Experiment No.: 7

Title: Experimental study of generation and detection of Spread Spectrum System (DSSS).

Roll No.: _________ Batch: __________
Date of Performance: _________________
Date of Assessment: ___________________

Particulars	Marks
Attendance (05)	
Journal (05)	
Performance (05)	
Understanding (05)	
Total (20)	
Signature of Staff Member	

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Title: Experimental study of generation and detection of Spread Spectrum System (DSSS).

Aim: To study and understand the working of direct sequence spread spectrum (DSSS) transmitter and receiver using a hardware trainer kit.

Prerequisites:

- Basic of digital communication system.
- Knowledge of modulation technique.
- Familiarity with PN sequence and spread spectrum concepts.

Objectives:

- To observe how data is spread and dispread in DSSS.
- To understand the generation of and role of PN codes.
- To analyze the transmitted and received signal using the hardware kit.

Theory:

This trainer kit has been designed with a view to provide practical / experimental knowledge of DSSS-CDMA Modulation / Demodulation technique as practically implemented in digital communication systems on a single P.C.B.

Code-division multiple access (CDMA)

Code-division multiple access-(CDMA) is a channel access method used by various radio communication technologies. CDMA an example of multiple access. Where, several transmitters can send information simultaneously over single communication channel. This allows several users to share a band of frequencies (see bandwidth). To permit this without undue interference between the user, CDMA employs spread spectrum technology and a special coding scheme (where each transmitter is assigned a code).

Spread-spectrum characteristic of CDMA

Most modulation schemes try to minimize the bandwidth of this signal since bandwidth is a limited resource. However, spread-spectrum techniques use a transmission bandwidth that is several orders of magnitude greater than the minimum required signal bandwidth. One of the initial reasons for doing this was military applications including guidance and communication systems. These systems were designed using spread spectrum because of its security and resistance to jamming. Asynchronous CDMA has some level of privacy built in because the signal is spread using a pseudo-random code; this code makes the spread-spectrum signals appear random or have noise-like properties. A receiver cannot demodulate this transmission without knowledge of the pseudo-random sequence used to encode the data. CDMA is also resistant to jamming. A jamming signal only has a finite amount of power available to jam the signal. The jammer can either spread its energy over the entire bandwidth of the signal or jam only part of the entire signal.

CDMA can also effectively reject narrow-band interference. Since narrow-band interference affects only a small portion of the spread-spectrum signal, it can easily be removed through notch filtering without much loss of information. Convolution encoding and interleaving can be used to assist in recovering this lost data. CDMA signals are also resistant to multipath fading. Since the spread-spectrum signal occupies a large bandwidth, only a small portion of this will undergo fading due to multipath at any given time. Like the narrow-band interference, this will result in only a small loss of data and can be overcome.

Another reason CDMA is resistant to multipath interference is because the delayed versions of the transmitted pseudo-random codes will have poor correlation with the original pseudo-random code, and will thus appear as another user, which is ignored at the receiver. In other words, as long as the multipath channel induces at least one chip of delay, the multipath signals will arrive at the receiver such that they are shifted in time by at least one chip from the intended signal. The correlation properties of the pseudo-random codes are such that this slight delay causes the multipath to appear uncorrelated with the intended signal, and it is thus ignored.

Some CDMA devices use a rake receiver, which exploits multipath delay components to improve the performance of the system. A rake receiver combines the information from several correlators, each one tuned to a different path delay, producing a stronger version of the signal than a simple receiver with a single correlation tuned to the path delay of the strongest signal.

