Experiment-1

- **Aim**:- To setup an active & passive satellite link & demonstrate link operation.

- **Equipments needed**:- uplink transmitter, dish antennas, downlink reciever, connecting cables, transponder.

- **Theory**:-

⇒ Active satellite →

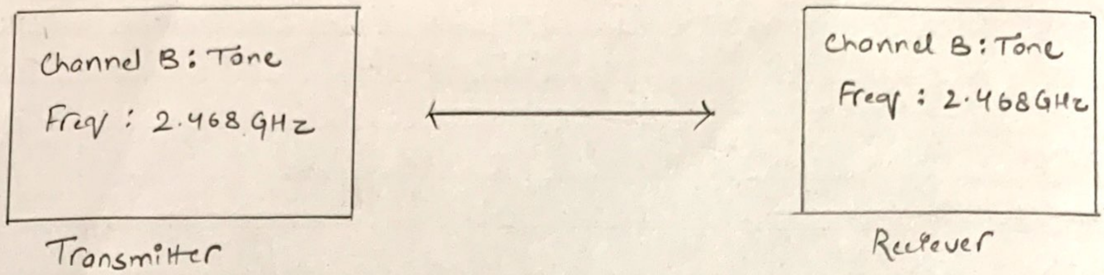
It has its own transmitting & recieving antennas. It amplifies the signal recieved from earth station or ground station & retransmits the amplified signal back to earth.
In addition to amplification, it performs frequency translation of the recieved signal before transmission. It can generate power for its own operation.

⇒ Passive satellite →

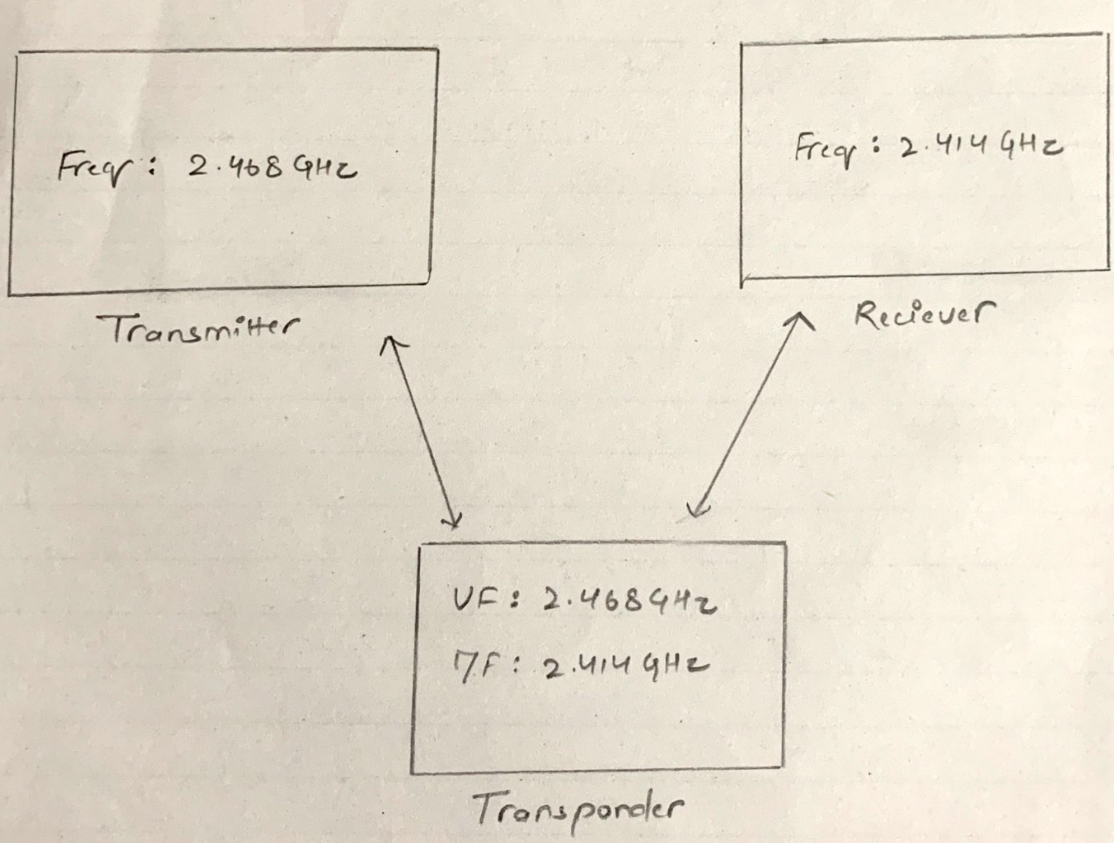
It is a reflector which recieves the signal from the transmitting earth station & scatters the signal in all directions. It reflects the EM radiation without any modification or amplification. It cannot generate the power of its own & simply reflects the incident power.

