Technical Information

**Prosonic S FMU90**

Transmitter in housing for field or top-hat rail mounting for the ultrasonic sensors FDU91/91F/92/93/95/96

**Application for level measurement**
- Continuous, non-contact level measurement of fluids, pastes, sludge and powdery to coarse bulk materials with 1 or 2 ultrasonic sensors
- Measuring range up to 70 m (depending on sensor and material measured)
- Level limit detection (up to 6 relays)
- Pump control (alternating)
- Screen and rake control
- Calculations: average, difference, sum

**Application for flow measurement**
- Flow measurement in open channels and measuring weirs with 1 or 2 ultrasonic sensors
- Simultaneous measurement of level and flow in a stormwater overflow basin with only 1 sensor
- Flow measurement with back water detection (2 sensors) or sludge detection
- Up to 3 (non-resettable) totalizers and 3 (resettable) counters configurable
- Counting or time pulse output for control of external units

**Your benefits**
- Simple, menu-guided operation with 6-line plain text display
- Envelope curves on the display for quick and simple diagnosis
- Easy operation, diagnosis and measuring point documentation with the supplied "ToF-Tool – FieldTool Package" operating program.
- Temperature dependent time-of-flight correction via the integrated temperature measurement in the sensors
- Linearisation (up to 32 points, freely configurable)
- Linearisation tables for the most common flumes and weirs pre-programmed and selectable
- Online calculation of the flume-/weir-flows via integrated flow curves
- System integration via HART or PROFIBUS DP
- Automatic detection of the sensors FDU91/91F/92/93/95/96
- The sensors of the former series FDU8x can be connected (for certificates see note on page 8)
- Adjustable to the individual requirements via product structure
# Table of Contents

## Function and system design
- Measuring principle ................................................. 3
- Blocking distance ................................................ 3
- Measuring frequency ............................................. 3
- Time-of-flight correction ....................................... 3
- Interference echo suppression .................................. 3
- Pump control ..................................................... 4
- Linearity .......................................................... 4
- Special functions ............................................... 4
- Datalog functions ............................................... 4
- Application examples for level measurements ............... 5
- Application examples for flow measurements ............... 6
- System integration HART ....................................... 7
- System integration PROFIBUS DP ............................... 7

## Input
- Sensor inputs .................................................. 8

## Output
- Analogue outputs ............................................... 9
- Relay outputs ................................................ 9
- PROFIBUS DP Interface ........................................ 10

## Auxiliary energy
- Supply voltage .................................................. 10
- Power consumption ........................................... 10
- Current consumption ......................................... 10
- Galvanic isolation ............................................. 10
- Fuse ............................................................. 10

## Electrical connection
- Terminal compartment of the field housing ................. 11
- Cable entries of the field housing ............................ 11
- Terminal compartment of the DIN-rail housing .......... 12
- Terminals ........................................................ 13
- Terminal assignment .......................................... 14
- Connection of the sensors FDU9x ............................. 17
- Synchronization line .......................................... 18
- Connection of the separate display and operating module 18

## Performance characteristics
- Reference operating conditions ............................... 19
- Measuring uncertainty ......................................... 19
- Typical accuracy ............................................... 19
- Measured value resolution ................................... 19
- Measuring frequency ......................................... 19

## Mechanical construction
- Housing versions ............................................... 20
- Dimensions of the field housing ............................ 20
- Dimensions of the DIN-rail housing ........................ 21
- Dimensions of the separate display and operating module 23
- Weight ........................................................... 23
- Materials ......................................................... 23

## Human interface
- Display and operating module ............................... 24
- Display menu .................................................. 24
- Quick Setup .................................................... 24
- Locking of the instrument ................................... 24

## Certificates and Approvals
- CE mark .......................................................... 25
- Ex approval .................................................... 25
- External standards and guidelines ......................... 25

## Ordering information
- Product structure ............................................... 26
- Scope of delivery ............................................. 26

## Accessories
- Commubox FXA191 HART .................................... 27
- Commubox FXA195 HART .................................... 27
- Commubox FXA291 IPC ....................................... 27
- Protection cover for the field housing .................... 27
- Mounting plate for the field housing ...................... 27
- Mounting bracket ............................................. 28
- Adaption plate for remote display ......................... 28
- Overvoltage protection HAW56x .............................. 29

## Supplementary documentation
- Innovation booklet ............................................. 33
- Technical Information ......................................... 33
- Operating instructions (for transmitter FMU90) ........ 33
- Description of Instrument Functions ...................... 33
- Safety Instructions (XA) ..................................... 33
- Control Drawings (ZD) ........................................ 33
Function and system design

Measuring principle

The sensor transmits ultrasonic pulses in the direction of the product surface. There, they are reflected back and received by the sensor. The transmitter Prosonic S measures the time $t$ between pulse transmission and reception. From $t$ (and the velocity of sound $c$) it calculates the distance $D$ from the sensor membrane to the product surface:

$$ D = \frac{c \cdot t}{2} $$

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

Blocking distance

The span $F$ may not extend into the blocking distance $BD$. Level echos from the blocking distance can not be evaluated due to the transient characteristics of the sensor. The blocking distances of the individual sensors are given in the following documents:
- TI 396F for the sensors FDU 91/91F/92/93/95/96
- TI 189F for the sensors FDU 80/80F/81/81F/82/83/84/85/86

Time-of-flight correction

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

Interference echo suppression

The interference echo suppression feature of the Prosonic S ensures that interference echos (e.g. from edges, welded joints and installations) are not interpreted as a level echo.

