



First Sensor

**Neue Sensor-Messprinzipien im
Niederdruckbereich unter 10 mbar**

14th LEIBNIZ CONFERENCE OF ADVANCED SCIENCE
SENSORSYSTEME 2012

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Schloss Lichtenwalde , 18. – 19. Oktober 2012



Overview

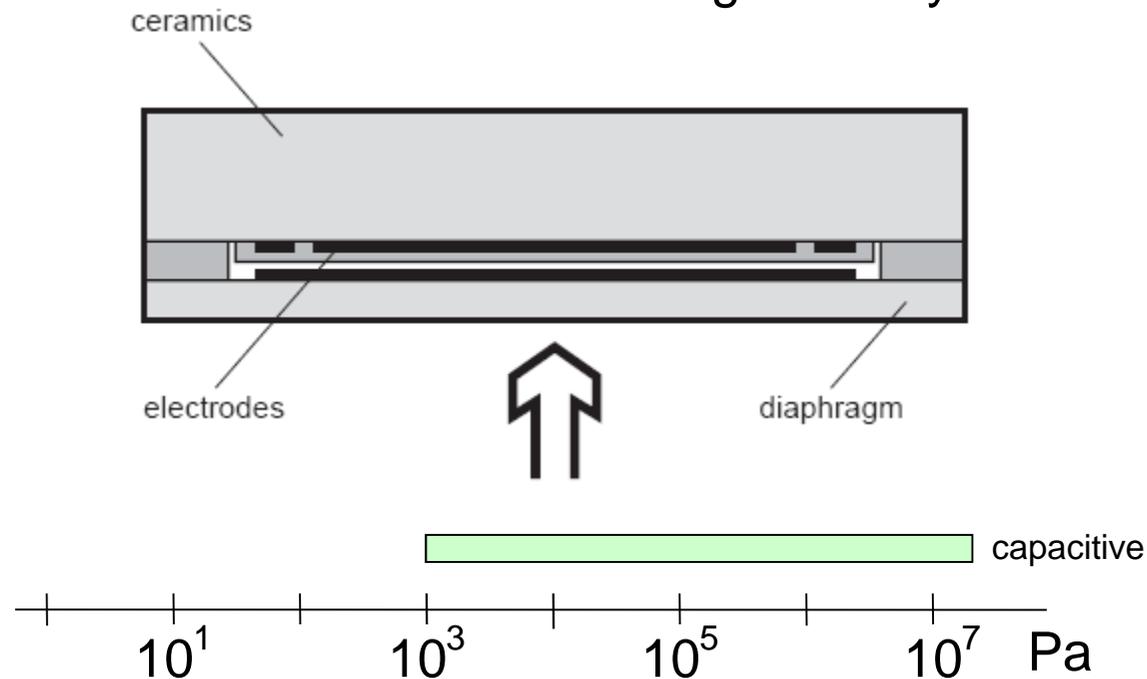
- Measurement principles for low differential pressures
- New μ -flow sensor
 - Packaging
 - HVAC applications
 - Medical applications
- Summary



Measuring technologies for low pressure

Capacitive

- Challenge for low pressure: - large membranes,
- packaging influence
- condensing humidity inside the chamber

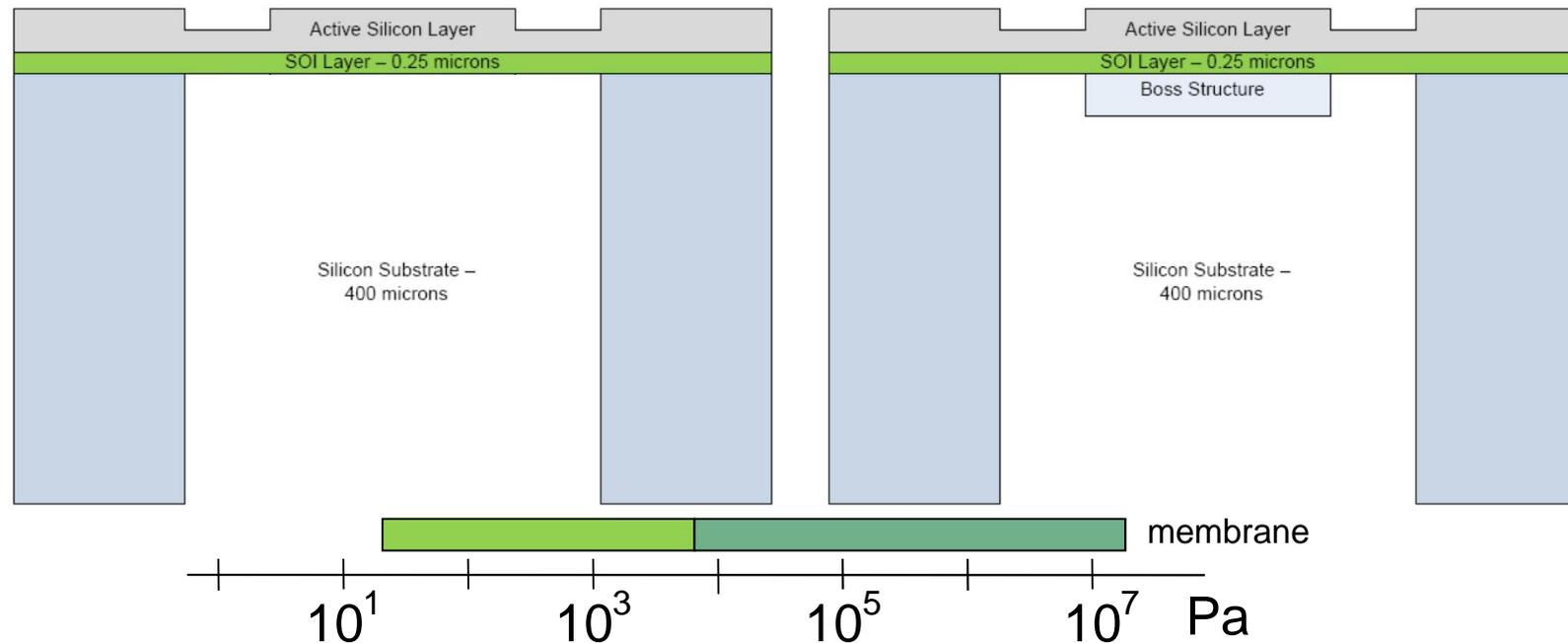




Measuring technologies for low pressure

Piezoresistive membrane-type sensors with Boss-structure

- Challenge for low pressure: - very thin membranes,
- packaging influence

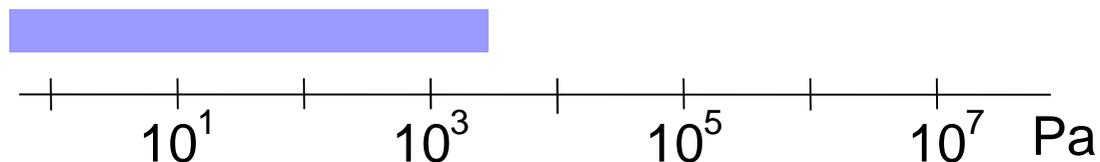
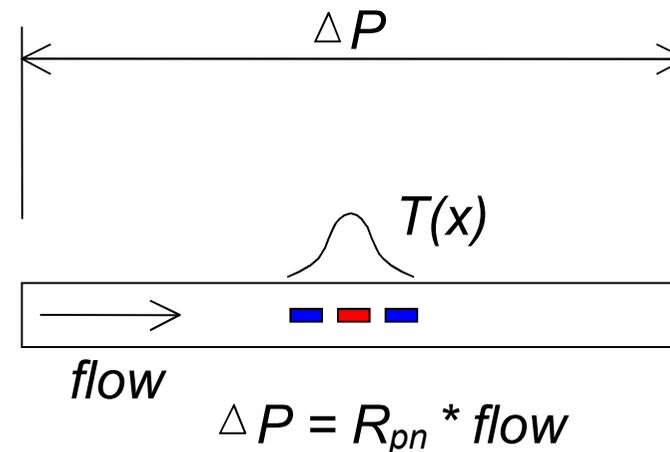
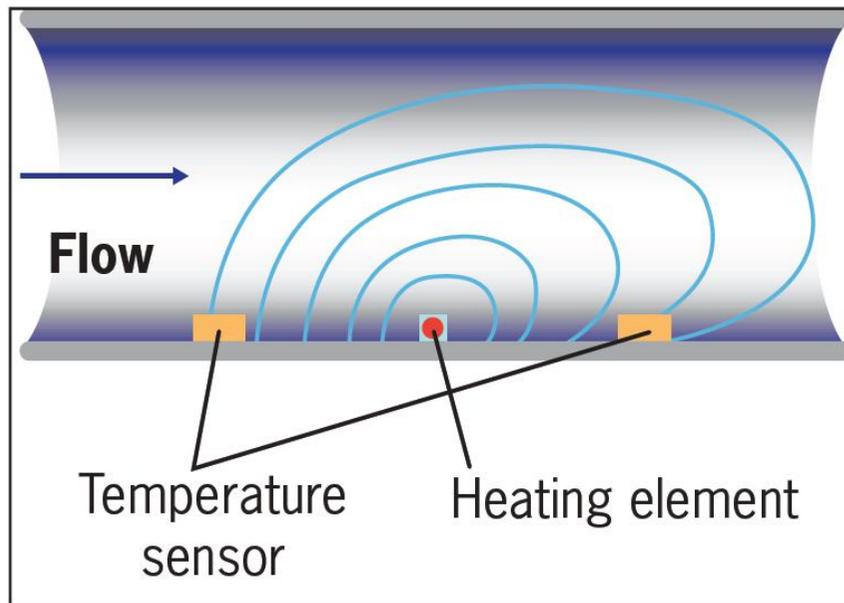


Effect of Boss-structure: stress concentration in peripheral area of membrane
→ improved linearity

Measuring technologies for low pressure

Calorimetric measuring principle – flow type

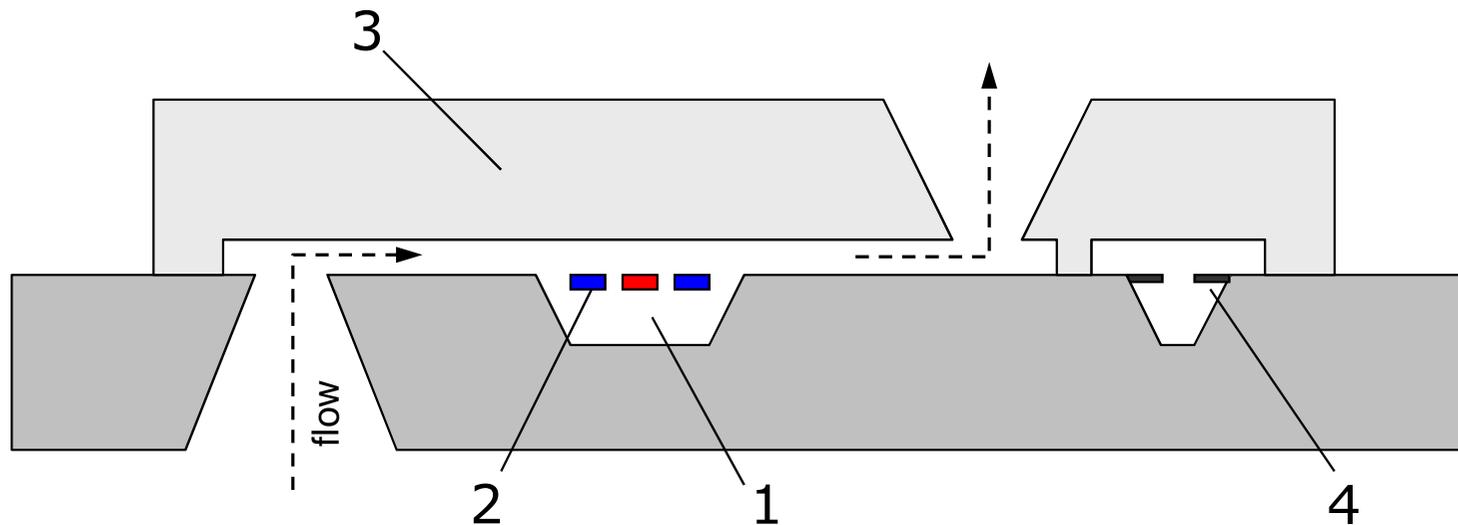
- Challenge for low pressure: - influence of environmental conditions
- accuracy for packaging (pneumatic resistance)





New μ -flow sensor

Si-flow channel with integrated sensing element



- 1 Bulk silicon etch to position thermal elements within the flow
- 2 High-TCR stable thermoresistors (Rejutor technology)
- 3 Wafer-scale cap, forms top of flow channel
- 4 Rejutors for calibration

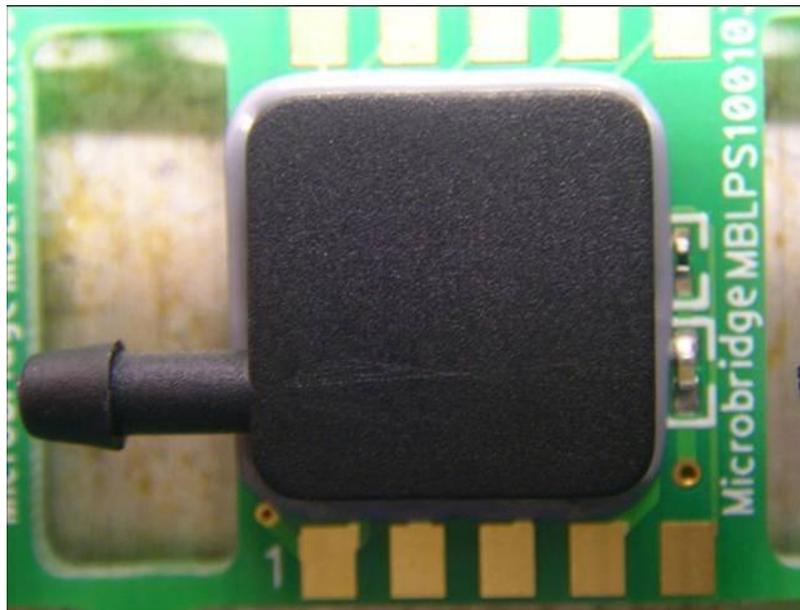


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New μ -flow sensor

Packaging of the micro-flow-based differential pressure sensor

First Sensor packaging



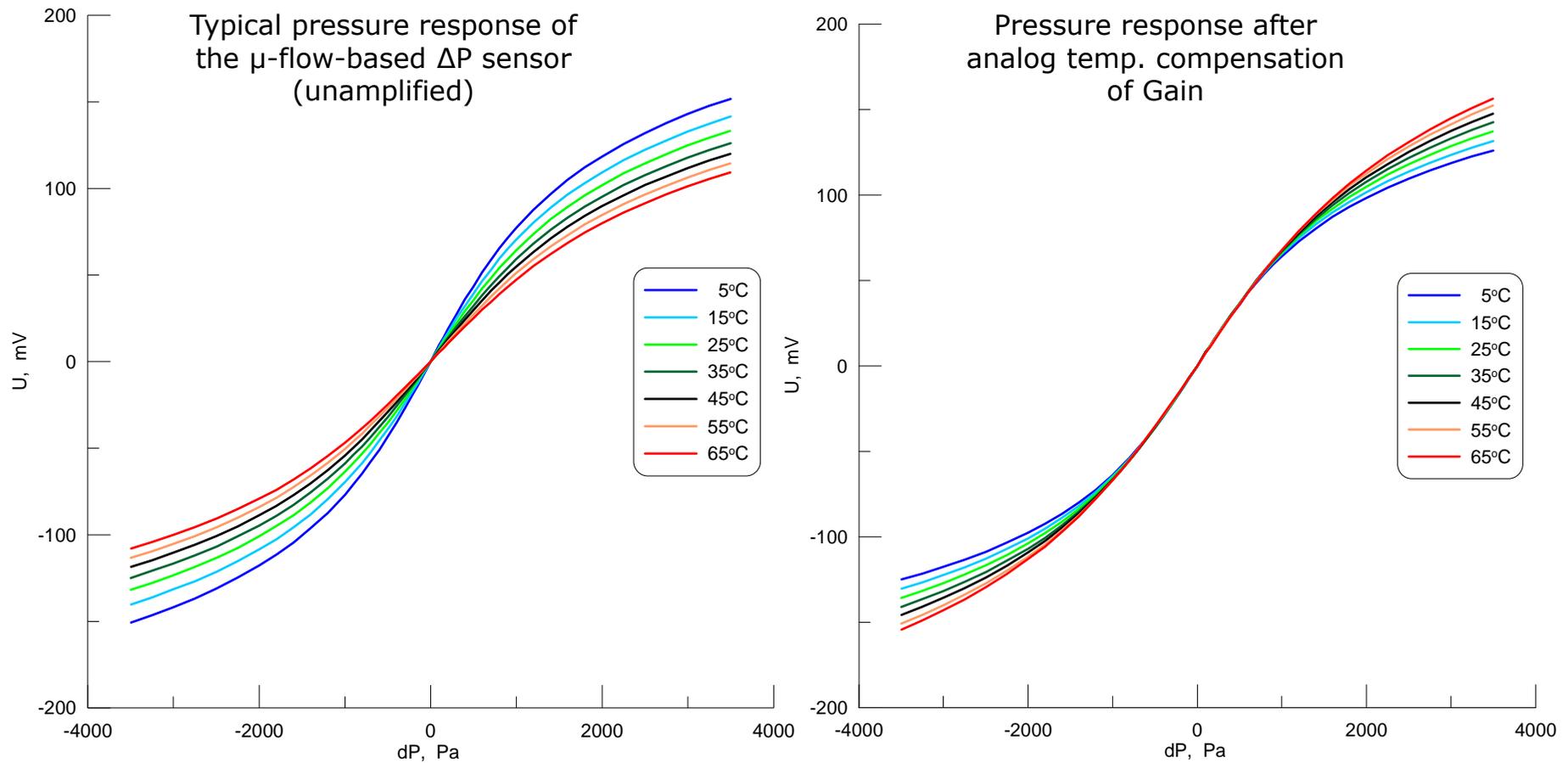
Result:

**Smallest package of any available
flow-based differential pressure sensor**



New μ -flow sensor

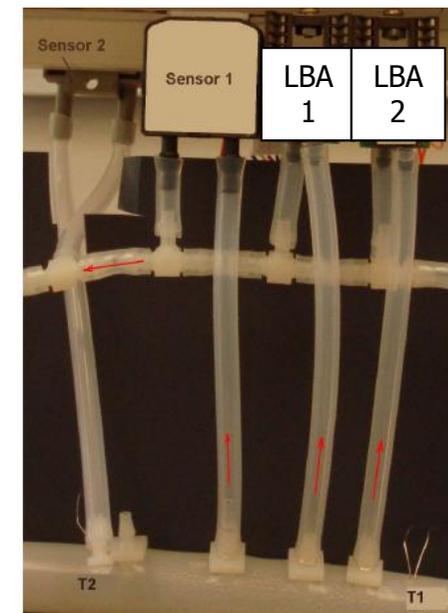
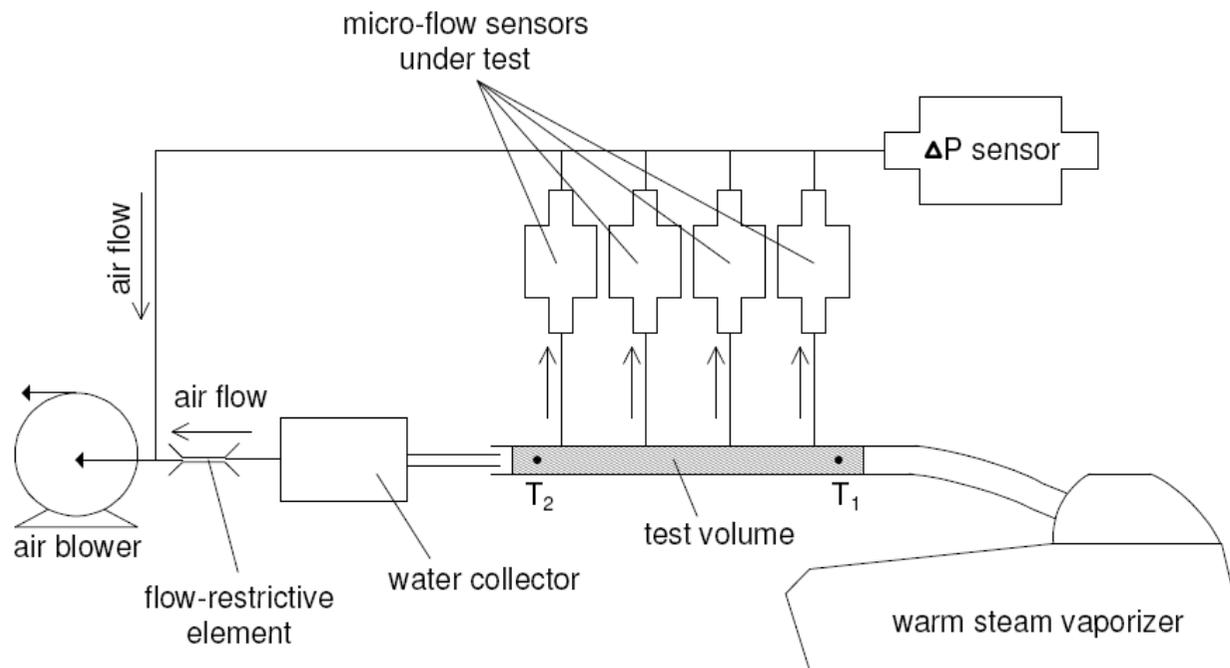
LBA – analog T Compensation of Sensitivity





New μ -flow sensor

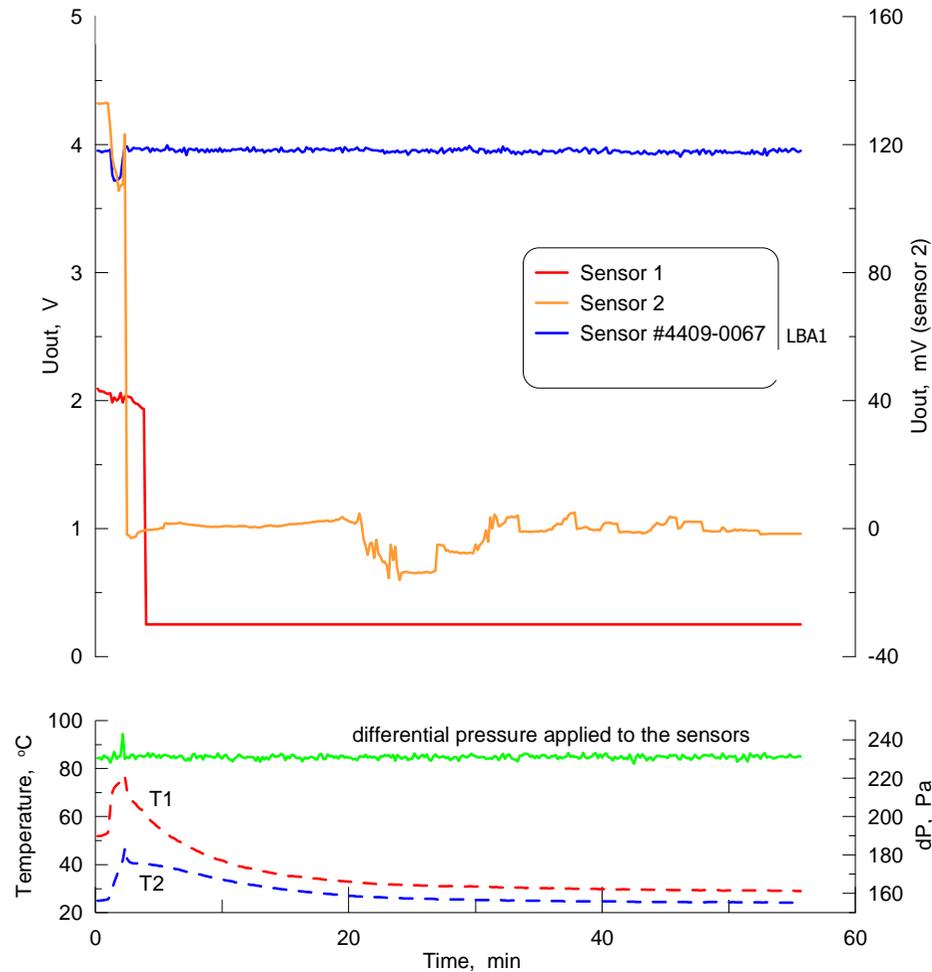
LBA - Insensitivity to humid Air





New μ -flow sensor

LBA – Insensitivity to humid Air

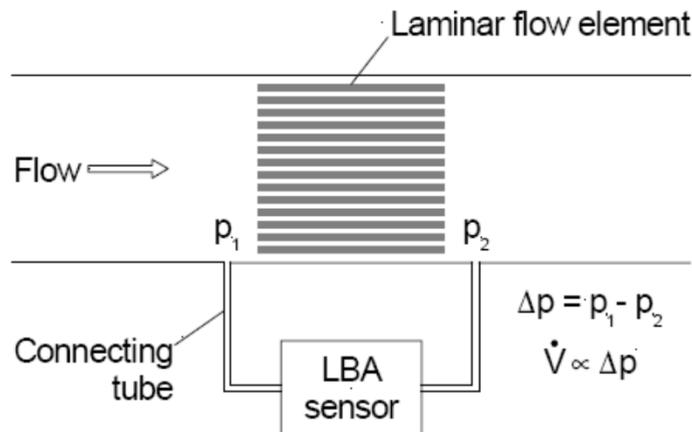


Sensor 1 and 2 with “classic” macroscopic flow channel

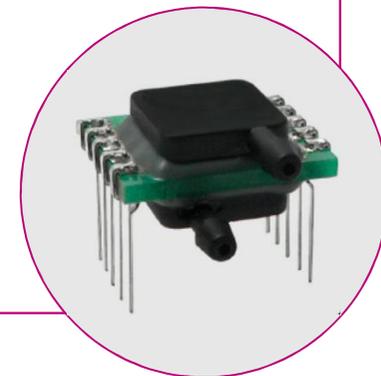


New μ -flow sensor

Integration according pressure range



- Extremely small flow through the sensor, therefore no impairment of main flow
- Immunity to both dust and humidity
→ very small and precise flow channels

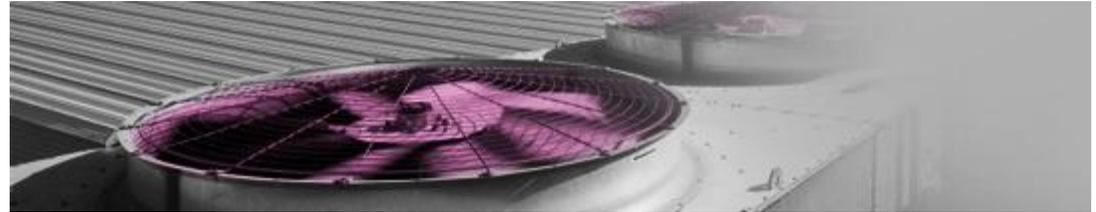




HVAC applications

Sensor requirements

- High sensitivity
- Short response time
- Insensitivity to dust contaminated air





Medical applications

Sensor requirements

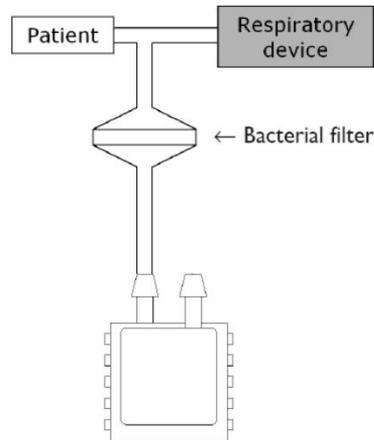


- Insensitivity to humid respiratory air
- High sensitivity, dynamic range
- Highest resolution in small flow range
- No interference with patient breathing through increase in resistance
- No contamination with infectious particles
- No position dependency (for mobile devices)
- Short response time



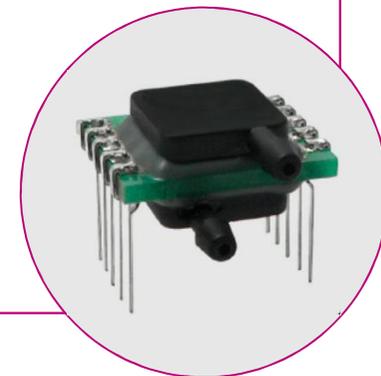
Medical applications

Integration of bacterial filter



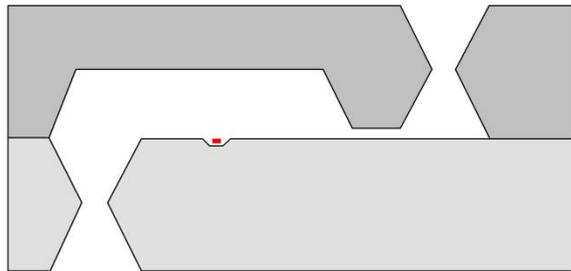
Bypass-flow dominated by μ -flow channel

- No loss in sensitivity in case different tube lengths/ diameters resp. filters are used
- No position sensitivity



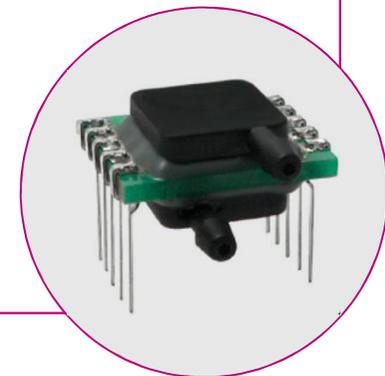


Summary



Flow channel integrated in MEMS-chip

- Extremely high pneumatic impedance, therefore nearly equivalent to piezoresistive ΔP -sensors
- Small package
- Extraordinary robustness
- Very high sensitivity through calorimetric measurement principle





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