SWTEST ASIA
PROBE TODAY, FOR TOMORROW

100+K ULTRA HIGH PIN COUNT PROBE CARD

MPI

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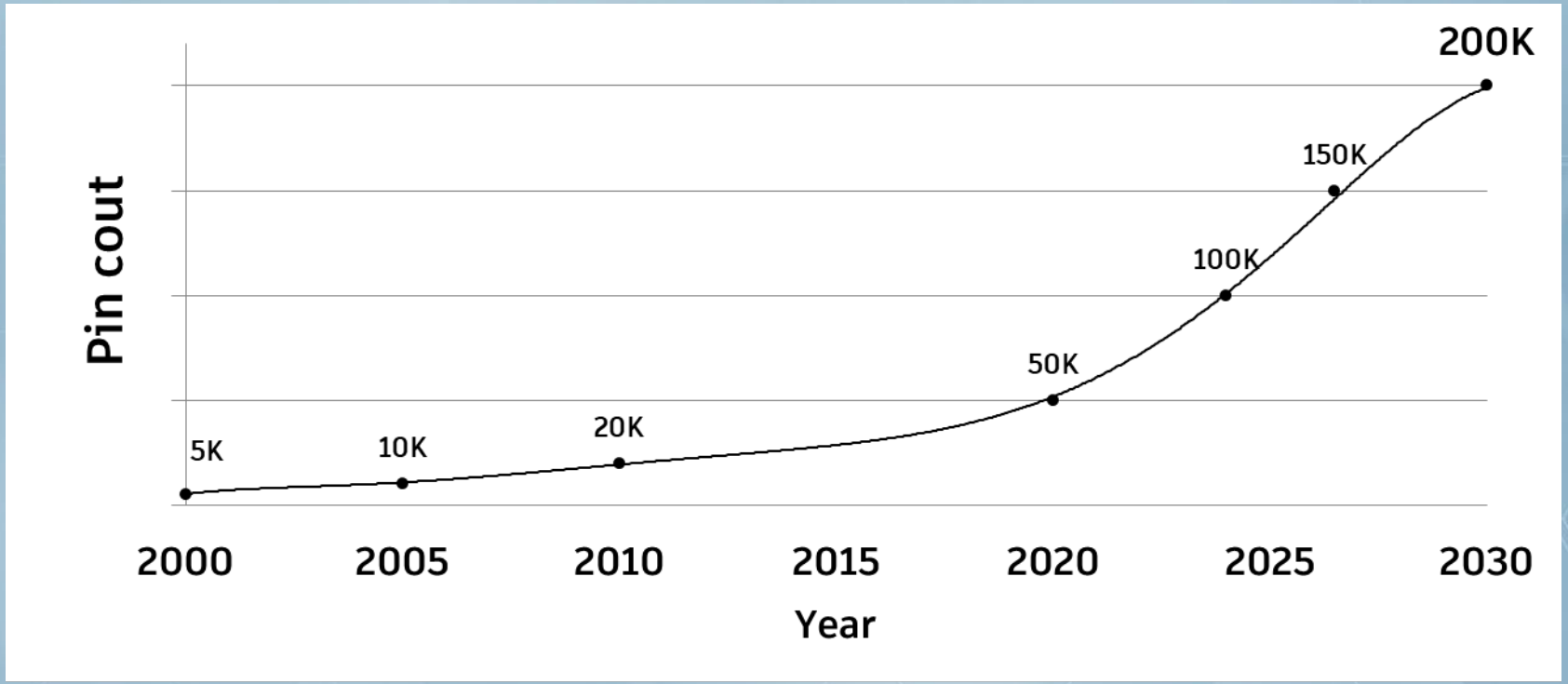
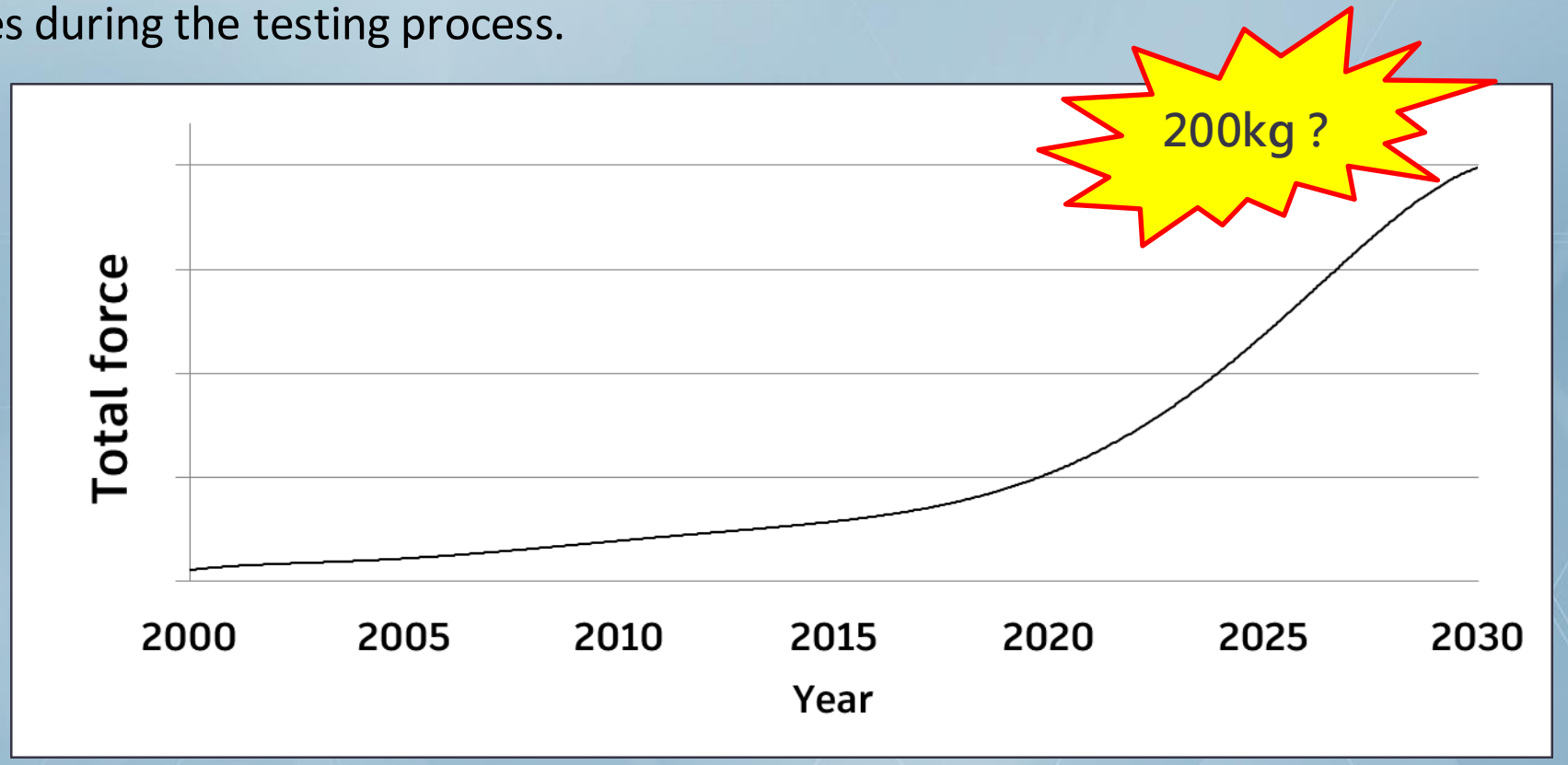
Market Status

With the semiconductor industry's increasing demand for more efficient testing, there has been a clear upward trend in the number of concurrent tests on probe cards. Consequently, the pin count has risen year by year, with a particularly rapid increase in recent years. By 2025, the demand is projected to reach 100,000 pins for testing.

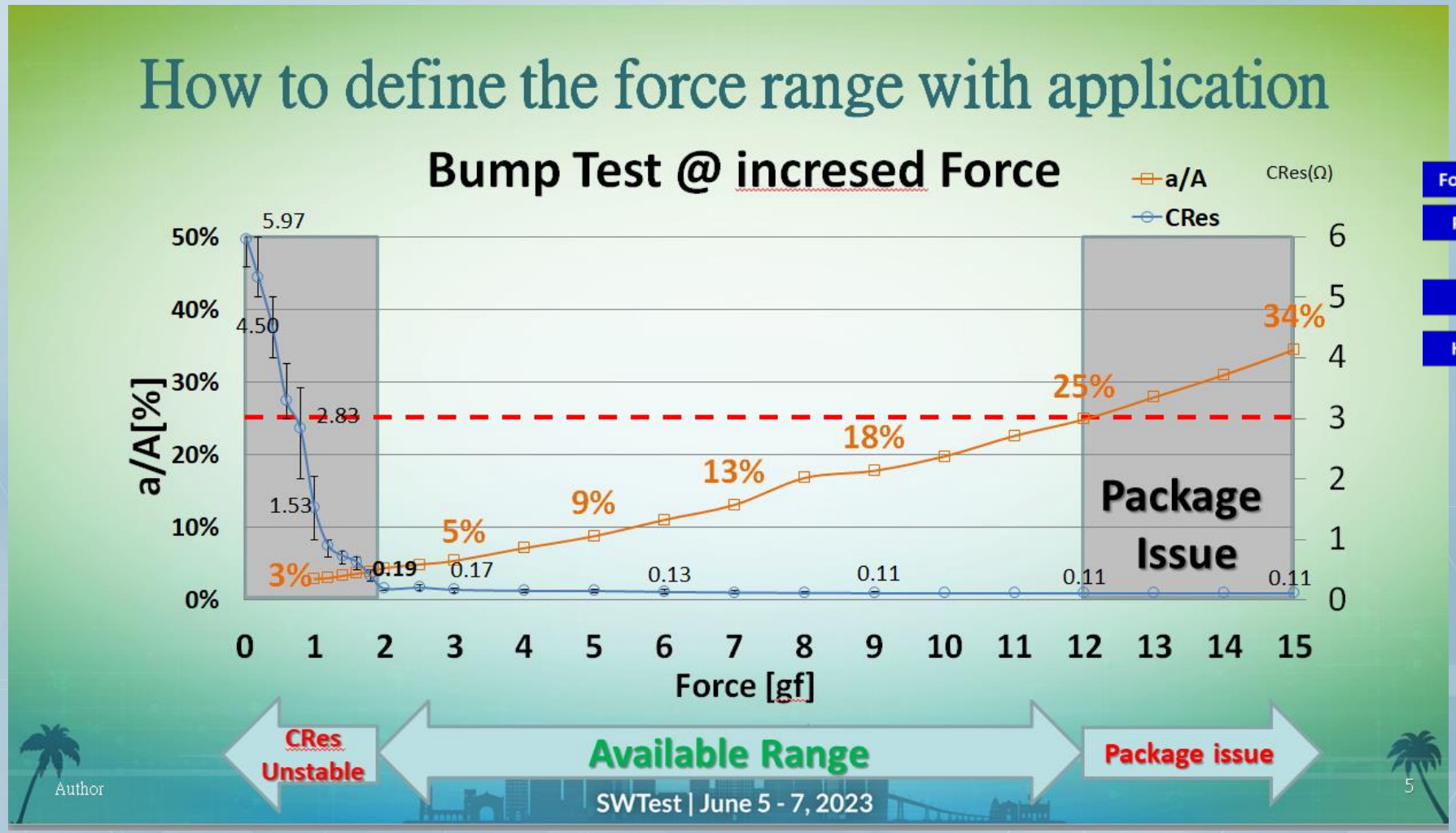


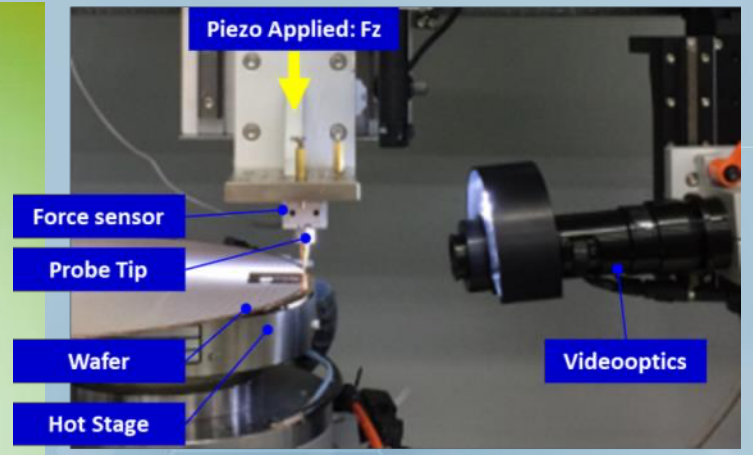
Market Status

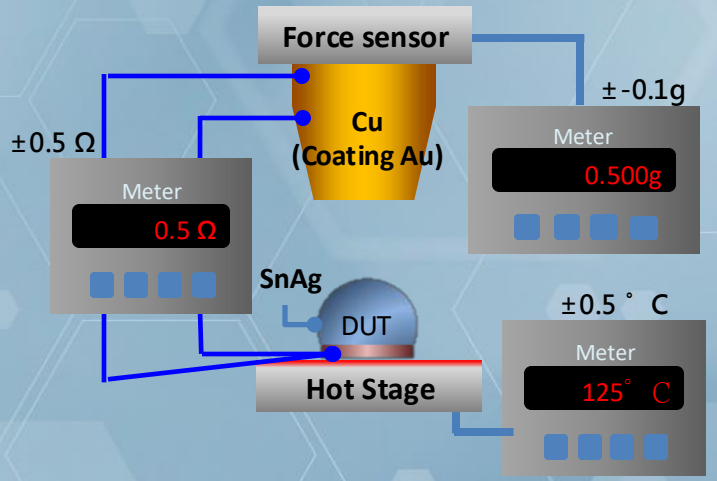
As the pin count rises, the total force exerted across the probe card escalates correspondingly. Each individual pin contributes to the cumulative force, which means that probe cards with higher pin counts, particularly those seen in advanced and future designs, will face the challenge of managing significantly greater forces during the testing process.