- **Result**:- Active & Passive satellite links were established successfully.

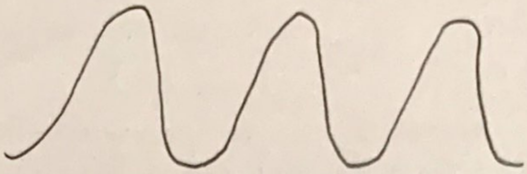
Passive Satellite Link :-



Active satellite link :-



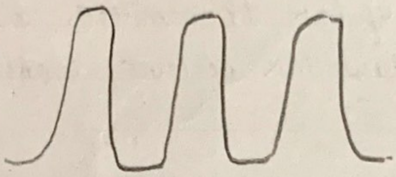
Input Wave :-



Pk-Pk = 48.8V

freq = 132.3Hz

Passive link :-

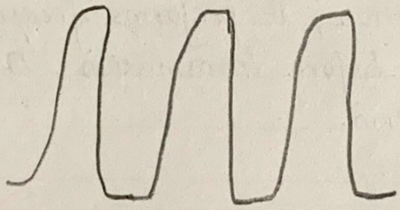


Pk-Pk = 34.4V

freq = 132Hz

Uplink/downlink = 2.468GHz

Active link :-



Pk-Pk = 33.6V

freq = 132.3Hz

Uplink/downlink freq

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Viva Questions

Q1. What is Passive satellite?
These Satellites simply reflect signal back to earth.

Q2. What is active satellite?
These electronically repeat the signal & send it back to earth.

Q3. What is non-synchronous satellite?
These Satellites rotate around earth in a low altitude elliptical or circular path.

Q4. What is synchronous satellite?
These satellite orbits in a circular pattern with an angular velocity equal to that of earth.

Q5. What is ITU?
International Telecommunication Union.

Q6. Define Transponder?
A microwave repeater, which recieves, amplifies, down convert & retransmits signals at a communication satellite.

Q7. Define uplink
The earth station electronics & antenna which transmit information to a communication satellite.

Q8. Explain IFRB.

International Frequency Registration Board.

Q9. What is CCIR.

International Radio Consultative Committee.

Q10. What is CCITT.

International Telegraph & Telephone Consultative committee.

Experiment -2

- **Aim**:- To have telemetric communication with the satellite:
  (a) To send tele-command & recieve intensity of light from satellite.
  (b) To send tele-command & recieve temperature of light from satellite.

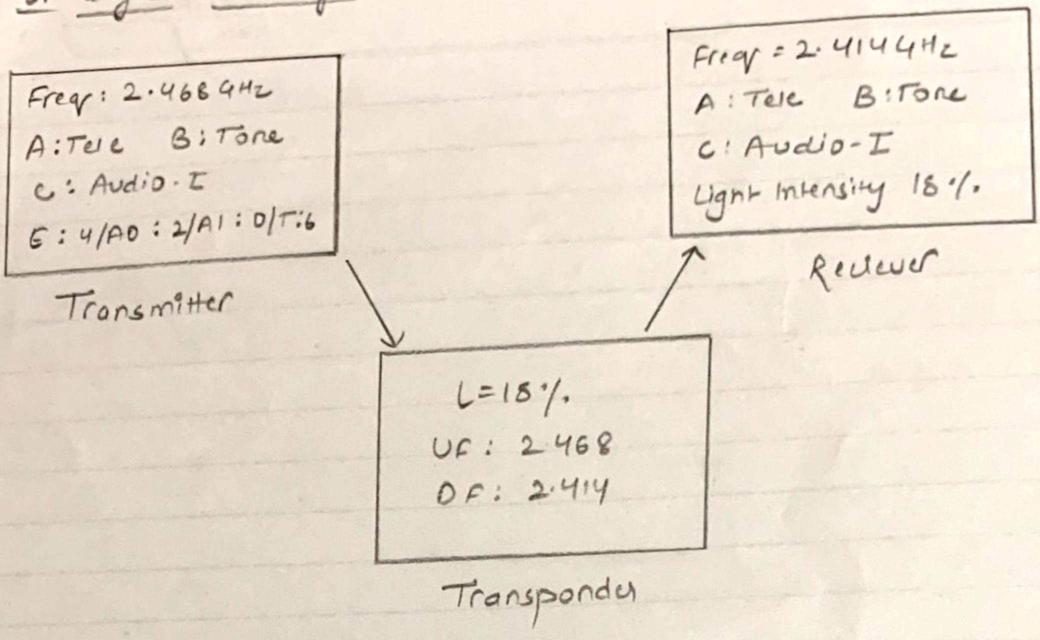
- **Apparatus** :- Uplink transmitter, downlink reciever, transponder, dish antennas, connecting cables, solder rod.

- **Theory** :-

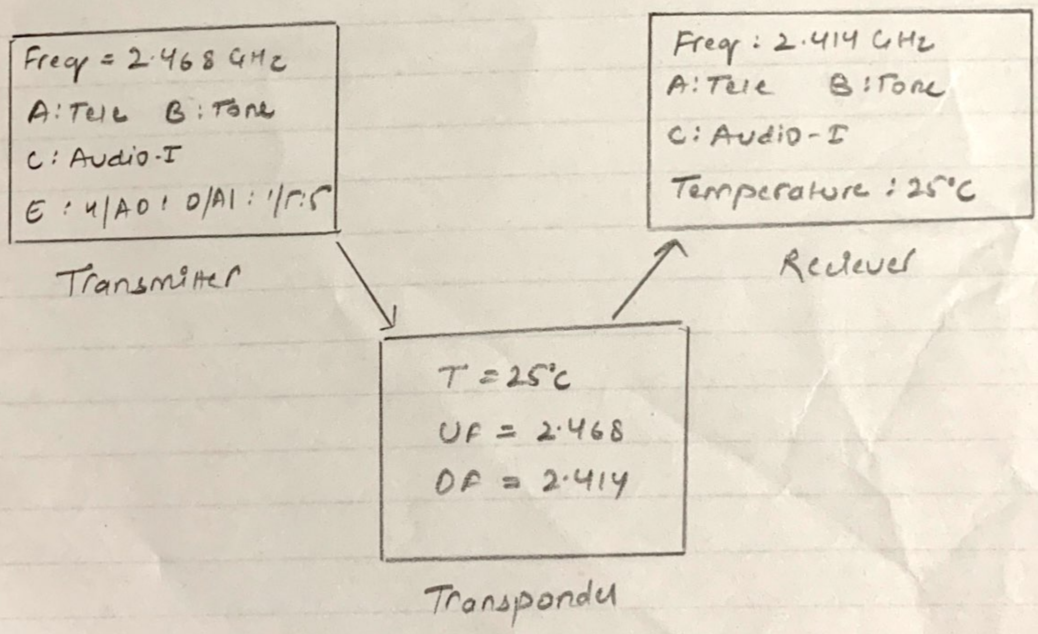
Telemetry, a highly automated communication process by which measurements are made & other data collected at remote or inaccessible points & transmitted to recieving equipment for monitoring, display & recording.
Originally, the information was sent over wires, but modern telemetry more commonly uses radio Transmission.

Among the major applications are monitoring electric power plants, gathering meterological data & monitoring manned & unmanned space flights.
Although, the term commonly refers to wireless data transfer mechanism, it also encompasses data transfered over other media such as telephone or computer network, optical link or other wired communication.

For light Intensity :-



For Temperature :-



A telemeter is a device used to remotely measure any quantity. It consists of a sensor, a transmission path & a display, recording or control device. These are physical devices used in telemetry.

⇒ SETTING OF TOGGLE SWITCHES

- For light intensity measurement, E = low, A1 = high, A0 = low
- For temperature measurement : E = low, A1 = high, A0 = high
- <u>Observations</u> :

→ Light intensity : Initial = 11%
Final = 18%

→ Temperature : Initial = 19°c
Final = 25°c

- <u>Result</u> :- Telemetric communication has been done successfully.

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Experiment-3

- **Aim** :- Study of Yagi-Uda 3 element folded dipole & 5 element folded dipole.

- **Apparatus** :- Antenna, transmitter, Reciever, dipole, reflector, director.

- **Theory** :-

A yadi-Uda antenna, commonly known as a Yagi antenna, is a directional antenna consisting of multiple paralel elements in a line, usually half-wave dipoles made of metal rods. Yagi-Uda antennas consist of a single driven element connected to the transmitter or reciever with a transmission line, & additional parasitic elements which are not connected to the Tx or Rx : so called reflector & one or more directors.

→ There are three types of element within a yagi antenna :-

(i) Driven element :- is the element to which power is applied. it is normally a half wave dipole or a folded dipole.

