



Level



Pressure



Flow



Temperature

Liquid  
Analysis

Registration

Systems  
Components

Services



Solutions

## Technical Information

# Proline Prosonic Flow 90P, 93P

## Ultrasonic Flow Measuring System

Volume flow measurement of liquids in chemical or process applications



### Applications

The sensors are perfectly suited for bidirectional measurement of pure or slightly contaminated liquids, regardless of the pressure, temperature, conductivity and viscosity.

- Applicable for all homogeneous fluids in acoustically transmissive pipes, even with lining
- For chemical or process applications
- Wide fluid temperature range  $-40\dots+170\text{ }^{\circ}\text{C}$
- Ideal for retrofitting
- Installation without process interruption

Approvals for hazardous area:

- ATEX, FM, CSA, TIIS

Connection to process control system:

- HART, PROFIBUS DP/PA, FOUNDATION Fieldbus

### Features and benefits

Prosonic Flow clamp-on is the flexible and cost-effective flow measuring system.

The **Proline transmitter concept** comprises:

- Modular device and operating concept resulting in a higher degree of efficiency
- Diagnostic ability and data back-up for increased process quality

The tried-and-tested **Prosonic Flow sensors** offer:

- Easy and safe installation and commissioning guarantee precise measurement
- Insensitivity to vibrations
- No pressure loss
- Robust, industrial design for a high degree of reliability in the process

## Function and system design

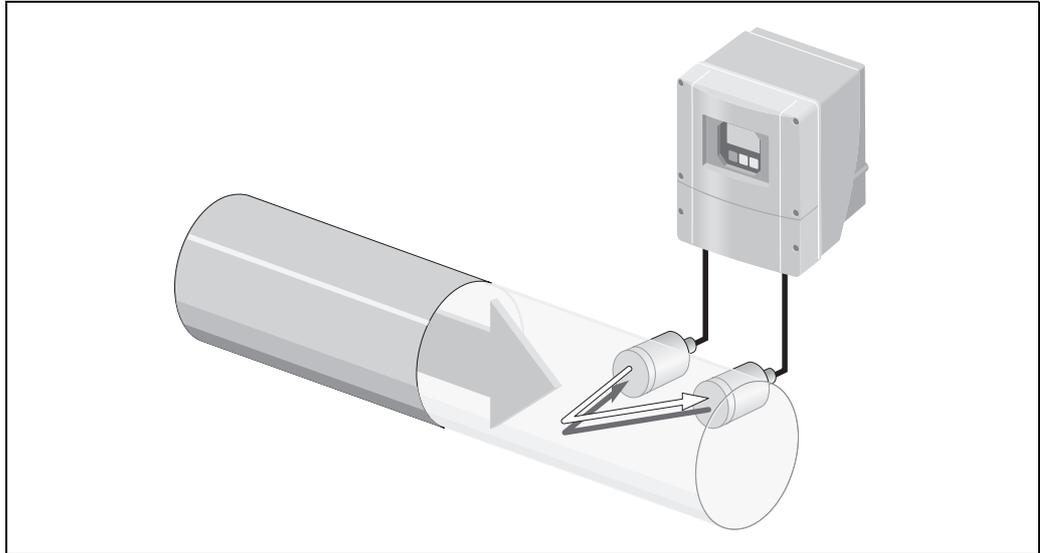
### Measuring principle

Prosonic Flow operates on the principle of transit time difference.

An acoustic (ultrasonic) signal is transmitted in both directions from one measuring sensor to the other.

As the signal 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 difference is directly proportional to the flow velocity.

Prosonic Flow calculates the flow from the pipe cross-sectional area and the measured transit time difference.



F06-9xxxxxx-15-xx-06-xx-000

$$v \sim \Delta t$$

$$Q = v \cdot A$$

$v$  = flow velocity

$\Delta t$  = transit time difference

$Q$  = volume flow

$A$  = pipe cross-sectional area

In addition to the volume flow, the system measures the sound velocity in the liquid. The sound velocity can be used to distinguish different liquids or as a measure of product quality. You can carry out an application-specific calibration of Prosonic Flow in the field using the Quick Setup.

### System design Measuring system

The Prosonic Flow ultrasonic flow measuring system always consists of a transmitter and the related measuring sensors. All components are available in different versions depending on the application requirements.

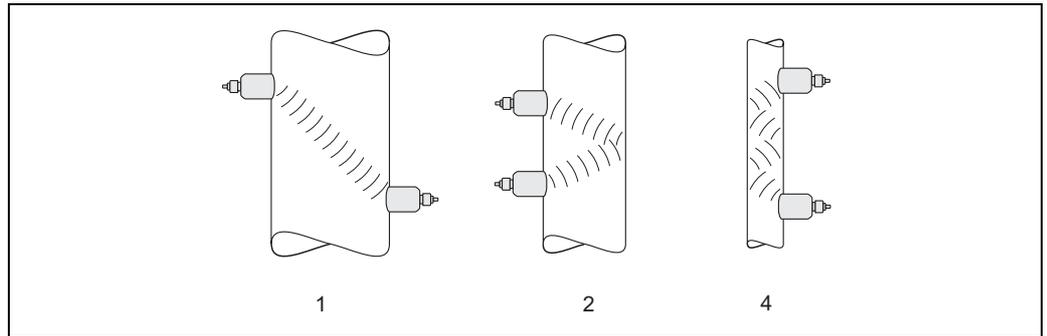
The transmitter is used to actuate the measuring sensors. The electronics and the software in the transmitter are used to prepare, process and evaluate the sensor signals and to convert the measuring signal to the desired output variables.

The measuring sensors work bidirectionally as sound transmitters and sound receivers. The electrical signals of the transmitter are converted to a pressure signal in the measuring sensors and vice versa.

Depending on the design, the different sensor versions of ultrasonic flow measuring devices offer unique possibilities in the application. The properties and benefits of the different versions are explained in detail on the following pages.

**Sensor arrangement**

The transmitter offers a number of options between 1 and 4 traverses for the type of installation.



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1 = 1 traverse, 2 = 2 traverses, 4 = 4 traverses

**Recommendations:**

Due to their design and properties, the Prosonic Flow sensors are particularly suited to certain nominal diameter ranges and pipe wall thicknesses. For this reason, various sensor types are offered for Prosonic Flow P for these different applications.

Recommendations for sensor installation can be found in the following table.

Sensor type	Nominal diameter	Type of mounting
Prosonic Flow P	DN 50...60	2 (or 1) traverses
	DN 80...600	2 traverses
	DN 650...4000	1 traverse

**Note!**

- Please note that the signal strength is reduced with each additional reflection point in the pipe. (Example: 2 traverses = 1 reflection point).
- The installation of clamp-on sensors is principally recommended in the 2 traverse type of 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.
- If the pipe nominal diameter is small (DN 60 and smaller), the sensor spacing with Prosonic Flow W/P can be too small for an installation with 2 traverses. In this case, the 1 traverse type of installation must be used. In all other instances, the 2 traverse configuration is the preferred method.
- The use of Prosonic Flow P sensors DN 100...4000 is principally recommended for plastic pipes with a wall thickness > 10 mm, pipes made of composites such as GRP, pipes with lining, even for nominal diameters < DN 100. This applies also to applications with media with high acoustic damping. For these applications, we principally recommend mounting the P sensors with 1 traverse configuration.
- If the measuring device displays an insufficient signal strength, reduce the number of the traverses.

### Two-channel measuring devices

Prosonic Flow 93 has two measuring channels which are independent of one another. In other words, the transmitter supports the simultaneous operation of two sensor pairs at two individual measuring channels. In doing so, the resources of the transmitter are split evenly between the two channels.

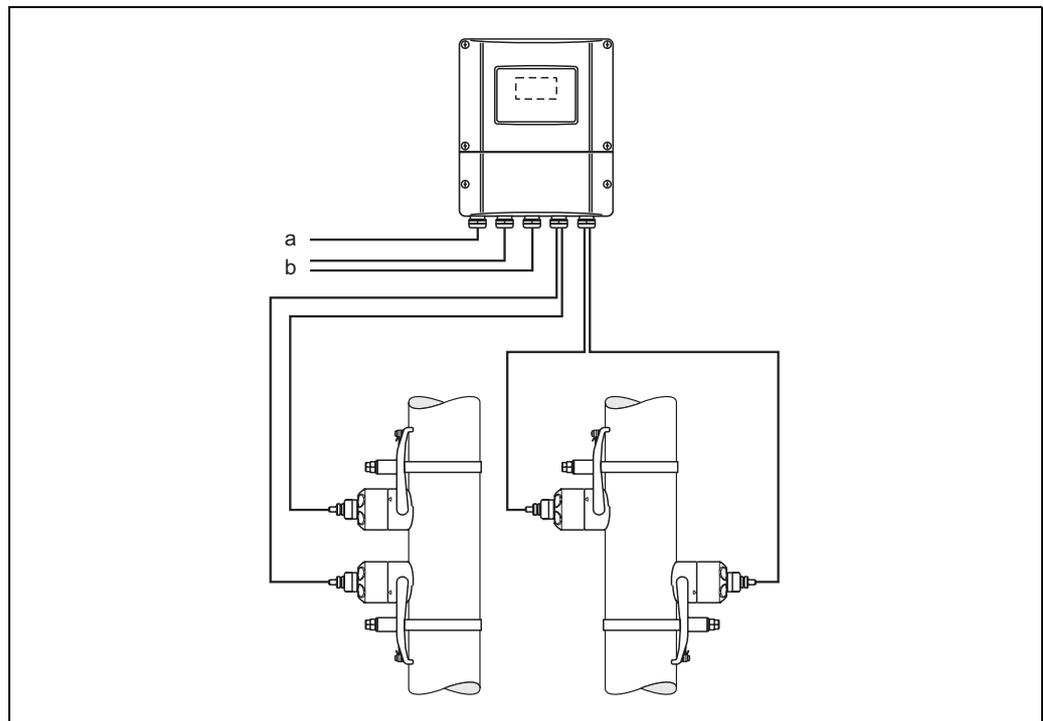
This ability of the transmitter can be used in many different ways:

- For two-channel measurement
- For two-path measurement

The transmitter can output the measured values of both channels either individually or arithmetically linked (as total, difference or mean).

### Two-channel measurement

In the case of dual-channel measurement, the measured values of two independent measuring points are determined and processed by one transmitter.