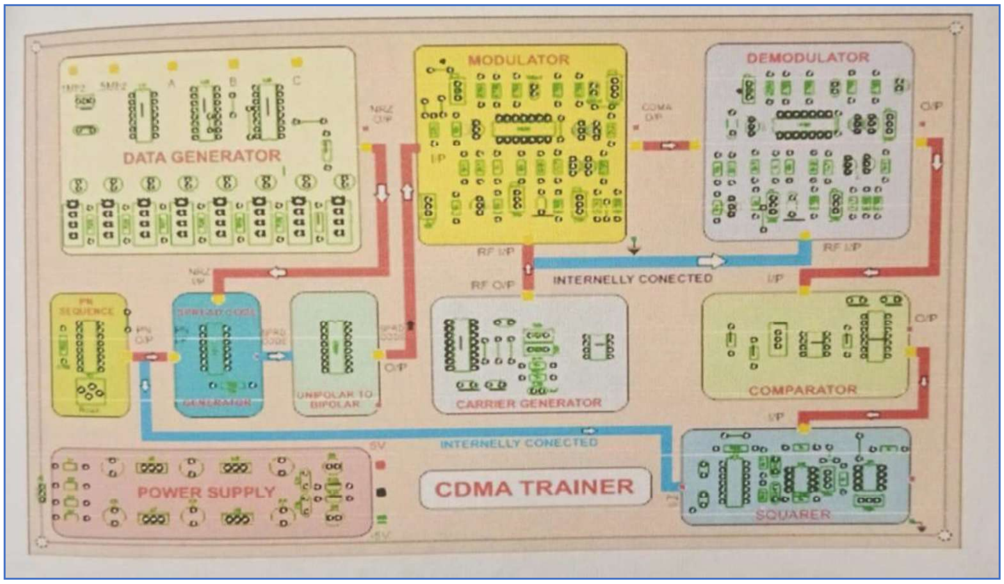
Frequency reuse is the ability to reuse the same radio channel frequency at other cell sites within a cellular system. In the FDMA and TDMA systems, frequency planning is an important consideration. The frequencies used in different cells must be planned carefully to ensure signals from different cells do not interfere with each other. In a CDMA system, the same frequency can be used in every cell, because channelization is done using the pseudo-random codes. Reusing the same frequency in every cell eliminates the need for frequency planning in a CDMA system; however, planning of the different pseudo-random sequences must be done to ensure that the received signal from one cell does not correlate with the signal from a nearby cell.

Since adjacent cells use the same frequencies, CDMA systems have the ability to perform soft hand-offs. Soft hand-offs allow the mobile telephone to communicate simultaneously with two or more cells. The best signal quality is selected until the hand-off is complete. This is different from hard hand-offs utilized in other cellular systems. In a hard-hand-off situation, as the mobile telephone approaches a hand- off, signal strength may vary abruptly. In contrast, CDMA systems use the soft hand-off, which is undetectable and provides a more reliable and higher-quality signal (d3 d2 d1) with the help of three redundant bits (C3 C2 C2). For the example data 1010, first C1 (0) is calculated considering the parity of bit positions 2, 3, 5 and 7. Then the parity bits C2 is calculated considering bit positions 4, 5, 6 and 7 as shown. If any corruption occurs in any of the transmitted code 1010010, the bit position in error can be found out by calculating C3 C2 C1 at the receiving end. For example, if the error can be received code word is 1110010, the recalculated value of C3 C2 C1 is 110, which indicates that bit position in error is 6, the decimal value of 110.

Procedure:

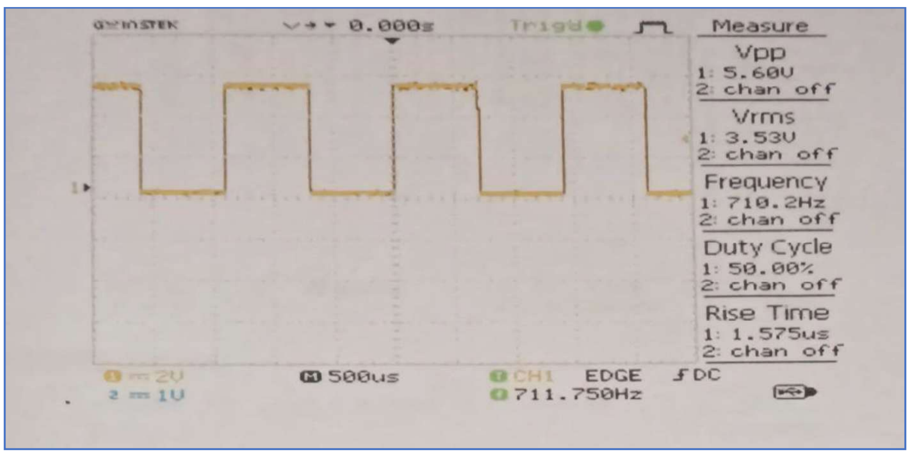
1) Connect CRO at Data generator O/P & observe the NRZ Data. [DATA Pattern].
2) Connect patch cord between NRZ O/P to Spread Code Mixer I/PAlso connect PN Sequence O/P to Spread Code I/P And observe Spread code.
3) Connect patch cord Bipolar O/P to Modulator I/P & Connect RF (Carrier internally connected) O/P to Modulator I/P & observe Signal O/P. [Modulation] Compare CDMA O/P with Spread Code.
4) Connect Patch cord CDMA O/P to Demodulator I/P & observe the Demodulated O/P. Compare Demodulated O/P with Spread Code.
5) Connect patch cord Demodulated O/P to dispread Code I/P and observe O/P.
6) Connect dispread Code O/P to I/P of Comparator And observe Data Pattern. (Compare O/P of Comparator with NRZ O/P). (PN sequence internally connected)

