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Performance Evaluation of Wideband Semiconductor Optical Amplifier

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Abstract:-. In this paper, we investigate and evaluate the Semiconductor Optical Amplifier (SOA) performance as a function of the intrinsic and extrinsic parameters. We build a model in the optisystem (tool)than set the intrinsic and extrinsic parameters and evaluate the performance .
KEYWORDS:- WDM, SOA, XGM, FWM, XPM

I. INTRODUCTION

All optical wavelength converters are expected to become key component in the future broadband networks. Their most important use will be for avoidance of wavelength blocking in optical cross connects in wavelength division multiplexed (WDM) networks [1-4].Thereby the converters increase the flexibility and the capacity of the network for a fixed set of wavelength [5-6].Equally important, the wavelength conversion function enables decentralized network management concerning the wavelength paths through the network and may facilitate easier protection switching [8-9].The potential of wavelength converters has already been demonstrated in a number of system experiments.

Efficient optical space switches can also be constructed using tunable wavelength converters together with an array of fixed output filters. This application of converters has been employed for internal routing in a complex 2.5 Gbps optical ATM switch block experiment [11].Wavelength conversion is a very useful function in a advanced optical systems. The requirements to the converters will be system dependent, but preferably the converters should have following features:-

A. Bit-rate transparency (up to at least 10Gbps).
B. 1/0 extinction ratio degradation.
C. High signal-to-noise ratio at the output.
D. Moderate input power levels (-0dBm).
E. Large wavelength span for both input and output signals.
F. Possibility for same input and output wavelengths (no conversion).
G. Low chirp.
H. Fast setup time of output wavelength.
I. Insensitivity to input signal polarization.
J. Simple implementation.

Several techniques have been proposed to achieve wavelength conversion. The straight forward solution is an electro optic converter consisting of a detector followed by a laser that retransmits the incoming signal on the new wavelength. Disadvantages of the electro optic converter such as complexity and large power consumption have, however, directed the interest to all optical wavelength converters. They enable direct translation of the information on the incoming wavelength to a new wavelength without entering the electrical domain. Examples of all optical wavelength converters are: Semiconductor optical amplifier (SOA's) used in the cross gain modulation (XGM) mode [12-13] or the cross phase modulation (XPM) mode[1]. SOA's using four wave mixing (FWM) [2-6], bistable lasers incorporating saturable absorber [6-8], and injection locked Y-lasers [9-10], and DBR lasers relying on optical frequency or intensity modulation [11-13].Wavelength conversion based on four-wave-mixing in optical fibers [14] and quasi phase matching in LiNbO3 waveguides [15], but semiconductor based converters generally appear to be most efficient SOA converters using the XGM and XPM conversion seems to be well suited for system use.

II. WAVELENGTH CONVERTER BASED ON XGM EFFECT IN A SOA STRUCTURE

Gain saturation of the SOA structure induces nonlinear polarization rotation that can be used to realize wavelength converters [8]. Depending on the system configuration, inverted and non-inverted polarity output can be achieved. Recently, a remarkable wavelength conversion at 40 Gb/s with multi-casting functionality based on nonlinear polarization rotation has been demonstrated [4].In order to evaluate the impact of polarization rotation on the performance of wavelength conversion based on XGM .

Description	Value
Bias current	400 mA
ut coupling loss	3 dB
Output coupling loss	3 dB
Input facet reflectivity	5e-005
Output facet reflectivity	5e-005
Active layer length	600 µm
Optical confinement factor	40%
Nonradioactive recombination coefficient	360 000 000 1/s
Bimolecular recombination coefficient	5.6e-016 m^3/s
Auger recombination coefficient	3e-041 m^6/s
Group velocity	75 000 000 m/s
Effective mass of electron in the CB	4.1e-032 Kg
Effective mass of a heavy hole in the VB	4.19e-031 Kg
Effective mass of a light hole in the VB	5.06e-032 Kg
Linear radiative recombination coefficient	10000000 1/s
Active refractive index	3.7

we present in this section the concept of this nonlinear effect and the SOA configuration used as wave- length converter whose simulation results will be discussed in the next section.

III. PROPOSED WAVELENGTH CONVERSION SCHEME

In the simulation of the proposed wavelength converter based on XGM effect in a wideband traveling wave SOA, we used available OptiSystem software. The physical features of the InP/GaInAsP SOA structure are listed in Table **1**. While, the transmitter power P_1=10 dBm at wavelength $\lambda 1$= 1553 nm and the CW laser power P_2 ranges from -40 to 20 dBm at wavelength $\lambda 2$ =1551 nm.

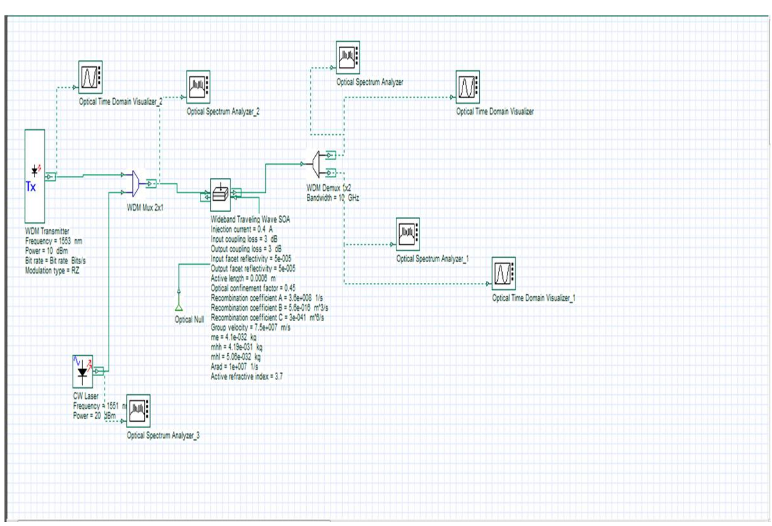

Fig: 1.0 SOA (intrinsic an extrinsic) parameters used in simulation

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IV. SIMULATION RESULTS AND DISSCUSSION

An input signal obtained from the WDM transmitter having the transmitter power P_1=10 dBm at wavelength λ_1= 1553 nm and a signal is obtained by the CW laser power P_2=20 dBm at wavelength λ_2 =1551 nm. These two signals are multiplexed and goes to the wideband TW-SOA .We can use two type signals RZ and NRZ at WDM transmitter end.

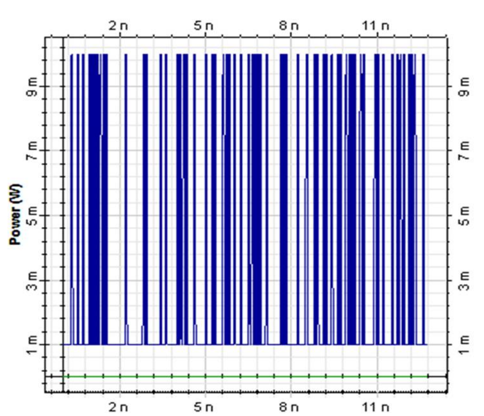

Fig: 1.1. RZ format

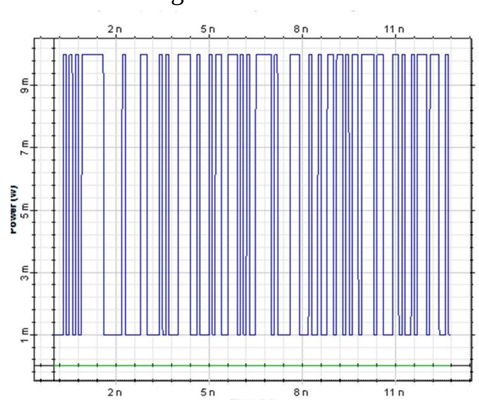

Fig: 1.3. NRZ format

But we use RZ format for at the WDM transmitter end. The power of the signal is 10dbm and wavelength is 1553nm and the CW laser power P_2=20 dBm at wavelength λ_2 =1551 nm .At the output end we use a WDM demultiplexer to obtain the output signal. We simulate the model with intrinsic and extrinsic parameters and get the simulation results. At the output, we get two output signals OS1 and OS2.

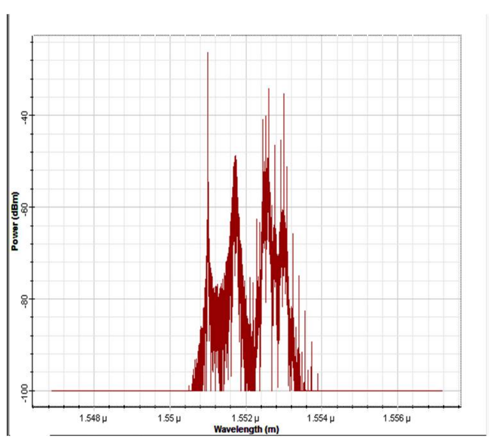

Fig: 1.2. Output after the multiplexing of two signals

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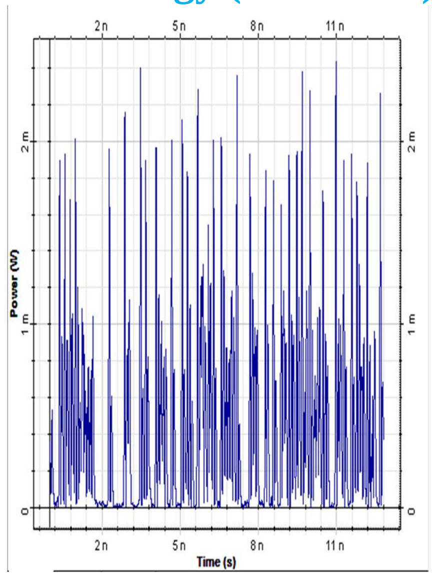

Fig: 1.4. OS1 (Output signal 1 with optical confinement factor 40%)

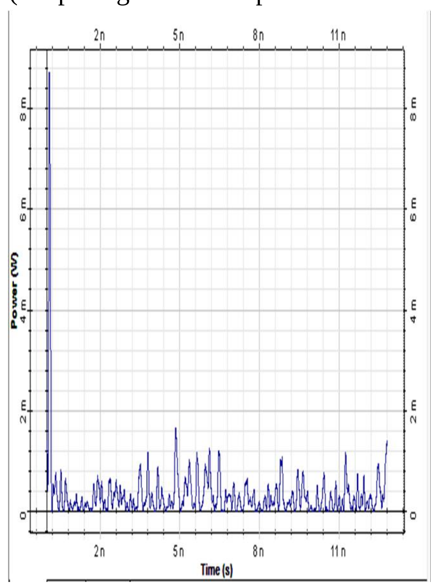

Fig: 1.5. OS2 (Output signal2 with optical confinement factor 40%)

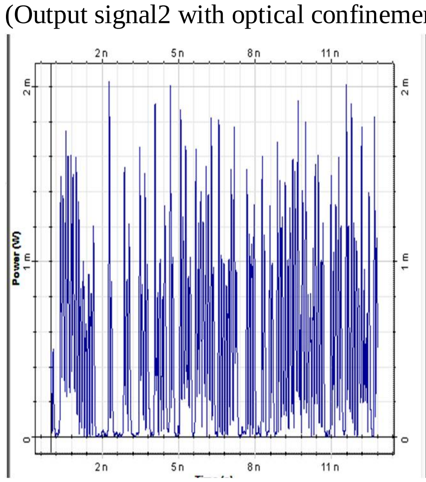

Fig: 1.7. OS1 (Output signal1 with optical confinement factor 50%)

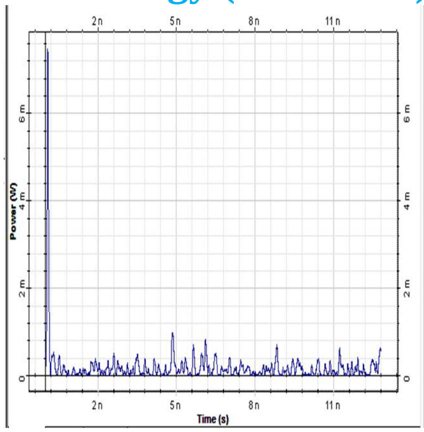

Fig: 1.6. OS2 (Output signal2 with optical confinement factor 50%)

V. CONCLUSION

We focused on the impact of noise on the performance of wavelength converter SOA structure. Noise figure decreases by using SOA having high optical confinement factor. RZ signal format with high optical confinement factor is useful in practical operation for assuring better operating condition of the XGM wavelength converter.

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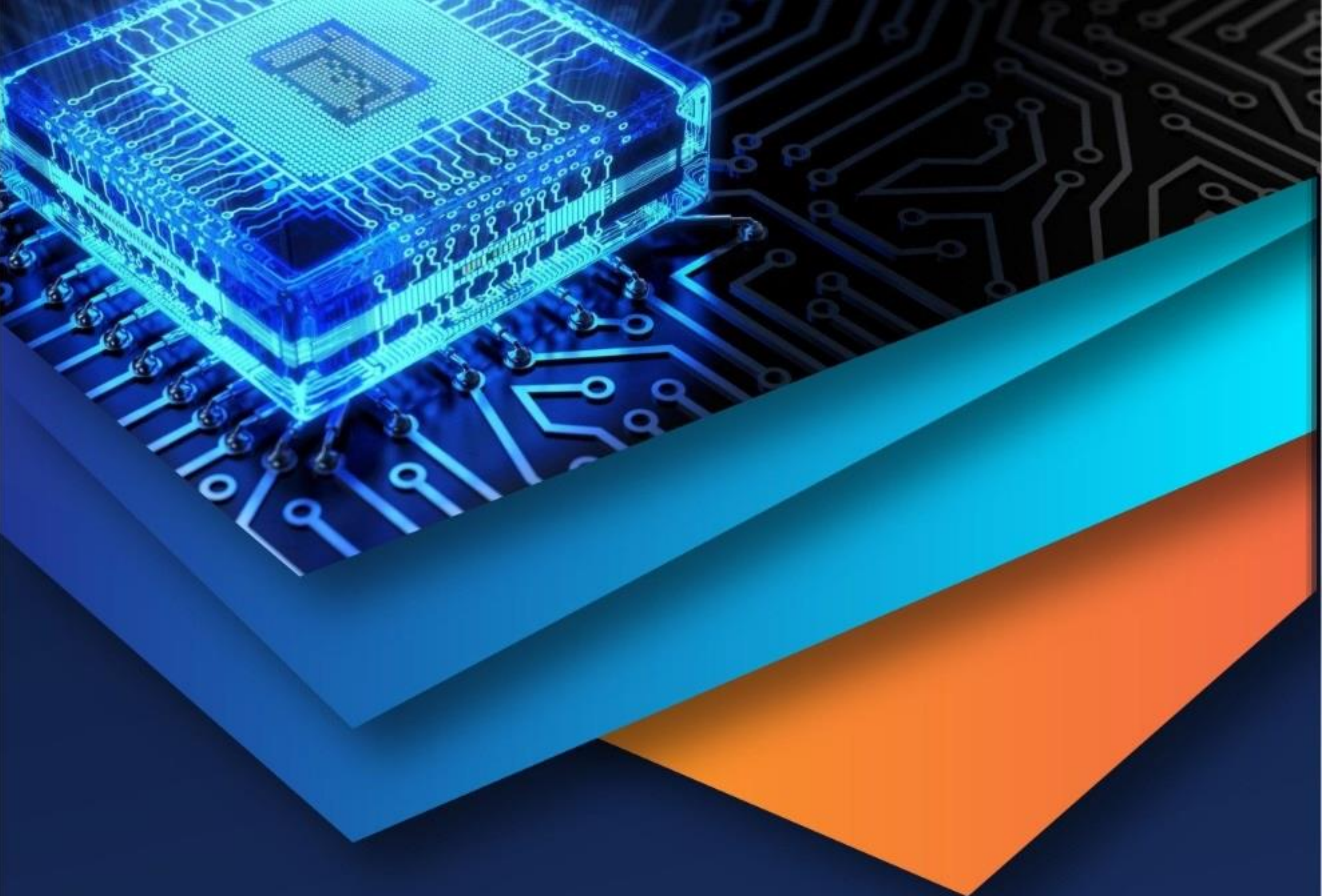

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