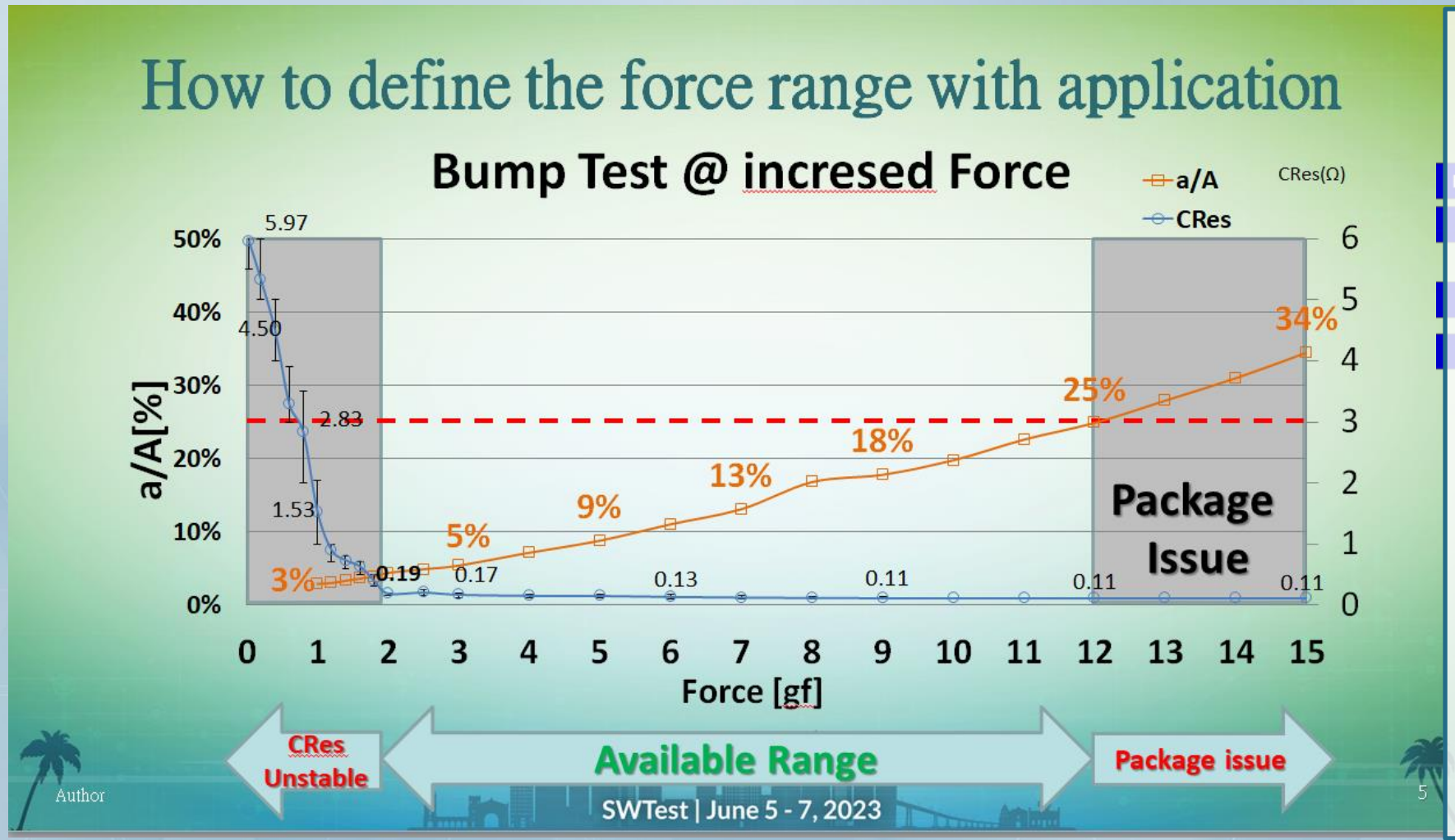
How to define the force range of the specific Bump

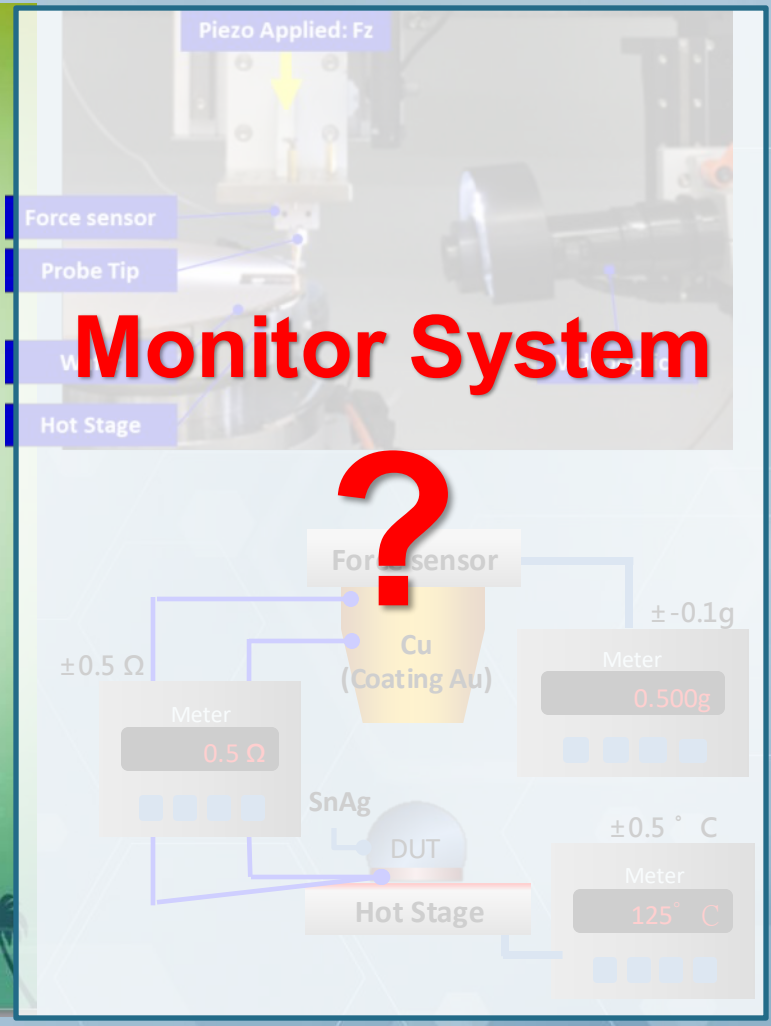






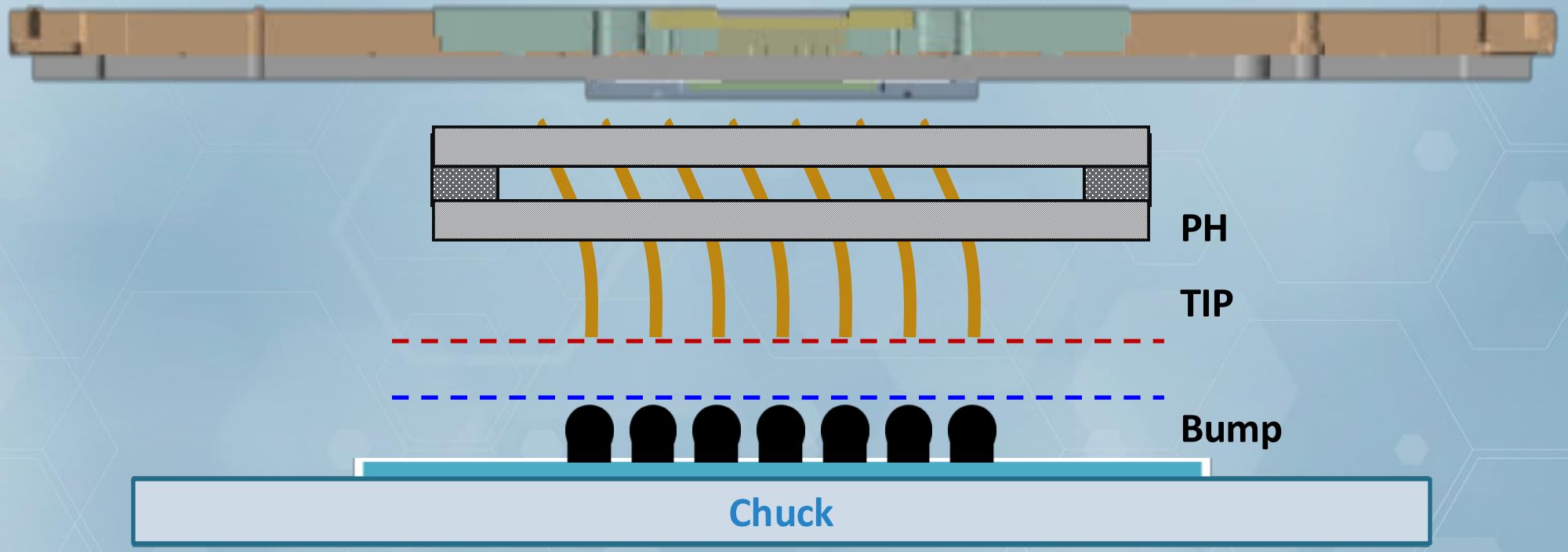
How to define the force range of 100K+ Bumps

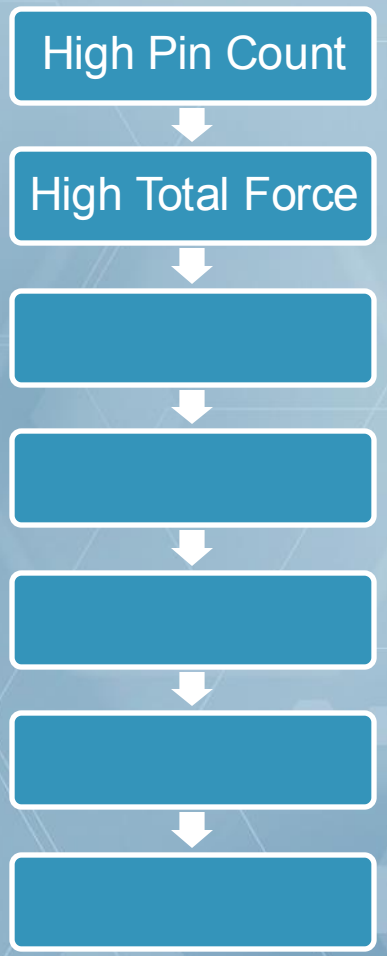




Why We need to know the Force Range of 100K+ Bump

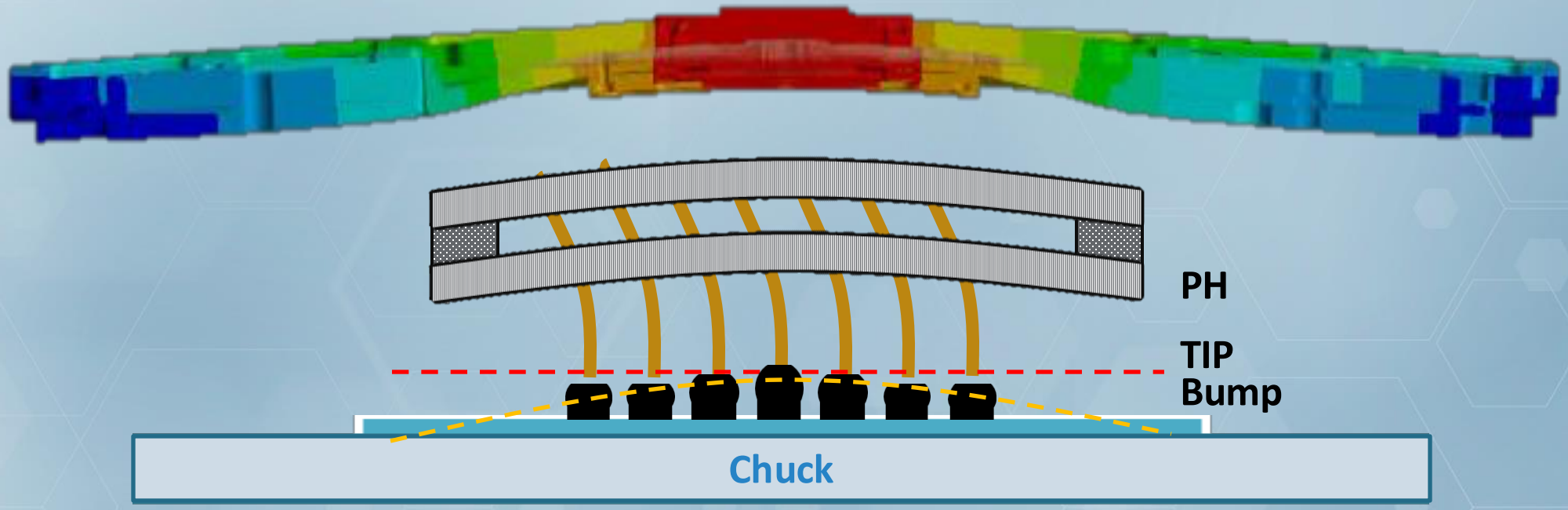
For a high pin count card, a high force is generated. Initially, before testing, all levels are uniform.





Why We need to know the Force Range of 100K+ Bump

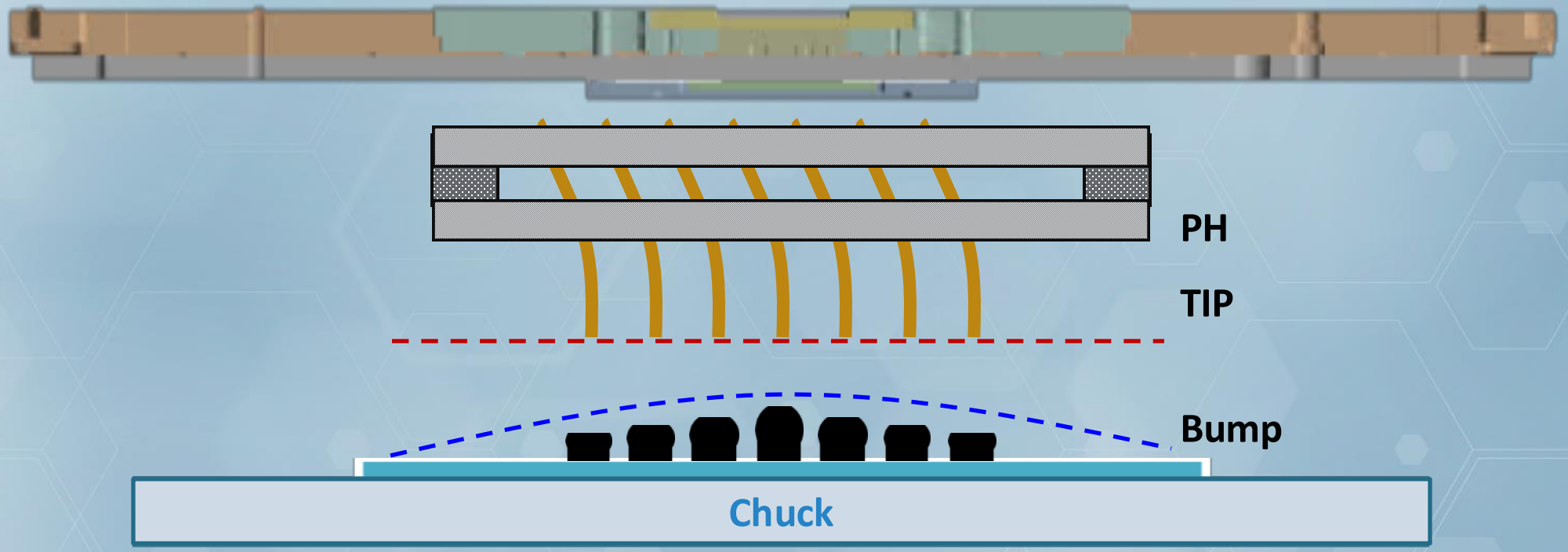
During testing, the entire card deforms under force, leading to inconsistencies between the inner and outer regions.



