SWTEST
PROBE TODAY, FOR TOMORROW
2025 CONFERENCE

First Silicon Photonics High Speed (up to 67GHz) Wafer Probe Card Demonstration for S-Parameter Testing on the Production Wafer

Hsu Hao (Andy) Chang – Marvell
Amit Agnihotri – Marvell
Don Lee – Marvell
Andrew Yick – Marvell

Giulia Rottoli – Technoprobe
Carlo Madè – Technoprobe

Agenda

- Motivation
- Objective
- Methodology
- Results
- Summary

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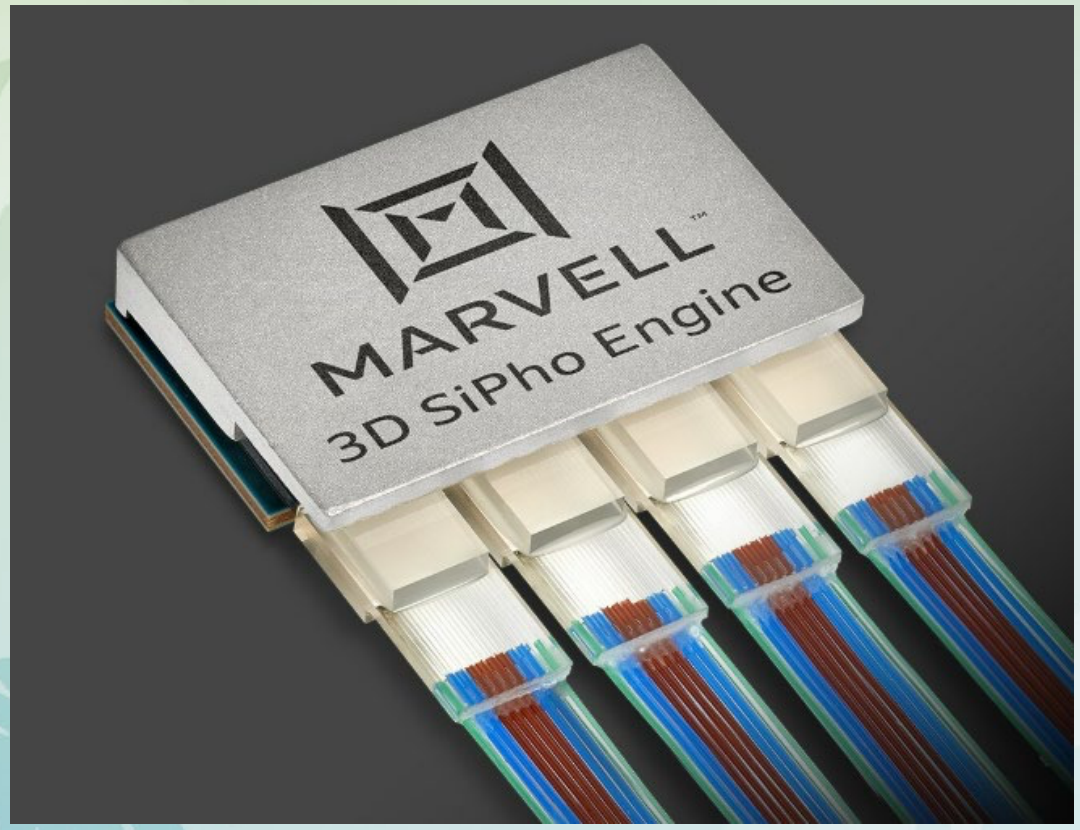
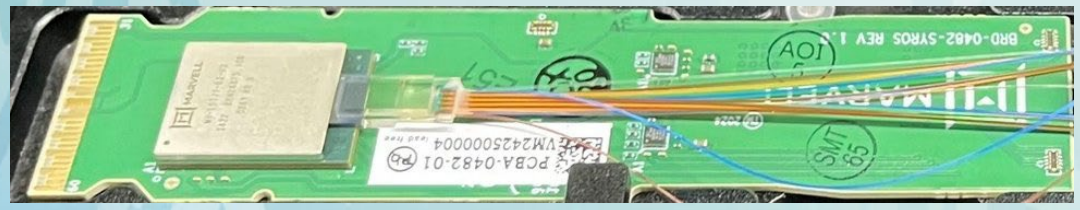
What is Silicon Photonics and Why ?



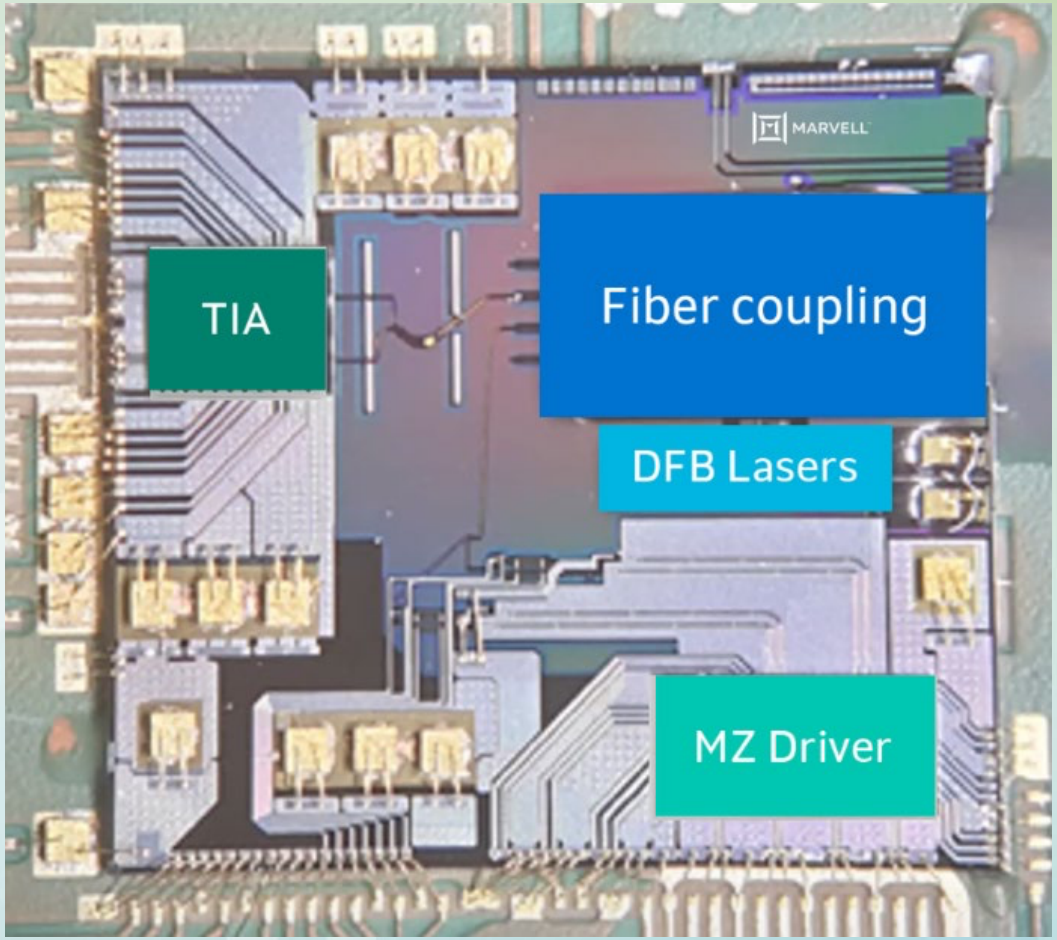


- Optical signal in Silicon
  - Prominent in communication
- High bandwidth
- Highly integrated channels
- Scalability
- Low latency (No RC limits)
- Energy efficiency

Integrated Silicon Photonics Demands Known Good Die

- Known Good Die
  - A Must for Silicon Photonics Integration
  - High Complexity of Silicon Photonics Modules (112Gbd, 224Gbd application)
  - Integration of photonics + electronics (e.g., lasers, modulators, drivers, TIAs)

- Risk of Using Unverified Die
  - Yield loss propagates to entire module
  - Debugging is complex and costly
  - Scrap and rework risk increase significantly



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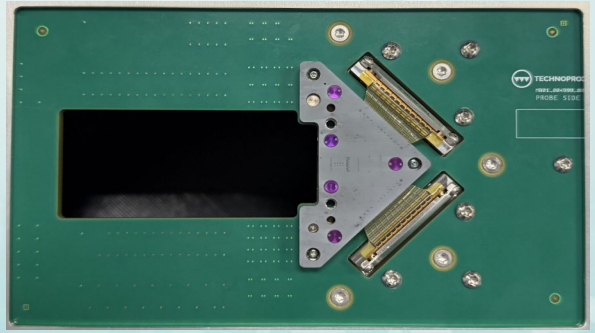
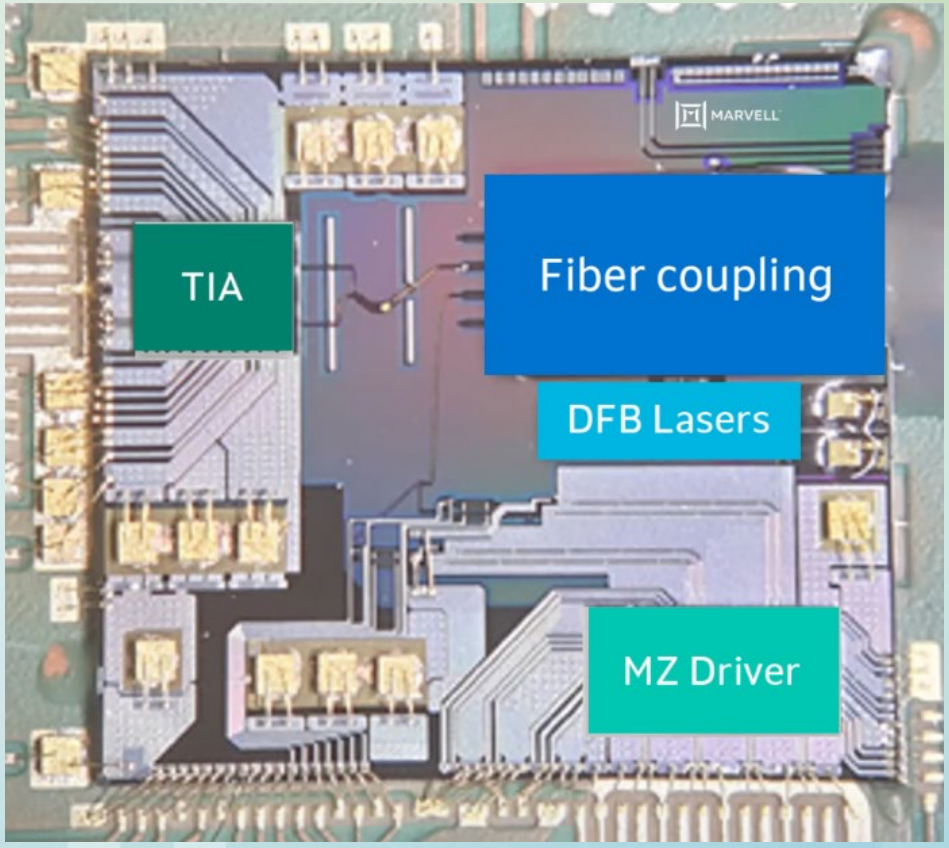
Key Tests for Silicon Photonics Wafer Screening

- DC
- RF
  - EO/OE/EE S parameter

Wedge Probe	Probe Card (This Work)
• Limited accessible pads • Small pad alignment challenging • Frequent manual adjustment	• High channel counts testing • Work for both bumped and pad wafers • Random pad patterns • Parallelism & throughput • Alignment accuracy • Key solution for Silicon photonics wafer HVM testing





Silicon Photonics Chip with Random Pad Pattern

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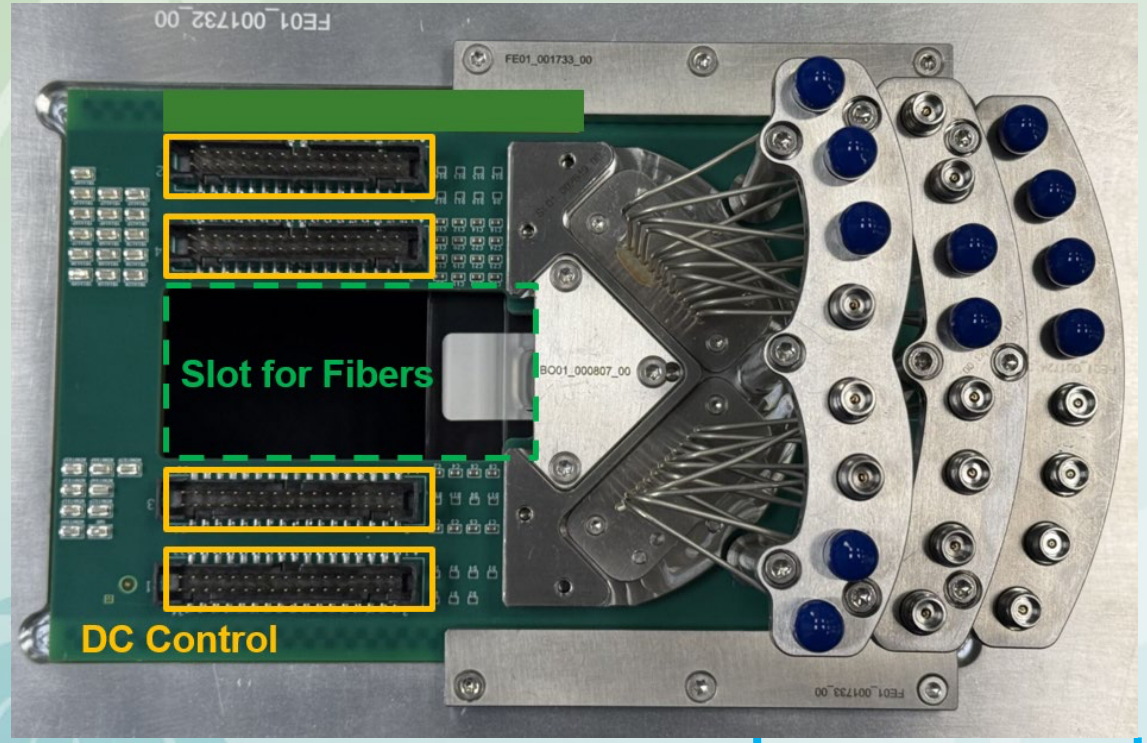
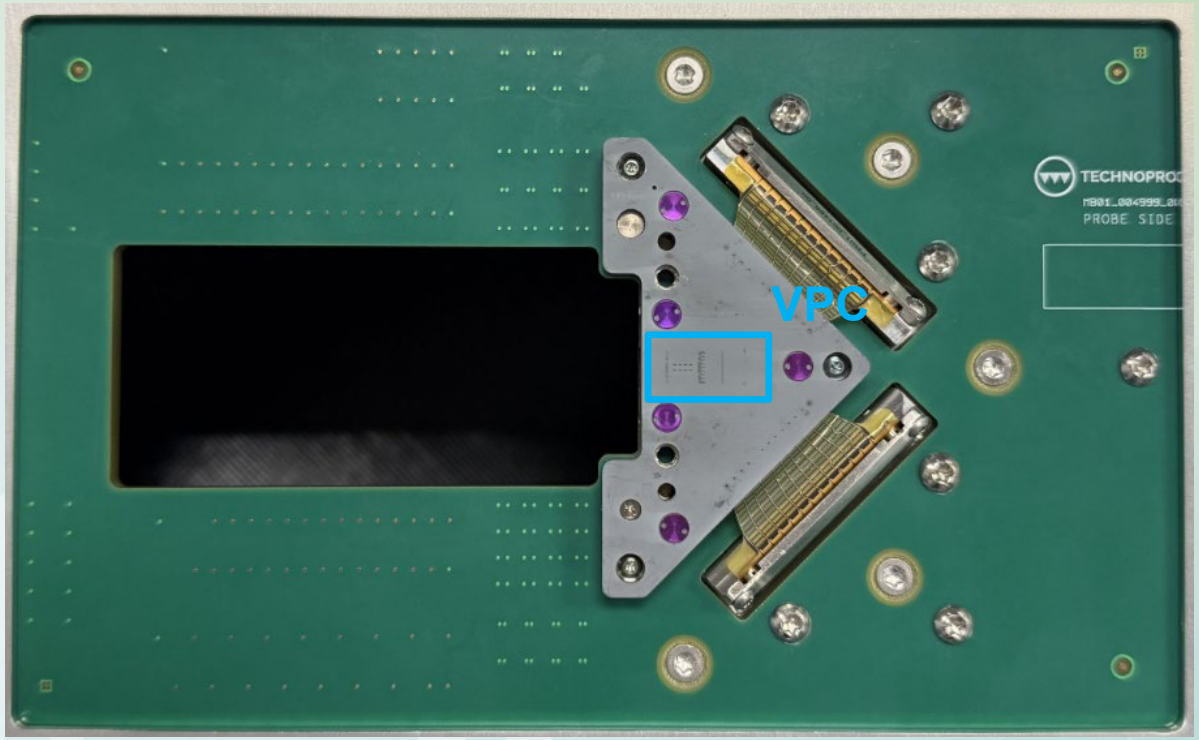
High Speed Silicon Photonics Wafer Probe Card

Top View



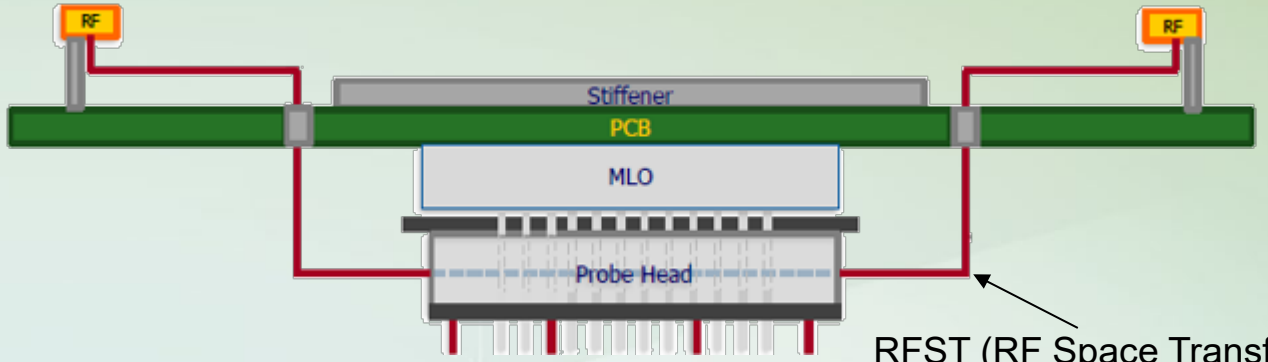
Bottom View

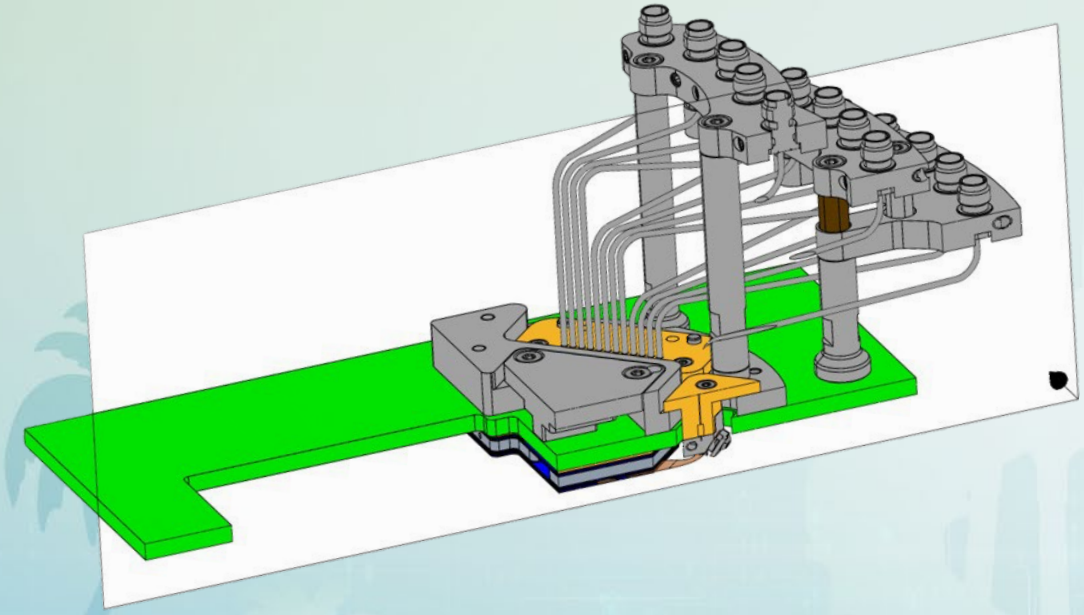


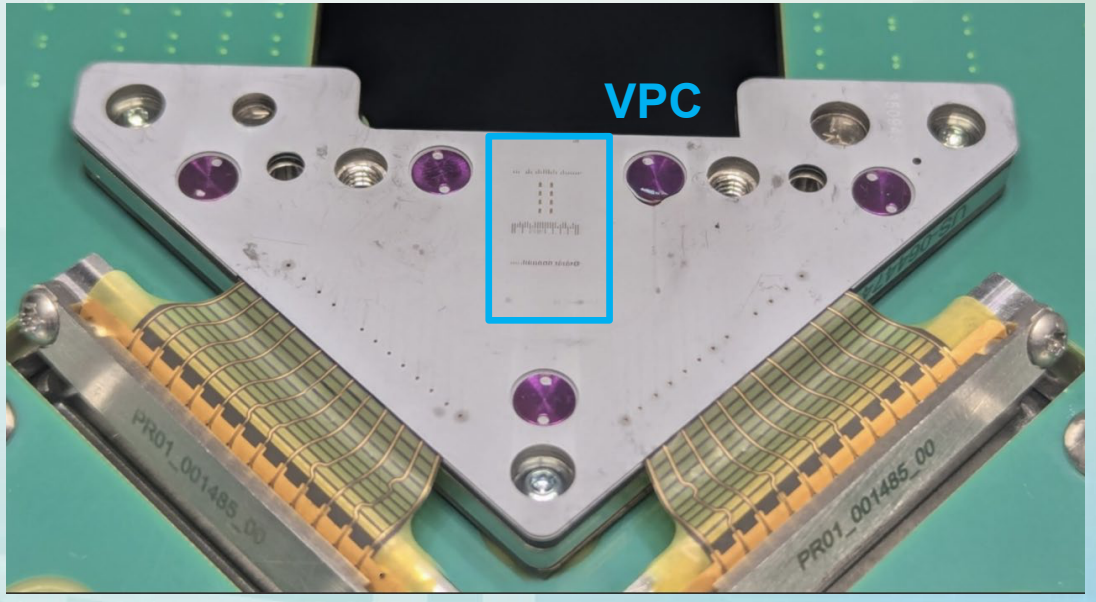
Vertical Probe Card

Probe Card with FCI transition

- The FCI (Flex to Coax Interface) transition allows the direct transition from flex to coax cables without going through PCB tolerance changes

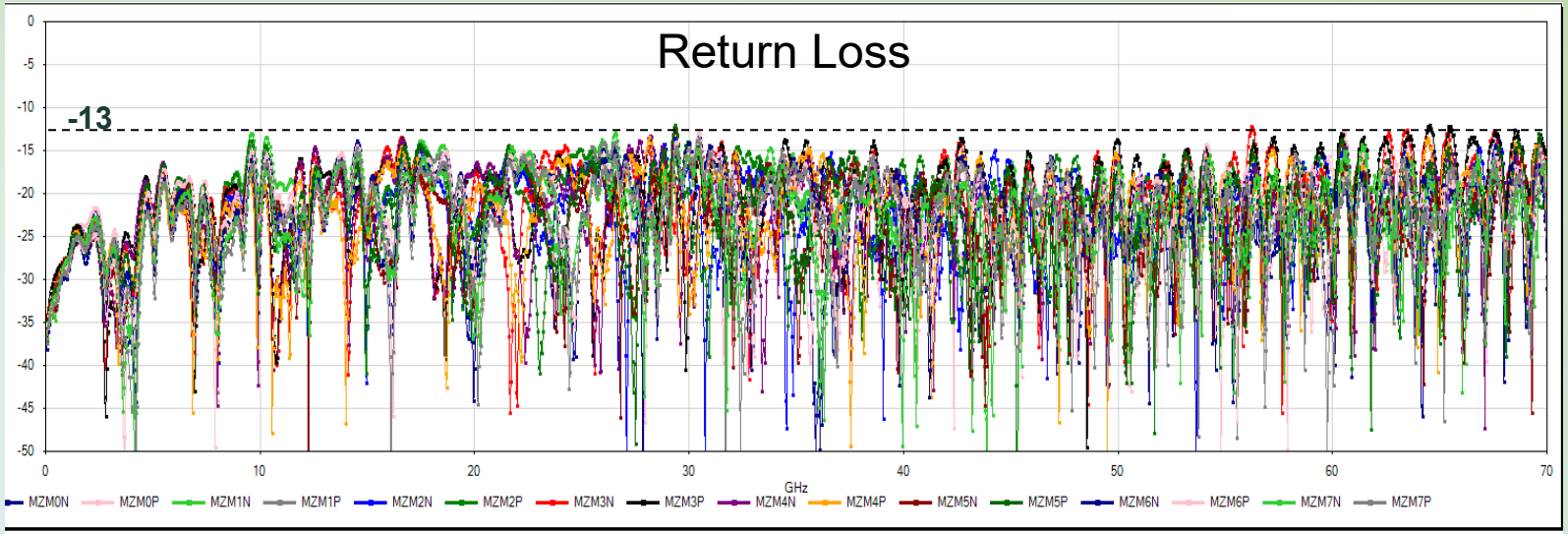


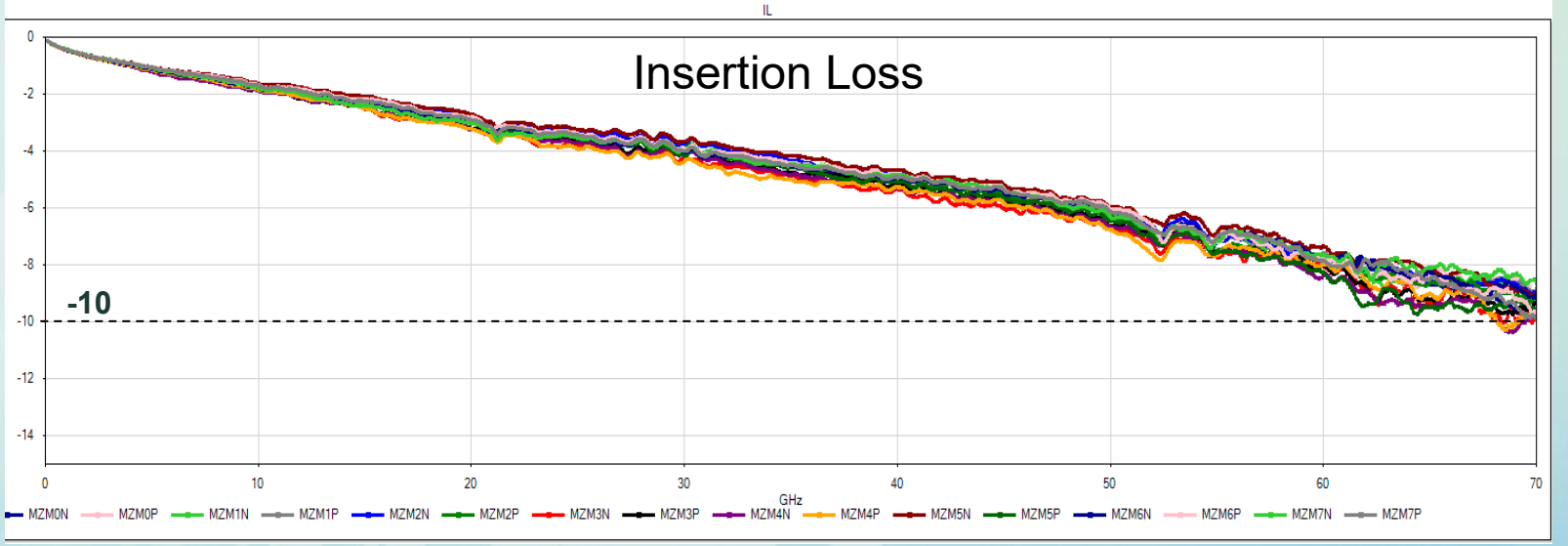




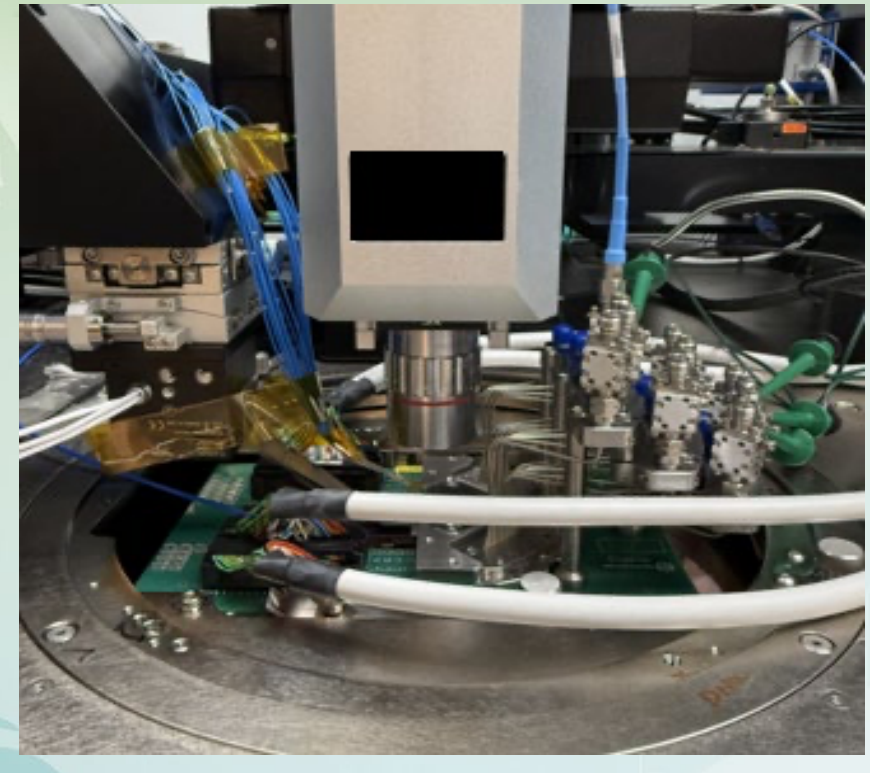
Probe Card with FCI transition

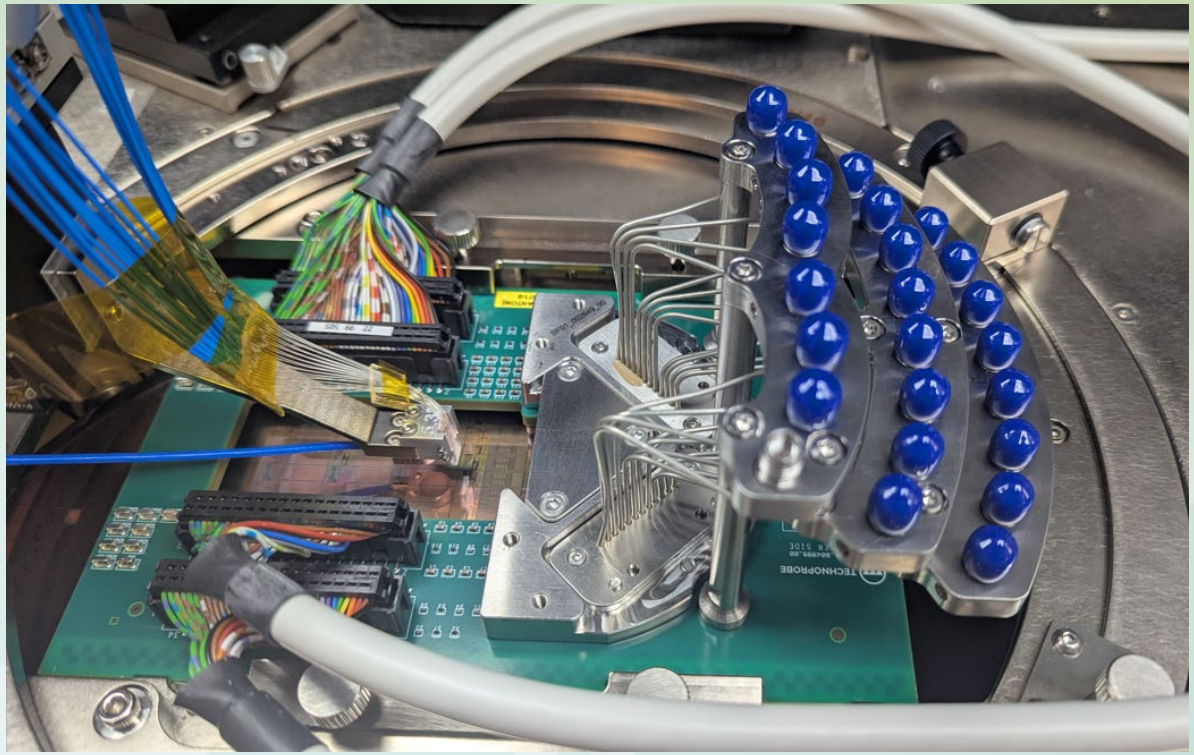
- Return loss < 13 dB up to 67GHz
- Insertion loss < 10dB up to 67Ghz

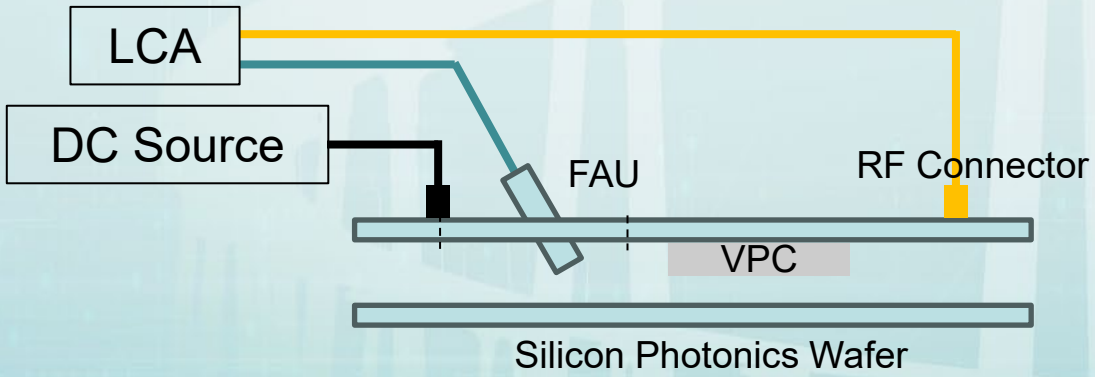




Test Setup







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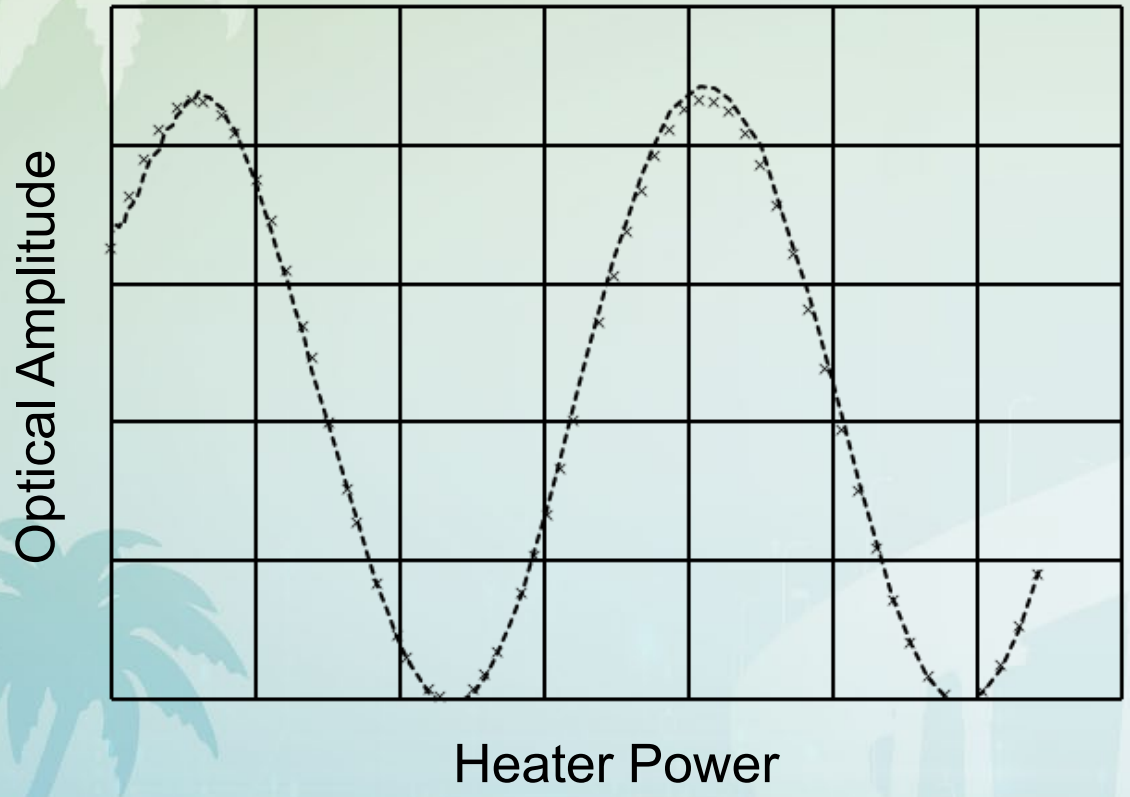
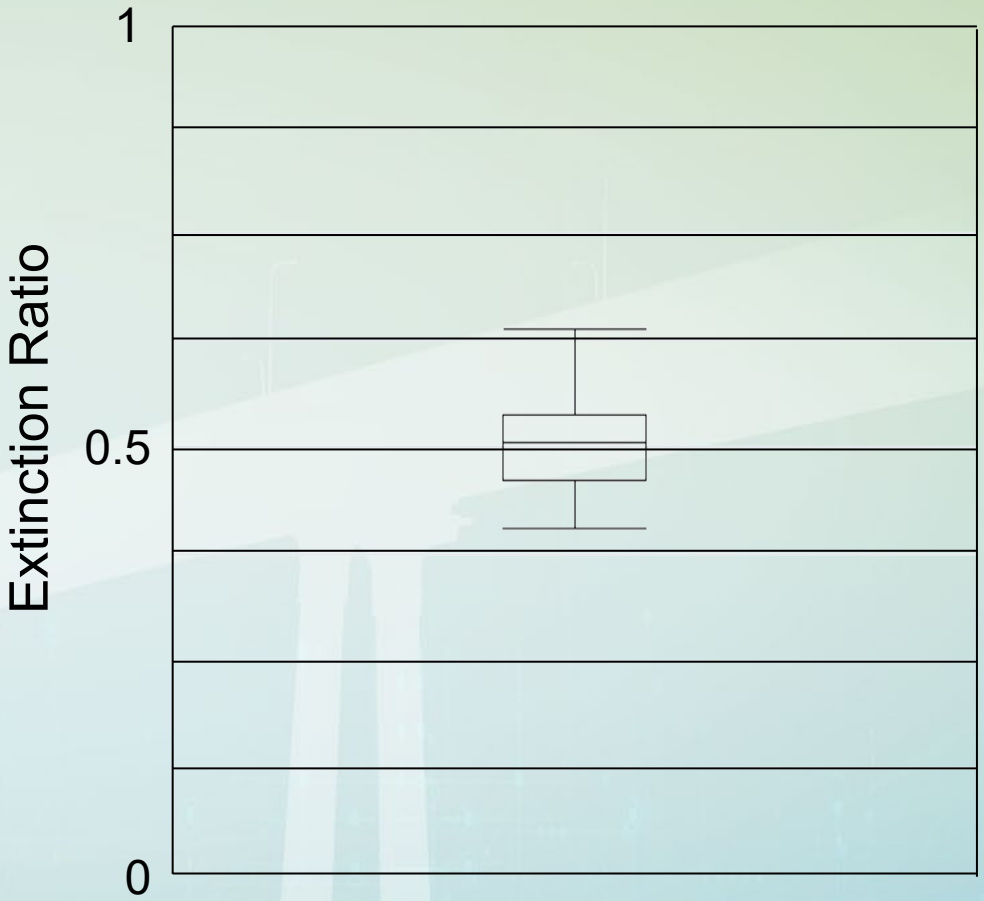
Experiment Data (DC)

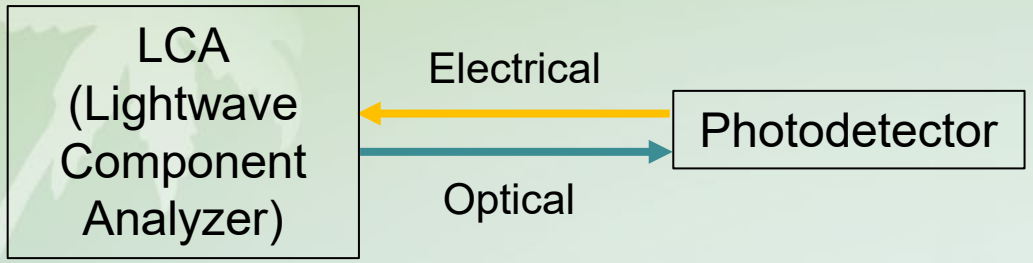


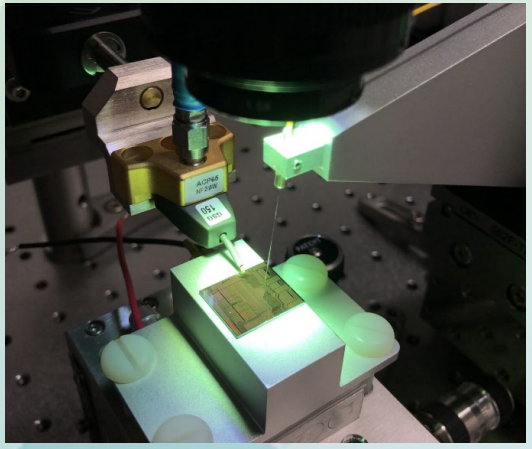
Mach-Zehnder Modulator Heater Scan



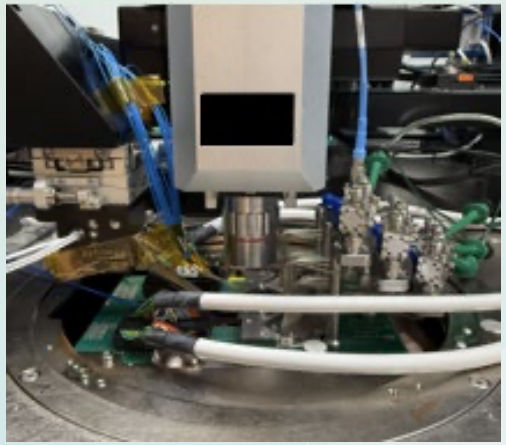
MZM Optical Extinction Ratio

Experiment Data (RF) – Wedge vs Probe Card

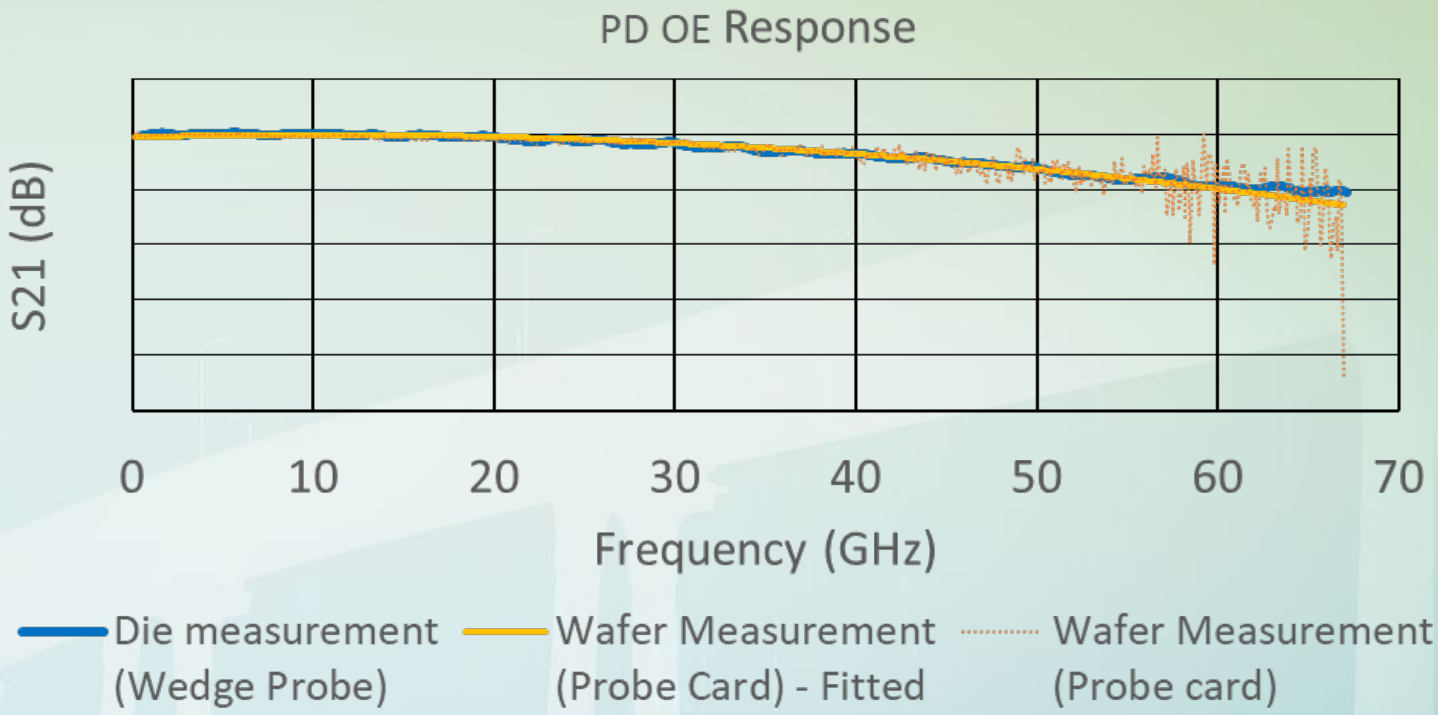




Wedge Probe

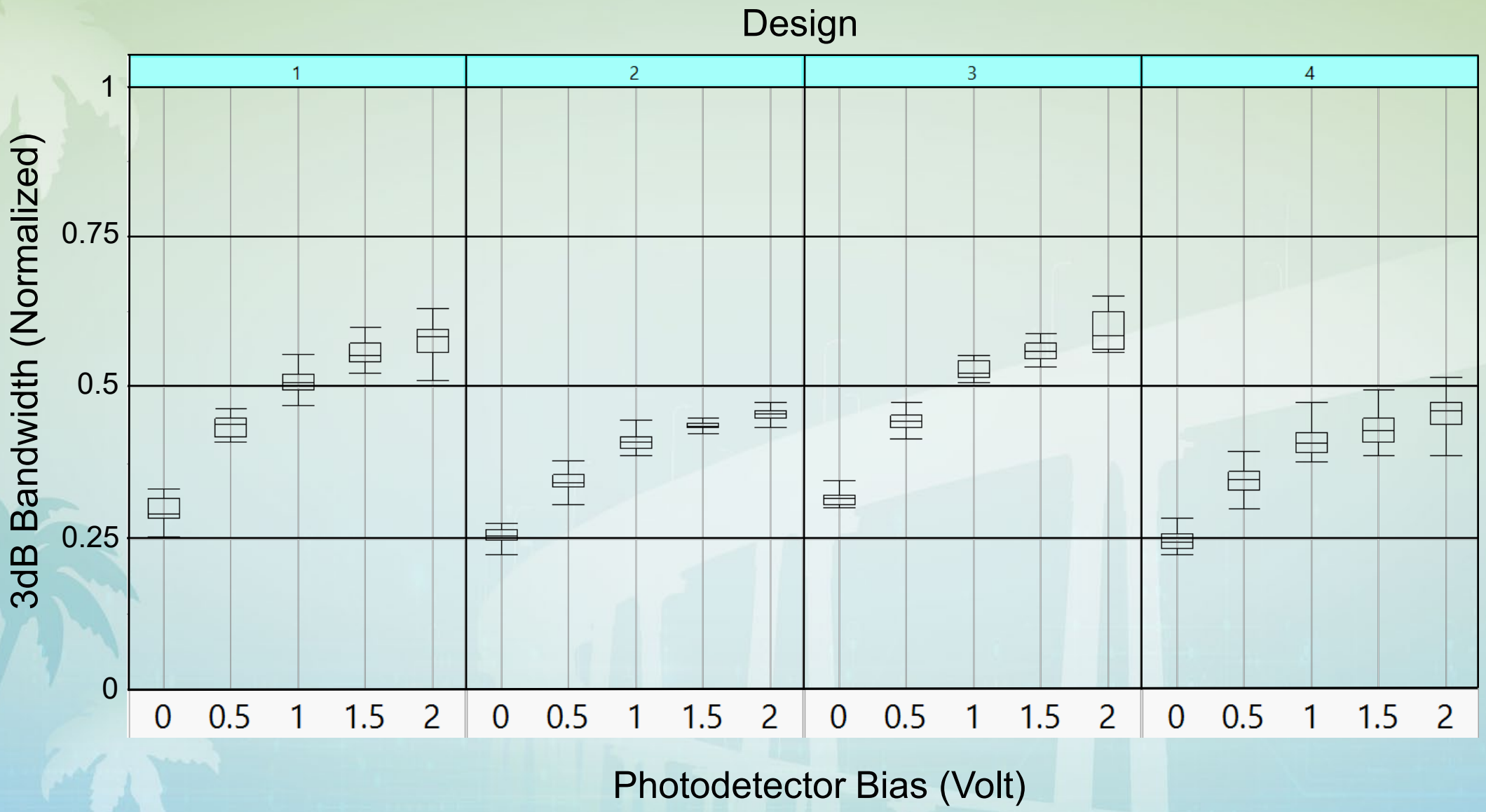


Probe Card



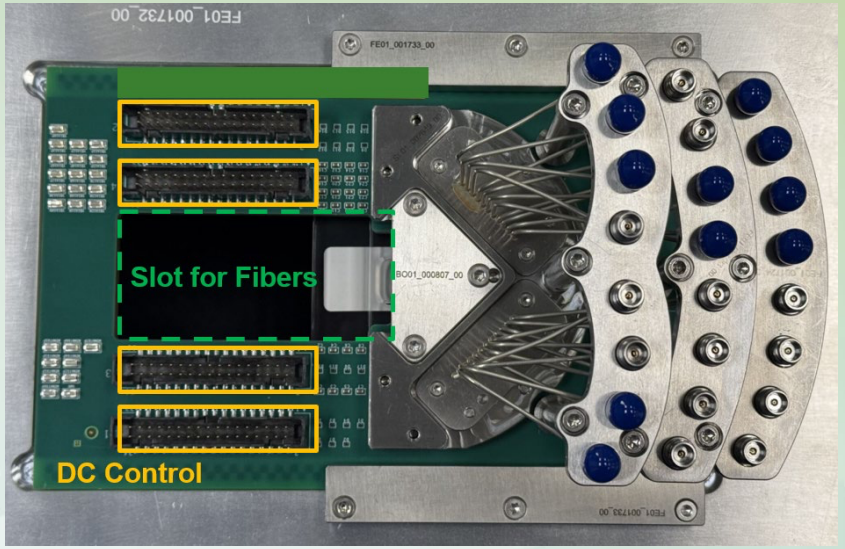
Good RF Measurement Correlation up to 67GHz

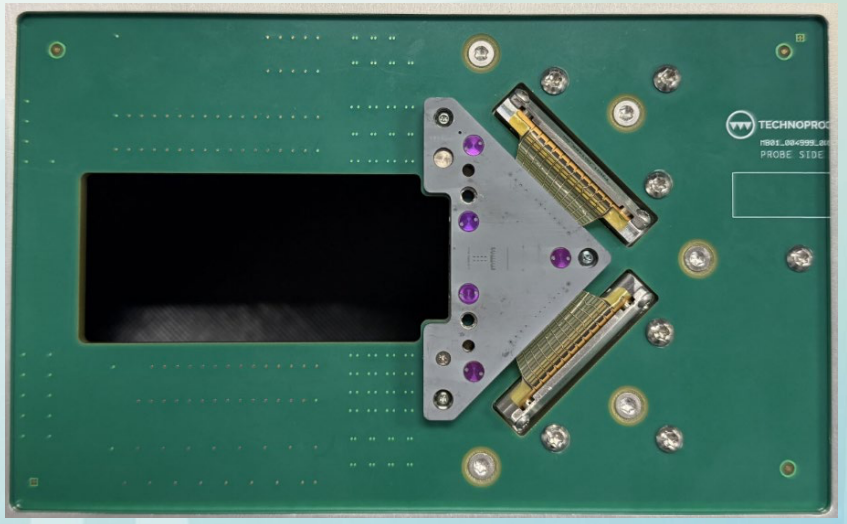
Experiment Data (RF) – Wafer Screening Results



Summary

- First high-speed Silicon Photonics wafer probe card demonstrated
  - Good DC measured data at wafer scale
  - Good RF measured data at wafer scale
    - Up to 67Ghz
- Silicon Photonics production wafer high speed testing enabled
  - Key milestone for Silicon Photonics production
  - Important for modern Silicon Photonics integration
- Future work
  - Integrate passive optics to the probe card





Marvell & Technoprobe