DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

राजकीय बहुतकनीकी, मानेसर Government Polytechnic, Manesar

LAB MANUAL

COMMUNICATION SYSTEMS LABORATORY

SEMESTER IV

Vision of the Institute

- To be a center of excellence imparting Technical Education and producing highly trained Diploma Engineers.

Mission of the Institute

- To produce industry ready Diploma Engineers.
- To promote technical skills in different areas of Engineering for higher studies.
- To develop human potential for entrepreneurship.
- To strengthen the bonding with allied industries.

Vision of the Department

To strive for continuous excellence in grant of Diploma in Electronics & Communication Engineering with Emphasis on Skills, Knowledge & behavior.

Mission of the Department

- To produce industry ready Electronics diploma engineers.
- To inculcate entrepreneurship skills.
- To impart knowledge to make the students ready for higher studies in their respective field.
- To strengthen bonding with Electronics and its allied industries.

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EXPERIMENT NO. 1

AIM: TO OBSERVE THE WAVEFORMS AT DIFFERRENT STAGES OF AN AM TRANSMITTER

EQUIPMENTS REQUIRED:
Modules ACL-01
Power Supply
20MHZ OSCILLOSCOPE
Connecting links.

THEORY:
Modulation is defined as the process by which some characteristics of a carrier signal is varied in accordance with a modulating signal. The base band signal is referred to as the modulating signal and the output of the modulation process is called as the modulation signal. The carrier frequency fc must be much greater than the highest frequency components fm of the message signal m (t) i.e. fc>>fm. The modulation index must be less than unity. If the modulation index is greater than unity, the carrier wave becomes over modulated. The modulating, carrier and modulated signals are given by

$V_m(t) = V_m \text{ Sin } \omega_m t$; $V_c(t) = V_c \text{ Sin } \omega_c t$;

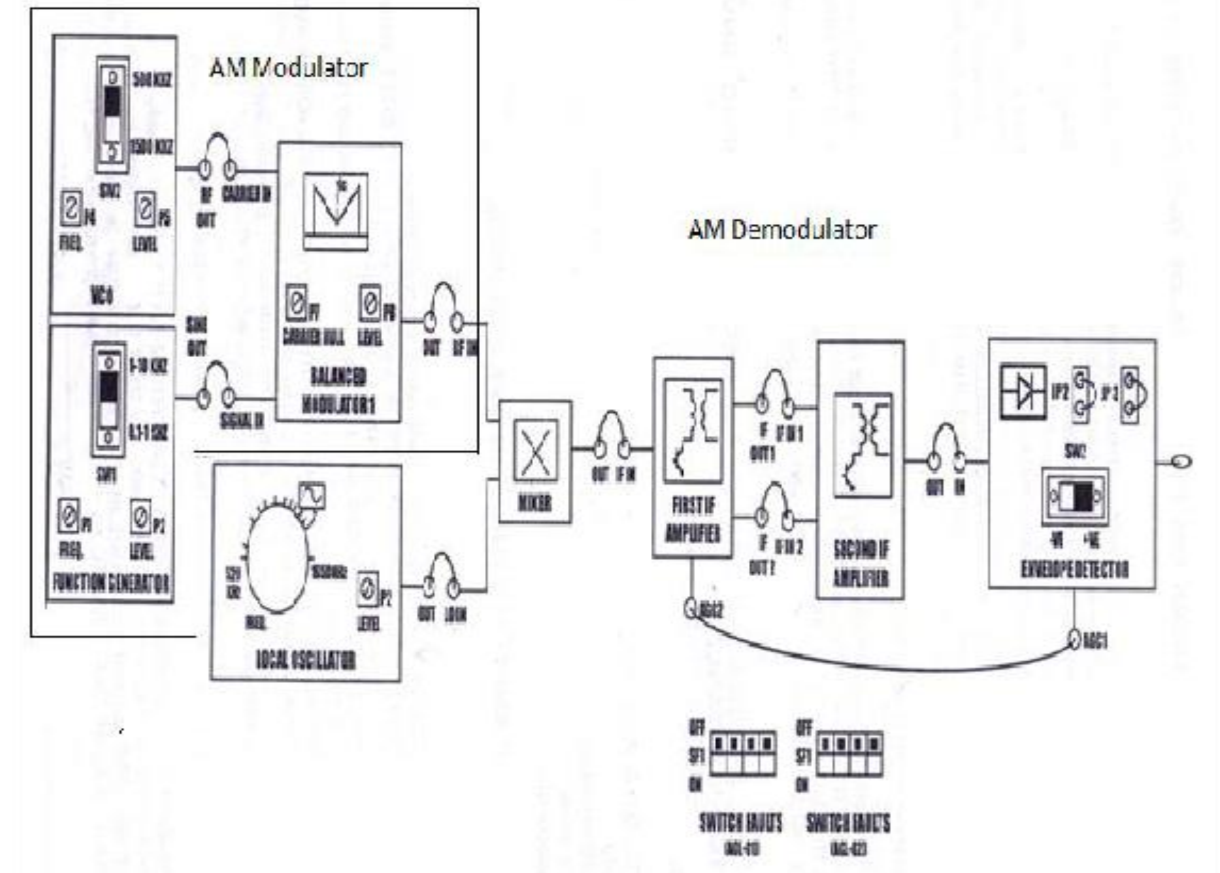
$V_{AM}(t) = V_c (1+ m_a \text{ Sin } \omega_m t) \sin \omega_c t$

The modulation index is given by, $m_a = V_m / V_c$.

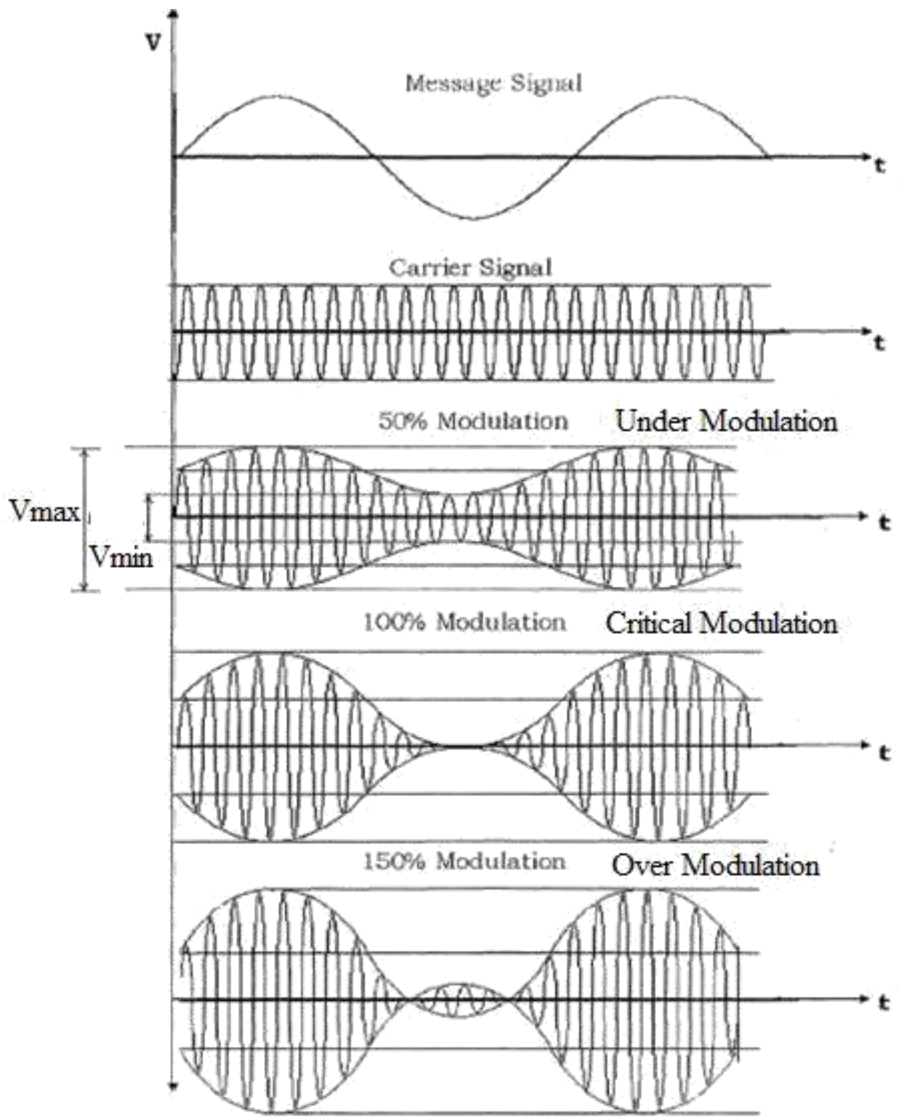
$V_m = V_{max} – V_{min}$ and $V_c = V_{max} + V_{min}$

NOTE: KEEP ALL THE SWITCH FAULTS IN OFF POSITION.
PROCEDURE:

1. Refer to the FIG. & carry out the following connections.
   Connect **SINE OUT** Post of **FUNCTION GENERATO**R SECTION (ACL- 01) to the I/P of BALANCE MODULATOR1 (ACL-01) **SIGNAL IN** POST.
2. Connect o/p of **VCO (**ACL -01) RF OUT post to the input of balance modulator1 CARRIER IN post (ACL-01).
3. Connect the power supply with proper polarity to the kit ACL-01 & ACL-02, while connecting this, ensure that the carry out the supply is OFF.
4. Switch on the power supply and carry out the following pre-setting.
   FUNCATION GENERATOR: LEVEL about 0.5Vpp: FREQ. about 1 KHZ.
   VCO: LEVEL about 1 Vpp: FREQ. About 450 KHZ, Switch on 500 KHZ
   BALANCED MODULATOR 1: CARRIER NULL completely rotated clockwise or counter clockwise, so as to" unbalance" the modulator and to obtain an AM signal with not suppressed carrier across the output: OUT LEVEL in fully clockwise.


AM Modulator
AM Demodulator
VCO
FUNCTION GENERATOR
BALANCED MODULATOR1
CARRIER IN
SIGNAL IN
MIXER
LOCAL OSCILLATOR
FIRST IF AMPLIFIER
SECOND IF AMPLIFIER
ENVELOPE DETECTOR
SWITCH FAULTS

5. Connect the oscilloscope to the inputs of the modulator post (SIG and CAR) and detect the modulator signal and the carrier signal.
6. Move the probe from post SIG to post OUT (output of the modulator), where signal modulator in amplitude is detected. Note that the modulator signal envelope corresponds to the waveform of the DSB AM modulating signal.
7. Vary the amplitude of the modulating signal and check the following condition: modulation percentage lower than the 100%, equal to the 100%, superior to 100% (over modulation).
8. Vary the frequency and amplitude of the modulator signal, and check the corresponding variation of the modulated signal.



EXPERIMENT NO. 2

AIM: TO OBSERVE THE WAVEFORMS AT DIFFERENT STAGES OF A RADIO RECEIVER

EQUIPENTS REQUIRED:

Modules ACL-01 & ACL-02
Power supply
20 MHZ oscilloscope.
Connecting Links

THEORY:

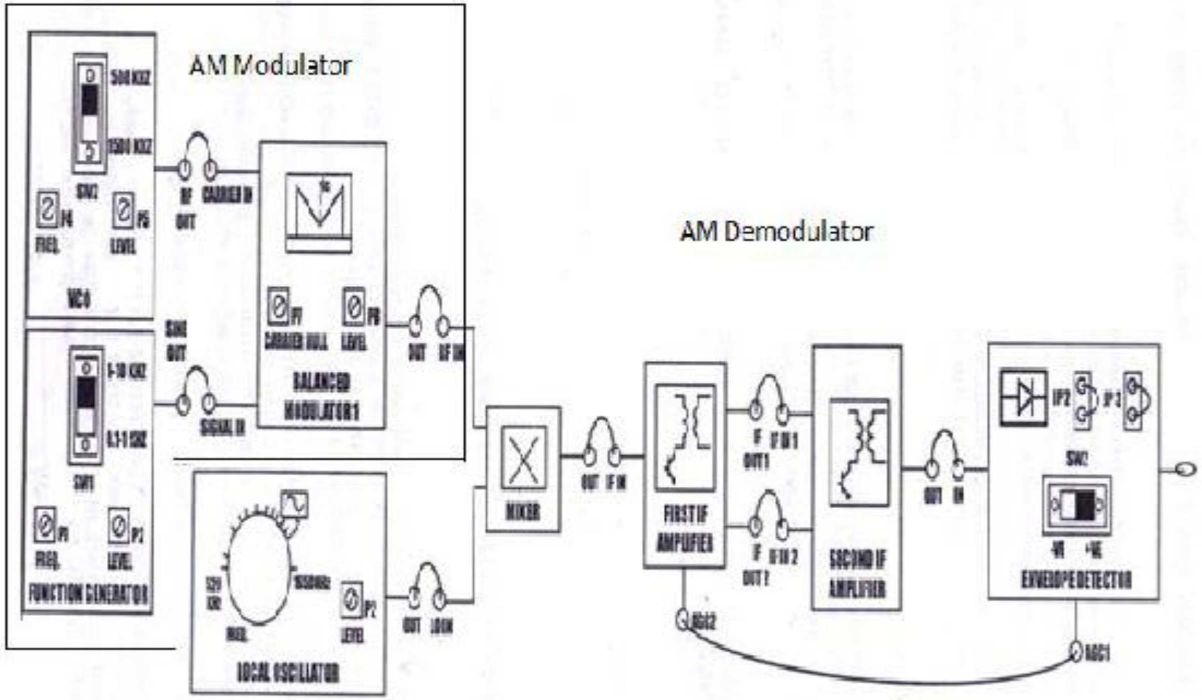
The demodulation circuit is used to recover the message signal from the incoming AM wave at the receiver. An envelope detector is a simple and yet highly effective device that is well suited for the demodulation of AM wave, for which the percentage modulation is less than 100%. Ideally, an envelope detector produces an output signal that follows the envelop of the input signal wave form exactly. Some version of this circuit is used in almost all commercial AM radio receivers. A diode detector followed by a filter circuit can perform demodulation.

NOTE: KEEP ALL THE SWITCH FAULTS IN OFF POSTION.

PROCEDURE:

