



# HIGHLY PRECISE (0,01%) PRESSURE TRANSMITTERS

MATHEMATICALLY COMPENSATED / PROGRAMMABLE

## SERIES 33 X SERIES 35 X

### Digital Output of Transmitter

These Series are based on the stable, floating piezoresistive transducer and a micro-processor with integrated 16 bit A/D converter. Temperature dependencies and non-linearities of the sensor are mathematically compensated. The high precision of 0,01 %FS is available as an option (a total error band of 0.05 %FS is specified as standard). With the CCS30 software and the KELLER converter K-114, the calculated pressure can be displayed on a computer or PC. The CCS30 software also allows the recording of pressure signals and the graphic display. Up to 128 transmitters can be hooked together to a Bus-system.

### Transmitter with Analog Output

Integrated in the processor is a D/A converter of 16 bit for analog signal outputs (4...20 mA, 0...10 V, ...). The output rate is 400 Hz. The accuracy is diminished by this converting process by 0,05 %FS. The digital output is available on all transmitters with analog output.

### Programming

With the KELLER software CCS30, a RS485 converter (i.e. K-114 from KELLER) and a PC, the pressure can be displayed, the units changed, a new gain or zero set. The analog output can be set to any range within the compensated range.

### Accuracy and Precision

"Accuracy" is an absolute term, "Precision" a relative term. KELLER uses commercial pressure sources that are at least 4 times better than the product to be tested and can therefore guarantee an accuracy of 0.05%. Below this range, KELLER uses the term "precision" for the ability of a pressure transmitter or manometer to be within 0.01% of these commercial standards for every pressure point. These pressure gauges can be adapted to a standard/reference of an accredited laboratory via the digital interface by correcting the zero point and amplification, which guarantees an "accuracy" of 0.01%FS.



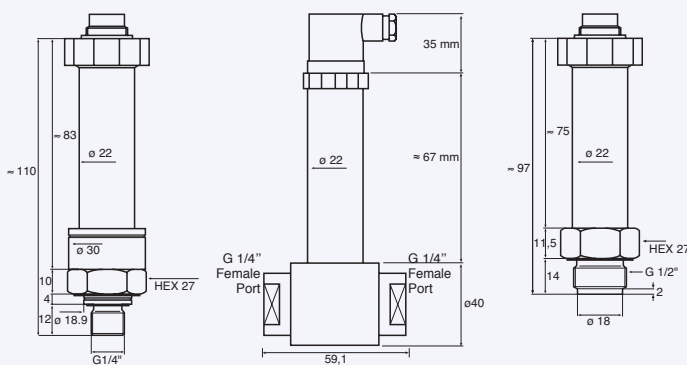
Series 33 X  
G1/4" thread



Series PD-33 X



Series 35 X  
G1/2", flush diaphragm



Series 33 X (G1/4")  
with Binder 723 plug

Serie PD-33 X  
with DIN 43650 plug

Serie 35 X (G1/2")  
with Binder 723 plug

### ELECTRICAL CONNECTIONS

Output	Function	Binder 723	M12 A-coded	DIN 43650	MIL C-26482	Cable
2-wire Current	OUT/GND	1	1	1	C	white
	+Vcc	3	3	3	A	black
3-wire Voltage	GND	1	1	1	C	white
	OUT	2	2	2	B	red
	+Vcc	3	3	3	A	black
Digital	RS485A	4	4	-	D	blue
	RS485B	5	5	-	F	yellow
Transmitter Housing						Shield

use shielded cable





## Specifications

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

PR-33 X / PD-33 X / PR-35 X	0,3 <sup>(1)</sup>	±0,3 <sup>(1)</sup>	1	±1	3	10	30				
PA(A)-33 X / PA(A)-35 X	0,8...1,2		1		3	10	30	100	300	700	1000
Overpressure	2	2	2	2	5	20	60	200	400	1000	1000
Overpressure neg. PD-33 X	2	2	2	2	5	7	20				
Line pressure <sup>(2)</sup> PD-33 X	200 bar, optional 600 bar (for all Pressure Ranges available)										

All intermediate ranges for the analog output are realizable with no surcharge by spreading the standard ranges. Accessing the extended area 0.1 bar. Also negative and further +/- ranges possible. Option: Adjustment directly to intermediate ranges (below 20 pieces against surcharge).

PAA: Absolute. Zero at vacuum PA: Sealed. Zero at 1 bar abs. PR: Gauge. Zero at atmospheric pressure PD: Differential

Type	<b>RS485</b>	<b>4...20 mA</b> (2-wire)	<b>0...10 V</b> (3-w)	<b>0...5 V</b> (3-w)	<b>0,1...2,5 V</b> (3-w)	<b>0,1...2,5 V</b> (3-w)
Digital Interface	RS485	RS485	RS485	RS485	RS485	RS485
Supply (U)	8...32 V	8...32 V	13...32 V	8...32 V	6...32 V	3,2...32 V
Accuracy <sup>(3)</sup> @ RT (digital) typ.	0.02 %FS	0.04 %FS	0.02 %FS	0.02 %FS	0.02 %FS	0.02 %FS
Total Error Band <sup>(4)</sup> (10...40 °C)	0.05 %FS	0.10 %FS <sup>(6)</sup>	0.10 %FS	0.10 %FS	0.10 %FS	0.10 %FS
Total Error Band <sup>(4)</sup> (-10...80 °C)	0.10 %FS	0.15 %FS <sup>(6)</sup>	0.15 %FS	0.15 %FS	0.15 %FS	0.15 %FS
<b>Optional: Precision<sup>(5)</sup> (10...40 °C)</b>	<b>0,01 %FS</b>					
Power Consumption (without comm.)	< 8 mA	3,2...22,5 mA	< 8 mA	< 8 mA	< 8 mA	< 5 mA

<sup>(1)</sup> Specified "Accuracy" and "Total error band" multiplied by a factor of 2 <sup>(2)</sup> Influence static line pressure < 0,005 %FS/bar <sup>(3)</sup> Linearity (best straight line), hysteresis and repeatability  
<sup>(4)</sup> Accuracy and temperature error within the selected, compensated temperature range <sup>(5)</sup> Only for Series PA(A) 33 X and for ranges ≥ 10  
<sup>(6)</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.

Output Rate	400 Hz
Resolution	0,002 %FS
Long Term Stability typ.	Range ≤ 1 bar: 1 mbar Range > 1 bar: 0.1 %FS

Load Resistance	< (U - 8 V) / 25 mA (2-wire) > 5 kΩ (3-wire)
Electrical Connections	DIN 43650*, Binder series 723*, M12, MIL-C 26482, Subconn BH MSS and MCBH MSS or cable * Mating connector included

Start-up Time (Supply ON)	< 600 ms
Insulation	> 10 MΩ @ 300 VDC
Storage-/Operating Temperature	-40...120 °C
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 AISI 316L / Viton
Weight	Series 33 X ≈ 240 g; Series 35 X ≈ 180 g; Series PD-33 X ≈ 500 g
Dead Volume Change	< 0,1 mm <sup>3</sup>

Note:

- The connector is interchangeable. If necessary, for example in laboratory applications, additional connectors can be supplied.
- All versions also for use in hazardous areas (see separate data sheet)
- Series 33 X and series 35 X also available with a pressure-resistant enclosure (see separate data sheet).

Options:

- Calculations such as density, differential pressure, flow, absolute value, etc.
- Different housing-material, oil filling, pressure thread or connector

### 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:

$$P(S,T) = A(T) \cdot S^0 + B(T) \cdot S^1 + C(T) \cdot S^2 + D(T) \cdot S^3$$

With the following coefficients A(T)...D(T) depending on the temperature:

$$A(T) = A_0 \cdot T^0 + A_1 \cdot T^1 + A_2 \cdot T^2 + A_3 \cdot T^3$$

$$B(T) = B_0 \cdot T^0 + B_1 \cdot T^1 + B_2 \cdot T^2 + B_3 \cdot T^3$$

$$C(T) = C_0 \cdot T^0 + C_1 \cdot T^1 + C_2 \cdot T^2 + C_3 \cdot T^3$$

$$D(T) = D_0 \cdot T^0 + D_1 \cdot T^1 + D_2 \cdot T^2 + D_3 \cdot T^3$$

The transmitter is factory-tested at various levels of pressure and temperature. The corresponding measured values of S, together with the exact pressure and temperature values, allow the coefficients A<sub>0</sub>...D<sub>3</sub> to be calculated. These are written into the EEPROM of the microprocessor.

When the pressure transmitter is in service, the microprocessor measures the signals (S) and (T), calculates the coefficients according to the temperature and produces the exact pressure value by solving the P(S,T) equation.

Calculations and conversions are performed at least 400 times per second.

### Interface

The X-line products have a digital interface (RS485 halfduplex), which supports the MODBUS RTU and KELLER Bus protocols. Details of the communication protocols can be found at [www.keller-druck.com](http://www.keller-druck.com). To integrate the communication protocol into your own software, documentation, a Dynamic Link Library (DLL) and various program examples are available.

### Accessories

The connection to a computer is established via an RS485-USB interface converter. To ensure smooth operation, we recommend the K-114 with the corresponding mating connector, robust driver module, fast RX/TX switching and connectable bias and terminating resistors.

### Software

The licence-free software CCS30 is used to carry out configurations and record measured values.

#### Measurement collection

- Graphical live display
- Adjustable measurement and storage interval
- Export function
- Parallel recording in Bus operation

#### Configuration

- Call up of information (pressure and temperature range, software version, serial number etc.)
- Readjustment of zero point and amplification
- Rescaling of analog output (unit, pressure range)
- Adjustment of low-pass filter
- Selection of instrument address and baud rate

