# Analysis of Fiber bragg grating as dispersion compensator

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***Abstract—*** *Speed is the essential part of communication system. It deals with the growth of the system, because in any system quick response is required in order to achieve the speed limit there are so many obstacle come in the path of telecommunication .Although Optical fiber plays the important role in the development of the system characteristics but also have some limitation like dispersion is on of them. While improving the sped of data transmission the dispersion will occur in the path of transmission which can be improve by using FBG (Fiber Bragg Grating). FBG is a key component in optical communication system as, dispersion compensators, filters and flatteners gain and improve Quality factor. Fiber Bragg Grating (FBG) as dispersion compensator. The analysis has been simulated in efficient optical communication software called optisystem. The performance of the FBG has been studied on the basis of input power, length of OFC, attenuation, line width, FBG grid size.*

***Keywords— FBG (Fiber Bragg Grating), Line width, FBG size, Otisystem, Optical Fiber Communication.***

## I. INTRODUCTION

Fibre optic communication a method of transmitting vital information from one point to another by sending pulses of light through an optical fiber. This light wave acts as an electromagnetic carrier wave which is modulated to carry information. Fiber optic cables are gaining popularity due to their fast transmission rates and the ease of use. Fibre optic cables are being used in place of electronic transmission. the various steps involved in the process of communication using fibre optic cables are as follows. creating an optical signal using a transmitter, relaying the signal along the wire, recieving the generated signal and converting it into an electrical signal. On the technology demand the transmition of information over large distances at appreciable speed is required. The fbg perform the task of transmission of the information with the speed with the requirement of the system .In today scenario we can see the network of FBG cable is being increased for digitalization of system. But as we know each system has some limitation, so optical fiber is running on the limitation of installation cost and the very important i.e. "Dispersion".

Because this is the property of signal pulse that it get broaden as it traveled into the fiber for some distance .so in order to improve the bit rate of the system one can improve the pulse entered in the optical fiber but it may possible that it ger broaden after some time travel into the fiber .Because these pulse get overlap o each other and create ISI so the noise come into the network and dispersion may present in system. We can also understand these term in the way like the phase velocity and group velocity of optical fiber is depend on frequency it is called "Dispersion". The generation of optical pulse should be in such manner that can generate pure pulse with proper spacing and according the requirement of application. This is the first step to generate optical system by converting electrical signal into optical one. These optical information signals get modulated with optical source signal and make two types of pulse RZ and NRZ. In the RZ format, each optical pulse representing bit 1 is shorter than the bit slot, and its amplitude returns to zero before the bit duration is over. In the NRZ format, the optical pulse remains on throughout the bit slot and its amplitude does not drop to zero between two or more successive 1 bits. As a bit pattern, pulse width varies whereas it remains the same in the case of RZ format. In optical communication the use of RZ format help the design of high-capacity light wave systems. The optical carrier frequencies are 200 THz, whereas the microwave carrier frequencies are 1 GHz. It increases the information capacity of optical communication systems by a factor of up to 10,000, because of high carrier frequencies used for light wave systems.

## II. Fiber Bragg Grating as Dispersion Compensator

FBG is the key component of the analysis ,here I am using this as dispersion compensator rather it also can e use as stress calculator filtering component , frequency selector and temperature sensor and many more.FBG perform periodic and non periodic absorption of refractive index and effective coefficient. Coupling of energy take place between co-propagating and counter propagating mode. A Bragg Grating can reflect a predetermined narrow or broad range of wavelengths of light incident on the grating, while passing all other wavelengths of the light. The capability of photo imprinting is depends on photosensitivity of glass fiber, which make the FBG as sensitive to selecting the proper reflecting pulse.

## III. DESCRIPTION OF COMPONENTS

The very first component is NRZ generator which generate the information signals the form of binary no say "0" ans "1" It has the ability to fix the bits in the state as the voltage is changing. Therefore, it is easy to indicate where the bits should start and stop. Besides, the NRZ pulse generator has an advantage on controlling bandwidth. This is due to the characteristic of the generator that the returning signals to zero between bits will not wasting the bandwidth of the data signal. Pseudo-random bit sequence generator is used to scramble data signal in terms of bit rate.

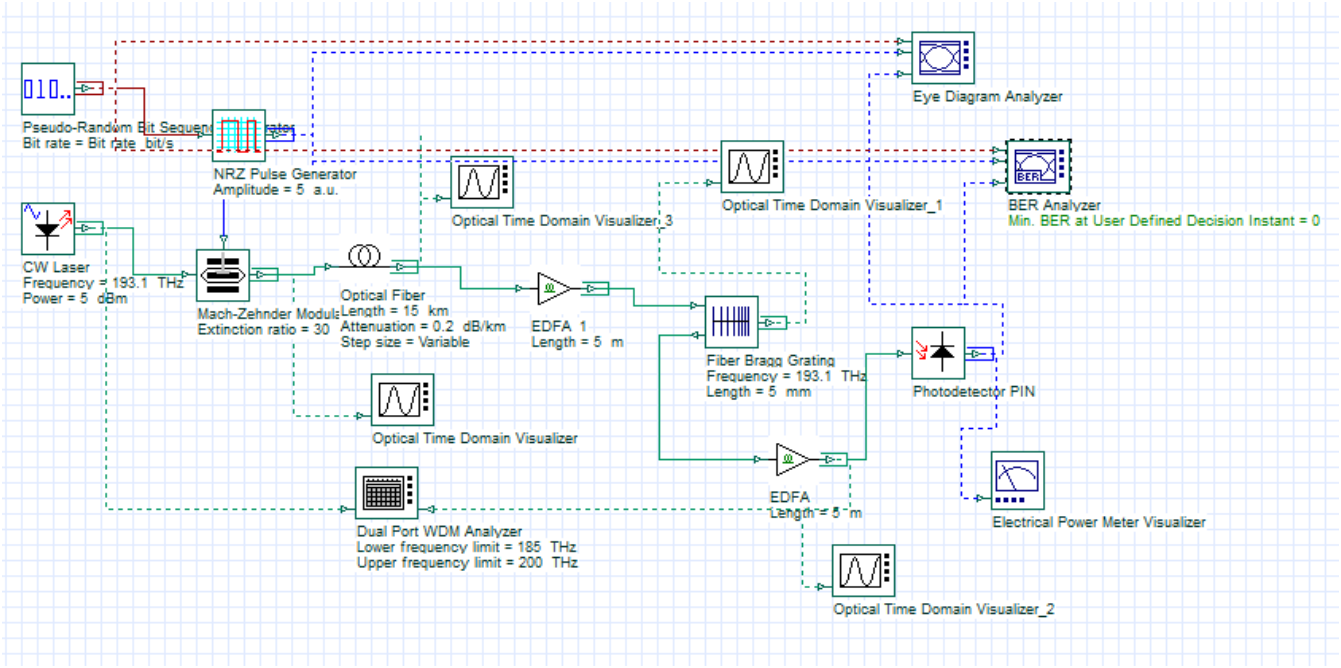
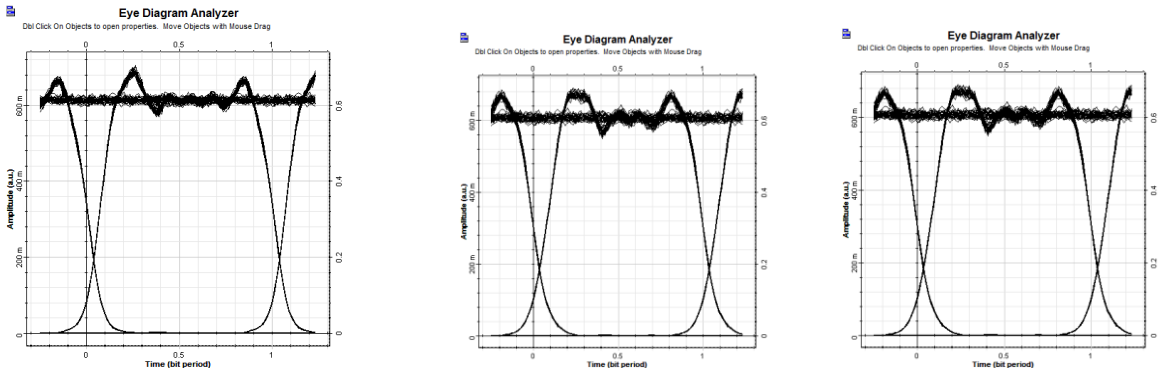