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- a Cable for power supply  
b Signal cable (Outputs)

If required, the measured values of measuring channel 1 and measuring channel 2 can be arithmetically linked together. The following possibilities for outputting measured values are suitable for dual-channel measurement:

- Individual output of measured values from channel 1 and 2
- Total of measured values from channel 1 and 2
- Difference of measured values from channel 1 and 2

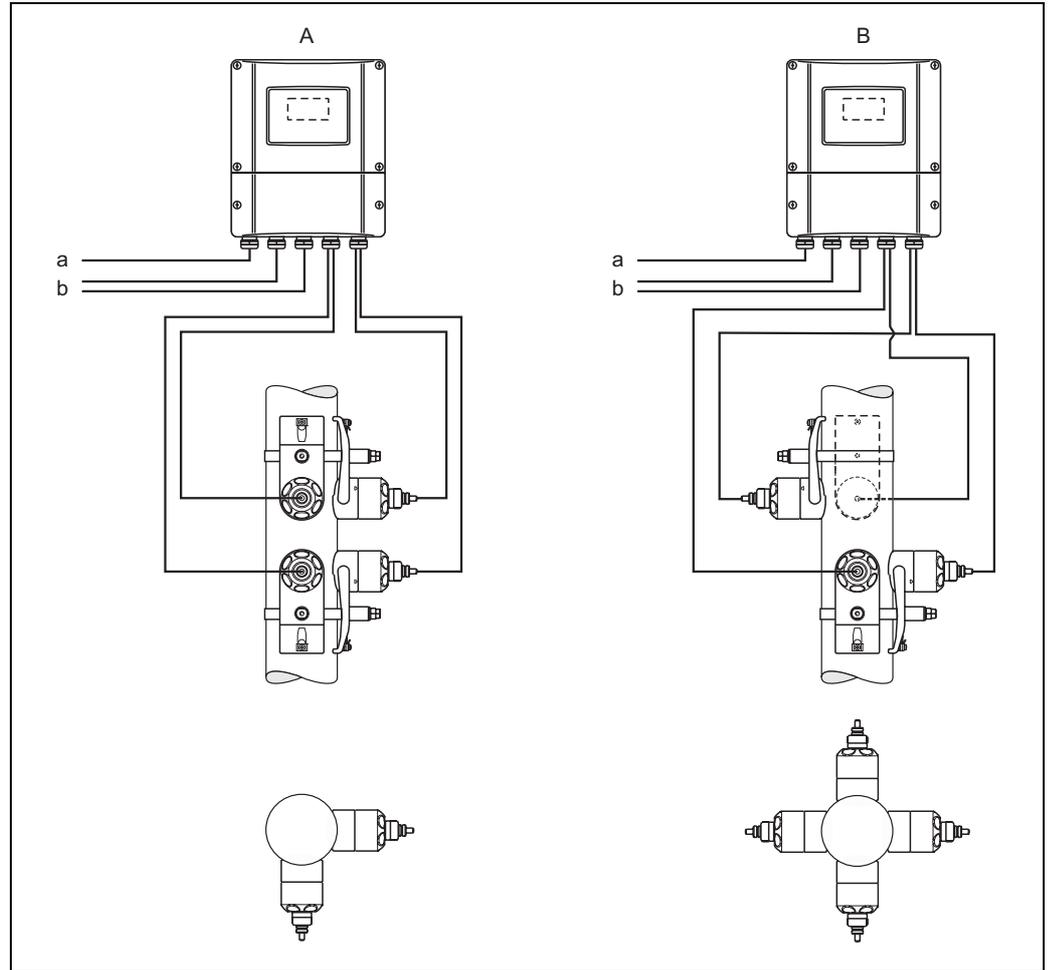
The measuring device supports the individual configuration of the measuring channels and the independent setting of the display and outputs. As a result, the sensor type and type of installation, for example, can be selected and configured separately for both channels.

Note!

Please pay special attention to the installation recommendations in Chapter "Mounting location", Page 19, Chapter "Orientation", Page 20, Chapter "Inlet and outlet runs", Page 21 as well as the recommendations on the type of installation in Chapter "Sensor arrangement", Page 3.

### Two-path measurement

In dual-path measurement, the transmitter is used to operate two sensor pairs which are installed on the same pipe. Different applications can necessitate different types of installation.



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- a Cable for power supply  
b Signal cable (Outputs)

#### Note!

Please note the recommendations in Chapter “Sensor arrangement”, Page 3.

The following possibilities for outputting measured values are suitable for dual-path measurement:

- Individual output of measured values from channel 1 and 2
- Arithmetic mean of the measured values from channel 1 and 2 ( $CH1 + CH2 / 2$ )

The possibility of obtaining the mean value in dual-path measurement provides the advantage of a more stable measured value. A measured value that is generated from two independent measuring signals is generally less sensitive to irregularities and faults in the application.

As a result, if conditions are not ideal, for example, the dual-path system means that the different flow components within the flow can be better determined thanks to the fact that the measured values are determined independently on two levels. Differences are then balanced out when the two measured values are subsequently averaged to form one process variable. This often results in a more stable and more accurate measured value than would be the case with single-path measurement.

The measuring device supports the individual configuration of the measuring channels.

#### Note!

Please pay special attention to the installation recommendations in Chapter “Mounting location”, Page 19, Chapter “Orientation”, Page 20, Chapter “Inlet and outlet runs”, Page 21 as well as the recommendations on the type of installation in Chapter “Sensor arrangement”, Page 3.

### Commissioning accessories

During mounting and commissioning, in order to determine the sensor distance, you require data on the measurement liquid, the pipe material used and the exact pipe dimensions. Data on the most common liquids, pipe materials and lining materials are programmed into the Prosonic Flow 93 program.

#### For liquids:

WATER – SEAWATER – DISTILLED WATER – AMMONIA – ALCOHOL – BENZENE – BROMIDE – ETHANOL – GLYCOL – KEROSENE – MILK – METHANOL – TOLUOL – LUBRICATING OIL – FUEL OIL – PETROL

#### For pipe materials:

STAINLESS STEEL – SS ANSI 304 – SS ANSI 316 – SS ANSI 347 – SS ANSI 410 – SS ANSI 430 – ALLOY C – PVC – PE – LDPE – HDPE – GRP – PVDF – PA – PP – PTFE – GLASS PYREX – ASBESTOS CEMENT – CARBON STEEL – DUCTILE IRON

#### Linings:

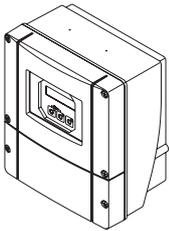
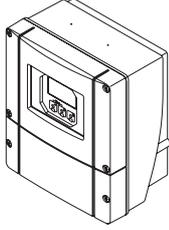
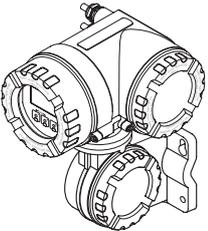
CEMENT – RUBBER – TAR EPOXY

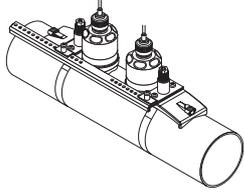
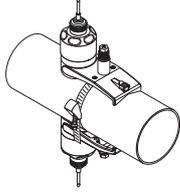
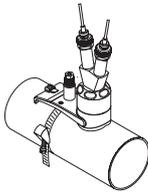
If your pipe material or liquid is not included in the pre-programmed selection of the transmitter nor known from the technical literature, establish the missing data with either method:

- Use the wall thickness sensor DDU 19 (see “Accessories” on page 30).
- Use the sound velocity sensor DDU 18 (see “Accessories” on page 30).

### Measuring system

The measuring system consists of the following transmitters and sensors.

<b>Measuring transmitter</b>	
<p><b>Prosonic Flow 90</b></p>  <p style="text-align: center; font-size: small;">F06-x0xxxxxx-21-03-06-xx-002</p>	<ul style="list-style-type: none"> <li>■ For mounting in non-hazardous areas.</li> <li>■ Two-line LCD display</li> <li>■ Configuration with keys</li> <li>■ Quick Setup</li> <li>■ All outputs are galvanically isolated from the power supply, measuring circuit and each other.</li> <li>■ Volume and sound velocity measurement</li> <li>■ Designed for single channel measurement as standard</li> <li>■ Degree of protection IP 67</li> </ul>
<p><b>Prosonic Flow 93</b></p>  <p style="text-align: center; font-size: small;">F06-x3xxxxxx-21-03-06-xx-002</p>	<ul style="list-style-type: none"> <li>■ For installation in the non hazardous areas and in Ex Zone II.</li> <li>■ Four-line liquid-crystal display</li> <li>■ Operation with Touch Control</li> <li>■ Application-specific Quick Setup</li> <li>■ All the outputs are galvanically isolated from the power supply, measuring circuit and each other.</li> <li>■ Volume and sound velocity measurement</li> <li>■ Prepared for wall thickness measurement as standard</li> <li>■ Prepared as standard for measurements with two sensor pairs at the same or at two different measuring points.</li> <li>■ Degree of protection IP 67</li> </ul>
<p><b>Prosonic Flow 93</b></p>  <p style="text-align: center; font-size: small;">F06-x3xxxxZZ-21-03-06-xx-001</p>	<ul style="list-style-type: none"> <li>■ For installation in Ex Zone I.</li> <li>■ Four-line liquid-crystal display</li> <li>■ Operation with Touch Control</li> <li>■ Application-specific Quick Setup</li> <li>■ All the outputs are galvanically isolated from the power supply, measuring circuit and each other.</li> <li>■ Volume and sound velocity measurement</li> <li>■ Prepared for wall thickness measurement as standard</li> <li>■ Prepared as standard for measurements with two sensor pairs at the same or at two different measuring points.</li> <li>■ Degree of protection IP 67</li> </ul>

<b>Measuring sensors</b>	
<p><b>P</b></p>  <p style="text-align: center; font-size: small;">F06-9xPxxxxx-21-05-06-xx-001</p>	<ul style="list-style-type: none"> <li>■ Clamp-on flow measuring sensors</li> <li>■ Sensor pair for flow measurement and sound velocity in the fluid during operation.</li> <li>■ 2 sensor types for DN 50...4000 (2"...160")</li> <li>■ Temperature ranges -40...+80 °C resp. 0...+170 °C</li> <li>■ Degree of protection IP 68</li> <li>■ Stainless steel sensor holders</li> </ul>
<p><b>DDU 18</b></p>  <p style="text-align: center; font-size: small;">F06-9xDDU18x-21-05-06-xx-001</p>	<ul style="list-style-type: none"> <li>■ Sound velocity measuring sensors for Prosonic Flow 93</li> <li>■ Sensor pair for measurement of sound velocity in the fluid. Only required to commission the clamp-on version, if the sound velocity in the fluid is unknown.</li> <li>■ DN 50...3000 (2"...120")</li> <li>■ Temperature range -40...+80 °C</li> <li>■ Degree of protection IP 68</li> <li>■ Stainless steel sensor holder</li> </ul>
<p><b>DDU 19</b></p>  <p style="text-align: center; font-size: small;">F06-9xDDU19x-21-05-06-xx-001</p>	<ul style="list-style-type: none"> <li>■ Wall thickness measuring sensor for Prosonic Flow 93</li> <li>■ Sensor for measuring pipe wall thickness. Only required to commission the clamp-on version.</li> <li>■ Wall thickness measuring range: 2...50 mm for steel pipes 4...15 mm for plastic pipes (not recommended for use with PTFE or PE pipes)</li> <li>■ Temperature range 0...+60 °C</li> <li>■ Degree of protection IP 67</li> <li>■ Stainless steel sensor holder</li> </ul>

## Input

<b>Measured variable</b>	Flow velocity (differential delay proportional to flow velocity)
<b>Measuring range</b>	Typically $v = 0...15$ m/s at the specified measuring accuracy
<b>Operable flow range</b>	Over 150 :1
<b>Input signal</b>	Status input (auxiliary input): $U = 3...30$ V DC, $R_i = 5$ k $\Omega$ , galvanically isolated. Configurable for: totalizer(s) reset, measured-value suppression, error-message reset.

