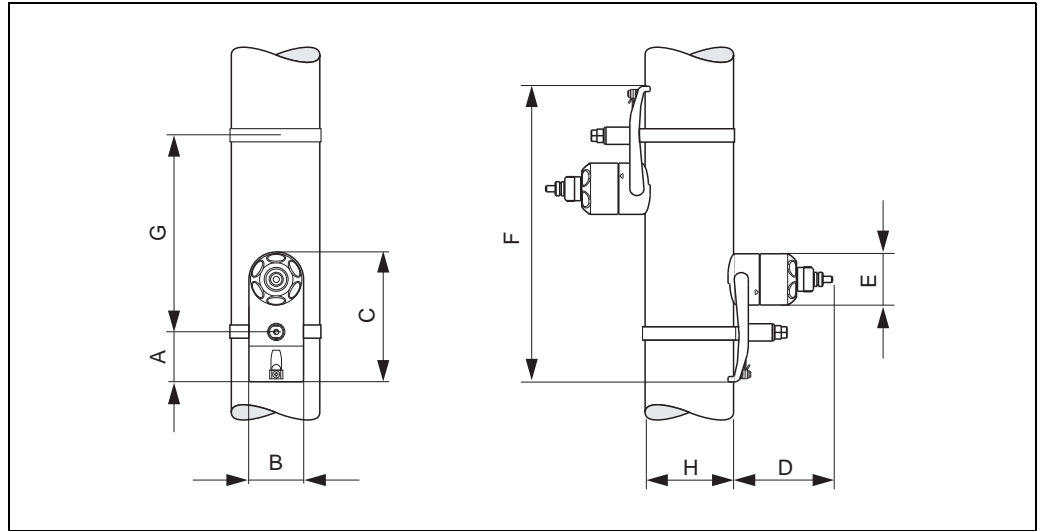
A	B	C	D	E	F	G	H
56	62	145	111	∅ 58	max. 872	min. 0.5	439 to 790
I						J	
Depends on the measuring point conditions (pipe, fluid, etc.). Dimension "I" can be determined:						Pipe outer diameter	
<ul style="list-style-type: none"> ■ Via transmitter programming Quick Setup (or FieldCare) ■ Online (Applicator) 							

All dimensions in [mm]

Dimensions in US units

A	B	C	D	E	F	G	H
2.20	2.44	5.71	4.37	∅ 2.28	max. 34.3	min. 0.2	16.3 to 31.1
I						J	
Depends on the measuring point conditions (pipe, fluid, etc.). Dimension "I" can be determined:						Pipe outer diameter	
<ul style="list-style-type: none"> ■ Via transmitter programming Quick Setup (or FieldCare) ■ Online (Applicator) 							

All dimensions in [inch]



A0001155

Mounting arrangement for measurement via one traverse

Dimensions in SI units

A	B	C	D	E	F
56	62	145	111	∅ 58	max. 872
G				H	
Depends on the measuring point conditions (pipe, fluid, etc.). Dimension "G" can be determined: <ul style="list-style-type: none"> ■ Via transmitter programming Quick Setup (or FieldCare) ■ Online (Applicator) 				Pipe outer diameter	

All dimensions in [mm]

Dimensions in US units

A	B	C	D	E	F
2.20	2.44	5.71	4.37	∅ 2.28	max. 34.3
G				H	
Depends on the measuring point conditions (pipe, fluid, etc.). Dimension "G" can be determined: <ul style="list-style-type: none"> ■ Via transmitter programming Quick Setup (or FieldCare) ■ Online (Applicator) 				Pipe outer diameter	

All dimensions in [inch]

Weight**Transmitter**

- Wall-mount housing: 6.0 kg (13.2 lbs)
- Field housing: 6.7 kg (14.8 lbs)

Sensor Prosonic Flow P

- DN 15 to 65 (½ to 2½") (incl. mounting material): 1.2 kg (2.65 lbs)
- DN 50 to 4000 (2 to 160") (incl. mounting material): 2.8 kg (6.2 lbs)

Sensor (accessories)

- Prosonic Flow DDU18 (incl. mounting material): 2.4 kg (5.3 lbs)
- Prosonic Flow DDU19 (incl. mounting material): 1.5 kg (3.3 lbs)



Note!
Weight information without packaging material.

