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Design of optical logical Multiplexer using SOA

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Abstract*:** ***This paper shows implementation of the logical multiplexer with the optical component. In optical communication the devices involved shows the behaviour of nonlinearity that causes the phenomenon's like Four wave mixing and also Cross gain modulation. These non linearity behaviours are very useful for forming the concept the optical logic multiplexer. This occurs due to variation in reflective index and gain. The optical logical multiplexer that we had designed in our module performs the logic operation like electrical multiplexer with the use of optical component. Input feed as well as terminal of output are in the form of optical.. Switching and operating several electronic devices under the same optical remote can be brought into the existence using the concept involved in our design module and that is implementing of optical multiplexer. Controlling of different electronic devices which are associated with their different functioning frequency can be executed with our design module. This optical logical multiplexer will play an essential role in the part of communication system like network and switch.

Index Terms*:** ***Cross gain modulation, four wave mixing(FWM), Digital Multiplexer, Optical nonlinearity, Semiconductor optical Amplifier **(SOA)**

I. INTRODUCTION

For the transmission of particular data in accordance to our input select lines, we are using the concept of multiplexer. In our digital electronics, we can frame or perform many kind of logical operations with reference to the user select lines using this type of tactic called as multiplexing. Multiple user usage in a span of simultaneous time is advantageous and that is possible with the approach of Multiplexing technique. Here in this project we are designing optical logical multiplexer with the help of semiconductor optical amplifier. In this segment of designing the desired one, we are letting continuous laser beam in place of the input data which is general in use for the digital multiplexer[1-3].In the perspective of the wavelength division multiplexing type of communication, the propagation is done in such a type, where different pulses are allowed to transmit with their respective different wavelengths.

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Here in our module with the help of the select lines (which are termed as user defined bit sequence generators in our module) we can transmit continuous laser beam with different frequencies, with a concept called as signal suppression[4,5].

Each outcome of particular frequency laser beam is depended upon the pair of user defined bit sequence that is used. CW lasers produces the beam that acquires a property of constant amplitude. Energy area is more in CW laser when compared with LED. Signal dominance concept is clearly illustrated as the signal suppression is done by the continuous wave laser, which compresses optical Gaussian pulse. Low powered signal gets suppressed by the high powered signal.

In every input select lines combination, there exists a pair of optical signal, where the phenomenon like four wave mixing occurs. Generally the term four wave mixing comes to the picture while dealing with the non linear optics, when two or more wavelengths interaction takes place, it produces a different new wavelength.

The power of the signal is not dribbled because of the semiconductor optical amplifier, which boosts the optical signal power and keeps optical signal alive. SOA has a structure of basic laser diode type, which is responsible for the process of amplification in optical signals. This optical signals which are to be amplified are allowed to pass into the optical structured region of SOA. With the help of the external current source, the carriers are feed into the active region corresponding to the semiconductor optical amplifier and at the point of saturation it possess the characteristics of non linear and it is advantageous to user because of the high gain property and small size which is easier, when it comes to the part of integration. Phase noise can be avoided with subsequent quick measures[6-8].

II. METHODOLOGY

In this paper we are hereby proposing the concept of 4x1 optical Multiplexer, where 193.1Thz frequency is used for the selection line and frequencies 193.2,193.3,193.4,193.5 are given as input feed to our designed module (Optical Multiplexer). Here we are using totally 8 user defined bit sequence generator, so by this we are supposed to get 4 pairs of user defined bit sequence generator. In our module UDBSG is assigned with 10 bit sequence, which are either one's(1) or zero's(0). These are connected or linked to the optical Gaussian pulse generator. The power that is assigned to the OGPG ranged from 34dBm to 44dBm.The frequency component associated with the OGPG is 193.1Thz. Binary NOT is placed in between these, so as to ensure that the desired beam with desired wavelength is the outcome to their corresponding select line combination.

The frequency and power components associated with all of the OGPG are maintained with the constant values in the total evaluation period. Here we are segmenting or grouping the set of components into subsystems, to avoid user complexity. There are totally 5 subsystems in this module. The subsystem1, subsystem2, subsystem3, subsytem4 are of same and the subsystem5 is the subsystem of these 4 subsystems. The subsystem1 consists of the travelling SOA and x coupler and a default power combiner (2x1) and a continuous wave laser. This outcome beam is feed into Gaussian optical filter. Optical spectrum analyzer and optical time domain visualizer are used to illustrate the time domain and frequency domain properties of the respective laser beam. The CW laser is assigned with the low power 5dBm and with the frequencies of 193.2,193.3,193.4,193.5 as we mentioned earlier that they are the inputs of the optical multiplexer. Power combiner outcome and CW laser outcome are feed into the input of the X coupler. Travelling wave SOA plays a essential role in increasing the amplitude, which is nothing but the power corresponding to the CW beam.

If the power of the CW laser is given as 5dBm then the resultant outcome beam power with its corresponding selection line pattern is increased to 15dBm to 25dBm. This increase in power is clearly visible to the user using optical spectrum visualizer and optical spectrum analyzer. In the optical spectrum analyzer the center frequency is 1.93225e+014 HZ and the start frequency is 1.91816+014 HZ and the ending frequency is as 1.94633e+014 HZ. Here the amplitude the outcome signal is scaled in Y axis region and the frequency of the outcome beam is visualized in the x axis region. The range of the amplitude of the signal must be optimized, so as its spectrum is clearly visible to the end user. The resolution bandwidth is 0.01nm.

TABLE 1 OPTICAL PROPERTIES OF COMPONENTS USED

S.NO	COMPONENT	PROPERTIES	VALUE
1	Optical Gaussian pulse generator	Frequency Power	193.1Thz 34dBm
2	CW Laser1	Frequency Power	193.2Thz 5dBm
3	CW Laser2	Frequency Power	193.3Thz 5dBm
4	CW Laser3	Frequency Power	193.4Thz 5dBm
5	CW Laser4	Frequency Power	193.5Thz 5dBm
6	Gaussian optical filter	Bandwidth	10Ghz
7	User defined bit sequence generator	Sequence length	Variable

III. DESIGN PRINCIPLE AND WORKING

Here in our module, user defined bit sequence generator pair are assigned with the bit patterns of (00,01,10,11) . Now when the 1st input selection pair is considered, there exist only one path pair where the power of the path is zero and the power of the corresponding optical Gaussian pulses becomes zero and, in this scenario the optical Gaussian pulses are not suppressing the input continuous beam

The continuous optical beam which is associated with the frequency of 193.2Thz comes out as the resultant and with the selection line pattern of (01), the input continuous laser beam is transmitted with its corresponding frequency of 193.3Thz and with the selection line pattern of (10), the input continuous laser beam is transmitted with the frequency of 193.4Thz. When the final selection line sequence is feed, the frequency of 193.5Thz continuous laser beam is transmitted throughout the module design and the resultant can be seen in the optical spectrum analyzer.In the other 3 pairs the phenomenon like four wave mixing happens and also the signal suppressing effect takes place, the suppression is done by the optical Gaussian pulses, they tend to suppress our input laser beam and thus in this section of module the input signal is not available at the outcome end. So any desired characterized optical beam or signal can be obtained by the user using the selection line sequence. Different wavelengths can be transmitted with the help of the selection line sequence.

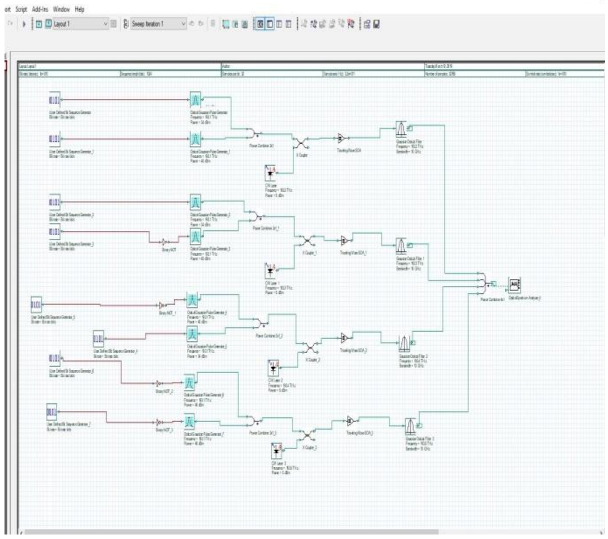

Figure. 1 Layout Module of Optical Logical Multiplexer

Table 2 Output Description

S.NO	SELECTION LINE	OUTPUT FREQUENCY
1	00	193.2Thz
2	01	193.3Thz
3	10	193.4Thz
4	11	193.5Thz

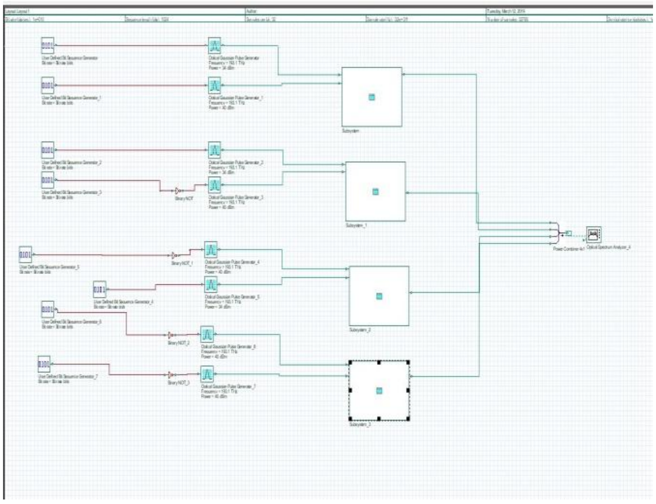

Figure.2 Design with Subsystems

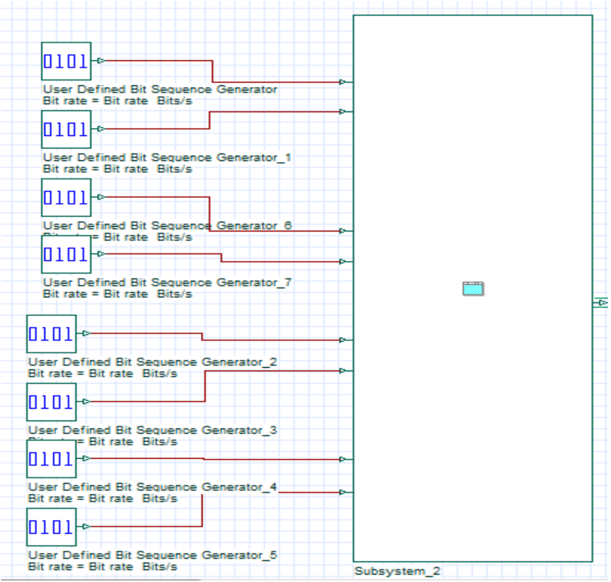

Figure.3 Basic Block of Design

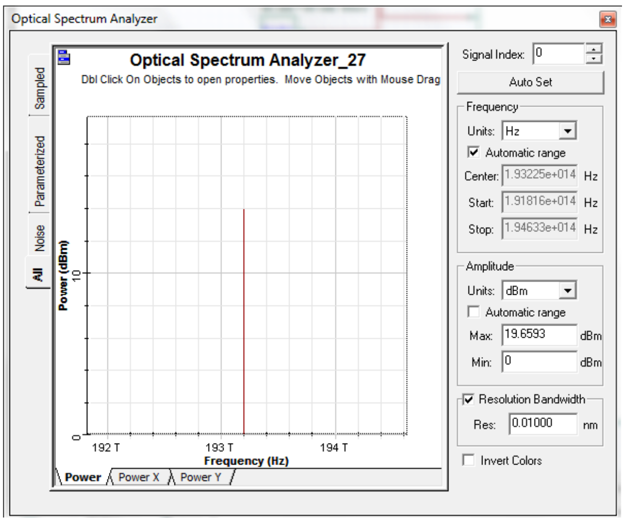

Fig.4 Output When input is 00

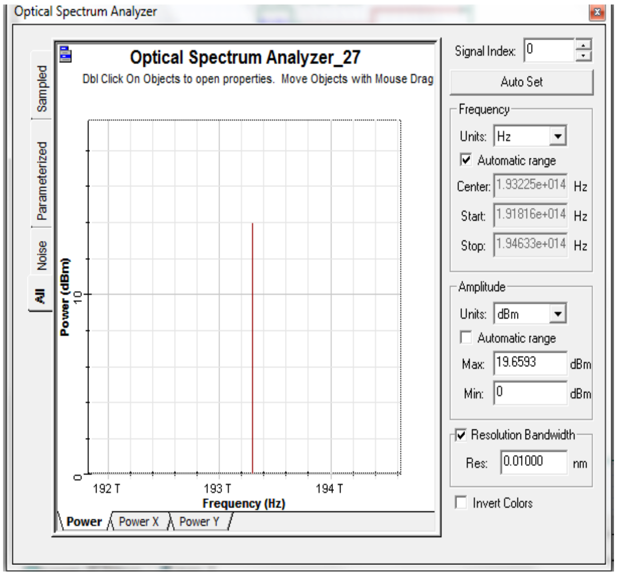

Fig.5 Output When input is 01

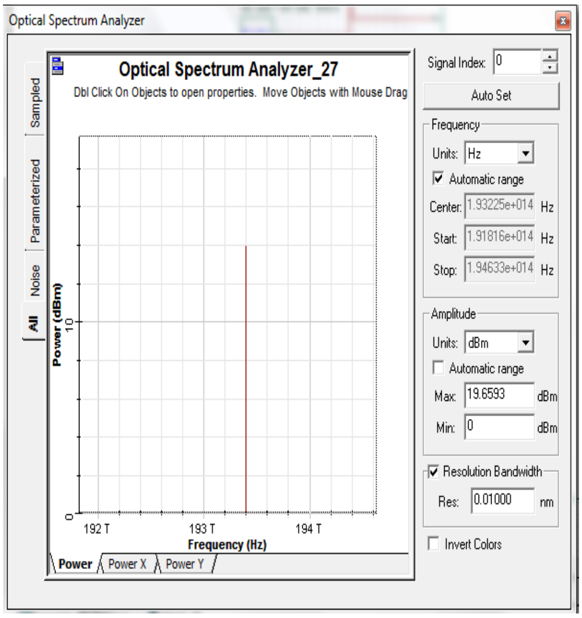

Fig.6 Output When input is 10

IV. RESULTS AND CONCLUSION

In the design when input selection line value is 00 then the outcome is the optical beam with the frequency of 193.2Thz and when selection line are 01 then the outcome is optical beam with the frequency of 193.3Thz , similarly for the selection lines 10 and for 11 , the outcome is the optical signals with frequencies 193.4Thz and 193.5Thz. So it is clear that output is obtained according to the value of the selection line. 193.1Thz is used for the low power signal to control the output and hence this optical multiplexer is used as network as well as switch in communication systems

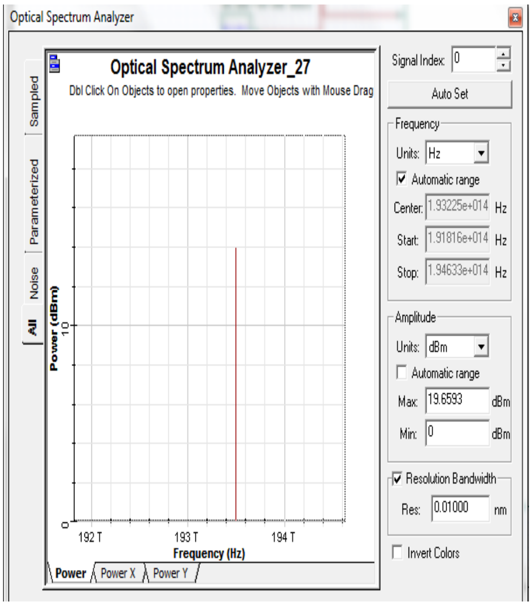

Fig.7 Output When input is 11

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