Laboratory Journal

of

ADVANCED ANTENNA THEORY

For completion of term work of 7th *semester*

curriculum program

Bachelor of Technology

In

ELECTRONICS AND TELECOMMUNICATION ENGINEERING

DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION

ENGINEERING

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INDIA

LIST OF EXPERIMENTS

Sr. No.	Title
1	Study of Dipole Antenna
2	Study of Loop Antenna
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4	Study of Horn Antenna (Variation of Field Strength/Inverse Square Law)
5	Study of Polarization
6	Study of Reciprocity Theorem
7	VSWR Measurement
8	Beam width of a Dipole Antenna
9	Study of Parabolic Dish Antenna
10	Study of Directivity of an Antenna

EXPERIMENT NO.

AIM: To Study of half wave simple dipole antenna.

APPARATUS: Scientech kit (850 MHz), Antenna (Tx, Rx), Multimeter.

PROCEDURE:

1) Initial Setting:

   Select Tx current in between 50 □A to 10 □A in forward direction.

   Now change the direction in reverse & note down the reading.

   Select the distance between Tx & Rx such that □=C/f=35cm.

2) Change the angle from reference in +ve & -ve direction.

3) For each angle, take the reading of receiver current & voltage.

4) Change the value of Tx current & keep that constant & repeat the same procedure.

THEORY:

The simple half wave dipole antenna is a metal rod or tubing or wire which has a physical length of approximately half wave in free space at the frequency of operation. It is known as half wavelength dipole or half wave doublet or simply dipole or doublet or Hertz antenna.

It may be define as “a symmetrical antenna” in which the two ends are at equal potential w.r.t. centre point.

The wavelength of a radio wave or sound wave or any other wave varies inversely as the frequency & given by

$$\lambda \propto \frac{1}{f}$$

$$\lambda = \frac{c}{f}$$

$$\lambda(meter) = \frac{3 \times 10^8}{f}$$

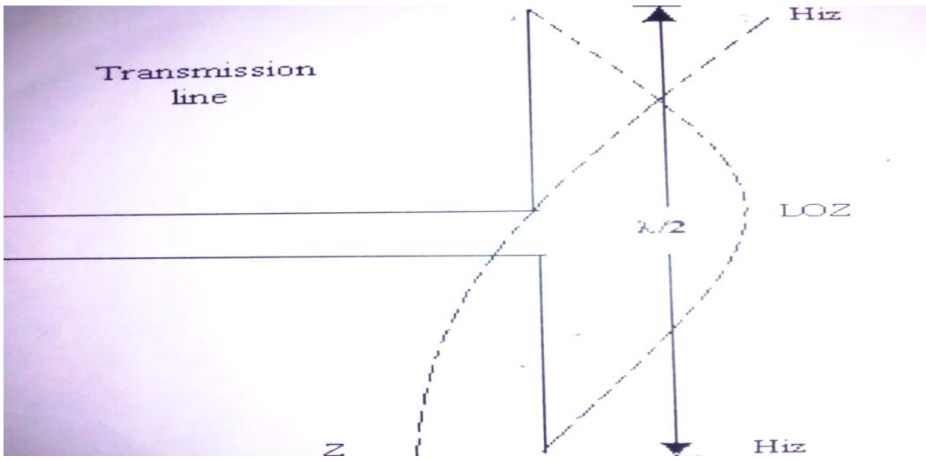
$$\frac{\lambda}{2} = \frac{300}{2f(MHz)} meters.$$

$$\frac{\lambda}{2} = \frac{150}{f(MHz)} \; meters.$$

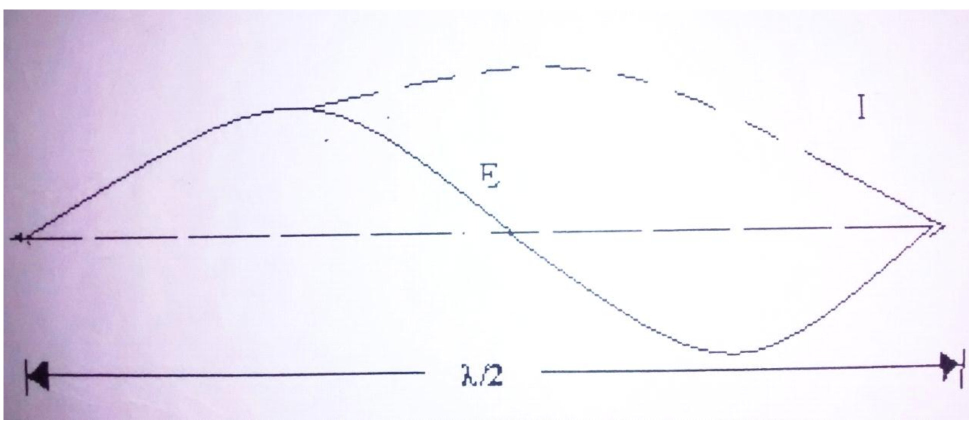
Thus, if used with a 1MHz radio transmitter, the basic length of antenna wire will be 150 meters or 492 feet. When an antenna of this length is excited a 1 MHz RF ac electron should have just enough time to reach the end of the wire. As the source RF ac reverses polarity. But this theory negates "end effect".

