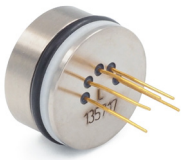
Series 7LHP

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

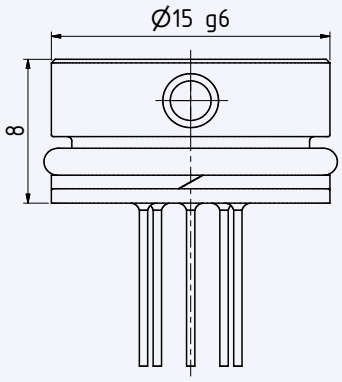
Typical applications

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

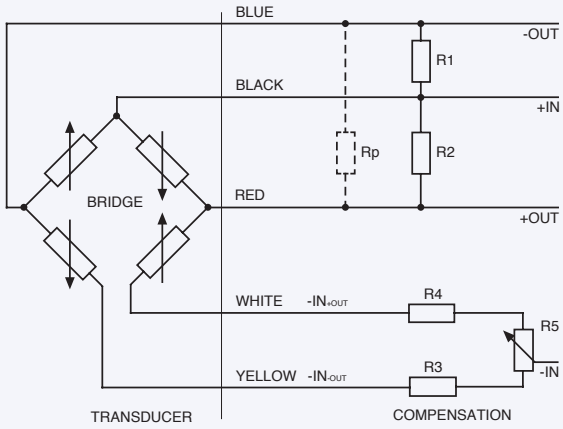
Accuracy
± 0,25 %FS
Long-term stability
± 0,25 %FS/year
Pressure ranges
0…100 bar to 0…2000 bar

CE

Series 7LHP



Electrical Diagram of a 7LHP with compensation resistors



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Measurement and data acquisition solutions

Contact Details:
Tel: +44 1382 443000
Fax: +44 1382 453197
Email: info@omni.uk.com

Mailing Address: Unit 1, 14 Nobel Road,
Wester Gourdie Industrial Estate,
Dundee, DD2 4UH.

Website: www.omniinstruments.co.uk

Series 7LHP – specifications

Standard pressure ranges

Absolute pressure PAA	Absolute pressure PA	Proof pressure	Sensitivity min.	Sensitivity typ.	Sensitivity 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, L = 70 mm, other lengths on request
Insulation	> 100 MΩ @ 500 VDC	

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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	FKM (75 Shore) ø 12 mm × 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 × 0,75 mm	

Other materials

Oil filling sensor	Silicone oil	Optional: others on request

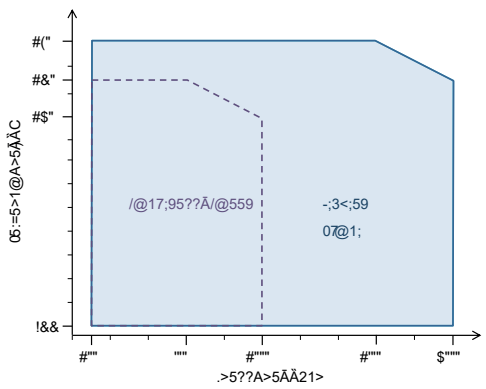
Further details

Diameter × height	ø 15 mm × 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	Icing not permitted
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 mm³		

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.

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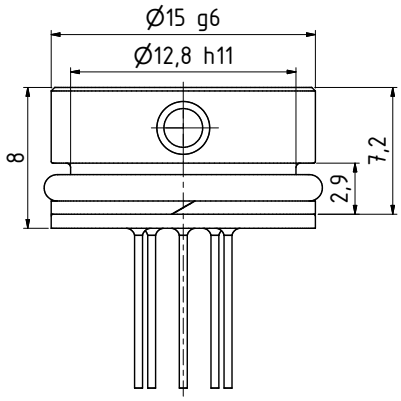
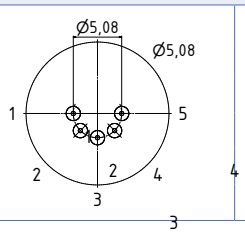
Series 7LHP – dimensions and options

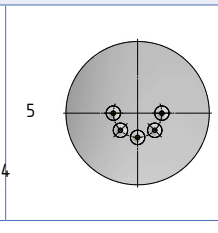
Dimensions



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	$-IN_{-OUT}$	Negative supply (half bridge -OUT)	yellow
5	$-IN_{+OUT}$	Negative supply (half bridge +OUT)	white

Overview of customer-specific options

- Custom pressure ranges
- Custom temperature ranges between -55…180 °C
- Custom mathematical modeling
- Electrical connection using silicone wires
- O-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

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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 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

```
---------------------------------------------------------------------- 449
PA-10L/10 bar/10-1005-118 (1)          Sn I107547 (2)
---------------------------------------------------------------------- 29/01
(3) Temp    (4) Zero    (5) +510    (6) Comp    (7) 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 (8)        R3      56.0 Ohm (8)
RB          3482 Ohm (9)
ZERO          -0.8 mV (10)      P_atm     964 bar
SENS        16.41 mV/bar (11)

LIN                                  (14) Lnorm   (15) Lbfsl
  (12) [bar]      (13) [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
----------------------------------------------------------------------
Long Term Stability Ok (16)
Lot 72114-2 (17)
Test 500 Volt Ok (18)
Supply 1.000 mA (19)
01.09.17 (20) ---------------------------------------- GOL3.A03DIK (20)
```

Key

1. Type (PA-10L) and measuring range (10 bar) of pressure sensor
2. Serial number of pressure sensor
3. Actual test temperatures
4. Uncompensated zero offset values
5. Zero offset values with compensation resistor R1 (+) or R2 (-) connected
6. Zero offset with calculated compensation resistors connected
7. Temperature zero error with compensation resistors connected
8. Calculated compensation resistor values R1 or R2 (TCzero) and R3 or R4 (offset)
9. RB: Bridge resistance at room temperature
10. Calculated offset with compensation resistors R1 or R2 and R3 or R4 connected
11. Sensitivity of pressure sensor at room temperature
12. Pressure test points
13. Signal at pressure test points
14. Nonlinearity (best straight line through zero)
15. Nonlinearity (best straight line)
16. Results of long-term stability test
17. Sensor traceability information
18. Insulation test
19. Excitation (constant current)
20. Date of test -------- Test equipment

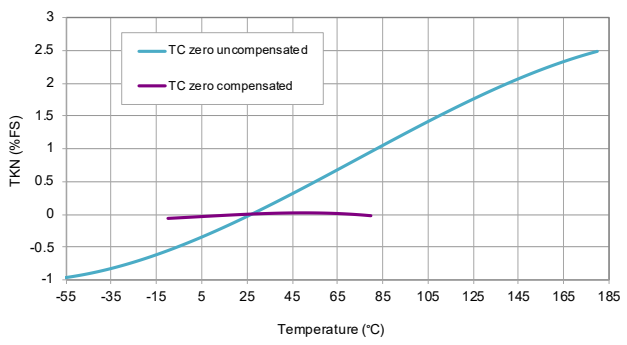
Notes

- 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 «Electrical Diagram of a 7LHP with Compensation» on page 1.

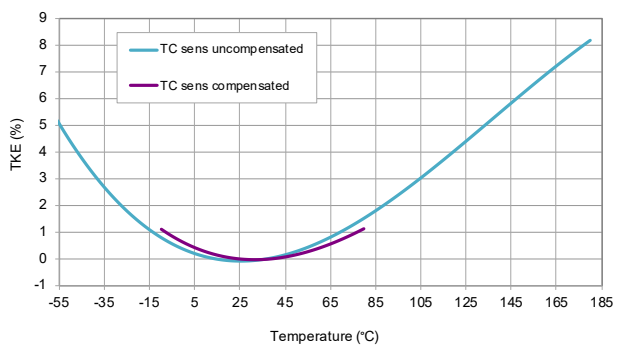
Characteristic lines

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

Temperature coefficient zero (TCzero)



Temperature coefficient sensitivity (TCsens)



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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.

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