JOURNAL OF CRITICAL REVIEWS

ISSN- 2394-5125 VOL 7, ISSUE 04, 2020

STUDY ON DESIGNING OF FEASIBILITY OF SEMICONDUCTOR OPTICAL AMPLIFIER DEVELOPMENT ON HYBRID LOGIC CIRCUITS (SOA-HLC)

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Received: 11.01.2020 Revised: 25.02.2020 Accepted: 04.03.2020

ABSTRACT: To start with, hybrid circuits to perform logic operations such as NOR and EX-OR are acknowledged and their usefulness have been exhibited via doing experimental work on bread board utilizing discrete parts. These essential hybrid logic squares have been utilized in building progressive hybrid circuits, as the information and yield logic levels are the equivalent. The standard utilization of the cross-gain modulation in SOA is as an intensity-regulated input signal that balances the addition in the SOA by means of increase immersion impact. A consistent wave signal at the chose yield wavelength is balanced by the increase variety. After the SOA, the persistent wave signal conveys a similar information as the intensity modulated signal. The input signal and the CW sign can be propelled either co-directionally or counter-directionally into the SOA. This paper studies another part of hybrid optic-electric logic circuits using semiconductor optical amplifier (SOA) with wavelength convertor methodology.

KEYWORDS: SOA, Logic Gates, Hybrid logic gates, wavelength convertor, XGM and Modulation.

 DOI: http://dx.doi.org/10.31838/jcr.07.04.305

I. INTRODUCTION

A SOA is an optoelectronic gadget that under reasonable working conditions can intensify an input light signal. A schematic diagram of an SOA is shown in Figure.1. The active region in the device confers increase to an input signal. An external electric flow gives the vitality source that empowers increase to occur. An installed waveguide is utilized to keep the spreading signal wave to the dynamic locale. In any case, the optical control is powerless so a portion of the signal will spill into the encompassing loss cladding locales. The output signal is joined by commotion. This added substance commotion is delivered by the intensification procedure itself and so can't be totally maintained a strategic distance from. The amplifier aspects are intelligent causing swells in the addition range. In a SOA electrons (more regularly alluded to as transporters) are infused from an external current source into the dynamic locale. An all optical wavelength converter is a gadget that moves information starting with one wavelength then onto the next without entering the electrical area. A straightforward procedure for the acknowledgment of this capacity is the utilization of cross gain modulation (XGM) in semiconductor optical amplifiers (SOA's).The XGM impact comprises on the variety of the SOA gain in capacity of the input power. The expansion of the intensity of the input signal causes in the SOA an exhaustion of the bearer thickness, and therefore the enhancement gain is decreased. The dynamic procedures that happen in the transporter thickness of the SOA are extremely quick, of the order of picoseconds, so it is conceivable to utilize this variety on the addition with bit to bit changes of the input power.

Typically, light doesn't have one specific optical frequency; its optical force is appropriated over some frequency extend, which in some cases spends an entire octave (i.e., a factor of two as far as frequency) or even significantly more. The optical range reveals to one how the force is disseminated over the frequencies, i.e., it determines the force unearthly thickness as a component of frequency or vacuum wavelength. There are specialized light sources (highly balanced out lasers) which can deliver light with a little optical bandwidth – here and there even well below 1 Hz, which is an extremely little part of the mean optical frequency of several terahertz. Such light sources are called optical frequency standards and are required for optical tickers, for

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example. The optical frequency can be determined as the vacuum speed of light isolated by the vacuum wavelength: $\nu = c / \lambda$. In any case, optical frequencies can be estimated unmistakably more absolutely than wavelengths; see the article on optical frequency metrology. Optical frequencies can't be legitimately recognized like microwave frequencies; there is just no counter which can enrol so quick motions. By the by, with aberrant strategies, these days for the most part including settled frequency brushes, it has gotten conceivable to exactly relate optical frequencies (from some optical frequency standards] to microwave frequencies. [(from cesium timekeepers), or to other optical frequencies. As optical frequency standards can be more exact than microwave frequency standards and additionally allow for considerably more quick frequency correlations, it is expected that the meaning of the second is the key unit for the time in the worldwide arrangement of SI units will before long be reclassified dependent on an optical frequency standard. A logic level is characterized as a particular state or voltage of a signal. We realize that 0 and 1 are the two conditions of logic gates. The logic levels 0 and 1 are known as LOW and HIGH separately. In computerized electronics, these paired logic levels assume a critical job in information storage, information move. By and large these logic levels can be understand as ON and OFF states. As we said before, the logic levels are acquainted with the logic gate by the gracefully voltage. In the event that the gracefully voltage to the logic gate is 0 volts, it alludes to Low logic level or OFF state. Also, if the gracefully voltage to the logic gate is 5 volts or 3.3 volts (for current ICs), it alludes to High logic level or ON state. The producers will follow the TTL or Transistor – Transistor Logic as standard voltage level, while planning the ICs.

