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Mitsubishi Electric Develops World's First Monolithically Integrated Laser Diode for 43Gbps RZ-DQPSK Transmission

Tokyo, March 3, 2011 – Mitsubishi Electric Corporation (TOKYO: 6503) announced today that it has developed a world’s first fully monolithically integrated laser diode for use in transmission devices that transmits large data volumes between metropolitan areas at 43 giga-bits per second (Gbps) in a method called Return to Zero Differential Quadrature Phase Shift Keying (RZ-DQPSK). Consisting of a tunable laser array, an RZ Mach-Zehnder modulator and a DQPSK Mach-Zehnder modulator, this new laser diode achieves tuning control over the range of 95 channels at 40 nm in standard set by the 50-GHz International Telecommunication Union Telecommunication Standardization Sector (ITU-T). This breakthrough will be presented at the Optical Fiber Communication Conference 2011 (OFC 2011) scheduled to be held at the Los Angeles Convention Center in Los Angeles, CA on March 6~10, 2011.

Key Accomplishments

1. Monolithic integration on a single chip consisting of a tunable laser array, a Mach-Zehnder intensity modulator and a Mach-Zehnder phase modulator
   - Three functional chips are monolithically integrated into one, an industry first
     (1) A tunable laser array whose wavelength can be controlled between 1572 nm and 1612 nm
     (2) RZ Mach-Zehnder modulator which modulates the intensity of output power
     (3) DQPSK Mach-Zehnder modulator which modulates signal phase
   - The chip's dimensions are 9.6 x 0.75mm, less than one hundredth of the size of conventional chips
   - The module’s volume, including the chip, can be minimized to less than one third of the size of conventional modules

2. Realization of 43Gbps DQPSK operation and densely divided wavelength control for long distance and high bit rate transmission
   - The chip covers 95 channels of the 50 GHz ITU-T grid in L-band from 1572nm to 1612nm
Future Development
In the future, Mitsubishi Electric plans to enhance the performance of high power, low consumption and clear optical waveforms. The company also plans to develop a light source for C-band from 1530 nm to 1570 nm.

Background
Transmission volume over optical communication networks is rapidly increasing. The densely spaced wavelength division multiplexed channels, higher bit rate transmission and multi-level formats such as DQPSK are in demand for long distance transmission. Previously, it was common for transmission device manufacturers to use several different chips such as the LiNbO3 Mach-Zehnder modulators and the tunable lasers. However, the device size is several centimeters or more in length and requires relatively large driving power. The fully monolithic integration and InP-based modulator effectively minimize device size and power consumption. Mitsubishi Electric developed for the first time a 40G RZ-DQPSK transmitter monolithically integrated with a tunable Distributed Feed-Back (DFB) laser array and Mach-Zehnder modulators.

Features
1. Monolithic integration on a single chip consisting of a tunable laser array, a Mach-Zehnder intensity modulator and a Mach-Zehnder phase modulator
The structure of a 43G RZ-DQPSK transmitter monolithically integrated with a tunable DFB laser array and Mach-Zehnder modulators is shown in Figure 1.

Figure 1: Design of RZ-DQPSK transmitter
2. The chip covers 95 channels of the 50 GHz ITU-T grid in L-band between 1572 nm and 1612 nm

A tunable laser array consists of 12 DFB lasers whose wavelengths are set at intervals of about 3.7 nm. 95 channels of the 50-GHz ITU-T grid in L-band can be achieved by controlling the temperature of the chip between 25 and 65 degrees Celsius.

![Optical spectrum of all generated channels](image)

Figure 2: Optical spectrum of all generated channels

3. Excellent extinction characteristics were realized

A high extinction ratio of 27dB and low driving voltage were realized.

![Optical transmissions vs the applied dc voltage](image)

Figure 3: Optical transmissions vs the applied dc voltage

About Mitsubishi Electric

With over 90 years of experience in providing reliable, high-quality products to both corporate clients and general consumers all over the world, Mitsubishi Electric Corporation (TOKYO: 6503) is a recognized world leader in the manufacture, marketing and sales of electrical and electronic equipment used in information processing and communications, space development and satellite communications, consumer electronics, industrial technology, energy, transportation and building equipment. The company recorded consolidated group sales of 3,353.2 billion yen (US$ 36.1 billion*) in the fiscal year ended March 31, 2010. For more information visit: [http://www.MitsubishiElectric.com](http://www.MitsubishiElectric.com)

*At an exchange rate of 93 yen to the US dollar, the rate given by the Tokyo Foreign Exchange Market on March 31, 2010

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