A
Project Report
On

"ASK FSK PSK Modulation Kit"

Submitted in partial fulfillment for the award of the degree of Bachelor of Technology

In

ELECTRONICS AND COMMUNICATION ENGINEERING

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DECLARATION

I hereby declare that the work, being presented in the project report entitled “ASK FSK PSK Modulation Kit” in partial fulfillment of the requirement for the award of the Degree in Bachelor of Technology in Electronics and Communication engineering submitted to the Department of Electronics Engineering of J.C. Bose University of Science and Technology, YMCA, Faridabad is an authentic record of my work carried out during a period from JAN 2025 to May 2025 under the supervision of Ms.Kusum Arora , Department of Electronics Engineering. No part of the matter embodied in the project has been submitted to any other University / Institute for the award of any Degree or Diploma

ABSTRACT

This project report presents a detailed exploration of the ASK FSK PSK Modulation Kit, an indispensable tool for electronics enthusiasts and learners alike. Comprising a comprehensive array of components, including IC8038, IC4016, IC4017, IC7414 , IC741 op amp, IC555, IC7805, IC7812, IC7905, IC7915, resistors, capacitors, diodes IN4007, banana sockets, DIP switch, the kit epitomizes versatility and utility in electronics education.

Through meticulous analysis, this report elucidates the intricate interplay of these components, delineating their roles in circuitry design and functionality. It delves into the nuanced implementation process, covering crucial aspects such as circuit design, programming (if applicable), component integration, and rigorous testing procedures.

Furthermore, the report explores the wide-ranging applications of the ASK FSK PSK Modulation Kit, spanning educational exercises, prototyping endeavors, and practical demonstrations. By elucidating its advantages, including scalability, customizability, and cost-effectiveness, as well as addressing potential challenges and limitations, this report offers valuable insights into maximizing the kit's efficacy.

Drawing upon these insights, the report outlines potential avenues for future enhancements, emphasizing the kit's adaptability to evolving educational and industrial needs. In essence, this project report serves as a definitive guide to understanding and harnessing the educational potential of the ASK FSK PSK Modulation Kit, empowering electronics enthusiasts to embark on enriching learning journeys and innovative projects.

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COMPONENTS USED

The following components for Digital Trainer Kit are required in the project:-

1. IC8038
2. IC4016
3. IC4017
4. IC7414
5. Banana sockets
6. IC741 op-amp
7. IC555
8. Resistors
9. Capacitors
10. IC7805
11. IC7812
12. DIP switches
13. IC7905
14. IC7915
15. Diodes IN4007

Fig: 1 IC8038

IC 8038 (Precision Waveform Generator)
The IC 8038 is a versatile waveform generator capable of producing high-precision sine, square, triangular, sawtooth, and pulse waveforms. It is widely used in function generators and waveform synthesizers. The output frequency and waveform shape can be adjusted using external resistors and capacitors, making it highly suitable for use in waveform generation experiments within digital and analog trainer kits. The IC plays a crucial role in educational labs for demonstrating waveform characteristics, signal modulation, and analog signal processing. Its inclusion enhances practical understanding of waveform behavior in electronic circuits.

Fig: 2 IC4016

IC 4016 (Quad Bilateral Switch)
The IC 4016 is a quad bilateral switch, meaning it contains four independent switches that can conduct current in both directions when enabled. Each switch in the IC is controlled via a digital control signal, allowing analog or digital signals to pass through when the control is high. It is especially useful in applications involving signal routing, multiplexing, analog signal switching, and waveform shaping. In educational setups, IC 4016 helps demonstrate switching mechanisms, signal control, and logic interfacing, making it a valuable component in digital trainer kits and experimental circuits.

Fig: 3 IC4017

IC 4017 (Decade Counter with 10 Decoded Outputs)
The IC 4017 is a decade counter/divider with ten decoded outputs, typically used in sequence generation, LED chasers, and timing circuits. It advances the output to the next pin on every clock pulse, making it ideal for applications like light pattern generators and frequency division. The IC is frequently used in trainer kits for teaching concepts related to digital counting, sequence generation, and event timing. Its ability to visually represent digital sequences on LEDs or displays makes it a practical and educational component.

