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BER Evaluation of The Optical System

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Abstract

Optical communications are considered more effective at present in communication networks in terms of data transfer rate and loss. In this paper, an optical communication system will be designed using the Optisystem program and study the effect of the energy change on the system with a length of 90 km and its effect on the designed system. From the results, we can see that the BER of the system decreases when the transmission power increases.

Based on the simulation results depicted in Figures 3-11, it is evident that increasing the transmission power leads to an increase in the Q-factor and a decrease in the bit-error rate. However, when the transmission power was decreased to -1 dBm, significant data loss and unsatisfactory results were observed. Additionally, it is notable that the EYE DIAGRAM became random and unstable under these conditions. In summary, higher transmission power correlates with higher Q-factorKey words: optical system, optical fiber, BER.

الملخص

تعتبر الاتصالات الضوئية أكثر فعالية في الوقت الحاضر في شبكات الاتصالات من حيث معدل نقل البيانات وفقدانها. في هذا البحث سيتم تصميم نظام اتصال بصري باستخدام برنامج Optisystem ودراسة تأثير تغير الطاقة على النظام بطول 90 كم وتأثيره على النظام المصمم. من النتائج يمكننا أن نرى أن معدل الخطأ في البنات (BER) للنظام ينخفض عندما تزيد قدرة الإرسال.

واستناداً إلى نتائج المحاكاة الموضحة في الأشكال 3–11، فمن الواضح أن زيادة قدرة الإرسال تؤدي إلى زيادة في عامل Q وانخفاض في معدل خطأ البتات. ومع ذلك، عندما انخفضت طاقة الإرسال إلى –1 ديسيبل ميلي واط، لوحظ فقدان كبير للبيانات ونتائج غير مرضية. بالإضافة إلى ذلك، فمن الملاحظ أن مخطط العين أصبح عشوائيًا وغير مستقر في ظل هذه الظروف. باختصار، ترتبط قوة النقل الأعلى بعامل Q الأعلى.

1.1 Introduction

An optical fiber communication system is similar in basic concept to any type of communication system.

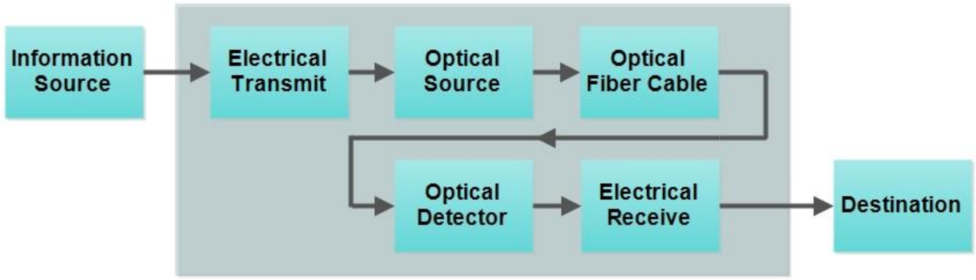

Figure (1) Optical Fiber Communication System.

For optical fiber communications system as shown in Figure (1), the information sourceprovides an electrical signal to a transmitter comprising an electrical stage which drives an optical source to give modulation of the light wave carrier. The optical source which provides the electrical–optical conversion may be either a semiconductor laser or light emitting diode (LED). The transmission medium consists of an optical fiber cable and the receiver consists of an optical detector which drives a further electrical stage and hence provides demodulation of the optical carrier. Photodiodes (*p–n*, *p–i–n* or avalanche) and, in some instances, phototransistors and photoconductors are utilized for the detection of the optical signal and the optical–electrical conversion. Thus there is a requirement for electrical interfacing at either end of the optical link and at present the signal processing is usually performed electrically [1].