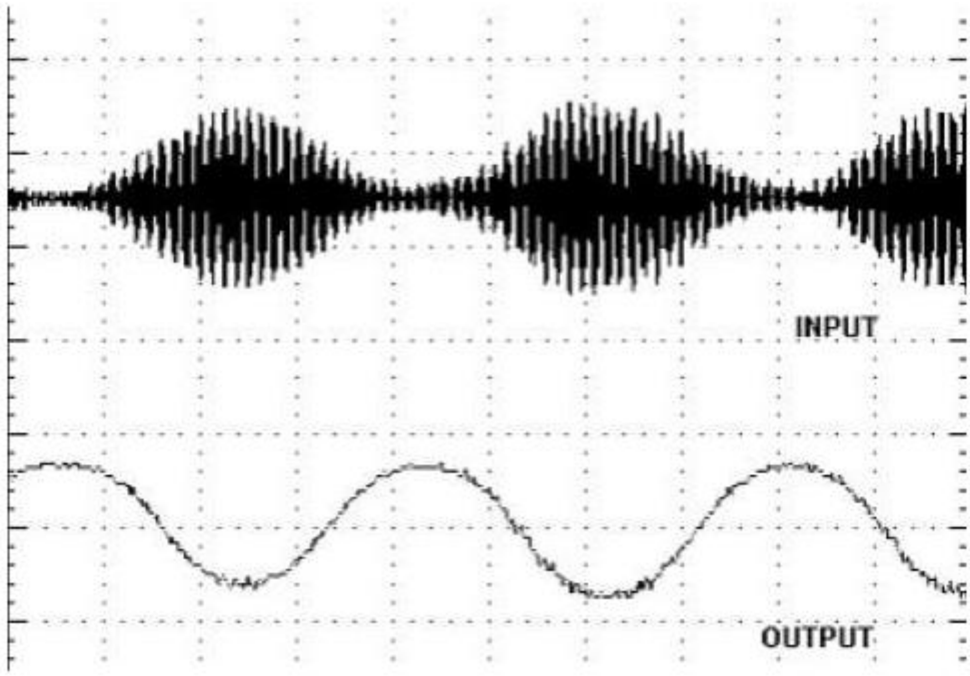
1. Refer to the FIG & carry out the following connections.
2. Connect o/p of **FUNCATION GENERATOR** section (ACL-01) OUT post to the i/p of balanced modulator (ACL-01) SIGNAL IN post.
3. Connect o/p of VCO (ACL-01) OUT post to the input of balanced modulator 1 (ACL-01) **CARRIER IN** post.
4. Connect the power supply with proper polarity to the kit ACL-01 &ACL -02, while connecting this, ensure that the power supply is OFF.
5. Switch on the power supply and carry out the following presetting:
   FUNCATION GENERATOR: Sine LEVEL about 0.5 Vpp , FREQ. ABOUT 1 KHz.
   VCO: LEVEL about 2Vpp FREQ. About 850 KHz switch on 1500KHz.
   BALANCED MODULATOR 1: CARRIER NULL completely rotates clockwise or counter clockwise, so that the modulator is “unbalanced” and an AM signal with not suppressed carrier is obtained across the output: adjust OUTPUT LEVEL to obtain an AM signal across the output whose amplitude is about 100m Vpp.

   LOCAL OSCILLATOR (ACL-02):1300 KHz 2V
6. Connect local oscillator **OUT** post to **LO IN** of the mixer section.
7. Connect balanced modulator1 out to **RF IN** of mixer section in ACL-02.
8. Connect mixer **OUT** to **IF IN** of 1^{ST} IF amplifier in ACL-02.



AM Modulator
AM Demodulator
VCO
FUNCTION GENERATOR
BALANCED MODULATOR1
LOCAL OSCILLATOR
MIXER
FIRST IF AMPLIFIER
SECOND IF AMPLIFIER
ENVELOPE DETECTOR
SWITCH FAULTS

9. Connect IF OUT1 of 1st to IF IN 1 and IF OUT 2 OF 1st to IF IN 2 OF 2ND IF AMPLIFIER
10. Connect **OUT** post of 2nd IF amplifier to IN post of envelope detector.
11. Connect post AGC to post **AGC2** and jumper position as per diagram.
12. Observe the modulating signal envelope, which corresponds to the waveform of the modulating signal **at OUT** post of the balanced modulator1 of ACL-01. Connect the oscilloscope to the IN and OUT post of envelope detector and detect the AM signal.
13. Check that the detected signal follows the behaviour of the AM signal envelope. Vary the frequency and amplitude of the modulating signal, and check the corresponding variations of the demodulated signal.



EXPERIMENT NO: 3

Aim: To align AM broadcast radio receiver.

EQUIPMENT:

- Modules ACL-01 & ACL-02
- Power supply
- 20 MHz oscilloscope
- Connecting links.

ADJUSTMENT OF RECIVER TUNED CIRCUITS:

Where signals are to be monitored with an oscilloscope, the scope's input channels should be ac coupled, unless otherwise indicated. Ensure that X 10 oscilloscope probes are used throughout.

A frequency counter should be used for all frequency measurement.

Use the trimming tool, supplied with the ACL-01 ACL-02 modules, for trimming inductor. Also, take care not to turn any inductor 's core past its end stop, as this may also result in damage.

ADJUSTMENT OF R.F AMPLIFIER TUNED CIRCUIT:

Ensure that the connection as per FIG. on the ACL-02 KIT:

(a) RX INPUT SELECT jumper on **JP1 pin ANT** position.
(b) GAIN preset **P1** (in the R.F AMPLIFIER block) in kit and transmit a sine wave of the R.F AMPLIFIER block at **OUT** post and follow the step below.

Set up a connection as per FIG. for ACL-01 kit and transmit a sine wave of 0.5V, on 850 KHz, R.F. AMPLIFIER block at OUT post and follow the step below.

Turn the tuning frequency dial upto 1300 KHz until the amplitude of the monitored signal is maximum.

Finally retune the R.F. amplifier GAIN preset to its fully clockwise (MAX) position for maximum output of monitor signal.

ADJUSTMENT OF LOCAL OSCILLATOR TUNED CIRCUIT:

Monitor the signal at **OUT** post of LOCAL OSCILLATOR block on the ACL-02 KIT: use a gang capacitor to adjust frequency in the LOCAL OSCILLATOR block.

By carefully tuning GANG CAPACITOR throughout its range of adjustment, check that the monitored signal is ac level at both ends of the adjustment range, frequency range can be adjusted from 900 KHz to 2MHz (+/- 200 Hz). Level of the signal can be adjusted by using POT P2.

Monitor the frequency at **OUT** post of LOCAL OSCILLATOR block.

ADJUSTMENT OF MIXER AND I.F. AMPLIFIER TUNED CIRCUITS:

Carry out the following preseting:

- **LOCAL OSCILLATOR:** LEVEL about 1 Vpp: FREQ. 1000 KHz.
- **VCO** (ACL-01: LEVEL about 100 mVpp FREQ. 550 KHz.

Connect the oscilloscope to the output of the mixer **OUT post** and accurately vary the frequency of LO until you detect a sine wave signal.

Measure the frequency of the two input signals and the output signal and check that also the last is the difference of the first two: $\mathbf{F_{if} = f_{lo} - f_{RF}}$.

We can tune trimmer CV1 until we get clear sine wave, which is equal to Fif. Also we can do the same procedure to observe signal receiving from antenna.

I.F. AMPLIFIER:

Refer to the connection as done in FIG.

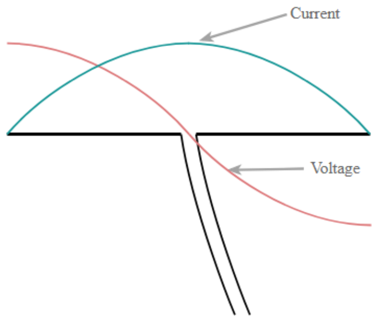
(a) Monitor output of the 1^{st} I.F. AMPLIFIER and tuned transformer TR6 until the amplitude of the monitored signal is maximum 3V.
(b) Tune transformer TR5 until the amplifier of the monitored signal is maximum.
(c) Tune transformer TR6 (in the 1^{st} I.F. AMPLIFIER block in component section.) until the amplitude of the monitored signal is once again maximum. So as to recover same DSB AM envelope as seen in transmitter.
(d) Center frequency of IF AMPLIFIER can be adjusted with the help of trimmer **CV2** and transformer TR6.

EXPERMENT NO. 4

Aim: To identify and study the various types of antennas used in different frequency ranges.

