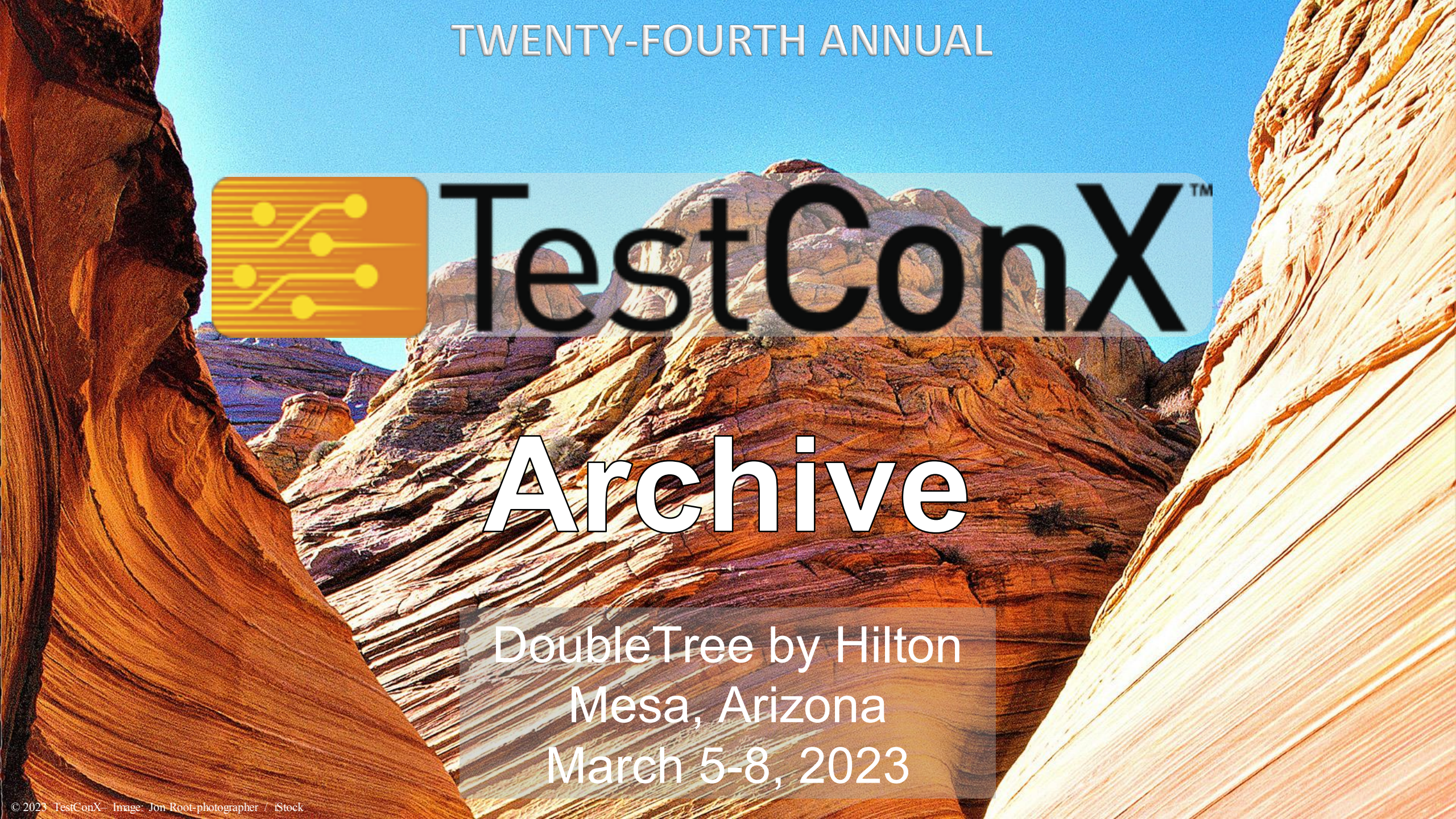


With Thanks to Our Sponsors!

Premier

HiCon

Honored

GLOBAL INNOVATION ISC

WIN SOLUTION

LEENO Total Interface Solutions

TSE

With Thanks to Our Sponsors!

Distinguished

Johnstech™

smiths interconnect

MICRO CONTROL COMPANY SINCE 1972

CTFE Align & Smart Contact

ADVANTEST®

Industry Partners

SWTEST

MEPTEC THE NEXT GENERATION

COPYRIGHT NOTICE

www.testconx.org

Compensation of device power dissipation during test

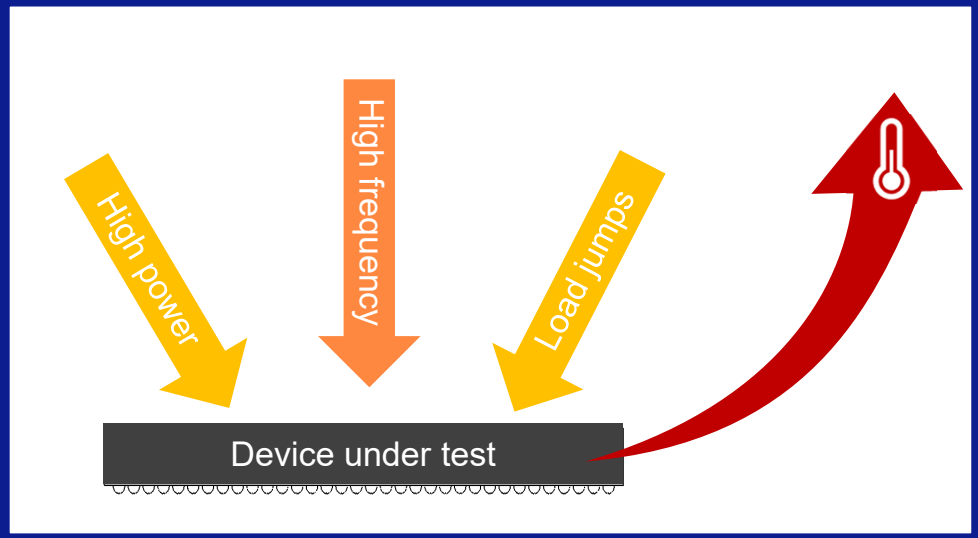
Markus Harzenetter
esmo

Mesa, Arizona • March 5-8, 2023

Contents

- Introduction
- Description of test setup & problem
- Concept
- Device temperature measurement
- Device temperature compensation
- Result
- Additional developments

Introduction



Thermal influences on an IC device under test due to new chip technologies makes it more and more difficult to keep the test temperature near the set point.

Description of test setup

esmo talos – engineering handler

- Pick & place tri-temp handler
- Active thermal control system (ATC)
- Temp. transfer by direct contact with device – **stability +/- 0.5K**

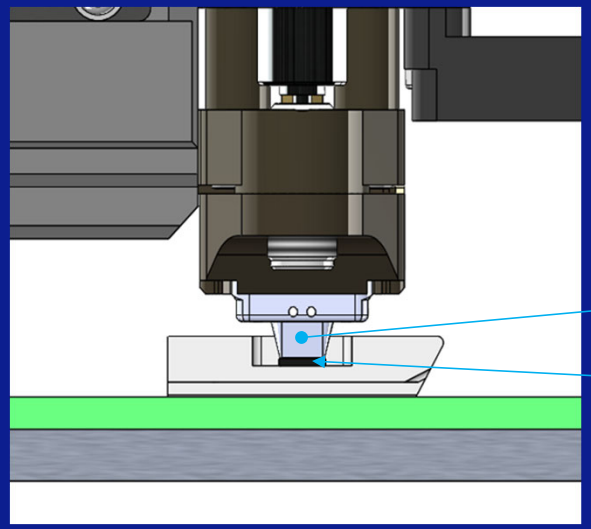
Advantest V93k LTH – test head

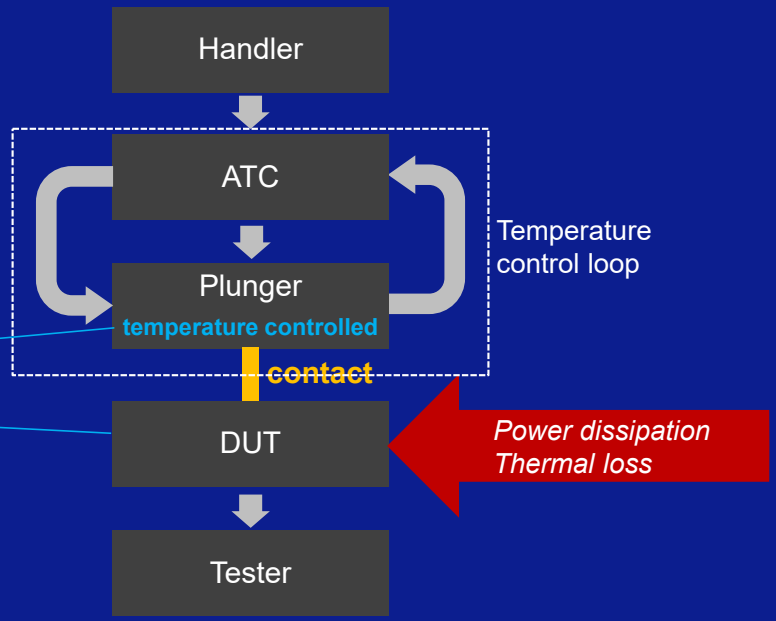
- Power jumps up to **8W** during test

BGA Microcontroller – tested device

- Test temperature **+160°C (320°F)**
- Critical temp. limit: **+169°C (336.2 °F)**

