



SWTEST
2026 CONFERENCE

35th
ANNIVERSARY

VARIOUS THERMAL CONTROL SOLUTION CAPABILITY UNDER ACTUAL DEVICE TESTING

TEL
TOKYO ELECTRON

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Overview

1. Background
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3. Features and Differences of TEL's Thermal Testing Solutions
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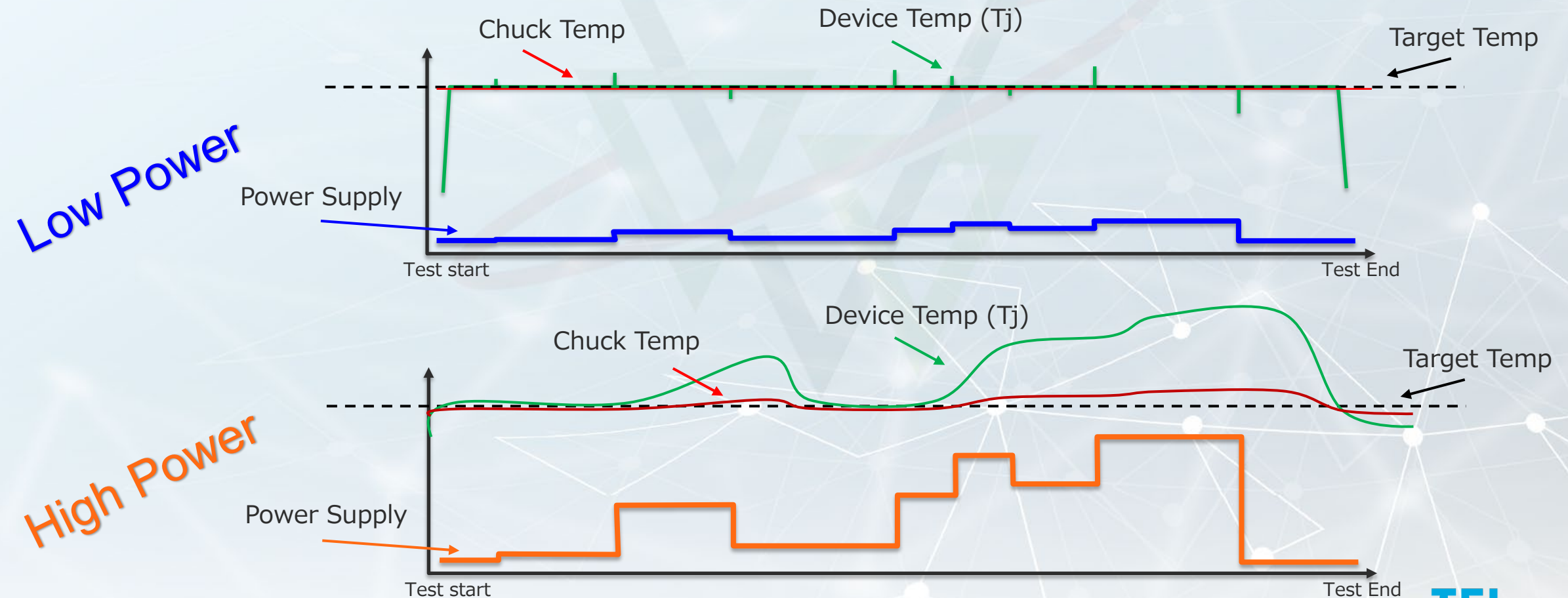
Background

- Supplied power during testing continues to increase
- T_j during testing will be increasing, and importance of T_j control capability is getting higher
- By more accurately controlling chuck and T_j Temp, it must be possible to improve Accuracy of Test
- We evaluated the potential improvements that could be achieved by utilizing various types of thermal control solutions

Challenges

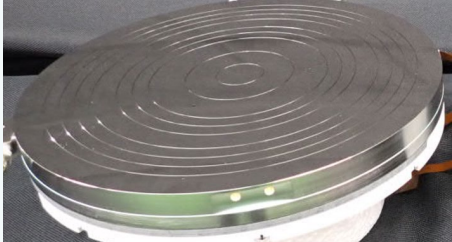
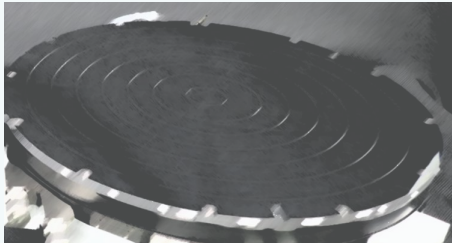
In the case of Power supply is not so high, Chuck and Device Temp. (T_j) must be close to Target Temp. and stable. On the other hand, when higher power will be supplied, Chuck Temp. must be stable, but T_j will be getting higher than Target Temp. and unstable.

Controlling Device Temp. (T_j) accurately while wafer testing is the necessary technology.



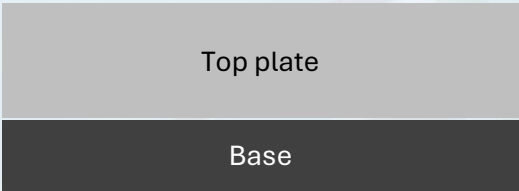
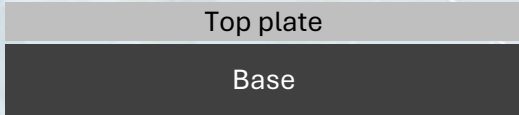
Comparison of Each Solutions

While UTCS uses a greater number of temperature sensors to control the chuck temperature more quickly and accurately, ATCS monitors the device temperature and controls it precisely

Items	Specification		
Tool model	Prexa (UTCS Plus)	Prexa LS (ATCS)	Device Test Prober (ATCS)
Chuck Type	UTCS Plus Chuck 	ATCS Chuck 	Thermal Head 
Temp. Monitoring Targets	Chuck	Chuck + Device (Tj)	Thermal Head + Device (Tj)
Control mode	Heater Temp. Feedback (HTF)	Device Temp. Feedback (DTF)	

Comparison of Heat Dissipation Capability

Heat Mass and Thermal Resistance are effective for rapid temperature changes, and they become increasingly effective for testing high-heat-generating devices in the order **Thermal Head > ATCS Chuck > UTCS Chuck**

	UTCS Chuck	ATCS Chuck	Thermal Head
Temp. Control Method	Chuck Temp. Control	Device Temp. Control	Device Temp. Control
Cross Section			
Heat Mass	Largest (Lowest Ramp Up/Down rate)	Larger (Lower Ramp Up/Down rate)	Smaller (Higher Ramp Up/Down rate)
Thermal Resistance	Lower	Lower	Lower

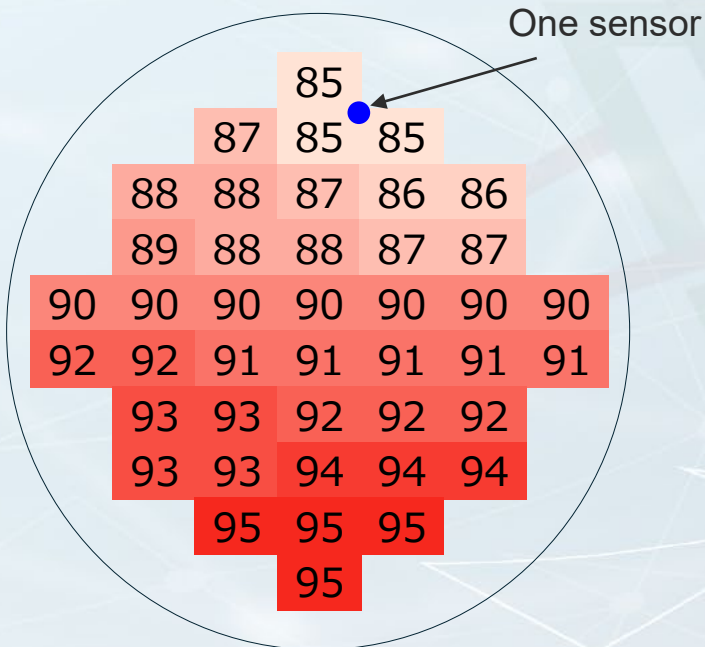
Feature of UTCS

*Uniformize Temp. Control System

Tj sensitivity of UTCS chuck is better than conventional chuck by multiple chuck temp. sensors

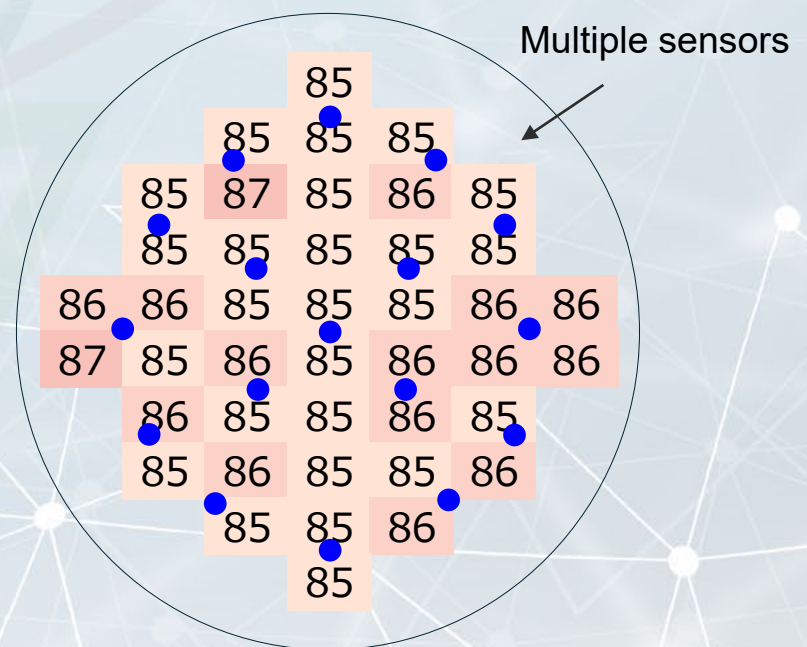
*The numbers are expected Tj (Image)

Conventional Chuck



Tj increases as the distance from the sensor increases

UTCS Chuck



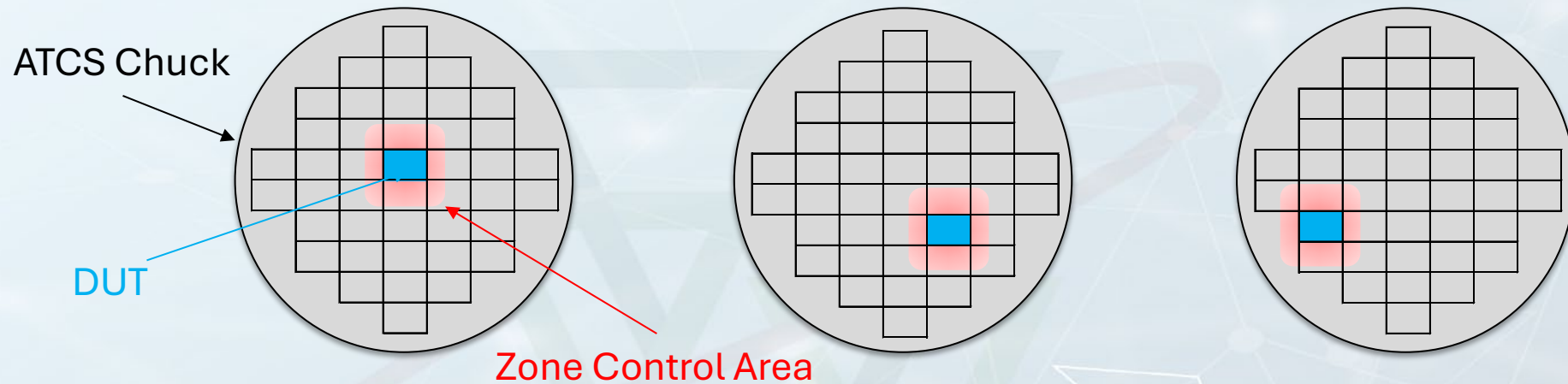
The temperature remains stable
because the sensor closest to the DUT is active

