POSTER #4

Towards Ultra-High Pin Count Probe Card for high end logic devices

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Aim of the work

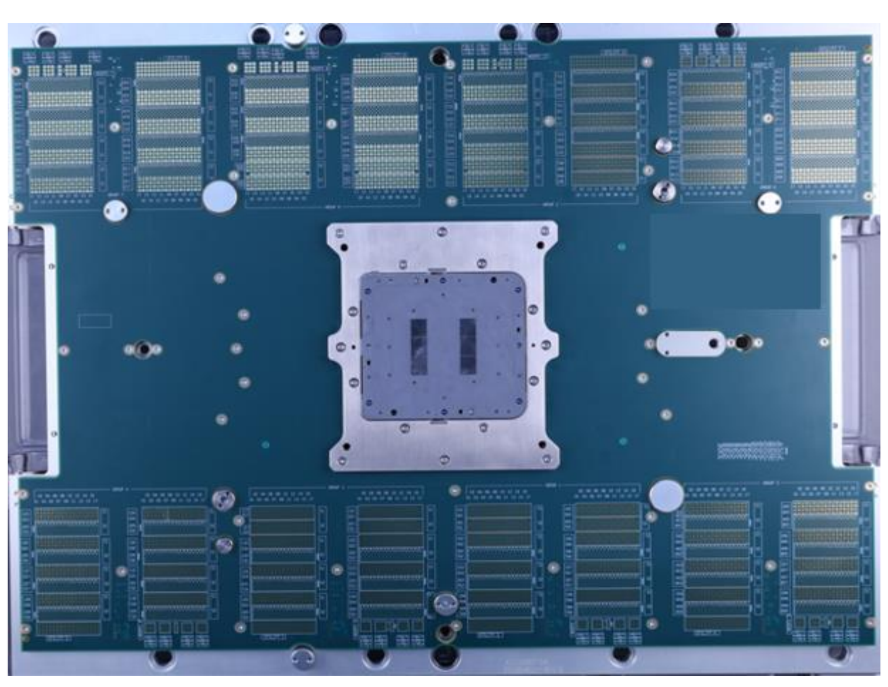
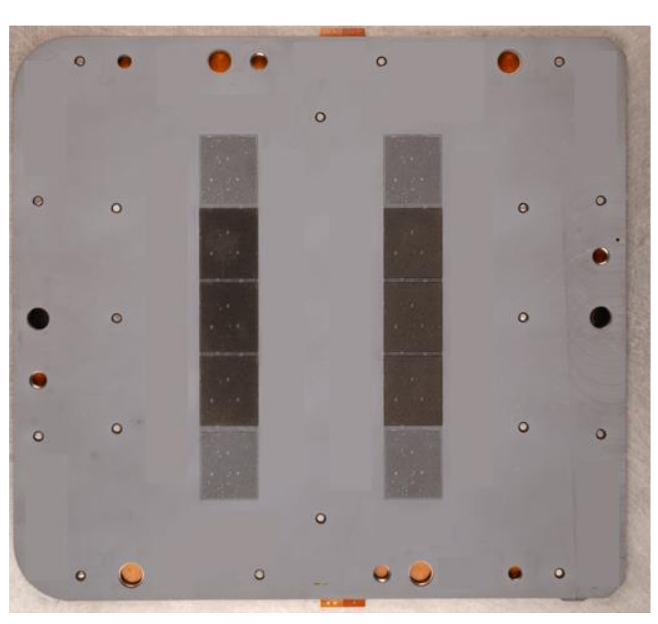
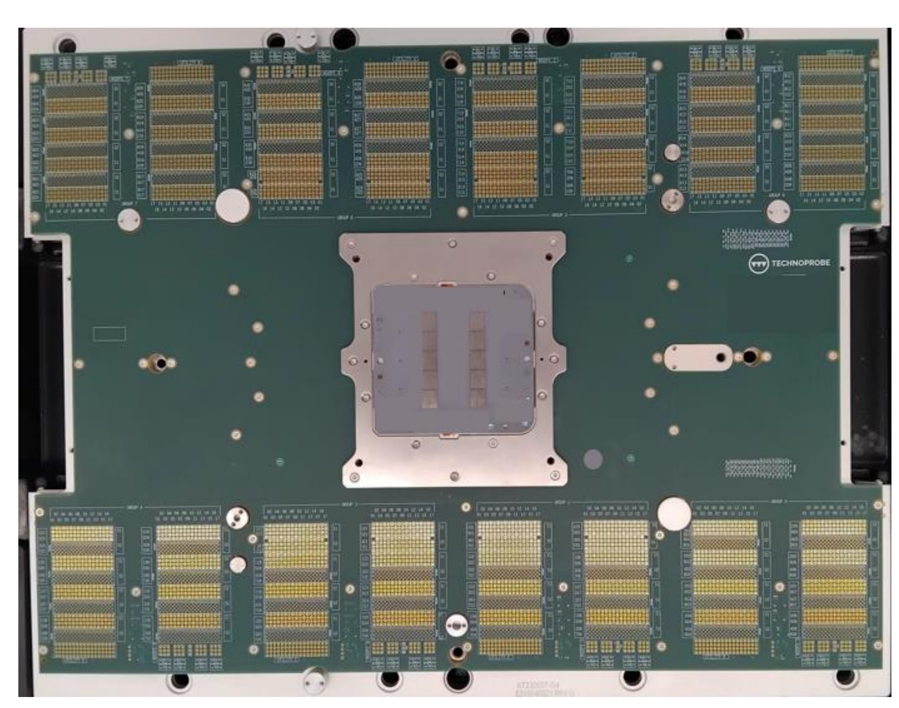
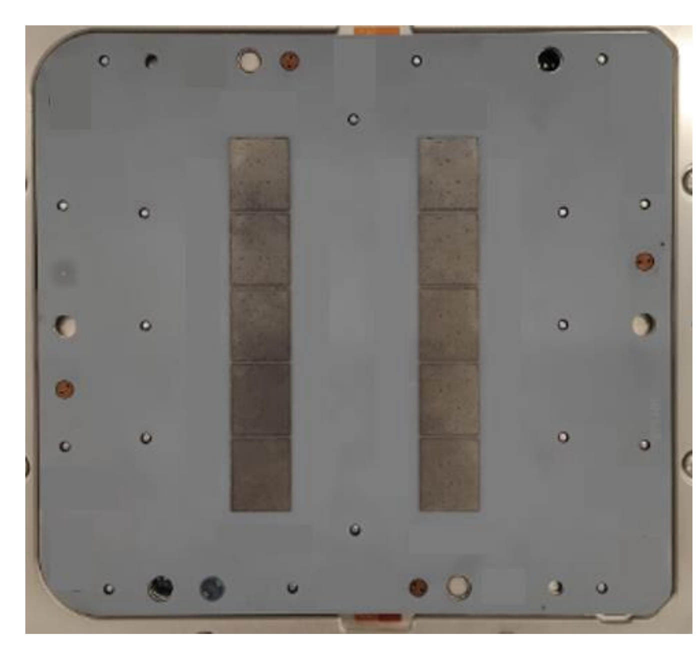
The ability to increase pin counts is one of the main challenges to overcome in the advanced vertical probe card industry. It requires a strong collaboration between every contributor in the wafer testing supply chain: tester supplier, prober supplier, probe card supplier, test houses, final customer. This paper will present:

1. **Ultra High Pin Count Probe Card:**
   a. Test Vehicle #1 with **95K pins** and Test Vehicle #2 with **160K pins**
2. **Deflection Study:**
   a. Experimental setup and measurement method
   b. Main contributors to deflection
   c. Experimental results
   d. Measurement method optimization: from standard pin method to capacitive sensors
3. **Upgrade on Probe Card Analyzer (PCA)**