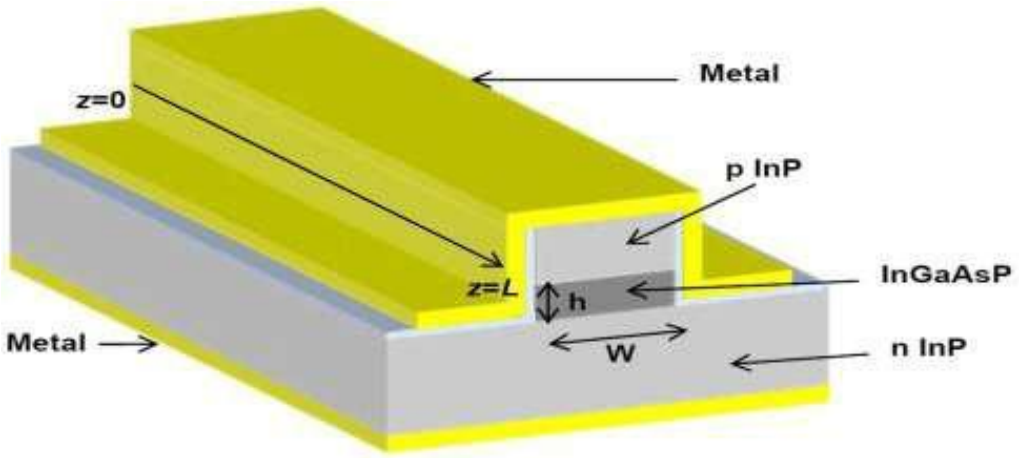

Figure 1: Semiconductor Optical Amplifier

II. LITERATURE REVIEW

Paolo Minzioni (2019) explained the capacity to process optical signals without going into the electrical area has consistently pulled in the consideration of the exploration network. Preparing photons by photons unfurls new situations, on a fundamental level allowing for concealed signal handling and processing abilities.

Optical calculation can be viewed as a huge logical field where analysts work, attempting to discover answers for their particular needs by various methodologies; in spite of the fact that the difficulties can be generously unique, they are normally tended to utilizing information and technological platforms that are shared over the entire field. This critical ability can likewise profit other mainstream researchers, giving parallel answers for their issues, just as prompting novel applications.

The point of this Roadmap is to give an expansive perspective on the cutting edge in this energetic logical exploration field and to examine the advances required to handle developing difficulties, because of commitments authored by experts partnered to both scholarly foundations and high-tech enterprises.

The Roadmap is organized in order to put next to each other commitments on various parts of optical preparing, meaning to upgrade the cross-defilement of thoughts between researchers working in three distinct fields of photonics: optical gates and logical units, high piece rate signal handling and optical quantum processing.

Pallavi Singh (2014) paper audits the current status and structures of every optical gate. Different plans with and without semiconductor optical amplifiers are examined and analysed. The optical gates are ordered according to their plan structures.

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It is separated into two major divisions that is, non-semiconductor optical amplifier based gates and semiconductor optical amplifier based gates.

In non-semiconductor optical amplifier based gates, various plans have been proposed to make non-linearity which is talked about. The semiconductor optical amplifier based gates of various plan structures are talked about to show the test beat that is modulated in various manners to get results.

III.PROPOSED METHODOLOGY

Again the gates are partitioned according to the interferometer methods, for example, ultra-high nonlinear interferometer (UNI), sagnac interferometer (SI), Michelson interferometer (MI), Mach-Zehnder interferometer (MZI), and postpone interferometer (DI) to actualize the nonlinearity in SOA. In the following areas the nonlinearity of SOA might be utilized in a few different ways.

Diverse structure structures and categories of SOA-based every single optical gate have been investigated in this area. SOA is a little size nonlinear amplifier that offers points of interest to be integrated to deliver an ensuing framework basic in optical correspondence framework. The SOAs exhibit low force utilization and their single mode waveguide structures make them especially suitable for use with single mode fibre. At present, SOA is the most evolved optical amplifier that gains a quick ground towards optical signal handling.