Materials**Transmitter**

- Wall-mounted housing: powder-coated die-cast aluminum
- Field housing: powder-coated die-cast aluminum

Sensor Prosonic Flow P

DN 15 to 65 (½ to 2½"); DN 50 to 4000 (2 to 160")

- Sensor holder: stainless steel 1.4308/CF-8
- Sensor housing: stainless steel 1.4301/304
- Strapping bands/bracket: stainless steel 1.4301/304
- Sensor contact surfaces: chemically stable plastic

Sensor (accessories)

Prosonic Flow DDU18; Prosonic Flow DDU19

- Sensor holder: stainless steel 1.4308/CF-8
- Sensor housing: stainless steel 1.4301/304
- Strapping bands/bracket: stainless steel 1.4301/304
- Sensor contact surfaces: chemically stable plastic

Connecting cable (sensor/transmitter)

Prosonic Flow 93P (DN 15 to 65 / ½ to 2½")

- TPE-V connecting cable
 - Cable sheath: TPE-V
 - Cable connector: stainless steel 1.40301

Prosonic Flow 93P (DN 50 to 4000 / 2 to 160")

- PVC connecting cable
 - Cable sheath: PVC
 - Cable connector: nicked brass 2.0401
- PTFE connecting cable
 - Cable sheath: PTFE
 - Cable connector: stainless steel 1.4301

Human interface

Display elements	<ul style="list-style-type: none"> ■ Liquid crystal display: illuminated, four lines each with 16 characters ■ Custom configuration for presenting different measured values and status variables ■ 3 totalizers
Operating elements	<ul style="list-style-type: none"> ■ Local operation with three optical keys ■ Application specific Quick Setup menus for straightforward commissioning
Language group	<p>Language groups available for operation in different countries:</p> <ul style="list-style-type: none"> ■ Western Europe and America (WEA): English, German, Spanish, Italian, French, Dutch and Portuguese ■ Eastern Europe/Scandinavia (EES): English, Russian, Polish, Norwegian, Finnish, Swedish and Czech ■ South and Eastern Asia (SEA): English, Japanese, Indonesian ■ China (CN): English, Chinese <p>You can change the language group via the FieldCare operating program.</p>
Remote operation	Operation via HART, PROFIBUS DP/PA, FOUNDATION Fieldbus

Certificates and approvals

CE mark	The measuring system is in conformity with the statutory requirements of the EC Directives. Endress+Hauser confirms successful testing of the device by affixing to it the CE mark.
C-Tick mark	The measuring system is in conformity with the EMC requirements of the "Australian Communications and Media Authority" (ACMA).
Ex approval	Information on the currently available Ex-rated versions (ATEX, IECEx, FM, CSA, NEPSI, etc.) can be supplied by your Endress+Hauser Sales Center on request. All information relevant to explosion protection is available in separate documents that you can order as necessary.
PROFIBUS DP/PA certification	<p>The flowmeter has successfully passed all the test procedures carried out and is certified and registered by the PNO (PROFIBUS/DP User Organization). The device thus meets all the requirements of the following specifications:</p> <ul style="list-style-type: none"> ■ Certified to PROFIBUS DP/PA, profile version 3.0 (device certification number: on request) ■ The device can also be operated with certified devices of other manufacturers (interoperability)
FOUNDATION Fieldbus certification	<p>The flowmeter has successfully passed all the test procedures carried out and is certified and registered by the Fieldbus Foundation. The device thus meets all the requirements of the following specifications:</p> <ul style="list-style-type: none"> ■ Certified to FOUNDATION Fieldbus Specification ■ The device meets all the specifications of the FOUNDATION Fieldbus H1. ■ Interoperability Test Kit (ITK), revision status 5.01 (device certification number: on request) ■ The device can also be operated with certified devices of other manufacturers ■ Physical Layer Conformance Test of the Fieldbus Foundation