Ultra High Pin Count Probe Card

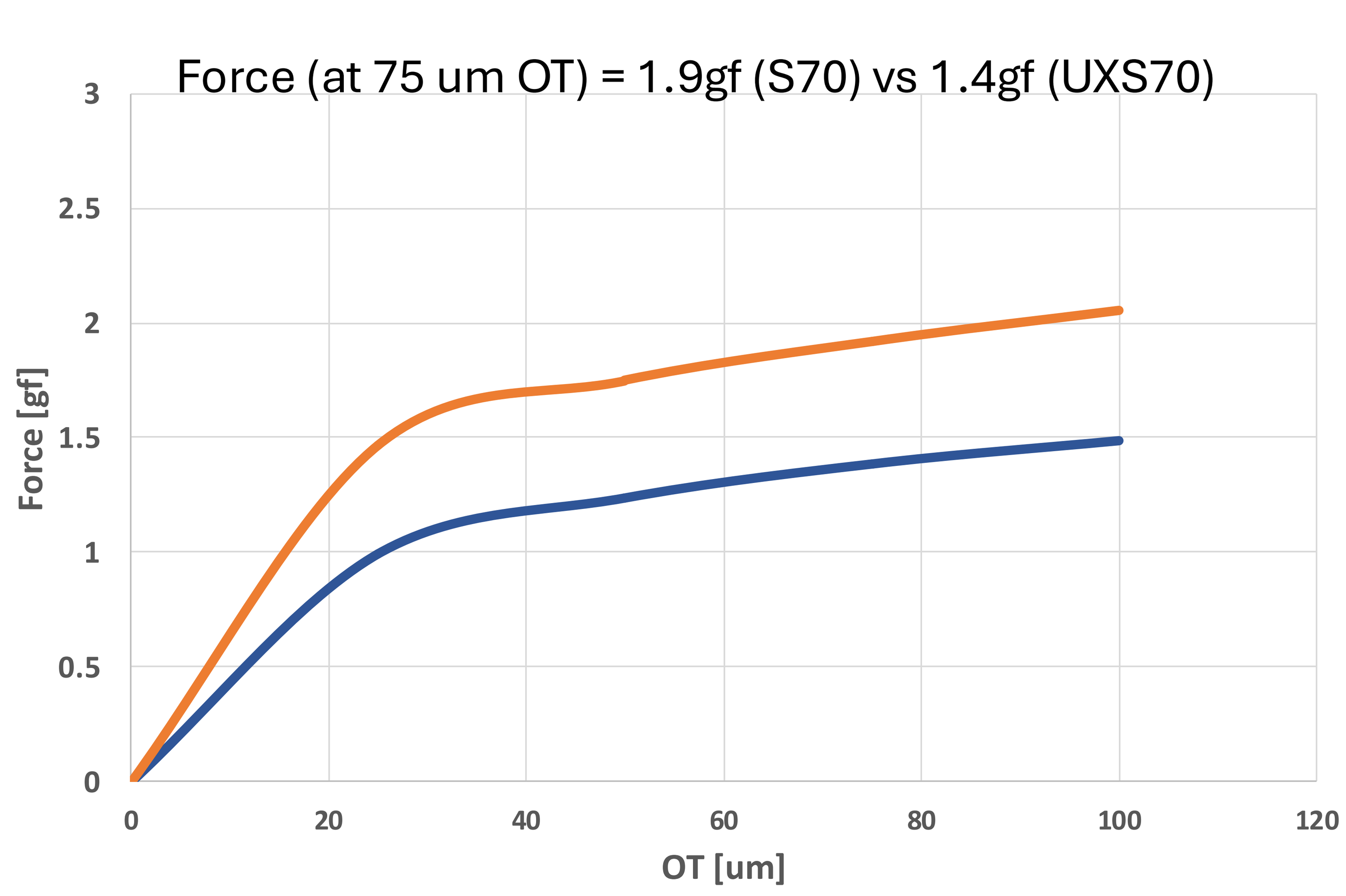
Test Vehicle #2 with **95K pins**	
Pin Count	94962 pins
Probe Technology	UXS: Low Force & Extra Short probes
Total Probe Force	**167 Kgf**
Parallelism	6 DUT
Array Size	X =39,2mm ; Y=43,6mm
Testing Platform	V93K Digital Bridge Beam

Test Vehicle #2 with **160K pins**	
Pin Count	158270 pins
Probe Technology	UXS: Low Force & Extra Short probes
Total Probe Force	**280 Kgf**
Parallelism	10 DUT
Array Size	X =43,6mm ; Y=65,6mm
Testing Platform	V93K Digital Bridge Beam

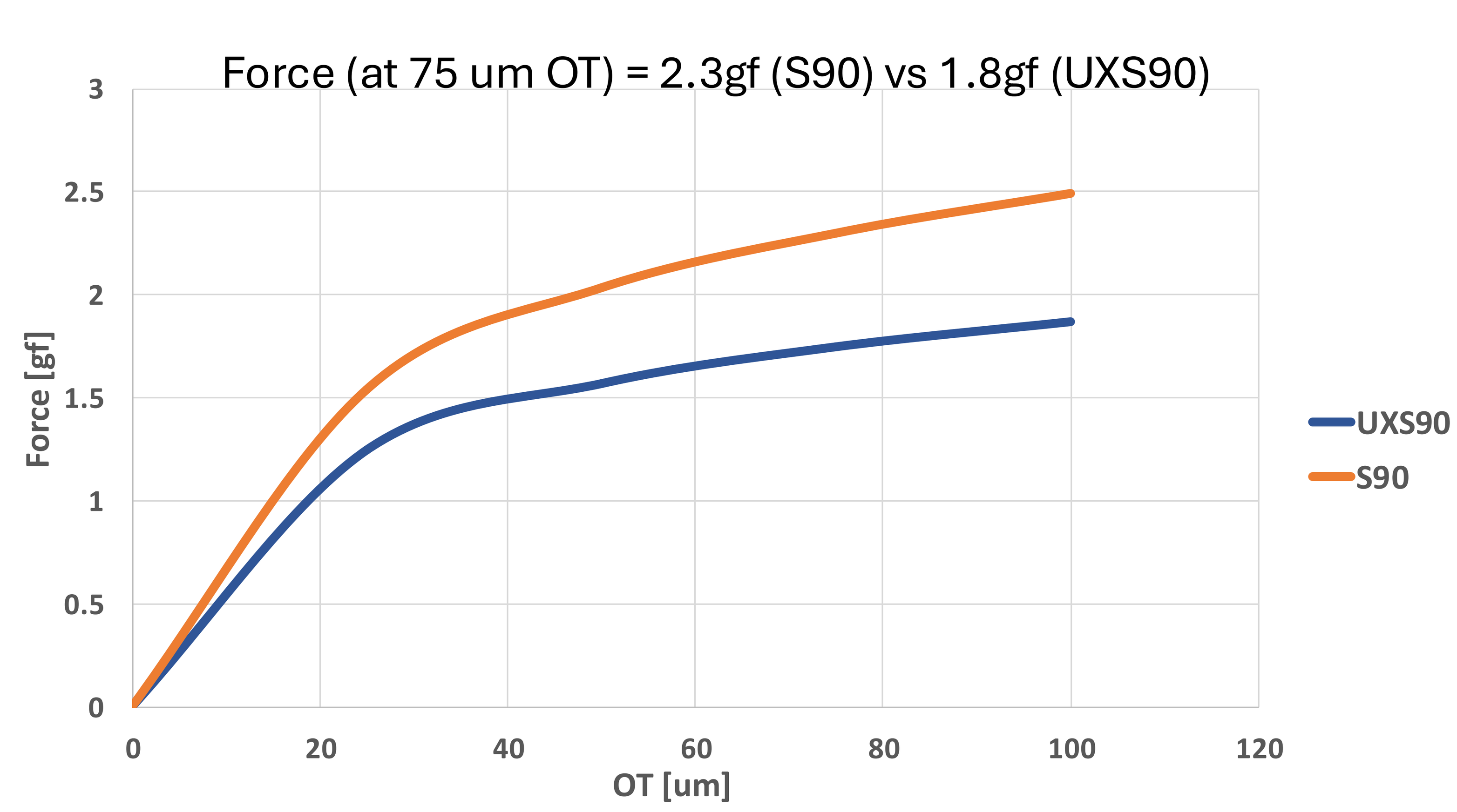





With ultra short and low force needles (UXS family) we can achieve remarkable improvements in terms of:
- **Force and Deflection reduction**
- SI performance
- PDN performance

S70 vs UXS70

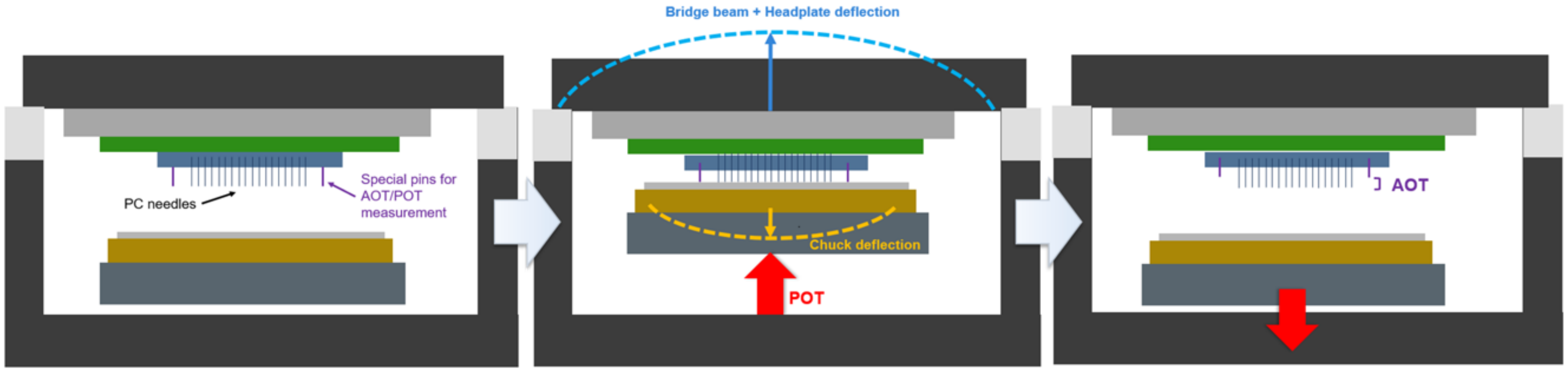


S90 vs UXS90



Deflection Study:

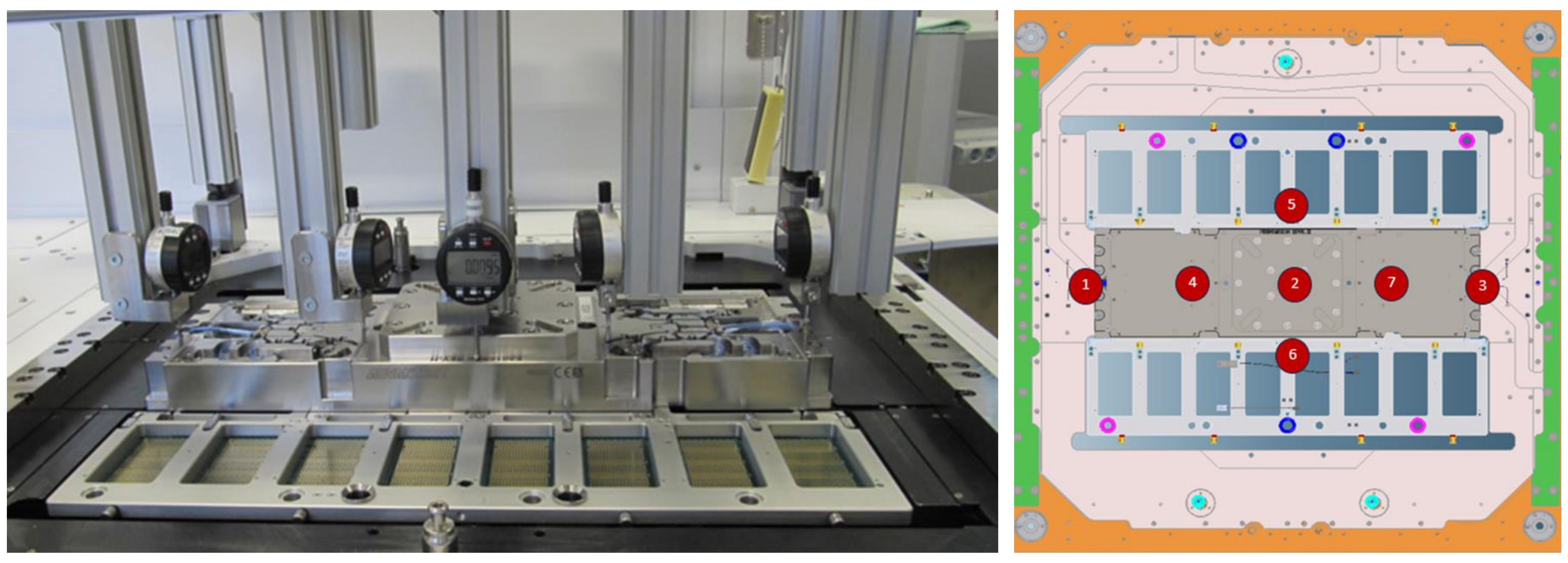
a) Experimental setup and measurement method



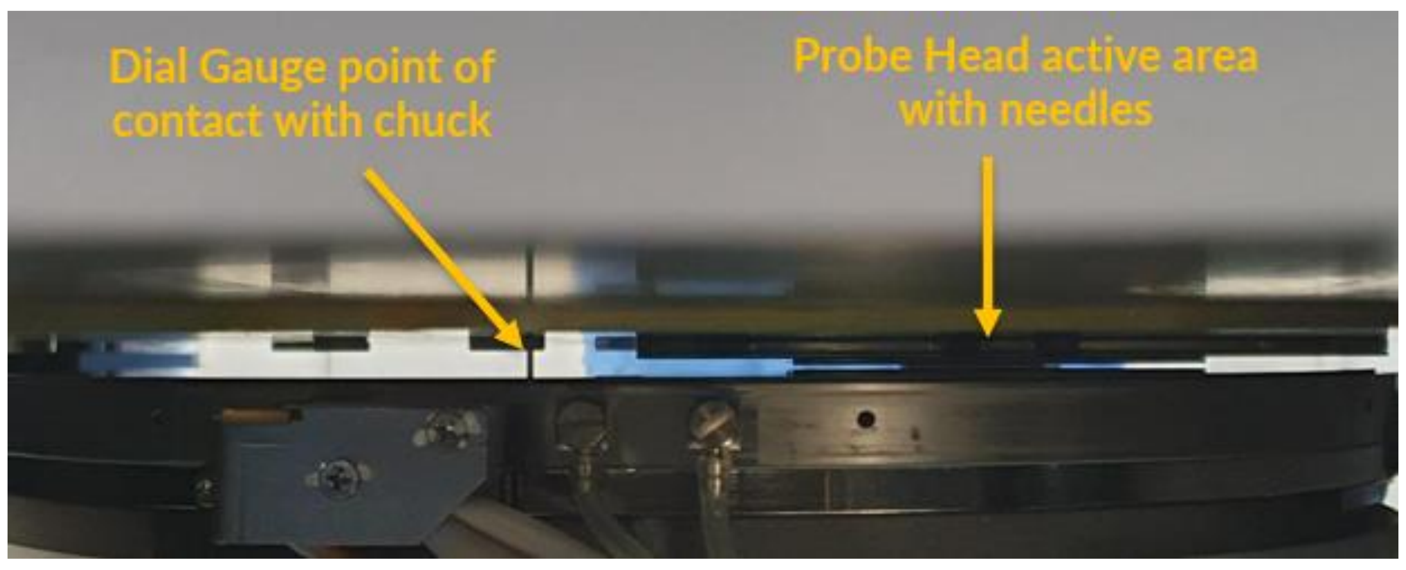
POT (Programmed Over Travel) = AOT (Actual Over Travel) + bridge beam + headplate deflection + chuck deflection + other?