- High Pin Count
- High Total Force
- P/C Deformation
- AOT≠POT
-
-
-

Why We need to know the Force Range of 100K+ Bump

The variation in AOT between the inner and outer regions causes a range of forces, leading to inconsistent probe mark performance and unstable contact resistance



High Pin Count

High Total Force

P/C Deformation

AOT≠POT

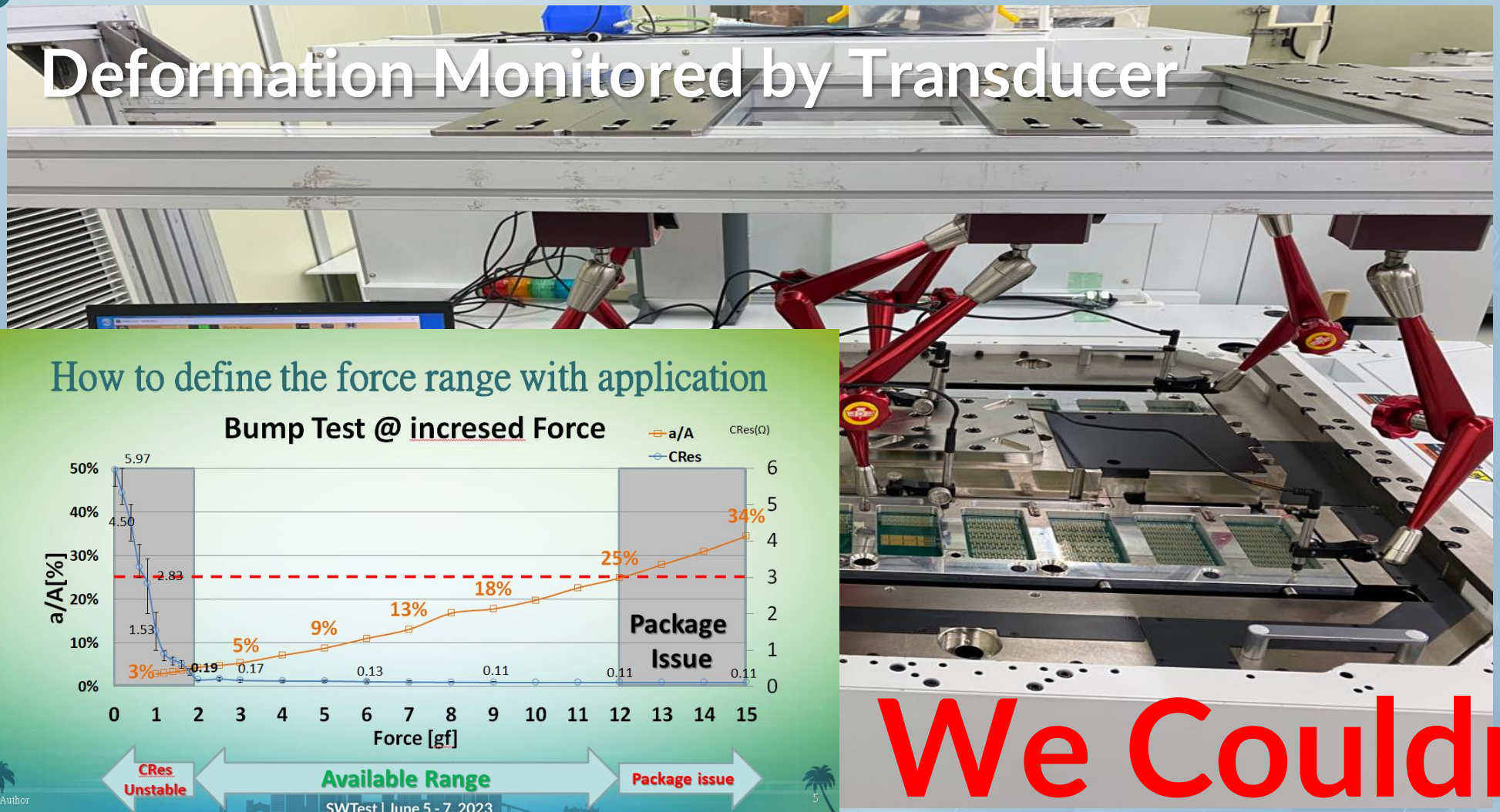
Force Range

P/M ununiformed

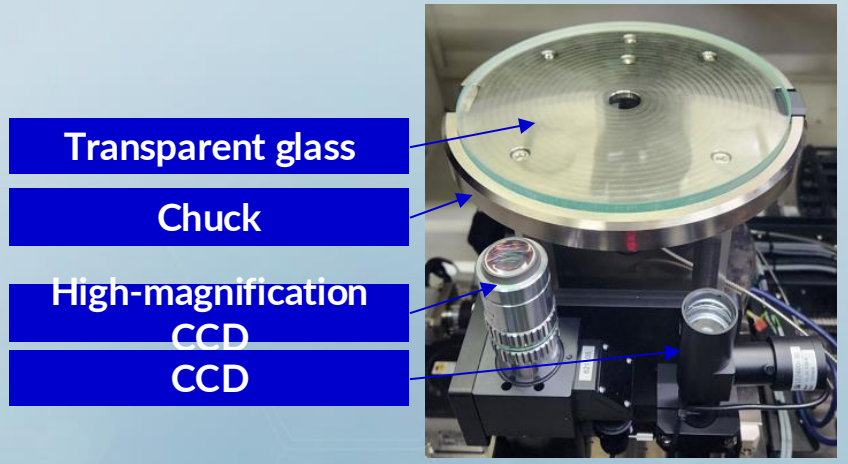
CRes unstable

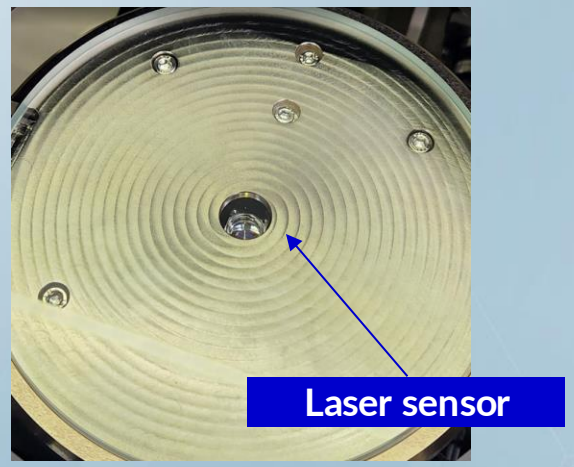
How We know the Force Range of 100K+ Bump

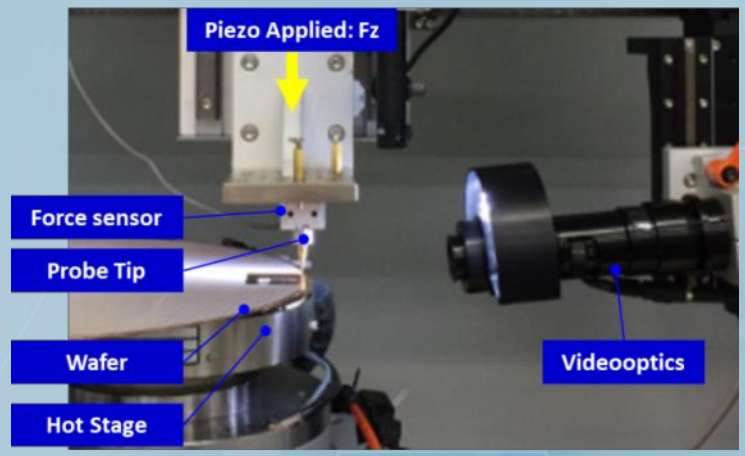
How We know the Force Range of 100K+ Bump

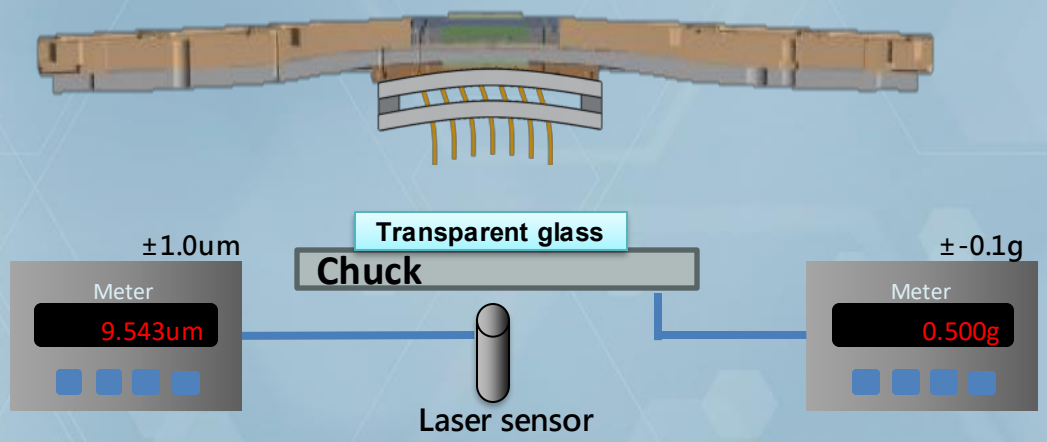


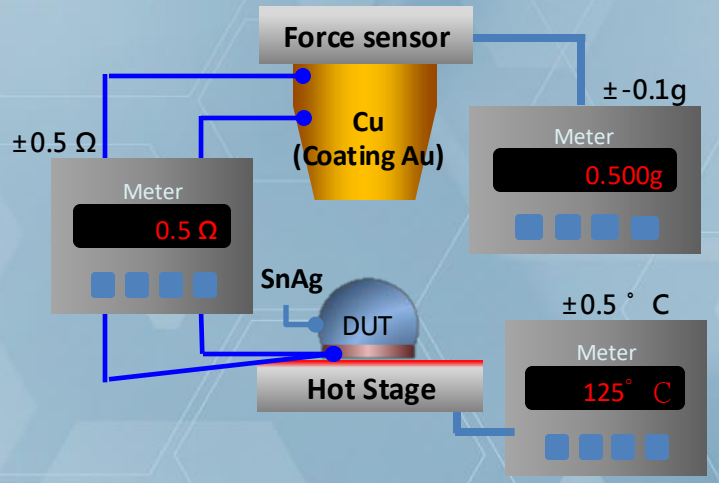
Probe Card Level Monitor System



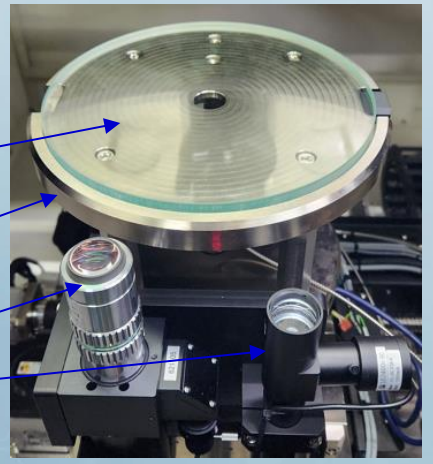


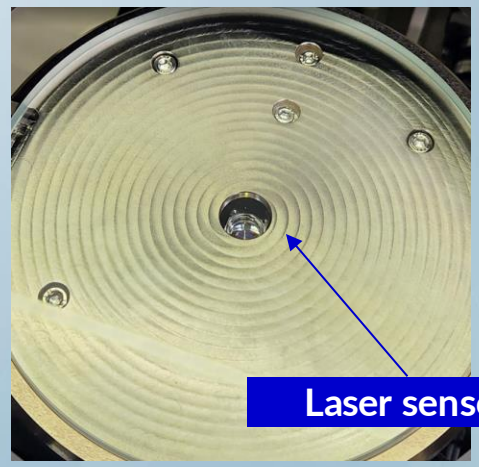




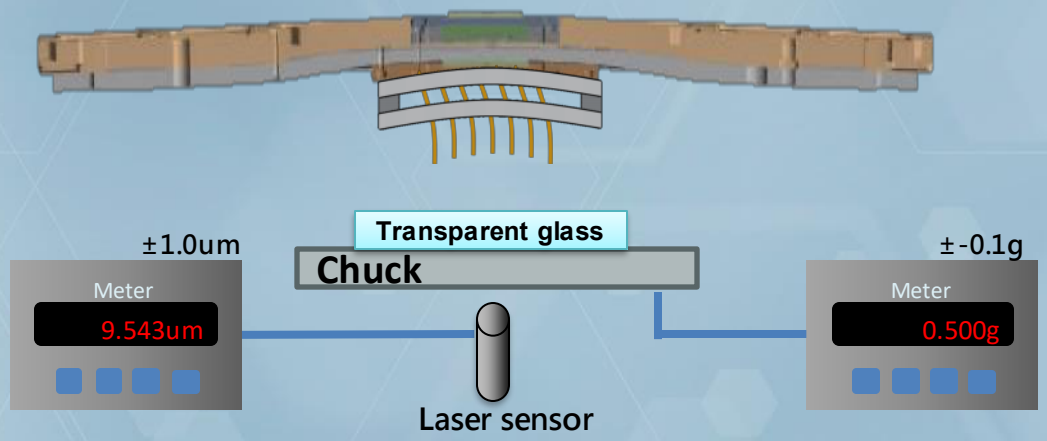


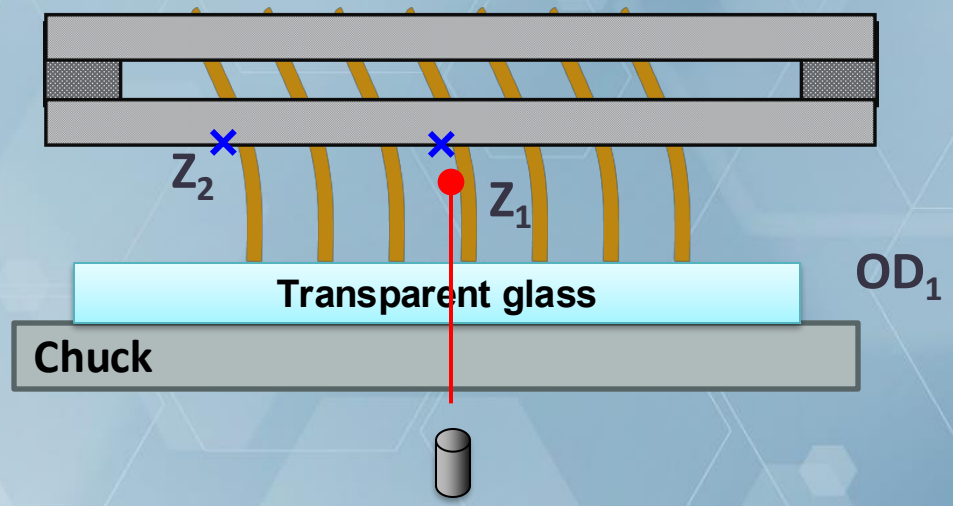
Probe Card Level Monitor System



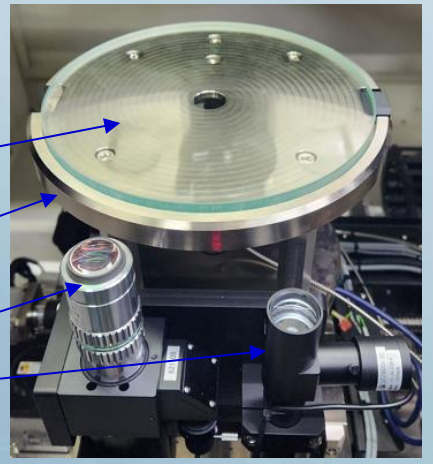


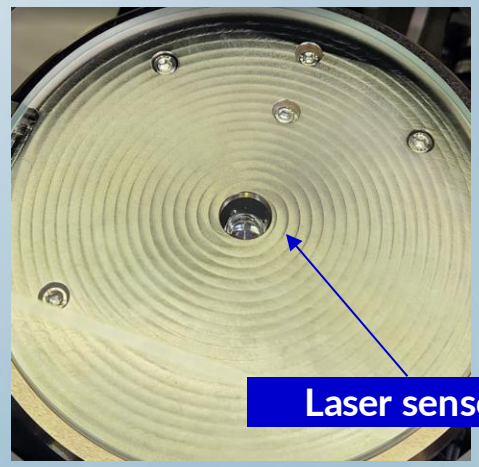
- $Z_1 = Z_2$
- POT = AOT
- $Force_1 = Force_2$
- $P/M_1 = P/M_2$





Probe Card Level Monitor System





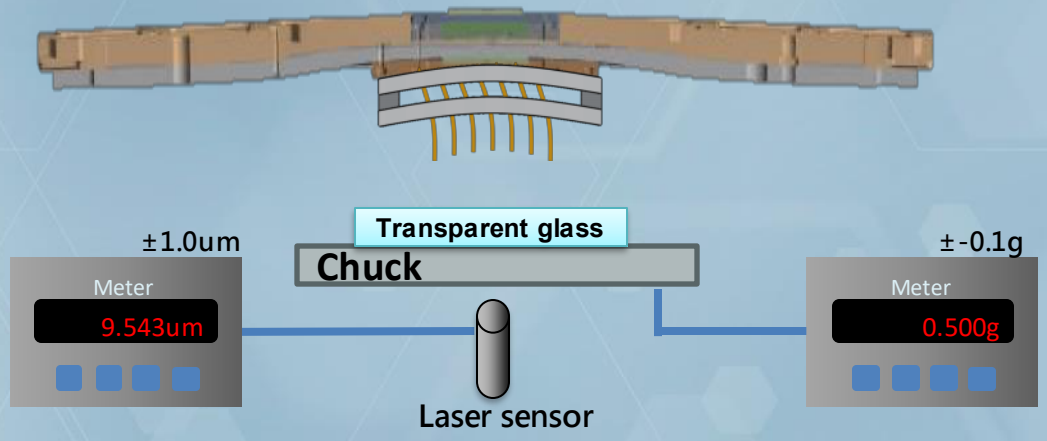
$Z_1 \neq Z_2$

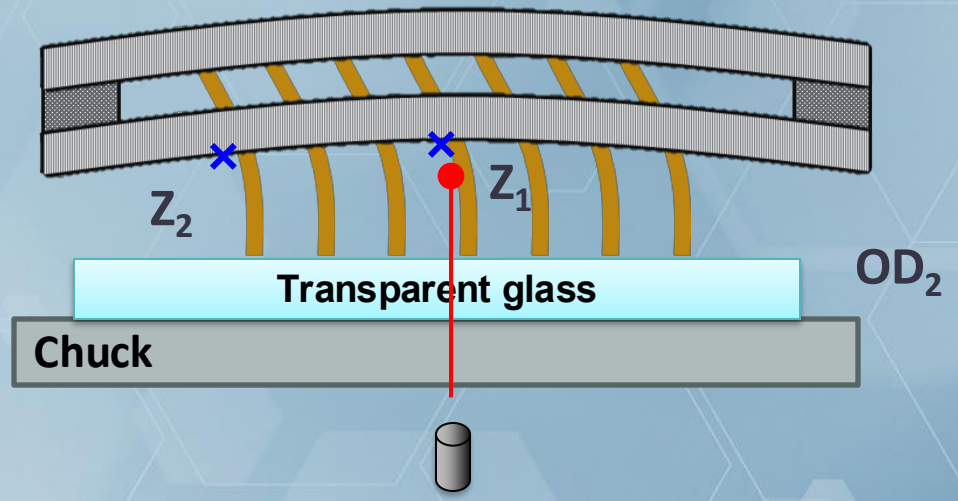
$POT \neq AOT$

$Force_1 \neq Force_2$

$P/M_1 \neq P/M_2$ ⇔ $CRes_1 \neq CRes_2$

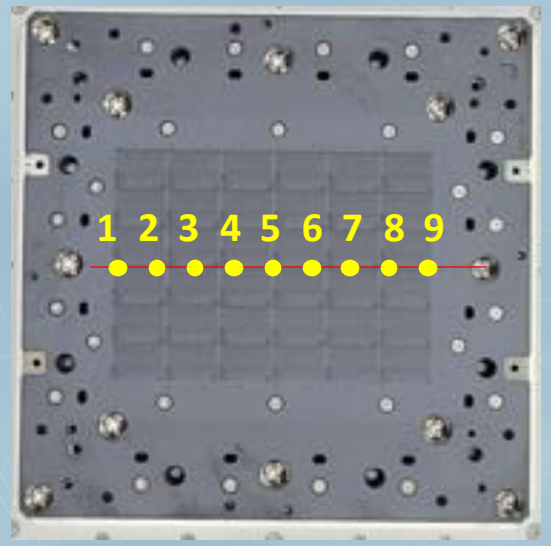
$POT - Z_1 = AOT_1$
$POT - Z_2 = AOT_2$

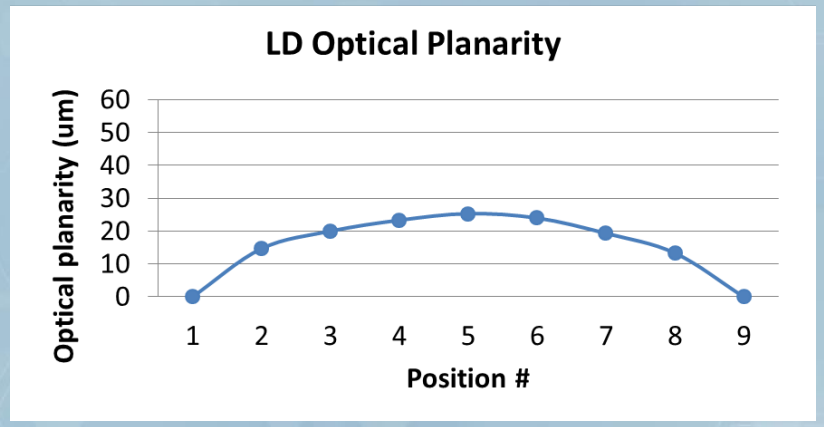




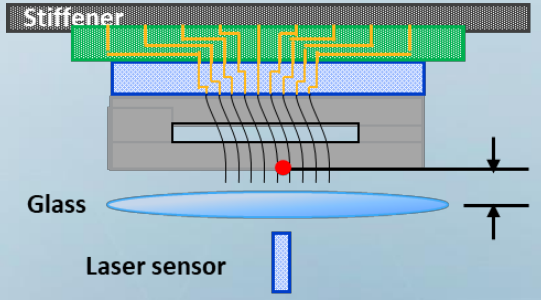
P/C Force Measurement System

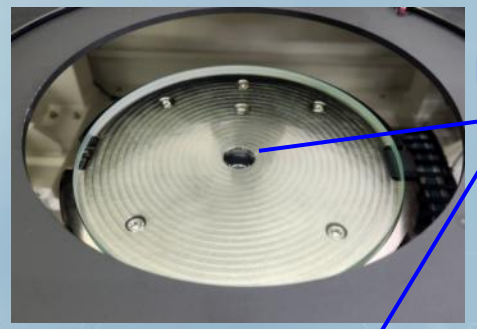
In order to better understand the relationship between the deformation of the entire card and probe mark performance, our PCF system incorporates a laser displacement sensor beneath the chuck. This design allows us to directly monitor the trend of LD deformation under loading conditions, providing real-time insight into the card's deformation behavior.



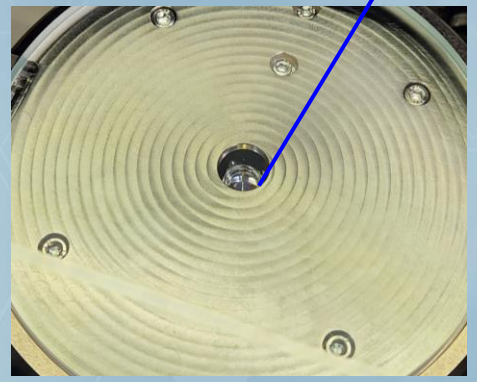


PC Force Measurement System (REAL TIME Recording)

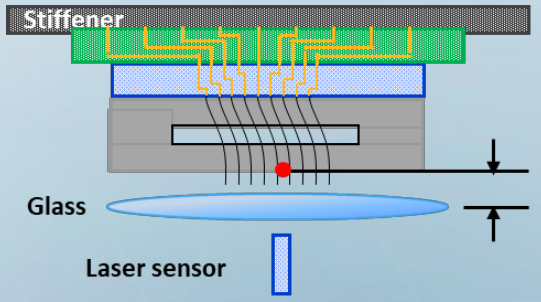


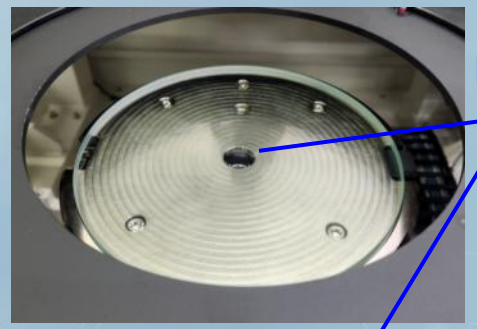


Laser sensor

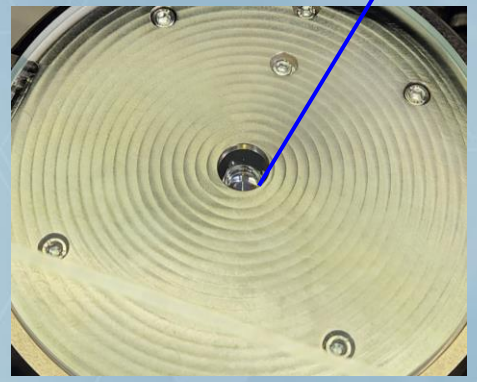


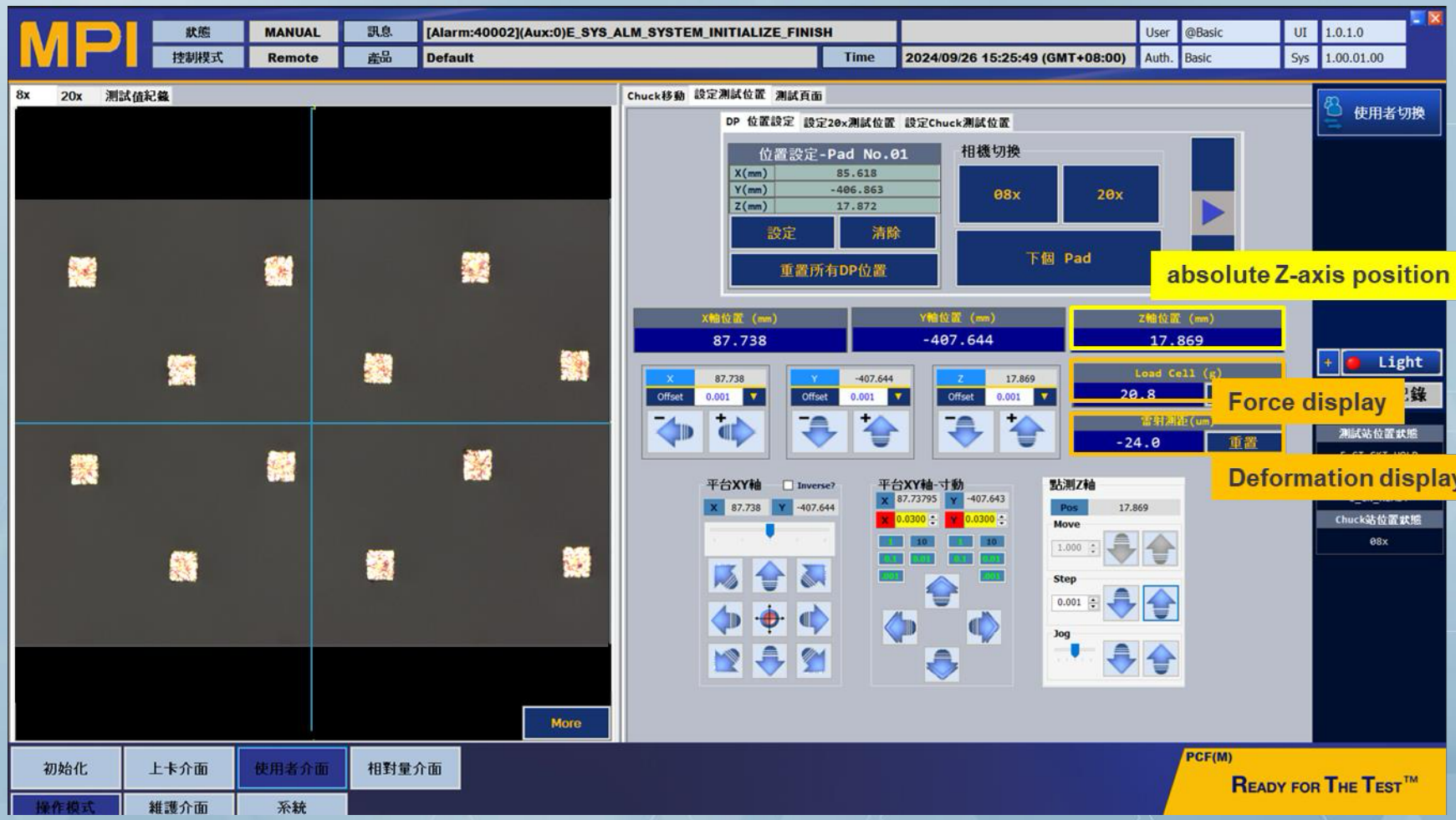
PC Force Measurement System (REAL TIME Recording)





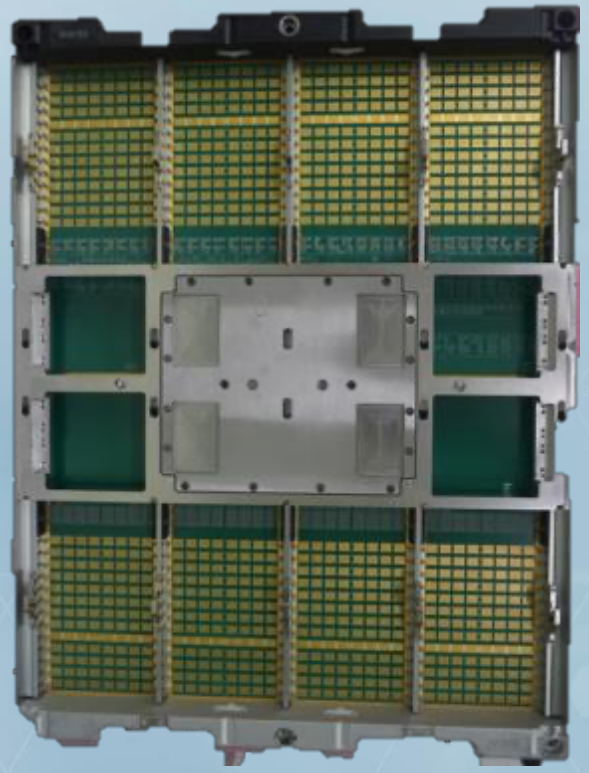
Laser sensor

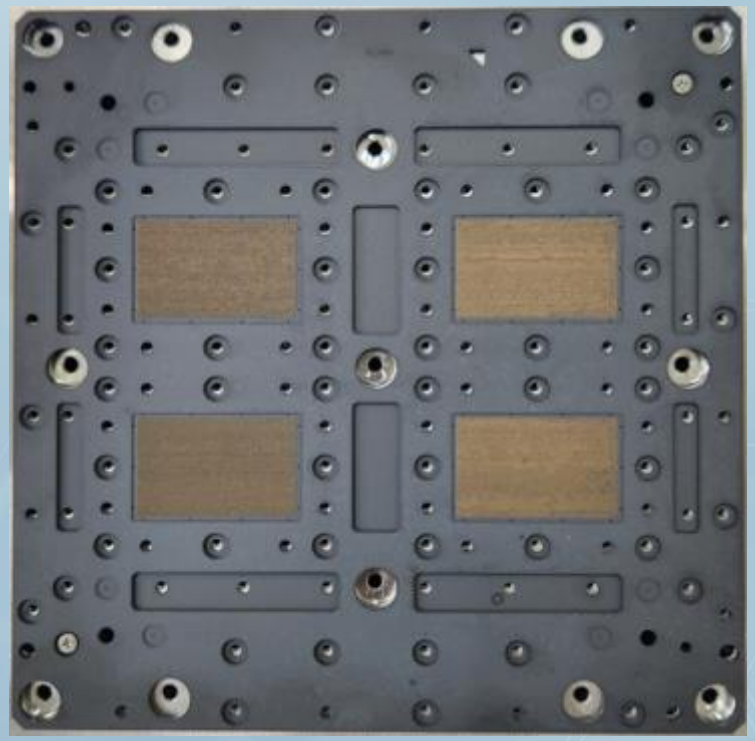




Example: Standard Card Types

Standard Type with the following specifications:



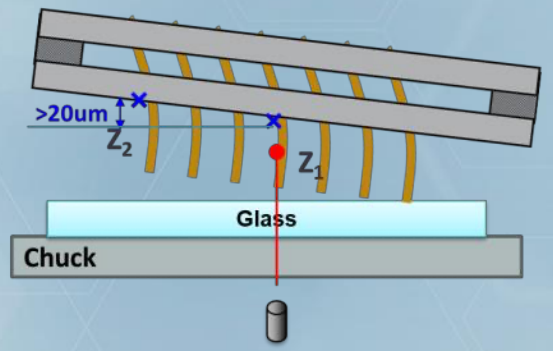


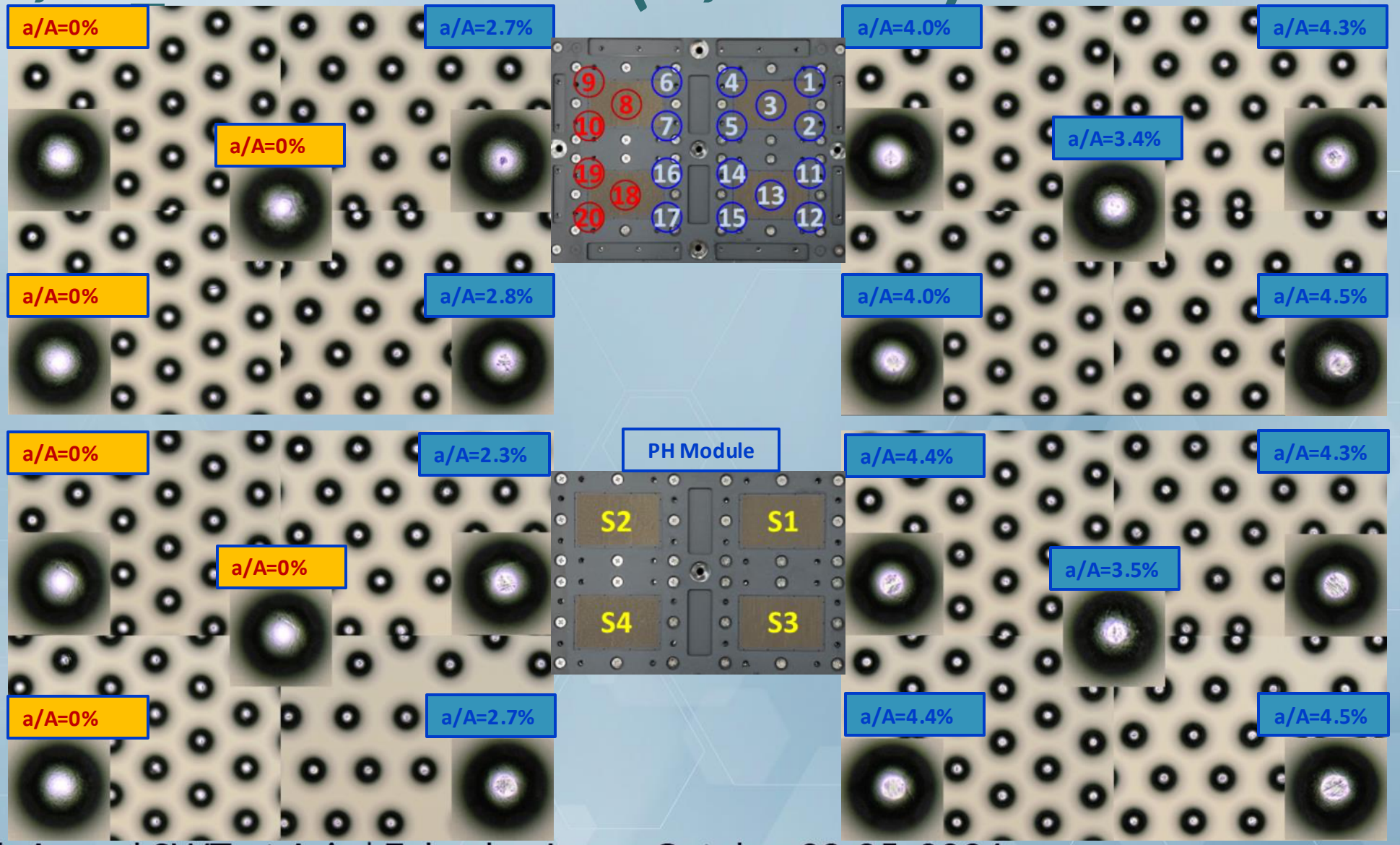
- ✓ **PCB：DD FLEX PLUS (Larger)**
- ✓ **Pin Count：≒100,000pins (2.5g per pin)**
- ✓ **Total force：250kg (Ideally)**
- ✓ **Probing area：78 x 51mm**
- ✓ **Needle Type: MEMS Needle**

Standard P/C Probe mark (P/C Tilt)

- ✓ **Bump：D80**
- ✓ **Pin Count：100,000pins**

  (2.5g per pin)
- ✓ **Probing area：78 x 51mm**

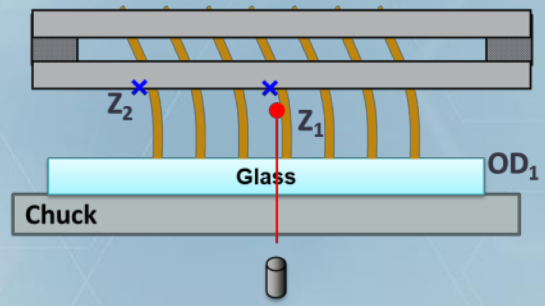


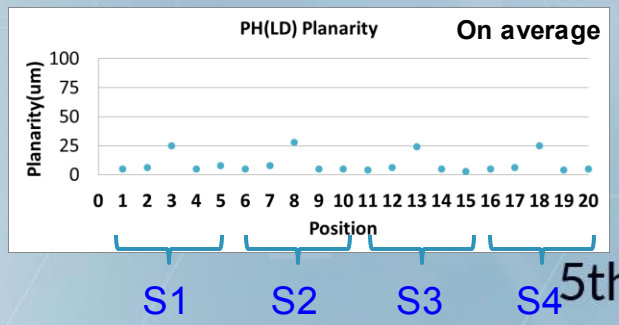


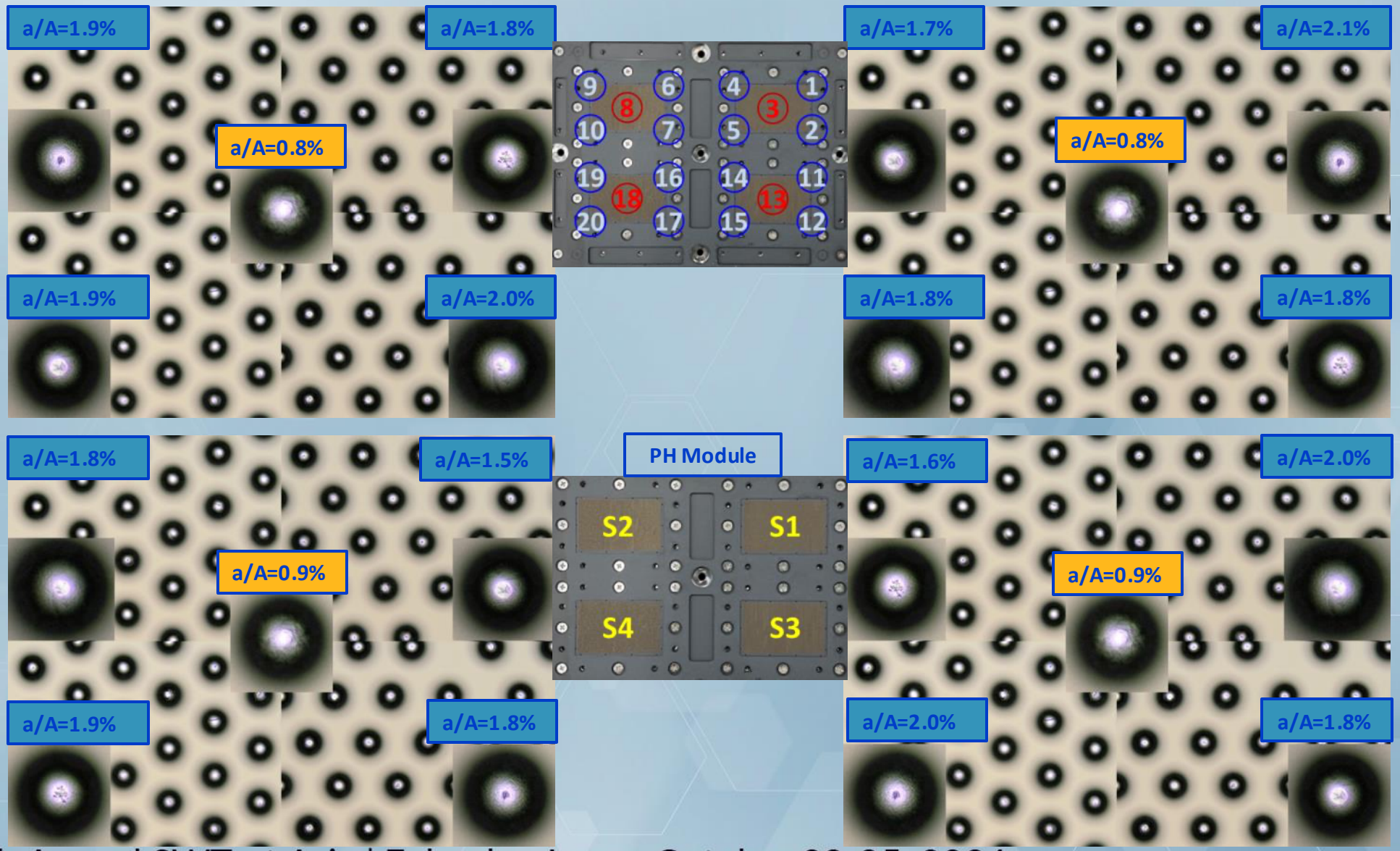
Standard P/C_Probe mark (POD50um)

- ✓ **Bump：D80**
- ✓ **Pin Count：100,000pins**

  (2.5g per pin)
- ✓ **Probing area：78 x 51mm**
- ✓ **Monitor point: 10 spot/area**



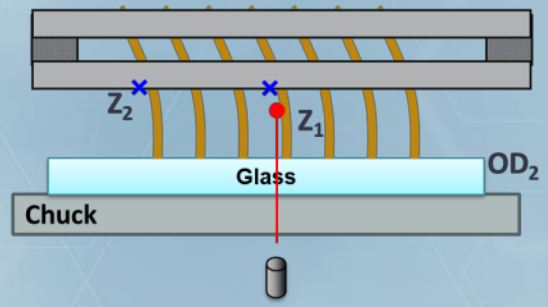


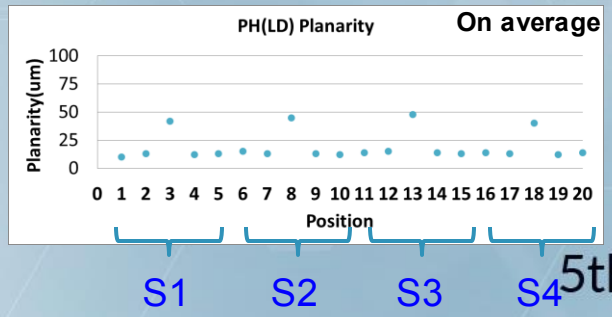


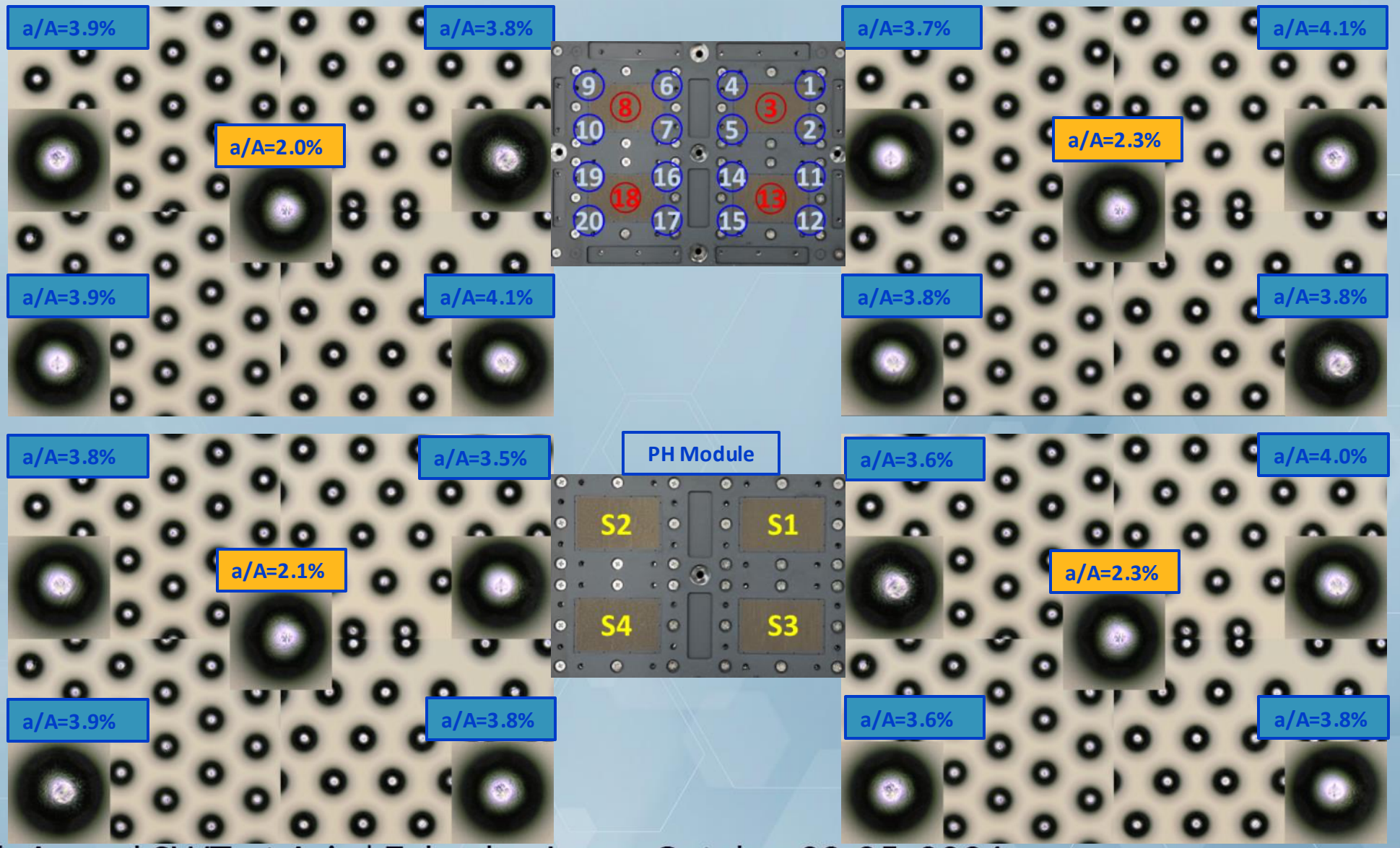
Standard P/C_Probe mark (POD75um)

- ✓ **Bump：D80**
- ✓ **Pin Count：100,000pins**

  (2.5g per pin)
- ✓ **Probing area：78 x 51mm**
- ✓ **Monitor point: 10 spot/area**



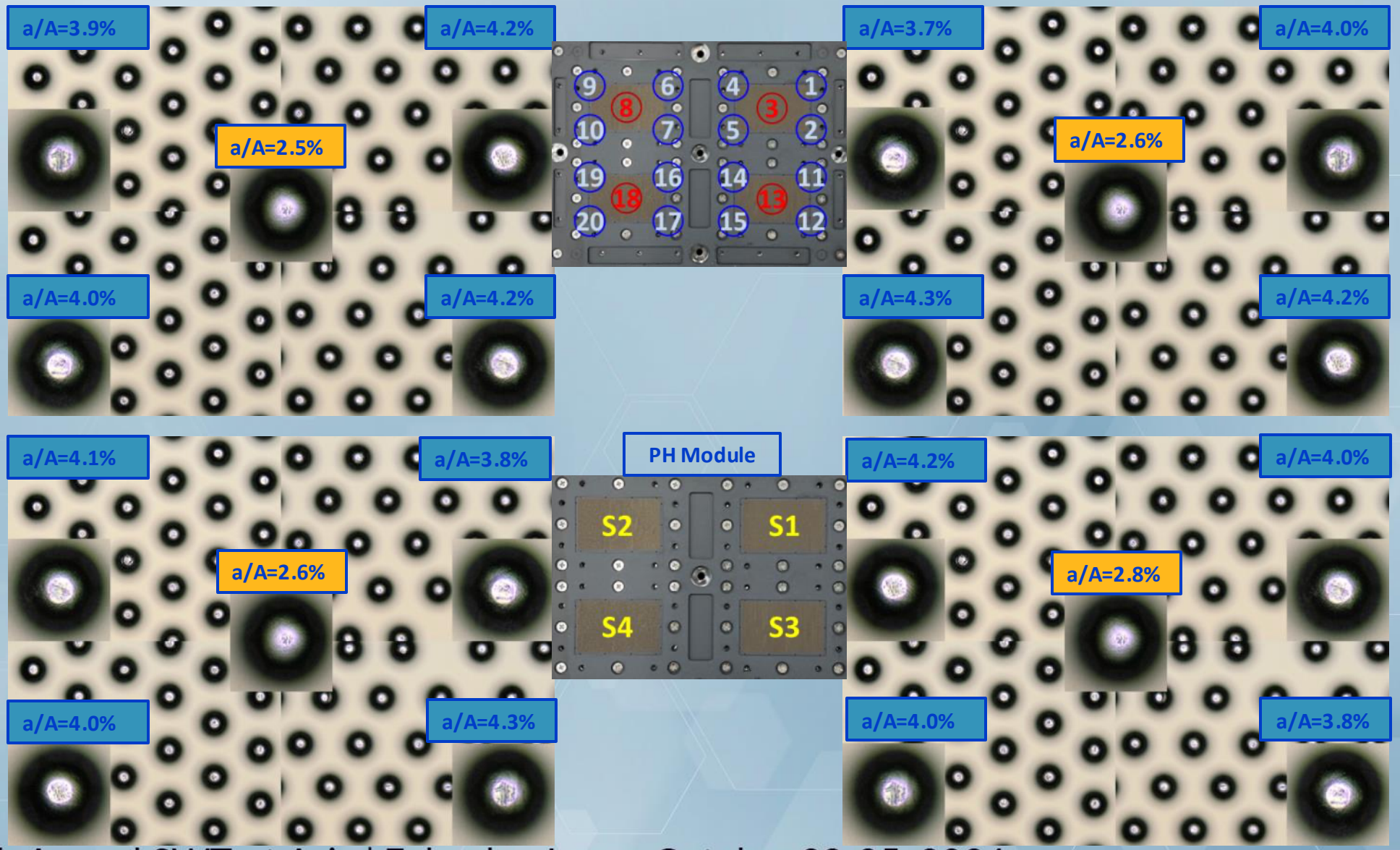


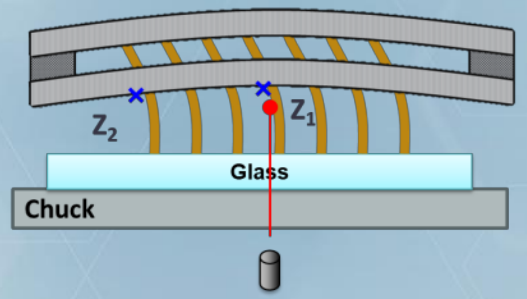


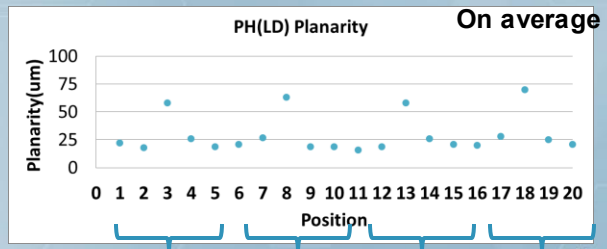
Standard P/C_Probe mark (POD100um)

- ✓ **Bump：D80**
- ✓ **Pin Count：100,000pins**

  (2.5g per pin)
- ✓ **Probing area：78 x 51mm**
- ✓ **Monitor point: 10 spot/area**

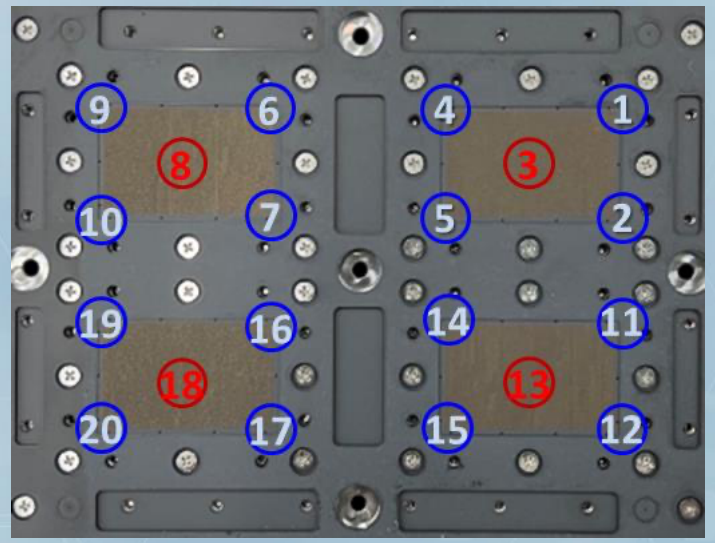


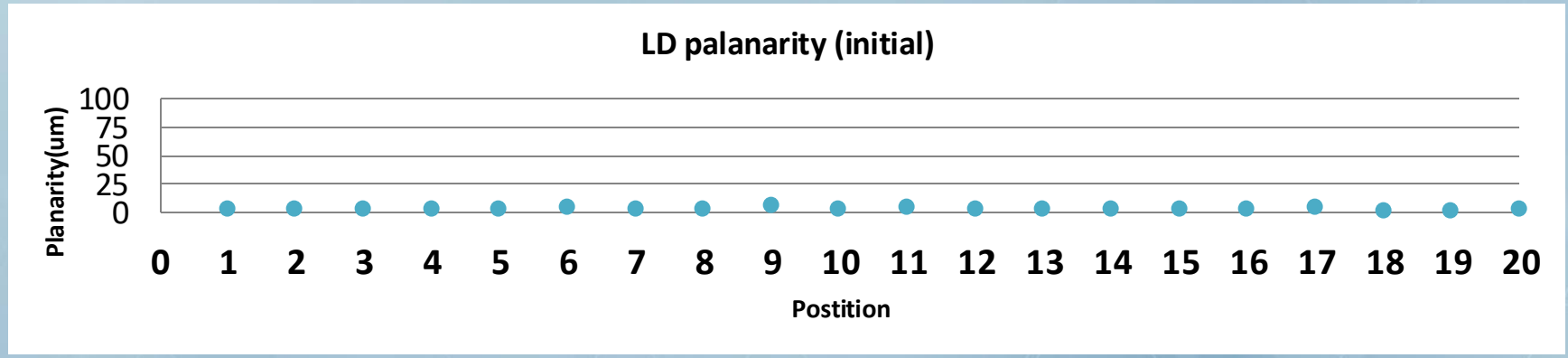


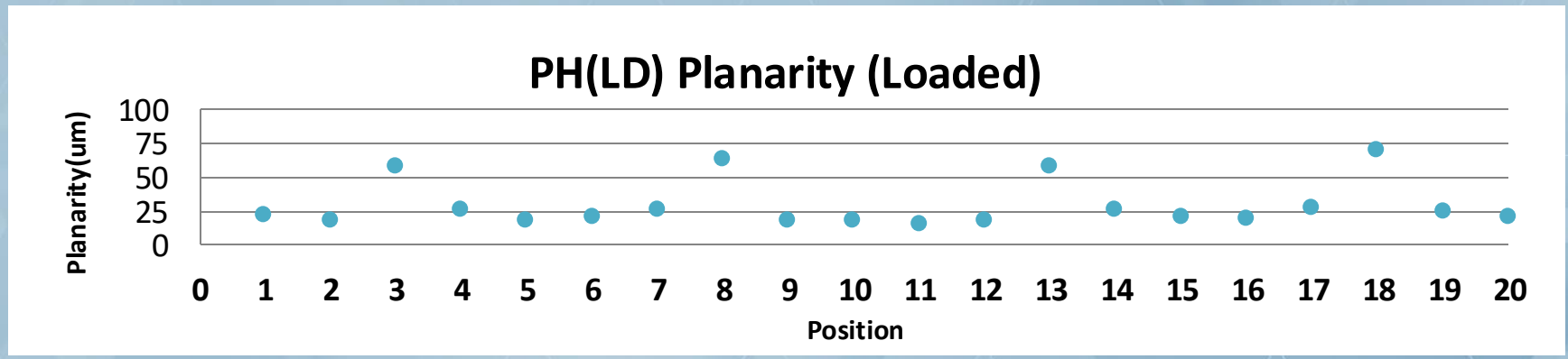


Standard P/C_LD Planarity

Under load, the deformation is most pronounced in the center of the layout.

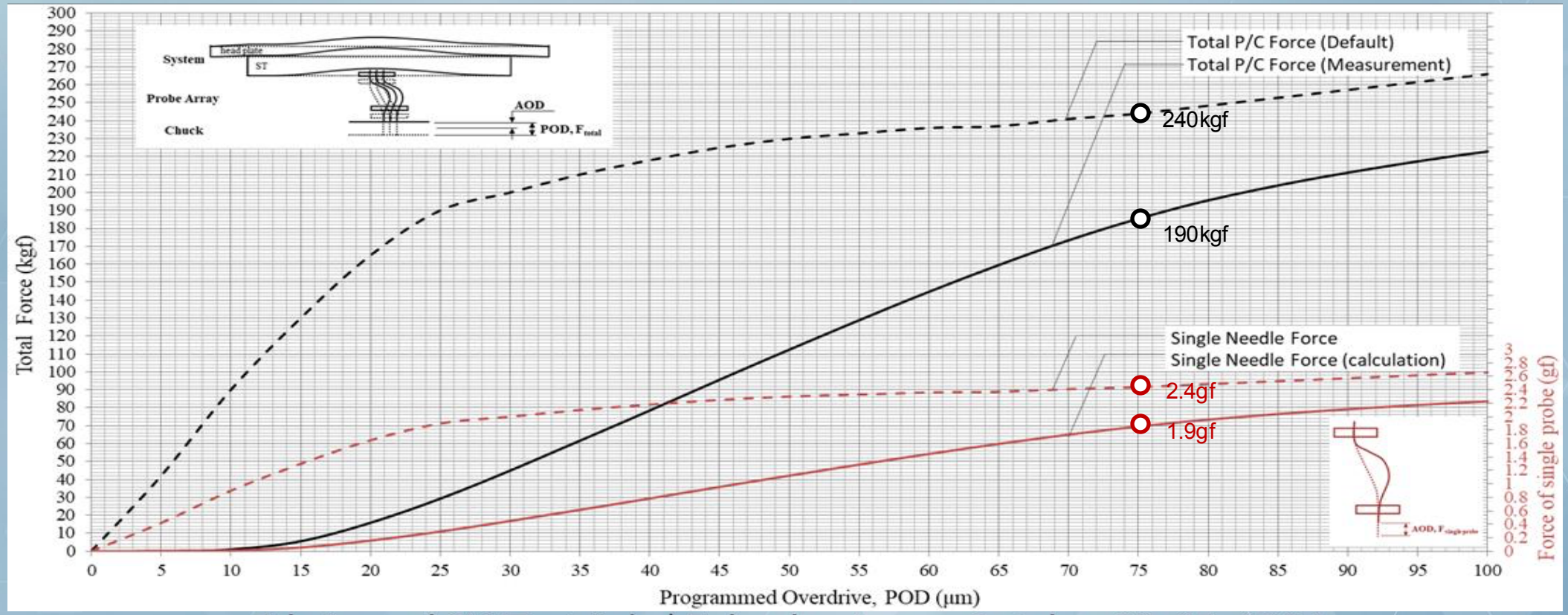






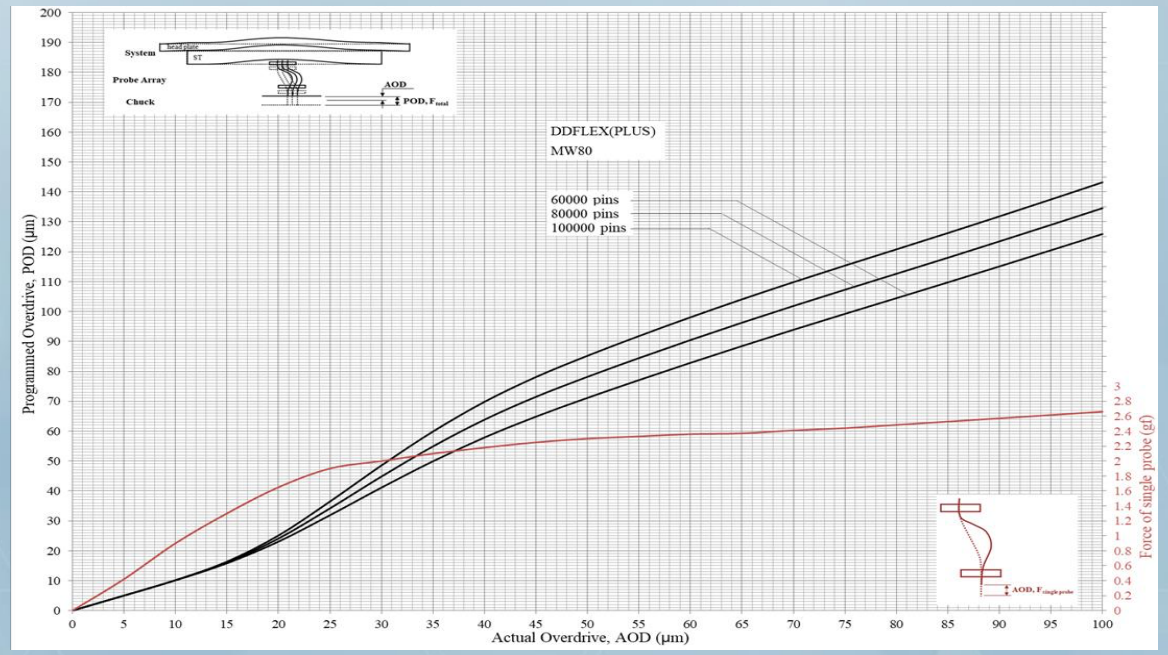
Standard P/C_ System Force and individual Force

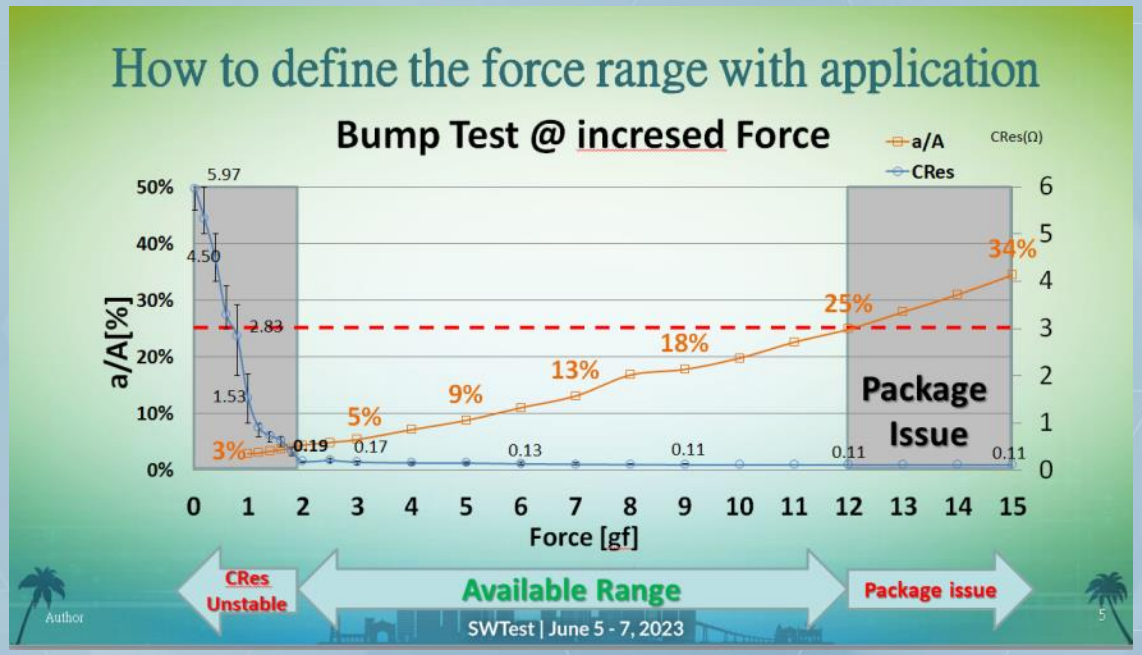
The system force generated by the entire probe card calculated using the set values on prober will cause the force per individual pin to be much greater than the actual force per pin. This discrepancy is mainly because, after a certain overdrive, the probe card begins to deform, meaning that the overdrive of some individual pins is not sufficient in practice. As a result, the force per pin is also relatively weaker.

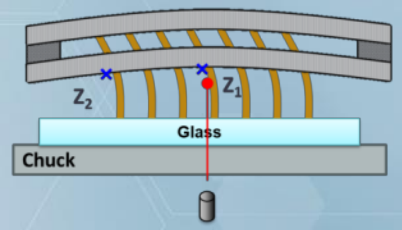


Multi-Bump Probe Mark Range Define

When the entire card deforms, the inner and outer areas experience different amounts of deformation, resulting in varying forces and different probe marks.



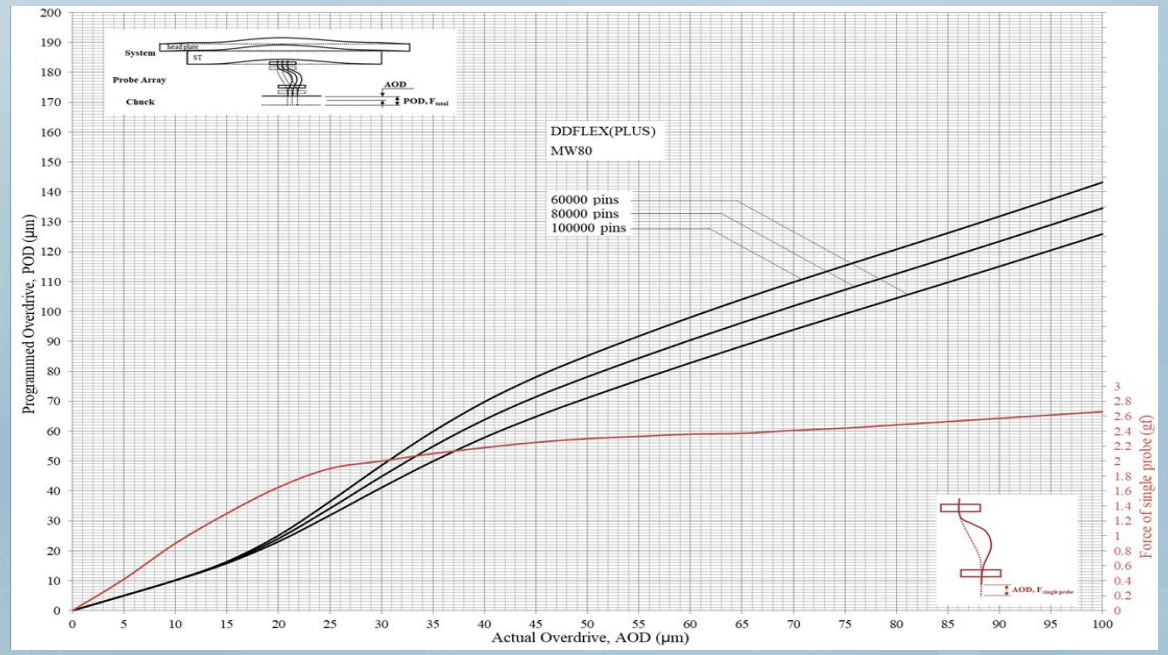


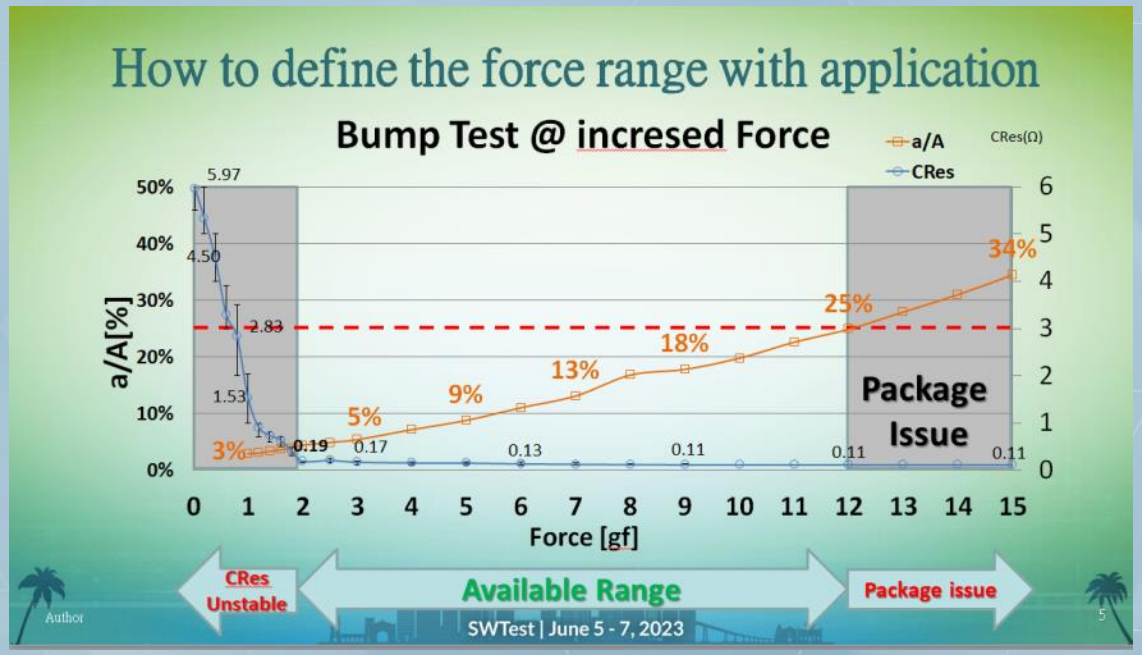


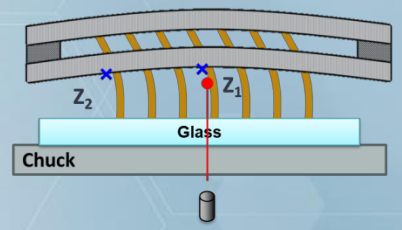
	POT	Deformation	AOT (Estimated)	Min Force (Estimated)	P/M a/A ratio (Estimated)
Z_1	100	60~80	20	1.6 gf	3.2 %
Z_2	100	10~30	70	2.4 gf	4.3 %

Multi-Bump Probe Mark Range Define for Real

When the entire card deforms, the inner and outer areas experience different amounts of deformation, resulting in varying forces and different probe marks.

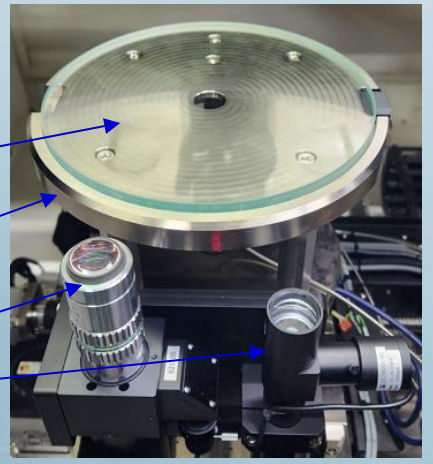


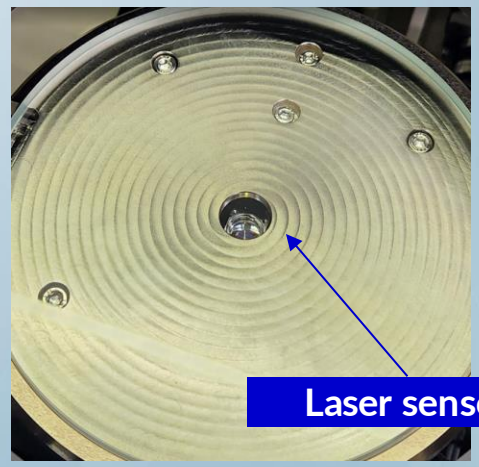




	POT	Deformation	AOT (Estimated)	Min Force (Estimated)	P/M a/A ratio (Estimated)	P/M a/A ratio (Measured)
Z_1	100	60~80	20	1.6 gf	3.2 %	2.6 %
Z_2	100	10~30	70	2.4 gf	4.3 %	4.0%

Probe Card Level Monitor System





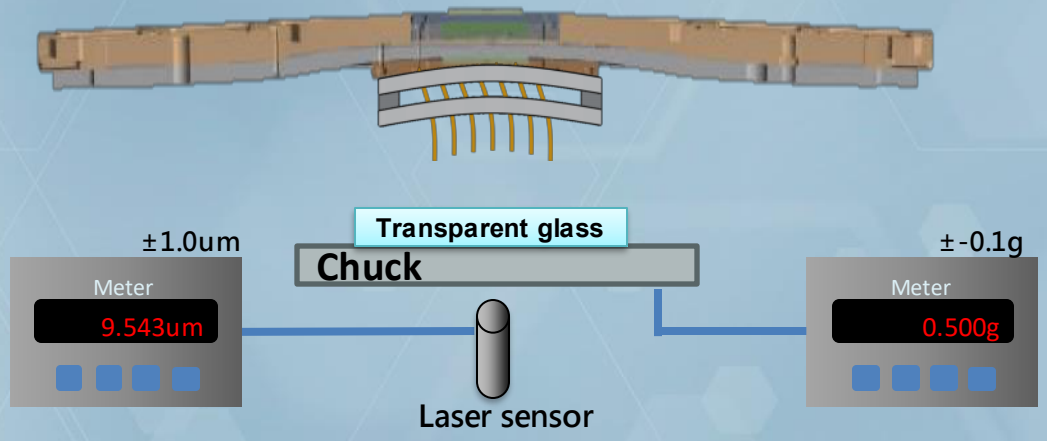
$Z_1 \neq Z_2$

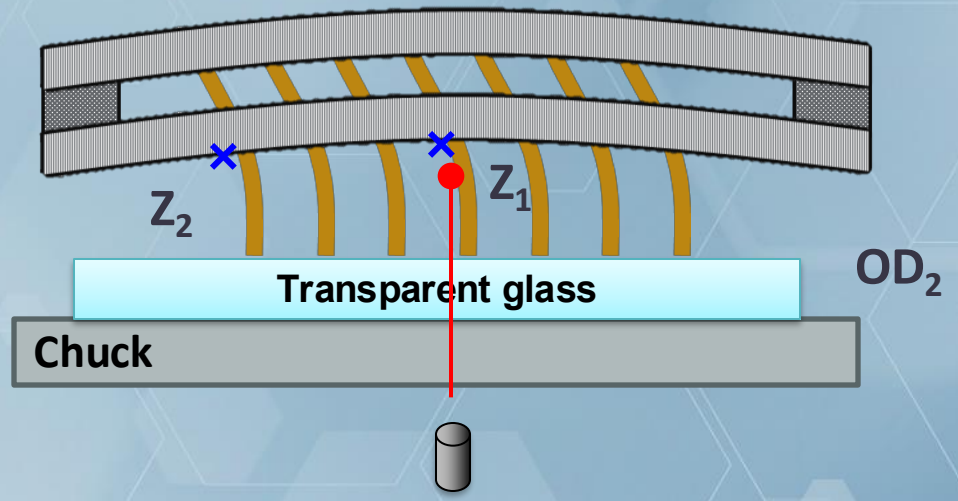
$POT \neq AOT$

$Force_1 \neq Force_2$

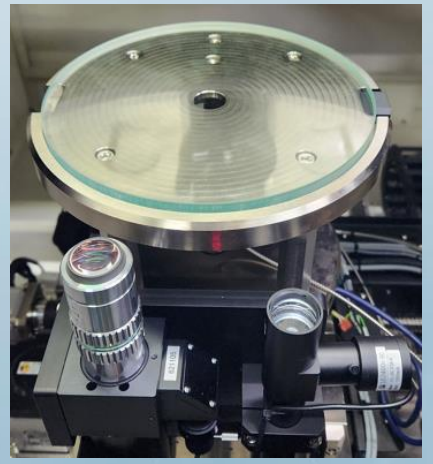
$P/M_1 \neq P/M_2$ ⇔ $CRes_1 \neq CRes_2$

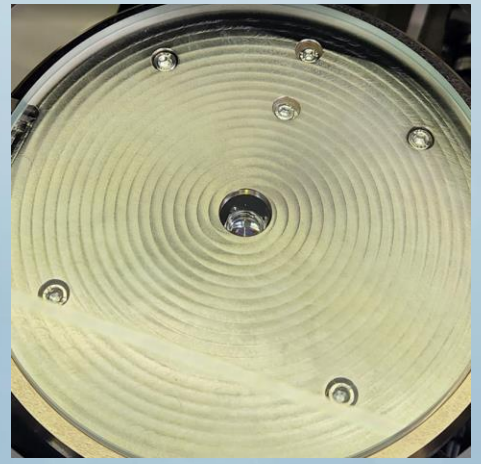
$POT - Z_1 = AOT_1$
$POT - Z_2 = AOT_2$

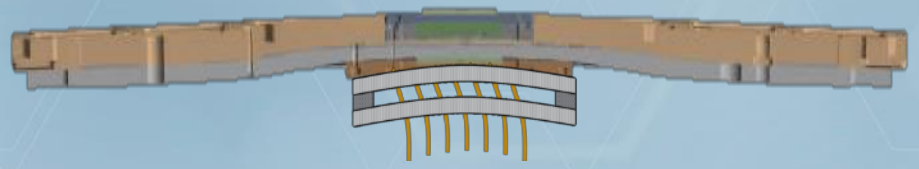


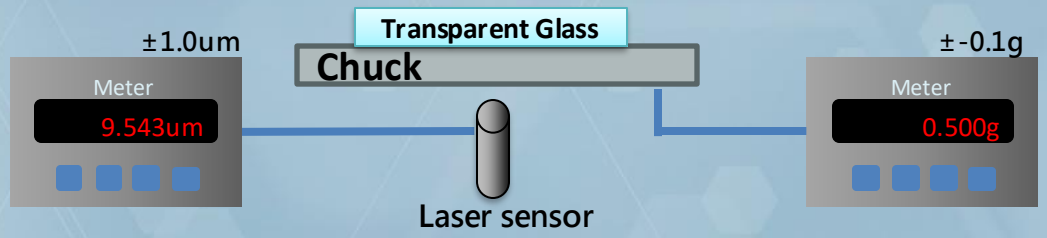


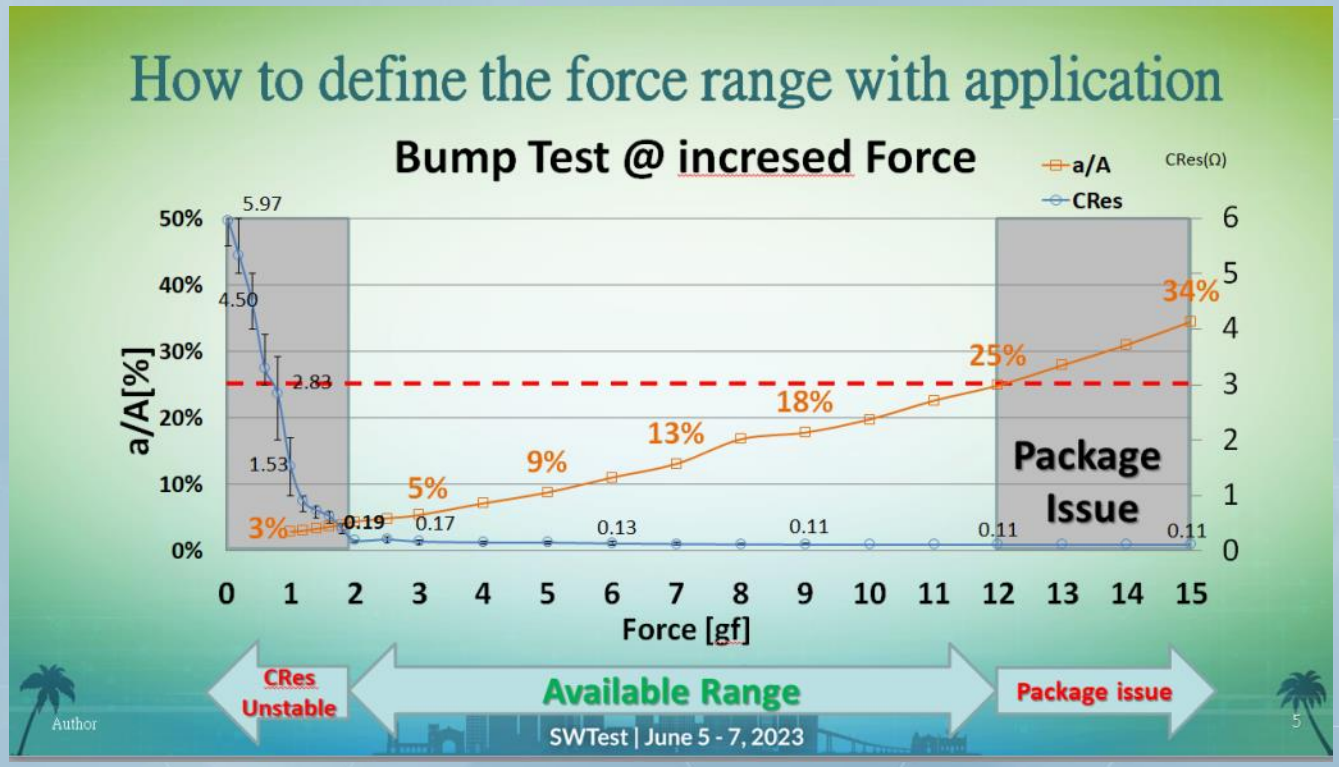
Probe Card Level Monitor System











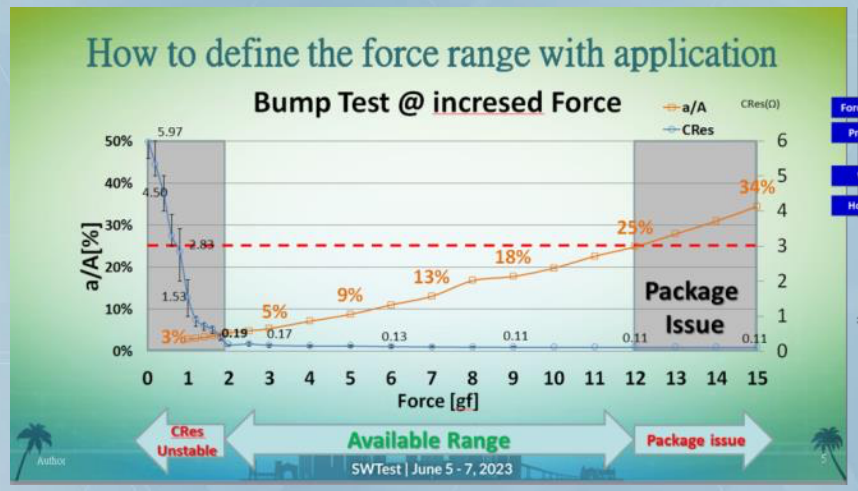
Measurement System Evaluation

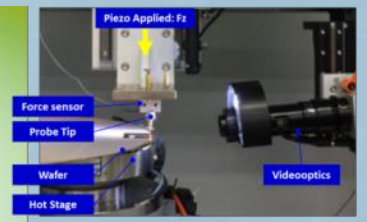
2023

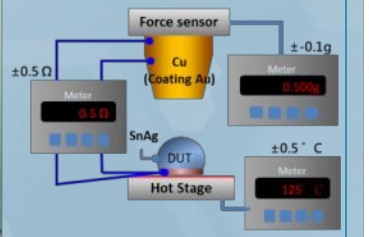
2024

Single Pin Measurement by

Force Censor

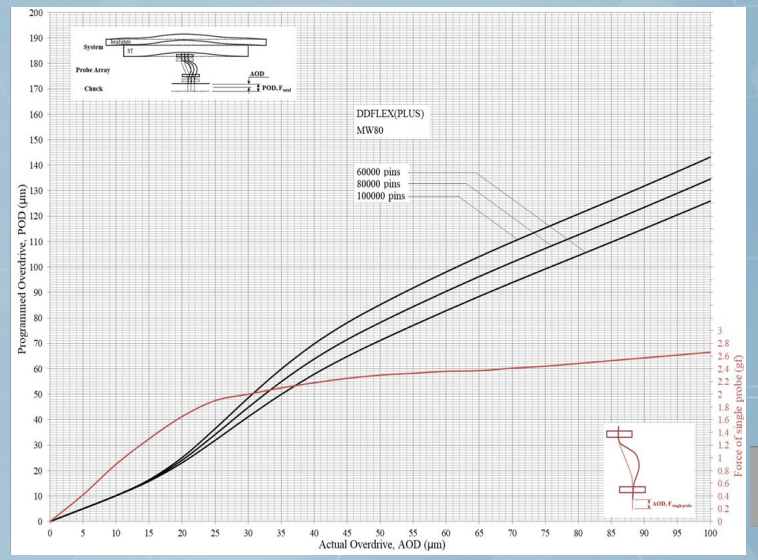


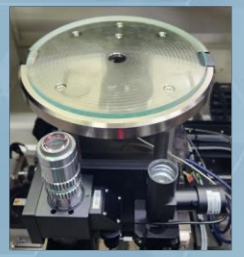


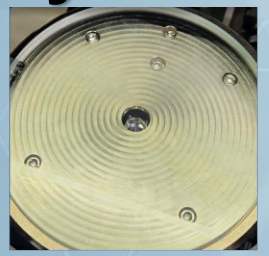


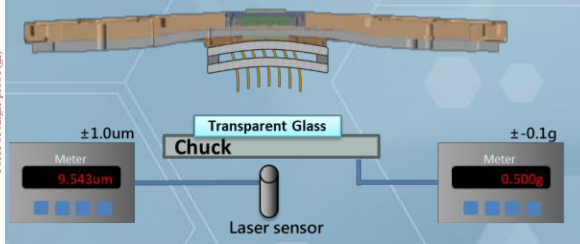
Multi-Pin Measurement by

Probe Card Force System









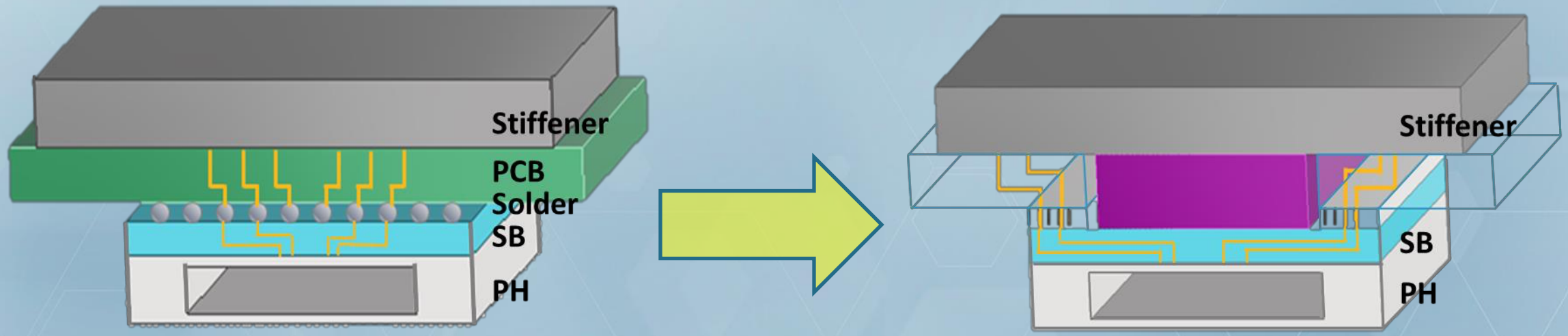
Summary

Conclusion:

- ✓ High pin count generates greater force, leading to significant deformation. This causes varying deformation between the inner and outer regions of the entire card.
- ✓ With varying forces, the resulting probe marks differ, leading to non-uniformity in the probe mark patterns.
- ✓ The PCF system can monitor deformation in real-time, allowing for the estimation of the size of the probe marks.

Work in Future

- ✓ How can we prevent the occurrence of varying probe mark sizes?



Standard P/C

Next Generation P/C

- ✓ **More Uniformed P/M**
- ✓ **More Stable CRes**

Thank You