Other standards and guidelines

- EN 60529
Degrees of protection provided by enclosures (IP code)
- EN 61010-1
Safety requirements for electrical equipment for measurement, control and laboratory use
- IEC/EN 61326
"Emission in accordance with Class A requirements".
Electromagnetic compatibility (EMC requirements).
- ANSI/ISA-S82.01
Safety Standard for Electrical and Electronic Test, Measuring, Controlling and Related Equipment -
General Requirements. Pollution Degree 2, Installation Category II.
- CAN/CSA-C22.2 No. 1010.1-92
Safety Requirements for Electrical Equipment for Measurement and Control and Laboratory Use.
Pollution degree 2, Installation Category II
- NAMUR NE 21
Electromagnetic compatibility (EMC) of industrial process and laboratory control equipment.
- NAMUR NE 43
Standardization of the signal level for the breakdown information of digital transmitters with analog output
signal.
- NAMUR NE 53
Software of field devices and signal-processing devices with digital electronics.

Ordering information

The Endress+Hauser sales and service organization can provide detailed ordering information and information on the order codes on request.

Accessories

Various accessories, which can be ordered separately from Endress+Hauser, are available for the transmitter and the sensor. The Endress+Hauser service organization can provide detailed information on the order codes on request.

Device-specific accessories

Accessory	Description	Order code
Wall-mount housing, transmitter Prosonic Flow 93	Transmitter for replacement or for stock. Use the order code to define the following specifications: <ul style="list-style-type: none"> ■ Approvals ■ Degree of protection/version ■ Cable entry ■ Display / power supply / operation ■ Software ■ Outputs / inputs 	Single-channel version: 93XXX - XX1XX***** Two-channel version: 93XXX - XX2XX*****
Conversion kit, inputs/outputs	Conversion kit with appropriate plug-in point modules for converting the current input/output configuration to a new version.	DK9UI - **
Sensor P (DN 15 to 65 / ½ to 2½") Clamp-on version	DN 15 to 65 (½ to 2½") <ul style="list-style-type: none"> ■ -40 to +100 °C (-40 to 212 °F) ■ -40 to +150 °C (-40 to 302 °F) 	DK9PS - 1* DK9PS - 2*
Sensor P (DN 50 to 4000 / 2 to 160") Clamp-on version	DN 50 to 300 (2 to 12") <ul style="list-style-type: none"> ■ -40 to +80 °C (-40 to 176 °F) ■ 0 to +170 °C (+32 to 338 °F) DN 100 to 4000 (4 to 160") <ul style="list-style-type: none"> ■ -40 to +80 °C (-40 to 176 °F) ■ 0 to +170 °C (+32 to 338 °F) 	DK9PS - B* DK9PS - F* DK9PS - A* DK9PS - E*
Sensor DDU18	Sensor for sound velocity measurement <ul style="list-style-type: none"> ■ -40 to +80 °C (-40 to 176 °F) ■ 0 to +170 °C (+32 to 338 °F) 	50091703 50091704
Sensor DDU19	Sensor for wall thickness measurement.	50091713

Measuring principle-specific accessories

Accessory	Description	Order code
Mounting kit for aluminum field housing	Mounting kit for wall-mount housing. Suitable for: <ul style="list-style-type: none"> ■ Wall mounting ■ Pipe mounting ■ Panel mounting 	DK9WM - A
Mounting kit for field housing	Mounting kit for aluminum field housing: Suitable for pipe mounting (¾ to 3")	DK9WM - B
Sensor holder set	<ul style="list-style-type: none"> ■ Prosonic Flow P (DN 15 to 65 / ½ to 2½"): Sensor holder, clamp-on version ■ Prosonic Flow P (DN 50 to 4000 / 2 to 160") <ul style="list-style-type: none"> - Sensor holder, fixed retaining nut, clamp-on version - Sensor holder, removable retaining nut, clamp-on version 	DK9SH - 1 DK9SH - A DK9SH - B

