Technical Information
TI 060D/06/en
50102085

Portable Ultrasonic Flow Measuring System
prosonic flow 92

Temporary volume flow measurement of liquids with “Clamp On” sensors

Features and benefits
- Portable transmitter, battery operated, for temporary measurements
- Built-in data logger with a capacity of 40000 measuring values
- Site Setup operating menus for straightforward commissioning of up to 20 measurement sites
- “Clamp On” sensors, non-contact measurement technique
- The sensors are affixed to the piping from the outside
- Very wide range of nominal diameters
  Sensors U DN 15...100
  Sensors W DN 50...4000
- Wide temperature range of –20…+80 °C
- Measuring transmitter in protected handheld housing in: IP 50
- Sensors U in: IP 52
  Sensors W in:
  – IP 67 Sensorbody
  – IP 52 BNC adapter
- Interfaces
  – Data readout software for use with a personal computer
  – Current in- and outputs (4...20 mA)

Application
Ideally suited for temporary, bidirectional measurement of pure or slightly soiled liquids with a gas content of < 1% or a solids content of < 5%.

- Application examples:
  – Water, wastewater etc.
  – Ultrapure water with low conductivity
  – Process facilities

- The “Clamp On” sensors are equally suitable for homogeneous piping as for piping made of composite materials:
  – steel, plastic, GRP and glass pipes
  – Lined pipes

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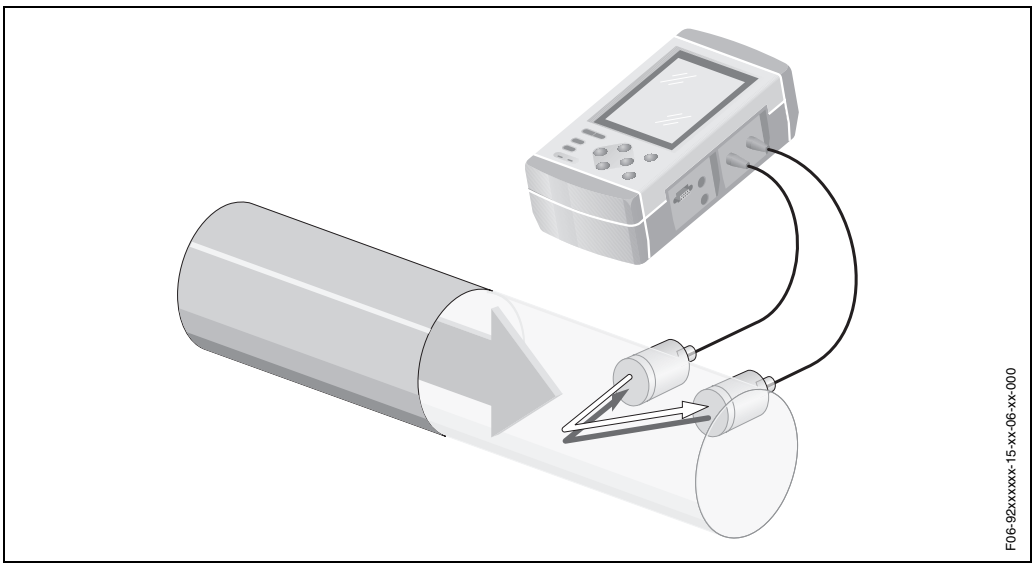
Function and system design

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.

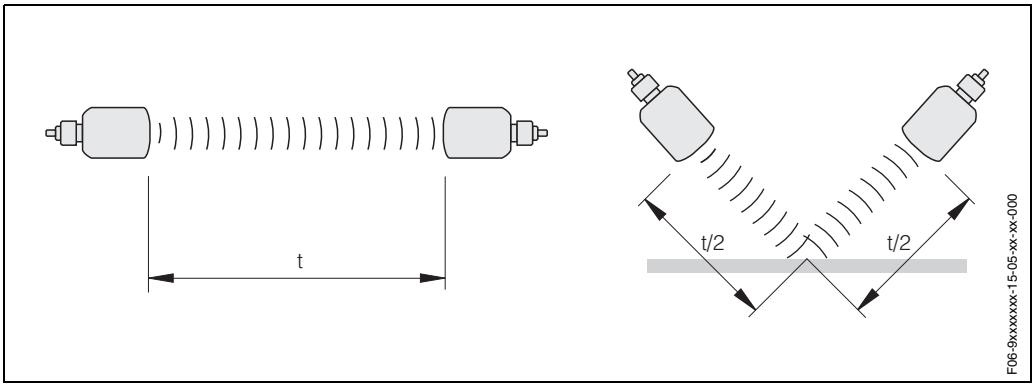


$v \sim \Delta t$
$Q = v \cdot A$

v = flow velocity
Δt = transit time difference
v = volume flow
A = pipe cross-sectional area

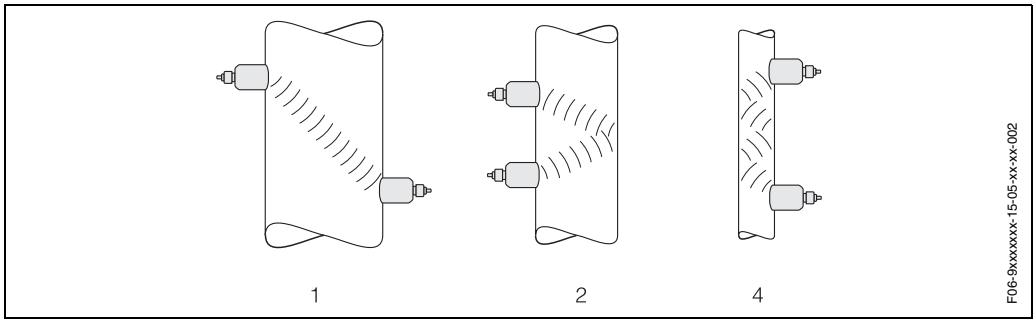
In addition to the volume flow, the system measures the sound velocity in the liquid. The sound velocity can be used to distinguish different liquids or as a measure of product quality. You can carry out application-specific calibrations of Prosonic Flow in the field using the Site Setup.

