ELVUX
Technologies

Satellite Communication

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Satellite Communication Trainer
ELX-2501

Features

Simultaneous communication of three different signals.

Communicate Audio, Video, Digital data, PC data, Tone, Voice, function generator waveforms etc.

2414 - 2468MHz PLL microwave operation.

Communication of external broad band digital signal.

Choice of different transmitting and receiving frequencies.

Built-in Speaker and Microphone for Voice and Audio link.

Detachable Dish Antenna at each station.

RS232 port for PC communication.

Scope of Learning

Transmitting & receiving three separate Signals (Audio, Video, and Tone/ Voice) simultaneously and perform Link Fail Operations.

Transmitting & receiving Function Generator Waveforms.

Transmitting and receiving PC data through satellite-link.

Changing different combinations of Uplink and downlink frequencies and to check the communication link

Send Tele-command and receive Temperature & intensity of light from Satellite.

Calculate the carrier to noise ratio for a satellite-link.

Calculate signal to noise ratio for a satellite-link.

Specifications

Uplink Transmitter:

Transmitter with selectable frequency conversion

2414-2468 MHz up-linking selectable frequencies

Wide band RF amplifier. No manual matching required.

Frequency select switch and LED indication.

FM Modulation for Information signal

Transmit Audio, Video, Digital data, PC data, Tone, Voice, function generator waveforms etc.

Condenser microphone for audio link, built in speaker.

Separate section for telemetry operation.

Detachable Dish Antennas.

Power Supply: 230 V AC ±10 %, 50/60 Hz

Inbuilt Tone generator:

Frequency: 1 KHz Fixed

Amplitude: 5Vpp.

Separate terminals provided for different inputs.

Satellite Link:

Transponder with selectable Uplink and downlinks frequency conversion.

Switch for selecting frequencies

Delay knob provided for simulated Transition delay experiment.

Detachable Dish Antennas.

Variable path loss at uplink and downlink channels

Power Supply: 230 V AC ±10 %, 50/60 Hz

Downlink Receiver:

Receiver with selectable frequency conversion.

Receives and demodulate three signals simultaneously.

Built in speaker for audio and video output.

Detachable Dish Antenna.

Power Supply: 230 V AC ±10 %, 50/60 Hz Included

Experiment – 1

Objective

Transmitting & receiving three separate Signals (Audio, Video, and Tone/ Voice) simultaneously and perform Link Fail Operations.

Apparatus required:

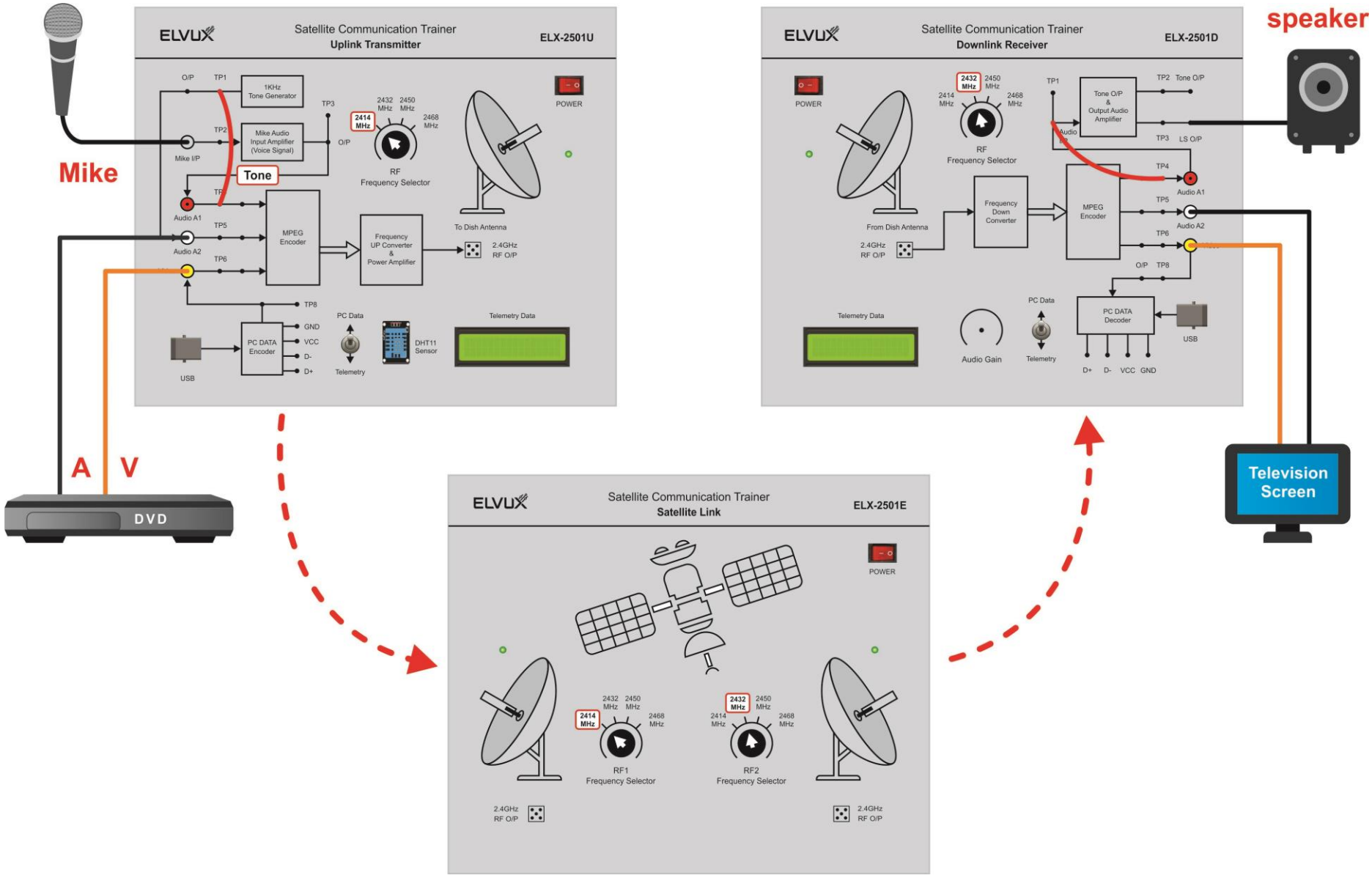
- Uplink Transmitter
- Dish Antennas
- Downlink Receiver
- Satellite Link (Transponder)
- Connecting cables.
- Function generator

