BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY

BUET

Department of Electrical and Electronic Engineering

Project Title: Frequency Shift Keying (FSK) Modulation and Reconstruction of Signal

Course No.: EEE 310

Course Title: Communication Systems I Laboratory

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OBJECTIVES:

The main objectives of the project include:

1. Implementation of frequency shift keying circuit.
2. Reconstruction of the digital signal from the frequency-shifted signal.

APPARATUS REQUIRED FOR PROJECT PURPOSE:

1. Signal Generator
2. LF398N (sample and hold amplifier)
3. uA741
4. Power Supply
5. Diodes (1N914,1N4007)
6. Resistors (1K,47K)
7. Capacitors (0.01uF)
8. Oscilloscope
9. PCB board

THEORETICAL BASIS:

FSK MODULATION:

Frequency shift keying (FSK) is the frequency modulation system in which digital information is transmitted through the discrete frequency change of a carrier wave. The simplest FSK is known as BFSK (Binary FSK) in which the carrier is shifted between two discrete frequencies to transmit binary (0s and 1s) information.

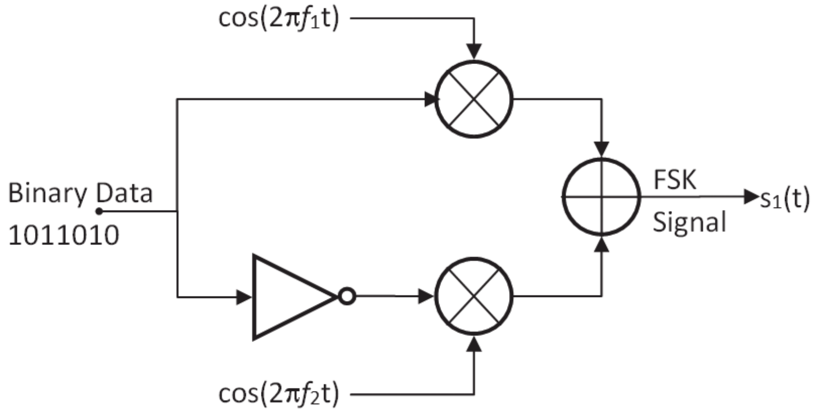


Fig: FSK MODULATOR

When the binary data is 1 then the data is multiplied by carrier ‘cos(2pi*f1*t)’ and when it’s 0 then the binary input passes through an inverter and gets multiplied by analog carrier ‘cos(2pi*f2*t)’. Thus we get FSK modulated signal as follows:

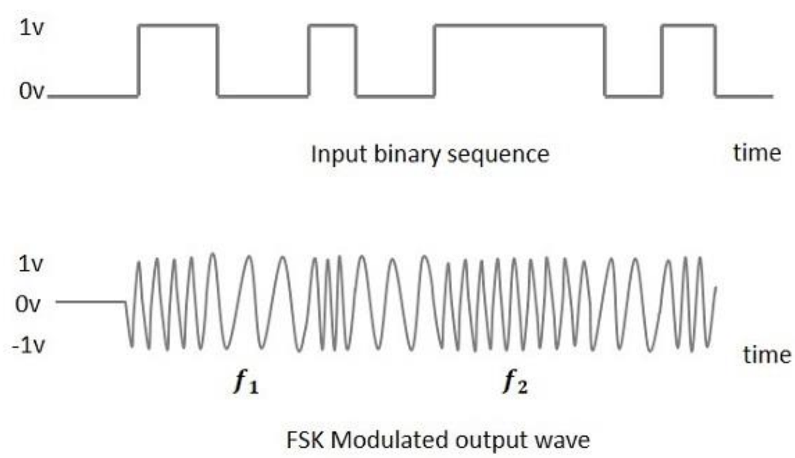
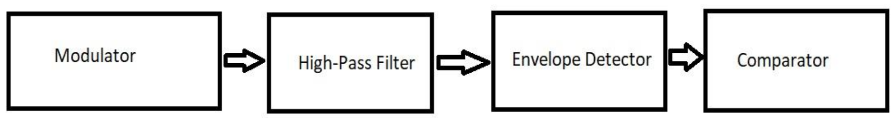


Fig: FSK modulated signal in time domain and magnitude spectrum

FSK DEMODULATION:

There are different methods for reconstructing digital signal from FSK modulated signal. The main methods are asynchronous and synchronous detector. In our project we used asynchronous or non-coherent detector.