Accessory	Description	Order code
Clamp-on installation set	<p>Sensor fastening for Prosonic Flow P (DN 15 to 65 / ½ to 2½")</p> <ul style="list-style-type: none"> ■ U-shaped screw DN 15 to 32 (½ to 1¼") ■ Strapping bands DN 40 to 65 (1½ to 2½") <p>Sensor fastening for Prosonic Flow P (DN 50 to 4000 / 2 to 160")</p> <ul style="list-style-type: none"> ■ Without sensor fastening ■ Strapping bands DN 50 to 200 (2 to 8") ■ Strapping bands DN 200 to 600 (8 to 24") ■ Strapping bands DN 600 to 2000 (24 to 80") ■ Strapping bands DN 2000 to 4000 (80 to 160") ■ Without mounting tools ■ Spacing ruler DN 50 to 200 (2 to 8") ■ Spacing ruler DN 200 to 600 (8 to 24") ■ Mounting rail DN 50 to 200 (2 to 8") ■ Mounting rail DN 200 to 600 (8 to 24") ■ Fastening, 1 traverse DN 50 to 4000 (2 to 160") 	<p>DK9IC - 1* DK9IC - 2*</p> <p>DK9IC - A* DK9IC - B* DK9IC - C* DK9IC - D* DK9IC - E*</p> <p>DK9IC - *1 DK9IC - *2 DK9IC - *3 DK9IC - *4 DK9IC - *5 DK9IC - *6</p>
Conduit adapter for connecting cable	<p>Prosonic Flow P (DN 15 to 65 / ½ to 2½")</p> <ul style="list-style-type: none"> ■ Conduit adapter incl. cable entry M20 × 1.5 ■ Conduit adapter incl. cable entry ½" NPT ■ Conduit adapter incl. cable entry G ½" <p>Prosonic Flow P (DN 50 to 4000 / 2 to 160")</p> <ul style="list-style-type: none"> ■ Conduit adapter incl. cable entry M20 × 1.5 ■ Conduit adapter incl. cable entry ½" NPT ■ Conduit adapter incl. cable entry G ½" 	<p>DK9CB - BA1 DK9CB - BA2 DK9CB - BA3</p> <p>DK9CB - BB1 DK9CB - BB2 DK9CB - BB3</p>
Connecting cable	<p>Prosonic Flow P (DN 15 to 65 / ½ to 2½")</p> <p>5 m sensor cable, TPE-V, -20 to +70 °C (-4 to +158 °F) 10 m sensor cable, TPE-V, -20 to +70 °C (-4 to +158 °F) 15 m sensor cable, TPE-V, -20 to +70 °C (-4 to +158 °F) 30 m sensor cable, TPE-V, -20 to +70 °C (-4 to +158 °F)</p> <p>Prosonic Flow P (DN 50 to 4000 / 2 to 160")</p> <p>5 m sensor cable, PVC, -20 to +70 °C (-4 to +158 °F) 10 m sensor cable, PVC, -20 to +70 °C (-4 to +158 °F) 15 m sensor cable, PVC, -20 to +70 °C (-4 to +158 °F) 30 m sensor cable, PVC, -20 to +70 °C (-4 to +158 °F)</p> <p>5 m sensor cable, PTFE, -40 to +170 °C (-40 to +158 °F) 10 m sensor cable, PTFE, -40 to +170 °C (-40 to +158 °F) 15 m sensor cable, PTFE, -40 to +170 °C (-40 to +158 °F) 30 m sensor cable, PTFE, -40 to +170 °C (-40 to +158 °F)</p>	<p>DK9SS - BAA DK9SS - BAB DK9SS - BAC DK9SS - BAD</p> <p>DK9SS - BBA DK9SS - BBB DK9SS - BBC DK9SS - BBD</p> <p>DK9SS - BBE DK9SS - BBF DK9SS - BBG DK9SS - BBH</p>
Acoustic coupling fluid	<ul style="list-style-type: none"> ■ Coupling fluid 0 to 170 °C (+32 to 338 °F), high temperature, standard ■ Adhesive coupling fluid -40 to +80 °C (-40 to +176 °F) ■ Water-soluble coupling fluid -20 to +80 °C (-4 to +176 °F) ■ Coupling fluid DDU 19, -20 to +60 °C (-4 to +140 °F) ■ Coupling fluid -40 to +80 °C (-40 to +176 °F), standard, type MBG2000 	<p>DK9CM - 2</p> <p>DK9CM - 3 DK9CM - 4 DK9CM - 6 DK9CM - 7</p>

