POSTER #16

Adjusting Device Temperature Measurement using a Thermocouple Probe Card

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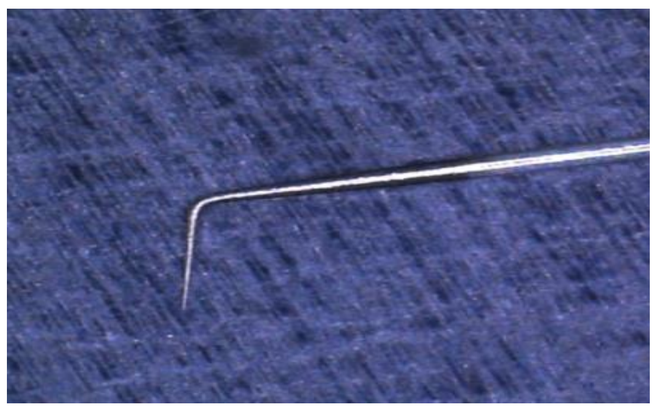
Nidec SV Probe

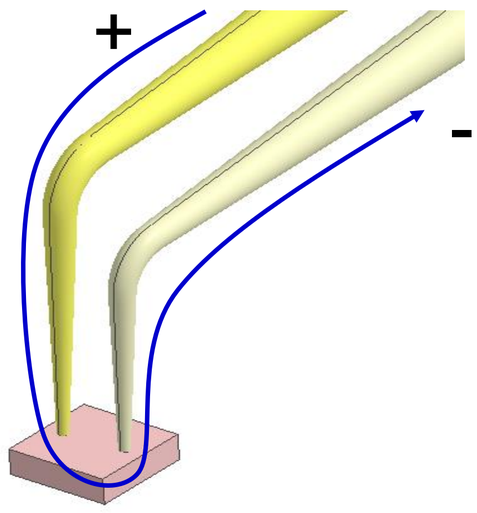
ABSTRACT

Adjusting Device Temperature Measurement using a Thermocouple Probe Card

In a test environment, temperature distribution across the wafer can cause issues due to varying test temperature between the chips. Without temperature sensors integrated into the device, it is necessary to perform chip temperature measurements with the probe card and adjust those measurements on the fly based on the results.



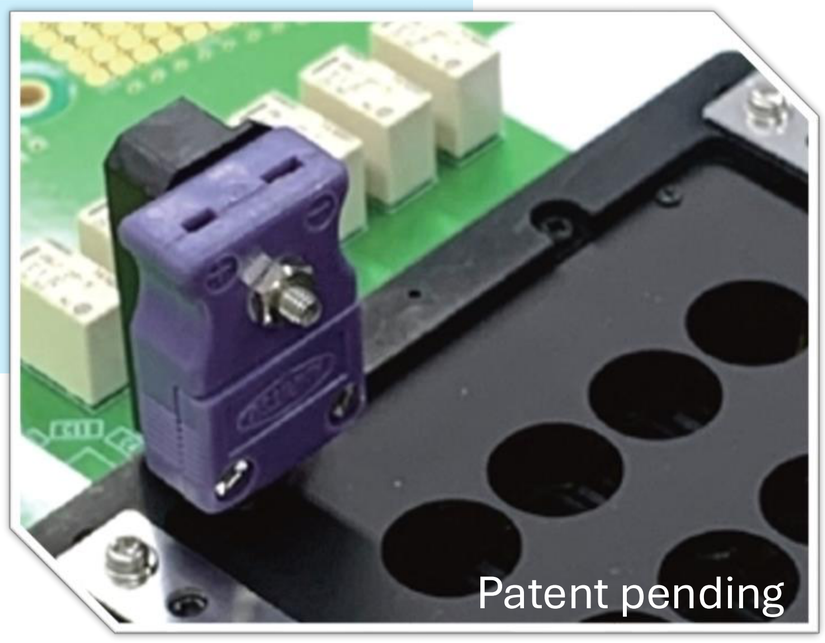
We will explore this temperature measurement challenge and how a probe card developed with thermocouple functionality can be utilized to make measurement decisions faster and easier.
We will also discuss the results from our evaluations of temperature measurement accuracy.



