
TestConX中国™
China
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Contact Probe CCC Study and Application

Terry Wang
Infineon Technologies

Tomohiro Yoneda
NHK Spring

Hongzhen Zhao
Testpro Singapore

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Suzhou ▪ October 23, 2018
Shenzhen ▪ October 25, 2018

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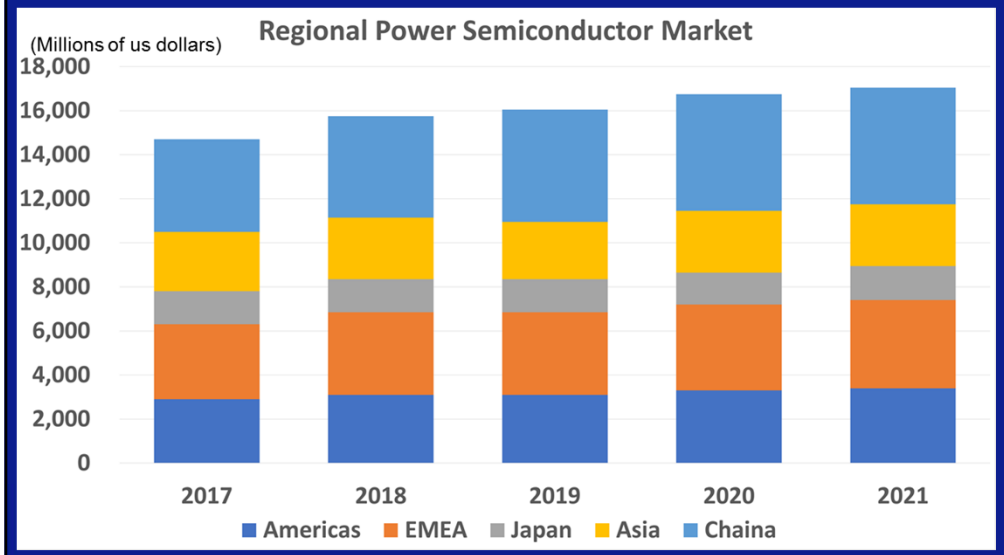
Power Semiconductor Market Trend



