

Report: Optical Module and Optical Connector - 1

High-speed InP Mach-Zehnder Modulator Module using LCP Transmission Line

A flexible liquid crystal polymer (LCP) transmission circuit with excellent high frequency performance was applied to a high-speed optical modulator module. We confirmed the error-free operation of an 80 Gbit/s NRZ signal using the InP-based Mach-Zehnder modulator (MZM) module.

In order to handle the explosive growth in network traffic, we need to build large-capacity transmission systems. Single wavelength, serial 100 Gbit/s on-off keying (OOK) transmission is one approach to the construction of simple component devices. Such a system requires high-speed optical modulators and receivers. We need packaging with a low RF loss to make high-speed optical devices.

Liquid crystal polymer (LCP) is an attractive material for high-speed transmission lines. It has good electrical properties up to millimeter-wave frequencies due to its low and stable dielectric constant ($\epsilon_r = 4.0$). The signal line width of the LCP circuit is wider than that of a ceramic circuit because of its low dielectric constant, which provides a low RF loss, low crosstalk and ease of assembly. Moreover, the physical flexibility of the LCP sheet makes assembly more flexible.

We developed a high-speed optical modulator for 100 Gbit/s systems that uses LCP transmission line.

Figure 1 shows the schematic structure of the InP MZM module. The coaxial connectors are connected to the MZM chip by a single LCP transmission line. Normally a ceramic transmission line must divide the substrate when there is a height difference between the chip carrier and the package connector. However, a flexible LCP transmission line can overcome this height difference problem. By eliminating the need for a wire connection between the transmission lines, the reflection point of the RF signal can be eliminated, and the RF excess loss can be decreased.

Figure 2b shows the 80 Gbit/s electrical eye diagrams, and Fig. 2c shows the optical eye diagrams that we obtained from the MZM module. The amplitude of the driving voltages applied to the dual ports of the modulator was $2.4 V_{pp}$. The dynamic extinction ratio of the optical eye diagram was 9 dB. We also confirmed error-free operation for a back-to-back transmission with an 80 Gbit/s NRZ signal as shown in Fig. 2a.

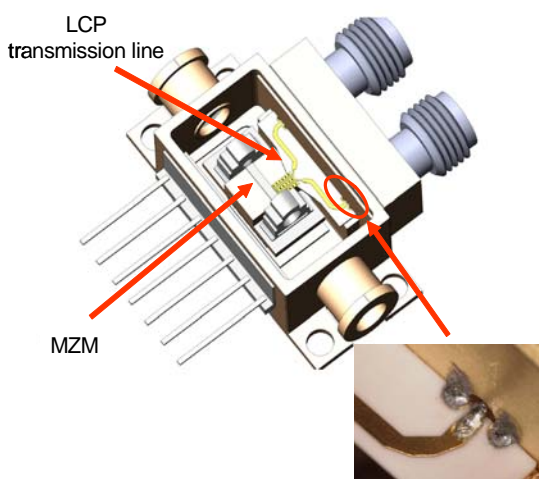


Fig.1 Schematic structure of an MZM module with an LCP transmission line.

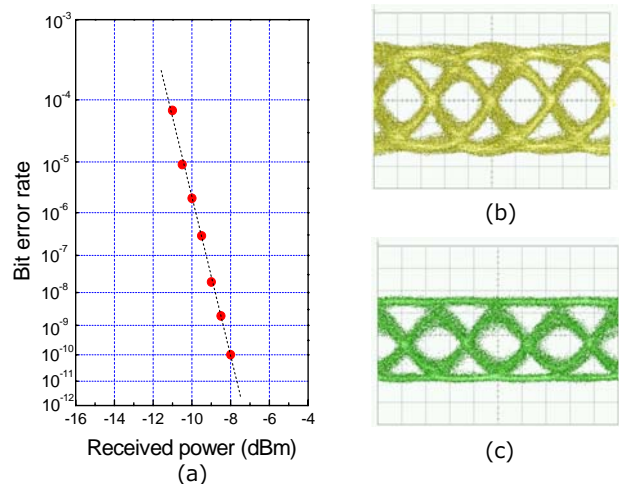


Fig.2 (a) 80 Gbit/s bit error rate versus received power. (b) Driver amplifier outputs for differential signal. (c) Intensity modulated optical signal.