PHASE SHIFT KEYING (PSK) TRANSCEIVER DESIGN

STEVER AK ABONG

Universiti Malaysia Sarawak
2000

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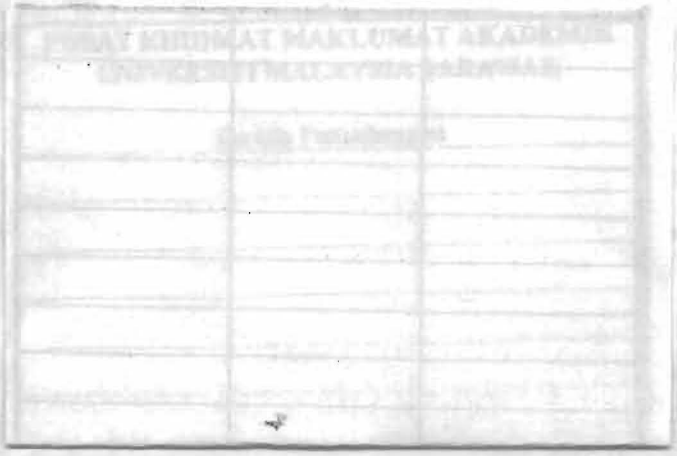

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Judul: Phase Shift Keying(PSK) Transceiver

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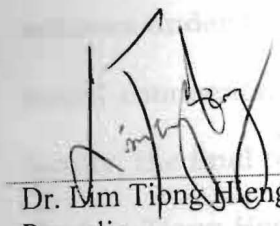

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~May God Bless You All~

Abstrak

Phase Shift Keying(PSK) transceiver adalah salah satu sistem komunikasi yang menggunakan halaju yang tinggi untuk penghantaran data. PSK transceiver boleh menghantar dan menerima data dalam 100Kbit/s. Penghasilan PSK transceiver ini ialah untuk mengembangkan lagi teknologi packet radio yang boleh menghantar data dalam 100Kbit/s dengan menggunakan antenna yang sederhana besarnya. PSK adalah salah satu teknik yang paling baik untuk digunakan bagi penghantaran data yang besar dan berfrekuensi tinggi. PSK juga digunakan untuk penghantaran data digital dalam radio gelombang mikro. Ini membolehkan julat isyarat bagi PSK transceiver ini diterima dalam frekuensi gelombang mikro. Isyarat yang masuk ke dalam sistem ini adalah dalam bentuk frekuensi radio. Litar bagi PSK transceiver ini boleh dikelaskan kepada dua bahagian iaitu pemancar dan penerima. Maklumat yang selanjutnya bagi tujuan aplikasi, lukisan litar dan pembinaan bagi sistem ini akan dipelajari dan dianalisis dan seterusnya akan dibincangkan dalam laporan ini.

Abstract

Phase Shift Keying(PSK) transceiver is one of the communication system that is required for a high speed data transmission. PSK transceiver can transmit and received data beyond about 100Kbit/s. The PSK transceiver design is used to develop a packet radio transceiver capable of transmitting data at 100Kbit/s with a free space radio range using moderate size antennas. The PSK is a desirable method for some applications such as high bit rates and high carrier frequencies. PSK is used for digital transmission on microwave radio. This is why the signal bandwidth for the PSK transceiver is acceptable at microwave frequencies. The input signal for the transceiver is in form of radio frequency(RF). The PSK modulator will modulate it into form of PSK signal, phase 0 and 1, before demodulate it into a suitable data. For further details about the features, applications, design circuits and implementation for the PSK transceiver will be studied, analyzed and will discussed in this report.

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Chapter1.0 Introduction

The purpose of this report is to analyze and study the Phase Shift Keying(PSK) transceiver. This report includes the theories and some of the information that are used to design the PSK transceiver. This report consists of six chapters. In Chapter 1.0, it includes the introduction for the project, objectives and review on each chapter. The purposed project is on the PSK transceiver. This chapter also includes some of the requirements that need to be considered for the design. Anyway, the objective will be stated in this chapter. The main objective of this project is to study, draw and to implement the circuits for the phase shift keying(PSK) transceiver.

In chapter 2.0, is about the background theory of the project. The background theory includes theories that are related to the PSK transceiver design. The background theory will explained the fundamental of the communication system, phase shift keying principals, modulation and demodulation techniques, microwave and the packet radio system. Chapter 2.0 is a hint for chapter 3.0, it will gives a clear review on the PSK transceiver. All the applications for the PSK transceiver design will be explained later in chapter 3.0. This chapter will also described the seven main parts of the PSK transceiver design. Chapter 3.0 will review all the circuits that are associated with the Phase Shift Keying (PSK) transceiver design and gave a point of view

on the function for each part of the circuits. The main point is to analyze the usage of the Phase shift Keying (PSK) transceiver.

In chapter 4.0, the project discussion will be described. Chapter 4.0 includes the testing and results and the recommendations for this project. The problems faced also will be discussed in this chapter. The testing and results includes almost all the testing that are have been done for all the circuits in the PSK transceiver. The overall conclusion will be written down on the last chapter, chapter 5.0. Chapter 5.0 includes the explanation for the PSK transceiver.

Before proceeding to chapter 2.0, first of all the requirements of the PSK transceiver will be discussed. The purpose of this project and thesis II is to design a circuit and build a PSK transceiver for high-speed packet radio. The PSK transceiver has it own advantages and disadvantages and at this point it is difficult to predict the success of the project. There are few specifications that need to be considered before building up the PSK transceiver. Here for the designs is to combine the used of the modulation and demodulation techniques, the high speed transmission, bandwidth and lots more specifications. However, to increase the transmission speed , both the signal bandwidth and the radio range need to be considered. Increasing the data speed beyond about 100Kbit/s, the resulting signal bandwidth is only acceptable at microwave frequencies. The transmitter power available at the microwave frequency is small and expensive. Therefore the radio range becomes a limitation even for line-of-sight terrestrial packet-radio links.

A PSK transceiver with coherent detector offers a radio range that is between 5dB and 15dB larger and a signal bandwidth which is less than half when compared to a FM transceiver. In packet-radio, the main problem of a PSK transceiver is the initial Receiver signal acquisition. The latter is a function of the carrier frequency uncertainty. In a simple Biphase PSK (BPSK) system with 0/180 degrees modulation, the initial signal acquisition requires a complicated searching loop, if the frequency error exceeds 10% of the bit rate. Quadriphase PSK (QPSK) allows a further halving of the signal bandwidth at the expense of a much more sophisticated demodulator design and an even more critical initial signal acquisition. Therefore PSK becomes simple at high data rates. On the other hand, the signal acquisition of low-Earth orbit amateur packet-radio satellites transmitting at only 1200 bit/s PSK is very difficult. In this first part of the project, a PSK transceiver will be described.

The project theorem will be described first before proceeding to the real fundamental of the hardware design. There are two main parts in this design which have a major constructions. The receiver and the transmitter parts. It is how the receiver receives signals from the event transmitter. Upon receiving a signal from the transmitter, the receiver speaks a prerecorded message telling that the transmitter has activated it. For transmitter, its send encoded address and data information in response to either the closing or opening of an input which may be a switch or any other device that produces conduction.

The design of the Phase Shift Keying transceiver for high-speed packet radio is the most quality products ever being produces. It showed the

perfection of the modulation and demodulation techniques. For further understanding of the PSK transceiver system, the basic theory of the communication, phase shift keying(PSK), modulator and modulator, microwave frequency will be discussed in the chapter 2.0.

Chapter2.0 Background Theory

2.1 Basic Communication Theory

2.1.1 Introduction

Telecommunication is also known as a communication over a distance. It is the artificial methods of communication which enables someone to send information over longer distances than can be spanned by the human voice. The features of the communication system is changing rapidly over the years, its development is due to the human demands. In this chapter, the fundamental of the communication will be discussed. Its includes the basic communication system, design considerations and the modulation technique.

2.1.2 Simple Communication System

The simplest communication system uses yet has all the three parts. These are the three parts very important in communication:

- **Sending End**

  Information system which operates a transmitter and then convert them in available transmission medium .

- **Transmission Channel**

  A medium where the signal from the sending end get through

- **Receiving end**

  The destination wanted to receive the information signal

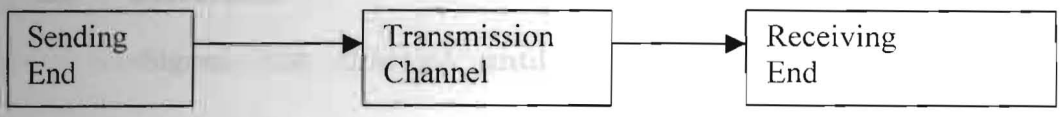

Figure 2.01 Basic parts of communication system

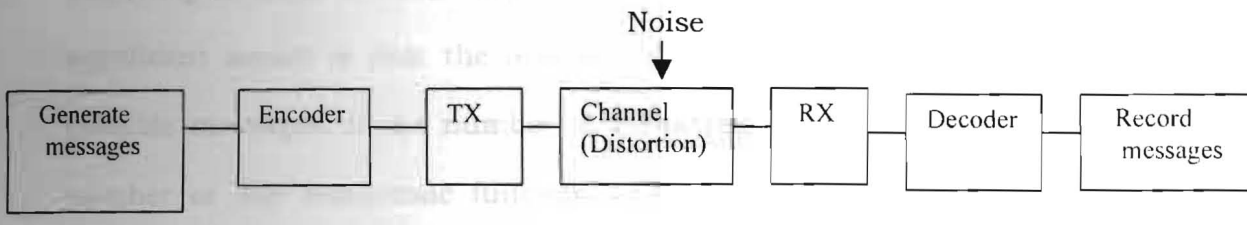

Figure 2.02 Parts of a communication system

Some other aspects in the communication systems are:

I. Coding

-Language the receiver can understand the signal transmitted such as Morse Code

II. Noise

-Unwanted random signals added to the original message

III. Distortion

-Signal that changed until the receiver cannot decode the messages

The fundamental problem of communication is that of reproducing at one point either exactly or approximately a message selected at another point. Frequently the messages have meaning; that is they refer to or are correlated according to some system with certain physical or conceptual entities. The significant aspect is that the actual message is one selected from a set of possible messages. If the number of messages in the set is finite then this number or any monotonic function of this number can be regarded as a measure of the information produced when one message is chosen from the set. Although this definition must be generalized considerably when considering the influence of the statistics of the message and there have a continuous range of messages, use an essentially logarithmic measure.

The logarithmic measure is more convenient for various reasons:

1. Parameters of engineering importance such as time, bandwidth, number of relays and many others, tend to vary linearly with the logarithm of the number of possibilities.

2. It is nearer to the intuitive feeling as to the proper measure. This is closely related to (1) since it is intuitively measures entities by linear comparison with common standards.

It is mathematically suitable. Many of the limiting operations are simple in terms of the logarithm but would require clumsy restatement in terms of the number of possibilities. The choice of a logarithmic base corresponds to the choice of a unit for measuring information. By a communication system we will mean a system of the type indicated in the communication system. It consists of five parts:

1. An *information sources* which produce a message to be communicated to the receiving terminal. The message may be of various types of signal.

2. A *transmitter* which operates on the message to produce a signal suitable for transmission over the channel. In a multiplex Pulse Code Modulation (PCM) system the different speech functions must be sampled, compressed, quantized and encoded, and finally interleaved properly to construct the signal.

3. The *channel* is the medium used to transmit the signal from transmitter to receiver. It may be a pair of wires, a coaxial cable, a band of radio frequencies, optical cable and lots more.

4. The *receiver* ordinarily performs the inverse operation of that done by the transmitter and reconstructing the message from the signal.

5. The *destination* is the person for whose the message is intended.

2.1.3 Design Considerations

Before starting with the design project, first of all the design considerations should be discussed. In doing a project, there are few specifications and considerations that need to be followed. These are the considerations that must be taken for the practical systems of the communication system:

(a) Range

For this project, the resulting signal bandwidth is only acceptable at microwave frequencies. Microwave for line-of-sight links. The further information has to be transmitted, the more difficult it is to get the message through uncorrupted.

(b) Power

Transmitted power is always kept to a minimum. The transmitter power available at microwave frequencies is small and expensive.

(c) Cost

The cost has to be kept as low as is compatible with the achievement of the desired system performance.

(d) Bandwidth

The information will be obtained unless the signal received contains a small range of frequencies. For telephone channel, the bandwidth needed is halved at the start by using single sideband (SSB) techniques and wide enough to recognize the voices. Using the standard 4KHz of bandwidth voice frequency channel for the telephone.

(e) Speed

To send information faster , more bandwidth is required but less time is taken.

(f) Reliability

The aim is to use the cheapest and simplest system that will give acceptable reproducibility of signal. Narrow bandwidths, low frequencies and intense multiplexing can be used.

(g) Convenience

The aspects of convenience occur with the growth of various network; the use of larger and more comprehensive integrated

circuits wherever possible; the need for ease of production and cheaper repair; and so on.

(h) Accuracy

The more accurate the received information signal must be compared with the original, the more complex and expensive the communication system has to be.

2.1.4 Modulation Techniques

Information signals will be carried between a transmitter and a receiver over a transmission medium. Modulation is defined as the process of transforming information from its original form to a form which is acceptable for transmission. Modulation takes place in the transmitter in a circuit called modulator. Modulation is an up-shifting of the messages frequencies to a range more useful for transmission. The selection of the particular modulation method used is determined by the application intended as well as by the channel characteristics such as available bandwidth and the susceptibility of the channel to fading. In order to allow simultaneous uses of the same channel called multiplexing. Each of the unique signals can be assigned a different carrier frequency but it still shares the same channel. The basic sine wave is like:

$$V(t)=V_0 \sin (2\pi ft + \phi) \text{----------} (2.01)$$