



## Series 7LHP

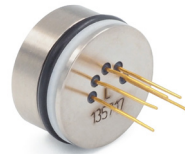
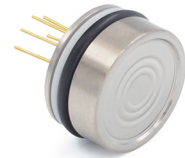
Piezoresistive OEM high-pressure transducers with a wide range of applications

### Features

- High long-term stability
- Robust housing made from stainless steel, Inconel or titanium
- Front-flush diaphragm welded with no gaps
- High operating temperature up to 180 °C
- Optimised thermal behaviour

### Technology

- Insulated piezoresistive pressure sensor encapsulated in an oil-filled metal housing
- Ideal for mounting with O-ring and support ring
- Typical output signal range of 160 mV/mA



### Typical applications

- Oil and gas
- Oceanology
- Geology
- Energy sector
- Hydraulics

#### Accuracy

± 0,25 %FS

#### Long-term stability

± 0,25 %FS/year

#### Pressure ranges

0...100 bar to 0...2000 bar



Series 7LHP

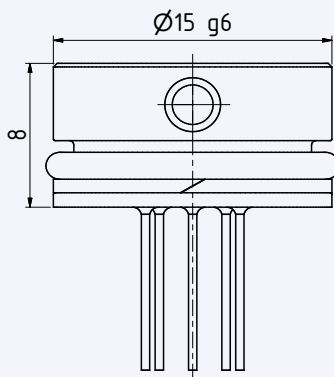
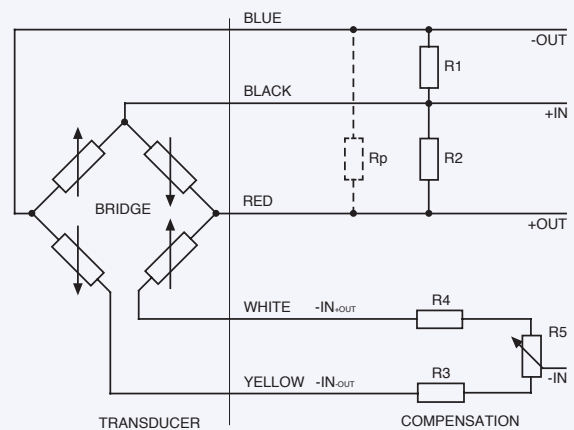


Diagram of a measurement bridge with compensation





## Series 7LHP – specifications

### Standard pressure ranges

Absolute pressure PAA	Absolute pressure PA	Overload resistance	Sensitivity		
			min.	typ.	max.
0...100	0...100	250	1,20	1,60	2,0
0...160	0...160	400	0,75	1,00	1,25
0...250	0...250	625	0,48	0,64	0,80
0...400	0...400	1000	0,30	0,40	0,50
0...600	0...600	1500	0,20	0,267	0,333
0...1000	0...1000	2200	0,12	0,16	0,20
0...1600	0...1600	2200	0,075	0,10	0,125
0...2000	0...2000	2200	0,075	0,10	0,125
bar abs.	bar abs.	bar	mV/(mA × bar)		
Zero at 0 bar abs. (vacuum)	Zero at 1 bar abs.	with reference to zero	The standard pressure ranges are available from the warehouse. Calibrations to any intermediate pressure ranges can also be made.		

### Performance

Accuracy @ RT (20...25 °C)	± 0,25 %FS typ.	Nonlinearity (BFSL), pressure hysteresis, non-repeatability
	± 0,50 %FS max.	
Offset @ RT (20...25 °C)	< ± 25 mV/mA	Uncompensated, the sensitivity value must be added for PA
	< ± 2 mV/mA	Compensated with R3 or R4
Compensated temperature range	-10...80 °C	Other temperature ranges between -55...180 °C are possible as an option
Long-term stability	≤ ± 0,25 %FS	Per year under reference conditions
Degree of dependency on location	≤ 2 mbar	Calibrated in vertical installation position with metal diaphragm facing downwards
Temperature coefficient (TC)	≤ ± 0,025 %FS/K	Zero (TCzero) pre-compensated with R1 or R2
	≤ ± 0,06 %/K	Sensitivity (TCsens)
	1800...3000 ppm/K	Total bridge resistance (TCres)

