HIGHLY PRECISE PRESSURE TRANSMITTERS  
FOR HAZARDOUS APPLICATIONS  

These piezoresistive pressure transmitters are approved for use in high explosive gas and dust atmospheres of groups I (mining industry) and II (industrial applications) where there is a high risk of explosion. Optionally available are Low Voltage Versions (LV) with 3,2…8,5 V.

Signal processing
This series features microcontroller-based electronic evaluation to ensure maximum accuracy. Each transmitter is gauged across the entire pressure and temperature range. This measurement data is used to calculate a mathematical model that enables correction of all reproducible errors. In this way, KELLER can guarantee high accuracy as an error band within the over-all compensated pressure and temperature range. Two compensated temperature ranges are available for the transmitters, according to choice: -10…80 °C and 10…40 °C. The level probes are gauged in the 0…50 °C temperature range only. The calculated pressure value can be read via the interface, and is simultaneously processed as an analog signal.

Interface
The interface is designed as a robust RS485 half-duplex for 9’600 and 115’200 baud. There is an external leadthrough for the interface on all products except the version with the DIN 43650 plug. Communication protocol: KELLER Bus and MODBUS RTU. The transmitters can be configured and the measured values can be recorded with the CCS30 software:
- Read out current measured pressure and temperature values with maximum resolution
- Speed: at 115’200 baud, up to 330 measured values per second (depending on the converter)
- Call up information and status (pressure and temperature ranges, serial number, software version, etc.)
- Reprogram analog output (e.g. different units or pressure range)
- Calibration: zero point and amplification can be adjusted
- Special calculations, such as non-linear curve adaptation or root calculation for flow
- Possibility of adjusting the low-pass filter and the communication parameters

Ex-Classification

T4 for $T_a \leq 90 \, ^\circ \text{C}$, T6 for $T_a \leq 70 \, ^\circ \text{C}$

ELECTRICAL CONNECTIONS

<table>
<thead>
<tr>
<th>Output</th>
<th>Function</th>
<th>Binder</th>
<th>M12</th>
<th>DIN 43650</th>
<th>MIL C-26482</th>
<th>Cable</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-Leiter</td>
<td>OUT/GND</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>C</td>
<td>white</td>
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<tr>
<td></td>
<td>+Vcc</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>A</td>
<td>black</td>
</tr>
<tr>
<td>3-Leiter</td>
<td>GND</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>C</td>
<td>white</td>
</tr>
<tr>
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<td>OUT</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>B</td>
<td>red</td>
</tr>
<tr>
<td></td>
<td>+Vcc</td>
<td>3</td>
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<tr>
<td>Digital</td>
<td>RS485A</td>
<td>4</td>
<td>4</td>
<td>–</td>
<td>D</td>
<td>blue</td>
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<tr>
<td></td>
<td>RS485B</td>
<td>5</td>
<td>5</td>
<td>–</td>
<td>F</td>
<td>yellow</td>
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<tr>
<td>Transmitter Housing</td>
<td>use shielded cable</td>
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<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Series 33 X Ei (LV) / 35 X Ei (LV) / 36 XW Ei (LV) / PD-33 X Ei (LV)
### Specifications

#### Standard Pressure Ranges (FS) and Overpressure in Bar

<table>
<thead>
<tr>
<th>Type</th>
<th>Digital Interface</th>
<th>Supply (U)</th>
<th>Accuracy &lt;sup&gt;[2]&lt;/sup&gt; @ RT (digital) typ.</th>
<th>Total Error Band &lt;sup&gt;[4]&lt;/sup&gt; (10...40 °C)</th>
<th>Total Error Band &lt;sup&gt;[4]&lt;/sup&gt; (10...80 °C)</th>
<th>Power Consumption (without communication)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PR-36 XW Ei</td>
<td>PR-36 XW Ei</td>
<td>10...30 Vcc</td>
<td>0,02 %FS</td>
<td>0,10 %FS</td>
<td>0,10 %FS</td>
<td>&lt;8 mA</td>
</tr>
<tr>
<td>PAA-36 XW Ei</td>
<td>PAA-36 XW Ei</td>
<td>10...30 Vcc</td>
<td>0,02 %FS</td>
<td>0,10 %FS</td>
<td>0,10 %FS</td>
<td>3...22,5 mA</td>
</tr>
</tbody>
</table>

#### Overdruck

<table>
<thead>
<tr>
<th>Value</th>
<th>Range</th>
<th>2</th>
<th>2</th>
<th>2</th>
<th>5</th>
<th>20</th>
<th>60</th>
<th>200</th>
<th>400</th>
<th>1000</th>
<th>1100</th>
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</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>3</td>
<td>10</td>
<td>30</td>
<td>30</td>
<td>100</td>
<td>300</td>
<td>700</td>
<td>1000</td>
<td>1100</td>
<td></td>
</tr>
</tbody>
</table>

<sup>[1]</sup> Specified "Accuracy" and "Total Error band" multiplied by a factor of 2
<sup>[2]</sup> Linearity (best straight line), hysteresis and repeatability
<sup>[3]</sup> Accuracy and temperature error within the selected, compensated temperature range
<sup>[4]</sup> Compensated temperature range for Series 36 XW Ei: TEB 1 % @ 0...50 °C
<sup>[5]</sup> Disturbance of the 4...20 mA signal occurs during communication through RS485. 3-wire types are suitable for simultaneous operation of analog output and RS485.

<table>
<thead>
<tr>
<th>Output Rate</th>
<th>Resolution</th>
<th>Long Term Stability typ.</th>
<th>Load Resistance</th>
<th>Electrical Connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>400 Hz</td>
<td>0,002 %FS</td>
<td>Range ≤ 1 bar: 1 mbar</td>
<td>(&lt;U&gt;10 V / 25 mA (2-wire) &gt; 100 kΩ (3-wire) &lt;sup&gt;[2]&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Range &gt; 1 bar: 0,1 %FS</td>
<td></td>
<td>DIN 43650*, Binder Series 723*, M12, MIL-C 26482, Subconn BH MSS and MCBH MSS or cable</td>
</tr>
</tbody>
</table>

#### Start-up Time (Supply On)

- <600 ms

#### Insulation

- 10 MΩ / 500 V

#### Storage Temperature

- -40...+120 °C

#### Operating Temperature*<sup>[3]</sup>

- -40...+90 °C for T4
- -40...+70 °C for T6

<sup>*</sup> Available for P<sub>1</sub> ≤ 840 mW, see operational manual for other options.

#### Pressure Endurance

- 10 Million Pressure Cycles 0...100 %FS @ 25 °C

#### Vibration Endurance, IEC 60068-2-6

- 20 g (10...2000 Hz)

#### Shock Endurance, IEC 60068-2-27

- 50 g (11 ms)

#### Protection

- IP 65 optional: IP 67 or IP 68 (with cable)

#### CE-Conformity (EMC)

- EN 61000-6-1 to 6-4 / EN 61326-1 / EN 61326-2-3

#### Material in Contact with Media

- Stainless Steel 316L (DIN 1.4435) / Viton®

#### Weight

- Series 33 X Ei: 140 g; Series 35 X Ei: 160 g
- Series PD-33 X Ei: 500 g, Series 36 XW Ei: 200 g

#### Dead Volume Change

- <0,1 mm³

#### Options:

- Special calculations with pressure and temperature
- Different housing-material, oil filling, pressure thread
- Different compensated temperature and pressure ranges
- Low Voltage Version labelled with "LV" in Type Designation
- Mining Version labelled with "M" in Type Designation

#### Further versions:

- Series PD-39 X Ei: for differential pressure measurements with high double-sided overload resistance
- Series 41 X Ei: for low pressure ranges
- Series 46 X Ei: for low pressure ranges, flush diaphragm

<sup>[1]</sup> With burden R<sub>i</sub> = 100 Ω. With burden R<sub>i</sub> = 100 kΩ the error increases by 0.1 %FS.

<sup>[2]</sup> Without burden of the voltage output (R<sub>i</sub> = 100 Ω). With burden R<sub>i</sub> = 100 kΩ the error increases by 0.1 %FS.

### Intrinsically safe in conjunction with certified intrinsically safe power circuits, with the following maximum connected loads:

- U<sub>1</sub> ≤ 30 V, I<sub>1</sub> ≤ 200 mA, P<sub>1</sub> ≤ 0,64...1,3 W

### Low Voltage Version "LV"

- U<sub>1</sub> ≤ 8,5 V, I<sub>1</sub> ≤ 200 mA, P<sub>1</sub> ≤ 1,3 W

### Polynomials

- <U> = A(T) + B(T) + C(T) + D(T) + E(T)
- P(S,T) = F(S) + G(T) + H(S,T) + I(T) + J(S,T) + K(T) + L(S,T) + M(T) + N(S,T) + O(T) + P(S,T) + Q(S,T) + R(S,T) + S(T) + T(S,T) + U(S,T) + V(S,T) + W(S,T) + X(S,T) + Y(S,T) + Z(S,T)

### Polynomial Compensation

This uses a mathematical model to derive the precise pressure value (P) from the signals measured by the pressure sensor (S) and the temperature sensor (T). The microprocessor in the transmitter calculates P using the following polynomial:

- P(S,T) = A(T)S<sup>3</sup> + B(T)S<sup>2</sup> + C(T)S + D(T)S<sup>3</sup> + E(T)

### Electrical Connection

- DIN 43650*, Binder Series 723*, M12, MIL-C 26482, Subconn BH MSS and MCBH MSS or cable
- Mating connector included

### Power Consumption

- Total Error Band
- Accuracy
- Lines, hysteresis and repeatability
- Linearly (best straight line)
- Compensated temperature range
- Temperature error within the selected, compensated temperature range

### Mathematical Model

When the pressure transmitter is in service, the microprocessor measures the signals (S) and temperature and produces the exact pressure (P(S,T)) with the following maximum connected loads:

- U<sub>1</sub> ≤ 30 V, I<sub>1</sub> ≤ 200 mA, P<sub>1</sub> ≤ 0,64...1,3 W

The transmitter is factory-tested at various levels of pressure and temperature, with the corresponding measured values of S, together with the exact temperature and produces the exact pressure value by solving the P(S,T) equation.