Fig: 4 IC7414

The IC 7414 contains six independent inverter gates with Schmitt Trigger action on the inputs. This configuration helps to clean up noisy or slowly changing signals by providing hysteresis and sharp transitions. It is highly effective in waveform IC 7414 (Hex Inverter with Schmitt Trigger Inputs)

shaping, signal conditioning, and pulse generation circuits. In trainer kits, the IC 7414 plays a key role in demonstrating noise immunity, waveform conversion, and logic level interfacing, aiding students in understanding signal reliability in digital circuits.

Fig: 5 IC741

IC 741 (General Purpose Operational Amplifier)

The IC 741 is a widely used general-purpose operational amplifier that forms the backbone of analog electronic circuits. It is employed in various applications including amplifiers, filters, oscillators, and analog computation. With high input impedance and low output impedance, it allows flexible circuit design. Within educational trainer kits, the 741 op-amp is indispensable for teaching analog concepts like voltage gain, comparator behavior, integrators, and differentiators. Its versatile use bridges theoretical concepts with real-world analog applications.

Fig: 6 IC555

IC 555 (Timer IC)

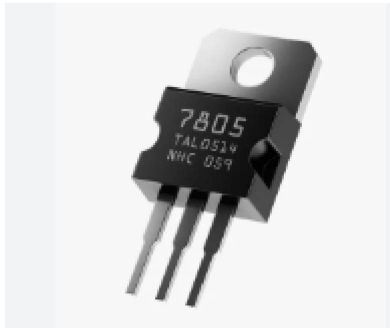
The 555 Timer IC is a highly stable device used for generating accurate time delays and oscillations. Configurable in monostable, astable, and bistable modes, it finds applications in timers, pulse generation, frequency dividers, and LED flashers. In digital trainer kits, the 555 timer serves as a fundamental building block for timing-based experiments and waveform generation.

Fig: 7 DIP Switches

DIP Switch (Dual In-line Package Switch)

The DIP switch is a manual electric switch packaged in a standard dual in-line format. It is used for setting configuration options within a circuit, typically for selecting input options or enabling/disabling features. Each switch can be toggled on or off, acting like a binary input. In educational trainer kits, DIP switches are often used to simulate digital inputs for logic circuits, allowing students to manually input binary values and observe system responses. They are instrumental in developing an intuitive understanding of digital logic and input configuration.

Fig: 8 IC7805



7805 Voltage Regulator (Positive +5V Regulator)

The 7805 is a widely used positive voltage regulator IC that provides a constant +5V output voltage. It is part of the 78xx series of voltage regulators, where the last two digits represent the output voltage. The 7805 is designed to maintain a stable 5 volts output regardless of variations in the input voltage (as long as it is sufficiently higher than 5V) and load current fluctuations. It can typically supply up to 1A of current to the load, making it suitable for powering microcontrollers, logic circuits, sensors, and other 5V devices. The IC includes internal circuitry for thermal overload protection and short-circuit current limiting, enhancing reliability and safety in electronic designs. Its simplicity and robustness have made it a staple component in power supply circuits.

Fig: 9 Resistors

In an ASK, PSK, and FSK modulation kit, resistors play several critical roles across all circuit stages, including signal generation, modulation, and demodulation. One of the primary uses of resistors is in setting the biasing conditions for active components such as transistors and operational amplifiers. Proper biasing ensures that these components operate in their intended regions, allowing for accurate amplification and switching behavior.

Resistors are also widely used in voltage divider configurations to derive reference voltages or to scale down voltages for compatibility between different circuit sections. In timing and frequency-determining circuits, resistors work alongside capacitors to set RC time constants, which directly influence signal frequency and phase characteristics. For example, in FSK modulation, a voltage-controlled oscillator (VCO) may use resistors to define its frequency deviation range, while in PSK, RC networks with resistors are essential for creating the required phase shifts.

