

## Series 7LHP

Piezoresistive high-pressure transducer capsules 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

- Piezoresistive pressure sensor chip, encapsulated insulated 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

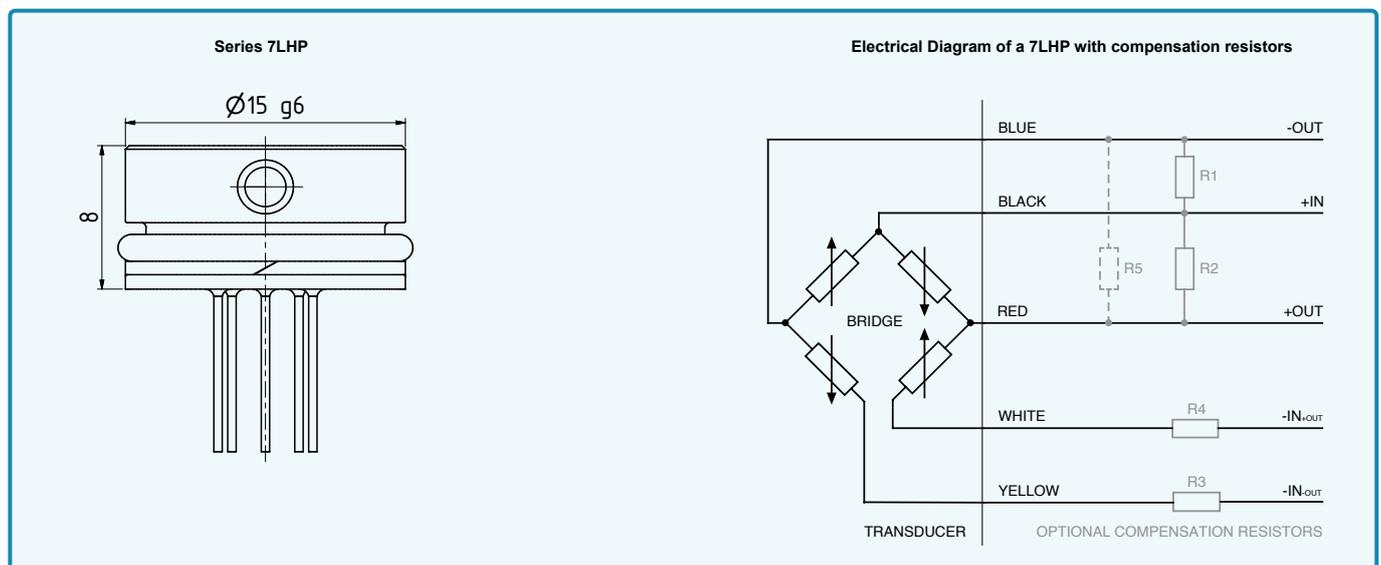
± 0,25 %FS

#### Long-term stability

± 0,25 %FS/year

#### Pressure ranges

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



## Series 7LHP – specifications

### Standard Pressure Ranges

Absolute pressure PAA	Absolute pressure PA	Proof pressure	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)		
Reference pressure at 0 bar abs. (vacuum)	Reference pressure at 1 bar abs.	Based on reference pressure	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.	Non-linearity (best fitted straight line 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-bridge configuration

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 (0,09 mm <sup>2</sup> ), 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
O-ring	ø 12 mm × 1,5 mm FKM (75 Shore) -20...200 °C	For medium temperatures < -20 °C FVMQ is used.
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 × 0,75 mm	

Other materials

Pressure transducer capsule oil filling	Silicone oil
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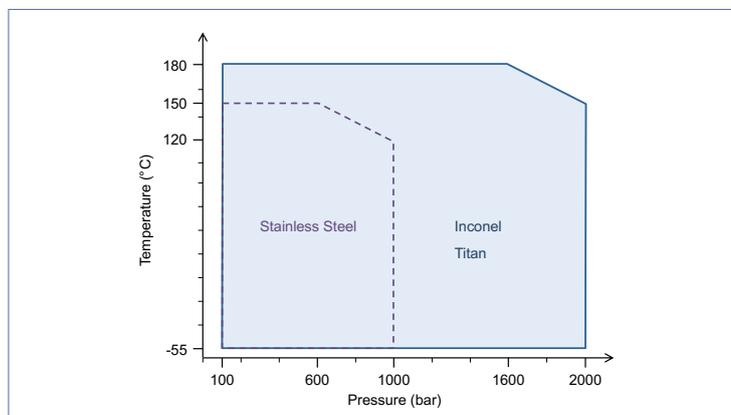
Further details

Diameter × height	ø 15 mm × 8 mm	See dimensions and variants
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	Operating temperature, consider o-ring. Icing not permitted.
Ambient temperature range	-40...150 °C	
Storage temperature range	-40...150 °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>	

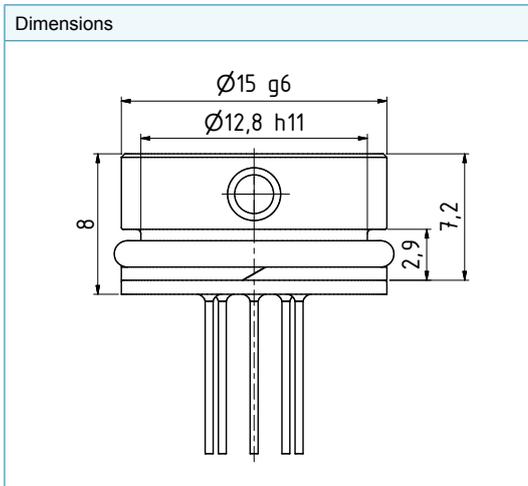
### Recommended Material Selection According to Pressure and Temperature



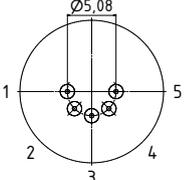
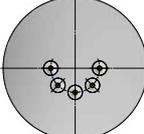
KELLER Pressure 7LHP series high pressure transducers are available with various material options. Stainless steel, Inconel 718 or titanium can be selected (see "Mechanical data") in line with requirements.

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 variants



### Electrical Connection

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

### Customised configurations on request

- Calibration to other pressure ranges
- Calibration to other temperature ranges between -55...180 °C
- Calibration with mathematical modeling
- Electrical connection via silicone wires execute
- O-rings made of other materials
- Other oil filling types for pressure transducer capsules
- Modifications to customer-specific applications

### Examples of Similar Products

- Series 6LHP: high-pressure transducer capsule with  $\varnothing$  13 mm
- Series 6LPH: high-pressure transducer capsule from Hastelloy C-276
- Series 7LHPX: high-pressure transducer capsule 7LHP with digital compensation electronics
- Series 10LHP: high-pressure transducer capsule with  $\varnothing$  19 mm

# Series 7LHP – Analysis and characteristic lines

## Standard Analysis

The 7LHP are intended for o-ring mounting and depend on the stress isolation provided by o-rings for performance within stated specifications. This installation enables the values measured during factory testing to remain valid. If the pressure transducers are not de-energised when they are installed, the mechanical forces may change the measured values and the stability.

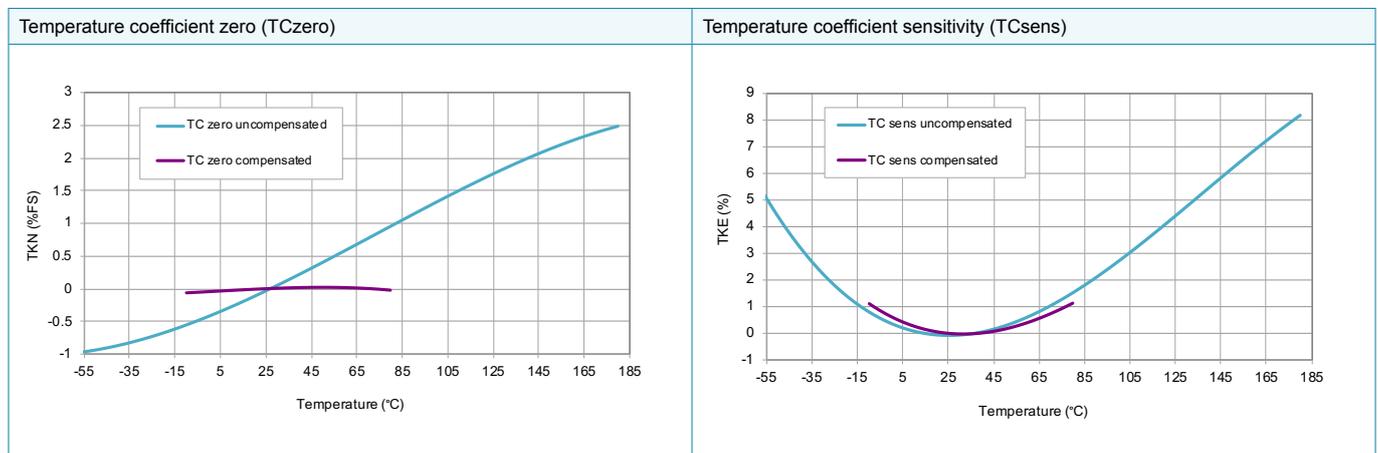
Calibration sheet: Example type PA-10L					Key
----- 449					<ol style="list-style-type: none"> <li>Type (PA-10L) and measuring range (10 bar)</li> <li>Serial number</li> <li>Actual test temperatures</li> <li>Uncompensated zero offset</li> <li>Zero offset values with calculated compensation resistor R1 (+) or R2 (-)</li> <li>Zero offset values with calculated compensation resistors</li> <li>Temperature zero error with calculated compensation resistors</li> <li>Calculated compensation resistor values R1 or R2 (TCzero) and R3 or R4 (offset)</li> <li>RB: Bridge resistance at room temperature</li> <li>Calculated offset with compensation resistors R1 or R2 and R3 or R4</li> <li>Sensitivity at room temperature 25° C</li> <li>Pressure test points</li> <li>Signal change at pressure test points at room temperature 25° C</li> <li>Non-linearity (best straight line through zero)</li> <li>Non-linearity (best straight line)</li> <li>Results of long-term stability test</li> <li>Sensor traceability information</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>			
----- 29/01					
<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]		[%Fs]	
0.000	0.0	0.00		-0.01	
2.500	41.1	0.02		0.01	
5.000	82.1	0.00		0.00	
7.500	123.1	-0.02		-0.01	
10.000	164.1	-0.01		-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>					
Supply <b>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 constant current supply of 1 mA. The pressure transducer module must not be supplied with more than 3 mA. The output voltage is proportional to the supply current. If the supply deviates from the calibration, this will cause signal shifts.
- The compensation resistors described in this data sheet are not part of the pressure transducer module and are not included in the scope of delivery.
- It is recommended to use compensation resistors with temperature coefficients of < 50 ppm/°C for large temperature ranges. Pressure transducer modules and resistors can be exposed to different temperatures.
- In addition, a maximum TC-sensitivity can be guaranteed on request or the value for the compensation resistor (R5) can be indicated. See «Electrical diagram of compensation resistors» 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.



### KELLER Pressure myCalibration

#### Content

myCalibration is a digital data platform provided free of charge to KELLER Pressure customers. It provides an easy option for transferring and providing sensor calibration data.

#### Format

The calibration data is available in the standard JSON file format, which facilitates smooth integration into the customer's software. The file structure is clearly defined in a publicly accessible JSON schema. This means that the customer is able to integrate the data seamlessly into their software.

#### Access

The platform can be accessed either via a standard web browser (web view) or directly within the customer's linked software using an API. The calibration data remains available in myCalibration for 24 months.

#### Web app

Customers can access the calibration data for their sensors via a user-friendly interface. The system ensures secure authentication by asking users to enter their personal login details, thereby preventing unauthorised access to the data by third parties.

The user has the option to use various search and filter functions to download calibration data for specific sensors or mass export multiple datasets simultaneously.

#### API

Customers have the option to use the REST API for automated access and to integrate it into their processes. This means that calibration data for new sensors can be called up automatically and then processed, for example.

#### Documentation

Comprehensive technical documentation including example software is available at the following link:

<https://mycalibration.github.io/>