EFFICIENT BANDWIDTH MEASUREMENTS OF FIBER BRAGG GRATINGS FOR NEXT-GENERATION OPTICAL ACCESS

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The research is performed in field of fiber optic (FO) dense wavelength division multiplexing (DWDM)-direct transmission systems for broadband access. DWDM-direct is a concept in which multiple wavelengths are directly connected to each optical network unit (ONU) in access network. The main idea of our investigation is to determine efficient bandwidth of fiber Bragg grating (FBG) device with 100 GHz full width half maximum (FWHM) bandwidth. Efficient bandwidth of passive device provides limitations which are required to take into consideration for realization of DWDM-direct transmission system for broadband access. Measurement scheme was realized to investigate FBG with 100 GHz FWHM bandwidth (see Fig. 1) with 2.5 Gbit/s optical signal.

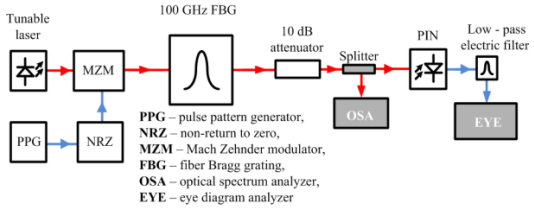

Fig.1. FBG device efficient bandwidth measurement scheme

The transmitter consists of pseudo-random data generator, non-return to zero (NRZ) code former, continuous wavelength (CW) laser source and $LiNbO_3$-based external Mach Zehnder modulator (MZM). The data source produces the information to transmit via device under test (DUT). Then a code former is used to form NRZ code from incoming bit sequence. The optical pulses are obtained by modulating CW laser irradiation in MZM. Then formed optical pulses are sent directly to a DUT at different CW laser central wavelength offset values within the pass-band of FBG device. Receiver block consists of optical attenuator, PIN photodiode and Bessel – Thomson electrical filter. Attenuator with 10 dB rated value was used to simulate loss of 20 km optical fiber, splicing and connectors in direct access systems.

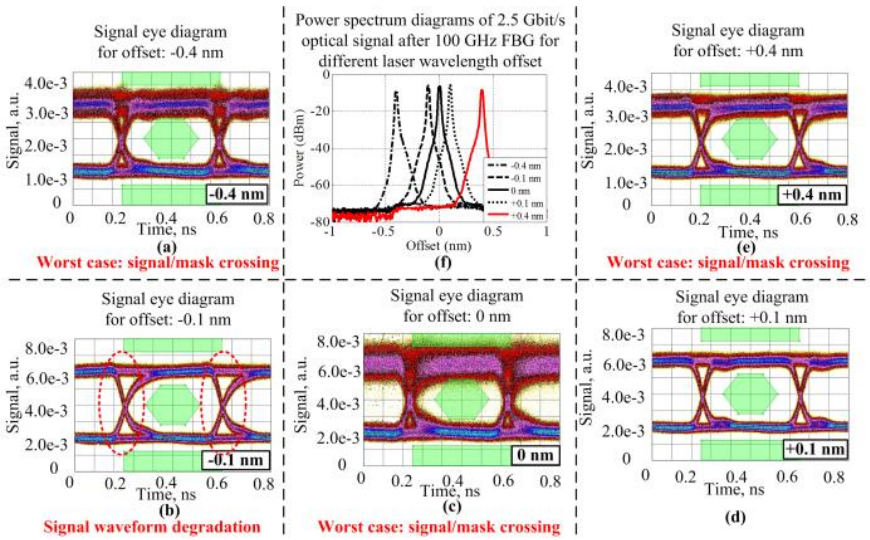

Fig.2. Eye diagrams (a-e) and optical power spectral densities (f) of 2.5 Gbit/s optical signal after 100 GHz FBG for different CW laser wavelength offset values shown in inset.

Fig. 2 shows 2.5 Gbit/s optical signals after 100 GHz FBG for different laser central wavelength offset values (-0.4 nm, -0.1 nm, 0 nm, 0.1 nm, 0.4 nm). Offset value was changed within FBG device pass-band with 0.1 nm step. This value was chosen to fit DWDM systems wavelength grid defined in ITU-T G.694.1 recommendation. On Fig.5.a,c,e are shown eye diagrams for -0.4 nm, 0 nm and +0.4 nm offset values and there are mask and signal crossing (defined bit error rate value is exceeded). From these results 100 GHz FBG efficient bandwidth is 0.4 nm or 50 GHz and is divided in to two 0.2 nm or 25 GHz pass-bands each due to enormous phase distortions of filter's complex transfer function.

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Key words: Fiber optics, wavelength division multiplexing, fiber Bragg gratings.