Signal propagation time
For accurate measurement, the ultrasonic signal needs a certain minimum signal propagation time [t].



The measuring accuracy increases with the length of the signal propagation time (t) in a liquid.

Sensor arrangement Prosonic Flow W/U
The Prosonic Flow W sensors offer a choice between 1, 2 and 4 traverses and the Prosonic Flow U sensors 2 traverses. Please note that the more reflection points there are in the pipe, the more the signal strength decreases. (Example: 2 traverses = 1 reflection point, etc.)



Prosonic Flow W: 1 = 1 traverse, 2 = 2 traverses, 4 = 4 traverses
Prosonic Flow U: 2 = 2 traverses

Therefore, to maintain good signal quality, you should choose as few traverses as necessary to achieve a sufficient transit time difference.

Recommendations:
To obtain optimum signal strength and the highest level of accuracy, we recommend the following:

- DN 15...50 → 2 traverses
- DN 50...60 → 2/4 traverses
- DN 80...600 → 2 traverses
- DN 650...4000 → 1 traverse

Sensor selection
Prosonic Flow U sensor type: DN 15...100
Prosonic Flow W sensor types (two versions): DN 50...300 and DN 100...4000.
- Both sensor types can be used in the DN 100...300 range.
- The W sensor type DN 50...300 should be used for a wall thickness < 4 mm and sensor type DN 100...4000 for a wall thickness > 4 mm.

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 92 program.

For liquids:
WATER – SEA WATER – DISTILLED WATER – AMMONIA – ALCOHOL – BENZENE – BROMIDE – ETHANOL – GLYCOL – KEROSENE – MILK – METHANOL – TOLUOL – LUBRICATING OIL – FUEL OIL – PETROL

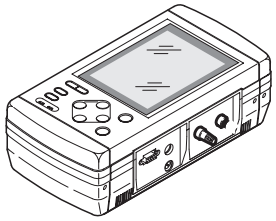
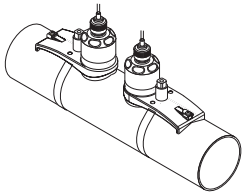
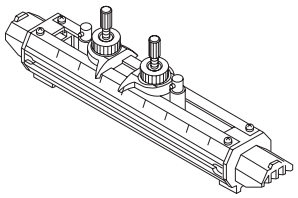
For pipe materials:
CARBON STEEL – STAINLESS STEEL – CAST IRON – COPPER – PVC – ALUMINIUM – DUCTILE IRON – ASBESTOS CEMENT – GRP – PEEK – PVDF – ACRYLIC GLASS

Liner material:
TAR EPOXY – MORTAR – RUBBER – TEFLON – GLASS PYREX – PVC

If your pipe material or liquid is not included in the pre-programmed selection of the transmitter establish the missing data from the technical literature.

Measuring system

The measuring system consists of the following transmitter and flow measuring sensors.

Measuring transmitter	
Prosonic Flow 92 	• For operation in the non hazardous area. • Battery operation (power adapter included) • Graphic display • Configuration with push buttons • Site Setup • Data logger • Volume and sound velocity measurement • Single channel measurement • Degree of protection IP 50 • Operation with Prosonic Flow W/U/P sensors
Flow measuring sensors	
Prosonic Flow W 	• Clamp On flow measuring sensors • Sensor pair for flow measurement and sound velocity in the liquid during operation. • 2 sensor types for DN 50...4000 (2"...160") • Temperature range -20...+80 °C • Stainless steel sensor holders • Degree of protection: – Sensorbody in IP 67 – BNC adapter in IP 52 • Adaptor plug for BNC cables
Prosonic Flow U 	• Clamp On flow measuring sensors for small pipe diameters. • Sensor pair for flow measurement and sound velocity in the liquid during operation. • 1 sensor type for DN 15...100 (0.6"...4") • Temperature range -20...+80 °C • Plastic/Aluminum sensor assembly • Degree of protection IP 52

Overview of components:

1 = Prosonic Flow 92 transmitter; 2 = Prosonic Flow W sensors, sensor holders and spacing ruler; 3 = Prosonic Flow U sensor assembly; 4 = Sensor connecting cables; 5 = Power adapter; 6 = Tensioning bands; 7 = Coupling medium; 8 = Carrying case

Input

Measured variable	Flow velocity (differential delay proportional to flow velocity)
Measuring range	Prosonic Flow W/U sensors typically v = 0...7 m/s at the specified measuring accuracy
Operable flow range	over 70 : 1
Input signal	Current input: 4...20 mA, galvanically not isolated, for input of externally measured variable (Display and data logging)

Output

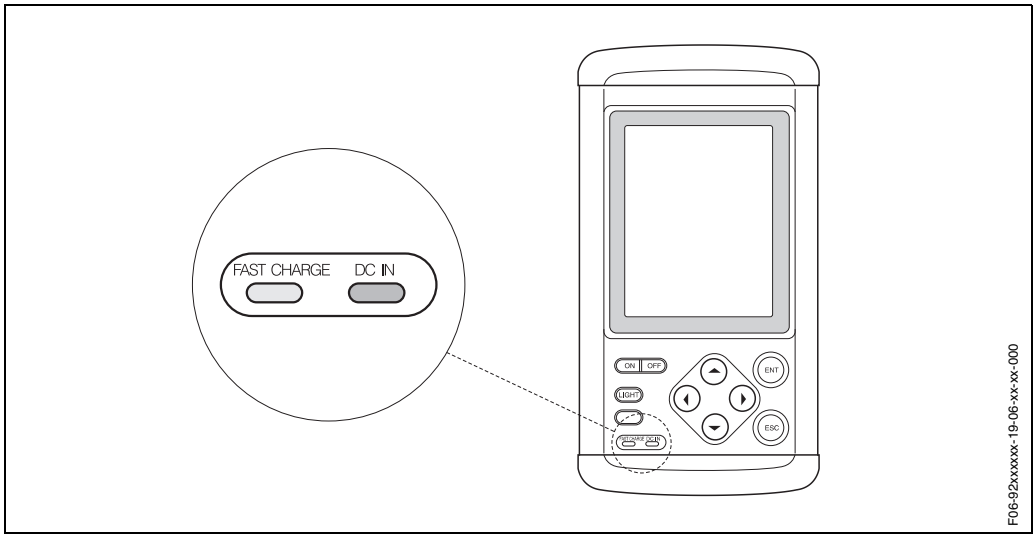
Output signal	Current output: active 4...20 mA, R_L = 0...1 kΩ, galvanically isolated (from ground and analog input)
Signal on alarm	Current output → failsafe mode selectable
Load	see “Output signal”
Low flow cutoff	Switch points for low flow cutoff are selectable
Galvanic isolation	All circuits for outputs and power supply are galvanically isolated from each other.