## Output

<b>Output signal</b>	<p><b>Prosonic Flow 90</b></p> <p><i>Current output:</i>                      Active/passive selectable, galvanically isolated, time constant selectable (0.05...100 s), full scale value adjustable, temperature coefficient: typically 0.005% o.r./°C; resolution: 0.5 <math>\mu</math>A</p> <ul style="list-style-type: none"> <li>■ Active: 0/4...20 mA, <math>R_L &lt; 700</math> <math>\Omega</math> (for HART: <math>R_L \geq 250</math> <math>\Omega</math>)</li> <li>■ Passive: 4...20 mA, supply voltage 18...30 V DC, <math>R_L &lt; 700</math> <math>\Omega</math></li> </ul> <p><i>Pulse/frequency output:</i>                      Passive, open collector, 30 V DC, 250 mA, galvanically isolated.</p> <ul style="list-style-type: none"> <li>■ <i>Frequency output:</i> full scale frequency 2...1000 Hz (<math>f_{max} = 1250</math> Hz), on/off ratio 1:1, pulse width max. 10 s</li> <li>■ <i>Pulse output:</i> pulse value and pulse polarity selectable, max. pulse width adjustable (0.5...2000 ms), max. pulse frequency selectable</li> </ul>
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*PROFIBUS PA interface:*

- PROFIBUS PA in accordance with EN 50170 Volume 2, IEC 61158-2 (MBP), galvanically isolated
- Current consumption: 11 mA
- Error current FDE (Fault Disconnection Electronic): 0 mA
- Data transmission rate, supported baudrate: 31.25 kBit/s
- Signal encoding: Manchester II
- Function blocks: 3 x Analog Input (AI), 1 x Totalizer
- Output data: volume flow, sound velocity, flow velocity
- 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

**Prosonic Flow 93***Current output:*

Active/passive selectable, galvanically isolated, time constant selectable (0.05...100 s), full scale value adjustable, temperature coefficient: typically 0.005% o.r./°C; resolution: 0.5  $\mu$  A

- Active: 0/4...20 mA,  $R_L < 700 \Omega$  (for HART:  $R_L \geq 250 \Omega$ )
- Passive: 4...20 mA, max. 30 V DC,  $R_i \leq 150 \Omega$

*Pulse/frequency output:*

Active/passive selectable, galvanically isolated

- Active: 24 V DC, 25 mA (max. 250 mA during 20 ms),  $R_L > 100 \Omega$
- Passive: open collector, 30 V DC, 250 mA
- *Frequency output:* full scale frequency 2...10000 Hz ( $f_{max} = 12500$  Hz), 2...5000 Hz for EEx ia, on/off ratio 1:1, pulse width max. 10 s
- *Pulse output:* pulse value and pulse polarity selectable, max. pulse width adjustable (0.05...2000 ms), the on/off ratio is 1:1 as of a frequency of  $1 / (2 \times \text{pulse width})$

*PROFIBUS DP interface:*

- PROFIBUS DP/PA in accordance with EN 50170 Volume 2, IEC 61158-2, galvanically isolated
- Data transmission rate, supported baudrate: 9.6 kBaud...12 MBaud
- Signal encoding: NRZ code
- Function blocks: 8 x Analog Input (AI), 3 x 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
- 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
- Automatic data transmission rate recognition

*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 x Analog Input (AI), 3 x 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...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 x Analog Input (AI), 1 x Discrete Output, 1 x 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, volume flow difference, totalizer 1...3
- Input data: positive zero return (ON/OFF), reset totalizer, zero point adjustment control
- Link Master function (LAS) is supported

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<b>Signal on alarm</b>	<ul style="list-style-type: none"> <li>■ Current output → failsafe mode selectable</li> <li>■ Pulse/frequency output → failsafe mode selectable</li> <li>■ Status output (Prosonic Flow 90) → “non-conductive” in event of error or power supply failure</li> <li>■ Relay output (Prosonic Flow 93) → “voltage-free” in event of error or power supply failure</li> </ul>
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<b>Load</b>	see “Output signal”
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<b>Switching output</b>	<p>Status output (Prosonic Flow 90): Open collector, max. 30 V DC / 250 mA, galvanically isolated. Configurable for: error messages, flow direction, limit values.</p> <p>Relay output (Prosonic Flow 93): Normally closed (NC) or normally open (NO) contacts 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.</p>
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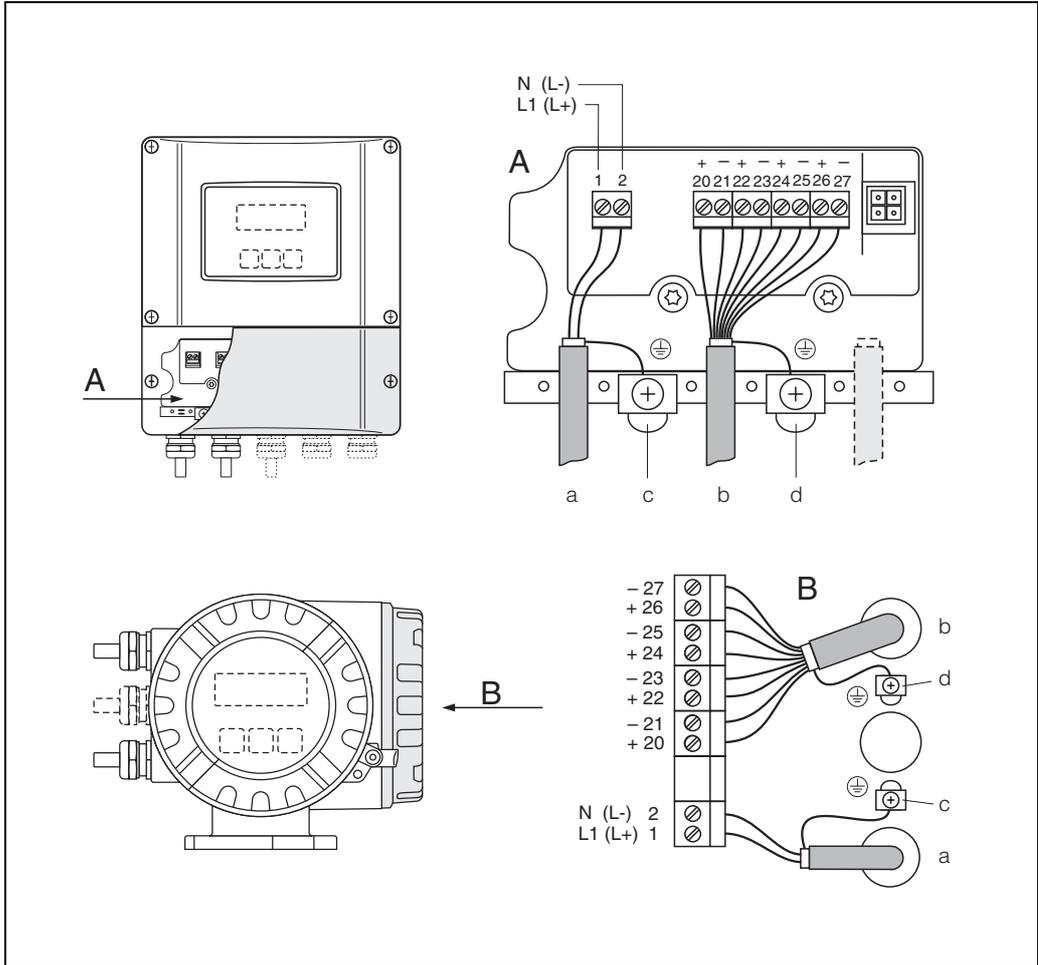
<b>Low flow cutoff</b>	Switch points for low flow cutoff are selectable
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<b>Galvanic isolation</b>	All circuits for inputs, outputs, and power supply are galvanically isolated from each other.
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# Power supply

Electrical connection measuring unit



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A = View A (wall-mounted housing; non hazardous area, Ex Zone 2)

B = View B (field housing; Ex Zone 1)

- a Cable for power supply: 85...260 V AC, 20...55 V AC, 16...62 V DC; power consumption: 18 VA / 10 W  
Terminal No. 1: L1 for AC, L+ for DC  
Terminal No. 2: N for AC, L- for DC
- b Signal cable: terminals No. 20-27
- c Ground terminal for protective conductor
- d Ground terminal for signal cable shield

Terminal assignment Prosonic Flow 90

Order variant	Terminal No. (inputs/outputs)			
	20 (+) / 21 (-)	22 (+) / 23 (-)	24 (+) / 25 (-)	26 (+) / 27 (-)
90***_*****W				Current output HART
90***_*****A	-	-	Frequency output	Current output HART
90***_*****D	Status input	Status output	Frequency output	Current output HART
90***_*****H	-	-	-	PROFIBUS PA

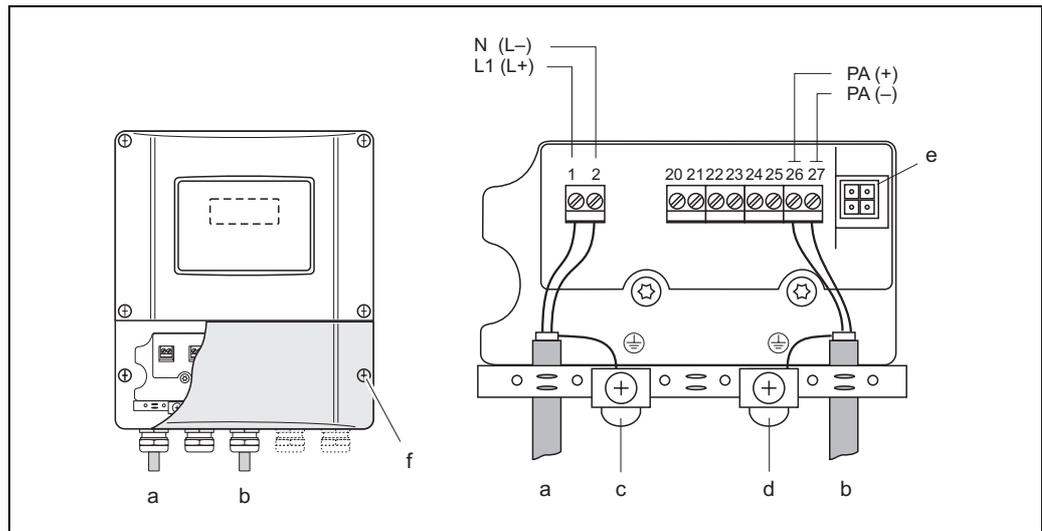
**Terminal assignment Prosonic Flow 93**

Depending on the version ordered, the inputs/outputs on the communication board can be either permanently assigned (fixed) or variable (flexible) (see Table). Plug-in point modules which are faulty or need 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	Relay output	Frequency output	Current output HART
93***_*****H	–	–	–	PROFIBUS PA
93***_*****J	–	–	–	PROFIBUS DP
93***_*****K	–	–	–	FOUNDATION Fieldbus
<i>Flexible communication boards</i>				
93***_*****C	Relay output	Relay output	Frequency output	Current output HART
93***_*****4	Frequency output	Frequency output	Current output	Current output HART
93***_*****D	Status input	Relay output	Frequency output	Current output HART
93***_*****6	Relay output	Relay output	Current output	Current output HART
93***_*****L	Status input	Relay output	Relay output	Current output HART
93***_*****M	Status input	Frequency output	Frequency output	Current output HART
93***_*****W	Relay output	Current output	Current output	Current output HART
93***_*****2	Relay output	Current output	Frequency output	Current output HART

**Electrical connection  
measuring unit for  
Prosonic Flow 90  
(PROFIBUS PA)**

Connecting power supply and bus cables in the connection compartment



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Connecting the transmitter (wall-mount housing). Cable cross-section: max. 2.5 mm<sup>2</sup>