In ASK modulation, resistors help in switching the carrier signal on and off by setting the appropriate base currents in transistor switches. In demodulation circuits, especially in ASK, resistors are used in envelope detectors in combination with capacitors to filter out the high-frequency carrier, leaving behind the original message signal. Similarly, in FSK and PSK demodulators, resistors are part of filter circuits that help isolate specific frequencies or phases for accurate signal reconstruction.

Throughout the kit, resistors are also used to limit current to protect LEDs and IC inputs, adjust amplifier gain, and provide feedback in op-amp circuits. Their role is fundamental in ensuring the overall stability, functionality, and accuracy of modulation and demodulation processes in ASK, FSK, and PSK systems.

Fig: 10 Capacitors

In ASK, PSK, and FSK modulation kits, **capacitors** serve crucial roles in various circuit stages, ranging from signal generation to filtering and demodulation. One of their primary functions is in conjunction with resistors to form **RC timing circuits**, which are essential in determining the frequency of oscillators and time constants in filters.

In PSK modulation circuits, capacitors are often used in **phase shift networks** to introduce controlled delays in the signal, enabling the required phase modulation. These RC networks create the specific phase differences needed to represent digital data through variations in the signal's phase. Capacitors also play an important role in **coupling and decoupling** applications

During the demodulation process, particularly in ASK, capacitors are critical in **envelope detectors**, where they store and smooth the signal amplitude after rectification, extracting the original modulating data. Similarly, in FSK demodulators capacitors in the loop filter help stabilize the frequency tracking and response time of the circuit. In PSK demodulators, capacitors contribute to coherent detection by filtering out high-frequency components and enhancing the desired phase information.

Overall, capacitors in modulation kits are indispensable for signal shaping, timing, filtering, noise reduction, and phase control. Their appropriate selection and placement ensure accurate modulation and demodulation, contributing to the reliable transmission and recovery of digital signals in ASK, FSK, and PSK systems.

Fig :11 Diode IN4007

One of the most common uses of diodes is in **demodulation circuits**, especially in **ASK (Amplitude Shift Keying)**. In ASK demodulation, a diode is typically used in an **envelope detector**, where it rectifies the modulated signal, allowing only the positive (or negative) half-cycles to pass.

In **FSK (Frequency Shift Keying)** demodulation circuits, especially those involving **zero-crossing detectors or frequency discriminators**, diodes may be used in **clipping or shaping circuits**. These circuits help condition the received waveform by removing unwanted signal portions .

In **PSK (Phase Shift Keying)** systems, diodes can be used in **coherent demodulator circuits** where they assist in phase comparison and signal separation.

In summary, diodes in ASK, PSK, and FSK modulation kits are primarily used for **rectification, signal detection, waveform shaping, voltage protection**, and **status** function.

Fig :12 Banana Sockets

Banana sockets, commonly referred to as banana jacks or banana plugs, serve as versatile electrical connectors renowned for their simplicity and efficiency. Featuring a cylindrical design, these sockets are equipped with either spring-loaded or screw-type mechanisms. The central aperture accommodates banana plugs, which boast a corresponding cylindrical shape and are equipped with either a spring-loaded pin or probe. This design enables quick and secure connections, making banana sockets ideal for applications in laboratory equipment, test instruments, and audio systems. Their widespread adoption is attributed to their ease of use and reliability, making them indispensable components for establishing temporary electrical connections in various electronic set.

Fig :13 IC7905

7905 Voltage Regulator (Negative -5V Regulator)
The 7905 is a negative voltage regulator IC that provides a fixed output voltage of -5V. It is part of the 79xx series, which consists of negative voltage regulators complementary to the 78xx positive regulators. The 7905 ensures a steady -5V supply by regulating the input voltage and compensating for load variations. It is commonly used in dual power supply configurations for operational amplifiers, analog circuits, and other components that require a negative voltage rail alongside a positive one. Similar to its positive counterparts, the 7905 features protection against thermal overload and short circuits, ensuring robust operation in demanding environments.

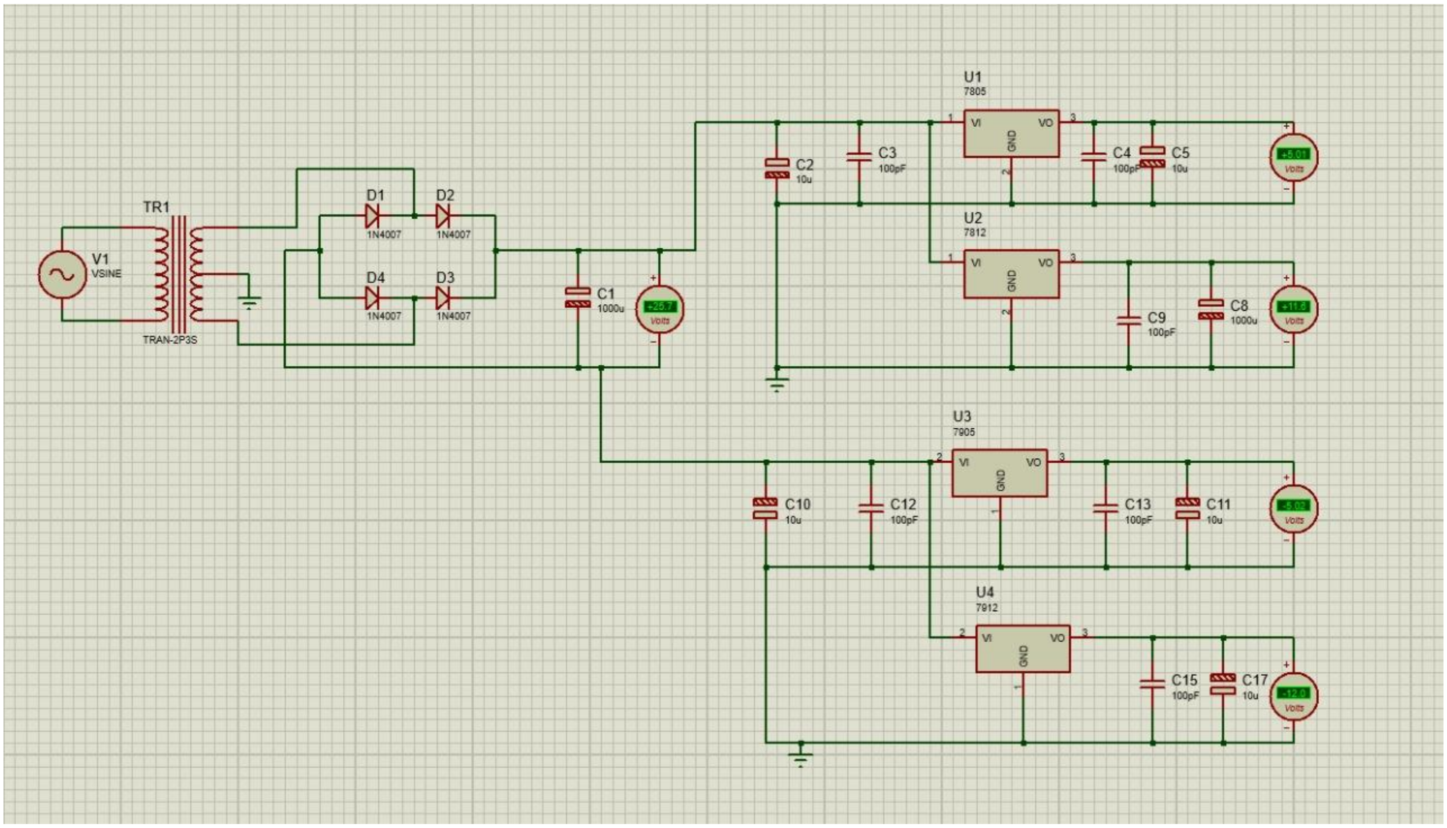
Fig :14 IC7812

7812 Voltage Regulator (Positive +12V Regulator)
The 7812 voltage regulator IC provides a fixed positive output voltage of +12V. Like the 7805, it belongs to the 78xx series and offers a stable and reliable voltage supply for electronic devices requiring 12 volts. The 7812 is widely used in applications such as powering relay coils, audio amplifiers, and other circuits operating at 12V. It also incorporates built-in protection features, including thermal shutdown and current limiting, to safeguard both the IC and connected components from damage due to overheating or excessive current. This regulator is essential in circuits where a regulated 12V supply is needed from a higher DC input voltage.

Fig :15 IC7915

7915 Voltage Regulator (Negative -15V Regulator)
The 7915 voltage regulator provides a fixed negative output voltage of -15V. Like the 7905, it belongs to the 79xx series of negative voltage regulators. The -15V supply is frequently required in analog circuits, such as audio amplifiers, op-amp circuits, and other systems that need a symmetrical dual power supply (+15V and -15V). The 7915 regulates and stabilizes the negative voltage from a higher negative DC input voltage, ensuring consistent performance of sensitive analog components. Built-in safety features like thermal protection and current limiting make the 7915 a reliable choice for negative voltage regulation needs.

Circuit Diagram of Power Supply



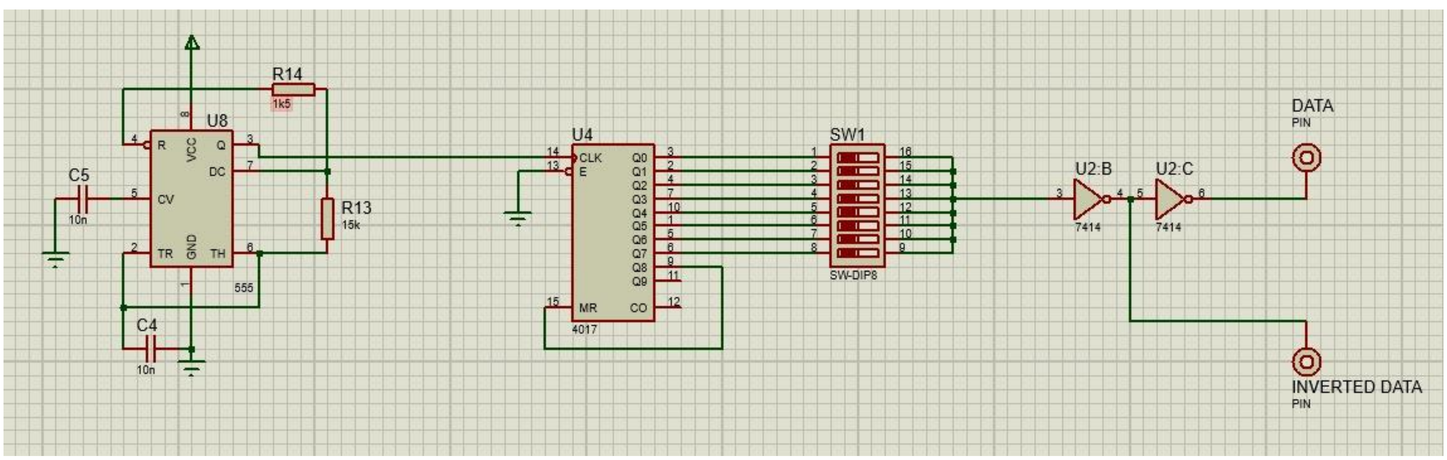
Working of Power Supply:

This circuit diagram represents a regulated dual power supply designed to convert an AC input voltage into multiple DC output voltages: +5V, -5V, +12V, and -12V. The AC input, shown as a sine wave source (V1), is fed into a center-tapped step-down transformer (TR1), which reduces the high-voltage AC to a lower AC voltage suitable for rectification. The output from the transformer is then passed through a bridge rectifier consisting of four diodes (D1–D4, type 1N4007), which converts the AC into pulsating DC. This pulsating DC is then filtered using a large electrolytic capacitor (C1, 1000µF) to produce a smoother DC voltage, approximately 25V in this case.

From here, the circuit splits into two main branches: one for positive voltage regulation and the other for negative voltage regulation. In the positive branch, two voltage regulators are used: a 7805 regulator (U1) outputs a constant +5V, while a 7812 regulator (U2) outputs +12V. Each regulator is supported by bypass capacitors (C2–C9) that help filter out high-frequency noise and stabilize the output voltage.

Similarly, the negative voltage branch consists of a 7905 regulator (U3), which provides -5V, and a 7912 regulator (U4), which provides -12V. These are also supported by filtering capacitors (C10–C17). The result is a power supply that can deliver four distinct output voltages: +5V, -5V, +12V, and -12V, which are commonly required in analog and digital electronic circuits, such as operational amplifier-based designs or microcontroller systems. The voltages measured at the outputs in the simulation confirm the expected performance, showing stable outputs close to the desired values.

Circuit Diagram of Input Data



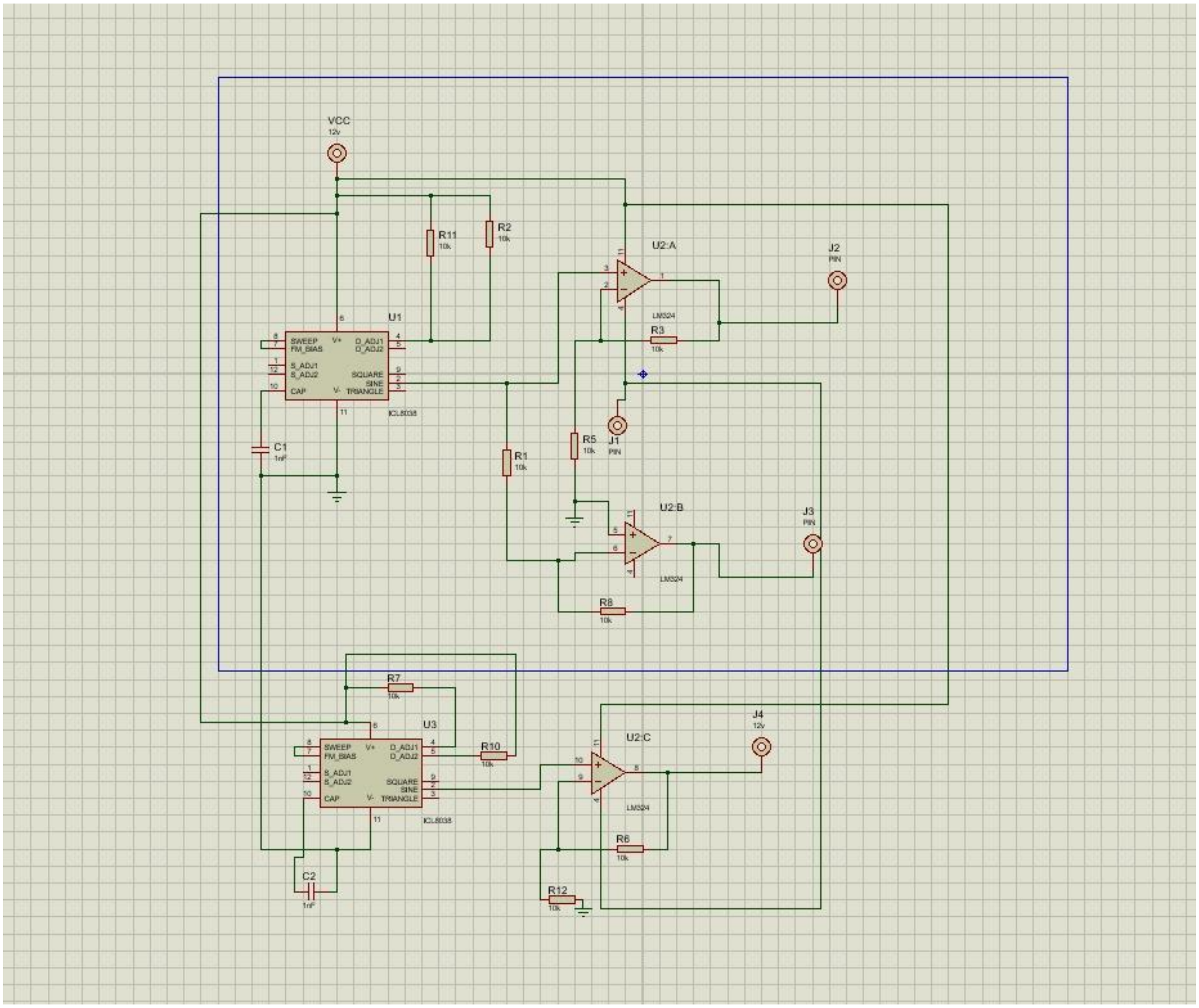
Working Of Input Data:

This circuit is a basic **data selection and inversion system** using a 555 timer, a 4017 decade counter, DIP switches, and logic inverters. The 555 timer (U8) is configured in astable mode to generate a continuous square wave clock signal. This clock signal is determined by resistors R13 and R14 along with capacitor C4, and it is output from pin 3 of the 555 timer. This clock signal is fed into the clock input (pin 14) of the CD4017 decade counter (U4), which sequentially activates its Q0 to Q7 outputs one by one with each clock pulse.

The outputs Q0–Q7 of the CD4017 are connected to an 8-position DIP switch (SW1), allowing the user to set one of the lines HIGH manually. This enables only one switch to control the data output at a time, effectively acting as a data selector or multiplexer. The selected data line from the DIP switch is then passed through a NOT gate (U2:B), which outputs the inverted logic level. This inverted signal is then passed through a second NOT gate (U2:C), which restores the original logic level. As a result, two outputs are produced: one direct (DATA) and one inverted (INVERTED DATA).

In summary, the circuit allows a user to manually input a data bit using DIP switches that are scanned sequentially using a 4017 counter. The selected data is then provided in both normal and inverted forms using a pair of NOT gates. This type of configuration can be useful for simple digital control or data selection applications where both true and complemented logic signals are needed.

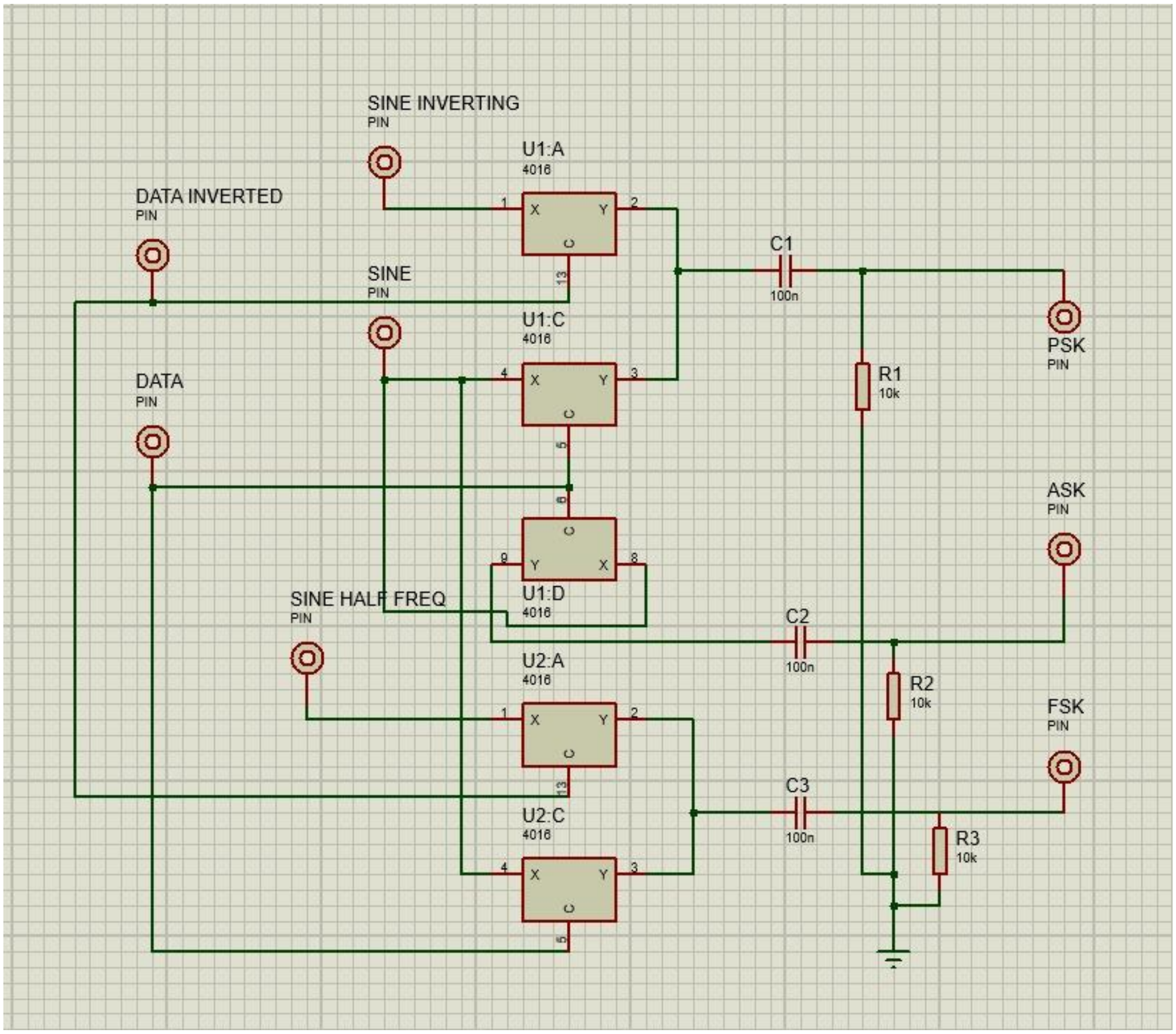
Circuit Diagram of Sine Wave Generator



Working of sine wave generator :

This circuit is a signal generation and conditioning system built using two XR-2206 function generator ICs and an LM324 quad operational amplifier. The XR-2206 ICs (U1 and U3) are configured to produce standard waveform outputs such as sine, triangle, and square waves. These waveforms are determined by the values of timing components—capacitors C1 and C2, and resistors like R1 and R7. The generated signals are then routed through sections of the LM324 op-amp (U2:A, U2:B, and U2:C), which are configured primarily as voltage comparators. U2:A compares the waveform from U1 against a reference set by a voltage divider network and outputs a conditioned digital signal at connector J2. Similarly, U2:B compares another version of U1's output with a different threshold, determined using potentiometer R5, and produces an output at J3. Meanwhile, the signal from the second XR-2206 (U3) is processed by U2:C, which again acts as a comparator and outputs to J4. The purpose of these op-amp stages is to convert the analog signals into digital-like pulses based on predefined voltage thresholds. This design allows for waveform analysis, signal thresholding, and logic-level interfacing, making it suitable for applications in waveform shaping, analog-to-digital signal conversion, and function generator testing setups. The entire circuit is powered by a +12V DC supply.

Circuit Diagram of Modulation Circuit



Working of Modulation Circuit:

This circuit is a digital modulation generator designed to produce three different modulation schemes: Amplitude Shift Keying (ASK), Phase Shift Keying (PSK), and Frequency Shift Keying (FSK). It uses CD4016 analog switches to selectively route signals based on a digital data input. The circuit takes in a binary data signal, along with its inverted form, and three sine wave signals: a regular sine wave, its inverted version, and a sine wave at half the frequency. For PSK generation, two switches (U1:A and U1:C) are controlled by the inverted and non-inverted data signals respectively, allowing either the normal or inverted sine wave to pass depending on the data bit. These outputs are combined and passed through capacitor C1 to produce a PSK signal with a 180-degree phase shift based on data transitions. ASK is implemented by allowing the sine wave to pass through switch U1:D only when the data bit is high; otherwise, the carrier is suppressed, resulting in amplitude modulation. The output is passed through capacitor C2 to produce the ASK signal. FSK is achieved by switching between the full-frequency sine wave and the half-frequency sine wave using switches U2:A and U2:C, which are controlled by the data and its inverted form. The output is passed through capacitor C3 to yield a signal whose frequency depends on the logic level of the data. Each modulated signal is filtered by a resistor and made available at separate output pins labeled PSK, ASK, and FSK. This circuit demonstrates how basic modulation techniques can be implemented using logic-controlled analog switches and is useful in educational and communication system applications.

Thank You