Power supply

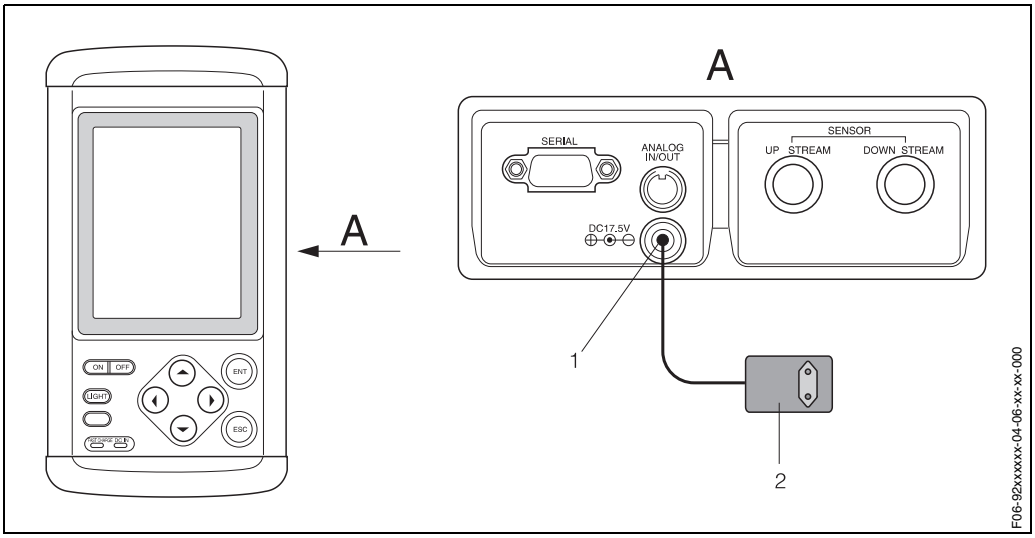
Electrical connection measuring unit

Power supply by built-in battery

To charge the battery, turn off the instrument power and connect the AC power adapter to the device as shown below. The “FAST CHARGE” LED is lighted in red, and the “DC IN” LED is lighted in green. When the instrument is fully charged, the “FAST CHARGE” LED flashes in red. With a fully charged battery pack, the instrument can measure for about 5 hours (with the backlight turned off). The time required for charging is approximately 3 hours.



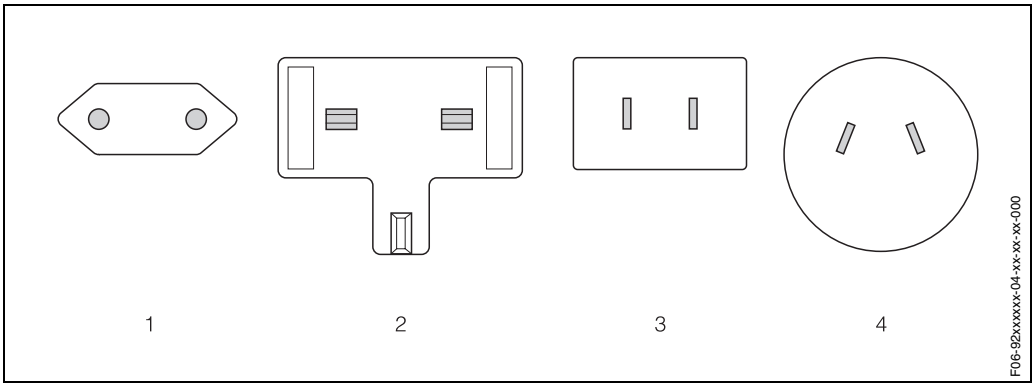
Power supply by power adapter



A = View A
- *1 = 17.5 V DC connector*
- *2 = AC power adapter for power supply and recharging the battery: 100...240 V AC, 47...63 Hz, Power consumption ≤12 W*

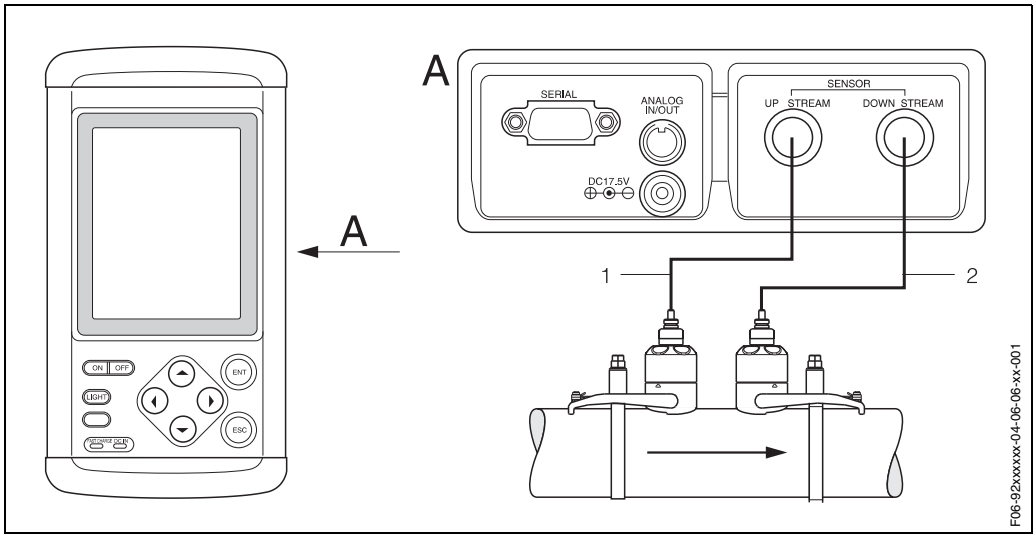
Don't use other power adapters, or it may result in an accident or in damage of the device.

The following mains connector adapters are delivered with the power supply:



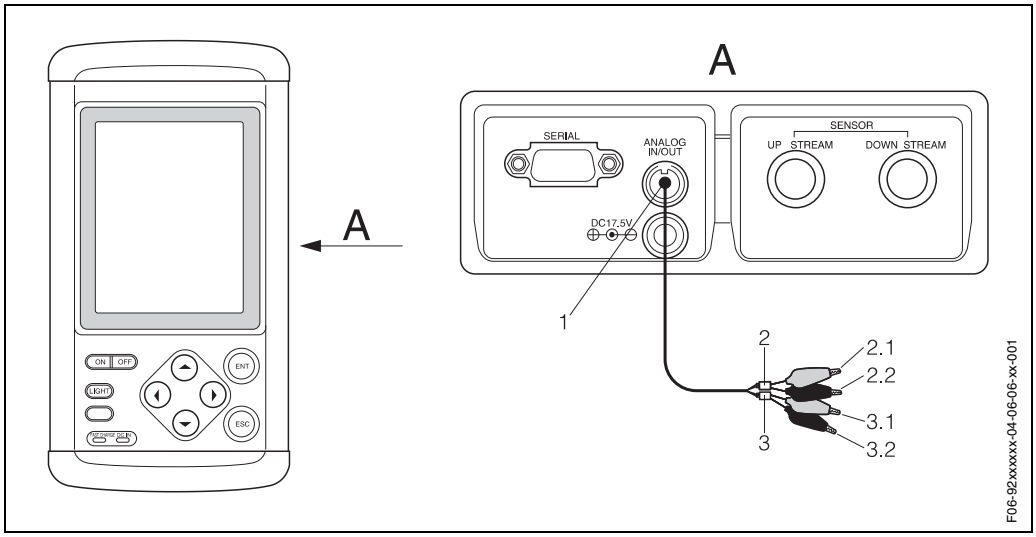
1 = European standard
2 = GB standard
3 = USA/Japan standard
4 = Australien standard

Electrical connection: sensor cable connection



A = View A
- *1 = Upstream sensor cable*
- *2 = Downstream sensor cable*

Electrical connection: analog input/output connection



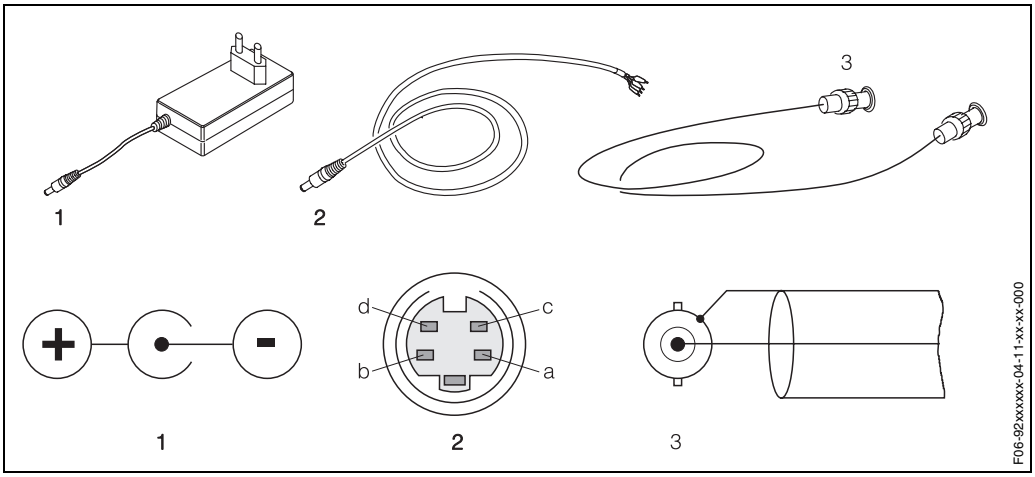
A = View A
- *1 = Analog input/output connector*
- *2 = Analog output wires; 2.1 = red (+); 2.2 = black (-)*
- *3 = Analog input wires; 3.1 = red (+); 3.2 = black (-)*

Potential equalisation

Special measures for potential equalisation are not necessary.

Cable connection

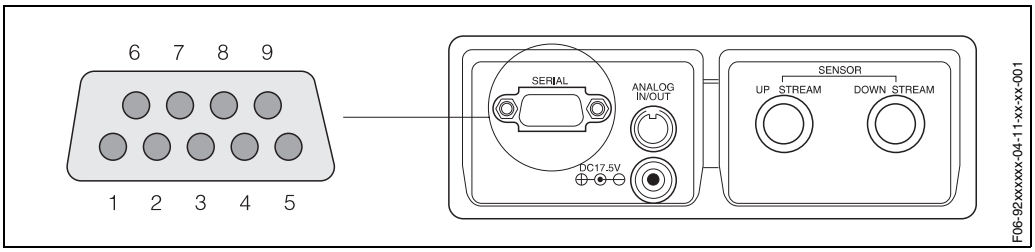
Power supply connection of standard power supply (1)
Signal cable connection (input/output), circular connector, 4 pin (2)
Sensor cable connection (up stream/down stream), BNC connector (3)



Cable connections at the transmitter

Pin	Item	Color
a	Analog input +	black
b	Analog output -	red
c	Analog input -	white
d	Analog output +	blue

Serial communication connection for data logging:
- D-SUB, 9 pin



D-SUB, 9 pin, socket

Pin No.	Symbol	Item
1	–	–
2	R x D	Recive data
3	T x D	Send data
4	D T R	Data terminal ready
5	G N D	Signal ground
6	D S R	Data set ready
7	R T S	Send request
8	C T S	Send ready
9	–	–

Cable specifications

Sensor cable:
- Special type coaxial cable.
- Use the ready-to-use cables supplied by E+H.
- The cables are available in lengths of 5 m and 10 m.

Mains connector adapters:
- Country specific mains connector adapters for mains supply connection.

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.

Supply voltage

Transmitter:
- Built-in battery
  Special type Ni-Cd battery
  Continuous operation time up to 5 hours (backlight OFF)
  Recharching time 3 hours (power adaptor used)
- Special type power adaptor
  100...240 V AC, 47...63 Hz

Flow measuring sensors:
- powered by the transmitter

Power consumption

DC: < 12 W (incl. sensor)

Power supply failure

Memory backup with lithium battery (lifetime approx. 5 years)

Performance characteristics

Reference operating conditions

- Liquid temperature: +28 °C ± 2 K
- Ambient temperature: +22 °C ± 2 K
- Warm-up period: 30 minutes

Installation:
- Inlet run > 10 x DN
- Outlet run > 5 x DN
- Sensors grounded.
- The measuring sensors are correctly installed.

Maximum measured error

For flow velocities between 0.5 m/s and 7 m/s and a Reynolds number of > 10000, the system accuracy is:

± 0.5 % o.r. (of current reading)

The system is dry calibrated. The calibration factor by dry calibration is calculated based on the actual pipe and liquid properties. This dry calibration procedure results in an additional uncertainty for the measurement. The resulting accuracy of the measurement therefore is better than 2 % typically.
The zero point instability is < 10 mm/s.

Repeatability

± 0.3 % for flow velocities > 0.5 m/s

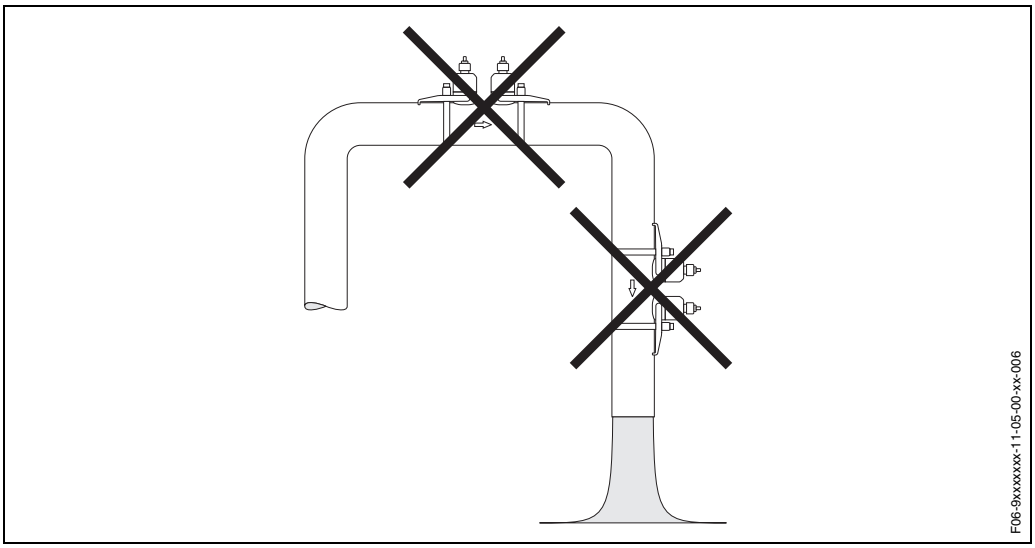
Operating conditions

Installation conditions

Installation instructions

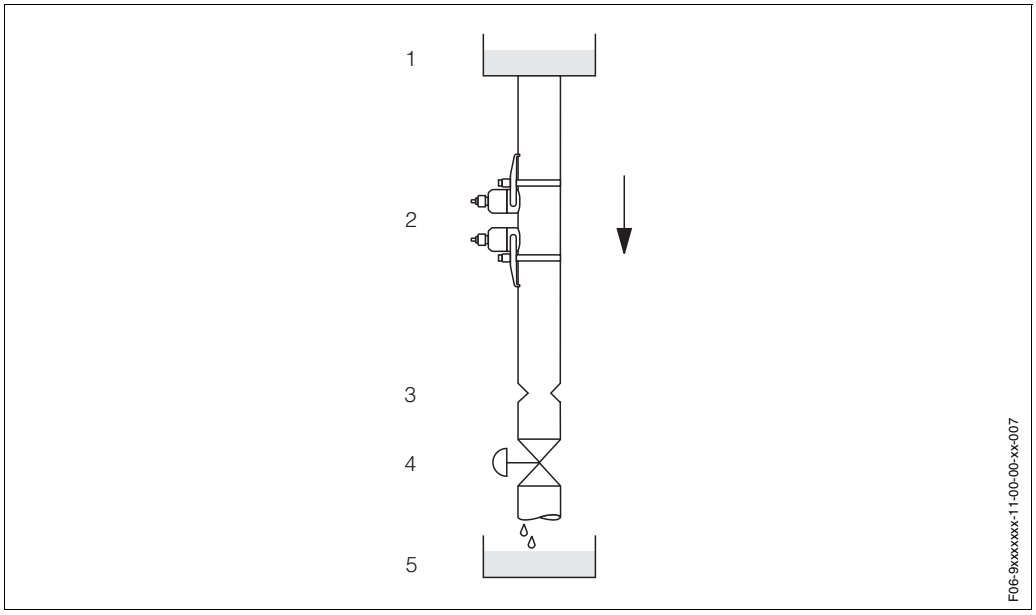
Mounting location

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.



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.

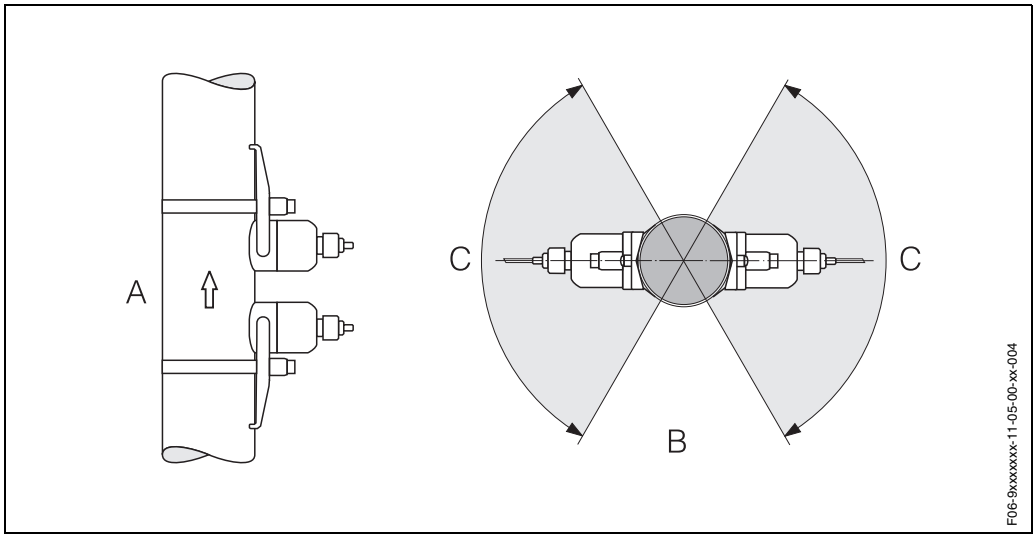


Installation in a vertical pipe
1 = Supply tank, 2 = Flow measuring sensors, 3 = Orifice plate, pipe restriction, 4 = Valve, 5 = Filling tank

Orientation

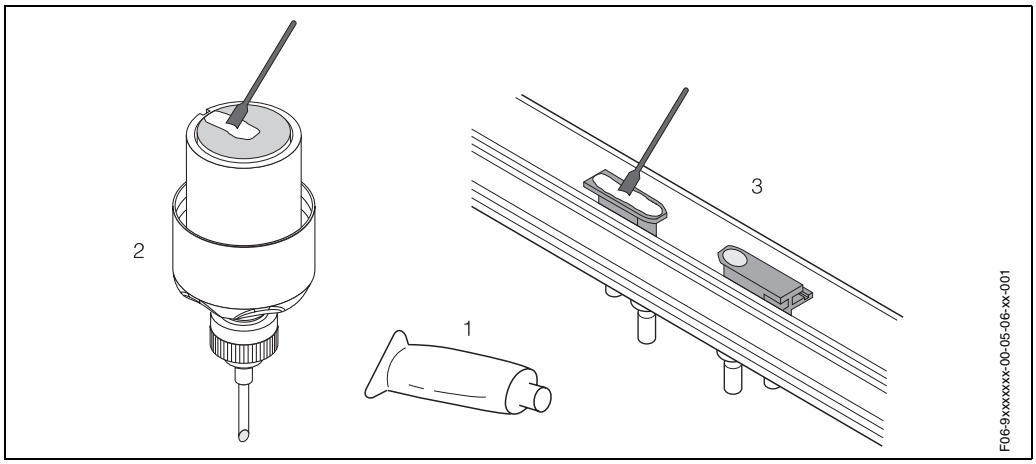
Vertical
Recommended orientation with upward direction of flow (View A). Entrained solids sink down. Gases rise away from the flow measuring sensor when liquid is not flowing. The piping can be completely drained and protected against solids build-up.

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



C = recommended installation range max. 120°

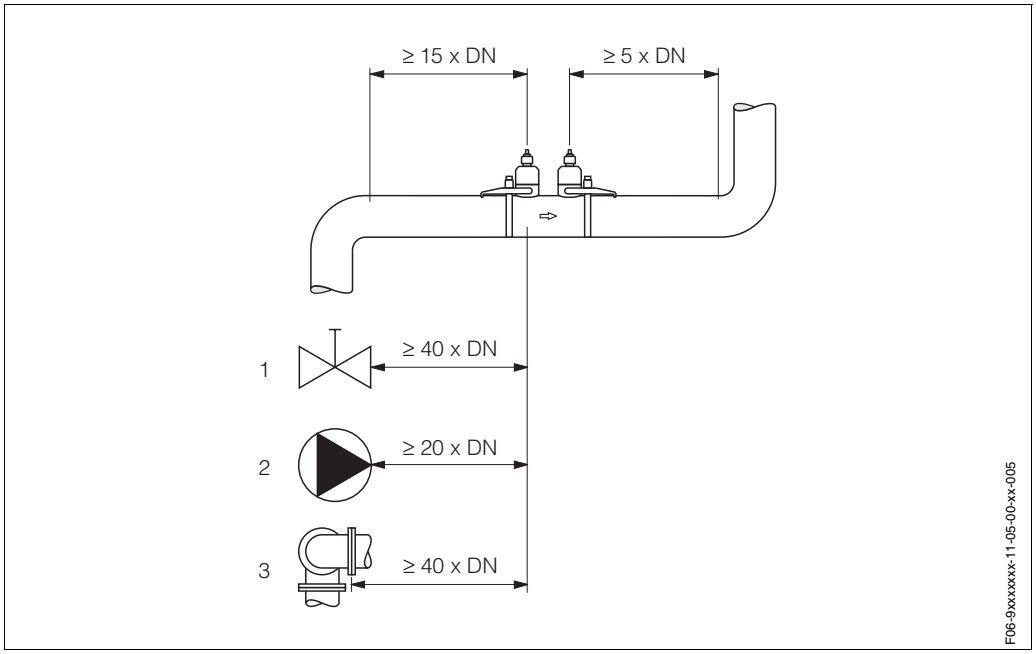
Coupling medium
A coupling medium (1) is required to ensure the acoustic coupling between the sensor and the piping. This is applied to the sensor surface (2/3) during commissioning. Replace the coupling medium for each new measuring point.



1 = Coupling medium
2 = Sensor surface Prosonic Flow W
3 = Sensor surface Prosonic Flow U

Inlet and outlet runs

If possible, install the flow measuring sensors well clear of fittings such as valves, T-pieces, elbows, etc. If several flow obstructions are installed, the longest inlet or outlet run must be considered. Compliance with the following requirements for the inlet and outlet runs is recommended in order to ensure measuring accuracy.



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

Connecting cable length

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

- Transmitter Prosonic Flow 92:
  -10...+45 °C

- Flow measuring sensors Prosonic Flow W/U:
  -20...+60 °C
- Sensor cable PVC -20...+70 °C

Avoid direct sunlight, particularly in warm climatic regions.

Storage temperature

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

Degree of protection

- Transmitter Prosonic Flow 92:
  IP 50

- Flow measuring sensors Prosonic Flow W:
  – Sensorbody in IP 67 (NEMA 4X)
  – BNC adapter in IP 52
- Flow measuring sensors Prosonic Flow U:
  IP 52

Shock and vibration resistance

According to IEC 68-2-6

Electromagnetic compatibility (EMC)

To EN 61326/A1 (IEC 1326) “Emmision to class A requirements”

Process conditions

Medium temperature range

- Flow measuring sensors Prosonic Flow W/U:
  -20...+80 °C

Medium pressure range (nominal pressure)

Perfect measurement requires that the static liquid pressure is higher than vapour pressure.

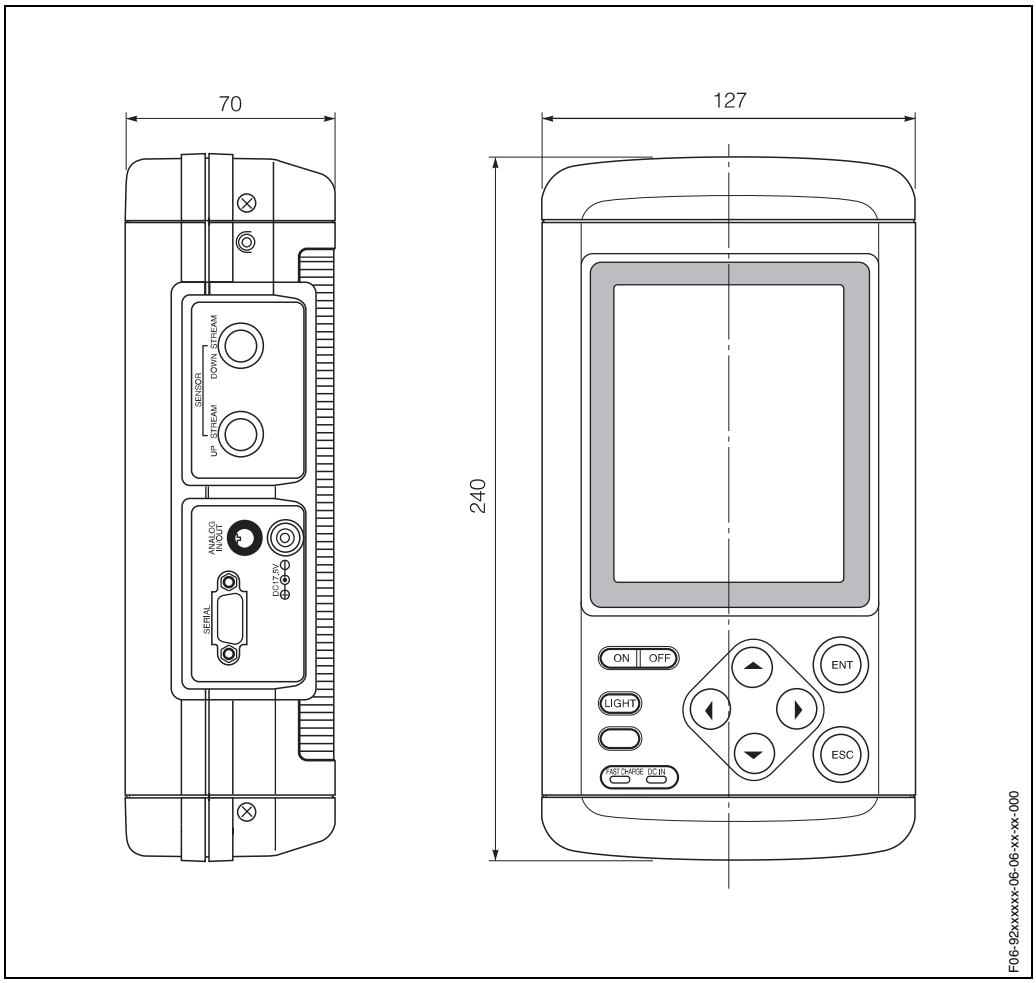
Pressure loss

There is no pressure loss.

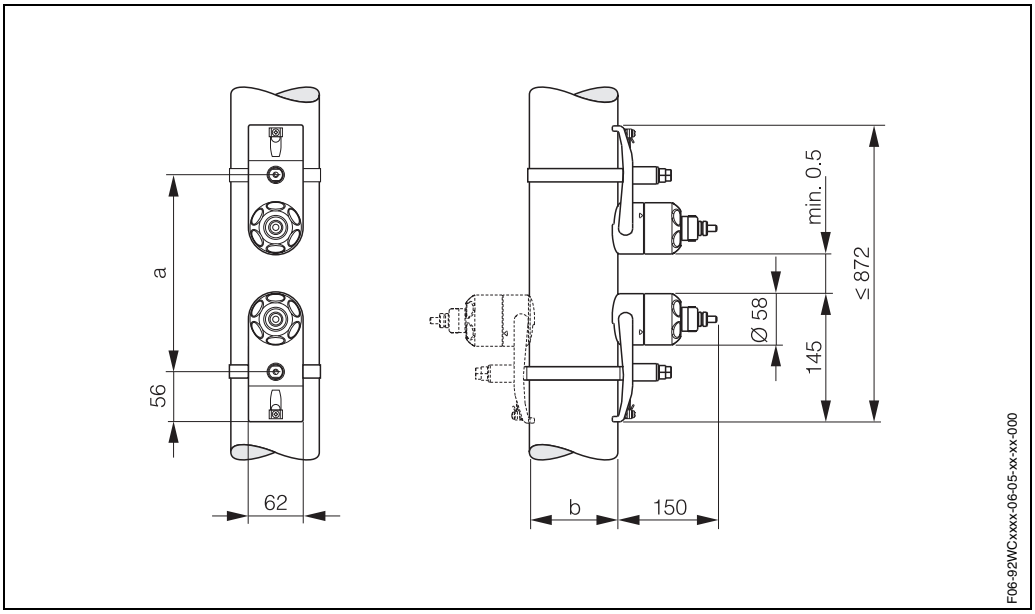
Mechanical construction

Design / dimensions

Dimensions: handheld housing

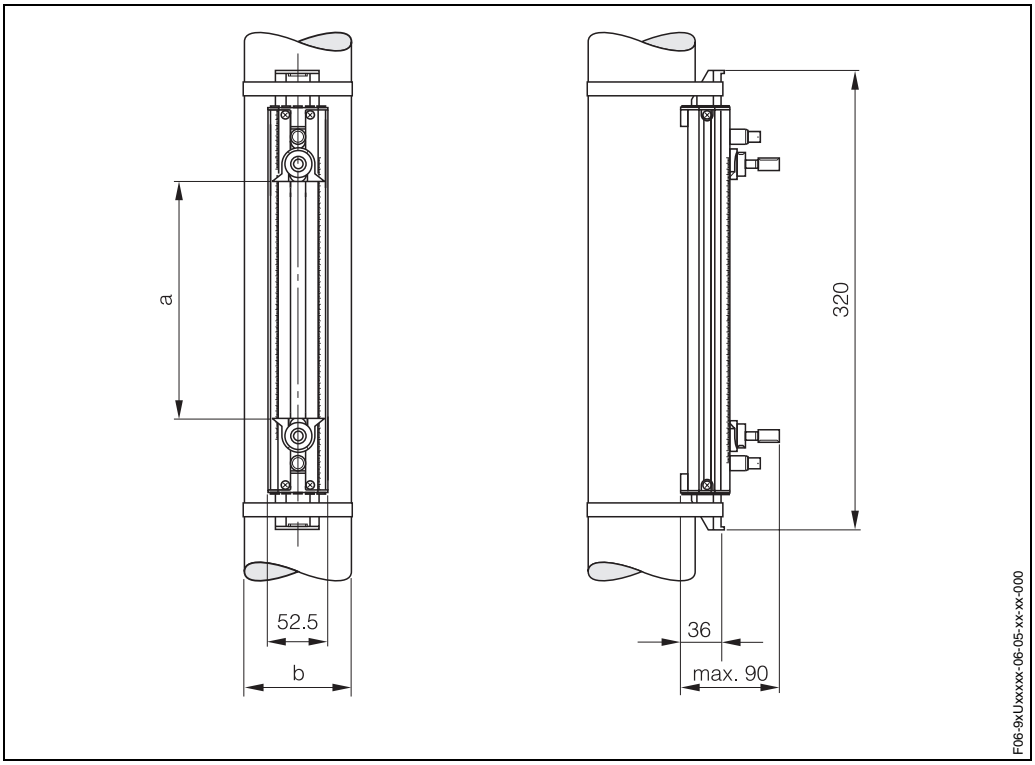


Prosonic Flow W



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

Prosonic Flow U



a = Sensor distance can be determined using Site Setup (0...135 mm)
b = Pipe outer diameter (defined by the application)

Weight

Transmitter Prosonic Flow 92:
- Handheld housing: 1.5 kg

Flow measuring sensors:
- Flow measuring sensors W incl. sensor holders and tensioning bands: 2.8 kg
- Flow measuring sensors U incl. tensioning bands: 0.6 kg

Materials

Transmitter housing Prosonic Flow 92
- Handheld housing: plastic case

Flow measuring sensors W
- Sensor housing, nickel plated brass: 2.0401 (DIN 17660), C38500 (UNS)
- Sensor fixing brackets: 1.4301 (DIN 17440), 304 (AISI)
- Sensor contact surface: chemical resistant plastic
- Tensioning bands: textile

Flow measuring sensors U
- Sensor housing: plastic
- Sensor mounting rail: aluminum alloy/plastic
- Sensor contact surface: chemical resistant plastic
- Tensioning bands: textile

Sensor cables
- PVC

Human interface

Display elements

- Liquid crystal graphic display
  240 x 320 dot (with backlight)
- Custom configurations for presenting different measured values and status variables
- Supported language for display: English, German, French, Italian and Spanish

Operating elements

9 push buttons:
ON, OFF, →, ↑, →, ↓, ESC, ENT, LIGHT

Serial communication

RS-232C (not isolated)
- Transmission speed: max. 9600 BPS
- Max. cable length 15 m

Logging functions:
- Site data (name, piping, liquid, sensor mounting method, type of sensor) for up to 20 sites
- A maximum of 40000 data points (time, velocity, flow rate, totals, analog input, status) can be stored in the memory.

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.

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 1326) “Emmision to class A requirements”:
Electromagnetic compatibility (EMC requirements)

The power adapter is approved according to UL/UL-C and IEC 950.

Ordering information

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

Accessories

Mounting material:
- Coupling medium -40...+80 °C
- Tensioning bands for DN 15...100 (U sensor)
- Tensioning bands for DN 50...1500 (W sensor)
- Tensioning bands for DN 1000...4000 (W sensor)

The E+H service organisation can provide detailed information on request.

Supplementary documentation

❑ System Information Prosonic Flow 92 (SI 038D/06/en)
❑ Operating Instructions Prosonic Flow 92 (BA 083D/06/en)

Subject to modifications

Endress+Hauser GmbH+Co.
Instruments International
P.O. Box 2222
D-79574 Weil am Rhein
Germany

Tel. (07621) 975-02
Tx 773926
Fax (07621) 975 345
e-mail: info@ii.endress.com

Internet:
http://www.endress.com

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