KELLER

DIFFERENTIAL PRESSURE TRANSMITTERS

SERIES PD-39

BASED ON TWO ABSOLUTE SENSORS

For applications where the differential pressure range is between 5% and 100% of the maximum line pressure, recent advances in micro-processor based compensation techniques now offer distinct advantages by using two absolute sensors, instead of conventional methods.

The Series PD-39 uses the PIC 1400 micro-processor, to compare the signals from two absolute sensors with a resolution of 10'000 points or 0,01%. The micro-processor analyses inputs from a temperature sensor built into the piezoresistive chip and the raw input from the pressure sensor. Both of these inputs are corrected using mathematical modelling techniques and polynomial equations, which are programmed into the EEPROM by the automated calibration test equipment. In effect, this eliminates all repeatable errors due to temperature coefficients and non-linearity of the basic sensors. The signal from the two absolute sensors is then compared and the differential value is fed into a 15 bit D/A which converts the information into an analog output signal of 4…20 mA or 0…10 V. The output updates at a rate of 50 measurements per second.

Digitally corrected pressure transmitters offer the user the elimination of nearly all repeatable errors. This inevitably means the way, in which the "accuracy" of such a device is quoted, is radically improved when compared with traditional analog instruments. Parameters such as non-linearity, thermal coefficients, line pressure zero shift, and end points are no longer relevant. The new term, Total Accuracy (TA), includes all repeatable errors over the compensated temperature range.

Theoretical Total Accuracy (TA) is 0,005%, but in practice the TA (-10…80°C) is 0,05%FS, determined by the calibration accuracy of the test equipment. Not included in the Total Accuracy are the stability errors of the base sensors.

The Series PD-39 transmitters are defined by the maximum line pressure. Both absolute pressure sensors are fully modelled over the whole line pressure. The Differential Pressure Range (DPR) is then set in the EEPROM in a final adjustement step.

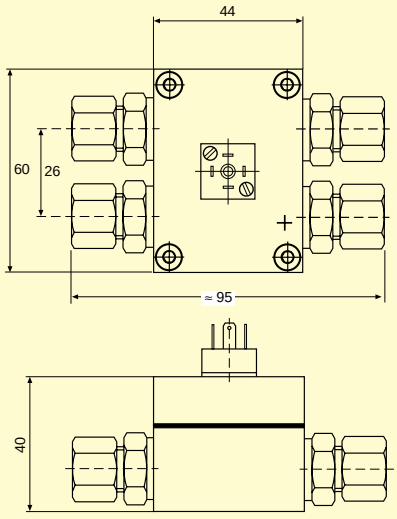
The accuracy of the Differential Pressure Range (DPR) can be calculated as follows:

TA of Differential Pressure Range (in % DPR) = 0.05% x (Line Pressure ÷ DPR)

Example: If the line pressure is 10 bar, and the DPR is 2 bar, then the Total Accuracy is:
TA = 0,05 x (10 ÷ 2) = 0,25%DPR, this includes all errors due to line pressure and temperature variation over the compensated range.

Series PD-39 with mPm plug

Series PD-39 with Binder plug and special housing cover



PIN ASSIGNMENT

Output	Function	mPm C193	MIL C-26482	Binder 723	DIN 43650
4…20mA	OUT / GND	1	C	1	1
2 Wire	+Vcc	3	A	3	3
0…10V	GND	1	C	1	1
3 Wire	OUT	2	B	2	2
	+Vcc	3	A	3	3
Program-	RS485A		D	4	
ming	RS485B		F	5	

CE

Subject to alterations

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SPECIFICATIONS

	Pressure Ranges (FS) and Overpressure in Bar							
Line Pressure	1	2	5	10	25	50	100	200
DP Ranges available	0…0,2 0…0,5 0…1	0…0,2 0…0,5 0…1 0…2	0…0,25 0…0,5 0…1 0…2 0…5	0…0,5 0…1 0…2 0…5 0…10	0…1,25 0…2 0…5 0…10 0…25	0…2,5 0…5 0…10 0…25 0…50	0…5 0…10 0…25 0…50 0…100	0…10 0…25 0…50 0…100 0…200
Overpressure	5	10	15	30	75	150	200	200

Storage-/Operating Temperature Range	-40…80 °C
Compensated Temperature Range	-10…80 °C
Total Accuracy (TA) (1) (2)	≤ 0,05 %FS typ. ≤ 0,1 %FS max.
Conversion Rate	20 ms
Resolution (2)	≤ 0,01 %FS
Long Term Stability typ.	Range ≤ 2 bar: 1 mbar Range > 2 bar: 0,05 %FS (2)

(1) Linearity + Hysteresis + Repeatability + Temperature Errors
(2) Accuracy and Resolution are valid for **Line Pressure**

Output Signal	4…20 mA, 2 Wire	0…10 V, 3 Wire
Supply (U)	8…28 Vcc	13…28 Vcc
Load Resistance (Ω)	(U-5V) / 0,02A	> 5 000
Electrical Connection	- mPm C193 (4 pole) - MIL C-26482-Plug (6 pole) (4) - Binder-Plug 723 (5 pole) (4) - DIN 43650 Plug (4)	
Programming (4)	RS485 (2 Wire) / option. PROG30, Read 30	
Insulation	100 MΩ / 50 V	

(4) only with special housing cover

Pressure Endurance	10 Million Pressure Cycles 0…100 %FS at 25 °C
Vibration Endurance	20 g, 20 to 5 000 Hz
Shock Endurance	20 g sinus 11 msec.
Protection	IP65 opt.: IP 67
CE-Conformity	EN 50081-2, EN 50082-2
Material in Contact with Media	Stainless Steel 316L (DIN 1.4435)
Dead Volume Change	< 0,1 mm^3
Pressure Ports	G1/4 female (4x)

Options

- The PD-39 is available with user re-programmable Differential Pressure Range.
- The two absolute sensors actually measure the full line pressure. Therefore it is possible to offer a version of the PD-39 with a digital output (RS485) that allows to monitor the differential pressure and line pressures simultaneously.
- Any Ranges between 1 and 200 bar / Supply 32 V (for 2-wire) / Electrical Cable Output / Oil Filling: Fluorized Oil (O_2-compatible), Olive Oil, Low Temperature Oil / Other Connections / Other Materials

Polynomial Compensation

This uses a mathematical model to derive the precise pressure value (P) from the 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 A0...D3 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 50 times per second depending on the format of the signals.
The theoretic resolution is 0,01 to 0,005%. In practice, however, accuracy is limited to 0,05% by the calibration equipment.

Double sensor with microprocessor electronic circuit.

In this state, the sensors are mounted in test fixtures and tested in furnaces in lots of 100, mounted with O-Ring seals in standard or custom-specific housings.

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