

PIEZORESISTIVE MINIATURE PRESSURE TRANSDUCERS FOR HYDRO- AND AERODYNAMIC PRESSURE MEASUREMENTS

SERIES 2Mi

These miniature pressure transducers have been specially developed by KELLER for the measurement of hydrodynamic and aerodynamic pressures over a wide frequency band. Their construction provides the user with a high-performance miniature pressure transducer at an attractive cost. The measurement, carried out in situ, eliminates the errors caused by transducers mounted at a distance from the sensing point.

The pressure-sensitive element is a high-sensitivity piezoresistive chip in micro-machined silicon. Mounted in a stainless-steel casing, it is protected from the external environment by a thin coating of silicone elastomer and is submersible on the chip side. Electrical supply and signal measurement are by means of a subminiature screened cable sealed to the back of the transducer casing.

The 2Mi transducer can easily be assembled on to a structure by simply gluing the casing to it. The electrical supply to the transducer can be either constant current or constant voltage. The high output signal enables easy conditioning by means of standard instrumentation amplifiers giving a current or voltage amplified signal (Progress, Ei-71...).

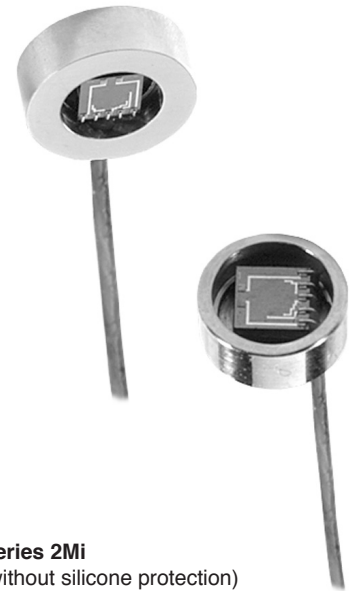
APPLICATIONS

Measurement of pressure on blades of hydraulic turbines, supervision of steam jets, dynamic measurements on profiles of aeroplanes and helicopters, cars, high speed trains, production of Pitot tubes and multidirectional speed probes, pressure transducers for subminiature data recorders, etc.

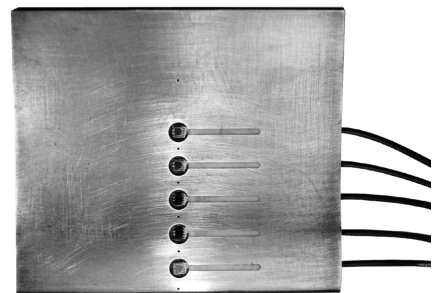
INTEGRATION OF TRANSDUCERS, MEASUREMENT CHAINS

KELLER is able to carry out the instrumentation of a variety of structures supplied by the user (for example turbine blades), either by means of 2Mi miniature transducers, or directly with piezoresistive chips when space is at a premium. The reconstitution of the structure's profile can also be undertaken by KELLER after installation of the transducers and electrical connections.

When several pressure transducers are used simultaneously, standard rack mounted conditioning electronics can be supplied by KELLER. Each measurement channel, individually compensated and calibrated, allows interchangeability of the transducers. Low noise instrumentation amplifiers enable high amplified outputs to be used.



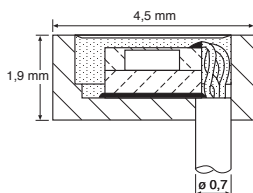
Series 2Mi
(without silicone protection)



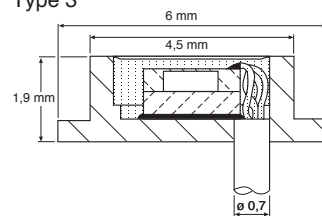
Series 2Mi on turbine profile

SELECTION OF SOME HOUSING TYPES:

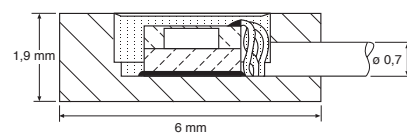
Type 1



Type 3



Type 2



Diameter of the silicon diaphragm:
1,3 mm

Electrical cable:
- \varnothing 0,7 mm (\varnothing 1,3 mm with protection sheathe)
- standard length 50 cm

ELECTRICAL CONNECTIONS

BLACK	+ IN
YELLOW	- IN
WHITE	- IN
RED	+ OUT
BLUE	- OUT



SPECIFICATIONS

	Pressure Ranges (FS)										
		bar	1	2	5	10	20	50	100	200	400
PR-2Mi	bar	1	2	5	10	20					
PAA-2Mi	bar	1	2	5	10	20					
PA-2Mi	bar	1	2	5	10	20	50	100	200	400	
Overpressure	bar	3	5	10	20	40	100	200	300	500	
Sensitivity typ. (at 1 mA or 3,5 V)	mV/bar	40	35	25	20	10	4	2	1	0,5	
Natural Frequency	kHz	> 300	> 300	> 300	> 400	> 500	> 800	> 1000	> 1000	> 1000	> 1000

PR: Vented Gauge. Zero at atmospheric pressure. PAA: Absolute. Zero at vacuum. PA: Sealed Gauge. Zero at ≈ 1 bar abs.

Bridge Resistance at 25 °C	Ω	3500	$\pm 20 \%$
Constant Current Supply	mA	$\leq 2,8$	3,5 max.
Constant Voltage Supply	V	≤ 10	12 max.
Insulation / 50 VDC	M Ω	> 100	

Storage- / Operating Temperature	°C	-20...80 / 0...80
Compensated Temperature Range	°C	0...40
Vibration	g	50, 20 to 5000 Hz
Shock	g	20, sinus 11 ms
Constant Acceleration	g	500
Dead Volume Change	mm ³ /FS	< 1

Accuracy ⁽¹⁾	%FS	< 0,5
Offset at 25 °C	%FS	< 5 (compensatable with R3 or R4)
Sensitivity Error	%FS	< 5 (compensatable with RE or RE*)
Temperature Error 0...40 °C		
• Zero	mbar/°C	0,15 typ. 0,25 max.
• Sensitivity	%/°C	0,05 typ.
Resolution	mbar	$\approx 1 \cdot 10^{-2}$ (1 pascal)
Acceleration Sensitivity		
• in sensitivity axis	%FS/g	FS ≤ 5 bar: < $3 \cdot 10^{-4}$ FS > 5 bar: < $1 \cdot 10^{-4}$
• vertically to sensitivity axis	%FS/g	FS ≤ 5 bar: < $5 \cdot 10^{-5}$ FS > 5 bar: < $2 \cdot 10^{-5}$

⁽¹⁾ Linearity + Hysteresis + Repeatability

Material Housing	Stainless steel type 316 L
Sensor Protection	Elastomer silicone
Elektrisches Kabel	Screened cable \varnothing 0,7 mm, length 0,5 m, nylon sheathed, 5 single strand copper AWG 40 nylon insulated $\approx 0,5$ Gramme
Weight	
Options	Intermediate ranges Other cable lengths Other housings and materials Protection IP68 on cable side

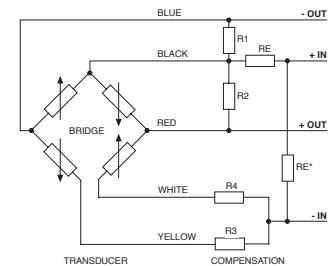
Calibration Sheet

Each pressure sensor is supplied with a calibration sheet with the following information:

- Type, serial number and range of the pressure sensor
- Tested pressure range with corresponding output signals and linearity error, the zero offset, in mV, after compensation with R3 or R4
- Sensitivity at determined excitation (voltage or current), in mV/bar, compensated with the resistors RE (if voltage excitation) or RE* (if current excitation)
- Value of resistor (temperature compensation) for adjustment of zero, R1 or R2
- Date of testing

Note

- The voltage output is proportional to the current voltage excitation
- If the compensation resistors are exposed to different temperatures, it is advisable to use temperature coefficients below 50 ppm/°C
- The resistors can be supplied on a miniature printed circuit as an extra



Measurement Chain

In multi channel applications where it is necessary to use several pressure sensors simultaneously, the conditioning electronics can be mounted in a standard rack. Each sensor is provided with a rationalising card which ensures the interchangeability of the sensor. The rationalising cards, accessible from the front face of the rack, incorporate the compensation and calibration components. The low noise amplifiers produce signals of 0...5 V or 0...10 V or ± 10 V for each measurement channel, and provide the transducer supply. Special versions on request.



Subject to alterations

11/99