DIAGRAM:

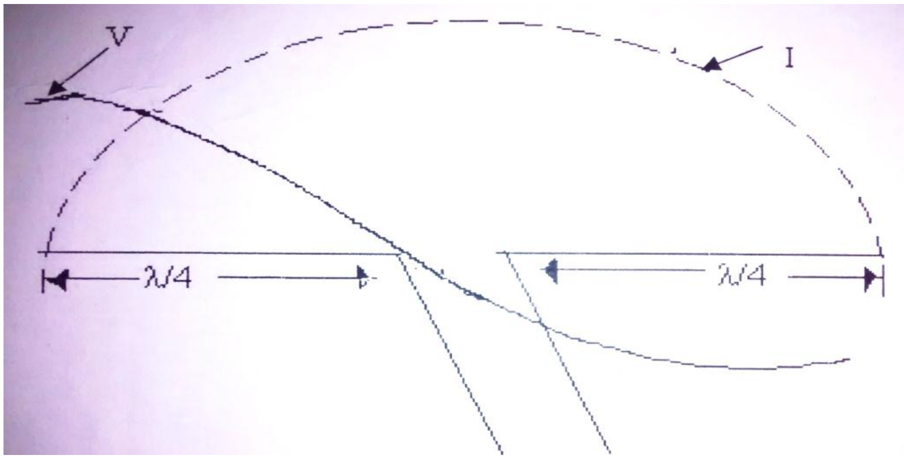
DipoleAntenna



Voltage distribution



Current Distribution



OBSERVATION:

Tx forword current:

Tx reverse current:

Angular position	**Voltage (mv)**	**Current (mA)**	**Angular position**	**Voltage (mv)**	**Current (mA)**	**Angular position**	**Voltage (mv)**	**Current (mA)**

CONCLUSION:

EXPERIMENT NO.

AIM: To Study loop antenna.

APPARATUS: Scientect kit, Multimeter.

PROCEDURE: 1) Initial settings:

Select Tx current in between 50 μA to 10 μA in forward direction.

Now change the direction in reverse & note down the reading.

Select the distance between Tx & Rx such that λ=c/f=35 cm.

2) Change the angle from reference in +ve & -ve direction.

3) For each angle take the reading of receiver current and voltage.

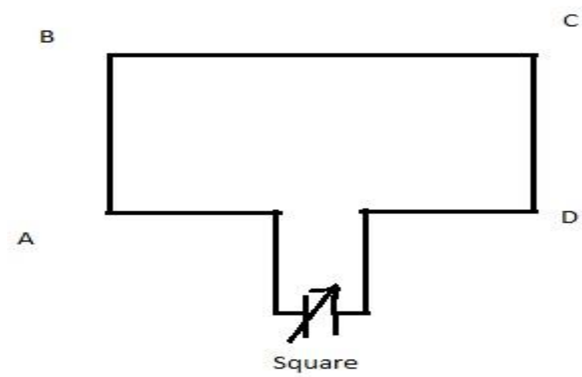
4) Change the value of Tx current & keep that constant & repeat the same procedure.

THEORY:

The loop antenna is radiating coil of any convenient cross section of one or more turns carrying radio frequency current. It may assume any shape or rectangular, square, triangular, hexagonal & circular on either on ferrite or air core. Loop is extensively used in radio receiver's aircraft receiver's direction finding & UHF transmitters. A loop of more than one then is often called as frame. Ordinary loop is so designed that is dimensions are small in comparison to wavelength, in which case the current are of same magnitude & phase throughout the loop.

Out of four arms of antenna, the two horizontal arms (AB & DC) acts as horizontal antenna while two vertical arms (AD & BC) acts as vertical antenna. If the plane of loop is set a right angle to the direction of from which vertically polarized waves are coming, then the same voltage will induced in the each of vertical sides of antenna. But these two voltages in two send current around the loop in opposite direction, hence they will be cancelled out as both the currents are equal in magnitude & opposite in phase. This happens because during normal position of loop antenna plane w.r.t. incoming wave both the sides are at equidistant from the transmitter.

DIRGRAM:



OBSERVATION:

Tx forword current:

Tx reverse current:

Angular position	**Voltage (mV)**	**Current (mA)**	**Angular position**	**Voltage (mV)**	**Current (mA)**	**Angular position**	**Voltage (mV)**	**Current (mA)**

CONCLUSION:

EXPERIMENT NO.

AIM : To measure direction paternof ‘ Yagi Uda folded dipole 5 element antenna.

APPARATUS: Scientech kit, Multimeter

PROCEDURE:

1) Initial Setting:
   - Select Tx current in between 50 A to 10 A in forward direction. Now change the direction inreverse& note down the reading.
   - Select the distance between Tx& Rx such that $\lambda = c/f = 105\text{cm}$ ($3\lambda = 3*35 = 105$)
2) Change the angle from reference in +ve& -ve direction.
3) For each angle, take the reading of receiver current & voltage.
4) Change the value of Tx current & keep that constant & repeat the same procedure.

