The Maharaja Sayajirao University of Baroda, Vadodara.
Polytechnic

PROJECT REPORT
ON
BINARY PHASE SHIFT KEYING MODULATION

Submitted by

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सत्यं शिवं सुन्दरम्

The Maharaja Sayajirao University of Baroda, Vadodara.
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Electronics and Communication (HPP)

CERTIFICATE

This is to certify that, **MR. DILON BRAHMBHATT,** student of Electronics and Communication have satisfactory completed their Project Work as a part of course curriculum in Diploma in Electronics and Communication (HPP),Final Year having a Project entitled As: **BINARY PHASE SHIFT KEYING**

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We are thankful to The Maharaja Sayajirao University of Baroda for providing all kind of required resources. I would also like to thank my friends who have directly or indirectly helped us for making this dissertation work successful.

Last, but not the least, no words are enough to acknowledge the constant support and sacrifies of our parents, because of whom we are able to complete this diploma program successfully.

ABSTRACT

Binary Phase Shift Keying (BPSK) is a digital modulation scheme that encodes data onto a sinusoidal carrier wave by shifting the phase of the wave by 180 degrees for a logic 1 and leaving it unchanged for a logic 0. BPSK is a form of amplitude-shift keying (ASK) modulation, where the amplitude of the carrier wave remains constant. BPSK is commonly used in wireless communication systems, such as Wi-Fi, Bluetooth, and satellite communication, due to its simplicity, robustness, and low cost. In this modulation scheme, the receiver demodulates the received signal by comparing the phase of the received signal with a reference carrier wave. BPSK has a spectral efficiency of 1 bit/s/Hz and is susceptible to noise, interference, and multipath propagation, which can cause errors in data transmission. To improve the reliability of data transmission, error-correcting codes such as convolutional codes and Reed-Solomon codes can be used in conjunction with BPSK.

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CHAPTER 1: INTRODUCTION TO BPSK

1.1 WHAT IS PSK?

PSK stands for Phase Shift Keying, which is a modulation technique used to transmit information over a communication channel. In PSK, the phase of the carrier wave is modulated to represent digital information. The information is encoded in the phase of the carrier wave, with different phase angles representing different symbols or bits.

PSK is commonly used in digital communication systems, such as wireless networks, satellite communication, and digital television broadcasting. It is a popular modulation technique because it is relatively simple and efficient, and it can provide good signal quality even in noisy environment.

There are several types of PSK modulation, including Binary Phase Shift Keying (BPSK), Quadrature Phase Shift Keying (QPSK). Each type of PSK has its own type of advantages and disadvantages.

1.2 WORKING PRINCIPLE

The working principle of PSK involves modulating the phase of a carrier wave to represent digital information. Here are the basic steps involved in PSK modulation:

Carrier wave generation: A high-frequency sine wave, called the carrier wave, is generated at the transmitter.

Digital information encoding: The digital information, which is typically in the form of binary data (0s and 1s), is encoded onto the carrier wave by modulating its phase.

Phase modulation: The phase of the carrier wave is changed to represent the digital information. The phase shift can be in one of two states, either 0° or 180°, corresponding to a binary 0 or 1.

Signal transmission: The modulated carrier wave is transmitted over the communication channel to the receiver.

Demodulation: At the receiver, the incoming signal is demodulated to extract the digital information. This is done by measuring the phase shift of the received signal and converting it back to binary data.

The process of PSK modulation and demodulation can be implemented using digital signal processing techniques. The exact method used to modulate and demodulate the signal depends on the specific type of PSK modulation being used, such as BPSK, QPSK.

1.3 Binary Phase Shift Keying

BPSK (Binary Phase Shift Keying) is a type of PSK (Phase Shift Keying) modulation scheme. In BPSK, the phase of the carrier wave is modulated to represent binary data. Specifically, a phase shift of 180 degrees (or pi radians) is used to represent a binary 1, while a phase shift of 0 degrees is used to represent a binary 0.

PSK, on the other hand, is a more general term that refers to any modulation scheme where the phase of the carrier wave is modulated to represent digital information. PSK can use any number of phases to represent multiple symbols or bits, while BPSK uses only two phases to represent binary data.

Therefore, BPSK is a specific form of PSK that is commonly used in digital communication systems, particularly in applications where binary data needs to be transmitted efficiently over a noisy channel. BPSK is simple to implement and requires less bandwidth compared to other modulation schemes, making it a popular choice for low-power wireless communication systems.

1.4 Quadrature Phase Shift Keying

QPSK (Quadrature Phase Shift Keying) is another type of PSK (Phase Shift Keying) modulation scheme. In QPSK, the phase of the carrier wave is modulated to represent two bits of digital information at once. Specifically, QPSK uses four different phase angles (0, 90, 180, and 270 degrees) to represent each pair of bits.

