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Design and Simulation of PSK Digital Communication Transceiver System (DCTS)

A project

Submitted to the Department of Electronic Engineering – College of Engineering University of Diyala in Partial Fulfillment of the Requirement for the Degree of Bachelor in Electronic Engineering

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وزارة التعليم العالي والبحث العلمي

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قسم الهندسه الالكترونيه

Design and Simulation of PSK Digital Communication Transceiver System (DCTS)

مشروع مقدم الى قسم الهندسه الالكترونية في كلية الهندسة جامعة ديالى كجزء من متطلبات نيل درجه البكلوريوس في الهندسة الالكترونيه

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Chapter one

Introduction

1.1 Introduction

There are three parts in any transceiver communication system.

1- Information.

2- Medium

3- Carrier.

Information can be defined in two forms, digital or analog. Analog signal is considered continuous. The amplitude of the signal can be take any number of values between the signal maximum and minimum .The voice is analog signal and can take any number of volume levels between its "dynamic – range" which is the range of volumes your vocal cords can produce. Digital devices convert analog voice to a digital signal by process of sampling and quantization. The analog signal is first sampled and then quantized in levels and then each level is converted to a binary number. For example, the human voice maybe quantized in 16 levels. Each level can be represented by four bits. **[1]** The medium is the path that the signal travels through it. This path may be air, space or wires of all sorts. Each of these medium offers its own unique set of advantages and disadvantage that determine what is used as a carrier. A short wire in a chip for example may not need a carrier at all. A signal through space such as for satellite transmission may need a very high frequency carrier that can overcome space loss and other atmosphericlosses

Depending on the medium, the signal should have frequency appropriate to the medium. It can be at high frequencies such as in optical fiber or a microwave frequency as for mobile communications .An electromagnetic carrier signal can be of any frequency depending on the medium and the communication needs. Most medium dictate what type of carrier signal (its frequency and amplitude) can propagate through it and type of distortions it will suffer while travelling through it. In general the talk about a digital system, usually talking about digital information over an analog medium. However, there are exceptions. Pulse coded modulation (PCM) is a form of modulation where there is no carrier, so that makes it a pure digital system. [**1, 2]**

1.2 Types of Analog Modulations

A carrier, usually a simple sinusoidal wave, contains no information in itself. To modulate a carrier, one of its properties (amplitude, frequency or phase) is varied by the information containing of massage signal. This gives us three possibilities.

- Amplitude modulation (AM) where the amplitude or strength of the amplitude of carrier is varied.
- Frequency modulation (FM), where the frequency of the carrier signal.
- Phase modulation (PM), where the phase of carrier signal is varied.

It isactually turns out that FM and PM are very close relatives Commercial radio stations are licensed to use carrier frequencies between about 500 KHZ to 1600 KHZ using amplitude modulation (the " AM " band) , and frequencies between 88MHZ and 108 MHZ using frequency modulation (the " FM " band). **[2]**

1.2.1 Amplitude Modulation (AM)

The simplest form of AM is not simply turn the carrier on and off . This type is shown in Figure (1.1) below

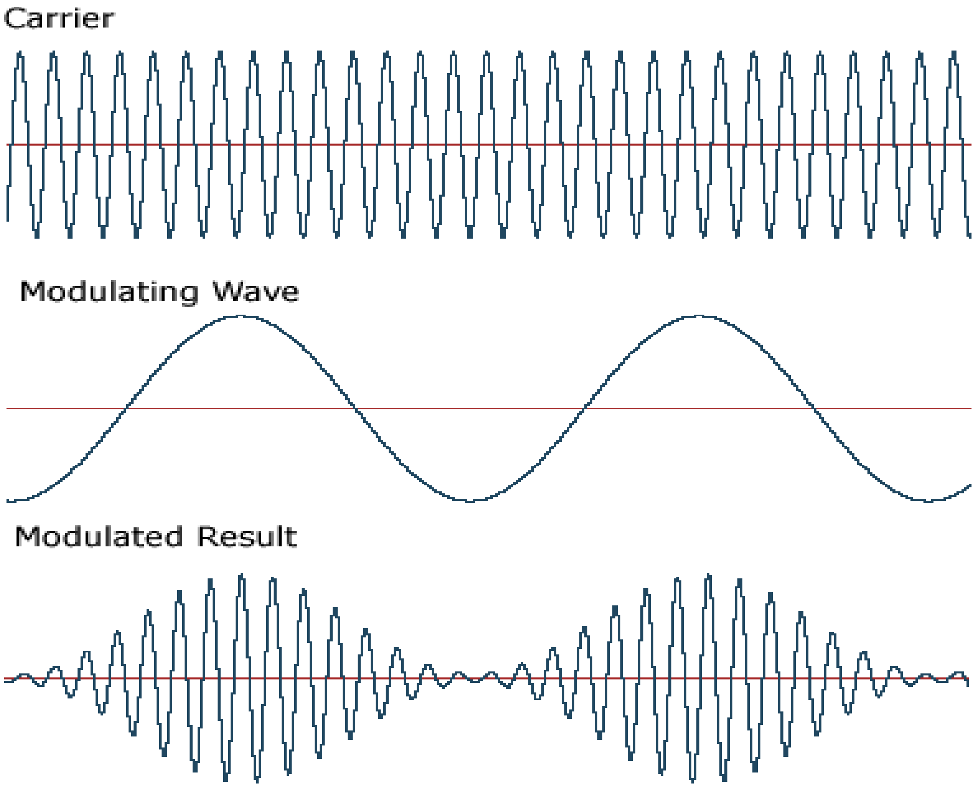

Figure (1.1)

Amplitude Modulation (AM)

1.2.2 Frequency Modulation

The basic idea of FM is shown in the Figure (1.2) below. Here the carrier frequency is controlled at each instant by the voltage of the modulating-signal voltages increase (the carrier frequency, while more negative

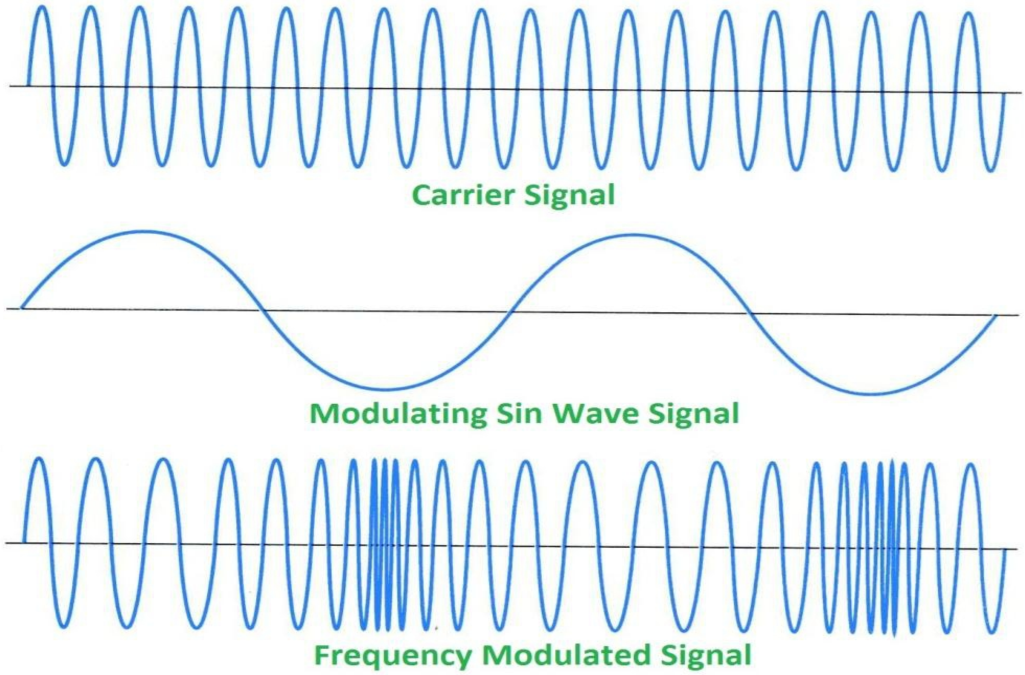

Figure (1.2): Frequency Modulation

The voltage of the modulated carrier in the FM case can be mathematically described by the expression:

$$V(t) = Ac\{\cos\left((2\pi fct)\right) - m\sin(2\pi fmt)\}$$

Where the symbols have the same meanings as for AM, and m is once again the modulation index, although it's exact meaning for FM is different Where the peak carrier deviation (Af) is the maximum frequency shift away from fc that the carrier experiences as it cycles higher and lower (this will occur when the modulating voltage is a maximum or minimum) .

Modulating the frequency of a carrier rather than its amplitude has some advantages, relating mainly to noise performance, although the tradeoff is that a good-quality commercial FM transmission requires significantly more bandwidth than AM transmission. A narrow-band version of FM can be used for voice communications where the quality does not need to be so high, and here the bandwidth requirements can be similar to AM .**[2,3]**

1.3 Demodulation of AM and FM Signals

Demodulation is the process of recovering the original modulating signal from a modulated carrier. As mentioned before, AM is really the "poor cousin" in terms of quality of consumer electronics. AM detectors almost invariably use envelope detection and consist of a simple diode rectifier circuit, which, roughly speaking, either the positive or negative half of an AM signal, as shown in the Figure (1.3). The resulting waveform is then smoothed, giving an output signal which approximates the shape of the envelope of the modulated carrier. Better (and rather more complex) AM detectors are available, but tend only to be used inrather exotic receivers

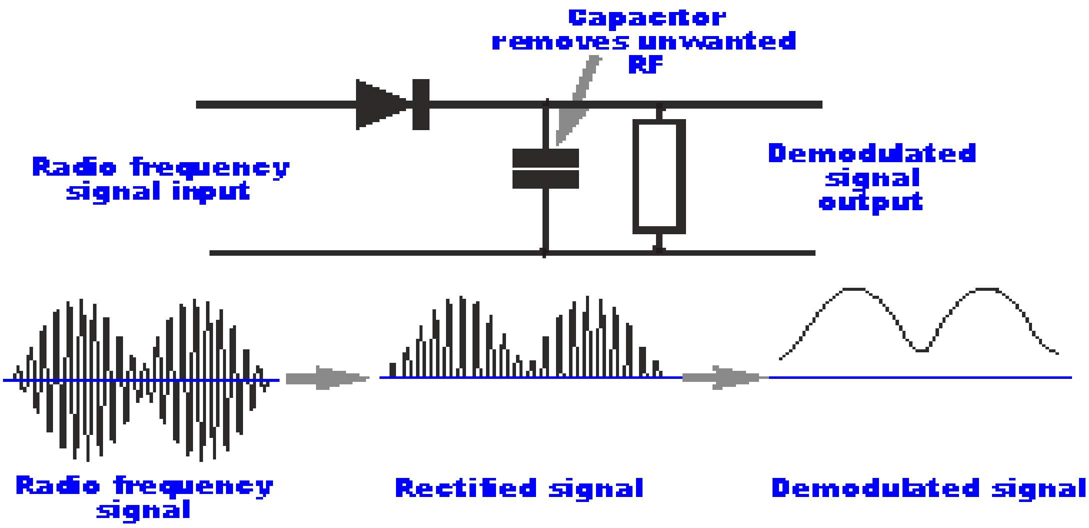

Figure (1.3): Demodulation of AM signal

With FM, even though there may be large variations in the amplitude of a received signal, receivers ignore them by first passing the signal through a limiting circuit which effectively clip4s the waveform, producing constant amplitude.. Recently, FM demodulators are almost universally use a phase locked loop (PPL), an extremely useful circuit which finds its way into all sorts of electronic systems, particularly where digitally-controlled tuning is used, (such as in most car radios). Briefly, it consists of an oscillator whose frequency can be varied by means of a voltage (that is, a voltage-controlled oscillator or (VCO), and a feedback loop, which results in the frequency of the oscillator bring locked to the frequency of the incoming signal. In the process the circuit produces a voltage which is proportional to the variation in the signal frequency. Unfortunately, its operation is rather complex

1.4 Basic Concepts of Digital Modulation

Modulation is the process of facilitating the transfer of information over a medium. Basically, the modulation can be achieved using amplitude modulation, frequency modulation or phase modulation.

The basic types of digital modulation techniques are:

1-Amplitude Shift Keying (ASK)

2-Frequency Shift Keying (FSK)

3-Phase Shift Keying (PSK)

All of these techniques vary a parameter of a sinusoid to represent the information which wishes to send. A sinusoid has three different parameters that can be varied. These are its amplitude, phase and frequency. Modulation is a process of mapping such that it takes the human voice (as an example of a signal) converts it into some aspect of a sine wave then transmits the sine wave, leaving the actual voice behind. The sine wave on the other side is remapped back to a near copy of human voice.

1.4.1 Amplitude Shift Keying (ASK)

It is one of basic type of digital modulation. In this type the amplitude of the carrier is changed in response to information and all else is kept fixed. But 1 is transmitted by a carrier of one particular amplitude to transmit zero, zero (0) the amplitude is changing and keeping frequency constant. On-Off keying (OOK) is a special form of ASK, where the amplitudes is zero as shown in Figure (1.4).

1.4.2 Frequency Shift Keying (FSK)

It is one of the basic types of digital modulation. In this type the digital modulation, the frequency is changing in response to information, one particular frequency for a 1 and another frequency for a zero as shown in Figure (1.5) for same bit sequence as above.

In the example below, frequency F1 for bit 1 is Lower than F2 used

for $= \begin{cases} \sin((2\pi F1t)), & \text{for bit 1} \\ \sin((2\pi F2t)), & \text{for bit 0} \end{cases}$ FSK (t)

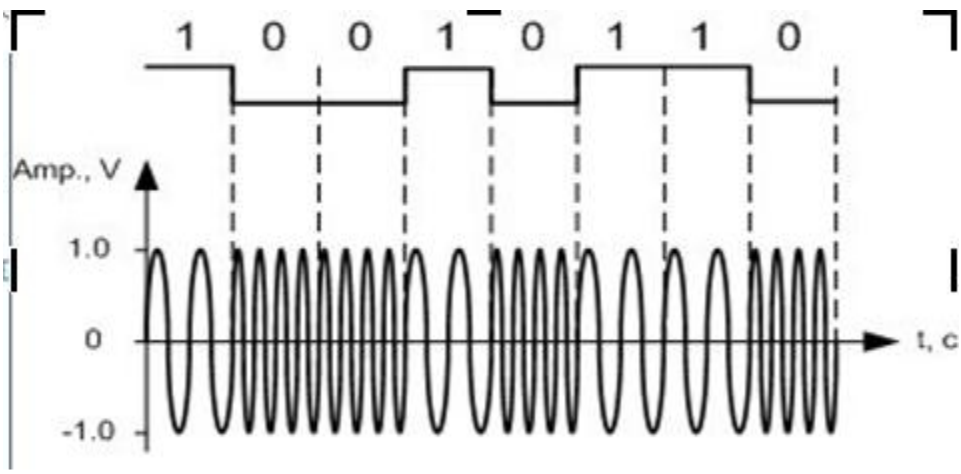

Figure (1.5): Frequencies shift keying (FSK)

1.4.3 Phase Shift Keying (PSK)

It is one of basic type of digital modulation. Figure (1.6) shows the process of PSK modulation. It is clear that by changing phase of the sinusoidal carrier signal for indicating the message of information. Phase in this context is the starting angle at which the sinusoid starts. To transmit 0 shift the phase of the sinusoid signal by180 degree. Phase shift represents the change in the state of the information in this case.

$$\text{PSK} = \begin{matrix} \sin((2\pi ft)), for bit 1 \\ \sin(2\pi ft) \quad \text{, for bit 0} \end{matrix}$$

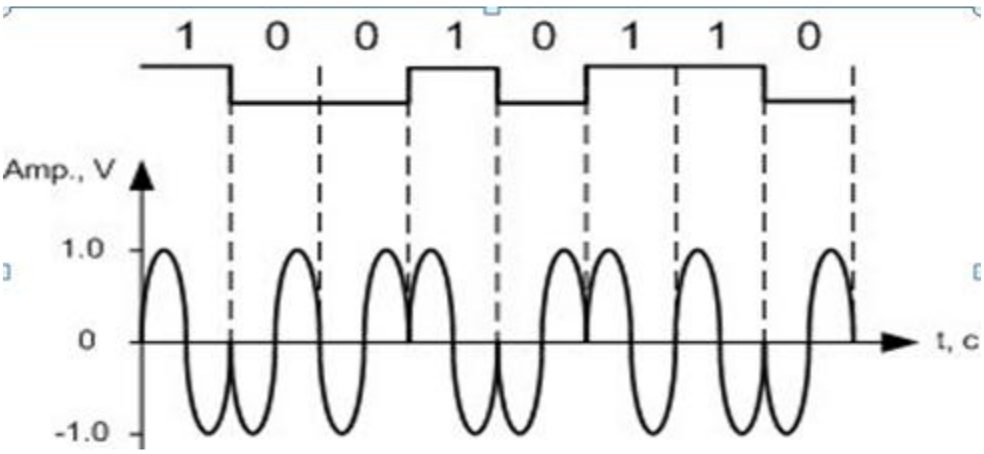

Figure (1.6): Phase shift keying

1.4.4 Advantage of Digital Communication System [4 , 5]

1-Relibale communication, less sensitivity to changes in environment conditions (temperature, etc).

2- Easy multiplexing.

3- Easy signaling.

4- Voice and data integration.

5-Easy processing like encryption and compression.

6- Easy system performance monitoring.

7-Integration of transmission and switching.

8-Signal regeneration, operation at low SNR , superior ,perform an

9 - Integration of service leading to ISDN

Chapter Three

Design &Simulation of BPSK Digital communication Transceiver System (DCTS)

3.1 Design and simulation of ASK Digital communication Transceiver system (DCTS)

3.1.1 The Transmitter Part

In this project digital communication-wireless transceiver system is proposed. Transceiver means content of transmitter side, transmission line (channel) and receiver side. The transmitter side constructed from massage, modulation (Amplitude Shift Keying) and digital filter. The circuit of Ask modulation is shown in Figure (3.1) is containing the following**:-**

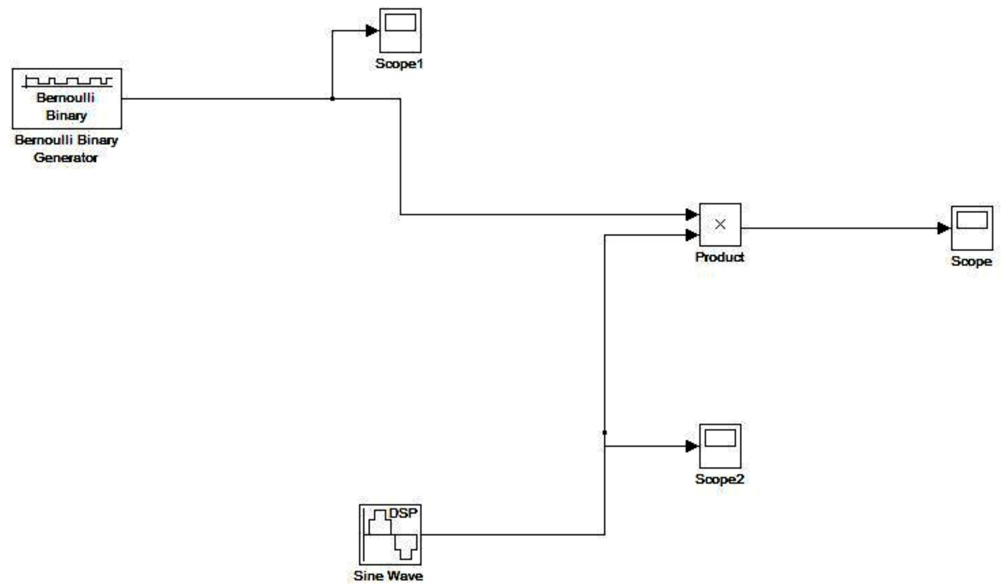

Figure (3.1) ASK modulation circuit

A. Generator of Data Binary

ASK signal generation represented by using Bernoulli massage as shown in Figure (3.2). The data rate of transmitted massage is (100 Kbps), which generate arbitrary binary non return to zero (NRZ) sequence with (Tb = 1/100k), this sequence is converted up with carrier frequency of (1 MHz), and the ASK output modulation simulated circuit is shown in Figure (3.1) above.

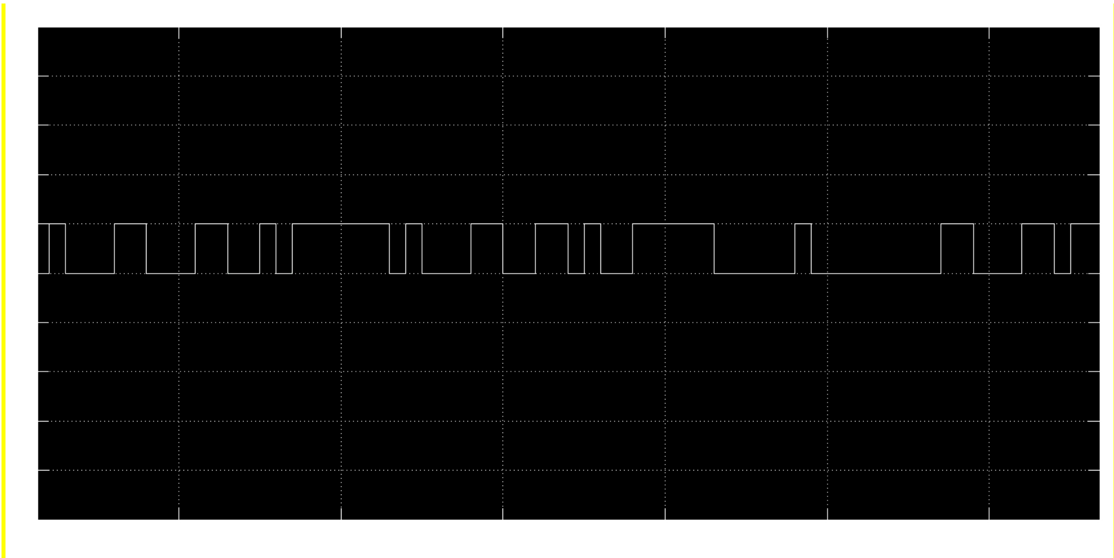

Figure (3.2) the Transmitted Data

B. Digital Band Pass Filter

The digital BPF used in the proposed system is IIR second order Butterworth BPF designed with 3db cutoff frequency (fs=10M Hz, f1 = 1MHz, f2= 1.4 MHz). This filter is implemented using matlab /simulink, it is used to reject unwanted signal the output waveform of the ASK modulation circuit is become as input to digital BPF is shown in Figure (3.3).

Figure (3.3) the output waveform of ASK

3.1.2 Transmission Medium (channel)

In this proposal designedsystem, the transmission medium is simulated as Additive White Gaussian Noise (AWGN).

3.1.3 Receiver Part

The simulation circuit diagram of receiver side is shown in Figure (3.4). It is the third part of the transceiver digital communication-wireless system. The input signal has been prossesd by digital filter; demodulation and thento reconstruct the message as it transmitted.

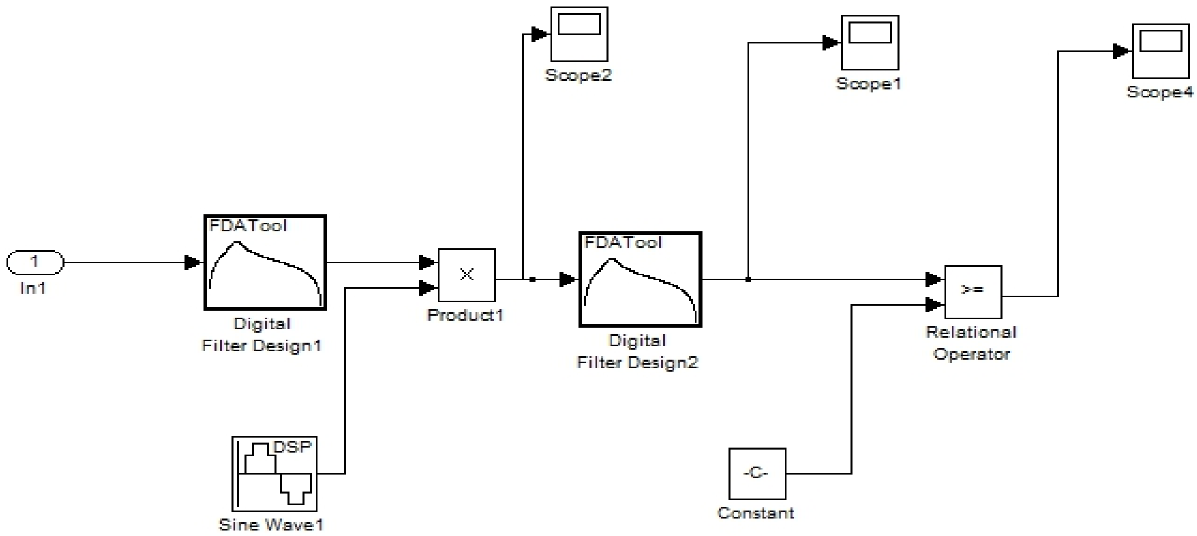

Figure (3.4) ASK demodulation circuit

A. Digital Band Pass Filter

As shown in Figure (3.5) the received signal from transmittedside forced to pass through digital band pass filter

(BPF) its function to reject the noise and interference which smearing the information also to make the information free from intersampling interference (ISI). The waveform result from (BPF) is shown in Figure (3.5).

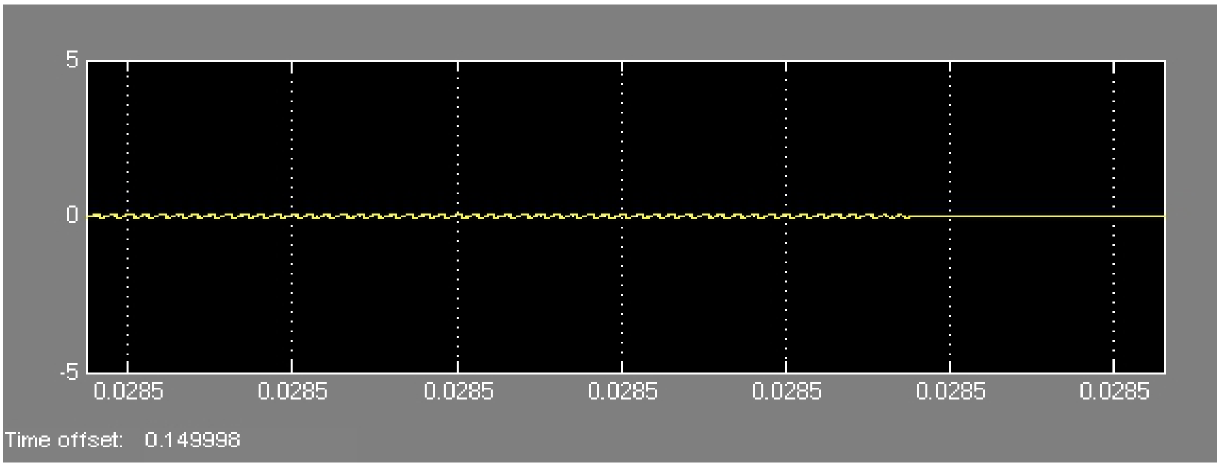

Figure (3.5) the signal result from Band Pass Filter

B. Demodulation

The simulation of demodulation circuit diagram is shown in Figure (3.6) above. After low pass filter we obtained information signal up to (100Kbps) and this information passed through, comparator (relational logical), to compare the bipolar signal with very small positive constant value to get unipolar digital signal. All the above processing to make the recovery data like the data before transmitted inOrder to make correct comparison between order them for obtaining bit error rate (BER). The output signal as shown in Figure (3.6)

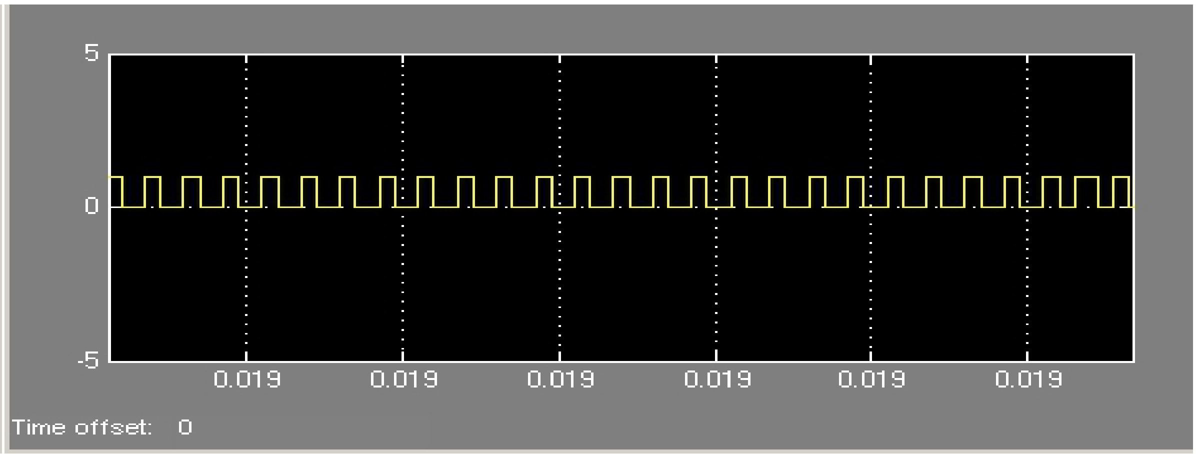

Figure (3.6) the output signal

3.4 BER Calculation

The Block diagram of it is shown in Figure (3.7). The block error rate calculation is gotten from simulink DSP, and its function is calculateBER. It has two inputs: one is the massage from the demodulator (Rx) and the other from data generator (Tx) at the transmitter after adding the measured delay between transmitter and receiver massage. Generally, an error in a digital transmission facility occurs when existing pulses are lost or transmitted 1's are detected by the receiver as 0's.The bit error rate is the average rate at which the errors occur and can be expressed as:-

BER = $\frac{Ne}{NT}$

Where:

Ne, NT: is the number of error bits and transmitted bits during simulation

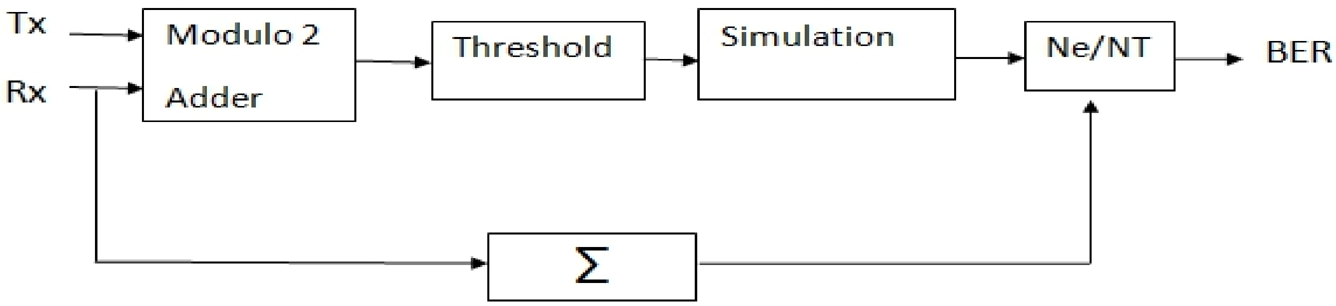

Figure (3.7) Block diagram of error rate calculation [4]

3.1.5 The Simulation Results

Figure (3.8) show the transmitted digital data.

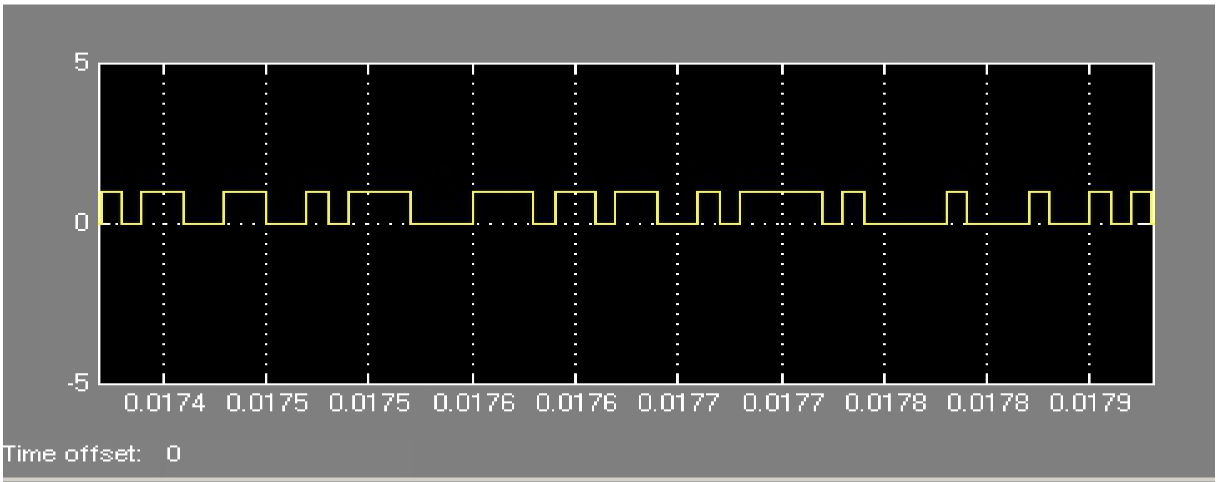

Figure (3.8) the Transmitted digital data

Figure (3.9) shows the received digital data results after demodulation and before delay.

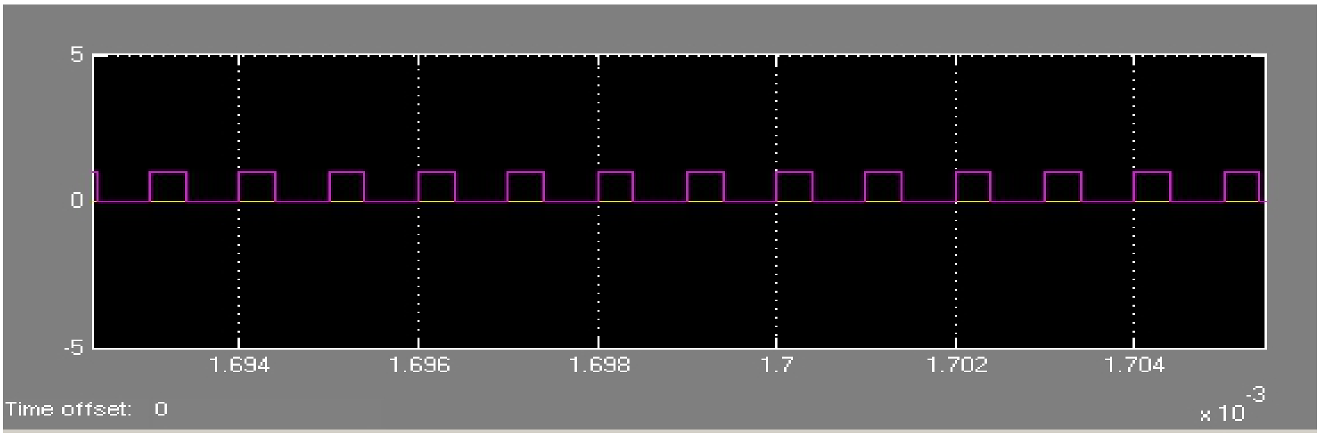

Figure (3.9) received digital data results after demodulation

Figure (3.10) shows the received digital data with applying S/N ratio (-10bB).

Process gain=10 log $\frac{\text{Carrier B.W}}{\text{Massage B.W}}$

$= 10 \log \frac{10000000}{1000000}$

$= 10 \log 10$

$= 10$ dB

The above results obtain when we apply process gain equal to (10 dB).

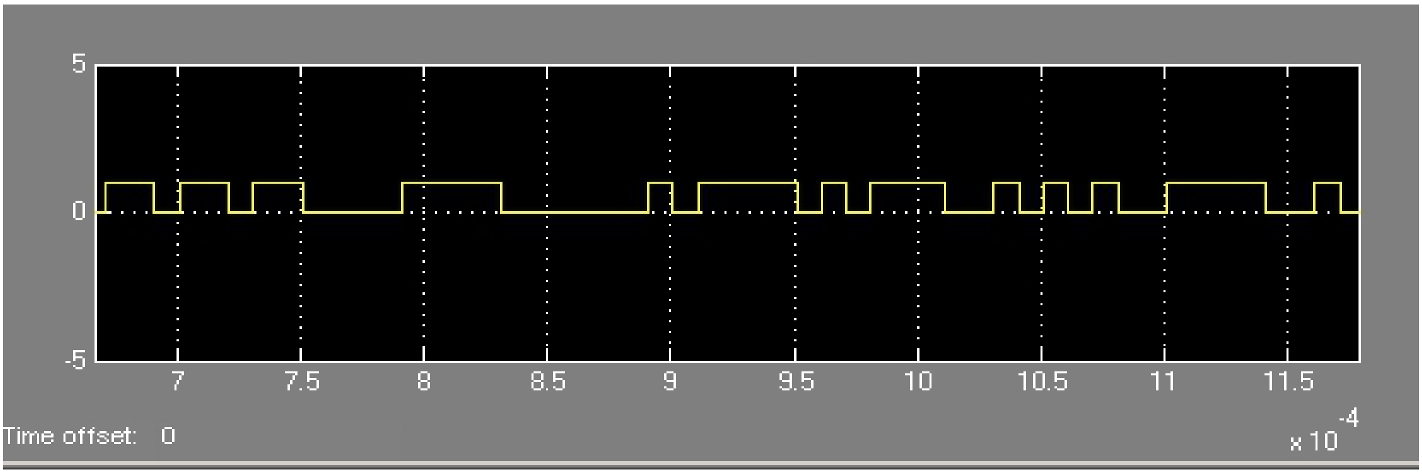

Figure (3.10)

Figure (3.11) show the output received digital data after applying the delay detect synchronization.

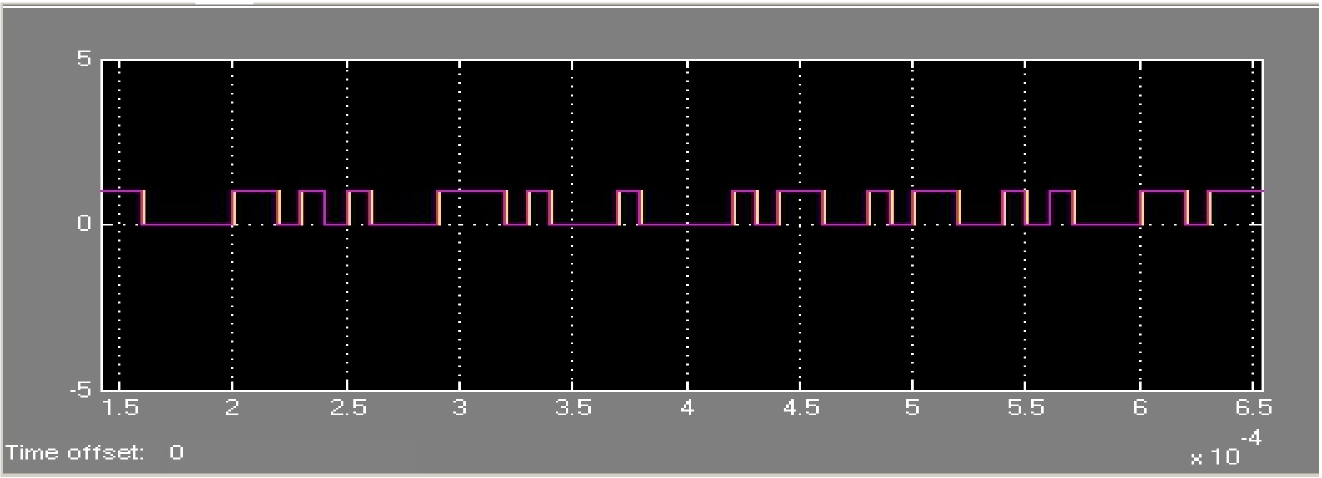

Figure (3.11) the output received digital data after applying the delay

Chapter two

Digital modulation

2 .1 Introduction to the Amplitude of Shift Keying (ASK)

It is a form of digital modulation that represents digital data as variation in the amplitude of carrier wave. The amplitude of an analog carrier signal varies in accordance with the bit stream (modulating signal), keeping frequency and phase constant. The level of amplitude can be used to represent binary logic zero's and one's the carrier signal can be represented as ON or OFF switch. In the modulated signal, logic 0 represented by absence of a carrier, the given OFF/ON keying operation and hence the name given. Like AM, ASK is also linear and sensitive to atmospheric noise, distortions, propagation conditions on different routes in PSTN, etc. Both ASK modulation and demodulation processes are relatively inexpensive. The ASK technique is also commonly used to transmit digital data by digital communication system (DCS). **[2]**

Amplitude-shift keying (ASK) and on-off keying (OOK) modulation can be used for intermittent low-data-rate applications in the transmitter system, home security, garage door openers and remote controls. **[4]**

The transmission of digital signals is increasing at a rapid rate. Low-frequency analog signals are often converted to digital format (PAM) before transmission. The source signals are generally referred to as base band signals **[5]**.

2.2 Amplitude Shift Keying (ASK) modulation

The transmission of digital signals is increasing at a rapid rate. Low-frequency analog signals are often converted to digital format (PAM) before transmission. The source signals are generally referred to as baseband signals. From electro-magnetic theory , for efficient radiation of electrical energy from an antenna it must be at least in the order of magnitude of a wavelength in size ; $c=f\lambda$, where c is the velocity of light , f is the signal frequency and λ is the wavelength . For a 1 KHz audio signals, the wavelength is 300 Km.

An antenna of this size is not practical for efficient transmission. The low-frequency signal is often frequency – translated to a higher frequency range for efficient transmission. The process is called modulation. The use of a higher frequency range reduces antenna size. In the modulation process, the baseband signals constitute the modulating signal and the high-frequency carrier signal is a sinusoidal waveform, there are three basic ways of modulating a sin wave carrier. For binary digital modulation, they are called binary amplitude-shift keying (BASK), binary frequency-shift keying (BFSK) and binary phase-shift keying (BPSK). Modulation also leads to the possibility of frequency multiplexing. In a frequency – multiplexed system, individual signals are transmitted over adjacent, non-overlapping frequency bands. They are therefore transmitted in parallel and simultaneously in time. If the operation at higher carrier frequencies, more bandwidth is available for frequency-multiplexing more signals [**4, 5]**.

2.2.1 Binary Amplitude – Shift Keying (BASK)

A binary amplitude –shift keying (BASK) signal can be defined

S (t) =Am (t) cos2πfct, $0 \le t \le T$……. (1)

m(t)= 0 or 1

Where A is a constant, fc is the carrier frequency, and T is the bit duration. A=$\sqrt{2p}$

It has a power p = $\frac{A^2}{2}$ thus equation (1) can be written as

S (t) =$\sqrt{2p}$ cos2πfct, $0 \le t \le T$

$=\sqrt{pT}\sqrt{\frac{2}{T}}\cos 2\,\pi f c t,$ $0 \le t \le T$

$= \sqrt{E}\sqrt{\frac{2}{T}}\cos 2\pi f c t$, $0 \le t \le T$

Where E= PT is the energy contained in a bit duration .if we take:

$\varphi(t) = \sqrt{\frac{2}{T}}\cos 2\pi f c t$ $0 \le t \le T$

As the orthonormal basis function, the application signal space or constellation diagram of the BASK signals is shown in Figure (2.1) below:-

$$\emptyset 1(t) = \sqrt{\frac{2}{T}} \cos 2\pi f c t$$

This Figure shows the BASK signal sequence generated by the binary sequence 0101001.

The amplitude of a carrier is switched or keyed by the binary signal m(t) .

This is sometimes called on – off keying (OOK). **[4, 5]**

2.4 Analog V.S Digital Transmission

Compare at two levels:

1. Data-continuous (audio) VS. Discrete (text).
2. Signal – continuously varying electromagnetic wave

vs. sequence of voltage pulses.

Also transmission-transmit with regard to signal content vs. being concerned with signal content.Different in low attenuation is handled, but not focus on this.Shift towards digital transmission despite large analog base to:

* Improving digital technology.

* Data integrity. Repeaters take out cumulative problems in transmission. Can thus transmit longer distances.

* Easier to multiplex large channel capacities with digital.

* Easy to apply encryption to digital data.

* Better integration if all signals are in one form. Can integrate voice, video and digital data.**[4 , 6]**

2.5 Introduction to Generation of ASK

Amplitude Shift Keying –ASK- in the context of digital communications is a modulation process, which imparts to a sinusoid two or more discrete amplitude levels. These are related to the number of levels adopted by digital message. For a binary message sequence there are two levels, one of which is typically zero. Thus the modulated waveform consists of bursts of a sinusoid there are sharp discontinuities shown at the transition points as shown in Figure (2.2) below:

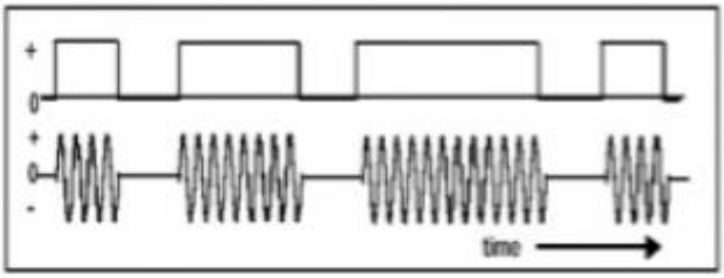

Figure (2.2) Message and ASK signal

There result in the signal having an unnecessarily wide bandwidth. Band limiting is generally introduced before transmission, in which case these discontinuities would be "rounded off". The band limiting may be applied to the digital message, or the modulated signal itself. The data rate is often made a sub-multiple of the carrier frequency. One of the disadvantages of ASKS, compared with FSK and PSK, for example, and is that it has not got a constant envelope. This makes its processing (e.g., power amplification) more difficult, since linearity becomes an important factor. However, it does make for ease of demodulation with an envelope detector.**[6 , 7]**

2.6 Introduction to Bandwidth Modification

As already indicated, the sharp discontinuities in the ASK waveform of Figure (2.3) imply a wide bandwidth. A significant reduction can be accepted before errors at the receiver increase unacceptably. This can be brought about by band limiting (pulse shaping) the message before modulation, or band limiting the ASK signal itself after generation. [**8**]

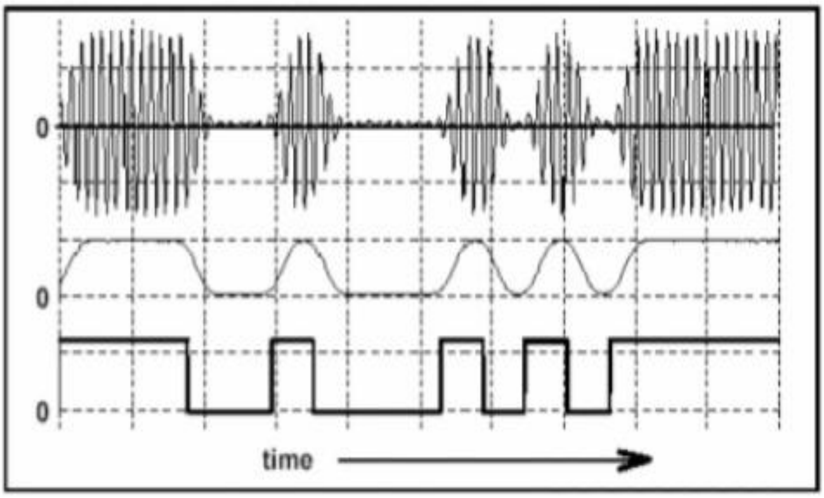

Figure (2.3) ASK generation method

Figure (2.4) shows the signals present in a model of Figure (2.3), where the message has been band limited. The shape, after band limiting, depends naturally enough upon the amplitude and phase characteristics of the band limiting filter.

2.7 Synchronization

1- The synchronization process is accomplished in two steps Acquisition: the acquisition process is the most difficult procedure for digital detection than for analog detection. Before any communication can take place over transceiver system, it is necessary to obtain initial synchronization at the receiver.

2-Tracking: the tracking process reduces the alignment error for a fraction of a chip, and maintains it for the duration time of the transmitter. Once code acquisition or coarse synchronization has been accomplished, tracking or fine synchronization takes place. In much practical system, no data are transmitted of specified time sufficiently long to ensure that acquisition has occurred...

2.8 PSK modulation

Design and Simulation of Binary Phase Shift Keying Modulation by Using MATLAB

2.8.1 Introduction

The PC is a modem device that helps communication; engineers-analyze and design communication systems. In general, help the reader to understand, analyze, and design. MATLAB simulink is a great simulation tool that provides the designers many ways to rapidly design, implement and the desired system. Also it gives the designers a clear idea about the system.

The digital system design contains the following.

2.8.2 The Transmitter

The transmitter basically contain: data generator (data source), two sinusoidal carriers (cosine wave), have the same frequency and different in phase, mixer, sum and scope are taken from communication block set and signal sources**.** The Bernoulli binary Generator block generates random binary [7] numbers using a Bernoulli distribution. The Bernoulli distribution with parameter p produces zero with probability p and one with probability 1-p. The Probability of a zero parameter specifies p, which can be any real number between zero and one, in this simulation case is set and adjusted with probability [7] of zero and one's are equal. It code type is unipolar non return to zero. It is transmitted with in data **rate** {50 bps}

2.8.3 BPSK Modulator

BPSK is a standard modulation technique in which a digital signal is modulated on to a sinusoidal carrier whose phase shifts between different values (0 and 180). The block modulates a one's by shifting the phase of the earner by 0 degrees and zero's by shifting the phase of the carrier by 180 degree. It was implemented choosing two signals, the first signal frequency equal to (600KHZ, with phase 0 degrees) and second signal frequency (600KHZ, with phase =180 degree), in order to get the separation between two phases by 180. The block NOT is the complement of binary sequence coming from of (Bernoulli Binary Generator) to the second a sinusoidal carrier. Sampling frequency (1 MHZ) to match the sample time in the all parameter

2.8.4 BPSK Modulator

BPSK is a standard modulation technique in which a digital signal is modulated on to a sinusoidal carrier whose phase shifts between different values (0 and 180). The BPSK modulation block diagram is shown in the following Figure (3.3). The block modulates a one's by shifting the phase of the earner by 0 degrees and zero's by shifting the phase of the carrier by 180 degree. It was implemented choosing two signals, the first signal frequency equal to (600KHZ, with phase 0 degrees) and second signal frequency (600KHZ, with phase =180 degree), in order to get the separation between two phases by 180. The block NOT is the complement of binary sequence coming from of Bernoulli Binary Generator) to the second a sinusoidal carrier.

Sampling frequency (1 MHZ) to match the sample time in the all parameter using in the project.

Chapter Three

3.2 Design and simulation of BFSK Digital Communication Transceiver System

3.2.1 Transmitter:-

The transmitter contains: - Data generator, a sinusoidal carrier (Cosine wave), mixer, NOT, Sum, and Scope are taken from communication block set (MATLAB-Simulation).
The digital circuit of BFSK modulation is shown in Figure (3.12)

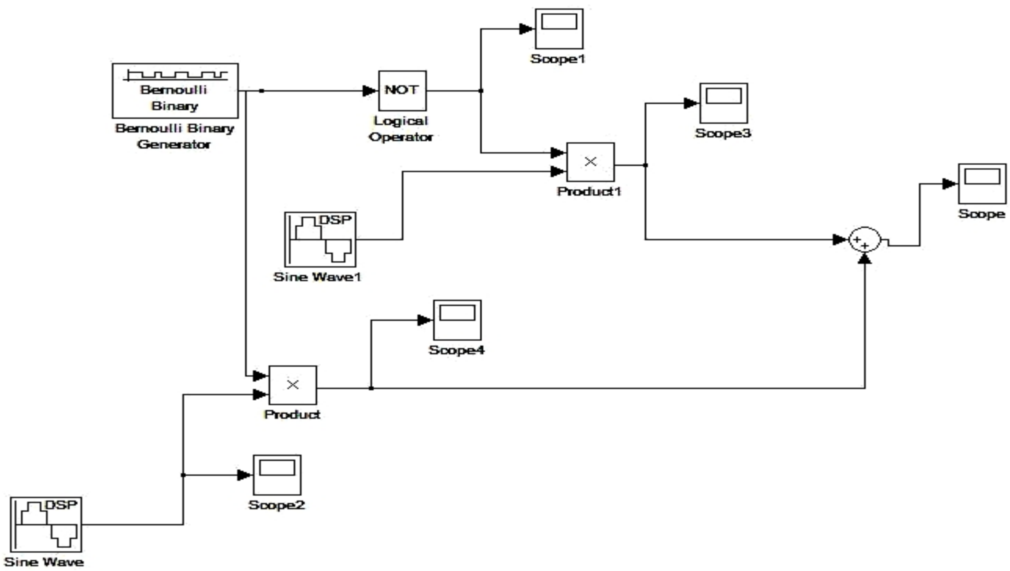

Figure (3.12) BFSK modulation circuit

A. Data Generator:-

The binary data generator (Bernoulli Binary Generator) from simulink communication block is set and adjusted with probability of zero 50% and 50% ones. It is unipolar non return to zero. It is transmitted with in data rate (100) Kbit/sec.The waveform and spectrum of data is shown in Figures (3.13).

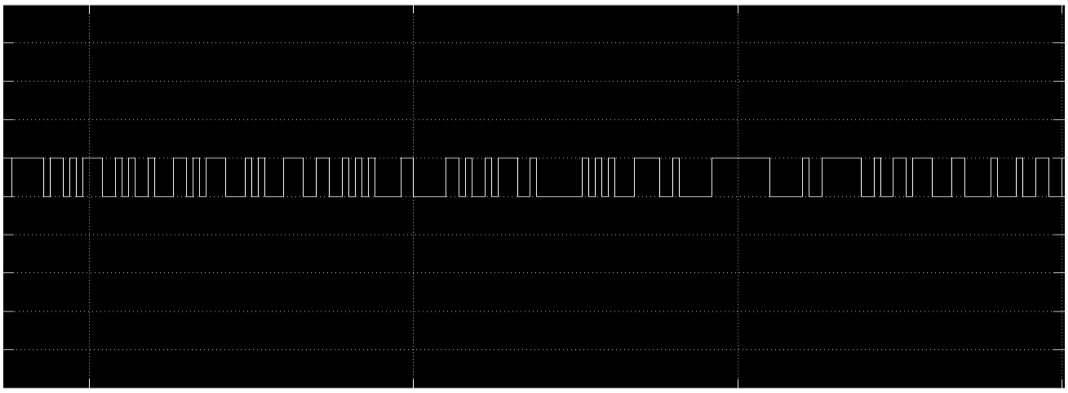

Figure (3.13) Waveform of data 100K bit /sec

B. BFSK Modulator:-

BFSK is a standard modulation technique in which a digital signal is modulated on to a sinusoidal carrier whose frequency shifts between different values.

The BFSK modulation shown in the following Figure (3.14) is an example of base band FSK.

The block modulates a ones by shifting the frequency of the carrier down to 400 K H Z (Fm1) and zeros by shifting frequency of the carrier up to 800 K H Z (Fm2) .

It was implemented choosing (Fm 1 = 400 KHZ), (Fm 2 = 800 KHZ), in order to get the separation between two adjacent frequency 400

KHZ (Fm 1 = 1 / T, Fm2 = 2 / T) for operating this proposed system with transmit data rate (100 k bits / sec) and out of distortion.

The block NOT is the complement of binary sequence coming from of (Bernoulli Binary Generator).

Set sampling frequency to (10 MHZ).

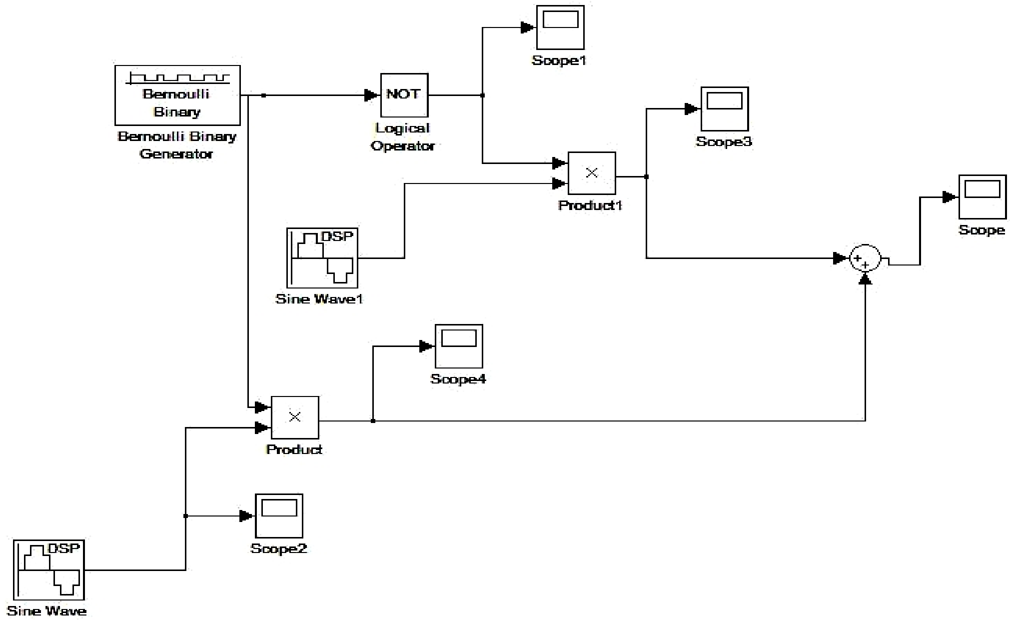

Figure (3.14) Design and Simulation of BFSK modulator

3.2.2Receiver Side

This simulation circuit diagram of receiver side is the third pant of transceiver digital transceiver communication system (DTCS).
The input signal has been prossesd by band pass digital filter (BPF) BFSK demodulation other circuit to produce of the same waveform data wave as the transmitter.

3.2.3 FSK Demodulation:-

In the receiver the information were detected using coherent type of detector for obtaining the phase and amplitude of the transmitted data.
The signed integer sample and its delayed version are multiplied together; in this application, an 8 x 8 signed multiplication loop is used.
The product made up of two frequency elements is low – pass filtered to remove the double frequency element the remainder is a signed integer value representing the original bit value transmitted.
The low – pass filter uses the digital wave filtering technique this technique gives stable characteristics with very good coefficient tolerance.
All multiplication is done through shifts and ads with the number of shift / adds operations minimized through rounding off the coefficients. Because the filter has good coefficient tolerance, this rounding off does not affect the filter. Performance the Butter worth filter used here gives approximately 40 – dB attenuation in thestop bandwith 1 – dB pass and ripple.

- **Result**

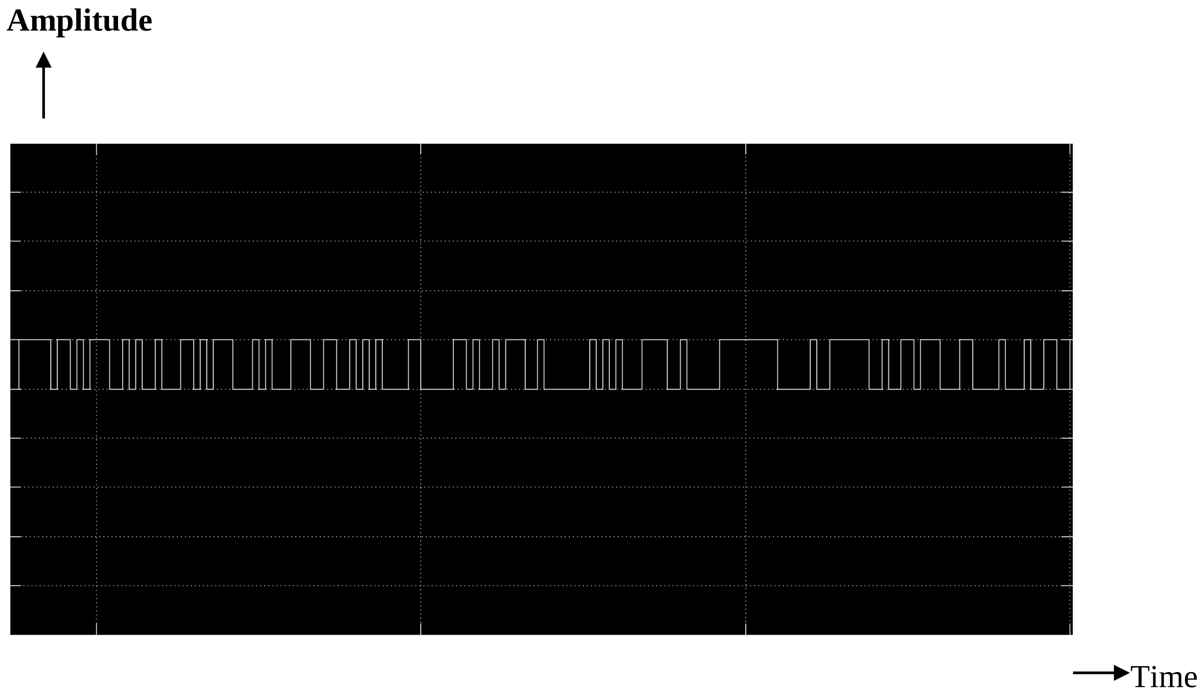

Figure (4.15) Transmitted Data for Message

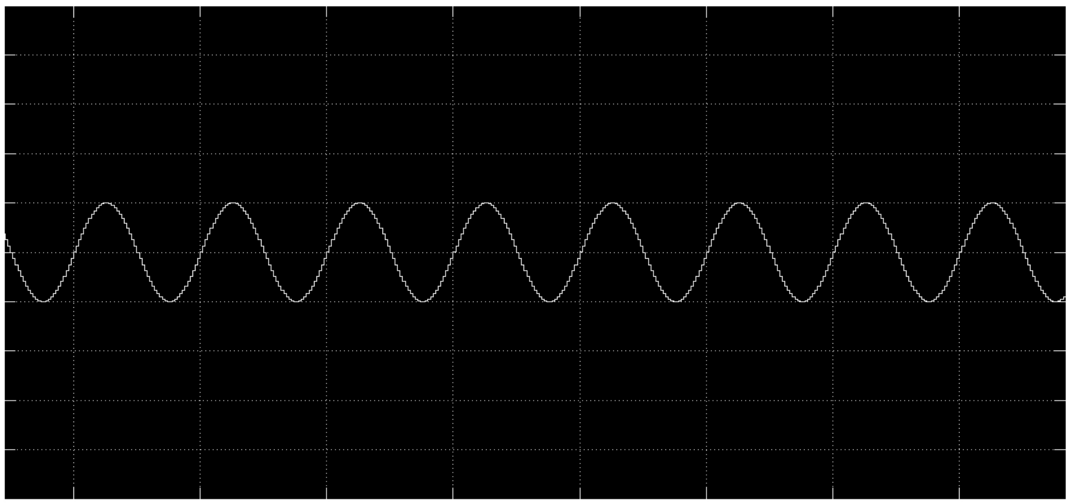

Figure (4.16) Carrier Signal

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Figure (4.17) First signal of ASK

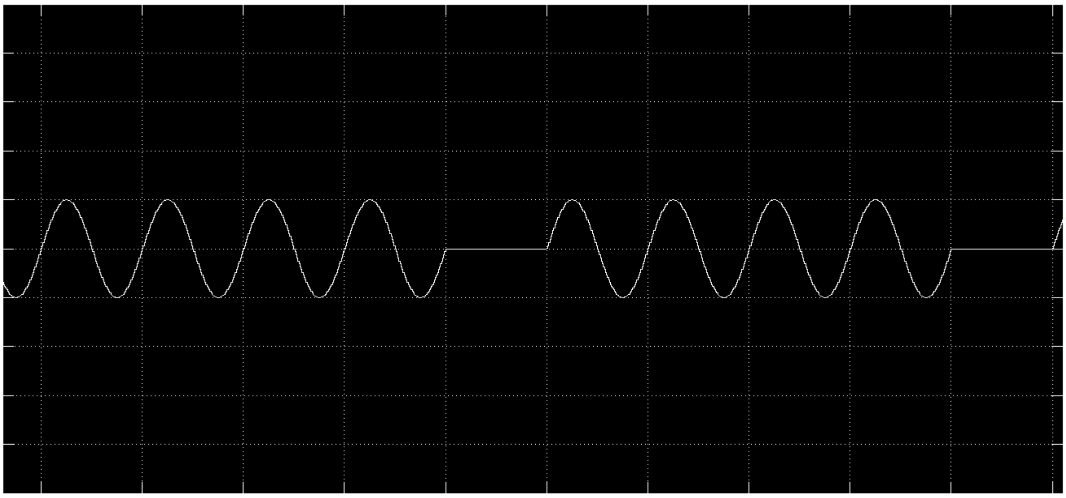

Figure (4.18) Second signal of ASK

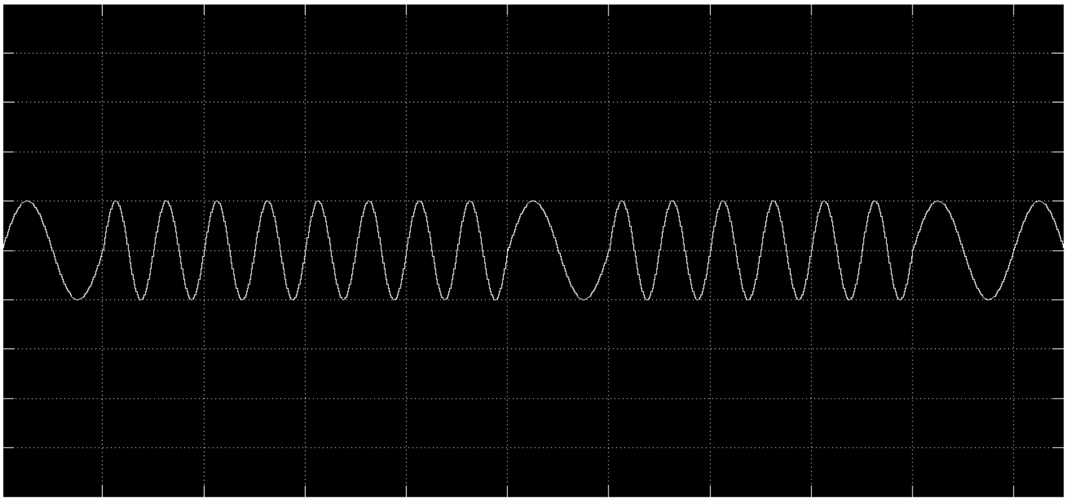

Figure (4.19) the Waveform output signal FSK

Chapter Four

4.1 Conclusion

In this project Phase Shift Keying (PSK) modulation and demodulation in digital communication system (DCS) has been achieved.

The design was simulated using simulink technique as shown in chapter three. As shown that from the results ,the use of binary phase shift keying (BPSK) modulation in digital communication transceiver system (DCTS) is better than that of amplitude shift keying (ASK)modulation binary shift keying (BFSK)modulation .

In this design the digital information was transmitted with data rate equal to (100Kbps) carrying by frequency carrier equal to (1000KHZ) so that the upper and lower frequency can be calculated as follows :-

Fu = Fc + Fm……………… (4.1)

Fl = Fc – Fm……………….(4.2)

Where:

Fu: upper frequency

Fl: lower frequency

The transmitted digital data has been received after demodulation with the same data rate (100Kbps)as that transmitted with Delay in time.successfully In order to get real and practical results, the design was implemented in this project must be done with pass band technique.

4.2 suggestions for future work

1. In responding to the demand for secure interference, immunity to noise and anti jamming communication system, the design must use M-array instead of BPSK.

2. To transmit and receive higher data than that used in this design, the spread between frequencies must be larger than that used in this project. Also the value of frequencies must be high.

3. For real implementation of the project, the band of frequency must be high using conversion up technique. Also the synchronization can be implementing as perfect, that mean may be use traditional synchronization or any type of new digital synchronization.

4. The presented design can be implemented practically by using the advance laboratory.

5. Also it can be implemented using neural network or genetic algorithm.

6. Also it can implemented neural using FPGA

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