Procedure:

1. Connect links in Satellite Uplink transmitter, Satellite Link and downlink Receiver as shown in Connection diagram below.
2. Connect all to AC Mains and make it ON.
3. Keep Transmitter and Receiver at 2 to 4 meter distance.
4. The transmitting frequency can be selected by rotary switch. The frequency can be set to any one of 2414, 2432, 2450, 2468MHz.
5. Keep switch positions as shown in diagram below.
6. Establish an AUDIO-VIDEO satellite link between Transmitter and Receiver
    - Connect DVD Player at Uplink transmitter board and TV screen at downlink receiver board as shown in diagram.
    - Play any DVD and observer movie on TV.
7. Communicate VOICE signal through satellite link
    - Now connect Mike at Uplink transmitter board and Loud Speaker at downlink receiver board as shown in diagram.
    - Speak to mike and here received voice in loud speaker at downlink receiver board. See effect of audio gain by varying gain of receiver by rotating ‘audio gain pot’ at receiver.

8. Establish an Tone link between Transmitter and Receive
    - Connect CRO at 1 KHz output at uplink transmitter.
    - Observer 1 KHz sine wave.
    - Connect lead as shown in Connection diagram below
    - Now the tone signal can be here in speaker of receiver.
    - Now set toggle switch at Emulator to OFF position. Then tone signal at downlink receiver will stop. This shows satellite link fail operation

Conclusion: Three separate signals (Audio, Video & Tone) are successfully received simultaneously at downlink receiver through satellite communication link.


Mike
A
V
DVD
ELVUX
Satellite Communication Trainer
Uplink Transmitter
ELX-2501U
O/P
TP1
1KHz Tone Generator
TP3
TP2
Mike Audio Input Amplifier (Voice Signal)
Mike I/P
Tone
Audio A1
TP4
TP5
Audio A2
TP6
MPEG Encoder
Frequency UP Converter & Power Amplifier
2.4GHz RF O/P
To Dish Antenna
2432 MHz
2450 MHz
2414 MHz
2468 MHz
RF Frequency Selector
POWER
TP8
PC DATA Encoder
GND
VCC
D-
D+
USB
PC Data
Telemetry
DHT11 Sensor
Telemetry Data
ELVUX
Satellite Communication Trainer
Satellite Link
ELX-2501E
POWER
2432 MHz
2450 MHz
2414 MHz
2468 MHz
RF1 Frequency Selector
RF2 Frequency Selector
2.4GHz RF O/P
2.4GHz RF O/P
ELVUX
Satellite Communication Trainer
Downlink Receiver
ELX-2501D
POWER
2432 MHz
2450 MHz
2414 MHz
2468 MHz
RF Frequency Selector
From Dish Antenna
2.4GHz RF O/P
Frequency Down Converter
MPEG Encoder
TP1
Tone O/P & Output Audio Amplifier
TP2 Tone O/P
TP3 LS O/P
TP4
Audio A1
TP5
Audio A2
TP6
O/P TP8
PC Data
PC DATA Decoder
USB
D+ D- VCC GND
Telemetry Data
Audio Gain
Telemetry
speaker
Television Screen

Experiment – 2

Objective

Transmitting & receiving Function Generator Waveforms.

