|| Volume 2 ||Issue 12 ||JULY 2017||ISSN (Online) 2456-0774
INTERNATIONAL JOURNAL OF ADVANCE SCIENTIFIC RESEARCH AND ENGINEERING TRENDS

Study the Impact of Biasing Current of SOA for UWB Pulse Generation Using It's Nonlinearity

Vishnu R Gupta[1], Mrs. Manisha Bharti[2]
M. Tech Scholar, Digital Communication, AIACTR, Geeta Colony, Delhi, India[1]
Assistant professor (Guide), ECE Department, AIACTR, Geeta Colony, Delhi, India[2]

***Abstract*— By using gain saturation effect of Semiconductor Optical Amplifier along with optical delay line we propose the scheme for generation of doublet pulse, which is equivalent to second order derivative of Gaussian pulse. Obtained IR-UWB doublet pulse should satisfied the condition instructed by FCC, to avoid the interference with other narrowband or impulse communication and by using proposed scheme we achieve it. Various modulation approach results in variation in output. In this paper we observe the change in output with respect to change in change in SOA current, Delay line values and attenuator used before to SOA. All these change we observed in terms of Q-factor and minimum BER values by using opti-system software.**

Keywords- IR-UWB, SOA, MZM, ODL,Q-factor, BER.

I INTRODUCTION

As per FCC (USA),UWB signal is any signal which occupy more than 500 MHz bandwidth or possesses a fractional bandwidth greater than 20%.UWB is low power (-41.3dBm/MHz) signal (Frequency Range in between 3.1GHz-10.6GHz) [1] ,initially used only for short range indoor communication [2].This problem is overcame after evolution of Micro-Wave Photonics [3].To meet this requirement, desired pulse shapes are obtained based on derivatives of Gaussian Functions(1st derivative-Monocycle, 2nd derivative-Doublet) [4] .Other than advantage for transmission distance, MWP also provide advantages of photonic generation, processing, control and distribution [3].UWB communication is differ from conventional narrowband wireless transmission communication in which instead of using sinusoidal radio wave, pulse train at hundreds of millions of pulse per time seconds is used.

The key benefits of UWB are high data rates, low equipment cost, multi-path immunity, ranging and communication at the simultaneously and is possible to be coexisting with other wireless techniques [5]. Obtained Gaussian doublet by using intensity modulation scheme does not satisfy criteria of FCC, due to biased in non-linear regime [6]. In another approach pulse was generated by using multiple nonlinearities of single SOA, but for this we require two lasers and hence cost and complexity increased [7-9].

In proposed approach, simple SOA and optical delay line is used for generation. In this by simply using gain saturation effect of single SOA, monocycle is generated and then this pulse is combined with delayed Gaussian pulse to generate UWB doublet in optical domain. This generated optical UWB pulse can be transmitted over 40 km SMF. Performance of link is measured and compared in terms of Q-factor and min. BER values.

II PRINCIPAL OF WORKING

MZM is electro-optic modulator in which signal-controlled object showing the electro-optic effect is utilized to modulate light beam, which may based on phase, frequency, amplitude or polarization of light beam [10]. For the proposed scheme output of MZM contain dc biased voltage, half-wave voltage of MZM and is along with the amplitude and angular frequency of input optical carrier .optical carrier phase change is caused due to applied driving voltages in upper and lower arms of MZM. Subsequently, coupler used to divide Gaussian pulse into two branches, in which ODL is introduced in lower branch. At the upper branch SOA with having some typical gain saturated recovery time is connected and is followed by attenuator which is used to control the input power before SOA as SOA is power sensitive device.

Gain saturation phenomena also results in Self Phase Modulation as Refractive Index change due to intensity dependency and is responds to change in carrier density. Gain saturation effect of an SOA has important role in change the shape of spectrum of amplified pulse. After equalization of pulse width to the carrier lifetime, during the pulse there has time to saturation gain for recover and this kind of recovering phenomena affect the spectrum and shape of pulse which is already amplified.

Other than this, shape and initial frequency pulse modulation results in distortion in shape and spectral pulse. At the upper branch of coupler we get normalized first order difference of Gaussian pulse, i.e. monocycle is generated. Further if delayed Gaussian pulse is superimposed with generated monocycle, it results in doublet which is equivalent to second-order difference of Gaussian pulse.

III EXPERIMENTAL SET UP AND RESULTS

As shown in experimental setup MZM is driven by CW light beam centered at wavelength 1555.6 nm with optical

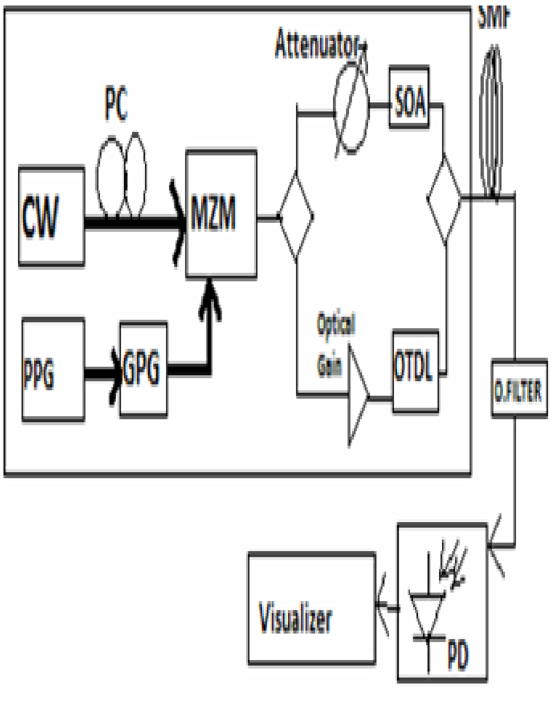

Figure 1 Experimental Set Up For UWB Pulse

power 10dBm. PPG generate bit pattern with fix pattern "1000 0000" at rate of 20 Gbps. Now modulated light beam is passed through coupler used at 50:50. By keeping gain saturation recovery time constant and observing the change in obtained output by varying other parameter, we obtain results as follows.

Case 1 (at SOA current 30mA)

Delay (in nsec)	Q	BER
0.1	7.624	1.2008e-14
0.21	7.586	1.6236e-14
0.30	**8.624**	**3.1701e-18**

Case2 (at SOA current 40 mA)

Delay (in nsec)	Q	BER
0.1	6.701	9.602e-12
0.21	**8.209**	**1.104e-16**
0.30	7.280	1.582e-13

Case3 (at SOA current 60mA)

Delay (nsec)	*Q*	BER
0.1	7.237	2.254e-13
0.21	8.117	2.434e-16
0.30	**8.568**	**4.100e-19**

Case4 (at SOA current 70mA)

Delay (nsec)	Q	BER
0.1	7.416	5.891e-14
0.21	**7.605**	**1.392e-14**
0.3	7.113	5.398e-13

Case5 (at SOA current 80mA)

Delay (nsec)	Q	BER
0.1	7.035	9.575e-13
0.21	**7.1338**	**4.671e-13**
0.3	5.835	2.55e-9

Case6 (at SOA current 90mA)

Delay (nsec)	*Q*	BER
0.1	6.423	6.28e-11
0.21	**8.081**	**3.19e-16**
0.30	6.740	7.62e-12

At delay .30nsec

Attenuator (dB)	Q	BER
1	8.613	3.463e-18
5	7.839	2.214e-15
10	7.198	2.978e-13

At 0.21 nsec

Attenuator (dB)	Q	BER
1	**8.209**	**1.104e-16**
5	8.137	1.963e-16
10	7.764	4.010e-15
15	7.659	9.154e-15

At 0.30 nsec

Attenuator (dB)	Q	BER
1	**8.723**	**1.343e-18**
5	7.920	1.126e-15
10	7.123	1.235e-14

At 0.21nsec

Attenuator (dB)	Q	BER
1	7.359	4.671e-13
5	**8.536**	**6.898e-18**
10	8.11	2.424e-16
15	7.4259	5.548e-14

At 0.21 nsec

Attenuator (dB)	Q	BER
1	**8.602**	**3.884e-18**
5	8.397	2.25e-17
10	7.563	1.914e-14

Attenuator (dB)	Q	BER
1	7.473	3.843e-14
5	7.815	2.721e-15
10	8.435	1.614e-17
15	**9.091**	**4.923e-20**
17	6.703	1.143e-10

At delay 0.21sec

From the above values we conclude that, we have control over the value of Q-factor and Min BER, which determine the performance of receiver.

From the Q-factor value we can measure the minimum SNR required to obtain sufficient BER for a given signal. BER and Q-value at different biasing current for different time delay and different attenuation value are observed by EYE diagram analyzer as shown in fig(1). Fig(2) shows Obtained doublet at output visualized by RF spectrum analyzer.

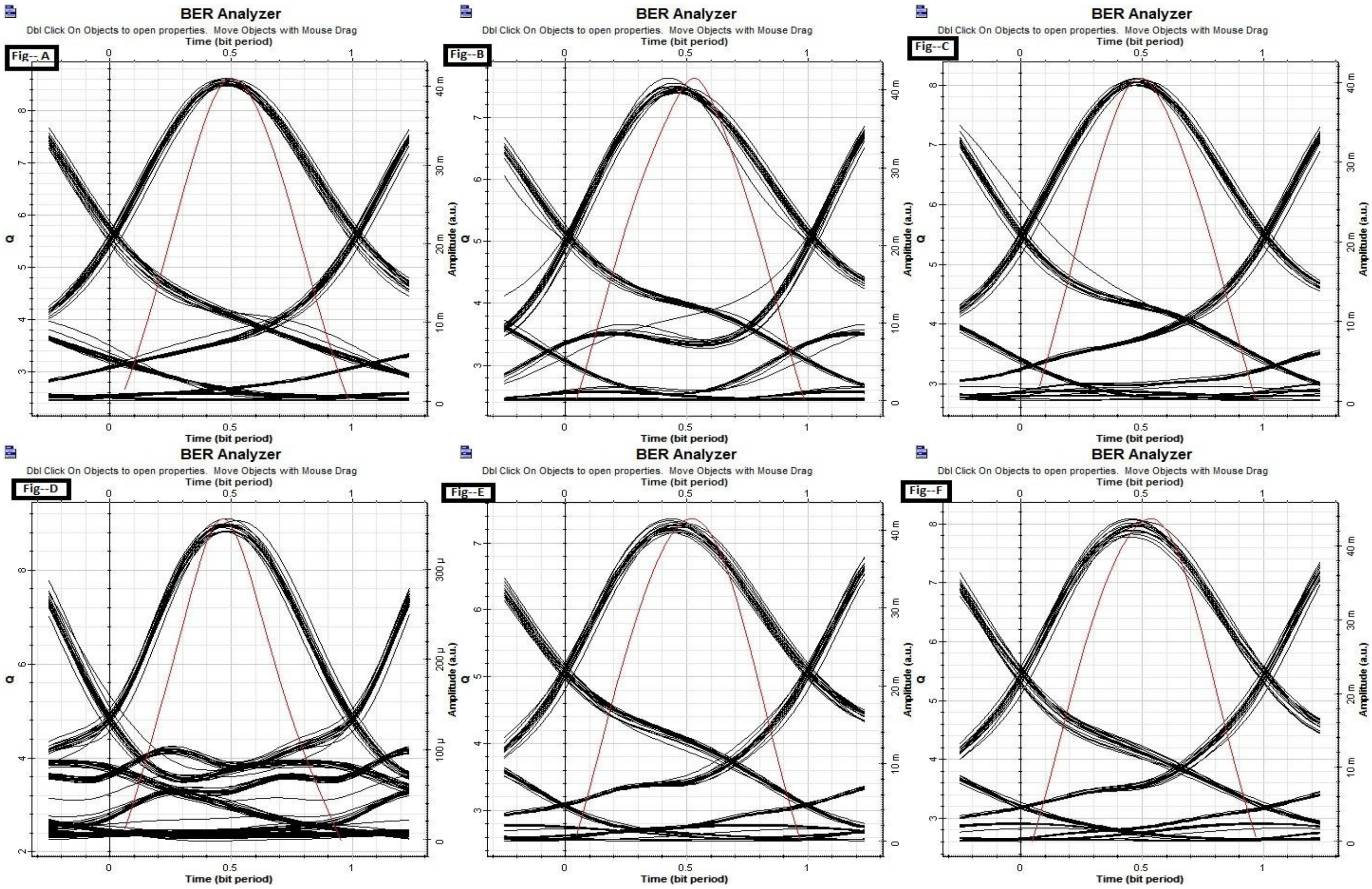

Figure 1 obtained eye diagram at different SOA biasing current

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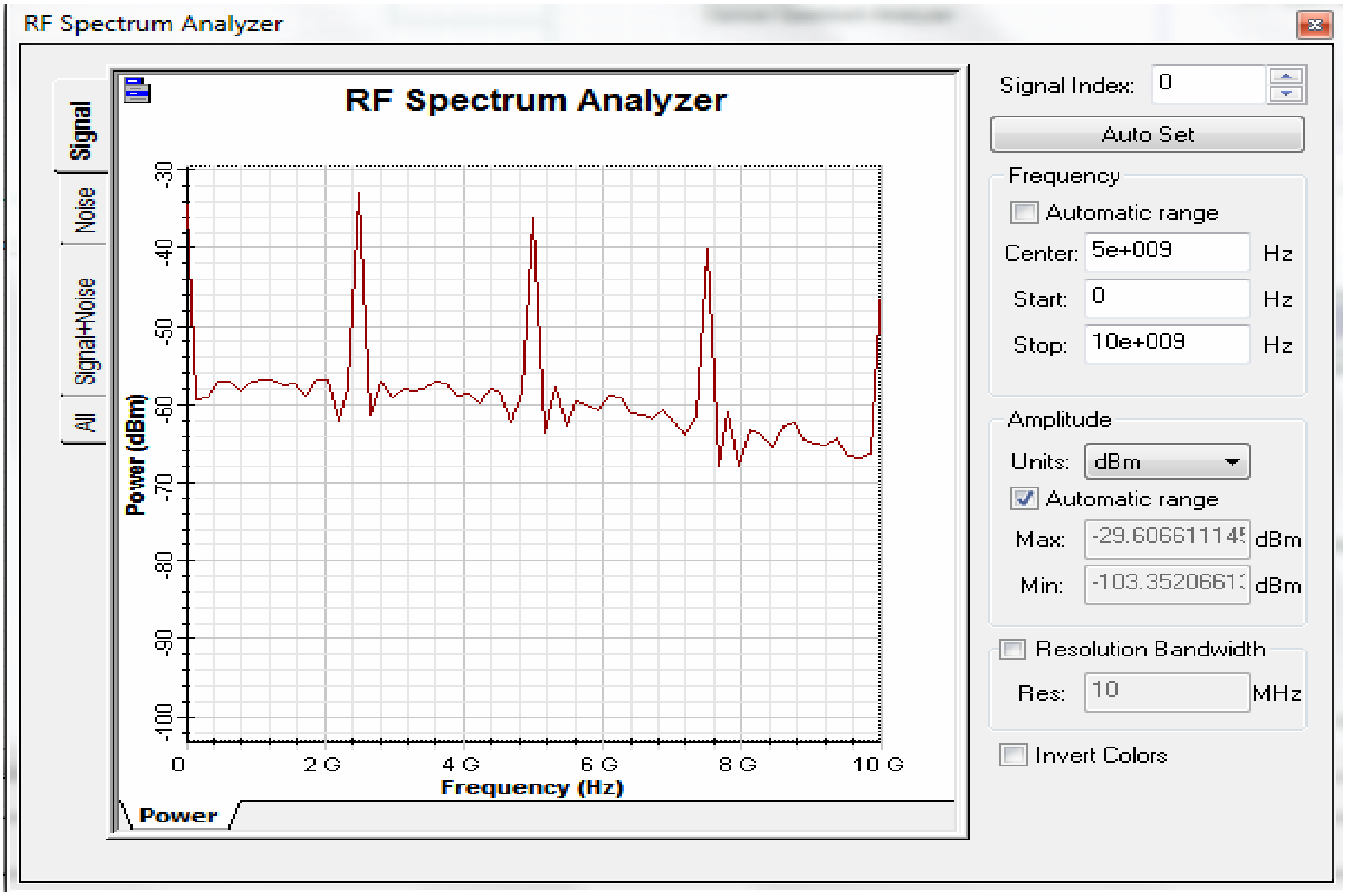

Figure 2 Obtained doublet at output

IV CONCLUSION

By controlling the values of SOA current, attenuator values and delay in the link we observed the variation. As shown in above observation tables and figure we find that there is non-linear variation in Q-factor and BER values with respect to linear change in SOA current, delay line and in attenuator values. Compare to all other values transmission is better for SOA current 70mA with delay line value 0.21 nsec and attenuator value of 15 dB. There are also other approaches in which we can generate UWB signal using non-linear effects viz. XGM, XPM, Chromatic Dispersion etc. Compared to these techniques proposed scheme is simpler and less sensitive to change in parameters of transmission link.

REFERENCES

1. "An introduction to UWB communication systems" by kshetrimayum, R.S. IEEE potentials. 28 (2): 9-13.
2. Research Highlight on "A tutorial on Microwave Photonics" by J. Yao, Microwave photonics research laboratory, University of Ottawa, Canada.
3. "Photonics for UWB communications" by J. Yao, IEEE Microw. Mag. Vol. 10, No.4 , PP. 82 to 95, June 2009
4. Text book of "UWB signals and systems in communication engineering" by M. Ghavami, R.Kohno and L.B.Micheal, chap.2, pp 25-63.
5. "UWBoF communication: Modulation and Transmission " by S.Pan and Y.Yao , Lightw. Technol., vol.28, no.16,.pp. 2445-2455, Aug 15, 2010.
6. "Generation of UWB pulses using direct modulation of semiconductor laser and optical filering" by Q.T.Le, D.Briggmann and F. Kueppers, Electr. Lett. Vol. 49, issue 18, Aug 29,2013.
7. IEEE Phot. Techn. Lett, on "Ultra-Wideband Waveform Generator Based on Optical Pulse-Shaping and FBG Tuning" byMohammad Abtahi, Mehrdad Mirshafiei, Julien Magne Vol. 20, no. 2, Jan 15, 2008.
8. "Optical UWB pulse generator using an *N* tap microwave photonic filter and phase inversion adaptable to different pulse modulation formats" by Mario Bolea, Jose Mora, Jose Campany, Conf. paper of OSA, vol.17, no.7, 30 march 2009.
9. Phot. Lett. On "UWB Monocycle Generation and Bi-Phase Modulation Based on Mach–Zehnder Modulator and Semiconductor Optical Amplifier" by Yuan Yu, J. Dong, Xiang Li, vol.4, no.2, Apr.2012
10. "Analysis and improvement of Mach-Zehnder modulator linearity performance for chirped and tunable optical carriers" by W.H.Steier, S.Dubovitsky, B.Jalali, Lightw. Tech. journal vol.20, issue 5, may 2002.