Feature of Wafer ATCS

① Zone Control System

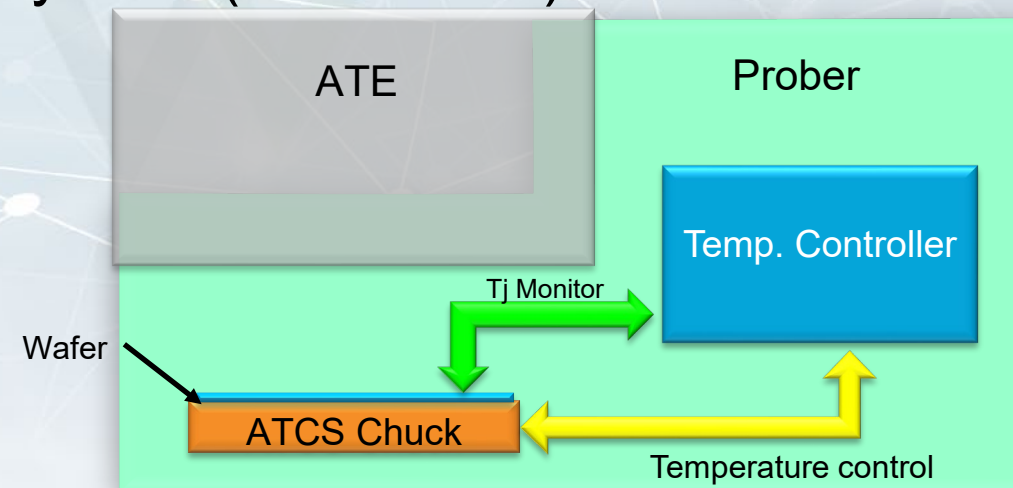
*Active Thermal Control System

Controlling chuck area just under DUT



② Tj (Device temp) feedback control system (DTF mode)

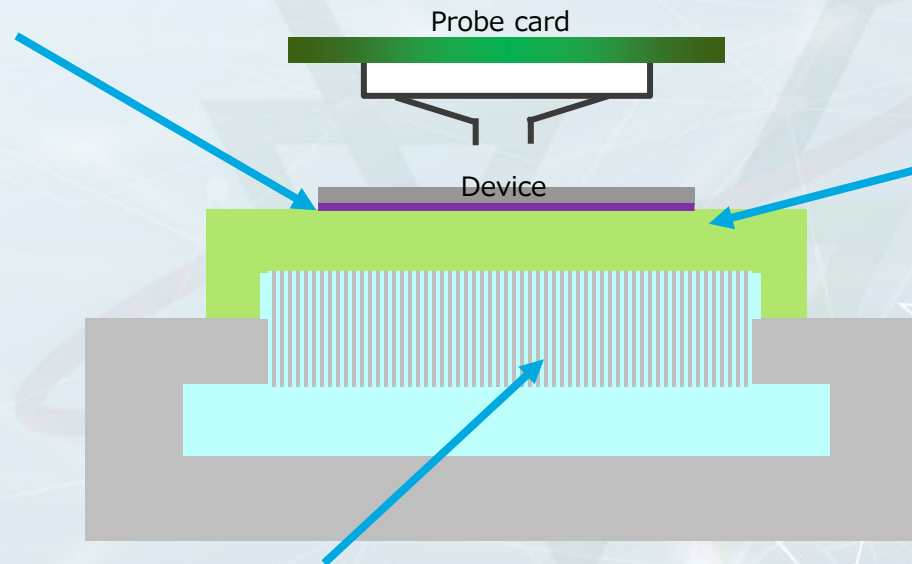
③ Rapid chuck temp control system



Feature of Device Level ATCS (TH)