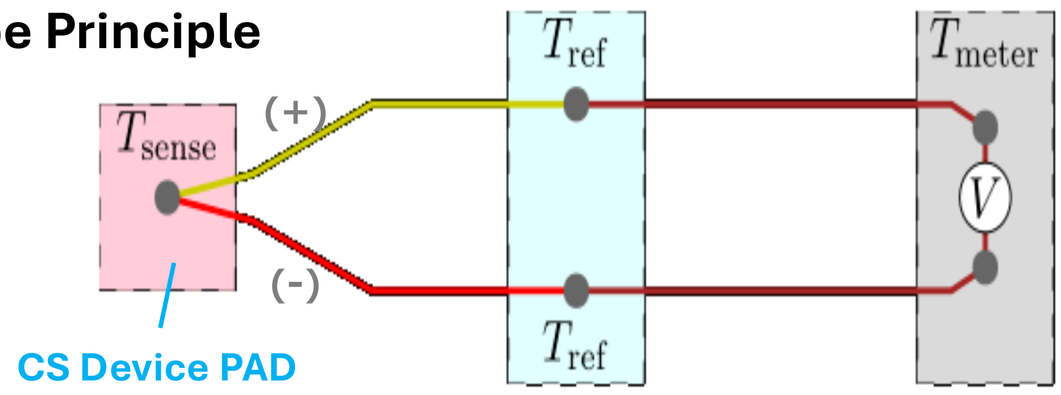
- ✓ **On the fly measurement of the actual chip temperature during device operation**
- ✓ **Measurement of temperature distribution in the wafer surface**
- ✓ **Calibration of prober chuck temperature**

The Concept of TC (Thermocouple) Probe Card ①

- **Type E, Class 1**
- **Range： -40℃～200℃**
- **Accuracy : ±1.5℃（Type E nature accuracy)**
- **Requirement.1 Customer must have Type E data logger**