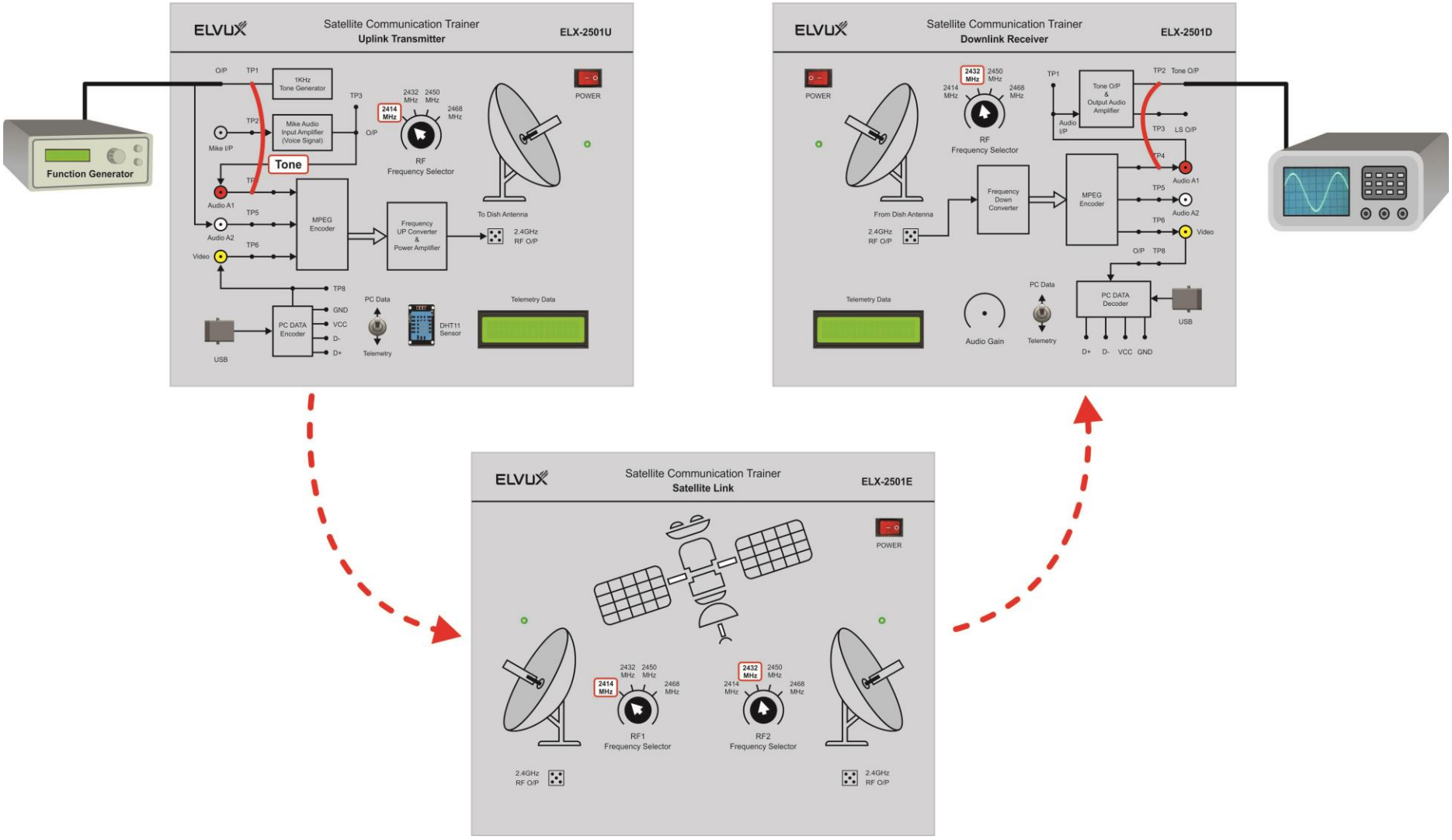
Apparatus required:

- Uplink Transmitter
- Dish Antennas
- Downlink Receiver
- Satellite Link (Transponder)
- Connecting cables.
- Function generator
- Oscilloscope

Procedure:

1. Connect links in Satellite Uplink transmitter, Satellite Link and downlink Receiver as shown in Connection diagram below.
2. Connect all to AC Mains and make it ON.
3. Keep Transmitter and Receiver at 2 to 4 meter distance.
4. The transmitting frequency can be selected by rotary switch. The frequency can be set to any one of 2414, 2432, 2450, 2468MHz.
5. Keep switch positions as shown in diagram below.
6. Connect Function generator Sine wave output to audio socket provided on Uplink transmitter.
7. Feed the signal of 1 KHz sine wave.
8. Connect audio socket of Downlink receiver to the Oscilloscope.
9. You will observe similar waveform of same frequency on Oscilloscope.

Conclusion: Function generator waveforms are successfully received at downlink receiver through satellite communication link.


ELVUX
Satellite Communication Trainer
Uplink Transmitter
ELX-2501U
O/P
TP1
1KHz Tone Generator
TP3
2432 2450 MHz
2414 MHz
2468 MHz
POWER
TP2
Mike Audio Input Amplifier (Voice Signal)
Mike I/P
O/P
RF Frequency Selector
Tone
Audio A1
TP4
TP5
MPEG Encoder
Frequency UP Converter & Power Amplifier
To Dish Antenna
Audio A2
TP6
2.4GHz RF O/P
Video
TP8
PC Data
GND
VCC
D-
D+
PC DATA Encoder
DHT11 Sensor
Telemetry Data
USB
Telemetry
Function Generator
ELVUX
Satellite Communication Trainer
Downlink Receiver
ELX-2501D
POWER
2432 2450 MHz
2414 MHz
2468 MHz
RF Frequency Selector
TP1
Audio I/P
Tone O/P & Output Audio Amplifier
TP2 Tone O/P
TP3 LS O/P
TP4
Audio A1
TP5
Audio A2
TP6
Video
From Dish Antenna
2.4GHz RF O/P
Frequency Down Converter
MPEG Encoder
O/P TP8
Telemetry Data
Audio Gain
PC Data
Telemetry
PC DATA Decoder
USB
D+ D- VCC GND
ELVUX
Satellite Communication Trainer
Satellite Link
ELX-2501E
POWER
2432 2450 MHz
2414 MHz
2468 MHz
RF1 Frequency Selector
RF2 Frequency Selector
2.4GHz RF O/P
2.4GHz RF O/P

Experiment – 3

Objective

Transmitting and receiving PC data through satellite-link.

Apparatus required:

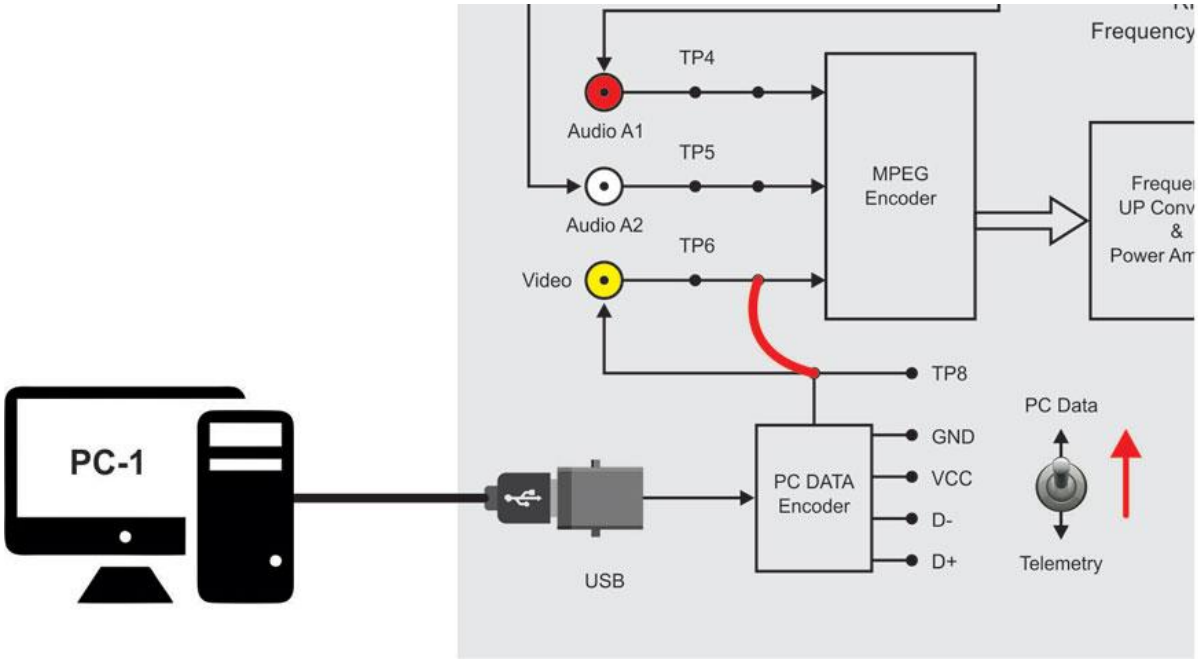
- Uplink Transmitter
- Dish Antennas
- Downlink Receiver
- Satellite Link (Transponder)
- ELVUX Satellite Communication Software
- Connecting cables.
- USB Cables – 2 nos.
- 2 Sets of PC's

Procedure

1. Keep all setting same as Exp. 2.
2. Connect 1st Computer at Transmitter and 2nd Computer at Receiver as shown in diagram below using USB cables.
3. Install the ELVUX Satellite Communication Software on both the PCs which are being used for transmitting and receiving PC data.
4. Once you get the setup ready as per the experiment 2, proceed as follows.
5. Carry out the following setting at all units starting from Uplink transmitter and at last Downlink receiver. This sequence of operation must be followed to avoid any kind of improper operation of the system.

