KELLER

Highly Precise Pressure Transmitters

for Hazardous Applications

Series 33 X Ei / 35 X Ei 36 XW Ei / PD-33 X Ei

These piezoresistive pressure transmitters are approved for use in hazardous areas of groups I (mining industry) and II (industrial applications) where there is a high risk of explosion.

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 industrial 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. It can be used to implement bus systems with 128 subscribers and line lengths of up to 1400 m. 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
KEMA 04 ATEX 1081 X
CE 0081

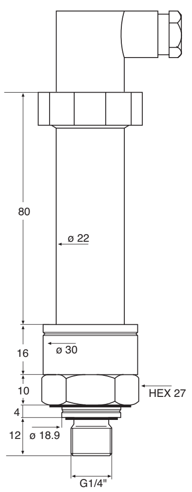
T4 for $T_a \leq 100$ °C, T5 for $T_a \leq 85$ °C, T6 for $T_a \leq 70$ °C

Series 33 X Ei
Industrial applications

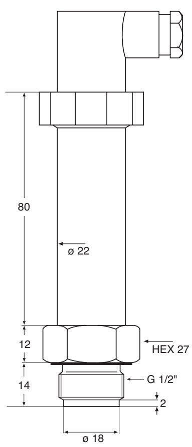
Series 35 X Ei
Flush diaphragm

Series 36 XW Ei
Level transmitter

Series PD-33 X Ei
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 05/2012

KELLER AG für Druckmesstechnik St. Gallerstrasse 119 CH-8404 Winterthur Tel. +41 (0)52 - 235 25 25 Fax +41 (0)52 - 235 25 00
KELLER Ges. für Druckmesstechnik mbH Schwarzwaldstrasse 17 D-79798 Jestetten Tel. +49 (0)7745 - 9214 - 0 Fax +49 (0)7745 - 9214 - 60

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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: Sealed Gauge. Zero at atmospheric pressure (at calibration day) PR: Vented Gauge. Zero at atm. 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…6,4 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 ≤ 30 V, I_i ≤ 200 mA, P_i ≤ 640 mW
L_i = 0 mH, C_i = 1 nF

Low Voltage Version "LV"

U_i ≤ 6,4 V, I_i ≤ 200 mA, P_i ≤ 640 mW
L_i = 0 mH, C_i = 18,4 μF

True Output Rate (preset)	400 Hz (33 X Ei)	100 Hz (35 X Ei, 36 XW Ei)
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 61000-6-2:2005 / EN 61000-6-3:2007 / EN 61326-2-3:2006
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

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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Companies approved to ISO 9001 www.keller-druck.com