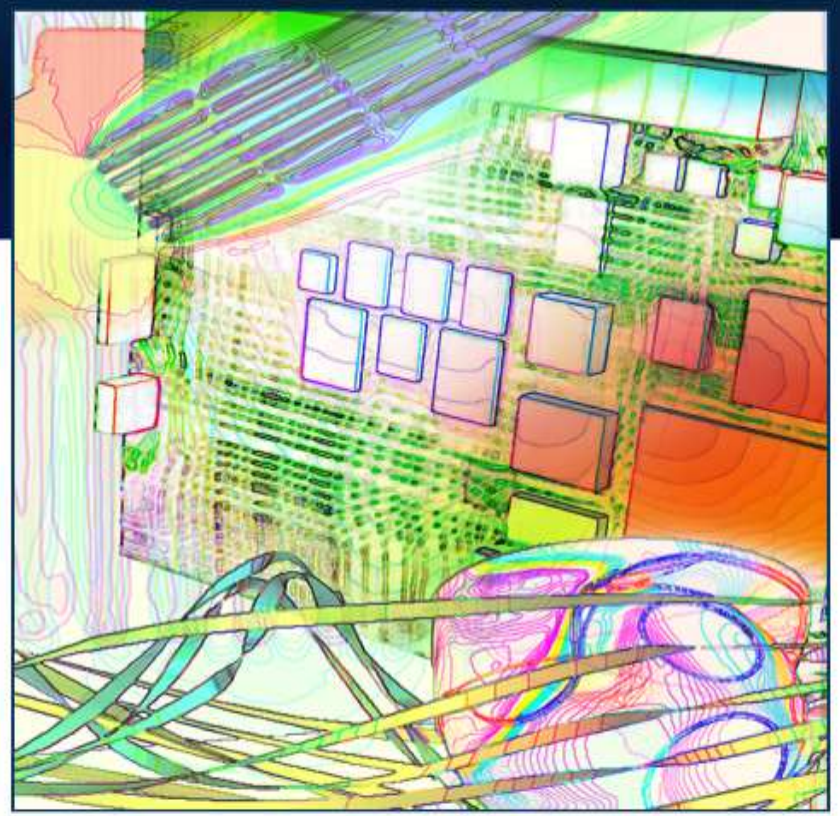

AUTOMATIC THERMAL CALIBRATION OF DETAILED IC PACKAGE MODELS

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Mentor Graphics®

Topics

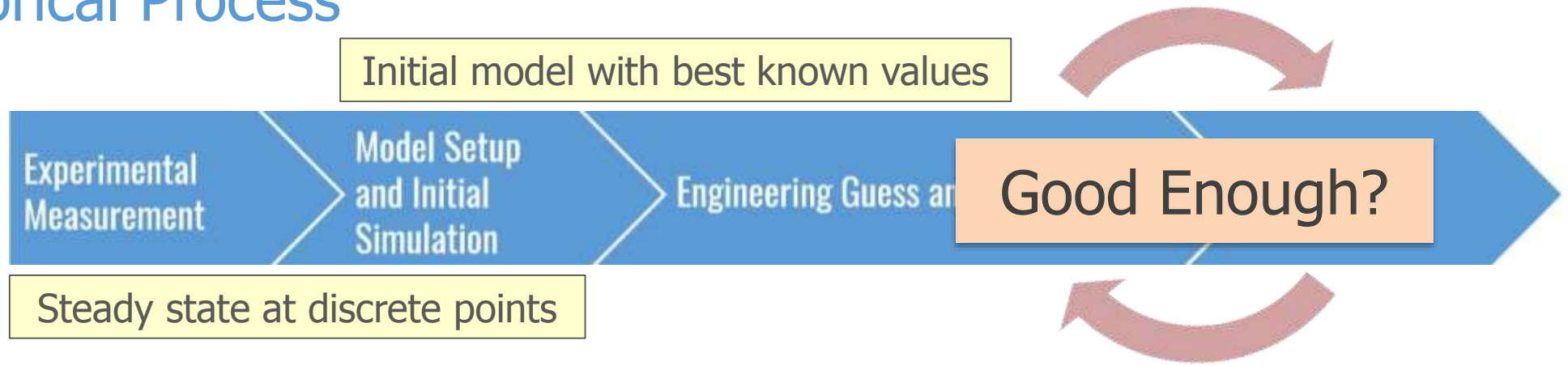
- Motivation
- Calibration Process Comparison
- Automated Calibration Example

Model Calibration - Motivation

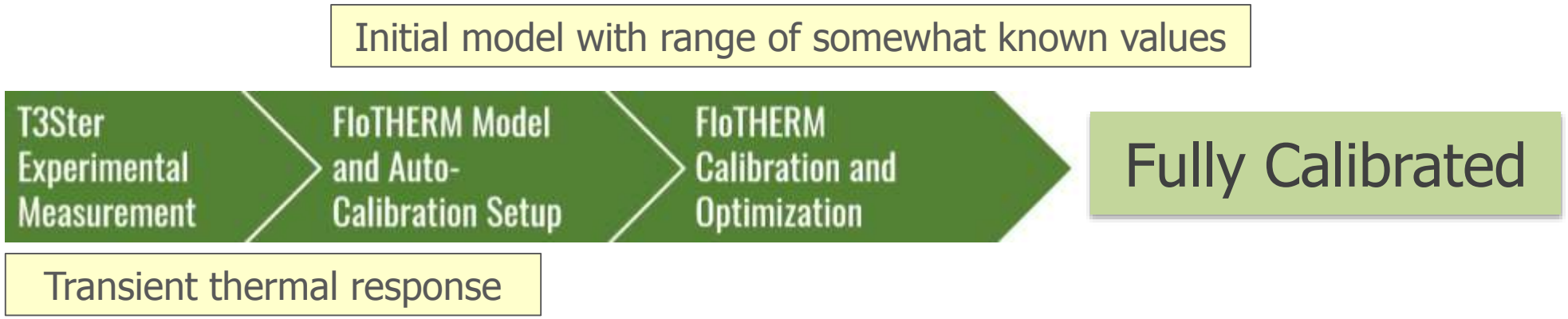
- Calibrating thermal models to match transient measurements is critically important for modern electronics thermal design.
- Maximize Model Accuracy
  - Calibrating all model aspects for all package time constants ensures the package will respond accurately for any steady state or transient application. Relying on single metric type data is not enough.
  - Vital to demonstrate this accuracy to ensure informed design decisions are made
- Certified Supply Chain Models
  - Provide simulation models that will respond correctly to any driving power profile.
  - Provide empirical evidence that this is the case.

