Pressure Transmitters and Pressure Transducers
**Product Lines at a Glance**

**MathMod Compensation:** Mathematical modelling of the sensor characteristics allows for accurate compensation and results in a standardized output signal. Depending on the complexity of the modelling or the compensation algorithms, this is practically free of temperature influences and linearity errors.

**CiO-Technology:** In chip-in-oil technology, the signal conditioning chip is housed with the pressure sensing chip inside the oil-filled housing. As there are no external electronics, more compact constructions are possible, and the products are extremely robust against environmental influences such as moisture, vibrations, shock and EMC.

<table>
<thead>
<tr>
<th>Line</th>
<th>Accuracy</th>
<th>Speed</th>
<th>Temperature Range</th>
<th>MathMod Compensation</th>
<th>Direct Analog Signal Path</th>
<th>GO-Technology</th>
<th>Low Power</th>
<th>ATEX / IECEx</th>
<th>Digital Interface</th>
<th>Analog Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>X-Line</strong></td>
<td>● ● ● ●</td>
<td>● ●</td>
<td>● ● ● ●</td>
<td>✓</td>
<td>✓</td>
<td>optional</td>
<td>✓</td>
<td>✓</td>
<td>optional</td>
<td>✓</td>
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<tr>
<td>The flagship in terms of precision, this line stands out thanks to its high level of accuracy achieved by the elaborate digital compensation of the sensor characteristics, as well as the wide range of digital and analog interfaces.</td>
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<tr>
<td><strong>Y-Line</strong></td>
<td>● ● ● ●</td>
<td>● ●</td>
<td>● ● ● ●</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>4…20 mA</td>
<td>0…10 V</td>
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<tr>
<td>The classic analog industrial transmitter with a very low temperature error. The temperature compensation allows for an accuracy specification as the overall error band across a defined temperature range.</td>
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<tr>
<td><strong>C-Line</strong></td>
<td>● ● ● ●</td>
<td>● ●</td>
<td>● ● ● ●</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>0,5…4,5 V ratiom.</td>
<td></td>
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<tr>
<td>This one-chip solution for signal processing serves as a supplement to the Y-Line and covers ratiometric applications. It can be operated up to an extraordinary 150 °C and stands out in general thanks to its robustness against environmental influences.</td>
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<tr>
<td><strong>D-Line</strong></td>
<td>● ● ● ●</td>
<td>● ●</td>
<td>● ● ● ●</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>PC</td>
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<tr>
<td>Probably the world’s smallest pressure transmitters; with their I2C interface, these are excellent for simple integration in microcontroller-based systems. The low-power optimised design lends itself well to battery-operated devices.</td>
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<tr>
<td><strong>HB-Line</strong> (High Bandwidth)</td>
<td>● ● ● ●</td>
<td>● ●</td>
<td>● ● ● ●</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>0…10 V</td>
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<tr>
<td>The hybrid wiring concept, which combines the accuracy of digital compensation with the high bandwidth of a direct analog signal path, was developed for highly dynamic applications and is paired with correspondingly highly reactive sensors.</td>
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<tr>
<td><strong>Laser-Line</strong> (22 M/S)</td>
<td>● ● ● ●</td>
<td>● ●</td>
<td>● ● ● ●</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>4…20 mA</td>
<td>0,5…4,5 V ratiom.</td>
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<tr>
<td>Pure amplifier circuits with laser-adjustable resistors are suitable for high-volume jobs with reduced accuracy requirements and allow for customer-specific analog solutions thanks to the high degree of design flexibility.</td>
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<tr>
<td><strong>Pressure transducers</strong> (basis of all lines)</td>
<td>to be defined</td>
<td>● ● ● ●</td>
<td>● ● ● ●</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Servo-open Wheatstone bridge</td>
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<tr>
<td>In contrast to pressure transmitters, pressure transducers do not contain active signal processing. The signals from the measurement bridge are provided directly to the user, and there are only minor limitations in terms of bandwidth and resolution. A calibration certificate indicates the sensor characteristics and the possibility of compensation with resistors.</td>
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</tbody>
</table>

**ratings:**
- ● ● ● excellent
- ● ● good
- ● adequate
Piezoresistive Pressure Transducers

Pressure transducers with laser-welded stainless-steel diaphragm:
- Series 3 L to 9 L – compact designs ø 9.5 to 19 mm
- Series 10 L – “the original” ø 19 x 15 mm
  - Pressure ranges from -1 to 1000 bar
  - Absolute, relative and differential pressure
  - Signal output typ. 200 mV @ 1 mA supply
  - Individual calibration certificate (including compensation values)
  - Very high long-term stability
  - Temperature ranges from -55 to 150 °C
  - Integrated temperature sensor (top of bridge)
  - Housing optionally made from Hastelloy® and Titanium
  - Mathematical modelling on customer request

Pressure transducers for high pressure:
- Series 6 L HP / 7 L HP / 8
- Series 7 L – Inconel™ up to 200 °C
  - Pressure ranges from 200 to 1500 bar
  - Absolute pressure
  - Signal output typ. 200 mV @ 1 mA supply
  - Individual calibration certificate (including compensation values)
  - Very high long-term stability
  - Robust and corrosion-resistant
  - Optionally available with integrated PT1000 temperature sensor
  - Also available as a screw-mounted housing with metallic seal
  - Mathematical modelling on customer request

OEM Pressure Transmitters

OEM pressure transmitters are built to various levels of completion to meet customer’s integration needs: these unique products can thus be supplemented with electronics and calibrations, for example.

Housing components such as pressure connections can be made on customer request thanks to the high degree of vertical integration.

Calibration

At KELLER, all pressure measuring devices are calibrated for pressure and temperature. Depending on the product’s expansion stage, an electronic circuit is responsible for compensating and processing the signals, or else the sensor’s calibration data are provided (calibration certificate left).

The following is an example of the effect of digital compensation of the X-line with a resulting typical error band of only 0.05 %FS from -10 to 80 °C.
High-precision pressure transmitters
Series 33 X / 35 X
- Pressure ranges from 0.3 to 1000 bar
- Accuracy 0.02% of the full range
- Precision of 0.01 %FS optionally available

Capacitive pressure transmitters
Series 41 X
- Pressure ranges from 10 to 300 mbar
- Resolution up to 1 µbar
- Gold-plated ceramic measuring cell

Differential pressure transmitters
Series PD-39 X
- High overload resistance thanks to double sensor design, numerical differential pressure build-up
- Basic pressure ranges from 3 to 300 bar
- Differential pressure range freely scalable within the basic pressure range

Differential pressure transmitters
Series PD-33 X
- Pressure ranges from 0.3 to 30 bar
- Classic “wet/wet” differential pressure measurement

Series PRD-33 X
- Pressure ranges from 0.35 to 3 bar, all with 40 bar basic pressure range
- With additional absolute basic pressure sensor

Digital Pressure Transmitters
X-Line Technical Features
- Digital interfaces: Modbus RTU via RS485, CANopen
- Scalable Analog output (2-conductor or 3-conductor)
- Mathematical compensation of non-linearity and temperature dependencies
- Temperature as an additional digital measured variable
- Free software for recording, configuring and readjusting
- Available in ex-version

D-Line Technical Features
- With I²C microcontroller interface
- Extremely low power consumption
- Hermetically sealed sensor electronics (chip-in-oil technology)
- Robust stainless-steel housing
- Available in ex-version
- Available with RFID interface and integrated logger: 21 D RFID / 21 DC RFID

Embedded OEM pressure transmitters
Series 4 LD to 9 LD
- “Probably the world’s smallest pressure transmitter!”
- Pressure ranges from 0.3 to 1000 bar
- Operating temperature range from -40 to 110 °C

Embedded OEM pressure transmitter heads
Series 20 D
- Based on 7 LD or 9 FLD
- Various pressure connections (thread, quick-fit, etc.)
- Also available as a complete transmitter with cable
Compact pressure transmitters
Series 21 Y / 21 PY
- Pressure ranges from 2 to 1000 bar
- Total error band max. ± 1 %FS @ 0 to 50 °C
- Optimised for high-volume series

Variable pressure transmitters
Series 23 SY / 25 Y
- Pressure ranges from 0,1 to 1000 bar
- Total error band max. ± 0,5 %FS @ 0 to 50 °C
- Various electrical and pressure connections possible

Compact pressure transmitters – ratiometric
Series 21 C
- Pressure ranges from 2 to 1000 bar
- Total error band max. ± 1 %FS @ 0 to 50 °C
- No internal seals

Embedded OEM pressure transmitters – ratiometric
Series 4 LC to 9 LC
- Pressure ranges from 1 to 1000 bar
- Can be compensated in the range of -40 to 150 °C
- Also available with thread connection

ATEX / IECEx

The ATEX directives apply in the EU and require the use of products that are suitable for explosive atmospheres.

KELLER produces intrinsically safe transmitters, as well as transmitters with a pressure-resistant enclosure. Intrinsically safe transmitters (ia) can only be operated in conjunction with an intrinsically safe power supply, which is not included. They can be used up to Zone 0, depending on the product. Transmitters with a pressure-resistant enclosure (db), on the other hand, can only be used up to Zone 1.

Y-Line Technical Features
- Analog outputs: 4 to 20 mA, 0 to 10 V, 0 to 5 V, 0,5 to 4,5 V not ratiometric
- Compensated over the entire temperature range
- No internal seals
- Optimised electromagnetic compatibility
- Ideal for industrial applications

C-Line Technical Features
- Ratiometric output: 0,5 to 4,5 V @ 5 VDC
- Reverse polarity and overload protection ± 33 VDC
- Hermetically sealed sensor electronics (chip-in-oil technology)
- Robust stainless-steel housing
- Exceptional electromagnetic compatibility
- Digitally compensated over the entire temperature range
**Front-flush pressure transmitters**
Series 35 X HT(T)
- Food-grade front-flush process connections
- Media temperatures of up to 150 °C
- FDA certification
- Material certificate DIN EN 10204
- Optionally also available in Hastelloy®

- Food industry
- Beverage production
- Pharmaceuticals sector

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**High-temperature pressure transmitters**
Series 35 X HTC
- Food-grade front-flush process connections
- Media temperatures of up to 300 °C
- Material certificate DIN EN 10204
- Optionally also available in Hastelloy®

- Biotechnology
- Chemical industry
- Pharmaceuticals sector

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**Miniature pressure transmitters**
Series M5 HB
- Temperature resistance up to 200 °C
- Measuring dynamics from static to 50 kHz
- Local measurement thanks to M5 fine thread
- Also available as a pressure transducer without electronics

- Engine test stands
- Wind tunnels / shock waves
- Compressors / pumps
- Leak tests

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**Inert gas-filled pressure transmitter**
Modifications of the Series 23 or 35 X
- Modular design
- Hermetically sealed housing
- Specification-dependent, also in accordance with DO 160, MIL 810 or similar
- KELLER centre of competence for design and approval

- Aviation
- Space flight

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**Homologated pressure transmitters**
Series 22 DT / 22 M/S
- Pressure ranges of 5 to 250 bar
- Ratiometric signal output
- Homologation E4-110R, E4-10R and E4-67R
- Series 22 DT with temperature sensor in volume flow

- Automotive industry
- Bivalent vehicles (22 DT / 14 bar)

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**High-precision pressure gauges**
Series 8 LX / 7 Li / 33 X with SubConn®
- Suitable for high pressures up to 1500 bar
- Suitable for media temperatures up to 200 °C
- Various materials such as titanium, Hastelloy®, Inconel™
- Oil & gas exploration

- Remotely operated vehicle (ROV)
- Marine research
- Downhole, topside, wellhead, “Christmas tree”

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**Application-specific Designs**

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Miniature Pressure Sensors

Series 2 Mi
- Pressure ranges from 1 to 400 bar
- Signal output typ. 200 mV @ 1 mA supply
- Optionally also available with offset compensation electronics
- Hydrodynamic and aerodynamic pressure measurements
- Typical overall size ø 4.5 x 3 mm
- Local measurement with minimal system intervention
- Sensors can be installed in delivered components

Special Devices

Piezoresistive pressure transducers and transmitters
Customer-specific products
In addition to more than 500 standard products, KELLER also develops and produces customer-specific solutions. In over 35 highly specialised production islands, the latest production processes are used to manufacture special designs in small quantities, among other things. Their operating sites could not be more varied: they can be found in painting facilities, dive computers, refrigeration units (in cooling compressors in general), in the aviation and auto industries and in oil and gas extraction (downhole), to name but a few.

Options and approvals

- Titanium, Hastelloy®, Inconel™ – in all metallic components
- Various cable materials possible such as PE / TPE / FEP (Teflon®)
- Various interfaces are available to choose from
- Customer-specific analyses
- Enhanced lightning protection
- Extended temperature ranges

Interface Converters

For communication between device and computer
- USB – RS485: K-114 family with various electrical connections
- USB – i2C: K-404 T

The K-114 interface converter is also available with a Bluetooth interface and integrated accumulator. This allows for a wireless connection via Serial Port Profile (SPP) in addition to the USB interface. The connected device is supplied by the converter’s battery.

ATEX and IECEx approval

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KELLER AG für Druckmesstechnik, which has its headquarters in Winterthur, Switzerland, is Europe’s leading manufacturer of media isolated pressure transducers and transmitters.

The entire production process, from the manufacturing of the individual components and the calibration of the sensors through to the final quality control of the finished products, takes place at the company’s headquarters in Winterthur. This means that all of KELLER AG’s products are officially “Made in Switzerland”.

The application areas for KELLER’s pressure transducers are just as broad as KELLER’s product range.

KELLER AG für Druckmesstechnik and KELLER Gesellschaft für Druckmesstechnik mbH Jestetten have ISO 9001 certification.

KELLER Software

KELLER AG für Druckmesstechnik has its own software department. Its comprehensive range of applications is always included with the relevant products. No licence fees are charged.

Other Product Overviews

Another special area of expertise of KELLER AG is the production and sale of level sensors and data loggers – usually in the water industry. These are presented in the overview of “Hydrostatic pressure measurement for fill levels and gauges”.

Our digital manometers are also presented in a product overview: these high-precision manometers are used to measure and monitor pressure. They can be found in measurement and testing technology, hydraulics and pneumatics and in medical technology, to name but a few industries.

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