

Synchronous Demodulation of Optical Phase Shift Keying in Coherent Systems with DFB Lasers

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Abstract: An I&Q digital coherent receiver with feedforward carrier recovery and clock recovery has been realized. QPSK data, currently 1.6 Gb/s over 63 km, is transmitted in real-time with FEC-compatible BER using standard commercial DFB lasers.

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1. Introduction

The need to better utilize the available bandwidth and to cope with chromatic and polarization mode dispersion of existing optical fiber has revived the interest in coherent optical transmission, in particular synchronous QPSK transmission with polarization division multiplex for quadrupled spectral efficiency and ultimate OSNR performance. A feedforward carrier recovery scheme [1] tolerates a sum linewidth of $\sim 0.001 \times$ symbol rate, which is in the reach of normal DFB lasers at 10 Gbaud. Such schemes have been verified offline, using oscilloscope-sampled 10 Gbaud QPSK data from coherent systems [2,3], and online (in real-time) at 400 Mbaud [4].

2. Synchronous 2×800 Mb/s QPSK transmission system

2×800 Mb/s PRBS data is impressed onto a DFB laser signal in a QPSK modulator (Fig. 1), and transmitted over 63 km of standard SMF. After optical preamplification, a local laser signal is superimposed to the received one in an optical 90° hybrid (CeLight Israel Ltd.). The sum linewidth is ~ 4 MHz. After differential photodetection, the resulting electrical I&Q signals are sampled at 800 MHz in 5-bit analog-digital converters. Clock recovery is made possible by a spare ADC (not shown) and a correlation technique. The ADCs interface with a Xilinx Virtex 2 FPGA where electronic clock, carrier and data recovery as well as automatic LO frequency control are implemented [1]. Fig. 2 shows current BER performance, clearly within FEC limits. The BER floor, currently $2.7 \cdot 10^{-4}$, should be negligible at 10 Gbaud, and polarization division multiplex would improve the situation further.

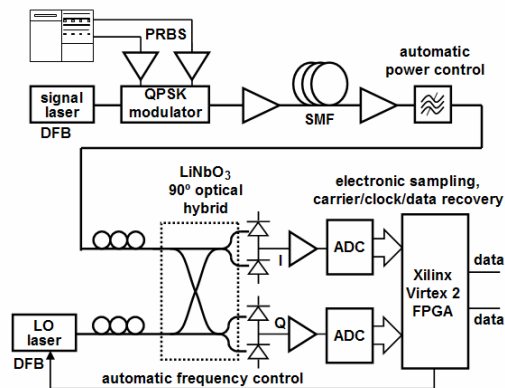


Fig. 1. Real-time QPSK transmission using DFB lasers.

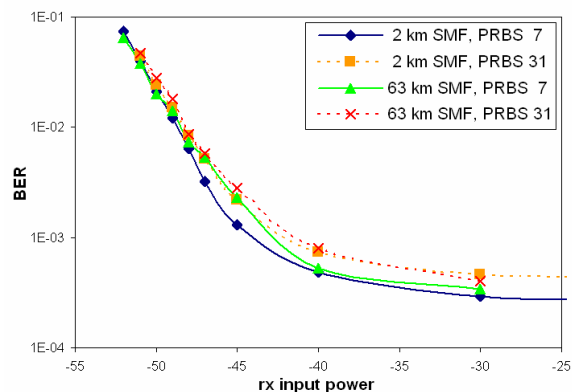


Fig. 2. BER vs. preamplifier input power

3. References

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