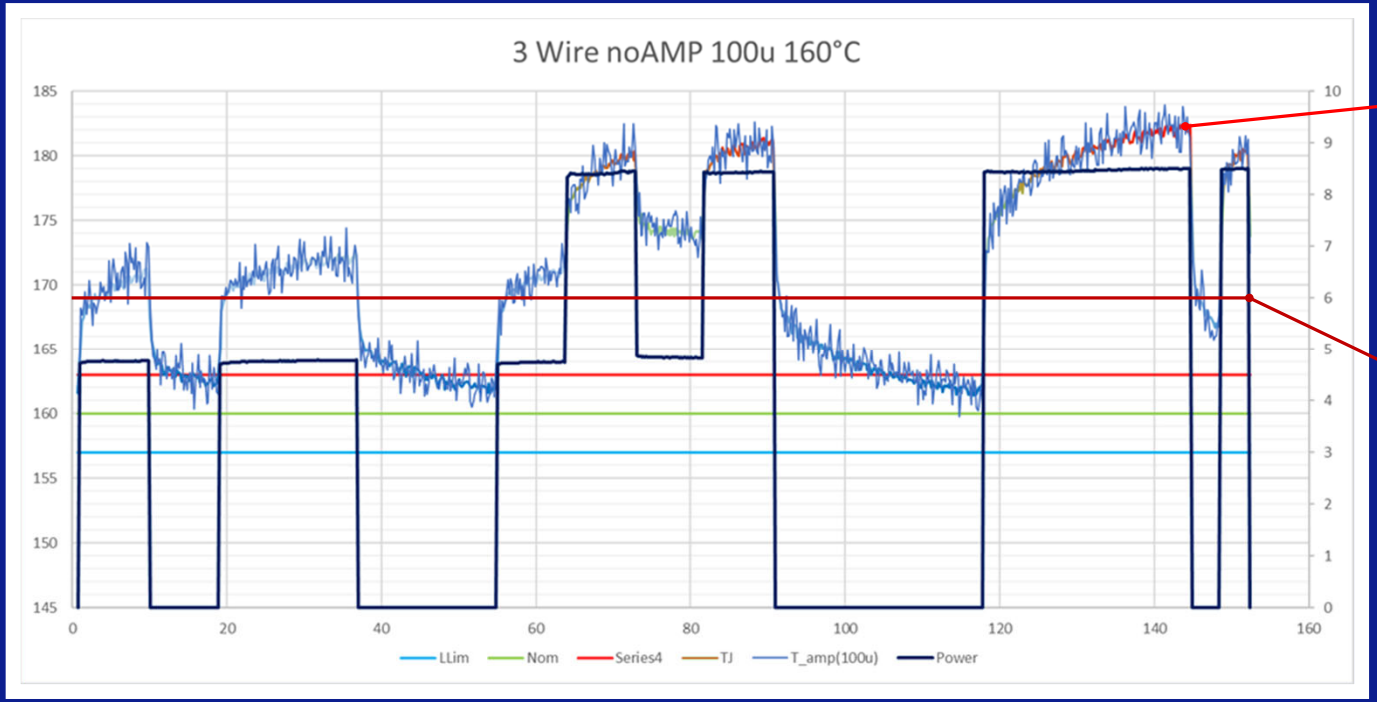
Description of ATC (active thermal control)





ATC controls the contact plunger temp. without recognizing / reacting to external influences on the device immediately.

Status quo - temperature



This graph shows a real case study. As a result of the power dissipation, the device temperature rises rapidly by more than **20K** when **8W** power is applied.

Conclusion – temperature increase

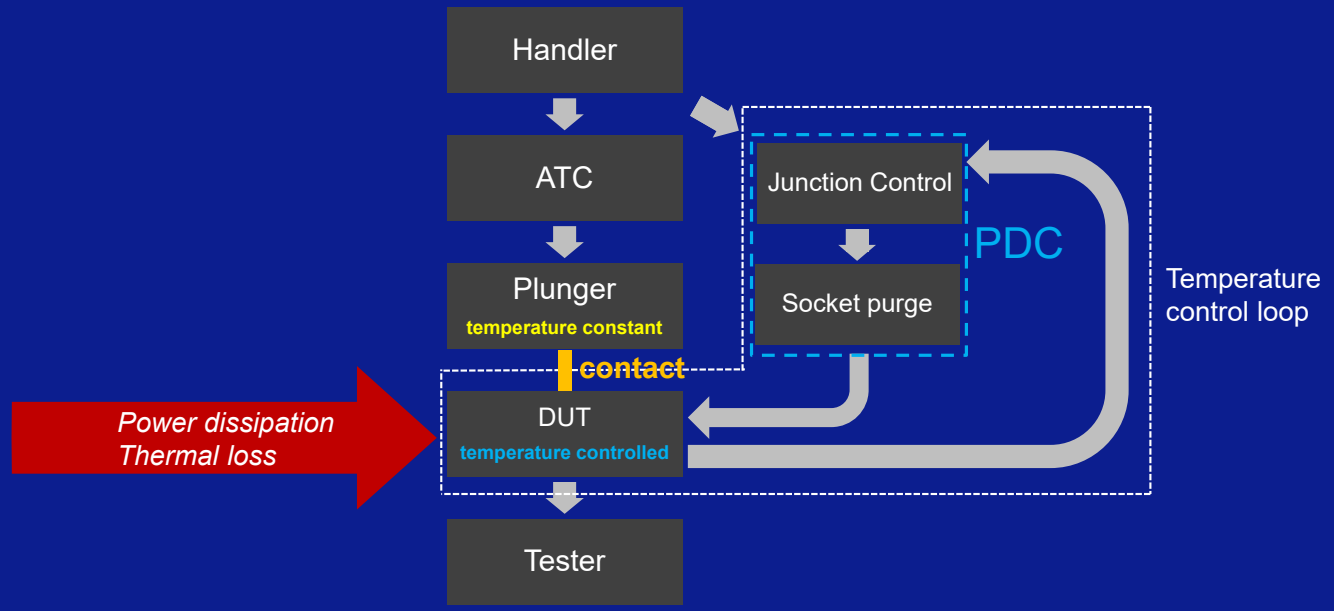
Difficult to **detect**

Difficult to **compensate**

- **Measure** temp. in real time.
- **Compensate** temp. increase instantly.

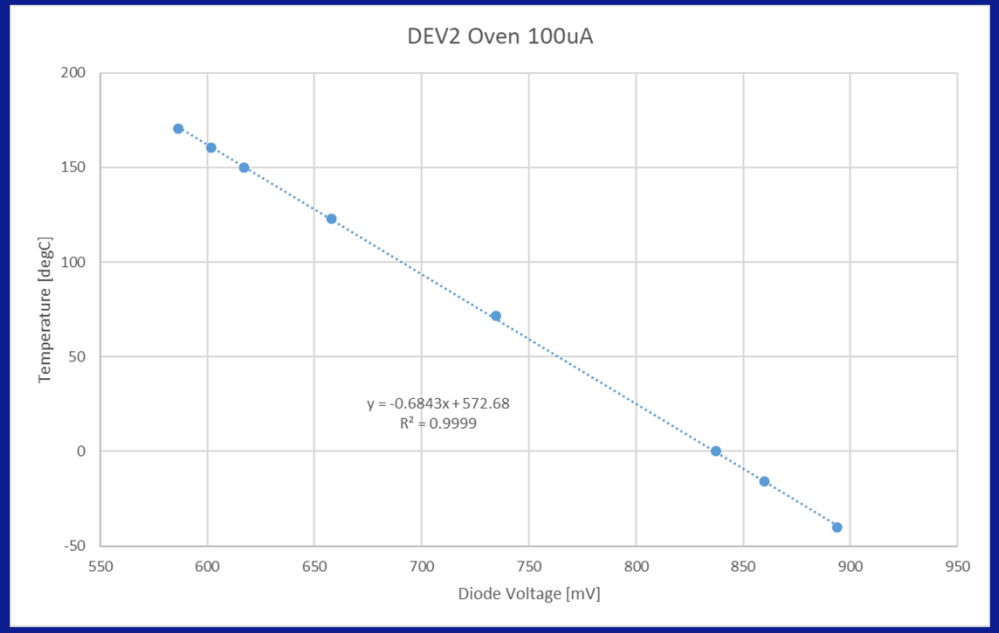
➔ **Junction control / PDC**

Concept overview – ATC & PDC



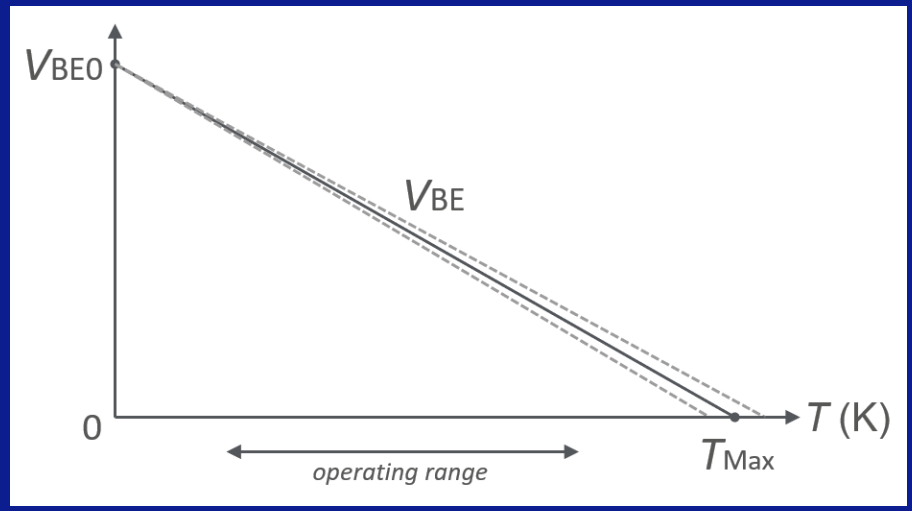
PDC (*power dissipation compensation*) allows instant reaction.