Communication-specific accessories

Accessory	Description	Order code
HART handheld terminal DXR375	Handheld terminal for remote configuration and for obtaining measured values via the HART current output (4 to 20 mA) and FOUNDATION Fieldbus. Contact your Endress+Hauser representative for more information.	DXR375 - *****
Fieldgate FXA320	Gateway for remote interrogation of HART sensors and actuators via Web browser: <ul style="list-style-type: none"> ■ 2-channel analog input (4 to 20 mA) ■ 4 binary inputs with event counter function and frequency measurement ■ Communication via modem, Ethernet or GSM ■ Visualization via Internet/Intranet in the Web browser and/or WAP cellular phone ■ Limit value monitoring with alarm signaling via e-mail or SMS ■ Synchronized time stamping of all measured values 	FXA320 - *****
Fieldgate FXA520	Gateway for remote interrogation of HART sensors and actuators via Web browser: <ul style="list-style-type: none"> ■ Web server for remote monitoring of up to 30 measuring points ■ Intrinsically safe version [EEx ia]IIC for applications in hazardous areas ■ Communication via modem, Ethernet or GSM ■ Visualization via Internet/Intranet in the Web browser and/or WAP cellular phone ■ Limit value monitoring with alarm signaling via e-mail or SMS ■ Synchronized time stamping of all measured values ■ Remote diagnosis and remote configuration of connected HART devices 	FXA520 - *****

Service-specific accessories

Accessory	Description	Order code
Applicator	Software for selecting and planning flowmeters. The Applicator can be downloaded from the Internet or ordered on CD-ROM for installation on a local PC. Contact your Endress+Hauser representative for more information.	DXA80 - *
Fieldcheck	Tester/simulator for testing flowmeters in the field. When used in conjunction with the "FieldCare" software package, test results can be imported into a database, printed out and used for official certification. Contact your Endress+Hauser representative for more information.	50098801
FieldCare	FieldCare is Endress+Hauser's FDT-based plant asset management tool. It can configure all intelligent field units in your system and helps you manage them. By using the status information, it is also a simple but effective way of checking their status and condition.	See the product page on the Endress+Hauser website: www.endress.com
FXA193	Service interface from the measuring device to the PC for operation via FieldCare.	FXA193 - *
Communication cable	Communication cable for connecting the Prosonic Flow 93P transmitter to the FXA193 service interface.	DK9ZT - A

Documentation

- Flow measurement (FA005D)
- Operating Instructions for Prosonic Flow 93 (BA070D and BA071D)
- Operating Instructions for Prosonic Flow 93 PROFIBUS DP/PA (BA076D and BA077D)
- Operating Instructions for Prosonic Flow 93 FOUNDATION Fieldbus (BA078D and BA079D)
- Supplementary documentation on Ex-ratings: ATEX, FM, CSA, IECEx, NEPSI

Registered trademarks

HART®

Registered trademark of HART Communication Foundation, Austin, USA

PROFIBUS®

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