1.2 Optisystem

OptiSystem is relatively new software in this field and has good features for the job. With a very simple user interface, this software provides the user with the possibility to use all kinds of optical connections and all kinds of cables and elements required by these networks, which can range from a small analog operator project to a huge communications infrastructure. Used nationally and across continents and accurately simulate and optimize the network. The graphic interface of this program allows you to visually arrange all the elements and connections and see immediately the impact of the applied changes by changing new specifications and configurations. Using this software will definitely reduce costs and prevent many potential losses due to improper physical implementation.

1.3 Design and simulation

Figure (2) shows the design circuit for the optical communication system proposed in this project with a transmission rate of 10 Gb/s, so that the system is divided into three main parts as shown in Figure (1) the transmitter part, the receiving part, and the optical communication channel, so that an Single-Mode Fiber (SMF) type optical channel was used The attenuation value was 0.2 db/km and the wavelength used was 1550 nm. The transmitting power were variable, as will be explained later.

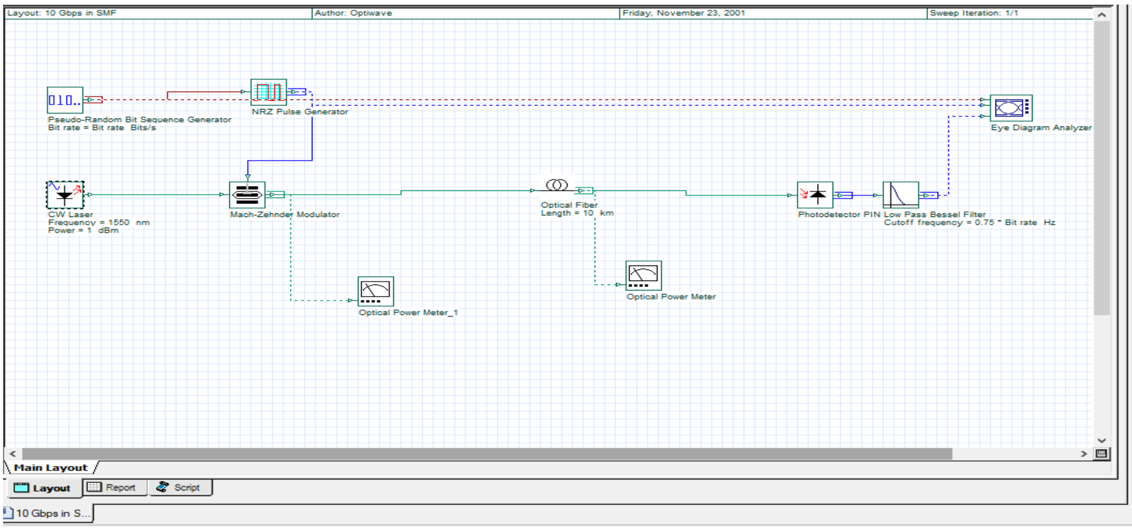

Figure (2) optical communication system designed in this project.

4.3.2 The effect of changing transmitter power

From the previous results obtained when changing the distance from 10 km to 90 km at energy = 0, the worst result we got was 90 km, now we will change the energy from -1dbm to 8dbm to see the results that can be obtained:

In this part, the effect of the energy change on the system with a length of 90 km and its effect on the designed system.

a- At (-1dbm) transmission power

The following figure (3) shows the value of the quality factor (Q-factor) and the value of the error between transmitted and received bits (BER) as well as the EYE DIGRAEM of the results obtained at a distance of 90km.

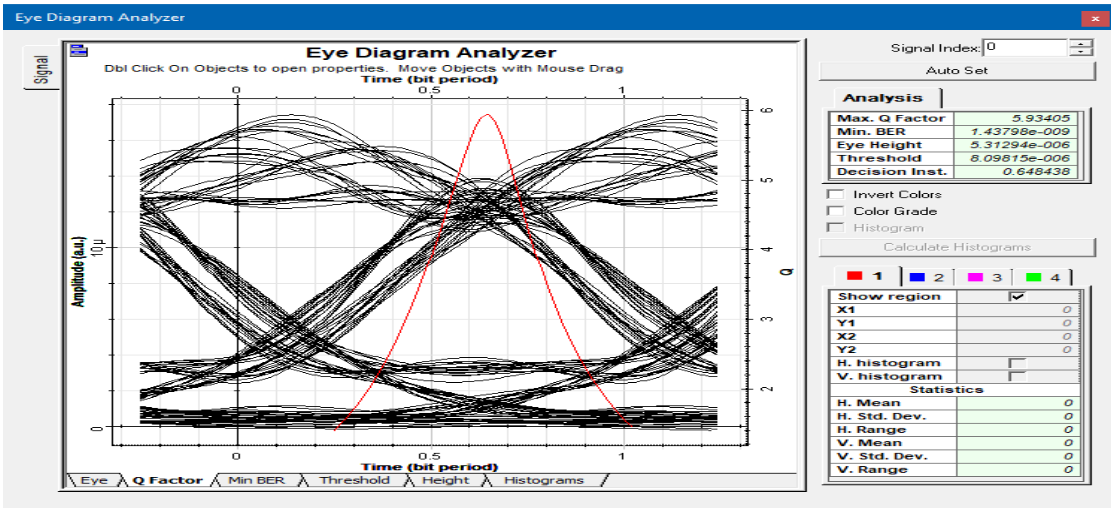

Figure (3) shows the system quality measurement parameters (-1dbm) at 90Km.

After increasing the cable length to 90 km, the Q-factor will be decreasing in to 5.93, and a decrease in the bit error rate to 1.43×10^{-009}. And here the result was also unsatisfactory and bad. When we change the transmit power to -1 dbm, we also notice that EYE DIGRAEM has become random and unstable, we can say that the greater the distance, the greater the data loss.

b- At (1dbm) transmission power

The following figure (4) shows the value of the quality factor (Q-factor) and the value of the error between transmitted and received bits (BER) as well as the EYE DIGRAEM of the results obtained at a distance of 90km.

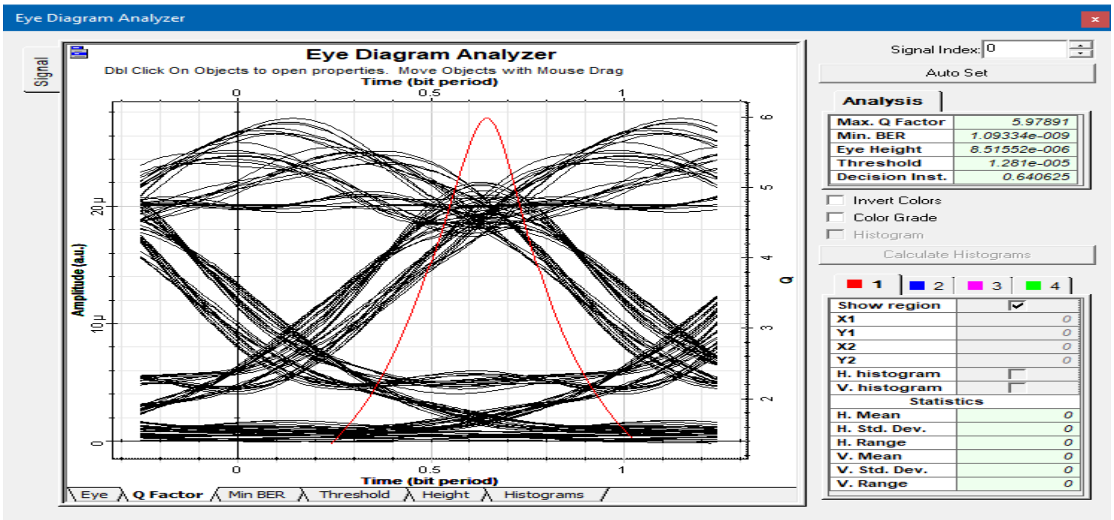

Figure (4) shows the system quality measurement parameters (1dbm) at 90Km.

After increasing the cable length to 90 km, the Q-factor will be decreasing in to 5.97, and a decrease in the bit error rate to 1.09×10^{-009}. Here the result was also unsatisfactory and bad, and the result we obtained now was very close to the results obtained previously. When we change the transmit power to 1dBm, we also notice that EYE DIGRAEM has become random and unstable, we can say that the greater the distance, the greater the data loss.

c- At (2dbm) transmission power

The following figure (5) shows the value of the quality factor (Q-factor) and the value of the error between transmitted and received bits (BER) as well as the EYE DIGRAEM of the results obtained at a distance of 90km.

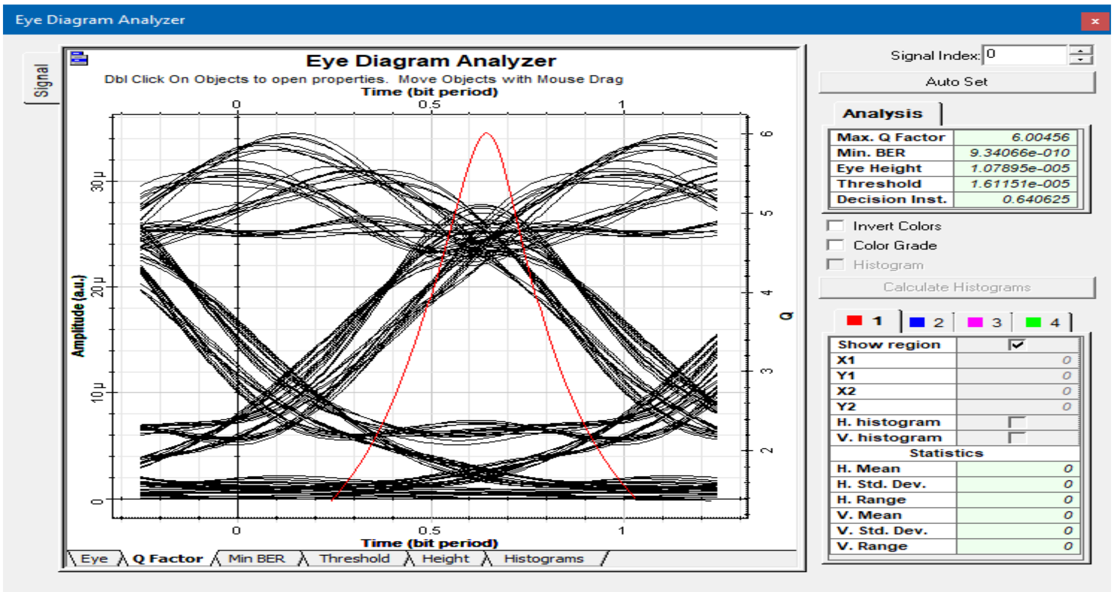

Figure (5) shows the system quality measurement parameters (2dbm) at 90Km.

After increasing the cable length to 90 km, the Q-factor will be decreasing in to 6.00, and a decrease in the bit error rate to $9.34\ x10^{-010}$. Here the result was also unsatisfactory and bad and the data loss was very big and noticeable, when we change the transmitting power to 2dBm, we also notice that EYE DIGRAEM became random and unstable.

d- At (3dbm) transmission power

The following figure (6) shows the value of the quality factor (Q-factor) and the value of the error between transmitted and received bits (BER) as well as the EYE DIGRAEM of the results obtained at a distance of 90km.

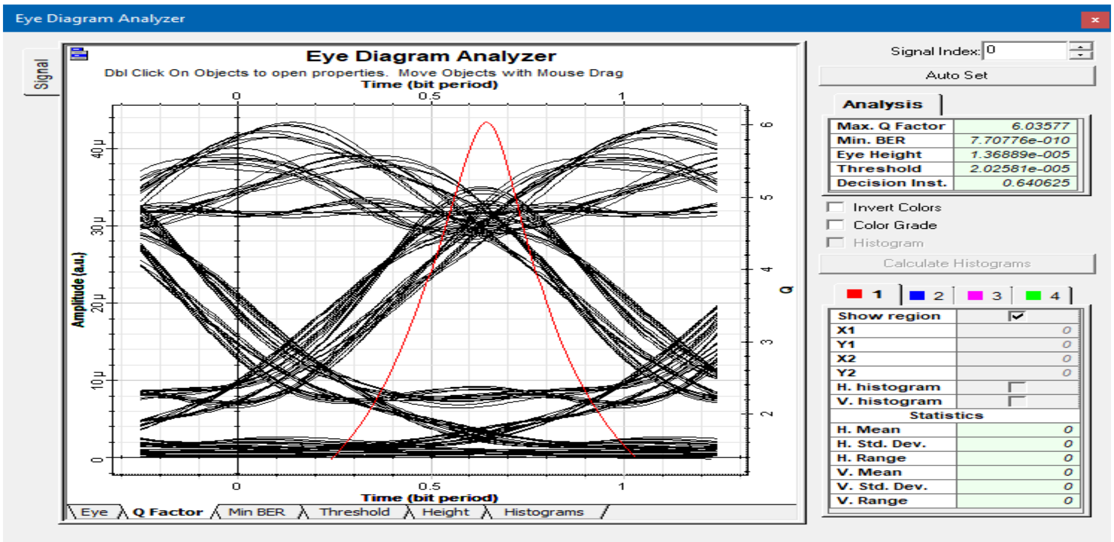

Figure (6) shows the system quality measurement parameters (3dbm) at 90Km.

After increasing the cable length to 90 km, we see a decrease in the Q factor to 6.03, and a decrease in the bit error rate to 7.70 x 10^{-010}. Here the result was also unsatisfactory and bad and the data loss was large, when we change the transmitting power to 3 dBm, we also notice that the EYE DIGRAEM became random and unstable.

e- At (4dbm) transmission power

The following figure (7) shows the value of the quality factor (Q-factor) and the value of the error between transmitted and received bits (BER) as well as the EYE DIGRAEM of the results obtained at a distance of 90km.

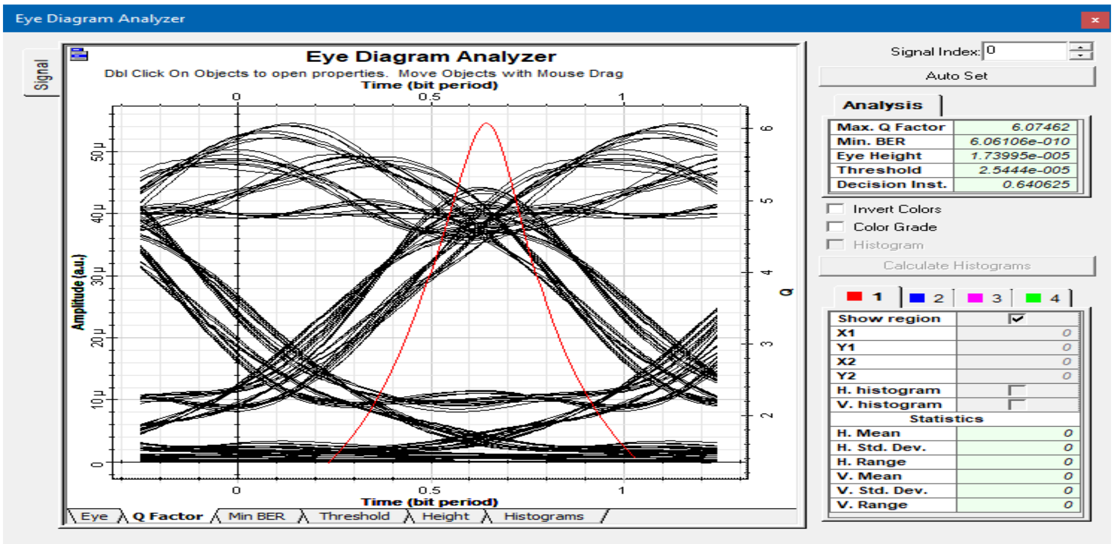

Figure (7) shows the system quality measurement parameters (4dbm) at 90Km.

After increasing the cable length to 90 km, the Q-factor will be decreasing in to 6.07, and a decrease in the bit error rate to 6.06 x 10^{-010}. Here the result was also unsatisfactory and bad and the data loss was huge, when we changed the transmit power to 4 dBm, we also notice that EYE DIGRAEM became random and unstable and also we noticed that when we increased the transmit power to 4, the q-factor increased and the bit-error rate decreased.

f- At (5dbm) transmission power

The following figure (8) shows the value of the quality factor (Q-factor) and the value of the error between transmitted and received bits (BER) as well as the EYE DIGRAEM of the results obtained at a distance of 90km.

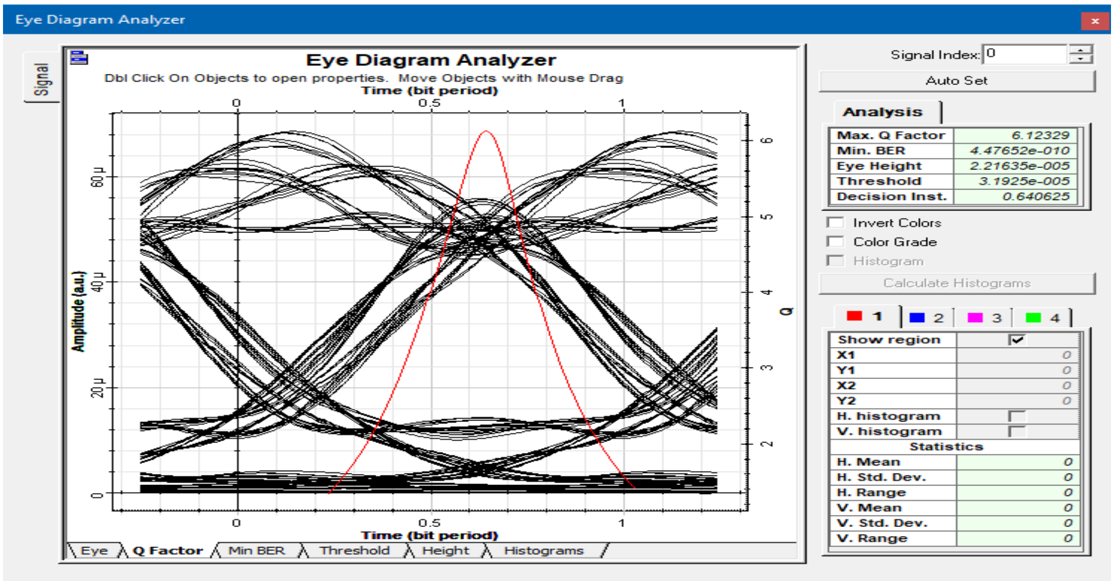

Figure (8) shows the system quality measurement parameters (5dbm) at 90Km.

After increasing the cable length to 90 km, the Q-factor will be decreasing in to 6.12, and a decrease in the bit error rate to 4.47 x10^{-010}. And here we noticed that at a distance of 90 km and when we changed the transmitting power to 5 dBm, we also noticed that the EYE DIGRAEM became random and unstable .

g- At (6dbm) transmission power

The following figure (9) shows the value of the quality factor (Q-factor) and the value of the error between transmitted and received bits (BER) as well as the EYE DIGRAEM of the results obtained at a distance of 90km.

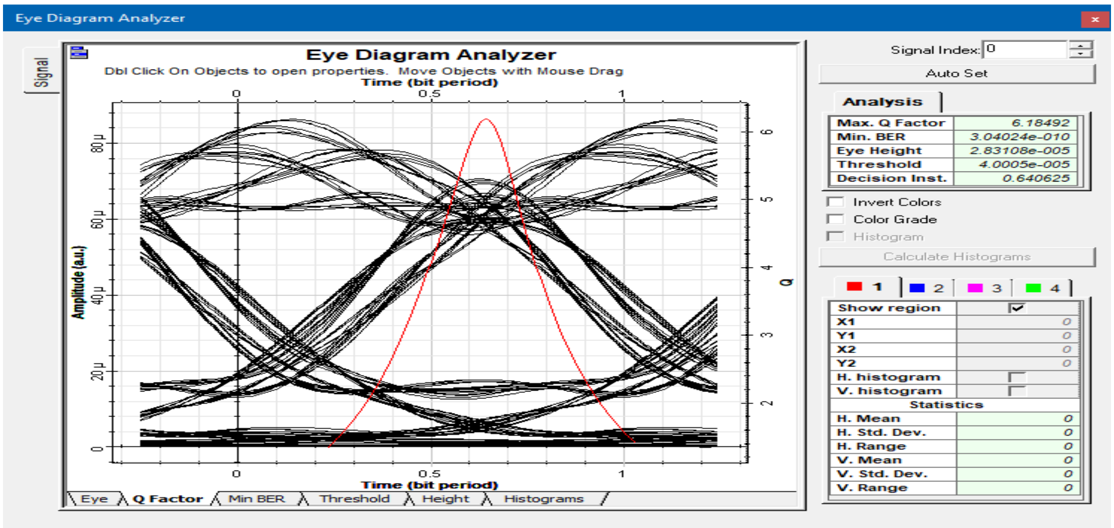

Figure (9) shows the system quality measurement parameters (6dbm) at 90Km.

After increasing the cable length to 90 km, the Q-factor will be decreasing in to 6.18, and a decrease in the bit error rate to 3.04 x 10^{-010}. And here we noticed that at a distance of 90 km and when we changed the transmitting power to 6 dBm, we also noticed that the EYE DIGRAEM became random and unstable

h- At (7dbm) transmission power

The following figure (10) shows the value of the quality factor (Q-factor) and the value of the error between transmitted and received bits (BER) as well as the EYE DIGRAEM of the results obtained at a distance of 90km.

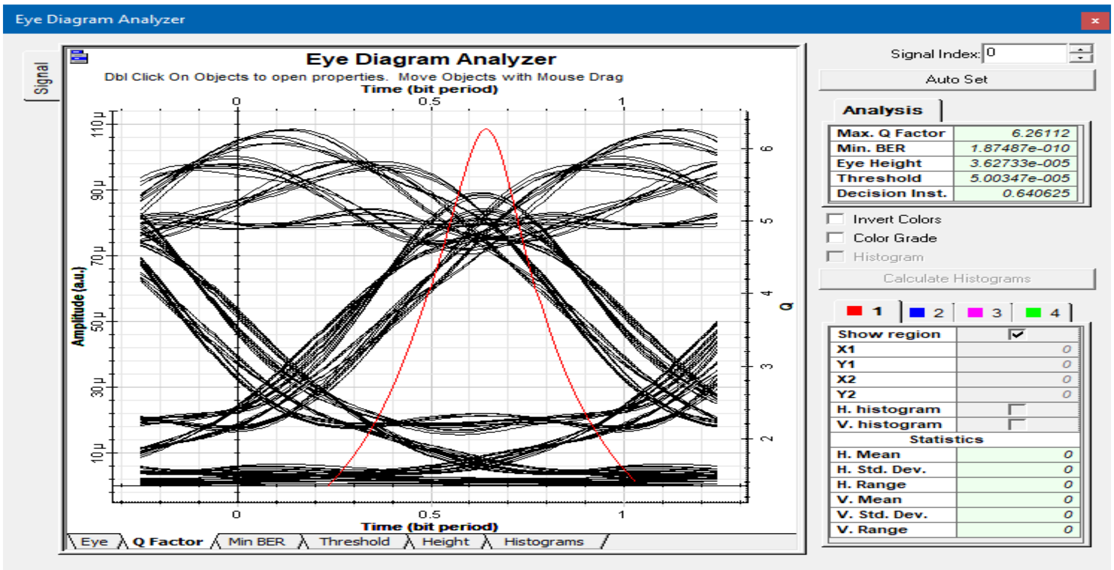

Figure (10) shows the system quality measurement parameters (7dbm) at 90Km.

After increasing the cable length to 90 km, the Q-factor will be decreasing in to 6.26, and a decrease in the bit error rate to 1.87 x $^{10-010}$. Here we noticed that at a distance of 90 km and when we changed the transmit power to 7 dB we noticed a much lower bit error rate than the previous distances, we also noticed that the EYE DIGRAEM became random and unstable.

i- At (8dbm) transmission power

The following figure (11) shows the value of the quality factor (Q-factor) and the value of the error between transmitted and received bits (BER) as well as the EYE DIGRAEM of the results obtained at a distance of 90km.

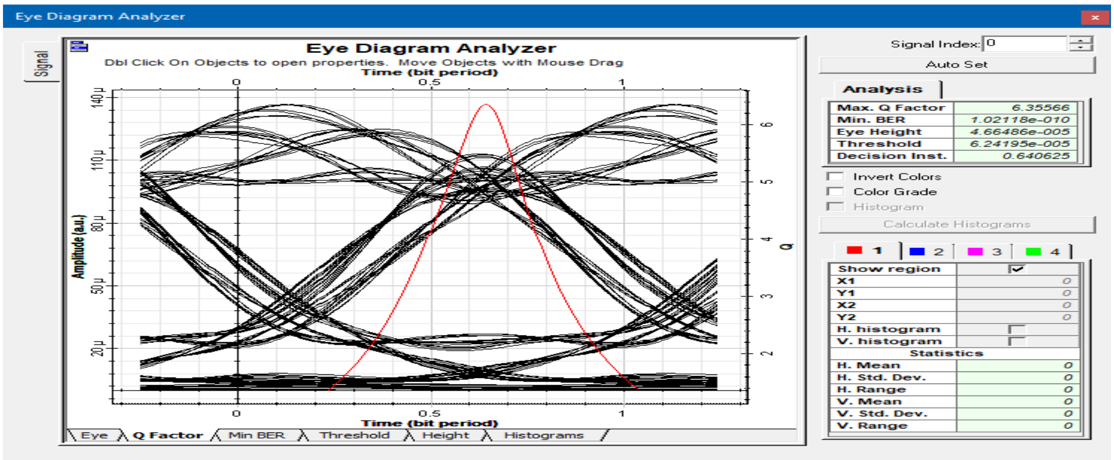

Figure (11) shows the system quality measurement parameters (8dbm) at 90Km.

After increasing the cable length to 90 km, the Q-factor will be decreasing in to 6.35, and a decrease in the bit error rate to 1.02 x 10^{-010}. Here we noticed that at a distance of 90 km and when we changed the transmit power to 8 dB we noticed a much lower bit error rate than the previous distances; we also noticed that the EYE DIGRAEM became random and unstable.

1.5 conclusion

From simulation results above (figures 3-11) we can see that After increasing the transmission power, the Q-factor will be increasing, and the bit-error rate will be decreasing. One of the worst results obtained, due to the decreased transmission power to -1dbm, causing huge data loss and unsatisfactory result. We also note that the EYE DIGRAEM has become random and unstable, we can say that the greater the transmission power, greater the Q-factor.

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