CONNECTION DIGRAM:

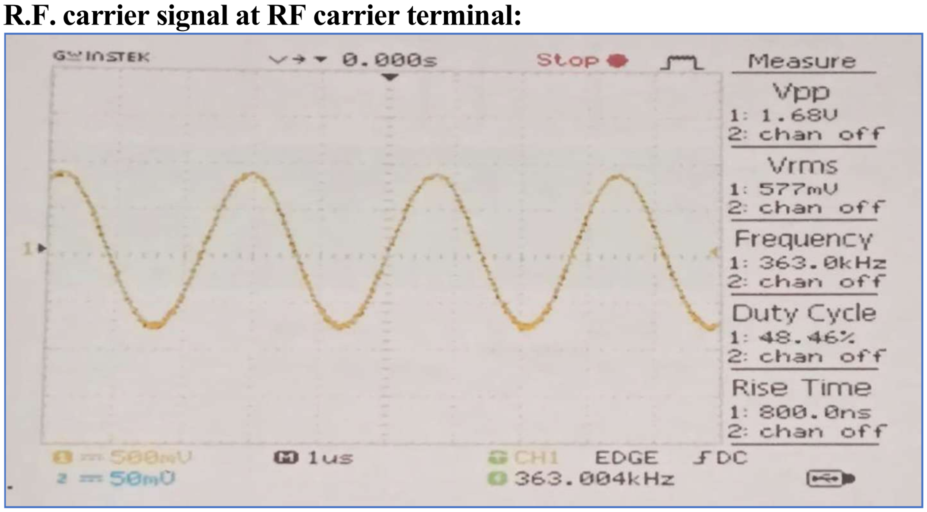


EXPERIMENT

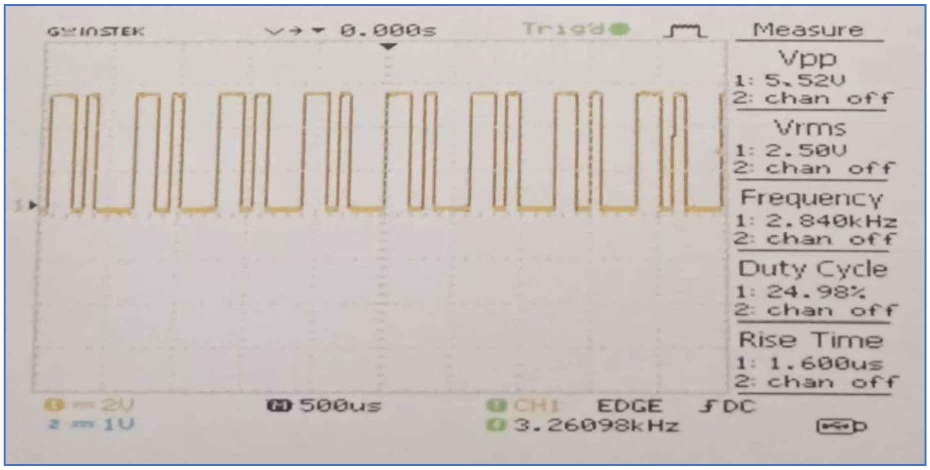
1. **Connect CRO channel to NRZ signal at NRZ terminal of Digital data generator:**



2. **R.F. carrier signal at RF carrier terminal:**

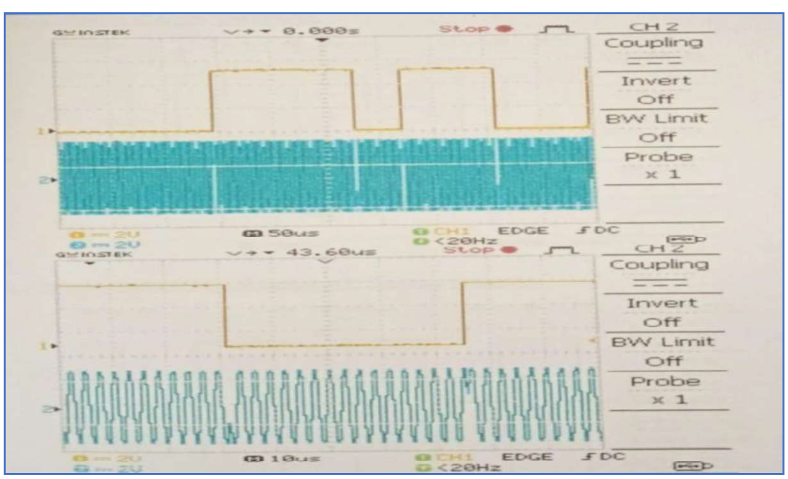


3. **PN Signal:**

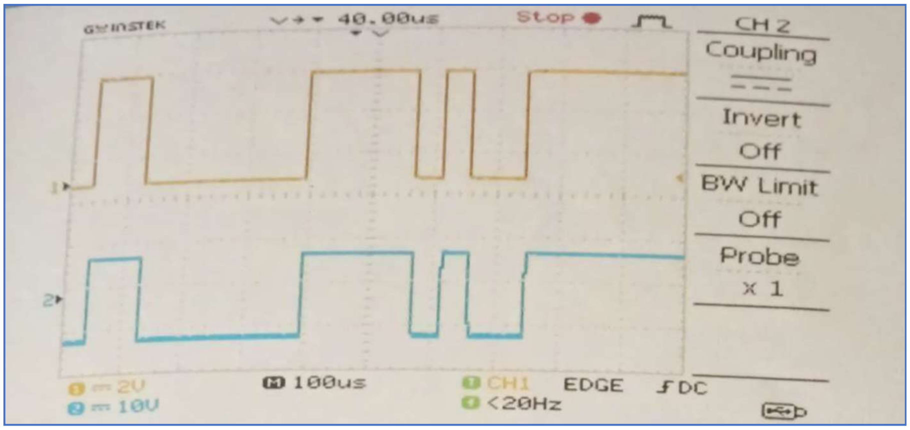


4. **Make connection as Shown in Diagram Spreading Code (SP) Signal-PN + Data:**

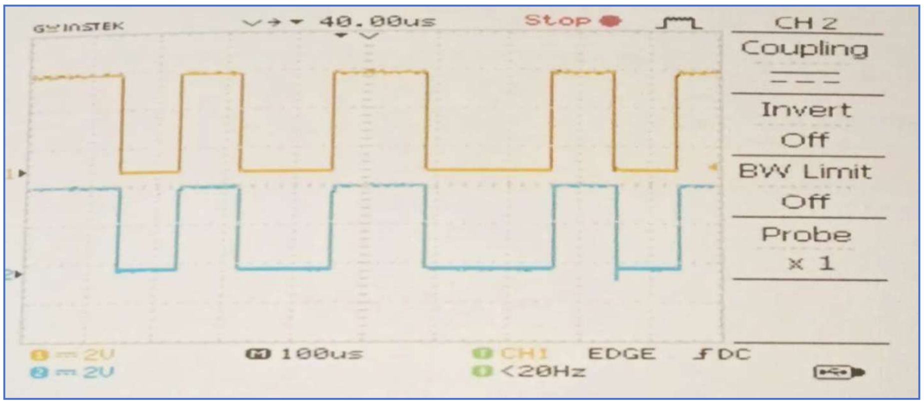
5. **CDMA Signal:**



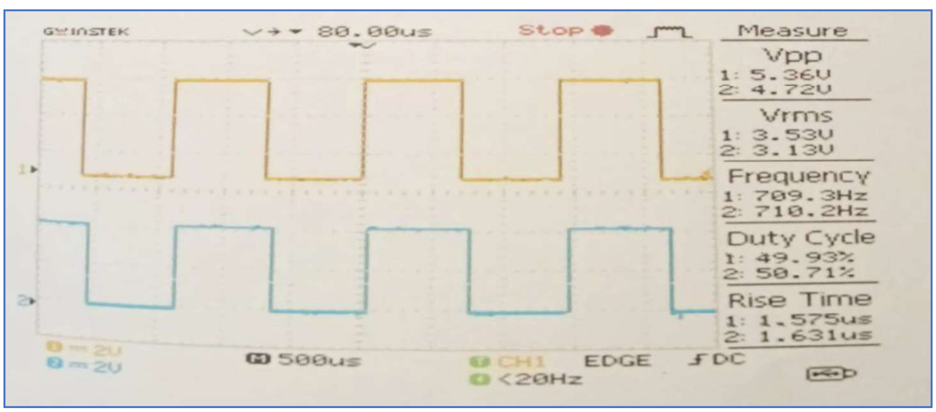
6. **Demodulated signal:**



7. Dispread code signal:



8. Received NRZ output at comparator:



9. Conclusion: