Series 9FL

Piezoresistive Pressure transducer capsule with very high stability and a flanged design

Features

- Very high long-term stability
- Robust, compact stainless-steel housing with flange
- Front-flush, crevice-free welded diaphragm
- Varied installation options
- Very high proof pressure
- Optimised thermal behaviour

Technology

- Piezoresistive pressure sensor chip, insulated encapsulated in an oil-filled metal housing
- Housing with flange for axial seal using an O-ring
- Typical range of output signal of 160 mV/mA

Typical Applications

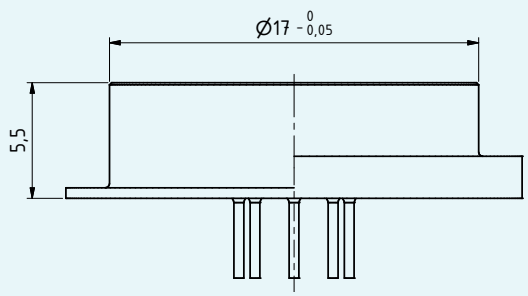
- OEM
- Heating pumps
- Autoclaves
- Meteorology

Accuracy
± 0,25 %FS

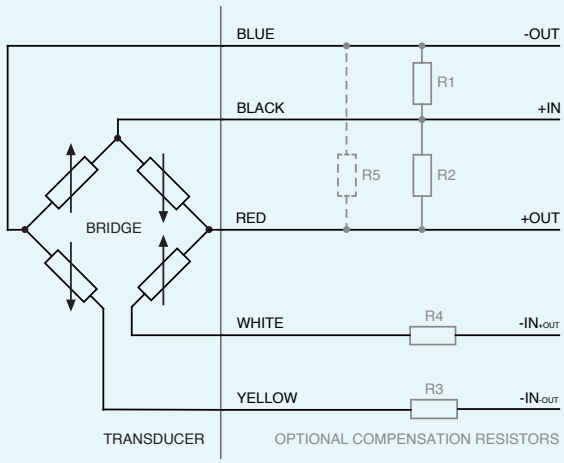
Long-term Stability
± 0,20 %FS/year

Pressure Ranges
0…0,2 bar to 0…200 bar

Series 9FL



Electrical Diagram of a 9FL with compensation resistors



Edition 08/2025
Subject to alterations
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Series 9FL – Specifications

Standard Pressure Ranges

Relative pressure PR		Absolute pressure PAA	Absolute pressure PA	Proof pressure	Sensitivity		
					min.	typ.	max.
-0,2…0,2	0…0,2	0…0,2		3	98	130	163
-0,3…0,3	0…0,3	0…0,3					
-0,5…0,5	0…0,5	0…0,5					
-1…0	0…1	0…1	0…1	6	60	80	100
-1…1	0…2	0…2	0…2	9	40	53	66,7
-1…2	0…3	0…3	0…3				
	0…5	0…5	0…5	15	24	32	40
	0…10	0…10	0…10	30	12	16	20
	0…20	0…20	0…20	60	6	8	10
	0…30	0…30	0…30	90	4	5,3	6,7
	0…50	0…50	0…50	150	2,4	3,2	4
		0…100	0…100	300	1,2	1,6	2
		0…160	0…160		0,75	1,0	1,25
		0…200	0…200				
bar rel.		bar abs.	bar	bar	mV / (mA × bar)		
Reference pressure at ambient pressure		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. Additional calibrations to intermediate pressure ranges can also be made.		

Performance

Accuracy @ RT (20…25 °C)	± 0,25 %FS typ.	Non-linearity (minimum value setting 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…150 °C are possible as an option.
Long-term stability	≤ ± 0,2 %FS	For pressure ranges > 1 bar, per year under reference conditions.
	≤ ± 2 mbar	For pressure ranges ≤ 1 bar, per year under reference conditions.
Position dependency	≤ 2 mbar	Calibrated in vertical installation position with metal diaphragm facing downwards.
Temperature coefficient zero TCzero pre-compensated with R1 or R2	≤ ± 0,02 %FS / K	For pressure ranges ≥ 2 bar
	≤ ± 0,4 mbar / K	For pressure ranges < 2 bar
Temperature coefficient sensitivity TCsens	≤ ± 0,06 %/ K	For pressure ranges ≥ 3 bar
	≤ ± 0,12 % / K	For pressure ranges < 3 bar
Temperature coefficient total bridge resistance TC-resistance	1800…3000 ppm / K	

Series 9FL – Specifications

Electrical Data

Half-bridge configuration

Constant current supply	1 mA nominal 3 mA max.	
Bridge resistance @ RT (20…25 °C)	3,5 kΩ ± 20 %	
Electrical connection	Gold-plated pins ø 0,45 mm L = 4 mm ± 0,5 mm	Optional: Silicone wires AWG28 (0,09 mm2), L = 70 mm, other lengths on request.
Insulation	> 100 MΩ @ 500 VDC	

Mechanical Data

Materials in contact with media

Housing and diaphragm	Stainless steel AISI 316L
O-ring	None

Other materials

Pressure transducer capsule oil filling	Silicone oil

Further details

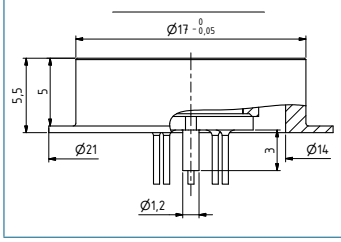
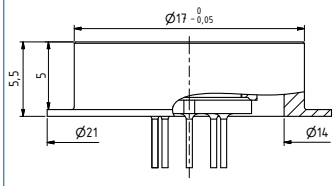
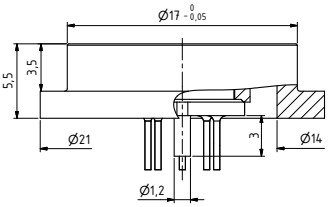
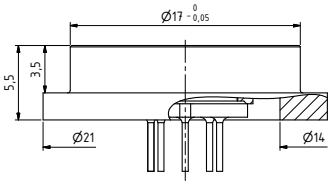
Diameter × height	ø 17 / 21 mm × 5,5 mm	See dimensions and variants
Connection for capillary for reference pressure compensation	ø 1,2 mm × 3 mm	Optional: Capillary (silicone)
Weight	approx. 7 g	

Environmental conditions

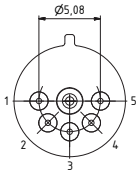
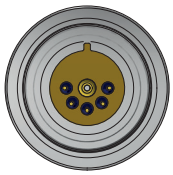
Media temperature range	-40…125 °C	Operating temperature, consider o-ring. Icing not permitted.
Ambient temperature range	-40…125 °C	
Storage temperature range	-40…125 °C	
Vibration resistance	10 g, 10…2000 Hz, ± 10 mm	IEC 60068-2-6
Shock resistance	50 g, 6 ms	IEC 60068-2-27
Natural frequency (resonance)	> 30 kHz	
Endurance @ RT (20…25 °C)	> 10 million pressure cycles	0…100 %FS
Dead volume change @ RT (20…25 °C)	< 2 mm^3	

Series 9FL – Dimensions and variants

Overview of Versions

Thin flange		Thick flange	
PR for pressure ranges up to 30 bar	PAA / PA for pressure ranges up to 50 bar	PR for pressure ranges up to 30 bar	PAA / PA for pressure ranges up to 200 bar
			

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

Customised configurations on request

- Calibration to other pressure ranges
- Calibration to other temperature ranges within -40…150 °C
- Calibration with mathematical modeling
- Electrical connection via silicone wires execute
- Housing and diaphragm made of Hastelloy C-276 or titanium
- Other oil filling types for pressure transducer capsule
- Modifications to customer-specific applications

Examples of Similar Products

- Series 9FLX: Pressure transducer capsule 9FL with digital compensation electronics
- Series PD-9FLX: Differential pressure transducer capsule version with digital compensation electronics
- Series 7FL: More compact design with flange
- Series 9L: Version without flange

Series 9FL – Analysis and Characteristic Lines

Standard Analysis

The 9FL 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 installed free from stress, the mechanical forces may change the measured values and the stability.

Calibration sheet: Example type PA-10L	Key

---------- 449

PA-10L / 10 bar / 10-1005-118 (1) **Sn I107547** (2)

---------- 29/01

(3) Temp [°C]	(4) Zero [mV]	(5) +510 [mV]	(6) Comp [mV]	(7) dZero [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 (12) [bar]	(13) [mV]	(14) Lnorm [%Fs]	(15) Lbfsl [%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.A03D1K (20)

1. Type (PA-10L) and measuring range (10 bar)
2. Serial number
3. Actual test temperatures
4. Uncompensated zero offset
5. Zero offset values with calculated compensation resistor R1 (+) or R2 (-)
6. Zero offset values with calculated compensation resistors R1 or R2 and R3 or R4
7. Temperature zero error with calculated compensation resistors
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
11. Sensitivity at room temperature 25°C
12. Pressure test points
13. Signal change at pressure test points at room temperature 25°C
14. Nonlinearity (best straight line through zero)
15. Nonlinearity (best straight line)
16. Result of the long-term stability test
17. Lot number and identification of silicon wafer
18. Insulation test
19. Excitation (constant current)
20. Date of test -------- Test equipment

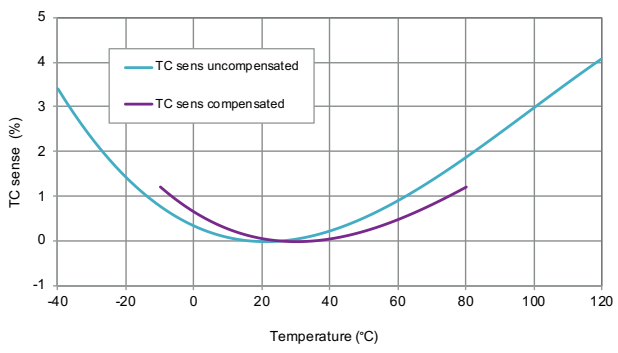
Notes

- 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.

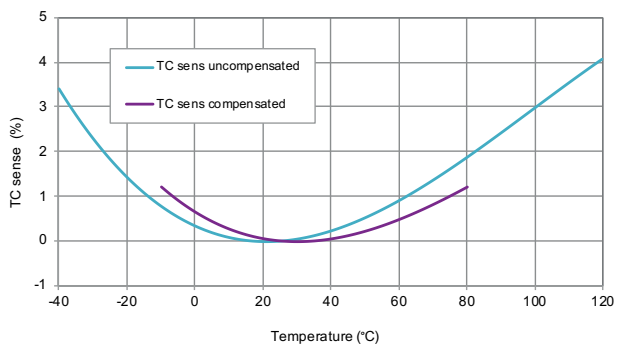
Characteristic Lines

Examples of typical characteristic curves of the temperature coefficients, normalised at 25 °C, uncompensated vs. compensated.

Temperature coefficient zero, TCzero



Temperature coefficient sensitivity, TCsens



Series 9FL – Analysis and Characteristic Lines

Mathematical compensation model

The 9FL series pressure transducers can be ordered with an optional 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 makes it possible to calculate the compensation coefficients of the pressure transducer. These compensation coefficients are made available to the customer along with the respective pressure transducer.

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/