THEORY:

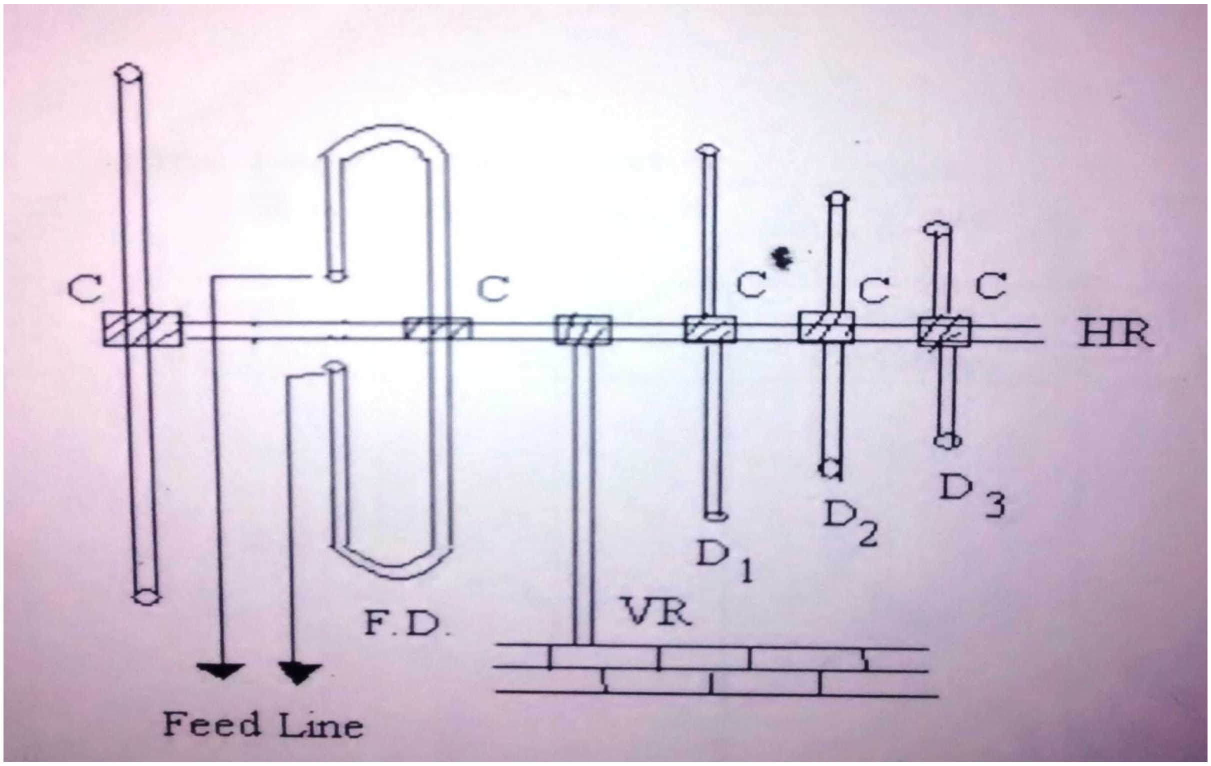
Yagi Uda or simply Yagi or Yagis are the most high gain antennas, It consists of driven element, a reflector & one or more directors i.e. Yagi-Uda antenna is an array of a driven element & one or more parasitic elements. The driven element is resonant half-wave dipole usually of metallic rod at the frequency of operation.

The parasitic elements of continuous metallic rods are arranged parallel to the driven element & at the same line of sight level. They are arranged collinearly& close together with one reflector & one director.

The parasitic elements receive their excitation from the voltages induced in them by current flow in the driven element. The phase & current flowing due the induced voltage depend on the spacing between the elements & upon the reactance of the elements.

The reactance may be varied by dimensioning the length of the parasitic element. The spacing between driven & parasitic elements are usually used in practice are of the order of λ/10, i.e. 0.10 λ, 01.5 λ. The parasitic element in front of driven element is known as director & its no. is more than one may be where as the element in back of it is known as reflector. Generally both directors & reflectors are used in the same antenna. The reflector is 5% more & director is 5% less than the driven element which is λ/2 at resonant frequency.

DIAGRAM



R	: Reflector
FD	: Folded dipole
D_1,D_2,D_3	: Directors
VR	: Vertical rod to support horizontal rods.
HR	: Horizontal rod to support elements.
C	: Clamps

OBSERVATIONS:

Tx antenna Forward current = ________µA

Reverse current = ________µA

Angular position	Voltage (mv)	Current (mA)	Angular position	Voltage (mv)	Current (mA)	Angular position	Voltage (mv)	Current (mA)

CONCLUSION:

EXPERIMENT NO.

AIM: To study the variation of field strength of radiated wave, with distance from transmitting antenna.

