SWTEST

PROBE TODAY, FOR TOMORROW

2024 CONFERENCE

Unleashing Data Transmission: Next-level Probe Card for 112Gbps PAM4 Test Solution

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- Data Transmission Trend
- CHPT Probe for high-speed PAM4 Test Solution
- Future Development
- Summary

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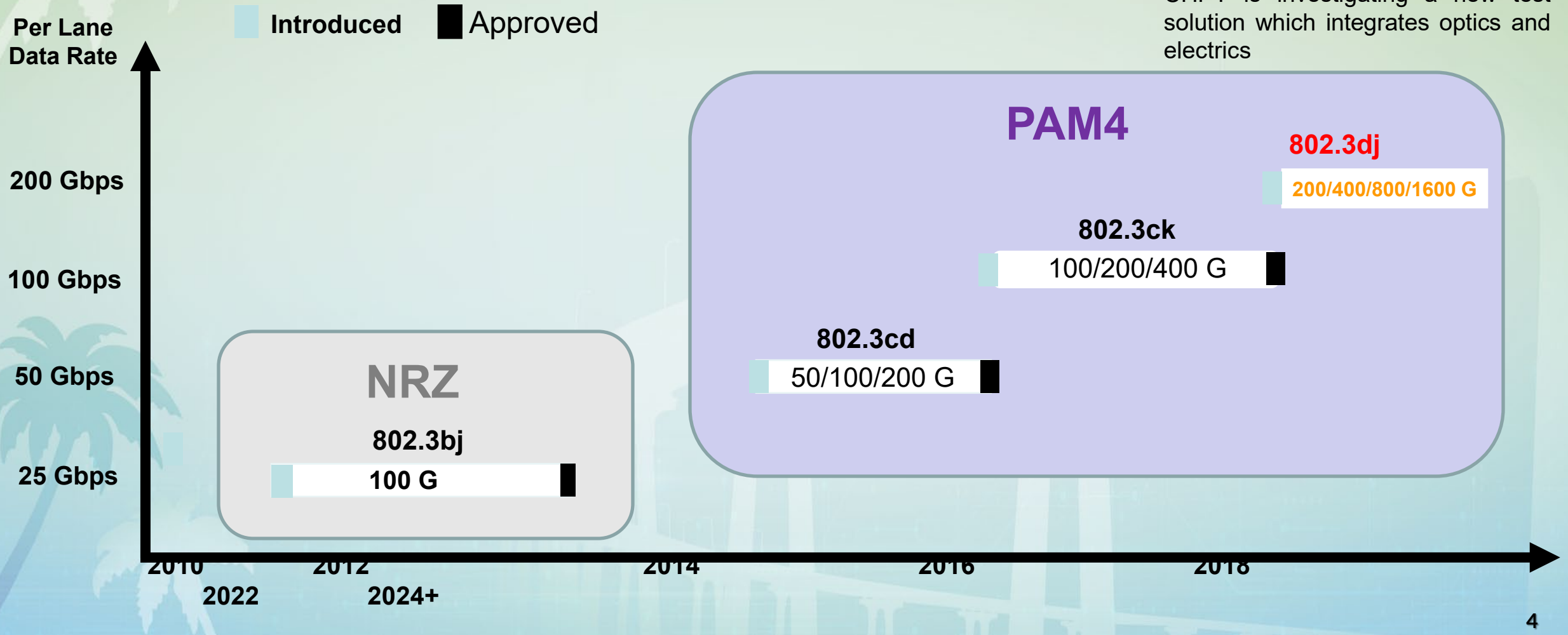
IEEE 802.3 at Ethernet Rate

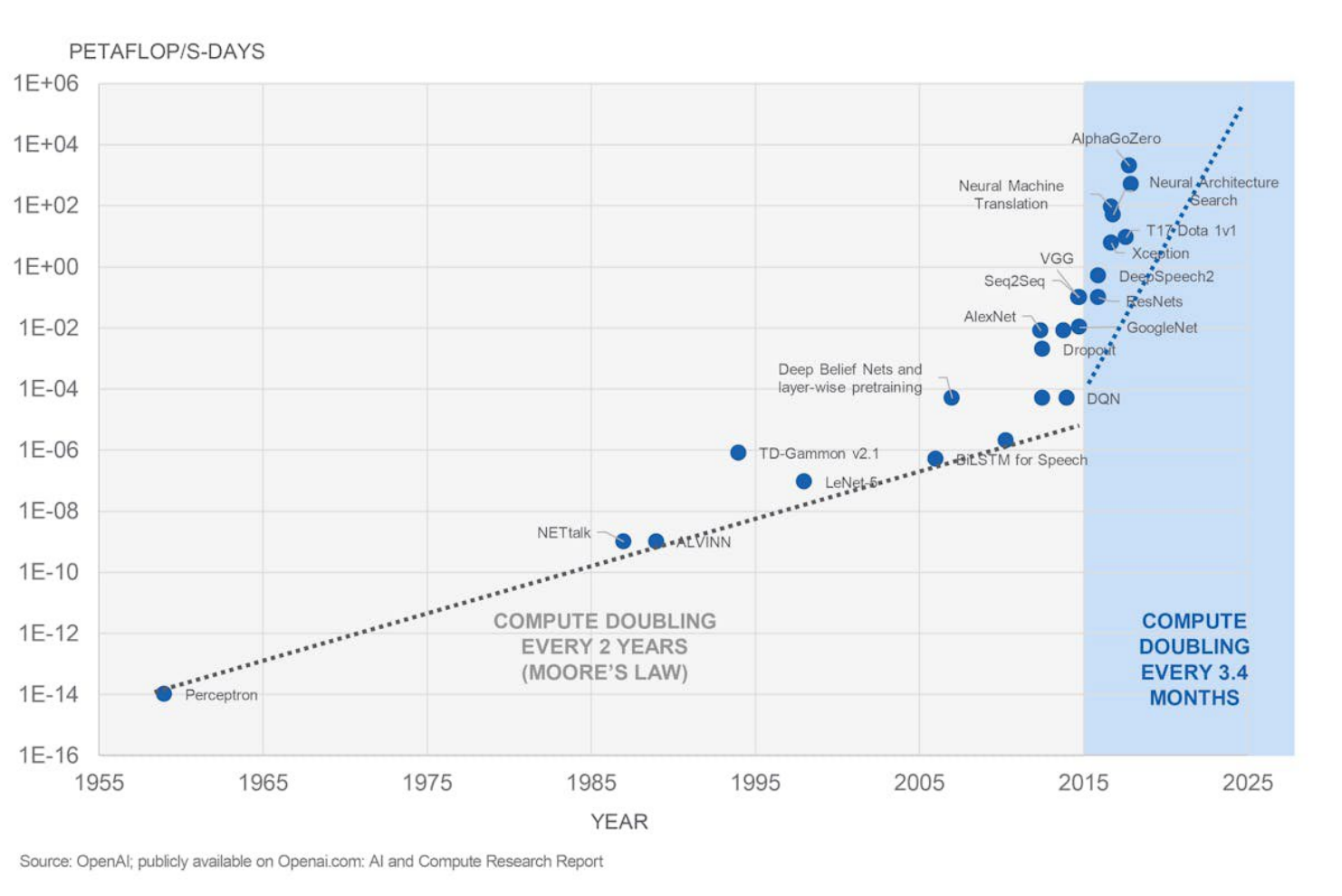
Graded-index Optical Fiber

CHPT is investigating a new test solution which integrates optics and electrics

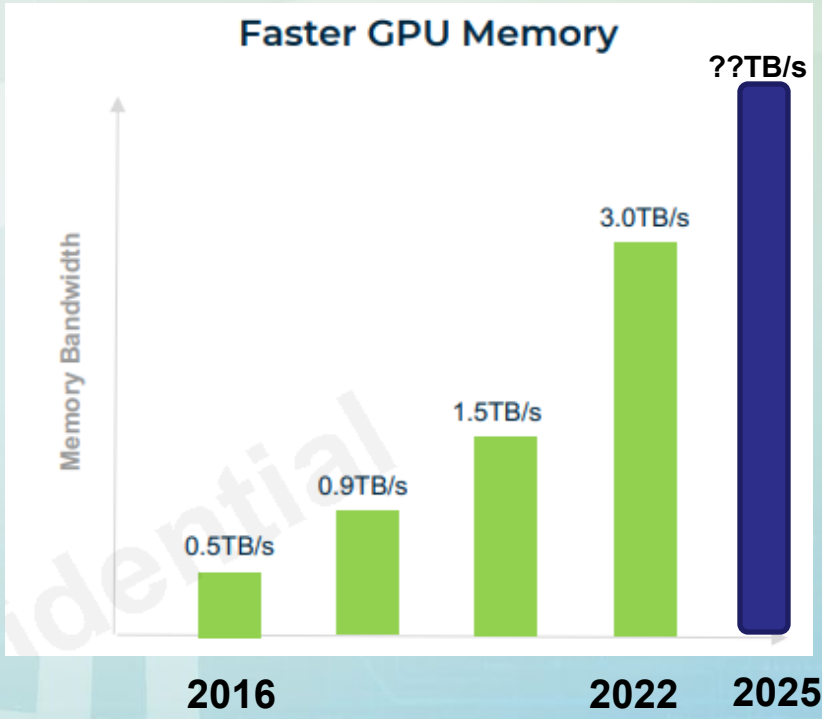


* CHPT's technology has been patented or patent pending.

Explosive growth in compute requirements for AI



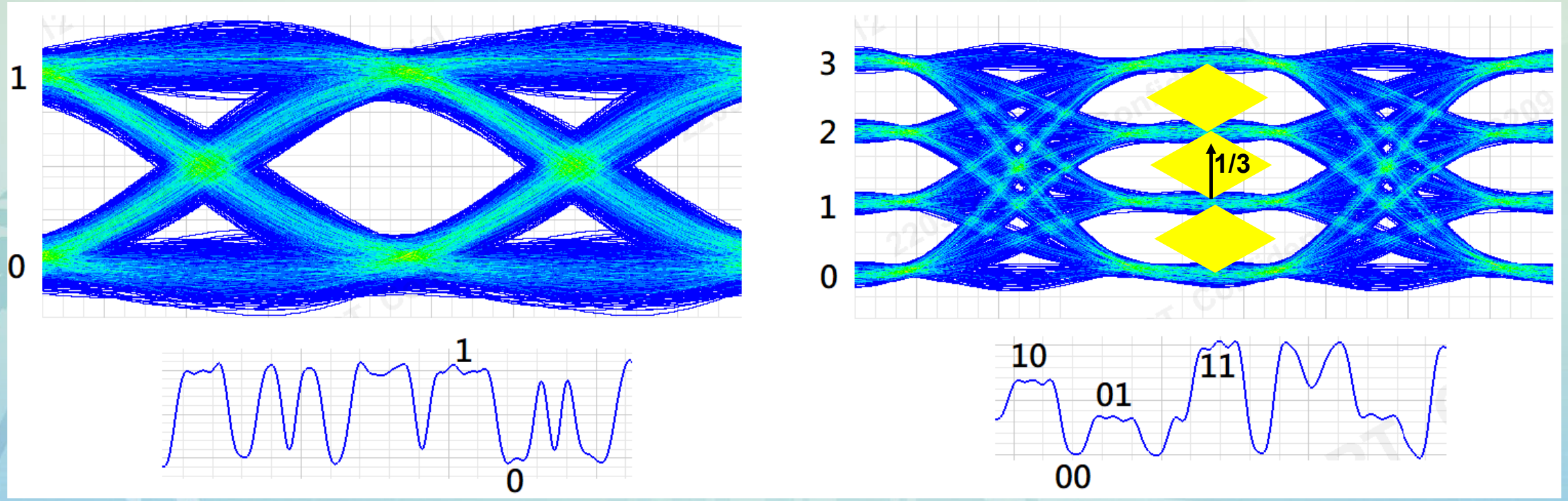
PCIe 4.0: 16Gbps
PCIe 5.0: 32Gbps
PCIe 6.0: 64Gbps PAM4
PCIe 7.0: 128Gbps PAM4



Modulation Methods: NRZ or PAM4

112Gbps	NRZ	PAM4
Baud Rate	112 GBaud	56 GBaud
Nyquist Frequency	56 GHz	28 GHz
Voltage level	2	4

- **Double Bit Rate : Higher efficiency for high-speed transmission**
- Half symbol rate : Reduce signal loss
- Worse **SNR : Eye height of PAM4 is approximately 33% of that for NRZ**
- Higher BER : Smaller vertical eye opening (more sensitive to noise)



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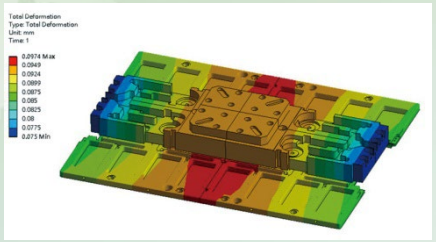
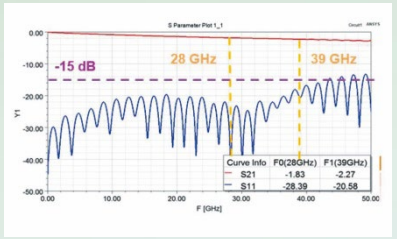
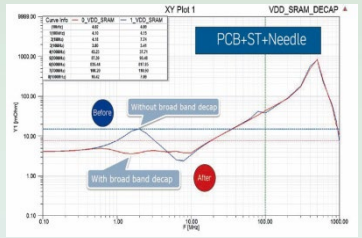
CHPT All in House

Mechanical Simulation

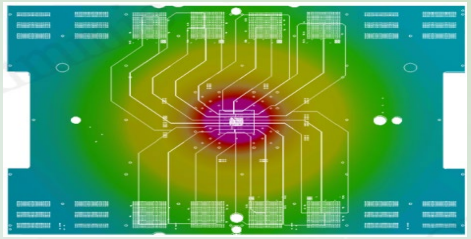


SI/PI Simulation





Thermal Simulation



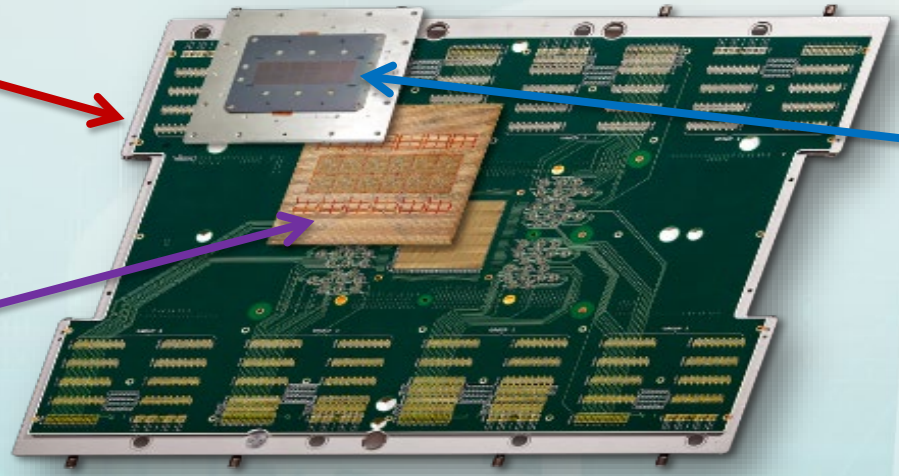
CHPT
AI Design System
Probe Head 4.0

PCB Capability

- Up to 100 layers
- A/R 60
- Pitch 0.3mm
- Material: FR4, M6, M7, MW2000, MW4000

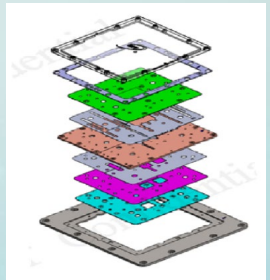
Substrate Capability

- Site: 20+
- C4 Count: 50,000 pins
- C4 Pitch: 35um



Probe Head

- Min. Pitch: 35um
- Max Pin Count: 50,000 pins
- -40~175 ℃



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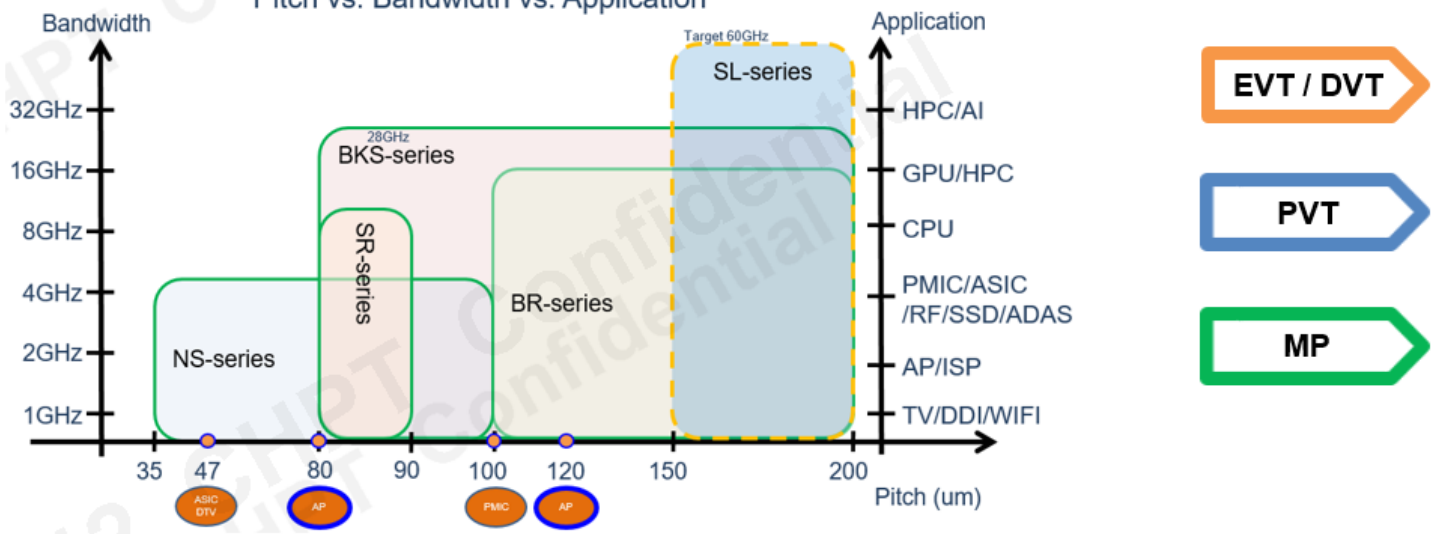
Mix Needle Application

1. NS80 + BR120_B(Flat) : Prevent burning needles by large current
2. BR120LF + BR155LF & BR120LF + BR160LF(Flat) ⟹ MP
3. BKS110 + BKS150(Flat) : 2024Q2/EVT
4. BKS110 + BKS200(Point) : 2024Q2/EVT
5. BKS90 + BKS180(Flat) : EVT Pass ⟹ MP

◆ CHPT is dedicated to improve PCB/ST fabrication capability and develop various series of probe needles for different application.

	Low Current Single needle < 1A [Force drop 20%]	High Current Single needle > 1A [Force drop 20%]
IP < 8GHz	✓ NS	✓ SR
IP > 8GHz	✓ BR	✓ BR ✓ BKS

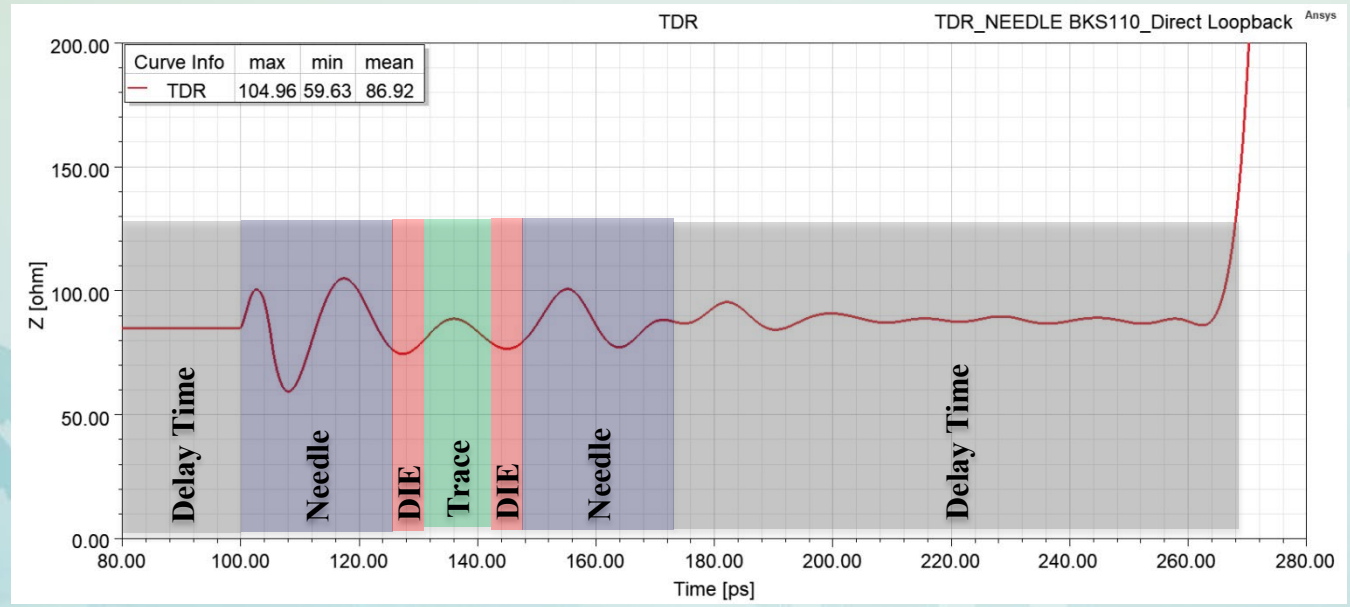
Pitch vs. Bandwidth vs. Application

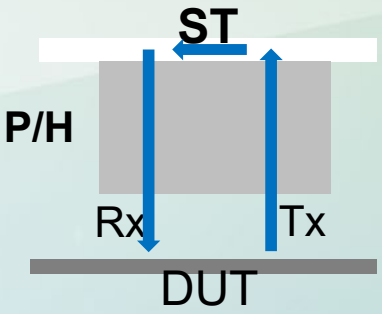


Current CHPT 112Gbps Solution

BKS Direct Loopback TDR

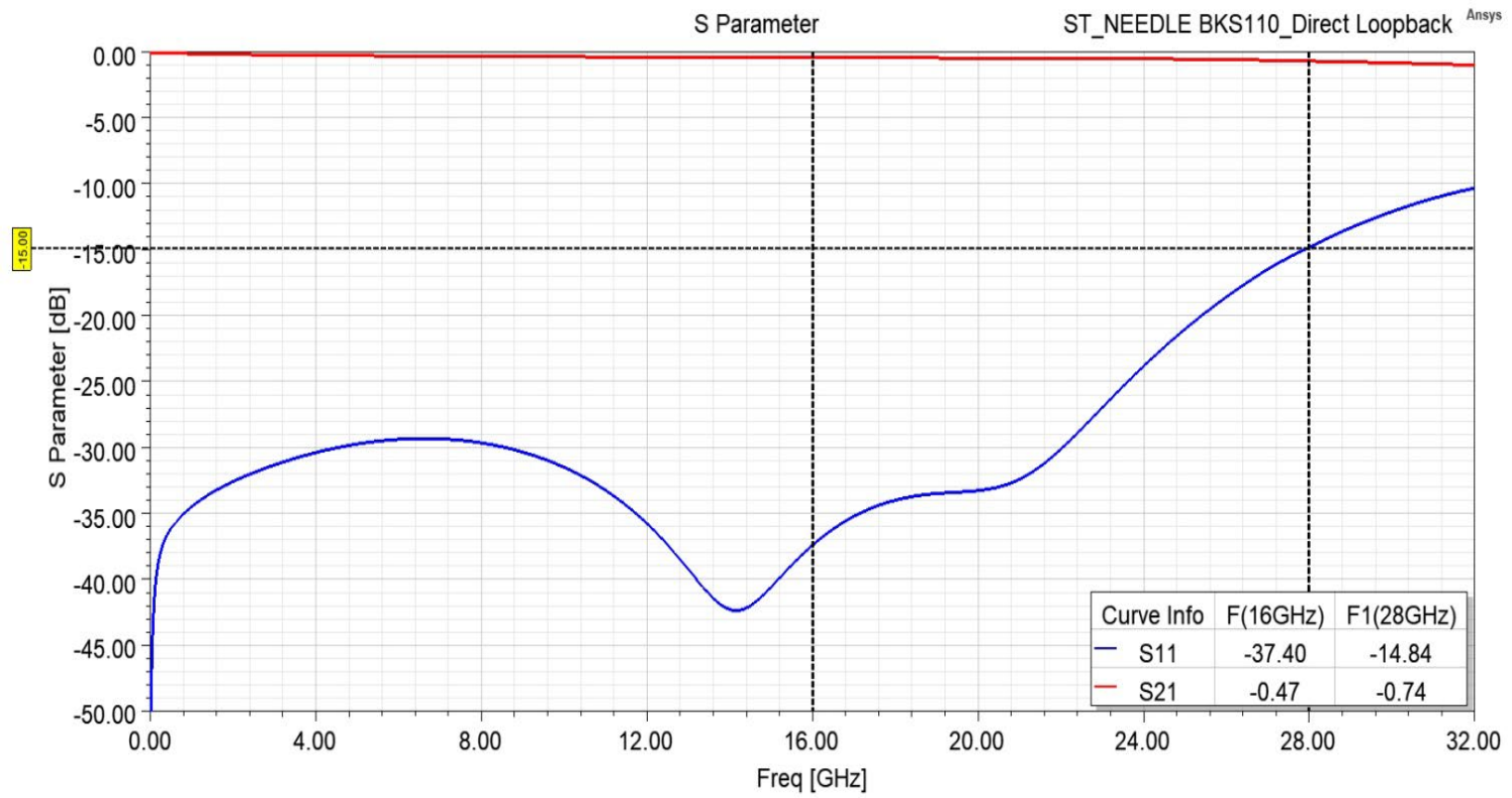
85 ohm impedance control

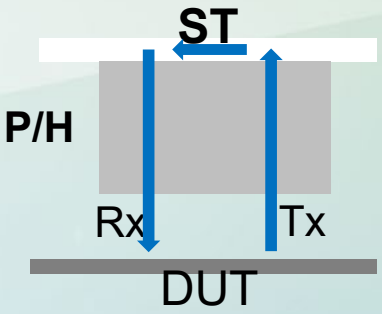




Current CHPT 112Gbps Solution

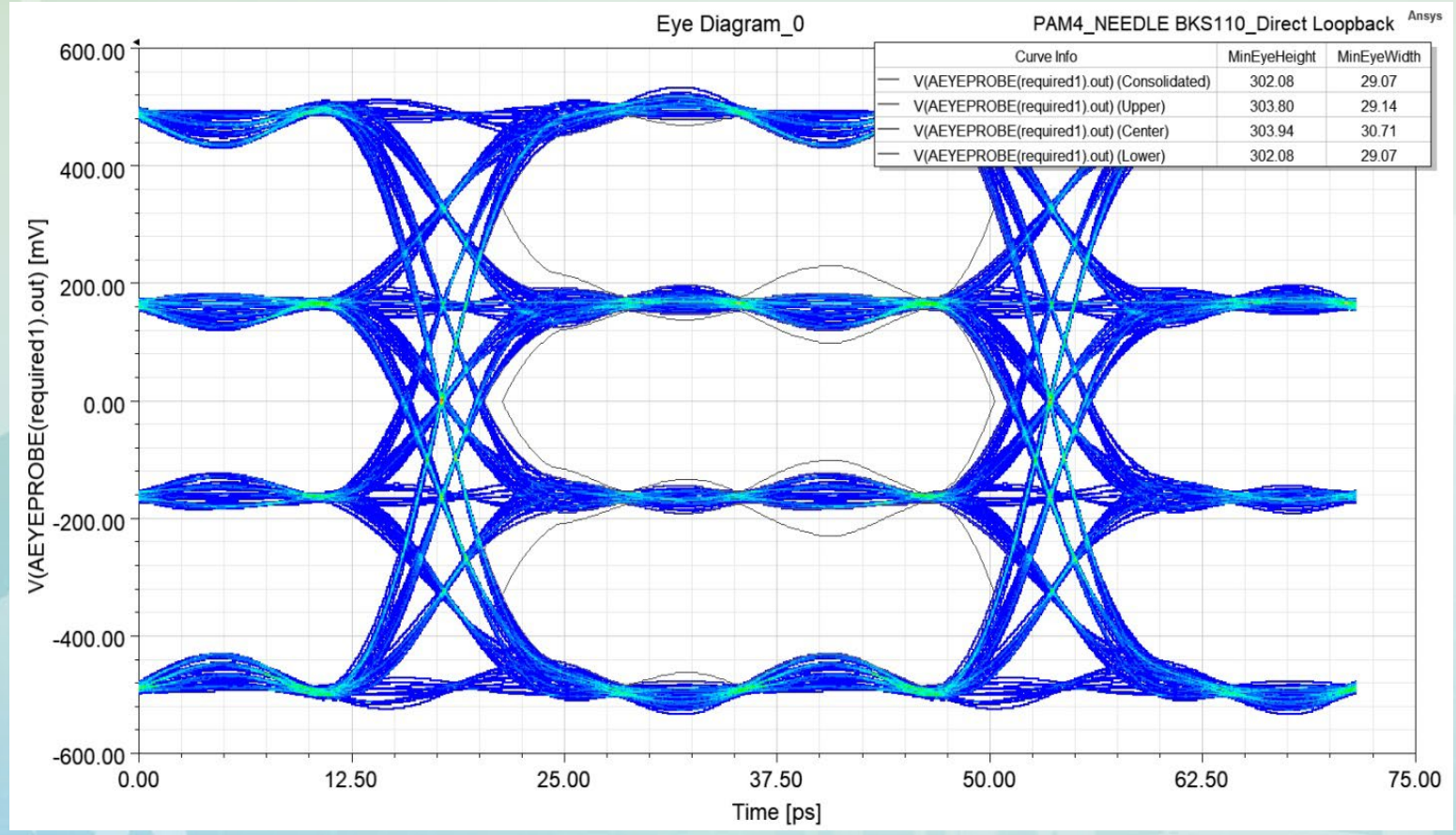
BKS Direct Loopback S Parameters

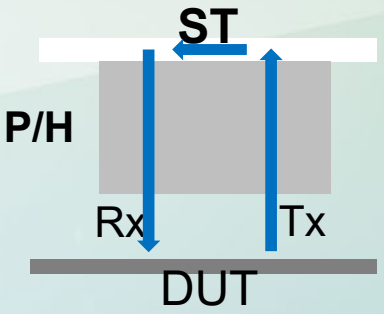




Current CHPT 112Gbps Solution

BKS Direct Loopback Eye Diagram





Contents

Push For Higher Frequencies

1. Tighter Impedance Control

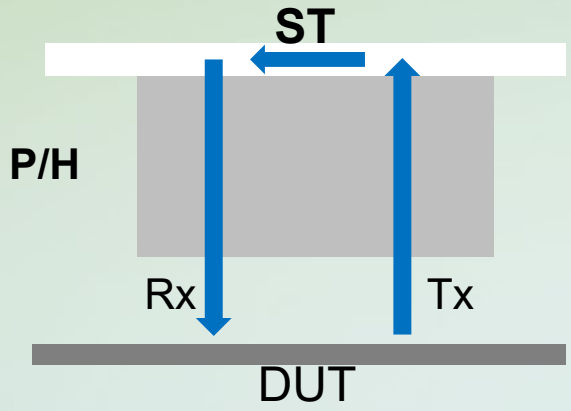
Not practical due to DIE pattern constraints on needle geometry

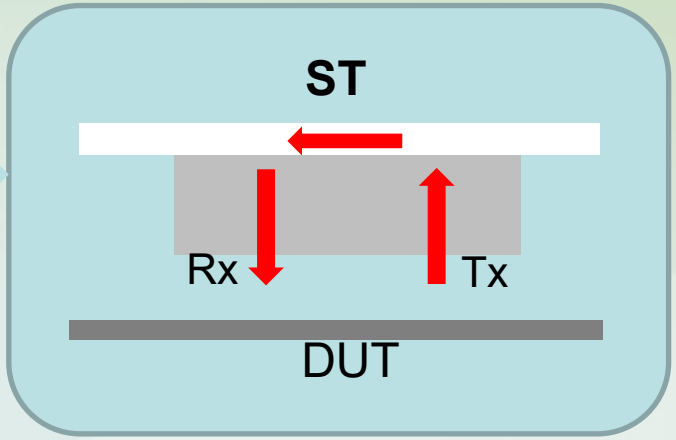
2. Shortening the Probe Needle ✓

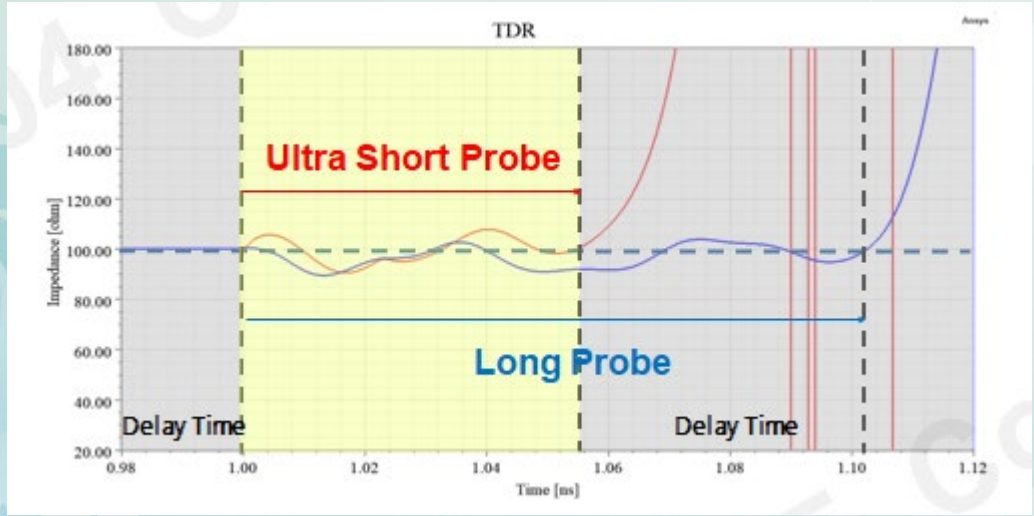
Based on idea of shrinking length to below ¼ wavelength

Evolution of Ultra Short Probe

SL Needle







- Shorter **Total Signal** Path
  - ✓ **Total Signal Trace is shorter than quarter wavelength**
  - ✓ Impedance control is less important
- Reduce Total Crosstalk Effect
  - ✓ Reduce Noise sensitivity (PAM4)

Significance of ¼ λ

Not enough rise time for return wave to significantly impact signal insertion

Target : 28 GHz for 112G PAM4

$$v = \frac{c}{\sqrt{\varepsilon_r \mu_r}} \qquad \lambda = \frac{v}{freq}$$

$$\lambda = \frac{c}{28\ \text{GHz}} \approx 10.7\text{mm}$$

Assuming perfect dielectric (air) and conductor (copper) for relative magnetic permeability and relative permittivity. V ≈ C

¼ λ requires needle shorter than 2.67mm

Γ = 0.5

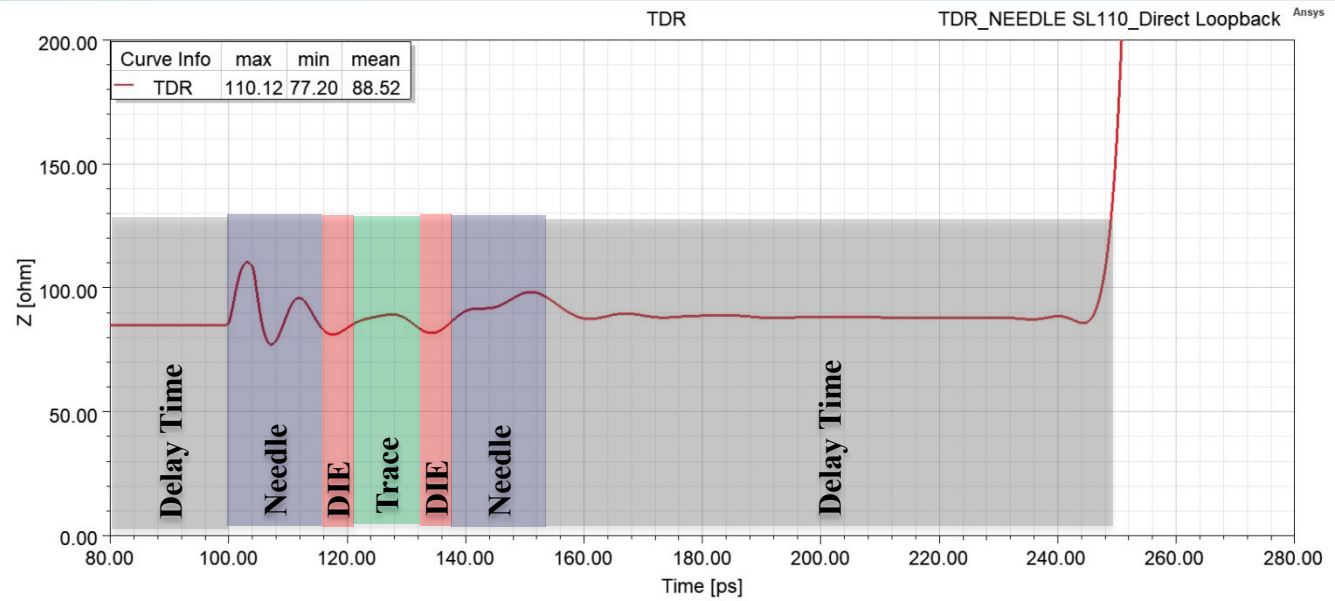
¼ λ

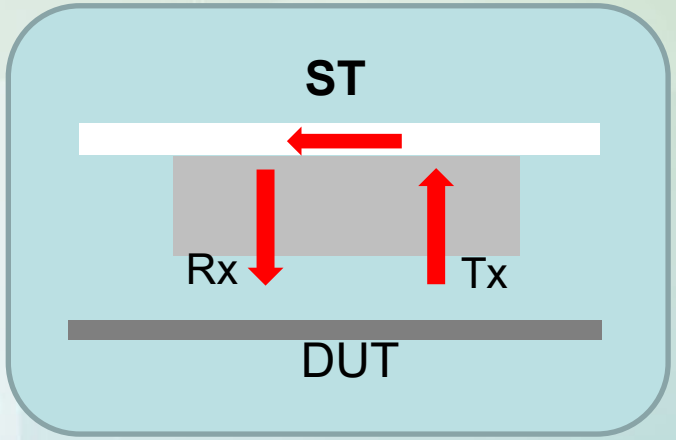
λ

Future Product Development

- SL Direct Loopback TDR

85 ohm impedance control





Future Product Development

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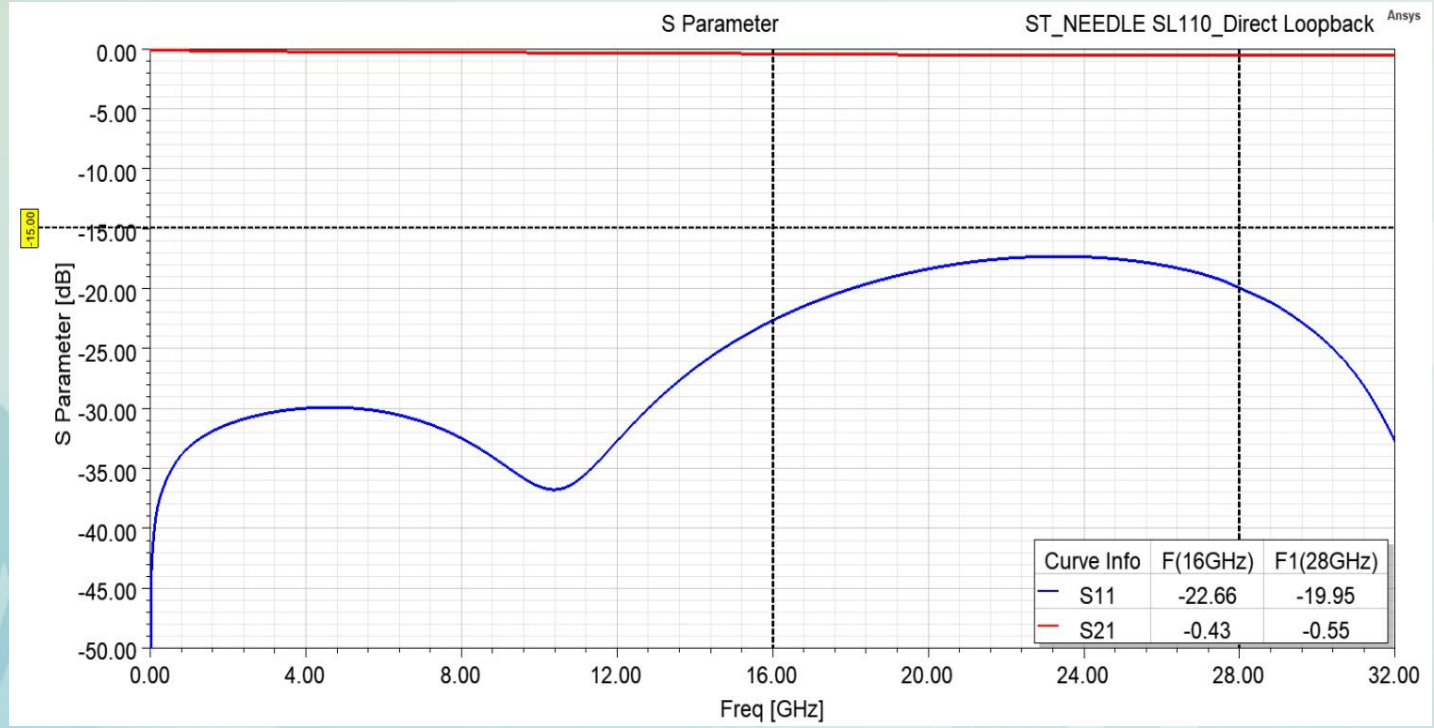
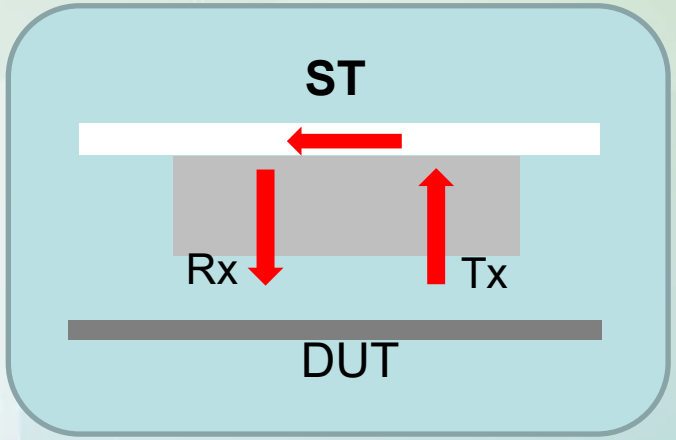
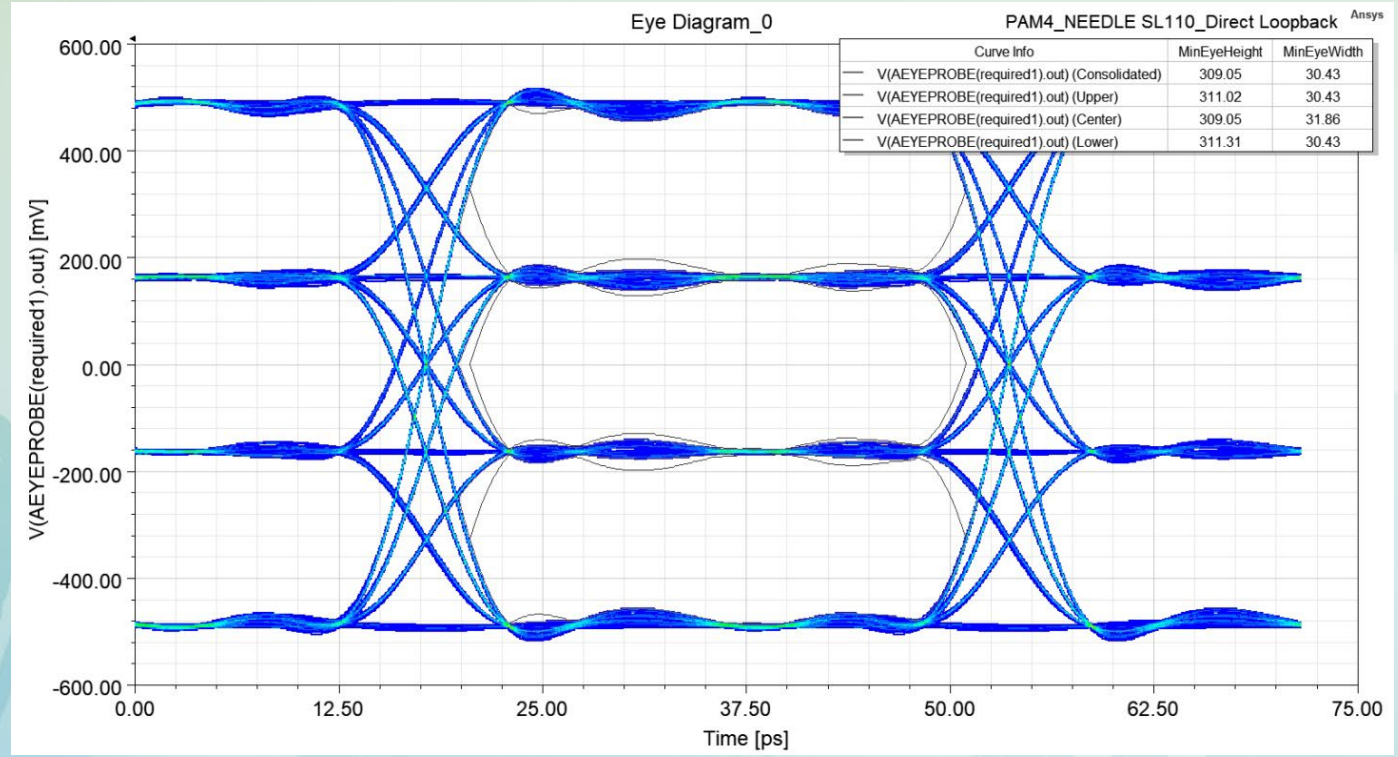
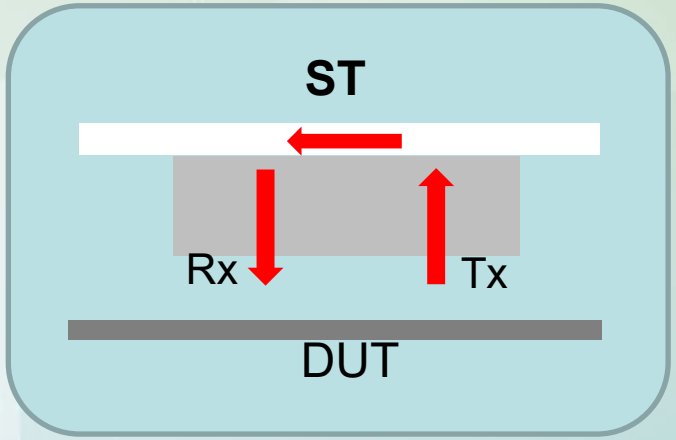




Future Product Development

- SL Direct Loopback Eye Diagram

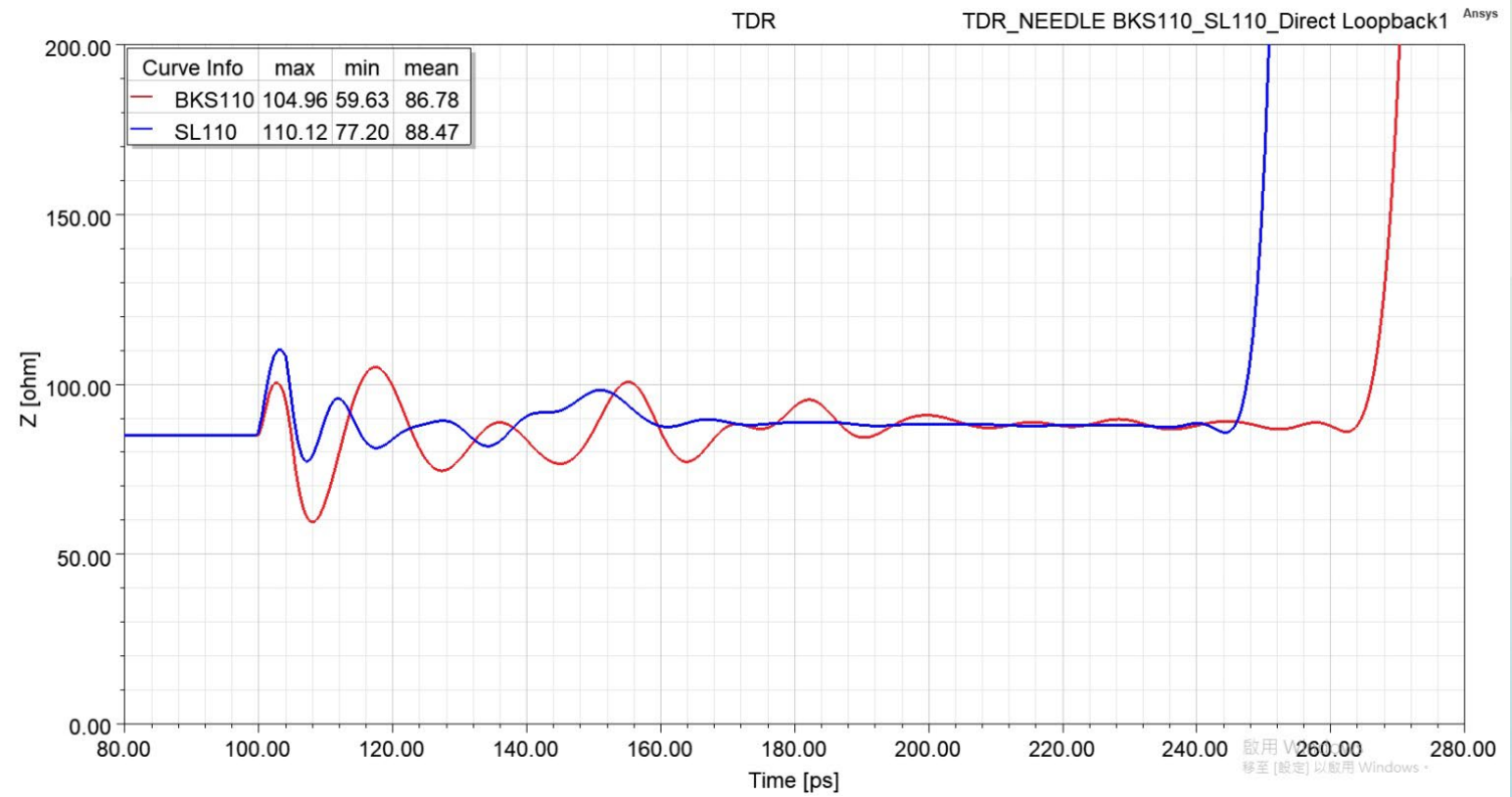




BKS and SL Comparison

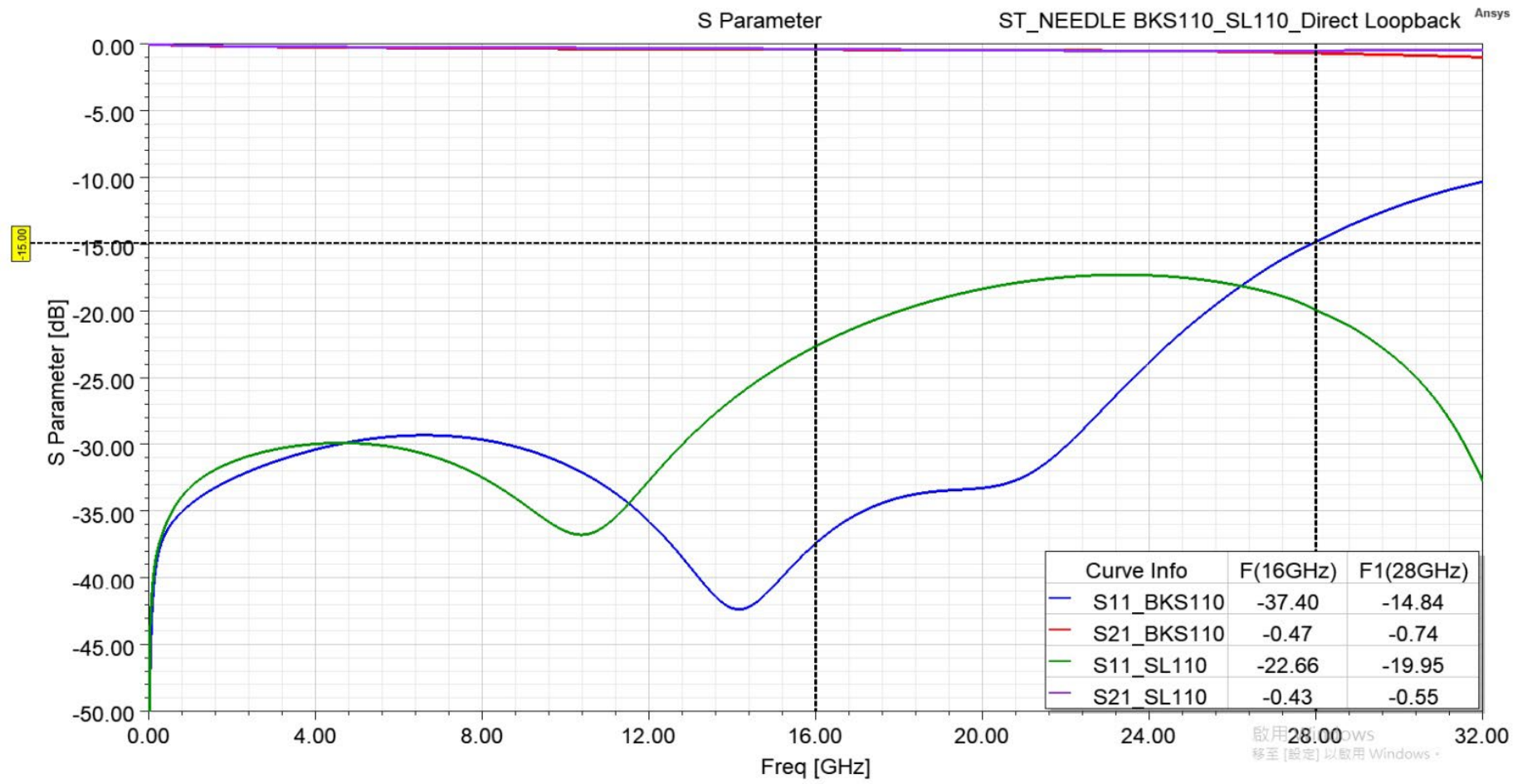
SL vs BKS Direct Loopback TDR

Rising Time: 4.16 ps



BKS and SL Comparison

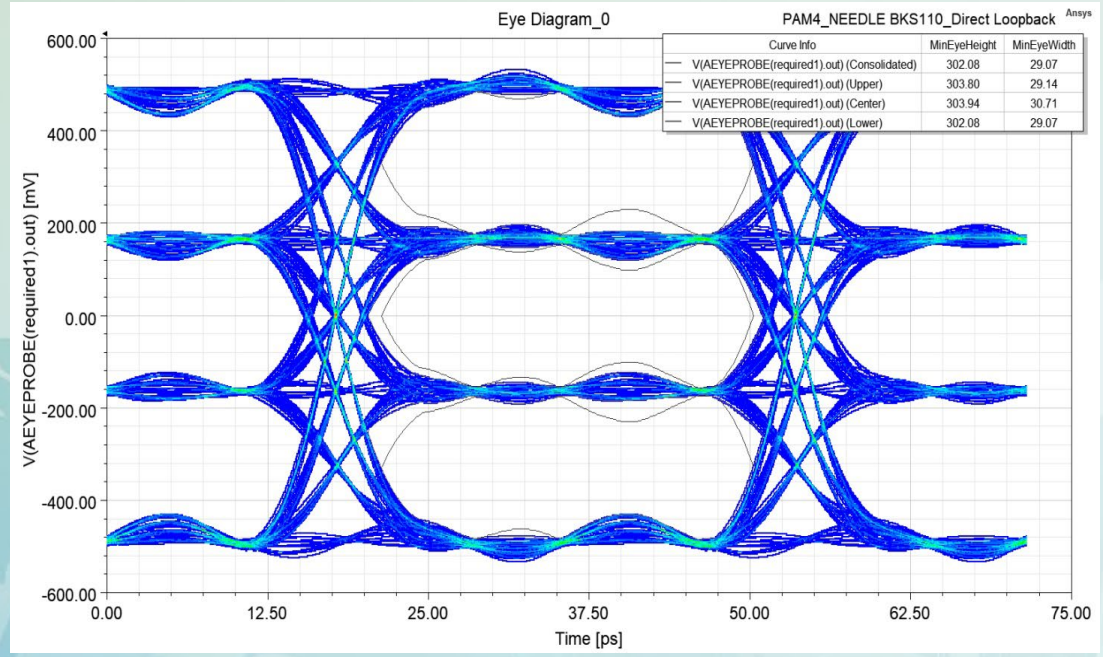
SL vs BKS Direct Loopback S Parameters



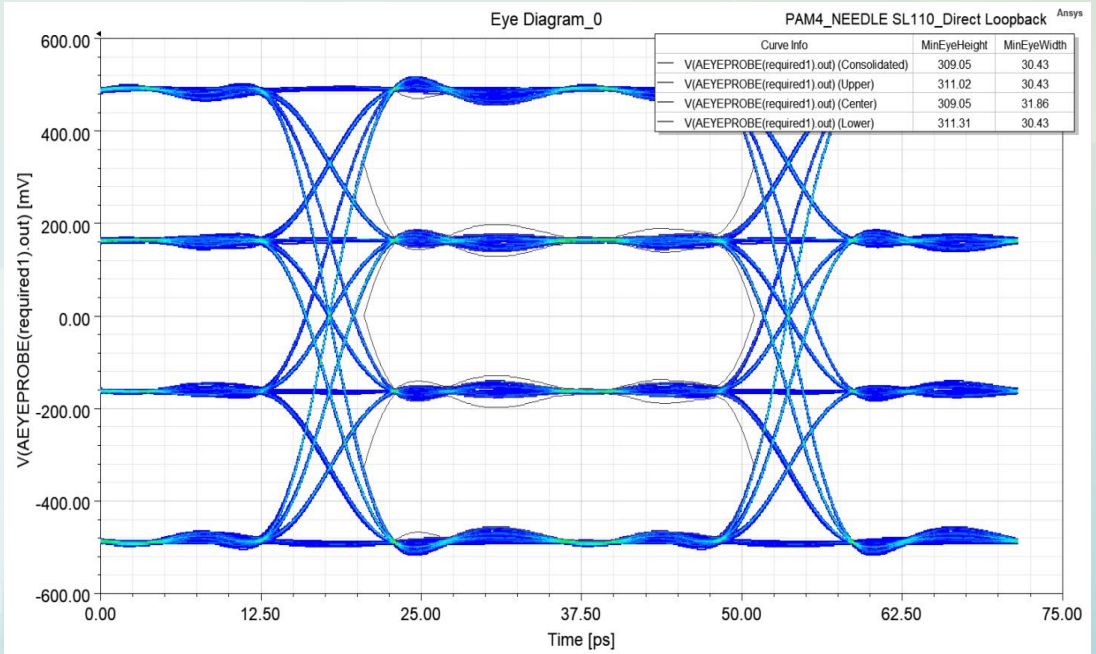
BKS and SL Comparison

SL vs BKS Eye Diagram

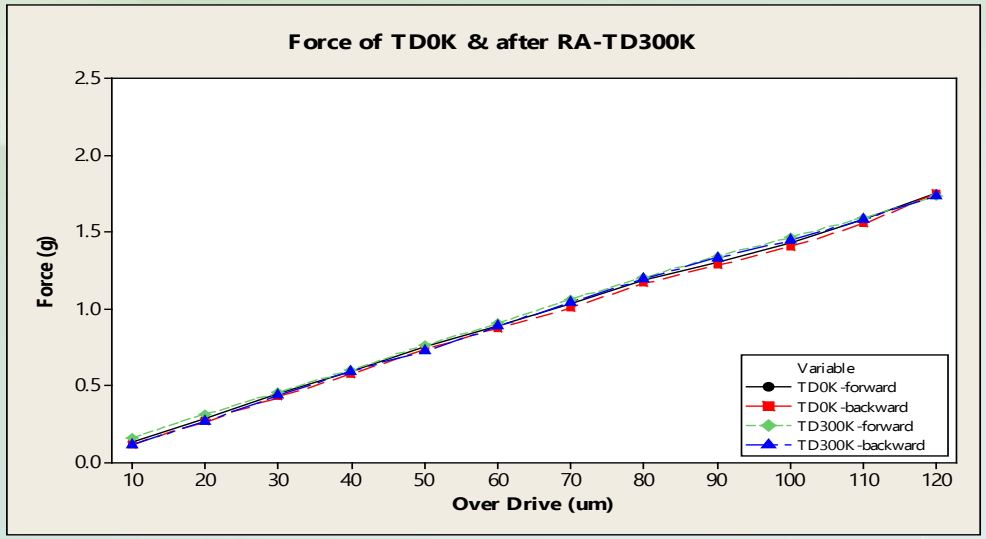
BKS Series Needle

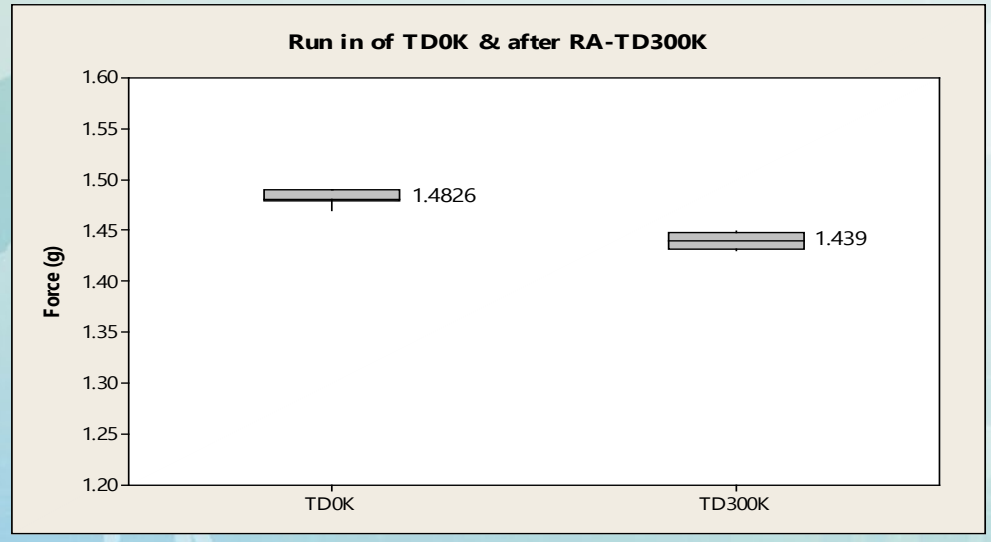


SL Series Needle



CHPT High-Speed Probe Reliability Test





- Test Temperature : 150 ℃
- Touch Down Frequency : 2 TD/sec
- Touch Down : 300K
- The average force @ OD100 um decline 2.9% after 300K TD

	CHPT High-Speed Probe
Minimum pitch [um]	150
Contact force(@ 4milsOT) [g]	1.5 to 2.0
Recommended O.D. [um]	30 to 100
Max. O.D. [um]	120
Probe length [um]	1580(SL)
Life time	300K at least
Temperature [℃]	-40 / 150

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Summary

- CHPT has successfully designed a probe for 112G PAM4 Test Solution
  - Deliver functional product to customer enabling high speed testing
- High quality and durability (The average force decline 2.9% after 300k touch down)
- CHPT is developing an Ultra-short Probe (SL Needle) to exceed current compliance standard and prepare for future high-speed testing, even for 224Gbps
  - Total signal path length < Quarter Wavelength
- Ready to serve the needs of high speed testing in future automotive and HPC products