Source: IHS Markit, Feb 2018

1. The power semiconductor market grows steadily.

2. Industry and automotive will be a driving force for the future.

3. By region, China is the highest growth rate, meanwhile Europe and the United States are expected to grow high.

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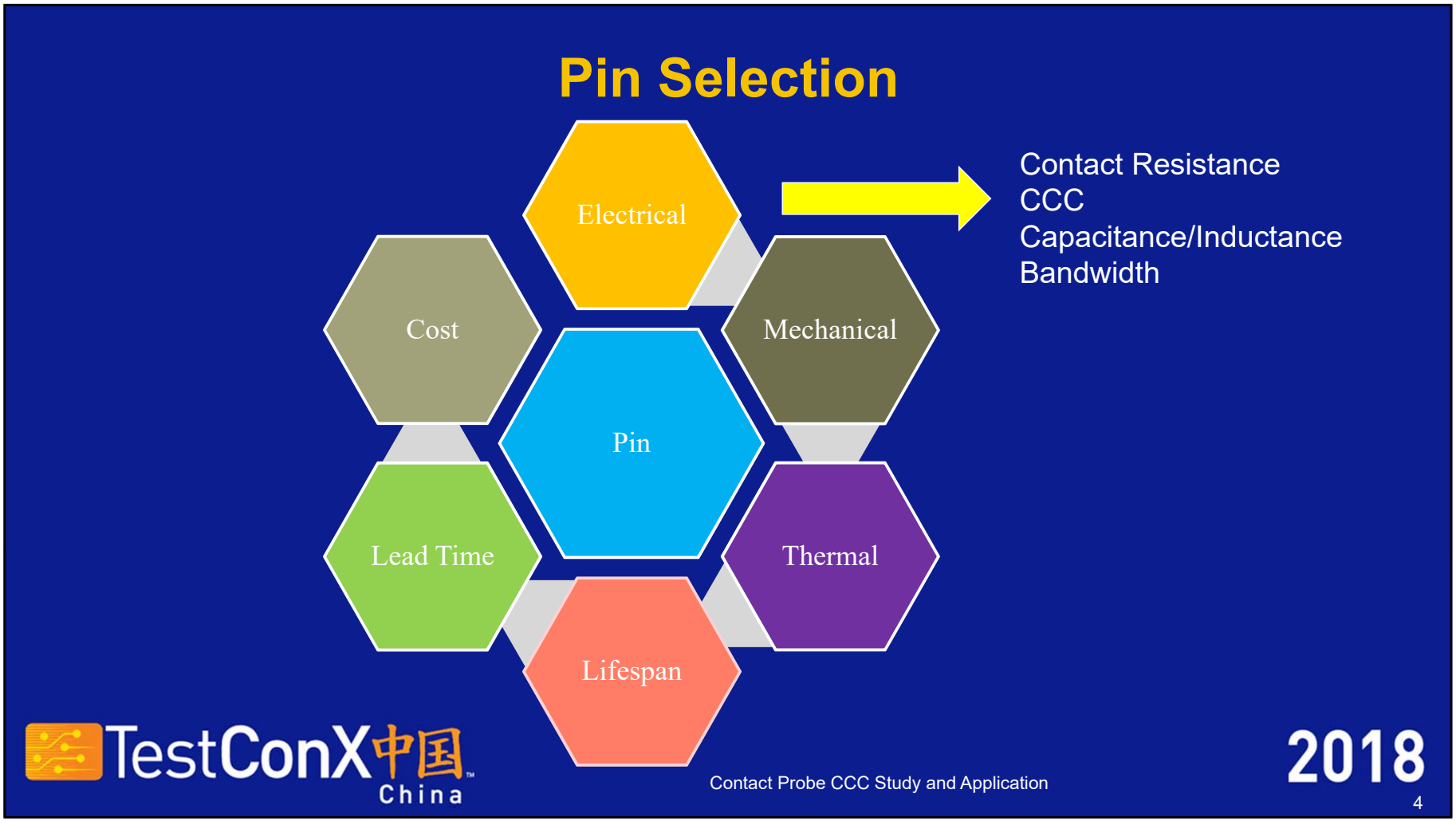
Pin Selection
Electrical
Cost
Mechanical
Pin
Lead Time
Thermal
Lifespan
Contact Resistance
CCC
Capacitance/Inductance
Bandwidth
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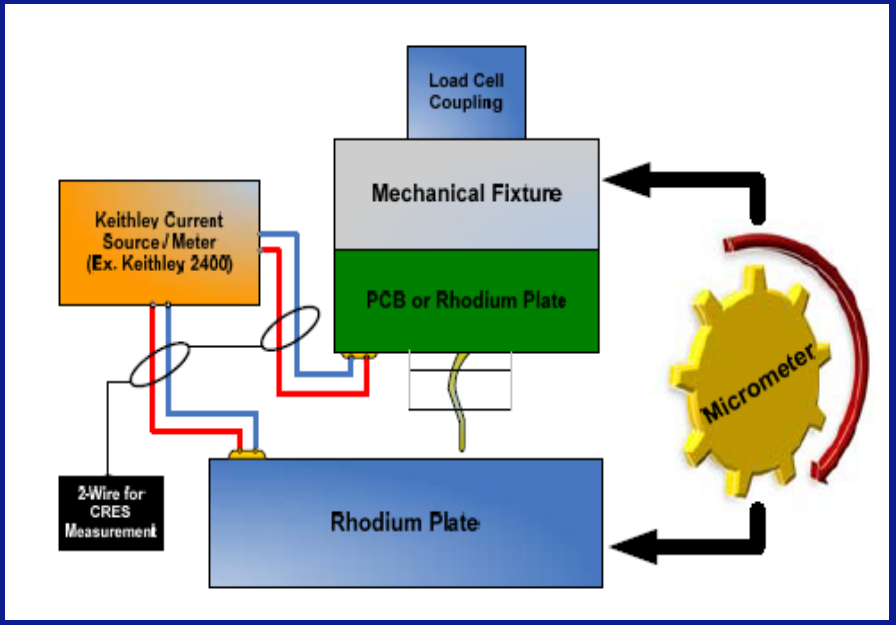
Current Carrying Capability

- Definition: CCC, Current Carrying Capability
- CCC is the most important factor that influences the test capability and stability of contact pins

Standard CCC Measurement Method - by Force

ISMI Measurement Method:

At nominal overtravel, DC current is applied to the probe for 2 minutes, then removed. A force measurement is taken at least 10 seconds after the current is removed. The current is then incremented and the cycle repeated until the probe spring force is reduced by 40%. The CCC rating becomes the average of all readings at which a permanent 20% force reduction is measured.



Vertical Probes

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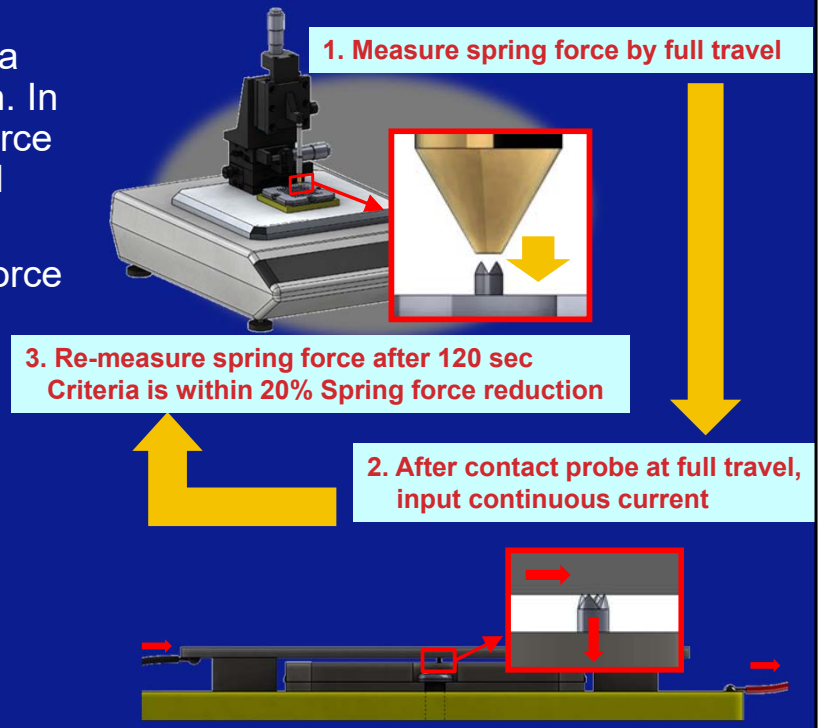
NHK CCC Measurement Method – by Force

NHK measurement conditions:

The failure signature decided for the CCC value is a permanent reduction of the spring force of the spring pin. In most cases, there is a direct relationship between the force applied for the pin to the pad and the quality of electrical contact.

NHK declare the pin is end of life if the pin spring force is reduced by 20% for the nominal overdrive settings.



NHK measurement setup:

- ✓ Plunger material: Alloy
- ✓ Test temperature: 25°C
- ✓ Current loading time: 120 sec continuous
- ✓ Housing material: Peek
- ✓ CCC: Spring force 20% reduction

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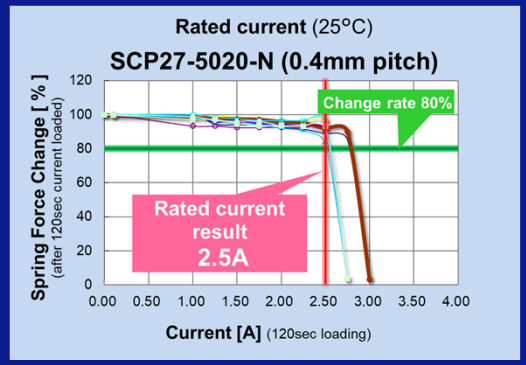
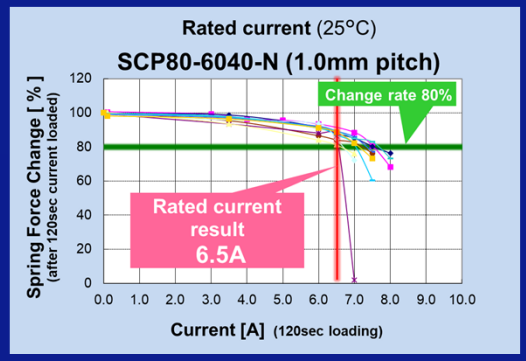
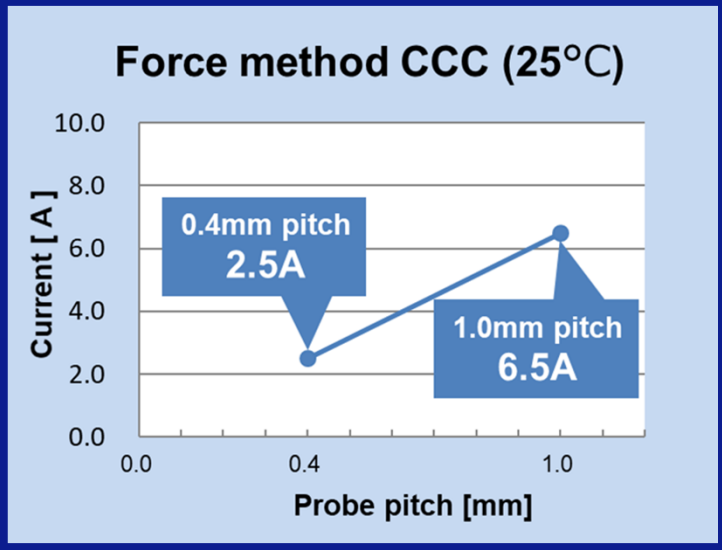
CCC Measurement Method – by Force





NHK measurement result (25°C)

- ✓ 0.4 mm and 1.0 mm-pitch pin
- ✓ DC current



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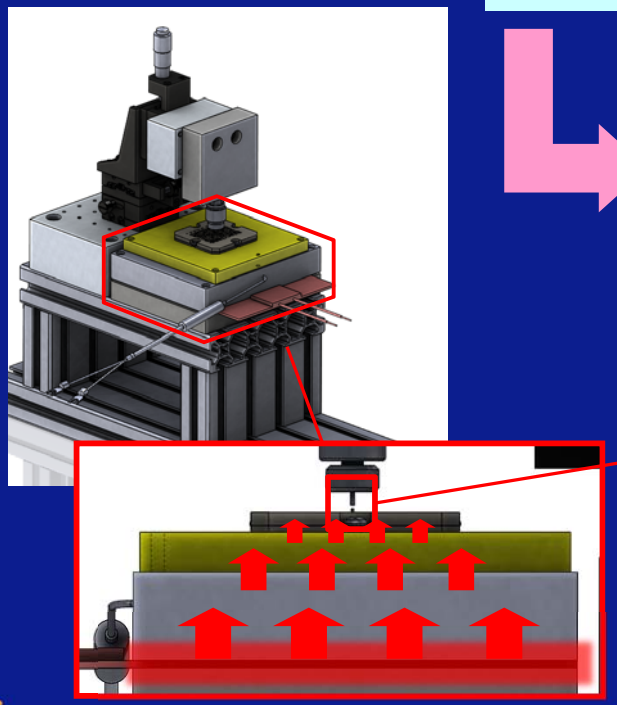
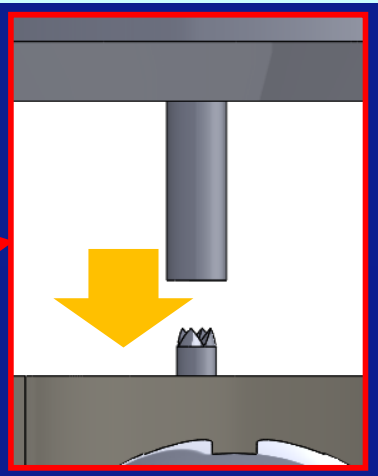
CCC Measurement Method – by Force at 150°C

1. Heater warms Hot plate, Au plate, and Probe

Heater temperature set @ 200°C



2. After heating up, full travel probe
3. Input continuous current



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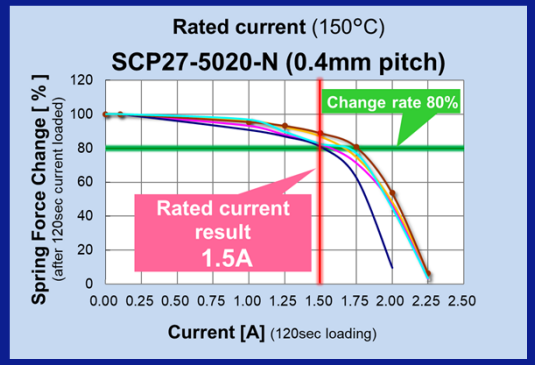
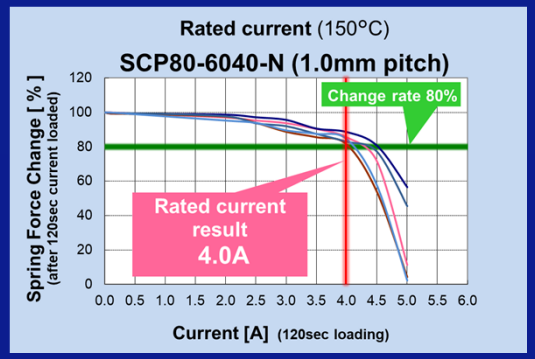
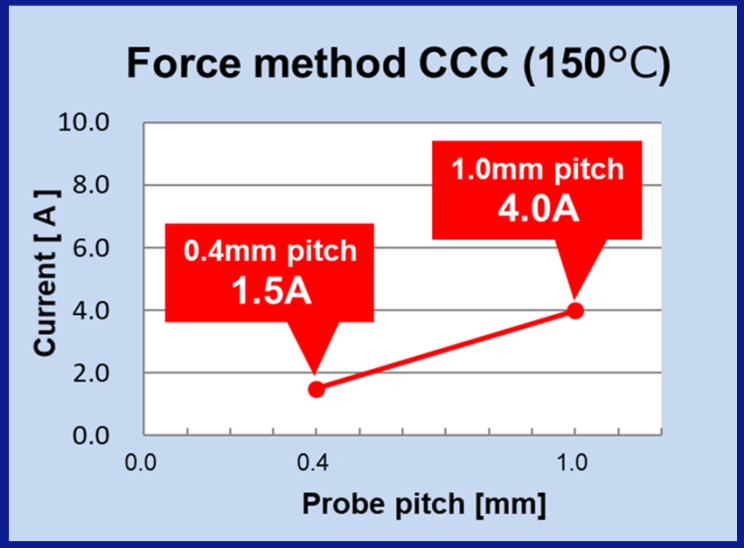
CCC Measurement Method – by Force at 150°C





NHK measurement result (150°C)

- ✓ 0.4 mm and 1.0 mm-pitch pin
- ✓ DC current



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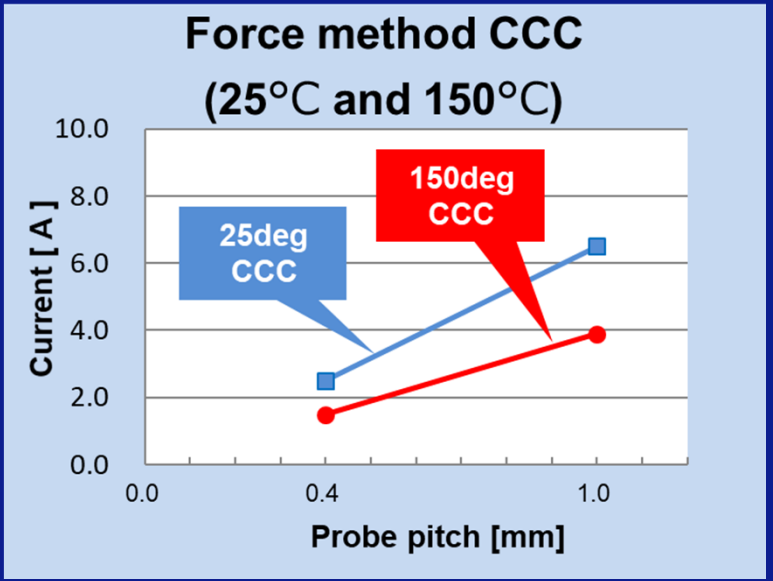
CCC Measurement Method – by Force

NHK measurement result (Comparison)

- ✓ 0.4 mm and 1.0 mm-pitch pin
- ✓ DC current



CCC value is observed 20% to 40% lower in the 150 °C compare to 25 °C

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CCC Measurement Method – by Temperature

Temperature Increase (20°C rising)

In the automotive or power IC industry, there is another common practice, CCC value is measured based on the 20°C rising up.

Why it's not 30°C or 40°C? For automotive or power IC products, the test temperature is required to be at 150°C, if temp raising too much, the traditional surface plating layer of the IC chips pad/leads will be softened, there is risk of Copper-exposed. 20°C is considered a safe and reasonable number.

CCC Measurement Method – by Temperature

NHK measurement setup:

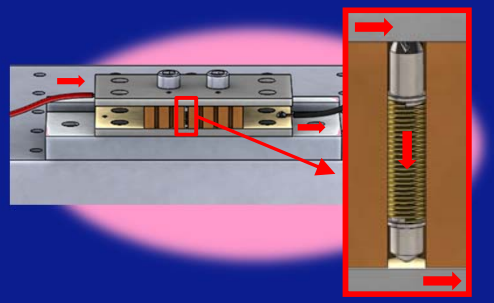
Power source spec

- ✓ Spec.: ±20 A 20 V
- ✓ Minimum current: 0.1 mA
- ✓ Minimum pulse: 0.1 msec step

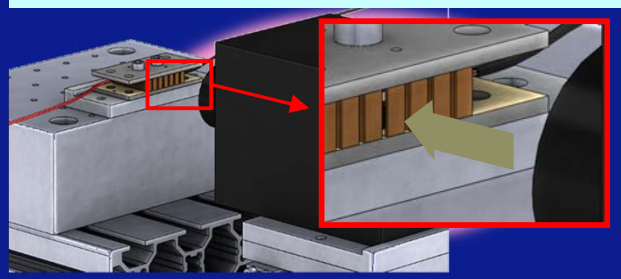
Infrared (IR) camera property

- ✓ Sampling: 60 fps
- ✓ Minimum resolution: 30 μm

1. Measure spring force by full travel



2. Observe Temperature change under Infrared (IR) camera



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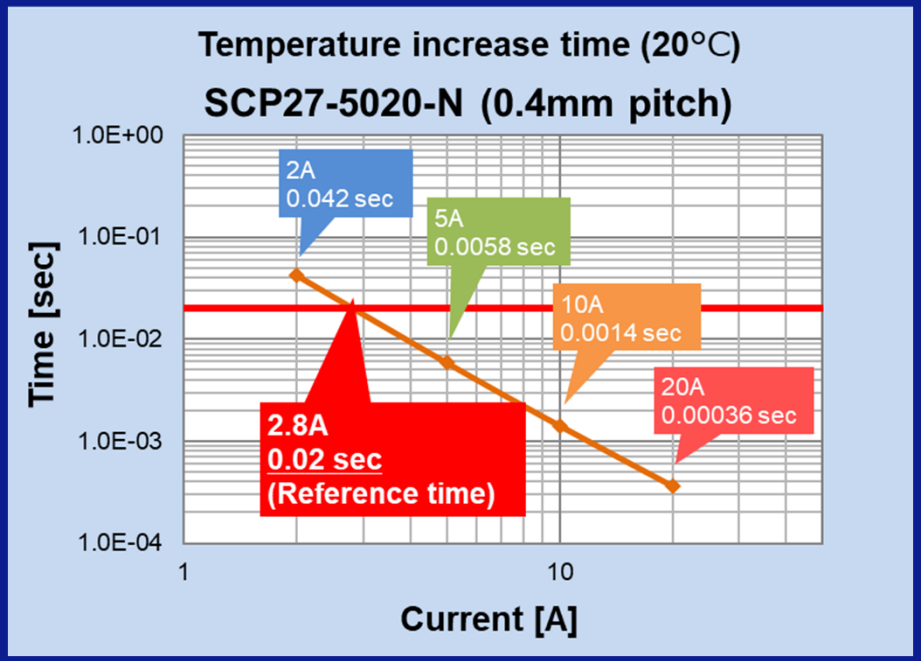
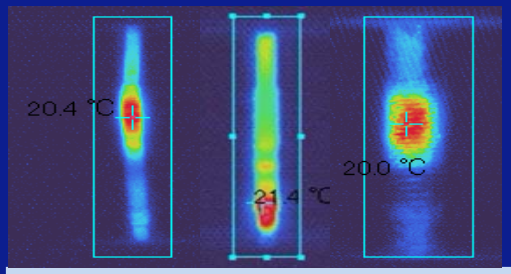
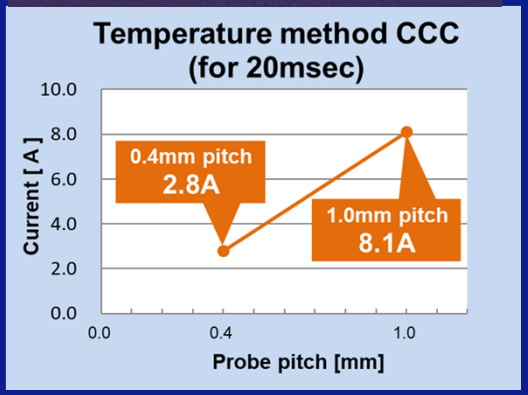
CCC Measurement Method – by Temperature