Temp. Measurement – thermal diode



- Integrated in many devices.
- Voltage over diode shows linear behavior over temperature.

Linear function – thermal diode



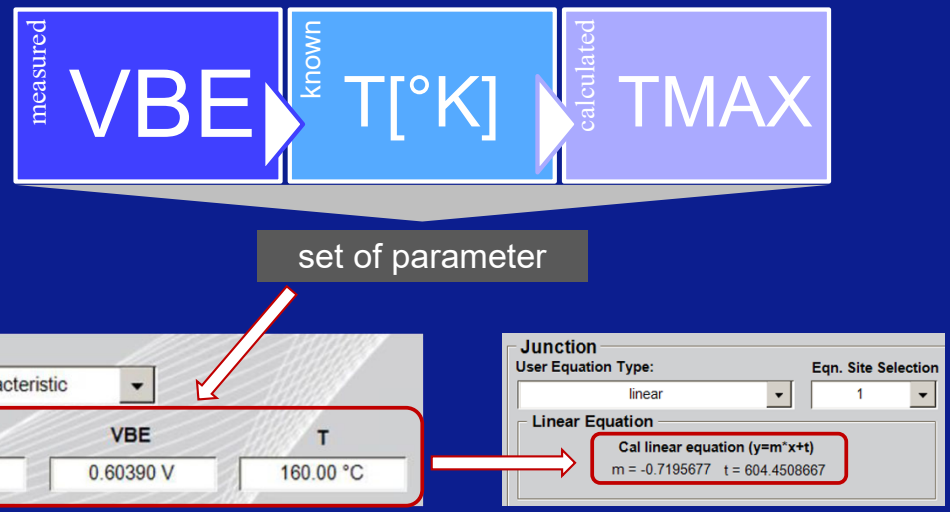
V_{BE0} : Voltage **V_{BE}** of a (silicon) diode @ 0K

- taken as fix point
- 1.2385V from literature,
- confirmed by measurement)

T_{MAX}: Theor. temp. @ **V_{BE}** = 0

- can vary
- depending on setup technology, lot or device

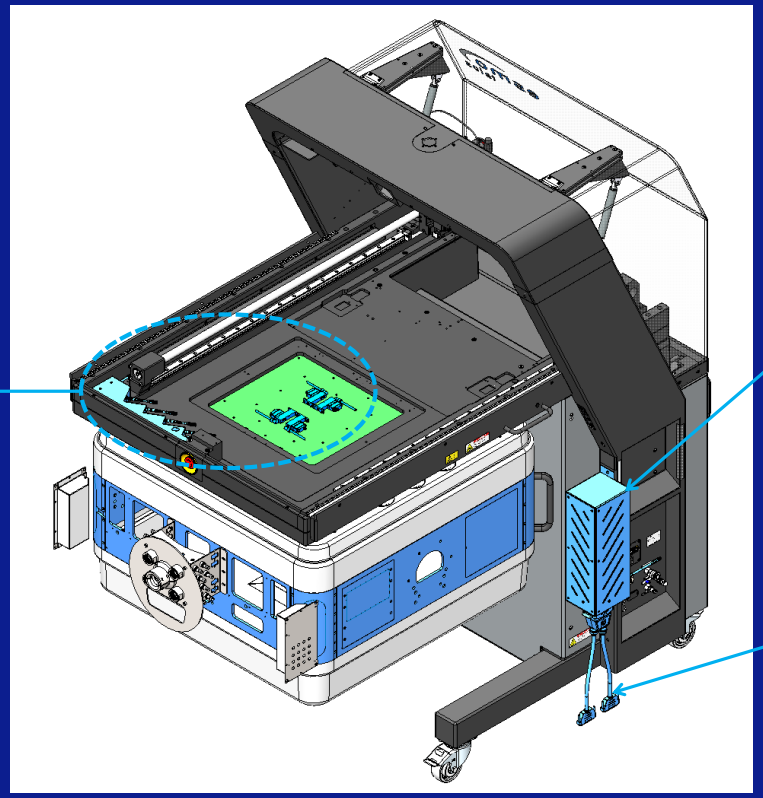
Transition into PDC parameters



V_{BE} (measured) at **T** (known) → T_{max} (calculated)

➢ **gain & offset** of linear function → $T_{junction}$ (calculated by PDC)

Handler hardware - overview



Hardware for compensation

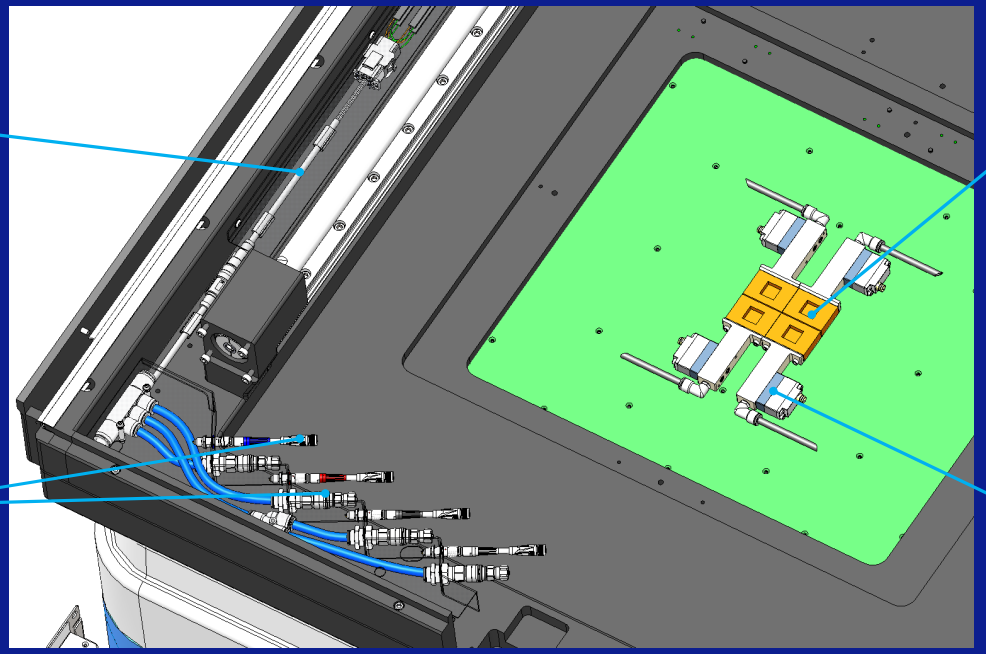
Junction control box
- Measuring electronics
- Signal processing
- Power supply

Signal cables for V93k tester

Temp. compensation - hardware

Main air & signal lines

Air & signal singulation for purge units

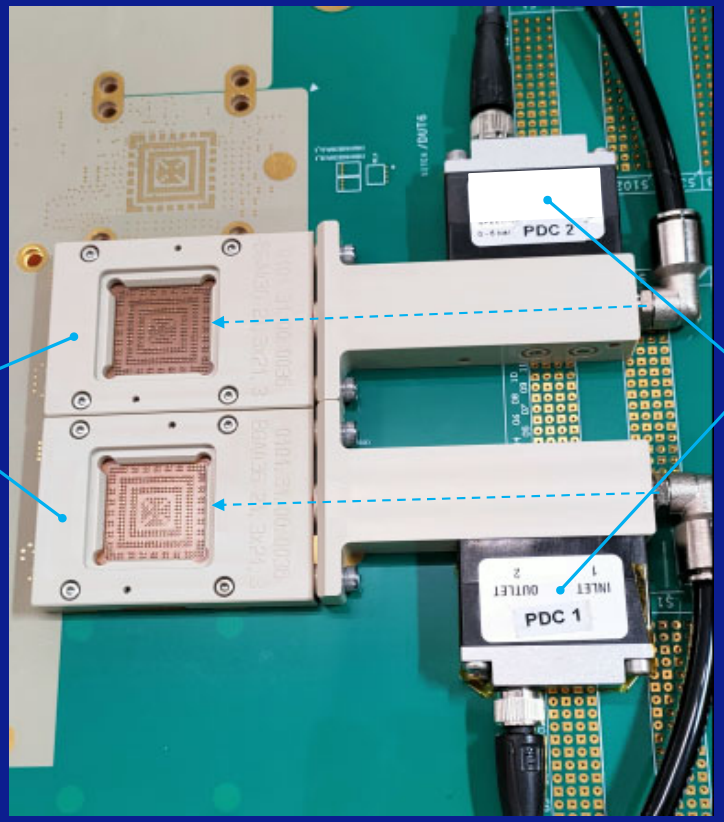


Sockets

Purge units (mounted to sockets)

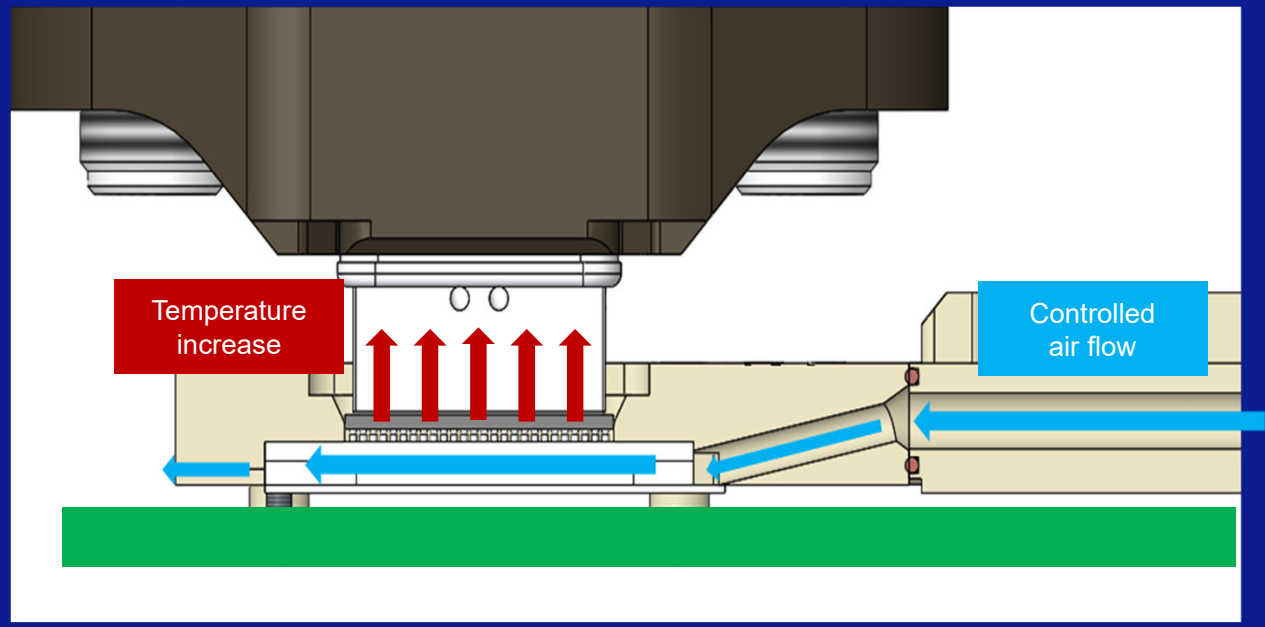
Temp. compensation - hardware

Sockets



High speed matrix valves
- Controlled by PWM signal from control box
- 100ms period (10Hz)
- on/off settable 0-100ms in steps of 1ms
- response time: 0.7-1.9ms (@6 bar, 87psi)

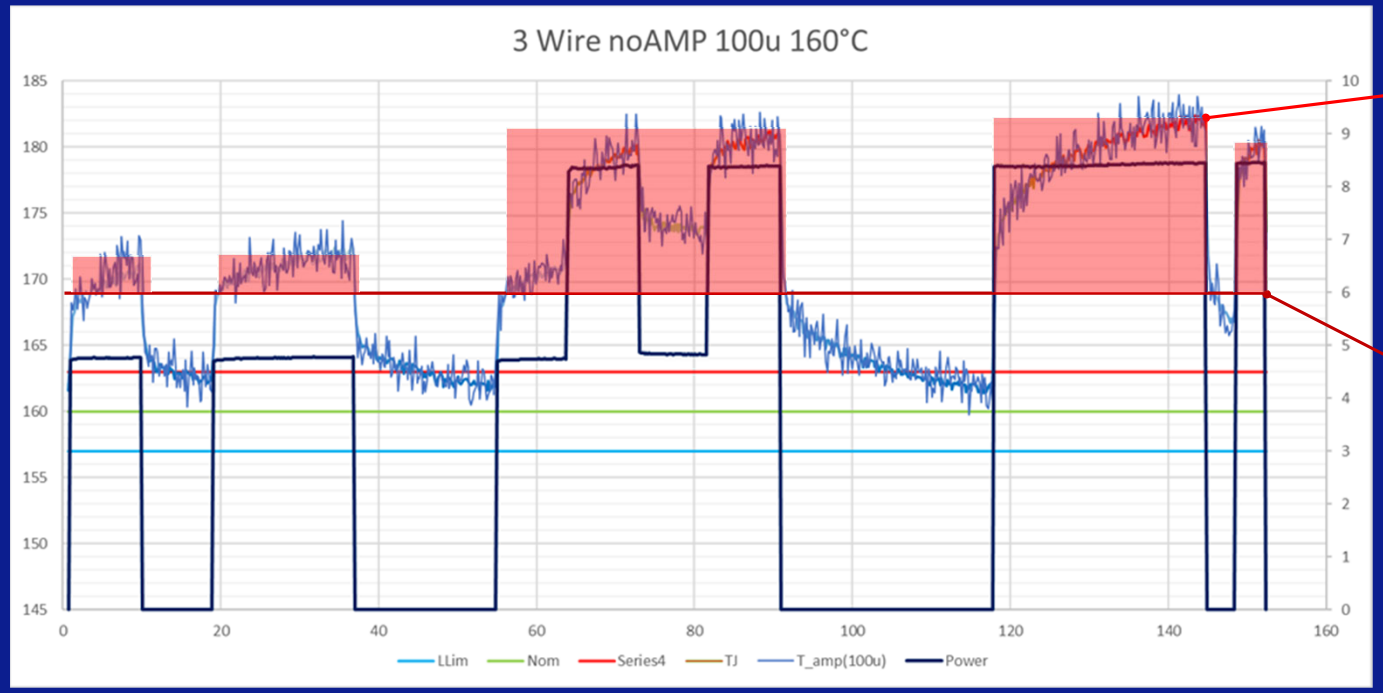
Temp. compensation - hardware



Rise of temperature is detected.