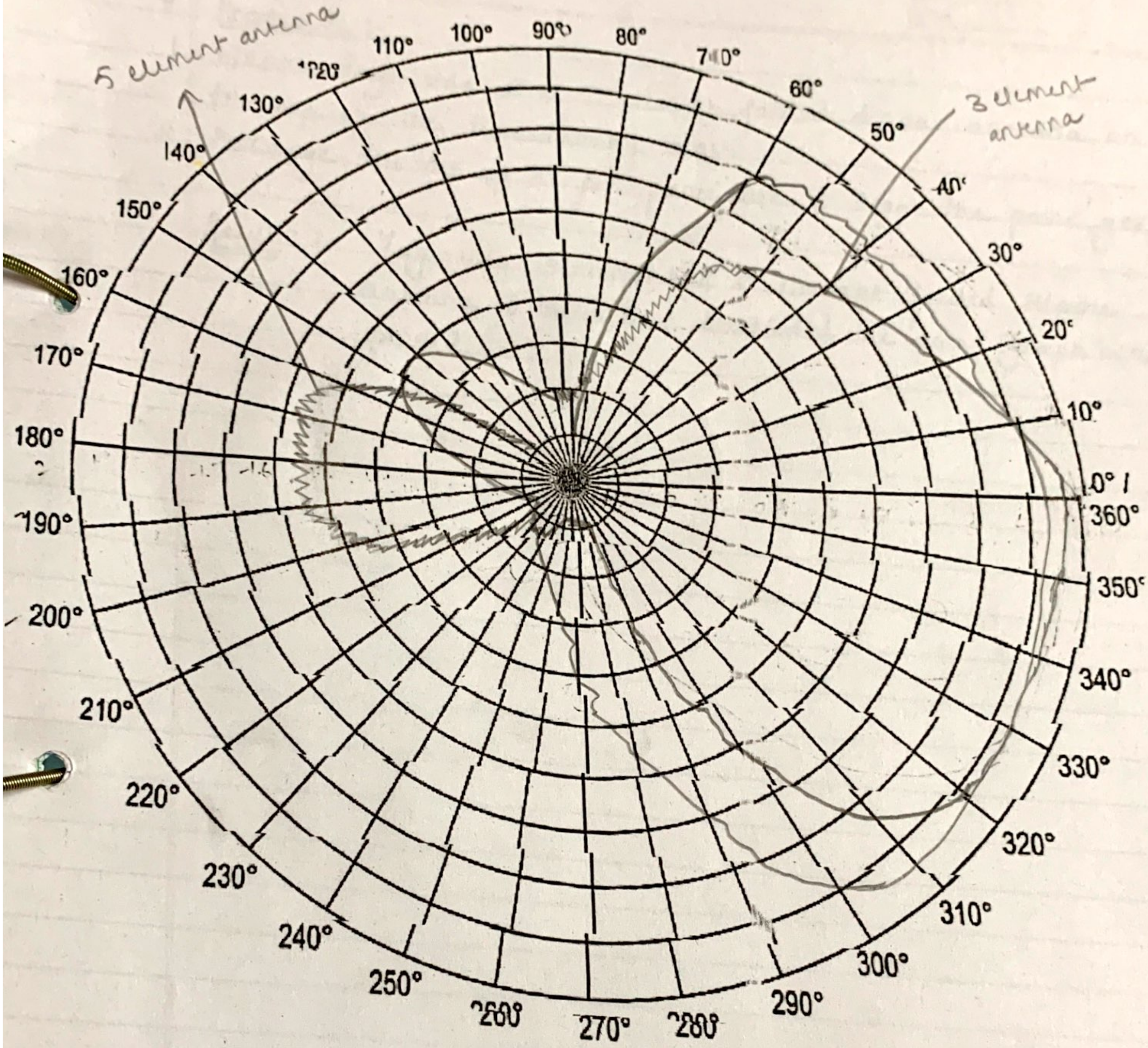
(ii) Reflector :- is made to be about 5% longer than the driven element. It is behind the main driven element.

(iii) Director :- are placed in front of driven element i.e. in the direction of maximum intensity.

Observations :-

	3-element		5-element	
	θ	I(μA)	θ	I(μA)
1	0'	24	0'	42
2	20'	19.3	20'	31.8
3	40'	10.0	40'	14.9
4	60'	3.3	60'	2.1
5	80'	0.6	80'	1.1
6	100'	0.5	100'	0.9
7	120'	1.5	120'	0.5
8	140'	1.9	140'	0.4
9	160'	1.7	160'	0.3
10	180'	1.3	180'	0.1
11	200'	1.0	200'	0.4
12	220'	0.3	220'	0.6
13	240'	0.2	240'	0.7
14	260'	0.4	260'	0.2
15	280'	1.0	280'	1.6
16	300'	3.6	300'	3.9
17	320'	9.4	320'	11.8
18	340'	18.4	340'	27.6
19	360'	24.0	360'	42

SCALE: 1div = 4dB



- **Procedure :-**

1. Mount Yagi-Uda 3 & 5 element folded dipole antenna on the top of the transmitting mast.
2. Arrange the set up as per procedure & draw the polar graph.

- **Result :-** Yagi-uda 3 element & 5 element folded dipole antenna & have been studied & the polar graph was plotted.

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Experiment - 4

- **Aim :-** To calculate SNR of established satellite link.

- **Equipment :-** Uplink Transmitter, Dish antenna, Satellite Transponder, Downlink reciever, oscilloscop connecting cables.

- **Theory :-**

SIGNAL TO NOISE RATIO :

Signal to noise ratio (SNR) is a measure used in science & engineering that compares the level of background noise.
SNR is defined as the ratio of signal power to noise power, often expressed in decibles (dB).
A ratio; higher than 1:1 (greater than 0 dB) indicates more signal than noise.
let S_1 be the power in Tone mode,

$$S_1 = S + N$$

$$S = S_1 - N$$

where S is signal power original, N is the noise.

$$(SNR)_{dB} = 10\log(SNR)$$

- **Result :-** SNR calculated for the established link is 31.04dB.

Observations :-

Uplink freq = 2.45GHz
Downlink freq = 2.43GHz

Channel B-Tone

$S_1 = S+N = 3.3V$

$N = 90mV$

Calculations :-

$S = S_1 - N$
$= 3.3 - 0.09$
$= 3.21V$

$S_p = V^2$
$= (3.21)^2$
$= (10.3) W$

$N_p = (0.09)^2$
$= 0.0081W$

$\frac{S}{N}$ in dB $= 10 \log\left(\frac{S}{N}\right)$ dB

$= 10\log\left(\frac{10.3}{0.0081}\right)$ dB

$= 31.04$ dB

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Experiment - 5

- **Aim** :- Study of variation in the radiation strength at a given distance from the antenna (to verify power distance relationship).

- **Apparatus** :- mount folded dipole antenna, RF detector, RF generator, antenna transmitter & reciever.

- **Theory** :-

Consider an isotropic source radiating power P_r [watts] uniformly in free space. An isotropic source is ideally not possible because it could not create transverse polarised em waves. Hence, a dielectric antenna like half wave dipole antenna is used to limit the transmitted power to be radiated primarily in one direction.

→ At a distance R from the source, the area of the spherical shell within centre at source is $4\pi R^2$.
→ Power flux density at distance R is given by,

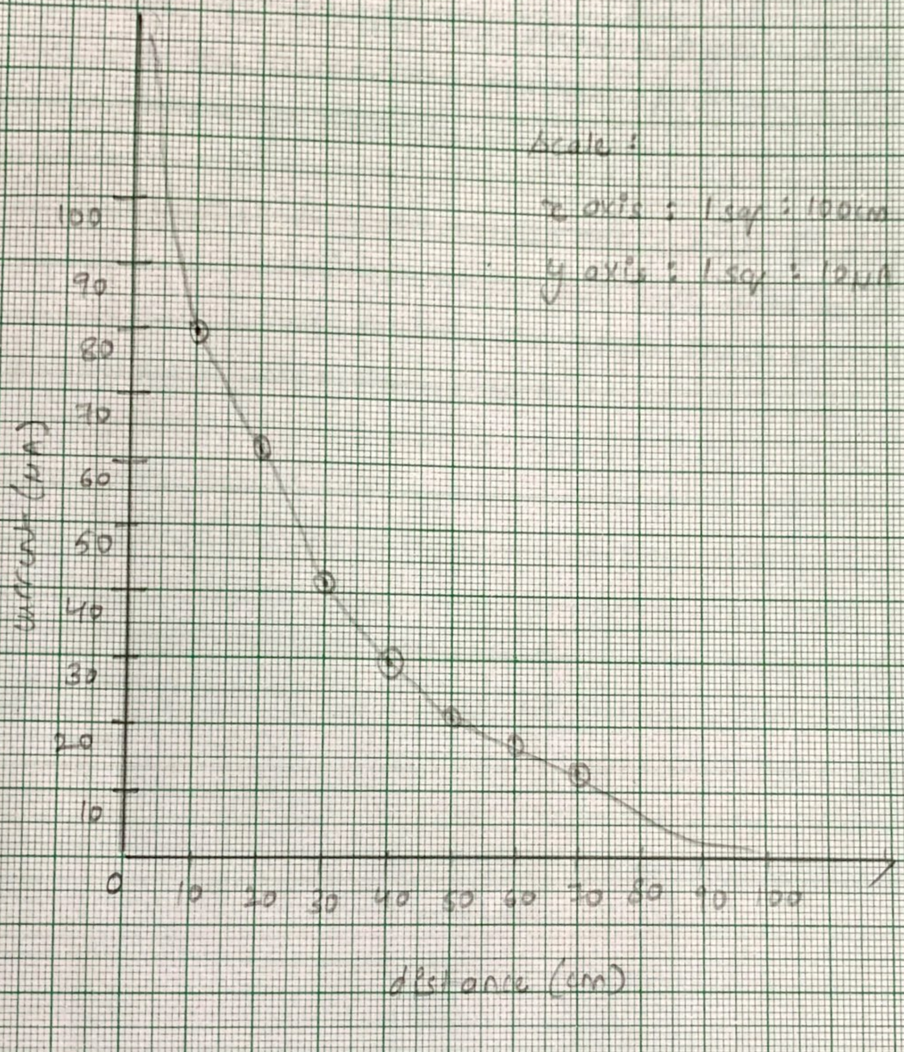
$$F = \frac{P_r G_r}{4\pi R^2} \quad W/m^2$$