Deflection of Test Cell has been measured in its entirety and divided in main components:

- **<u>Upper deflection</u>: Bridge Beam, Prober headplate and inner ring** vertical displacements are measured with Dial Gauges
- **<u>Lower deflection</u>: Chuck** vertical displacements is measured with Dial Gauge inserted in hole through PCB

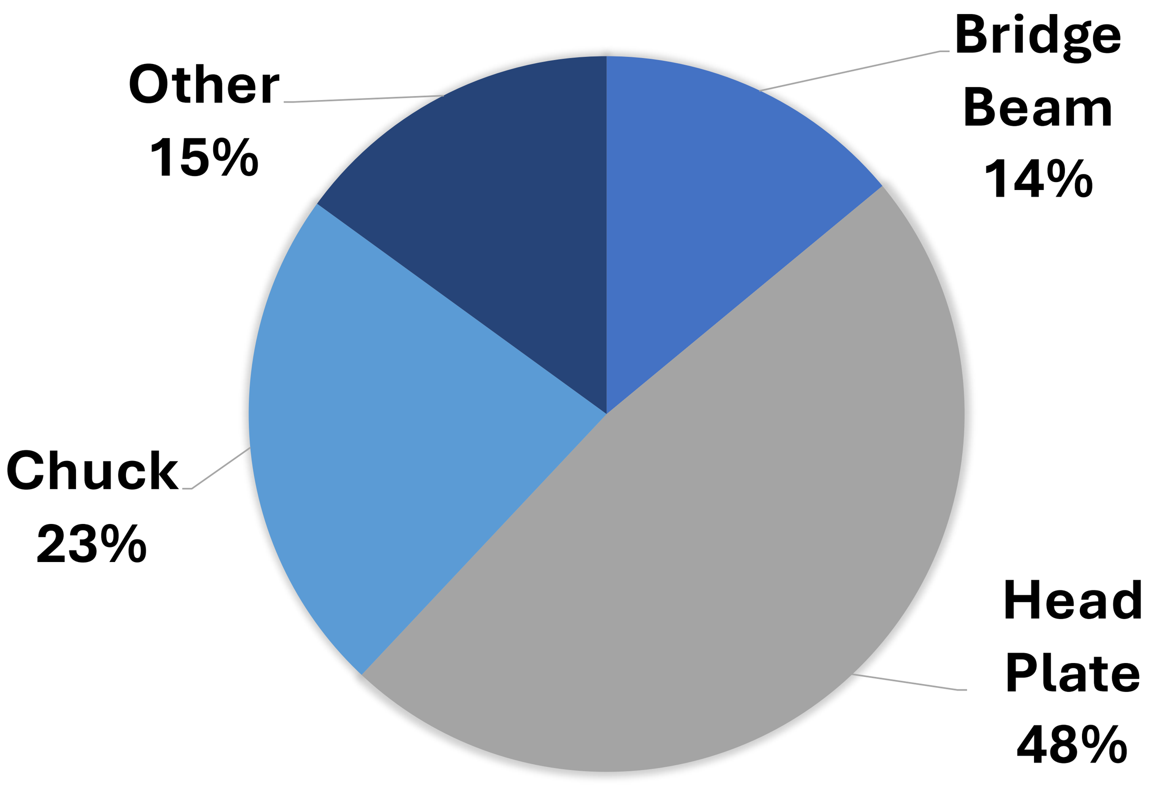


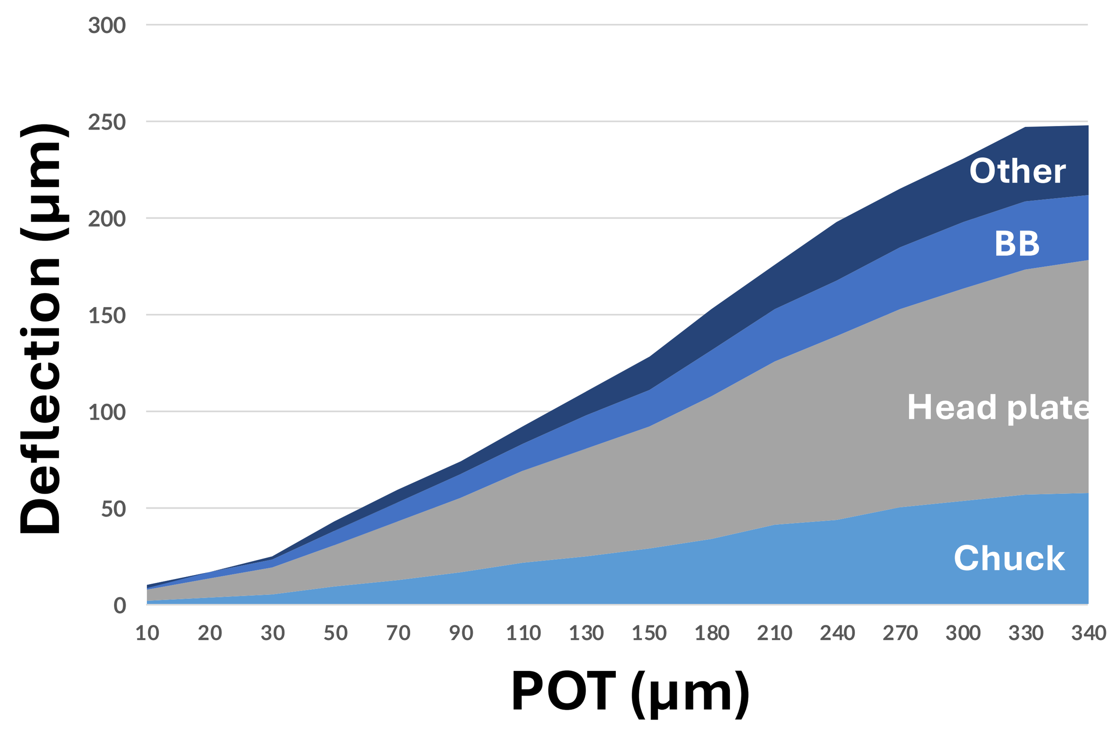
Upper deflection measurement method



Lower deflection measurement method

b) Deflection Main Contributors

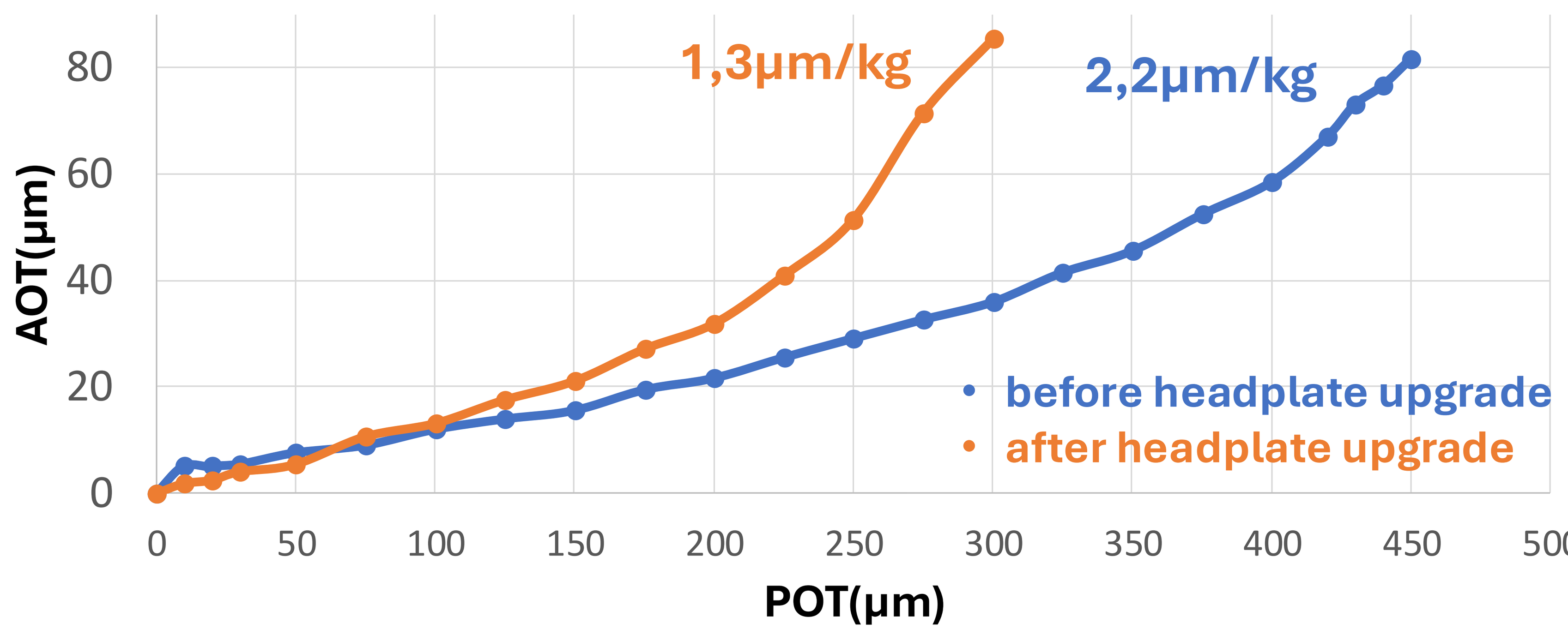




Component	Deflection	Compliance
Prober Head Plate + Prober Inner ring	120 µm	0.72 µm/Kgf
Bridge Beam (center - edge)	34 µm	0.2 µm/Kgf
Chuck	58 µm	0.34 µm/Kgf
Other	38 µm	0.23 µm/Kgf
Total	**250 µm**	**1.5 µm/Kgf**

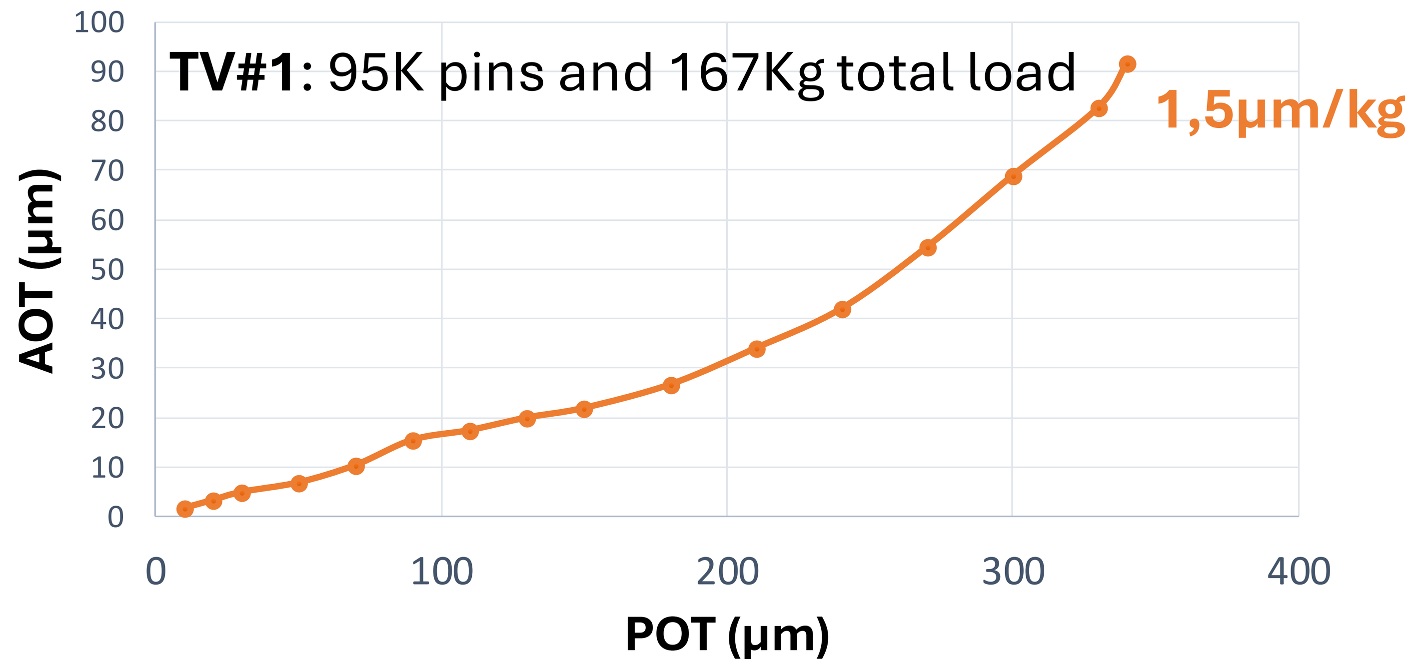
To demonstrate the key role played by headplate configuration and material, AOT/POT has been measured, on the same prober, before and after the headplate upgrade. During upgrade, **aluminum headplate** was replaced by **stainless steel headplate.** Compliance value of the total test cell decreases from 2.2µm/Kg to 1.3µm/Kg.
Test vehicle used for this trial is PC with 95K pins and 167Kg as total load.

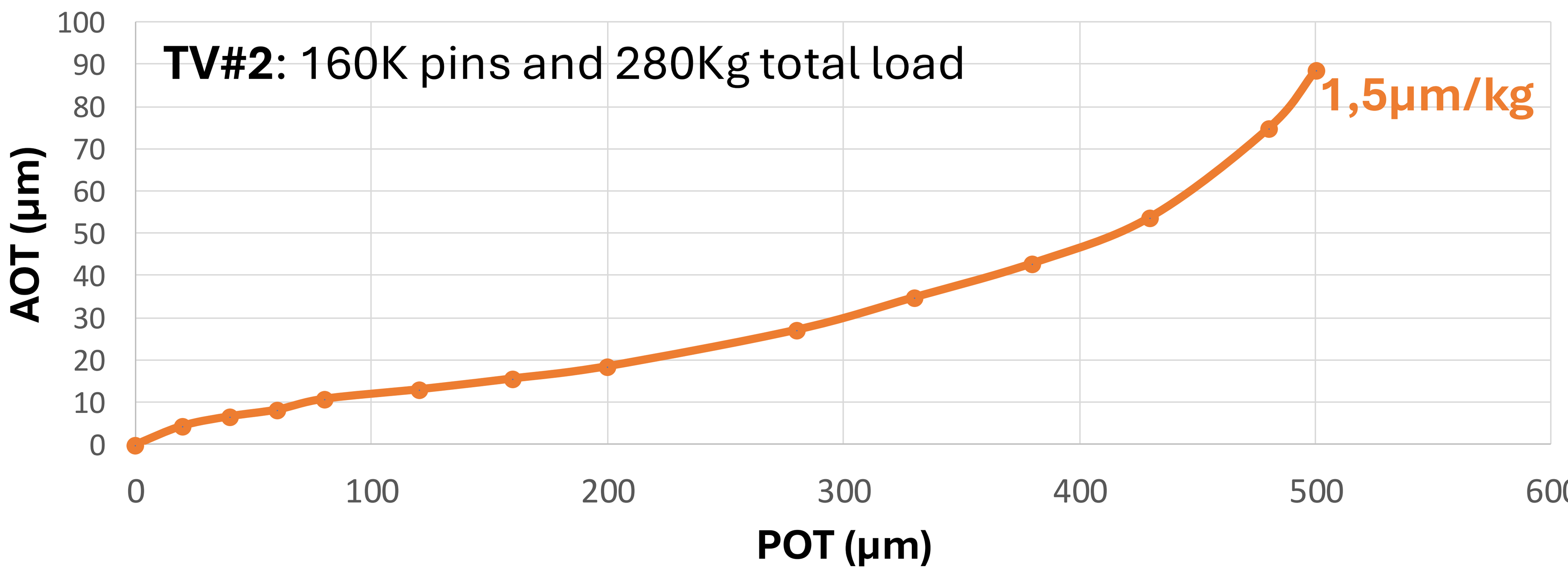
COMPLIANCE COMPARISON:
BEFORE and AFTER HEADPLATE UPGRADE



c) Experimental results on 95K pins (TV#1) end 160K pins (TV#2)

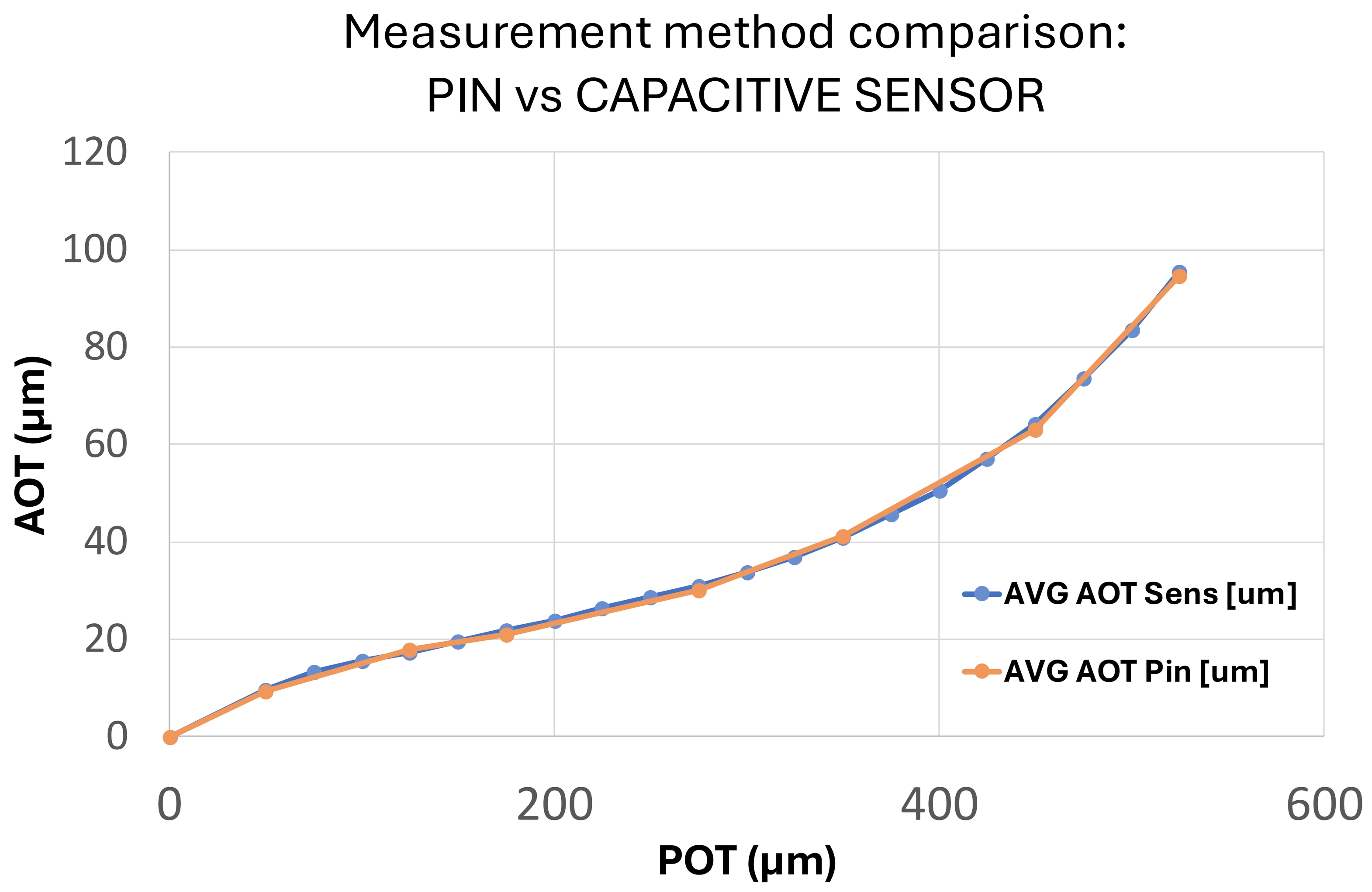
To explore test cell capability limit, both 95K pins (TV#1) end 160K pins (TV#2) has been tested. Total load is 167Kg and 280Kg, respectively. Prober's configuration used in this experiment includes stainless steel headplate and inner ring, and chuck with 300Kgf as maximum load. Compliance value, as expected, doesn't change (1,5µm/kg)