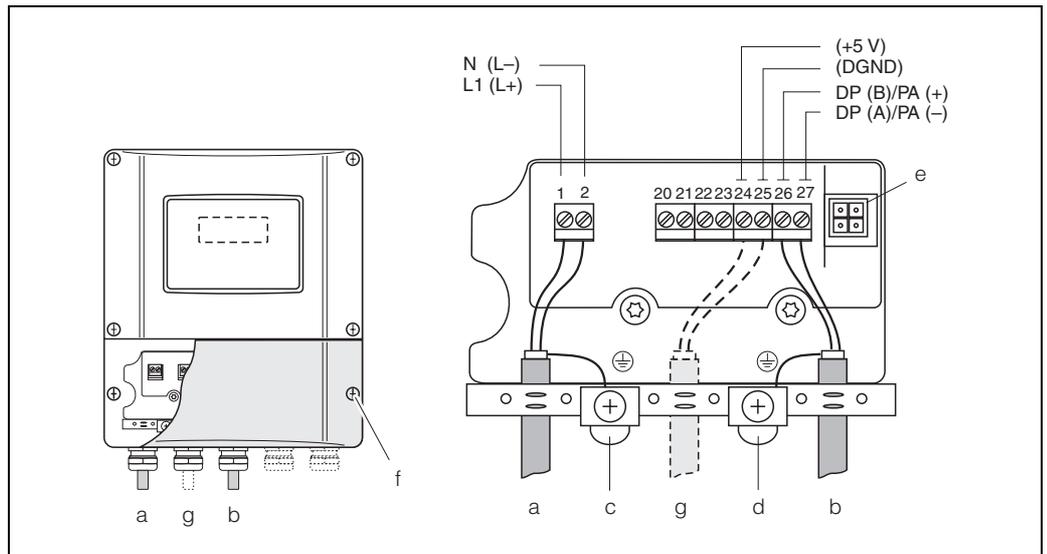
- a Cable for power supply: 85...260 V AC, 20...55 V AC, 16...62 V DC  
Terminal **No. 1**: L1 for AC, L+ for DC  
Terminal **No. 2**: N for AC, L- for DC
- b PROFIBUS PA line:  
Terminals **No. 20**: PA+  
Terminals **No. 27**: PA-
- c Ground terminal for protective earth
- d Ground terminal for signal cable screen
- e Service connector for connecting service interface FXA193 (Fieldcheck, ToF Tool - Fieldtool Package)
- f Cover of the connection compartment

**Terminal assignment**

Order variant	Terminal No. (outputs/inputs)
	<b>26</b> : PA+ <b>27</b> : PA-
90***_*****H	PROFIBUS PA (non Ex)
<b>Connection values PROFIBUS PA</b>	
PROFIBUS PA: Power supply: 9...32 V DC Current consumption: 11 mA	

**Electrical connection measuring unit for Prosonic Flow 93 (PROFIBUS DP/PA)**

Connecting power supply and bus cables in the connection compartment



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Connecting the transmitter (wall-mount housing), cable cross-section: max. 2.5 mm<sup>2</sup>

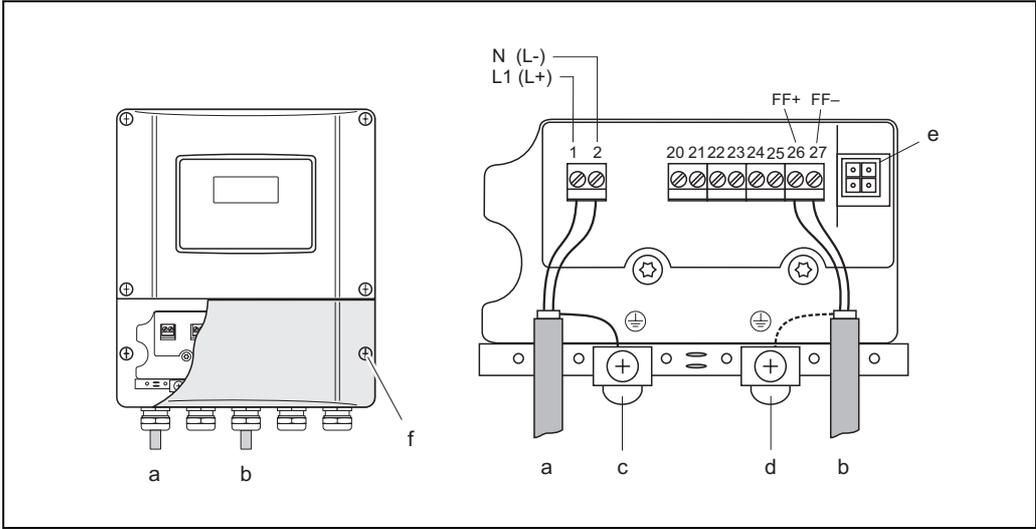
- a Cable for power supply: 85...260 V AC, 20...55 V AC, 16...62 V DC  
Terminal **No. 1**: L1 for AC, L+ for DC  
Terminal **No. 2**: N for AC, L- for DC
- b PROFIBUS DP/PA line :  
Terminals **No. 26**: DP(B) / PA+  
Terminal **No. 27**: DP(A) / PA -  
DP(A) = RxD/TxD-N, DP(B) = RxD/TxD-P
- c Ground terminal for protective earth
- d Ground terminal for signal cable screen
- e Service connector for connecting service interface FXA193 (Fieldcheck, ToF Tool - Fieldtool Package)
- f Cover of the connection compartment
- g Cable for external termination:  
Terminal **No. 24**: DGND  
Terminal **No. 25**: +5V

**Terminal assignment**

Order variant	Terminal No. (outputs/inputs)
	<b>26</b> : DP(B) / PA+ <b>27</b> : DP(A) / PA-
93***_***** <b>H</b>	PROFIBUS PA
93***_***** <b>J</b>	PROFIBUS DP
<b>Connection values PROFIBUS PA</b>	
PROFIBUS PA: Power supply: 9...32 V DC Current consumption: 11 mA	

**Electrical connection measuring unit for Prosonic Flow 93 (FOUNDATION Fieldbus)**

Connecting power supply and bus cables in the connection compartment



F06-xxxPFxxx-04-03-xx-xx-000

Connecting the transmitter (wall-mount housing). Cable cross-section: max. 2.5 mm<sup>2</sup>

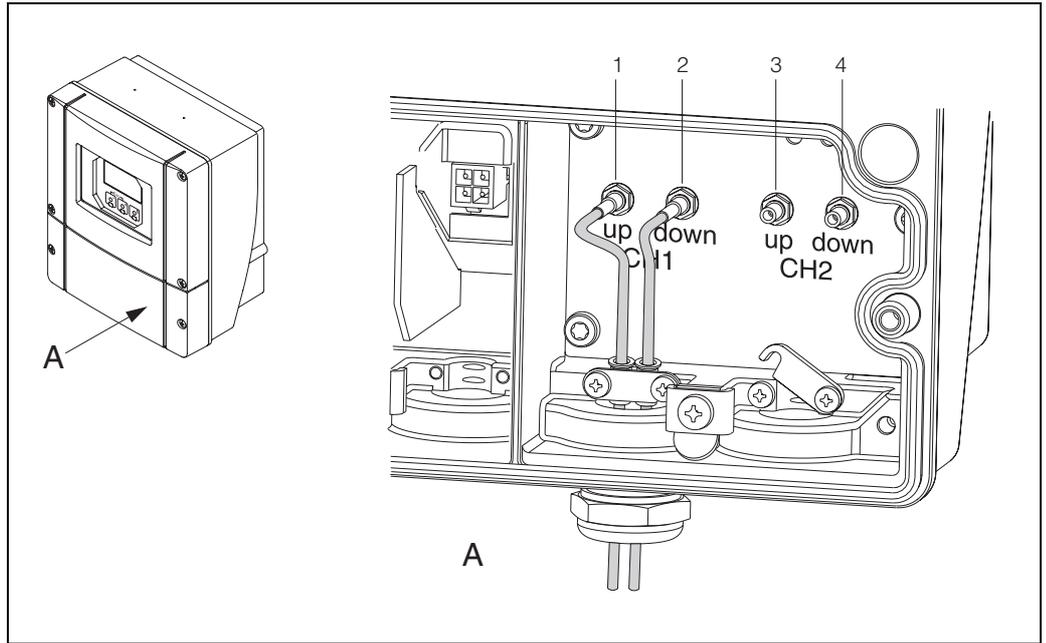
- a Cable for power supply: 85...260 V AC, 20...55 V AC, 16...62 V DC  
Terminal **No. 1**: L1 for AC, L+ for DC  
Terminal **No. 2**: N for AC, L- for DC
- b Fieldbus cable:  
Terminal **No. 26**: FF+ (with integrated reverse polarity protection)  
Terminal **No. 27**: FF- (with integrated reverse polarity protection)
- c Ground terminal for protective earth
- d Ground terminal for fieldbus cable screen
- e Service connector for connecting service interface FXA193 (Fieldcheck, ToF Tool - Fieldtool Package)
- f Cover of the connection compartment

**Terminal assignment**

Order variant	Terminal No. (outputs/inputs)
	<b>26</b> : FF + <b>27</b> : FF -
93***_***** <b>K</b>	FOUNDATION Fieldbus
<b>Connection values FOUNDATION Fieldbus</b>	
FOUNDATION Fieldbus: Power supply: 9...32 V DC Current consumption: 12 mA	

**Electrical connection:  
Sensor cable connection**

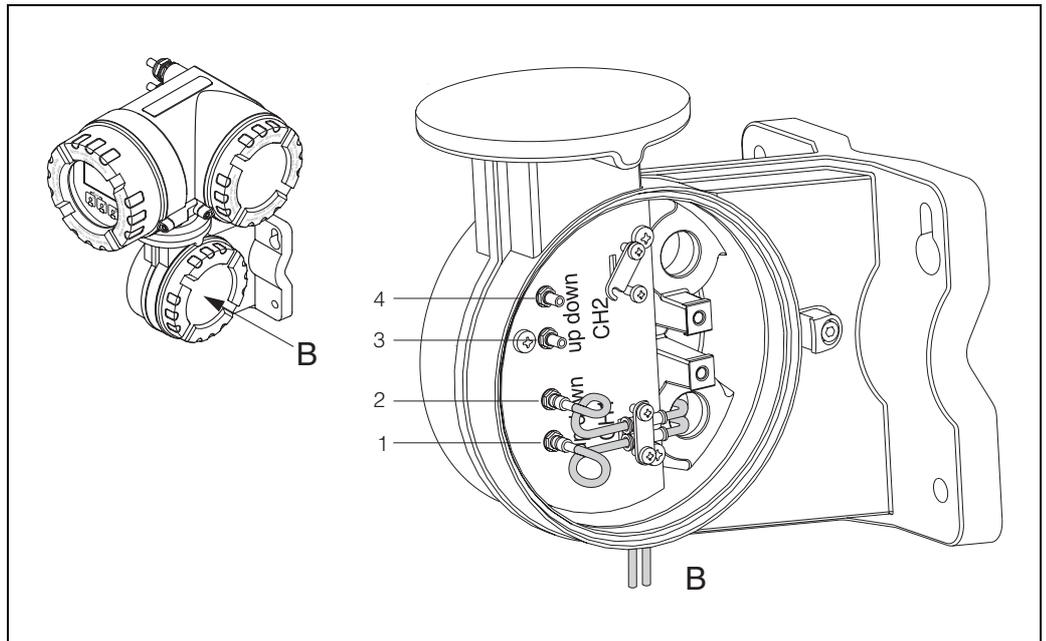
Connecting power sensor cables in the connection compartment



F06-9xxxxxxx-04-06-06-xx-001

A = View A (wall-mounted housing; non hazardous area, Ex Zone 2)

1 = Channel 1 upstream; 2 = Channel 1 downstream  
3 = Channel 2 upstream; 4 = Channel 2 downstream



F06-9xxxxxxx-04-06-06-xx-001

B = View B (field housing; Ex Zone 1)

1 = Channel 1 upstream; 2 = Channel 1 downstream  
3 = Channel 2 upstream; 4 = Channel 2 downstream

**Potential equalisation**

For potential equalisation, no special measures are necessary.

Note!

For instruments for use in hazardous areas, observe the corresponding guidelines in the specific Ex documentation.