### Electrical data

#### Half-open measurement bridge

Constant current supply	1 mA nominal 3 mA maximum	
Bridge resistance @ RT (20...25 °C)	3,5 kΩ ± 20 %	
Electrical connection	Gold-plated pins ø 0,45 mm L = 9 mm ± 0,5 mm	Optional: Silicone wires AWG28, L = 70 mm, other lengths on request
Insulation	> 100 MΩ @ 500 VDC	



## Series 7LHP – specifications

### Mechanical data

Materials in contact with media

Housing and diaphragm	Stainless steel AISI 316L	Series 7LHP
	Inconel 718	Series 7LHPI
	Titanium	Series 7LHPTi
Seal ring	FKM (75 Shore) ø 12 mm x 1.5 mm -20...200 °C	Optional: others on request
Support ring	> 100...600 bar: PTFE	Installation via O-ring/support ring is not suitable for pressures >1600 bar. We recommend welding the pressure transducer to a housing.
	> 600...1600 bar: PEEK	
	ø 1,8 mm / ø 15 mm x 0,75 mm	

Other materials

Oil filling sensor	Silicone oil	Optional: others on request
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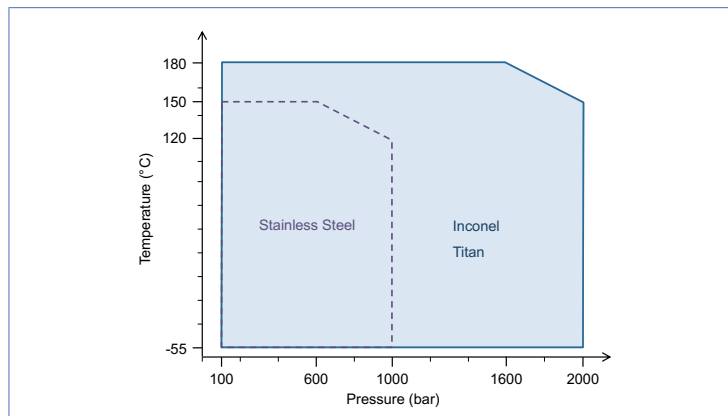
Further details

Diameter x height	ø 15 mm x 8 mm	See dimensions and options
Weight	approx. 8,6 g	Series 7LHP
	approx. 9,2 g	Series 7LHPI
	approx. 5,2 g	Series 7LHPTi

### Ambient conditions

Media temperature range	-40...150 °C	Optional: -55...180 °C
Ambient temperature range	-40...150 °C	
Storage temperature range	-20...70 °C	
Vibration endurance	10 g, 10...2000 Hz, ± 10 mm	IEC 60068-2-6
Shock endurance	< 50 g, 6 ms	IEC 60068-2-27
Natural frequency (resonance)	> 30 kHz	
Pressure endurance @ RT (20...25 °C)	> 10 million pressure cycles	0...100 %FS
Dead volume change @ RT (20...25 °C)	< 2 mm <sup>3</sup>	

### Recommended material selection according to pressure and temperature

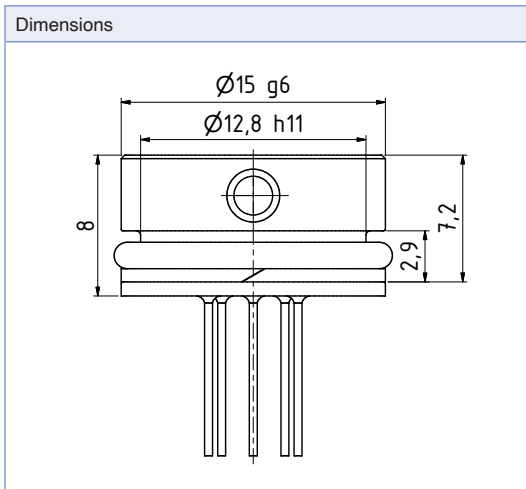


KELLER 7LHP series high pressure transducers are available with various material options. Stainless steel, Inconel 718 or titanium can be selected (see "Mechanical data") in line with requirements.

The diagram opposite shows the material options available depending on pressure and temperature. All the materials mentioned are compatible with pressure ranges up to 1000 bar. Only Inconel or titanium is offered for pressures above 1000 bar and above 150 °C due to their mechanical strength.



## Series 7LHP – dimensions and options



### Electrical connection

Glass feedthrough connection		Half-open measurement bridge pin assignment			
		PIN	Label	Designation	Wire colour
		1	+OUT	Pos. output	red
		2	+IN	Pos. supply	black
		3	-OUT	Neg. output	blue
		4	-IN <sub>OUT</sub>	Neg. supply (half bridge -OUT)	yellow
		5	-IN <sub>OUT</sub>	Neg. supply (half bridge +OUT)	white

### Overview of customer-specific options

- Analysis for other pressure ranges
- Analysis for other temperature ranges between -55...180 °C
- Analysis using a mathematical compensation model
- Electrical connection using silicone wires
- Seal rings made of other materials
- Other oil filling types for pressure transducers: e.g. special oils for oxygen applications
- Modifications to customer-specific applications

### Examples of related products

- Series 6LHP: high-pressure transducer with ø 13 mm
- Series 6LHPH: high-pressure transducer from Hastelloy C-276
- Series 7LHPX: high-pressure transducer 7LHP with digital compensation electronics
- Series 10LHP: high-pressure transducer with ø 19 mm



## Series 7LHP – Analysis and characteristic lines

### Standard analysis

The pressure transducers are intended for O-ring mounting and are therefore designed for low transmission of forces. This installation enables the values measured in the test equipment to remain unchanged. If the transducers are not de-energised when they are installed, the mechanical forces may change the measured values and the stability of the pressure transducers.

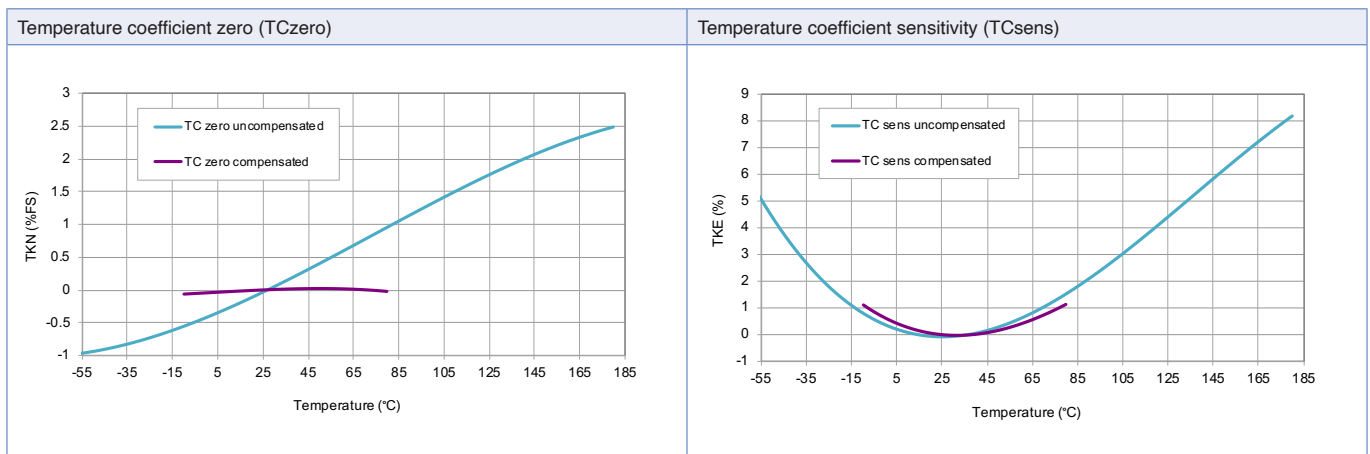
Calibration sheet: Example type PA-10L					Key
----- 449					<ol style="list-style-type: none"> <li>Type (PA-10L) and measuring range (10 bar) of pressure sensor</li> <li>Serial number of pressure sensor</li> <li>Test temperatures</li> <li>Uncompensated zero offset values</li> <li>Zero offset values with compensation resistor R1 (+) or R2 (-) connected</li> <li>Zero offset with calculated compensation resistors</li> <li>Temperature zero error with compensation resistors</li> <li>Compensation resistor values R1 or R2 (TCzero) and R3 or R4 (offset)</li> <li>RB: Bridge resistance at room temperature</li> <li>Offset with compensation resistors R1 or R2 and R3 or R4</li> <li>Sensitivity of pressure sensor at room temperature</li> <li>Pressure test points</li> <li>Signal at pressure test points</li> <li>Nonlinearity (best straight line through zero)</li> <li>Nonlinearity (best straight line)</li> <li>Results of long-term stability</li> <li>Lot number and identification of silicon wafer</li> <li>Insulation test</li> <li>Excitation (constant current)</li> <li>Date of test ----- Test equipment</li> </ol>
<b>PA-10L/10 bar/10-1005-118</b> <sup>(1)</sup>		<b>Sn I107547</b> <sup>(2)</sup>			
<sup>(3)</sup> Temp	<sup>(4)</sup> Zero	<sup>(5)</sup> +510	<sup>(6)</sup> Comp	<sup>(7)</sup> dZero	
[°C]	[mV]	[mV]	[mV]	[mV]	
-9.5	18.5	13.3	-0.6	0.2	
0.1	18.7	13.3	-0.6	0.2	
25.0	19.1	13.1	-0.8	0.0	
50.2	19.8	13.0	-0.9	-0.1	
79.9	20.8	12.9	-1.1	-0.2	
----- L1					
COMP	R1	510 kOhm <sup>(8)</sup>	R3	56.0 Ohm <sup>(8)</sup>	
RB	3482 Ohm <sup>(9)</sup>				
ZERO	-0.8 mV <sup>(10)</sup>		P_atm	964 bar	
<b>SENS</b>	<b>16.41 mV/bar</b> <sup>(11)</sup>				
LIN			<sup>(14)</sup> Lnorm	<sup>(15)</sup> Lbfsl	
<sup>(12)</sup> [bar]	<sup>(13)</sup> [mV]			[%Fs]	
0.000	0.0			-0.01	
2.500	41.1			0.01	
5.000	82.1			0.00	
7.500	123.1			-0.01	
10.000	164.1			-0.01	
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Long Term Stability Ok <sup>(16)</sup>					
Lot 72114-2 <sup>(17)</sup>					
Test 500 Volt Ok <sup>(18)</sup>					
<b>Supply 1.000 mA</b> <sup>(19)</sup>					
01.09.17 <sup>(20)</sup> ----- GOL3.A03DIK <sup>(20)</sup>					

#### Notes

- The indicated specifications apply only for a constant current supply of 1 mA. The sensor should not be supplied with more than 3 mA. The output voltage is proportional to the current supply (excitation). If the supply deviates from the calibration, signal shifts may occur.
- The compensation resistors described in this data sheet are not part of the pressure transducer and are not included in the scope of delivery.
- Compensation resistors must have a temperature coefficient of < 50 ppm/°C in extreme temperatures. The sensor and the resistors can be exposed to different temperatures.
- Fine adjustment of zero with R5 potentiometer (20 Ω) is possible. In addition, a maximum TCsens can be guaranteed on request or the value for the compensation resistor (Rp) can be indicated. See Diagram "Measurement bridge with compensation" on page 1.

### Characteristic lines

Examples of typical characteristic lines of the temperature coefficients, normalised at 25 °C, uncompensated and compensated





## Series 7LHP – Analysis and characteristic lines

### Mathematical compensation model

As an option, the 7LHP series KELLER pressure transducers can be ordered together with a mathematical compensation model.

The compensation model is a mathematical formula that helps to calculate the compensated pressure value of the pressure transducer.

Both the pressure signal and the temperature signal of the pressure transducer are incorporated into the calculation. Polynomial functions are used as the basis for this mathematical model.

The pressure transducers are characterised in the factory in order to produce the compensation model. This involves measuring pressure and temperature signals at various pressure and temperature levels. Comparing the measured values with the known pressure and temperature values enables the calculation of the compensation coefficients of the pressure transducer. These compensation coefficients are made available to the customer along with the respective pressure transducer.