EQUIPMENT: MAT10 instrument, power cord, waveguide to coax. Adapter, waveguide stand, pyramidal horn, transmitter antenna stand, measuring tape.

PROCEDURE:

1. Keep both TX and RX at a minimal distance of 1m from each other, centre to centre using measuring tape.
2. This minimal distance ensures that we are testing the antennas in the far field region.
3. Transmitted microwave signal from horn antenna is intercepted by another horn and sent to receiver. Measure the level on receiver in dbu.
4. Note down the level reading at 1m distance.
5. Take the reading at 1.4m distance. Ensures that no scattering objects are in the vicinity of the antenna, which could radiate and distort the field pattern and consequently the readings. Avoid any movement of persons while taking the readings.
6. Take further reading at a distance of 1m, 1.5m, 2m….
7. Readings can be distorted if the horn antenna captures signal from its behind due to wall.
8. Plot this reading on Cartesian plane with distance between antennas on X-axis and signal level in dB as Y-axis.
9. Repeat the measurements once again to confirm the reading.
10. Use the graph template provided at the end of this manual for plotting your graph.

INVERSE SQUARE LAW

In physics, an inverse-square law is any physical law stating that a specified physical quantity or intensity is inversely proportional to the square of the distance from the source of that physical quantity. In equation form:

$$\text{Intensity} \propto \frac{1}{\text{distance}^2}$$

The divergence of a vector field which is the resultant of radial inverse-square law fields with respect to one or more sources is everywhere proportional to the strength of the local sources, and hence zero outside sources. Newton's law of universal gravitation follows an inverse-square law, as do the effects of electric, magnetic, light, sound, and radiation phenomena.

OBSERVATION TABLE

Distance	Power(dBu)
1.	
2.	
3.	
4.	
5.	

CONCLUSION:

EXPERIMENT NO.

AIM: To plot the radiation pattern of directional antenna and omni-directional antenna.

EQUIPMENT: MAT 10 instrument, power cord, waveguide to coax adapter, waveguide stands, and pyramidal horn antenna.

PROCEDURE:

1) Connect the pyramidal horn antenna to transmitter keep antenna in horizontal direction.
2) Now connect horn antenna to receiver at stepper monopod.
3) Set distance between antennas to be around 2m. Remove any stray object around antenna.
4) Now rotate horn antenna around its axis in step of 5 degrees.
5) Now replace pyramidal horn with other horn & find weather they are directional antennas or not.
6) Plot the readings on a polar or Cartesian plane using linear scales on graph paper.
7) While plotting take max reading as zero reference & subtract the subsequent reading from the reference reading and plot.
8) Now replace the monopod with a vertical helix dipole and observe if they are all omnidirectional in azimuth plane.

THEORY:

Directional Antenna

A directional antenna or beam antenna is an antenna which radiates greater power in one or more direction. Directional antennas like yagi-uda antennas provide increased performance over dipole antennas.

All practical antennas are at least somewhat directional, although usually only the direction in plane parallel to the earth is considered and practical antennas can easily be omnidirectional in one plane.

The most common types are the yagi-uda antenna, log periodic antenna, corner reflector which are frequently combined and commercially sold as residential TV antennas.

Omni-directional Antenna

In radio communication an omni-directional antenna is a class of antenna which radiates radio wave power uniformly in all direction in one plane with the radiated power decreasing with elevation angle above or below the plane, dropping to zero. This radiation pattern is often described as ‘Dough-nut shaped’.

Omni-directional antennas are widely used for radio broadcasting antennas and in mobile devices that use radio such as cell phones, FM radios, walki-talkie, GPS as well as for base station that communicate with mobile radios that are used in aircraft communication.

CONCLUSION:

EXPERIMENT NO.

AIM: To study phenomenon of linear and circular polarization of Antennas.

EQUIPMENT: MAT10 instrument, power cord, waveguide to coax. Adapter, waveguide stand, pyramidal horn, transmitter antenna stand, LHCP and RHCP Helix.

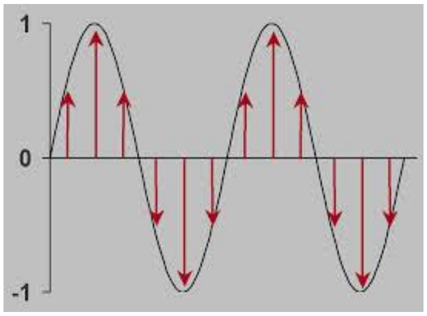
PROCEDURE:

1. Set up the equipment with two pyramidal horn antennas pointing each other and spaced by 2m.
2. Remove and stray object from around the antennas. Avoid any unnecessary movement while taking the readings.
3. Note the received reading.
4. Keep both the waveguides in the horizontal plane. The feeds of both antennas should parallel to each other.
5. Replace the horn at stepper end with helix antenna mounted on cube by replacing the shaft rod.
6. Connect a RHCP/LHCP axis mode helix antenna and point it towards the transmitter with pyramidal horn. Set the distance for axil mode helix to be around 2m and take care to point it precisely towards the other horn and ensures that same height is kept and horn waveguide is parallel to centre of helix while taking readings.
7. Now manually rotate the axial mode helix along its axis by connecting the helix on 3 faces of cube and observe the change in the level reading. Make sure the connector is tightened each time.
8. Now replace a helix by dipole antenna. Observe the change in the receiver reading.
9. Find correlation between plane of antennas at TX and RX and RX readings.

