KELLER

Highly Precise Pressure Transmitters

for hazardous applications

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

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 3,5…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 overall 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

Ex I M1 Ex ia I
Ex II 1G Ex ia IIC T4…T6
Ex II 1D Ex ia IIIC T 130 °C Da
KEMA 04 ATEX 1081 X
CE 0081

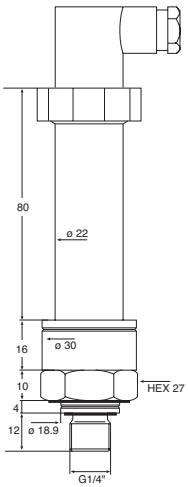
T4 for $T_a \leq 90$ °C, T6 for $T_a \leq 70$ °C

Series 33 X Ei (LV)
Industrial applications

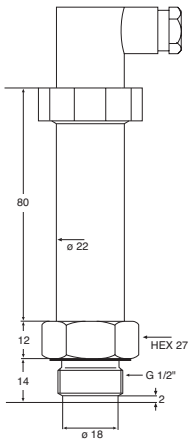
Series 35 X Ei (LV)
Flush diaphragm

Series 36 XW Ei (LV)
Level transmitter

Series PD-33 X Ei (LV)
Differential pressure measurement



Series 33 X Ei (G1/4")



Series 35 X Ei (G1/2")

PIN ASSIGNMENT

Output	Function	DIN 43650	M12	Binder 723	Cable
4…20 mA	OUT/GND	1	1	1	white
2-wire	+Vcc	3	3	3	black
0…10 V	GND	1	1	1	white
3-wire	OUT	2	2	2	red
	+Vcc	3	3	3	black
Digital	RS485A	–	4	4	blue
	RS485B	–	5	5	yellow
Transmitter Housing		⏚			Screen

Drawings of **Series 36 XW Ei**, **PD-33 X Ei** and **mining version M** available on request.

Subject to alterations

04/2016

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Specifications

Standard Pressure Ranges (FS) and Overpressure in Bar

PR-33 X Ei, PR-35 X Ei, PR/PA(A)-36 XW Ei	1	3	10	30				
PA(A)-33 X Ei, PA(A)-35 X Ei	0,8…1,2	3	10	30	100	300	700	1000
(pressure ranges Series PD-33 X Ei on request)								
Overpressure	2	5	20	60	200	400	1000	1100

All intermediate ranges for the analog output are realizable with no surcharge by spreading the standard ranges. Smallest range: 0,1 bar.

Also negative and +/- ranges possible.

Option: Adjustment directly to intermediate ranges (below 20 pieces against surcharge).

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

	(digital)	(analog)	(analog)	(analog)	Low Voltage (LV)
Output	**RS 485**	**4…20 mA** (2-wire)	**0…10 V** (3-wire)	**0…5 V** (3-wire)	**0,1…2,5 V** (3-wire)
Supply (U)	10…30 Vcc	10…30 Vcc	15…30 Vcc	10…30 Vcc	3,5…8,5 V
Accuracy @ RT	0,02 %FS typ.	0,03 %FS typ.(1)	0,03 %FS typ.	0,03 %FS typ.	0,03 %FS typ.
Error Band (10...40 °C)	0,05 %FS	0,10 %FS (1)	0,10 %FS (2)	0,10 %FS (2)	0,10 %FS
Error Band (-10...80 °C) (3)	0,10 %FS	0,15 %FS (1)	0,15 %FS (2)	0,15 %FS (2)	0,15 %FS
Power consumption (without communication)	< 8 mA	3,2…22,5 mA	< 8 mA	< 8 mA	< 3 mA

(1) Disturbance of the 4...20 mA signal occurs during communication through RS485. Use the 3-wire type, if you need the analogue output and the RS485 at the same time

(2) Without burden of the voltage output (R_i = 100 Ω). With burden R_a = 100 KΩ the error increases by 0,1 %FS.

(3) Compensated temperature range for Series 36 XW Ei: 0…50 °C

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

$U_i \leq 30$ V, $I_i \leq 200$ mA, $P_i \leq 0{,}64…1{,}3$ W (depending on the application, see operating instructions)

Low Voltage Version "LV"

$U_i \leq 8{,}5$ V, $I_i \leq 200$ mA, $P_i \leq 1{,}3$ W
$L_i = 0$ mH, $C_i = 6{,}5\ \mu$F

True Output Rate (preset)	400 Hz
Resolution	0,002 %FS
Long Term Stability typ.	Range ≤ 1 bar: 1 mbar Range > 1 bar: 0,1 %FS
Load Resistance (kΩ)	<(U-10 V) / 25 mA (2-wire)
Electrical Connection	DIN 43650*, Binder Series 723*, M12, MIL-C 26482, Subconn BH MSS and MCBH MSS or cable * Mating connector included
Power-ON time	< 600 ms
Insulation	10 MΩ / 500 V
Storage Temperature Range	-40…+120 °C
Operating Temperature Range	-40…+100 °C for T4 -40… +85 °C for T5 -40… +70 °C for T6
Pressure Endurance	10 Million Pressure Cycles 0…100 %FS @ 25 °C
Vibration Endurance, acc. to IEC 68-2-6	20 g (5...2000 Hz, max. amplitude ± 3 mm)
Shock Endurance	20 g (11 ms)
Protection	IP 65 optional: IP 67 or IP 68 (with cable)
CE-Conformity	EN 61000-6-2:2011 / EN 61000-6-3:2011 / EN 61326-2-3:2013
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
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

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_0...D_3 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.

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