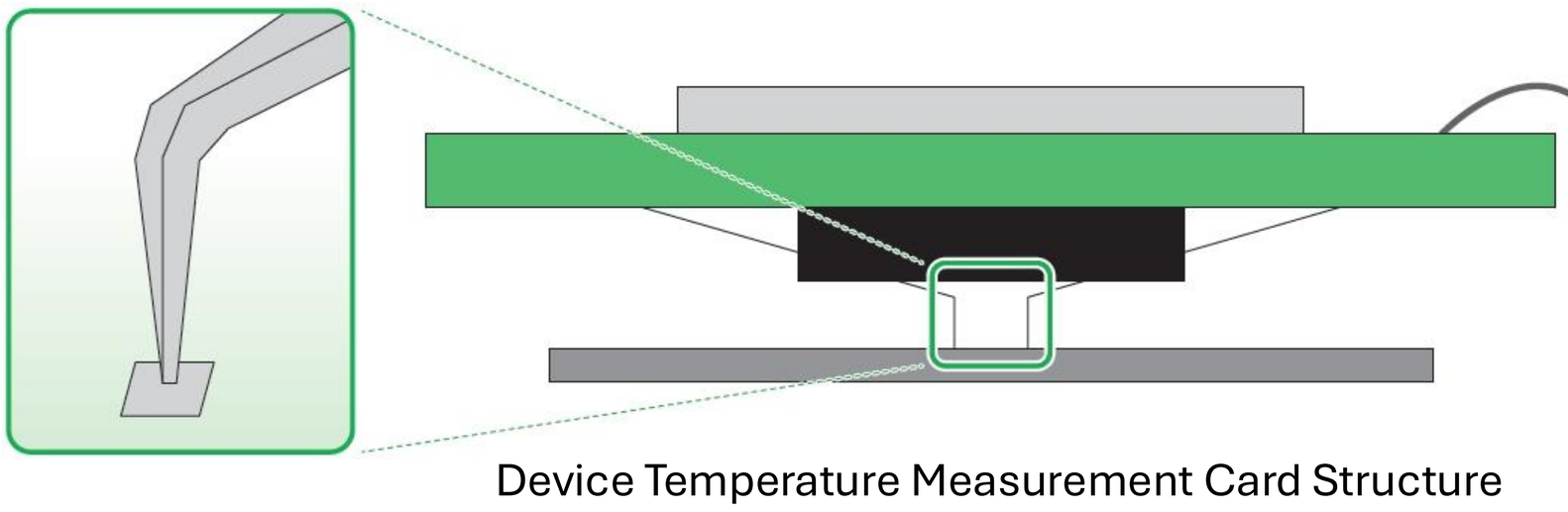


TC Probe Principle



Result to tester
- *WiFi*
- *GPIB*

Card Configuration

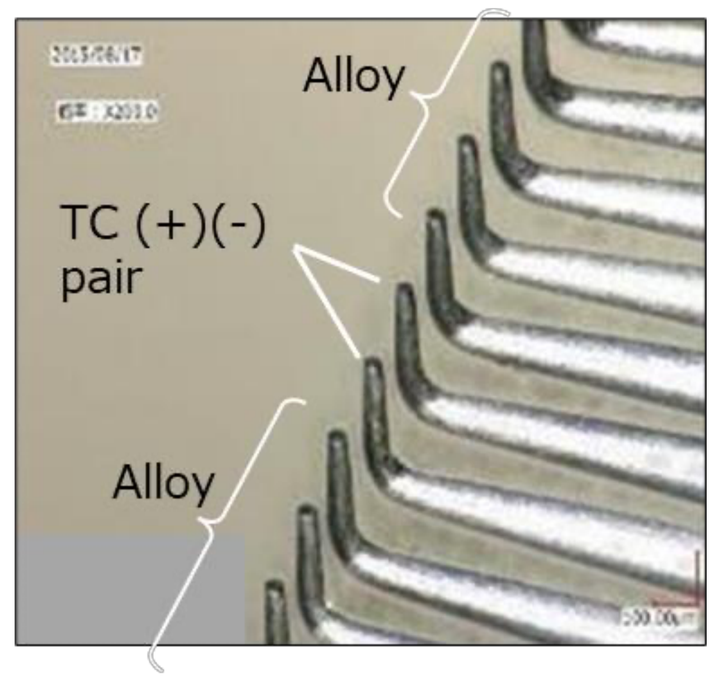


Device Temperature Measurement Card Structure

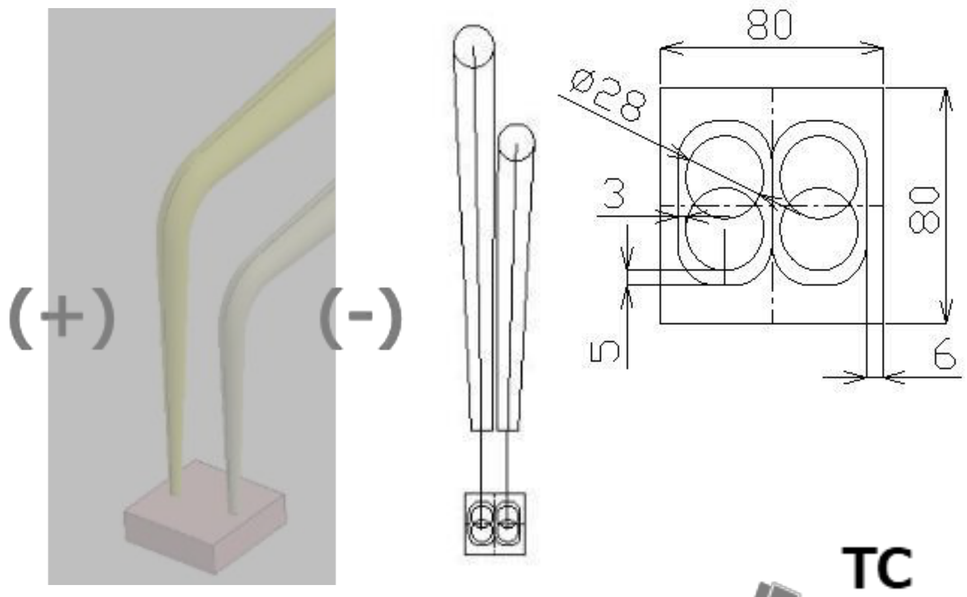
Data Logger (Prepared by customer)

The Concept of TC (Thermocouple) Probe Card ②

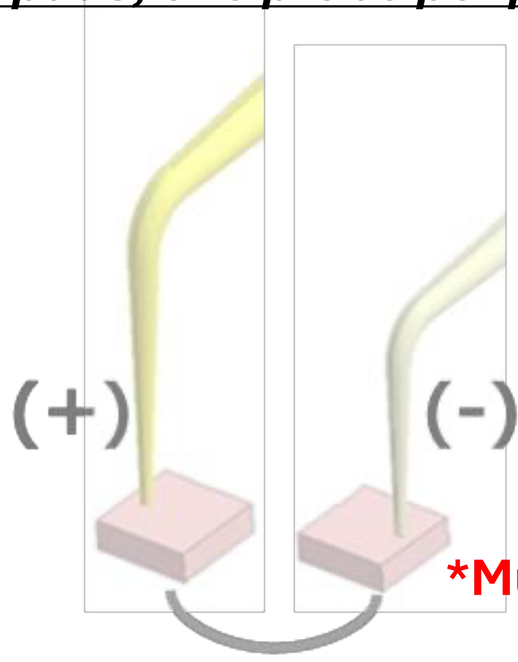
- Signal, Power and GND　Metal Alloy probe
- Dummy pad or any pad　TC Probe



