Course Name:	**Analogue Digital Systems**	**Semester:**	**IV**
Date of Performance:	**12 / 04 / 2024**	**Batch no.:**	**A - 2**
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Faculty Sign & Date:		**Grade / Marks:**	**___ / 25**

Experiment No.: 8

Title: To generate and study Digital Modulation technique Binary Frequency Shift Keying (BFSK) using LABVIEW/HARDWARE

Aim and Objective of the Experiment:

- To understand the working of BFSK.
- To visualize the BFSK output and make appropriate conclusions.

COs to be achieved:

CO5: To understand Pulse Shaping techniques for optimum transmission of signal and Band-pass digital modulation and demodulation.

Theory:

In BFSK system two logic levels (1 and 0) of the data are represented by two carrier signals which are of different frequencies. In frequency shift keying the carrier frequency is shifted in steps i.e. from one frequency to another, corresponding to modulating signal. If higher frequency is used to represent data '1', lower frequency is used to represent Data '0'.

On a closer look at the BFSK waveform it can be that it can be represented as the sum of two BASK waveform. Functional blocks required in order to generate the BFSK signal is shown in the fig. The two carriers have different frequencies and the digital data is inverted in one case. The demodulation of BFSK waveform can be carried out by phase locked loop. The phase locked loop tries to 'lock' the input frequency. It achieves this by generating corresponding output voltage to be fed to the voltage-controlled oscillator, if any frequency deviation at its input is encountered.

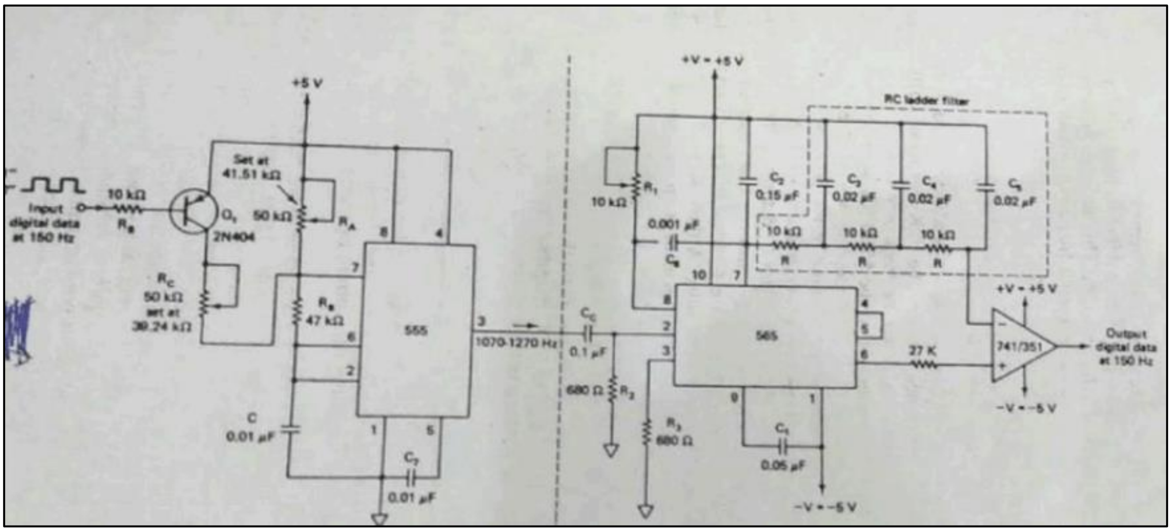
Thus, the PLL detector follows the frequency changes and generates proportional output voltage. The output voltage from PLL contains the carrier component. Therefore, the signal is passed through a low pass filter to remove them. The resulting signal is too rounded to be used for digital data processing. Also, the amplitude level may be very low due to channel attenuation. Since the amplitude change in BFSK waveform does not matter this modulation technique is very reliable even in noisy and fading channels.

However, the required bandwidth increases depending on the two carrier frequencies. The bandwidth required is at least doubled than that in BASK Modulation. This means lesser no. of communication channels for a given band of frequencies.

Step-Wise Procedure:

1. Assemble the circuit as shown in circuit diagram.
2. Apply modulating signal as square wave of 10Vp-p & 200Hz, carrier signal 1 as Sine wave of 5Vp-p & 1 kHz and carrier signal 2 as Sine wave of 5Vp-p & 2 kHz.
3. Observe the BFSK output at pin no. 3.
4. Draw corresponding waveforms of modulating, carrier and BFSK signal on graph paper.

Circuit Diagram:



Observation Table:

Modulating Signal:

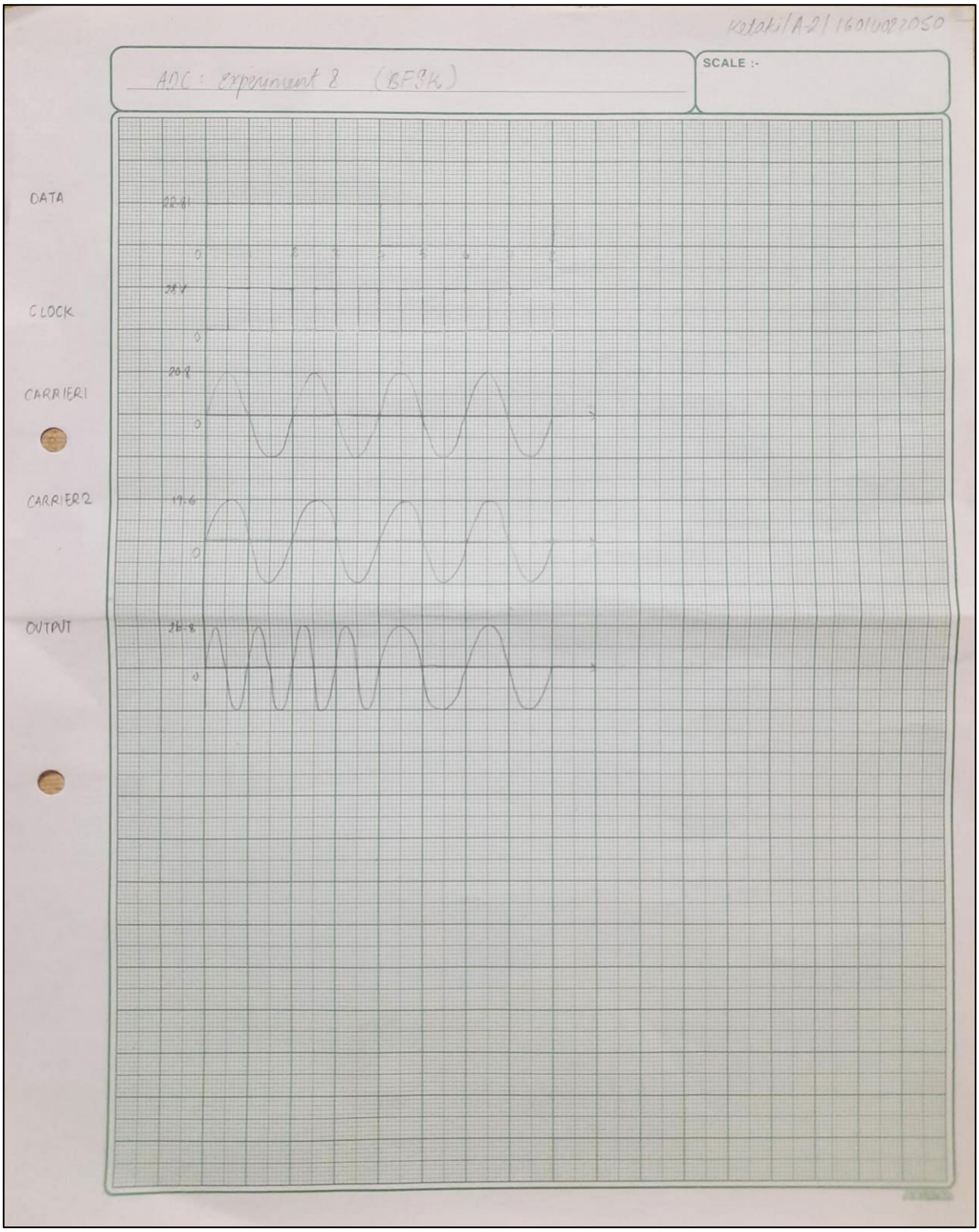
Amplitude – 5.2V and Frequency – 60kHz

Carrier Signal 1:

Amplitude – 20.8V and Frequency – 1.44MHz

<u>Carrier Signal 2</u>:

<u>Amplitude</u> – 19.6V and <u>Frequency</u> – 960kHz



Post Lab Subjective / Objective type Questions:

1. **Differentiate coherent and non-coherent systems.**
Coherent Systems: In coherent systems, the receiver has knowledge of the phase of the carrier signal. This allows for more efficient demodulation techniques like coherent detection, which can achieve better performance in terms of bit error rate (BER) compared to non-coherent systems. Examples include coherent phase shift keying (PSK) and coherent frequency shift keying (FSK).

   Non-coherent Systems: In contrast, non-coherent systems do not require phase synchronization between the transmitter and receiver. These systems are simpler and more robust in environments with phase noise or frequency offsets. However, they often suffer from higher BER compared to coherent systems. Examples include non-coherent PSK (NC-PSK) and non-coherent FSK (NC-FSK).

2. **What are applications of BFSK?**
BFSK is commonly used in various digital communication systems, including:

   a) Wireless Communication Systems: BFSK is utilized in wireless communication systems such as Bluetooth and RFID (Radio Frequency Identification).
   b) Data Transmission: It's used in data transmission applications where binary data needs to be transmitted efficiently over a communication channel.
   c) Digital Broadcasting: BFSK can be used in digital broadcasting systems for transmType equation here.itting digital audio or data streams.
   d) Telemetry Systems: BFSK finds applications in telemetry systems used for remote monitoring and control.

3. **Probability of error and bandwidth of BFSK is given respectively by ______________ and ______________.**
Probability of error (Pe): $P_e = Q(\sqrt{\frac{2E_b}{N_o}})$

   Bandwidth: $B = 2 \times R$, where R is the data rate

4. **How phase continuity is maintained in frequency shift keying?**
In FSK modulation, phase continuity is maintained by ensuring a smooth transition between the different frequency states. This can be achieved by using techniques such as:
   a) Minimum Shift Keying (MSK): MSK is a special case of FSK where the frequency shift between the two states is exactly half the bit rate. This ensures constant phase between adjacent symbols, maintaining phase continuity.

b) Continuous Phase Frequency Shift Keying (CPFSK): CPFSK is another method where the phase of the modulated signal is continuously adjusted to ensure phase continuity between symbols, even if the frequency changes abruptly.

Conclusion:

The experiment enabled us to generate and examine Binary Frequency Shift Keying (BFSK) modulation. By understanding BFSK's operation and visualizing its output, we gained valuable insights into digital modulation techniques, enhancing our comprehension of communication systems and their real-world applications.

Signature of faculty in-charge with date: