



A Better Tester-Prober Interface Paradigm: Direct Docking

Roger Sinsheimer, P.E.
Sr. Staff Engineer
Xandex, Inc.

New Orleans, LA

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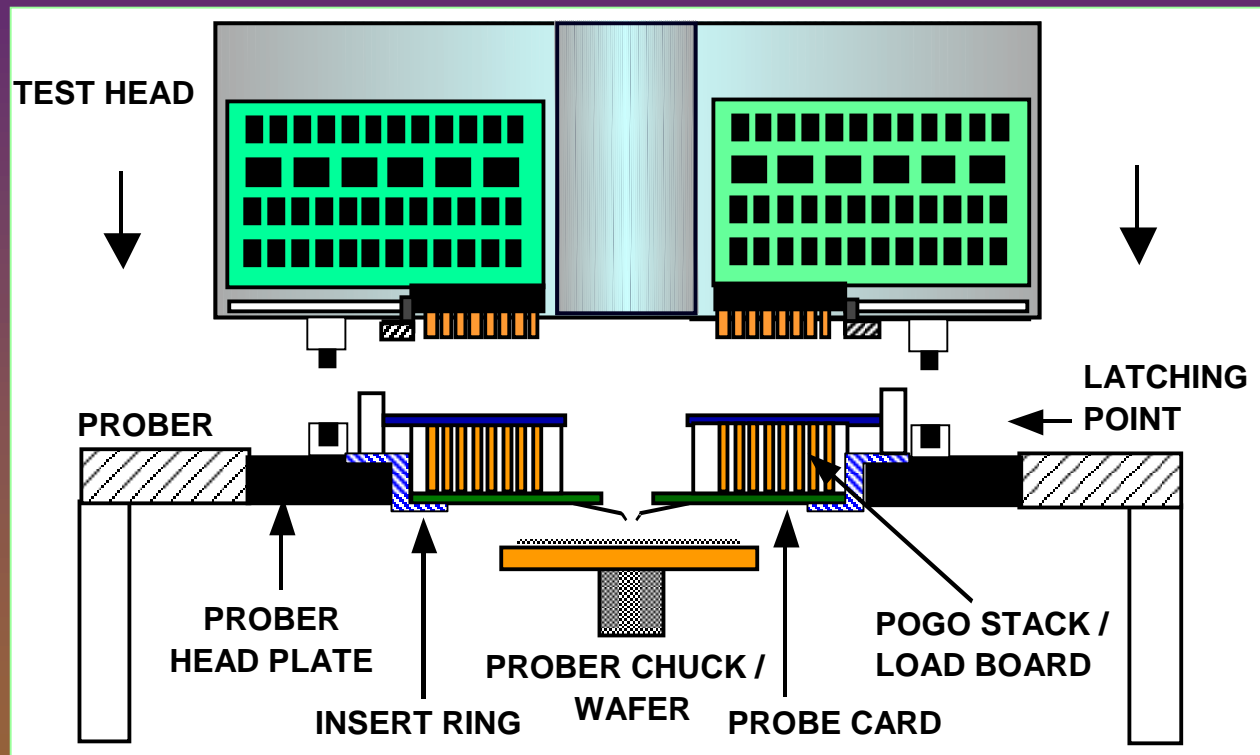
Agenda

- **What is Direct Docking?**
- **Why Direct Dock?**
- **Z-Budget – What is it?**
- **Probe Card Deflection**
- **Mixed-Signal Test and Direct Dock**
- **Pretty pictures**



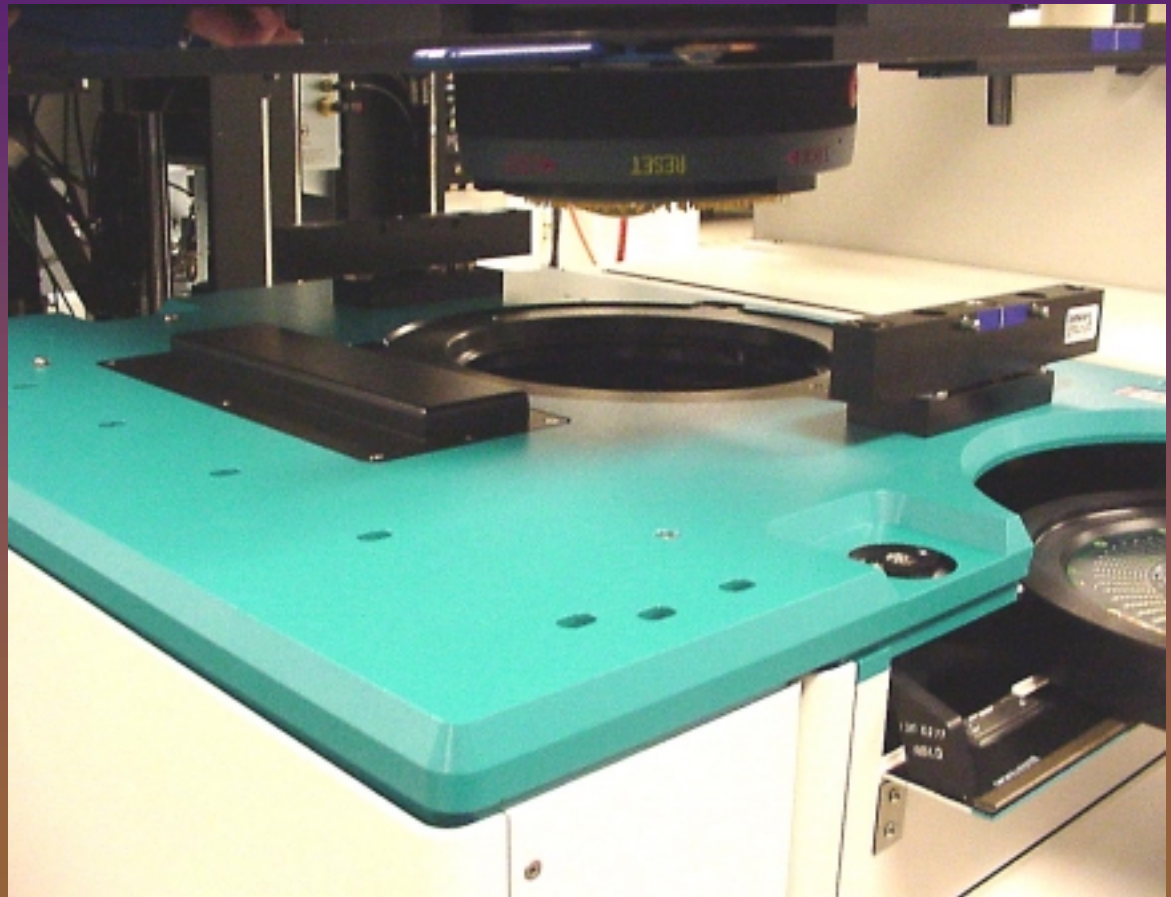
What is Direct Docking?

Conventional System



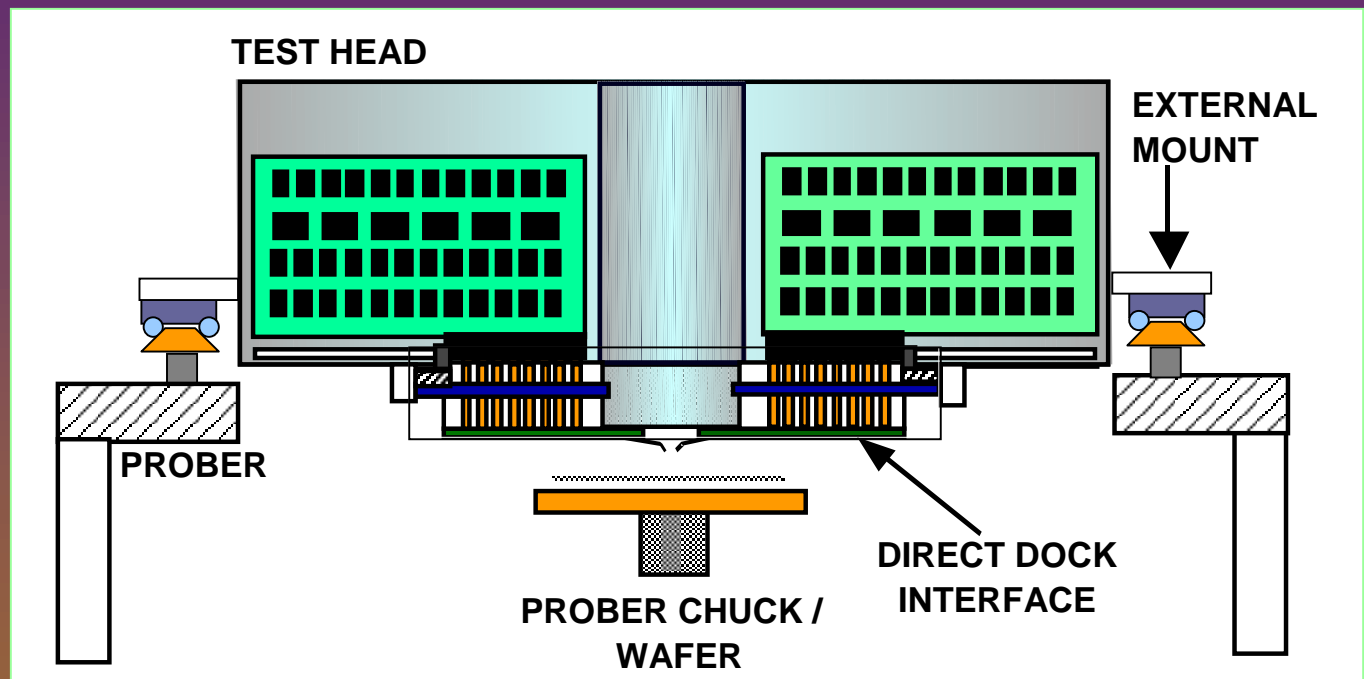
What is Direct Docking?

LTX HT / PPS with
Xandex AutoLoader
and conventional
docking



What is Direct Docking?

Direct Docking System



So why Direct Dock?

- Repeatable Z-location and planarity of probe needles
- Reliable electrical connection between the probe card and the tester



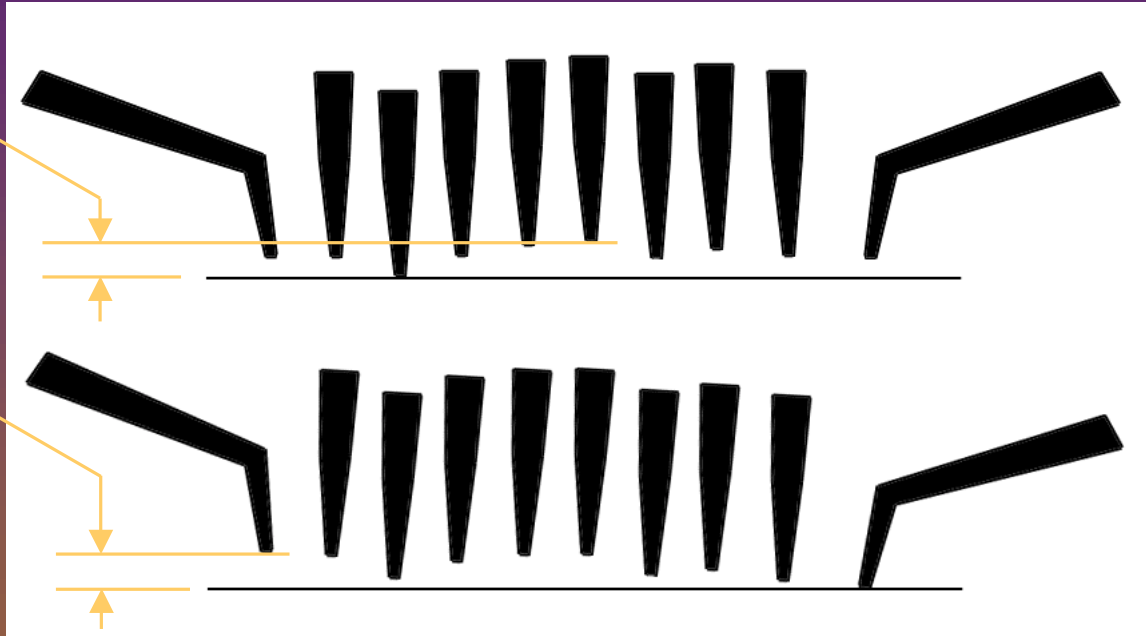
So why Direct Dock?

With Direct Docking,
probe card alignment
and support issues are
isolated from (virtually)
all mechanical forces
induced by docking the
test head!



Z-Budget – what is it?

Z-budget

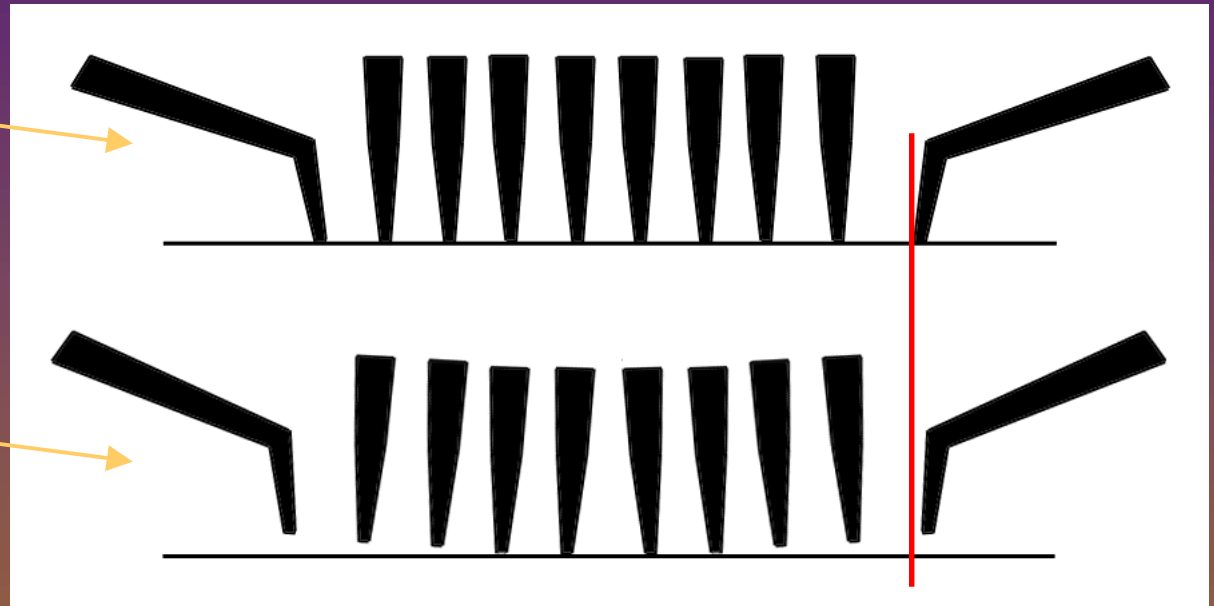


Z-budget ?



Z-budget & Probe Metrology

Probe Card at the metrology station



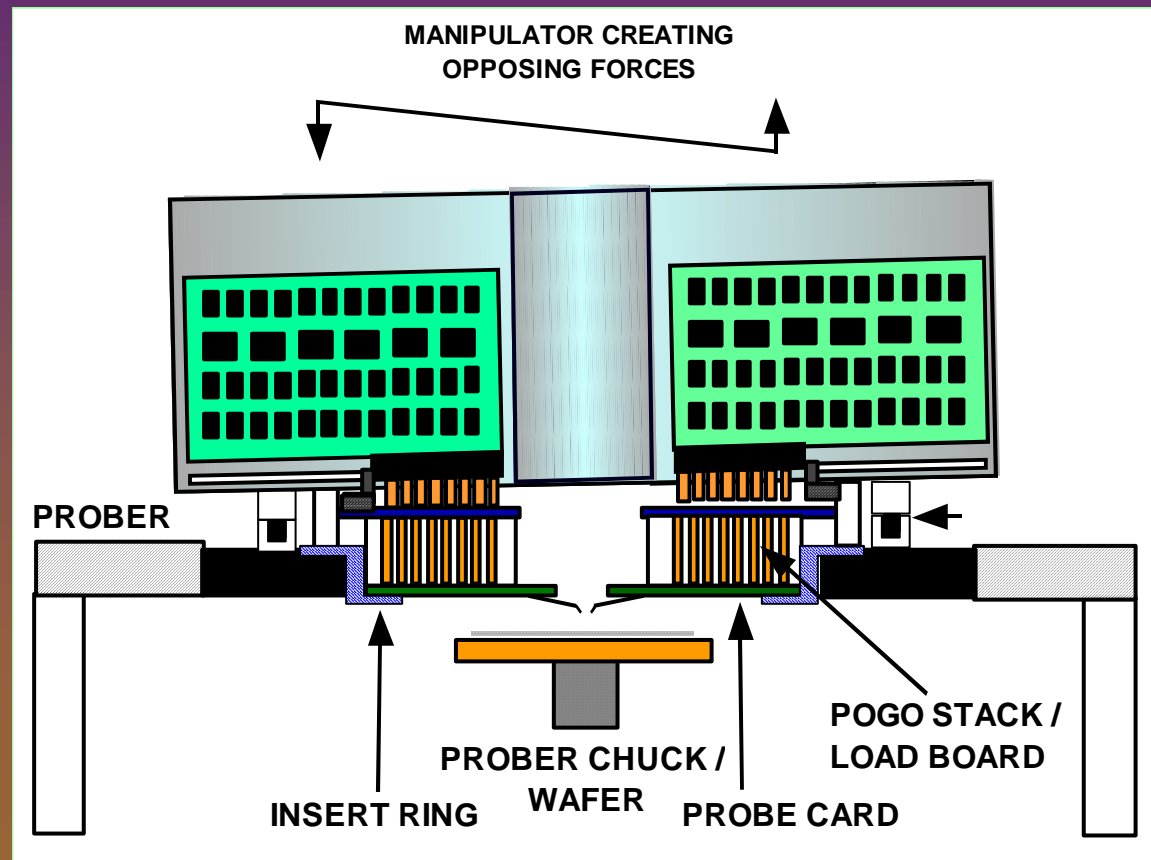
Probe Card in use



Probe Card Deflection

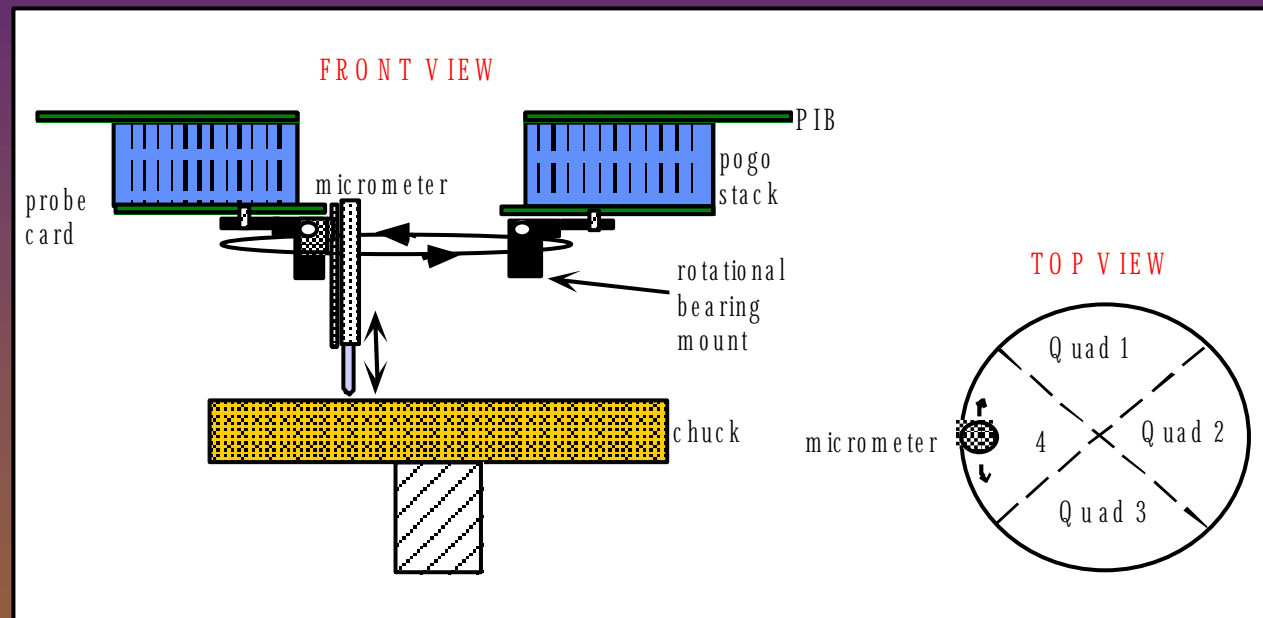
Premise: Conventional docking creates misalignment that results in probe card deflection.

Conventional system

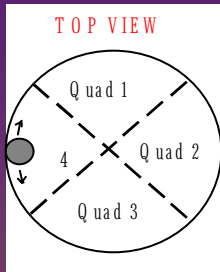


Probe Card Deflection Data

Test Methodology:



Probe Card Deflection Data, cont.

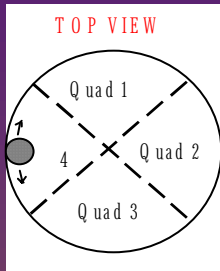


Results: Effect of Planarity Offset

AVERAGE Δ FROM UNDOCKED POSITION (μm)*				
	Quadrant	2° initial offset	4° initial offset	6° initial offset
System A	1	10.2	13.4	14.1
	2	9.2	9.8	10.8
	3	12.9	15.1	18.3
	4	8.3	10.6	12.2
System B	1	14.3	13.8	12.9
	2	19.8	23.5	29.8
	3	26.1	28.2	29.1
	4	20.0	18.6	16.2
Direct Dock	1	1.2	1.3	0.9
	2	3.0	3.6	4.2
	3	2.4	2.3	4.0
	4	3.7	3.1	3.1

*all initial angular offsets are counter-clockwise

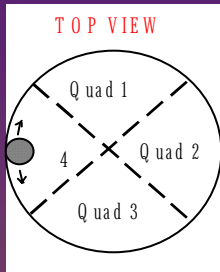
Probe Card Deflection Data, cont.



Results: Effect of Counter-Balance Offset

AVERAGE Δ FROM UNDOCKED POSITION (μm)					
	Quadrant	-10 lb.	-5 lb.	+5 lb.	+10 lb.
System A	1	19.1	14.4	9.2	9.9
	2	19.1	15.2	10.2	10.6
	3	20.3	18.4	11.6	12.2
	4	18.9	15.5	10.1	11.9
System B	1	22.2	18.2	16.0	17.4
	2	27.2	23.1	18.2	22.0
	3	32.2	28.1	17.2	24.2
	4	30.3	26.0	18.2	19.1
Direct Dock	1	2.5	3.1	2.0	2.7
	2	2.7	2.4	1.6	3.9
	3	2.2	0.8	1.7	1.0
	4	3.2	1.8	3.2	2.1

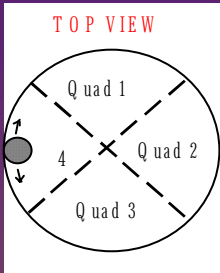
Probe Card Deflection Data, cont.



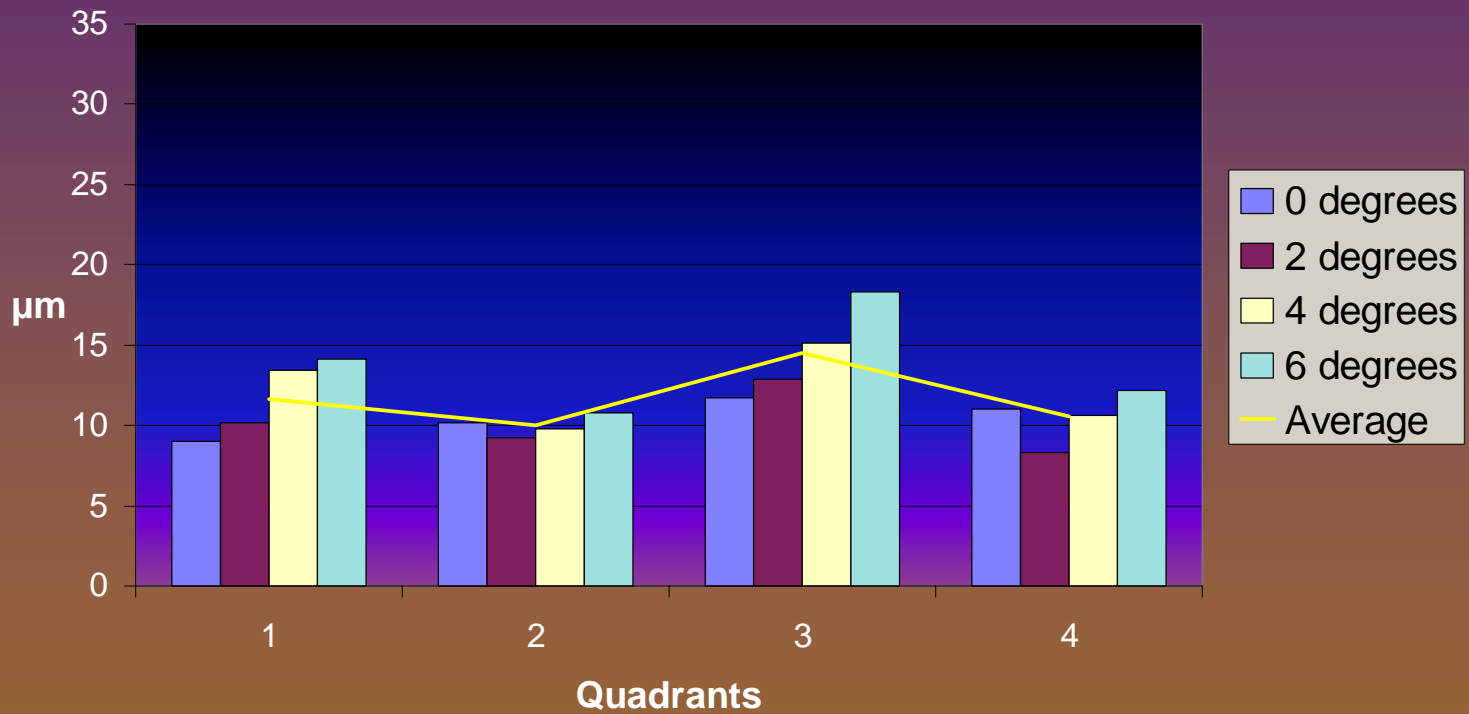
Results: No Offset
(level & balanced)

AVERAGE Δ FROM UNDOCKED POSITION (μm)				
	Quadrant 1	Quadrant 2	Quadrant 3	Quadrant 4
System A	9.0	10.2	11.7	11.0
System B	15.2	22.1	24.0	17.7
Direct Dock	1.6	3.5	2.0	3.0

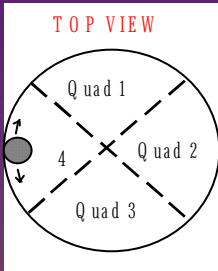
Graphical Representation of Data



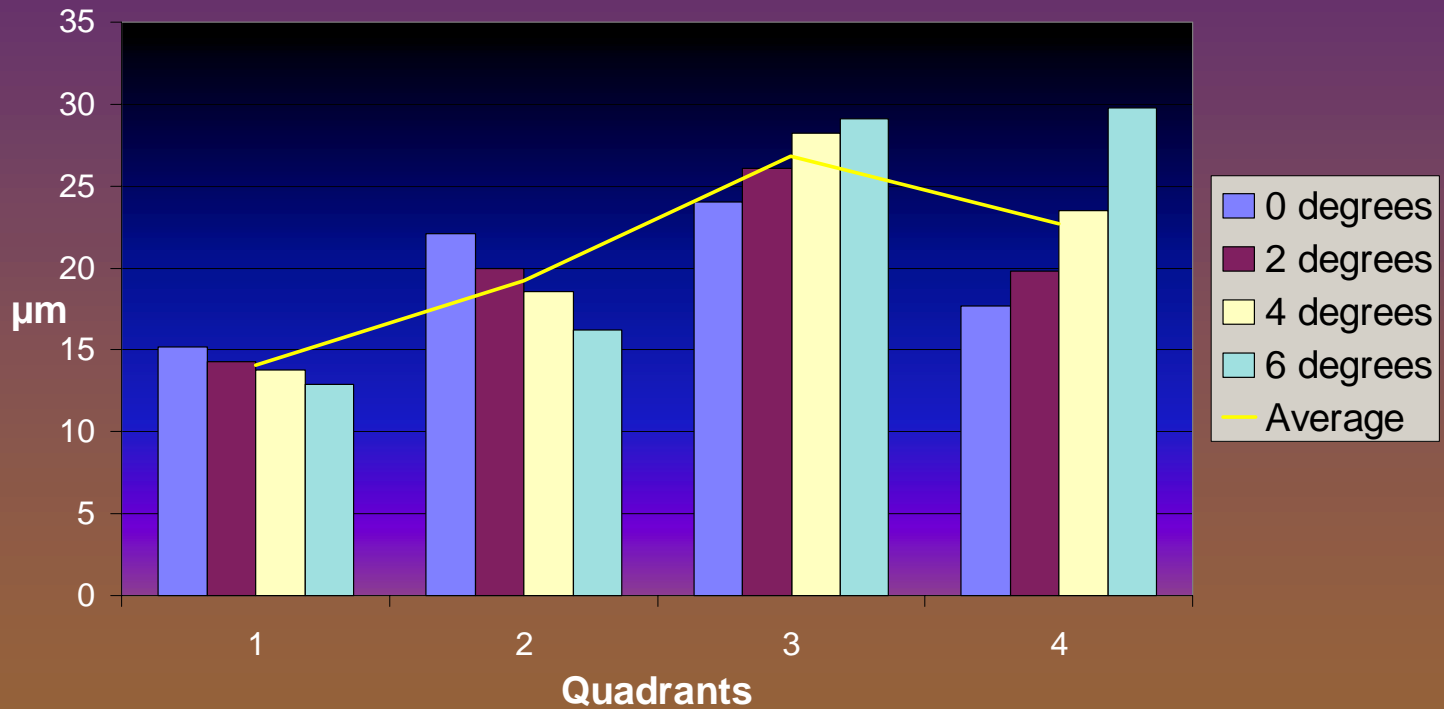
System A theta



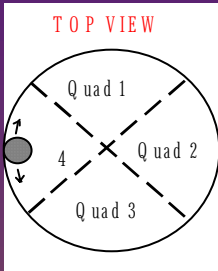
Graphical Representation of Data



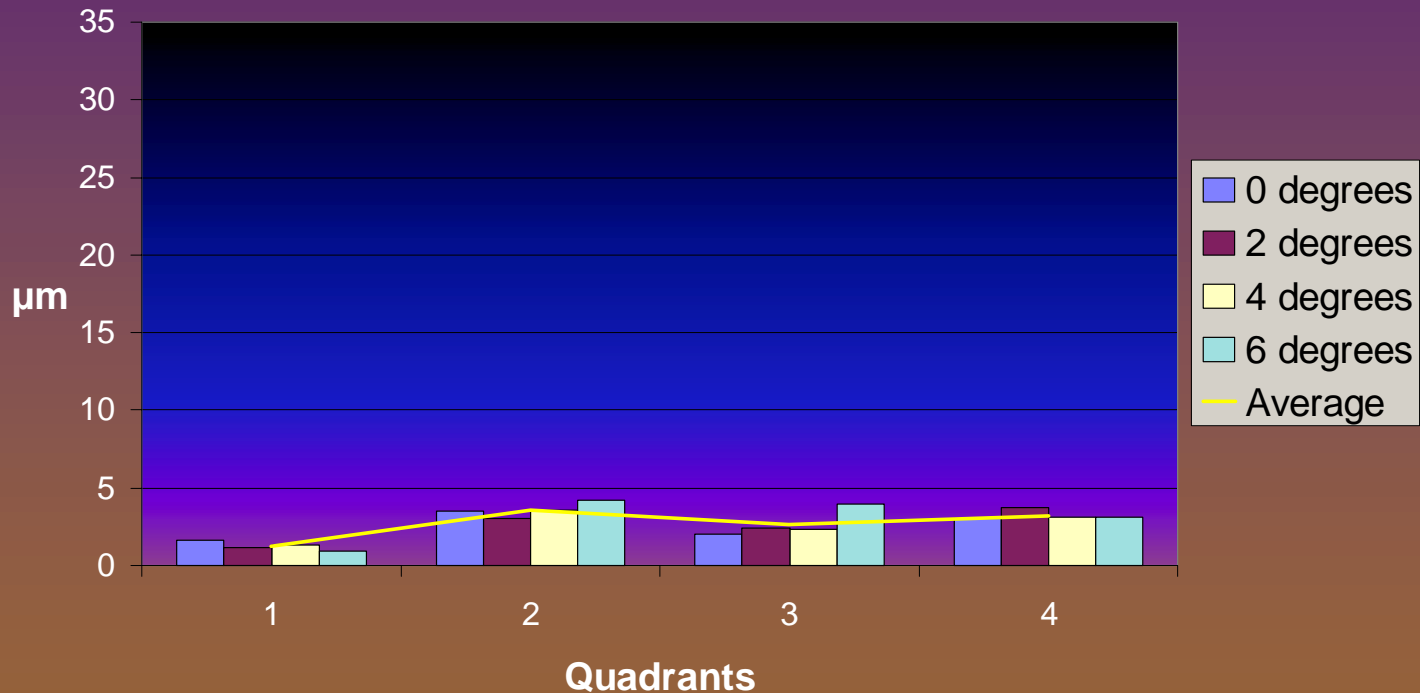
System B theta



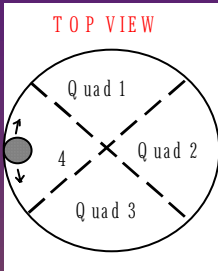
Graphical Representation of Data



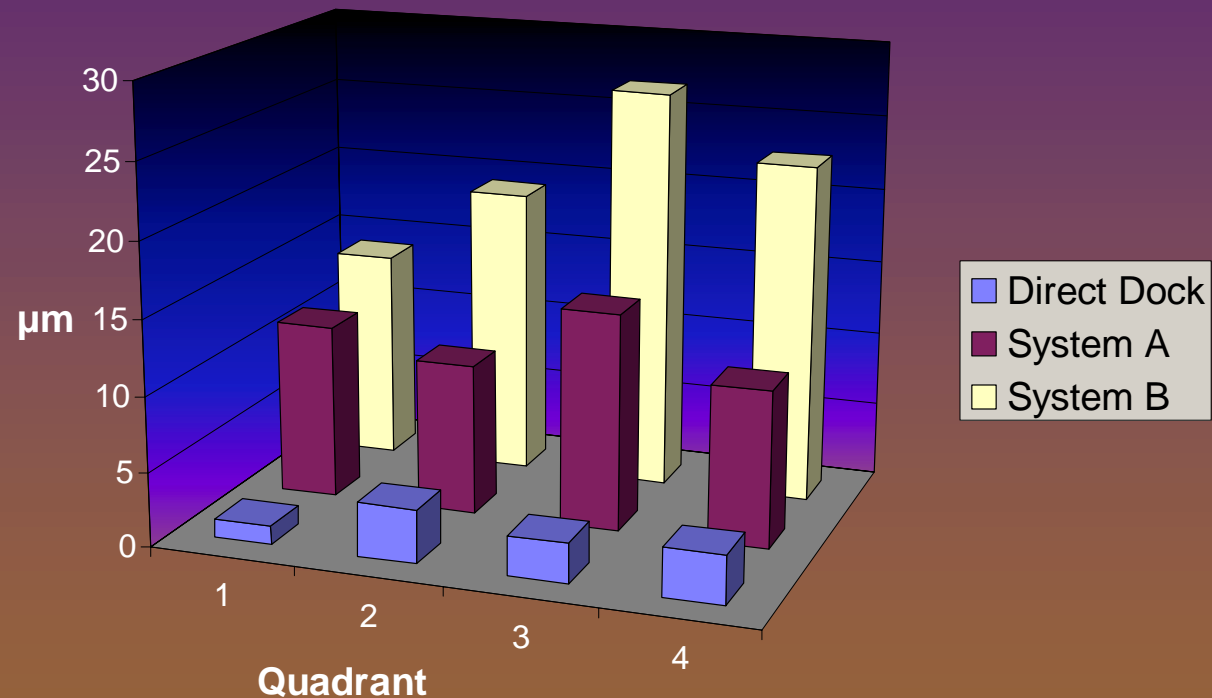
Direct Dock theta



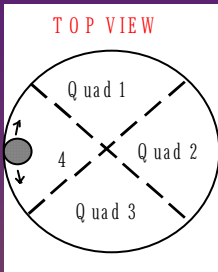
Graphical Representation of Data



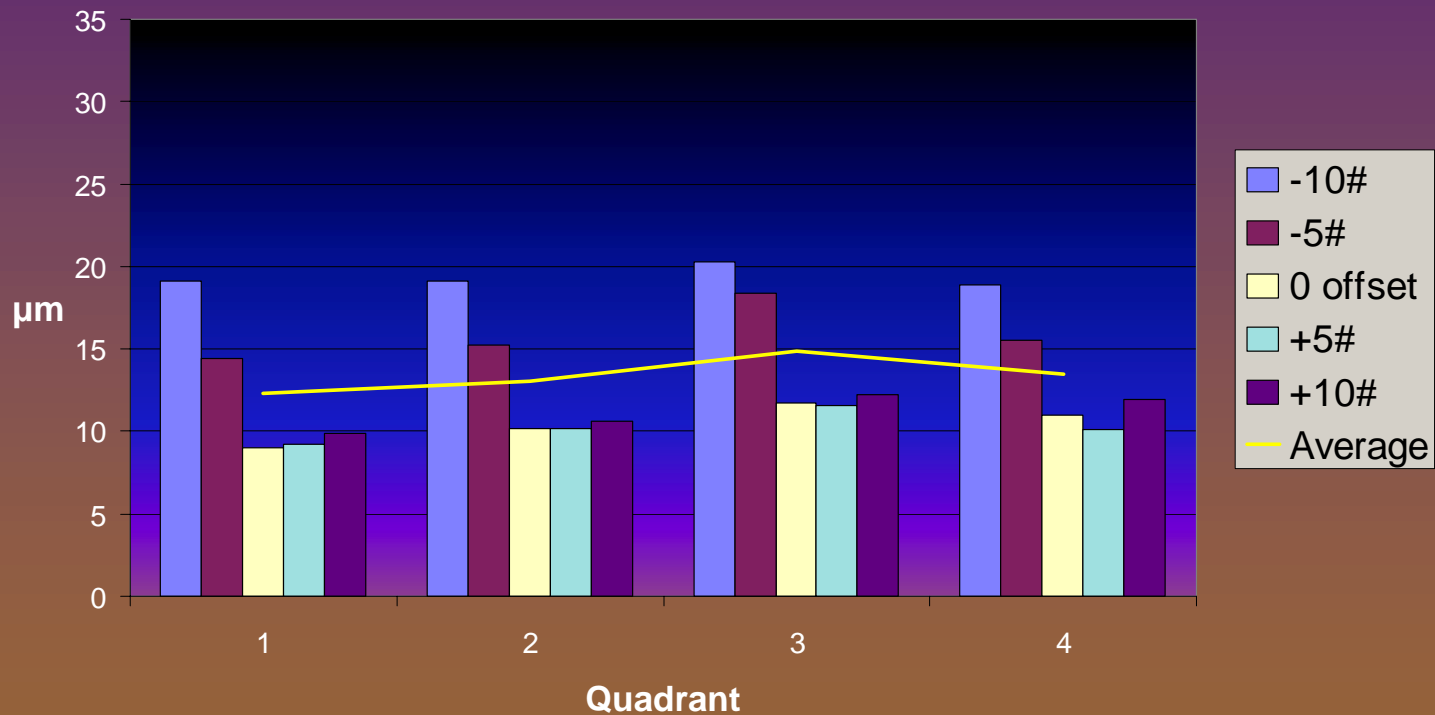
Comparison, theta



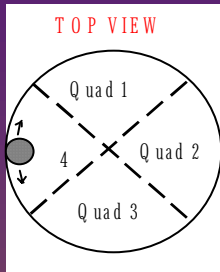
Graphical Representation of Data



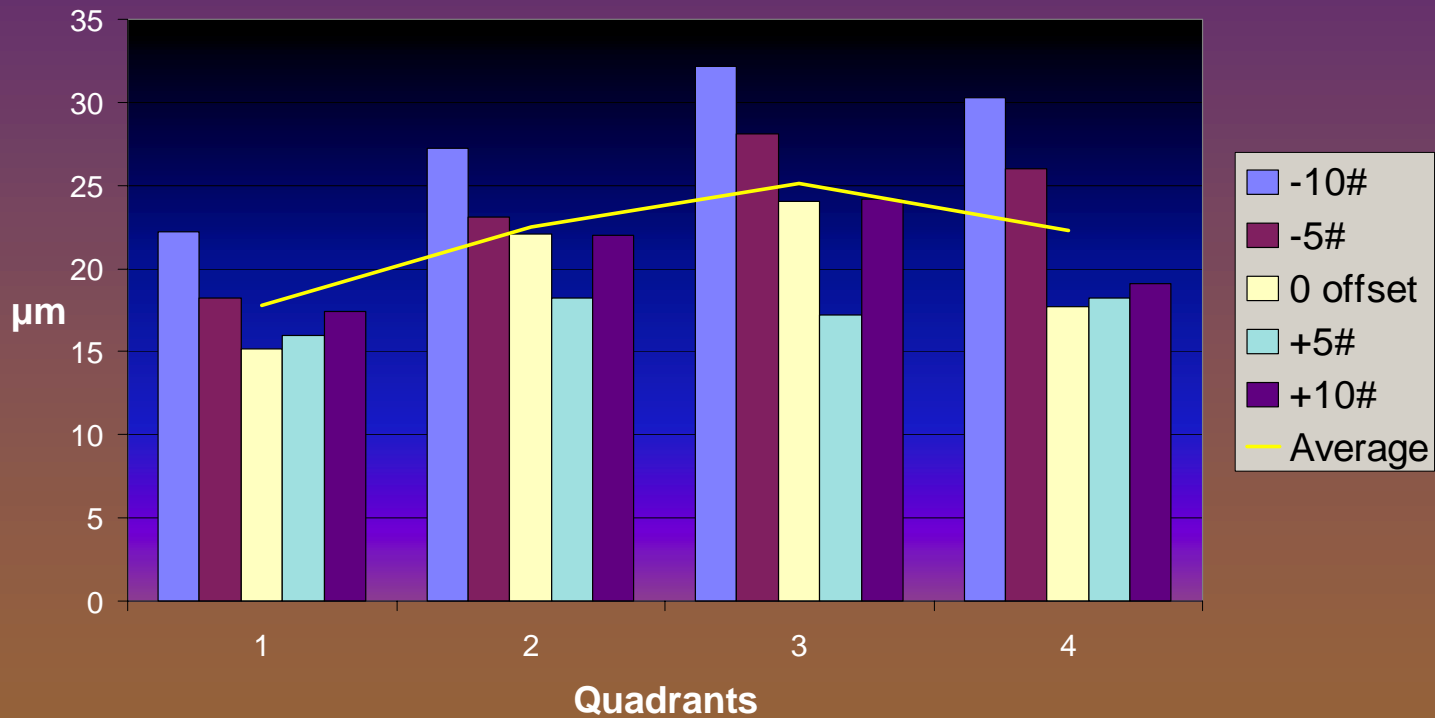
System A Manipulator Balance



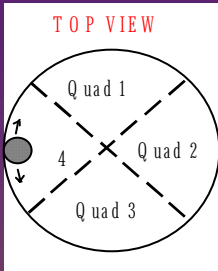
Graphical Representation of Data



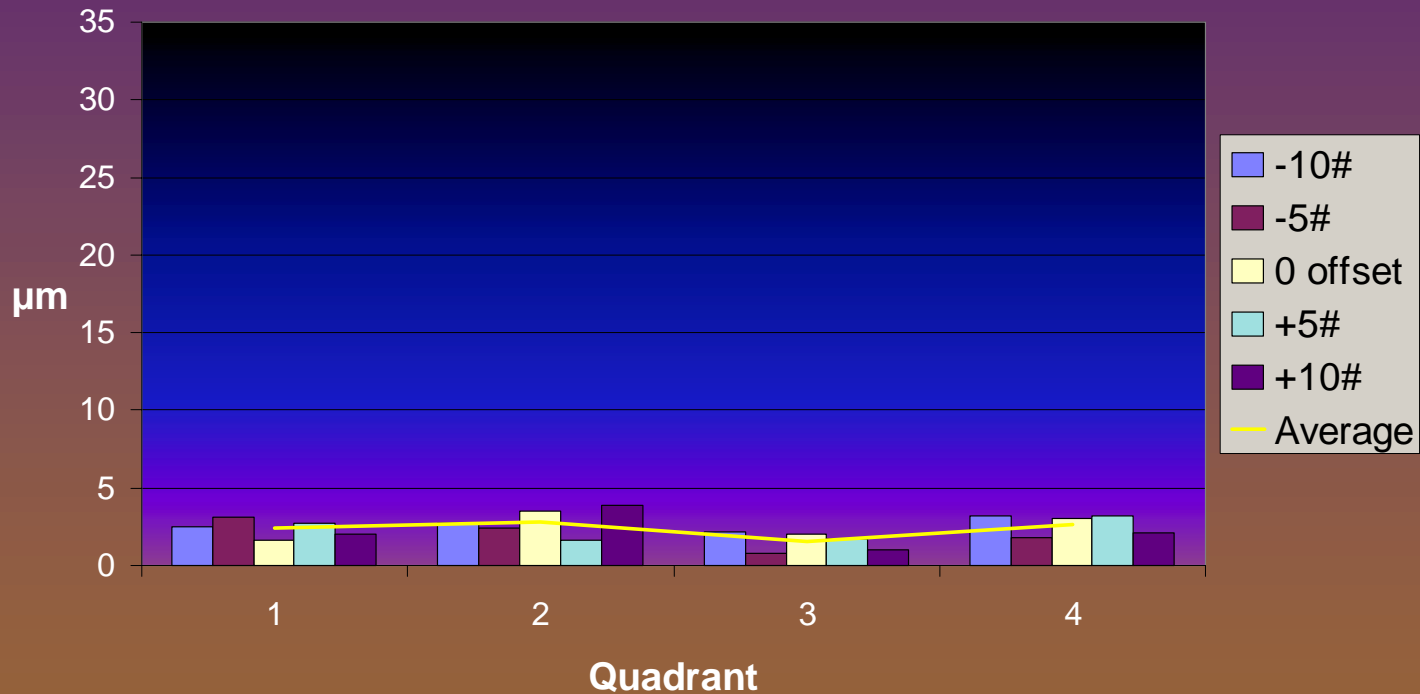
System B Manipulator Balance



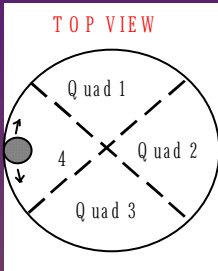
Graphical Representation of Data



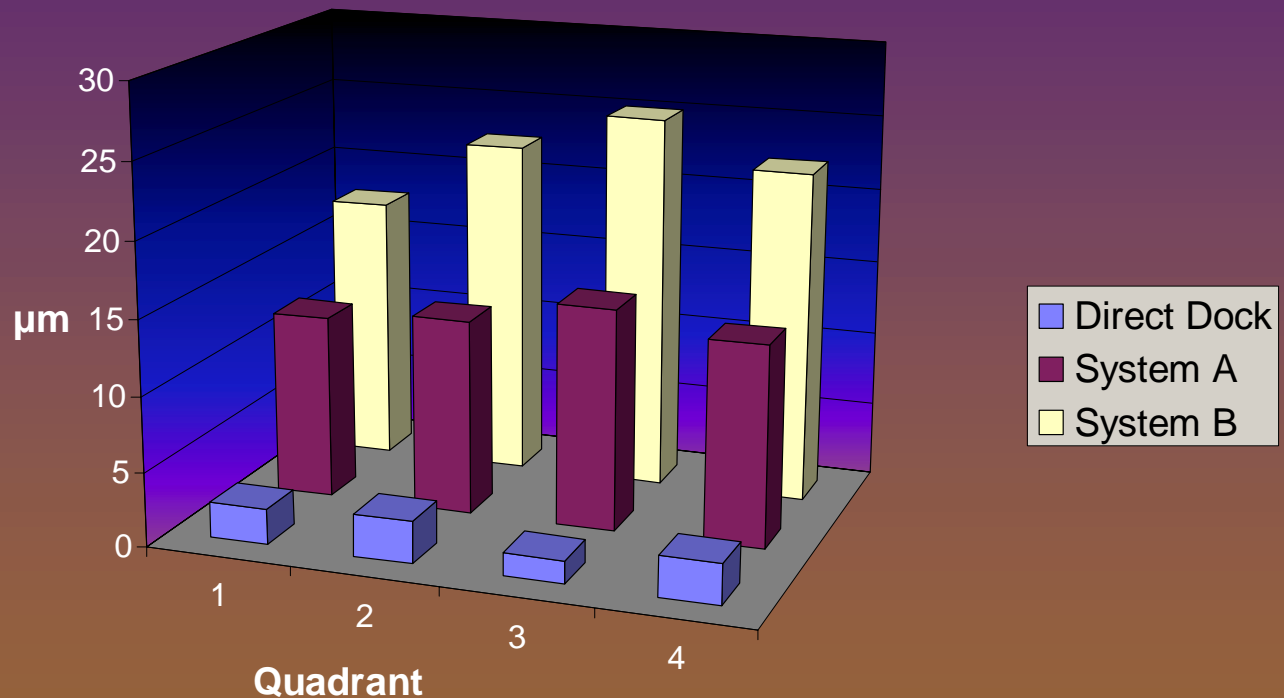
Direct Dock Manipulator Balance



Graphical Representation of Data

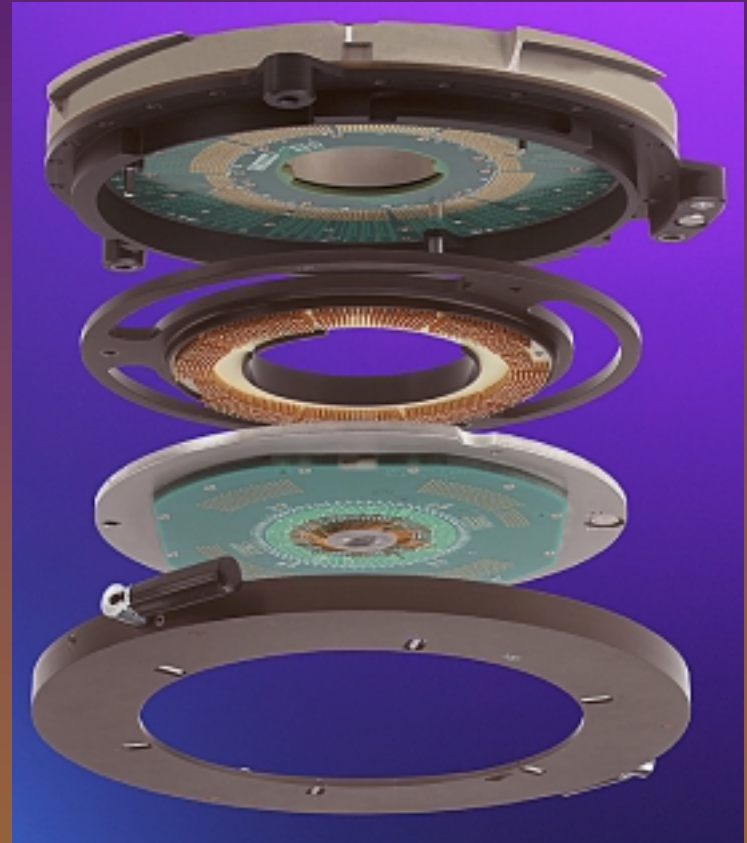


Comparison, Manipulator Balance



Mixed-signal Testing

The "PCLBA" makes possible Direct Docking in those test environments where a separate load board and probe card are required.



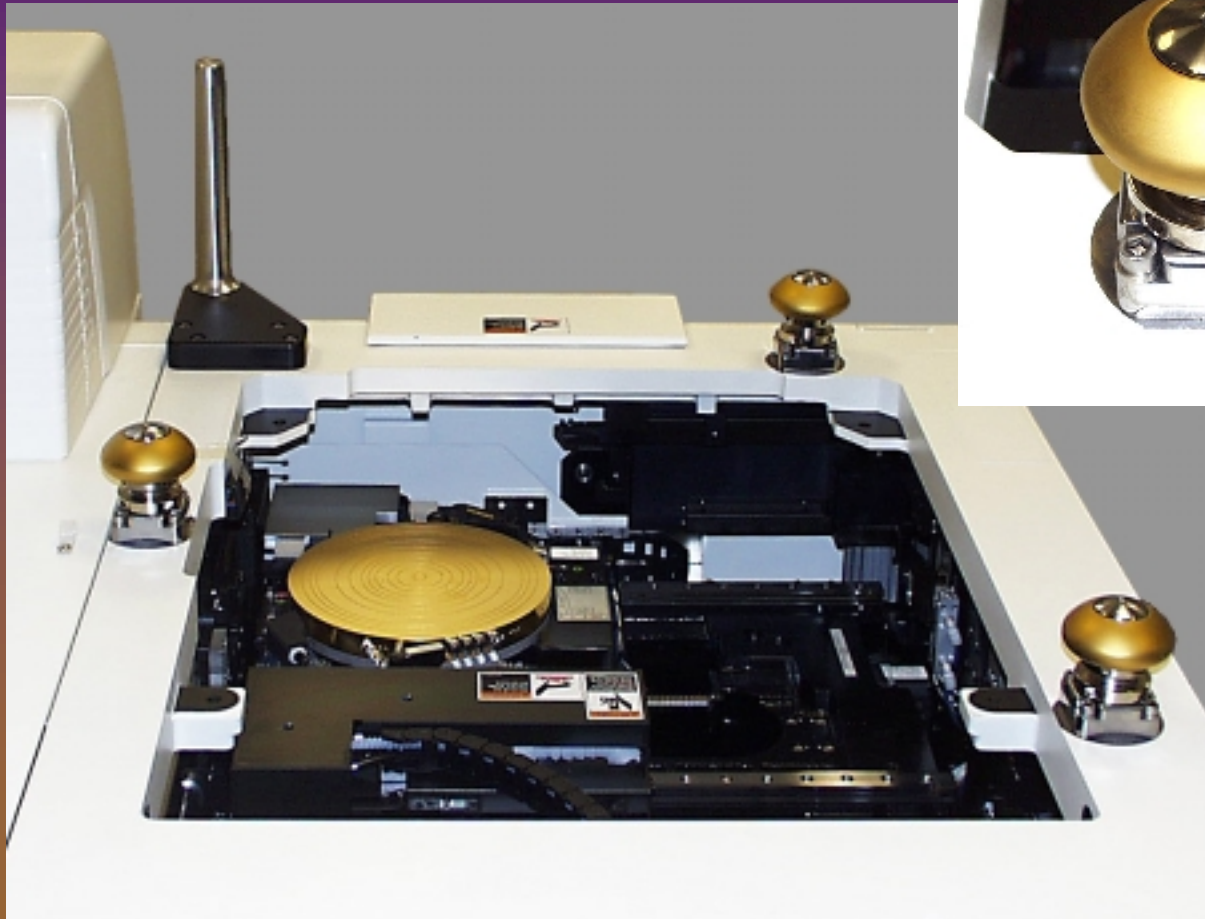
US Patent 6,166,553

PCLBA changing with Direct Dock

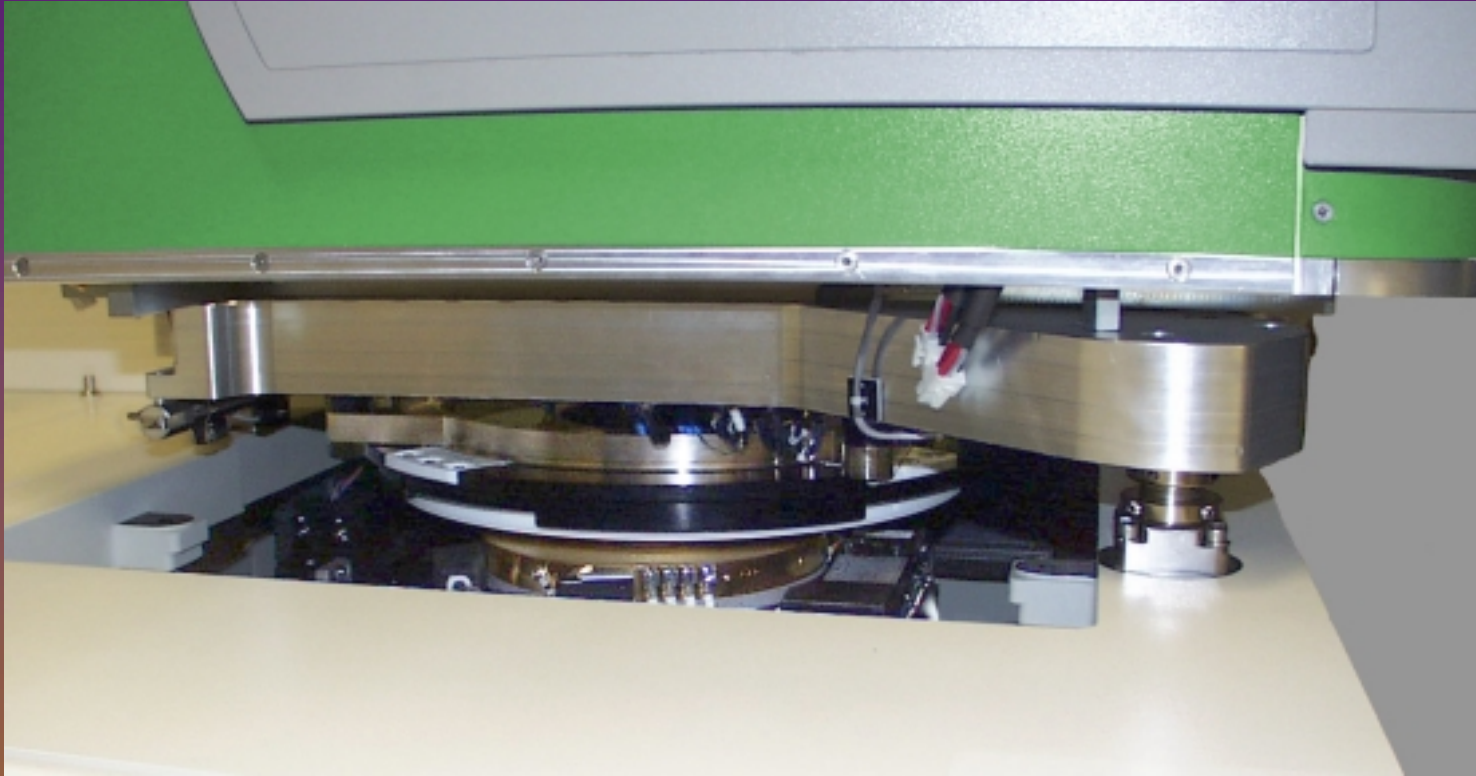


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Docking Balls



Complete interface solution



Conclusions

- **Repeatability:** Perfect co-planarity of the probe card to the chuck ensures “true” z-budget numbers, extending the life of the probe card and improving sort floor throughput.
- **Reduced Board Deflection:** Elimination of externally-induced (i.e. docking forces) probe card deflection improves the reliability of interface-to-probe card contact, shortening lot set-up times.



In Appreciation

This paper could not have been created without the gracious assistance of Mr. Ted Khoury and Mr. Doug Lefever of Motorola's Semiconductor Products Sector.

