# VISHNU INSTITUTE OF TECHNOLOGY

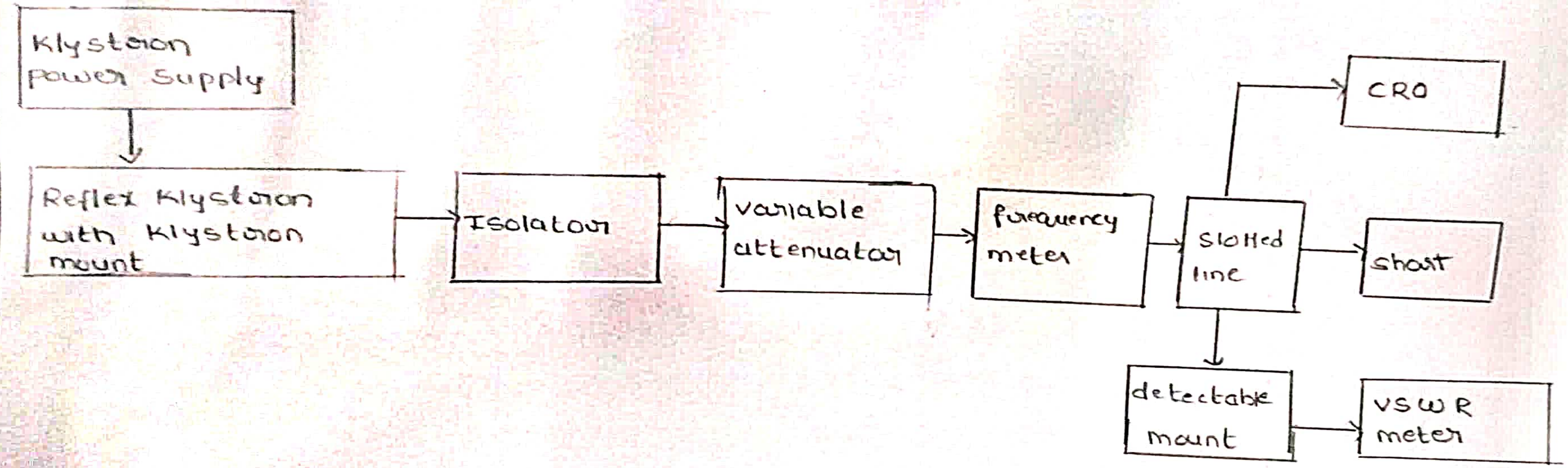
(Approved by AICTE, New Delhi & Affiliated to JNTUK, Kakinada)

Vishnupur, BHIMAVARAM - 534 202

## INDEX

| S.No. | Date | Experiment | Page | Marks |
|---|---|---|---|---|
| 1. | 05-10-2021 | REFLEX KLYSTRON | 1-3 | 9 12/10/21 |
| 2. | 12-10-2021 | ATTENUATION MEASUREMENT | 4-6 | 9 26/10/21 |
| 3. | 26-10-2021 | GUNN DIODE V-I CHARCTERISTICS | 7-8 | 9 2/11/21 |
| 4. | 2-11-2021 | DIRECTIONAL COUPLER | 9-11 | 10 16/11/21 |
| 5. | 16-11-2021 | CHARECTIRISTICS OF CIRCULATOR | 12-14 | 10 3/12/21 |
| 6. | 3-12-2021 | SCATTERING PARAMETERS OF MAGIC TEE | 15-17 | 10 17/12/21 |
| 7. | 17-12-2021 | CHARACTERISTICS OF LED | 18-20 | 10 28/12/21 |
| 8. | 28-12-2021 | DATA RATE FOR DIGITAL LINK | 21-22 | 10 4/1/22 |
| 9. | 4-01-2022 | NUMERICAL APERTURE OF OPTICAL FIBRE | 23-24 | 10 11/1/22 |
| 10. | 11-01-2022 | STUDY OF LOSSES IN OPTICAL FIBRE | 25-27 | 10 13/1/22 |
| | | Total Avg. Marks (Max. Marks 15) | | 8.167 |

**Block diagram:-**



Exp no: 1

Date:- 05/10/2021

P.No 1

# REFLEX KLYSTRON

**Aim:-** To study the characteristics of the Reflex Klystron.

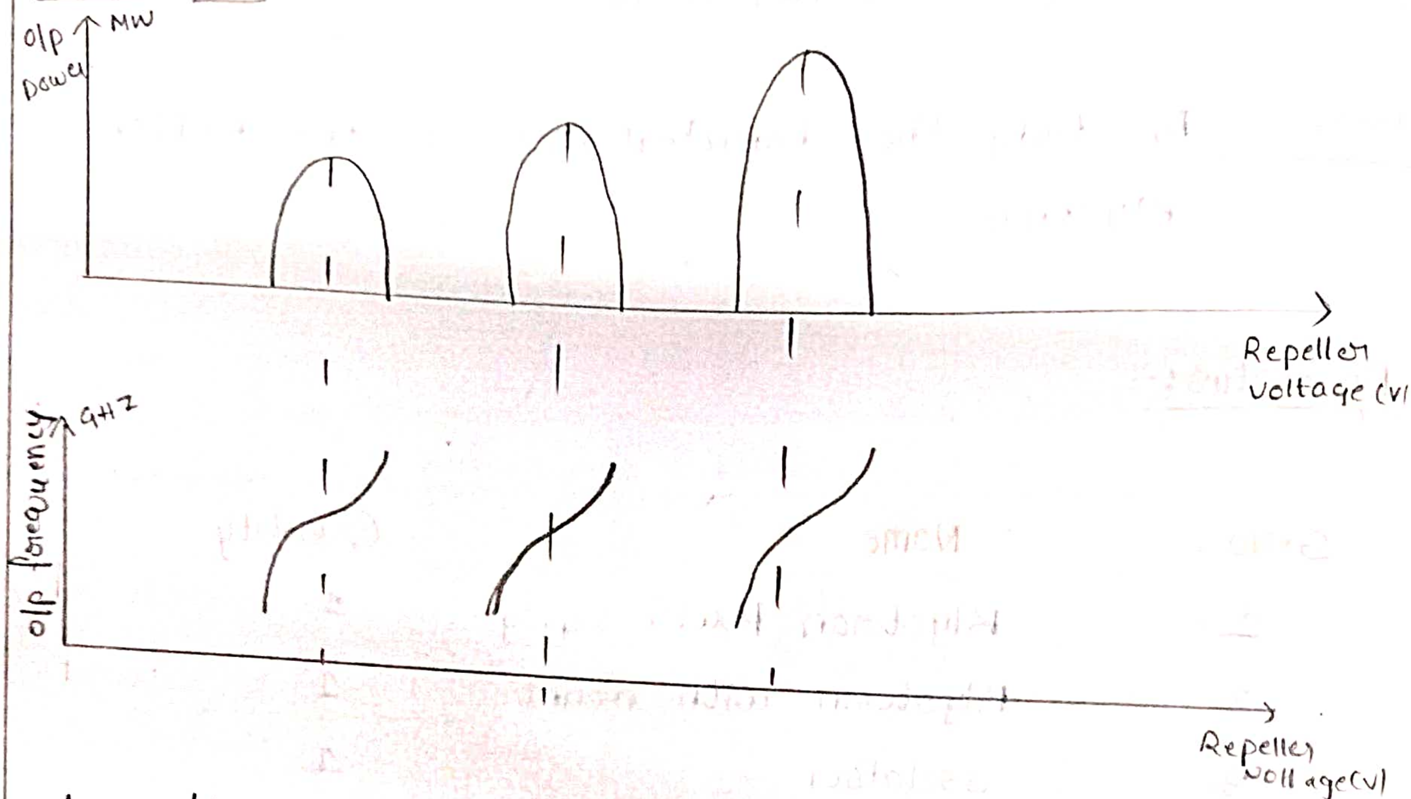
**Apparatus:-**

| S.NO | Name | Quantity |
|---|---|---|
| 1. | Klystron Power supply | 1 |
| 2. | Klystron with mount | 1 |
| 3. | Isolator | 1 |
| 4. | Variable attenuator | 1 |
| 5. | Frequency meter | 1 |
| 6. | Slotted line | 1 |
| 7. | Tunable Probe and CRO | 1 |
| 8. | Detector mount / Matched load | 1 |
| 9. | VSWR meter | 1 |

**Theory:-**

Reflex Klystron works on the Principle of velocity and current modulation. The electron beam is injected from the cathode. The electron beam passes through the accelerating anode. The electron moves in the tube with uniform velocity until it reaches the cavity.

MODEL GRAPH :-




Observations:-

| S.No | Repeller voltage (volts) | power | | frequency (GHz) | Mode number |
|---|---|---|---|---|---|
| | | dB | $MW = 10^{(P(dB)/10)}$ | | |
| 1. | -246 | -47 | 0.0158 | 9.87 | 1 |
| 2. | -230 | -52 | 0.0063 | 9.8555 | 1 |
| 3. | -210 | -48 | 0.0158 | 9.75 | 1 |
| 4. | -196 | -39 | 0.12 | 9.825 | 2 |
| 5. | -180 | -41 | 0.07 | 9.8 | 2 |
| 6. | -170 | -39 | 0.12 | 9.75 | 2 |

The velocity of electrons is modulated in the cavity gap and these electrons try to reach the repeller. The repeller is connected with the negative polarity of a voltage source. Hence, because of the same polarity, it opposes the force of electrons. The kinetic energy of electrons decreases in the repeller space and at some point, it will be zero. After that, the electron pulls back to the cavity. And in return journey electrons bunched at the one point. There will be current modulation due to the bunch formation. The energy of electrons are converted in the form of RF and RF o/p is taken from the cavity. For maximum efficiency of klystron, the bunching of the electron must take place in the centre of the cavity gap.

output power $P_{RFmax} = \frac{0.398 V_0 I_0}{N}$ watt

Procedure:-

1. connect the components and equipment as shown in the microwave bench. set the beam voltage control knob to fully anticlockwise and reflector voltage control knob to fully clockwise in klystron power supply.
2. Adjust the beam voltage to 300V and beam current

as 20mA

3. change to the Reflector voltage, such that observe the square wave in the CRO

4. change the Reflector voltage and note down the power output & frequency for different modes and plot in the Graph.

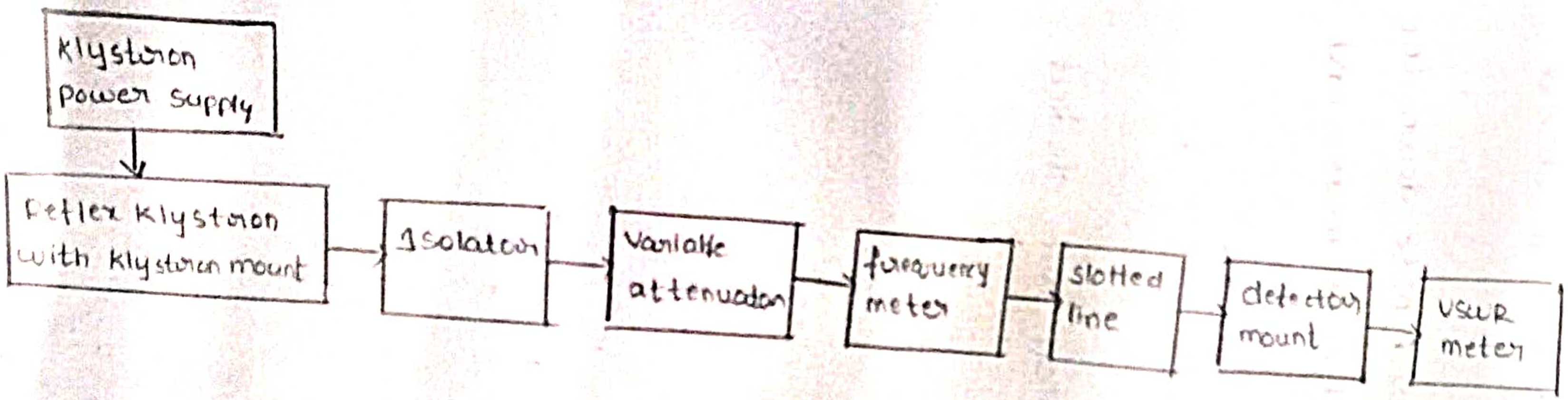
**Result:-**

The characteristics of Reflex Klystron are studied

12/10/21

9

Block diagram:-




WITHOUT ATTENUATOR

Exp no : 2

Date : 12/10/2021



# ATTENUATION MEASUREMENT

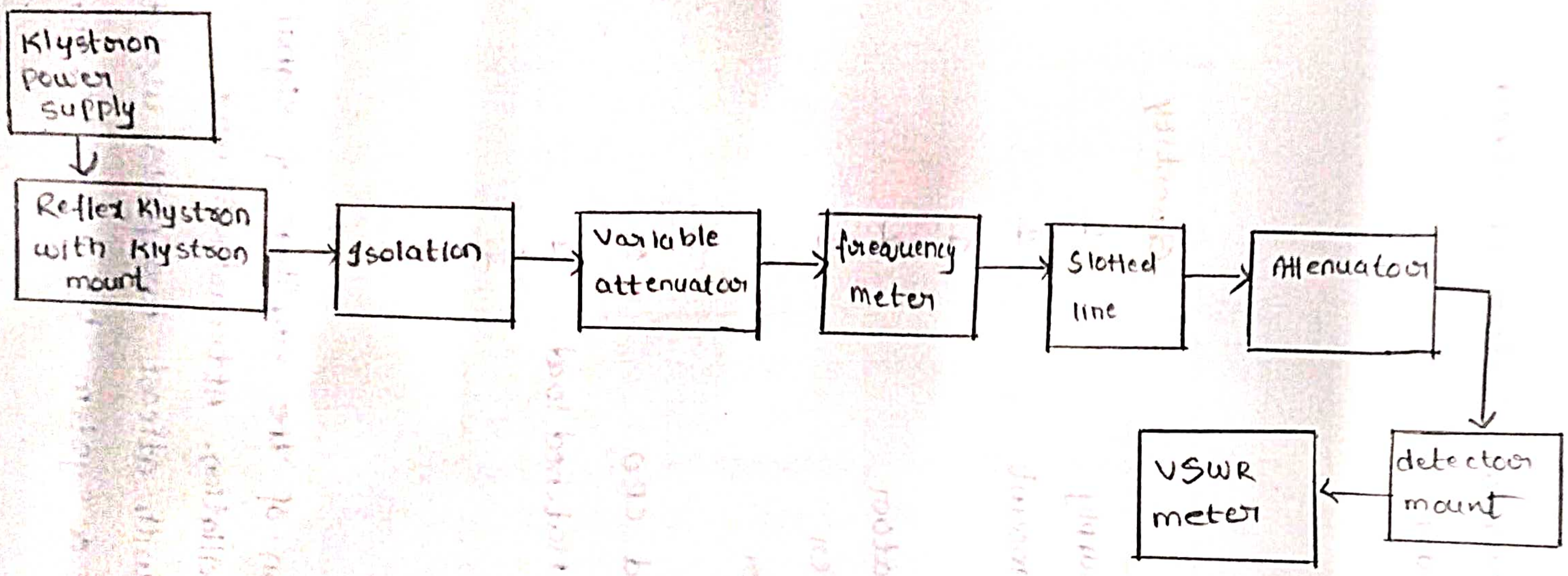
**Aim:-** To study the attenuation factor of fixed and variable attenuators.

**Apparatus:-**

| S.NO | Name | Quantity |
|---|---|---|
| 1. | Klystron power supply | 1 |
| 2. | Klystron with mount | 1 |
| 3. | Isolator | 1 |
| 4. | Variable attenuator | 2 |
| 5. | Frequency meter | 1 |
| 6. | Fixed attenuator | 1 |
| 7. | Slotted line | 1 |
| 8. | Tunable probe and CRO | 1 |
| 9. | Detector mount / Matched load | 1 |
| 10 | VSWR meter. | 1 |

**Theory:-**

Attenuation is the reduction of the amplitude of signal, electoric current or other oscillation. Attenuators are transmission line components with atleast two ports used to reduce the input power in a system by a predetermined amount.




WITH ATTENUATOR.

Fixed attenuators are those whose attenuation is factor present at some nominal level. It is afixed value and cannot be changed..

Variable attenuators, on other hand can be controlled by the user to vary the attenuation level of of the device.

Power attenuation $A_p = 10\log_{10}(P_s/P_d)$

in terms of voltage $A_v = 20\log_{10}(V_s/V_d)$

Procedure:-

1. connect the components and equipment as shown in the microwave bench setup 1.
2. Set the beam voltage control knob to fully anticlockwise and reflector voltage control knob to fully clockwise in Klystron power supply.
3. Adjust the beam voltage to 300V and beam current as 20mA
4. change to the reflector voltage such that to observe the square wave in the CRO and note down the power output (P1) in VSWR meter.
5. connect the components and equipment as shown in the Microwave bench setup 2 for fixed attenuator and notedown the power output ($P_2$)

## Observations:-

Beam voltage : 199V

Repeller voltage : -222V

Input power ($P_1$) : -51dB

for a fixed attenuator

output power ($P_2$) = -60dB

Attenuation $= P_1 - P_2$

$= -51 + 60$

$\simeq 9dB$

6. calculate the Attenuation $A(dB) = 10\log(P_1/P_2)$

7. Do the steps 4 and 5 by changing the fixed attenuator to variable attenuator by changing the value of attenuation.

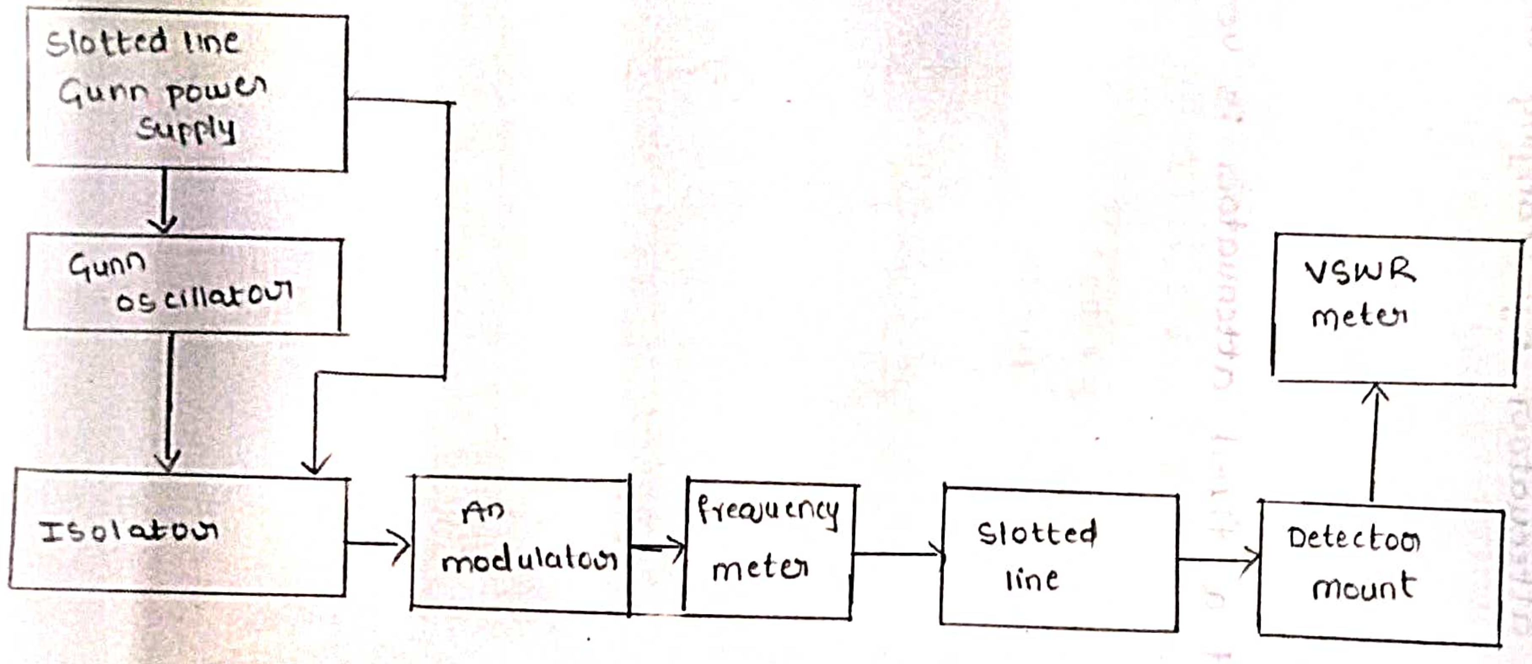
Result:-

The Attenuation factor of a fixed attenuator is verified.

26/10/21

9

Block diagram:-




SET UP FOR THE V-I CHARACTERISTICS OF GUNN DIODE

Exp no: 3

Date: 26/10/2021

P.No 7

# GUNN DIODE V-I CHARACTERISTICS

**Aim:-** To study the volt-amp characteristics, frequency vs power characteristics.

**Equipment Required:-**

1. Gunn Power Supply
2. Gunn Oscillator
3. Gunn Diode Mount
4. PIN Modulator
5. Isolator
6. Frequency Meter
7. Slotted Section
8. Tunable Probe.
9. VSWR Meter
10. Movable short.

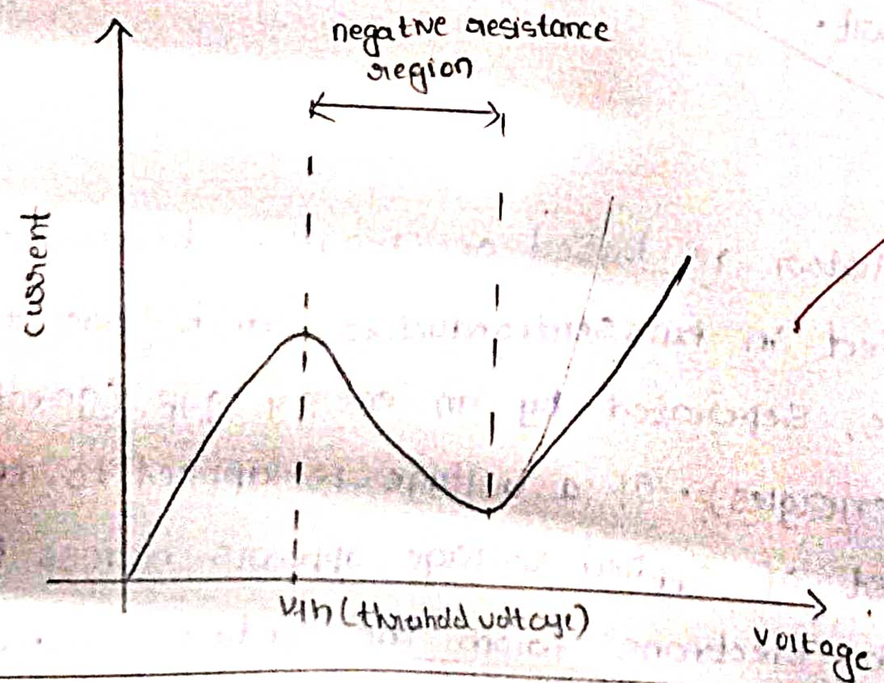
**Theory:-**

The Gunn Oscillator is based on negative differential conductivity effect in bulk semiconductors, which has two conduction bands, seperated by an energy gap (greater than thermal energies). If a voltage is applied to this device, the most of applied voltage appears across the active region. The electrons from the conduction band

OBSERVATIONS:-

| S.NO | Gunn Bias Voltage (V) | Gunn current (mA) |
|---|---|---|
| 1 | 0 | 0 |
| 2 | 0.45 | 0.045 |
| 3 | 1.3 | 0.123 |
| 4 | 2.01 | 0.182 |
| 5 | 2.66 | 0.224 |
| 6 | 3.03 | 0.244 |
| 7 | 3.5 | 0.270 |
| 8 | 4.34 | 0.292 |
| 9 | 5.08 | 0.295 |
| 10 | 5.51 | 0.252 |
| 11 | 6.6 | 0.255 |

MODEL GRAPH :-



having negligible electrical resistivity are transferred into the third band because these electrons are scattered by the applied voltage. Because of this increase in Va increases the field strength (for field strength where Va > Vth), then the no of ē reaching the state at which effective mass increases by decreasing their velocity and thus current will decrease. Thus if field strength is increased, drift velocity will decrease, this creates a negative incremental resistance region in V-I relationship.

Procedure:-

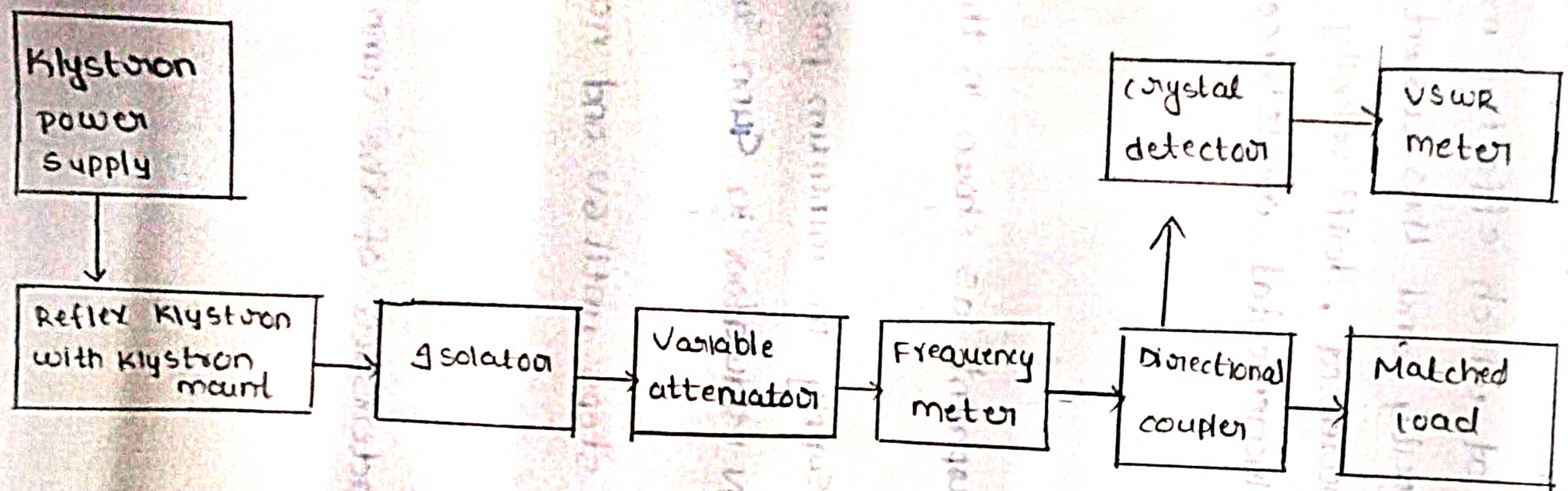
1. connect the components and equipment as shown in the Microwave bench.
2. Set the control Knob of Gunn Supply in minimum position
3. Set the control knobs of PIN Modulator in Gunn Supply in middle position
4. Change the Gunn Voltage in steps until 6V and note down the Gunn Current.

Result:- Hence, studied the characteristics of the Gunn diode.

2/4/21

10

Block diagram:-




SETUP FOR THE MEASUREMENT OF DIRECTIONAL COUPLER

Exp no: 4

Date: 02/11/2021



# DIRECTIONAL COUPLER

Aim:- To find the parameters of a Directional Coupler.

