Performance Analysis of Optical Transmitter with the Single Mode Laser

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Abstract

During these days, optical fiber networks are widely used in telecommunication for transmitting the signal or information from one corner to another corner in the world. The efficiency of optical fiber networks deteriorates due to several limitations like attenuation, dispersion, non-linearities, fragility of fiber and other losses. So for the effective and successful communication it is important to reconsider about how optical signal is transmitted; what amount of this signal is transmitted and what distance is covered by the signal through the fiber. The non-return to zero technique based optical communication system with single channel over single mode fibre is investigated in this simulation process. On the basis of modulated outputs of NRZ technique, a comprehensive comparison is developed in terms of Quality factor and bit error rate (BER) , histogram and peak current of single mode laser to establish the merits and demerits of the network system in short as well as long haul optical transmission system. Finally, it is to be investigated the performance analysis of optical transmitter for the given fiber length with the effect of peak current of single mode laser improved by OptiSystem 19.0.

Keywords- Peak current, Single mode laser, Non return to zero, Quality factor, Bit error rate

1. Introduction

The optical transmission system on the basis of three basic components which are input devices (convert electrical signal into optical signal), transmission channel and the output devices (convert optical signal into electrical signal) we analysed its efficiency. loop control is major component used as a multiple optical fibre communication system. Another key component is single mode laser. These provide high bit rate data transmission over long distance with appropriate optical amplification. With two different options for the modulation format of the signal known as the RZ pulse generator and NRZ techniques we prefer NRZ techniques in optical fibre communication has been discussed by analysing the different peak current value of the single mode laser with using other parameters setting. The value of different parameters has been analysed such as quality factor, bit error rate, eye height for given input powers and the satisfactory outputs. Opti System Simulator Software is an advanced, innovative, rapidly developing and powerful software simulator tool for the design, testing and optimization of virtually any type of optical link in the physical layer of a broad spectrum of optical networks from ultra-long-haul system. It is an innovative optical communication system simulation package which was explored by opti Wave Company in order to meet the academic requirement of the system designers, optical communications engineers, researches.

In present year, our honourable Prime Minister Narendra Modi started **"PM Ghar Tak Fiber Yojna 2022"** in which Bharat Net Projects implemented in a phased manner to provide broadband Connectivity to all the Gram Panchayats (GPs) in the country through an optimal mix of media i.e. OFC/Radio/Satellite. As on 28.02.2022 total 5, 67, 941 km optical fiber cable (OFC) has been laid by Bharat Net Projects.

2. Simulation for the optical transmitter

Now the basic design of optical transmitter NRZ (Non Return to Zero) format with single mode LASER as shown in the figure 1.

Pseudo-random bit sequence generator generates a stream of bits, and all the bits are applied on the NRZ pulse generator. NRZ pulse generator output is applied on the ideal single mode LASER and the output of the laser is applied on the pin photo diode The PIN photo-diode convert the light signal to electrical form, then amplified signal will pass through low pass Bessel filter. Properties of the low pass Bessel filter are carrier wavelength & lambda; =1550 nm and bandwidth = 4 x Bit rate.