Model Calibration Process Comparison

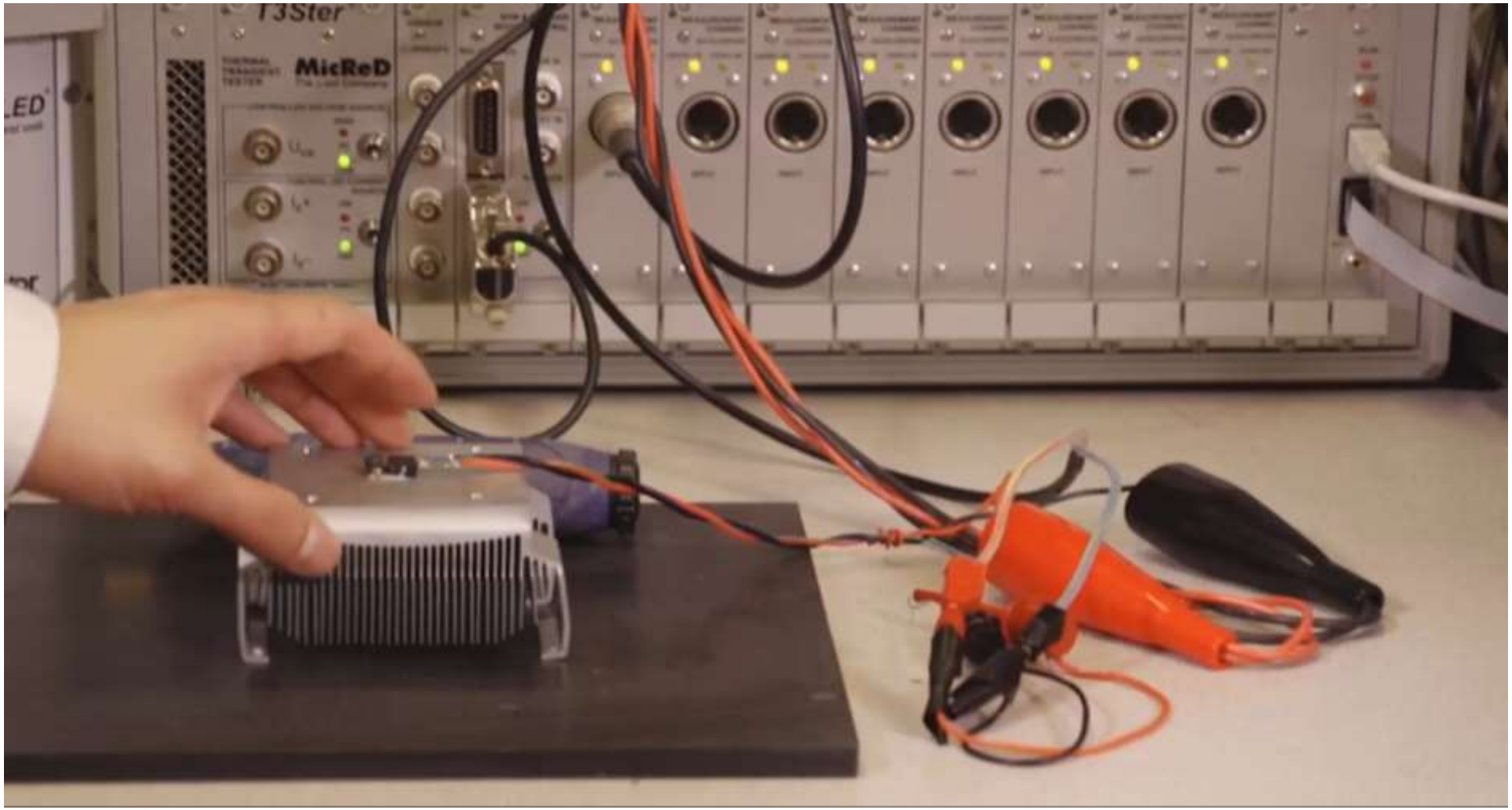
Historical Process



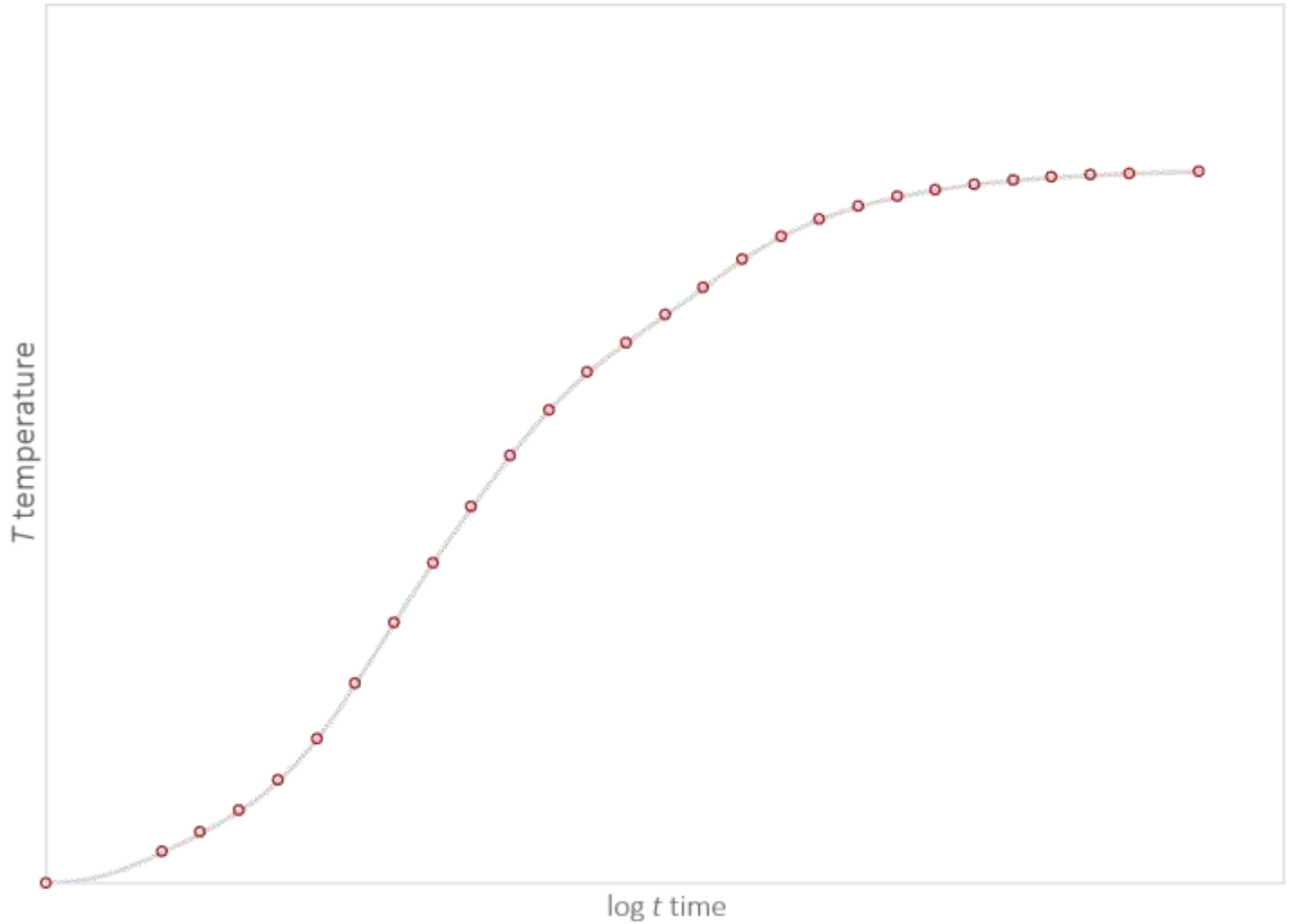
FloTHERM and T3Ster Automated Process

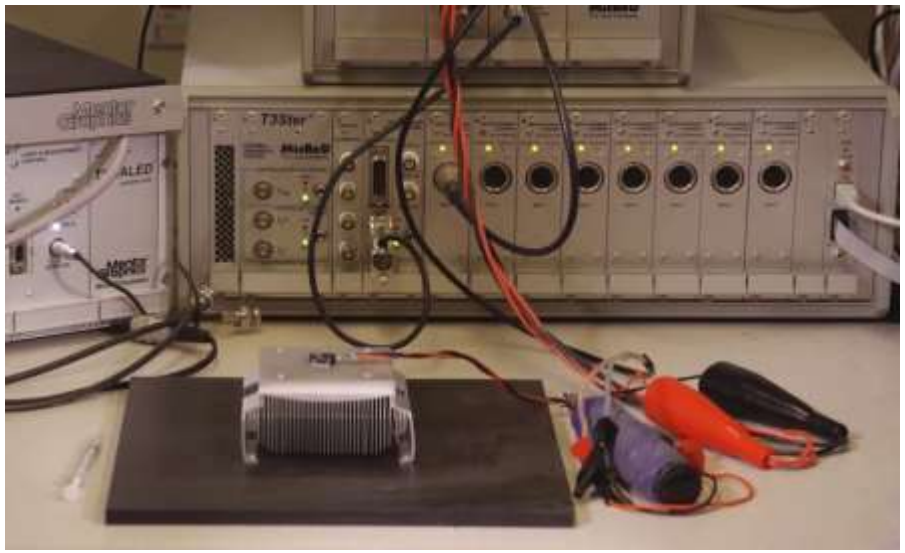


