

THERMAL AND FLOW CONTROL IN MEDICAL DEVICES

How to customize sensors for your application

Zuzana Pronayova

Innovative Sensor Technology IST AG

- Design & Manufacturing of sensor elements since 1991
- Competent support within easy reach: HQ in Switzerland + offices in Czech Rep., USA, China, India
- Technology Partner: Thin-Film & Thick-Film Sensor Technology
- Solution Provider: annually >150 new products and application specific customizations
- Highest Quality as standard: Corporate Quality Management with ISO, 5S, 6 σ , ESA qualified sensors
- Innovative partner with 1:4 ratio of Sales : R&D engineers



Applications in monitoring + control

Application Area:

Temperature:

Flow:

Patient
Treatment +
Comfort

Blood temperature - Dialysis, ECMO
Thermal stimulation
Wound treatment & spot heaters

Ventilators
Inhalators
Vacuum pumps
IV fluids

Patient
monitoring

Core body temperature
(thermal flux sensors)
Disposable patches, tubing,
catheters, etc.

Spirometry
Breathing cycle
monitoring

Analytical
Equipment

Thermal cycling / PCR analysis
Temperature compensation
Heating regulation

Gas supply / Switch
Coolant control





Thermal Control

1. Why get close & personal with your temperature sensors?

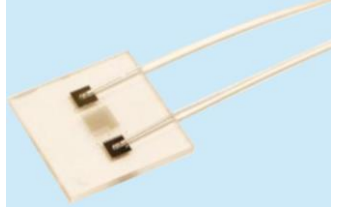
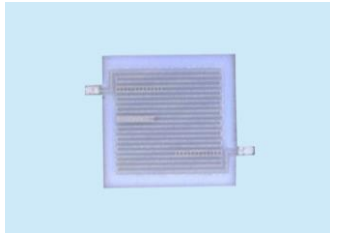
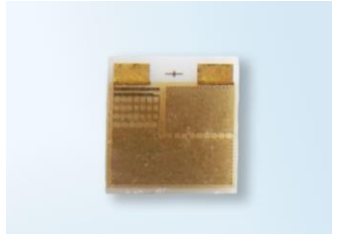
- New options to cluster and evaluate measuring signals
- New housing options
- 4S: Sensitivity, Selectivity, Stability, Speediness

2. When is it advantageous to use platinum RTD sensors?

- Need a low drift, fail-safe assembly with simple electronics
- Require a fast response time and / or high precision

3. How to assembly RTD for optimal thermal control?

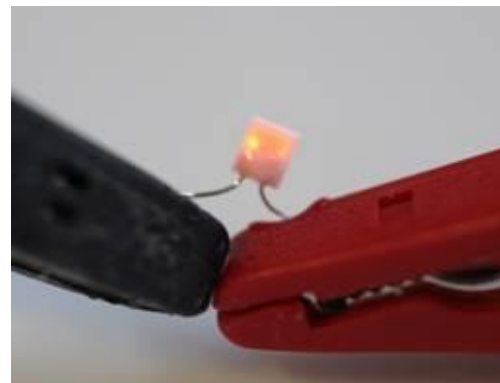
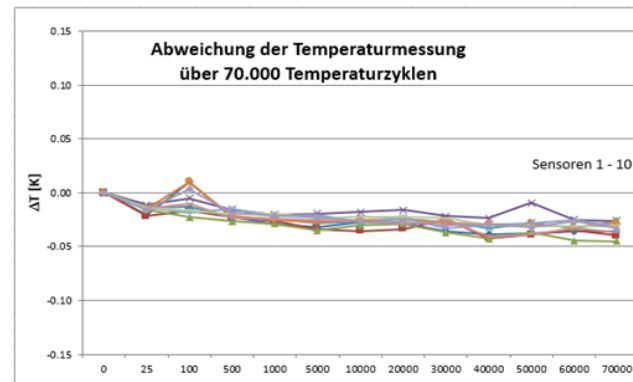
- Position - contact time & area
- Thermal mass
- New thermal conductive options – plastics, glues, additive manufacturing with metals





What can a platinum RTD do?