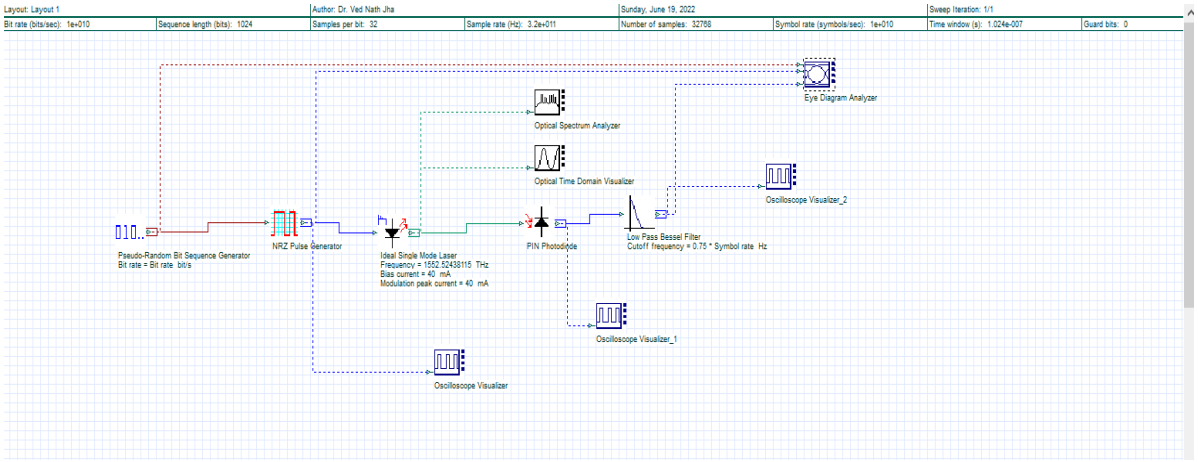

Figure 1: Design of optical transmitter with single mode LASER

3. Simulation Result and eye diagram analysis –

There are many different simulations conducted for different values of peak current of ideal single mode laser and we get the different values of Q-factor which are shown below in the different eye diagrams.

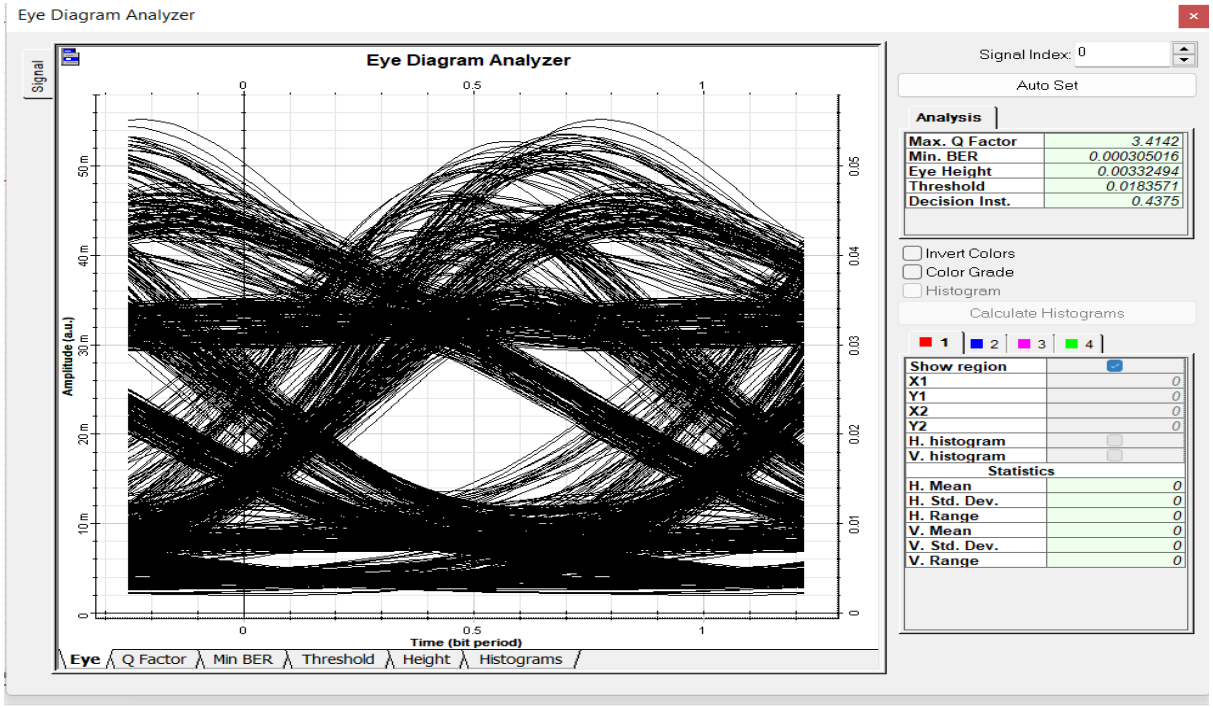

Figure 2: Eye diagram for the peak current of 20mA of single mode LASER

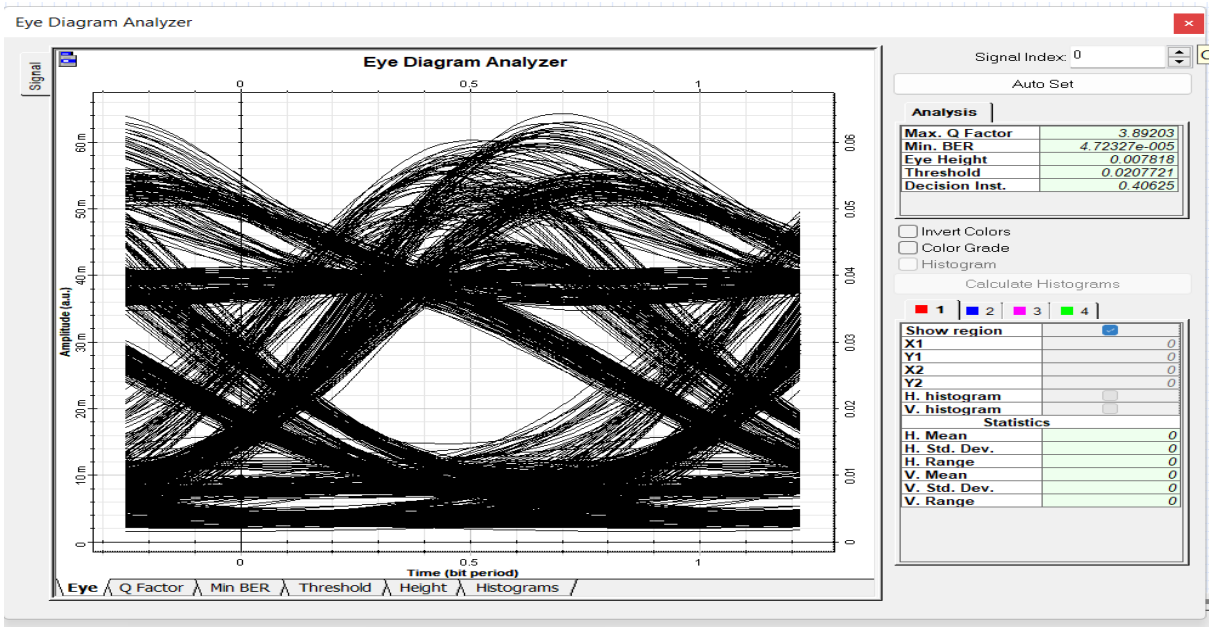

Figure 3: Eye diagram for the peak current of 25mA of single mode LASER

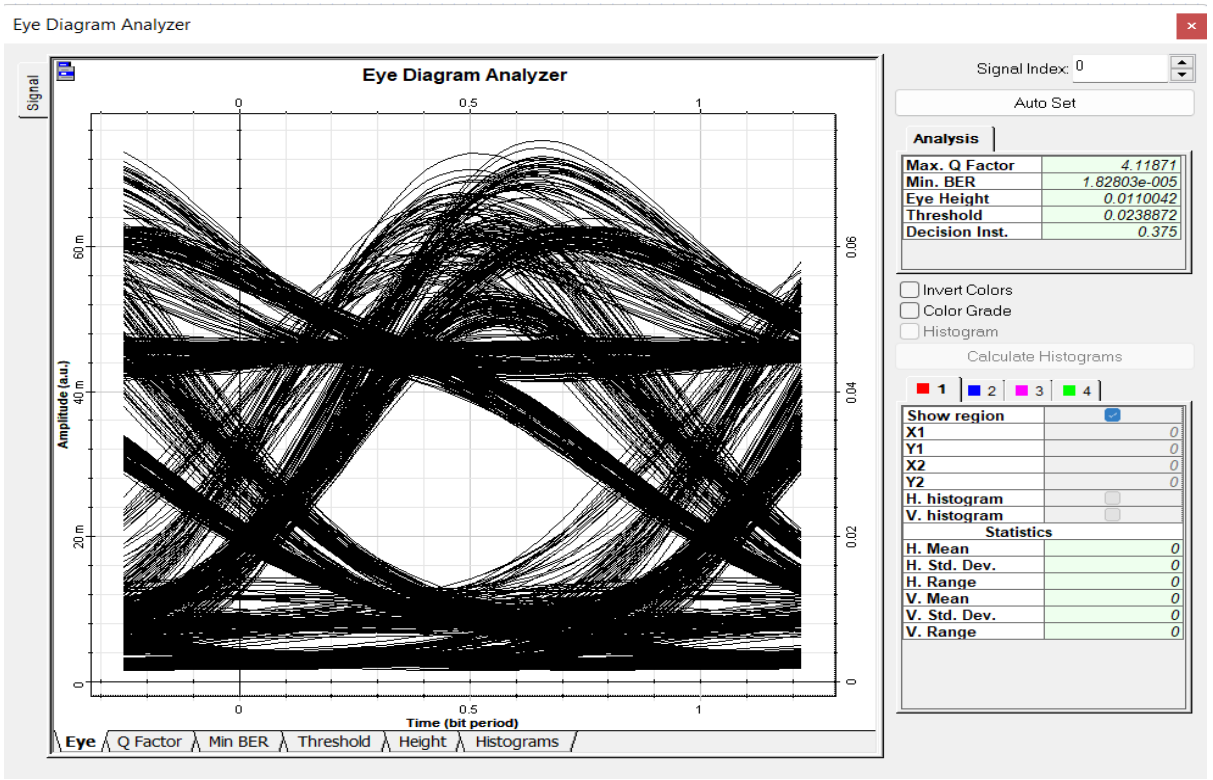

Figure 4: Eye diagram for the peak current of 30mA of single mode LASER

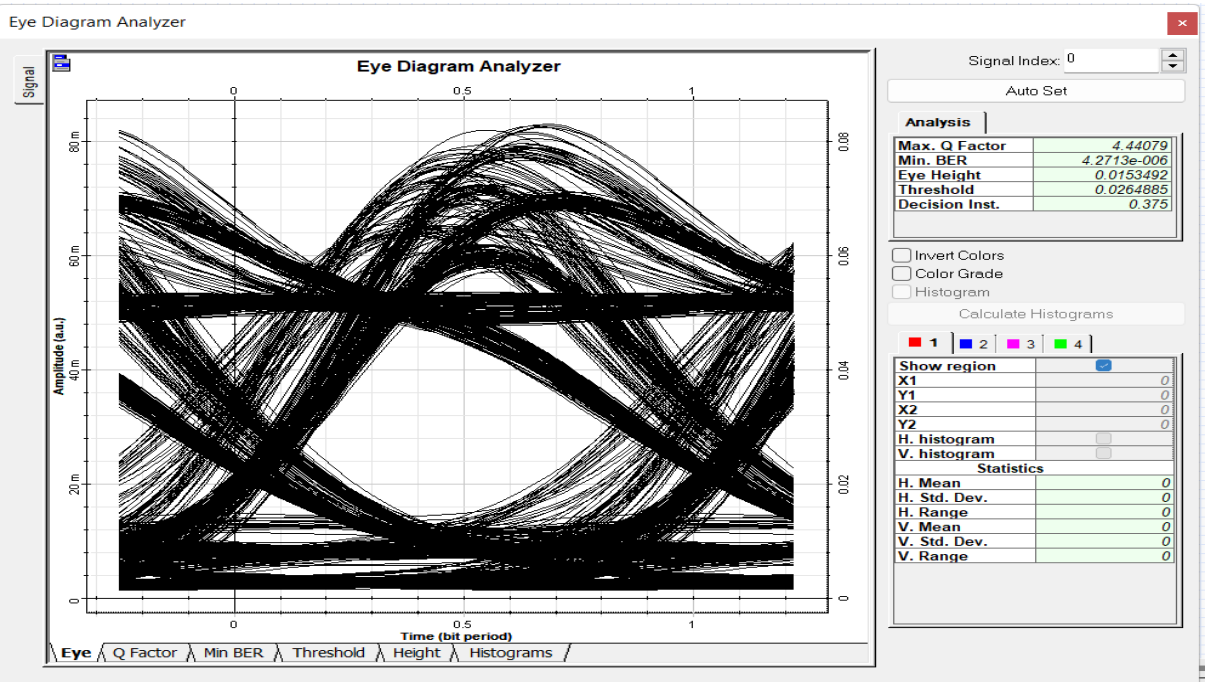

Figure 5: Eye diagram for the peak current of 35mA of single mode LASER

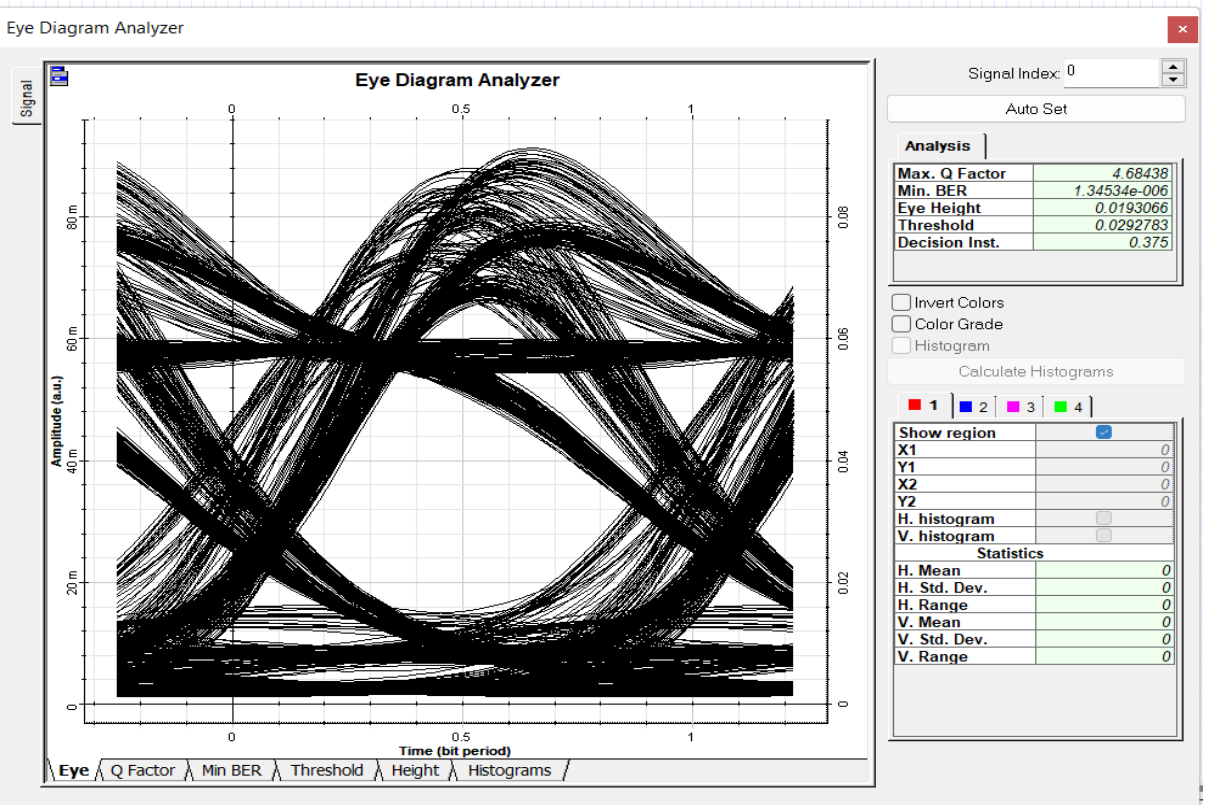

Figure 6: Eye diagram for the peak current of 40mA of single mode LASER

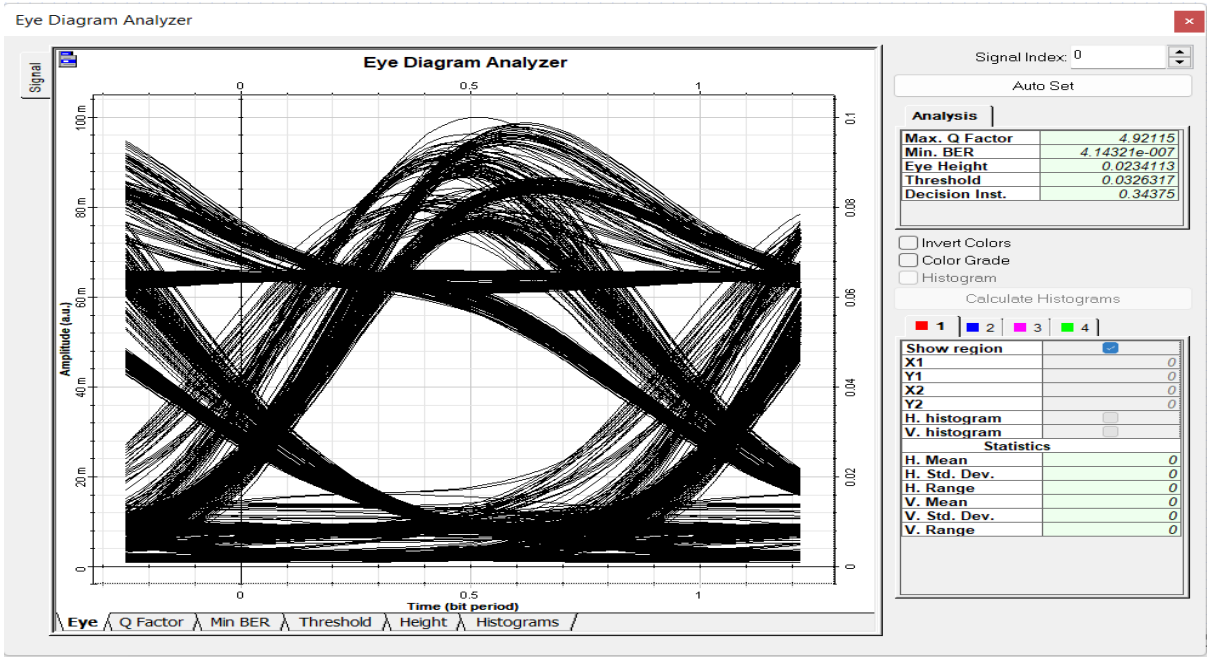

Figure 7: Eye diagram for the peak current of 45mA of single mode LASER

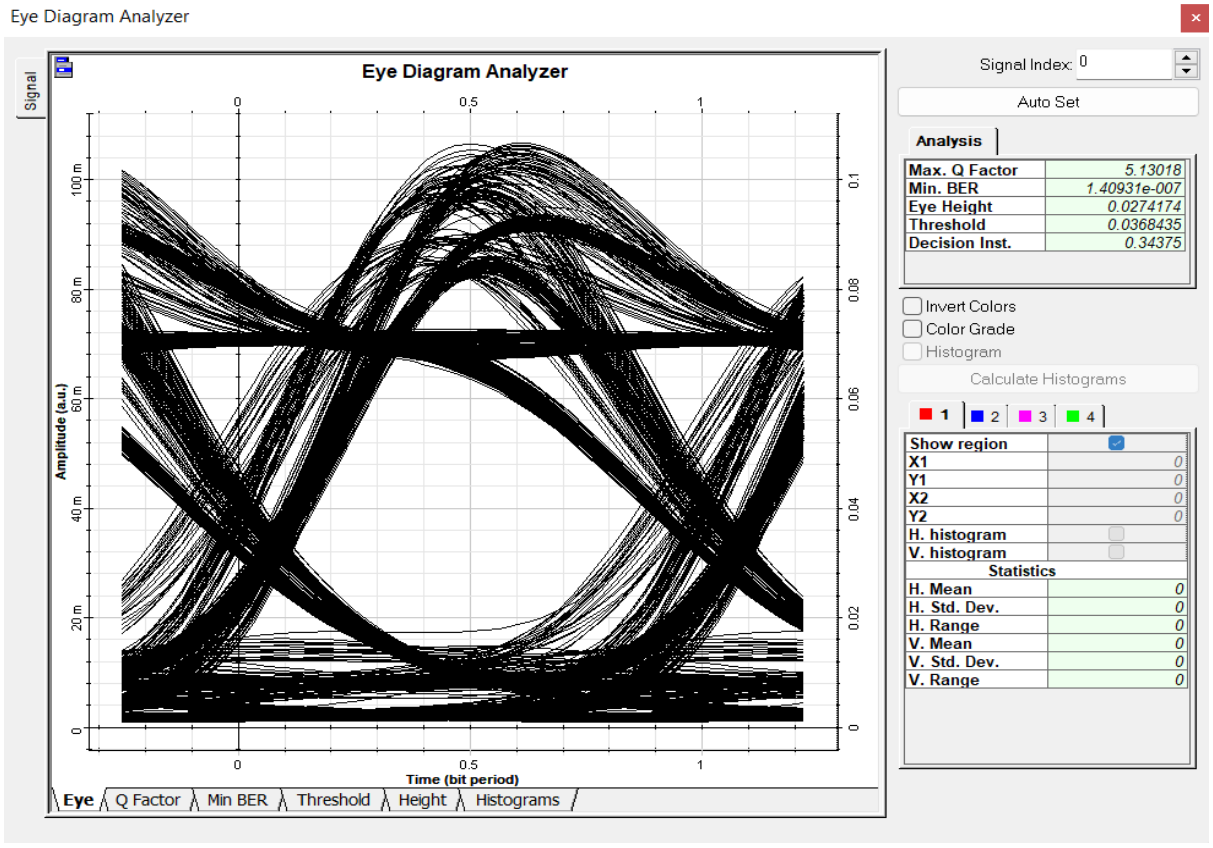

Figure 8: Eye diagram for the peak current of 50mA of single mode LASER

4. Result and Discussion-

The simulation based on the varying peak current of single mode LASER from 20mA to 50mA with the up gradation of 5mA then we get the table-1 which shows the relation between peak current and Q-factor.

Table 1. Relation between peak current (I) and Q-factor

S.NO.	Peak Current(I) mA	Q-factor
1	20	3.4142
2	25	3.89203
3	30	4.11871
4	35	4.44079
5	40	4.68438
6	45	4.92115
7	50	5.13018

5. Conclusion-

In this research, we have established the relation between peak current of single mode laser and Quality factor of optical transmitter and result shown in different eye diagrams for each outcome.

So, for better performance of optical transmitter we increase the Quality factor of the system by increasing the peak current of single mode LASER.

Furthermore, this research will helpful to establish the better and stable optical transmission in this era of data demand and globalization.

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