**FIG. 1.THE DESIGNED MODEL OF SIMULATED SYSTEM WITH OPTISYSTEM SOFTWARE**

Then we used Mach Zehnder Modulator to modulate the information pulse with the CW laser source output. Then they transmit over the fiber, the optical fiber we have taken is single mode because it has less distortion occur. The simulation is taken by putting the FBG in the path of optical fiber and without using FBG , FBG is so chosen which has step size of 6 mm. the following parameters are so select for simulation

**TABLE 1: SIMULATION PARAMETERS**

| | |
|---|---|
| C/W Input Power | 10dBm |
| C/W laser Frequency | 193.1THZ |
| Reference Wavelength | 1550 nm |
| Mach-Zehnder modulator with of extinction ratio | 7dB |
| Fiber length | 10 km |
| Attenuation at cable section | 4dB/km |
| EDFA length | 5m |
| FBG length | 6mm |




5 km 10 Km 15 Km

**FIG. 2 : IMPROVED EYE DIAGRAM ANALYZER USING DIFFERENT OFC LENGTH**

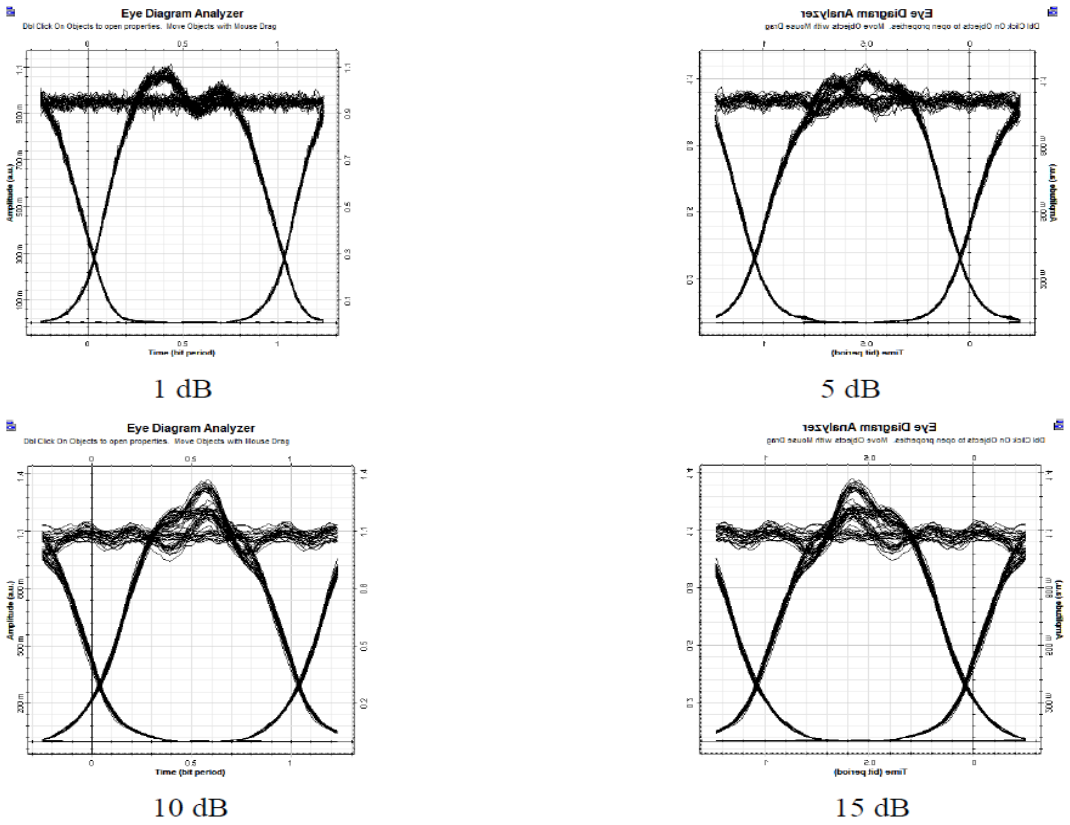



**FIG. 3: IMPROVED DIAGRAM OF EYE ANALYSER FOR DIFFERENT POWER INPUT**

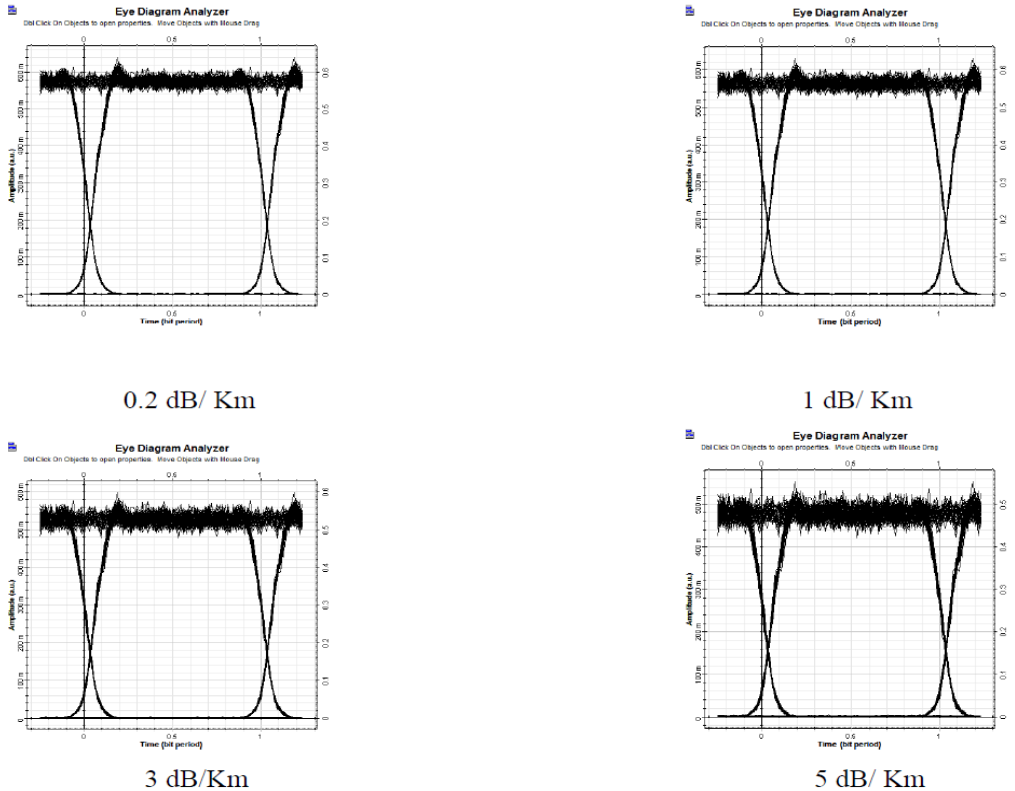
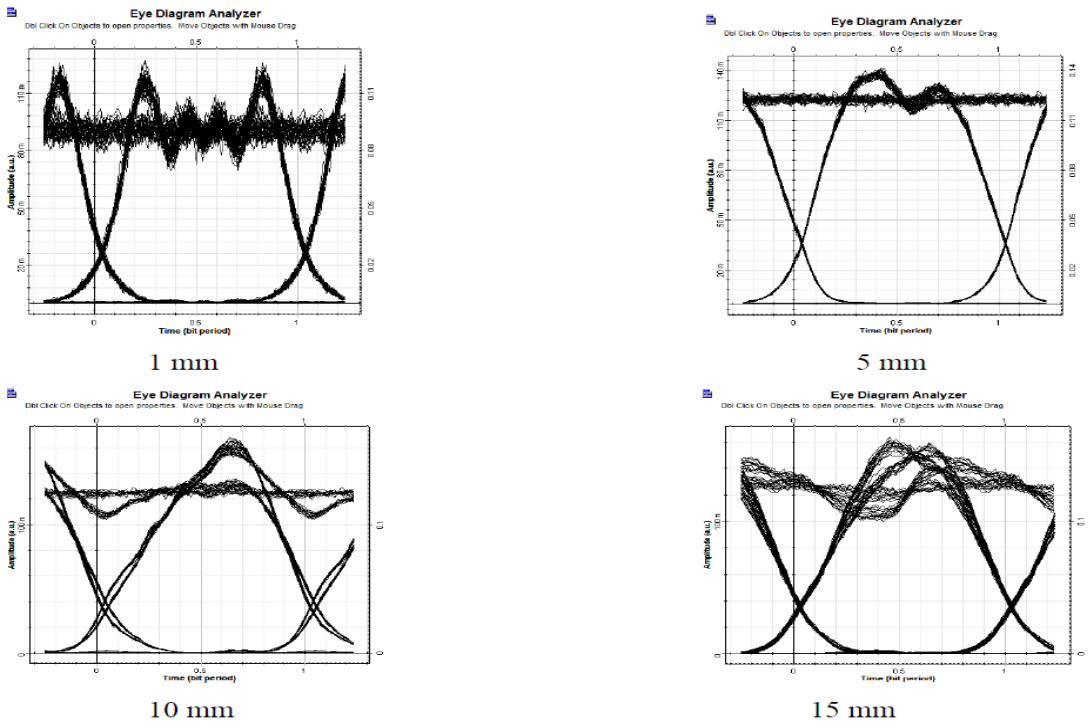