- Air flow through socket is increased.

Starting point- temperature



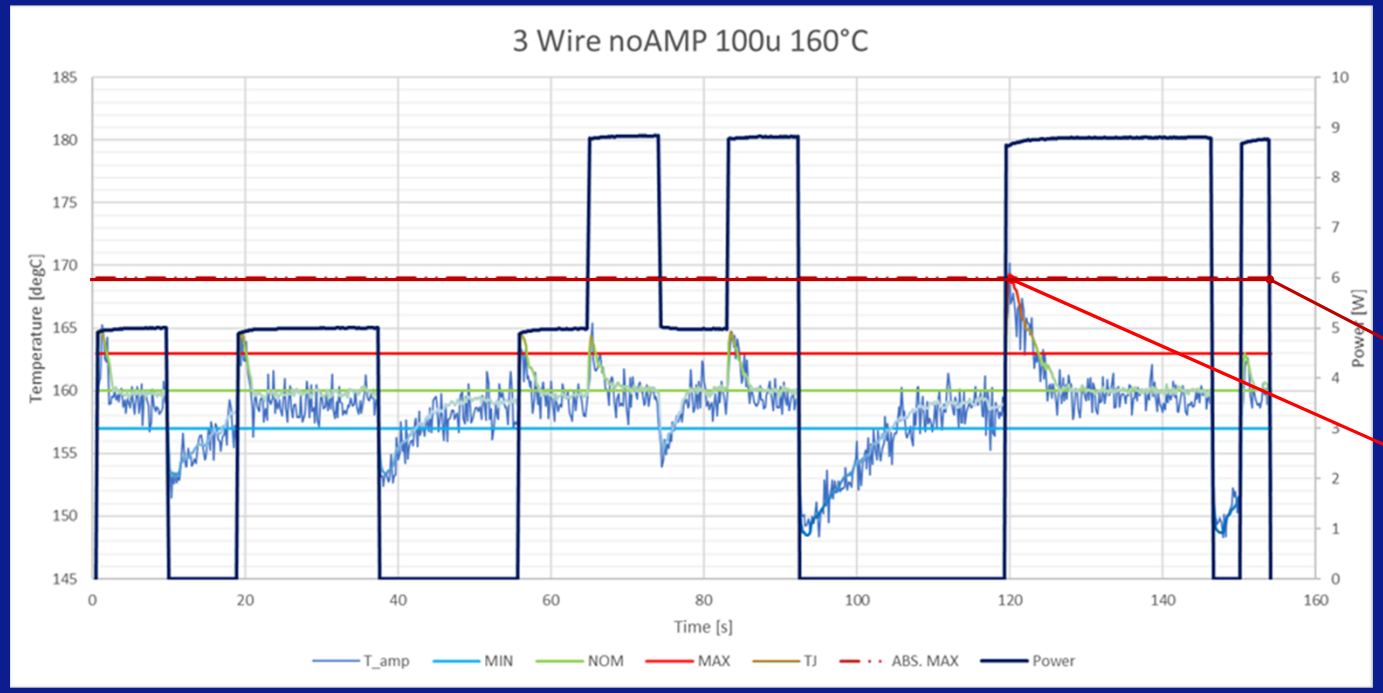
T_{max} = 182°C

$T_{critical}$= 169°C

$T_{critical}$: Exceeded during ~ 60% of test time

$T_{average}$ = ~ 173°C (T_{set} = 160°C), Delta = 13K

Result PDC - temperature



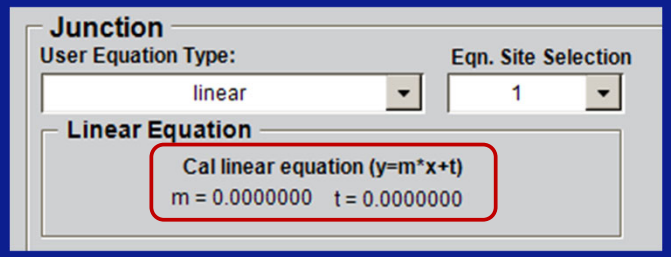
$T_{critical}$ = 169°C

T_{max} = 169°C

$T_{critical}$: Not exceeded

$T_{average}$ = ~ 157°C (T_{set} = 160°C), Delta = 3K

Additional developments



No thermal diode available in the device?

- **Different temp. characteristic (linear polynomic) can be used**

Additional developments

T_{max} can vary between different devices

- PDC can recalculate T_{max} based on the **T** and V_{BE} for each device individually.