The nonlinearity impact in SOA makes it a promising module for optical logic gates. The three nonlinearity impacts that is cross gain modulation (XGM), cross stage modulation (XPM), and four wave blending (FWM) make it conceivable to utilize it as nonlinear transport for gates. In XGM information beats at one wavelength, balances the transporter thickness and simultaneously results as a gain variety space in transformed duplicate of the clock beat infused into the SOA as appeared in Figure 9(a). Because of the modulation of a bearer thickness there is a gain pressure in the siphon signal that creates a trilling of the changed over signal.

The SOA is worked under the high optical intensity to decrease the gain recuperation time. The issue identified with XGM is at longer wavelength extinction proportion punishment related with it. This marvel can be effectively suited at high piece rate.

The tweet of the changed over signal is utilized as a bit of leeway by including the SOA in an interferometer setup that changes over this XPM into an intensity modulation. This can be done by SOA, incorporated with interferometer setup. To acquire a total extinction in an interferometer a stage shift of is required. Which can be accomplished with gain pressure in SOA.

The stage shift is free of wavelength, so the change to a more extended wavelength has no issue with XPM. The drawback of an interferometer structure is that if the stage shift increments more than, it weakens the extinction proportion which may be constrained by changing the inclination state of SOA. The interferometer setup might be characterized in two different ways, co-propagation and counter propagation.

In co-propagation, channel is required in light of the fact that siphon and test travel in the same heading to channel the test signal with siphon. Be that as it may, in counter propagation both travel in inverse ways, so the channel isn't required.

NOR Gate

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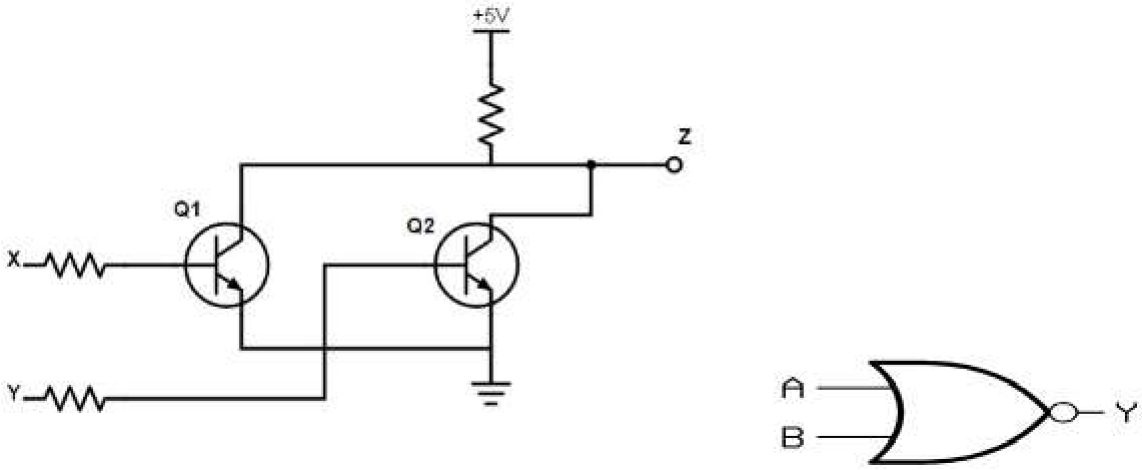

Figure 2: NOR Circuit & NOR Diagram

XOR Gate

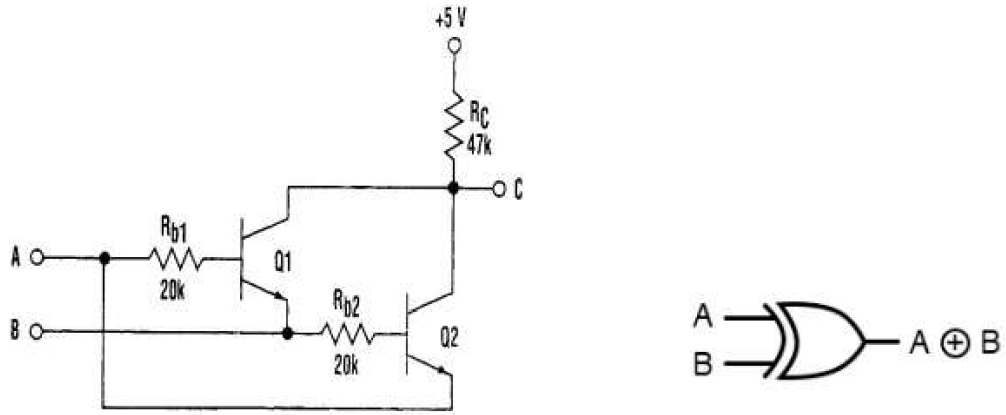

Figure 3: XOR Circuit & XOR Diagram

Optical amplifiers are every now and again utilized parts for wavelength division multiplex frameworks. Conversely with repeaters, they empower restoration of the light flow in the fibre without the need of transformation into electrical form. They are general segments intensifying simple and numeric signs at any self-assertive exchange speed [13]. Right now there are optical SOA semiconductor amplifiers, EDFA fibre amplifiers, and amplifiers in the bases of the Raman impact.

Optical integrated logic circuits

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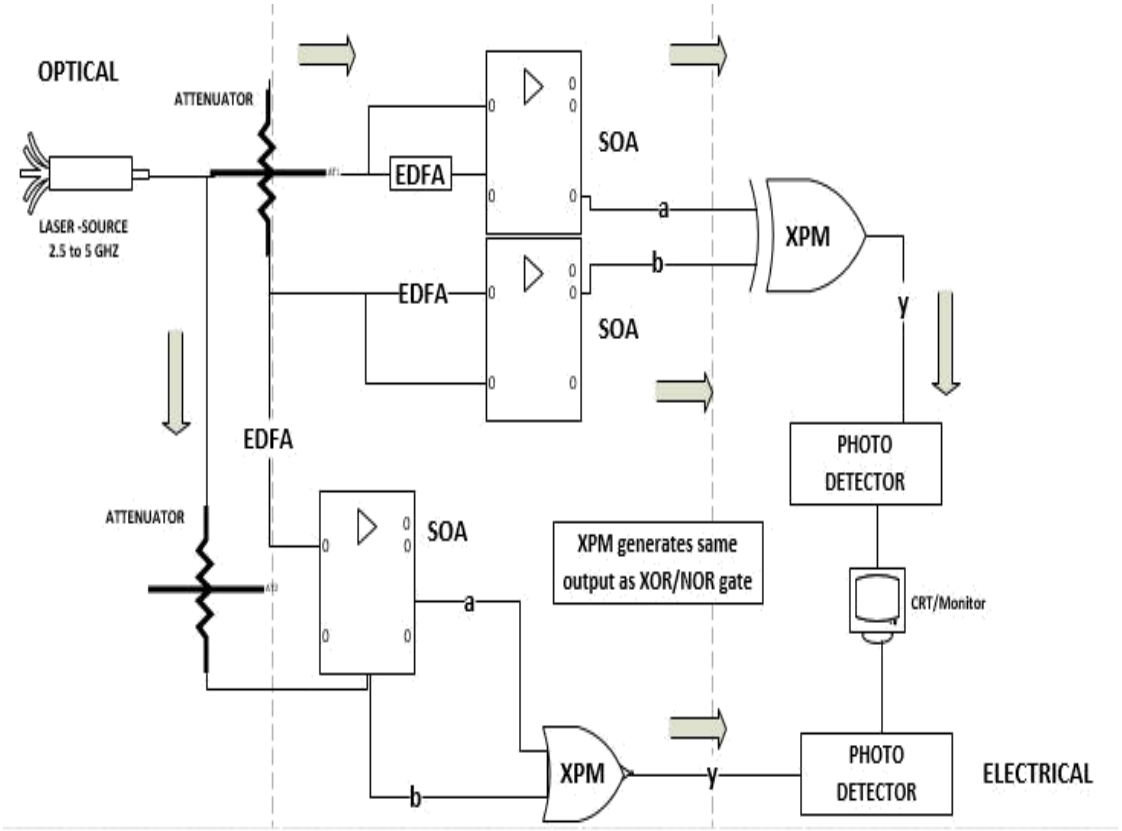

Figure 4: Optical Hybrid Logic Circuits

The principle distinction between the SOA and EDFA amplifiers is the dynamic territory where the addition age occurs. In the EDFA case it is produced straightforwardly in the optical fibre however on account of SOA it happens legitimately in the structure of the semiconductor. Another important contrast is the guideline of vitality flexibly which is utilized for acquiring the enhancement). In SOA the vitality is provided by electrical excitation flow. The input signal is intensified on entire dynamic zone because of a lucid semiconductor invigorated outflow. The standard of light intensification through SOA depends on the recombining electrons and gaps at the progress of structure. The semiconductor amplifiers are made as chip in an encased case ready to keep a consistent temperature. By directing temperature it is conceivable to set suitable wavelength to get most extreme addition. SOA are like lasers in their development and working standard yet with one key distinction. SOA amplifiers contain anti reflex layer against production of reverberation and the sign amassing inside the medium. During development the most important thing is the decision of a semiconductor material with great quantum productivity. Quantum effectiveness is characterized as a proportion between maximal measures of produced photons to the quantity of excited charges of the transporter [16]. Among relevant components for the development are the following: arsenic (As), gallium (Ga), aluminium (Al), indium (In), and phosphor (P). The pre-owned materials are the combinations of these components: GaAs, AlGaAS, InGaAs, InGaAsP, InAlGaAs, and InP.

IV.EXPERIMENTAL RESULT

Our simulation output is as same as actual output of XOR/NOR gate. Hence we proved that our system worked properly and simulated successfully. XOR actual output is [0 1 0 0] and NOR gate actual output is [1 0 1 1]. These output matches our simulation result. Please refer the below truth table inputs and its respective outputs.

Table 1: Truth Table of Laser Inputs A, B & Actual XOR/NOR Gate Output

				Simulation Result		
Input a	**Input b**	**Output (aNORb)**	**Output(aXORb)**			
				NOR	**XOR**	
0	0	1	0	1	0	
0	1	0	1	0	1	

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0	0	1	0	1	0	
0	0	1	0	1	0	

Output: [CHANNEL 1 = NOR] [CHANNEL 2 = XOR]

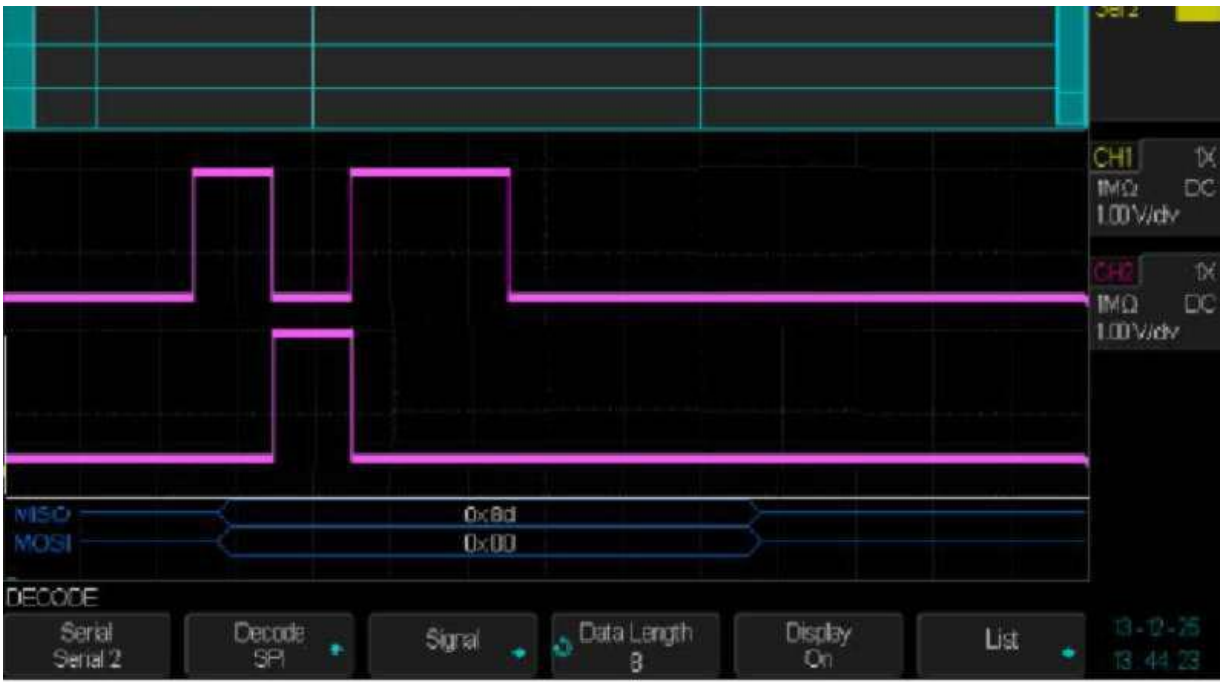

Figure 5: Simulation Output

V. CONCLUSION

The input and output signals are configured in Table1. Overlapping signal A with signal B produces an output signal with the pattern 0100 and 1011 which is the correct proof for characteristics of an XOR & NOR logic gate. Therefore, the optical hybrid XOR as well as NOR gate has been successfully demonstrated at constant speed provided by attenuator. The optical hybrid logic circuits has been realized by using the static characteristics of the SOA wavelength amplifier.

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