Linear Polarization:

Linear polarization or plane polarization of electromagnetic radiation is a confinement of the electric field vector or magnetic field vector to a given plane along the direction of propagation. See polarization for more information.

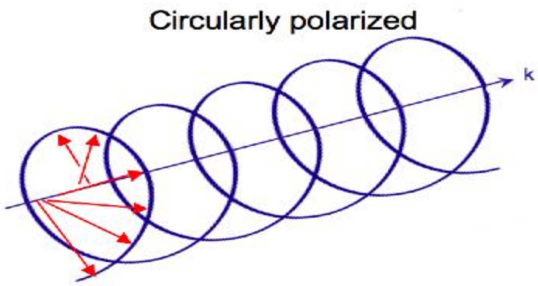
The orientation of a linearly polarized electromagnetic wave is defined by the direction of the electric field vector. For example, if the electric field vector is vertical (alternately up and down as the wave travels) the radiation is said to be vertically polarized.



Linear polarization

Circular Polarization:

Circular polarization of an electromagnetic wave is a polarization in which the electric field of the passing wave does not change strength but only changes direction in a rotary manner.
In electrodynamics the strength and direction of an electric field is defined by what is called an electric field vector. In the case of a circularly polarized wave, as seen in the accompanying animation, the tip of the electric field vector, at a given point in space, describes a circle as time progresses. If the wave is frozen in time, the electric field vector of the wave describes a helix along the direction of propagation.

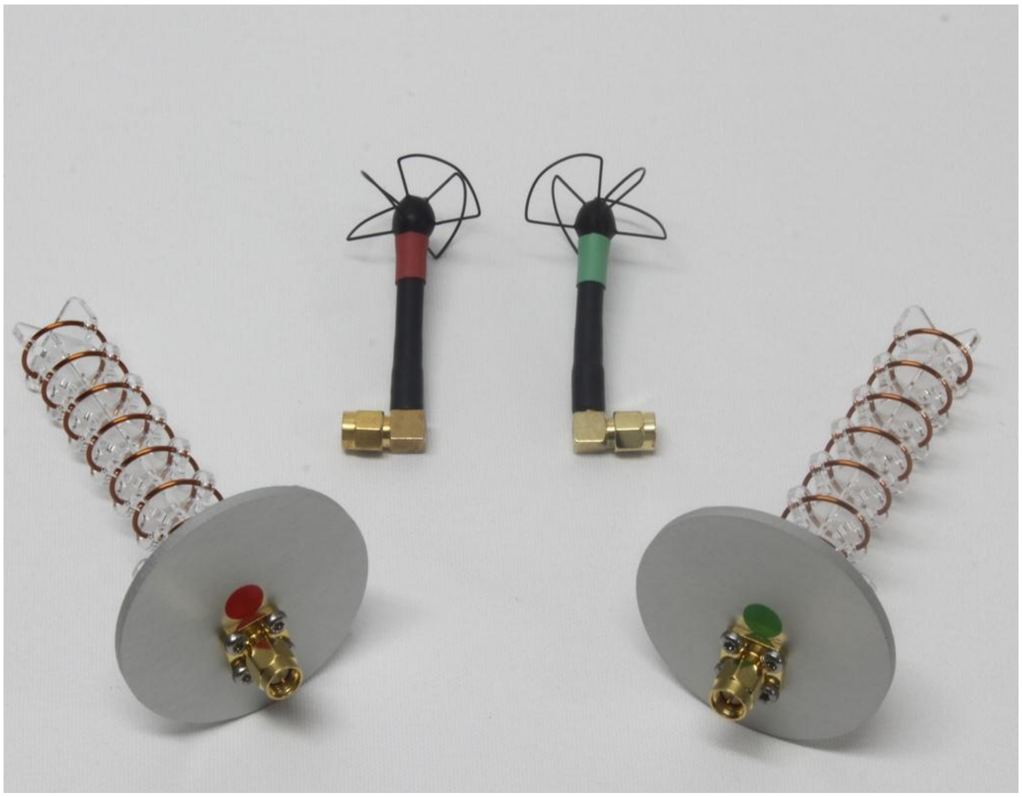


RHCP Helix:

- If the circular polarization is takes place in clockwise direction, then it is called as RHCP (right handed circular polarization).
- RHCP is also known as CW (clockwise) polarization.

LHCP Helix:

- If the circular polarization is takes place in counter-clockwise direction, then it is called as LHCP (left handed circular polarization).
- LHCP is also known as CCW (counter-clockwise) polarization.



OBSERVATION TABLE:

TRANSMITTER (Type of polarization)	RECEIVER (Type of polarization)	POWER RECEIVED (in dbu)

1. Horn (vertical)	Horn (vertical)	
2. Horn (horizontal)	Horn (horizontal)	
3. Horn (horizontal)	Horn (vertical)	
4. Horn (horizontal)	Helix(LHCP)	
	Helix(RHCP)	
5. Horn (vertical)	Helix(LHCP)	
	Helix(RHCP)	

CONCLUSION:

EXPERIMENT NO.

AIM: To measure the VSWR (Return loss)

EQUIPMENT: MAT10 instrument, power cord, waveguide to coax. Adapter, waveguide stand, pyramidal horn, transmitter antenna stand, directional coupler (D.C.)

PROCEDURE:

1. Set up the directional coupler for forward power measurement.
2. Connect transmitter port at input (port 1) of directional coupler.
3. Connect receiver at coupled port (port 3) of directional coupler.
4. Connect the antenna at output port (port 2) of directional coupler.
5. Now reverse the direction of directional coupler and set up the directional coupler for reverse power measurement.
6. Connect transmitter port at output port (port 2) of directional coupler.
7. Connect receiver at coupled port (port 3) of directional coupler.
8. Connect the antenna at input port (port 1) of directional coupler.
9. The difference between forward and reverse power in dB is return loss of antenna.
10. If return loss is more, VSWR is less and better is the antenna.
11. The directional coupler is matched to 50 ohms input impedance of receiver and 50 ohms output impedance of transmitter. It compares the antenna impedance to its internal reference impedance of 50 ohms (which is port 4).
12. Keep your hands away from antenna while taking measurements.

VSWR:

VSWR stands for ‘Voltage Standing Wave Ratio’ and is also referred to as standing wave ratio (SWR). VSWR is a function of reflection coefficient, which describes the power reflected from antenna. If reflection coefficient is given by ‘α’ then VSWR is defined by following formula, VSWR= (1+ α)/(1- α)

Reflection coefficient α is calculated as follows,

Return Loss= Forward power – Reverse power

Return Loss (in dB)= -20 log(α)

Reflection coefficient α = 10^(-return loss/20)

Significance:

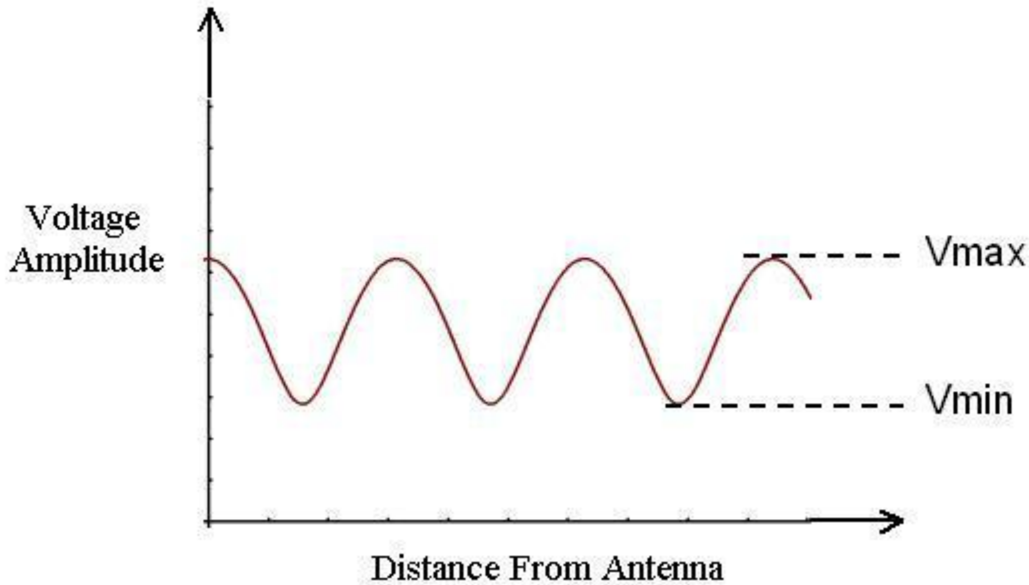
"Standing waves" are set up in an antenna feed line if the antenna does not present a pure resistance to the transmitter at its designed output impedance. If the match is perfect, the VSWR is said to be "1:1" or the feed is "flat".

There are various ways of determining the match by measurement of VSWR. It gives an indication of how much of the transmitter power is being radiated, and how much is being reflected back towards the transmitter.

It is this reflection that sets up the standing waves (i.e. voltage and current maxima and minima) along the line. The voltage highs were more convenient to measure.

If the designed output impedance is 50 ohms (very common these days), and the antenna presents a load resistance of 75 ohms (or 25 ohms) the VSWR will measure at a ratio of 1.5:1. Although that sounds terrible, the actual power loss from the mismatch is only around 4%. Using VSWR measurements is a simple way to see how efficiently the antenna is at taking the output power of the transmitter, and radiating it.