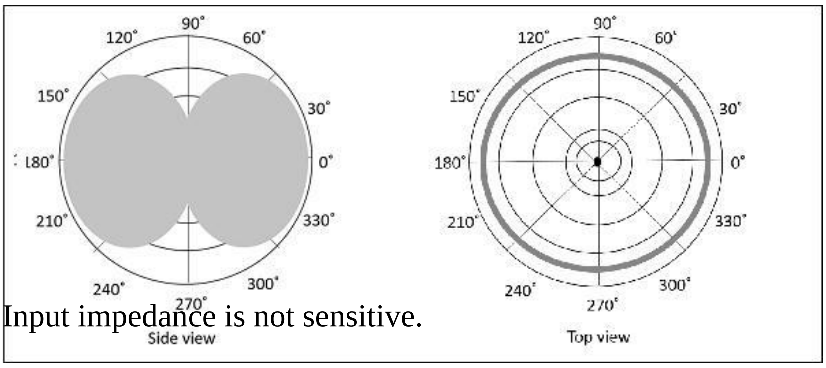
Half wave dipole

The half wave dipole is formed from a conducting wire or metal tube which is an electrical half wavelength long. It is normally fed in the middle where the impedance decreases to its lowest. The length of the half wave dipole is an half of the electrical wavelength for the wave travelling in the antenna conductors.



Current and voltage waveforms on a half wave dipole

The voltage and current amplitude vary along the length of the radiating section of the antenna. This happens because standing waves are set up along the length of the radiating element. The current at end points is zero, but the voltage is at its maximum. The current reaches a maximum and the voltage a minimum at a length equal to an electrical quarter wavelength from the ends as shown in figure. The feeder is connected to the centre point where there is a current maximum and a voltage minimum. This results in the antenna presenting low impedance to the feeder. The impedance for a half wave dipole antenna in free space is dipole 73 Ω which presents a good match to 70Ω coaxial feeder.
The radiation pattern of the half-wave dipole is omni-directional. It is used for many applications such as mobile communications, radio receivers etc.



Advantages: Input impedance is not sensitive.

Length of the antenna matches with size and directivity.

Disadvantages: Not much effective due to single element. It can work better only with a combination.

Applications: Used in radio receivers, television receivers, antenna arrays etc.

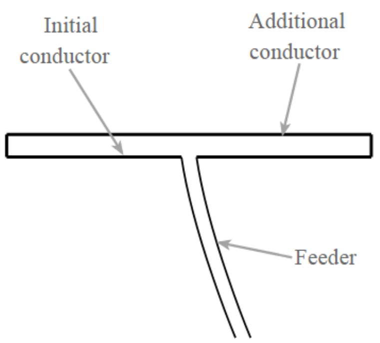
Medium wave antenna

The MW or mast antennas have been developed in order to cover mobile systems needs as well as the emergency service of temporary MW AM broadcasting. They can also be employed as stationary antennas for services in the MW broadcasting range. The antenna system comprises of antenna, matching unit and a coaxial feeder line. This antenna system consists of a grounded vertical tower with six folded wires spaced in 60 degrees around the tower.

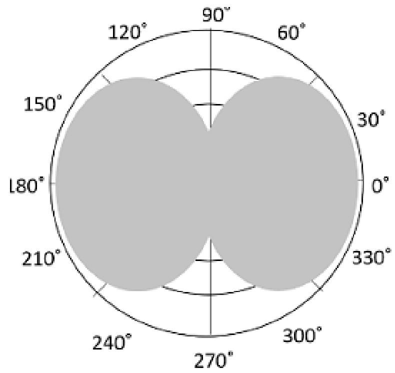
Medium wave antennas are placed vertically closed to the ground, radiating vertically polarized signals. Their height is between one-fourth to five-eighth of the wavelength. Three ways of feeding the mast antennas are: base feed, shunt feed and multiple feed.

Folded dipole antenna

The folded dipole antenna comprises a basic dipole with an added conductor connecting the two ends together to make a complete loop of wire. The antenna is called a folded dipole due to its folded ends. The first element of the folded dipole is fed directly while the second is coupled inductively. The radiation pattern of folded dipole is same as of a simple dipole with increased input impedance.



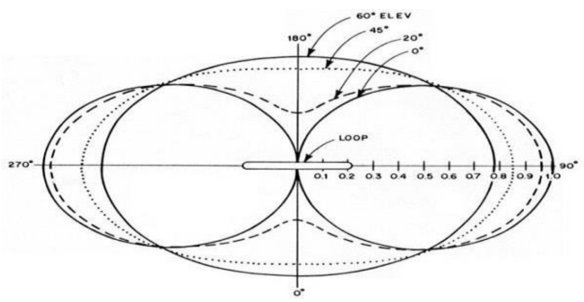
Basic folded dipole antenna



The power supplied to a folded dipole antenna is evenly divided between the two sections of the antenna. So, when compared to a standard dipole the current in each conductor is reduced to a half. As the same power is applied, the impedance has to be raised by a factor of four, so that $P = I^2 \times R$. The half wave folded dipole operates in the frequency range from 3KHz to 300GHz. The folded dipole antenna has the advantage of having high impedance and wide bandwidth. The limitations of the antenna are difficult installment and large size. It is used as a feeder element in Yagi antenna, Parabolic antenna, turnstile antenna, log periodic antenna etc.

Loop antenna

A loop antenna is a radio antenna consisting of a loop or coil of wire which can have the shape of a circle, rectangle, square etc. Its dimensions are much smaller than a wavelength. The loop is always surrounded by a perpendicular magnetic field. The radiation pattern is independent of its shape and is generally of doughnut shape given below. These are used on frequencies between 3–30 MHz for both transmission and reception.

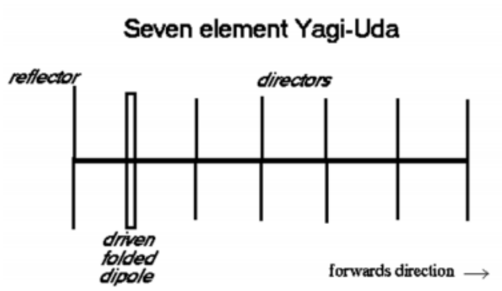


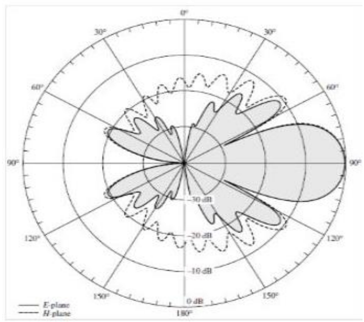
They are used in RFID devices, MF, HF and Short wave receivers, Aircraft receivers for direction finding. The advantages of Loop antenna are its compact size and high directivity.

The disadvantages of Loop antenna are poor impedance matching and low radiation efficiency.

Yagi-Uda Antenna

Yagi-Uda antenna is named after the inventors Prof. S.Uda and Prof. H.Yagi. The basic element used in this antenna is half wave dipole placed horizontally called as driven element or active element. In order to convert bidirectional dipole into unidirectional system, the passive elements are used which include reflector and director. The passive or parasitic elements are placed parallel to driven element placed close together as shown in figure. The length of director is 5% less than the driven element. The length of reflector is 5% more than that of driven element. The space between the elements varies between 0.1λ to 0.3λ. For a three element system, Reflector length = 500/f (MHz) feet, Driven element length = 475/f (MHz) feet and Director length = 455/f (MHz) feet.





It radiates in only one direction and is most commonly used in point-to-point communications. The Yagi-Uda antenna is used in a wide variety of applications where an RF antenna design with high gain and directivity is required such as television reception. It has disadvantage of complexity and large size.

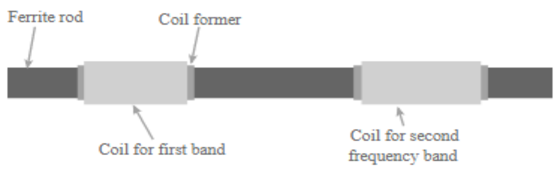
A Yagi system has the following characteristics:

- The three element array is generally referred as "beam antenna"
- It has unidirectional pattern of moderate directivity with light weight, low cost and simplicity in design.
- The bandwidth increases between 2% when the space between elements ranges between 0.1λ to 0.15λ.
- It gives a gain of 8 dB and a front-to-back ratio of 20dB.
- Yagi is also known as super-directive or super gain antenna because of its high gain.

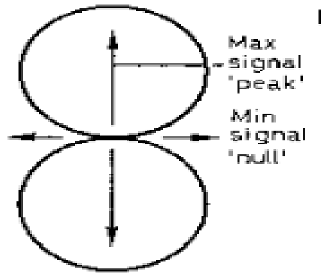
- For achieving greater directivity, more directors are used. Arrays can be stacked to increase the directivity.
- Yagi is essentially a fixed frequency device. Frequency sensitivity and bandwidth of about 3% is achievable.

Ferrite Rod Antenna

The ferrite rod antenna is a form of RF antenna design that is used in portable transistor broadcast receivers as well as many hi-fi tuners for reception on the long, medium and short waves. The antenna consists of a rod made of highly permeable ferrite material. A coil is wound around the ferrite rod and this is brought to resonance using a variable tuning capacitor. Its radiation pattern is as given below.



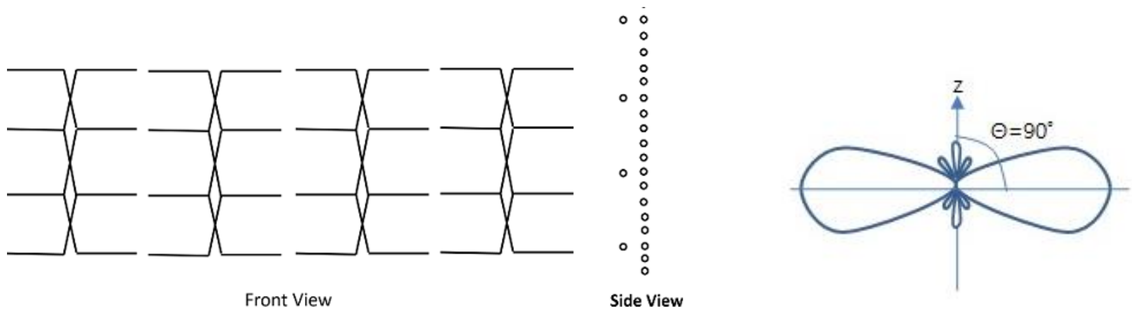
Typical ferrite rod antenna assembly used in a portable radio



Its advantages are its small size and low cost. The limitations include low efficiency and high power losses.

Broadside Array

The phasing of linear array elements may be done such that the main lobe of the array pattern lies along the array axis (end-fire array) or perpendicular to the array axis (broad side array). The broadside array is designed such as the radiation pattern's direction is perpendicular or broadside to the array axis. It consists of the dipole elements that are fed in phase and separated by the one-half wave length. A broadside array is used to radiate the energy in a particular direction to make better transmission. It operates in VHF and UHF bands.

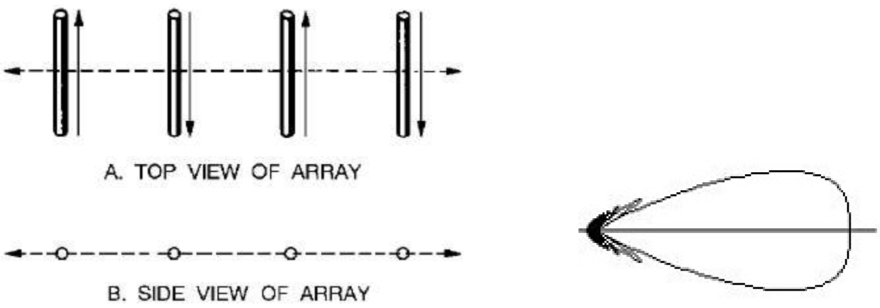


Advantages: high gain and directivity.

Disadvantages: high complexity and cost.

End fire array

The physical orientation of end-fire array is same as that of the broad-side array. The magnitude of currents in each element is same, but there is a phase lag between the succeeding elements. So the radiation pattern of the array lies in its plane, not perpendicular to it. It is unidirectional in nature. It is also a type of linear, resonant antenna like broadside array.

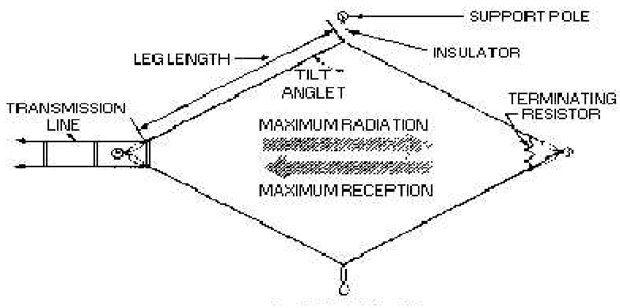


There is nil radiation in the right angles to the plane of the array because of cancellation. The first and third elements are fed out of phase and therefore cancel each other's radiation. Likewise, second and fourth are fed out of phase, to get cancelled.

The usual dipole spacing is λ/4 or 3λ/4. This arrangement helps to avoid the radiation perpendicular to the antenna plane and therefore the radiated energy get diverted to the direction of radiation of the whole array. Therefore, the minor lobes are avoided resulting in increased directivity.

Rhombic antenna

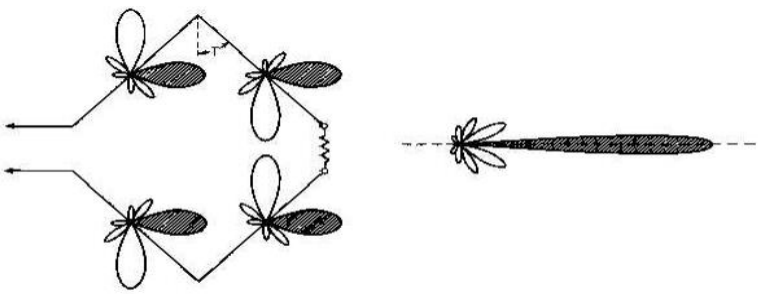
The Rhombic Antenna is an equilateral parallelogram shaped antenna. It has two opposite acute angles. The tilt angle is approximately equal to 90° minus the angle of major lobe. Rhombic antenna works as a travelling wave radiator. It is placed horizontally above the surface of the earth. The antenna works in HF and VHF ranges. The top view of rhombic antenna is given below.



The rhombic antenna is widely used for long-distance, high-frequency transmission and reception, point-to-point communications. The rhombic antenna is much easier to construct and maintain with high gain and directivity.

But a large antenna site is required for its erection. A high-frequency rhombic antenna has wires of several hundred feet in length. Also the horizontal and vertical patterns depend on each other.

The figure below shows the individual and resultant radiation pattern of the antenna:



A. INDIVIDUAL RADIATION PATTERNS B. RESULTANT RADIATION PATTERNS

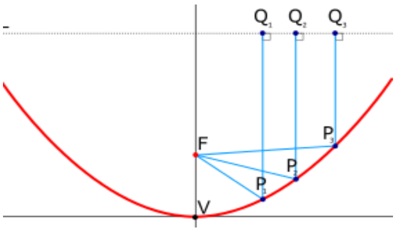
Parabolic Dish antenna

A parabolic dish antenna is an antenna that uses a parabolic reflector to direct the radio waves. It has high directivity, high gain and narrow beam width. The parabolic reflector must be much larger than the wavelength of the radio waves in order to achieve narrow beam widths.

Standard Parabolic Antenna   Shielded Antenna

Features of Dish antenna are:

1. The basic structure of a parabolic dish antenna is consists of a feed antenna (horn antenna with a circular aperture) pointed towards a parabolic reflector. The working principle of a parabolic antenna is that a point source of radio waves at the focal point in front of a parabolic reflector will be reflected into a collimated plane wave beam along the axis of the reflector and vice-versa.



2. Directive gain of parabolic antenna is given by

$$G_a\,(\text{dBi}) = 10 \log_{10} \eta\, [\, 4\, \pi\, A_e / \lambda^2\,]$$

Where:

G_a = Antenna Directive Gain

η = Aperture Efficiency (50-55%)

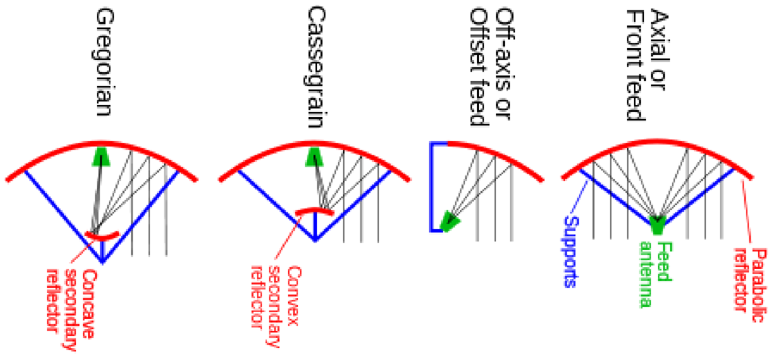
A_e = Antenna Aperture Area

λ = Wavelength (speed of light / frequency)

3. Advantages: High gain and high directivity.
4. Disadvantages: Requires reflector and drive elements, large size and high cost.
5. Applications: Parabolic antennas are used for point-to-point communications, in microwave relay links to carry telephone and television signals , wireless WAN/LAN links for data

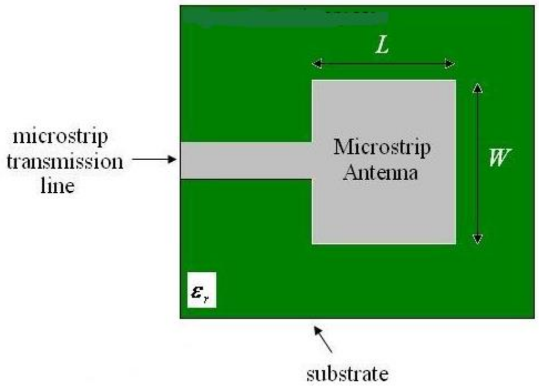
communications, satellite communications and spacecraft communication antennas. They are also used in radio telescopes.

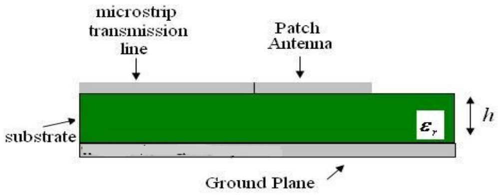
6. Feeding methods: Parabolic antennas are classified by the type of feed.
   - *Axial* or *front feed* – The feed antenna is located in front of the dish at the focus, on the beam axis, pointed back toward the dish. The feed and its supports block some of the beam limiting the aperture efficiency to only 55–60%.
   - *Off-axis* or *offset feed* – The focus and the feed antenna, are located to one side of the dish, so as to move the feed structure out of the beam path, therefore it does not block the beam. It is used in home satellite television dishes, multiple reflector designs such as the Cassegrain and Gregorian.
   - *Cassegrain* – Here, the feed is located on or behind the dish, and radiates forward, illuminating a convex hyperboloidal secondary reflector at the focus of the dish.
   - *Gregorian* – It is similar to the Cassegrain design except that the secondary reflector is concave in shape.



Patch Antenna

A patch or microstrip antenna is a type of low profile radio antenna, which can be mounted on a flat surface. It consists of a rectangular sheet or patch of metal, mounted over a larger sheet of metal called a ground plane. The patch and the ground plane are separated by a dielectric sheet called as substrate. The radiating elements and the feed line are photo-etched on the substrate. The top and side view of patch antenna is as given below:





Advantages of patch antenna are its small size, low cost, easy and accurate design, ans high directivity.

Disadvantages: narrow bandwidth and low efficiency.

Applications: The patch antenna is mainly used at microwave frequencies in portable wireless devices like mobile phones because of the ease of fabricating it on printed circuit boards. Multiple patch antennas can be used to make high gain array antennas and phased arrays.

EXPERIMENT NO. 5

ARRANGING THE TRAINER & PERFORMING FUNCTION CHECKS

Arrange the trainer with the Tx antenna and the detector as shown in fig.

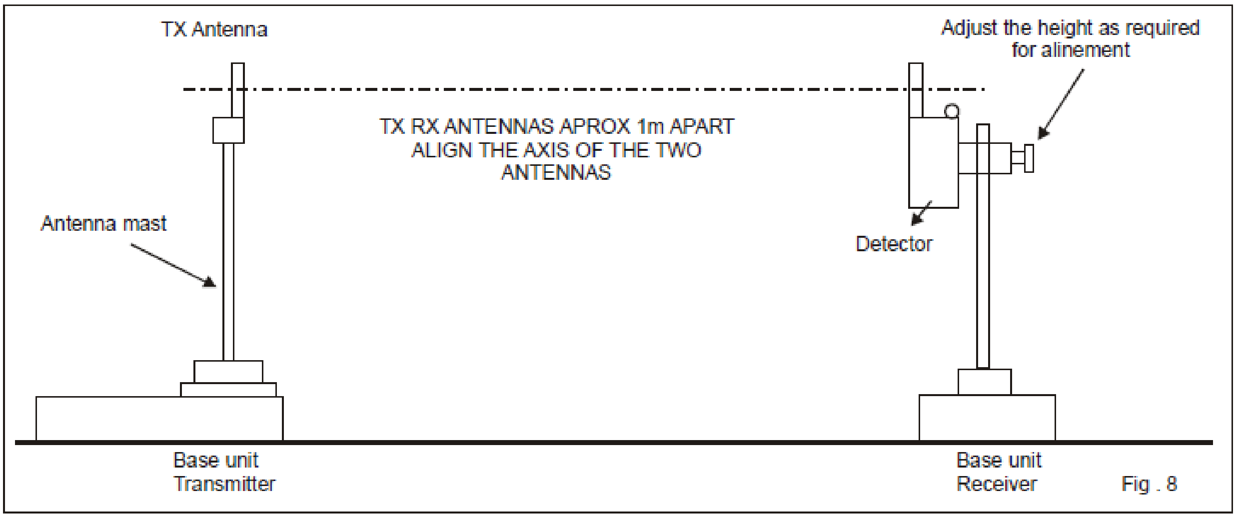


Fig . 8

Functional Checks:

1. Check the AC mains input voltage and switch ON the trainer. The Pilot lamp should glow, indicating DC power supply is OK.
2. Check the output of Tone Generator on the oscilloscope (frequency 1.5 KHz approx.) by connecting probe at Audio OUT terminal. Vary the level of tone generator & see that it varies from 0 to 3 V peak to peak. This confirms proper functioning of tone generator.
3. Turn the RF level to minimum and FS adjust to maximum. Put coupler switch to FWD. Increase RF level gradually from minimum to maximum. There will be indication in the meter. Change the switch from FWD to REV and see that meter has deflection. This confirms working of RF generator & directional coupler.
4. Install transmitting antenna mast on the main unit of tile trainer and connect folded dipole on it.
5. Mount detector assembly on the detector stand in horizontal plane and keep it approx. 0.5m away from the main unit. Align both transmitting and receiving antenna in line keeping same heights. When the RF level is increased or decreased, the detector meter will show the deflection indicating that the system is functioning.
6. Rotate the transmitting antenna between 0 – 360^0 and the detector will indicate different values depending upon the radiation pattern of the antenna.
7. Connect Audio output to Modulation IN by banana patch cord. Check the sine wave output of tone generator on the oscilloscope and also similar output (slightly distorted and with noise) on the out terminal of the detector. This confirms that the transmitting antenna

transmits modulated signal which is detected by detector and available on RF detector terminal for verification.

Objective:

To study and plot the radiation pattern of dipole antenna.

Apparatus:

1. Antenna trainer kit

2. BNC connecting chords

3. RF detector

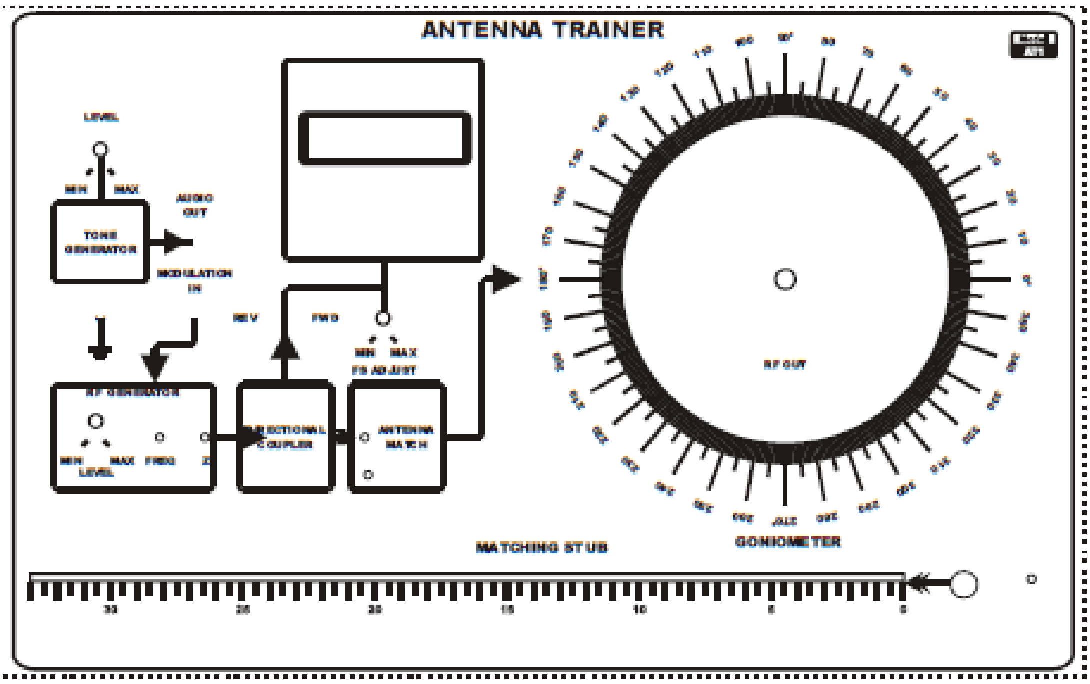
4. Transmitting and receiving antenna.

Theory: The half wave dipole is formed from a conducting wire or metal tube which is an electrical half wavelength long. It is normally fed in the middle where the impedance decreases to its lowest. The length of the half wave dipole is half of the electrical wavelength for the wave travelling in the antenna conductors.

Procedure:

1. Mount the antenna on transmitting mast.

2. Bring the detector assembly near to the main unit and adjust the height of both Tx and Rx antenna for same.



3. Keep detector assembly away from the main unit about 1 meter and align both of them. Ensure that there is no reflector sort of thing in the vicinity of the experiment such as steel structure, mobile phones etc.

4. Adjust the RF detector so that deflection in detector is approx. 30-35 microampere.

5. Align arrow mark of the disk with zero of the goniometer scale.

6. Start taking reading at the interval of 10 degree.

7. Convert the reading into dB with the help of formula 8. Plot polar plot with all the readings and find HPBW of antenna.

Observation: -

S. no.	**Angle (in degrees)**	**Detector current (in micro ampere)**	**Power (in dBs)**

Result:

The radiation pattern is studied and plot is as given.

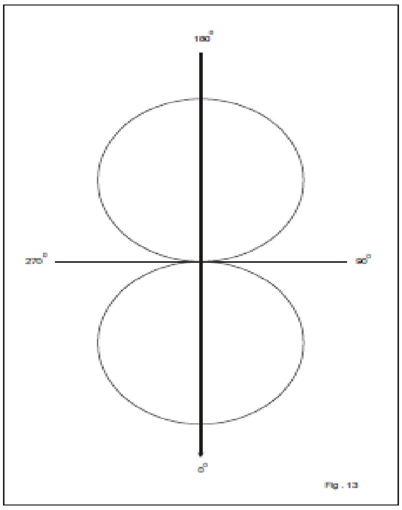


Fig . 13

Precautions:

1. Connection and alignment of both antennas should be make carefully.
2. Reading must be taken carefully.

Objective

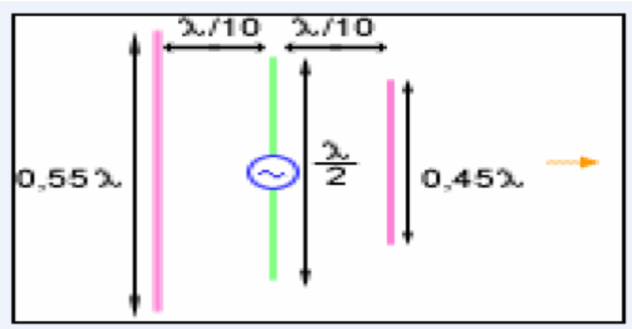
To study and plot the radiation pattern of Yagi -Uda antenna.

Apparatus: -

1. Antenna trainer kit
2. BNC connecting chords
3. RF detector
4. Transmitting and receiving antenna

Theory:

Yagi-Uda antennas are directional along the axis perpendicular to the dipole in the plane of the elements, from the reflector through the driven element and out via the director(s). Typically, all elements are spaced about a quarter-wavelength apart. All elements usually lie in the same plane, supported on a single boom or crossbar; however, they do not have to assume this coplanar arrangement: for example, some commercially available Yagi-Uda antennas for television reception have several reflectors arranged to form corner reflector behind the dipole.



The bandwidth of a Yagi-Uda antenna, which is usually defined as the frequency range for which the antenna provides a good match to the transmission line to which it is attached, is determined by the length, diameter and spacing of the elements. For most designs bandwidth is typically only a few percent of the design frequency. Yagi-Uda antennas can be designed to operate on multiple bands.

Procedure: -

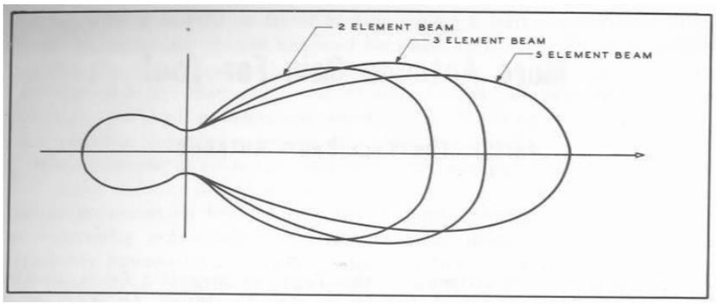
1. Mount the antenna on transmitting mast.
2. Bring the detector assembly near to the main unit and adjust the height of both Tx and Rx antenna for same.
3. Keep detector assembly away from the main unit about 1 mts and align both of them. Ensure that there is no reflector sort of thing in the vicinity of the experiment such as steel structure, mobile phones etc.
4. Adjust the RF detector so that deflection in detector is approx. 30-35 microampere
5. Align arrow mark of the disk with zero of the goniometer scale
6. Start taking reading at the interval of 10 degrees.
7. Convert the reading into dB with the help of formula
8. Plot polar plot with all the readings and find HPBW of antenna.

Observation: -

S. no.	Angle (in degrees)	Detector current (in micro ampere)	Power (in dBs)

Result:

The radiation pattern is studied and plot is attached



EXPERIMENT NO 6.

OBJECTIVE:

To plot the variation of field strength of a radiated wave, with distance from a transmitting antenna.

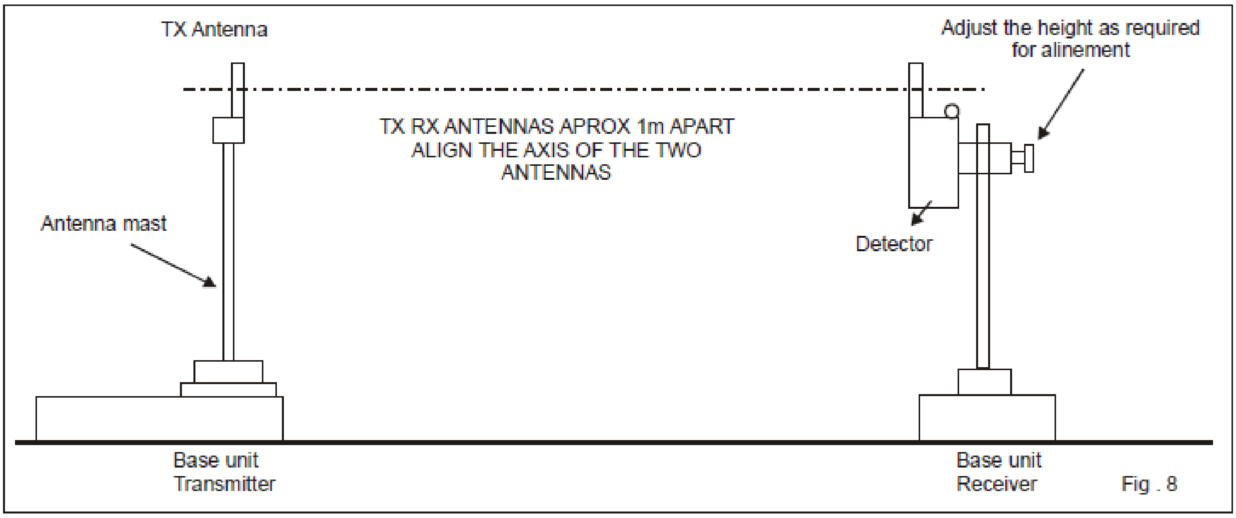
EQUIPMENTS:

1. Antenna trainer kit

2. BNC connecting chords

3. RF detector

4. Transmitting and receiving antenna



PROCEDURE:

1. Mount the antenna on transmitting mast.

2. Bring the detector assembly near to the main unit and adjust the height of both Tx and Rx antenna for same.

3. Keep detector assembly away from the main unit and align both of them. Ensure that there is no reflector sort of thing in the vicinity of the experiment such as steel structure, mobile phones etc.

4. Note down the signal reading at 0.5- meter distance.

5. Take the reading at 0.7- meter distance. Avoid any movement of persons while taking the reading.

6. Take further readings at distance of 1m, 1.2m, 1.4m, 1.6m, 1.8m, 2m.

7. Plot these readings on Cartesian plane with distance between antennas on X-axis and signal level in as Y- axis.

8. Repeat the measurement once again to confirm the readings.

Observation: -

S. no.	**Distance**	**Detector current (in micro ampere)**

Result:
The variation of field strength is plotted using the readings.

EXPERIMENT NO. 7

Aim: To study and rectify different faults in a broadcast radio receiver.

Equipment required: Radio receiver kit, power supply, multimeter etc.

Different kind of faults that one generally encounters are given below.

- **Fault No. 1** No sound output (transistor set dead)

1. If the receiver is not working after switching on, and the set is powered by cells.
2. first of all, check the cell using mustimeter. They may have been exhausted. If they are O.K clean any corrosion present on the clamps of the cell.
3. Check on/ off switch.
4. Check the wire feeding to speaker for breakage and then the speaker coil for continuity.
5. Check the PCB for any kind of short.
6. Check the ear phone socket.
7. Check output transistor. They may be ban open or short.
8. Check driver transformer.
9. Check main filter capacity in de supply.
10. Also check series resistor in the supply line.
11. If the set is powered by a.c check the output of eliminator if no output voltage is available check its power card, and filter capacitor.

- **Fault No. 2:** Transistor set works on cells but not on a.c.

1. Check the eliminator.
2. Check the battery/ A.C. selector switch.

- **Fault No. 3:** Transistor set works on a.c but not with cell.

1. Check the corrosion on the clamps.
2. Check AC- battery switch and its connecting wires.
3. Check the cell.
4. Check polarity of the clamps.

- **Fault No.4**: Put put sound from speaker or motor boating. It occurs because of the low battery voltage and opening up of filter capacitor.

1. replace filter capacitor if faulty.
2. check the cell potential and replace if they are weak.
3. Check IF amplifier transistor replace it.
4. Check the volume control potentiometer connections. The earth wire may be loose.

- **Fault No.5:** Humming sound along with signal.

To avoid humming, it is desired that antenna trimmer and oscillator trimmer should not be very close to each other. Also, no wire should be kept loose but all the wire should be properly harnessed near the chassis.

1. If the humming stops on operating the set with cells, then the fault lies in eliminator. Check its filter capacitor. Sometime, poor shielding of transformer also result in humming.
2. If humming is present when the set is operating on cell as well. Change the filter capacitor by a higher value of capacitance.

❖ **Fault No. 6:** Hissing sound with the signal**.**

1. Tune all the IFLs.
2. Adjust antenna coil and trimmer if required.
3. Check battery.
4. It may result due to mismatching between coils and gang capacitor.

❖ **Fault No 7**: one band is working and second is not working.

1. Check the band switch and connection.
2. Check the trimmer of the concerned band.

❖ **Fault No.8:** Initially set works normally and afterwards volumes go low and low and no signal is audible.

1. Fell the temperature of output transistor with the back of the finger. If they are heated check the resistor connected to the transistor. If the fault persists. Replace both the output transistor. Also check output capacitor and driver transformer.

❖ **Fault No. 9**: Poor quality sound

1. Check the AGC line. i.e its resistor and capacitor.
2. Check audio coupling capacitor.
3. Check detector transistor.
4. Change the speaker and check.
5. Check detector transistor.

❖ **Fault No**. **10**: disturbance in sound on changing volume.

1. Clean the volume control pot using a cleaner like carbon tetra chloride.
2. If disturbance persists, change the volume control pot.

❖ **Fault No. 11:** Intermittent fault. (i.e. when the set works properly for some time and then become dead. This happens repetitively.)

1. Look for any dry solder.
2. Look for any corrosion on the cell clamps.
3. Fault in speaker’s voice coil.
4. Some loose connection.

❖ **Fault No. 12:** Two station at same setting.

This fault occurs due to the mistuning of oscillator section.

1. Carefully tune the oscillator coil and trimmer.
2. Otherwise, replace oscillator coil and gang capacitor.

❖ **Fault No. 13: Volume** increases on picking up the set in hands and decreases if the set is placed on the table.

1. Tune antenna coil and antenna trimmer with an insulated screw driver.
2. Check for any dry solder.
3. Ground the PCB with chassis at least at three point. Any metallic part the cabinet has also to be grounded properly.
4. Grounding of every coil from different point is to be done.

❖ **Fault No. 14**: auto tuning to other stations when the set is on.

1. Check the gang condenser and replace if required.
2. Check the tension of the thread. It may be loose.
3. Core of yellow IFT may also be loose.
4. Check core of oscillator coil.
5. also check the drum.

❖ **Fault No. 15**: Sound O.K. at low volume but disturbance at high volume settings.

1. check the transistors and output capacitor in output section.
2. Inspect the cone of the speaker.
3. Detector diode may be faulty.
4. Tune IFTs.

❖ **Fault No. 16:** Stations are received on half dial and on rest half of the of the dial no station audible.

   1. Change the gang capacitor.
   2. Change mixer transistor
   3. Tune all the IFTs
   4. Interchange the connections at the 2 and 3 ends of antenna coil.