Equipment required :-

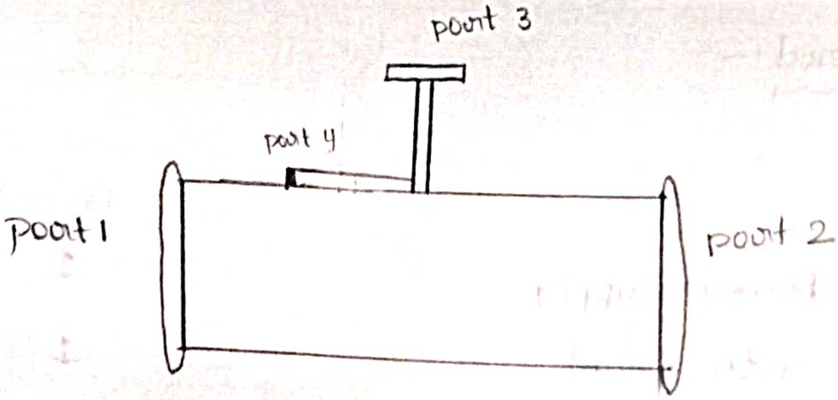
| S.NO | Name | Quantity |
|---|---|---|
| 1. | Klystron Power Supply | 1 |
| 2 | Klystron with mount | 1 |
| 3. | Isolator | 1 |
| 4. | Variable attenuator | 1 |
| 5. | Frequency meter | 1 |
| 6. | Slotted line | 1 |
| 7. | Directional Coupler | 1 |
| 8. | Tunable probe and CRO | 1 |
| 9. | Detector mount / Matched load | 1 |
| 10. | VSWR meter. | 1 |

Theory :-

A Directional coupler is a device that samples a small amount of Microwave power for measurement purposes. The power measurements include incident power, reflected power, VSWR values etc.

In directional coupler all terminations are matched to the ports. when the power travels from port 1 to

## DIRECTIONAL COUPLER




### Observations:-

Current = 20mA

Voltage = 270V

Repeller voltage = -140V

Reference power $P_1 = 41dB$

$P_2 = \cancel{3}42dB$

$P_3 = 45dB$

$P_4 = 51dB$

Insertion loss $= \cancel{4d}\cdot P_1 - P_2$

$= 41 - 42$

$= -1dB$

port 2, some portion of it gets coupled to port 4 but not to port 3. Being bidirectional coupler, when power travels from port 2 to port 1, some portion coupled to port 3 but not to port 4. If the power is incident through port 3, a portion is coupled to port 2 but not to port 1 similar case is observed for port 4. Ideally output port 3 should be zero, practically a small amount of power called back power is observed at port-3.

coupling factor $C = 10\log_{10} P_i/P_f \ dB$

Directivity $D = 10\log_{10} P_f/P_b \ dB$

Isolation $I = 10\log_{10} P_i/P_b \ dB$

Isolation = coupling factor + Directivity

Procedure:-

1. connect the components and equipment as shown in the microwave bench setup.
2. Set the beam voltage control knob to fully anticlockwise and reflector voltage control knob to fully clockwise in klystron power supply
3. Adjust the beam voltage to 300V and beam current as 20mA
4. Change to the Reflector voltage such that to observe the square wave in the CRO and note down the power output (P1) in VSWR meter.
5. Connect the components and equipments as shown in the

Coupling (dB) = $P_1 - P_3$

$= 41 - 45$

$= -4\,dB$

Isolation (dB) $= P_1 - P_4$

$= 41 - 51$

$= -10\,dB$

Directivity (dB) = $P_3 - P_4$

$= 45 - 51$

$= -6\,dB$

microwave bench with directional coupler and note down the power output ($P_2$) with terminating port 3 and 4.

6. connect the components and equipment as shown in the microwave bench setup2 with Directional coupler and note down the power output (3) with terminating port 2 & 4

7. connect the components and equipment as shown in the microwave bench setup2 with Directional coupler and note down the power output ($P_4$) with terminating port 1 & 3.

8. calculate insertion loss $I = 10 \log (P_1/P_2)$

9. Calculate coupling coefficient $C = 10 \log (P_1/P_3)$

10. calculate isolation loss $= 10 \log (P_2/P_3)$

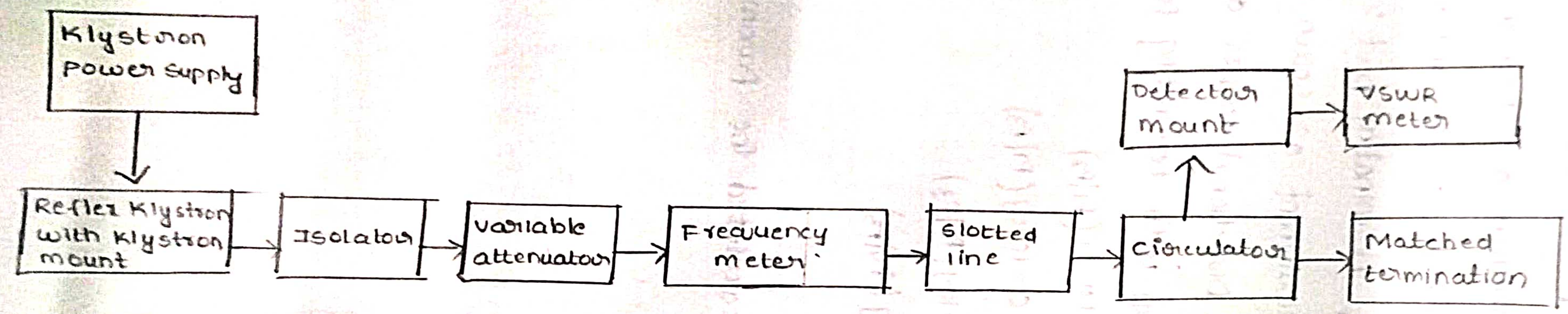
11. calculate Directivity $D = 10 \log (P_4/P_3)$

Result:- Hence we studied and calculated the parameters of a Directional coupler.

16/11/21

10

Block diagram:-




SETUP FOR CIRCULATOR CHARACTERISTICS.

Exp no : 5 Date : 16/11/2021



## CHARACTERISTICS OF CIRCULATOR

**Aim:-** To find the scattering matrix for a 3 port circulator

**Equipment :-**

| S.NO | Name | Quantity. |
|---|---|---|
| 1. | Klystron power supply | 1 |
| 2. | Klystron with mount | 1 |
| 3. | Isolator | 1 |
| 4. | Variable attenuator | 1 |
| 5. | Frequency meter | 1 |
| 6. | Slotted line | 1 |
| 7. | 3 port circulator | 1 |
| 8. | Tunable probe and CRO | 1 |
| 9. | Detector mount / Matched load | 1 |
| 10. | VSWR meter | 1 |

**Theory:-**

The circulator is a ferrite device including two or more ports. When the input signal enters into any port. then the signal will transmit in a particular direction. There are different models, these components are mainly used in different applications like radar systems

Observation:

| Input port | output power | output power | Scattering coefficient |
|---|---|---|---|
| $P_1$ = | $P_2$ = | $P_3$ terminated | $S_{12} = \frac{P_2}{P_1}$ |
| $P_1$ = | $P_2$ terminated | $P_3$ = | $S_{13} = \frac{P_3}{P_1}$ |
| $P_2$ = | $P_3$ = | $P_1$ terminated | $S_{23} = \frac{P_3}{P_2}$ |
| $P_2$ = | $P_3$ terminated | $P_1$ = | $S_{21} = \frac{P_1}{P_2}$ |
| $P_3$ = | $P_1$ = | $P_2$ terminated | $S_{31} = \frac{P_1}{P_3}$ |
| $P_3$ = | $P_1$ terminated | $P_2$ = | $S_{32} = \frac{P_2}{P_3}$ |

$P_{ref}$ = 40·8dB

$P_{12}$ = 30·8dB

$P_{13}$ = 58 dB

amplifier systems etc. The communication of the magnetic field towards the ferrite material within circulator makes magnetic fields related to the flow of water in the cup. The rotating field is extremely strong and will cause any RF signals inside the frequency band at one port to track the magnetic flow toward the nearby port but not in the reverse direction.

Procedure:-

1. Connect the components and equipment as shown in the microwave bench setup 1.
2. Set the beam voltage control knob to fully anti clockwise and reflector voltage control knob to fully clockwise in klystron power supply.
3. Adjust the beam voltage to 300V and beam current as 20mA
4. change to the reflector voltage such that to observe the square wave in the CRO and note down the power output ($P_1$) in VSWR meter.
5. Connect the components and equipment as shown in the microwave bench setup 2 with circulator and note down the power output ($P_2$) with terminating port 3.
6. calculate the scattering matrix coefficient $S_{12} = P_2/P_1$
7. Now calculate the output power $P_3$ while terminating port 2 and calculate scattering matrix coefficient

$S_{13} = P_3 / P_1$

8. Do the step 5 and 6 by giving input to $P_2$ and calculate $S_{23}, S_{21}$

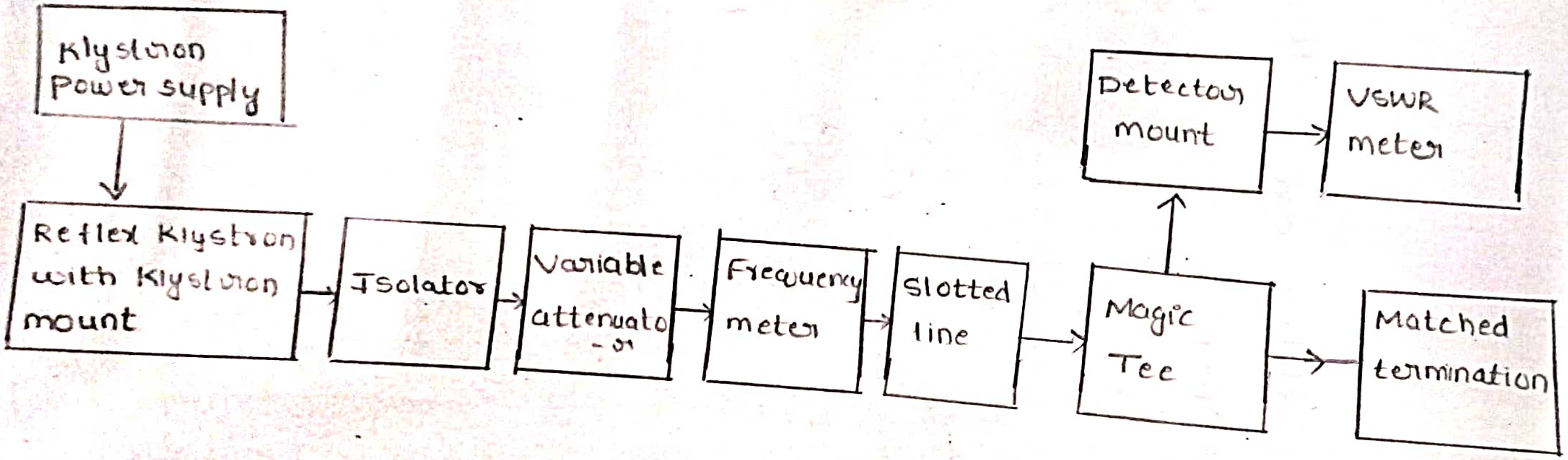
9. Do the step 5 and 6 by giving input to $P_3$ and calculate $S_{31}, S_{32}$

Result:-

The insertion loss, Isolation and scattering matrix of the devices are found.

3/11/24

Block diagram:-




SETUP FOR MAGIC TEE

Exp no : 6

Date : 3/12/2021

P.No 15

# SCATTERING PARAMETERS OF MAGIC TEE

**Aim:-** To find the scattering matrix of a Magic Tee

**Equipment required:-**

| S.No | Name | Quantity |
|---|---|---|
| 1. | Klystron Power Supply | 1 |
| 2. | Klystron with mount | 1 |
| 3. | Isolator | 1 |
| 4. | Variable attenuator | 1 |
| 5. | Frequency meter | 1 |
| 6. | Slotted line | 1 |
| 7. | Magic Tee | 1 |
| 8. | Tunable probe and CRO | 1 |
| 9. | Detector mount / Matched load | 1 |
| 10. | VSWR meter | 1 |

**Theory:-**

A magic Tee is a combination of E and H plan tee, Arm 3 is the H-arm and arm 4 is the E arm. If the power is fed, into arm 3 (H-arm) the electric field divides equally between arm 1 and 2 with the same phase and no electric field exists in arms. If power is fed in arm 4 (E-arm), it divides equally into arm 1 & 2

Observation:

Current = 20mA

Repeller voltage = 270V

$P_W$ = 41dB

$P_1$ = 42dB

$P_2$ = 43dB

$P_3$ = 49dB

$P_4$ = 47dB

but out of phase with no power to arm 3, further, If the power is fed in arm 1 and 2 simultaneously it is added in arm 3 (H-arm) and it is obtained subtracted in E-arm i.e arm 4. The basic parameters to be measured for magic Tee are discussed.

Procedure:-

1. connect the components and equipment as shown in the Microwave bench setup 1
2. Set the beam voltage control knob to fully anticlockwise and reflector voltage control knob to fully clockwise in Klystron Power Supply.
3. Adjust the beam voltage to 300V and beam current as 20mA
4. Change to the reflector voltage such that to observe the square wave in the CRO and note down the power output ($P_1$) in VSWR meter.
5. connect the components and equipment as shown in the Microwave bench setup2 with Magic tee and note down the power output ($P_2$) with terminating port 3 & Port 4
6. calculate the scattering matrix coefficient $S_{12} = P_2/P_1$
7. Now calculate the output Power $P_3$ while terminating port 2 and port 4 calculate scattering matrix $S_{13} = P_3/P_1$

8. calculate the output power $P_4$ while terminating port 2 and port 3 & calculate scattering matrix $S_{14} = P_4/P_1$

9. Do the steps 5, 6, 7 by giving input to $P_2$ and calculate scattering coefficients $S_{21}, S_{23}, S_{24}$

10. Do the steps 5, 6 and 7 by giving input to $P_3$ and calculate scattering matrix coefficients $S_{31}, S_{32}, S_{34}$

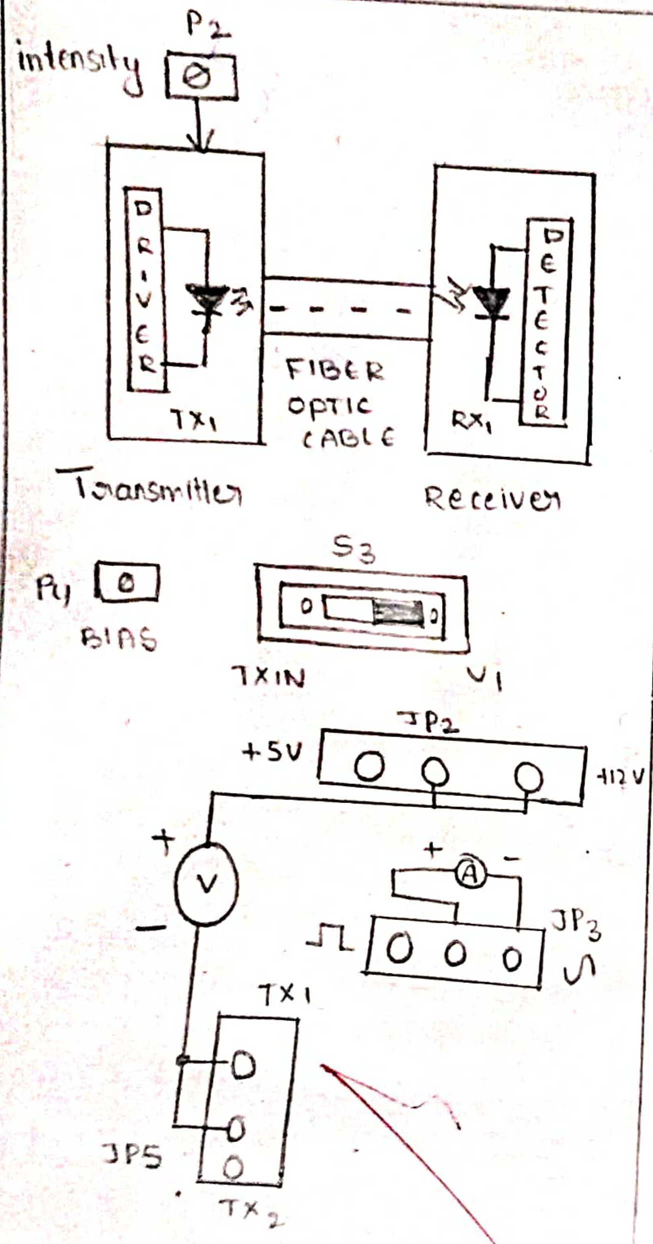
11. Do the steps 5, 6 and 7 by giving input to $P_4$ and calculate scattering coefficients $S_{41}, S_{42}, S_{43}$.

Result:- The scattering matrix of magictee is found.

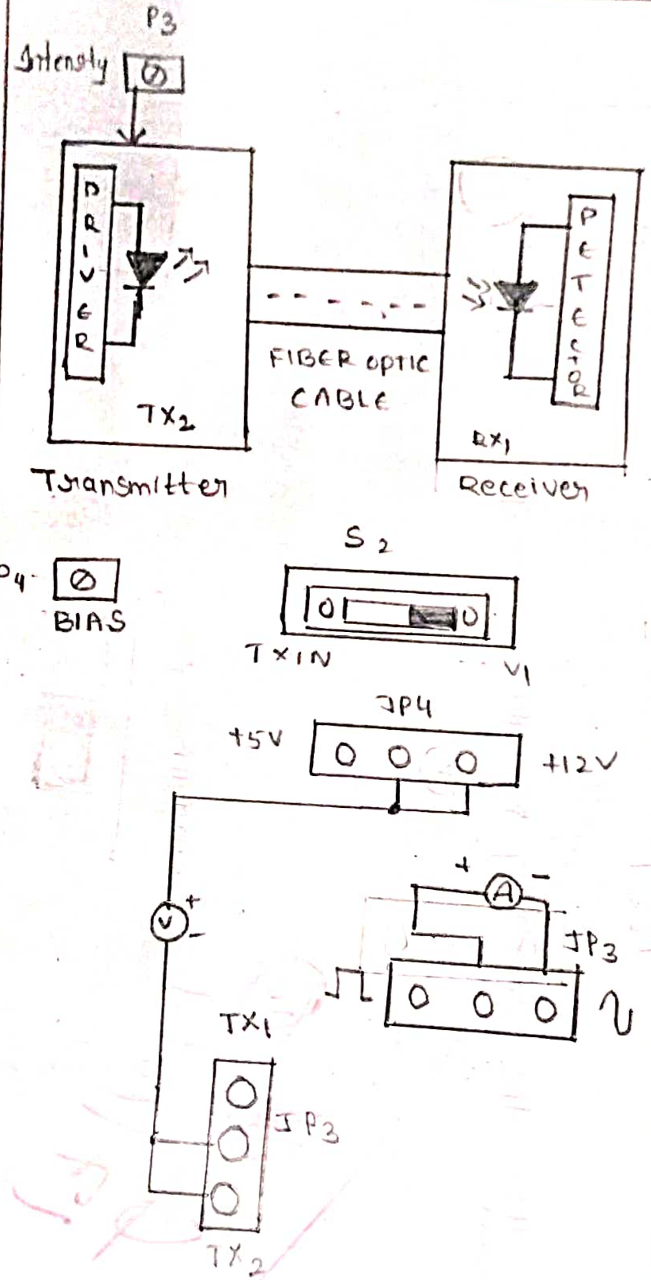
10

17/12/11

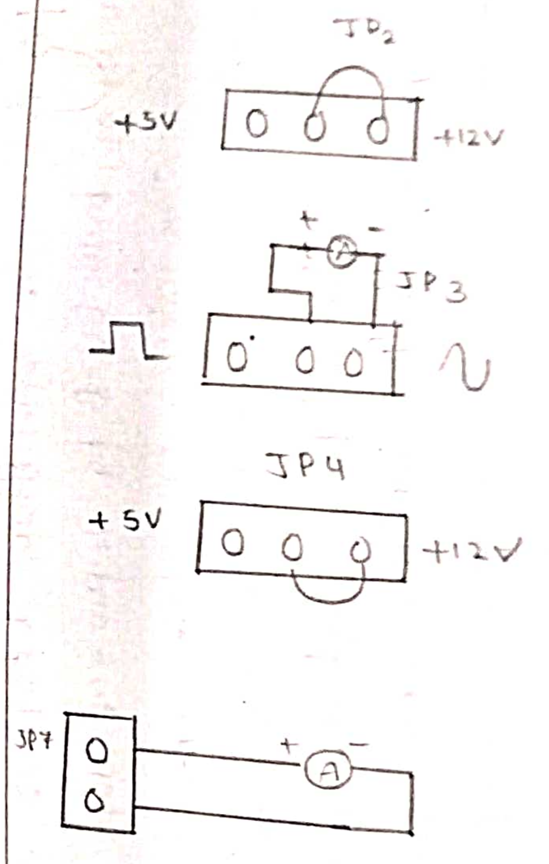
## Block diagram:-




CHARACTERISTICS OF SFH756V




CHARACTERISTICS OF SFH450V




CHARACTERISTICS OF SFH250V

Exp no: 7 Date: 17/12/2021



# CHARACTERISTICS OF LED

**Aim:-** To find the V-I characteristics of LED

**Equipment required:-**

| S.NO | Name | Quantity. |
|---|---|---|
| 1. | Fibre Link -A Kit | 1 |
| 2. | 20 MHZ Dual channel Oscilloscope | 1 |
| 3. | 1 meter Fibre Cable | 1 |
| 4. | Voltmeter | 1 |
| 5. | Ammeter | 1. |

**Theory:-**

In optical fibre communication system, Electrical signal is first converted into optical signal with the help of E/O conversion device such as LED or LASER DIODE here. After this optical signal is transmitted through optical fiber, it is retrieved in its original electrical form with the help O/E conversion device such as photodetector.

Different technologies employed in chip fabrication lead to significant variation in parameters for the various laser diodes. All the laser diodes distinguish themselves in

## Observations :-

FOR SFH756V

| current (mA) | Voltage (v) |
|---|---|
| 0 | 1.5 |
| 1 | 1.63 |
| 2 | 1.641 |
| 3 | 1.657 |
| 4 | 1.673 |
| 5 | 1.682 |
| 6 | 1.69 |
| 7 | 1.7 |
| 8 | 1.715 |
| 9 | 1.725 |
| 10 | 1.73 |
| 11 | 1.739 |
| 12 | 1.74 |
| 13 | 1.753 |
| 14 | 1.763 |
| 15 | 1.769 |

FOR SFH250V

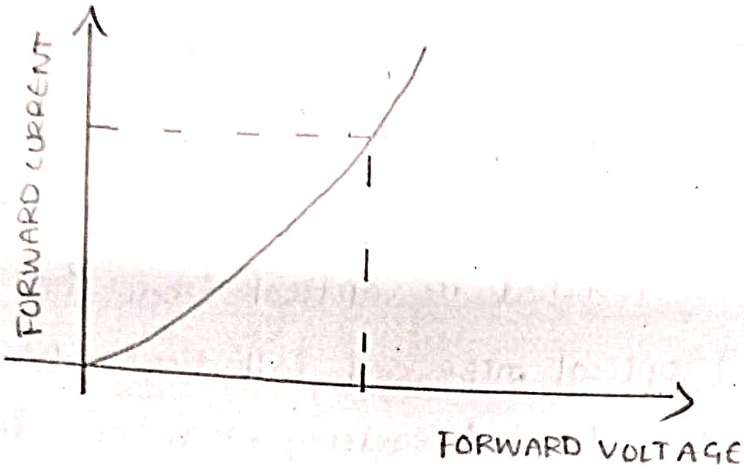
| current (mA) | voltage (v) |
|---|---|
| 0 | 1.56 |
| 1 | 1.59 |
| 2 | 1.618 |
| 3 | 1.631 |
| 4 | 1.643 |
| 5 | 1.653 |
| 6 | 1.667 |
| 7 | 1.667 |
| 8 | 1.668 |
| 9 | 1.683 |
| 10 | 1.688 |
| 11 | 1.691 |
| 12 | 1.693 |
| 13 | 1.70 |
| 14 | 1.703 |
| 15 | 1.709 |

offering high output power coupled into the important peak wavelength of emission, conversion efficiency (usually Specified in terms of power launched in optical Fiber peak wavelength of emission, conversion efficiency (usually specified in terms of power launched in optical fiber for specified forward current) optical rise and fall times which put the limitation on operating frequency, maximum forward current through laser diode and typical forward voltage across laser diode.

An important feature of laser diodes is their ability to respond to direct, high speed modulation. In pulse drive operation, if the Dc bias current, $I_b$ is less than the threshold current $I_{th}$, a time delay will result between the drive current pulse and the optical power output pulse. Therefore, the Dc bias current is normally set just above the threshold current to obtain quick response

Photodectors usually comes in variety of forms photoconductive, photovoltaic, transistor type output and diode type output. Here also characteristics to be taken into account are response time of the detector, which puts the limitation on the operating frequency,

MODELGRAPH :-




CHARACTERISTIC CURVE OF LED

wavelength, sensitivity and responsivity

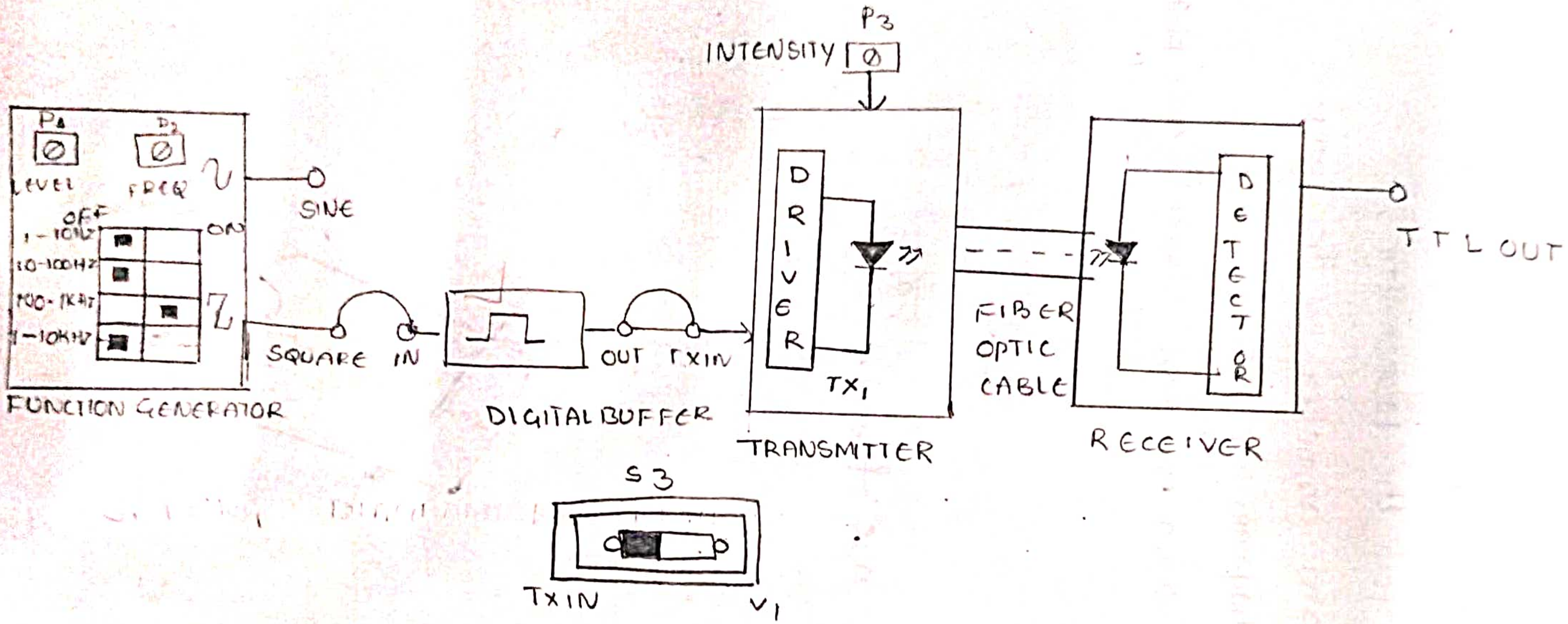
Procedure:-

1. Switch on the power supply of analog kit
2. Set the Jumper setting four the transmitter
3. connect the voltmeter and ammeter to the Jumpers as show in the block diagram
4. By changing pot $P_3$. Note down voltage current and plot the graph.

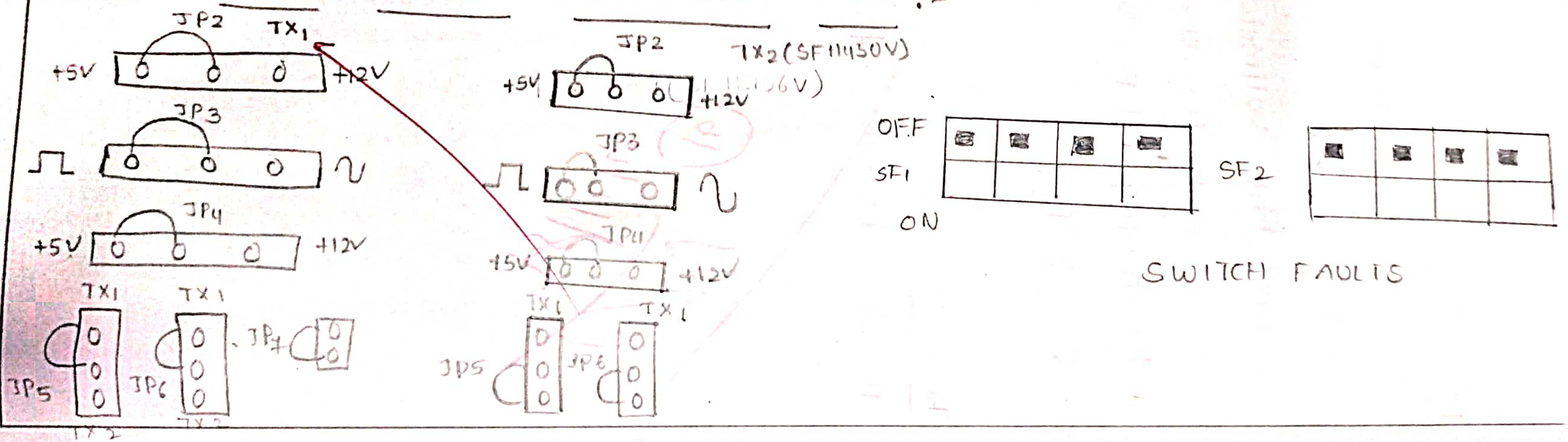
Result:-

The characteristics of LED are found.

## BLOCK DIAGRAM :-




## JUMPER SETTING DIAGRAM FOR DIGITAL LINK :-



Exp no: 8

Date: 28/12/2021

P.No 21

# DATA RATE FOR DIGITAL LINK

**Aim:-** To setup a fiber optical digital link and find the data rate.

**Apparatus required:-**

| S.NO | Name | Quantity. |
|---|---|---|
| 1. | Fibre Link - A Kit | 1 |
| 2. | 20 MHz Dual Channel Oscilloscope | 1 |
| 3. | 1 meter Fiber cable | 1 |
| 4 | Function Generator | 1 |

**Theory:-**

Fibre optic links can be used for transmission of digital as well as analog signals. Basically a fibre optic link contains three elements a transmitter, an optical fibre and a receiver.

The transmitter module takes the input signal in electric form and then performs it into optical energy ongoing the same information. The optical fibre is the medium which carries this energy to the receiver. At the receiver, light is converted back into electric form with the same pattern as originally fed to the transmitter.

Observation :-

$V_{in} = 4.96V$ freq = 700HZ

| S.NO | Frequency (HZ) | o/p (v) | o/p(dB) gain |
|---|---|---|---|
| 1. | 788 | 4.96 | 0dB |
| 2. | 3K | 6.15 | 1.867 |
| 3. | 5K | 6.9 | 2.867 |
| 4. | 7K | 6.6 | 2.481 |

Thus LED emits full intensity of light at this time. This variation in the intensity has linear relation with the input electrical signal. optical signal is then carried over by the optical filter.

Procedure:-

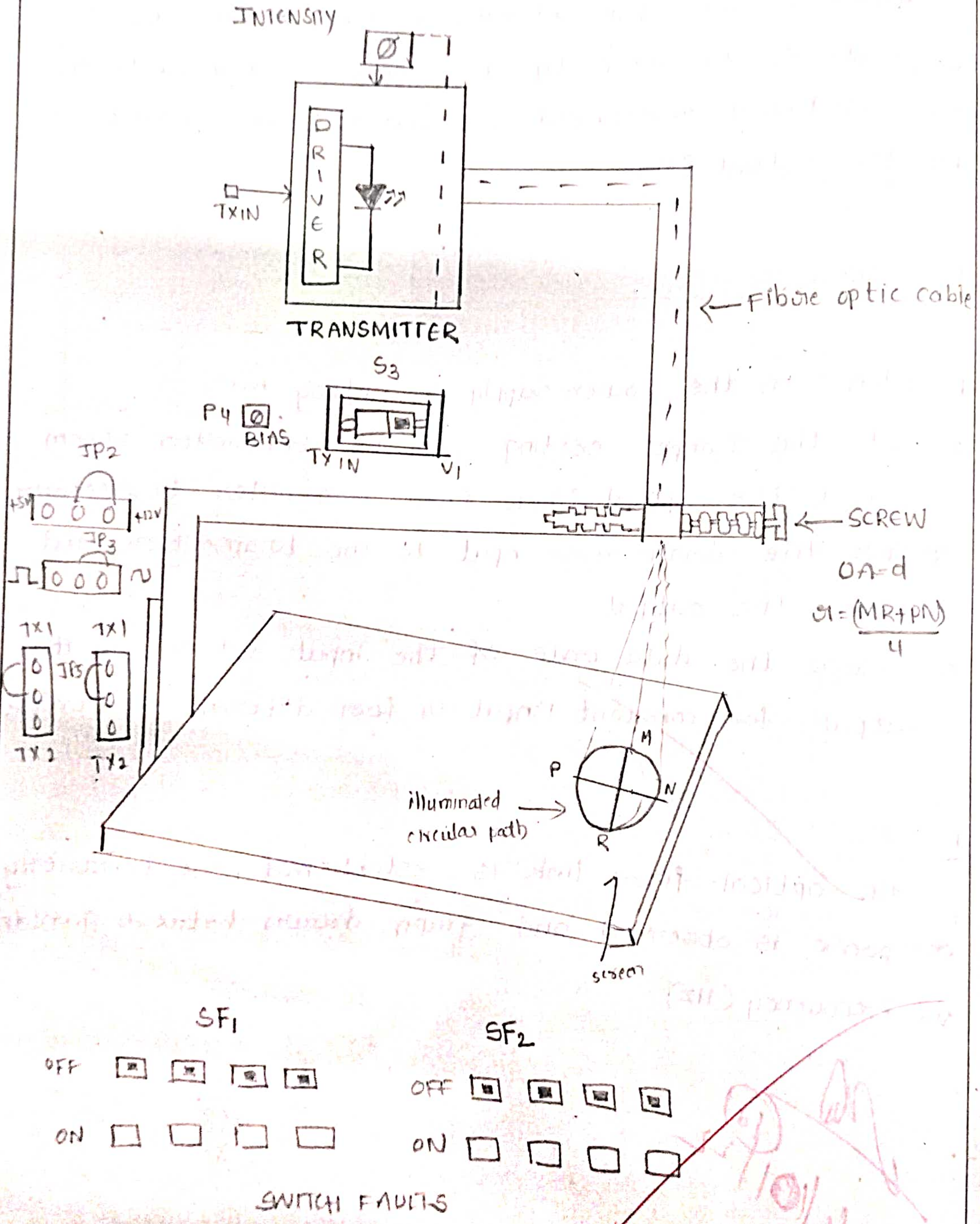
1. Switch on the power supply of antilog kit
2. Set the Jumper setting for the transmitter 650nm
3. connect the optical fibre from transmitter to receiver
4. Give the square wave input to the transmitter and observe the output
5. change the data rate of the input and observe the output for constant input $v_i$ for different data rates.

Result:-

An optical fibre link is established. The frequency response is observed and graph drawn between gain(dB) vs frequency (Hz)

4/10/22

BLOCK DIAGRAM FOR NUMERICAL APERTURE SETUP:-



Exp no: 9

Date: 4/01/2022

P.No 23

# NUMERICAL APERTURE OF OPTICAL FIBRE

**Aim:-** To find the numerical aperture of optical fibre

**Equipment Required:-**

| S.NO | Name | Quantity |
|---|---|---|
| 1. | Fibre link A kit | 1 |
| 2. | 20MHz Dual channel oscilloscope | 1 |
| 3. | 1 meter fibre cable | 1 |
| 4. | Steel Ruler | 1 |
| 5. | power Supply | 1 |

**Theory:-**

Numerical aperture refers to the maximum angle at which the light incidents on the fibre end is totally internally reflected and is transmitted properly along the filter. The cone forward by the rotation of this angle along the axis of the fibre is the cone acceptance of the fibre. The light may should strike the fibre end within its cone of acceptance else it is refracted out of fibre cone.

Observation:-

| Distance between source and centre of circular path D = d cm | vertical diameter MR (cm) | Horizontal diameter PN (cm) |
|---|---|---|
| 1 | 1.4 | 1.3 |
| 1.5 | 1.7 | 1.6 |
| 2 | 2.0 | 1.8 |

mean radius $r = \frac{MR+PN}{4} = \frac{1.4+1.3}{4} \Rightarrow r = 0.625 cm$

Numerical aperture $N.A = \sin\theta_{max}$

$$N.A = \frac{r}{\sqrt{r^2+d^2}}$$

$$= \frac{0.625}{\sqrt{(0.625)^2+1^2}}$$

$$N.A = 0.529$$

Procedure:-

1. Switch on the power supply of analog kit
2. Set the jumper setting for the transmitter.
3. Keep the port $P_3$ fully clockwise and $P_4$ fully anti clockwise
4. Adjust port $P_3$ and $P_4$ such that illuminated circular path of light on the screen.
5. calculate the diameters MR and PN indicated in the figure and also d.
6. calculate $r = (MR+PN)/4$
7. calculate the numerical aperture of the fibre by using the formulae.

