# Tunable DPSK Wavelength Converter Using an SOA-MZI Monolithically Integrated with a Sampled-Grating Distributed Bragg Reflector


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Wavelength converters play an important role in wavelength routed optical networks. Among these, an SOA-MZI based wavelength converter monolithically integrated with a tunable sampled-grating distributed Bragg reflector (SG-DBR) laser has been previously demonstrated [1] for amplitude shifted keying (ASK) signals. The integration of a tunable laser with the SOA-MZI enhances the reliability, the efficiency and the performance of the wavelength conversion process. Recently, the differential phase shift keying (DPSK) data format has received much attention owing to its higher immunity to optical nonlinearities in fiber transmission. In this work, we demonstrate 10-Gb/s DPSK wavelength conversion using a tunable SG-DBR laser-integrated SOA-MZI wavelength converter.

Figure 1(a) shows the experimental setup. A 10-Gb/s RZ-DPSK signal is generated through pulse carving and phase modulation of a CW laser at 1557.13 nm with a $2^{31}$-1 pseudorandom binary sequence. The DPSK signal is decoded using a one bit period (100-ps) delay interferometer. Complementary ASK signals (ASK and $\overline{\text{ASK}}$) are obtained at the two output ports of the decoder, and are launched respectively to the upper and lower arms of the SOA-MZI for wavelength conversion. Tunable delay lines are used in the setup to align the two complementary input signals in the time domain. Cross-phase modulation between the input signals and the integrated SG-DBR probe laser occurs within the two SOAs in the upper and lower arms of the MZI. The two modulated branches are combined to form the SOA-MZI output, and a tunable bandpass filter at the output of the device is then used to extract the wavelength converted signal. A phase shifter is integrated in the lower MZI arm and the phase is adjusted such that a 10-GHz pulse train is obtained at the output before decoding. After decoding, the wavelength converted signal shows the expected bit pattern resulting from the differential phase. Eye diagrams of the input DPSK signal and the wavelength converted DPSK signal are shown in Fig. 1(b)(i) and (ii), respectively. To check the accuracy of the conversion process, a differentially encoded pattern of "10011100" instead of a pseudorandom sequence is used for the phase modulation. After the DPSK decoder, a bit pattern of "10100101"is obtained as shown in Fig. 1(c)(i). The expected decoded pattern after wavelength conversion is "11101110" and it agrees well with the experimental output shown in Fig. 1(c)(ii). Since the coding scheme is changed during the wavelength conversion process, a differential encoder can be used to convert the bits back to those of the input signal. The integrated SG-DBR probe laser is tunable from 1543.38 nm to 1575.63 nm by changing the injected current in the grating mirror. Across the tuning range, we observe similar wavelength conversion results at different probe wavelengths.

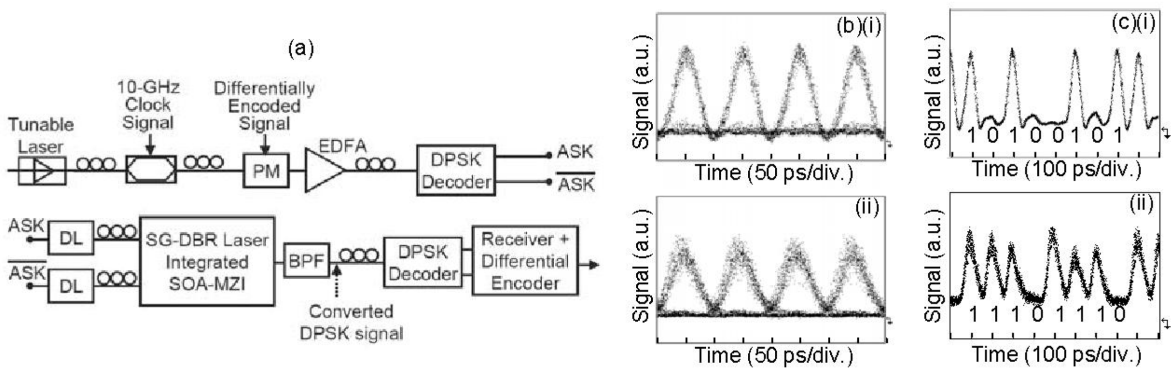


Fig. 1. (a) Experimental setup for DPSK signal wavelength conversion (b) Eye diagram (i) decoded input signal (ii) decoded converted signal (c) Bit pattern (i) input signal (ii) converted signal.

## References


[1] Milan L. Mašanović, Vikrant Lal, Joseph A. Summers, Jonathon S. Barton, Erik J. Skogen, Larry A. Coldren, and Daniel J. Blumenthal, "Design and performance of a monolithically integrated widely tunable all-optical wavelength converter with independent phase control, " IEEE Photon. Technol. Lett., vol. 16, pp. 2299 – 2301 (2004).