Pump control

Individually configurable for each pump:
- pump switching delay, e.g. to prevent overload of the power supply system
- backlash time and backlash interval, e.g. for complete draining of shafts or channels
- crust reduction at pump shaft walls by fine adjustment of the switch point
## Linearisation

### Pre-programmed linearisation curves

*Types of vessels*
- horizontal, cylindrical tank
- spherical tank
- tank with pyramidal bottom
- tank with conical bottom
- tank with flat, inclined bottom

*Flow curves for flumes and weirs*
- Khafagi-Venturi flume
- ISO-Venturi flume
- BST\textsuperscript{2} Venture flume
- Parshall flume
- Palmer-Bowlus flume
- Rectangular weir
- Rectangular constricted weir
- NFX\textsuperscript{3} rectangular weir
- NFX\textsuperscript{3} rectangular constricted weir
- Trapezoidal weir
- V-notch weir
- BST\textsuperscript{2} V-notch weir
- NFX\textsuperscript{3} V-notch weir

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

### Linearisation formula for flow measurements\textsuperscript{1}

\[ Q = C (h^{\alpha} + \gamma h^{\beta}) \]

"h" is the upstream level. The parameters \(\alpha\), \(\beta\), \(\gamma\) and \(C\) can be freely programmed by the user.

### Linearisation table

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

## Special functions

- limit detection
- rake control
- alternating pump control or control according to pump rate
- totalising of the flow volume with (resettable) counters and (non-resettable) totalisers\textsuperscript{1}
- triggering of a sampler by time or quantity pulses\textsuperscript{1}
- low flow cut off\textsuperscript{1}
- backwater detection in flumes\textsuperscript{1}
- sludge detection in flumes\textsuperscript{1}
- trend detection

## Datalog functions

### Basic version

- Peak hold indicator of the min./max. levels or flows and the min./max. temperatures at the sensors
- Recording of the last 10 alarms
- Indication of the operating status
- Trend indication of the outputs on the on-site display
- Indication of the operating hours

---

\textsuperscript{1)} for instrument versions with flow software (FMU90 - *2**********)
\textsuperscript{2)} BST: British Standard
\textsuperscript{3)} French standard NFX 10-311
<table>
<thead>
<tr>
<th>Application examples for level measurements</th>
<th>Level measurement with limit detection and alarm output</th>
<th>Average level measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Level measurement with limit detection and alarm output" /></td>
<td><img src="image2.png" alt="Level measurement with limit detection and alarm output" /></td>
<td><img src="image3.png" alt="Average level measurement" /></td>
</tr>
<tr>
<td><img src="image4.png" alt="Rake control (differential measurement)" /></td>
<td><img src="image5.png" alt="Rake control (differential measurement)" /></td>
<td><img src="image6.png" alt="Alternating pump control (up to 6 pumps)" /></td>
</tr>
<tr>
<td><img src="image7.png" alt="Conveyor belt" /></td>
<td><img src="image8.png" alt="Conveyor belt" /></td>
<td></td>
</tr>
</tbody>
</table>

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

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

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

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

**Order code e.g.: FMU90 - "1***111**** (1 input, 1 output)**
Application examples for flow measurements

Pulses for volume counter + time pulses (e.g. for sampler)

Flow measurement with backwater alarm or sludge detection

If the ratio "downstream level:upstream level" rises above or falls below a critical value, an alarm will be generated.

Order code e.g.: FMU90 - *2***131****
(1 input, 3 relays, 1 output)

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

Stormwater overflow basin

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

Order code e.g.: FMU90 - *2***112****
(1 input, 2 outputs)
In the standard version a HART signal is superimposed onto the first output current. In order to use the HART communication, the circuit must contain a communication resistor of 250Ω.

**Operating options**
- via the operating and display module at the Prosonic S (if present)
- via the service interface of the Prosonic S with the Commubox FXA291 and the operating program "ToF Tool - FieldTool Package" or "FieldCare"
- via the HART protocol, e.g. with the Commubox FXA191 or FXA195 and the operating program "ToF Tool - FieldTool Package" or "FieldCare"
- via the HART handheld terminal DXR375

**System integration PROFIBUS DP**

**Operating options**
- via the display and operating module at the Prosonic S
- via the service interface with the Commubox FXA291 and the operating program "ToF Tool - FieldTool Package" or "FieldCare"
- via PROFINET with ProfiBoard or Proficard and the operating program "ToF Tool - FieldTool Package" or "FieldCare"
## Input

### Sensor inputs

Depending on the instrument version, 1 or 2 of the sensors FDU91, FDU92, FDU93, FDU95 and FDU96 can be connected. The Prosonic S identifies these sensors automatically.

<table>
<thead>
<tr>
<th>Sensor</th>
<th>FDU91</th>
<th>FDU92</th>
<th>FDU93</th>
<th>FDU95</th>
<th>FDU96</th>
</tr>
</thead>
<tbody>
<tr>
<td>max. range(^1) in liquids</td>
<td>10 m</td>
<td>20 m</td>
<td>25 m</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>max. range(^1) in solids</td>
<td>5 m</td>
<td>10 m</td>
<td>15 m</td>
<td>45 m</td>
<td>70 m</td>
</tr>
</tbody>
</table>

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

In order to support existing installations, the sensors of the former series FDU8x can be connected as well. The type of sensor must be entered manually.