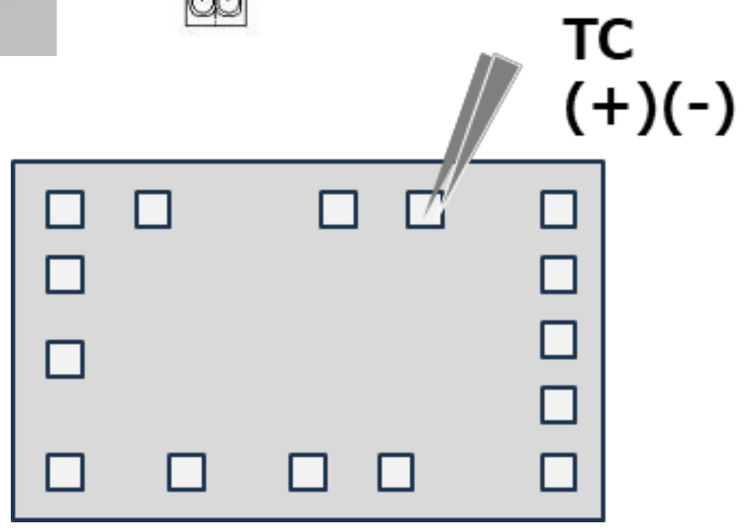
One pad, two probes

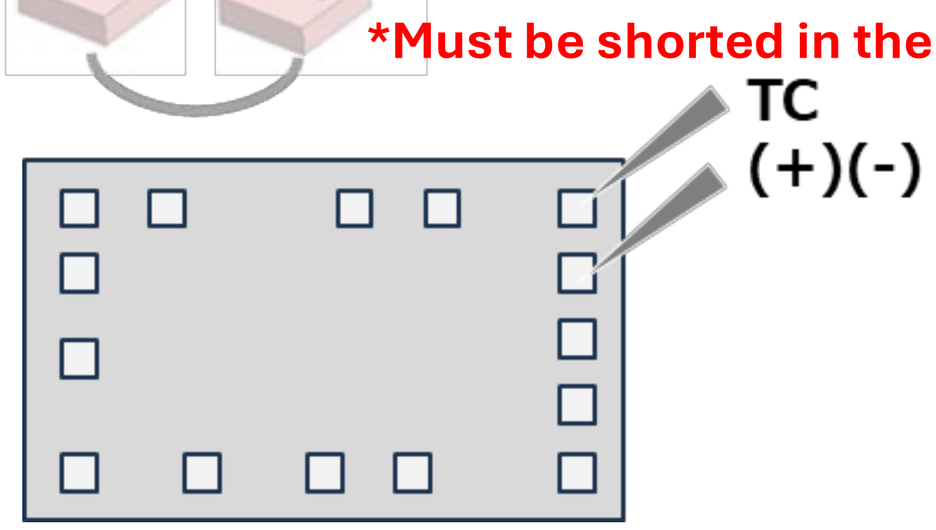


Two pads, one probe per pad

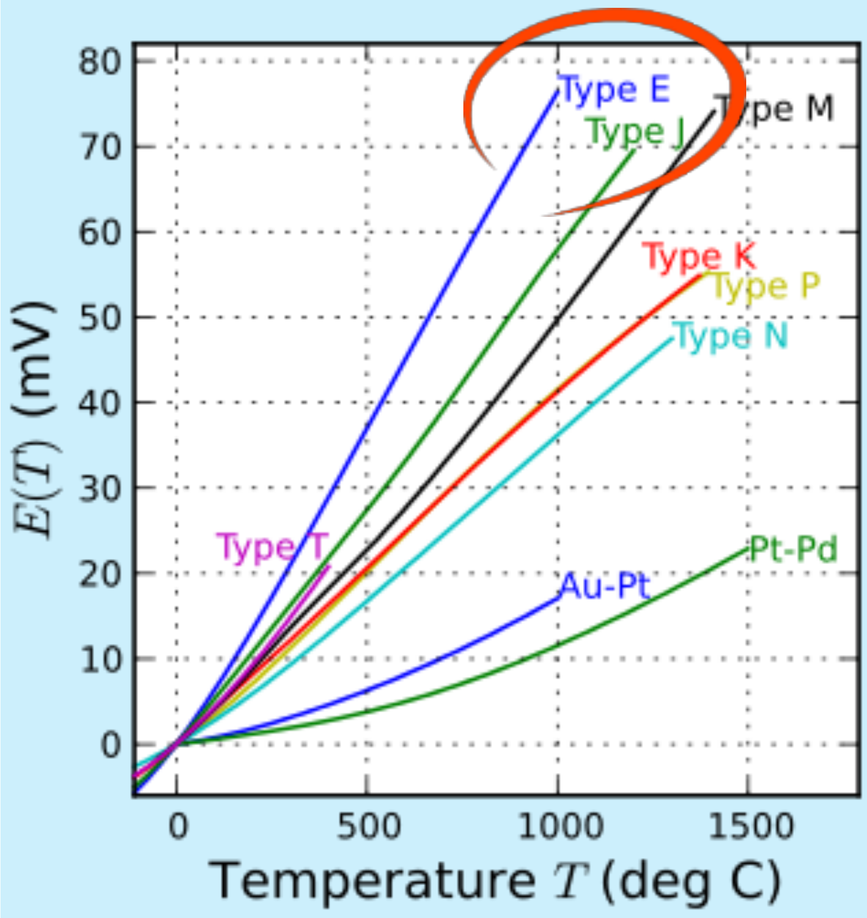


***Must be shorted in the devise**





Thermocouple Type E general specification



Thermocouple Type E Technical Details

Thermocouple E type has a very high EMF output of 68 µV/°C which provides a strong signal for instrumentation and a high accuracy. Type E is also non-magnetic. It is very rare thermocouple type and is not used as much as the other types of thermocouple.

Type E Thermocouple Temperature Range

Continuous:

0 to +800 °C

Short Term:

-40 to +900 °C

Type E Thermocouple Material

Chromel

Constantan

Type E Thermocouple Tolerance Details

Tolerance Class 1

-40 to +375 ± 1.5 °C

375 to 800 ± 0.004*[t]°C

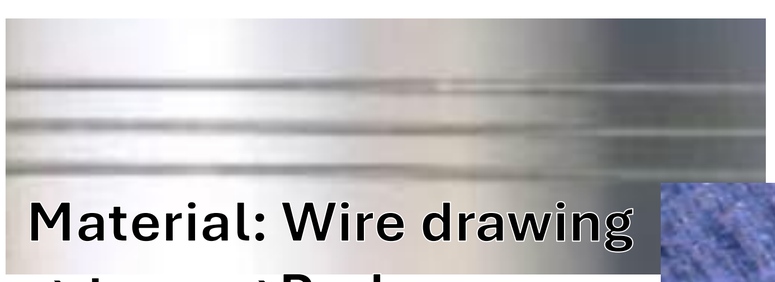
Tolerance Class 2

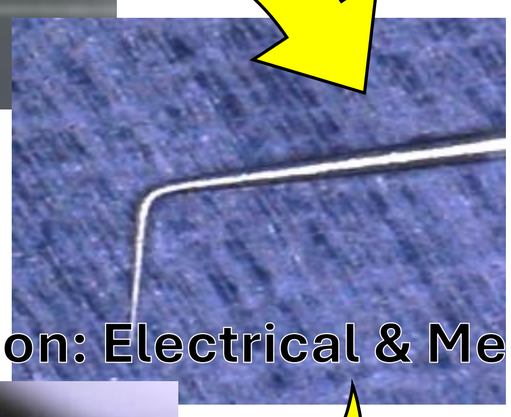
-40 to +333 ± 2.5 °C

333 to 900 ± 0.0075*[t]°C

SV – TC(Thermocouple) Probe

- **Evaluation process**





Evaluation: Electrical & Mechanical

Evaluation: Probe card

Objective

- Temp. measurement accuracy
- Basic requirement as cantilever probe material
- Basic requirement as the probe card

Commercialization

Patent pending

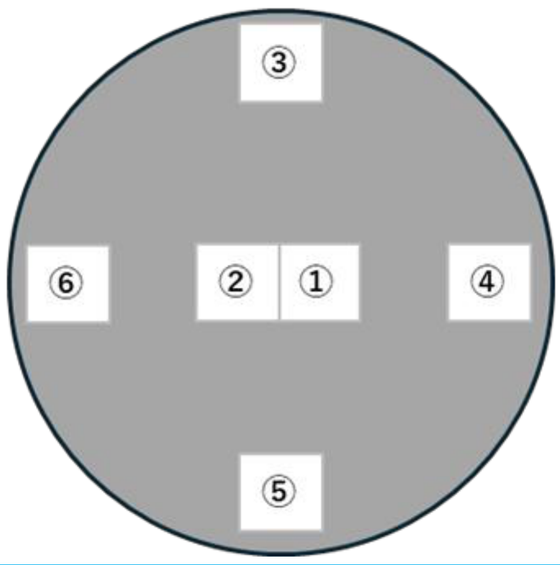
Evaluation: TC Probe Meas. Wafer Temp. distribution

Chuck Temp. : Set -40℃

Center	CH 1	Distribution Δ2.6℃	-40.5 ℃
	CH 2		-40.5 ℃
Edge	CH 3		-37.9 ℃
	CH 4		-39.0 ℃
	CH 5		-38.0 ℃
	CH 6		-39.1 ℃

SV probe lab.

UF3000-EX prober
- STD chuck
- Φ300mm Al WF 800um thickness
- Wait time 30 minutes
- Meas. 6 locations on WF



Chuck temp : Set 100℃

CH 1	Distribution Δ2.1℃	99.1 ℃
CH 2		99.0 ℃
CH 3		97.0 ℃
CH 4		98.2 ℃
CH 5		97.2 ℃
CH 6		98.0 ℃

Chuck temp : Set 0℃

CH 1	Distribution Δ1.6℃	-0.8 ℃
CH 2		-0.8 ℃
CH 3		0.8 ℃
CH 4		0.3 ℃
CH 5		0.6 ℃
CH 6		0.3 ℃

Chuck temp : Set 150℃

CH 1	Distribution Δ4.1℃	148.9 ℃
CH 2		148.6 ℃
CH 3		144.8 ℃
CH 4		147.7 ℃
CH 5		145.3 ℃
CH 6		147.1 ℃

☞ SV Lab prober UF3000-EX, observed some Δ
☞ WF edge Δ is larger than the middle

Summary

Adjusting Device Temperature Measurement using a Thermocouple Probe Card

- ✓ *On the fly measurement of the actual chip temperature during device operation*
- ✓ *Measurement of temperature distribution in the wafer surface*
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Utilized Thermocouple Type E to match with metal alloy probe

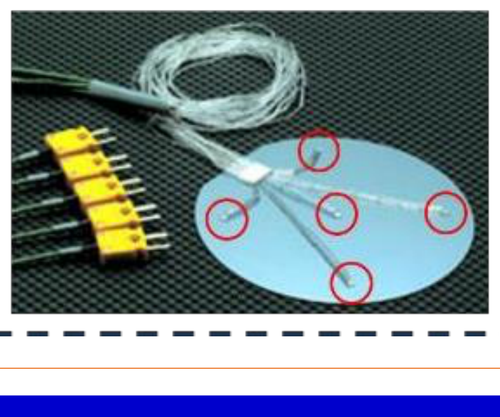
- ✓ *Accuracy ±1.5℃from native Type E specification*
- ✓ *Min pitch 70um*
- ✓ *1.8gf@60umOD*
- ✓ *Temp. -40 to +200℃*

Requirement

- ✓ *TC probe touchdown on one pad or two pads connected in device*
- ✓ *Interface to Data logger on PCB top*
- ✓ *Data logger*

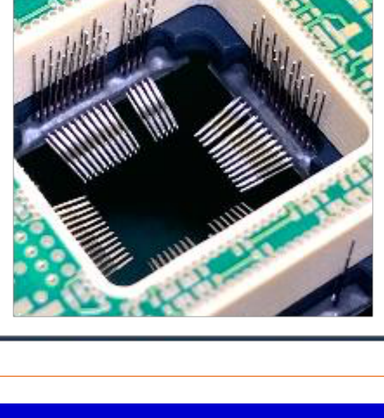
•*In general*

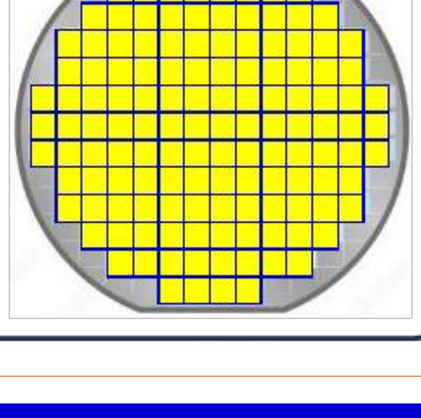
Ta = Prober Chuck Temp. = Prober Set
Tj = Never know
Preparation → Maintenance data w Dummy WF



•*TC Probe advantage*

Tj = Measure it on the fly every TD





Contact

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