- TIM between Device and Thermal Head

- ✓ Reduce Thermal Resistance



- Heater

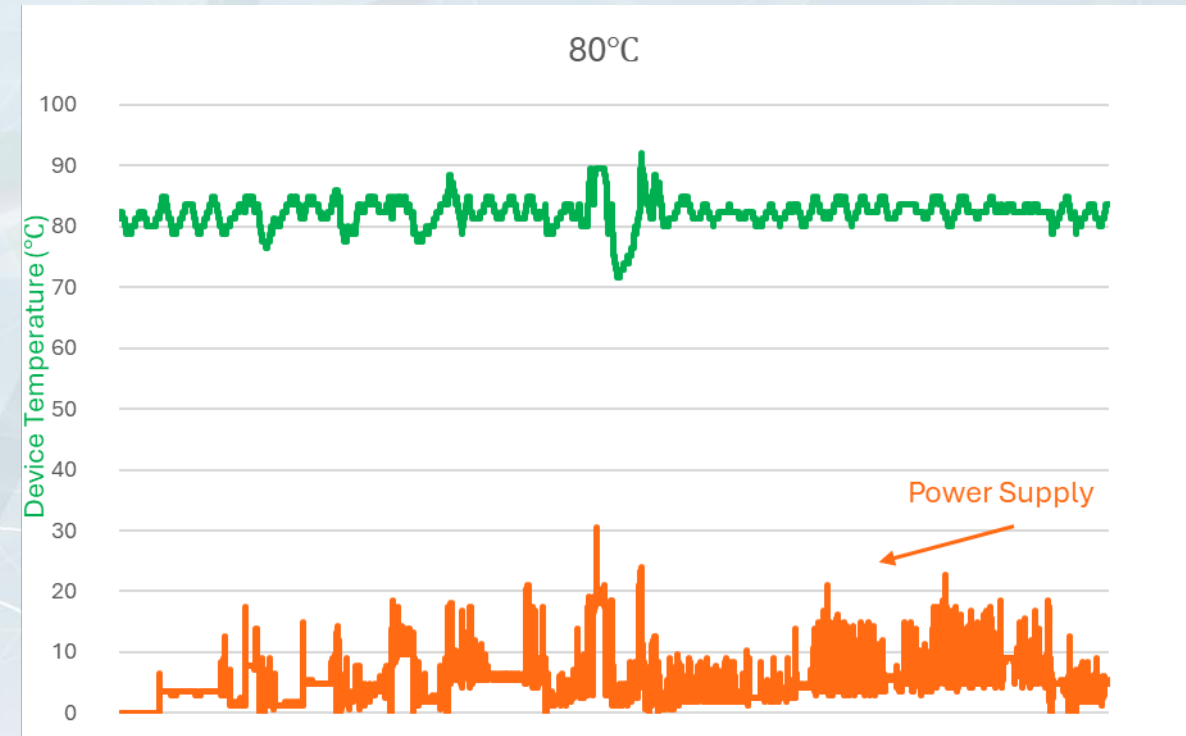
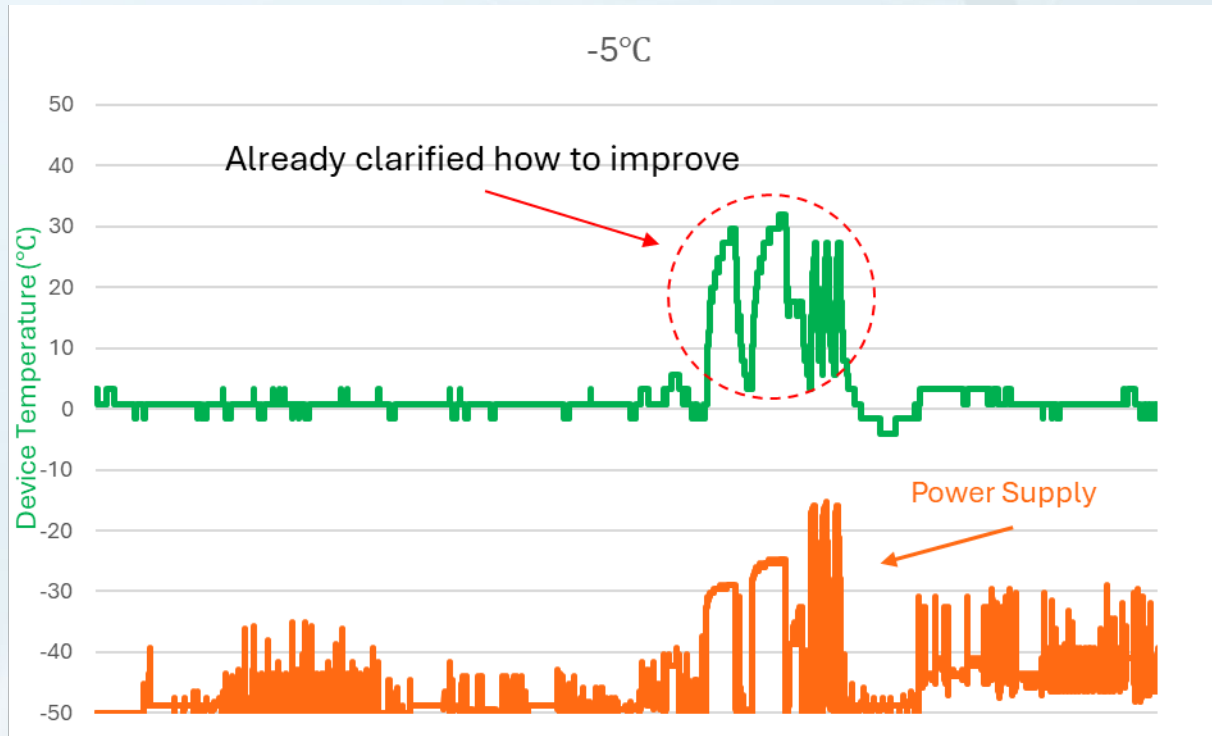
- ✓ High Heater Power
- ✓ High Thermal Conductivity
- ✓ Small Heat Mass

- Flow Distributer

- ✓ High Efficiency Cooling
- ✓ Cooling Uniformity

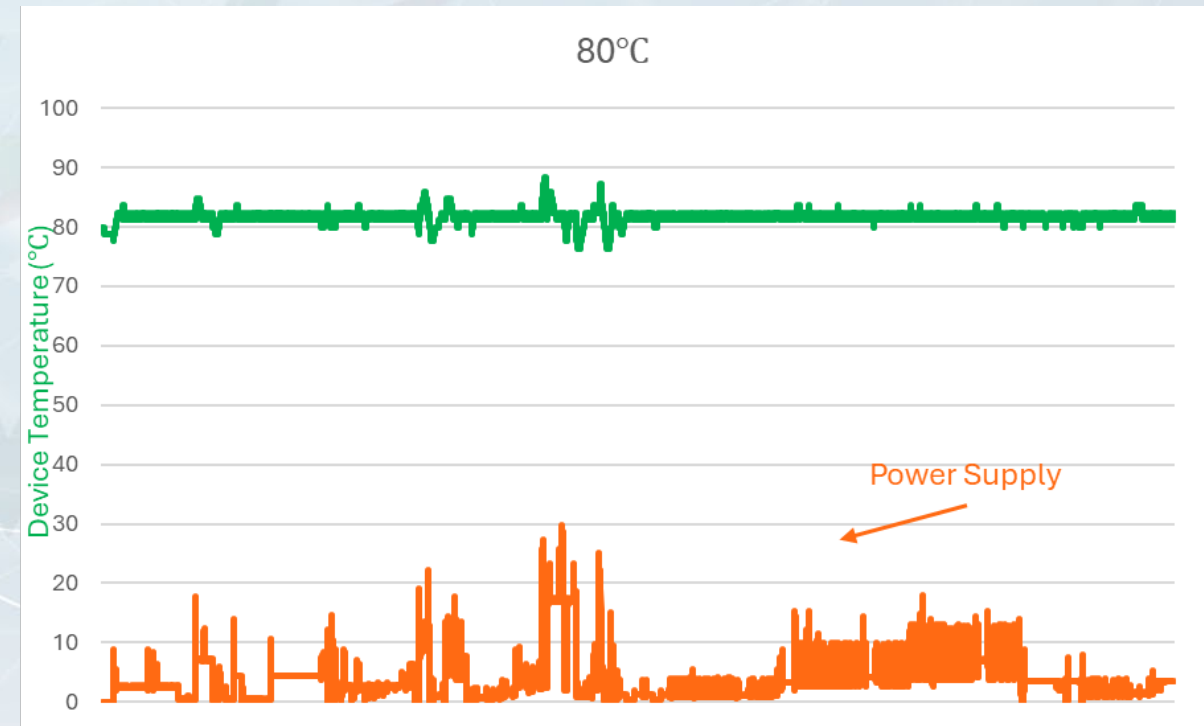
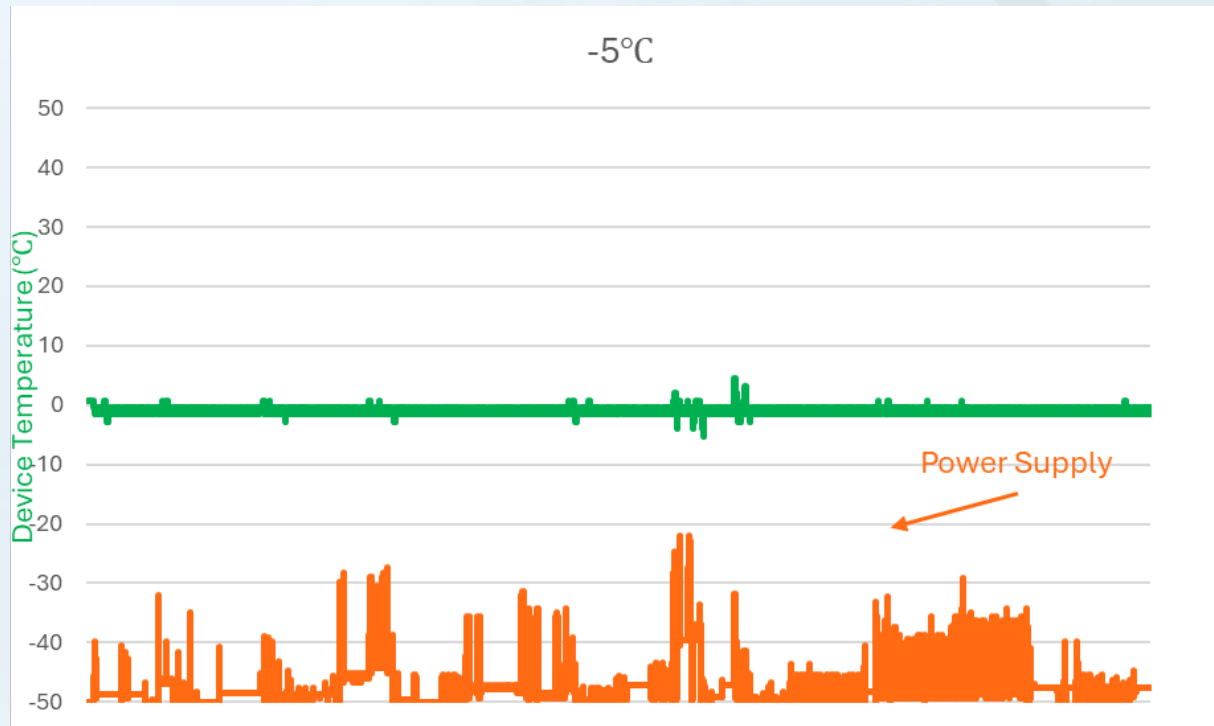
Wafer ATCS Data

Even supplying power, Device Temp. (T_j) is almost stable around set temperature
There are some unstable portion, but it is clarified to improve with the developing next Gen. Wafer ATCS



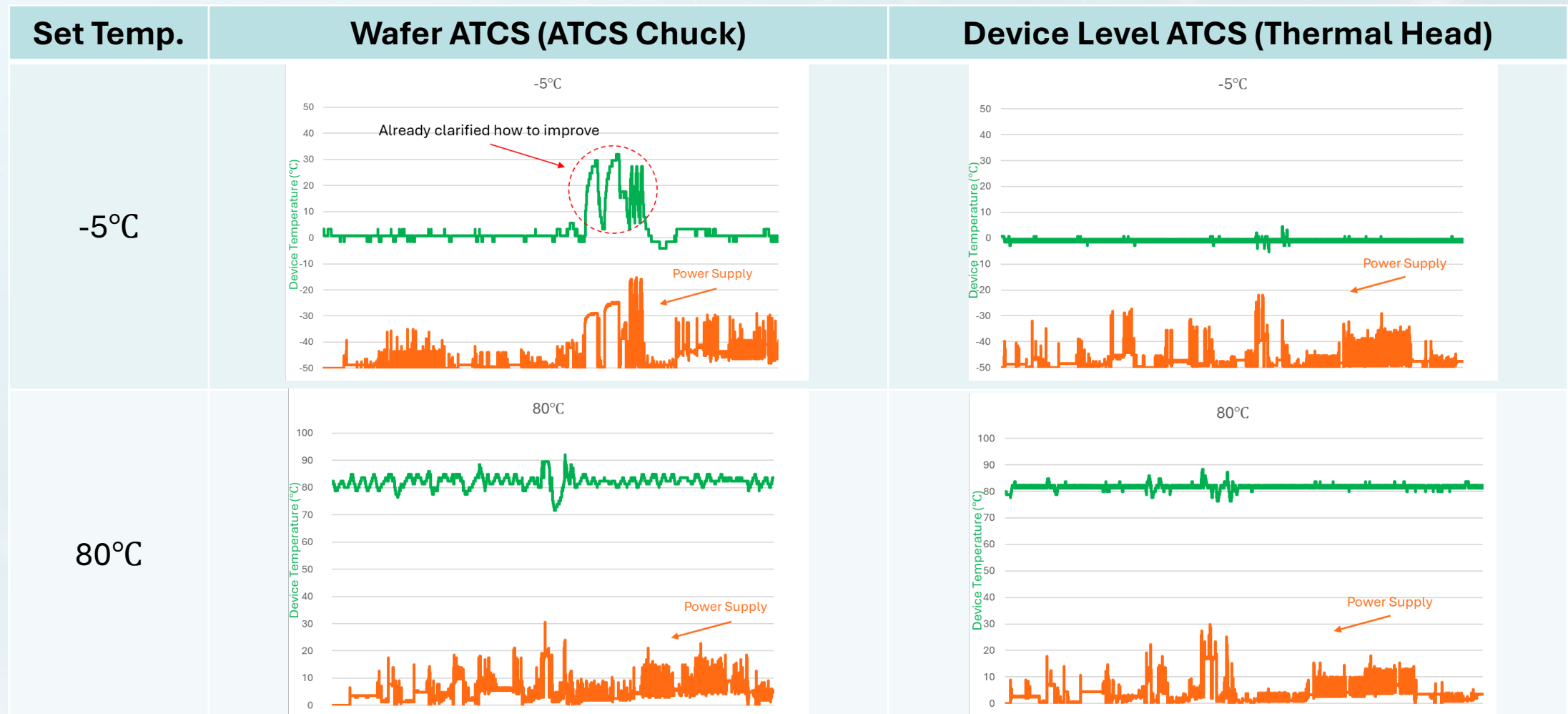
Device Level ATCS (TH) Data

Thermal Head control Device Temp. (T_j) quickly according to supplied power and stable around set temperature



Device Temp Data Comparison

Wafer ATCS could control Device Temp. and stable but comparing with Device Level ATCS, Device Level ATCS is more stable



Summary

- **TEL have verified ATCS (Active Thermal Control System) for Wafer and Device Prober could work well**
- **ATCS is necessary for higher power testing for high-end device testing**
- **Wafer ATCS is already effective for high power testing and TEL is developing improved Wafer ATCS solution**
- **Since Thermal Head heat dissipation capability is higher than Chuck, Device Prober must be effective higher power testing**

Future Activities

- **TEL keeps improving ATCS chuck and Thermal Head heat dissipation capability and thermal control capability**
- **Also keep trying to make sure which solution is effective for what type of testing**

Special Thanks

Xin-Reng Foo - AMD Singapore

Francis Treyes - AMD Singapore

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