PSK, as mentioned earlier, is a general term that refers to any modulation scheme where the phase of the carrier wave is modulated to represent digital information. QPSK is a specific form of PSK that uses four phases to represent two bits at a time.

Compared to BPSK (Binary Phase Shift Keying), which uses only two phases to represent one bit at a time, QPSK provides higher data transmission rates and improved spectral efficiency since it can represent two bits per symbol. However, QPSK is also more complex to implement and requires more bandwidth than BPSK.

In summary, QPSK is a specific form of PSK that is commonly used in digital communication systems where higher data transmission rates are required. It uses four phases to represent two bits at a time, while BPSK uses only two phases to represent one bit at a time.

1.5 Difference between BPSK and QPSK

Bit Rate: BPSK transmits one bit per symbol, while QPSK transmits two bits per symbol. This means that QPSK can transmit data twice as fast as BPSK for the same symbol rate.

Spectral Efficiency: QPSK is more spectrally efficient than BPSK because it can transmit more data per unit of bandwidth. However, QPSK is also more complex to implement than BPSK.

Error Rate: BPSK is more robust than QPSK against noise and interference, as it has a larger distance between symbols in the phase plane, which reduces the probability of error. QPSK is more susceptible to errors due to its smaller distance between symbols in the phase plane.

Implementation: BPSK is simpler to implement than QPSK since it only uses two phases, while QPSK uses four phases. This makes BPSK a popular choice for low-power, low-complexity communication systems.

BPSK is a simpler and more robust modulation scheme suitable for applications where low power consumption and low complexity are important factors.

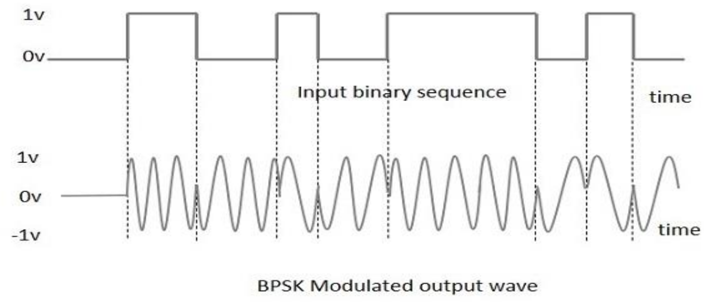


Fig. 1.1 (A)

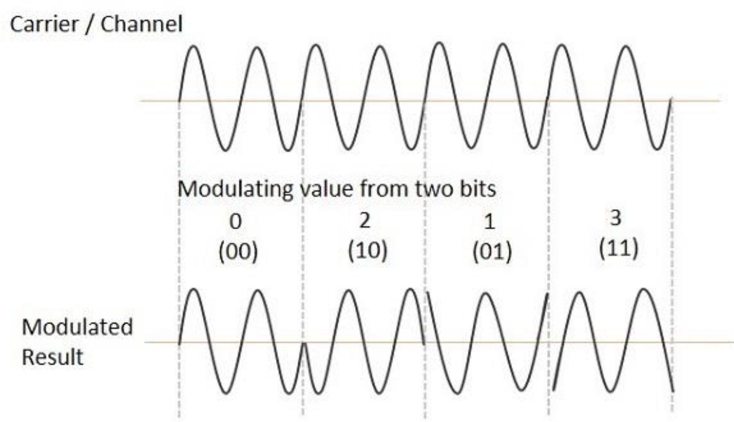


Fig. 1.1 (B)

