Piezoresistive OEM Pressure Transmitters

Series 4 LD…9 LD

WITH I²C INTERFACE AND EMBEDDED SIGNAL CONDITIONING

With the D-line, Keller introduces a unique combination consisting of an exceedingly robust industrial pressure transducer and the popular I²C microcontroller interface. Pressure transmitters with this interface are commonly available only in consumer market housings made of plastic or ceramic, where merely the parameters for compensation are stored in an integrated memory. The D-line OEM transmitters however have an unprecedented embedded digital signal processing (DSP) core for the compensation and normalization of the output values.

4 LD

7 LD

9 LD

9 FLD

Technology

The Series 4 LD...9 LD is based on KELLER's famous Chip-In-Oil (CIO) technology. The "L" stands for the laser welded stainless steel housing and could equally be representative for low-power (typ. 0,1 µA in idle/sleep mode) and low-voltage (Supply: 1,8...3,6 VDC). The housing is hermetically-sealed, oil-filled and builds a Faraday cage with feed-through capacitors around the entire electronics. The digital interface of the electronics with dual information of pressure and temperature is indicated by the "D".

Interfaces

The easiest way to couple an OEM pressure transmitter to a microcontroller based system is a digital I/O-compatible interface; no amplification, no analog to digital conversion, no calibration, no temperature coefficients. In short: no problems.
I²C (Inter-Integrated Circuit) is designed for a direct connection between devices on a printed circuit board. It is a BUS-system because it allows the connection of multiple transmitters (slaves) to the same communication lines, but it is not a fieldbus with the classic long distance inter-connectability. So the D-Line combines an industrial pressure interface for harsh environment with an electrical interface for OEM applications.
The values are in 16 Bit unsigned integer format and the scaling is given by constants or by the memory content of the transmitter (two floating point values IEEE 754 for the pressure scaling).

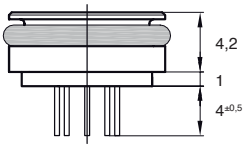
Performance features

- Ultra low power consumption, optimised for battery powered applications
- Hermetically protected sensor electronics – extremely resistant to environmental influences
- Ultra-compact, robust housing made from stainless steel (optional Hastelloy C-276)
- No external electronics for compensation or signal processing
- Extremely accurate, outstanding long-term stability, no hysteresis
- Pressure ranges of 1 bar to 200 bar
- Easy to integrate into microcontroller based systems
- Internal two-chip solution with pressure sensor and signal processing separation provides a high degree of flexibility

I²C is a trademark of NXP

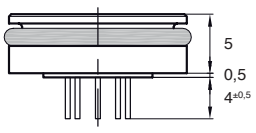
Serie 4 LD

Ø 11

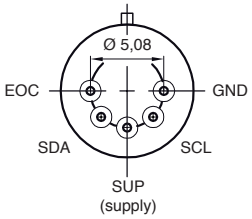


Serie 7 LD

Ø 15

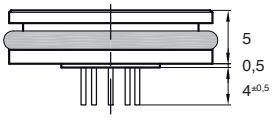


Connection



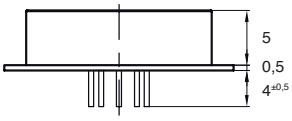
Serie 9 LD

Ø 19



Serie 9 FLD

Ø 17 / Ø 21



Label	Description	Wire
SUP	1,8…3,6 V	BK
GND	GND	WH
SCL	I²C Clock	YE
SDA	I²C Data	BU
EOC	End of Conv.	RD

Generally applies: No force must be applied to the pins!

Subject to alterations

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KELLER

Specifications

Pressure ranges rel.								
PR	0…1	-0,5…0,5	-1…3	-1…10	-1…30			bar
Pressure ranges abs.								
PA			0…3	0…10	0…30	0…100	0…200	bar
PAA	0…1	0,5…1,5	0…3	0…10				bar

Accuracy max. ± 0,15 %FS (Linearity best straight line@RT, hysteresis, repeatability)

Overpressure 4 x pressure range (max. 350 bar)

Stability typ. ± 0,1 %FS, max. ± 0,2 %FS

Type/ Version	Dimensions [mm] (4)	Pressure Range	Operating Temperature	Comp. Temp. Range	TEB (1) [%FS]
4 LD	ø 11 x 4,2	3…200 bar abs.(2)	-10…+80 °C	0…50 °C	± 0,7 %FS
7 LD	ø 15 x 5	3…200 bar abs. 3…30 bar rel. (3)	-40…+110 °C	0…50 °C -10…80 °C	± 0,5 %FS ± 0,7 %FS
9 LD	ø 19 x 5	1…200 bar abs. 1…30 bar rel.	-40…+110 °C	0…50°C -10…80 °C	± 0,5 %FS ± 0,7 %FS
9 FLD	ø 17 x 5,5 Flange ø 21	1…30 bar abs. 1…30 bar rel.			

(1) TEB (Total Error Band): Maximum deviation within specified pressure and operating temperature range
(2) abs: Absolute Pressure Measurement (PAA: Absolute. Zero at vacuum PA: Sealed Gauge. Zero at 1,0 bar abs.)
(3) rel: Referential version (PR: Vented Gauge. Zero at atmospheric pressure)
(4) Dimensions without glass feed through

Interface digital I²C (serial synchronus)
Signal Output P [bar], T [°C]: normalised to 16 Bit unsigned integer
Signal Reserve typ. ± 10 %FS, min. ± 5 %FS

Supply 1,8…3,6 V
Power Consumption typ. 1,5 mA during conversion
typ. 100 nA in idle mode

Bit Rate ≤ 3,4 MHz
Start-up Time (Supply ON) < 2,5 ms
Conversion Time < 4 ms (for P and T)
Noise Floor max. ± 0,015 %FS (temperature 4 Bit)
Temperature Accuracy typ. ± 2 °C (≥ 30 bar: additional ±0,01 °C/bar)
Supply Voltage Dependency none
Isolation > 100 MΩ @ 500 VDC

Material in Contact with Media
- Stainless Steel AISI 316L (DIN 1.4404 / 1.4435)
- O-Ring: Viton® 70 Shore A (exchangeable)

Oil Filling Silicone oil, others on request

Pressure Endurance 0…100 %FS @ 25 °C: > 10 million pressure cycles with appropriate installation

Vibration Endurance 20 g, 5…2000 Hz, X/Y/Z-axis
Shock 75 g sine 11 ms

Electrical Connection
- Glass feed through pins D = 0,45 mm, L = 4 ± 0,5 mm (standard)
- 7 cm silicone wires 0,09 mm² at the glass feed through pin (optionally, on request)

Options
- Pressure connection (i.e. G 1/4")
- Housing made of Hastelloy C-276
- Extended temperature range within -40…110 °C

Remarks
- Other pressure ranges for high volume projects only
- This series is not available in transmitter housings with plugs or cable (I²C is not a fieldbus)

Communication Protocol

D-Line OEM-transmitter samples only on request. The idle state is the sleep mode to save power.

Sequence for data acquisition:

1. Request measurement
   2 bytes from master

ADDR	0	0xAC

2. Await the end of conversion (three ways)
   - Simple delay of 10 ms
   - Polling of the "Busy?" flag [5] in the status byte (only one byte reading needed)
   - Event triggering by the additional "EOC" handshake pin (goes to VDD)

3. Read out measurement results
   1 byte from master, 3…5 bytes from slave

ADDR	1	STATUS	P MSB	P LSB	…
…			T MSB	T LSB	

4. Interpretation of new data
   P [bar] = P min…P max ≙ 16384…49152
   T [°C] = -50…150 °C ≙ 384…64384

The complete communication protocol can be provided upon request.