SYNOPSYS®
Silicon to Software™

RSoft Application: VCSEL for Data Center and Automotive Interconnects

High-Speed, VCSEL-Based Transceiver Design

Overview

A leading Ethernet solutions provider in Israel needed an accurate modeling tool for VCSEL-based interconnect solutions for hyper-converged infrastructure.

The Challenge

VCSEL is an attractive choice as a source of light in transceivers due to manufacturing, testing, scaling, packaging, efficiency and reliability benefits. VCSEL is a complex physical device and accurate modeling of the VCSEL, its driver circuit and parasitics is required for successful connectivity and transceiver product lines. The availability of required physical parameters is a challenge. Measured driver outputs and temperature-sensitive behavior often need to be used for predictive fitting.

The Solution

RSoft™ OptSim™ provides an excellent platform for prototyping various "what-if" scenarios, including an industry-preferred powerful model of a VCSEL. In addition to the laser rate equations, phase rate equation, mode-carrier overlap, thermally dependent gain, thermal carrier leakage, spatial hole burning, lateral carrier diffusion, temperature rate equation and polarization are taken into account for accurately modeling the VCSEL[1]. Realistic options for modeling VCSEL's electrical drive and packaging parasitics are available.

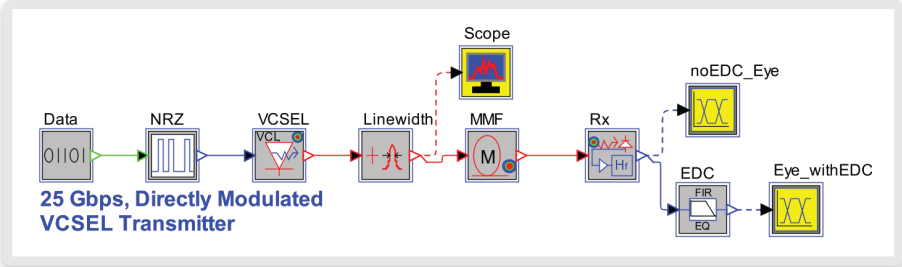

Figure 1. Layout of a high-speed modulation of VCSEL

The Result

Dotted (experimental) and solid (OptSim simulation) plots in Figure 2 show excellent agreement between measured characteristics and modeling. The VCSEL under test (Figure 1) is successfully driven by 25G data in a high-speed interconnect as evident from eye diagrams before (Figure 3a) and after (Figure 3b) electronic dispersion compensation (EDC).

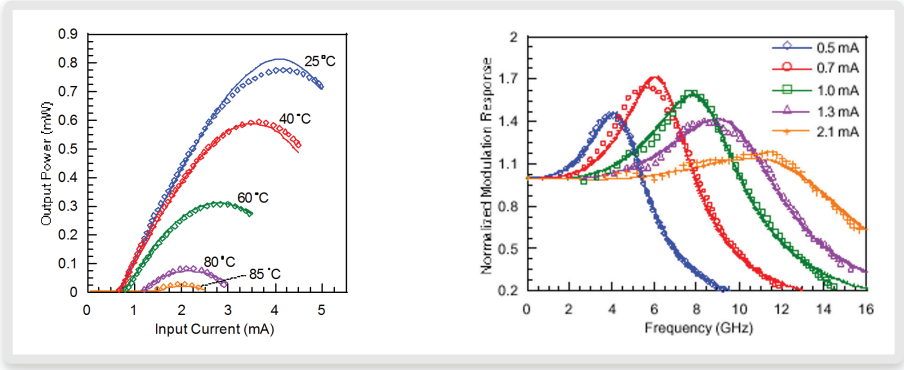

Figure 2. Comparison of simulation results (solid lines) vs. actual measurements (dotted lines)

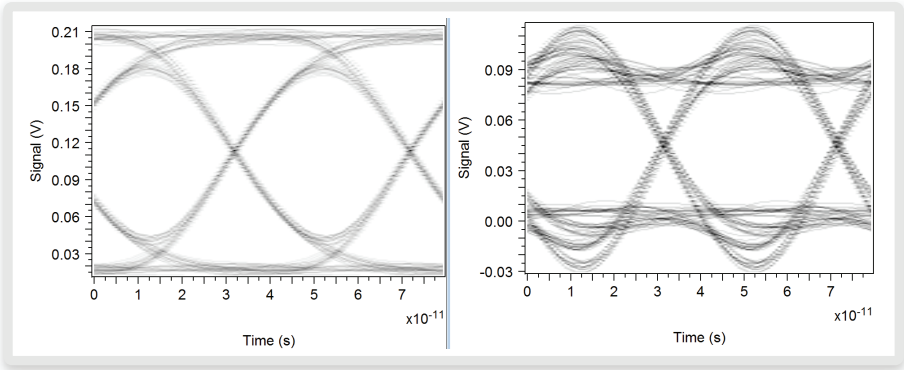

Figure 3a. Eye diagram before the EDC **Figure 3b. Eye diagram after the EDC**

[1]P. Mena, J. Morikuni, S. Kang, A. Harton, and K. Wyatt, "A comprehensive circuit-level model of vertical-cavity surface-emitting lasers", Journal of Lightwave Technology, vol. 17, no. 12, pp. 2612-2632, December 1999.

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