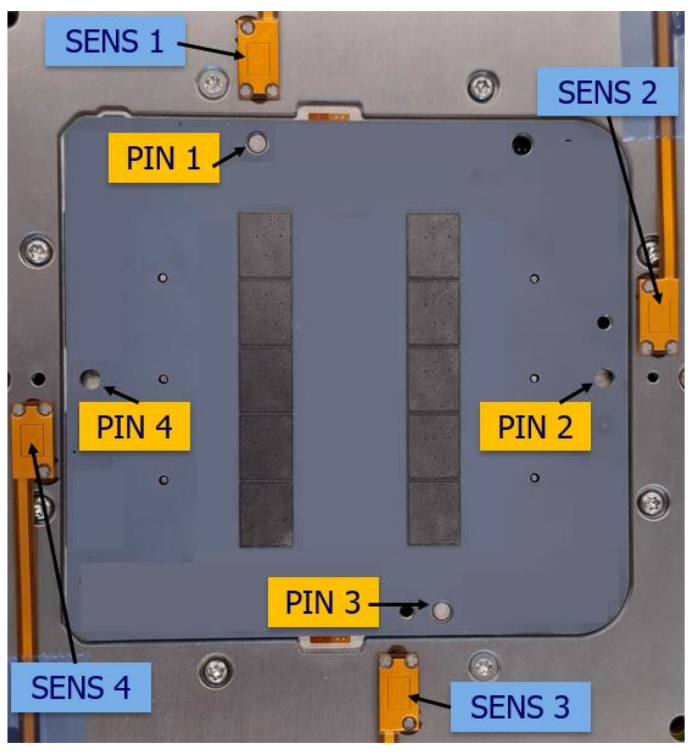


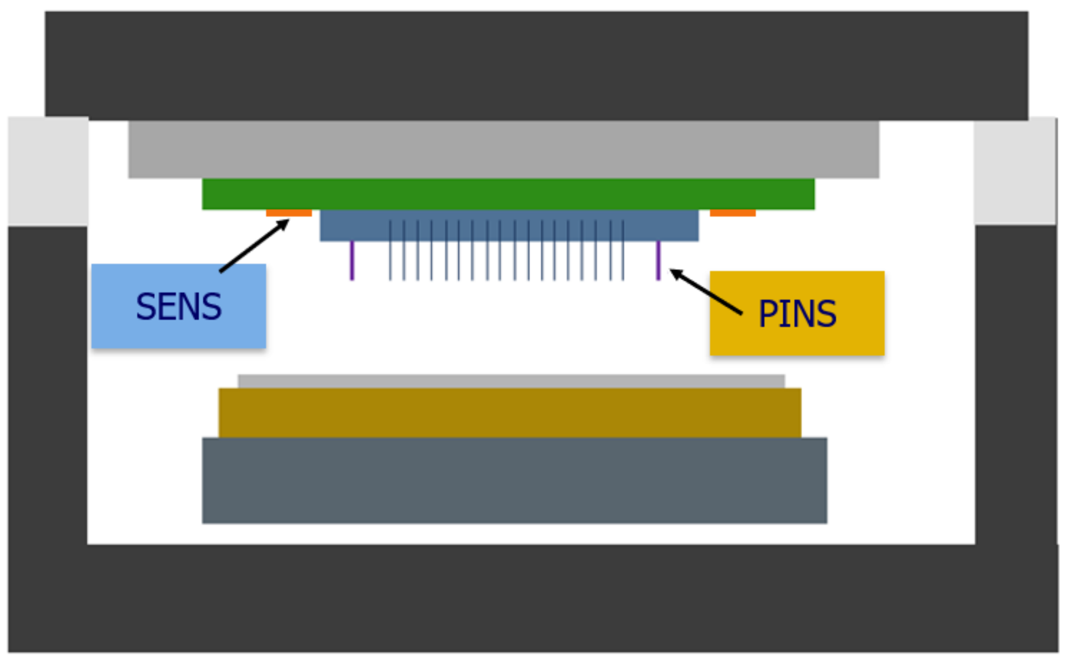


d) Measurement method optimization: from standard pin method to capacitive sensors

Standard pin method, currently used for AOT/POT measurement, has several limitations in terms of accuracy (±3µm), long time needed to take measurements, high temperatures test disabled. On the other hand, capacitive sensor method enables higher accuracy (±1,5µm), real time measurements and test at high temperature.



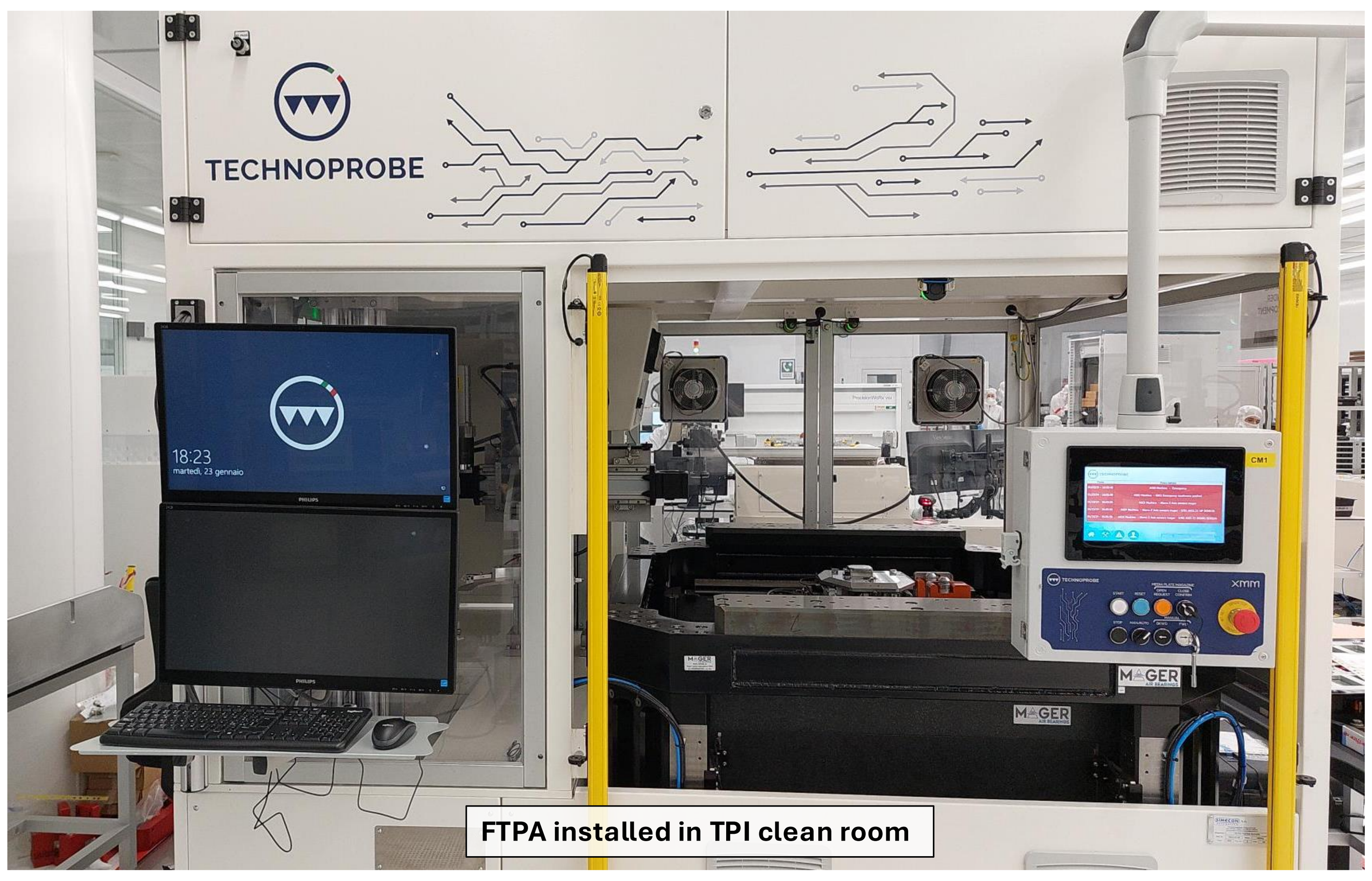




Data collected on TV#2 (280Kg 160K pins) are showing a very good agreement between capacitive sensor method and standard pins method. Prober's configuration used in this experiment includes stainless steel headplate and inner ring, and chuck with 300Kgf as maximum load.

Upgrade on Probe Card Analyzer (PCA)

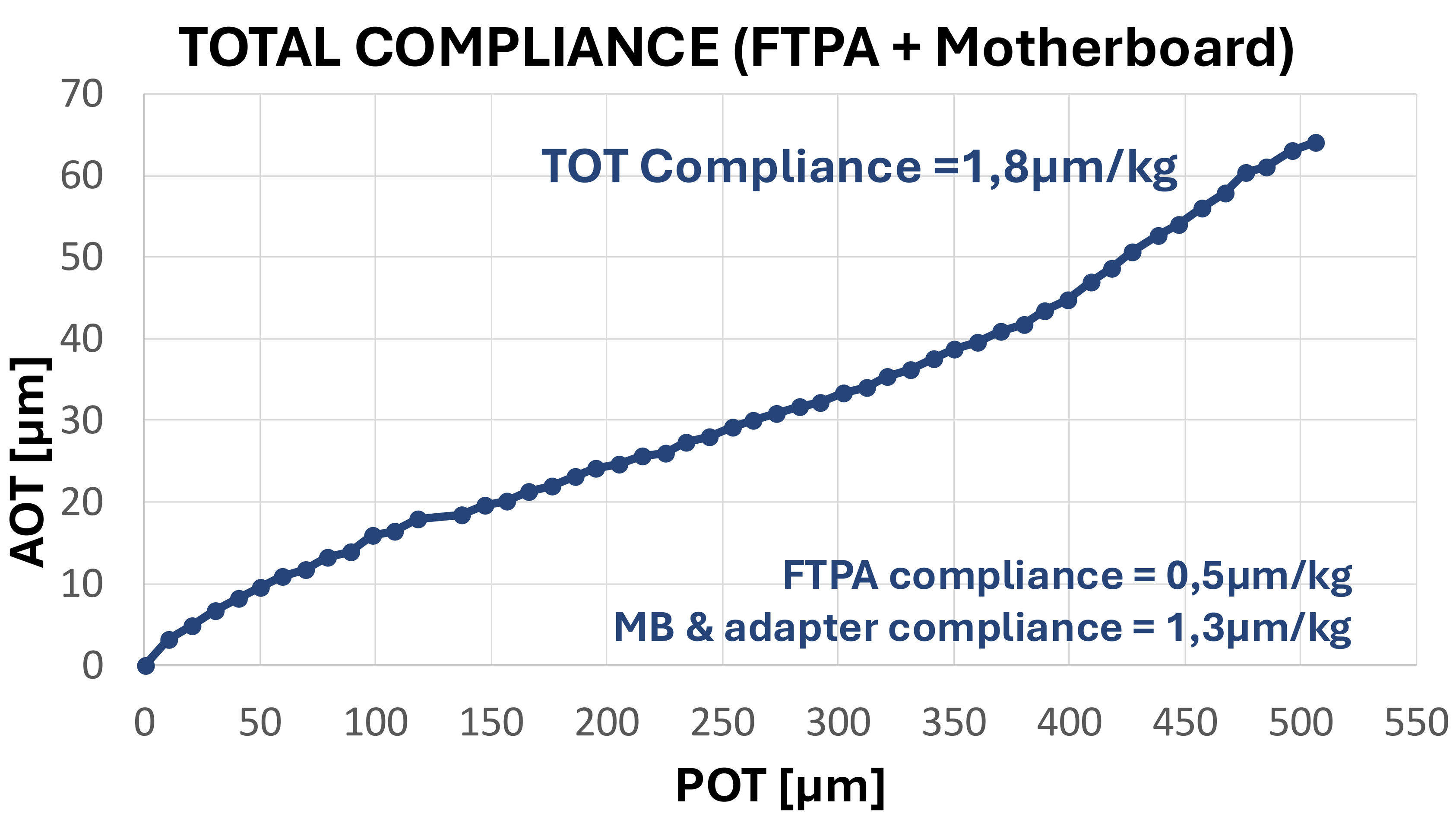
Every Probe Card must be in house tested before delivery to customer, therefore testing must be reliable to avoid any early electrical issue on field. As well as test cells, probe card analyzer (PCA) must enable high load PCs testing.
Since current PCA (PRVX4) max load capability is 150Kgf, Technoprobe decided to develop new PCA analyzer with enhanced performances. FTPA (internally-developed PCA) enables several measurements: alignment, planarity, electrical continuity, leakage, CRES.

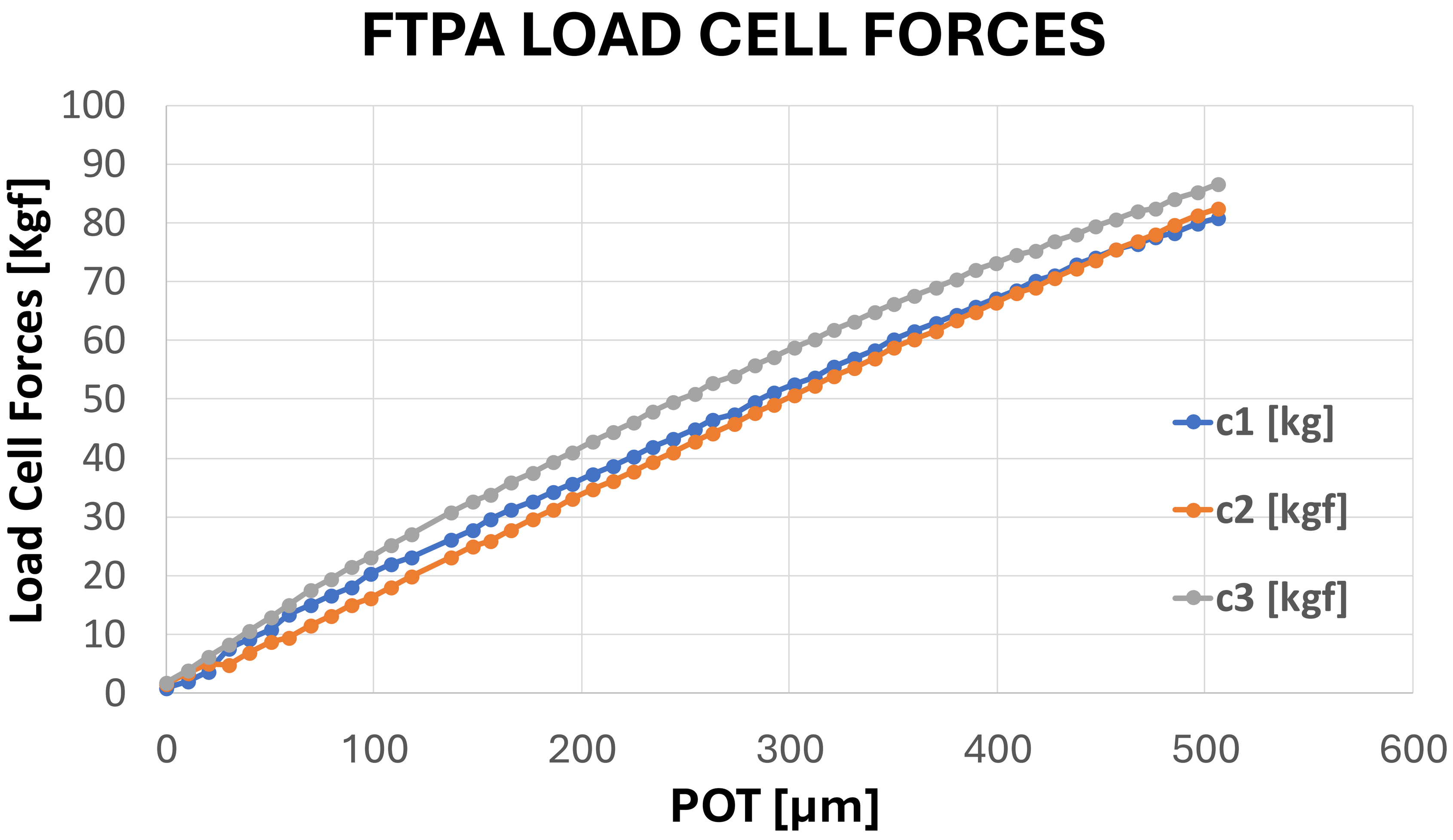


FTPA installed in TPI clean room

	PRVX4	FTPA
Max Probe-head Size	112.5 mm x 112.5 mm	320mm
Max Chuck Force	80kg for EX, **150kg** for STD	**350kg**
Max Travel	23mm for EX, 8mm for STD	110mm
Overall Accuracy	7 um	<2um
Test Time	More than 16h for a 50K pins PH	We expect less than 8h
Optical	1x2D with limited field of view	1x2D with large field of view 2x3D (interferometers)
Electrical Channels	Up to 6000	Up to 18.432
Autoloader	No	Yes up to 5 PCs
Flying probes	1	2 independent
Tilt Correction	No	Yes
Repair	Yes on the equipment (flipping)	TBD

Capacitive sensor method has been used to measure FTPA compliance.





Acknowledgement & Contact informations

The authors express their gratitude to Michael Ott, Markus Fahrner, Marc Mössinger from Advantest as well as Riccardo Acquaviva, Alberto Berizzi and Raffaele Vallauri from Technoprobe for their valuable contribution to this paper

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