Block diagram of FSK demodulator:



The high pass filter is where the FSK modulated signal from the modulator initially enters before only the high frequency carrier can pass through. Envelope detection follows, and we ultimately obtain the demodulated digital signal using a comparator.

PRACTICAL IMPLEMENTATION:

We initially attempted to simulate the FSK modulation and demodulation circuit in a simulation software. To do this, we employed PROTEUS. Below is a diagram of our simulated circuit's overall configuration:

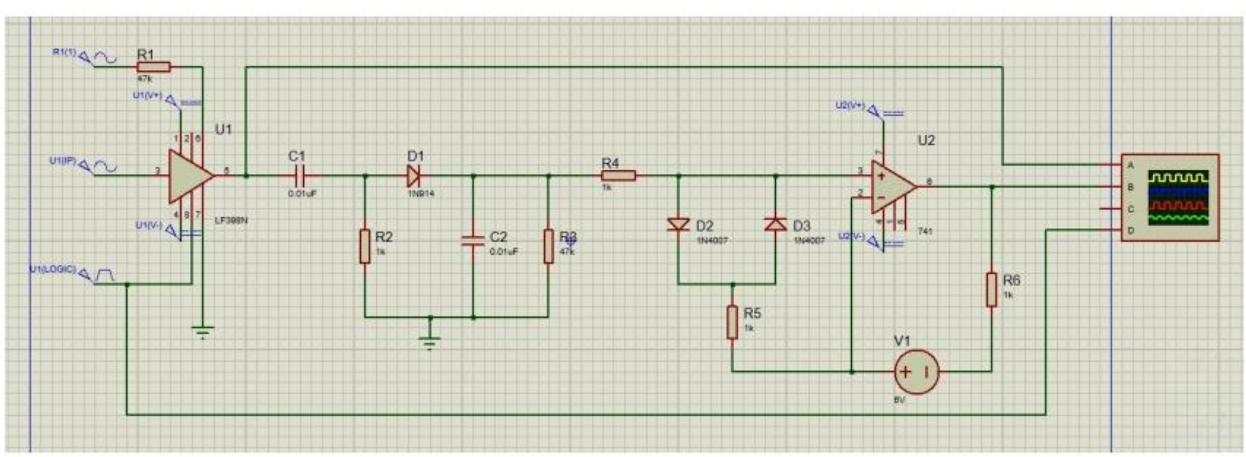


Fig: Overall circuit model for FSK modulation and demodulation

MODULATOR BLOCK:

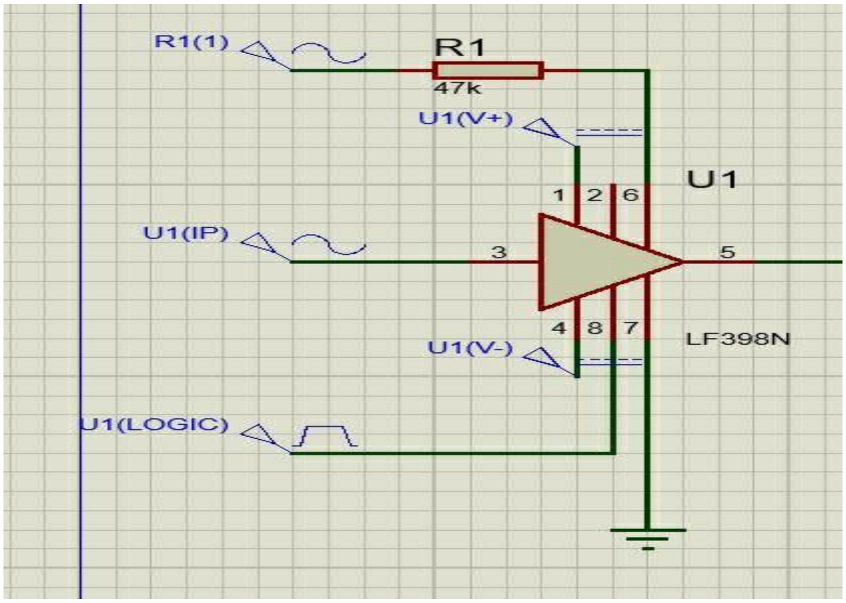
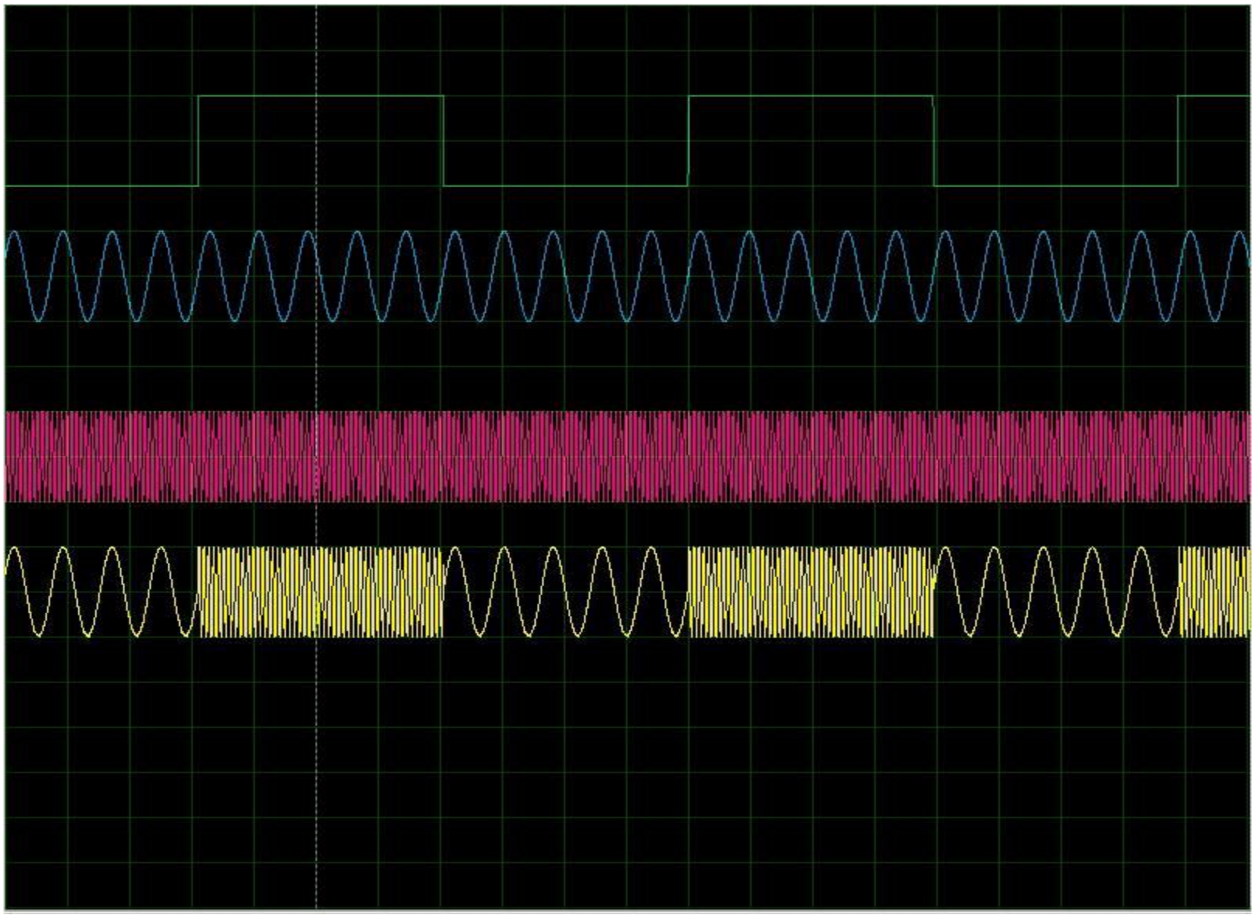


Fig: Modulator circuit

For modulation purposes we used the LF398N sample and hold amplifier which uses a combination of bipolar and junction FET transistors to provide precision, high speed and long hold times. Three inputs were used to create the FSK modulated signal: one contained digital message signal, and the other two were two different frequency sinusoid carriers. One analog carrier had a 10V amplitude (peak-peak) and a 5KHz frequency, while the other had the same amplitude with a frequency of 50KHz. We designed the modulator in such a way so that when the binary data is logic '1' we would get a high-frequency FSK modulated signal and when it's '0' then the modulated frequency will be low.

The output from the modulator block is shown below:



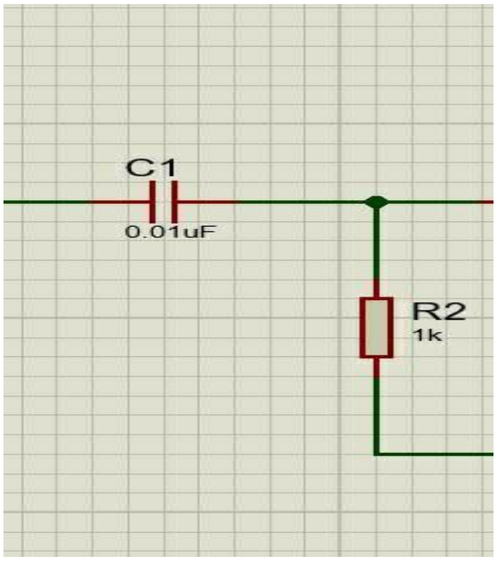
GREEN- Digital signal; **BLUE**-Low freq. (5KHz) carrier; **RED-**High freq.(50KHz) carrier; YELLOW-Modulating signal.

Fig: FSK modulated signal

RECONSTRUCTION BLOCK:

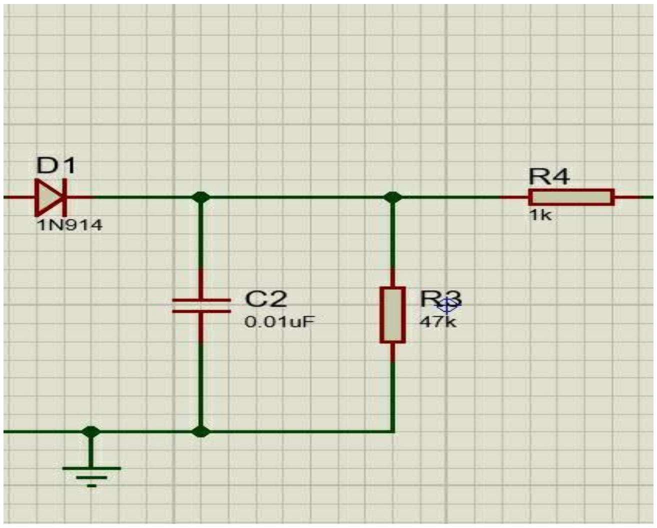
1) HPF BLOCK:

The following high pass filter lets the high-frequency portion of the modulated signal pass through. To create the HPF, we utilized a 0.01uF capacitor with a 1K resistance. The HPF will offer a cutoff frequency of 15 kHz, which let the higher carrier frequency of 50KHz to pass.



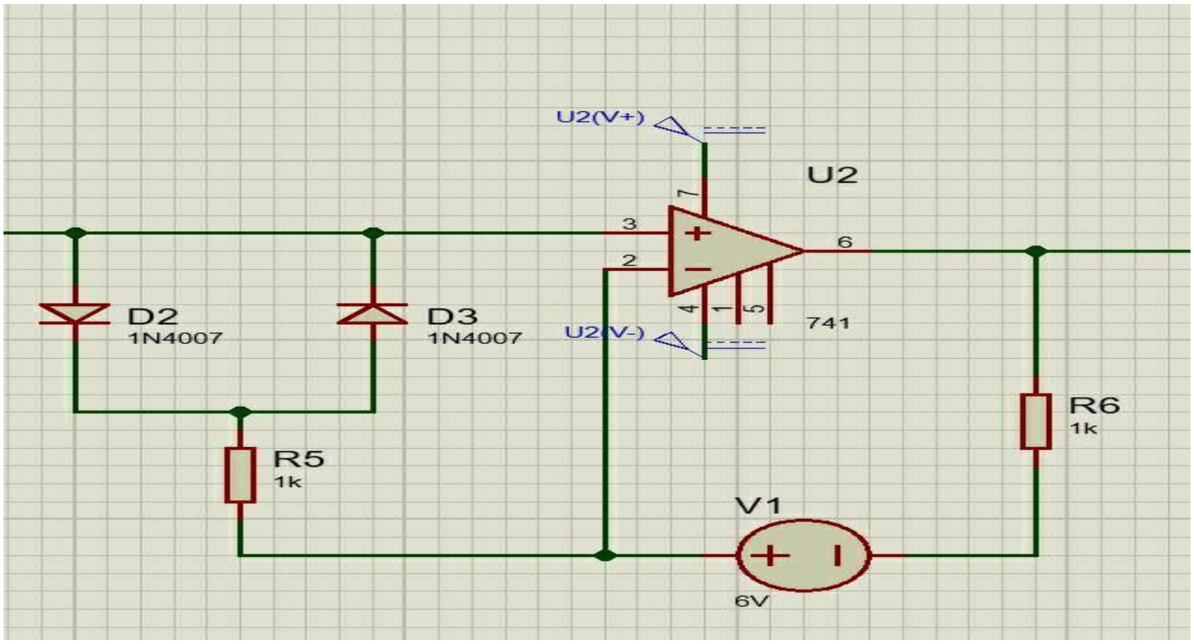
2)ENVELOP DETECTOR:

High frequency modulating signal than enters into the designed envelop detector where envelop detection takes place.

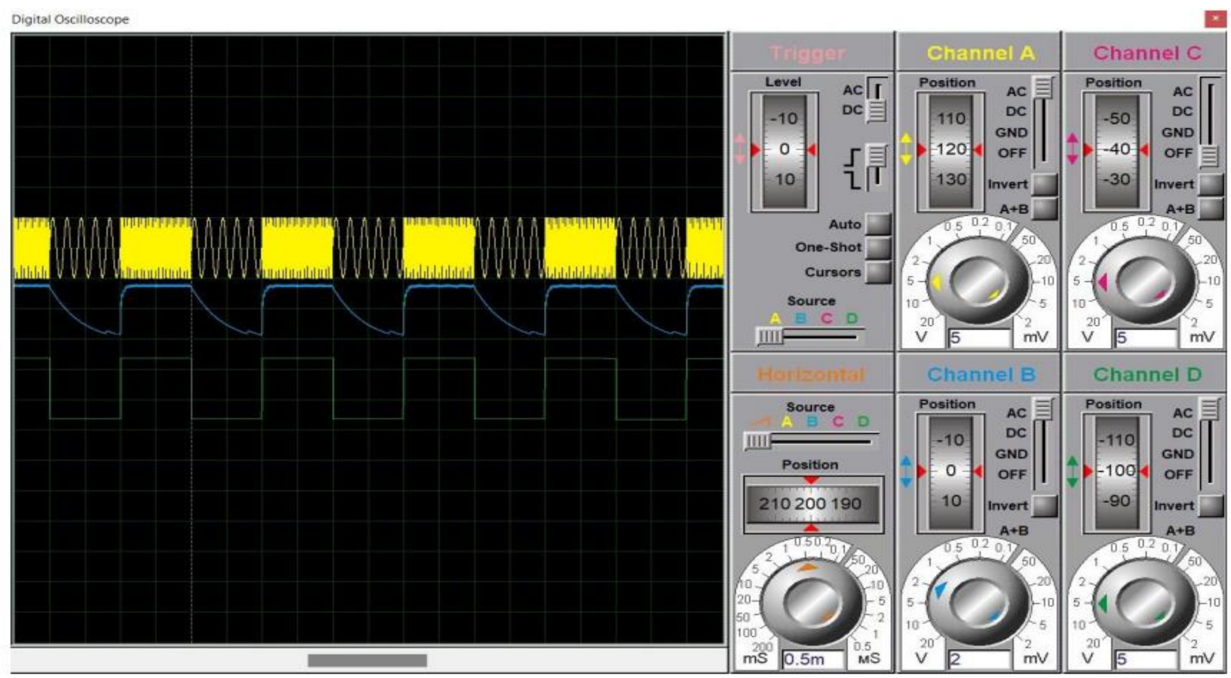


3) COMPARATOR:

At last the comparator decides whether the output is logic ‘1’ or ‘0’.



Finally, the reconstructed signal is achieved as follows:

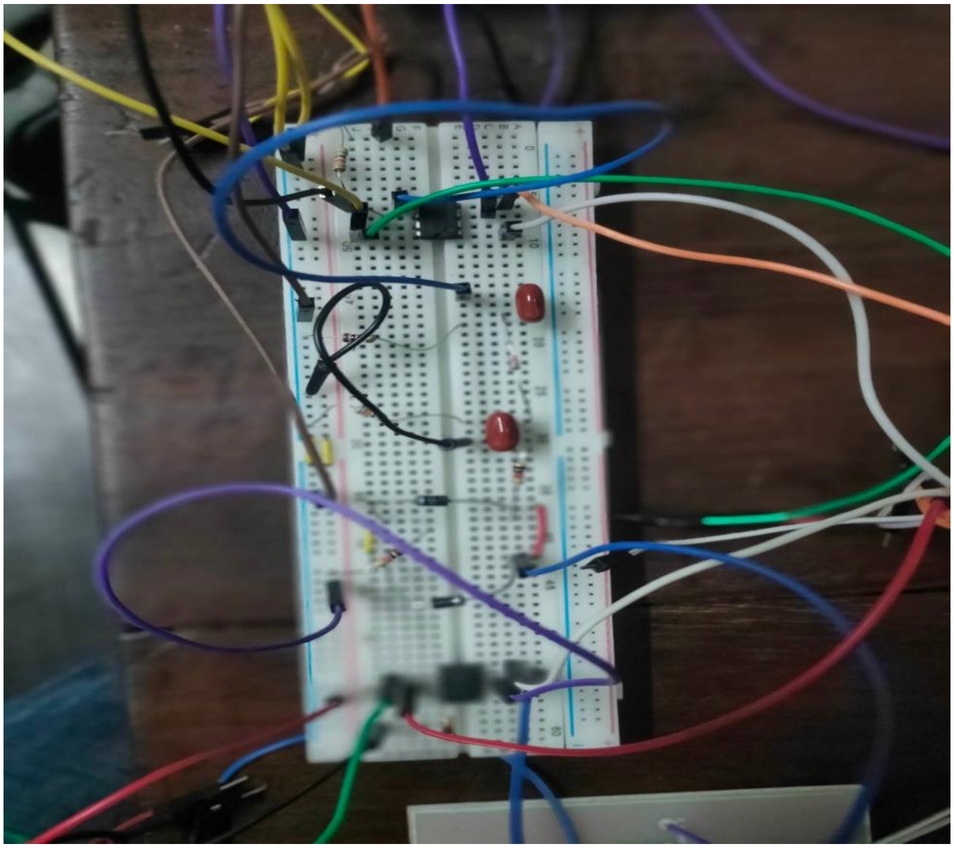


YELLOW-Modulating signal; **BLUE**- reconstructed signal; **GREEN**-Digital message signal

FIG: RECONSTRUCTED SIGNAL

After simulating the modulation and reconstruction in software program, we practically designed the circuit in a breadboard and then printed the design in a PCB (Printed Circuit Board).

This is the final outlook of our project:



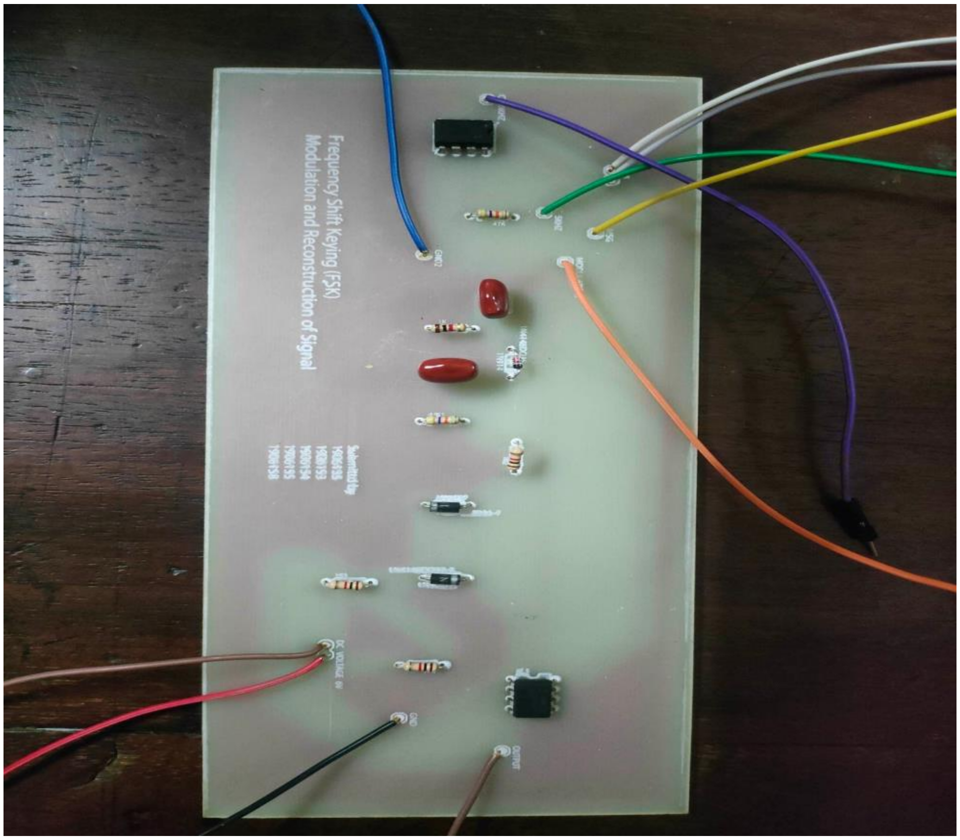


FIG: Hardware implementation of the project

WORKING PROCEDURE:

The steps below should be followed in order to acquire the desired result:

1. From the signal generator, take two analog carriers with frequencies of 5 KHz and 50 KHz and 10 V (peak-peak) amplitude as input.

2. Take the digital message (High Value – 10 V, Low Value – 0V, frequency = 500 Hz) signal as an input.

3. Provide the IC a DC bias voltage (± 12 V).

4. Provide the comparator a 6-volt threshold voltage.

5. Attach an oscilloscope so you can watch the message signal and the modulating signal together. Use channel 1 to watch the modulated signal and channel 2 to watch the input message signal.

6. Connect the oscilloscope to observe the reconstructed signal with the message signal. Use channel 1 for the message and channel 2 for the reconstructed signal.

Using the aforementioned procedures, we successfully connected the circuit, and the output was as follows:

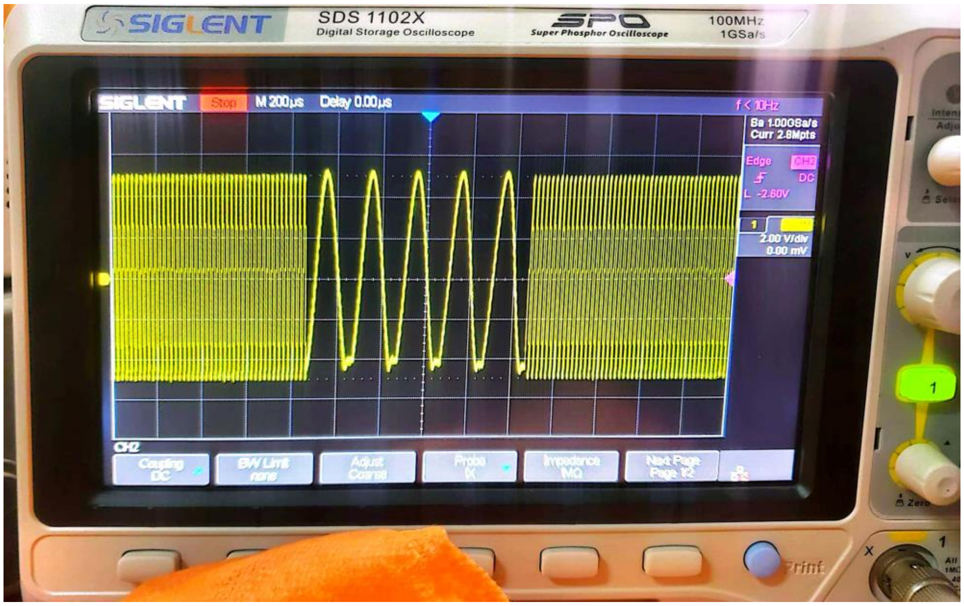


FIG: FSK modulated signal at the oscilloscope

Hence, the modulating signal seen by the oscilloscope corresponds to the anticipated result.

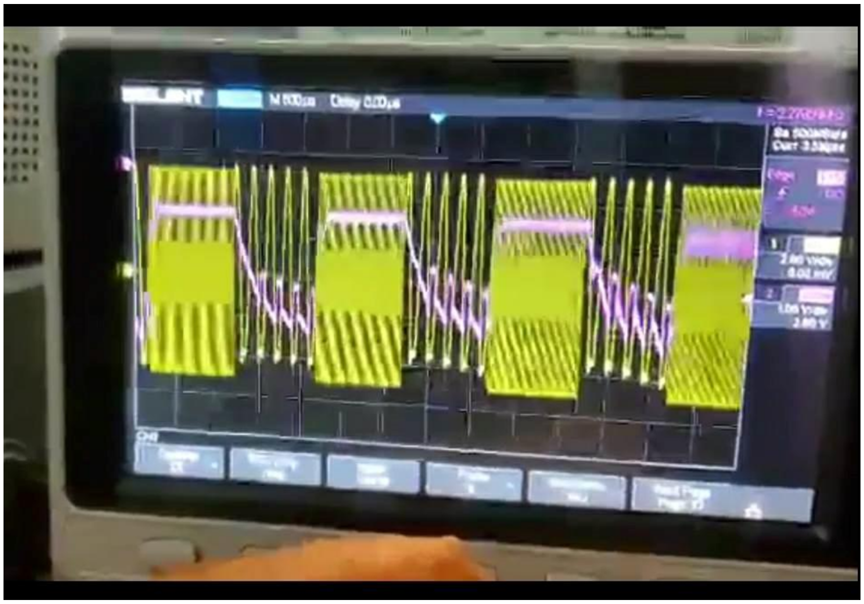


FIG: FSK demodulated signal

Cost Analysis:

Equipment Name	Price
PCB	Tk. 350/-
Op-Amp	Tk. 40/-
LF398N	Tk. 90/-
Resistors	Tk. 10/-
Capacitors	Tk. 20/-
Diodes	Tk. 20/-
Connectors	Tk. 10/-
Breadboard	Tk. 80/-
Total	Tk. 620/-