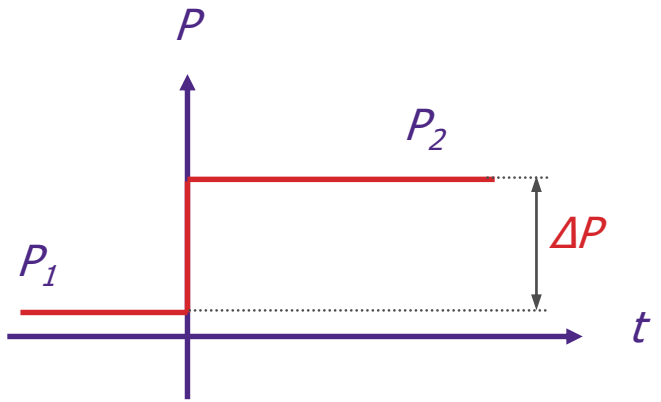
T3Ster: Experimental Measurement



T3Ster Measurement Output

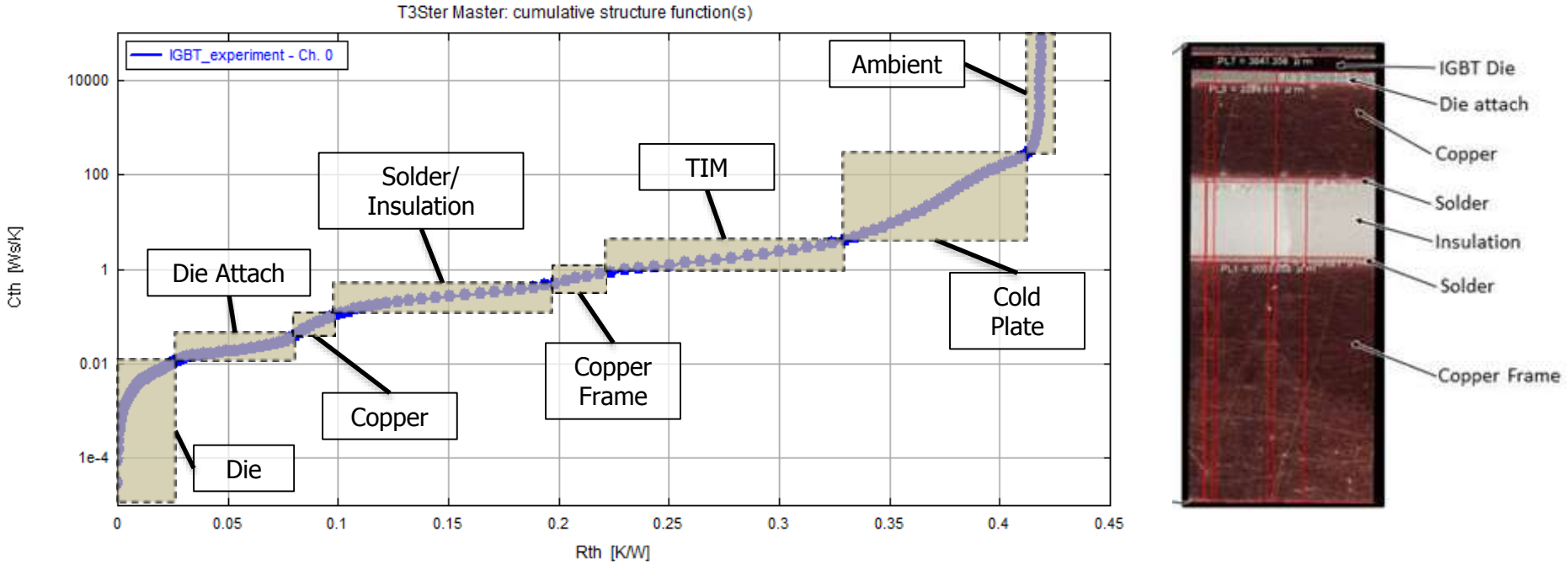






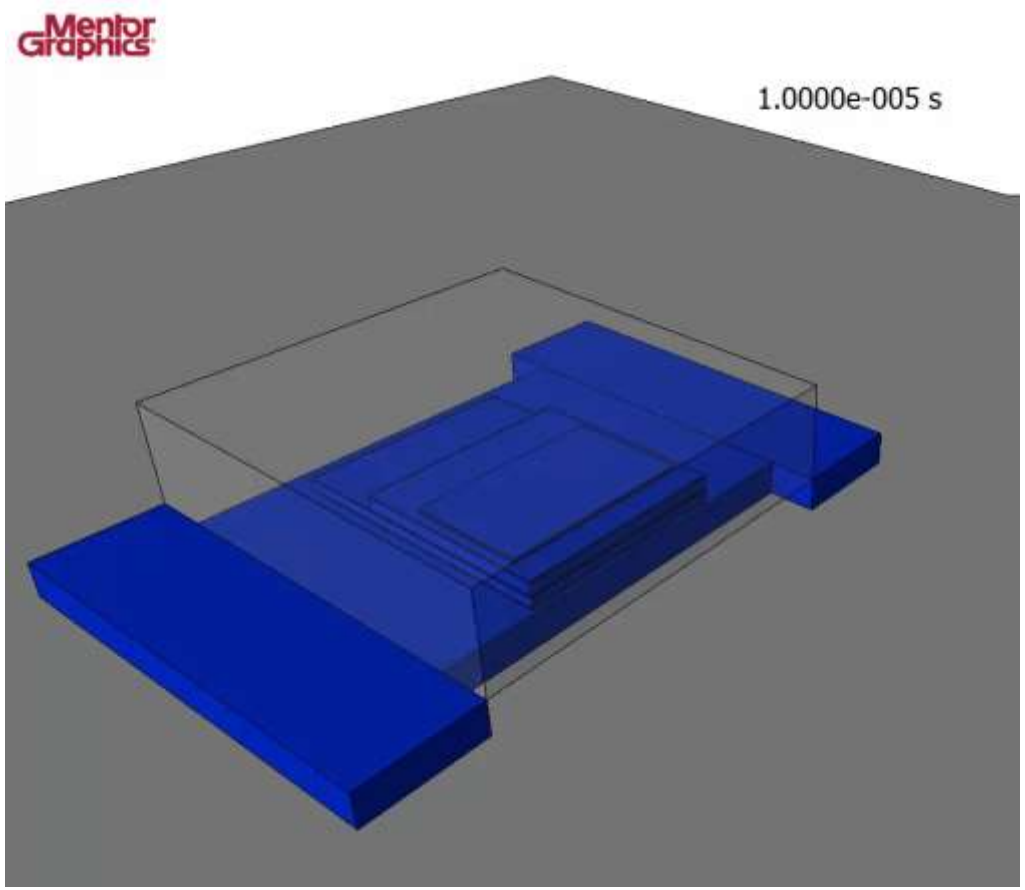
T3Ster Structure Function

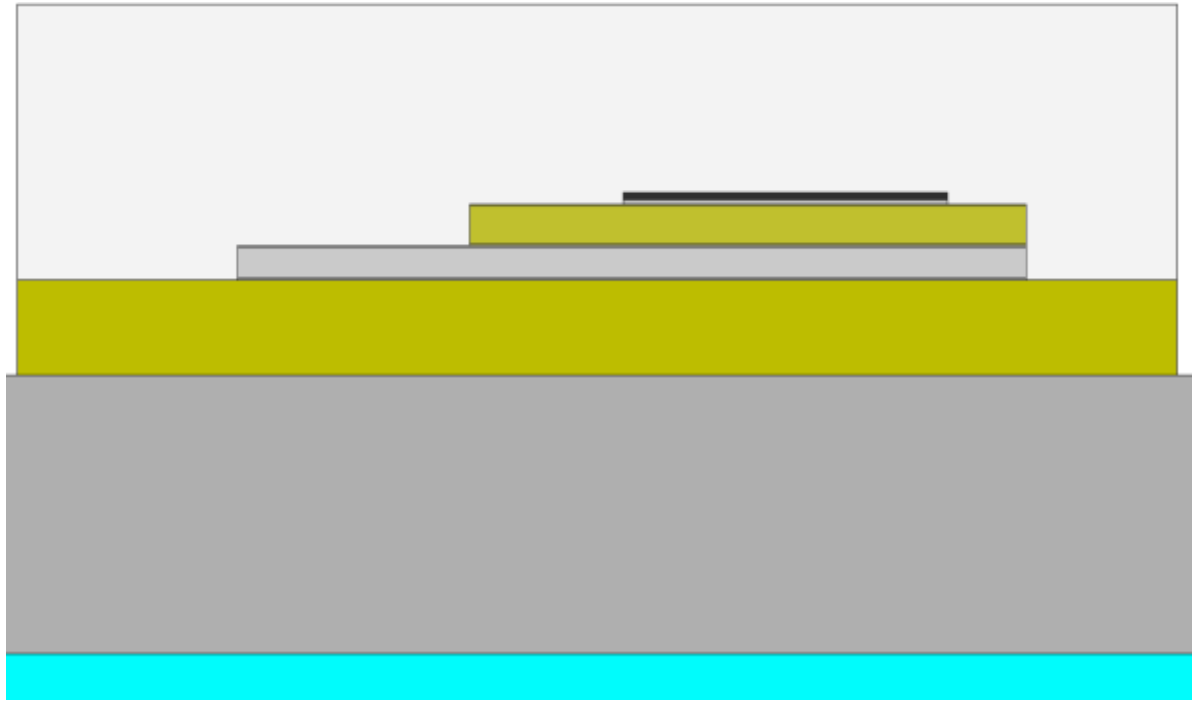
- T3Ster Master software converts the measured thermal response into a Structure Function. One way to interpret this is the RC path that the heat takes from the junction, through the device, and to the ambient.



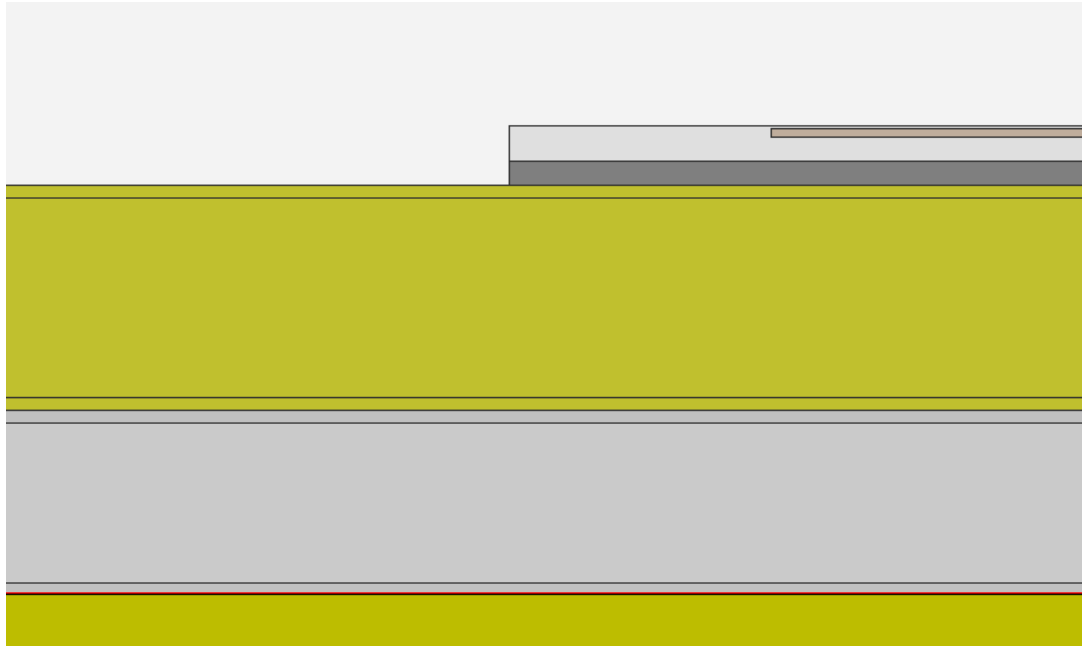
Calibration Example

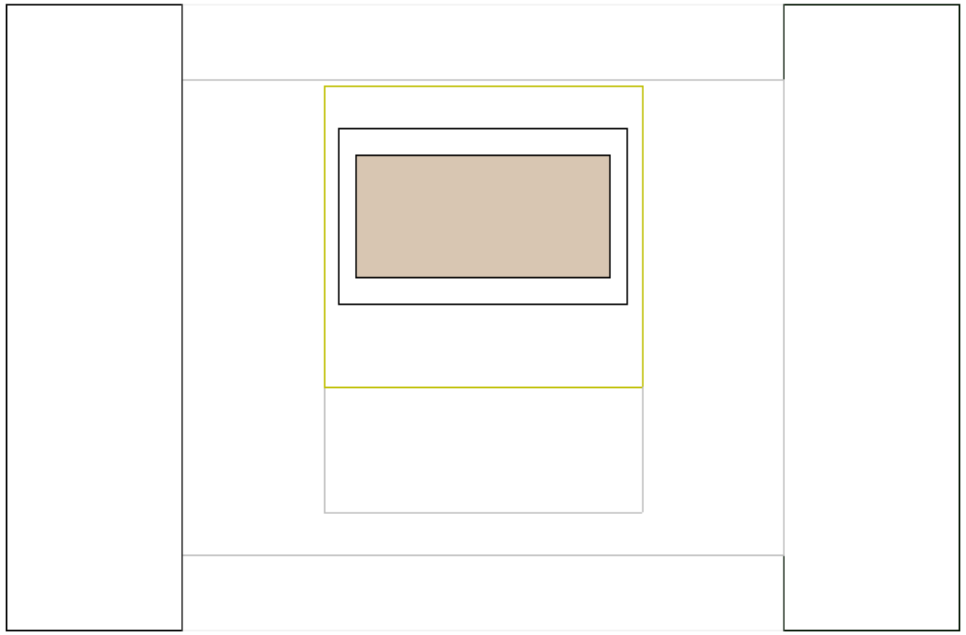
- A detailed FloTHERM model of the package was simulated in a virtual test environment with best known input values





Quantifying Uncertainties





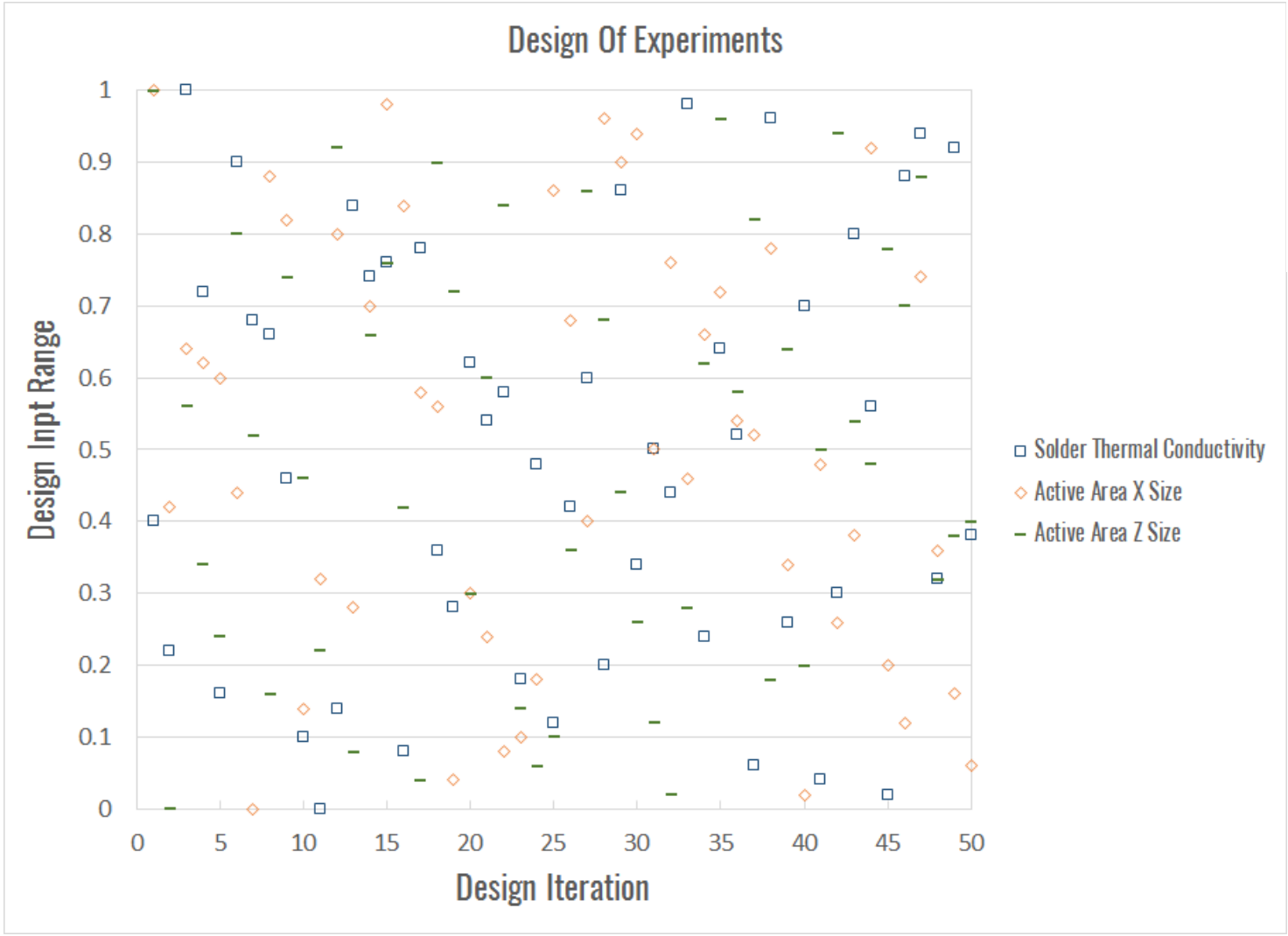
Design Parameter	Minimum	Maximum
Die Solder : Conductivity [W/mK]	20	45
Source : X Size [mm]	4	7
Source : Z Size [mm]	8	11.5

...And the range of somewhat known values

Calibration Interface

- Important factors
  - Import measurement data, define temperature to calibrate
  - Specify/adjust design limits
  - Verify measurement and analysis consistency
  - Design Experiments
  - Calibration extent

Design Of Experiments



Design Parameter	Minimum	Maximum
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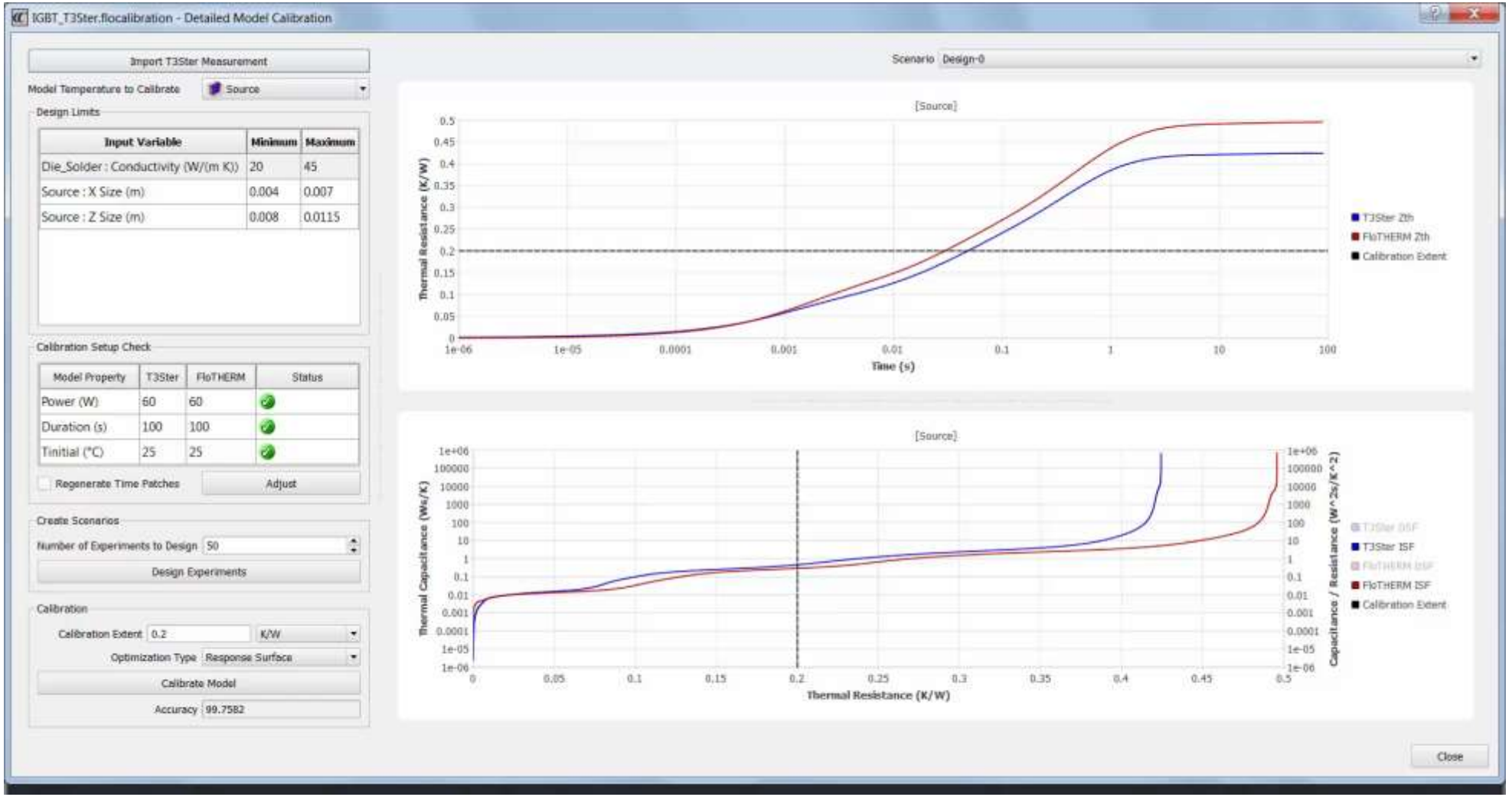
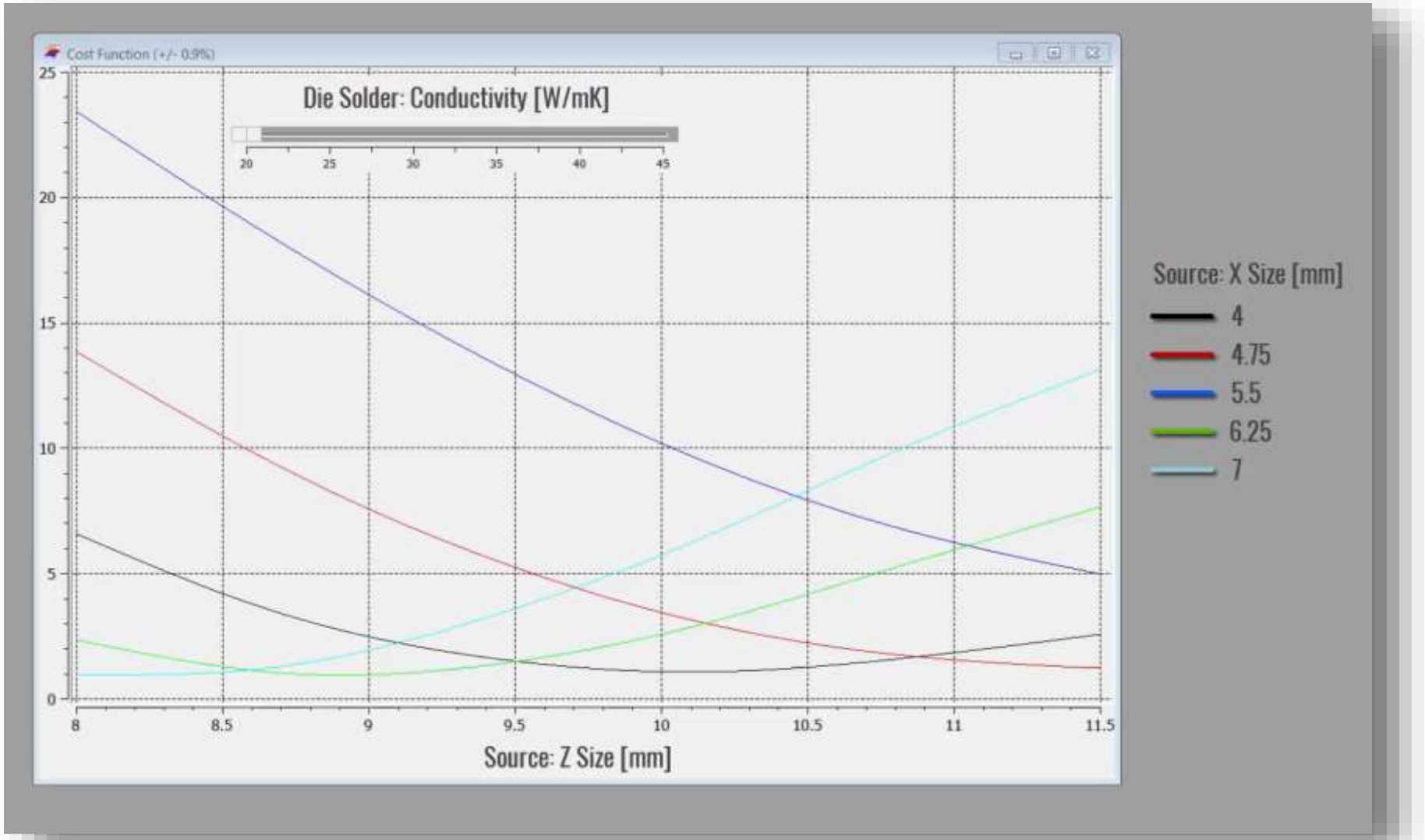
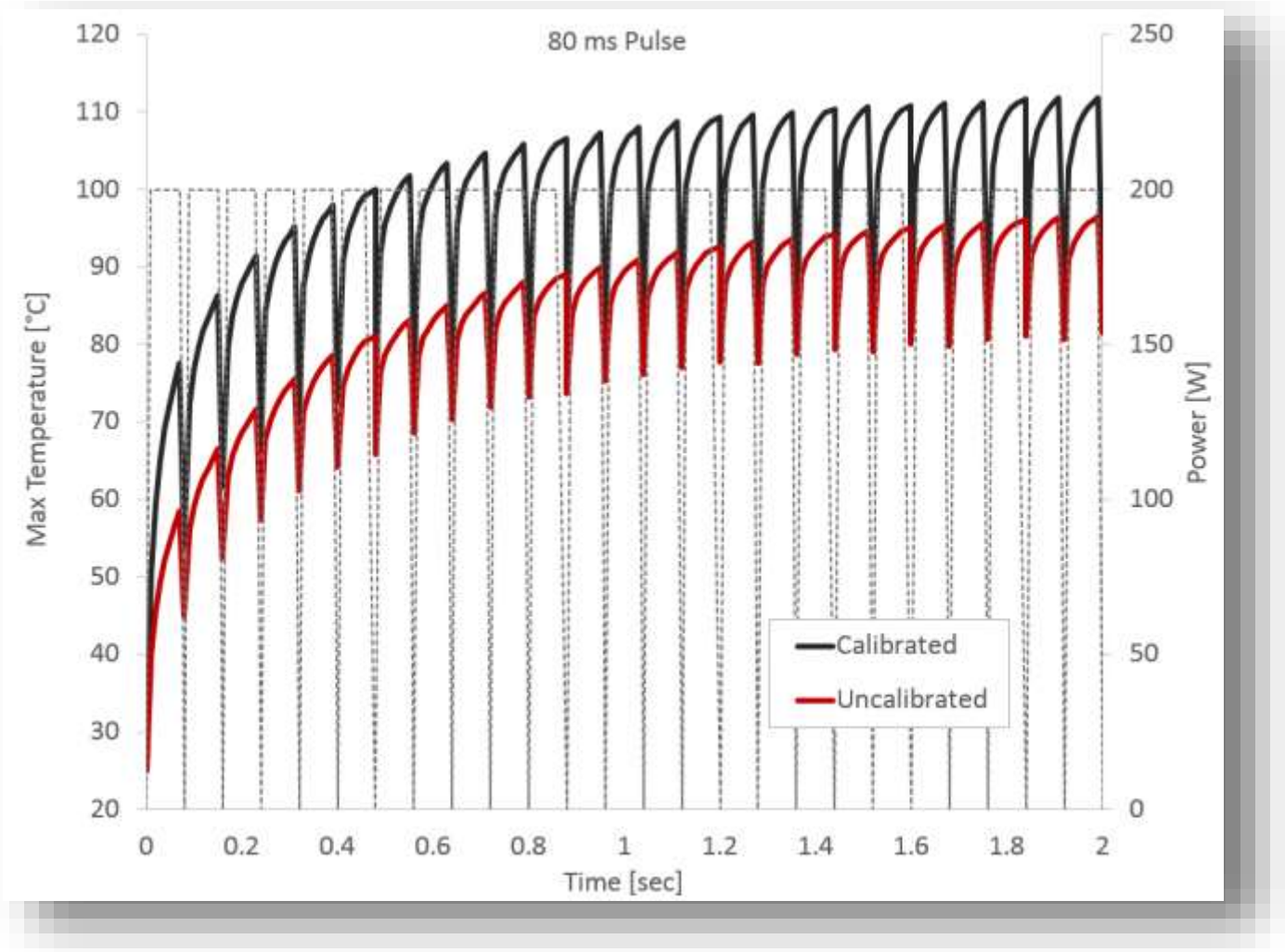
Calibration Results



Response Surface Optimization Output



Result Comparison: Peak Temperature

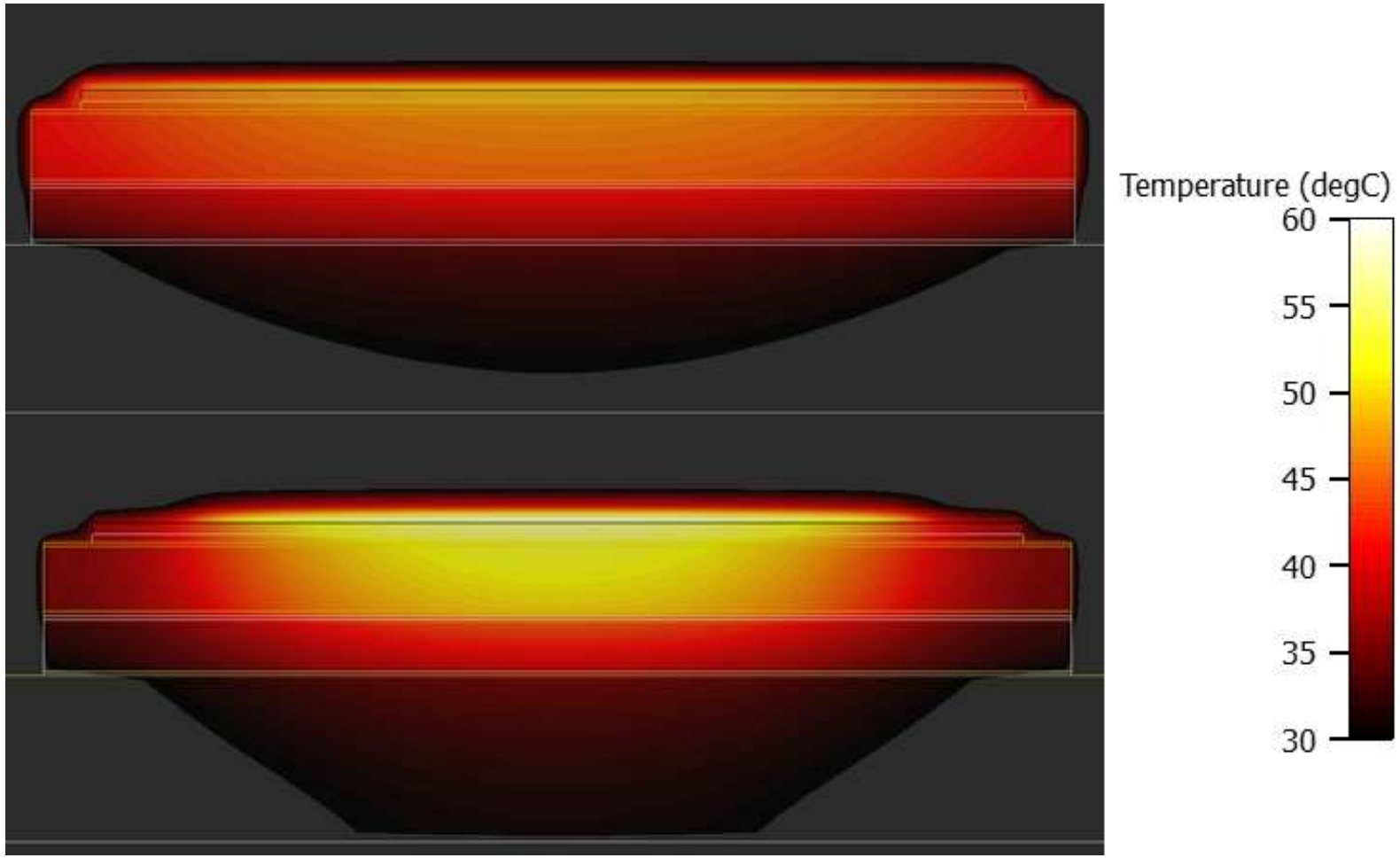


Result Comparison: Temperature Distribution

80ms Pulse, t: 20ms

Uncalibrated

Calibrated



Summary

- Correlating a model against transient measurements provides the most accuracy
- Structure functions help identify areas of inconsistency between the assigned model values and measurement results
- Automating calibration provides for a repeatable and scalable process
- Thanks!

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