Strip barrel staves integration

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Strip barrel staves integration

- Tests of stave cooling: new results*
- New pressure drop measurements*
- Flex PCB design
- Assembly tool for staves

* thanks to V. Fracassi, D. Grunwald, E. Rosenthal, S. Wolf

Stave cooling tests

Stave cooling tests

- Presented at PANDA meeting in March in Gießen

Summary

- First validation of stave cooling system: satisfactory results!
- Negligible heat transfer from the chips to the sensor
- The uniformity of the glue layer is crucial
- With maximum power, $T_{chip} < 35°C$ and $T_{sensor} < 25°C$
- CAVEAT: influence of room temperature not studied!
  → New tests with higher room temperature are required.

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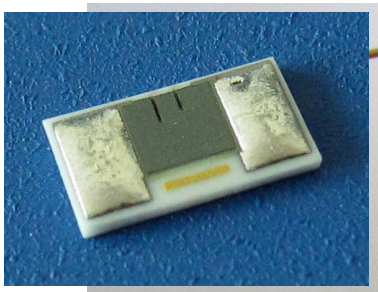
- New test with setup enclosed in a polystyrene box with temperature sensors and heating plate (June and Sept. 2015)

Test stave

Dummy-chip resistors:

- Area 7.15 × 4 mm^2
- Active area 3 × 3 mm^2
- Nominal power 256 mW (max. 600 mW)
- High power density: 2.8 W/cm^2

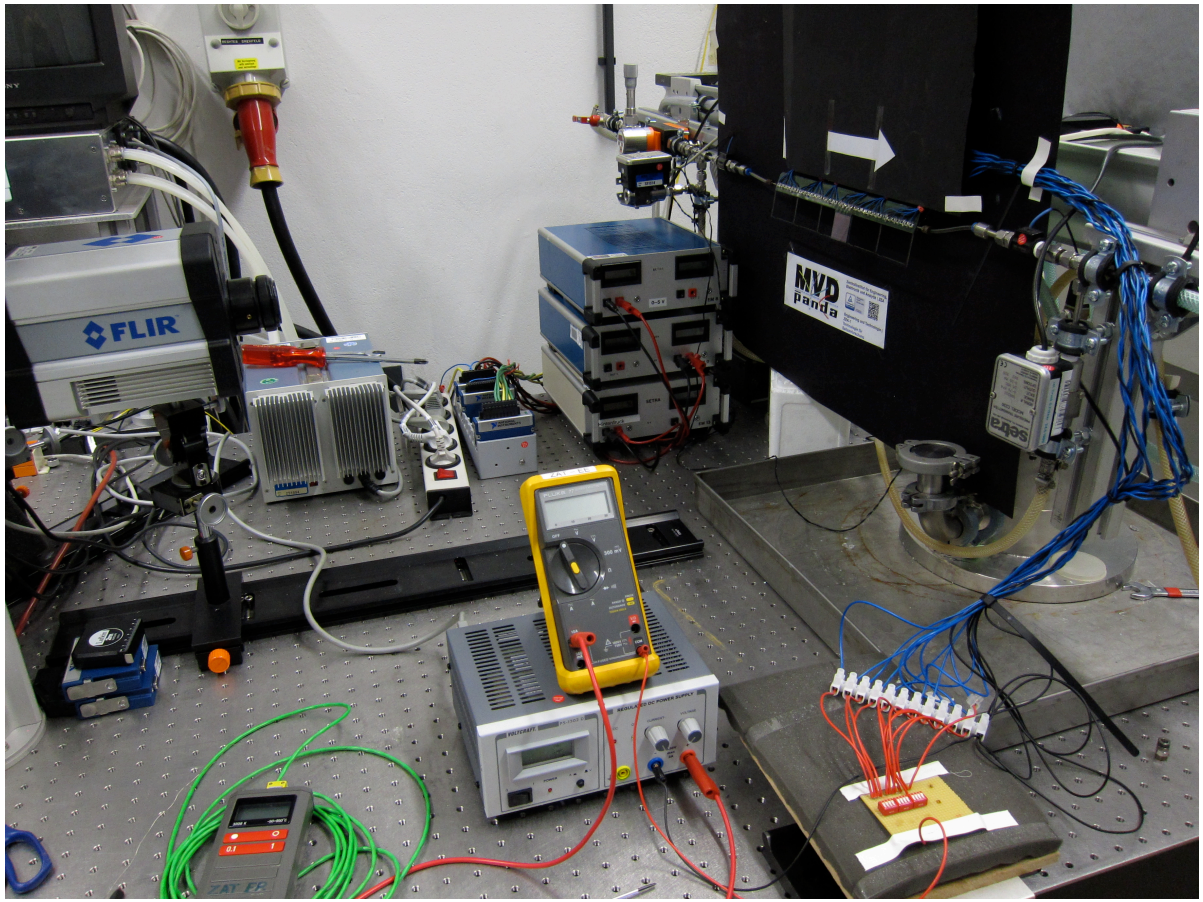


Lack (15 µm)
Copper (12 µm)
A-2003ED Glue-PI-Glue (50 µm)
Copper (12 µm)
Lack (15 µm)

Flex PCB (Kapton-copper)

Square PANDA sensor

Stave cooling test system



FLIR SC6000

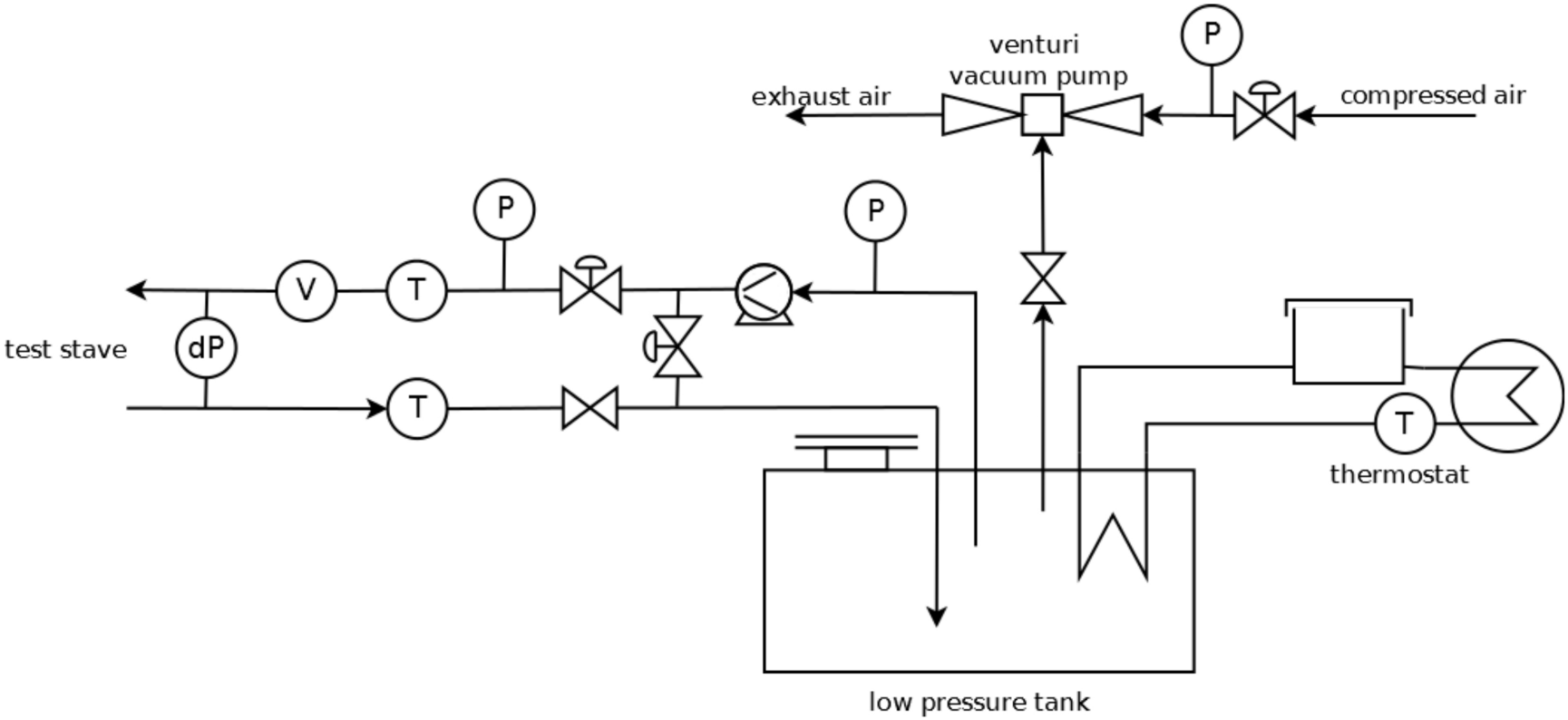
- Spectral range 8 – 9.2 µm
- Resolution 640 × 512 pixel
- Frame rate 1 – 125 Hz

Available Measurements:

- Inlet and outlet water temperature
- Closed, underpressure water cooling circuit
- Water temperature control
- Volume flow
- Pressure

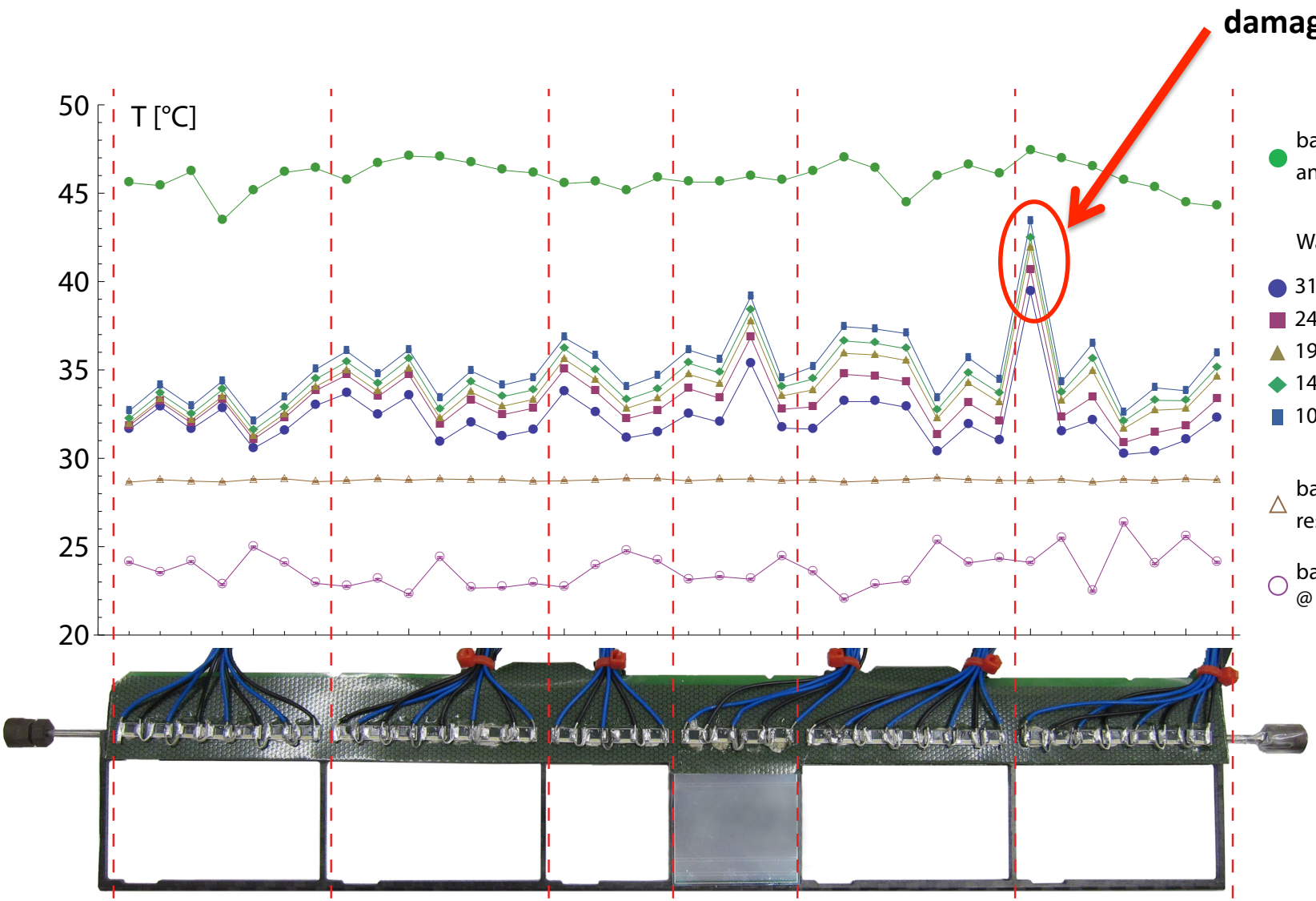
Cooling tests – Setup

Setup for cooling and pressure drop tests



Cooling tests – Stave profile

Temperature profile with heating at nominal power (16.9 W); cooling water @ 20°C, different fluxes. Room temperature 28.5 °C



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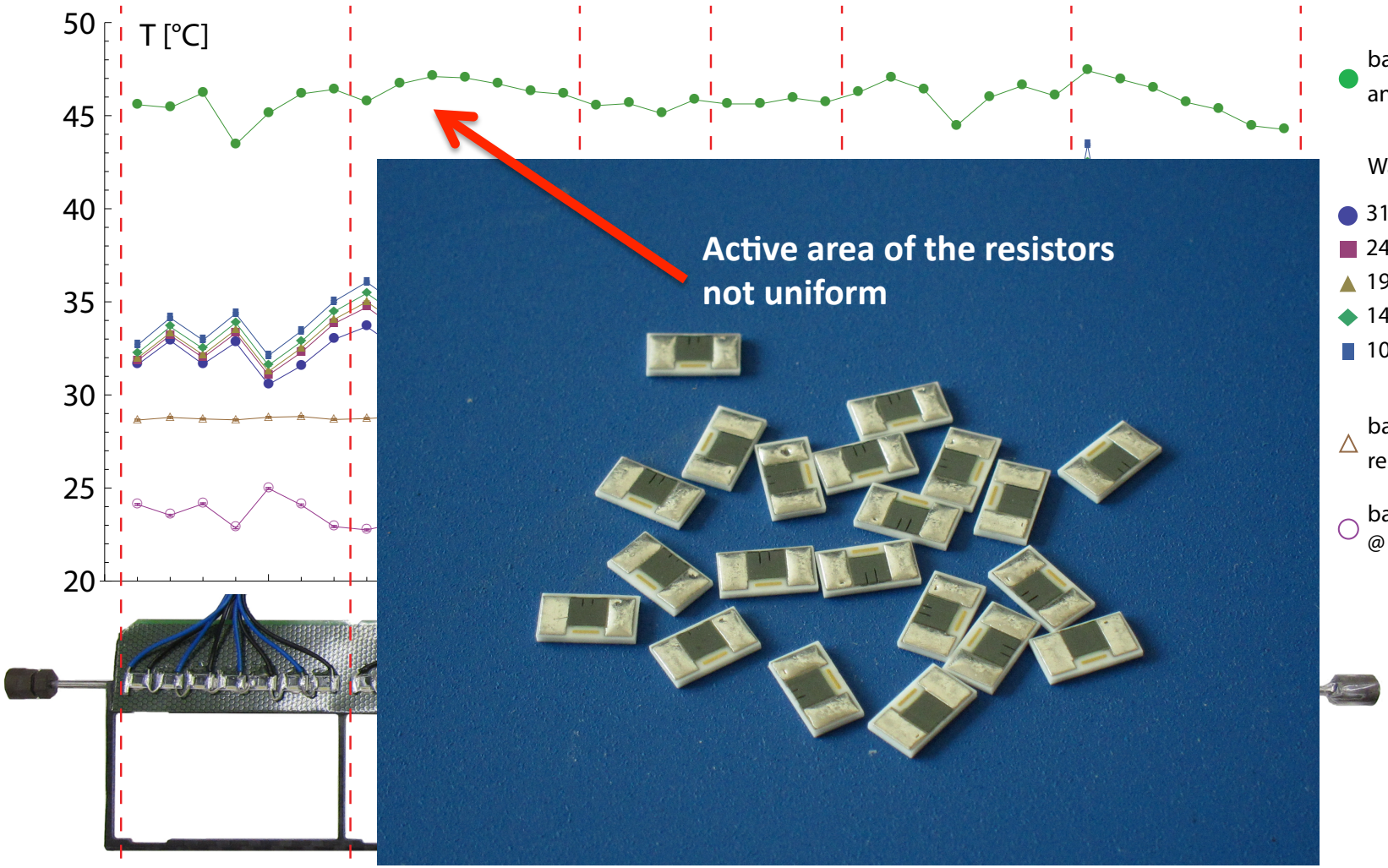
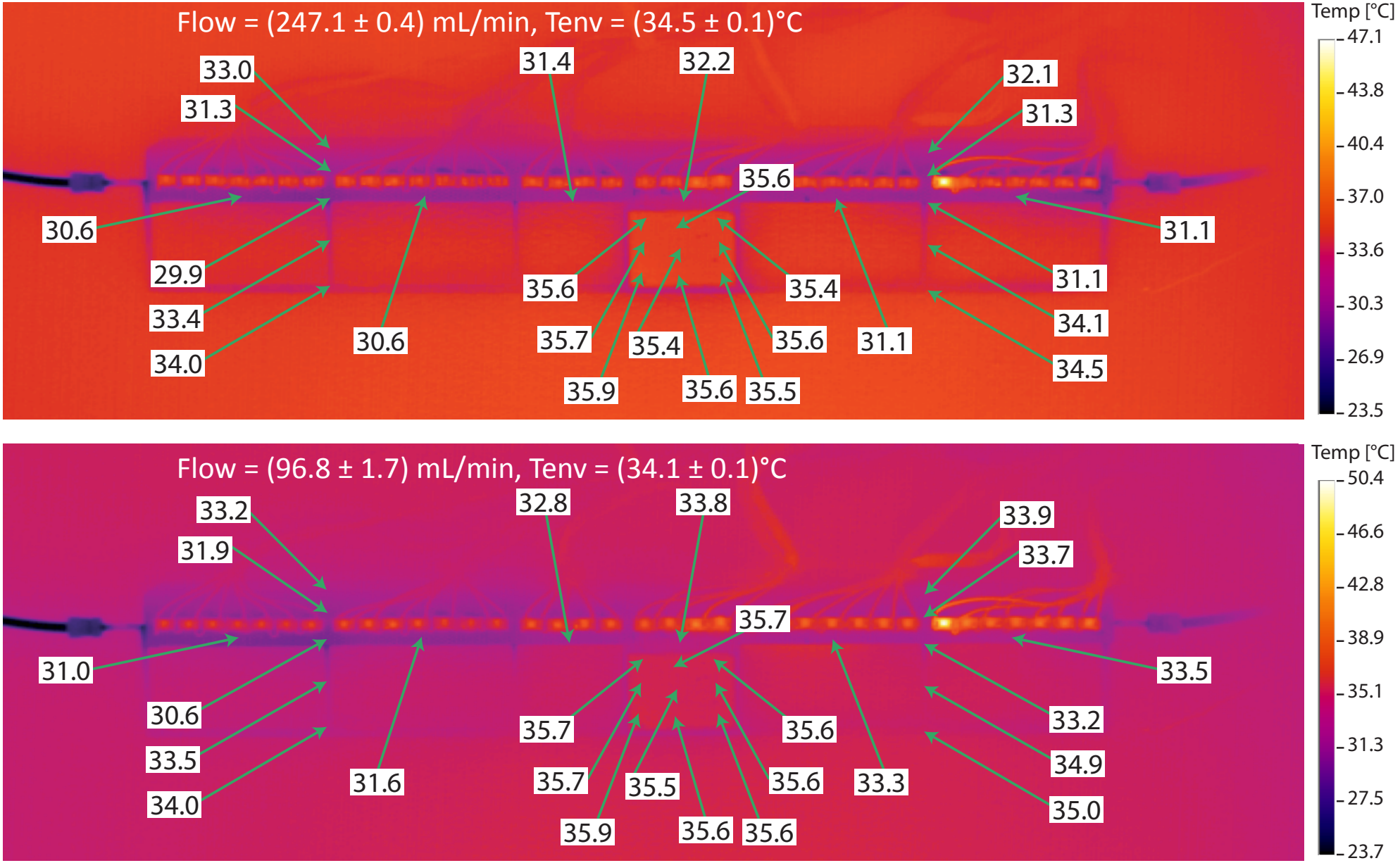
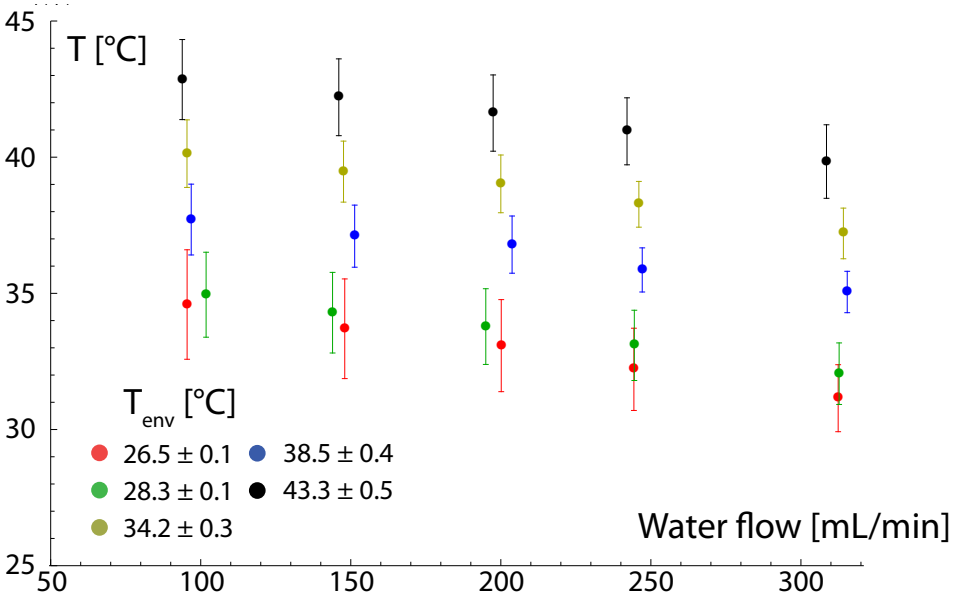


Cooling tests – Measurement points

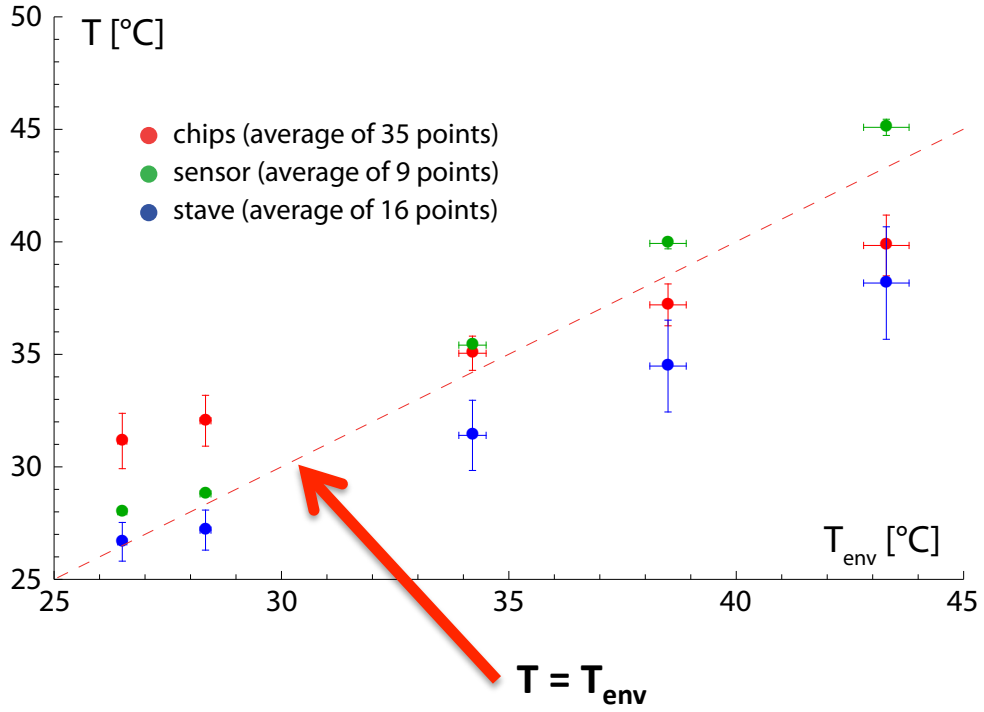


Cooling tests – Environment temperature

Average temperature of 35 front-side resistors for different flows and environment temperature

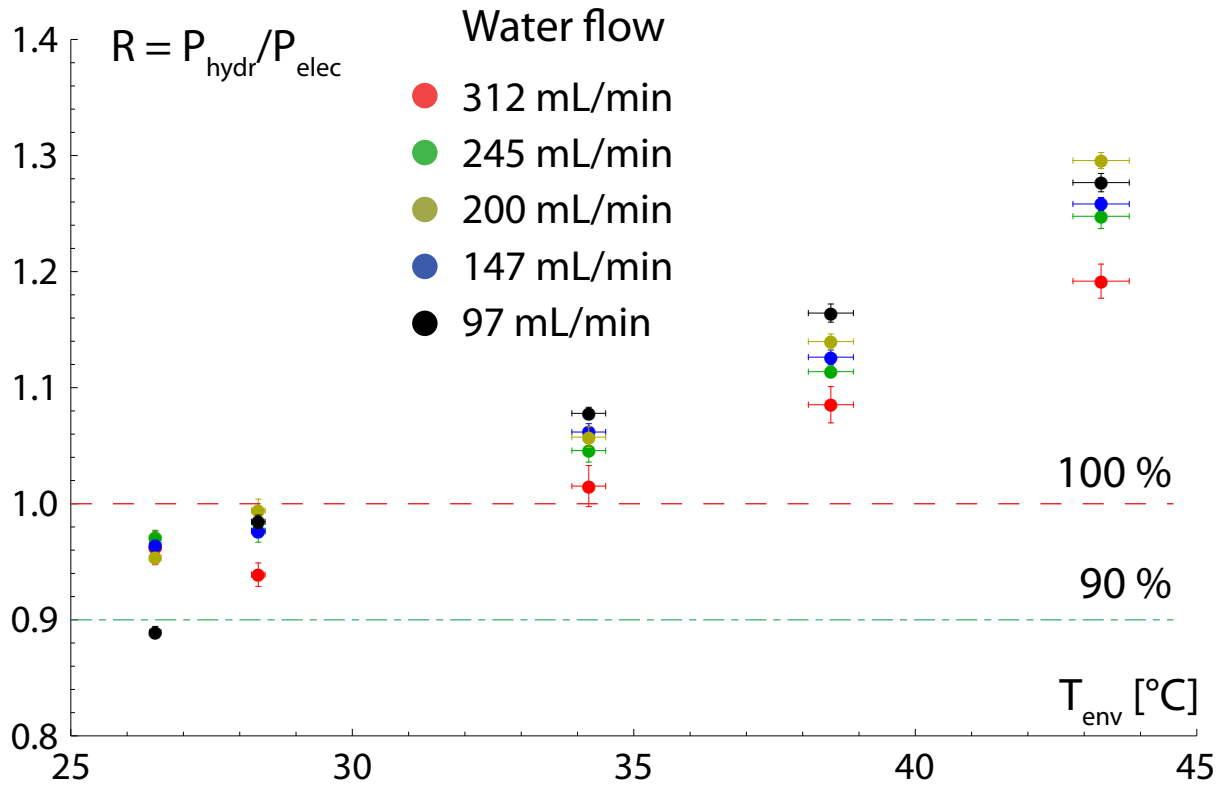


Average temperature of the resistors, of the stave and of the sensor @315 mL/min



Cooling tests – Efficiency

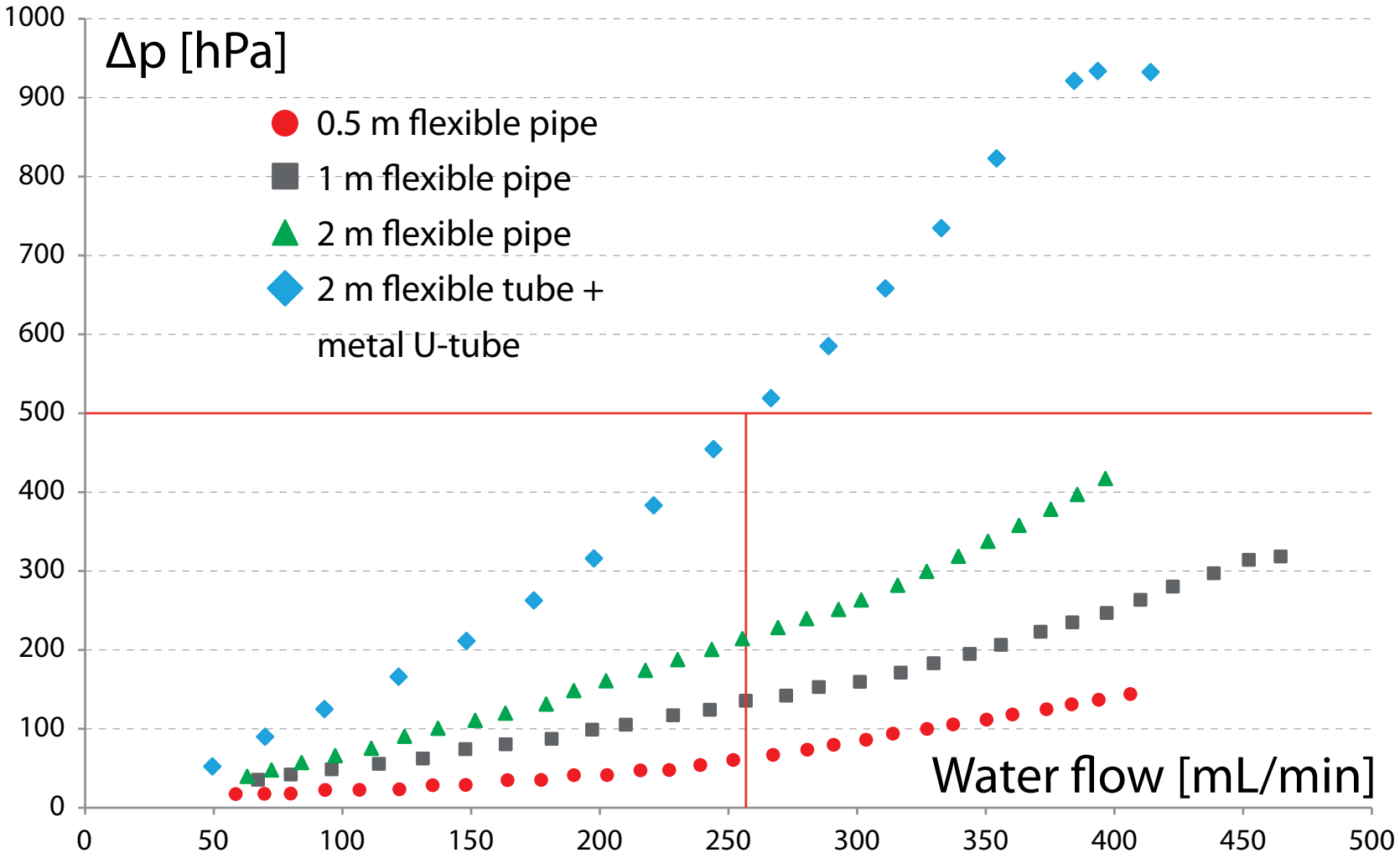
Ratio between power removed through the cooling water and electrical power provided in input



Pressure drop tests

Pressure drop measurements

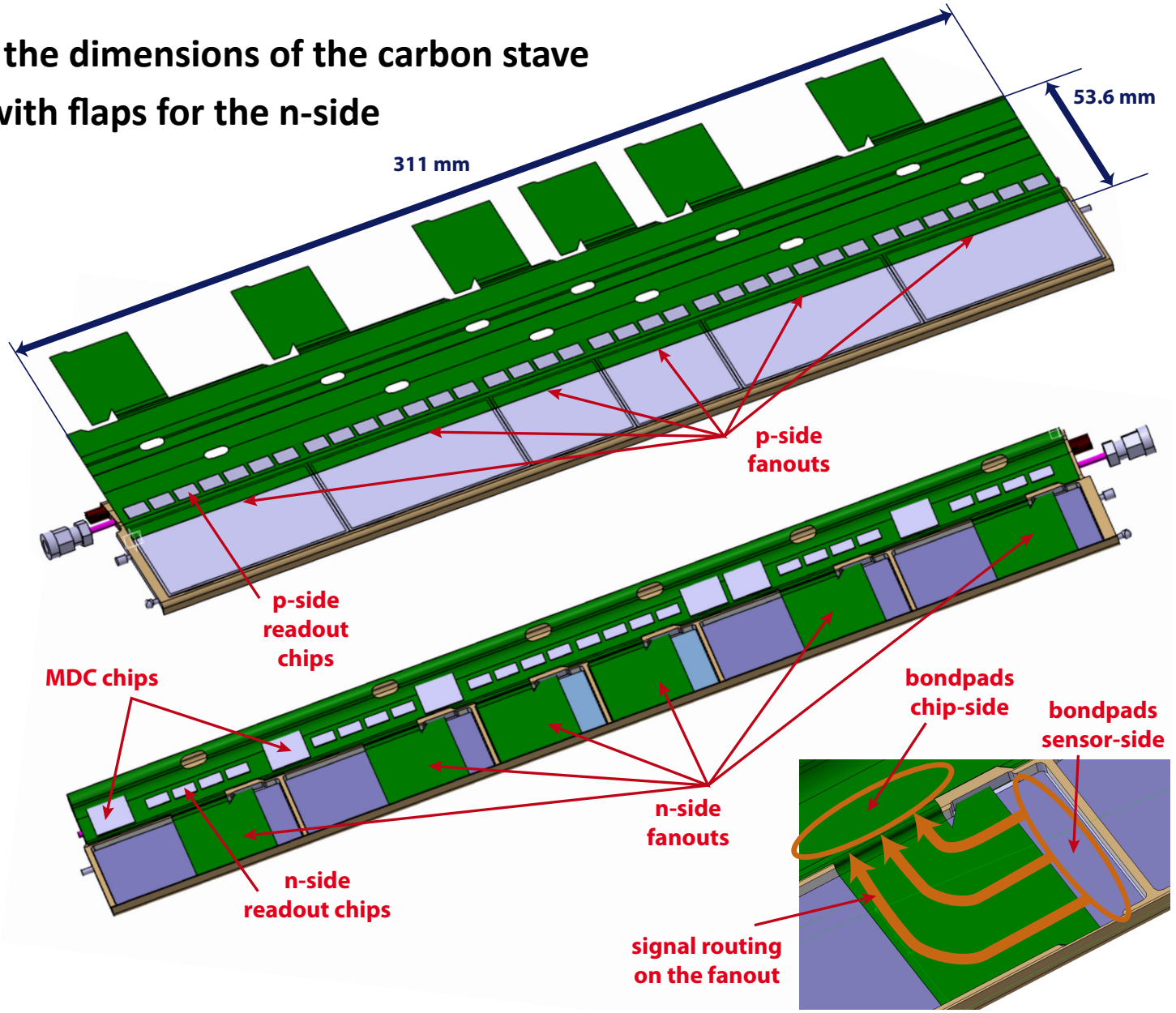
- **@300 mL/min: total drop 620 hPa, 2m flex tube 260 hPa → U-tube alone 360 hPa**
- **To have a drop below 500 hPa, flow must be < 250 mL/min**



Flex PCB Design

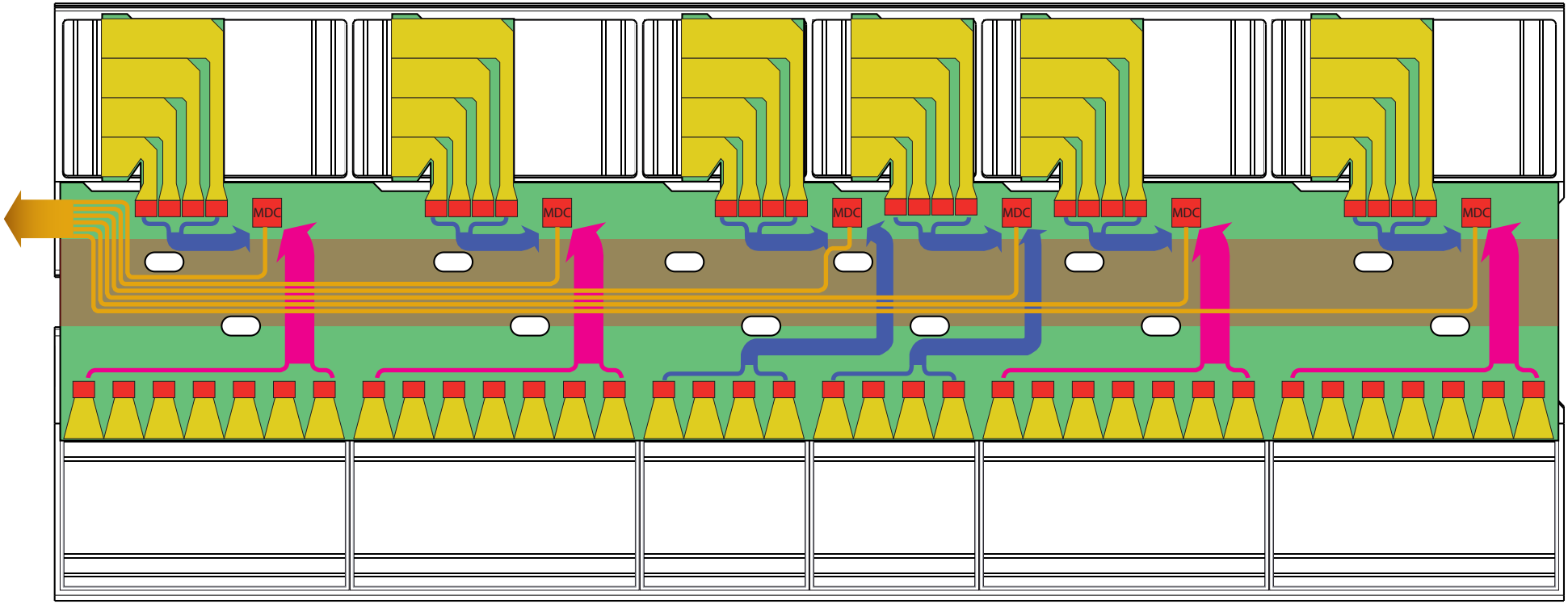
Flex PCB Design

- **Design driven by the dimensions of the carbon stave**
- **Foldable layout with flaps for the n-side**



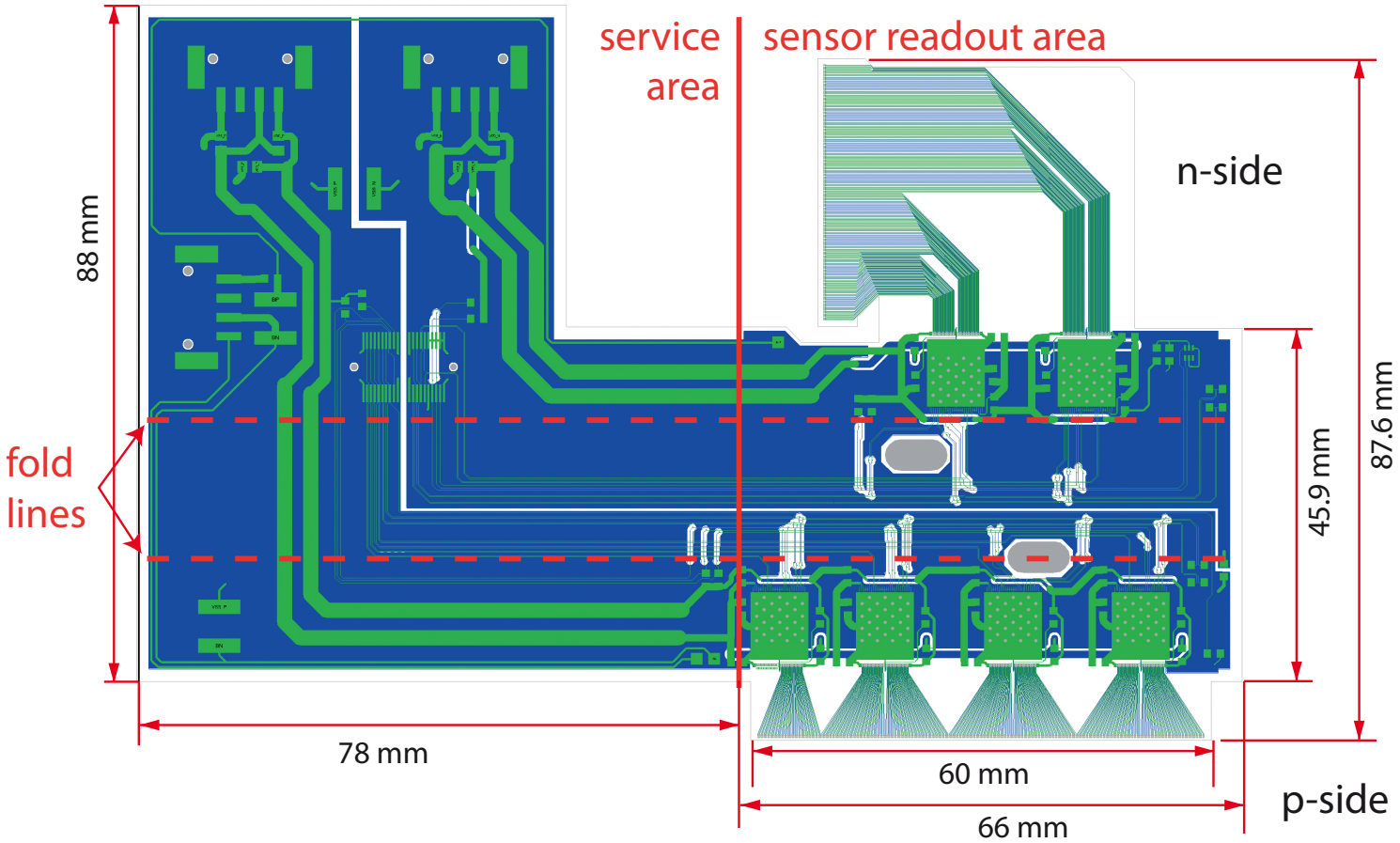
Flex PCB Design

- **Layout of the board strongly constrained by the large number of chips**
- **Maximum two layers allowed**
- **Powering provided through the holes from the cable duct**



Flex PCB Design

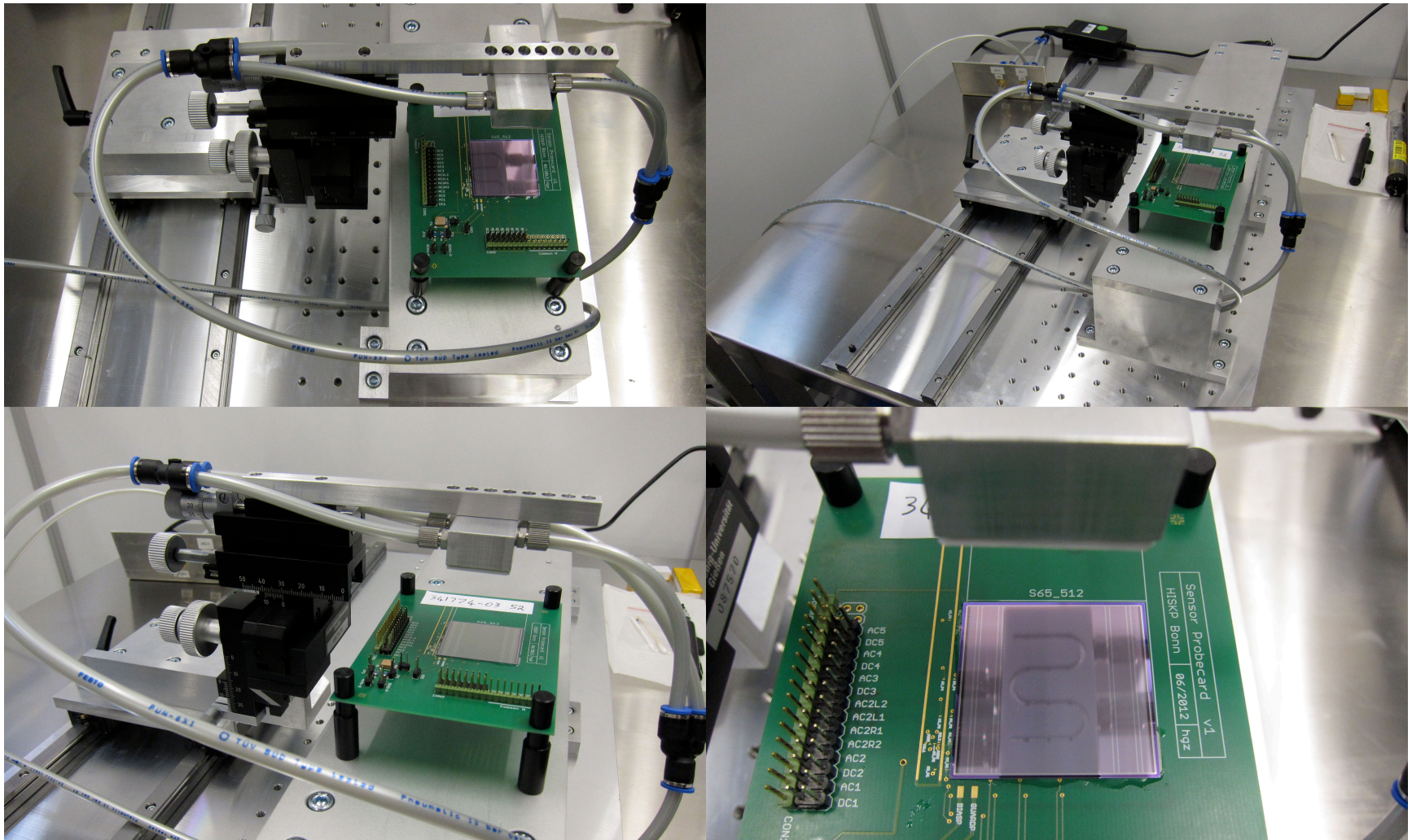
- **New design for a flex PCB prototype:**
  - **One sensor and all relevant electronics, but…**
  - **APV instead of PASTA (more channels, more I/O lines…)**
  - **Powering provided from external connector (cable duct not used)**
  - **Service area for signal and power breakout**

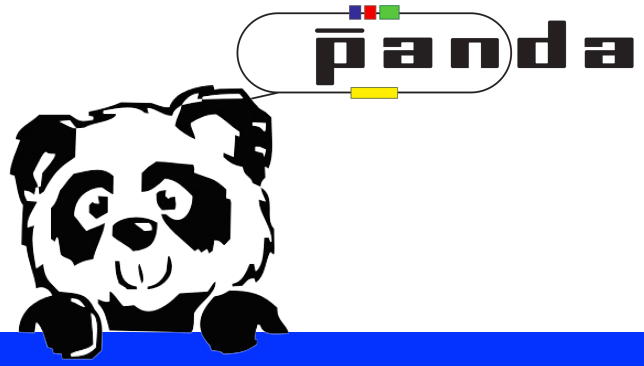


Manual stave assembly tool

Manual stave assembly tool

- **3-axis manipulator mounted on rails**
- **Modular stave/board holder**
- **Vacuum operated sensor holder**





Thank you for your attention!