**FIG. 4: EYE DIAGRAM ANALYZER FOR DIFFERENT ATTENUATION**




1 mm 5 mm

10 mm 15 mm

**FIG. 5:EYE DIAGRAM ANALYZER FOR DIFFERENT VALVE OF FBG**

**TABLE 2: THE OUTPUT READINGS ARE TABULATED BY VARYING THE OFC LENGTH (KM)**

| Improved output readings are tabulated by varying the OFC Length (km) | | | |
|---|---|---|---|
| OFC length | Gain (dB) | Noise Figure (dB) | Q factor |
| 5 | 19.53 | 9.82 | 137.88 |
| 10 | 19.49 | 10.82 | 110.05 |
| 15 | 19.44 | 11.42 | 81.83 |
| 20 | 19.38 | 12.83 | 69.97 |

**TABLE 3: THE OUTPUT READINGS ARE TABULATED BY VARYING THE INPUT POWER**

| Improved Q factor tabulated by varying the input power | | | |
|---|---|---|---|
| input power (dBm) | Gain (dB) | Noise Figure (dB) | Q Factor |
| 1 | 25.24 | 9.99 | 46.77 |
| 5 | 21.46 | 10.95 | 40.2 |
| 10 | 11.77 | 12.1 | 34.33 |
| 15 | 6.8 | 13.64 | 17.68 |
| 20 | 6.71 | 14.63 | 12.28 |

## IV. RESULT

The simulation and analysis is done by optisystem 7 simulation software The eye diagrams and results of output power, Signal power (dBm) at receiver, noise power by using different values of input power (dBm), attenuation coefficient

(dB/km), and variable length of FBG (mm).All the results are tabled accordingly the eye diagrams are showing the sharpness with improve quality factor.

## V. CONCLUSION

From the obtain result we can conclude that FBG can be use as dispersion compensator with analysis of input power , optical fiber length,FBG step size, attenuation factor and the line width are the parameter which help to improve the quality of the system .the optimize step size is 5 mm over which we obtain the best quality of the system. Input power length and attenuation directly proportional to nose, output power and Q- factor are decrease with increase in length and attenuation coefficient of OFC.

## REFERENCES

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