Setting at Uplink Transmitter:

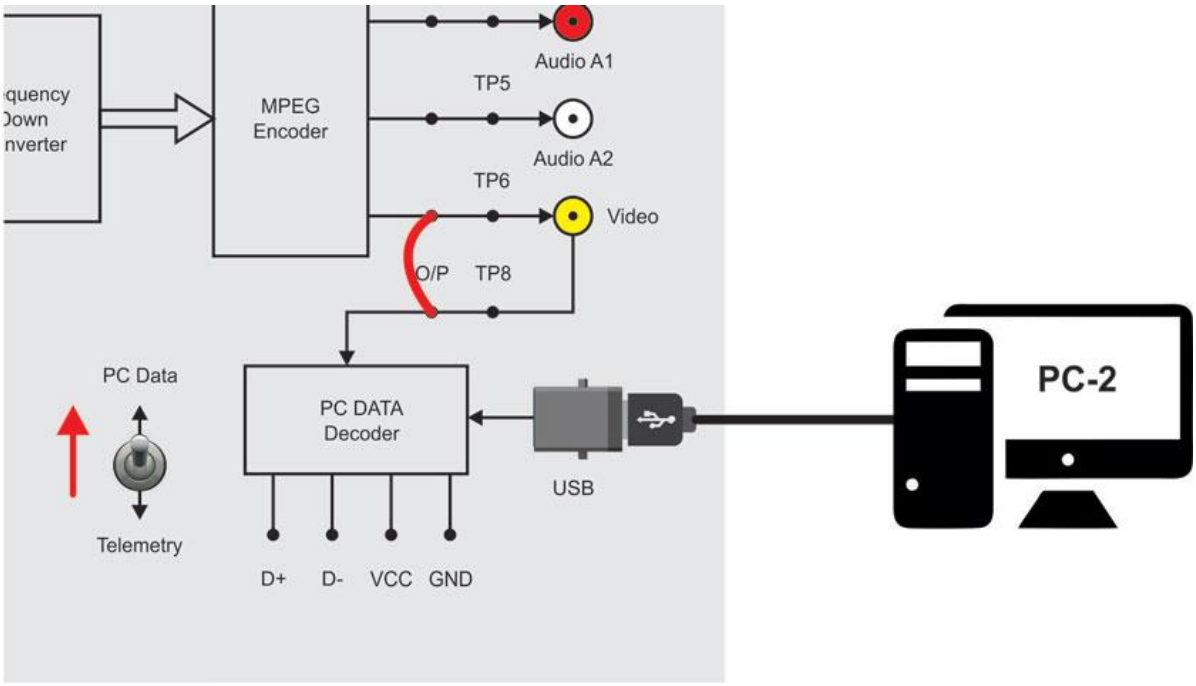
1. Now set the toggle switch to “PC data” mode
2. Connect 2mm lead between PC data O/p and Video I/P, so the PC data signals are transmitted through “Video” channel of transmitter.
3. Connect the USB cable to USB connector of Uplink Transmitter and the other end to the USB port of PC 1.
4. Set frequency 2432 MHz on Uplink transmitter and on Satellite Link RF1.



Uplink Transmitter - Connections

Setting at Downlink Receiver:

5. Set the toggle switch to “PC data” mode
6. Connect 2mm lead between Video O/P and PC data I/P, so as to receive the PC data signals from Uplink Transmitter.
7. Connect the USB cable to USB connector of Downlink Receiver and the other end to the USB port of PC 2.
8. Set frequency 2414 MHz on Satellite Link RF2 and Downlink receiver.



Downlink Receiver - Connections

Transmit and receive data using software:

9. Open the Satellite Communication Software window at PC 1.
10. Select COM port using <select COM port> button, now press connect symbol.
11. Repeat same process in PC 2.
12. Now, type any text in textbox left to send button window of transmitting computer and observer received text in receiving computer.
13. If there is any noise or wrong data at receiver computer then align all satellite dish antennas to receiver proper text. *(Note: some noise in signal is expected in most cases.)*

Experiment – 4

Objective

Changing different combinations of Uplink and downlink frequencies and to check the communication link

Apparatus required:

- Uplink Transmitter
- Dish Antennas
- Downlink Receiver
- Connecting cables.
- Satellite Link
- Audio/Video input (VCD)
- Monitor (TV monitor)

Important:

The following frequency combinations can be set to communicate between Uplink Transmitter, Satellite Link and Downlink Receiver.

Uplink Transmitter	Satellite Link Uplink RX (UF)	Satellite Link Downlink TX (DF)	Downlink Receiver
2468 MHz	2468 MHz	2414 MHz	2414 MHz
2468 MHz	2468 MHz	2432 MHz	2432 MHz
2450 MHz	2450 MHz	2414 MHz	2414 MHz

Procedure:

- Once you get the set up ready as per the experiment 1, proceed as follows.
- Carry out the following settings at all three units starting from Uplink Transmitter then Satellite Link and at last Downlink Receiver. This sequence of operation must be followed to avoid any kind of improper operation of the system.
- Now change the downlink transmitter frequency (DF) of Satellite Link from 2414 to 2432 MHz and similarly change Downlink Receiver frequency to 2432 MHz you will be receiving the same quality of signal.
- Observe the video and audio outputs at Downlink Receiver.

- Now change downlink transmitting frequency of Satellite Link back to 2414 MHz and also change the Downlink Receiver frequency back to 2414 MHz
- Now change the uplink-transmitting frequency of Uplink Transmitter from 2658 to 2450 MHz and correspondingly the uplink receiver frequency (UF) of Satellite Link to 2450 MHz, You will receive the same quality of signal at the output of the Downlink Receiver.

Conclusion: The above experiment shows a successful establishment of satellite audio/video link between Uplink Transmitter and Downlink Receiver at different up-link and down-link frequencies.

Experiment – 5

Objective

Send Tele-command and receive Temperature from Satellite.

Apparatus required:

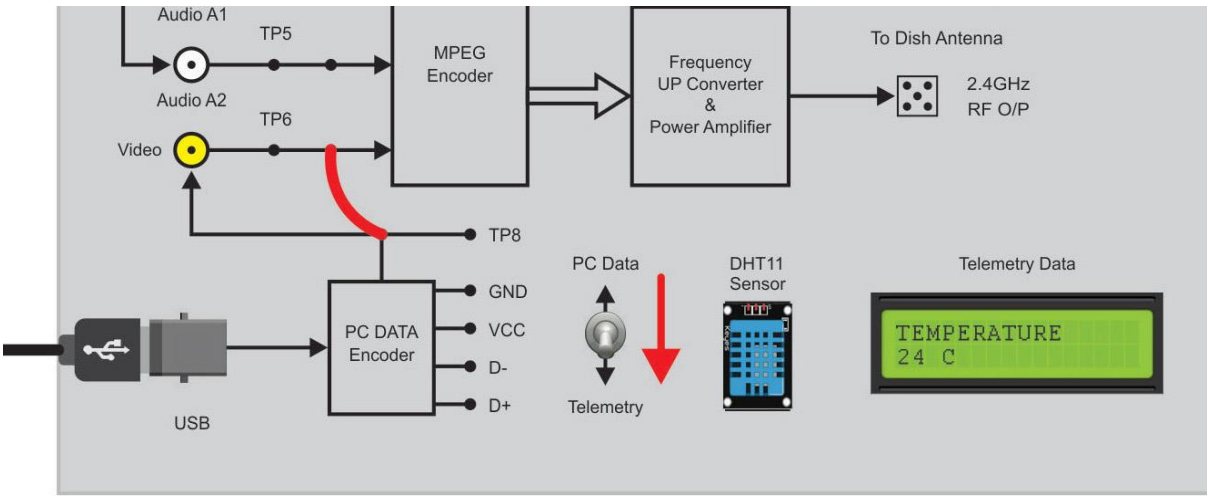
- Uplink Transmitter
- Dish Antennas
- Downlink Receiver
- Satellite Link (Transponder)
- Connecting cables.
- USB Cables – 2 nos.

Procedure

1. Keep all setting same as Exp. 4.
2. Connect 1st Computer at Transmitter and 2nd Computer at Receiver as shown in diagram below using USB cables.
3. Once you get the setup ready as per the experiment 4, proceed as follows.

Setting at Uplink Transmitter:

4. Now set the toggle switch to “Telemetry” mode
5. You can see the current temperature reading on LCD display.
6. Connect 2mm lead between PC data O/P and Video I/P, so the command signal are transmitted through “Video” channel of Uplink transmitter.
7. Set frequency 2432 MHz on Uplink transmitter and on Satellite Link RF1.



Setting at Downlink Receiver:

8. Now set the toggle switch to “Telemetry” mode
9. Connect 2mm lead between Video O/P and PC data I/P, so as to receive the command signals from Uplink Transmitter.
10. Set frequency 2414 MHz on Satellite Link RF2 and Downlink receiver.
11. Observe that the ‘Temperature’ in degree Celsius appears on LCD display of Downlink Receiver.
12. To observe the variation in the temperature, put a heated solder iron on the top of the ‘Temperature sensor’ on Uplink transmitter for some time and see that the variation will appear on the LCD screen.
13. Observe the same on Downlink receiver.

Conclusion: As you send tele-command for temperature, the Satellite link start sending status of temperature to the Downlink receiver.

Experiment – 6

Objective

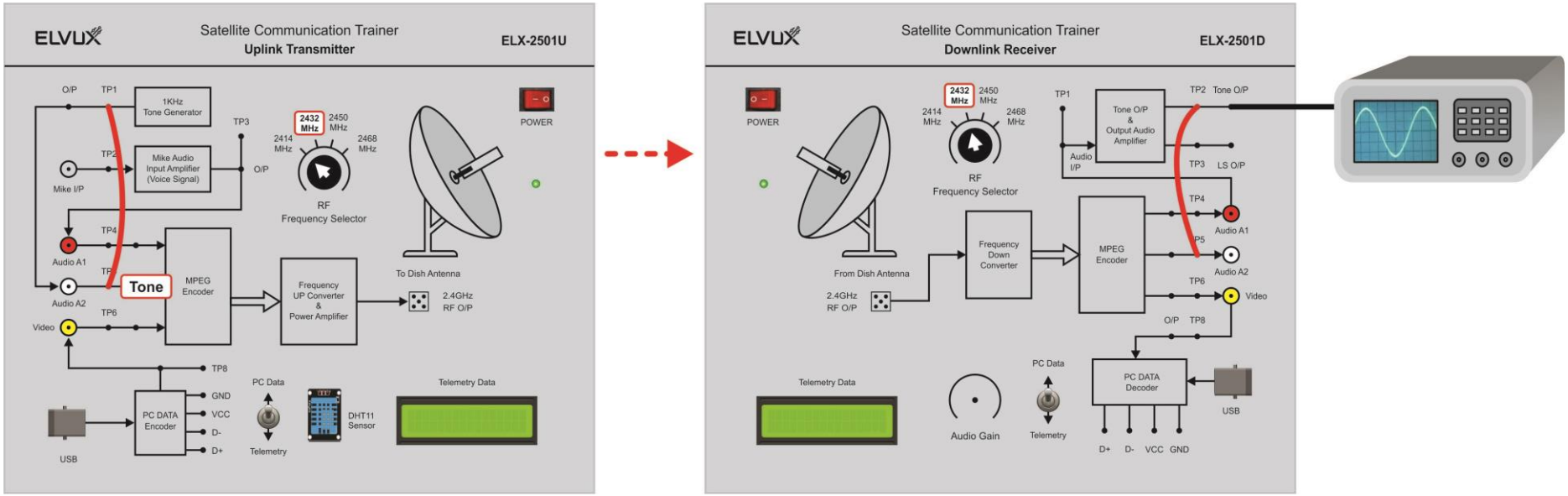
Calculate the carrier to noise ratio for a satellite-link.

Apparatus required:

- Uplink Transmitter
- Dish Antennas
- Downlink Receiver
- Satellite Link (Transponder)
- Oscilloscope Connecting cables

Procedure

1. Connect links in Satellite Uplink transmitter, Satellite link and downlink Receiver as shown in Connection diagram below.
2. Switch ‘OFF’ Uplink Transmitter and Satellite Link, keep only Downlink receiver ‘On’.
3. Connect Oscilloscope at 1 KHz Tone output at Downlink receiver.
4. Receiver Dish antenna will receive only Noise from air. This is Noise signal “N”
5. Measure its level on Oscilloscope. It may be about 1Vpp which is equal to -89dBm.
6. Now switch ‘ON’ Uplink Transmitter and set the frequency.
7. Align both the transmitter and receiver Antenna’s in line such that both are in parallel alignment.
8. Now measure output again. It is about 3.44V which equal to -53dBm. This is Carrier signal level “C”.
9. Thus C/N = Carrier Level / Noise level, as both noise and carrier signal measured in dB. C/N can be calculated by taking the difference of two readings i.e C/N = -53 – (-89) = 43dB.


ELVUX
Satellite Communication Trainer
Uplink Transmitter
ELX-2501U
O/P
TP1
1KHz
Tone Generator
TP3
2432 MHz
2450 MHz
2414 MHz
2468 MHz
POWER
TP2
Mike Audio
Input Amplifier
(Voice Signal)
O/P
Mike I/P
RF
Frequency Selector
TP4
Audio A1
TP5
Tone
MPEG
Encoder
Frequency
UP Converter
&
Power Amplifier
To Dish Antenna
Audio A2
2.4GHz
RF O/P
TP6
Video
TP8
PC Data
Telemetry Data
GND
VCC
D-
D+
PC DATA
Encoder
DHT11
Sensor
USB
Telemetry
ELVUX
Satellite Communication Trainer
Downlink Receiver
ELX-2501D
POWER
2432 MHz
2450 MHz
2414 MHz
2468 MHz
RF
Frequency Selector
TP1
Tone O/P
&
Output Audio
Amplifier
TP2
Tone O/P
Audio
I/P
TP3
LS O/P
TP4
Audio A1
TP5
Audio A2
TP6
Video
From Dish Antenna
2.4GHz
RF O/P
Frequency
Down
Converter
MPEG
Encoder
O/P
TP8
Telemetry Data
PC Data
PC DATA
Decoder
USB
Audio Gain
Telemetry
D+
D-
VCC
GND

Experiment – 7

Objective

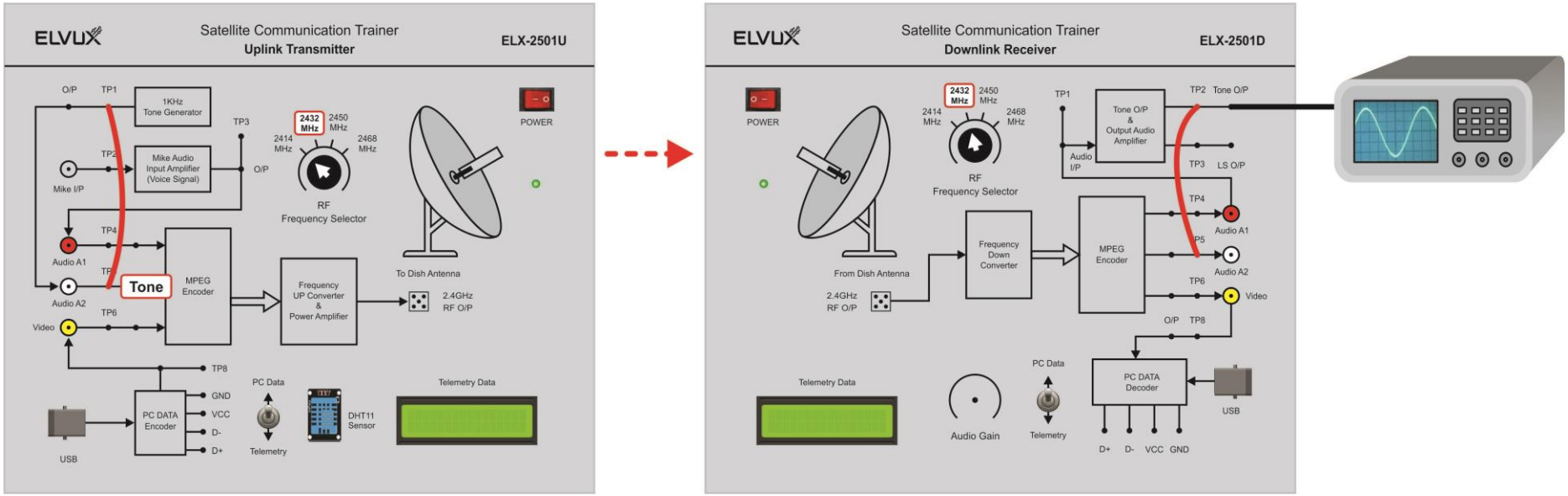
Calculate signal to noise (S/N) ratio for a satellite-link.

Apparatus required:

- Uplink Transmitter
- Dish Antennas
- Downlink Receiver
- Satellite Link (Transponder)
- Oscilloscope Connecting cables

Procedure

1. Keep all setting same as Exp. 7.
2. Connect links in Satellite Uplink transmitter, Satellite link and downlink Receiver as shown in Connection diagram below.
3. Connect Oscilloscope at 1 KHz Tone output at Downlink receiver.
4. Connect Sine wave Signal from Function generator. Keep Sine wave level to Zero and measure signal on Oscilloscope.
5. This is Noise level in absence of Signal. It is about 20mv.
6. Now apply 1Vpp sine wave. Measure signal again on CRO.
7. This is 1020mV. It is Signal + Noise signal. Hence Signal is 1020-20=1000mV.
8. Thus S/N gain = 1000/20 = 50 which in db is = dB = 20 log S/N = 20 x 1.7 = 34 dB.


ELVUX
Satellite Communication Trainer
Uplink Transmitter
ELX-2501U
O/P
TP1
1KHz
Tone Generator
TP3
2432 MHz
2450 MHz
2414 MHz
2468 MHz
POWER
TP2
Mike Audio
Input Amplifier
(Voice Signal)
O/P
Mike I/P
RF
Frequency Selector
TP4
Audio A1
TP5
Tone
MPEG
Encoder
Frequency
UP Converter
&
Power Amplifier
To Dish Antenna
Audio A2
2.4GHz
RF O/P
TP6
Video
TP8
PC Data
Telemetry Data
GND
VCC
D-
D+
PC DATA
Encoder
DHT11
Sensor
Telemetry
USB
ELVUX
Satellite Communication Trainer
Downlink Receiver
ELX-2501D
POWER
2432 MHz
2450 MHz
2414 MHz
2468 MHz
RF
Frequency Selector
TP1
Tone O/P
&
Output Audio
Amplifier
TP2
Tone O/P
Audio
I/P
TP3
LS O/P
TP4
Audio A1
TP5
Audio A2
TP6
Video
From Dish Antenna
2.4GHz
RF O/P
Frequency
Down
Converter
MPEG
Encoder
O/P
TP8
PC Data
PC DATA
Decoder
USB
Telemetry Data
Audio Gain
Telemetry
D+
D-
VCC
GND