Plot the time at increasing 20℃ of each current



Monitor temperature using IR camera





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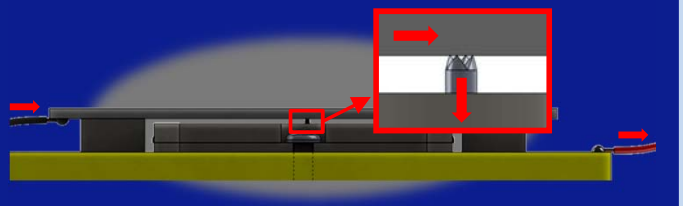
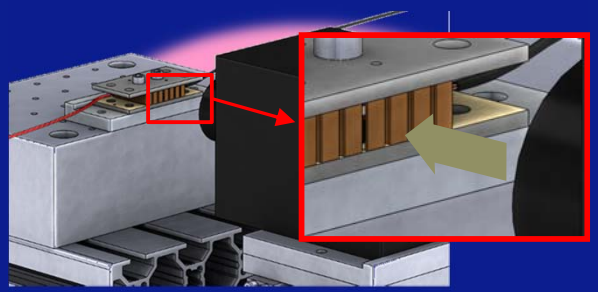
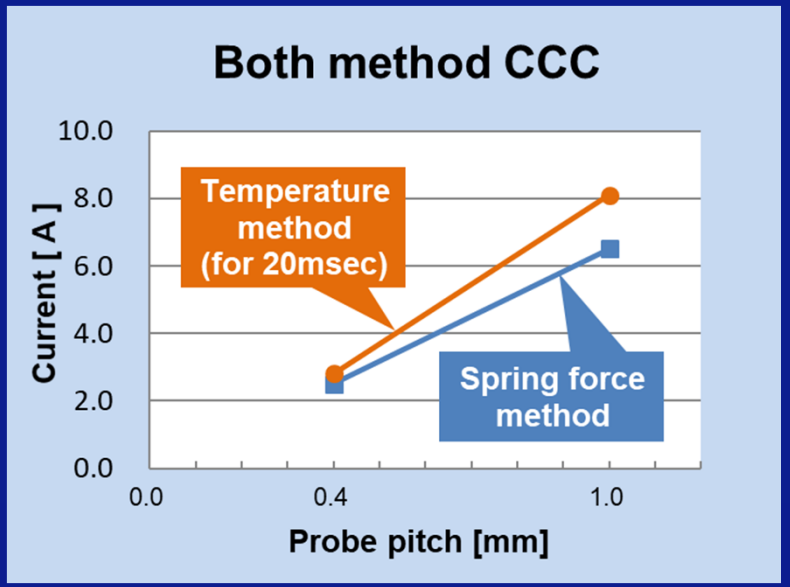
CCC Difference Between The Two Methods

Spring Force-method CCC



Temperature-method CCC





The CCC value can be different if using the different rising time

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Effect of Pin Tip Shape on CCC Value

1. The pin tip shape is not affecting the CCC value
2. The CCC value is in direct proportion to pin pitch

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Summary

1. There are two common CCC measurement methods, by force and by temperature
2. The CCC value goes down as temperature goes up
3. The CCC is nearly linear increasing according to pin size
4. The pin tip shape doesn't effect the CCC because the failure is with spring instead of pin tip

Future Plan

1. To study the CCC result at the cold temperature
2. To study the pin structure's effect on the CCC value
3. To verify if the pin count's effect on the CCC value