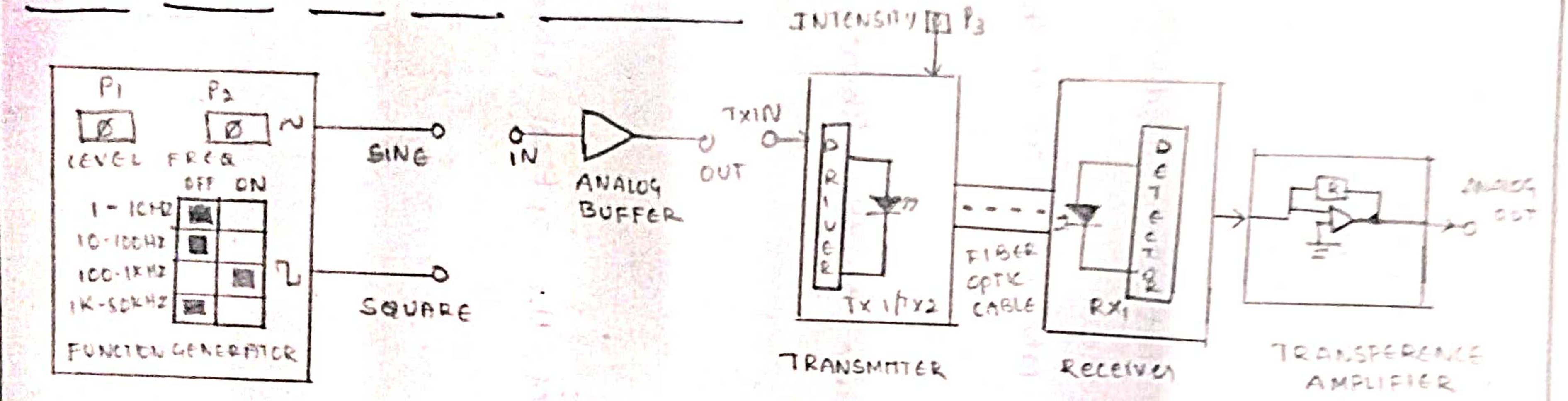
$$N.A = \sin\theta = \frac{r}{\sqrt{d^2+r^2}}$$

Result:- The numerical aperture of the optical fibre is found.

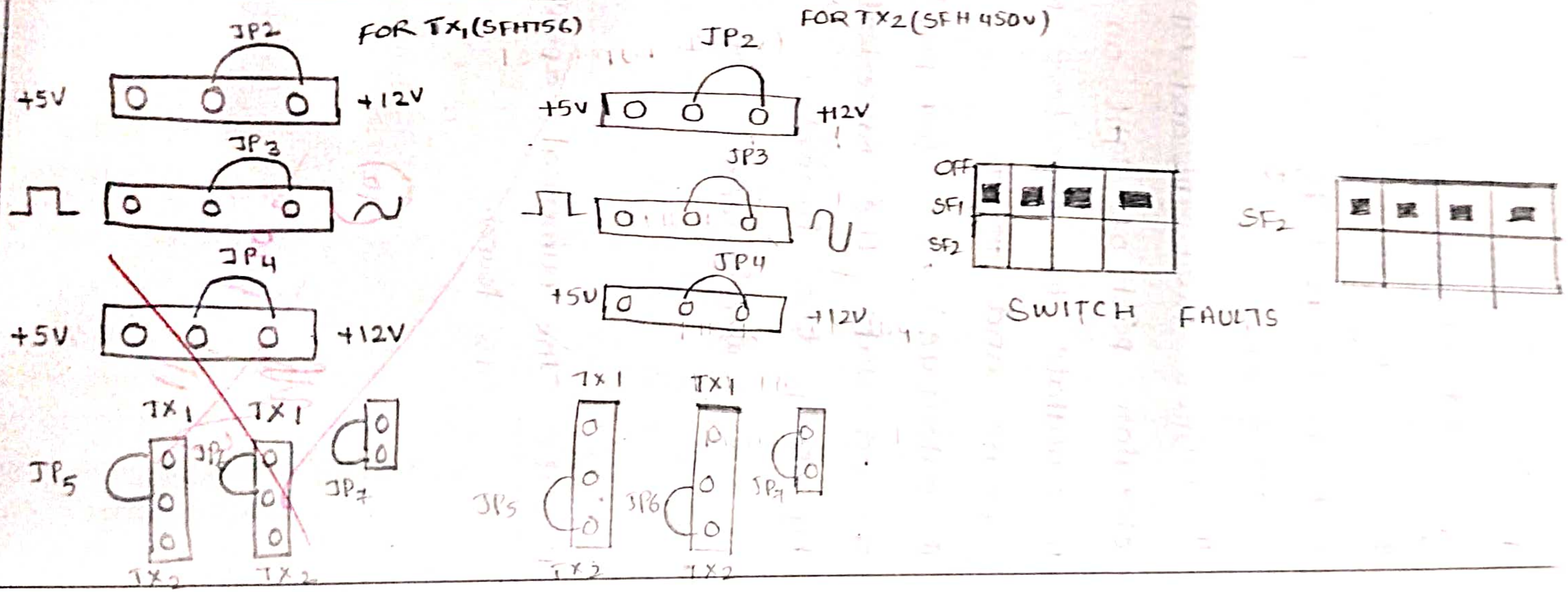
10

11/1/2022

## BLOCK DIAGRAM FOR LOSS MEASUREMENT:-




## JUMPER SETTING DIAGRAM:-



Exp no : 10

Date: 11/01/2022



# STUDY OF LOSSES IN OPTICAL FIBRE

(or)

## FIBRE OPTIC LOSSES

**Aim:-** To find the losses of fibre optic cable

**Equipment required:-**

| S.NO | Name | Quantity. |
|---|---|---|
| 1. | Fibre Link-A Kit | 1 |
| 2. | 20MHz Dual channel oscilloscope | 1 |
| 3. | 1 meter fibre cable | 1 |
| 4. | 3 meter fibre cable | 1 |

**Theory:-**

Optical fibres are available in different variety of materials. These materials are usually selected by taking into account their absorption characteristics for different wavelengths of light. In case of optic fibre, since the signal is transmmited in the form of light, which is completely different in nature as that of electrons one has to consider the interaction of matter with the

Observation :-

input voltage ($V_i$) = 2V   frequency 1KHZ

| S.NO | Diameter (cm) | output voltage (volts) $V_0$ | Frequency (HZ) | loss in dB $= -20\log_{10}\left(\frac{V_0}{V_i}\right)$ |
|---|---|---|---|---|
| 1. | 9cm | 1.29V | 1KHZ | 3.80dB |
| 2. | 15cm | 1.41V | 1KHZ | 3.03dB |
| bendy loss 3. | 1m | 1.42V | 1KHZ | 2.974 dB |
| 4 | 3m | 1.1V | 1KHZ | 5.1927dB |

Attenuation:-

$L_1 = 1m$   $V_1 = 1.42V$

$L_2 = 3m$   $V_2 = 1.1V$

$$\alpha = \left[\frac{10}{L_1 - L_2}\right] \log\left(\frac{V_2}{V_1}\right)$$

$$= \frac{10}{(1-3)} \log\left(\frac{1.1}{1.42}\right)$$

$$\alpha = 0.55 \text{ dB}$$

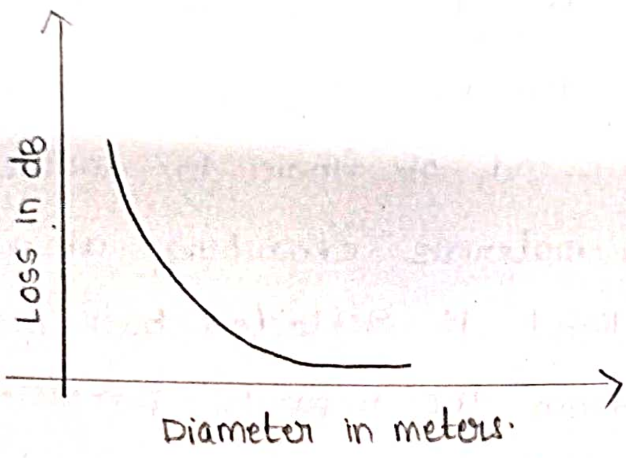
radiation to study the losses in fibre. losses are introduced in fibre due to various reasons. As light propagates from one end of fibre to another end, part of it absorbed in materials exhibiting absorption loss. Also part of this light is reflected back or in some other directions from the impurity particles present in the material contributing to the loss of the signal at the other end of the fibre. In general terms it is known as propagation loss.

Plastic fibres have higer loss of the order of 180dB/km. Whenever the condition for angle of incidence of the incident light is violated the losses are introduced due to refraction of light. This occurs when fibre is subjected to bending lower the radius.

Procedure:-

1. Switch ON the power supply of analog kit
2. Set the Jumper settings for the transmitter 650 nm
3. connect the optical fibre from transmitter to receiver
4. Give the sinusoidal input to the transmitter and observe the output
5. For length $L_1 = 1m$, find the output $V_1$.

MODEL GRAPH:-



6. For length $L_2 = 3m$, find the output $V_2$.

7. Attenuation is calculated by using the formulae.

$$\alpha = \left(\frac{10}{L_1 - L_2}\right) * \log\left(\frac{V_2}{V_1}\right)$$

8. Find the bending losses by doing steps 1 to 7 after bending the fibre.

Result:-

The attenuation factor '$\alpha$' is found. The bending loss is found for different diameters of curvature.

10

13/7/2022