Indian Institute of Information Technology, Allahabad

Electronics and Communication Engineering Department

Course Name: Radar & Satellite Communication

Experiment No. 10

Aim :- To send telecommand and receive the telemetry Data.

TELECOMMAND & TELEMETRY

OBJECTIVE:

To send telecommand and receive the telemetry Data

EQUIPMENT REQUIRED:

- Satellite uplink transmitter, satellite downlink receiver and satellite link emulator
- RHCP & LHCP axial mode helix antennas, Dish Antennas, Patch antennas
- Antenna stands with connecting cables, PC monitor(from Lab) , Video to VGA converter card provided, Camera, Function generator (from lab), CRO X 2 (from lab), spectrum analyzer (from lab)

PROCEDURE:

1. Setup the link in same fashion with Tx, Rx and Satellite link emulator at 3 vertices of a triangle. If switching ON the 1kHz tone on transmitter will make the receiver sound to 1KHz test tone via satellite, PLL of complete link are O.K. and a successful sat link is said to be established. **Make sure that video/data select switch at Tx, Rx and satellite (at satellite's back panel) should be at data. Also, satellite's telecommand Enable switch should be off. Also, the data trigger pot at digital demodulation should be turned fully clockwise.**
2. Set the data/video select switch to data at Tx end. Turn on telemetry enable on TX end. Preferably connect a CRO at Tx end and Rx end for viewing transparency of signals using T connectors
3. To send the telecommand signal from Tx to Satellite link emulator, set addresses of both Tx & Satellite link emulator same.
4. Now, switch ON the ENABLE function at Tx and see if VALID LED glows at Satellite link emulator. If it blinks intermittently or doesn't glow at all, vary the digital/video deviation at Tx till LED glows permanently. Also, ensure the select switch at Tx is turned towards Digital side during Digital transmission.
5. Now, select the data switches at Tx side and see if corresponding LED's glow or not. If during data selection LED again starts blinking set the digital/video deviation again. Set till all the data can be send transparently. To visualize as to what is happening by digital/video deviation connect a CRO at Tx at Data in and see the address and data pulses selection and their framing.
6. Now, once data has been send from Tx to uplink channel of Satellite link emulator ; same data can be send to Rx end by selecting the same address. Ensure not to switch ON ENABLE at Downlink channel of Satellite link emulator. Hence telecommand data at 2.481 GHz gets received by Rx at 2.400GHz. **Keep trigger threshold at Rx end fully clockwise for best transparency.** Adjust the Trigger Threshold level at Rx end by varying the pot in order to recover the data correctly and the valid led to glow

7. In order to send telemetry data to Rx from Downlink channel of Satellite link emulator, switch OFF the ENABLE of Tx (**Do not switch OFF the carrier at Tx**) and then set the addresses of both Rx and Downlink Satellite link emulator same. Now, send the data from downlink channel of Satellite link emulator to Rx.

8. If LED at Rx (VALID) blinks intermittently or doesn't glow at all, vary the Trigger Threshold level at Rx end by varying the pot at Rx till LED glows permanently. Now, select the data switches at downlink channel of Satellite link emulator side and see if corresponding LED's at Rx glows or not. If during data selection LED again starts blinking set the Trigger Threshold level at Rx end by varying the pot again. Set till all the data can be send transparently or else use different address. To visualize as to what is happening by Trigger Threshold level at Rx end by varying the pot, connect a CRO at Rx at Data out and see the address and data pulses selection and their framing.

9. Measure the level, distortion, noise added to waveform at Rx end on each channel. Measure how much noise/distortion has been added to signal after it has passed through.

10. Also see how much noise is added to waveforms if path loss at Tx and Rx end is varied. Find at what level of path loss does waveforms vanishes at Rx end.

11. Observe on CRO, how does waveforms behaves on fading the carrier by introducing the Fading from satellite link emulator.

12. Observe on CRO, how does waveforms behaves on introducing the thermal noise onto carrier by introducing the noise from satellite link emulator. See if noise introduced can completely shadow the data and addresses.

13. Thus, the Telecommand and Telemetry signals can also be viewed at CRO. But make sure not send any video or data signal at Tx though audio channels can be used simultaneously.

RESULT :

The Telecommand and Telemetry signals can be transmitted over a distance via a satcaom link and same signals can be received at Rx input. Telecommand function encodes 8 lines of information and serially transmits the information upon receipt of enable signal. The words are transmitted twice per encoding sequence to increase security. The Telemetry function receives the serial data stream and interprets 4 of the digits as address code. The valid led glows on two conditions - first, two addresses must be consecutively received in one encoding sequence, which must match the local addresses. Second the 4 bits of data must match the last 4 bits of valid data received.
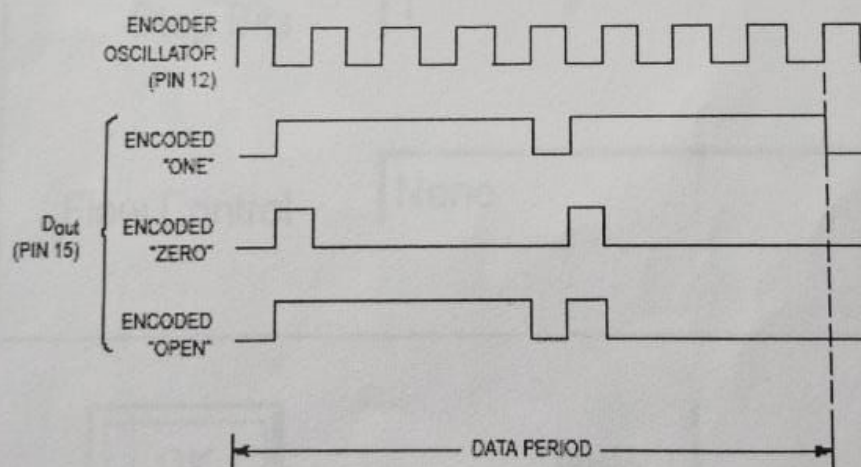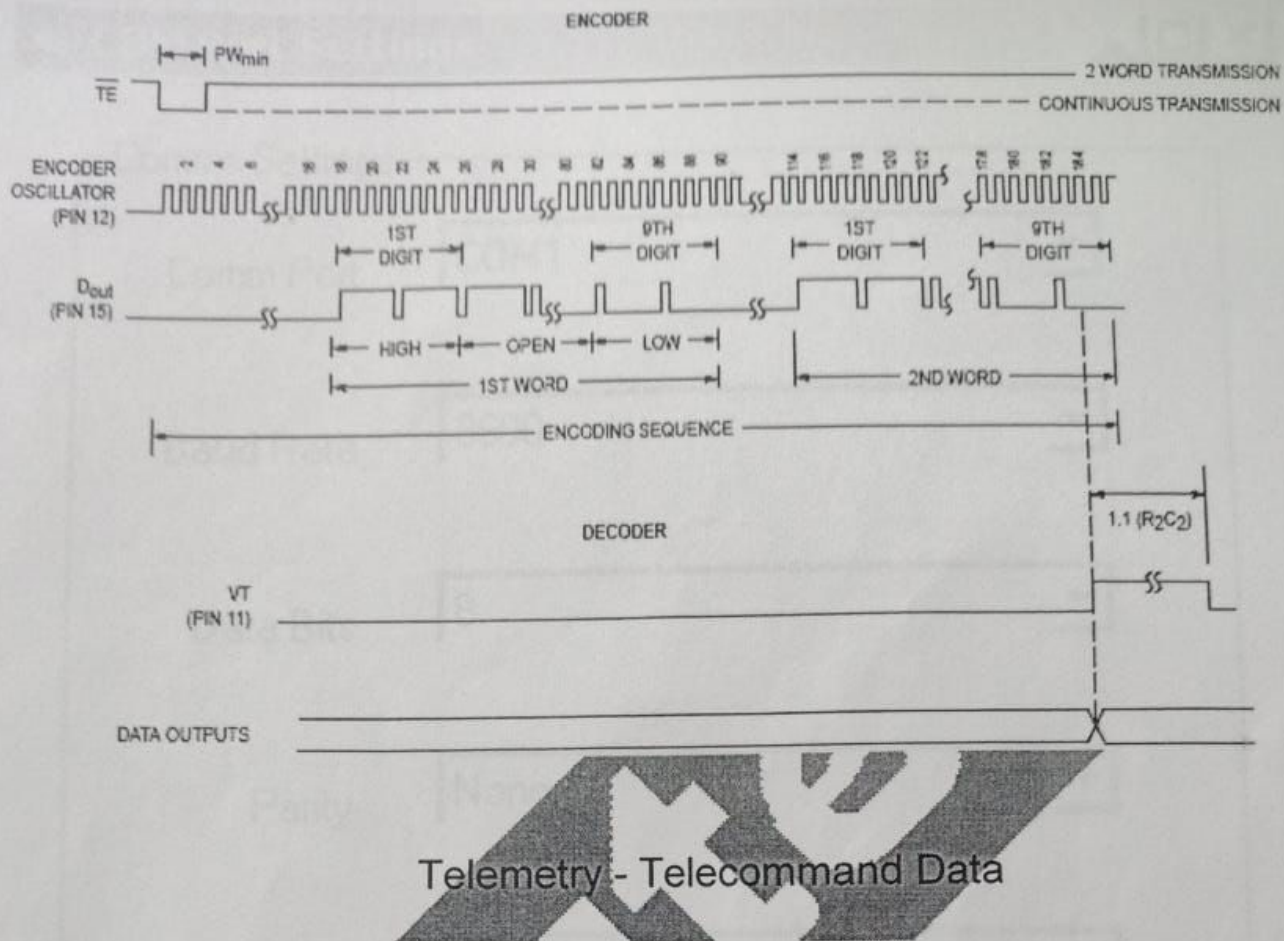
Figure 11. Encoder Data Waveforms