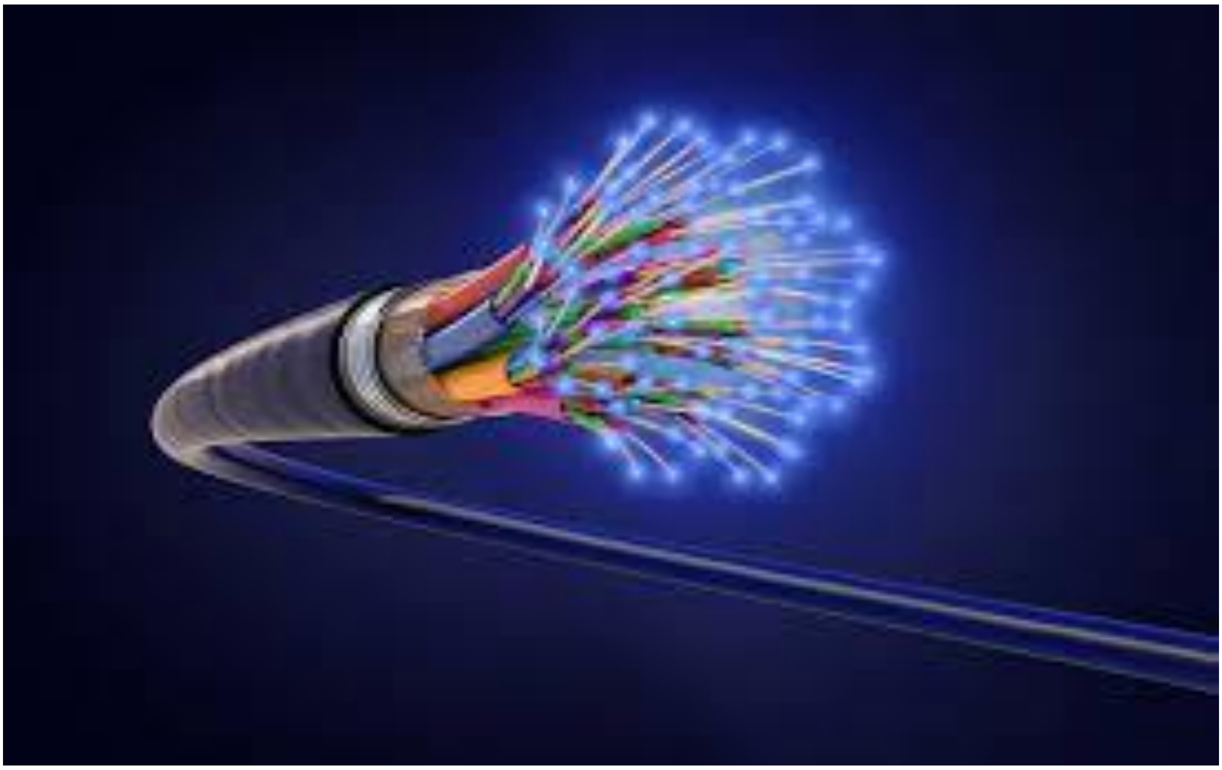
LAKSHMI NARAIN COLLEGE OF TECHNOLOGY EXCELLENCE

Optical Fiber Communication [EC-801] Laboratory Manual



Name of the Student :- ………………………………….

Enrollment No:- ………………………………………...

Vision and Mission of the Department

Vision

To become reputed in providing technical education in the field of electronics and communication engineering and produce technocrats working as leaders.

Mission

- To provide congenial academic environment and adopting innovative learning process.
- To keep valuing human values and transparency while nurturing the young engineers.
- To strengthen the department by collaborating with industry and research organization of repute.
- To facilitate the students to work in interdisciplinary environment and enhance their skills for employability and entrepreneurship.

Program Specific Outcomes (PSO's)

- PSO1: Analyze specific engineering problems relevant to Electronics & Communication Engineering by applying the knowledge of basic sciences, engineering mathematics and engineering fundamentals.
- PSO2: Apply and transfer interdisciplinary systems and engineering approaches to the various areas, like Communications, Signal processing, VLSI and Embedded system, PCB Designing.
- PSO3: Inculcate the knowledge of Engineering and Management principles to meet demands of industry and provide solutions to the current real time problems.
- PSO4: Demonstrate the leadership qualities and strive for the betterment of organization, environment and society.

Program Educational Objectives (PEO's)

Student will be able to

PEO1: Recognize and apply appropriate experimental and scientific skills to solve real world problems to create innovative products and systems in the field of electronics and communication engineering.

PEO2: To evolve graduates with ability to apply, analyze, design in Electronics & Communication Systems.

PEO3: Motivate graduates to become responsible citizens with moral & ethical values for the welfare of Society.

PEO4: Inculcate the habit of team work with professional quality of leadership to become successful contributors in industry and/ or entrepreneurship in view of Global & National status of technology.

Code of Conducts for the Laboratory

- All bags must be left at the indicated place.
- The lab timetable must be strictly followed.
- Be **PUNCTUAL** for your laboratory session.
- Noise must be kept to a minimum.
- Workspace must be kept clean and tidy at all time.
- Handle the experiment kit and interfacing its with care.
- All students are liable for any damage to the accessories due to their own negligence.
- Students are strictly **PROHIBITED** from taking out any items from the laboratory.
- Students are **NOT** allowed to work alone in the laboratory without the Lab Supervisor
- Report immediately to the Lab Supervisor if any malfunction of the accessories, is there.
- Before leaving the lab Place the stools properly.
- Please check the laboratory notice board regularly for updates.

Lakshmi Narain College of Technology Excellence, Bhopal

CONTENT

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1	The objective of this experiment is to study a 650-mm fibre optic analog link. In this experiment you will study the relationship between the input signal and received signal.			
2	The objective of the experiment is to obtain Amplitude Modulation of the analog signal, transmit it over a fibre optic cable and demodulate the same at the receiver and to get back the original signal.			
3	The objective of this experiment is to obtained amplitude modulation of digital signal, transmit it over fiber optic cable and demodulate the same at the receiver end to get back the original signal			
4	To study Frequency Modulation (FM).			
5	To study Pulse Width Modulation.			
6	The objective of this experiment is to study bending loss.			
7	The object of this experiment is to measure to the Numerical Amplitude (NA) of the fibre.			
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Experiment No 1

Objective:

The objective of this experiment is to study a 650-mm fibre optic analog link. In this experiment you will study the relationship between the input signal and received signal.

Theory:

Fibre optic can be used for transmission of digital as well as analog signals. Basically, a fibre optic link contains three main elements, a transmitter, an optical fibre and a receiver. The transmitter module takes the input signal in electrical form and then transforms it into optical (light) energy containing the same information. The optical fibre is the medium, which takes the energy to the receiver. At the receiver light is converted back into electrical form with the same pattern as originally fed to the. transmitter.

Transmitter:

Fibre optic transmitters are typically composed of a buffer, driver and optical source. The buffer provides both an electrical connection and isolation between the transmitter & the electrical system supplying the data. The driver provides electrical power to the optical source. Finally, the optical source converts the electrical current to the light energy with the same pattern. Commonly used optical sources are light emitting diodes (LEDs) and Laser beam. Simple LED circuits, for digital and analog transmission are shown as below:

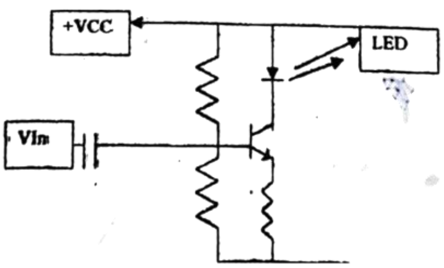


Fig shows Trans conductance drive circuits for analog transmission-common emitter configuration. The Transmitter section comprises of

1. Function generator.
2. Frequency modulator &
3. Pulse with modulator block.

The function generates the input signals that ere going to be used as information to through the fibre optic link. The output voltage available are 1KHz sinusoidal signal of adjustable amplitude, and fixed amplitude 1 KHz square wave signal. The modulator accepts the information signal and converts it into suitable from for transmission through the fibre optic link. The output voltages available are 1 KHz sinusoidal signal of adjustable amplitude, and fixed amplitude 1 KHz square wave signal. The modulator section accepts the information and converts it into suitable from for transmission the fibre optic link.

The Fibre Optic Link:

Emitter and Detector circuit on board the fibre optic link. This section provides the light source for the optic fibre and the light detector at the far end of the fibre optic links. The Optic plugs into the connectors provided in this part of the board. Two separate links are provided.

The Receiver:

The Comparator circuit, Low Pass Filter Locked Loop, AC Amplifier Circuits form receiver on the board. It is able to undo the modulation process in order to recover the original information signal. In this experiment the trainer board is used to illustrate one way communication between digital transmitter and receiver circuits.

Procedure:

1. Connect the power supply to the board.
2. Ensure that all faults are off.
3. Make the following connections. (As shown in Diagram 1).
4. (a). Connect the F.G. 1 KHz sine wave output to emitter 1's Input.

(b). Connect the F.O cable between emitter output and directors’ input,

(c) Detector 1's output to AC Amplifier 1 input.

5. On the board, switch emitter 1's driver to Analog mode.
6. Switch ON the power.
7. Observe the input to emitter 1 (t.p 5) with the output from A/C Amplifier 1 (1.p28) and note that the two signals are same.

Result:

The input and output signals are the same.

Experiment No. 2

Objective:

The objective of the experiment is to obtain Amplitude Modulation of the analog signal, transmit it over a fibre optic cable and demodulate the same at the receiver and to get back the original signal.

APPARATUS REQUIRED:

ST2502 WB SCIENTECH Trainer Board, Oscilloscope, Optical Fibre Patch Cords, Connecting Cords.

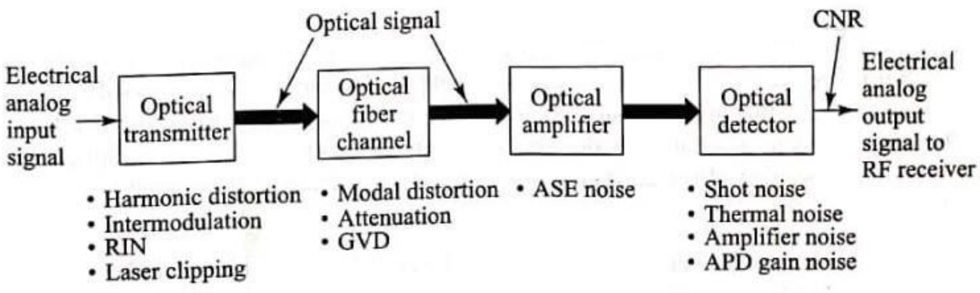
THEORY:

Modulation-

In order to transmit information via an optical fiber communication system it is necessary to modulate a property of the light with the information signal. This property may be intensity, frequency, and phase with either digital or analog signals. The choices are indicated by the characteristics of optical fiber, the available optical sources and detectors, and considerations of the overall system.

Amplitude Modulation:

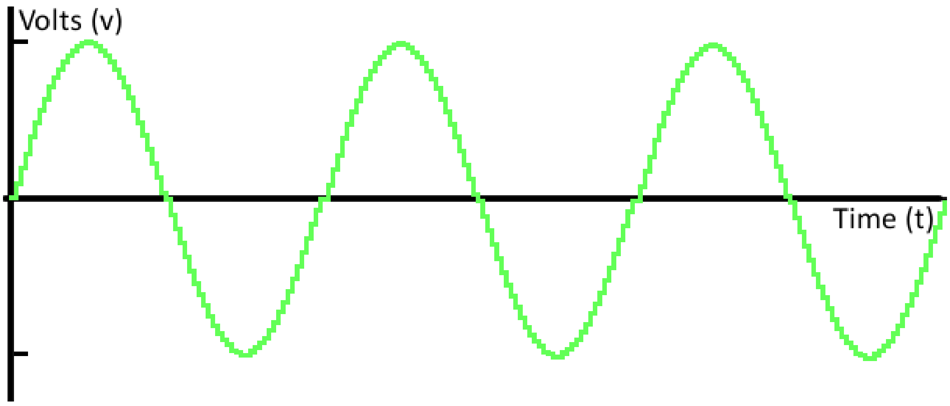
In this system the information signal is used to control the amplitude. At the far end, the variation in the amplitude of the received signal is used to recover the original information signal.



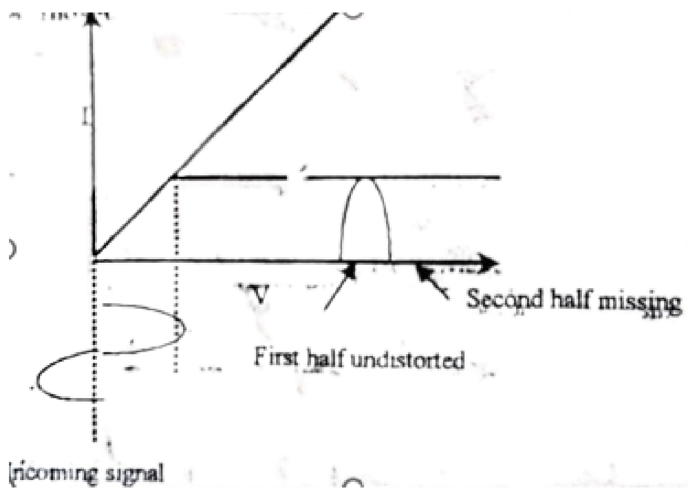
The audio input signal is used to control the current through an LED, which in turn controls the light output. The light is conveyed to the detector circuit by optic fibre. The detector is a phototransistor, which converts the incoming light to a small current that flows through a series resistor. This gives rise to a voltage whose amplitude is controlled by the received light intensity. The voltage is then amplified within the detector circuit and, if necessary, further amplified by an amplifier circuit.

The Analog Bias Voltage:

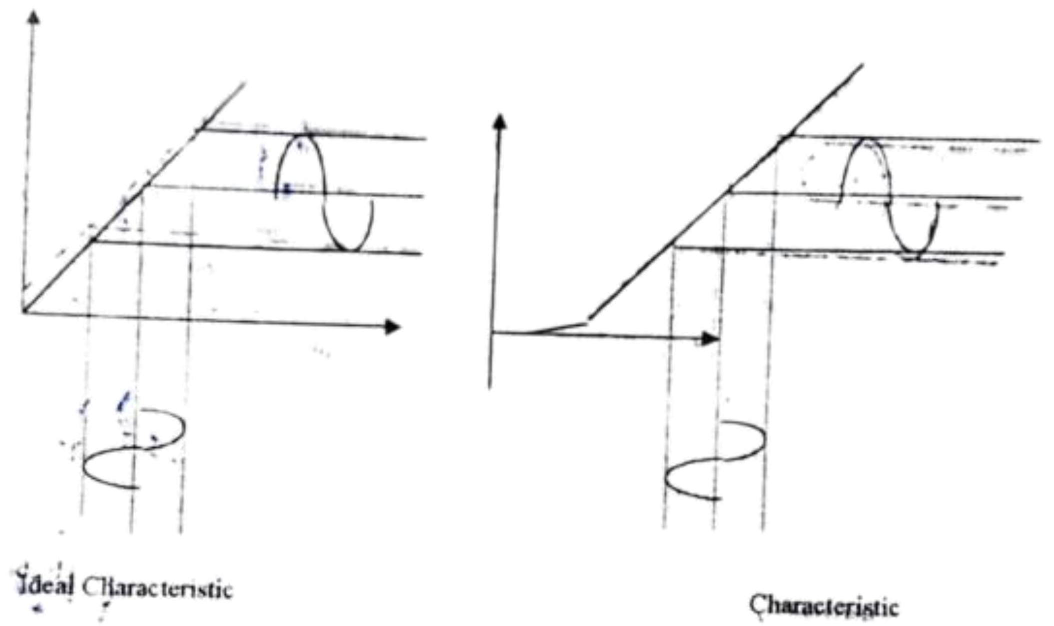
There are two problems using amplitude modulation with an analog signal, The first is to do with the signal itself.



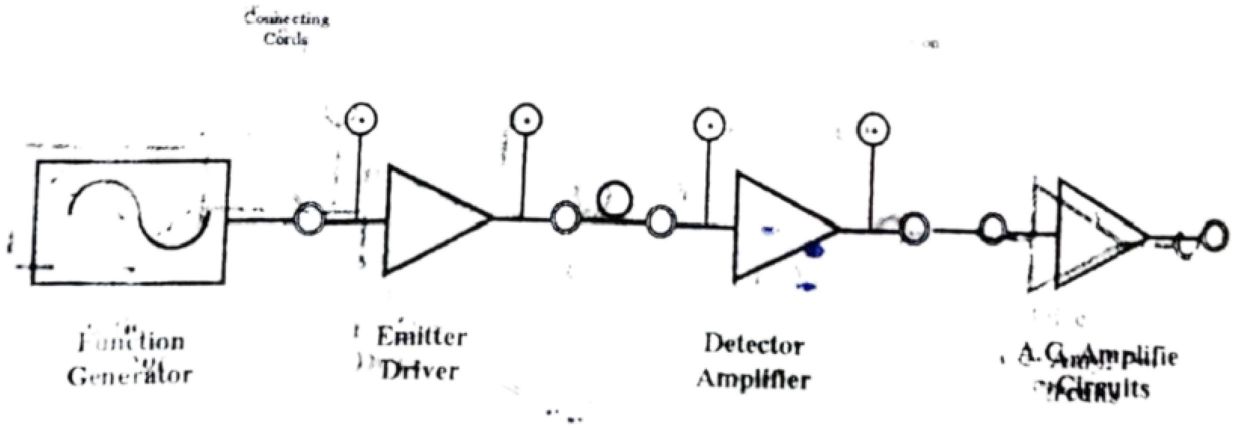
If Figure No. 2 is observed, it can be seen that the analog waveform moves both positive and negative of the zero line. The second problem is that the shape of the waveform carries the information. Ideally, the emitter characteristic would be a straight line. However, in this case, one would lose the negative-going half cycles, as shown.



The solution is to superimpose the sinusoidal signal on a positive bias voltage. Both halves of the incoming signal have an effect on the light intensity. The combination of a linear characteristic would be ideal, but in reality, the characteristic is not completely straight. However, it does have a straight section that can be used if a suitable value of bias voltage is employed. Figure 23 shows the ideal and practical situations.



Connection Diagram:



PROCEDURE:

1. Connect the power supply cord to the board.
2. Ensure that all switches are off.
3. Make the following connections as shown in Figure 4: (a) Connect the Function Generator's 1 KHz sine wave output to emitter 1's input. (b) Connect the Fiber Optic cord between the differential output and detector 1's input. (c) Connect Detector 1's output to AC Amplifier input.
4. On the board, switch emitter 1's driver to Analog node.
5. Turn the 1KHz preset in the function generator block to the maximum clockwise position (maximum amplitude).
6. Switch ON the power.
7. Observe the input to emitter 1 (TP5) with the output from detector 1 on the oscilloscope, and note that the signal at the detector should carry a smaller version of the original 1KHz sine wave, illustrating that the modulated light beam has been reconverted back into an electrical signal.
8. The output from detector 1 is further amplified by AC Amplifier, which increases the amplitude of the received signal and removes the DC component that is present at the detector output. Monitor the output of Amplifier 1 (TP28) on the CRO and adjust the gain adjustment present until the monitored signal has the same amplitude as that applied to emitter 1's input (TP5).
9. While monitoring the output of Amplifier 1 (TP28), change the amplitude of the modulating sine wave by varying the 1KHz preset in the function generator block. Note that as expected, the amplitude of the receiver output signal changes.

Result:

The signal is modulated, transmitted through the optical fiber, and the original signal is obtained back.

Experiment No. 3

Objective:

The objective of this experiment is to obtained amplitude modulation of digital signal, transmit it over fiber optic cable and demodulate the same at the receiver end to get back the original signal

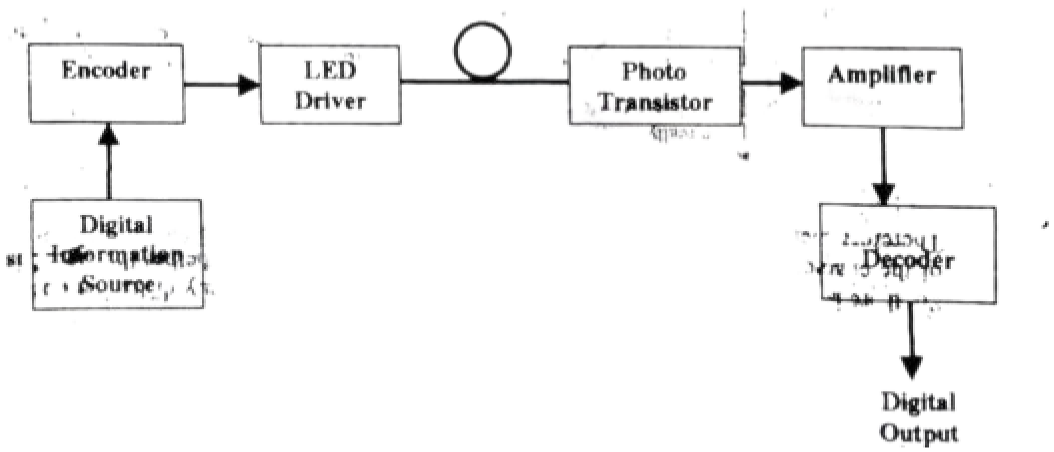
Theory:

Modulation:

In order to transmit information via an optical fiber communication system it is necessary to modulate a property of the light with the information signal. This property may be intensity, frequency, and phase with either digital or analog signals. The choices are indicated by the characteristics of optical fiber, the available optical sources and detectors, and considerations of the over all system.

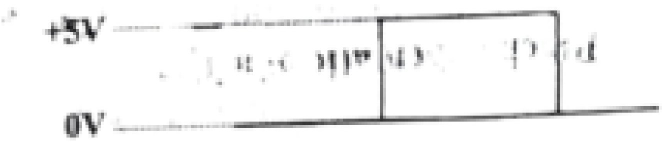
Digital Modulation:

With digital modulation, discrete changes in light intensity are obtained (i.c. ON-OFF pulse) figure 1 shows a block schematic a typical digital optical fiber link.

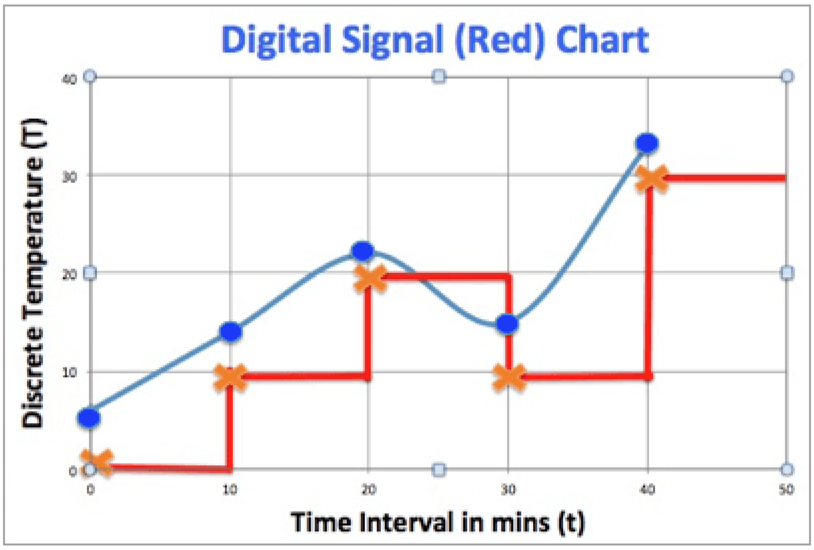


The LED drive circuit directly modulates the intensity of the light with encoded digital signal. Hence, a digital optical signal is launched into the optical fiber cable. The photo transistor used as detector is followed by an amplifier is provide gain. Finally, the signal obtained is deded to give theoriginated digital information

The key information that needs to be conveyed is the ON state and OFF state of the optical signal. In the case of a digital signal, the input signal is entirely positive-going, as shown in the figure. However, in order to detect the digital signal, a detector is used that is sensitive to the positive-going part of the signal. Hence, the digital input signal is used to determine the ON and OFF states of the optical signal.

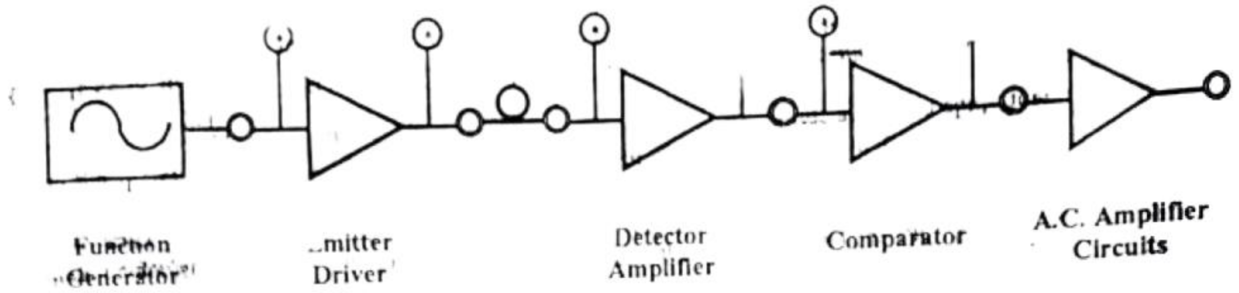


So, there is no negative part of the signal to be lost, and furthermore, any distortion due to non-linearity of the characteristic is of no importance. All one needs to know is whether the signal is ON or OFF. Therefore, there is no need to generate a bias voltage.



When amplitude modulation is used with a digital input, one has to employ a comparator at the receiving end to convert the modulated waveform back into a square waveform, which is often referred to as "cleaning up" the waveform. This is necessary to accurately detect and decode the digital signal from the modulated carrier signal. The comparator compares the received signal with a reference level and produces a square waveform output that represents the original digital signal.

CONNECTION DIAGRAM:



PROCEDURE:

1. Connect the power supply cord to the board.
2. Ensure that all switched faults are off.
3. Make the following connections, as shown in Figure 4:
   (a) Connect the Function Generator's 1 KHz sine wave output to emitter 1's input.
   (b) Connect the Fiber Optic cord between emitter 1 output and detector 1's input.
   (c) Connect Detector-1's output (t.p. 10) to Comparator's non-inverting (+ve) input.
   (d) Connect Comparator's output to AC Amplifier input.
4. Switch on the board and switch emitter 1's driver to digital mode. This ensures that the signal applied to the driver's input causes the emitter LED to switch quickly between On and OFF states.
5. Examine the input to emitter 1 on an oscilloscope. This should show a 1 KHz square wave, which is now being used to amplitude modulate the emitter LED.
6. Examine the output of detector 1 (t.p. 10). It should carry a smaller version of the original 1 KHz square wave, illustrating that the modulated light beam has been reconverted back into an electrical signal.
7. Monitor both input to the comparator (t.p. 13 and 14) and slowly adjust the comparator bias 1 present until the DC level on the negative input (t.p. 13) lies midway between the high and low levels of the signal on the positive input (t.p. 14). This DC level is the comparator's threshold level.

8. Examine the output of the comparator (t.p. 15). Note that the original digital modulating signal has been reconstructed at the receiver.
9. Once a carefully flex the fiber optic cable, one can see that there is no change in output on bending e fiber. The output amplitude is now independent of the bend radius of the cable and that of length of cable, provided that detector output signal, is large enough to cross flight bean by threshold level. This illustrates one of the advantages of amplitude modulation of light beam by digital rather than analog means. Also, non-linearity within the emitter LED. & photo transistor causing distortion of the signal at the receiver output are disadvantages associated with amplitude modulating a light source by analog means. Linearly is not a problem if the light beam is switched ON and OFF with a digital signal, since the detector output is simply squared up by a Comparator circuit.
10. To overcome problems associated with amplitude modulation of a light beam by analog means, analog signals are often used to vary or modulate some characteristic of a digital signal (e.g freq. or goyd pulsavidth)he digital signal being used to switch the light beam ON and OFF"

RESULT:

The digital signal is modulated, transmitted through the optical fiber and the original signal is obtained back

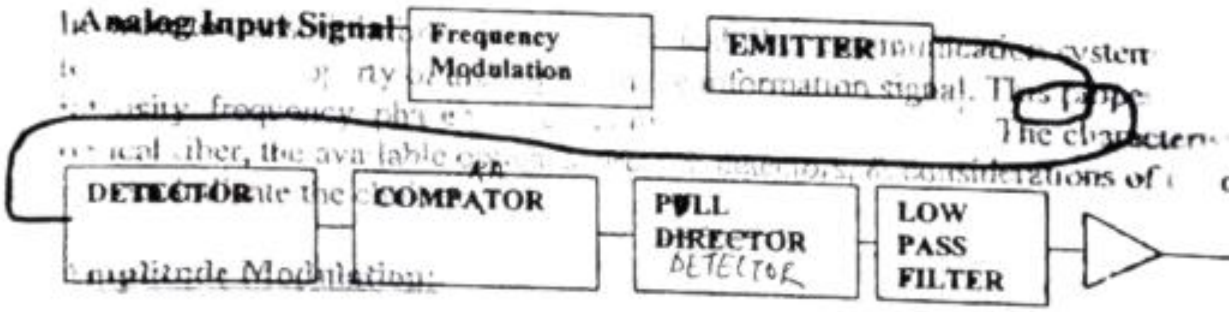
Experiment No. 4

Objective:

To study Frequency Modulation (FM).

Theory:

In the traditional form of FM the carrier frequency is changed or modulated by the amplitude of the analog signal. In a Siber optic system, this is not feasible since both our light sources, the LED and the LASER are fixed frequency devices. In fiber option Isystems FM is achieved by using the original analog input signal to vary the frequency of 4.train of digital pulses.



The digital pulses are communicated through the optic fiber and squared at the receiver by a comparator, similar to amplitude modulation. The LED, in turn, controls the light output, which is conveyed to the detector.

Procedure:

1. Connect the power supply cord to the board.
2. Ensure that all switched faults are off.
3. Make the following connections (as shown in Diagram 5):

   a. Connect the output of the function generator (1 kHz sine wave) to the input of the frequency modulator.
   b. Connect the output of the frequency modulator to the input of the LED, which acts as the light source.
   c. Connect the output of the LED to the input of the phototransistor, which acts as the detector.
   d. Connect the output of the phototransistor to a series resistor to convert the small current into a
   e. Further amplify the voltage using an amplifier, if necessary.

4. Connect the output of Detector 1 to the input of AC Amplifier 1, which further amplifies the signal from the detector and removes the DC component. Monitor the output of Amplifier 1 at test point 28 and adjust the gain adjust preset until the monitored signal has the same amplitude as the signal applied to the emitter input at test point 5.
5. While monitoring the output of Amplifier 1 at test point 28, change the amplitude of the modulating sine wave by varying the 1 kHz preset in the Function Generator block. Note that, as expected, the amplitude of the receiver output signal changes accordingly.
6. Disconnect the input of the 1 kHz sine wave from the emitter 1 socket.
7. Make the following additional connections:
   a. Connect the audio input block's input to the microphone.
   b. Connect the output of the audio input block to the input of emitter 1.
   c. Connect the output of AC Amplifier 1 to the input of the audio output block.
8. Switch on the power supply.
9. Observe that the same audio output is available on the speaker as fed to the microphone, indicating successful audio modulation of the fiber optic signal.

Note: The specific values of components, connections, and test points may vary depending on the actual setup and requirements of the system. Please refer to the relevant documentation and circuit diagrams for accurate details.

RESULT:

Voice communication through F.O. cable using amplitude modulation has been studied.

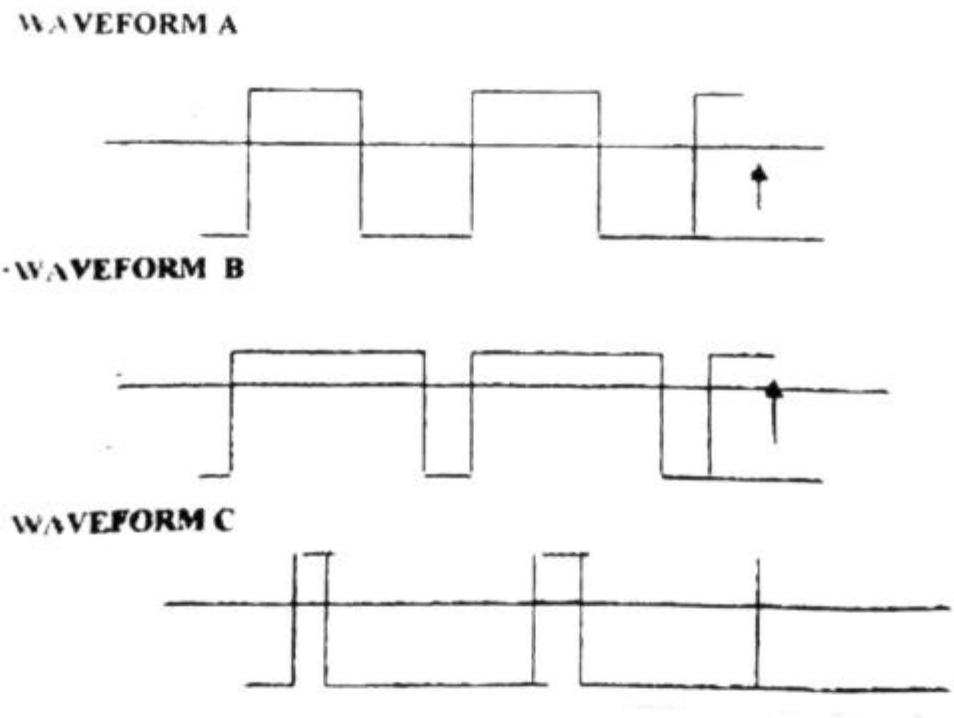
Experiment No. 5

Objective:

To study Pulse Width Modulation.

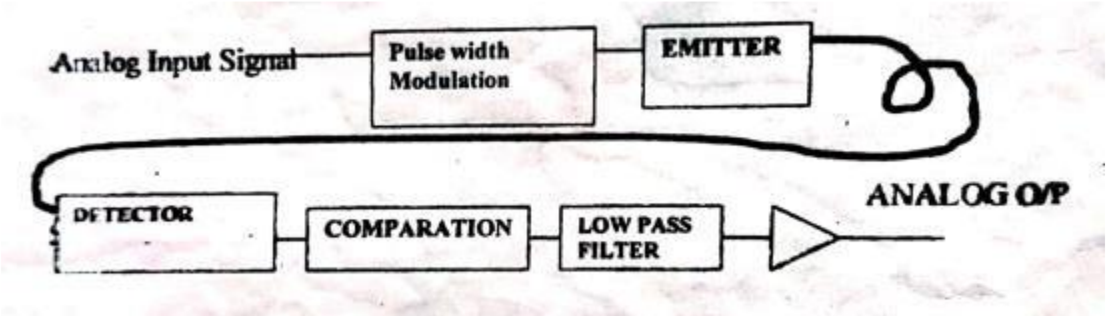
THEORY

Pulse width modulation (PWM) is an alternative to frequency modulation. They are botla digital transmissions, the incoming analog signal is used to change the frequency of the digital stream. In pulse width modulation the width of the pulse is changed by the amplitude of the analog signal to be transmitted. It is an extremely simple system of modulation. Assume a input signal at zero volts. The digital stream and the average voltage level would be as shown in Fig.



If the input voltage moves to a positive value, the pulse width of the digital pulses will increase, as the waveform will be ON for a longer duration compared to OFF. This will result in an increase in the average value of the digital voltage. Similarly, if the input voltage goes negative, the pulse width will decrease, resulting in a decrease in the average values of the digital voltage. This means that the average voltage level is increasing or decreasing in accordance with the input voltage.

At the far end of the transmission system, the digital pulses are cleaned up by a comparator and then passed through a low pass filter. The filter removes the square waves, but the average level remains, forming the output signal. However, at this stage, the output signal may still contain a DC level due to the input signal. To remove this DC level, blocking capacitors are used at the input to the final amplifier.



Procedure:

1. The power supply is connected to the board.
2. All switched faults are set to off.
3. Connections are made as per Diagram 6, which includes connecting the function generator's 1KHz sine wave signal to the pulse width modulator input at TP4, and connecting the output of the pulse width modulator at TP4 to the emitter 1 input at TP5. Additionally, the optic fiber is connected between the emitter 1 circuit and detector 1 circuit, and various connections are made between different blocks and detectors in the system.
4. The 1KHz preset in the function generator block is turned fully anticlockwise to zero amplitude position.
5. The power supply is switched on.
6. The output of the pulse width modulator block at TP4 is monitored, and it is noted that the pulse width of the digital signal is currently constant since the modulating 1KHz sine wave has zero amplitude.
7. The output of detector at TP10 is examined to check if the transmitted digital pulses are successfully detected at the receiver.
8. The inputs of comparator 1 at TP13 and TP14 are monitored, and if necessary, the bias present of the comparator is slowly adjusted until the DC level on the negative input TP13 lies midway between the high and low levels of the signal on the positive input TP14.

9. The average level of comparator 1's output, which is proportional to the pulse width, is examined at LPF 1 input at TP19, and then amplified by AC Amplifier 1 input at TP27. The output of AC Amplifier 1 is monitored at TP28 and noted that the output voltage is currently zero, as there is no modulating voltage at the transmitter.
10. While monitoring the input to the pulse width modulator block at TP3 and the output of AC Amplifier 1 at TP28, the 1KHz preset in the function generator block is turned fully clockwise to its maximum amplitude position. The modulating 1KHz signal appears at the amplifier output, and if necessary, the gain adjust 1 preset of the amplifier is adjusted until the two nominated signals are equal in amplitude.
11. To fully understand how the pulse width modulation transmitter/receiver system works, the inputs and outputs of all functional blocks within the system are examined using an oscilloscope.

RESULT:

The method of pulse width modulation is studied.

Experiment No. 6

Objective:

The objective of this experiment is to study bending loss.

APPARATUS REQUIRED

Fibre optic trainer kit.

THEORY: -

Whenever the condition for an angle of incidence of the incident light is violated the losses are introduced due to refraction of light. This occurs when fiber is subjected to bending. Lower the radius of curvature more is the loss.

PROCEDURE:

1. Connect the power supply to board.
2. Make the following connections. (a).F.G.-1 KHz sinewave output to input 1 socket of emitter 1 circuit via 4mm lead. (b).Connect Im optic fiber emitter 1 output & detector I's input. (c).Connect detector 1 output to amplifier 1 input socket via 4mm lead.
3. Switch ON the power supply.
4. Set the oscilloscope channel 1 to 0.5 V/div and adjust 4-6 div amplitude by using XI probe with the help of variable pot in function generator block at input I of emitter 1.
5. Observe the output signal from detector t.p. 10 on CRO.
6. Adjust the Amplitude of the received signal as that of transmitted one with the help of gain adjust pot in AC Amplifier block. Note this amplitude & call it V1.
7. Wind the FO cable on the mandrel & observe the corresponding AC amplifier output on CRO, it will be gradually reducing showing loss due to bends.

RESULT:

The bending losses in optical fibre is studied.

Experiment No. 7

Objective:

The object of this experiment is to measure to the Numerical Apertame (NA) of the fibre

APPARATUS REQUIRED:

Numerical aperture measurement Jig.

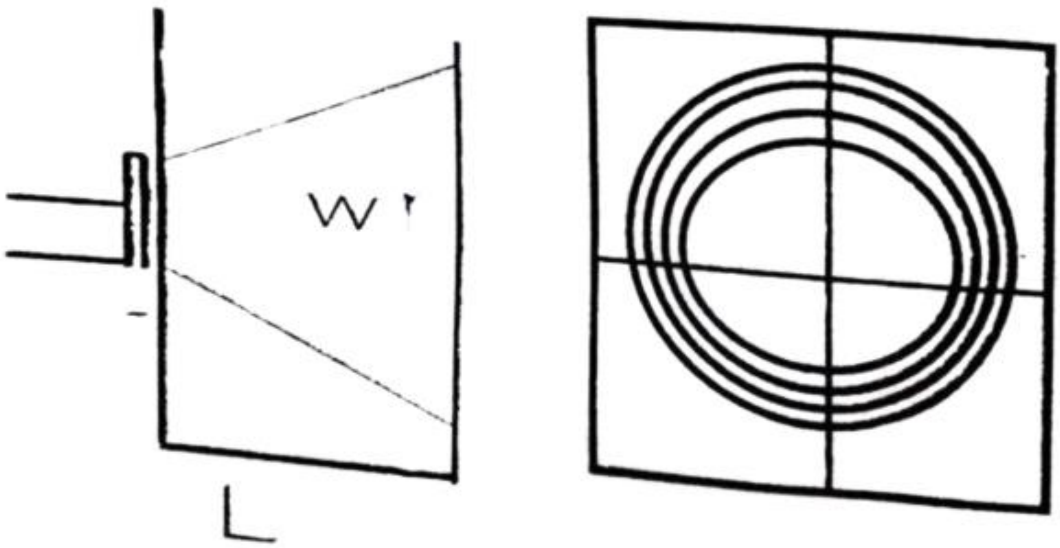
Theory:

Numerical aperture refers to the maximum angle at which the fight incident on the fiber end is totally internally refecited and is transmitted properly along the fiber. The cone formed by the rotation of this angle along the axis of the fiber is the case of auceptance of the fiber. The light ray should strike the fiber end within its one of acompte dise it is refracted out of the fiber. Consideration in NA measurement

1. It is very important that the optical source should be properly aligned with the cable and the distance from the launched point and cable be property selected to me that the maximum amount of optical power is transferred to the cable.

Procedure:

1. Connect power supply to the board.
2. Connect the frequency generartor's 1KHZ sine wave output to input of emineri circuit. Adjust its amplitude 5 V p-p.
3. Connect one end of the fiber cable to the output socket of the emitter circuit and the other end to the Numerical Aperture measurement jig. Ensure that the white screen is facing the fiber with its cut face perpendicular to the fiber.
4. Hold the white screen with four concentric circles (10mm, 15mm, 20mm, and 25mm diameter) vertically at a suitable distance, so that the red spot from the fiber coincides with the 10mm circle on the white screen.
5. Record the distance of screen from fiber end L and the diameter W of the spot.



6. Compute the numerical aperture from the formula given below,

$$NA = \frac{W}{\sqrt{4L^2 + W^2}} = \sin\theta_{max}$$

7. Vary the distance between in screen and fivber optic cable and make it coincide with one of the concentric Note its distance.
8. 8.Tabulate the various distances and diameters of the circles made on the white screen and compute the numerical aperture from the formula given above.

RESULT:

The value of the numerical aperture of fiber cable is_____.

Experiment No. 8

Objective:

The objective of this experiment is to study voice communication through F.O. cable sing amplitude modulation.

APPARATUS REQUIRED

Fiber optic trainer kit.

THEORY

Modulation:

In order to transmit information via an optical fiber communication system it is necessary to modulate a property of the light with the information signal. This property may be intensity, frequency, phase with either digital or analog signals. The characteristics of optical fiber, the available optical sources & detectors, & considerations of the overall system indicate the choices.

Amplitude Modulation:

In this system the information signal is used to control the amplitude of the signal: At the far end, the variation in the amplitude of the received signal is used to recover the original information signal. The audio input signal is used to control the current through an LED which in turn controls the light output. The light is conveyed to the detectorals Circuit by optic fiber. The detector is a phototransistor, which converts the incoming light to a small current, which flows through a series resistor. This gives rise to a voltage whose amplitude is controlled by the received light intensity. The voltage is now amplified within the detector circuits & if necessary, amplified further by amplifier circuit.

The Analog Bias Voltages:

One issue with using amplitude modulation with an analog signal is that the signal waveform moves above and below the zero line, as shown in the figure. This means that the negative half-cycle of the waveform, which carries information, would be lost. To address this, a solution is to superimpose the sinusoidal signal on a positive voltage called the bias voltage, so that both halves of the incoming signal have an effect on the light intensity.

The ideal scenario would be to have a linear characteristic for the emitter, but in reality, the characteristic is not completely straight. However, by employing a suitable value of bias voltage, we can compensate for this non-linearity. The figure below illustrates the ideal and practical situations for bias voltages.

PROCEDURE:

1. Connect the power supply to the board and check that the transmitter (emitter 1) is receiving power.
2. Make the following connections:
   a) Connect the FG (function generator) output marked "1 KHz sinewave" to the input of emitter 1.
   b) Plug in a fiber optic link from the output of emitter 1 LED to the phototransistor at the detector 1:16th with the remember and c) Connect the output of detector 1 to the input of amplifier 1:27, after its transmission through.

3. In the emitter 1 block switch, select the mode to "analog conversion" mode.

4. Turn the 1 KHz preset in the function generator block to the fully clockwise position and then examine.

5. Switch ON the power supply and adjust the voltage as required.

6. With the help of a dual trace oscilloscope, observe the input signal at emitter 1 (output from function generator) on channel 1, and observe the output from the detector on channel 2. The output from the detector should carry a small version of the original 12 KHz sinewave, illustrating that the modulated light beam has been reconverted back into an electrical signal.

7. While monitoring the input to the frequency modulator block (TP1) and the output from AC Amplifier 1 (TP28), turn the 1 KHz preset to its fully clockwise position (maximum amplitude). Note that the modulating 1 KHz signal now appears at the amplifier output. If necessary, adjust the amplifier's gain adjust 1 preset until the two monitored signals are equal in amplitude.

8. Examine the output of the amplifier using an oscilloscope to fully understand how this frequency modulation transmitter/receiver system works, and observe the outputs of all functional blocks within the system.

RESULT:

The method of frequency modulation is studied.

Experiment No. 9

Objective:

The objective of this experiment is to study eye pattern using fiber optic link.

APPARATUS REQUIRED:

Oscilloscope

Theory:

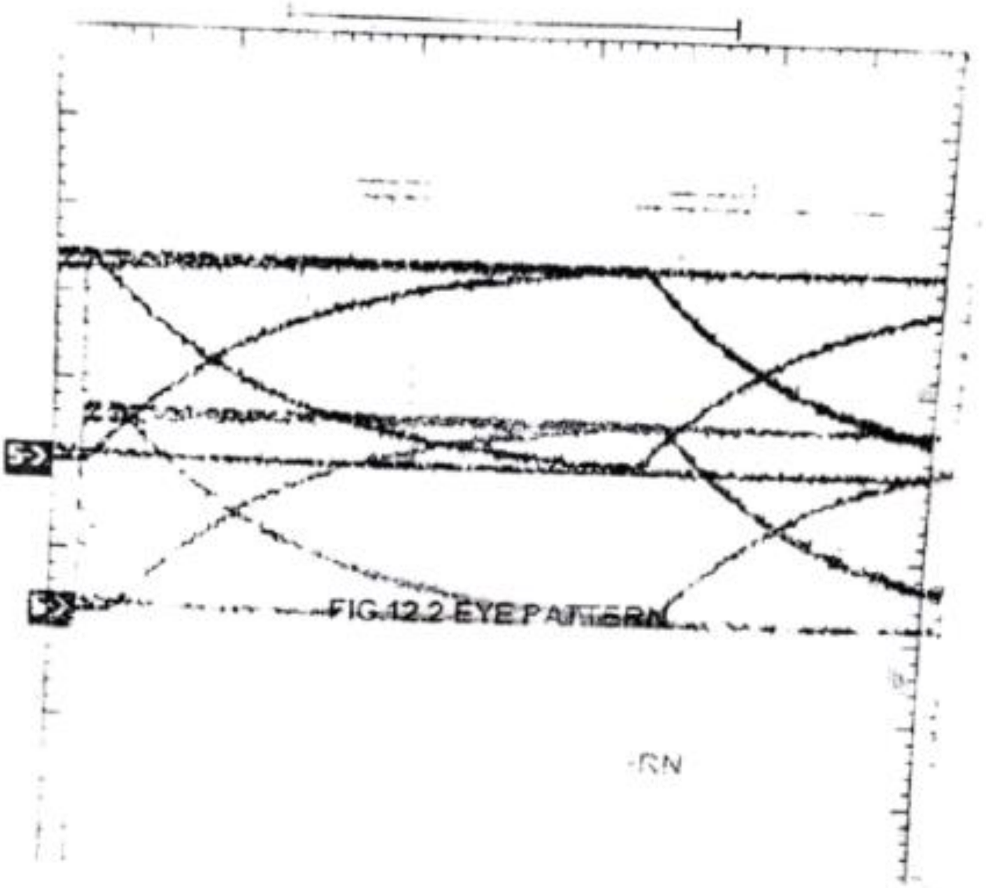
The eye-pattern technique is a useful method for evaluating the performance of digital transmission systems, both for wire systems and optical fiber data links. It is a time-domain measurement that allows the effects of waveform distortion to be visually observed on an oscilloscope display.

To create an eye pattern, a pseudorandom data pattern is generated and applied as an input to an oscilloscope, with the data rate used to trigger the horizontal sweep. The resulting display resembles the shape of a human eye, hence the name "eye pattern". The eye pattern is formed by superimposing the possible combinations of the data pattern, which can be observed simultaneously on the oscilloscope display.

To measure system performance using the eye pattern method, a variety of pseudorandom data patterns can be used. Pseudorandom means that the generated combinations or sequences of ones and zeros will eventually repeat, but they are sufficiently random for testing purposes. Pseudorandom data patterns can be generated using available pseudorandom bit sequence (PRBS) generators, which produce different combinations of N-bit long sequences up to a limit set by the instrument. Once the limit is reached, the data sequence will repeat.

By analyzing the eye pattern, valuable information about system performance can be deduced. To create an eye pattern and analyze it, follow the procedure provided by the instrument or measurement setup being used, which typically involves generating a pseudorandom data pattern, applying it as an input to an oscilloscope, triggering the horizontal sweep with the data rate, and observing the resulting eye pattern on the oscilloscope display.

Procedure:



1. Connect the power supply to the board, ensuring proper polarity, as shown in fig. 12.
2. Make connections as shown in fig. 12, including the proper connections for the PRBS (Pseudorandom Binary Sequence) signal.
3. Keep switch SW7 in the position shown in fig. 12.1 to generate the PRBS signal, and move switch SW8 towards the TX (transmit) position.
4. Connect the power supply cables with proper polarity to the Link-B kit, ensuring the power supply is off while making the connections. Keep switch SW9 in the TXI (transmit inverted) position.
5. Set switch SW10 to the Eye-pattern position.
6. Select the PRBS (Pseudorandom Binary Sequence) generator clock at 32 kHz by setting jumper JP4 to the 32K position.
7. Set jumper JP5 to the +5V position.

8. Keep jumper JP6 shorted.
9. Set jumper JP8 to the TTL position.
10. Switch on the power supply.
11. Connect the DATAOUT post of the PRBS generator to the IN post of the digital buffer.
12. Connect the OUT post of the digital buffer to the TX IN post.
13. Slightly unscrew the cap of the LED SFH756V (660 nm), but do not remove it from the connector. Insert the 1-meter fiber into the cap, then tighten the cap by screwing it back.
14. Slightly unscrew the cap of the RX1 phototransistor with TTL logic output SFH551V, but do not remove it from the connector. Insert the other end of the fiber into the cap, then tighten the cap by screwing it back.
15. Connect the CLK OUT of the PRBS generator to the EXT.TRIG. of the oscilloscope.
16. Connect the detected signal TTL OUT to the vertical channel Y input of the oscilloscope. Then observe the Eye-pattern by selecting the EXT.TRIG knob on the oscilloscope, as shown in fig. 12.2. Observe the Eye-pattern for different clock frequencies, noting that as the clock frequency increases, the Eye opening becomes smaller.

Result:

Eye pattern is studied.

Experiment No. 10

Objective:

Computer to Computer communication using RS232 interface via OBJECTIVA Fiber OpticLink

Theory:

There are 2 fiber optic Links provided on fiber optic trainer. We shall utilize, these two links to communicate from one PC to other & via-versa. That means it is a Duplex system of communication using fiber optic link. The Software developed will help to Hansmit & receive messages from the computers. You will need the following the

5tter ulcottications Personal computer-2 Nos. 486 or Pentium, DOS 6.0 or onwards. ed Fu win need the following hep to

2 RS232 cables for connecting PC's to Trainer

Procedure:

1. Position one PC to the left of the fiber optic trainer and the other PC to the right.
2. Load the software from the supplied CD onto both PC 1 and PC 2.
3. Ensure that one COM port is available on each PC for connecting the RS232 cables. Set the baud rate to the same value, for example, 57600 baud.
4. Switch off both PCs.
5. Make the following connections on the fiber optic trainer:
    a. Connect the Fiber Link on CH1 (emitter to detector).
    b. Connect the Fiber Link on CH2 (emitter to detector).
    c. Connect the output of Detector 1 to comparator input.
    d. Connect the output of Detector 2 to comparator 2 input.
    e. Connect a 1 kHz square wave to the input of CH1 (emitter).
6. Set the mode switch of both channels to digital and ensure all switched faults are in the off position.
7. Switch on the trainer and observe the input to emitter 1 and the output of comparator 1.
8. Adjust the bias of comparator 1 for a square wave output.

9. Switch the 1 kHz square wave from the input of CH1 to the input of CH2 (emitter).
10. Adjust the bias of comparator 2 for a square wave output.
11. Switch off the trainer.
12. Make the connections as shown in diagram 17 and switch on the trainer.
13. Connect PC 1 and PC 2 to the D-type connectors on the fiber optic trainer using RS232 cables, any-to-any configuration. Switch on the PCs and the trainer.
14. Start working with the software on the PCs. Whatever you type in PC 1 will be seen in the transmit column of PC 1 and received in the receive column of PC 2 simultaneously, and vice versa.
15. To test, remove any of the fiber links to transmit and receive data only on one link. Change the baud rate of either PC, and observe that data is not transmitted if the baud rates are different. Keep the baud rates the same.
16. Reduce the baud rate of both PCs and observe that the transmit rate is lower.
17. Switch off the trainer and the PCs when finished.

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