Physical Interpretation: VSWR is determined from the voltage measured along a transmission line leading to an antenna. VSWR is the ratio of the peak amplitude of standing wave to the minimum amplitude of a standing wave, as shown below:



In industry, VSWR is sometimes pronounced "viz-wer". When an antenna is not matched to the receiver, power is reflected (so that the reflection coefficient, α, is not zero). This causes a "reflected voltage wave", which creates standing waves along the transmission line. The results are the peaks and valleys as seen in Figure 1. If the VSWR = 1.0, there would be no reflected power and the voltage would have a constant magnitude along the transmission line.

Observation table:

Sr. no.	Forward power(dBu)	Reverse power(dBu)	Return loss	Reflection coefficient (α)	VSWR
1.					

CONCLUSION:

EXPERIMENT NO.

AIM: To demonstrate that the transmitting and receiving radiation patterns of an antenna are equal and hence confirm the reciprocity theorem of antennas.

EQUIPMENT: MAT10 instrument, power cord, waveguide to coax. adapter, waveguide stand, pyramidal horn, transmitter antenna stand, H-plane horn antenna.

PROCEDURE:

1. Connect H-plane horn antenna to the stepper monopod.
2. Point the horn antenna in the direction of H plane horn.
3. Set the distance between antennas to be around 2 meter. Remove any stray object from around the antennas. Avoid any unnecessary movement while taking the reading.
4. Now remove the H-plane antenna around its axis in steps of 5 degrees using stepper motor controller. Take the reading in the receiver at each step and note down.
5. Plot the readings on the graph paper.
6. Now without disturbing the setup, connect the pyramidal horn to stepper monopod and H-plane horn to the transmitter. Do not disturb their directions. Now H-plane horn is connected to transmitter and pyramidal horn at receiver. Take another set of reading by rotating the transmitter at stepper monopod from the controller every 5 degrees.
7. Keep in mind that it is antenna that is being rotated is plotted in reception and transmission mode both for providing the reciprocity theorem.
8. Observe the two plots and find if they are any different from each other.

Reciprocity theorem:

Reciprocity is one of the most useful (and fortunate) property of antennas. Reciprocity states that the received and transmit properties of an antenna are identical. Hence, antennas do not have distinct transmit and receive radiation patterns - if you know the radiation pattern in the transmit mode then you also know the pattern in the receive mode. This makes things much simpler, as you can imagine.

The reciprocity theorem is applied to transmitting and receiving antenna systems in order to establish several important relationships. Formulas are deduced which establish a relation between the receiving current and power of any given antenna and the field intensity of the arriving waves, all the parameters entering into the formulas being the parameters of the same antenna when it is used as a transmitting antenna. It is shown that, in the case of strong interference,

(1) The highest possible directivity is of importance both in the transmitting and in the receiving antennas.

(2) The efficiency and the coefficient of exploitation of the receiving antenna are of no importance.

In the case of low interference, it was found that,

(1) The directivities of both the receiving and transmitting antennas are of equal importance.

(2) The efficiency and coefficient of exploitation of the receiving antenna are just as important as the efficiency of the transmitting antenna.

OBSERVATION TABLE:

Sr. No.	Angle (in degrees)	Power(in dbu) H-plane horn(TX) &Pyramidal (RX)	Power(in dbu) Pyramidal (TX) H-plane horn(RX)	Sr No.	Angle (in degrees)	Power(in dbu) H-plane horn(TX) &Pyramidal (RX)	Power(in dbu) Pyramidal (TX) H-plane horn(RX)
1.	5			37.	185		
2.	10			38.	190		
3.	15			39.	195		
4.	20			40.	200		

5.	25			41.	205		
6.	30			42.	210		
7.	35			43.	215		
8.	40			44.	220		
9.	45			45.	225		
10.	50			46.	230		
11.	55			47.	235		
12.	60			48.	240		
13.	65			49.	245		
14.	70			50.	250		
15.	75			51.	255		
16.	80			52.	260		
17.	85			53.	265		
18.	90			54.	270		
19.	95			55.	275		
20.	100			56.	280		
21.	105			57.	285		
22.	110			58.	290		
23.	115			59.	295		
24.	120			60.	300		
25.	125			61.	305		
26.	130			62.	310		
27.	135			63.	315		

28.	140			64.	320		
29.	145			65.	325		
30.	150			66.	330		
31.	155			67.	335		
32.	160			68.	340		
33.	165			69.	345		
34.	170			70	350		
35.	175			71.	355		
36.	180			72.	360		

CONCLUSION:

EXPERIMENT NO.

AIM:

A. To plot the radiation pattern of dish antenna in E and H-plane on log and linear scales on polar and Cartesian plots.

B. To measure the beam width (-3dB), front to back ratio, side lobe level and its angular position, plane of polarization, directivity and gain of parabolic dish antenna.

C. To measure the VSWR, return loss using directional coupler.

EQUIPMENT: Mat10 instrument, power cord, waveguide to coax. adapter, waveguide stand, pyramidal horn, parabolic dish, directional coupler.

PROCEDURE:

A. To plot the radiation pattern of dish antenna in E and H-plane on log and linear scales on polar and Cartesian plots.

1. Connect the horn antenna to the TX. Keep the horn horizontally polarized.
2. Now connect a parabolic dish antenna to RX at the stepper monopod such that feed elements are vertical.
3. Set the distance between antennas to be around 2m.
4. Now rotate the parabolic dish antenna around its axis in steps of 5 degrees using stepper motor controller.
5. Note the maximum reading out of the whole set of reading. This will form the 0dB reference reading.
6. Plot readings on a polar plane with log/linear scales on the graph papers.
7. This plot with parabolic dish in horizontal plane shall form an E-plane plot.
8. Now without disturbing the setup- rotate the parabolic dish's feed dipole antenna at receiver from horizontal to vertical plane. And also rotate TX horn by also keeping the TX horn vertically polarized.
9. Rotate the parabolic dish antenna around its axis in steps of 5 degrees using stepper motor controller. Take the level reading of receiver at each step and note down.

10. Plot the readings also on a polar plane with linear scale on the graph.
11. This plot shall constitute the H-plane plot of the parabolic dish antenna.
12. Try to plot the same pattern using PC with the software provided.

B. To measure the beam width (-3dB), front to back ratio, side lobe level and its angular position, plane of polarization, directivity and gain of parabolic dish antenna.

1. From the E-plane radiation patterns drawn in experiment find the following.
2. The -3dB or half power beam width is defined as the angular width in degrees at the points on either sides of the main beam where the radiated level is 3dB lower than the maximum lobe value.
3. From polar plot measure the angle where 0dB reference is there.
4. Measure the angle when this reading is -3dB.
5. The difference between angular position of the -3db point is the E-plane bandwidth of the parabolic dish antenna.
6. Side lobe level is usually taken as level below bore sight gain.
7. Nulls can be up to -20dB from the bore sight direction gain.
8. If plot forms distinct side lobes then each ones angular position and level can be inferred from the plot.
9. The front to back ratio is measure of the ability of directional antenna to concentrate its beam in required forward direction.
10. Observe the difference in levels from bore sight direction and direction diametrically opposite to it.
11. Polarization is shape and orientation of locus of the extremity of electric field vector.
12. For a linear antenna like parabolic dish polarization direction is the direction of its feed element.
13. Find the direction of the polarization of parabolic dish antenna.
14. Measure the H-plane Beam width of parabolic dish antenna.
15. Calculate the directivity as 41000/(3dB beamwidth E-plane*3dB beamwidth H-plane degrees). Take a log of this value and multiply by 10 for reading in dbi.

C. To measure the VSWR, return loss using directional coupler.

1. Set up the directional coupler for forward power measurement.
2. Connect the TX at port 1 using coax to waveguide adapter.
3. Connect the RX at port 3 using coax to waveguide adapter.
4. Connect the antenna at port 2 using coax to waveguide adapter.
5. Eg. Forward power is 67 dBuv.
6. Now reverse the direction of directional coupler.
7. Connect the TX of port 2 of directional coupler using coax to waveguide adapter.
8. Connect the RX of port 3 of directional coupler using coax to waveguide adapter.
9. Connect the antenna at port 1 of directional coupler using coax to waveguide adapter.
10. Eg. Forward power is 52 dBuv.
11. The difference between forward power and reverse power in dB is return loss of antenna. Hence it is 67-52=15dB, VSWR is 1.43
12. If return loss is more VSWR is less, and better is the antenna.
13. The directional coupler is matched to 50 ohms i/p impedance of RX and 50 ohms o/p impedance of TX. It compares the antenna impedance to its internal reference impedance of 50 ohms.
14. Keep your hands away from the antenna while taking measurements.

THEORY:

Parabolic Dish Antenna:

- A parabolic dish antenna is an antenna that uses a parabolic reflector, a curved surface with the cross sectional shape of a parabola, to direct the radio waves.
- The main advantage of a parabolic antenna is that it has high directivity.
- Parabolic antennas are used as high gain antennas for point-to-point communication.

Parameters:

1. **Gain:**

The directive qualities of an antenna are measured by a dimensionless parameter called its gain, which is the ratio of the power received by the antenna to the power received by a isotropic antenna.

2. Aperture efficiency:

The Aperture efficiency of typical parabolic antennas is 0.55 to 0.70. Lager the aperture compared to the wavelength, the higher the gain. The gain increases with the square of the ratio of aperture width to wavelength.

3. Beam width:

The angular width of the beam radiated by high-gain antenna is measured by the half-power beam width (HPBW), which is the angular separation between the points on the antenna.

Application:

- Parabolic antennas are used in the high frequency part of the radio spectrum, at UHF and microwave frequencies.
- The other large use of parabolic antennas is for radar antenna in which there is a need to transmit a narrow beam of radio waves to locate objects like ships, airplanes and guided missiles.

CONCLUSION: