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WHERE THE CHIP MEETS THE BOARD

Simulation and Analysis of Electrical/Optical Communication Links Using Free Software

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Abstract

Copper and electrical channels have dominated the computer and data center ecosystem for years, with optical communications relegated to long-haul communications. The demise of copper has been predicted for years as speeds continue to increase unabated – a demise that has not materialized. Cracks are forming in copper's dominance, however, as reach has diminished and power has soared, portending more optical integration into previously all-electrical systems.

Since signal integrity involves the analysis of the transmission and reception of signals throughout the entire link, optical components can complicate traditional analysis techniques. Much of this complication comes from optical modulators that are often unfamiliar to signal integrity engineers.

This paper serves as a small tutorial on how optical modulators and receivers can be integrated into signal integrity analysis.

Biography

Pete Pupalaikis is a signal integrity engineer with Nubis Communications. Prior to Nubis, he worked for twenty-five years at Teledyne LeCroy designing high speed measurements instruments. He is the author of the book "S-parameters for Signal Integrity" and is an IEEE Fellow.

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Introduction

Copper and electrical channels have dominated the computer and data center ecosystem for years, with optical communications relegated to long-haul communications. The demise of copper has been predicted for years as speeds continue to increase unabated – a demise that has not materialized. Cracks are forming in copper's dominance, however, as reach has diminished and power has soared, foretelling more optical integration into previously all-electrical systems.

Since signal integrity involves the analysis of the transmission and reception of signals throughout the entire link, optical components can complicate traditional analysis techniques. Much of this complication comes from optical modulators that are often unfamiliar to signal integrity engineers.

This paper serves as a small tutorial on how optical modulators and receivers can be integrated into signal integrity analysis when the entire electical-optical path (in the case of the transmitter) and the entire optical-electrical path (in the case of the receiver) must be considered.

Consult [1] for a more in-depth discussion.

Optical Modulators

Mach-Zehnder Modulators

- General principle
- The segmented model

Ring Modulators

- General principle
- Tilt model

Packaging Challenges

- Present the different OIF type pictures.
- Issue of driver/TIA mounted directly on the PIC
- Issues of crosstalk between the driver and TIA

PDN Challenges

As an expert in power integrity instructs, "usually one can optimize the signal integrity or the power integrity, but not both". In copackage optics (CPO) this cannot be any truer.

References

[1] P. J. Pupalaikis, *S-Parameters for Signal Integrity*. Cambridge University Press, 2020.