**Cable entry**

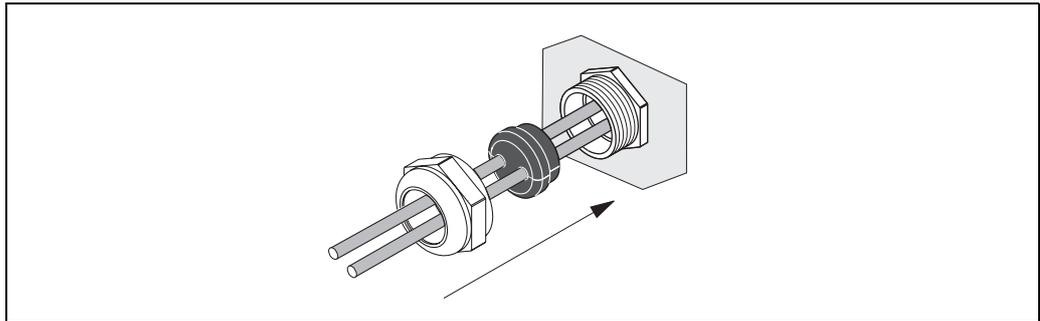
Power supply and signal cables (inputs/outputs):

- Cable entry M20 x 1.5
- or
- Cable gland for cables with  $\text{Ø } 6...12 \text{ mm}$
- Threaded adapter 1/2" NPT, G 1/2"

Sensor cable connection:

A special cable gland allows you to insert both sensor cables (per channel) into the connection compartment simultaneously.

- Cable gland M20 x 1.5 for 2 x  $\text{Ø } 4 \text{ mm}$
- or
- Threaded adapter 1/2" NPT, G 1/2"



F06-9xxxxxxx-17-11-06-xx-000

*Special cable gland for sensor cable connection on the transmitter side*

**Cable specifications**

Sensor cable:

- Use the ready-to-use cables supplied by Endress+Hauser with each sensor pair.
- The cables are available in lengths of 5 m, 10 m, 15 m and 30 m.
- You can choose between PTFE and PVC cable materials.

Operation in zones of severe electrical interference:

The measuring device complies with the general safety requirements in accordance with EN 61010, the EMC requirements of EN 61326, and NAMUR Recommendation NE 21.

Signal and power supply cable:

Caution!

Grounding is by means of the ground terminals provided for the purpose inside the connection housing. Keep the stripped and twisted lengths of cable shield to the terminals as short as possible.

**Supply voltage**

Transmitter:

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

Measuring sensors:

- powered by the measuring transmitter

**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

EEPROM (Prosonic Flow 90) or HistoROM/T-DAT (Prosonic Flow 93) save measuring system data if the power supply fails

## Performance characteristics

### Reference operating conditions

- Fluid temperature:  $+28\text{ °C} \pm 2\text{ K}$
- Ambient temperature:  $+22\text{ °C} \pm 2\text{ K}$
- Warm-up period: 30 minutes

#### Installation:

- Inlet run  $>10 \times \text{DN}$
- Outlet run  $> 5 \times \text{DN}$
- Sensors and transmitter grounded.
- The measuring sensors are correctly installed.

### Maximum measured error

For flow velocities of  $> 0.3\text{ m/s}$  and a Reynolds number of  $>10000$ , the system accuracy is:

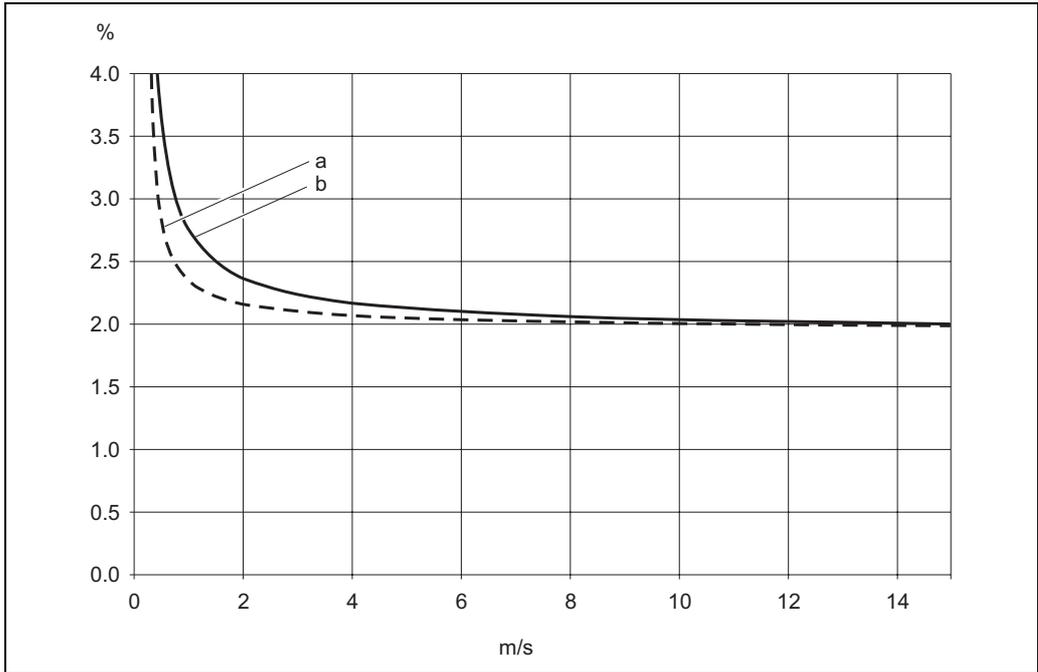
Version	Guaranteed error limits		Report
Prosonic Flow P – Clamp-on	DN 50...200	$\pm 2.0\% \text{ o.r. plus } \pm 0.05\% \text{ o.f.s}^{(3)}$	A report is not issued. The value given are typical values.
	DN $> 200$	$\pm 2.0\% \text{ o.r. plus } \pm 0.02\% \text{ o.f.s}^{(3)}$ See note <sup>(1)</sup>	
		$\pm 0.5\% \text{ o.r. plus } \pm 0.05\% \text{ o.f.s}^{(3)}$	Verification of accuracy <sup>(2)</sup>

o.r. = of reading

o.f.s. = of full scale value

- (1) The basic accuracy of the measuring system is 0.5%.  
The dry calibration represents additional uncertainty due to mounting and actual pipe properties.  
This additional uncertainty is better than 1.5% typically.
- (2) Accuracy verification is carried out on a DN 100 pipe.  
The verification applies under reference operating conditions.
- (3) Maximum full scale value: 15 m/s

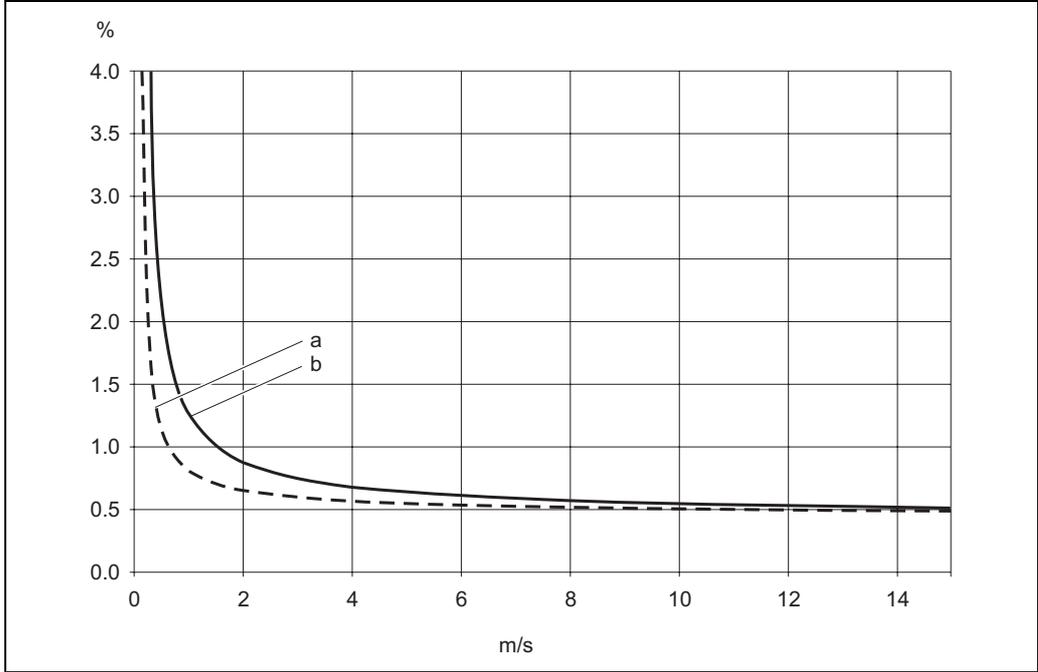
**Max. measured error for dry calibration in % of reading**



a = Pipe diameter > DN 200  
b = Pipe diameter < DN 200

A0003719

**Max. measured error for verification of accuracy in % of reading**



a = Pipe diameter > DN 200  
b = Pipe diameter < DN 200

A0003798

**Repeatability** ± 0.3% for flow velocities > 0.3 m/s

# Operating conditions

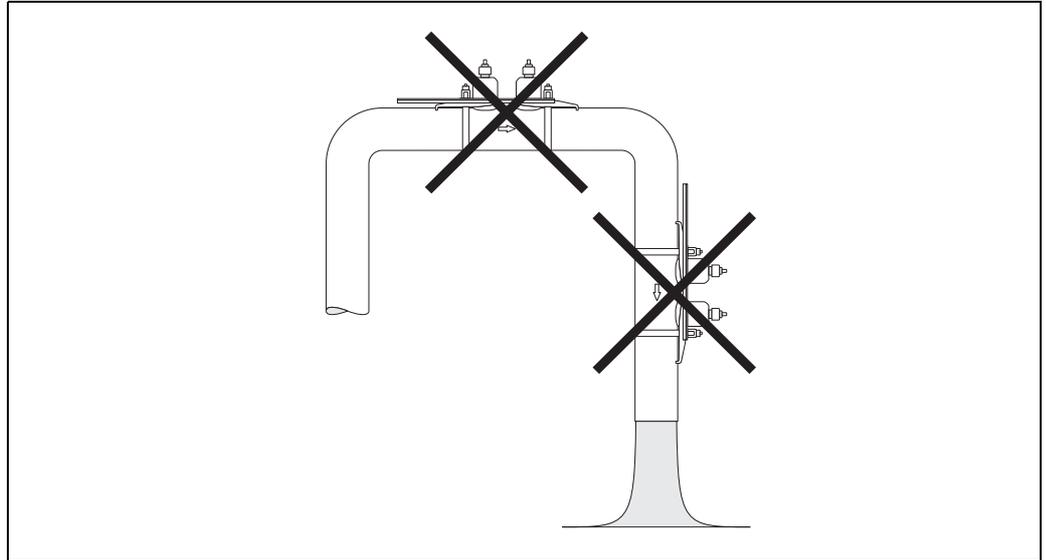
## Installation conditions

### Installation instructions

#### Mounting location

Correct measuring is possible only if the pipe is full. **Avoid** the following locations:

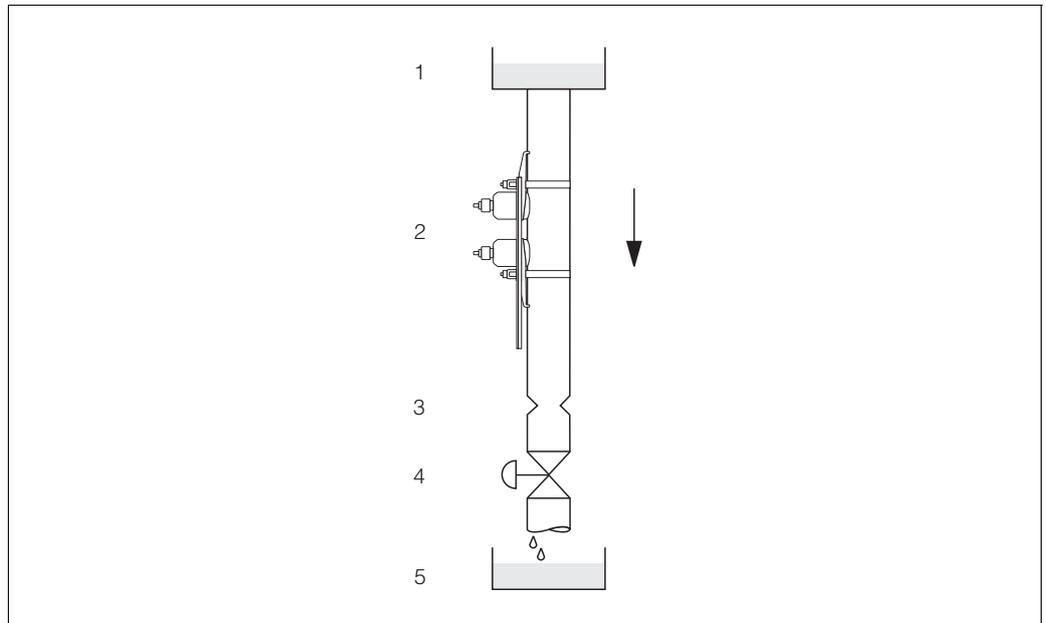
- Highest point of a pipeline. Risk of air accumulating.
- Directly upstream of a free pipe outlet in a vertical pipe.