CHAPTER 2: CIRCUIT SIMULATION

2.1 Circuit diagram

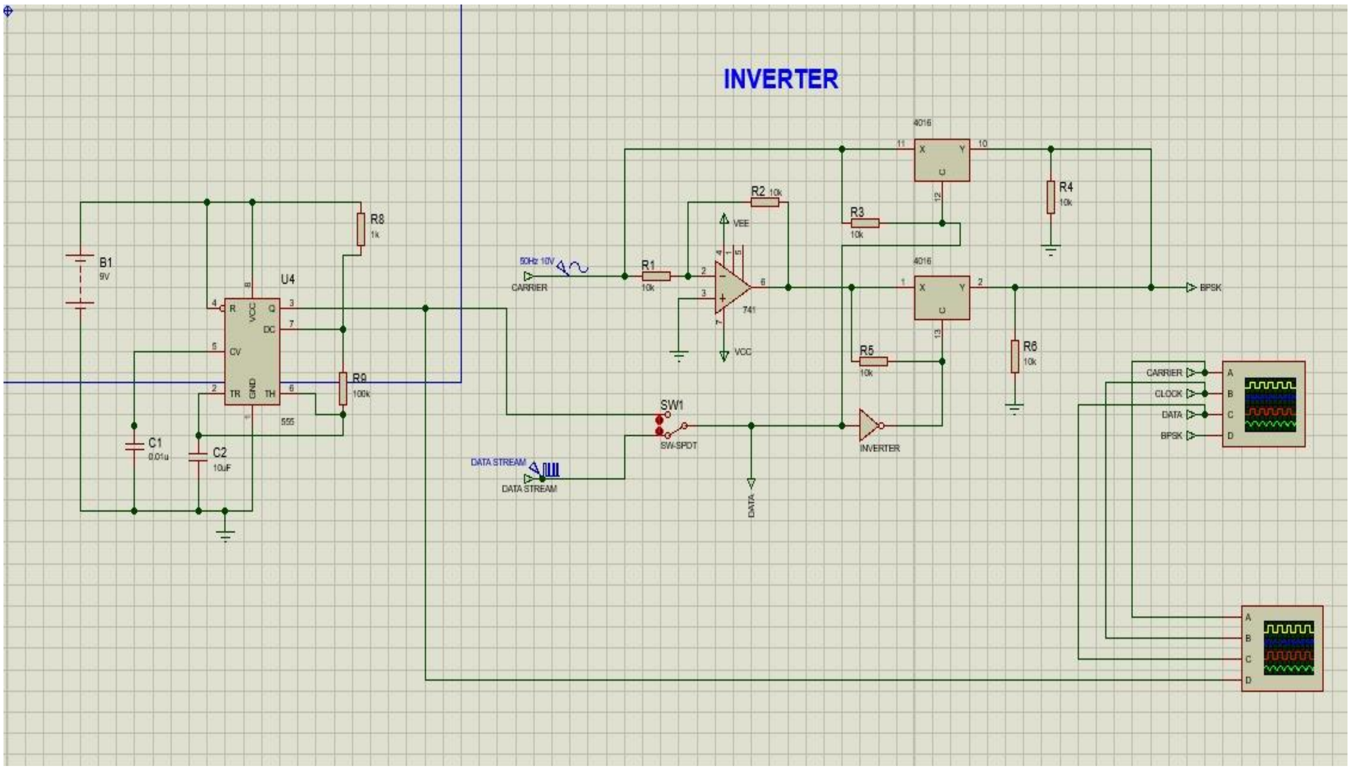


Fig. 2.1 Circuit Diagram of BPSK

2.1.1 Components Used

- 555 Timer IC
- IC 741 Op Amp
- IC 4066 CMOS x2

- IC 7404
- Battery 9V x3
- Capacitor x2
- Resistor x8
- PCB x2

2.1.2 Step by step procedure

- For BPSK communication we need 3 input waves, they are carrier signals, message signals, and reference signal
- For the reference signal, 555 timer IC is used which will give us wavelength of the message signal and will be displayed on function generator.
- The oscillator will generate the carrier signal which will go further in the circuit.
- The oscillator will also provide us message signal in binary form.
- The carrier signal get divided into two paths, one will go to IC 4066 (1), second will go to Op Amp. The op amp is in inverting amplifier mode, so that the signal gets inverted and will go into IC 4066 (2).
- The message signal will get divided into two paths, one will go to IC 4066 (1). The second will go to IC 4066 (2) before passing through inverter. The inverter will invert the message signal.
- So both the IC 4066 (1) & (2) will work alternately. The function of this IC is to pass the input signal when it gets high threshold.

- The output of both the ICs will merge ahead and we get modulated signal. This signal will be shown on function generator.

CHAPTER 3: COMPONENTS DESCRIPTION

3.1 IC 741 OP AMP

The 741 op-amp has a high input impedance, a low output impedance, and a high gain. It has two inputs, an inverting (-) and a non-inverting (+) input, and a single output. The output voltage of the op-amp is the differential voltage between the two inputs multiplied by the gain of the op-amp.

An op-amp can be used as an inverting amplifier by connecting the input signal to the inverting (-) input and providing feedback through a resistor from the output to the inverting input.

The acronym of the term Op-Amp is an operational amplifier and it is a one type solid state integrated circuit. The op-amp is the basic building blocks of analog electronic circuits that perform a various types of analog signal processing tasks. Operational amplifiers use external feedback to control its functions and these are the multipurpose devices in all electronic devices.

Gain = $-R_F/R_1$

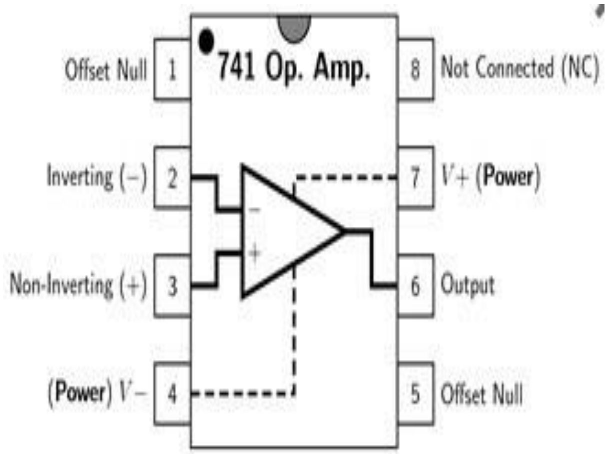


FIG 3.1 OP Amp Pin diagram

Offset Null (NC) - This pin is not connected to any internal circuitry and is left unconnected.

Inverting Input (-) - This is the inverting input of the op-amp. It is used to apply the input signal that needs to be amplified.

Non-inverting Input (+) - This is the non-inverting input of the op-amp. It is used to provide a reference voltage to the op-amp.

V- (Negative Supply) - This is the negative power supply pin of the op-amp.

Offset Null (NC) - This pin is not connected to any internal circuitry and is left unconnected.

Output - This is the output of the op-amp. The amplified signal is available at this pin.

V+ (Positive Supply) - This is the positive power supply pin of the op-amp.

Offset Null (NC) - This pin is not connected to any internal circuitry and is left unconnected.

3.2 IC 4066

The IC 4066 is a CMOS quad bilateral switch, which means it has four independent switches that can be used to connect or disconnect two signals. The 4066 IC is a part of 4000 series of CMOS integrated circuits, which are designed to operate at low power and voltage levels.

The IC 4066 is commonly used in audio applications, such as audio mixers and audio signal routing, as well as in digital circuits for signal routing and multiplexing. It can also be used for analog signal processing, such as filtering and modulation.

3.3 IC 7404

The IC 7404 is commonly used in digital circuits for signal inversion, buffering, and level shifting. It can also be used as a building block for more complex digital logic circuits, such as gates, flip-flops, and counters.

The IC 7404 has several advantages, such as low power consumption, high noise immunity, and fast switching speed.

3.4 555 TMER IC

The 555 timer IC is an integrated circuit that can be used as a timer, oscillator, or flip-flop. It was first introduced by Signetics Corporation in 1971 and has since become one of the most popular and versatile ICs in electronics.

Astable mode: In this mode, the 555 timer IC operates as an oscillator, which generates a continuous square wave output with a fixed frequency and duty cycle.

The 555 timer IC has several advantages, such as low cost, wide operating voltage range, and ease of use. It can be used in a wide range of applications, including timing circuits, pulse generators, frequency dividers, and tone generators.

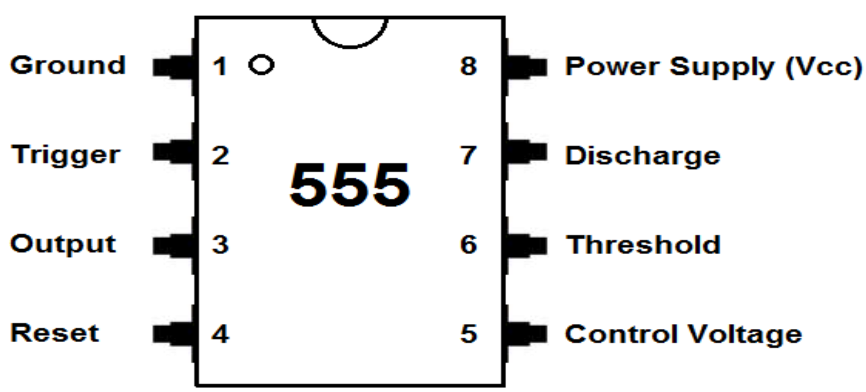


FIG 3.2 Pin Diagram

3.5 Resistor:

Resistor is that component which are called “passive device”. It can contain no source of power or amplification only attenuate or reduce the voltage or current signal. Resistors are use as load in circuit for controlling the one of current and voltage. The results is expressed as electrical energy being loss in the form of the heat as the resistor the flow of electron through it. Then a potential difference is require between the two terminals resistor for current to flow. This potential difference balance out the energy lost. When use in DC circuit the potential difference, also known as resistor voltage drop, is measure across the terminal and circuit current flows through the resistor. Most types of resistor are linear devices that produce voltage drop across themselves. Symbol resistor and how resistor looks like as shown below.

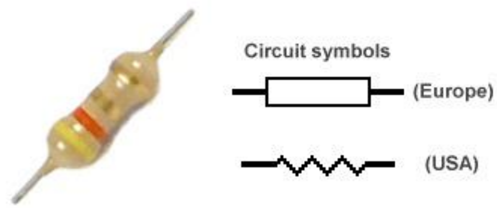


Fig 3.3 Resistor

3.6 Capacitor:

Capacitor is also known as condenser. The electrically can be stored with the help of this kind of passive device. Capacitor is a device which is having excellent capacity of storage of energy. It will be in the form of electrical charge for producing a potential difference. The capacitor can be consists as a two or more parallel metal plates are not connected to each other. In between the two plates there were having a dielectric modern as in form of air or by some of good insulating material.

The symbol of capacitor is look like below figures:

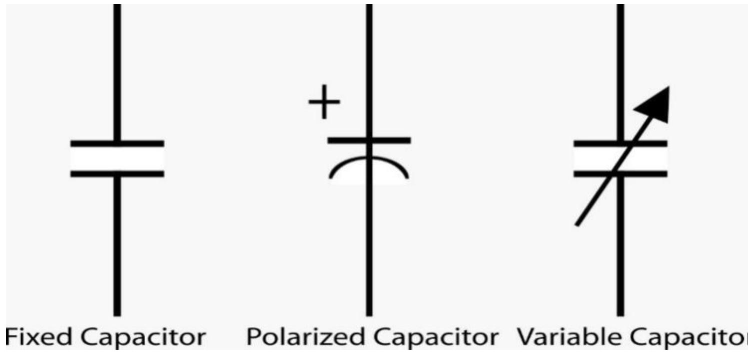


Fig 3.4 Symbolic representation of capacitor

For our circuit designing we are using electrolyte capacitor and ceramic capacitor for power supply. We are using these capacitors as a filter capacitor. Where as electrolyte capacitor is shown in below figure:

FIG 3.5 capacitor

3.7 BATTERY 9V:

A 9V battery is a rectangular-shaped battery that produces a nominal voltage of 9 volts. It is commonly used in devices such as smoke detectors, remote controls, and guitar pedals.

The 9V battery is typically made up of six smaller 1.5V cells connected in series inside a single casing. The battery terminals are located at the top of the casing, with one terminal marked as positive (+) and the other as negative (-).

CHAPTER 4: ADVANTAGES, DISADVANTAGES & APPLICATIONS

4.1 ADVANTAGES:

Spectral Efficiency: BPSK is a bandwidth-efficient modulation scheme as it transmits one bit per symbol, allowing it to achieve a higher data rate within a given bandwidth compared to analog or other digital modulation schemes.

Simplicity: BPSK is one of the simplest modulation schemes to implement, making it cost-effective and easy to integrate into different communication systems.

Robustness: BPSK is robust to noise and interference, making it suitable for communication over noisy channels or channels with a high bit error rate. It is commonly used in wireless communication systems where noise and interference are prevalent.

Low Power Consumption: BPSK requires low power consumption, making it suitable for battery-operated devices and applications that require low power consumption.

Compatibility: BPSK is compatible with many different types of communication systems, making it a widely adopted modulation scheme in various applications, including satellite communications, wireless LANs, and cellular networks.

High data rates: Although BPSK is a simple modulation scheme; it can still achieve high data rates. This makes it ideal for use in communication systems where high-speed data transfer is required, such as in satellite communication systems.

4.2 DISADVANTAGES

Poor spectral efficiency for high data rates: Although BPSK is a very efficient modulation scheme in terms of its use of the available frequency spectrum, its spectral efficiency decreases as the data rate increases. For high data rates, other modulation schemes, such as QPSK or 16-QAM, may be more suitable.

Vulnerability to fading: BPSK modulation is vulnerable to fading, which is a phenomenon that can cause the amplitude and phase of the signal to vary unpredictably. This can result in errors in the demodulated signal and can reduce the reliability of the communication system.

Limited error correction capability: BPSK modulation has limited error correction capability, which means that it may not be suitable for systems that require high levels of error correction, such as satellite communication systems.

Susceptibility to noise: BPSK is more susceptible to noise and interference in the communication channel. Any noise or interference can cause errors in the received data, which can lead to a decrease in the communication system's overall performance.

4.3 APPLICATIONS

BPSK (Binary Phase Shift Keying) is a modulation technique commonly used in digital communication systems to transmit digital data over a communication channel.

Here are some applications of BPSK:

4.3.1 Barcode

It involves transmitting a sine wave carrier signal that is either in phase (0 degrees) or out of phase (180 degrees) with respect to the original signal, based on the binary value being transmitted.

BPSK can be used in barcode technology to encode binary information into a series of bars and spaces of varying widths. In this case, the bars represent the "1" bit and the spaces represent the "0" bit. The width of the bar or space is used to determine the phase of the carrier signal that is transmitted.

For example, in a Code 128 barcode, a wide bar represents a "1" bit and a narrow bar represents a "0" bit. The carrier signal for a "1" bit would be transmitted in phase, while the carrier signal for a "0" bit would be transmitted out of phase.

FIG 4.1 barcode

4.3.2 Wireless communication

BPSK is widely used in wireless communication systems such as Wi-Fi and Bluetooth. In Wi-Fi, BPSK is used to transmit data over the 2.4 GHz band. BPSK is also used in satellite communication systems for data transmission.

Digital television: BPSK is used in digital television broadcasting systems, such as the Digital Video Broadcasting (DVB) standard. In DVB systems, BPSK is used for forward error correction.

Military communication: BPSK is used in military communication systems due to its robustness and resistance to interference and noise. Military communication systems also use BPSK for secure data transmission.

Remote sensing: BPSK is used in remote sensing systems, such as radar and sonar, for data transmission and detection. In radar systems, BPSK is used to transmit and receive signals. In sonar systems, BPSK is used to transmit and receive acoustic signals.

Radio frequency identification (RFID): BPSK is used in RFID systems for identification and tracking of objects. In RFID systems, BPSK is used for modulation and demodulation of signals.

4.3.3 Fingerprint scanner

Fingerprint screening is a biometric technology that involves analyzing the unique patterns on an individual's fingers to verify their identity.

It is not clear how BPSK could be directly used in fingerprint screening, as these are two very different technologies. However, BPSK could potentially be used in the transmission of data related to fingerprint screening, such as transmitting the fingerprint data from a scanner to a computer for analysis or transmitting authentication information for access control systems.

For example, if a fingerprint scanner is connected to a computer through a digital communication channel, BPSK could be used to encode and transmit the binary data from the scanner to the computer. This could involve using BPSK to modulate the carrier signal that carries the digital data from the scanner to the computer.

FIG 4.2 Finger print scanner

4.3.4 Military Application

In military applications, BPSK is used to ensure secure and reliable communication between different military units, both on the ground and in the air.

Here are some military applications of BPSK:

- Secure communication: BPSK can be used to encrypt the communication signals between military units, preventing unauthorized access to sensitive information. This can include voice, data, and video transmissions.
- Signal jamming: BPSK can be used to detect and counter signal jamming by the enemy. By analyzing the phase shifts in the received signal, military units can determine if the signal has been intentionally disrupted and take countermeasures.

- Satellite communication: BPSK is often used in military satellite communication systems, which provide a secure and reliable means of communication between military units around the world.
- Radar systems: BPSK can be used in radar systems to detect and track enemy aircraft and missiles. By analyzing the phase shifts in the radar signal, military units can accurately locate and track targets.
- Electronic warfare: BPSK is used in electronic warfare applications to disrupt enemy communication and radar systems, preventing them from accurately targeting military units.
- Overall, the use of BPSK in military applications can help to ensure secure and reliable communication between military units, while also providing a means of detecting and countering enemy signal disruptions.

4.3.5 OFDM

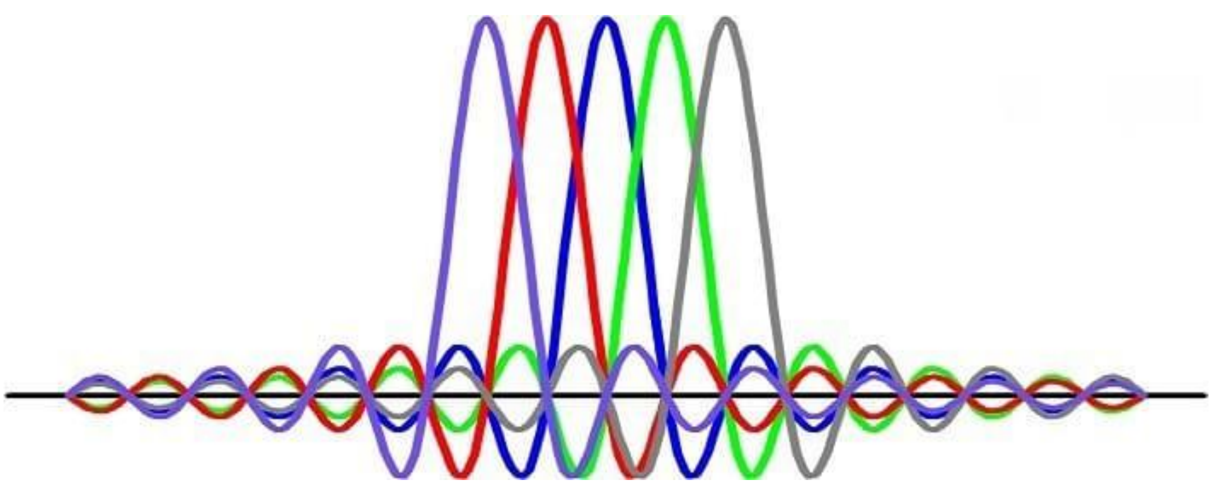


FIG 4.3 OFDM Waves

BPSK is a popular modulation scheme used in OFDM (Orthogonal Frequency Division Multiplexing) systems, which is a multi-carrier modulation technique, used for high-speed data transmission over wireless communication channels.

In an OFDM system, the available frequency spectrum is divided into multiple subcarriers, each carrying a narrowband signal. The subcarriers are orthogonal to each other, meaning that they are spaced at a specific distance from each other so that they do not interfere with each other. BPSK modulation can be applied to each subcarrier independently, allowing for high-speed data transmission.

In BPSK modulation, a binary sequence of 1's and 0's is mapped to a sequence of phase shifts of the carrier wave. A binary 1 is represented by a phase shift of 180 degrees, while a binary 0 is represented by a phase shift of 0 degrees. The modulated signal is then transmitted over the subcarrier.

At the receiver end, the subcarriers are demodulated using the inverse process of modulation, and the binary sequence is recovered.

4.5.6 BPSK in ECG

It can also be applied to medical applications, particularly in electrocardiography (ECG) for signal transmission and analysis.

In ECG, BPSK can be used to transmit digital signals representing ECG waveforms between medical devices, such as between an ECG monitor and a central monitoring station. BPSK can ensure the accurate transmission of ECG signals over long distances and in noisy environments, as it is less susceptible to interference and signal distortion than analog transmission methods.

BPSK can also be used in the analysis of ECG signals, particularly in the detection of arrhythmias. Arrhythmias are abnormal heart rhythms that can be life-threatening if not detected and treated promptly. BPSK can be used to detect the presence of specific ECG waveforms associated with arrhythmias, such as premature ventricular contractions (PVCs) and atrial fibrillation (AF), by analyzing the phase shifts in the ECG signals.

Overall, the application of BPSK in ECG can improve the accuracy and reliability of ECG signal transmission and analysis, which can lead to better diagnosis and treatment of cardiac conditions.

CHAPTER 5: Block Diagram & Hardware

5.1 Modulator Block Diagram

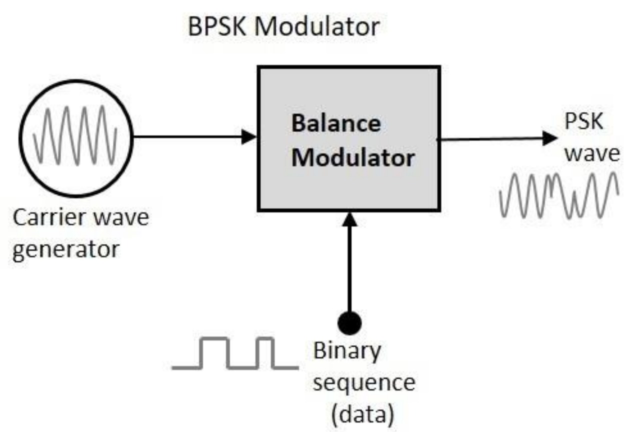


FIG 5.1 Modulator block diagram

The block diagram of BPSK modulation consists of the following components:

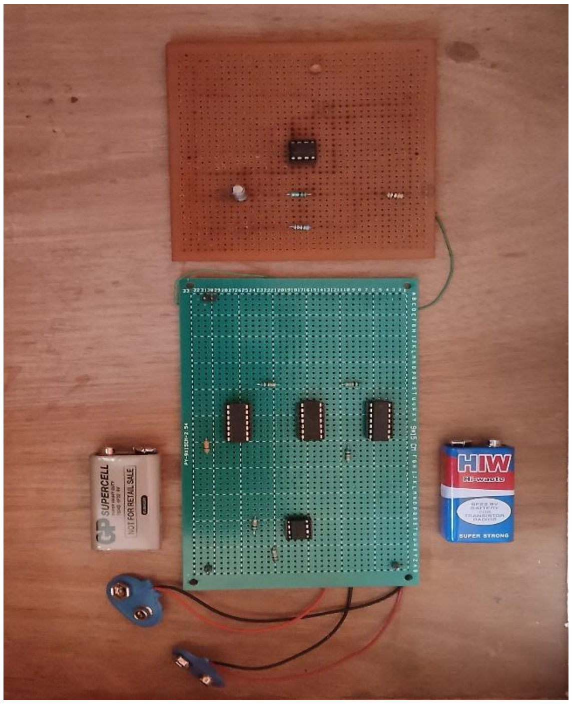
•Binary data source: This block generates a stream of binary data, consisting of 0's and 1's, which are to be transmitted.

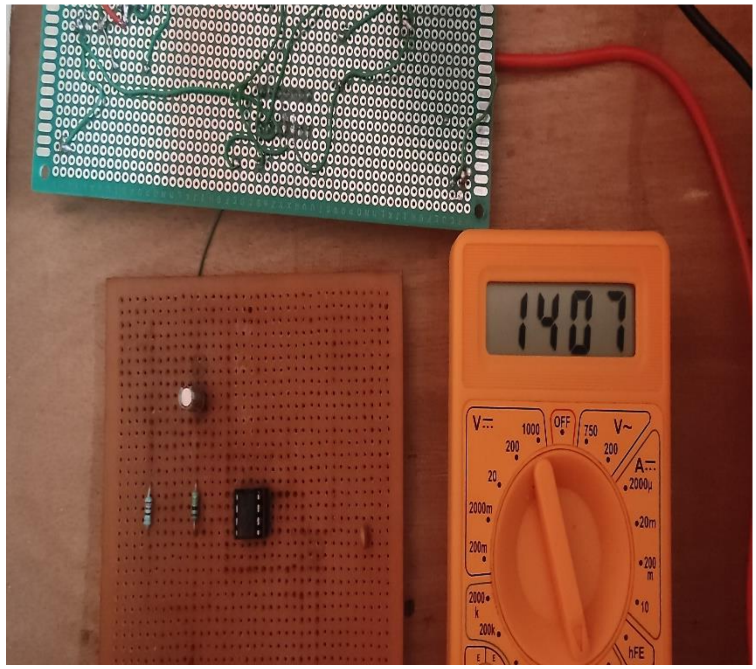
•Modulation signal generator: This block generates a carrier signal, which is a sinusoidal waveform with a specific frequency and amplitude.

•BPSK modulator: This block modulates the carrier signal with the binary data to produce the BPSK signal. The modulator phase shifts the carrier signal by 180 degrees for binary 1, and leaves it unshifted for binary 0.

•Channel: The BPSK signal is transmitted over a communication channel, which may introduce noise, distortion, and other forms of interference.

HARDWARE


GP SUPERCELL
NOT FOR RETAIL SALE
HIW
SUPER STRONG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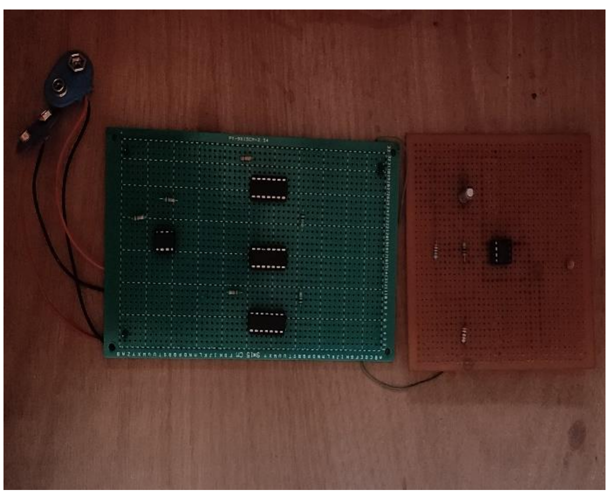

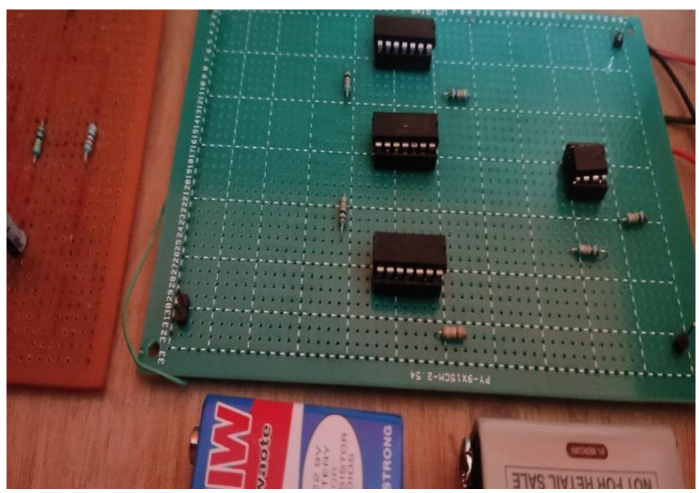
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CHAPTER 6: CONCLUSION

In conclusion, BPSK modulation is an important digital modulation technique that has found wide applications in modern communication systems. It provides a reliable and efficient means of transmitting binary data over a communication channel, and it is an essential building block in many modern communication technologies.