HIGH-PRECISION PRESSURE LEVEL TRANSMITTER
MULTI-PARAMETER PROBE WITH DIGITAL INTERFACES

The 36XiW series is built on the latest-generation microcontroller platform, which KELLER has developed to meet extremely high precision requirements and increase compatibility with a wide variety of interfaces. Along with pressure (level) information, digital interfaces also transmit other water parameters such as temperature and conductivity.

- **RS485** Robust interface with differential gauges, for lines up to 1.4 km in length. Modbus RTU and proprietary KELLER bus protocol
- **SDI-12** Standard interface for environmental monitoring, ideal for battery operation

The 36XiW series is based on the proven KELLER 36XW series using the high-quality 10L-series pressure transducer. All series X pressure level transmitters feature an RS485 interface, which provide pressure and temperature standard, while versions requiring higher accuracy, temperature or conductivity sensor are available options. Multi-parameter probes fitted with pressure, temperature and conductivity sensors (CTD – conductivity, temperature, depth), are approximately 90 mm longer.

**36XiW**
- Pressure sensor: accuracy 0.05 %FS
- Temperature sensor: accuracy 0.5 °C or 0.1 °C

**36XiW-CTD**
- Pressure sensor: accuracy 0.05 %FS
- Temperature sensor: accuracy 0.1 °C
- Conductivity sensor: accuracy 2.5 % of the selected measuring range 4 ranges: 0.2 / 2 / 20 / 200 mS/cm

Both versions can be supplied configured for absolute pressure (measured relative to a vacuum → PAA) or relative pressure (fitted with capillary tubes for measuring relative to atmospheric pressure → PR).

**Characteristics**
- Pressure sensor: resolution 5 ppm
- Mathematical compensation of nonlinearities and temperature dependencies
- Sturdy stainless steel housing (titanium or Hastelloy also available)
- Extended lightning protection fitted to the SDI-12 interface as standard
- Level measuring ranges from 0…3 to 0…300 mH2O. Higher ranges are possible using a SubConn® connector
- Ultra-high long-term stability

**Electrical connections**

<table>
<thead>
<tr>
<th>Function</th>
<th>Wires</th>
</tr>
</thead>
<tbody>
<tr>
<td>+Vcc</td>
<td>Black</td>
</tr>
<tr>
<td>GND</td>
<td>White</td>
</tr>
<tr>
<td>RS485A</td>
<td>Blue</td>
</tr>
<tr>
<td>RS485B</td>
<td>Yellow</td>
</tr>
<tr>
<td>SDI-12</td>
<td>Red</td>
</tr>
<tr>
<td>CASE</td>
<td>Cable shield</td>
</tr>
</tbody>
</table>

Optional:
- 36XiW with Subconn® connector

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Interfaces

RS485
Modbus RTU / KELLER bus protocol

The extremely robust RS485 interface enables a bus system to be created with up to 128 users and a total line length of up to 1.4 km. The baud rate of the half-duplex interface can be switched between 9600 and 115'200. The proprietary KELLER bus protocol and the Modbus RTU protocol are already implemented, allowing the measured values to be read off and configuration and calibration to be performed. The free CCS30 software for PC can be used for this.

Measuring channel assignment (up to 4 channels):
- P1 Pressure
- TOB1 Temperature (silicon sensor)
- T Temperature (Pt1000)
- Con Conductivity

A detailed description of RS485 communication can be found on the KELLER website.

SDI-12

As well as the standard RS485 interface, which provides access to all configuration registers, the pressure level transmitter can also be ordered with an SDI-12 interface. Only one interface will be active at any one time. Corresponding commands are used to switch between interfaces (default setting on delivery: SDI-12).

SDI-12 is a tried-and-tested standard for connecting data loggers and digital sensors in environmental monitoring applications. The SDI-12 interface has been optimised for use in battery-operated systems that employ a data logger and multiple sensors on the same bus. The interface is underpinned by a standardised, ASCII-based bus protocol. In SDI-12 mode, the pressure level transmitter is only active when it is being actuated by the data logger or logging a measurement. At all other times, the transmitter is in standby mode, requiring very little current (< 0,1 mA).

Standard commands:
- Reading off measurements with and without checksum
- Changing the sensor address
- Reading off ID

Advanced commands:
- Adjusting the pressure and temperature unit
- Adjustable zero point and amplification
- Adjustable gravitational constant to increase measuring accuracy
- Programming a user-specific ID
- Configurable continuous measurement with adjustable measuring interval and communication of up to eight pressure waves
- Switching to RS485

A detailed description of SDI-12 communication can be found on the KELLER website.

Sensor system

Pressure measurements

The pressure level transmitters are calibrated with pressure in bar. The measuring and testing equipment used has been calibrated to national standards. The RS485 interface always displays pressure in bar. In SDI-12 mode, it is possible to select the unit in which the pressure value is transmitted. The pressure can be read off as a level (water depth) based on the following formula:

\[ h = f \cdot \frac{p}{\rho} \cdot g \]

- \( p \) Pressure (measured value)
- \( \rho \) Water density at 3,98 °C (constant of 1000 kg/m³)
- \( g \) Gravitational acceleration (can be configured; default: 9,80665 m/s²)
- \( f \) Factor used in conversion to unit of height (underlying table)

Depending on the design of the pressure level transmitter, pressure can be recorded relative to a vacuum (PAA models) or to ambient pressure (PR models).

Temperature measurements

Two different temperature sensors are available with varying degrees of calibration and accuracy. End-of-line calibration is performed on Pt1000 sensors in a water bath. The temperature information (TOB) from the silicon sensor is always available and is used for temperature compensation in the pressure sensor, with which it forms a single unit. The Pt1000 sensor in the conductivity module is positioned directly behind the electrodes to provide as accurate a medium temperature as possible, which is then used for temperature compensation of the conductivity.

Conductivity measurements

Conductivity measurements are used in the monitoring of bodies of water (environment). Thanks to four-wire technology, the conductivity probe is not influenced by polarisation effects or dirt. Methods for temperature compensation of the conductivity output*:

- Normalization to 25 °C or to 20 °C through linear compensation in the range of 0 to 8%/K according to DIN/EN27888.
- or normalization to 25 °C through non-linear table The Conductivity is calibrated via the RS485 interface using the software “ConductivityCalibration Tool”.

The conductivity probe is only switched on in SDI-12 mode when a conductivity measurement is requested. In RS485 mode, the conductivity probe can be switched on and off to save energy.

* Default configuration is linear compensation with 2,2 %/K normalized to 25 °C. Other customised factory setting possibly upon demand. Customer can enter new alternative settings any time via software.
## Specifications

<table>
<thead>
<tr>
<th>Pressure</th>
<th></th>
<th>RS485</th>
<th>SDI-12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard ranges in bar</td>
<td>0,3…32 bar</td>
<td>3,2…32 VDC</td>
<td>6…32 VDC</td>
</tr>
<tr>
<td>PR (relative pressure)</td>
<td>0,8…2,3</td>
<td>4,5…32 VDC</td>
<td></td>
</tr>
<tr>
<td>PAA (absolute pressure)</td>
<td>0,8…1,1</td>
<td>&gt; 0,1 mA (active)</td>
<td>&lt; 14 mA (active)</td>
</tr>
<tr>
<td>Water column in m approx.</td>
<td>3…10</td>
<td>0,1…2 % (sleep)</td>
<td>6…15 %FS</td>
</tr>
<tr>
<td>Overload resistance</td>
<td>max. 300 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technology</td>
<td>oil-filled, insulated, piezoresistive pressure transducer in a metallic casing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resolution</td>
<td>typ. 5 ppm (corresponds to 0,0005 %FS)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accuracy &amp; Comp. temp. range</td>
<td>± 0,05 %FS max. (0,3 bar Range: ± 0,04 %FS)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total error band</td>
<td>± 0,1 %FS max. (0,3 bar Range: ± 0,2 %FS)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating temperature (icing not permitted)</td>
<td>-20…80 °C without conductivity</td>
<td>&lt; 1 s</td>
<td></td>
</tr>
<tr>
<td>-5…55 °C with conductivity</td>
<td></td>
<td>&lt; 3 s</td>
<td></td>
</tr>
<tr>
<td>Int. measuring rate</td>
<td>120, 240 (default), 480 Hz (adjustable)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Long-term stability</td>
<td>ranges &gt; 1 bar: ± 0,1 %FS max.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Degree of dependency on location</td>
<td>± 1,5 mbar max.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Temperature</th>
<th></th>
<th>RS485</th>
<th>SDI-12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring range</td>
<td>-10…80 °C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technology</td>
<td>silicon (pressure measuring bridge, TOB®)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comp. temp. range</td>
<td>0…50 °C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resolution</td>
<td>&lt; 0,01 °C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accuracy</td>
<td>silicon sensor: typ. ± 0,3 °C</td>
<td>± 0,1 %FS max.</td>
<td></td>
</tr>
<tr>
<td>Int. measurement rate</td>
<td>12 Hz TOB only</td>
<td>± 0 %FS</td>
<td></td>
</tr>
<tr>
<td>6 Hz PT1000 without conductivity</td>
<td></td>
<td>± 0,2 %FS max.</td>
<td></td>
</tr>
<tr>
<td>1 Hz PT1000 with conductivity</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Conductivity</th>
<th></th>
<th>RS485</th>
<th>SDI-12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring range</td>
<td>0 µS/cm…200 mS/cm</td>
<td>± 32 VDC power supply and RS485</td>
<td>± 24 VDC SDI-12</td>
</tr>
<tr>
<td>Selectable Ranges*</td>
<td>0,2 / 2” / 20 / 200”</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technology</td>
<td>6 titanium electrodes, 4-wire technology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comp. temp. range</td>
<td>0…50 °C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resolution</td>
<td>&lt; 0,05 % of the selected range</td>
<td>± 1 %FS max.</td>
<td></td>
</tr>
<tr>
<td>Accuracy</td>
<td>&lt; 2,5 % of the selected range</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Int. measurement rate</td>
<td>1 Hz</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Options

- Housing options: Hastelloy and titanium
- Process connection with thread
- Other cable materials (e.g. FEP) available on request

### Electrical data

- Supply voltage: 3,2…32 VDC
- Power consumption: < 0,1 mA (sleep)
- Start-up time: P1, TOB1 3 s typ., 6 s max.
- Insulation GND-CASE: > 10 MΩ at 300 V
- Endurance: > 10 mio. pressure cycles
- Storage temperature: -20…+80 °C

### Digital interface

- Communication protocol: Modbus RTU
- Baud rate: 9600*, 115'200 bps
- Identification: Class Group: 5.21
- Units of pressure: bar, mbar, mH2O, psi, ftWC, inWC
- Units of temperature: °C, °F, K
- Unit of conductivity: mS/cm

### Mechanical data

- Dimensions: ø 22 mm, length see drawing
- Weight: ca. 150 g excl. cable (CTD ca. 300 g)
- Housing material: stainless steel 316L (DIN 1.4435 / 1.4404)
- Cable material: PR: polyethylene (PE)
- Other materials in contact with media: seals: Viton®, protective cap: POM (additional): titanium, PEEK

### Standards and protection

- CE-Conformity (EMC): EN 61326-2-1 to 6-4
- Reverse polarity and overvoltage protection: ± 32 VDC
- Standard lightning protection in accordance with EN 61000-4-5
- Extended lightning prot. (standard at SDI-12): Line-Case: 10 kA @ 8/20 µs
- Degree of protection: IP68

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1) Pressure range buffer: pressures can be measured at up to 10 % outside the pressure range either way, in which case “+Inf” or “-Inf”, as appropriate, will be displayed.
2) Subconnectors increase the pressure range to above 30 bar.
3) Pressure ranges > 21 bar are only possible without a conductivity sensor.
4) Temperature information for the pressure sensor (TOB: top of bridge)
5) Outside the compensated temperature range up to the limits of the operating temperature range, the deviation will be up to twice the value displayed.
6) Temperature information for the pressure sensor (TOB: top of bridge)
7) Power consumption without communication. During the response time (9 ms @ 9600 Baud, 1 ms @ 115'200 Baud), an extra 1…40 mA depending on the line termination.
8) Using software
9) Default setting, other defaults on demand. Customer can enter new alternative settings any time via software.

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