<table>
<thead>
<tr>
<th>Sensor</th>
<th>FDU80</th>
<th>FDU81</th>
<th>FDU82</th>
<th>FDU83</th>
<th>FDU84</th>
<th>FDU85</th>
<th>FDU86</th>
</tr>
</thead>
<tbody>
<tr>
<td>max. range(^1) in liquids</td>
<td>5 m</td>
<td>9 m</td>
<td>20 m</td>
<td>25 m</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>max. range(^1) in solids</td>
<td>2 m</td>
<td>5 m</td>
<td>10 m</td>
<td>15 m</td>
<td>25 m</td>
<td>45 m</td>
<td>70 m</td>
</tr>
</tbody>
</table>

1. This table gives the maximum range. The range depends on the measuring conditions. For an estimation see Technical Information TI 189F, chapter "Planning Recommendations".

⚠️ **Warning!**  
The sensors FDU83, FDU84, FDU85 and FDU86 with an ATEX, FM or CSA certificate are not certified for connection to the transmitter FMU90.
## Output

### Analogue outputs

<table>
<thead>
<tr>
<th>Number</th>
<th>1 or 2, depending on instrument version</th>
</tr>
</thead>
</table>
| Output signal | configurable at the instrument:  
  - 4 ... 20 mA with HART ¹  
  - 0 ... 20 mA without HART |
| Signal on alarm |  
  - for setting 4 ... 20 mA, selectable:  
    - -10% (3.6 mA)  
    - 110% (22 mA)  
    - HOLD (last current value is held)  
    - user specific  
  - for setting 0 ... 20 mA:  
    - 110% (21.6 mA)  
    - HOLD (last current value is held)  
    - user specific |
| Output damping | freely selectable, 0 ... 1000 s |
| Load | max. 600 Ω, influence negligible |
| max. ripple | \( U_{ss} = 200 \text{ mV at } 47 \ldots 125 \text{ Hz (measured at } 500 \text{ Ω) } \) |
| max. noise | \( U_{eff} = 2.2 \text{ mV at } 500 \text{ Hz... 10 kHz (measured at } 500 \text{ Ω) } \) |

¹) The HART signal is assigned to the first analogue output. The second analogue output does not carry a HART signal.

### Relay outputs

<table>
<thead>
<tr>
<th>Number</th>
<th>1, 3 or 6; depending on the instrument version</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>potential-free relay, SPDT, can be inverted</td>
</tr>
<tr>
<td>Assignable functions</td>
<td></td>
</tr>
</tbody>
</table>
  - limit (inband, out-of-band, trend, level limit)  
  - counting pulse¹ (pulse width adjustable)  
  - time pulse¹ (pulse width adjustable)  
  - alarm/diagnosis  
    (e.g. indication of backwater², sludge¹, echo loss etc.)  
  - pump control (alternating/fixed limit/pump rate)  
  - rake control (difference or relative measurement)  
  - fieldbus relay (to be switched directly from the Profibus DP-bus) |
| Switching power |  
  - DC voltage: 35 V DC, 100 W  
  - AC voltage: 4 A, 250 V, 100 VA at \( \cos \phi = 0.7 \) |
| State on error | selectable:  
  - HOLD (last value is held)  
  - energized  
  - de-energized  
  - present value is used |
| Behaviour after power failure | switch-on delay selectable |
| LEDs²) | A yellow LED on the front panel is allocated to each relay, which lights if the relay is energized.  
  The LED of an alarm relay lights during normal operation.  
  The LED for a pulse relay briefly flashes at every pulse. |

¹) for instrument versions with flow software (FMU90 - *2**********)

²) for instrument versions with display and operating module
### PROFIBUS DP interface

<table>
<thead>
<tr>
<th>Profile</th>
<th>3.0</th>
</tr>
</thead>
</table>

#### Transmittable values
- main value (level or flow, depending on the instrument version)
- distances
- counters
- temperatures
- average/difference/sum
- relay states
- rake control
- pump control

#### Function blocks
- 10 Analog Input Blocks (AI)
- 10 Digital Input Blocks (DI)
- 10 Digital Output Blocks (DO)

#### Supported baud rates
- 9.6 kbaud
- 19.2 kbaud
- 45.45 kbaud
- 93.75 kbaud
- 187.5 kbaud
- 500 kbaud
- 1.5 Mbaud
- 3 Mbaud
- 6 Mbaud
- 12 Mbaud

#### Addressing
via dip switches at the instrument or via software (e.g. ToF Tool)

### Auxiliary energy

<table>
<thead>
<tr>
<th>Instrument version</th>
<th>Supply voltage</th>
<th>Power consumption</th>
<th>Current consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC voltage (FMU90 - <strong><strong>A</strong></strong>***)</td>
<td>90 ... 253 V AC (50/60 Hz)</td>
<td>max. 23 VA</td>
<td>max. 100 mA at 230 V AC</td>
</tr>
<tr>
<td>DC voltage (FMU90 - <strong><strong>B</strong></strong>***)</td>
<td>10,5 ... 32 V DC</td>
<td>max. 14 W (typically 8 W)</td>
<td>max. 580 mA at 24 V DC</td>
</tr>
</tbody>
</table>

### Galvanic isolation

The following terminals are galvanically isolated from each other:
- auxiliary energy
- sensor inputs
- analogue output 1
- analogue output 2
- relay outputs
- bus connection (PROFIBUS DP)

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

accessible in the terminal compartment
Electrical connection

Terminal compartment of the field housing

The field housing has a separate terminal compartment. It can be opened after loosening the four screws of the lid.

For easier wiring, the lid can be completely removed by unplugging the display plug (1) and pulling off the hinges (2):

Cable entries of the field housing

On the bottom of the housing the following openings for cable entries are prestamped:
- M20x1.5 (10 openings)
- M16x1.5 (5 openings)
- M25x1.5 (1 opening)

A suitable cutting device must be used for cutting out the openings.
The catch can be unlocked by slightly pressing onto the clip. Then, the cover of the terminal compartment can be opened.

**Several instruments mounted side by side**

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

**Note!**
The cables can be inserted into the housing from above or from below.
Pluggable spring-force terminals for connection of the cables are supplied in the terminal compartment. Rigid conductors or flexible conductors with cable and sleeve can directly be inserted and are contacted automatically.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conductor cross section</td>
<td>0.2 mm² - 2.5 mm²</td>
</tr>
<tr>
<td>Cable and sleeve cross section</td>
<td>0.25 mm² - 2.5 mm²</td>
</tr>
<tr>
<td>min. stripping length</td>
<td>10 mm</td>
</tr>
</tbody>
</table>
**Terminal assignment**

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

<table>
<thead>
<tr>
<th>Conductor cross section</th>
<th>0.2 mm² – 2.5 mm²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cable and sleeve cross section</td>
<td>0.25 mm² – 2.5 mm²</td>
</tr>
<tr>
<td>min. stripping length</td>
<td>10 mm</td>
</tr>
</tbody>
</table>

The terminal configuration depends on the instrument version ordered. There is a basic terminal area, which is present in every instrument version. Additional optional terminal areas are only present if the respective option has been selected in the product structure.

<table>
<thead>
<tr>
<th>Terminal area</th>
<th>present for the following instrument versions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic area A</td>
<td>for all versions</td>
</tr>
<tr>
<td>Optional areas B</td>
<td>for instrument versions with 2 sensor inputs and/or 2 analogue outputs (FMU90 - *<strong><strong><strong>2</strong></strong></strong> and/or FMU90 - **<em><strong><strong>2</strong></strong></em>)</td>
</tr>
<tr>
<td></td>
<td>for instrument versions with 3 or 6 relays (FMU90 - **<em><strong><strong>3</strong></strong></em> oder FMU90 - **<em><strong><strong>6</strong></strong></em>)</td>
</tr>
<tr>
<td>D</td>
<td>for instrument versions with PROFIBUS DP interface (FMU90 - **<em><strong><strong>3</strong></strong></em>)</td>
</tr>
</tbody>
</table>

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

**A:** Basic terminal area; **B-D:** Optional terminal areas (present if the respective option has been selected in the product structure)

Note!
The depicted switching states of the relays refer to the de-energized state.
### Terminals | Meaning | Terminal area | Remarks
--- | --- | --- | ---
#### Auxiliary energy
1, 2 | Auxiliary energy | A | depending on instrument version:
- 90 ... 253 V<sub>AC</sub>
- 10.5 ... 32 V<sub>DC</sub>
3 | Potential equalization | A | 
#### Analog outputs (not available for ProBus DP instruments)
4, 5 | Analog output 1; 4 ... 20 mA with HART/ 0 ... 20 mA w/o HART | A | not present for the PROFIBUS DP version
41, 42 | Analog output 2 (optional); 4 ... 20 mA/ 0 ... 20 mA | B | only for the version with two analog outputs; no HART signal at this output
#### Relay outputs
6, 7, 8 | Relay 1 | A | 
50, 51, 52 | Relay 2 (optional) | C | only for the versions with 3 or 6 relays
53, 54, 55 | Relay 3 (optional) | C | only for the versions with 3 or 6 relays
56, 57, 58 | Relay 4 (optional) | C | only for the version with 6 relays
59, 60, 61 | Relay 5 (optional) | C | only for the version with 6 relays
62, 63, 64 | Relay 6 (optional) | C | only for the version with 6 relays
#### Bus communication (only available for Profibus DP instruments)
65 | PROFIBUS A (RxT/TxD - N) | D | only for the PROFIBUS DP version
66 | PROFIBUS B (RxT/TxD - P) | D | 
#### Synchronization
39, 40 | Synchronization | A | see section 4.6, "Synchronization line"
#### Level inputs
9 (YE), 10 (BK), 11 (RD) | Sensor 1 (FDU8x/9x)
- YE: yellow strand
- BK: black strand
- RD: red strand | A | • A: for versions with 1 sensor input
• B: for versions with 2 sensor inputs
12 (YE), 13 (BK), 14 (RD) | Sensor 2 (FDU8x/9x) (optional)
- YE: yellow strand
- BK: black strand
- RD: red strand | B | only for the version with 2 sensor inputs

---

1) In this case, terminals 9/10/11 are not present on terminal area A.

---

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

**Note!**
- In order to avoid interference signals, the sensor cables should not be laid parallel to high voltage or electric power lines.
- The cables may not be laid in the proximity to frequency converters.
<table>
<thead>
<tr>
<th>Designation</th>
<th>Meaning/Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuse</td>
<td>Fuse: 2 A T/DC or 400 mA T/AC</td>
</tr>
<tr>
<td>Display</td>
<td>Connection of the display or the remote display and operating module (see chap. 4.7)</td>
</tr>
<tr>
<td>Service</td>
<td>Service interface for connection of a PC/Notebook via Commubox FXA291 (see chap. 5.1)</td>
</tr>
<tr>
<td>![icon]</td>
<td>Locking switch, see chap. 5.5.3</td>
</tr>
<tr>
<td>Term.</td>
<td>Bus termination (only applicable for instruments with PROFIBUS interface)</td>
</tr>
<tr>
<td>Address</td>
<td>Bus address (only applicable for instruments with PROFIBUS interface)</td>
</tr>
</tbody>
</table>
Connection of the sensors FDU9x

(A): Terminal box (recommended or cable lengths > 30 m); (B): Grounding at the terminal box; (C): Grounding at the transmitter or in the control room; (1): Terminals for sensor input 1 at the FMU9x; (2): Terminals for sensor input 2 at the FMU9x (optional)

For details refer to Technical Information TI 396F.
Synchronization line

- If wiring several Prosonic S, which are mounted in a common cabinet and if the sensor cables run in parallel, the synchronization terminals (39 and 40) must be interconnected.
- Up to 20 instruments can be synchronized in this way.
- If there are more than 20 instruments, groups must be formed, each containing a maximum of 20 instruments. For the instruments within each group, the sensor cables may run in parallel. The sensor cables of different groups must be separated from each other.
- Usual commercial screened cable can be used for synchronization
  - max. length: 10 m between the individual instruments
  - cross section: 2 x (0.75 - 2.5 mm²)
  - for lengths up to 1 m, an unscreened cable can be used; for lengths exceeding 1 m, screening is required. The screen must be connected to ground
- Instruments of the Prosonic FMU86x family can be connected to the synchronization line as well. In this case a maximum of 10 instruments can be connected to each synchronization line.

Connection of the separate display and operating module

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

Note!
Minimum diameter for cable bushing: 2 cm
Performance characteristics

Reference operating conditions
- Temperature = 24±5 °C
- Pressure = 960±100 mbar
- Relative humidity = 60±15 %
- Ideally reflecting surface, sensor vertically aligned (e.g. calm, plane liquid surface of 1 m²)
- No interference echoes within the signal beam
- Settings of the application parameters:
  - tank shape = flat ceiling
  - medium property = liquid
  - process condition = calm surface

Measuring uncertainty\(^4\) ±0,2 % of the maximum span of the sensor

Typical accuracy\(^5\) ±2 mm + 0,17 % of the measured distance

Measured value resolution 1 mm with FDU91

Measuring frequency max. 3 Hz
The exact value depends on the settings of the application parameters and the instrument version (1- or 2-channel).

Ambient conditions

Ambient temperature -40 ... 60 °C
The functionality of the LC display becomes restricted at T_1 < -20 °C.
If the device is operated outdoors in strong sunlight, a protective cover should be used (s. chapter "Accessories").

Storage temperature -40 ... 60 °C

Climate class
- Housing for DIN rail mounting: according to DIN EN 60721-3 3K3/3Z2/3Z5/3B1/3C2/3S3/3M1 (DIN 60721-3 3K3 corresponds to DIN 60654-1 B2)

Vibration resistance
- Housing for DIN rail: DIN EN 600068-2-64 / IEC 68-2-64; 20 ... 20000 Hz; 0,5 (m/s²)²/Hz
- Field housing: DIN EN 600068-2-64 / IEC 68-2-64; 20 ... 20000 Hz; 1,0 (m/s²)²/Hz

Ingress protection
- Field housing: IP66 / NEMA 4x
- Housing for DIN rail: IP20
- separate display:
  - IP65 / NEMA 4 (front panel, if mounted in cabinet door)
  - IP20 (rear panel, if mounted in cabinet door)

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

\(^4\) according to NAMUR EN 61298-2
\(^5\) after calibration
Mechanical construction

**Housing versions**
- Field housing; optionally with integrated display and operating module
- Housing for top-hat rail mounting; optionally with integrated display and operating module
- Housing for top-hat rail mounting with separated display and operating module for cabinet door mounting

**Dimensions of the field housing**

![Diagram of field housing dimensions]

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

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

**Hinweis**
The mounting help must be mounted on a plane surface and must not become bent. Otherwise the mounting of the field housing may be difficult or impossible.
## Dimensions of the DIN-rail housing

The dimensions of the DIN-rail housing depend on the instrument version. The version determines, which terminal areas the Prosonic S contains. The dimensions are influenced by the following features of the product structure (see chapter 2.3):

- **60**: Level Input
- **70**: Switch Output
- **80**: Output

In order to determine the dimensions of a specific version, perform the following steps (see the example on page 22):

1. Using the product structure, determine the options of the features 60, 70 and 80 of the instrument version in question.

   ![Feature and option of the product structure](image)

   **Feature and option of the product structure** | **corresponds to the following terminal area** | **present?**
   --- | --- | ---
   feature 60; option 2 and/or feature 80, option 2 | 2 sensor inputs and/or 2 analogue outputs | yes = 1 no = 0
   feature 70, option 3 or 6 | 3 or 6 relays | yes = 1 no = 0
   feature 80, option 3 | PROFIBUS DP interface | yes = 1 no = 0

   **Sum =**

2. Using the following table, determine how many optional terminal areas this instrument version contains.

   ![Dimensions in mm](image)

   **Sum = 0**
   **(only basic terminal area)**

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

<table>
<thead>
<tr>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
<th>60</th>
<th>70</th>
<th>80</th>
<th>90</th>
<th>100</th>
<th>110</th>
<th>120</th>
</tr>
</thead>
<tbody>
<tr>
<td>FMU90 -</td>
<td>R</td>
<td>1</td>
<td>2</td>
<td>A</td>
<td>A</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>A</td>
<td>A</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>feature and option of the product structure</th>
<th>corresponds to the following terminal area</th>
<th>present?</th>
</tr>
</thead>
<tbody>
<tr>
<td>feature 60; option 2 and/or feature 80, option 2</td>
<td>2 sensor inputs and/or 2 analogue outputs</td>
<td>1 (yes)</td>
</tr>
<tr>
<td>feature 70, option 3 or 6</td>
<td>3 or 6 relays</td>
<td>1 (yes)</td>
</tr>
<tr>
<td>feature 80, option 3</td>
<td>PROFIBUS DP interface</td>
<td>0 (no)</td>
</tr>
</tbody>
</table>

Sum = 2
=> 104 mm x 150 mm x 140 mm

Dimensions of the separate display and operating module

Dimensions in mm

Weight

<table>
<thead>
<tr>
<th>Housing version</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field housing</td>
<td>approx. 1,6 ... 1,8 kg; depending on instrument version</td>
</tr>
<tr>
<td>Housing for DIN rail</td>
<td>approx. 0,5 ... 0,7 kg; depending on instrument version (s. section: &quot;Dimensions of the DIN-rail housing&quot;)</td>
</tr>
<tr>
<td>separate display and operating module</td>
<td>approx. 0,5 kg</td>
</tr>
</tbody>
</table>

Materials

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

Display and operating module

![Diagram of Display and Operating Module]

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

Display (Examples)

- **[Display of a function including help text and descriptive graphic]**
- **[Display of the envelope curve including the mapping. The level echo and the empty distance are marked.]**

Keys (softkey operation)

The function of the keys depends on the current position within the operating menu (softkey functionality). The key functions are indicated by softkey symbols in the bottom line of the display.

LEDs

- 1 LED (a) indicates the operating state ("normal operation", "alarm" or "warning")
- 6 LEDs (b) indicate the switching state of the relays (LED glows if the respective relay is energised)

Illuminated display

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

Operating menu

The Prosonic S has got a dynamical operating menu. Only those functions are visible which are relevant for the instrument version and installation environment at hand.

Quick Setup

The operating menu contains Quick Setups for easy commissioning of level and flow measurements and menus for adjusting pump and rake controls. The Quick Setups and menus guide the user through the complete commissioning procedure.

Locking of the instrument

The instrument can be locked against parameter changes in the following ways:

- Locking switch in the terminal compartment
- Key combination at the operating module
- Input of a locking code via software (e.g. "ToF Tool" or "FieldCare")
## Certificates and Approvals

<table>
<thead>
<tr>
<th>CE mark</th>
<th>The measuring system meets the legal requirements of the EC-guidelines. Endress+Hauser confirms the instrument passing the required tests by attaching the CE-mark.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ex approval</td>
<td>The available certificates are listed in the ordering information. Note the associated safety instructions (XA) and control or installation drawings (ZD). Note! Sensors FDU9x with Ex-approval can be connected to the transmitter FMU90 without Ex-approval.</td>
</tr>
</tbody>
</table>
| External standards and guidelines | **EN 60529**  
Protection class of housing (IP code)  
**EN 61326**  
Electromagnetic compatibility (EMC requirements)  
**NAMUR**  
Standards committee for measurement and control in the chemical industry  
**US Standard UL 61010-1**  
CSA General Purpose Units FMU9x-N********** are tested according to US standard UL 61010-1, 2nd edition |
# Ordering information

## Product structure

<table>
<thead>
<tr>
<th>10</th>
<th>Approval</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>Non-hazardous area</td>
</tr>
<tr>
<td>J</td>
<td>ATEX II 3D</td>
</tr>
<tr>
<td>N</td>
<td>CSA General Purpose</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>20</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Level + pump control, alternating</td>
</tr>
<tr>
<td>2</td>
<td>Flow + totalizer + level + sample control + preprogrammed OCM flow curves</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>30</th>
<th>Housing, material</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Field mounting PC, IP66 NEMA 4x</td>
</tr>
<tr>
<td>2</td>
<td>DIN rail mounting PBT, IP20</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>40</th>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>Illuminated display + keypad</td>
</tr>
<tr>
<td>E</td>
<td>Illuminated display + keypad, 96x96, panel mounting, front IP65</td>
</tr>
<tr>
<td>K</td>
<td>w/o display, via communication</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>50</th>
<th>Power supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>90-253 VAC</td>
</tr>
<tr>
<td>B</td>
<td>10,5-32 VDC</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>60</th>
<th>Level input</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1x sensor FDU9x/8x</td>
</tr>
<tr>
<td>2</td>
<td>2x sensor FDU9x/8x</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>70</th>
<th>Switch output</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1x relay, SPDT</td>
</tr>
<tr>
<td>2</td>
<td>3x relay, SPDT</td>
</tr>
<tr>
<td>3</td>
<td>6x relay, SPDT</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>80</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1x 0/-4-20mA HART</td>
</tr>
<tr>
<td>2</td>
<td>2x 0/-4-20mA HART</td>
</tr>
<tr>
<td>3</td>
<td>PROFIBUS DP</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>90</th>
<th>Additional input</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>w/o additional input</td>
</tr>
<tr>
<td>B</td>
<td>4x limit switch + 1x temperature PT100/FMT131 (in preparation)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>100</th>
<th>Datalog function</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Basic version</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>110</th>
<th>Languages</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>de, en, nl, fr, es, it</td>
</tr>
<tr>
<td>3</td>
<td>en, zh, ja (in preparation)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>120</th>
<th>Additional option</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Basic version</td>
</tr>
</tbody>
</table>

 FMU90- complete product designation

## Scope of delivery

- Instrument according to the version ordered
- Operating program: ToF Tool – FieldTool Package
- Operating Instructions (depending on communication version, see chapter "Supplementary documentation")
- for certified instrument versions: Safety Instructions (XAs) or Control Drawings (ZDs) (s. chapter "Supplementary documentation")
- field housing units for flow measurement FMU90-*21********* are delivered with 2 screws for plumbing the device
## Accessories

**Commubox FXA191 HART**  
For intrinsically safe communication with ToF Tool/FieldCare via the RS232C interface. For details refer to TI237F/00/en.

**Commubox FXA195 HART**  
For intrinsically safe communication with ToF Tool/FieldCare via the USB interface. For details refer to TI404F/00/en.

**Commubox FXA291 IPC**  
For intrinsically safe communication with ToF Tool/FieldCare via the service interface (IPC) of the instrument and the USB interface of a PC/Notebook.

### Protection cover for the field housing
- Material: 316Ti/1.4571
- is mounted by the mounting help of the Prosonic S
- Order Code: 52024477

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

---

**A: mounting help of the field housing**
Mounting bracket

![Mounting bracket diagram]

<table>
<thead>
<tr>
<th>Height</th>
<th>Material</th>
<th>Order Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>700 mm</td>
<td>galv. steel</td>
<td>919791-0000</td>
</tr>
<tr>
<td>700 mm</td>
<td>316 Ti</td>
<td>919791-0001</td>
</tr>
<tr>
<td>1400 mm</td>
<td>galv. steel</td>
<td>919791-0002</td>
</tr>
<tr>
<td>1400 mm</td>
<td>316 Ti</td>
<td>919791-0003</td>
</tr>
</tbody>
</table>

Adaption plate for remote display

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

Order-Code: 52027441

![Adaption plate diagram]

(a): remote display of FMU90 with adaption plate;
(b): opening of the remote display FMU860/861/862
### Overvoltage protection

#### HAW56x

<table>
<thead>
<tr>
<th>Application examples</th>
</tr>
</thead>
</table>

**Prosonic S FMU90**

#### Measurement signal
- Current output 1
  - 0/4 to 20 mA
- Current output 2
  - 0/4 bis 20 mA

**Transducer Prosonic S FMU90 with 2 Prosonic FDU9x sensors**

<table>
<thead>
<tr>
<th>Measurement point requirements</th>
<th>Connection diagram</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 x HAW560 + 562 for 0/4 to 20 mA signals</td>
<td><img src="image1" alt="Connection Diagram" /></td>
</tr>
<tr>
<td>2 x HAW561 for power supply to the transducer</td>
<td><img src="image2" alt="Connection Diagram" /></td>
</tr>
<tr>
<td>2 x HAW560 + 566 for the sensor signal line</td>
<td><img src="image3" alt="Connection Diagram" /></td>
</tr>
</tbody>
</table>

**Current output 0/4 to 20 mA**

**Prosonic S FMU90 transducer with Prosonic FDU9x level measurement sensors**

<table>
<thead>
<tr>
<th>Measurement point requirements</th>
<th>Connection diagram</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 x HAW560 + 562 for 0/4 to 20 mA signals</td>
<td><img src="image4" alt="Connection Diagram" /></td>
</tr>
<tr>
<td>2 x HAW561 for power supply to the transducers</td>
<td><img src="image5" alt="Connection Diagram" /></td>
</tr>
<tr>
<td>1 x HAW560 + 566 for the sensor signal line</td>
<td><img src="image6" alt="Connection Diagram" /></td>
</tr>
</tbody>
</table>
### Measurement signal
- **no current output**
  (only relay outputs)

Prosonic S FMU90 transducer with Prosonic FDU9x level measurement sensor

### Measurement point requirements
- 1 x HAW560 + 1 x HAW566 for signal line.
  Use gas discharge tube for indirect shield earthing.
- 2 x HAW561 for power supply line

### Connection diagram

![Connection diagram image](image-url)
Electrical connection

_HAW561 and 561K_

A fixed allocation of the phase and ground terminal is not allocated (pole security). The unit is fitted on both ends with a multi function connection terminal. This gives the opportunity to simultaneously connect a cable as well as a fork ferrule from standard busbars.

Connection of the unit is as in the diagram above. Dependent on the cabling, up to four units will be required.

_HAW562/562Z, HAW565 and HAW566_

Connection of the unit as in the diagram. The ground connection is made using the DIN rail. For the signal cable screen connection on the HAW565 unit a special EMC spring terminal is supplied. For indirect screening (as required if connecting the Prosonic S signal line to an HAW566) a gas-discharge arrester is supplied. It must be inserted into the provided plug-in bay on the HAW560.
**Product overview**

<table>
<thead>
<tr>
<th>Order code</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>51003569</td>
<td><strong>Surge arrester HAW561K</strong>&lt;br&gt;For low voltage users 24/48V, single pole, requirement class C, basic component with plugged in protection unit, defect display, 18 mm housing width</td>
</tr>
<tr>
<td>51003570</td>
<td><strong>Surge arrester HAW561</strong>&lt;br&gt;For standard voltage users 115/230 V, single pole, requirement class C, basic component with plugged in protection unit, defect display, 18 mm housing width</td>
</tr>
<tr>
<td>51003571</td>
<td><strong>Surge arrester module carrier HAW560</strong>&lt;br&gt;Two pole through terminated for fitting surge arrester modules for units in information technology, 12 mm housing width, colour grey</td>
</tr>
<tr>
<td>51003572</td>
<td><strong>Surge arrester module HAW562</strong>&lt;br&gt;For protection of 2 single lines, e.g. 2 asymmetrical single lines, e.g.: 0/4 to 20 mA, Profibus PA, 12 mm housing width, colour grey</td>
</tr>
<tr>
<td>51003573</td>
<td><strong>Surge arrester module HAW565</strong>&lt;br&gt;For protection of 2 single lines, e.g. 2 asymmetrical single lines with high frequency signal transmission, e.g.: Profibus DP, RS 485, 12 mm housing width, colour grey</td>
</tr>
<tr>
<td>51003574</td>
<td><strong>Surge arrester module carrier HAW560Z</strong>&lt;br&gt;Two pole through terminated for fitting surge arrester modules for units in information technology in Ex areas, 12 mm housing width, colour blue</td>
</tr>
<tr>
<td>51003575</td>
<td><strong>Surge arrester module HAW562</strong>&lt;br&gt;For protection of 2 single lines, e.g. 2 asymmetrical single lines in Ex areas, e.g.: 0/4 to 20 mA, Profibus PA, 12 mm housing width, colour blue</td>
</tr>
<tr>
<td>71028875</td>
<td><strong>Surge arrester module HAW566</strong>&lt;br&gt;Protection for 2 signal inputs, e.g. 2 asymmetrical inputs, e.g. Prosonic S signal 12 mm housing with, colour grey</td>
</tr>
</tbody>
</table>

For details see Technical Information TI093R.
### Supplementary documentation

**Innovation booklet**  
**IN 003**  
Ultrasonic measurement – the solution for your application

**Technical Information**  
**TI 396F**  
Technical Information for the ultrasonic sensors FDU91/FDU92/FDU93/FDU95/FDU96

**Operating instructions**  
(for transmitter FMU90)

Depending on the instrument version, the following operating instructions are supplied with the Prosonic S FMU90:

<table>
<thead>
<tr>
<th>Operating instructions</th>
<th>Output</th>
<th>Application</th>
<th>Instrument version</th>
</tr>
</thead>
<tbody>
<tr>
<td>BA 288F</td>
<td>HART</td>
<td>• level measurement</td>
<td>FMU90 - <em>1*****1</em>***</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• alternating pump control</td>
<td>FMU90 - <em>2*****1</em>***</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• screen and rake control</td>
<td>FMU90 - <em>1*****2</em>***</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>FMU90 - <em>2*****2</em>***</td>
</tr>
<tr>
<td>BA 289F</td>
<td></td>
<td>• flow measurement</td>
<td>FMU90 - <em>2*****1</em>***</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• backwater and dirt detection</td>
<td>FMU90 - <em>2*****2</em>***</td>
</tr>
<tr>
<td>BA 292F</td>
<td>PROFIBUS DP</td>
<td>• level measurement</td>
<td>FMU90 - <em>1*****3</em>***</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• alternating pump control</td>
<td>FMU90 - <em>2*****3</em>***</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• screen and rake control</td>
<td>FMU90 - <em>2*****3</em>***</td>
</tr>
<tr>
<td>BA 293F</td>
<td></td>
<td>• flow measurement</td>
<td>FMU90 - <em>2*****3</em>***</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• backwater and dirt detection</td>
<td>FMU90 - <em>2*****3</em>***</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• totalizers and counters</td>
<td>FMU90 - <em>2*****3</em>***</td>
</tr>
</tbody>
</table>

These operating instructions describe installation and commissioning of the respective version of the Prosonic S. It contains those functions from the operating menu, which are required for a standard measuring task. Additional functions are contained in the “Description of Instrument Functions” (BA 290F, see below).

**Description of Instrument Functions**  
**BA290F**  
contains a detailed description of all functions of the Prosonic S and is valid for all instrument versions. A PDF file of this document can be found  
- on the CD-ROM of the "ToF-Tool - FieldTool Package", which is supplied together with the instrument  
- in the internet at "www.endress.com"

**Safety Instructions (XA)**  
in preparation

**Control Drawings (ZD)**  
in preparation