F06-5xxxxxxx-11-00-00-xx-000

#### Vertical pipes

Notwithstanding the above, the installation proposal below permits installation in an open vertical pipe. Pipe restrictors or the use of an orifice with a smaller cross-section than the nominal diameter prevent the pipe from running empty while measurement is in progress.



F06-9xxxxxxx-11-00-00-xx-001

*Installation in a vertical pipe*

*1 = Supply tank, 2 = Measuring sensors, 3 = Orifice plate, pipe restriction, 4 = Valve, 5 = Filling tank*

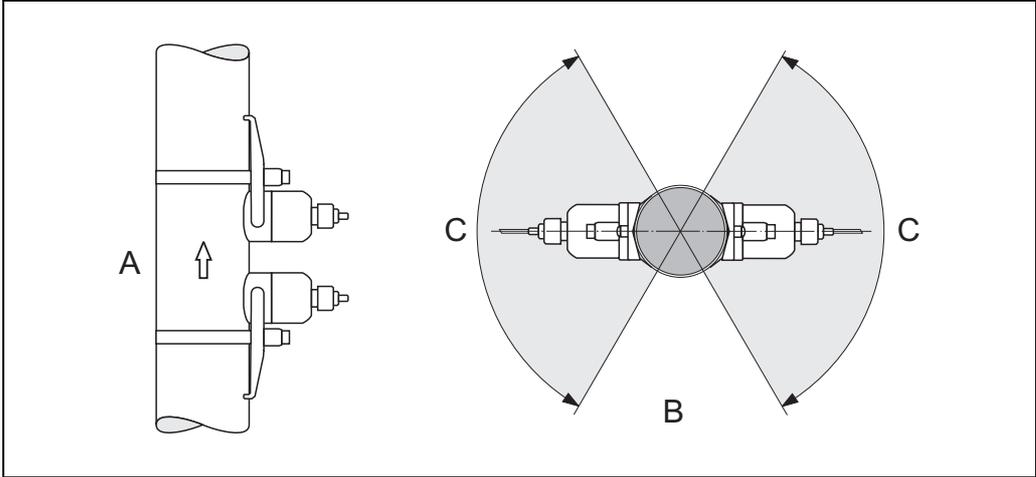
**Orientation**

*Vertical*

Recommended orientation with upward direction of flow (View A). Entrained solids sink down. Gases rise away from the measuring sensor when fluid is not flowing. The piping can be completely drained and protected against solids build-up.

*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.



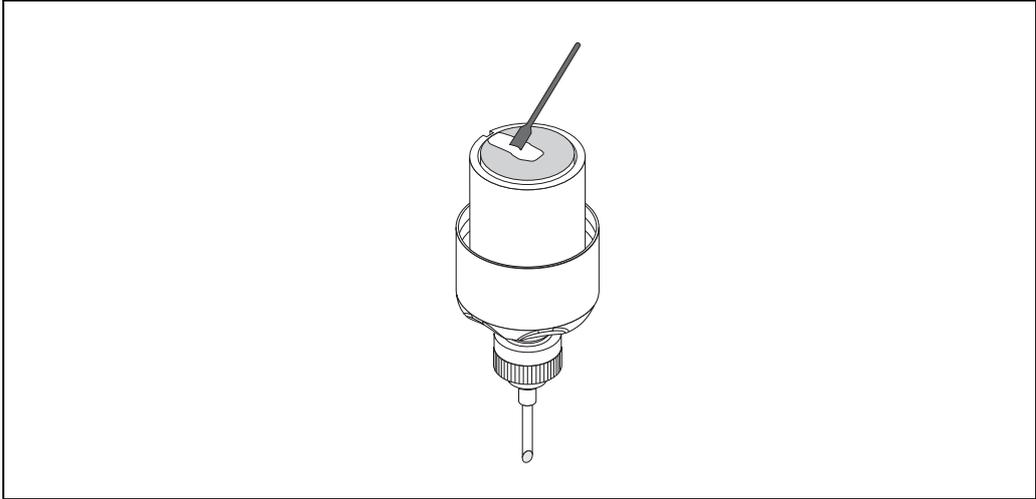
A0001105

C = Recommended installation range max. 120°

**Coupling medium**

A coupling medium is required to ensure the acoustic coupling between the sensor and the piping. This is applied to the sensor surface during commissioning. Periodic replacement of the coupling medium is usually not required.

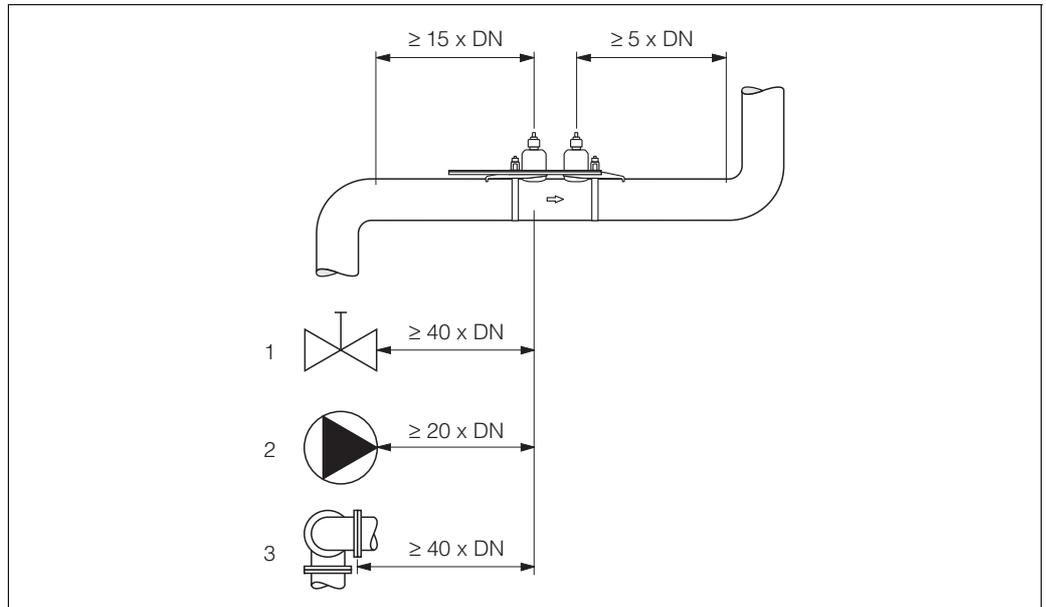
Prosonic Flow 93 offers a coupling medium monitoring function as part of its “Advanced Diagnostics” software package. This function outputs the signal strength as a limit value.



F06-9xxxxxxx-00-05-06-xx-000

**Inlet and outlet runs**

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



F06-9xxxxxxx-11-05-00-xx-003

1 = Valve, 2 = Pump, 3 = Two pipe bends in different directions

**Connecting cable length**

Shielded cables are offered in the following lengths:  
5 m, 10 m, 15 m and 30 m

In order to ensure measuring accuracy, comply with the following instructions during installation:  
Route the cable well clear of electrical machines and switching elements.

**Environment**

**Ambient temperature**

- Measuring transmitter Prosonic Flow 90/93:  
-20...+60 °C
- Flow rate measuring sensors Prosonic Flow P:  
-40...+80 °C / 0...+170 °C
- Sound velocity measuring sensors DDU 18:  
-40...+80 °C
- Wall thickness measuring sensor DDU 19:  
0...+60 °C
- Sensor cable PTFE -40...+170 °C; sensor cable PVC -20...+70 °C
- In heated piping or piping conveying cold fluids, it is always permissible to insulate the piping completely with the mounted ultrasonic sensors.
- Install the measuring transmitter at a shady location. Avoid direct sunlight, particularly in warm climatic regions.

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**Storage temperature** The storage temperature corresponds to the operating temperature range of the measuring transmitter and the appropriate measuring sensors and the corresponding sensor cable (see above).

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**Degree of protection**

- Measuring transmitter Prosonic Flow 90/93:  
IP 67 (NEMA 4X)
- Flow measuring sensors Prosonic Flow P:  
IP 68 (NEMA 6P)
- Sound velocity measuring sensors DDU 18:  
IP 68 (NEMA 6P)
- Wall thickness measuring sensor DDU 19:  
IP 67 (NEMA 4X)

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**Shock and vibration resistance** According to IEC 68-2-6

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**Electromagnetic compatibility (EMC)** Electromagnetic compatibility (EMC requirements) according to EN 61326/A1 (IEC 1326) "Emission to class A requirements" and NAMUR Recommendation NE 21/43

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### Process conditions

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**Medium temperature range**

- Flow rate measuring sensors Prosonic Flow P:  
-40...+80 °C / 0...+170 °C
- Sound velocity measuring sensors DDU 18:  
-40...+80 °C
- Wall thickness measuring sensor DDU 19:  
0...+60 °C

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**Medium pressure range (nominal pressure)** Perfect measurement requires that the static fluid pressure is higher than vapour pressure.

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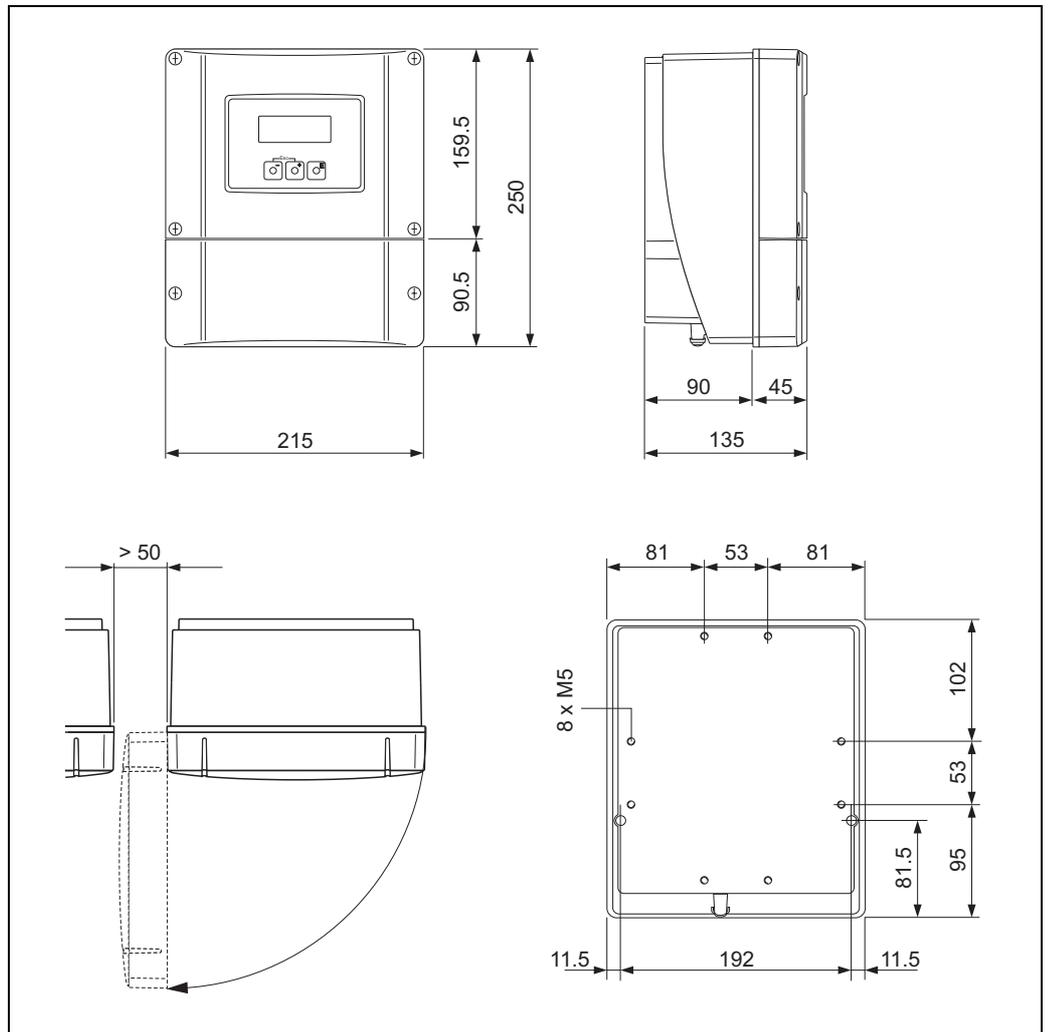
**Pressure loss** There is no pressure loss

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## Mechanical construction

### Design / dimensions

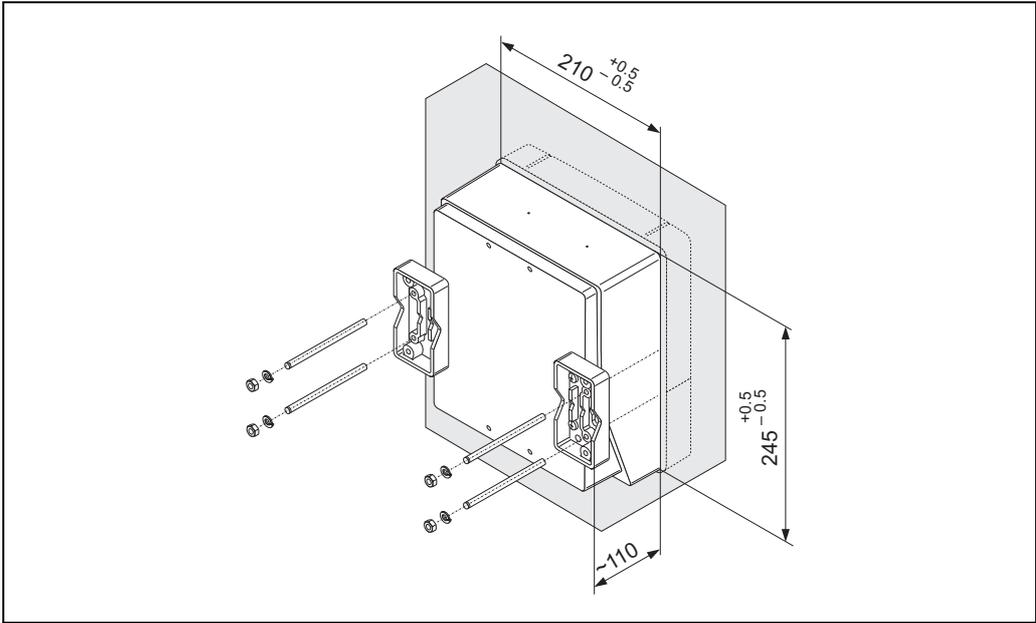
### Dimensions: wall-mounted housing (non hazardous area and Ex Zone 2)



A0001150

There are several mounting kits for the wall-mounted housing. They can be ordered separately from Endress+Hauser as an accessory. The following installation variants are possible:

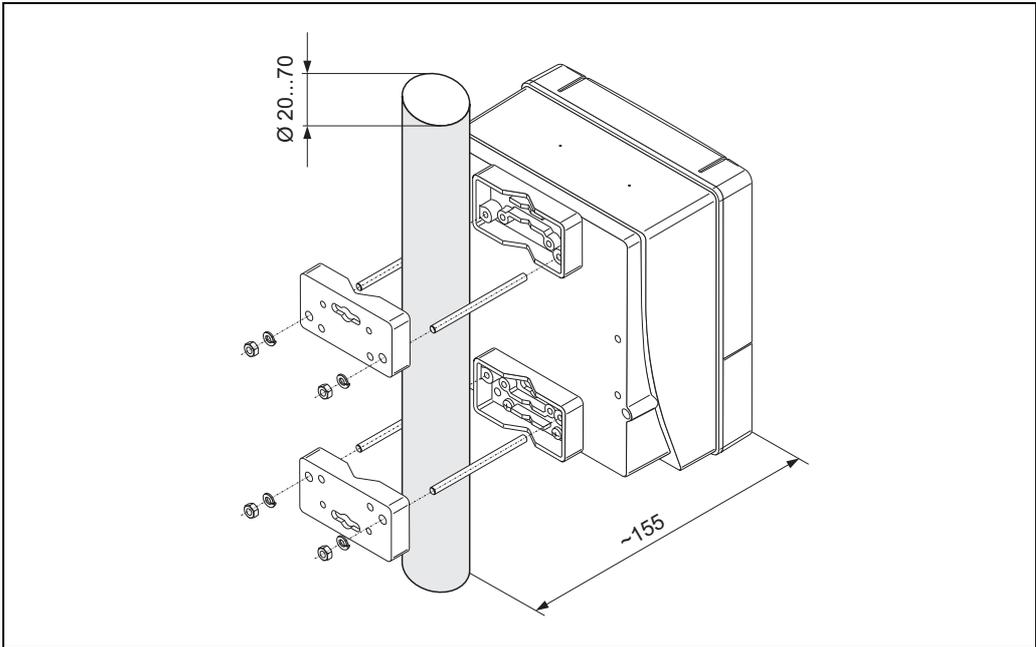
**Panel-mounted (separate mounting set)**



A0001131

*A mounting kit, which can be ordered separately, is available for panel mounting the transmitter Prosonic Flow 90/93. Please contact your local Endress+Hauser representative.*

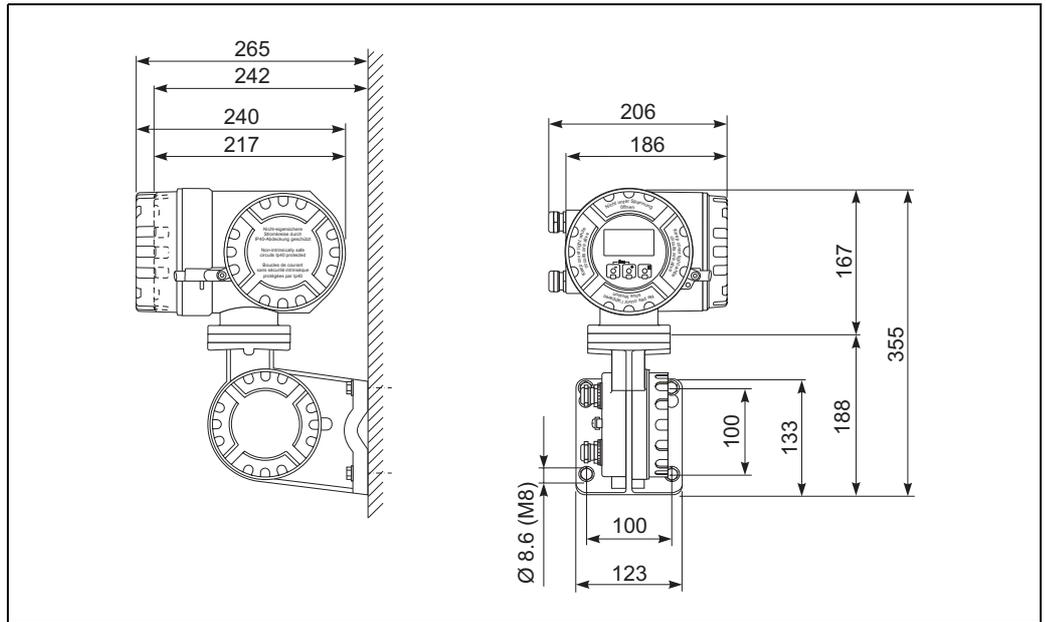
**Pipe mounting (separate mounting set)**



A0001132

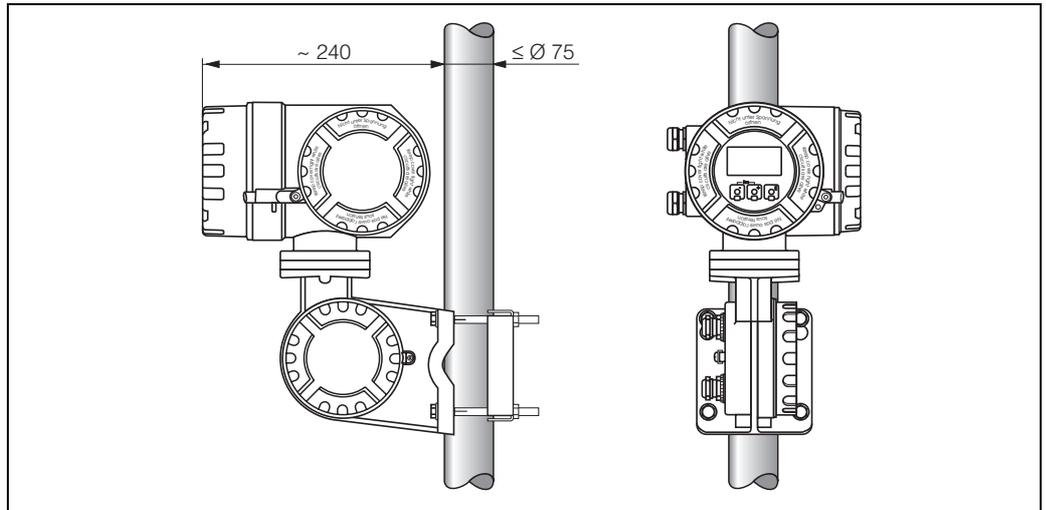
*A mounting kit, which can be ordered separately, is available for pipe mounting the transmitter Prosonic Flow 90/93. Please contact your local Endress+Hauser representative.*

Dimensions field housing (Ex Zone 1)



A0002128

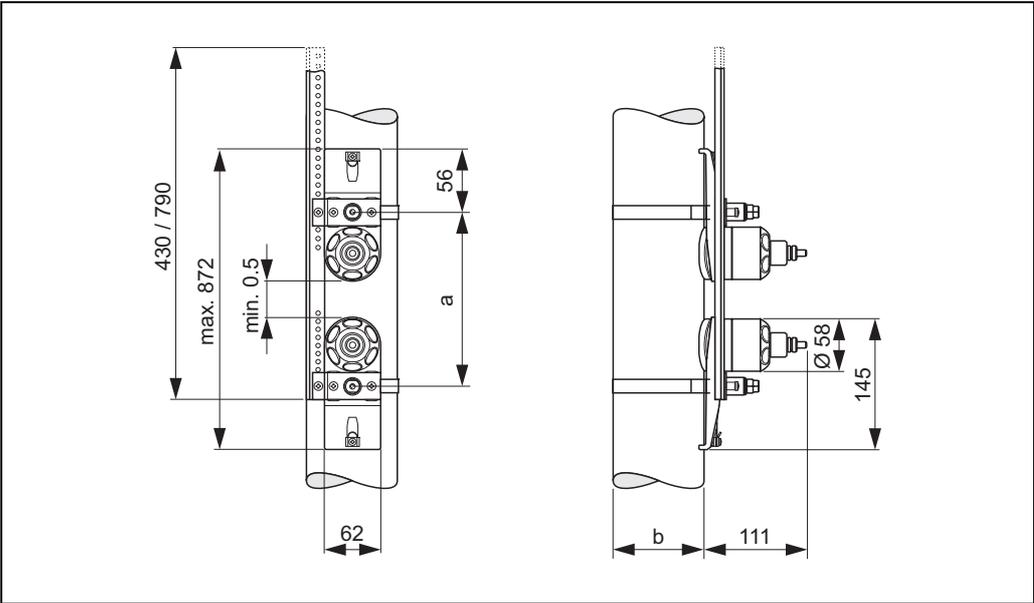
Pipe mounting (separate mounting set)



F06-x3xxxxZZ-06-03-xx-xx-003

A mounting kit, which can be ordered separately, is available for pipe mounting the transmitter Prosonic Flow 93. Please contact your local Endress+Hauser representative.