- Qualification of Hi-Rel RTDs for space application: 70'000 cycles between -200°C and 150°C, 1 minute cycles, no failures, minimal drift
- Passive sensor elements with MTBE > 50 years under standard working condition
- Heating applications with up to 1W at >500°C (e.g. sample preparation, skin application, gas sensors)
Picture: failure test at $P > 2.3\text{W}$ and $\sim 700^\circ\text{C}$





Platinum RTD to the extreme

Faster?

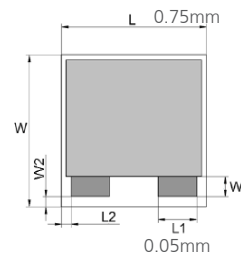
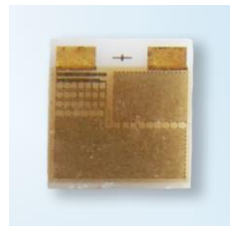
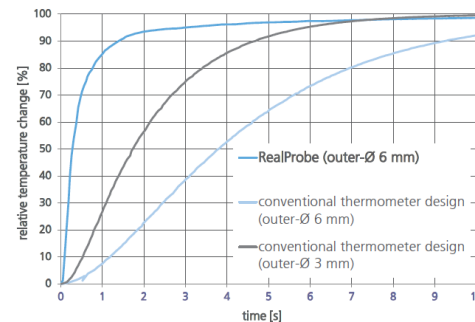
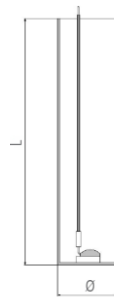
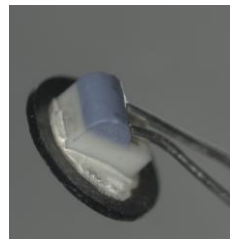
- RTD sensors soldered with metallized backside
- pre-assembled RealProbe

Smaller?

- BONDESENS = worldwide smallest Pt1000 < 1 mm²
- suitable for microelectronics, implants, microfluidic systems (incl. organ-on-chip)

More precise?

- Individual tolerance class definition in the application temperature range
- 37°C for body temperature
- 25-45°C for bodily fluids temperature control
- -80°C for ULT cryo-freezers and dataloggers





Flow monitoring and control

1. Where and why use thermal flow sensors?
2. What information can be extracted from flow sensors?
3. How to integrate a flow sensor into an assembly?



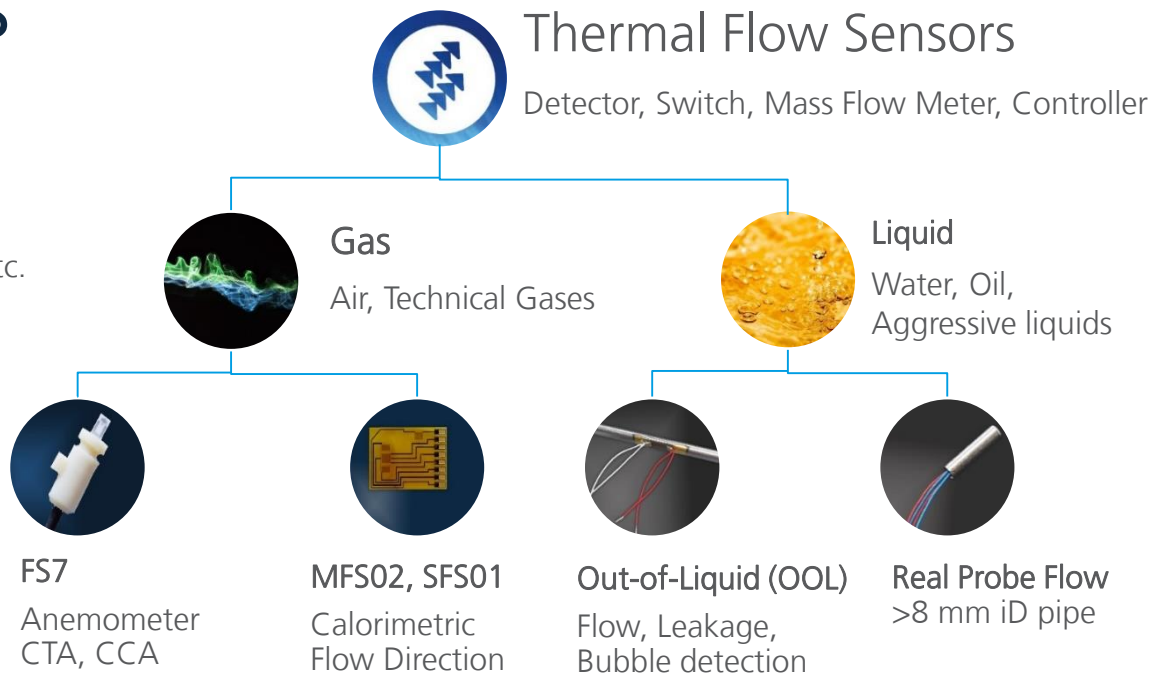
Flow sensors

WHERE?

- Ventilators
- Spirometry
- Fluids – IV, breast milk, blood, etc.

WHY?

- Require sensitivity especially at low flow rates
- Fast response time
- Need to detect flow direction
- Have only limited space for sensor & electronics
- Dosing or switching
- Bubble detection
- Need a fail-safe flow sensor

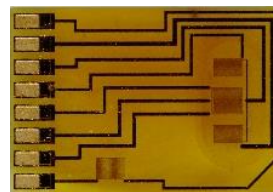
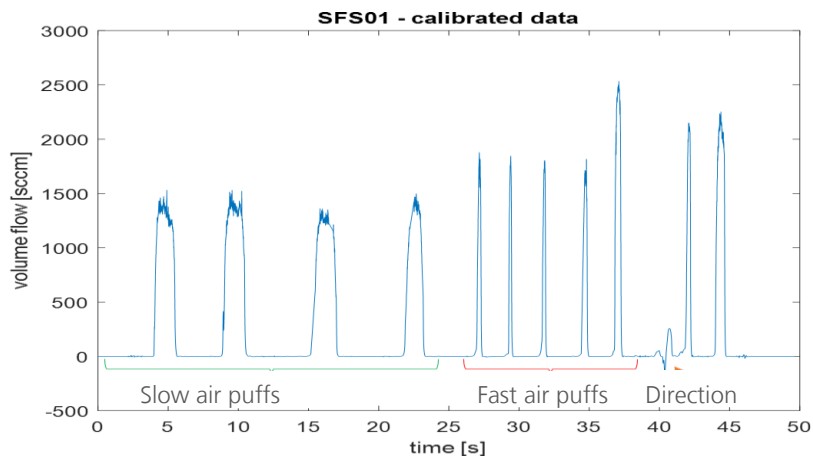




Calorimetric Flow sensors

WHAT for?

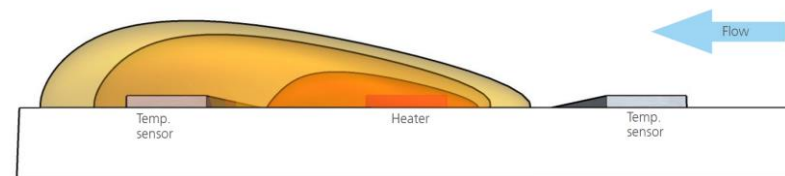
- Gas / Air Mass flow with extremely fast response time (<5ms)
- Direction detection at breathing rate
- Signal integration => Volume
- High accuracy at low flowrates (0-3.5m/s)



[MFS02](#)



[SFS01](#)



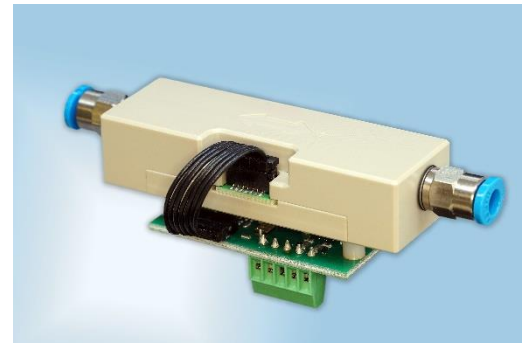
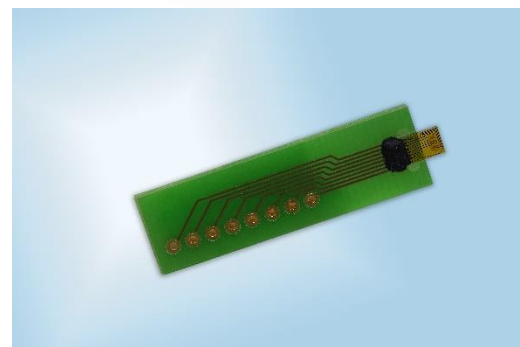
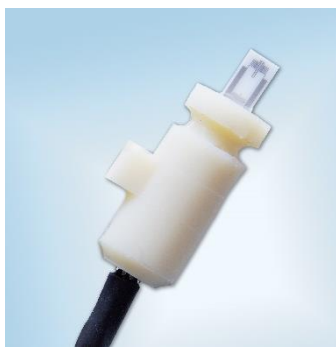
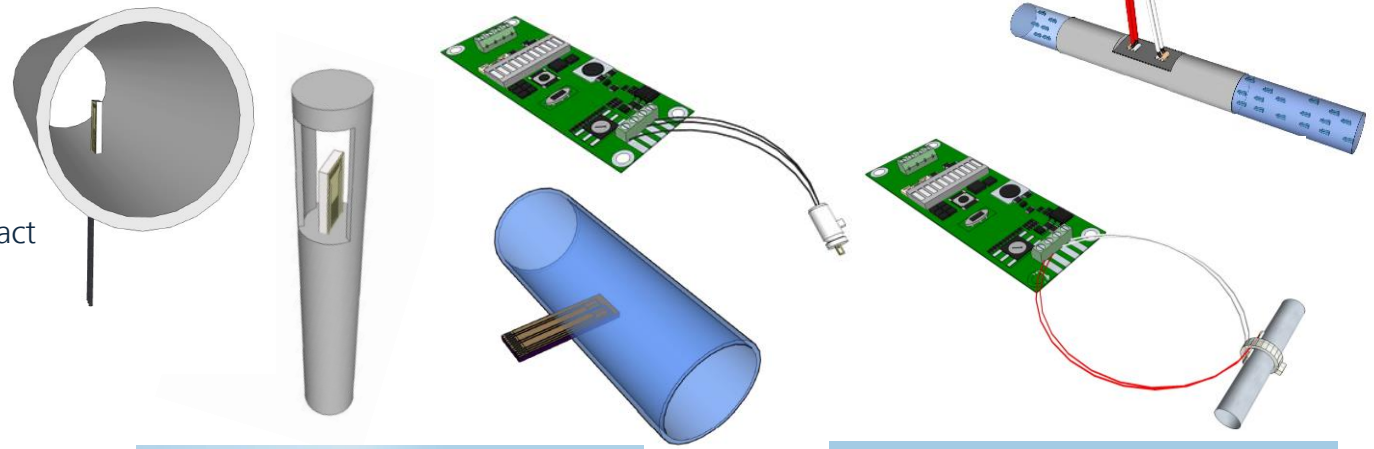


Assembly of thermal Flow sensors

Positioning

- Flow cell
- Open channel
- Without medium contact

Pre-assembly options:



THANK YOU! ANY QUESTIONS?

Want to learn more?

[Temperature Sensors](#)

[Flow Sensors](#)

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