An Innovative Design and Implementation of Vertical Probe Card for High Speed Loopback (12Gbps) Application

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Agenda

- Background
- Introduction
- Electrical Performance
- Design of Taguchi Methods
- Experiment Validation
- Conclusion
There are several types of high-speed transmission interface which are shown at the chart below. In order to achieve the required speed on the wafer level testing, the demand of the advanced loopback design is certainly more and more important.
Background

- How to improve the performance of the probe card

There are several factors, such as:
1. PCB
2. SUB.
3. Needles
Background

- Conventional P/C

- I/O channel
Background

- The channel1. of P/C measurement result and eye diagram

Channel 1.

- Channel 1. 2Gbps

- Channel 1. 6Gbps

- Channel 1. 10Gbps

Worse!

Blind!
Introduction

- What is Super Eye™ technology?

**Conventional P/C**

**Super Eye™ technology P/C**

Alex Wei

June 7-10, 2015

SW Test Workshop
Introduction

- About Super Eye™ technology
- MPI design the impedance matching on the transmission line.

Super Eye™ technology is patented and patents pending.
By using 3D EM software and Super Eye ™ technology, it will help to progress the conventional electrical performance.
Electrical Performance (Sim.)

Conventional P/C

Super Eye Tech. P/C

S21, S11

2Gbps

6Gbps

12Gbps

Better!
Electrical Performance

- Measurement result of P/C
  The simulation and measurement results are inconsistent.

![Super Eye™ technology graph]

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Alex Wei

June 7-10, 2015 25TH ANNIVERSARY 2015 SW Test Workshop
There are several sensitive factors which cause the inconsistency between the measurement result and simulation. MPI analyzed those factors and made an improvement to the simulation resulting in more accurate results.

Super Eye™ technology

Electrical Performance
Design of Taguchi Methods

- We found 4 sensitive factors during the process of sensitivity analysis.
Design of Taguchi Methods

- We found 4 sensitive factors during the process of sensitivity analysis.
Design of Taguchi Methods

- Each sensitive factor might impact different Via, Metal, or landing pad.
Design of Taguchi Methods

- Taguchi Methods: Orthogonal Arrays & Experimental Data log, S/N Ratios.

<table>
<thead>
<tr>
<th>Experiment</th>
<th>A</th>
<th>B</th>
<th>C</th>
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<th>S/N Ratios</th>
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![S/N Ratios Chart]
Design of Taguchi Methods

- Analysis Result

According to the sensitive factors, we use Taguchi Methods to improve the design and let the performance better.
Experiment Validation

- Measurement system

Reference plane after calibration.
Experiment Validation

Measurement system
We adopted SOLT calibration method and de-embedded each probe to generate measurement result.
Experiment Validation

- Measurement result
  The measurement result shows the characteristics are improved.
Experiment Validation

- Eye diagram of 5 Gbps

**Super Eye™ 5Gbps**

- Rise/Fall time = 50 ps
- Data rate = 5 Gbps
- Data type = PRBS(2^{32}-1)
- Vo/Vi *100% = 74%
Experiment Validation

- Eye diagram of 6 Gbps

**Super Eye™ 6Gbps**

Rise/Fall time = 41.667 ps
Data rate = 6 Gbps
Data type = PRBS(2^{32}-1)
Vo/Vi *100% = 72%

**Conventional P/C 6Gbps**
Experiment Validation

- Eye diagram of 8 Gbps

Rise/Fall time = 31.25 ps
Data rate = 8 Gbps
Data type = PRBS($2^{32}-1$)
Vo/Vi *100% = 66%
Experiment Validation

- Eye diagram of 10 Gbps

Super Eye™ 10Gbps

Rise/Fall time = 25 ps
Data rate = 10 Gbps
Data type = PRBS(2^{32}-1)
Vo/Vi *100% = 64%

Conventional P/C 10Gbps
Experiment Validation

- Eye diagram of 12 Gbps

**Super Eye™ 12Gbps**

- Rise/Fall time = 20.8 ps
- Data rate = 12 Gbps
- Data type = PRBS(2^{32}-1)
- Vo/Vi *100% = 60%

**Conventional P/C 12Gbps**
Conclusion

Super Eye™ technology

1. Super Eye™ technology can support 12Gbps for vertical probe card loopback application on high speed transmission interface (USB3.0: 5Gbps, SATA3: 6Gbps, PCI-E 3.0: 8Gbps, Ethernet: 10Gbps...etc.).

2. Improve conventional loopback design: Impedence matching on the transmission line to improve electrical performance.
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Thank you
Q & A

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