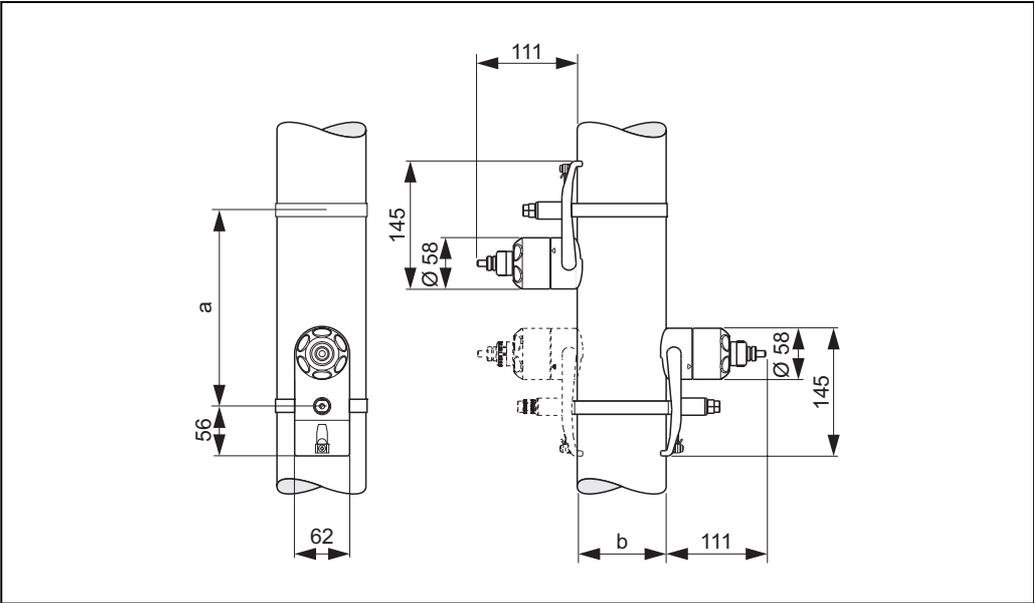
**Prosonic Flow P**  
2 or 4 traverses version



A0001154

- a Sensor distance can be determined using Quick Setup
- b Pipe outer diameter (defined by the application)

1 or 3 traverses version



A0001155

- a Sensor distance can be determined using Quick Setup
- b Pipe outer diameter (defined by the application)

**Weight**

- Housing for transmitter 90/93:
- Wall-mounted housing: 6.0 kg
  - Field housing: 6.7 kg

Measuring sensors:

- Flow measuring sensors P incl. mounting rail and tensioning bands: 2.8 kg
- Sound velocity measuring sensors DDU 18 incl. tensioning bands: 2.4 kg
- Wall thickness measuring sensor DDU 19 incl. tensioning band: 1.5 kg

**Materials**

Transmitter housing 90/93:

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

Measuring sensors P / DDU 18 / DDU 19:

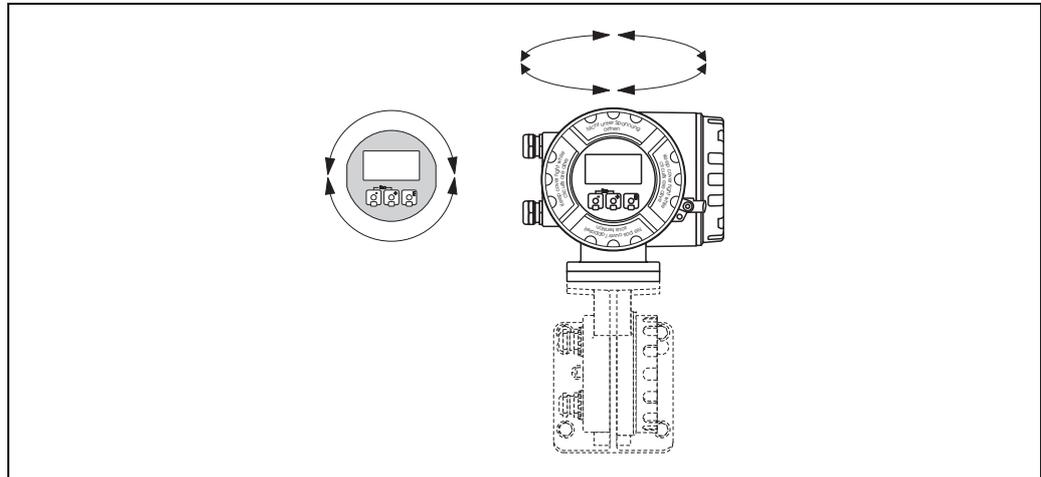
	<b>DIN 17440</b>	<b>AISI</b>
Sensor fixing bracket	1.4301	304
Sensor housing	1.4301	304
Sensor contact surface	Chemical resistant plastic	
Tensioning bands	1.4301	304
High temperature sensor cable – Cable connector (stainless steel) – Cable sheath	1.4301 PTFE	304 PTFE
	<b>DIN 17660</b>	<b>UNS</b>
Standard sensor cable – Cable connector (nickled brass) – Cable sheath	2.0401 PVC	C38500 PVC

## Human interface

### Display elements

- Liquid crystal display: illuminated, four lines each with 16 characters
- Custom configuration for presenting different measured values and status variables
- 3 totalizers

To obtain the optimum orientation of the display of the field housing (only used in Ex Zone 1), it is possible to turn the display or the head of the measuring transmitter housing up to 360°.



F06-x3xxxxZZ-17-06-00-xx-000

### Operating elements

Operating concept:

- Local operation with Touch Control (←, →, ↵)
- Application specific Quick Setup menus for straightforward commissioning

### Remote operation

Prosonic Flow 90:  
Operation via HART, PROFIBUS PA

Prosonic Flow 93:  
Operation via HART, PROFIBUS DP/PA, FOUNDATION Fieldbus

### Language group

Language groups available for operation in different countries:

- Western Europe and America (WEA):  
English, German, Spanish, Italian, French, Dutch and Portuguese
- Eastern Europe and Scandinavia (EES):  
English, Russian, Polish, Norwegian, Finnish, Swedish and Czech
- South and east Asia (SEA):  
English, Japanese, Indonesian
- China (CIN):  
English, Chinese

You can change the language group via the operating program “ToF Tool - Fieldtool Package.”

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## Certificates and approvals

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### Ex Approvals

- The transmitter housing (wall-mounted housing) is suitable for use in ATEX II3G (Ex Zone 2).
- The transmitter housing (field housing) is intended for use in ATEX II2G (Ex Zone 1). The sensor current circuits are intrinsically safe (EEx ib IIC). The transmitter housing has degree of protection “explosion proof enclosure” (EEx d/de).

Information on the currently available Ex-rated versions (ATEX, FM, CSA, TIIS) can be supplied by your Endress+Hauser Sales Centre on request. All information relevant to explosion protection is available in separate Ex-documents that you can order as necessary.

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### PROFIBUS PA certification

The flow device has successfully passed all the test procedures carried out and is certified and registered by the PNO (PROFIBUS User Organisation). The device thus meets all the requirements of the following specifications:

- Certified to PROFIBUS 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

The flow device 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:

- Certified to FOUNDATION Fieldbus Specification
  - The device meets all the specifications of the FOUNDATION Fieldbus H1.
  - Interoperability Test Kit (ITK), revision status 4.0 (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
- 

### 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.

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### C-Tick mark

The measuring system is in conformity with the EMC requirements of the Australian Communications Authority (ACA).

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### Other standards and guidelines

EN 60529:  
Degrees of protection by housing (IP code)

EN 61010:  
Protection Measures for Electrical Equipment for Measurement, Control, Regulation and Laboratory Procedures.

EN 61326/A1 (IEC 6326):  
Electromagnetic compatibility (EMC requirements)

NAMUR NE 21:  
Electromagnetic compatibility (EMC) of industrial process and laboratory control equipment.

NAMUR NE 43:  
Standardisation of the signal level for the breakdown information of digital transmitters with analogue output signal.

NAMUR NE 53:  
Software of field devices and signal-processing devices with digital electronics.

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## Ordering information

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

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## Accessories

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Measuring sensors:

- DDU 18 (sound velocity measuring sensors)
- DDU 19 (wall thickness measuring sensor)

Pipe installation set for transmitter:

- Wall-mounted housing
- Field housing

Mounting material:

- Coupling medium -40...+80 °C
- Coupling medium 0...170 °C
- Tensioning bands for DN 50...200
- Tensioning bands for DN 200...600
- Tensioning bands for DN 600...2000
- Tensioning bands for DN 2000...4000

The Endress+Hauser service organisation can provide detailed information on request.

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## Supplementary documentation

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- System Information Prosonic Flow 90/93 (SI 034D/06/en)
- Technical Information Prosonic Flow 90U, 90W, 93C, 93U, 93W (TI057D/06/de)
- Operating Instructions Prosonic Flow 90 (BA068D/06/en and BA069D/06/en)
- Operating Instructions Prosonic Flow 93 (BA070D/06/en and BA071D/06/en)
- Supplementary documentation on Ex-ratings: ATEX, FM, CSA, etc.

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## Registered trademarks

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HART®

Registered trademark of HART Communication Foundation, Austin, USA

PROFIBUS®

Registered trademark of the PROFIBUS User Organisation, Karlsruhe, Germany

FOUNDATION™ Fieldbus

Registered trademark of the Fieldbus Foundation, Austin, USA

HistoROM™, T-DAT™, F-CHIP®, ToF Tool – Fieldtool® Package, Fieldcheck®

Registered or registration-pending trademarks of Endress+Hauser Flowtec AG, Reinach, CH



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**Subject to modification**

**International Head Quarter**

Endress+Hauser  
GmbH+Co. KG  
Instruments International  
Colmarer Str. 6  
79576 Weil am Rhein  
Deutschland

Tel. +49 76 21 9 75 02  
Fax +49 76 21 9 75 34 5  
[www.endress.com](http://www.endress.com)  
[info@ii.endress.com](mailto:info@ii.endress.com)

**Endress+Hauser**   
People for Process Automation