

Fine-Pitch RDL with Excellent Signal Transmission Performance Formed on Glass for Heterogeneous Integration

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DNP



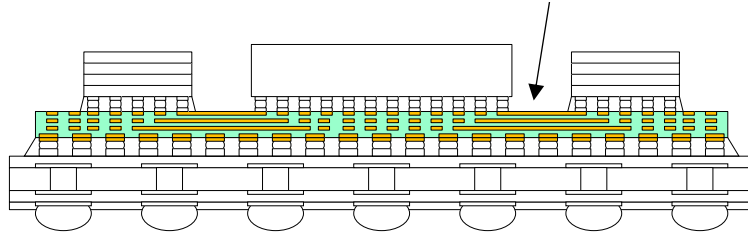
Outline

1. Introduce of our developed package and DNP proposed Redistribution Layer (RDL)
2. RDL Evaluation of High-Frequency Characteristic
3. Measured Transmission Characteristics and Analysis of Operational Waveforms
4. Summary

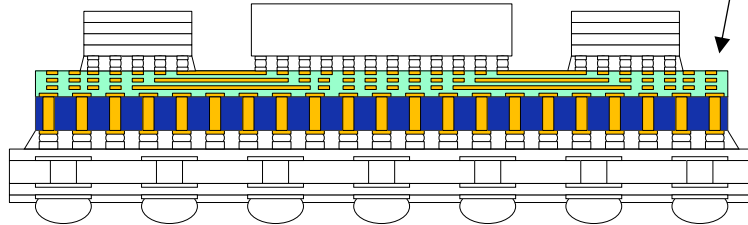
Overview our developed package

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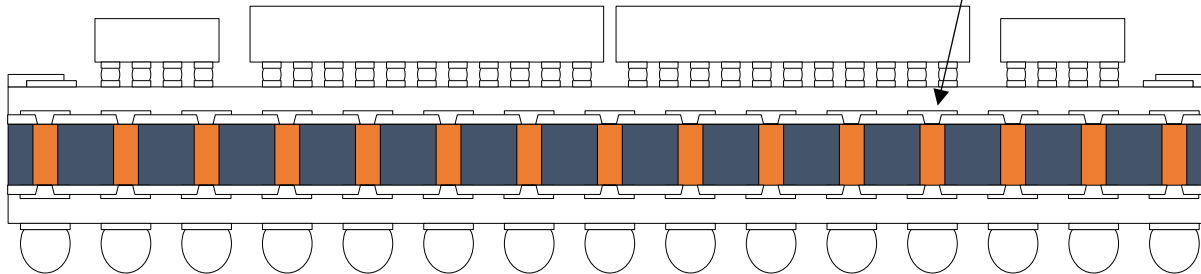
RDL interposer



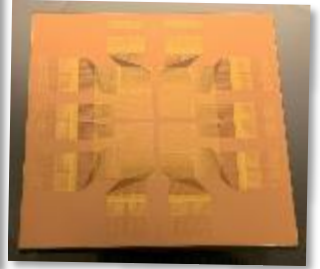
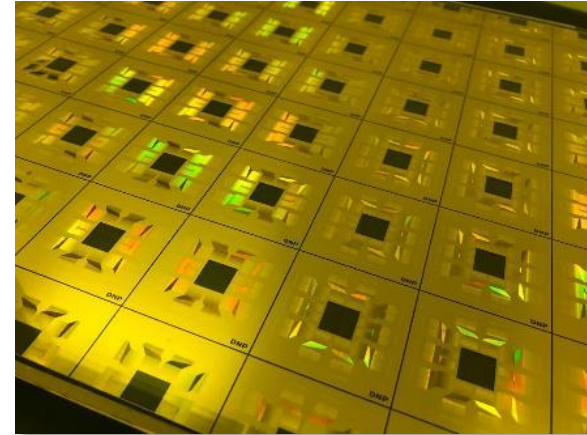
Glass interposer



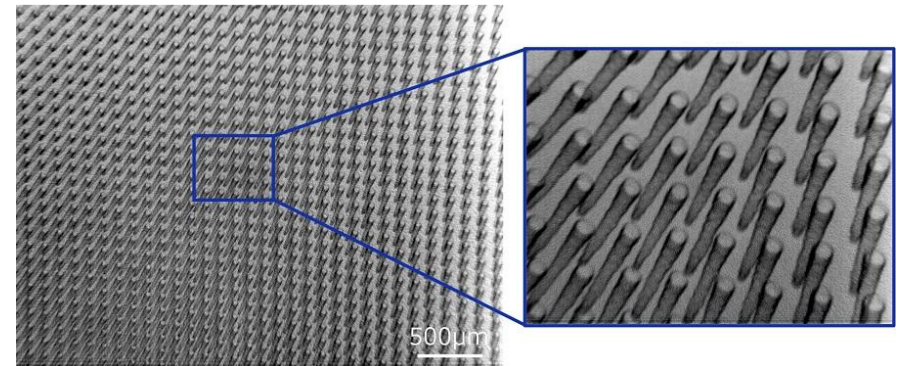
Glass core substrate



RDL (Redistribution Layer)

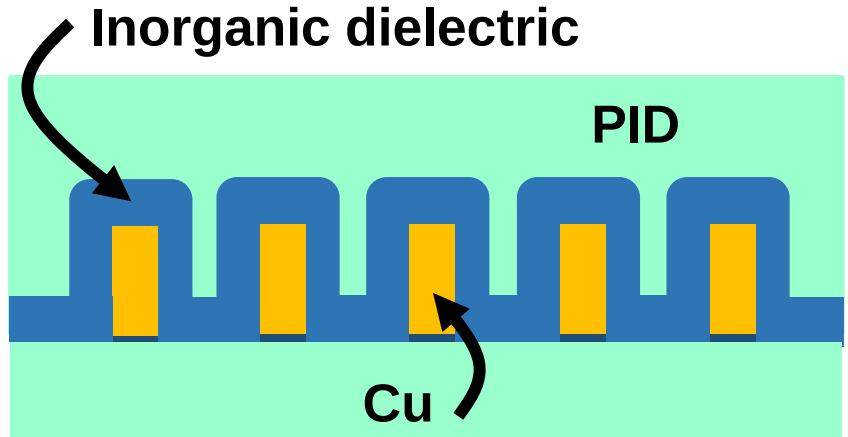


TGV (Through-Glass Vias)



Innovative Features of Our Developed RDL

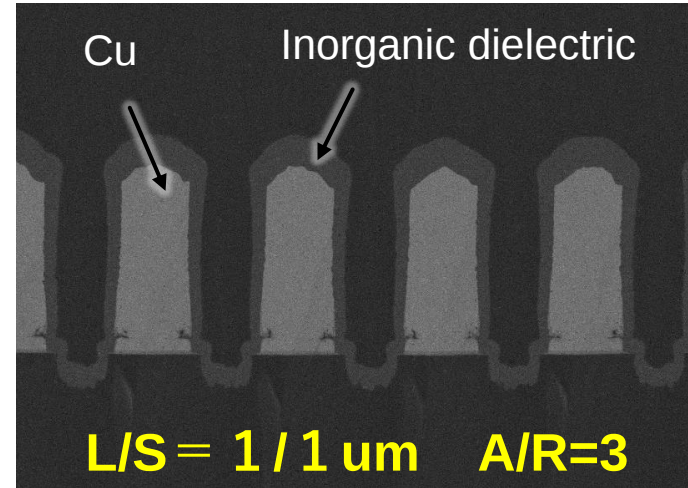
DNP



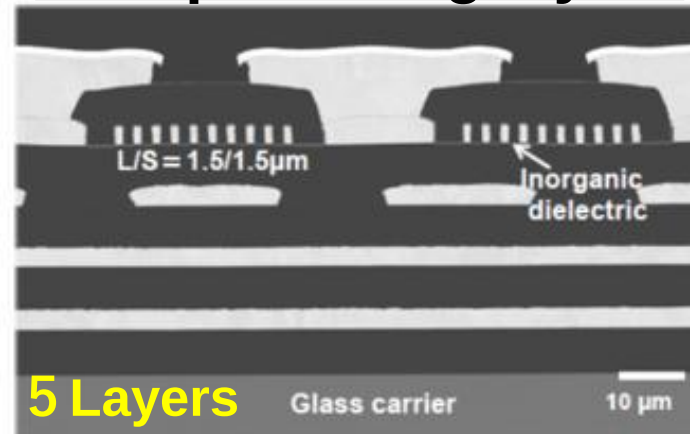
PID : Photo Imageable Dielectric Material

1. Fine wiring
2. High Aspect ratio (Low loss)
3. Inorganic coverage
4. High reliability
5. Low warpage
6. Multiple wiring layers
7. Large panel level fabrication

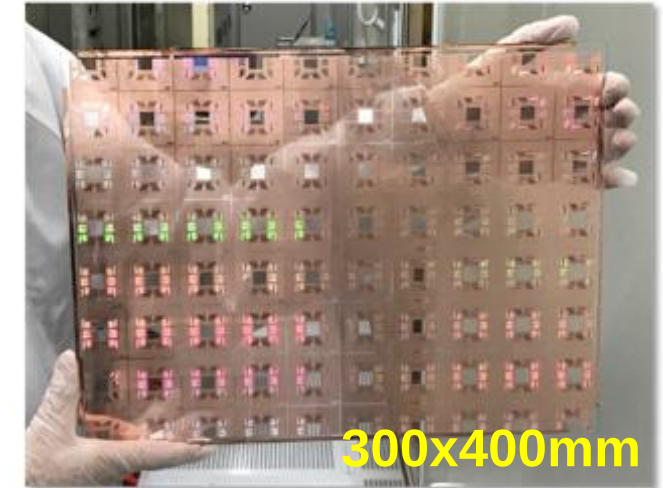
Fine and High A/R



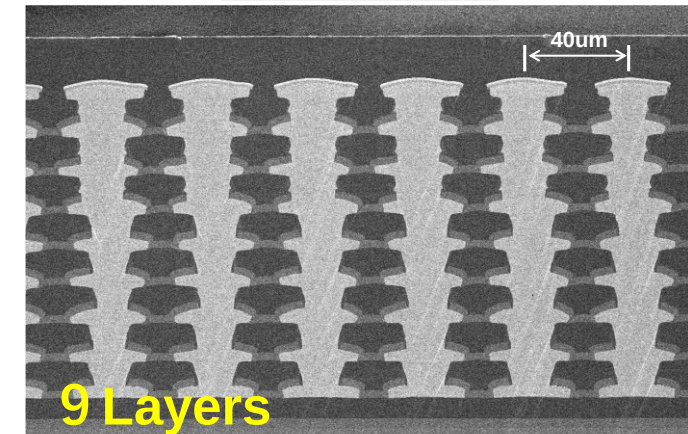
Multiple wiring layers



Large panel size



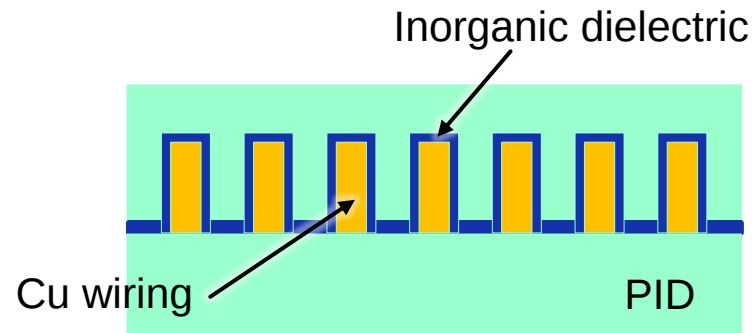
Stack via



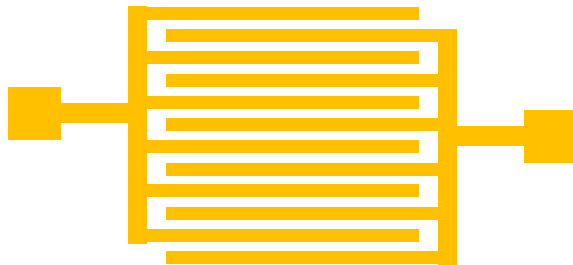
Reliability of Our developed RDL

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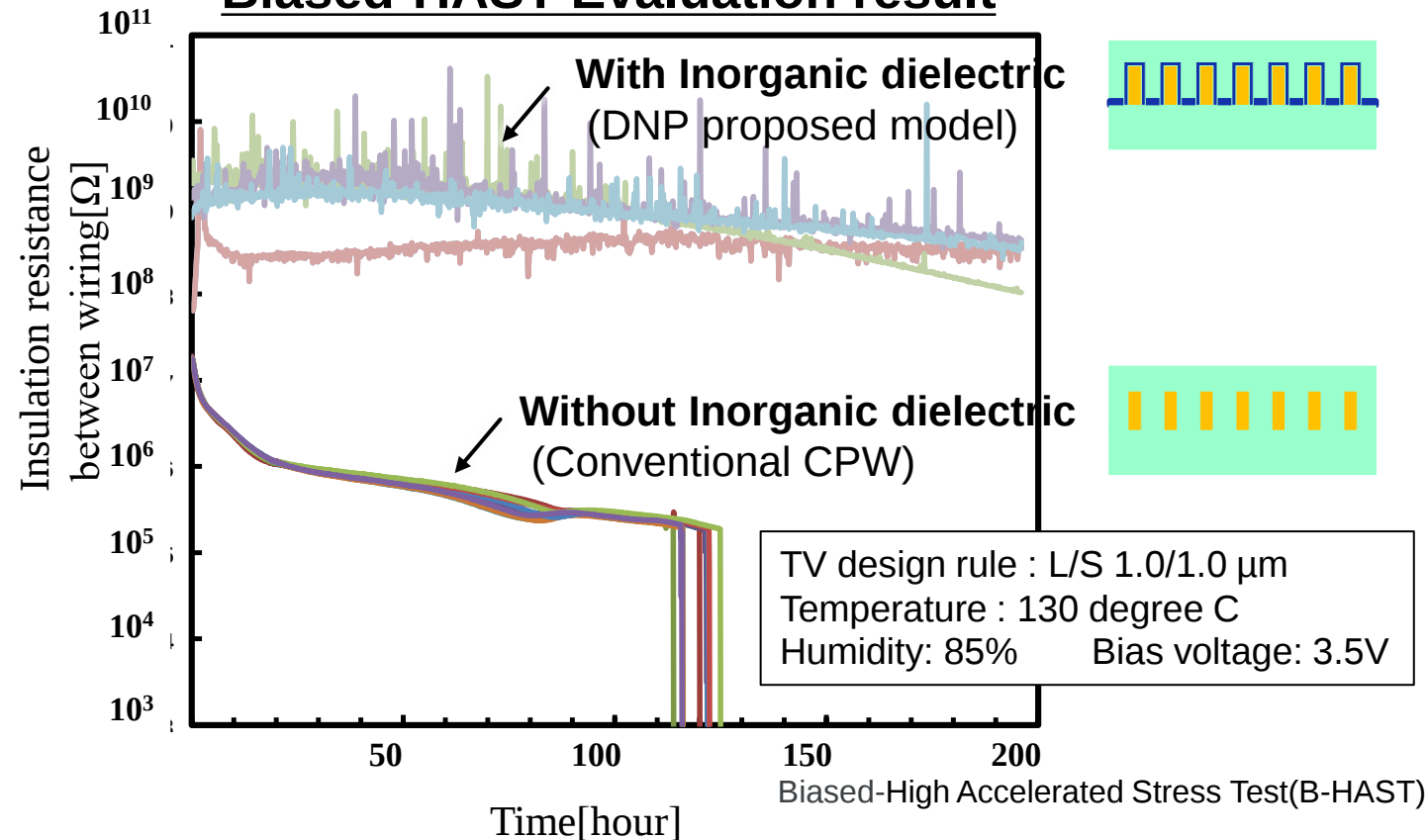
DNP proposed model



Comp monitor for Biased-HAST



Biased-HAST Evaluation result



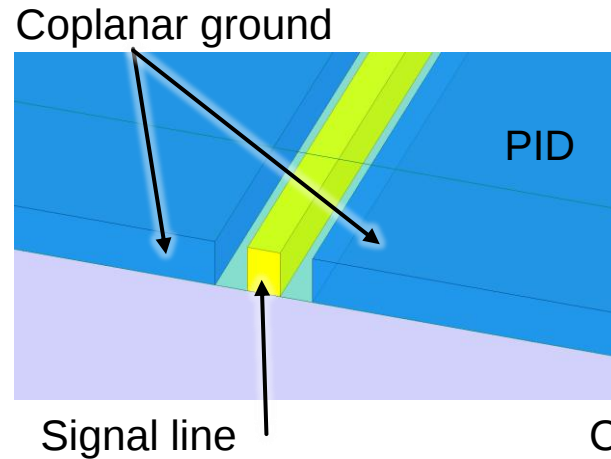
By coating fine wiring with inorganic materials, it is possible to ensure high reliability.

Impact of Inorganic dielectric on High-Frequency Characteristics

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Conventional CPW

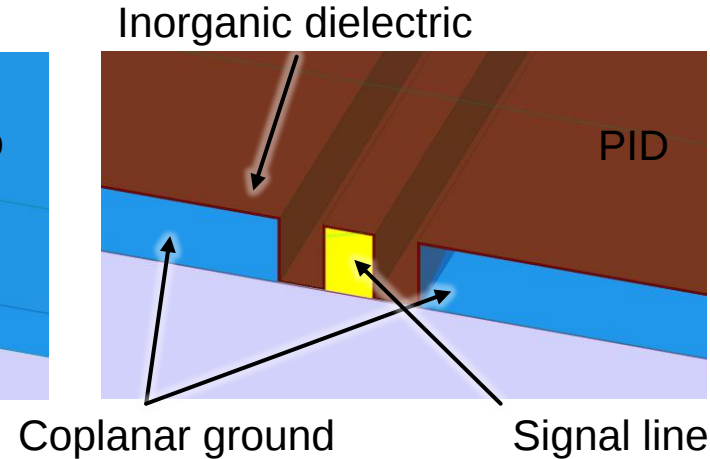
Without Inorganic dielectric



Simulation Model

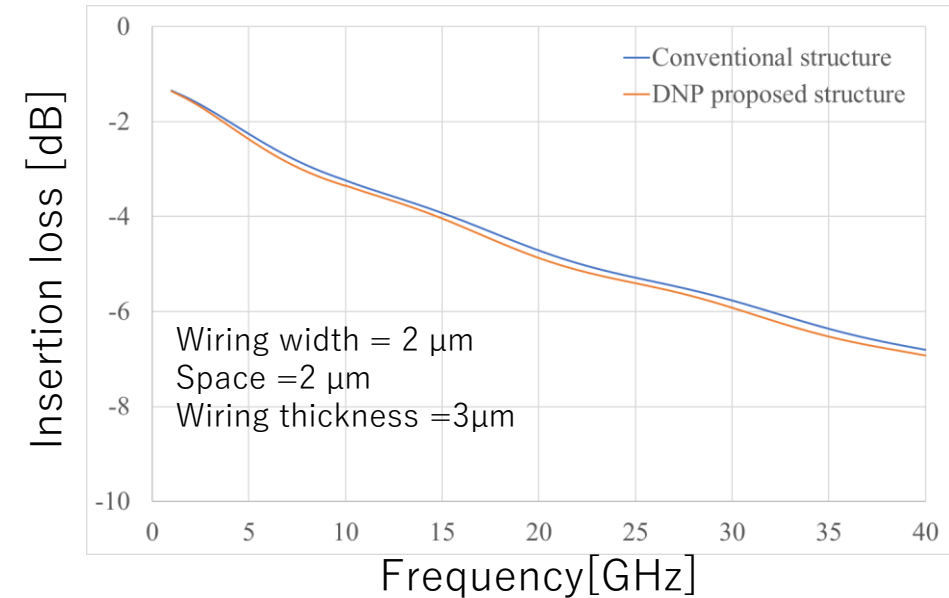
DNP proposed model

With Inorganic dielectric



CPW : Coplanar Waveguide

Simulation result of Insertion loss



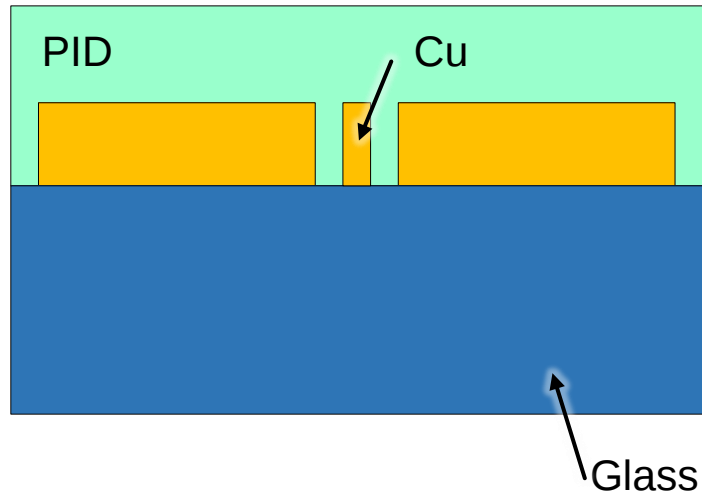
The difference in insertion loss with and without the inorganic coating is very small

Test Vehicle Measurement Details

DNP

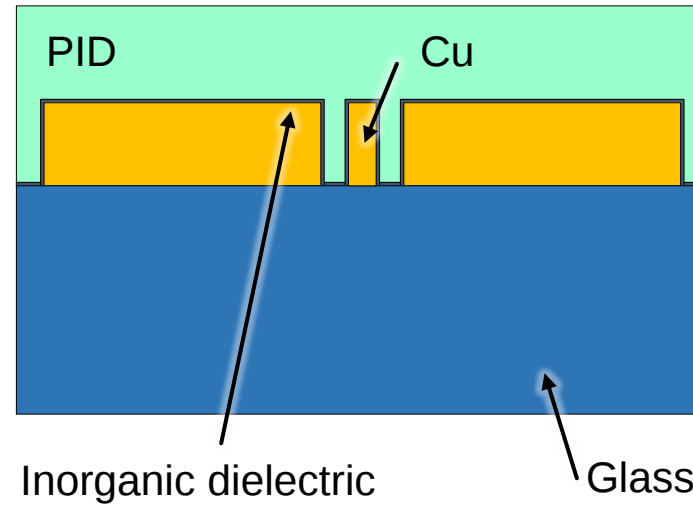
Conventional CPW

Without Inorganic dielectric



DNP proposed model

With Inorganic dielectric



Parameters

Design parameters	Value.
Wiring width/space	1.5 μm to 3.0 μm
Wiring thickness	3.0 μm
Insulation thickness	7.0 μm
Glass thickness	400 μm

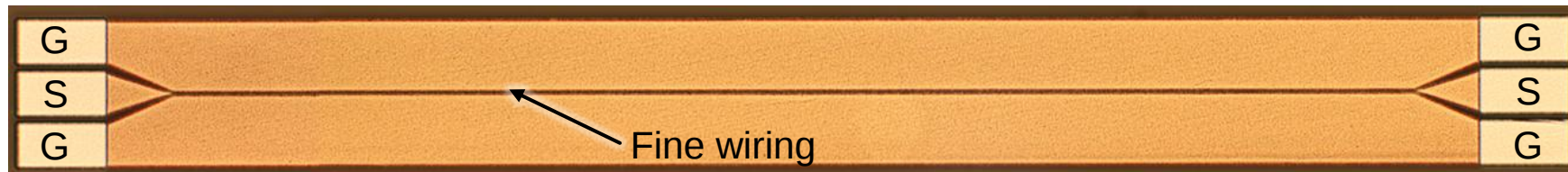
Material property	Relative permittivity	Dielectric constant
Insulator	3.4	0.03
Glass	5.8	0.006

Material property	Electrical conductivity
Copper	5.8E7 [S/m]

Outer view of test vehicle

Wiring length 5mm and 10mm

Measurement
Terminal

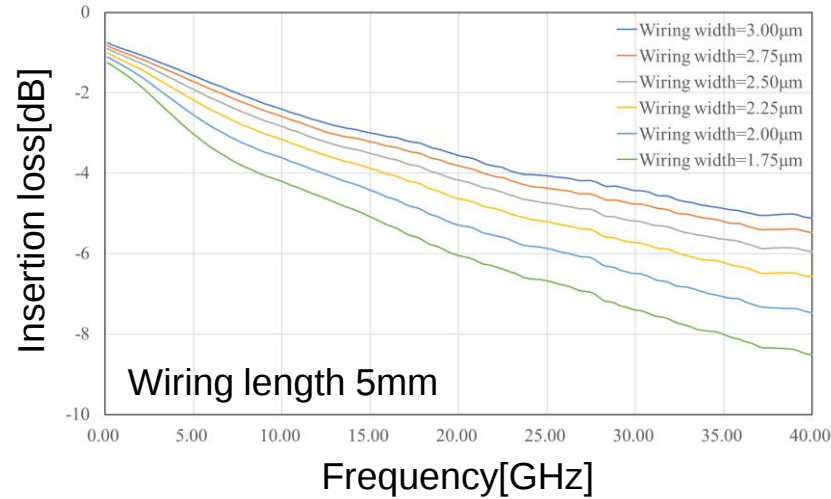


Measurement
Terminal

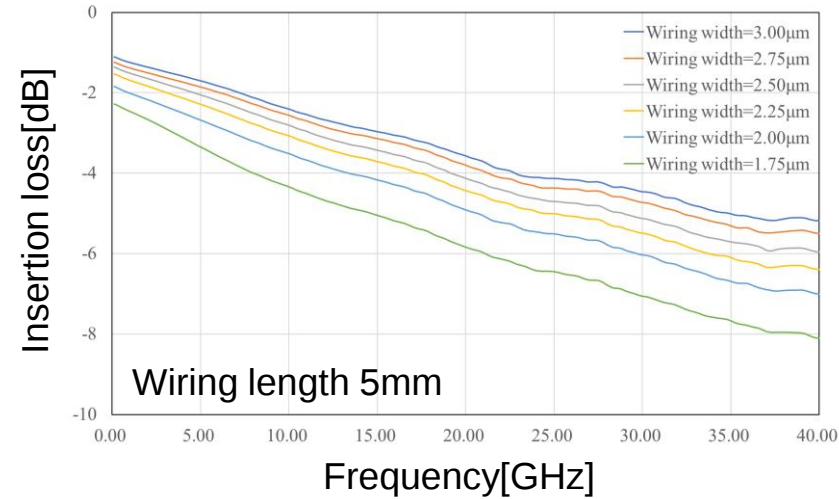
Measurement result of insertion loss

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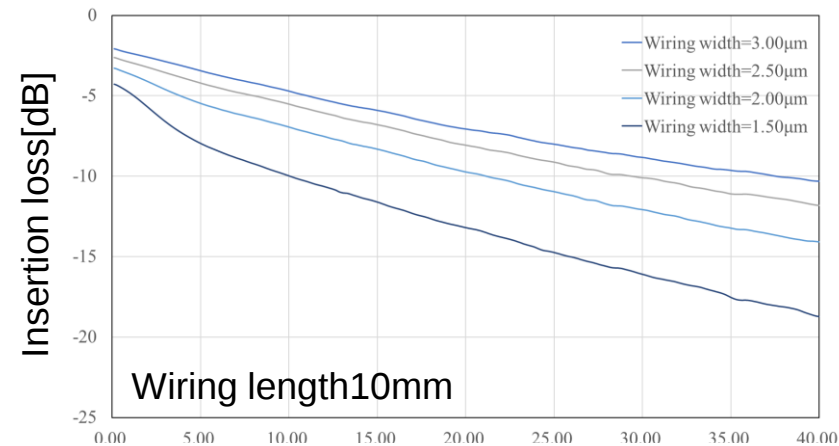
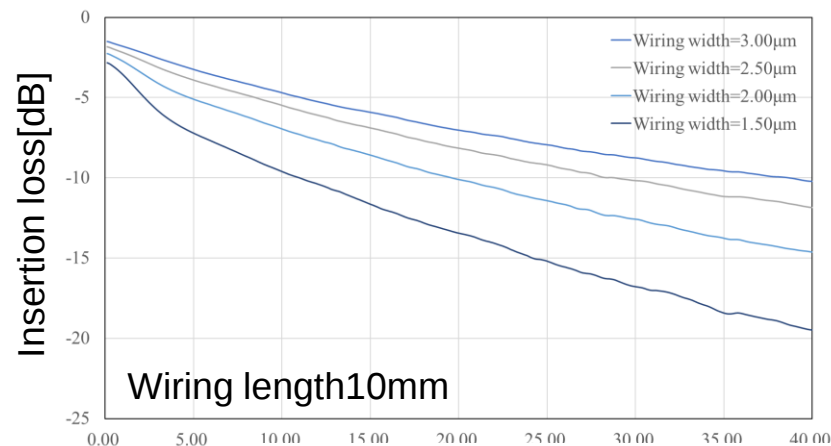
Conventional CPW



DNP proposed model



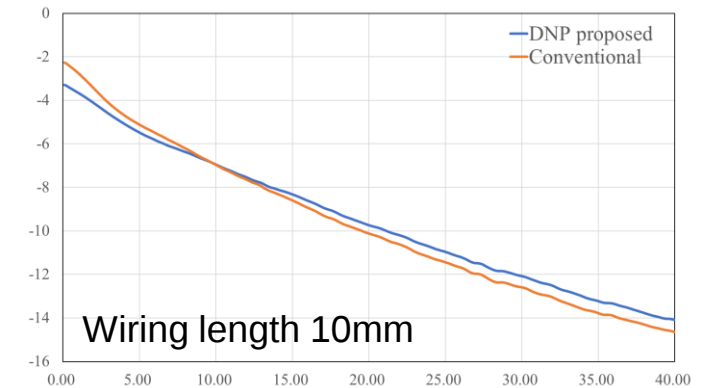
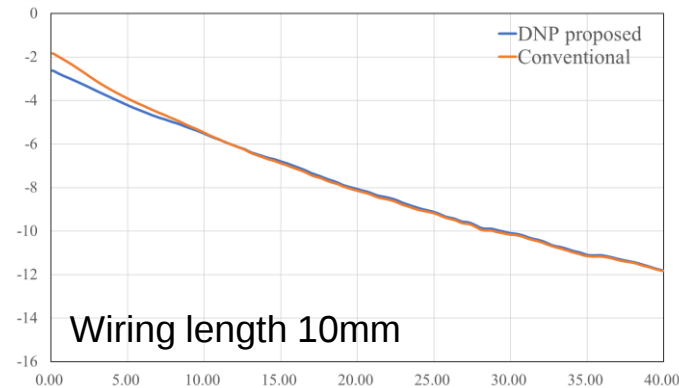
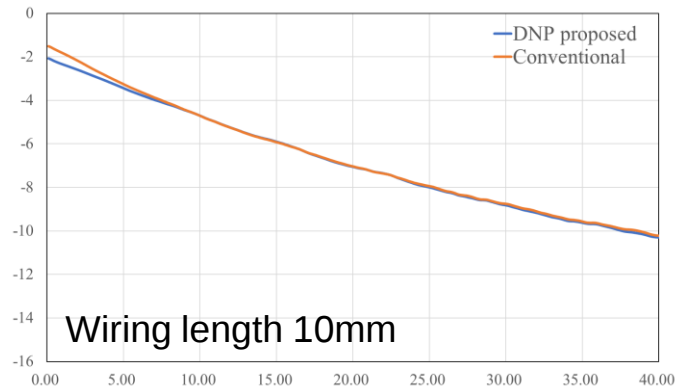
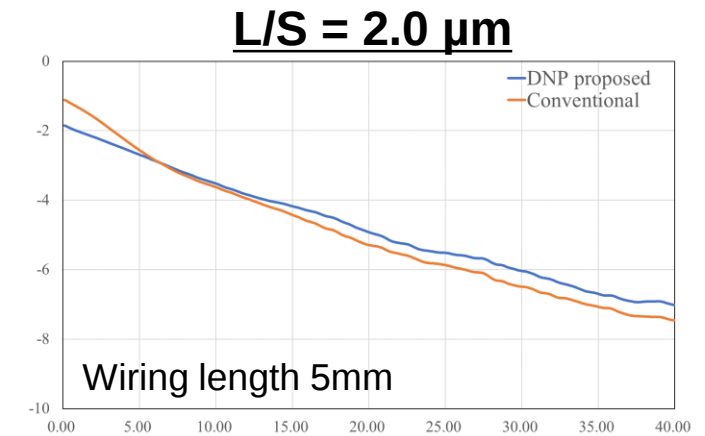
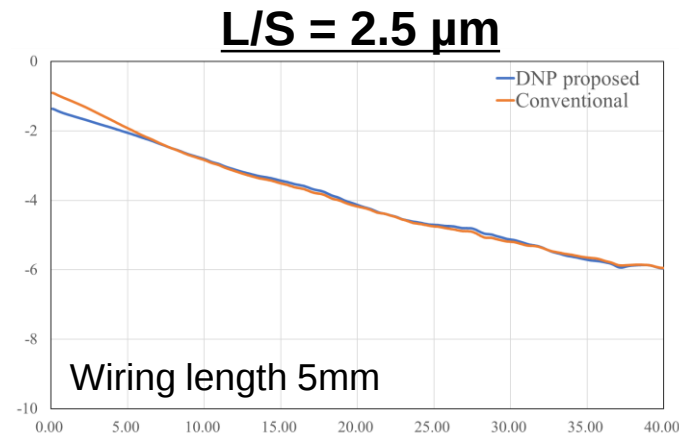
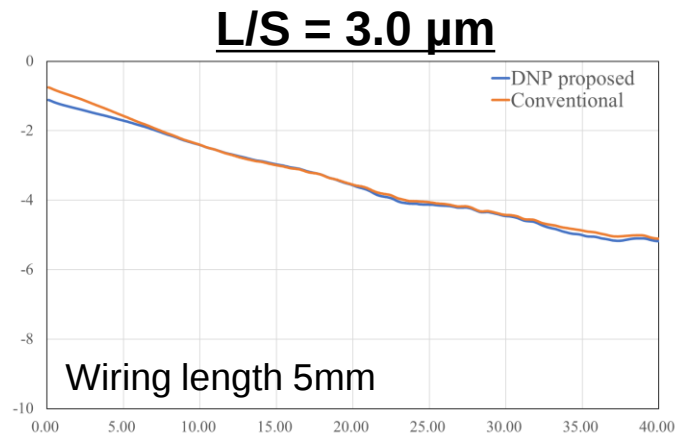
From 1.75μm to 3.0μm



From 1.50μm to 3.0μm

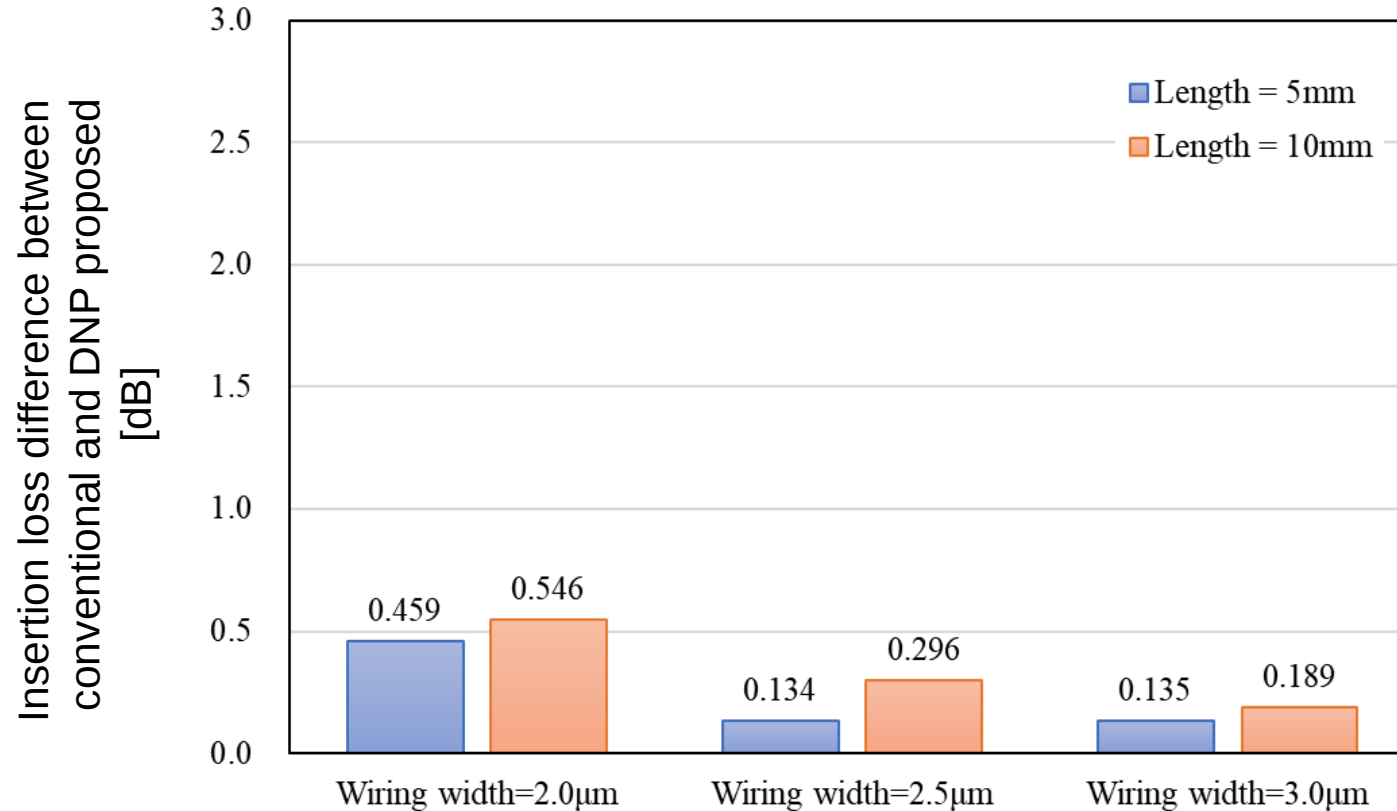
There is no difference with or without the inorganic coating.

Comparison result of the effect of inorganic material

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The difference between the conventional structure and DNP proposed structure is minimal.

Difference in Insertion Loss with and without Inorganic Coating up to 40GHz **DNP**

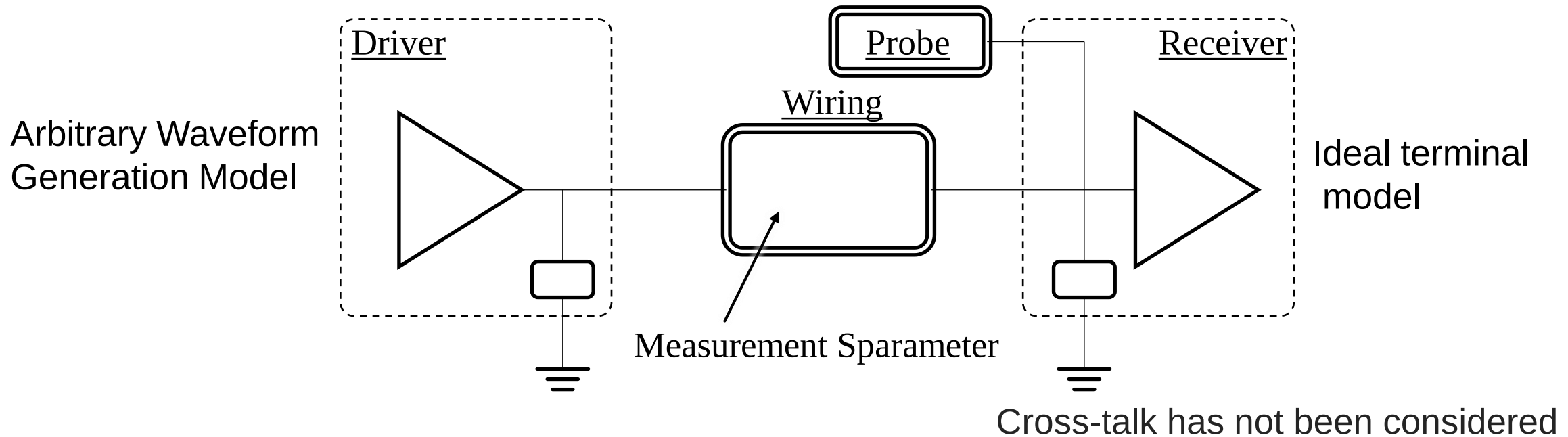


- The longer the wiring length, the greater the difference, and the narrower the wiring width, the greater the difference .
- The maximum difference within the 40GHz bandwidth is approximately 0.6dB.

Operational Analysis Using Measured S-Parameters

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Simulation topology



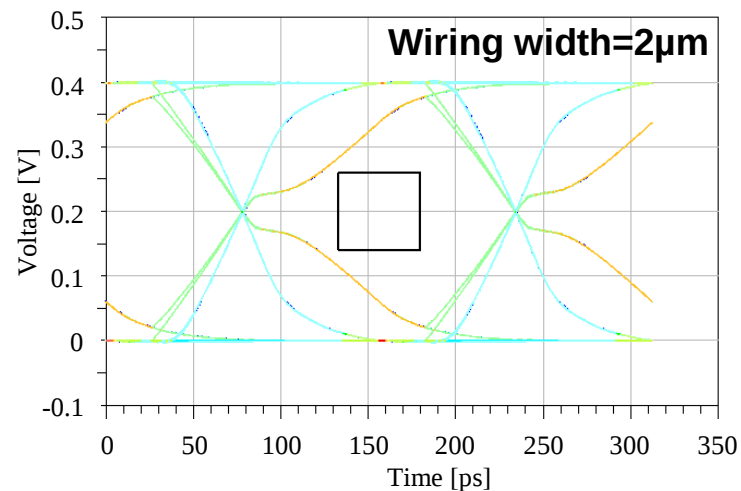
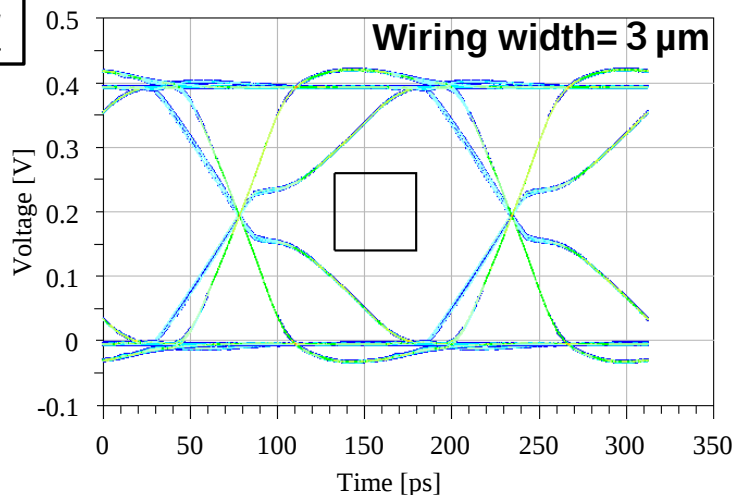
Eye pattern analysis uses actual measurement data with a wiring length of 5 mm

Eye pattern simulation result

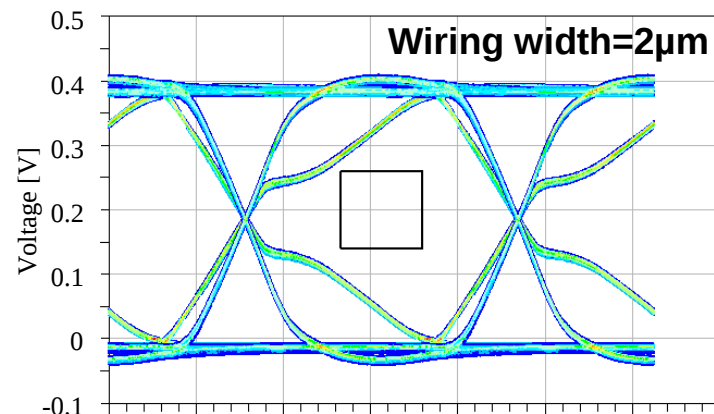
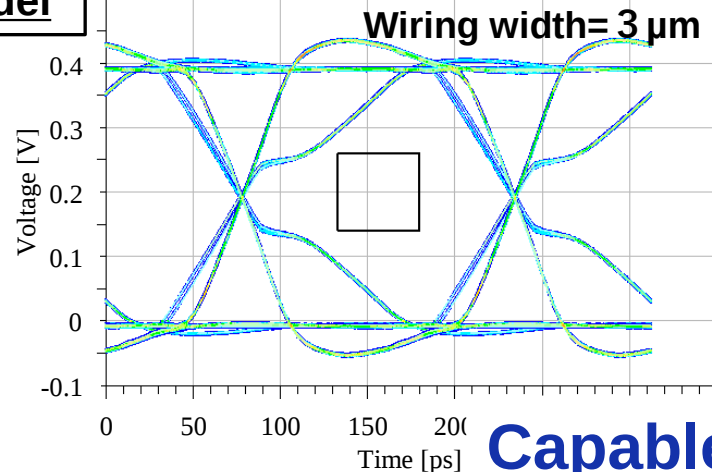
HBM3 at 6.4Gbps Assumption

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Conventional CPW



DNP proposed model



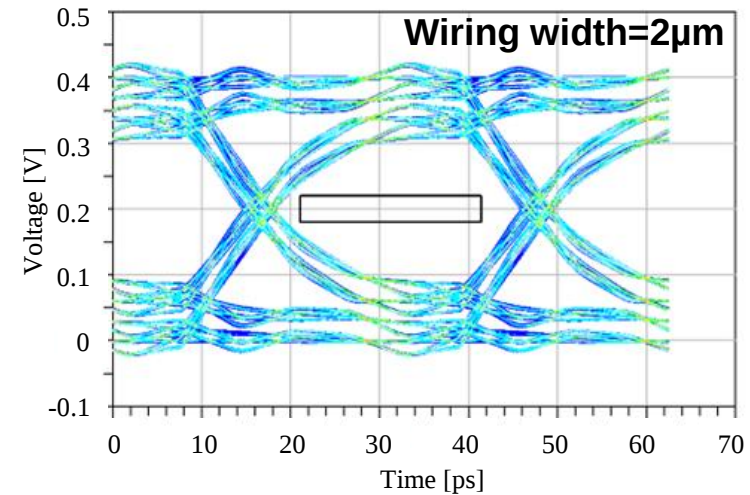
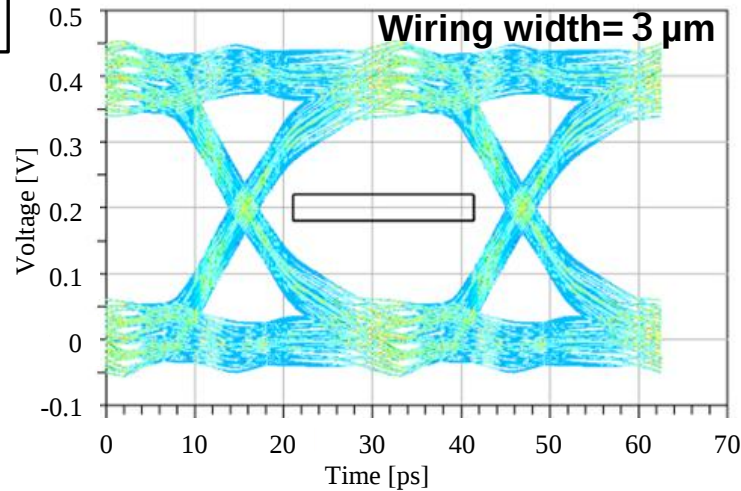
Capable of 6.4Gbps Signal Transmission

Eye pattern simulation result

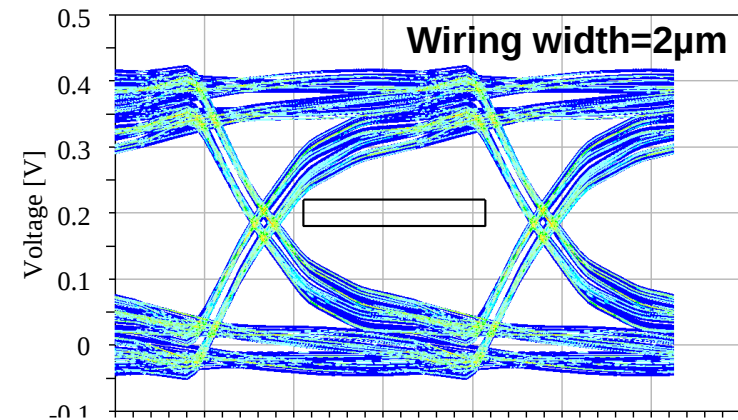
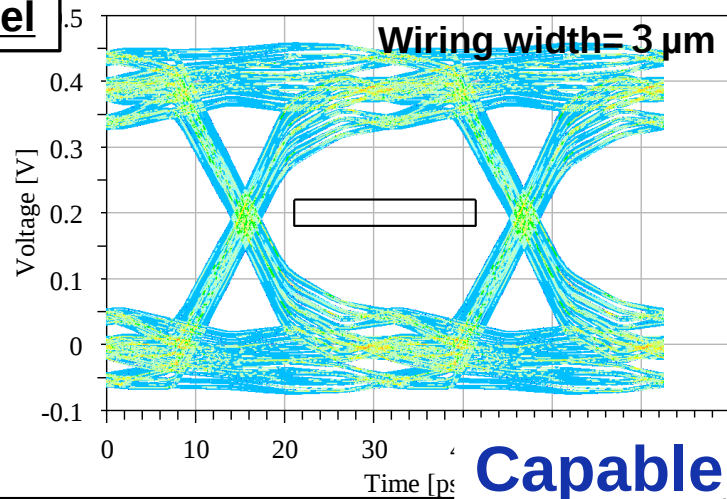
UCIe at 32Gbps Assumption

DNP

Conventional CPW



DNP proposed model



Capable of 32Gbps Signal Transmission

Summary

1. We investigated the differences in transmission characteristics due to the presence or absence of inorganic dielectric structures in wiring width up to 1.5 μm . As a result, we confirmed that the loss difference due to the presence or absence of the inorganic film structure is approximately 0.6dB within the frequency range up to 40GHz.
2. Eye pattern analysis of the measured data confirmed that the inorganic dielectric structure has minimal impact on transmission characteristics and supports signal speeds of 6.4Gbps and 32Gbps.
3. Our innovative fine wiring structure combines high reliability with exceptional high-speed signal transmission capabilities. These attributes make the inorganic-coated transmission line structure an ideal solution for next-generation high-speed signal transmission needs.

Thank you for your attention.

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