SWTEST ASIA 2022

# High wattage dissipation under temperature – a new method for test evaluation


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ERS electronic GmbH

Hsinchu, Taiwan, October 26-28, 2022

# Outline

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  - New generation liquid chucks
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- **Results**
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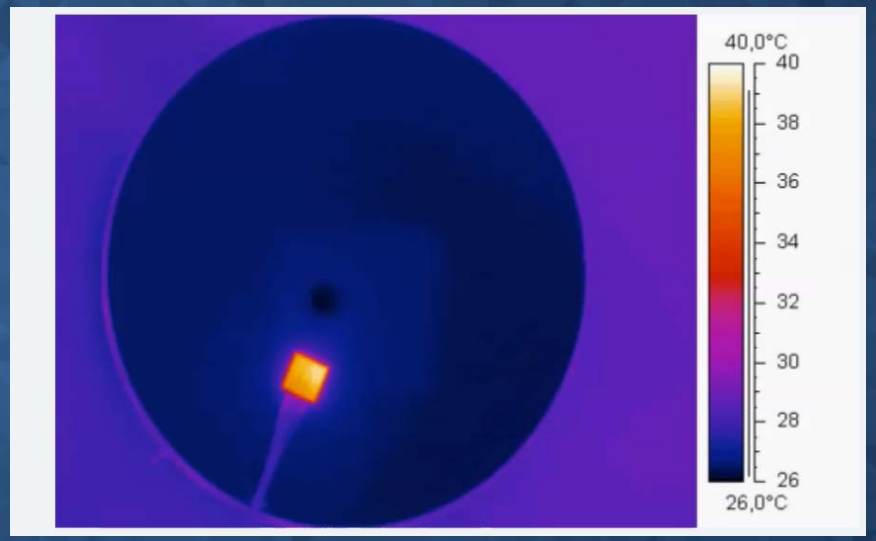
  - Concept of integrated power jig inside ProbeSense™

# Background

- **High thermal load applied to wafer during probing**
  - Thermal load is not applied uniformly to wafer
- **Applications include**
  - Photonics testing/Laser Burn-in Process (wafer level)
  - Memory chips/DRAM
  - CPU/GPU test
- **Device characterization**
  - Chuck system should be able to absorb high thermal load and maintain temperature
  - Multi-sensor monitoring to map chuck response to wafer
- **Simulate behavior of DUT beforehand**



# Objectives

- Characterize the thermal impact of the different test scenarios
- Develop a thermal chuck system for wafer probing suitable to these scenarios
- Find a path to reliably predict the behaviour of a specific test scenario on-site

# Concept

- **Using a thermal test device with a temperature sensor to simulate thermal load**
  - Benefit to test the chuck system before the wafer is tested
  - Better understanding of performance
- **ERS presented a temperature calibration solution at SWTest San Diego:**
  - **“Automated calibration: Tackling the challenge of temperature accuracy and uniformity measurements in wafer probing”**
- **Adapting the ProbeSense™ for power measurements**

# ProbeSense™ Re-introduction

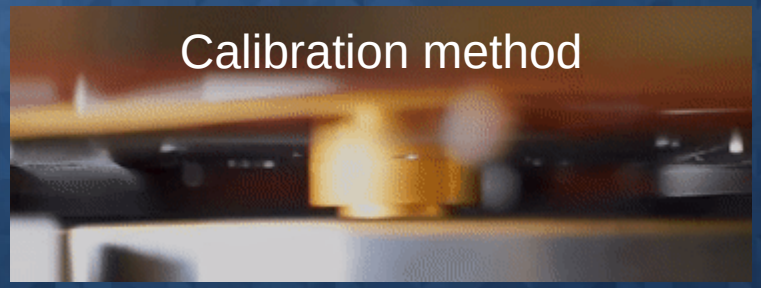
- **ProbeSense™ is a chuck temperature calibration tool that addresses challenges of a traditional wafer-based calibration**
  - Automation to reduce measurement uncertainty
  - Uses a single calibrated sensor
  - Increased temperature range (-65°C to +300°C)
  - Dynamic temperature uniformity measurement in wafer probing

ERS chuck system

+

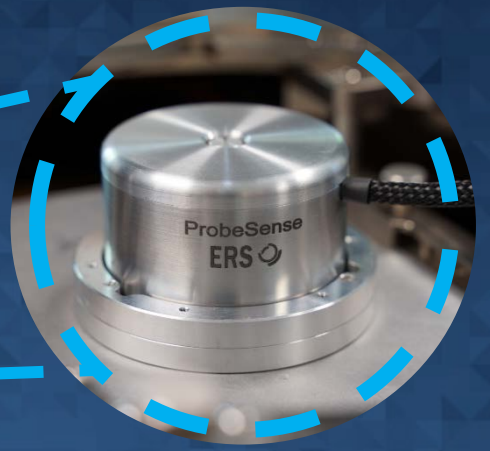
Calibration tool

+



# ProbeSense™ Set-up

PT100 Readout

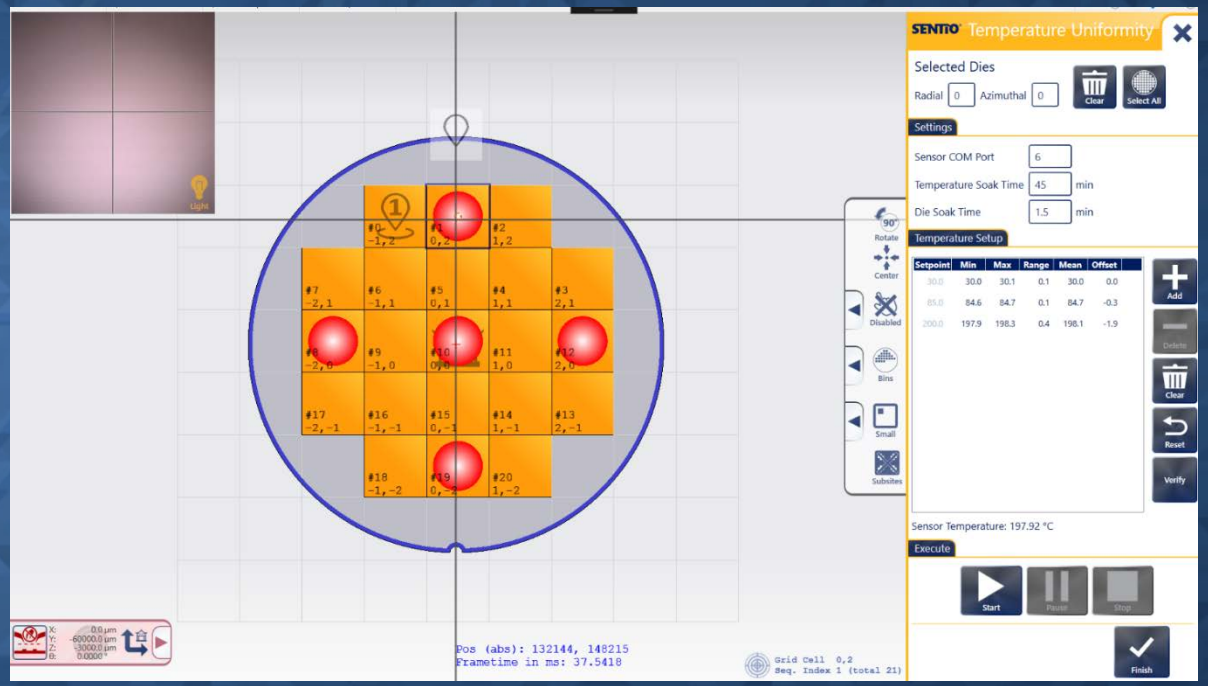


Software tool on laptop

Prober image provided by MPI Corporation

# ProbeSense™ Automation

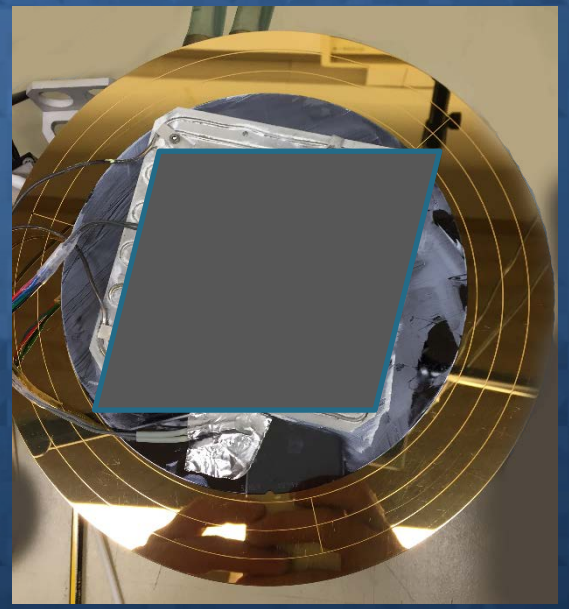
- No special operator skill required
- Automated software
- Measurement points can be defined
- Compatible with different prober types and chuck systems




Screenshot provided by MPI Corporation

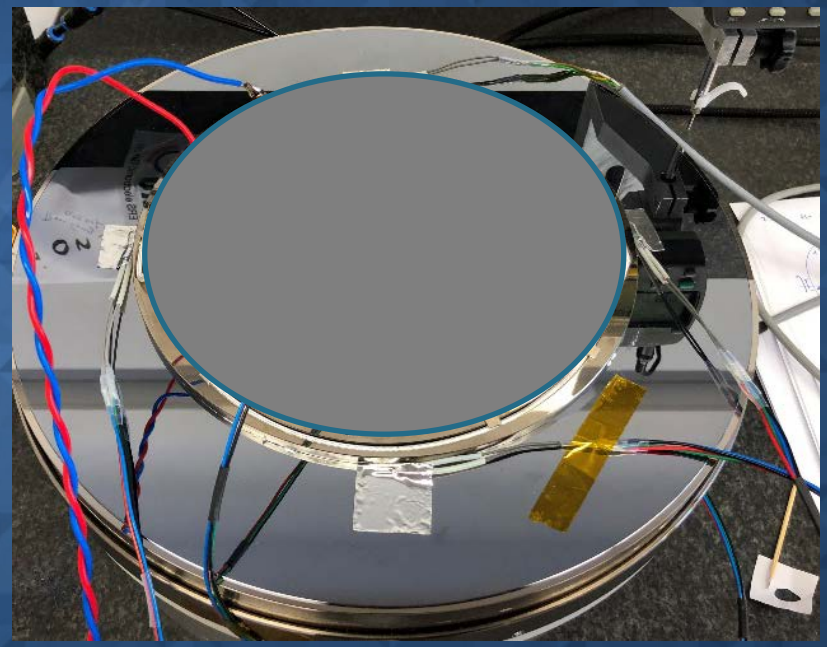
# Power Measurements

- **Using a power device to simulate the behavior of the chuck under different loads**
  - Simulates the performance of the chuck under high thermal load
- **Small power device vs. large power device**



# New Generation Liquid Chucks

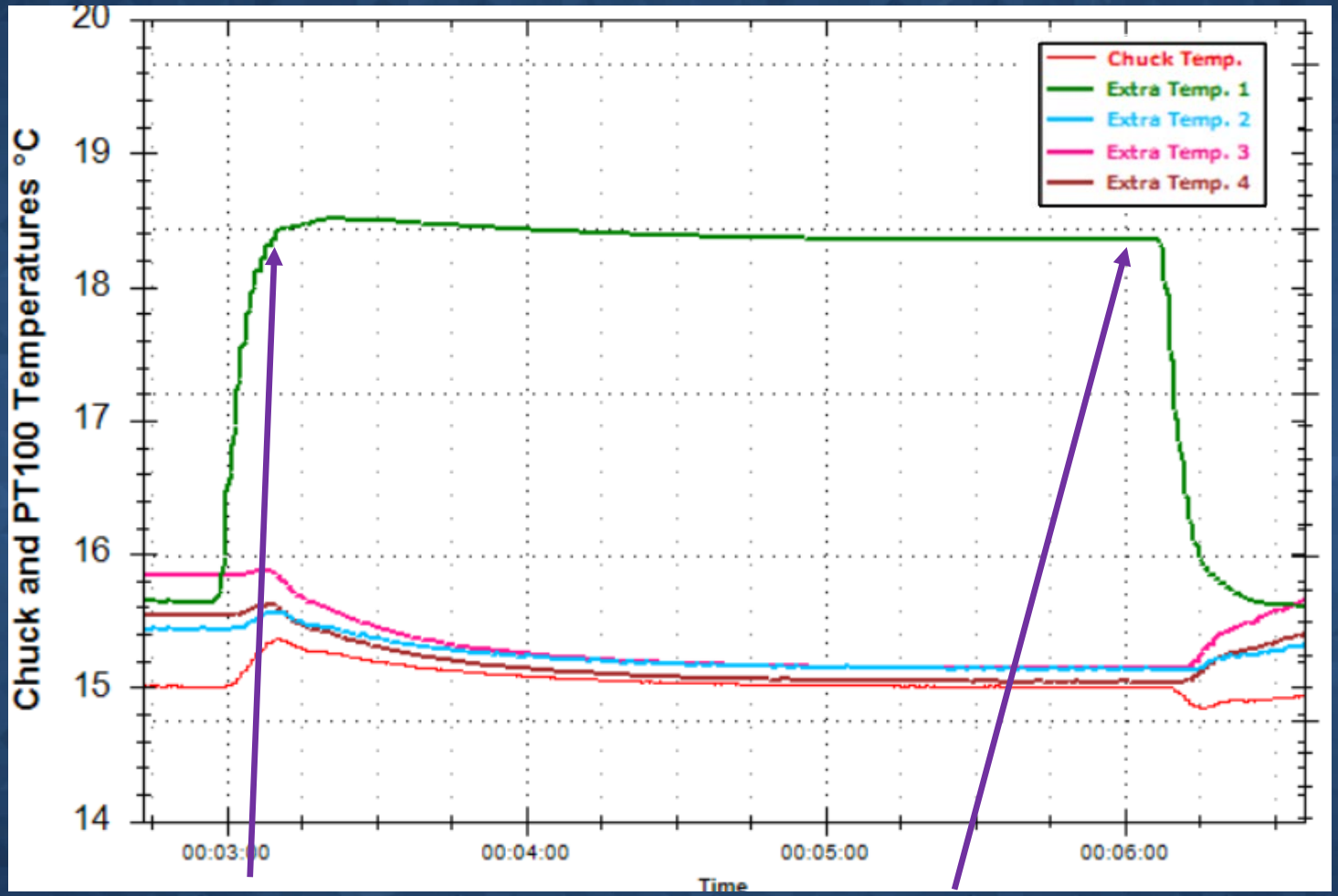
- Power measurements were done on ERS liquid chucks
- ERS liquid chucks are optimized for better heat dissipation
- Equipped with multiple sensors for zonal monitoring
- 2500W at -40°C dissipation capability



# Power Dissipation Data

Small device vs. large device

# Small Device: Position 1 at 15°C

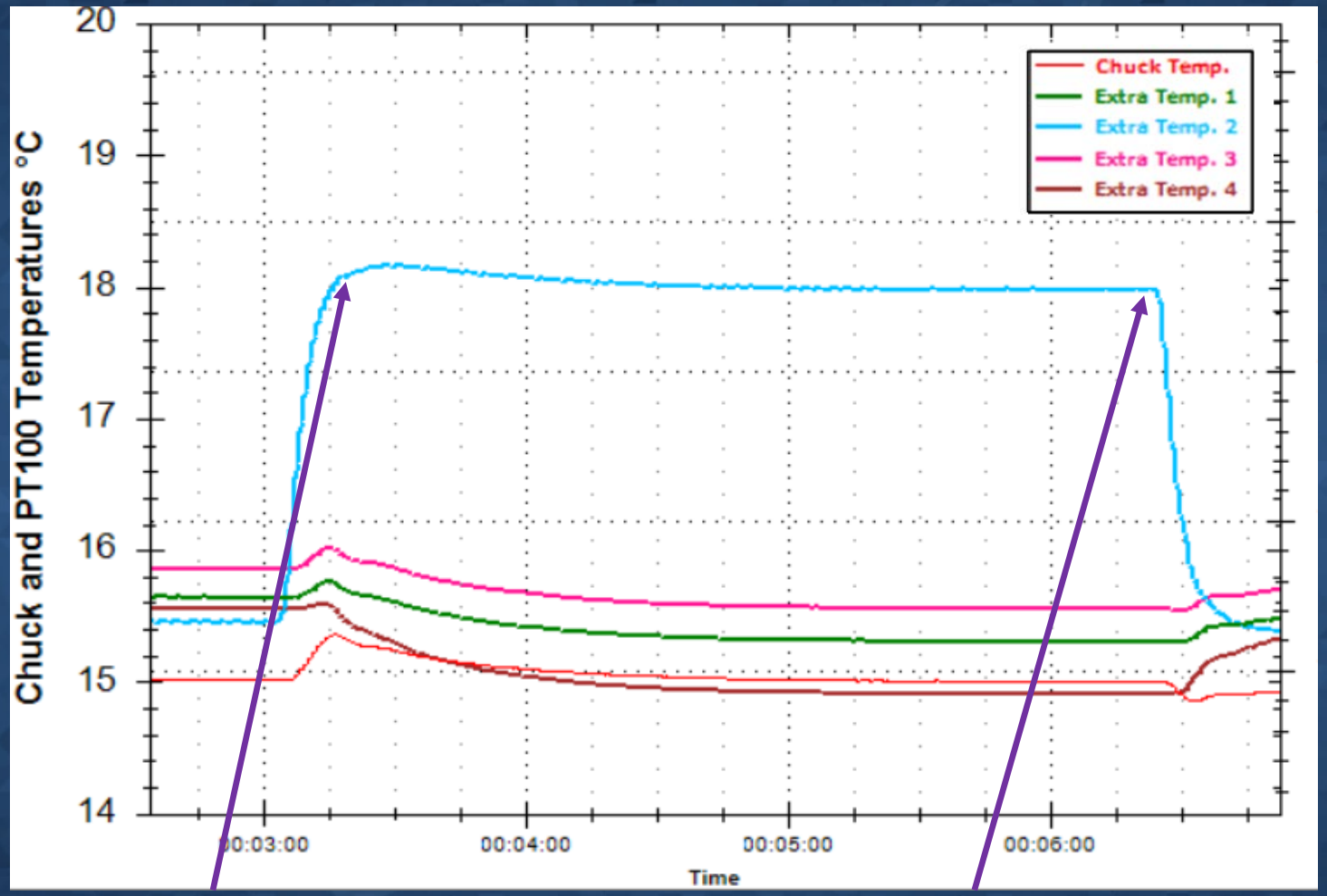



Load applied

Load removed

Load Power: 120W

# Small Device: Position 2 at 15°C

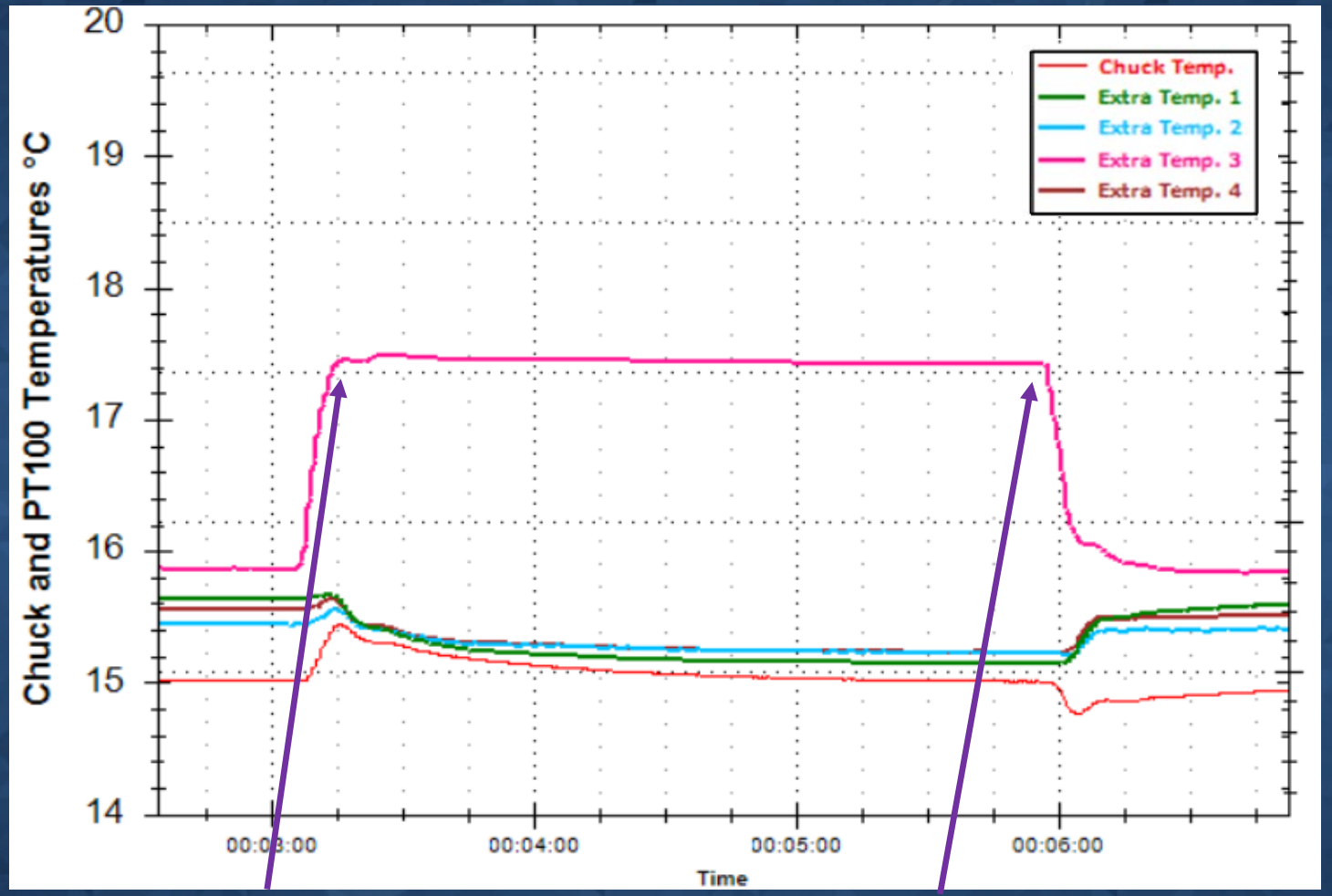



Load applied

Load removed

Load Power: 120W

# Small Device: Position 3 at 15°C

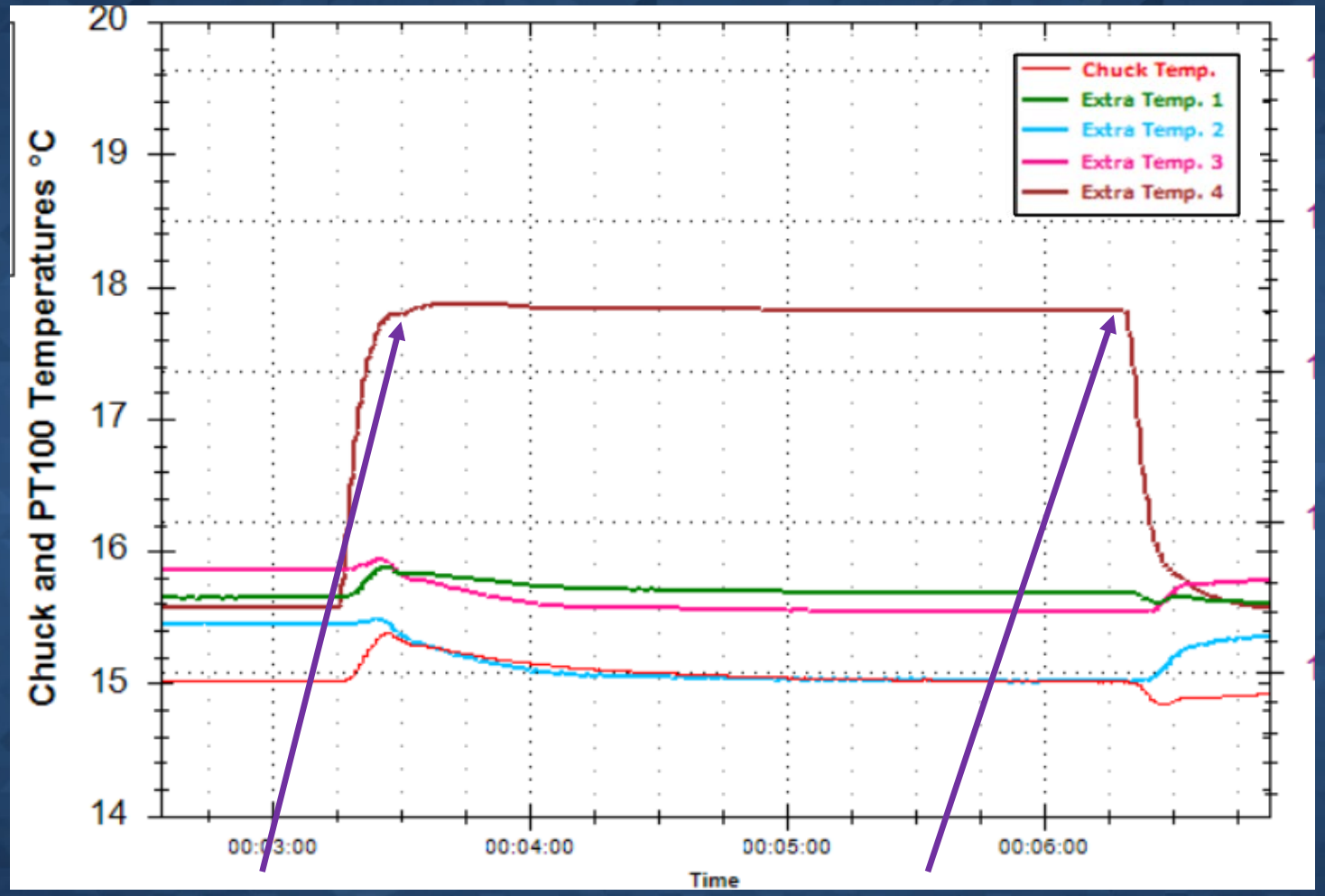



Load applied

Load removed

Load Power: 120W

# Small Device: Position 4 at 15°C

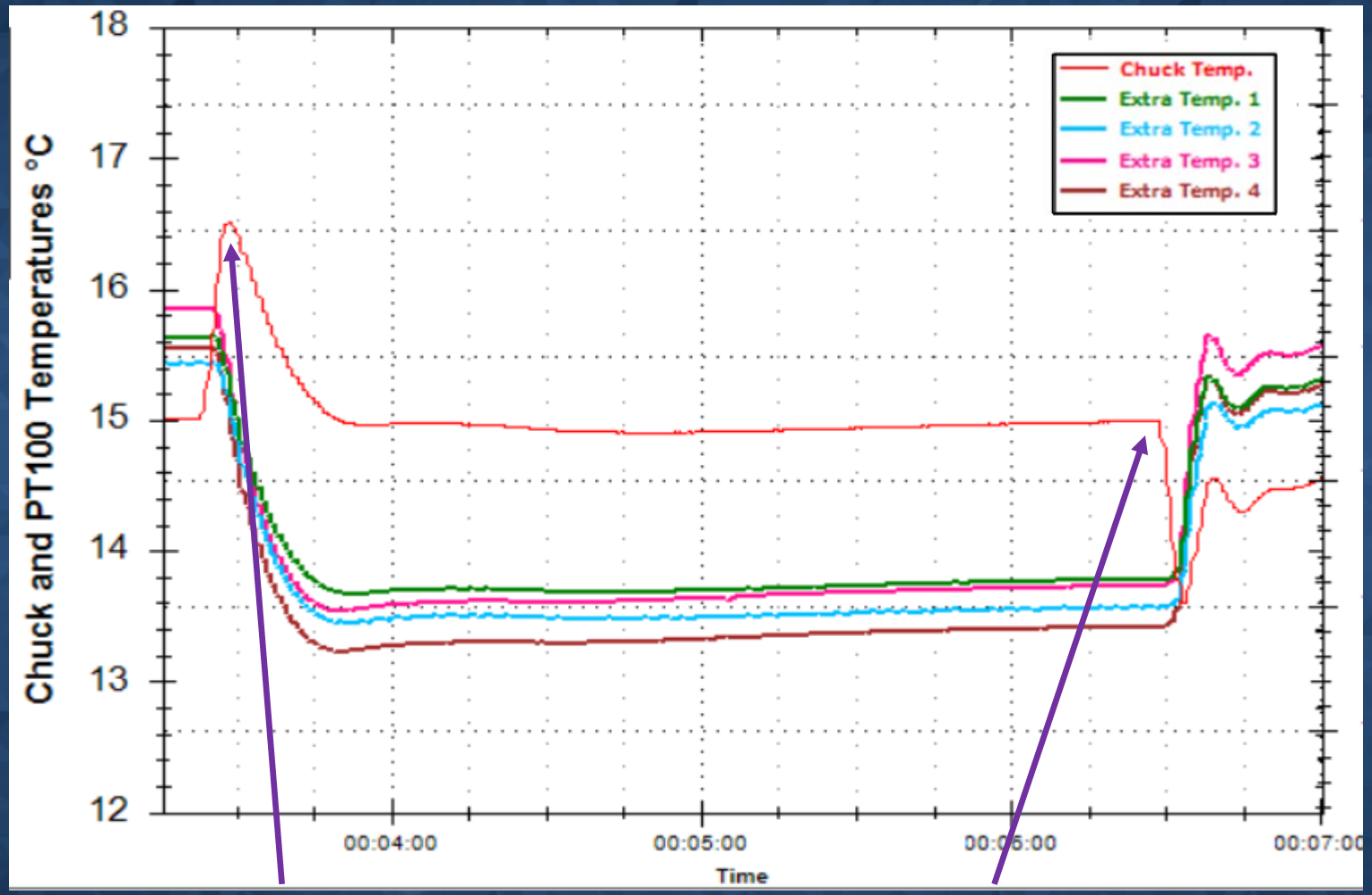



Load applied

Load removed

Load Power: 120W

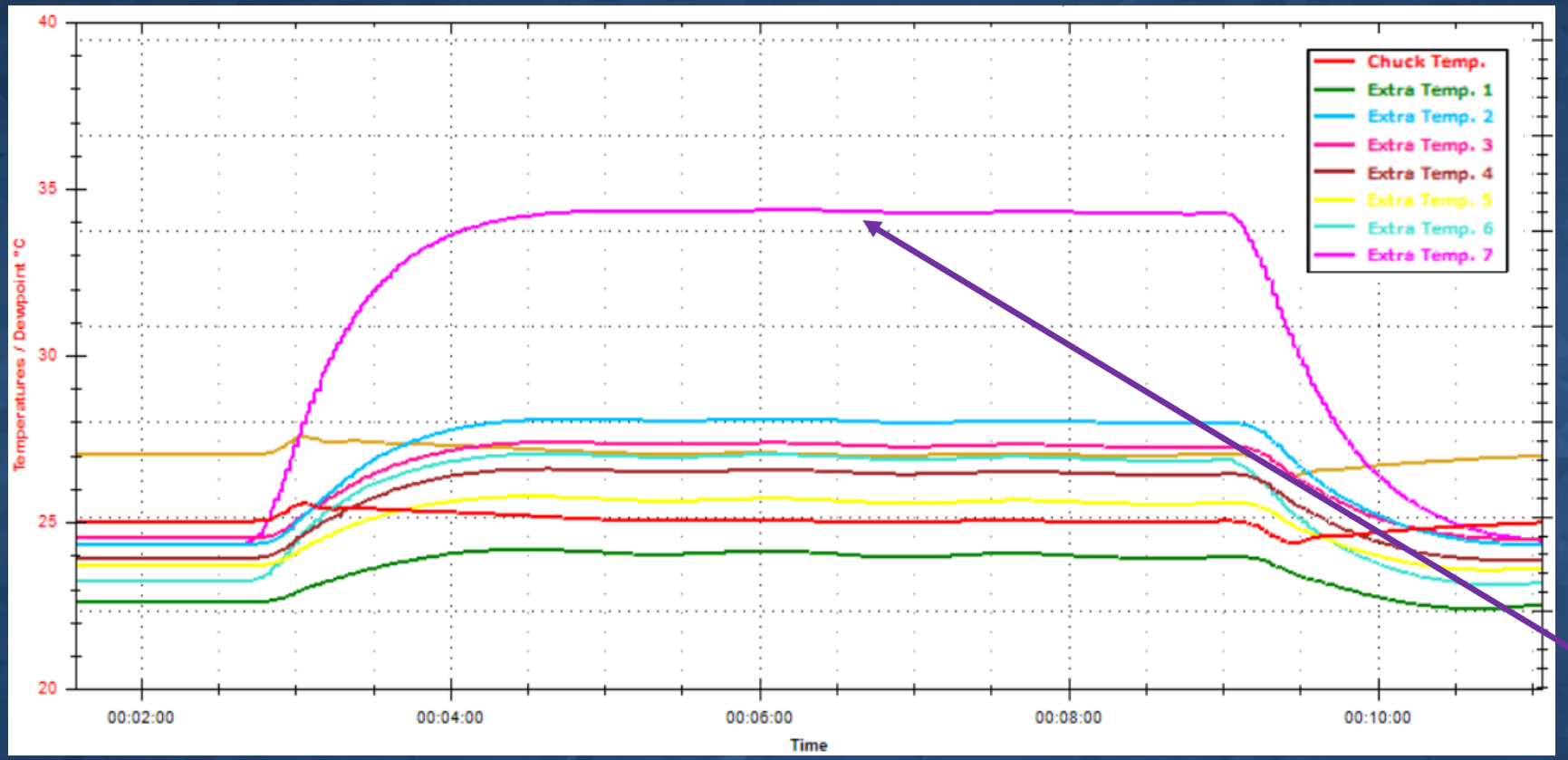
# Small Device: Any position at 15°C




**Solution:** Software detection of power input location

Load Power: 120W

# 25°C, 1000W Big Device (200mm)




Max: +36,5°C

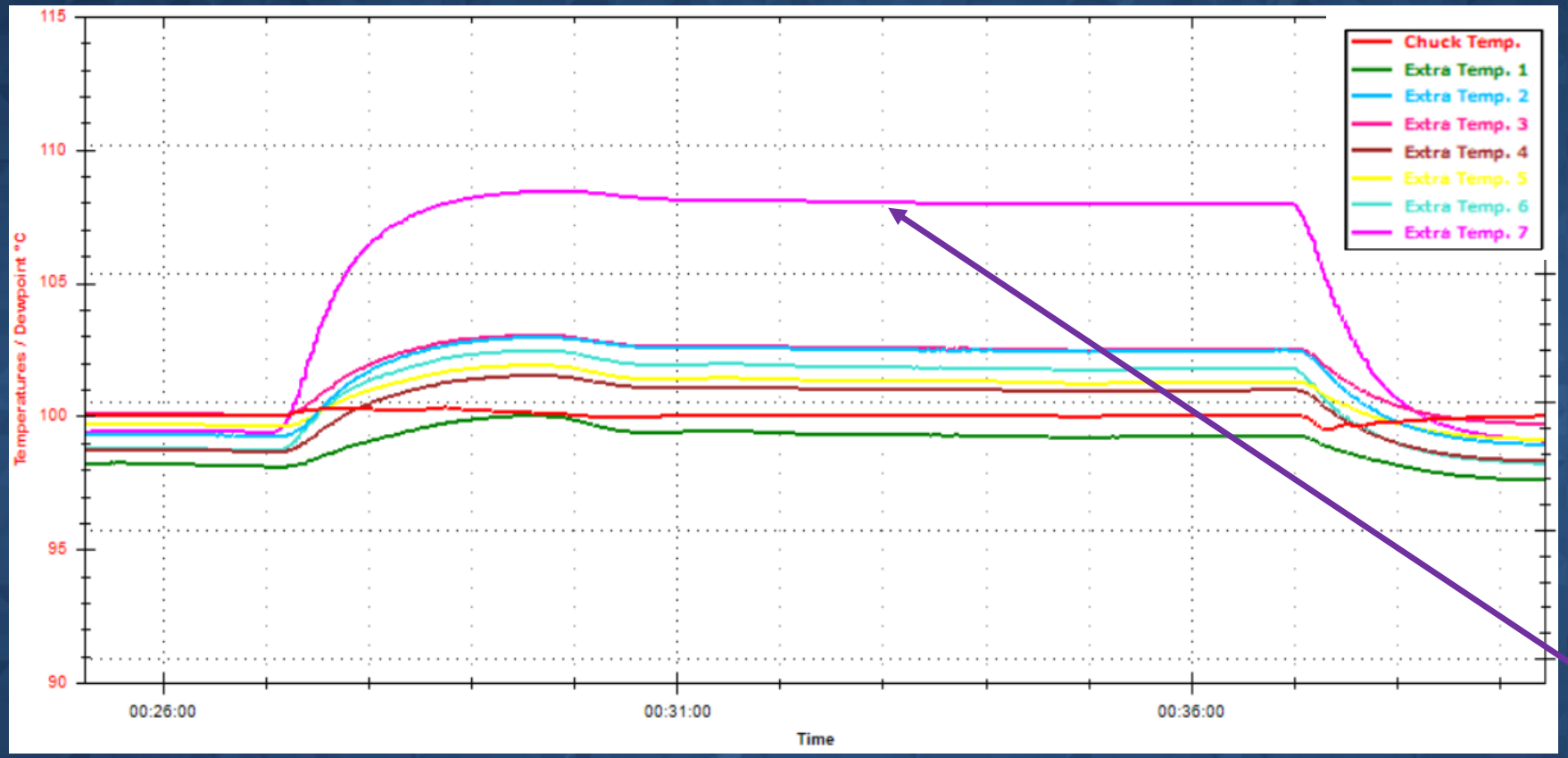
Min: +33,0°C

Delta under Load = 3,5°C

Center position

Improvement: Heat dissipation in center position

# 100°C, 1000W Big Device (200mm)




Max: +109,5°C

Min: +106,2°C

Delta under Load = 3,3°C

Center position

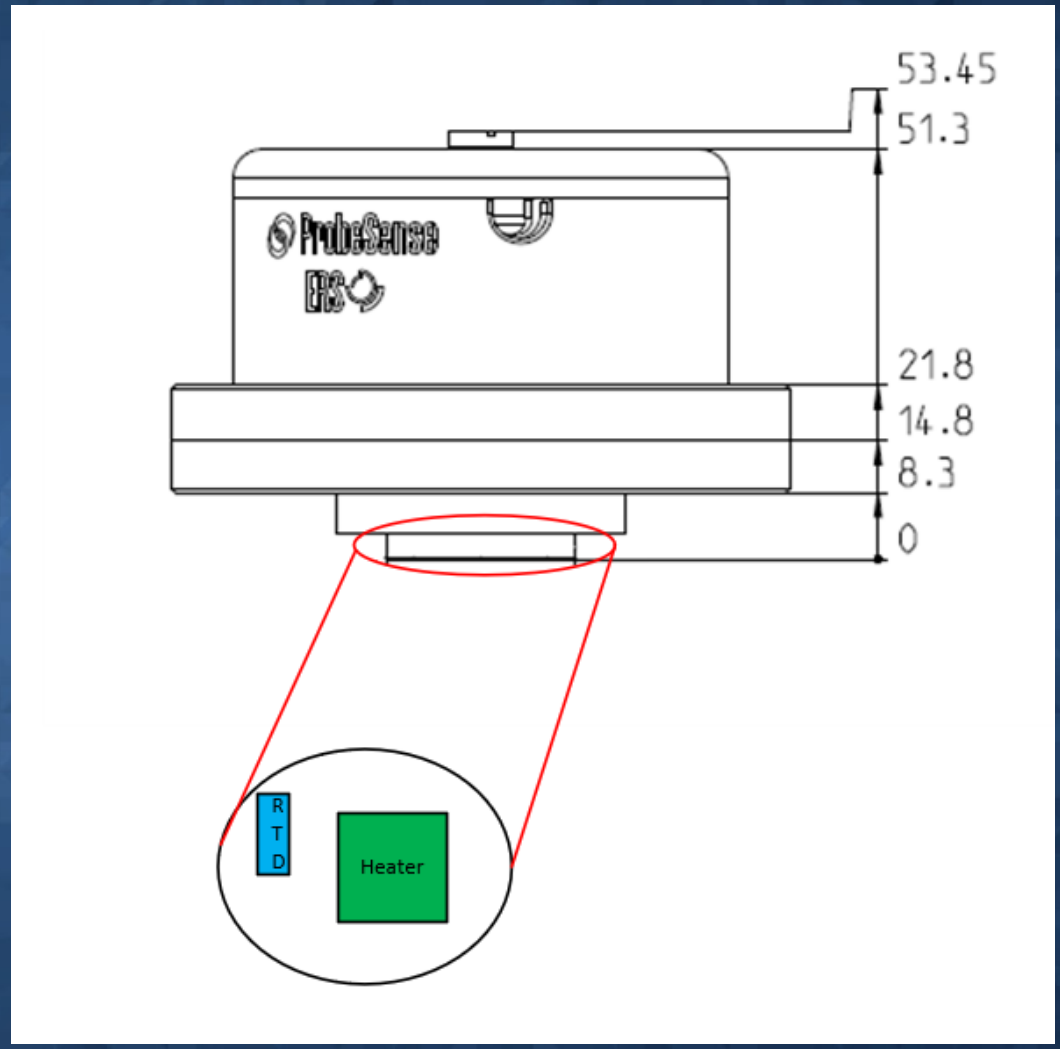
Improvement: Heat dissipation in center position

# Results

- **Large thermal load is applied over a small area**
  - The controlling sensor doesn’t always observe a temperature change
  - The extra monitoring sensors give a better indication of the area under test
  - Small area can be compensated with a special software
- **Large thermal load is applied over a larger area**
  - Creates a uniform temperature change on the chuck surface
  - Chuck needs to be capable of removing the power at given temperature
  - Large area needs suitable hardware to compensate the load

# Future works: Power Device in ProbeSense™

- Integration of power device within a ProbeSense™
- RTD to measure the surface temperature response to thermal load
- Dynamic measurement capabilities
- Integrated within probing environment
- Automation adjusted to control the power device



# Discussion / Strengths & Weaknesses

- The new tool allows a good prediction of the temperature profile at any place on the chuck
- The new tool allows predicting this with a specific power profile at any place on the chuck
- The software related to this data allows a fast and reliable decision of the ideal test temperature
- The software allows a precise prediction of the reachable accuracy guard band which can be reached with the set-up
- The ability to predict the behavior of the DUT does not help for the case the expected target temperature cannot be reached

# Acknowledgements


- Bengt Haunerland, Sophia Oldeide and Flora Huang from ERS electronic GmbH
- Sebastian Giessmann and Frank Fehrmann from MPI Corporation

# Thank you!