R = distance of reciever from transmitter
P_r = transmitted Power.
G_r = Transmitted gain.

Observations :-

Distance	Current
0 cm	150 μA
10 cm	80 μA
20 cm	62 μA
30 cm	42 μA
40 cm	30 μA
50 cm	22 μA
60 cm	16 μA
70 cm	13 μA
80 cm	~0.1 μA

Scanned with CamScanner


Scale :
x axis : 1 sq : 100cm
y axis : 1 sq : 10μA
current (μA)
100
90
80
70
60
50
40
30
20
10
0
10
20
30
40
50
60
70
80
90
100
distance (cm)

Considering the above equation, a non linear relation b/w the radiation strength & distance is expected.
So, the detector will show a higher strength when it is nearer to the transmitting antenna & shall reduce gradually with increasing distance.

- **Result :-** A graph between the current & distance showing the relationship between both distance & radiation intensity was plotted. The graph shows a non linear relationship b/w the same.

Experiment - 6

- **Aim :-** Transmitting & recieving three separate signals (audio, Video, Tone) simultaneously through satellite link.
- **Apparatus :-** uplink Transmitter, dish antenna, downlink reciever, connecting cables, satellite transponder.
- **Theory :-**

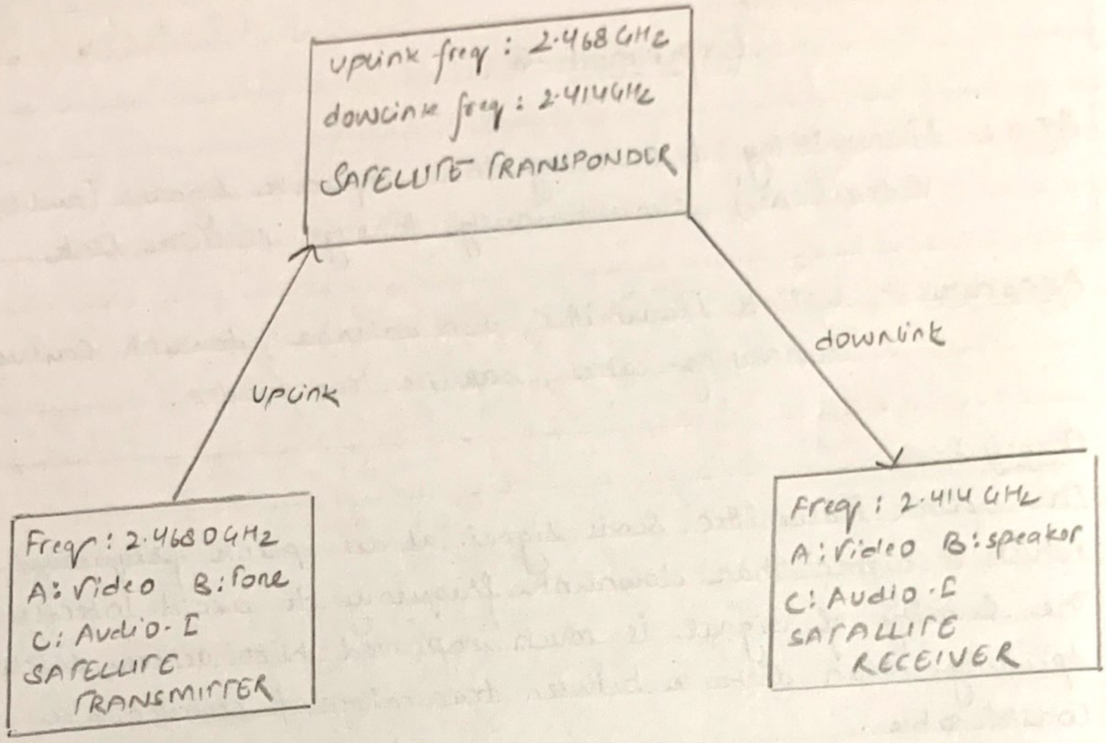
The uplink transmitter sends signal at an uplink frequency which is higher than downlink frequency to avoid interference. The Quality of signal is much improved with active satellite specially when distance between transmitter & reciever are considerable.

In This, uplink transmitter is set by setting up the 'channel A' to video mode in order to transmit the video signal through this channel of the transmitter.

Also, 'channel B' is set to 'tone mode' to transmit the tone signal from uplink transmitter. And, connect the audio signal/video signals at the input socket.

The downlink Transmitter is then set up by setting up the "Channel A" to video mode & 'channel B' to speaker mode to hear the tone signals. Then the downlink reciever is connected to the monitor.

The TV monitor displays the video & audio signals which were sent to uplink transmitter unit. The Tone signal can be heard in the speaker of the reciever.



upLink freq : 2.468 GHz
downLink freq : 2.414 GHz
SATELLITE TRANSPONDER
upLink
downLink
Freq : 2.4680 GHz
A: Video B: Tone
C: Audio. I
SATELLITE TRANSMITTER
Freq : 2.414 GHz
A: Video B: speaker
C: Audio. I
SATELLITE RECEIVER

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- **Result**:- Three separate signals (audio, video & tone) are successfully recieved at downlink reciever through satellite communication link.

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Experiment-7

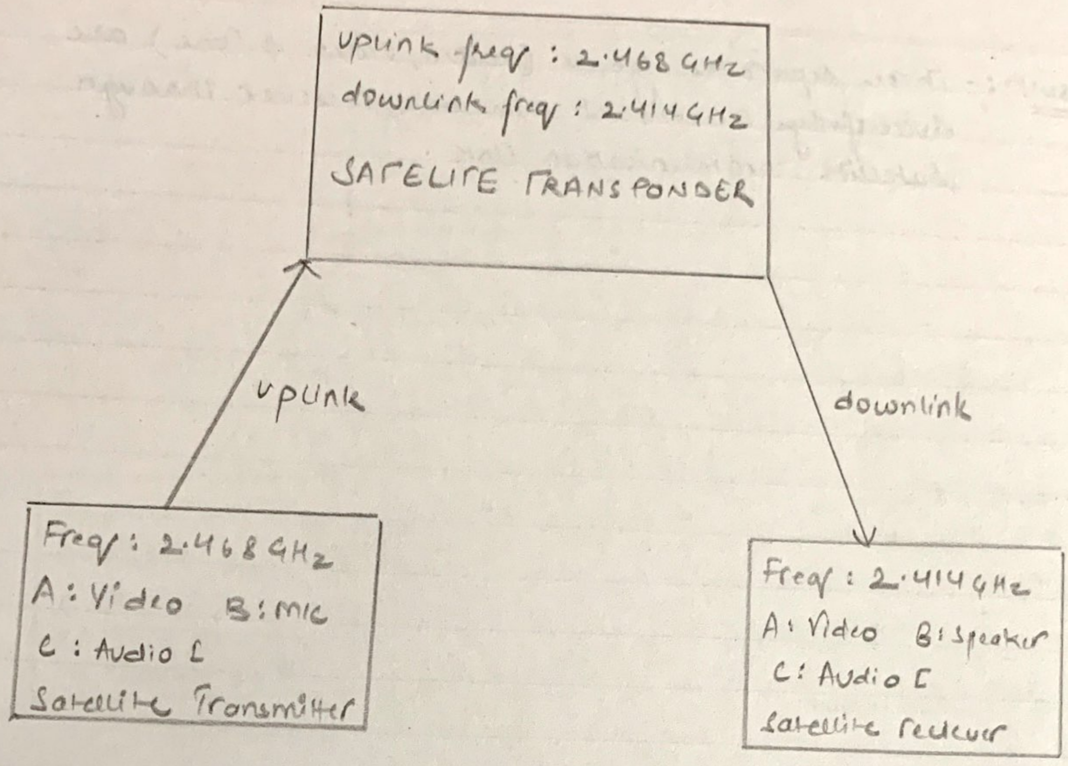
- **Aim:-** Commuticating voice signal through satellite link.

- **Apparatus:-** uplink transmitter, dish antennas, downlink reciever, connecting cables, satellite transponder, microphone.

- **Theory:-**

The uplink transmitter sends signals at an uplink frequency, which is higher than the downlink frequency to avoid the interference. The quality of signal is much improved with active satellite specially when distances between transmitter & reciever are considerable. A mic is used to send the voice signal (on the transmitter) & is recieved by a reciever through a speaker.
Channel B is set to 'mic' using the 'channel select B' key so as to transmit the voice signal from uplink transmitter.
The 'tone' signal is transmitted through 'Audio II' channel of the transmitter.
Mic is connected to the socket marked 'Mic' on transmitter.
Similarly, 'Channel B' is set to 'speaker' mode using 'channel select B key' so as to recieve the voice signal on the dowlink reciever.

- **Result:-** Voice link was successfully estabeished between the satellite transmitter & reciever.



VOICE SIGNAL TRANSMISSION

DELTA Pg No.
Date / /

Experiment-8

- **Aim :-** Study the delay between uplink transmitter & downlink reciever during data transmission.

- **Apparatus :-** uplink transmitter, dish antenna, downlink reciever during transmission, connecting cables, digital storage Oscilloscope, satellite transponder.

- **Theory :-**

Satellite delay (mostly propogation delay) is the noticable delay which occurs due to the distance of satellite from the Earth mainly. Hence it will be more for geostationary/geosynchronous satellites compared to MEO or LEO.
Radio waves go at a speed of light.
Extreme delays occurs due to the length of cable extensions at either end, & very much so if a signal is routed by more than one satellite hop.
Significant delay can also be added in routers, switches & signal processing points along the routes.

Uplink Transmitter : channel A is set to Data mode. Data signals are transmitted through radio channel. DSO CH1 connected to Data generator test point. Telemetery switch is Toggled on.

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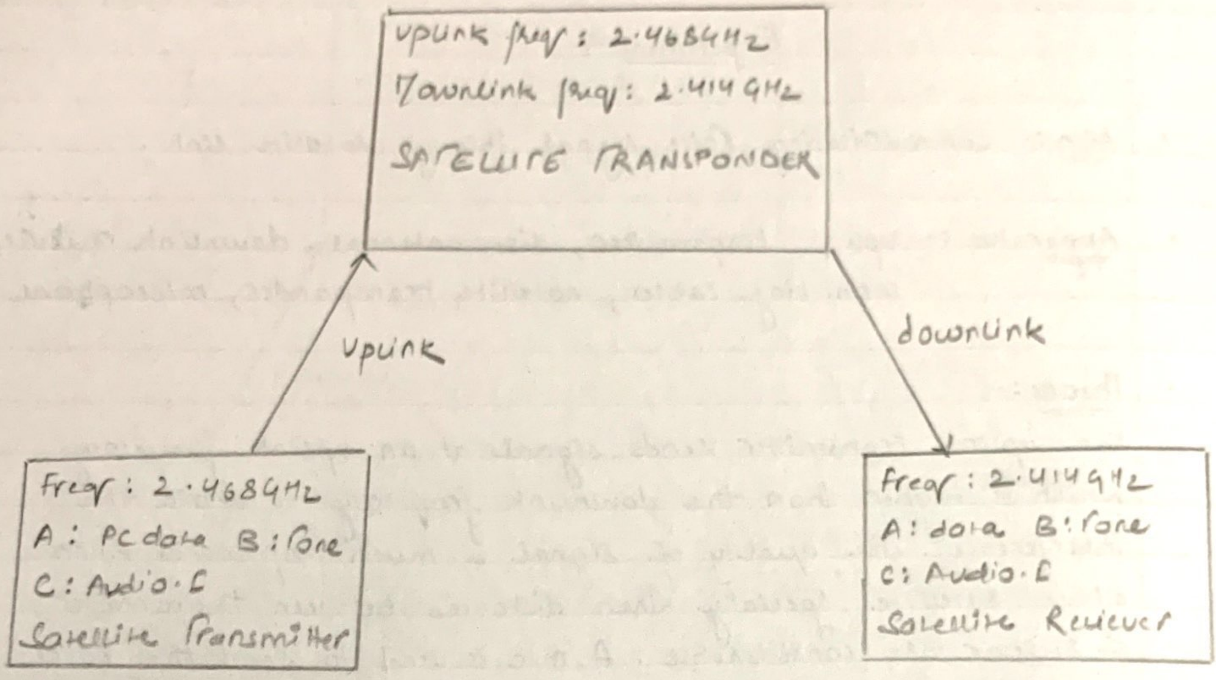
Uplink freq : 2.468GHz
Downlink freq: 2.414GHz
SATELLITE TRANSPONDER
Uplink
downlink
Freq : 2.468GHz
A : PC data B: Tone
C: Audio.E
Satellite Transmitter
Freq : 2.414GHz
A: data B: Tone
C: Audio.E
Satellite Reciever

downlink reciever : channel A is set to data mode. DSO CH1 is connected to 'Recieved data' section.

Appropriately set the DSO settings & gradually rotate 'delay adjust' knobe.

- Result :- Simulated delay between uplink transmitter & downlink reciever was observed successfuly during transmission.

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