Summer Fellowship Report

On

Integrated Circuit Design using Subcircuit feature of eSim

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I take this occasion to offer our heartfelt gratitude to the FOSSEE, IIT Bombay Team for offering me this wonderful opportunity to work on the design and integration of multiple sub-circuits in eSim. Working on eSim has provided me invaluable insights into various open-source EDA tools for circuit simulation and their applications in the practical world.

I extend my sincere regards to Prof. Kannan M. Moudgalya for his valuable guidance and motivation to throughout this fellowship program.

I would like to express my heartfelt appreciation to the entire FOSSEE team including our mentor Mr. Sumanto Kar for constantly guiding and mentoring me throughout the duration of the internship.

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Overall, it was a delightful experience interning at FOSSEE and contributing to its growth and I take away some great insights and knowledge from it. As enthusiastic beginners in the semiconductor industry, this internship is a milestone for me in our pursuit of a successful career.

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Chapter 1

Introduction

FOSSEE which stands for Free/Libre and Open Source Software for Education is an organization, based at IIT Bombay, as a remarkable initiative aimed at promoting the use of open-source software in education and research. It was established with the mission to reduce the dependency on proprietary software and to encourage the adop tion of open-source alternatives. FOSSEE offers a wide range of tools and resources that cater to various academic and professional needs.

It provides comprehensive documentation, tutorials, workshops, and hands-on training sessions, for empowering students, educators, and professionals to leverage open source software for their projects and coursework. The organization's commitment to fostering a collaborative and inclusive environment has significantly contributed to the democratization of technology and has opened up new avenues for innovation and learning.

1.1 eSim

eSim, created by the FOSSEE project at IIT Bombay, is a versatile open-source soft ware tool for circuit design and simulation. It combines various open-source software packages into one cohesive platform, making it easier to design, simulate, and ana lyze electronic circuits. This tool is particularly useful for students, educators, and professionals who need an affordable and accessible alternative to proprietary software.

eSim offers features for schematic creation, circuit simulation, PCB design, and includes an extensive library of components. The Subcircuit feature is a significant enhancement, enabling users to design complex circuits by integrating simpler subcir cuits. Through eSim, FOSSEE promotes the use of open-source solutions in engineer ing education and professional fields, encouraging innovation and collaboration.

1.2 NgSpice

NgSpice is the open-source spice simulator for electric and electronic circuits. Such a circuit may comprise JFETs, bipolar and MOS transistors, passive elements like R, L, or C, diodes, transmission lines and other devices, all interconnected in a netlist.

Digital circuits are simulated as well, event-driven and fast, from single gates to complex circuits and the combination of both analog and digital as well as a mixed signal circuits. NgSpice offers a wealth of device models for active, passive, analog, and digital elements. Model parameters are provided by our collections, by the semi conductor device manufacturers, or from semiconductor foundries. The user adds her circuits as a netlist, and the output is one or more graphs of currents, voltages and other electrical quantities or is saved in a data file.

1.3 Makerchip

Makerchip is a platform that offers convenient and accessible access to various tools for digital circuit design. It provides both browser-based and desktop-based environments for coding, compiling, simulating, and debugging Verilog designs. Makerchip supports a combination of open-source tools and proprietary ones, ensuring a comprehensive range of capabilities.

One can simulate Verilog/SystemVerilog/Transaction-Level Verilog code in Mak erchip. eSim is interfaced with Makerchip using a Python based application called Makerchip-App which launches the Makerchip IDE. Makerchip aims to make circuit design easy and enjoyable for users of all skill levels. The platform provides a user friendly interface, intuitive workflows, and a range of helpful features that simplify the design process and enhance the overall user experience.

The main drawback of these open source tools is that they are not comprehensive. Some of them are capable of PCB design (e.g. KiCad) while some of them are capable of performing simulations (e.g. gEDA). To the best of our knowledge, there is no open source software that can perform circuit design, simulation and layout design together. eSim is capable of doing all of the above.

Chapter 2

Feautures Of eSim

The objective behind the development of eSim is to provide an open source EDA solution for electronics and electrical engineers. The software should be capable of performing schematic creation, PCB design and circuit simulation (analog, digital and mixed-signal). It should provide facilities to create new models and components. Thus, eSim offers the following features -

1. **Schematic Creation:** eSim provides an easy-to-use graphical interface for drawing circuit schematics, making it accessible for users of all levels. Users can drag and drop components from the library onto the schematic, simplifying the design process. Comprehensive editing tools allow for easy modification of schematics, including moving, rotating, and labeling components.

2. **Circuit Simulation:** eSim supports SPICE (Simulation Program with Integrated Circuit Emphasis), a standard for simulating analog and digital circuits. Users can perform various types of analysis such as transient, AC, and DC, providing insights into circuit behavior over time and frequency. An integrated waveform viewer helps visualize simulation results, aiding in the analysis and debugging of circuit designs.

3. **PCB Design:** The PCB layout editor allows users to place components and route traces with precision. eSim includes DRC capabilities to ensure that the PCB design adheres to manufacturing constraints and electrical rules. Users can generate Gerber files, which are standard for PCB fabrication, directly from their designs.

4. **Subcircuit Feature:** This feature enables users to create complex circuits by integrating smaller, simpler subcircuits, promoting modular and hierarchical design approaches. Subcircuits can be reused in different projects, saving time and effort in redesigning common circuit elements.

5. **Open Source Integration:** eSim integrates several open-source tools like KiCad, Ngspice, and GHDL, providing a comprehensive suite for electronic design automation. Being open-source, eSim is free to use, making advanced circuit design tools accessible without the need for expensive licenses.

Chapter 3

Problem Statement

To design and develop various Analog and Digital Integrated Circuit Models in the form of sub-circuits using device model files already present in the eSim library. These IC models should be useful in the future for circuit designing purposes by developers and users, once they get successfully integrated into the eSim subcircuit Library.

3.1 Approach

Our approach to implementing the problem statement began with examining datasheets from prominent Integrated Circuit (IC) manufacturers such as Texas Instruments, Analog Devices, and NXP Semiconductors. We selected ICs that offer a diverse range of functionalities, including precision amplifiers, comparators, encoders, and audio amplifiers. After building the subcircuits, we tested them to verify basic circuit configurations using NgSpice simulations. The step-by-step roadmap of this process is outlined below:

1. **Analyzing Datasheets:** The primary step is to browse through various analog and digital IC datasheets, and hence find suitable circuits to implement in eSim, that are not previously included into the eSim library. Check for the detailed schematic of the IC's and once the component values and the truth table is ascertained, then finalise the IC to be created.

2. **Subcircuit Creation:** After deciding the IC, we start modeling it as a subcircuit in eSim, using the model files present in the eSim device model library only. The design is strictly according to the information given in the official data-sheets of the ICs. This step also includes building the Symbol/Pin diagram of the IC according to the packaging and pin description given in the data-sheets only.

3. **Test Circuit Design:** Once the component of the IC is ready, now we can build the test circuits, according to the data-sheets. In this step we build the test cases and test circuits using the component IC.

4. **Schematic Testing:** Once the test circuits are ready, now it's time to simulate the test circuits so that the output can be obtained in the form of wave-forms

and plots. Here we take help of KiCad to NgSpice conversion and Simulation feature in eSim.

If the output of the test circuit is not as per expectation, this implies that the test case has failed, and there is some error in the schematic. In such cases we go back to the design phase of the IC or the test circuits, to look for possible errors and then repeat the testing process again after making required changes.

Once the expected output of the test cases are correct and satisfy the expected results, then in such a case the IC is declared successfully working. The test case has been verified and the designing process is complete.

Chapter 4

Integrated Circuit Design

4.1 LH0004 - High Voltage Operational Amplifier

The **LH0004** is a general-purpose, high-voltage operational amplifier designed for wide output swing and low power dissipation. It operates from $\pm 5\,\mathrm{V}$ to $\pm 40\,\mathrm{V}$ supply and delivers up to $\pm 35\,\mathrm{V}$ into a $2\,\mathrm{k}\Omega$ load, with a low quiescent power of just $8\,\mathrm{mW}$ at $\pm 40\,\mathrm{V}$. This makes it ideal for power-sensitive, high-voltage applications.

It features high open-loop gain and a low input offset voltage of typically $0.3\,\mathrm{mV}$, ensuring precision in analog designs. Frequency compensation is externally adjustable using two small capacitors, allowing flexibility in optimizing bandwidth and stability based on application needs.

The LH0004C operates over 0°C to 85°C, while the military-grade version covers −55°C to 125°C. It is suited for high-voltage power supplies, wideband amplification, and transducer excitation.

4.1.1 IC Layout

This figure represents the Pin Package Diagram of LH0004 IC

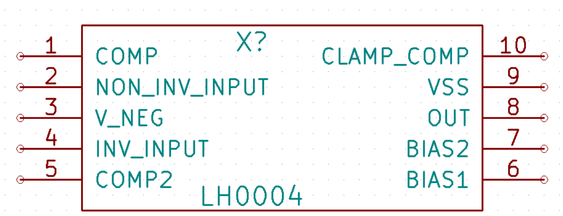


Figure 4.1: Pin diagram of LH0004 IC

4.1.2 Subcircuit Schematic Diagram

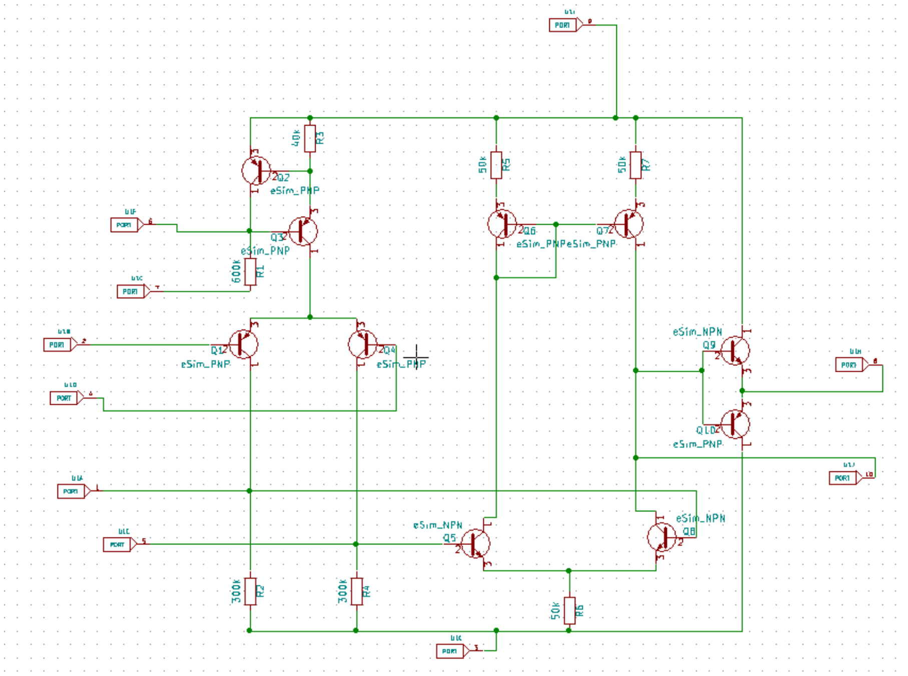


Figure 4.2: Subcircuit Schematic of LH0004 IC

4.1.3 Test Circuit

The figure below shows the test circuit layout of the LH0004 operational amplifier configured as an **inverting amplifier**. In this configuration, the input signal is applied to the inverting input through a resistor, while the non-inverting input is grounded. The feedback from the output to the inverting input establishes the gain, which is determined by the resistor values.

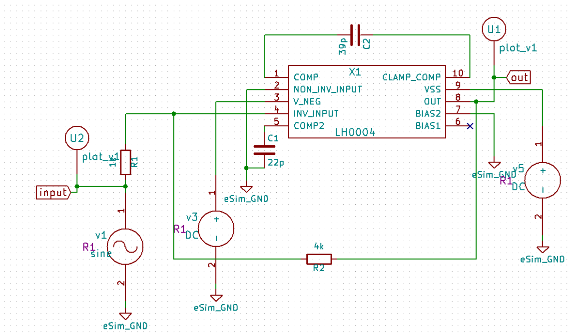


Figure 4.3: Test Circuit of LH0004 IC

4.1.4 Input Plots

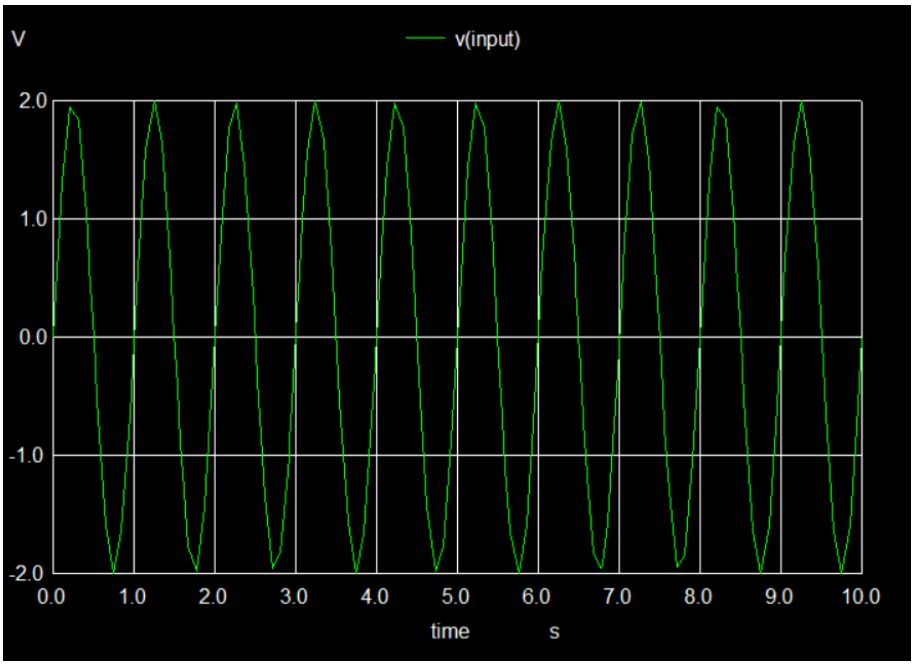


Figure 4.4: Input Voltage Waveform of LH0004

4.1.5 Output Plots

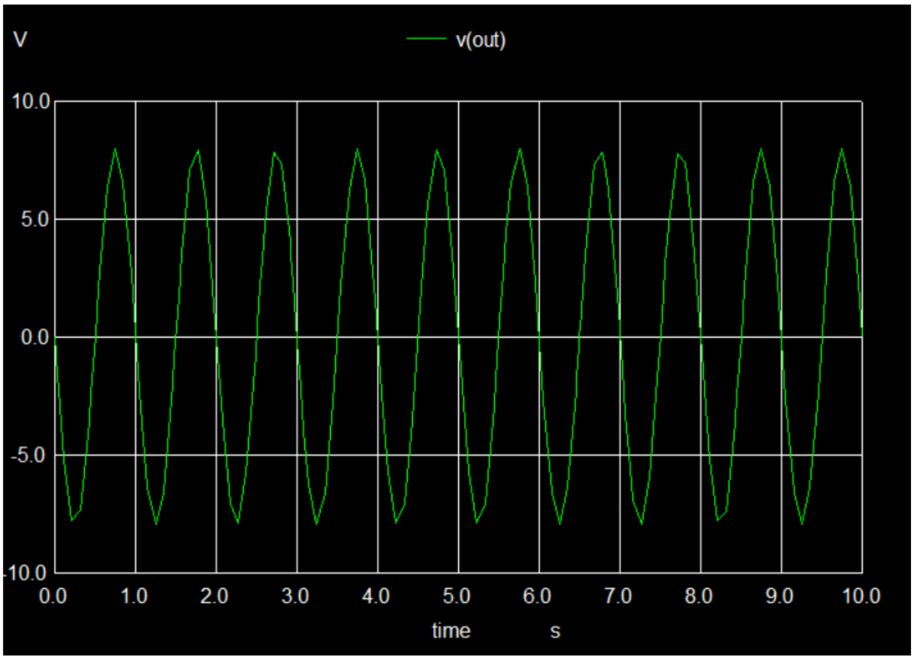


Figure 4.5: Output Voltage Waveform of LH0004

4.2 HCF4066B - CMOS Quad Bilateral Switch

The **HCF4066** is a CMOS IC featuring four independent bilateral switches capable of passing both analog and digital signals. These switches can conduct in both directions when enabled, allowing for flexible signal routing in a variety of electronic systems. The IC operates reliably across a wide voltage range (3V to 18V), making it compatible with most logic families.

Unlike mechanical relays, the HCF4066 uses solid-state technology, offering faster switching, no contact bounce, and higher reliability. When activated, each switch exhibits low ON resistance, ensuring minimal signal loss. When deactivated, it presents high impedance, effectively isolating the connected parts of a circuit.

This IC is widely used in signal multiplexing, analog routing, audio switching, and communication circuits. Its compact quad-switch configuration is ideal for applications such as sample-and-hold circuits and data acquisition systems, and it is available in standard 14-pin DIP or SOIC packages.

4.2.1 IC Layout

This figure represents the Pin Package Diagram of HCF4066B IC

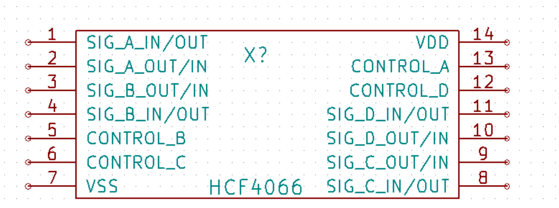


Figure 4.6: Pin diagram of HCF4066B IC

4.2.2 Subcircuit Schematic Diagram

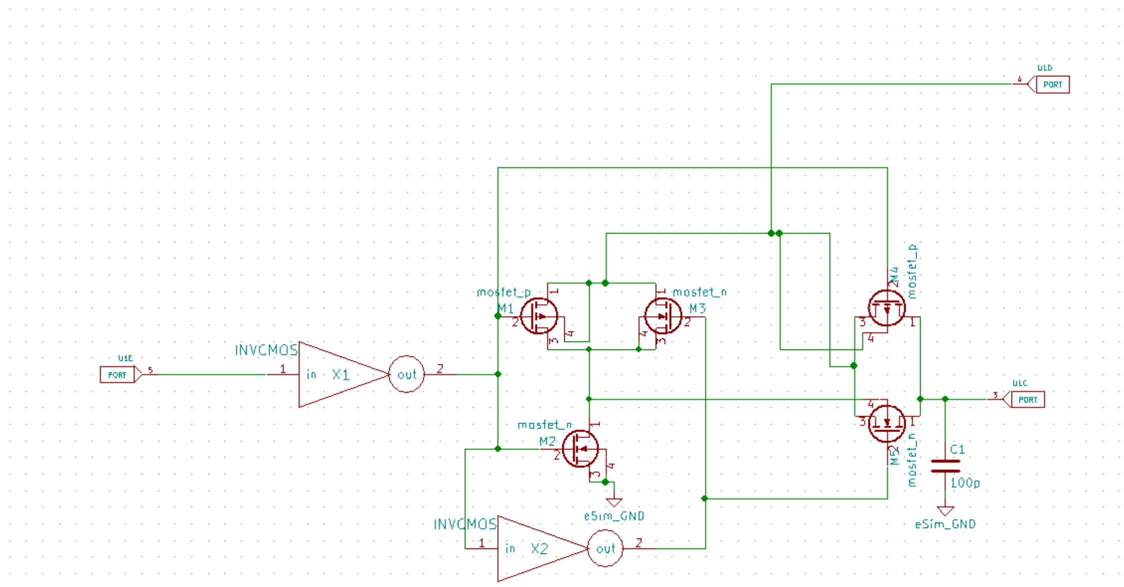


Figure 4.7: Subcircuit Schematic of HCF4066B IC(1/4th)

4.2.3 Test Circuit

In the test circuit, switches A and D have their control inputs set to **high**, enabling conduction, while switches B and C are controlled with a **low** signal, keeping them OFF. This setup demonstrates the selective switching capability of the HCF4066.

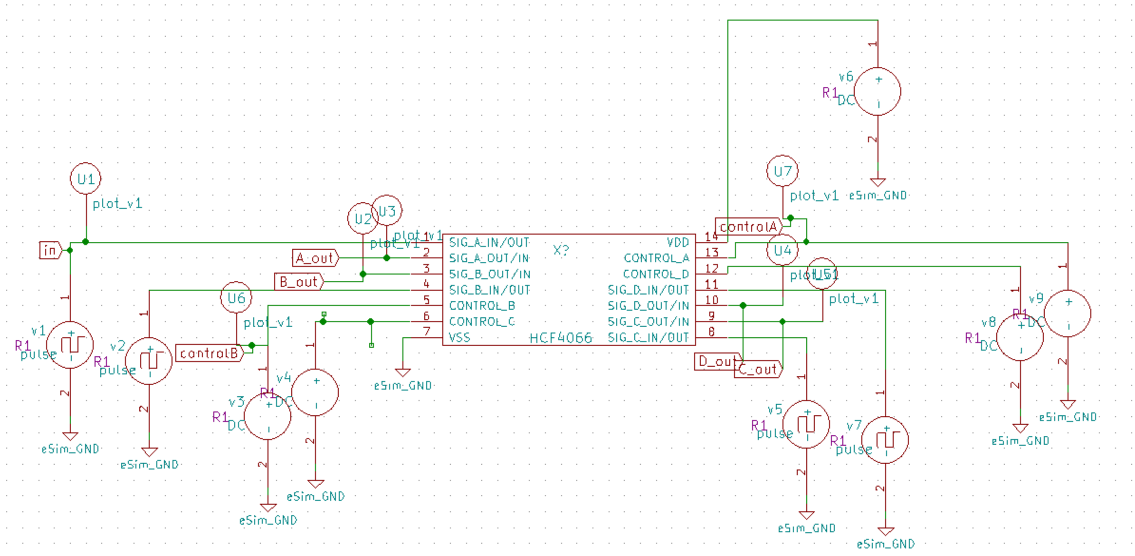


Figure 4.8: Test Circuit of HCF4066 IC

4.2.4 Input Plots

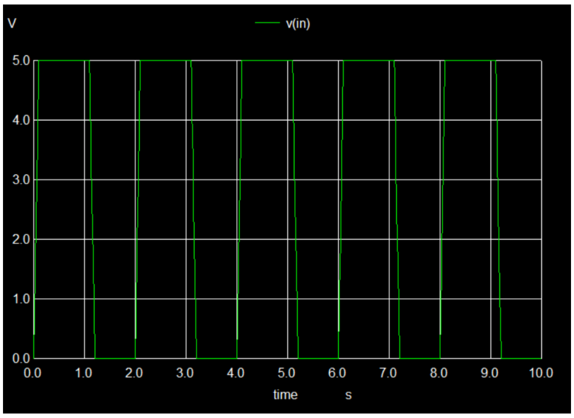


Figure 4.9: Input Voltage Waveform of HCF4066B

4.2.5 Output Plots

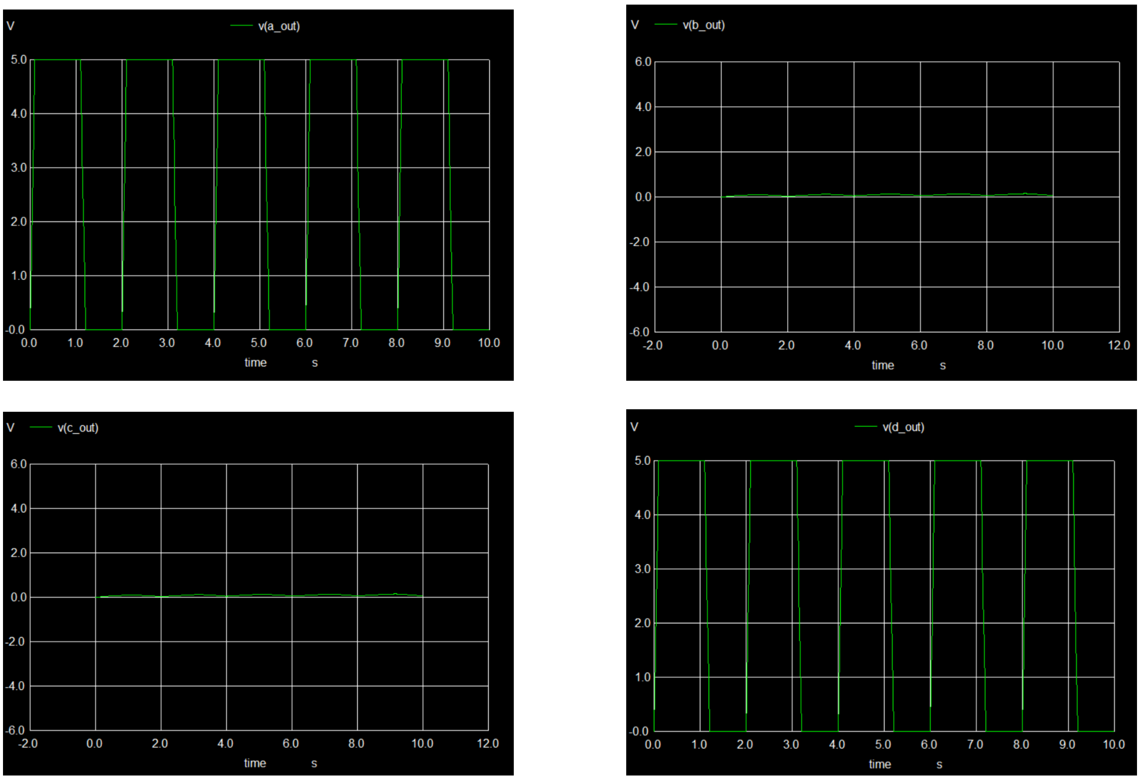


Figure 4.10: Output Voltage Waveform of HCF4066B

4.3 NE5517 - Dual Operational Transconductance Amplifier

The *NE5517* is a dual operational transconductance amplifier (OTA) IC designed for applications needing variable gain or current-controlled amplification. Each amplifier section includes an OTA and a linear buffer, enabling functions like voltage-controlled amplification, filtering, modulation, and oscillation. The output current is linearly proportional to the input voltage and regulated by an external bias current.

Unlike traditional op-amps, the NE5517's gain is controlled electronically via a bias current rather than external resistors. This feature allows greater flexibility in analog signal processing, including voltage-controlled filters, AGC systems, and analog computation circuits. It supports a wide supply range from ±3V to ±18V, offers a high gain-bandwidth product, and maintains low distortion.

Commonly used in audio systems, synthesizers, instrumentation, and analog computing, the NE5517 eliminates the need for mechanical components in dynamic signal control. Available in standard 14-pin DIP or SOIC packages, it is popular in both commercial and industrial analog designs due to its versatility and compact form factor.

4.3.1 IC Layout

This figure represents the Pin Package Diagram of NE5517 IC

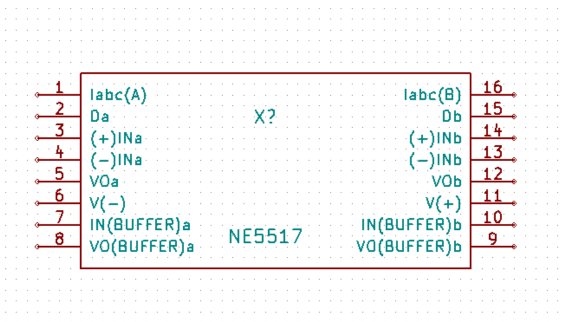


Figure 4.11: Pin diagram of NE5517 IC

4.3.2 Subcircuit Schematic Diagram

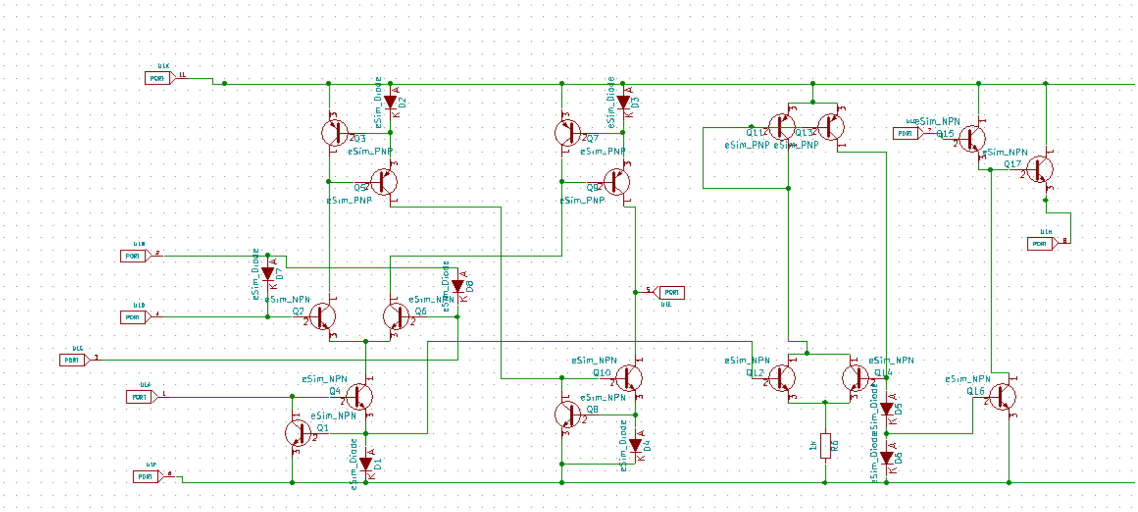


Figure 4.12: Subcircuit Schematic of NE5517 IC(1/2th)

4.3.3 Test Circuit

The test circuit is configured as a unity gain amplifier, where the output voltage directly follows the input. This setup demonstrates the NE5517's capability in buffer or voltage follower applications.

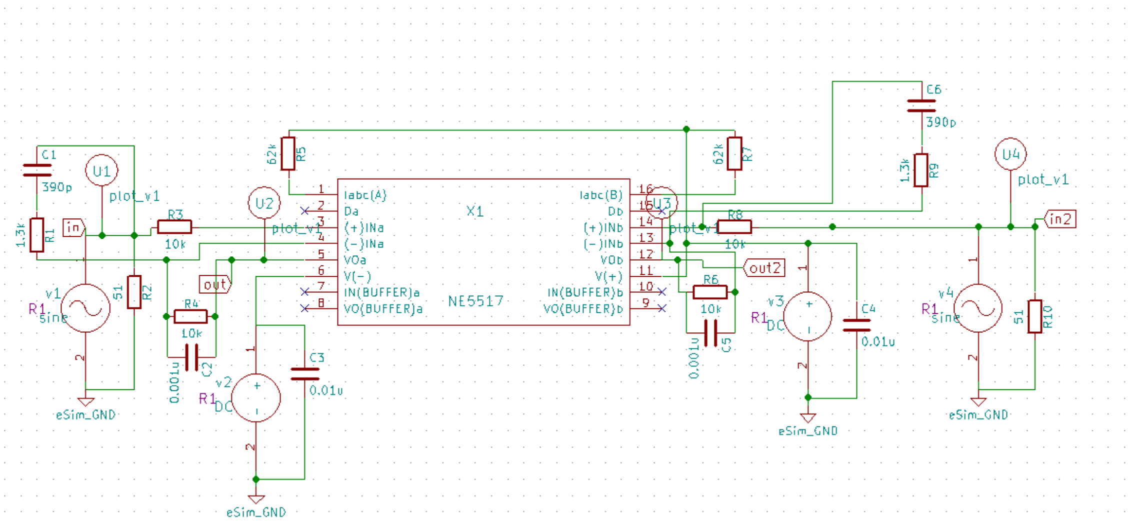


Figure 4.13: Test Circuit of NE5517 IC

4.3.4 Input Plots

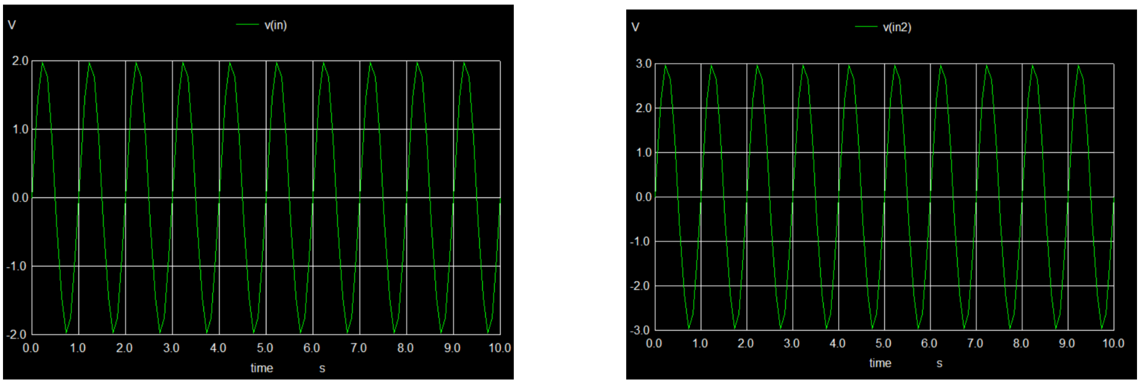


Figure 4.14: Input Voltage Waveform of NE5517 IC

4.3.5 Output Plots

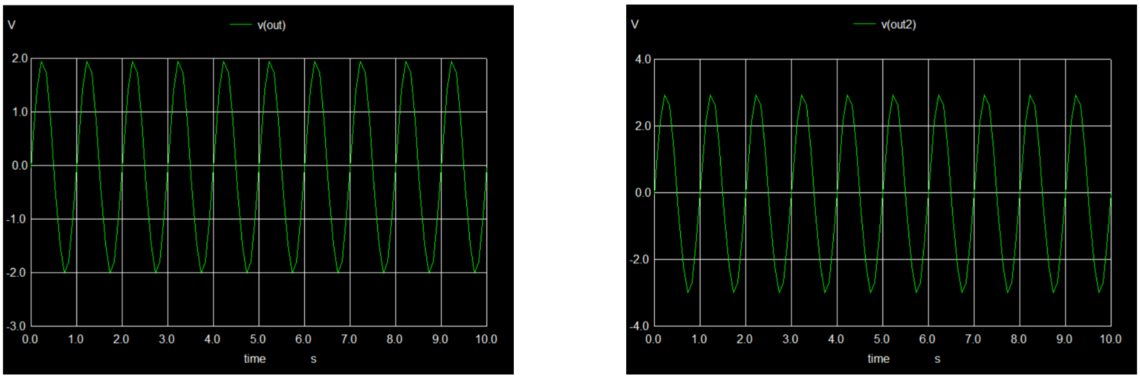


Figure 4.15: Output Voltage Waveform of NE5517 IC(Unity Gain Amplifier)

4.4 M5223 - Dual Operational Amplifier

The **M5223** is a dual operational amplifier IC designed for single power supply operation with high performance and internal phase compensation. It features two independent op-amps in an 8-pin SIP, DIP, or FP package, supporting wide input and output voltage ranges starting from the ground level. This makes it suitable for various analog signal processing applications.

With a wide supply voltage range (3V to 36V), high voltage gain of 100 dB (typical), and power dissipation capacity up to 800 mW, the M5223 is ideal for use in environments with limited power availability. It also allows the output voltage to go near the GND level, enhancing flexibility in low-voltage operations.

Common applications include cassette decks, turntables, VTRs, audio disc players, automotive electronics, communication equipment, and electronic toys. Its versatile design also supports use as a simple comparator in digital and analog control circuits.

4.4.1 IC Layout

This figure represents the Pin Package Diagram of M5223 IC

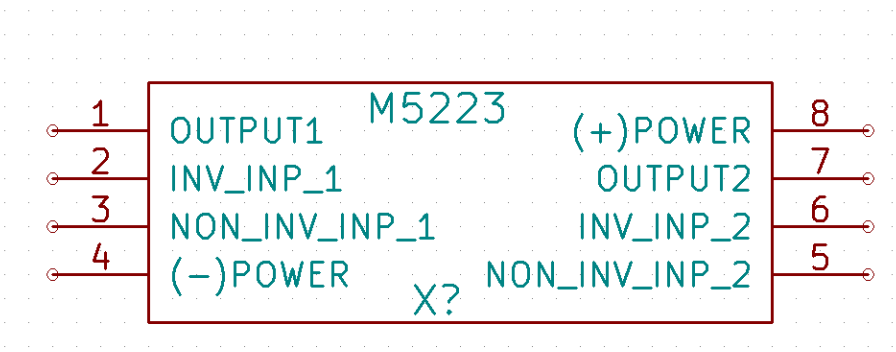


Figure 4.16: Pin diagram of M5223 IC

4.4.2 Subcircuit Schematic Diagram

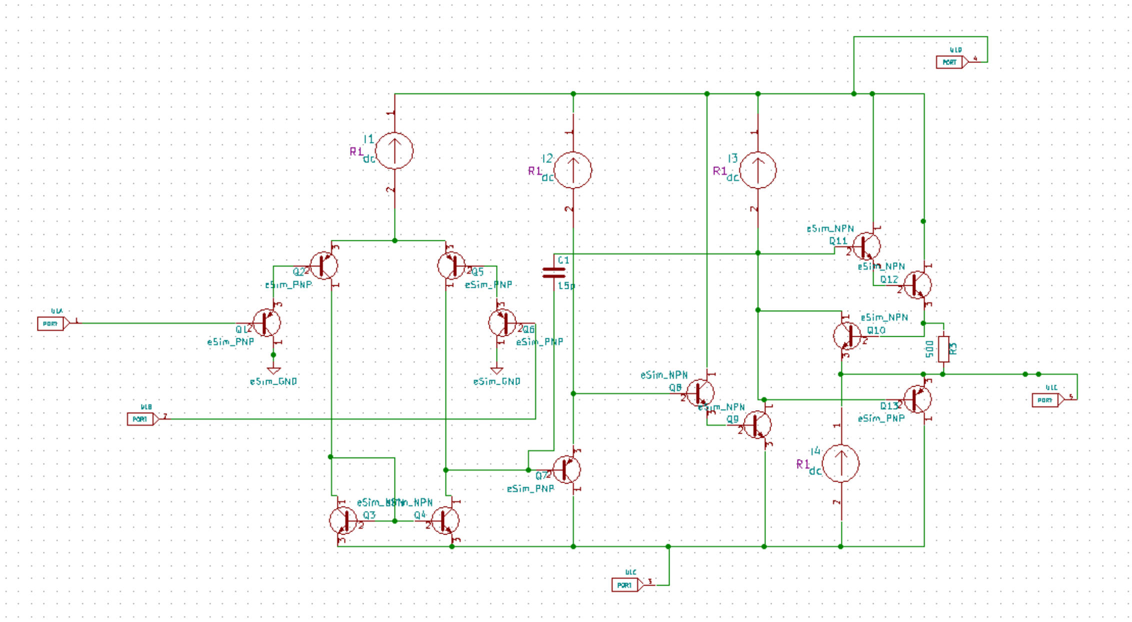


Figure 4.17: Subcircuit Schematic of M5223 IC(1/2th)

4.4.3 Test Circuit

The test circuit uses the M5223 in **inverting mode** with a voltage gain of **-2**. The input is fed to the inverting terminal, and the output is an amplified, inverted version of the input signal.

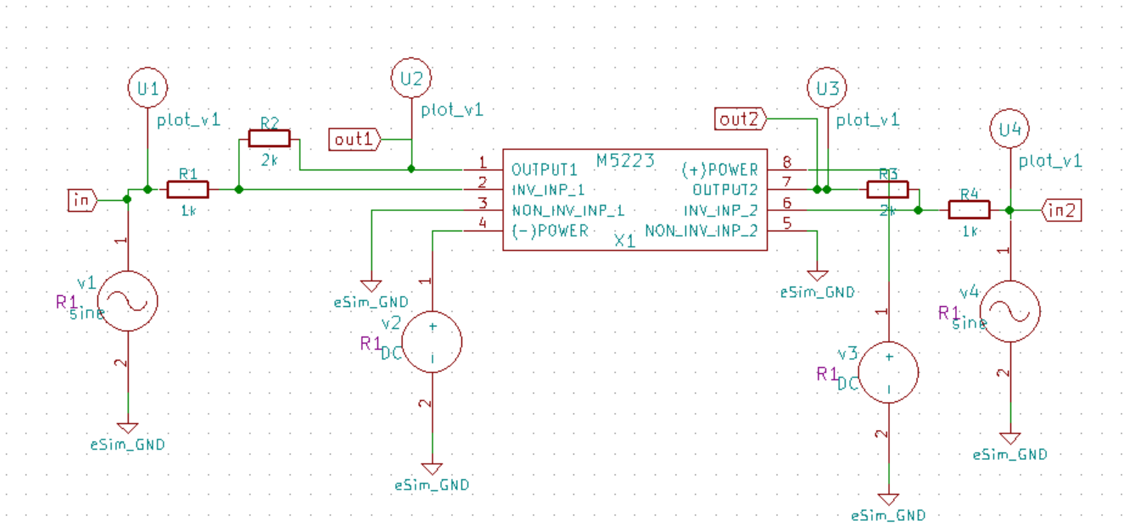


Figure 4.18: Test Circuit of M5223 IC

4.4.4 Input Plots

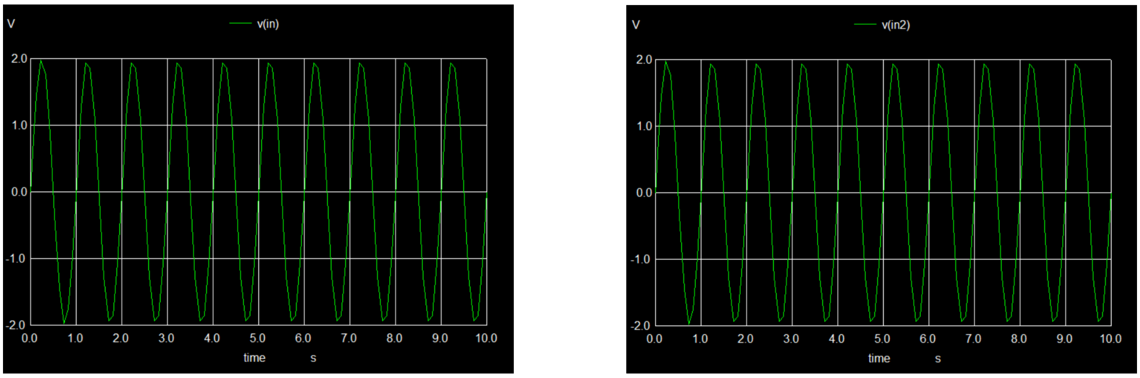


Figure 4.19: Input Voltage Waveform of M5223 IC

4.4.5 Output Plots

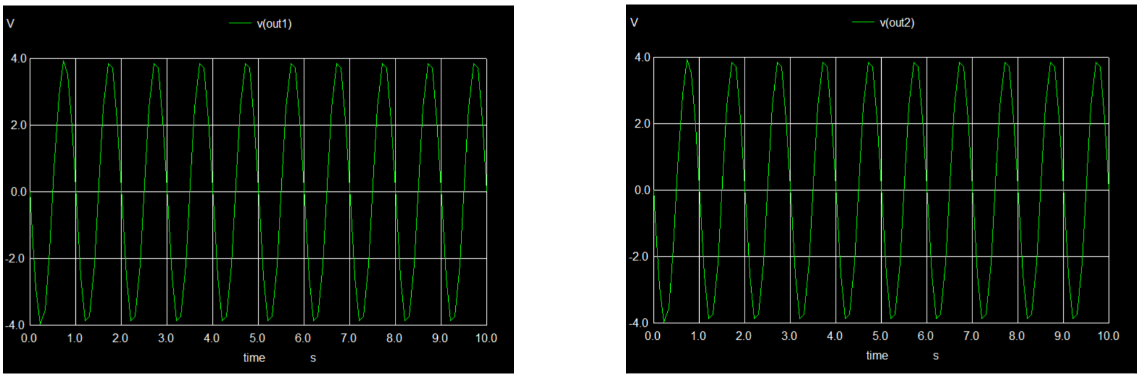


Figure 4.20: Output Voltage Waveform of M5223 IC(Inverting Amplifier)

4.5 M5234 - Quad Comparator

The **M5234** is a quad comparator IC designed for single-supply operation over a wide voltage range from **2V to 36V**. It includes four comparator circuits in a 14-pin DIP or flat package, suitable for various electronic control and signal processing applications. A differential circuit enhances input operation near ground level for improved performance.

This IC features a low typical current consumption of **0.8 mA**, fast response time of **1.3** μ**s**, and an open-collector output capable of sinking up to **25 mA**. It supports common-mode input voltage from 0V to $\mathbf{V_{CC} - 1.5V}$.

The M5234 is pin-compatible with standard comparator ICs like LM339 and LM2901, making it ideal for CR timers, voltage comparators, oscillators, window detectors, and time delay circuits.

4.5.1 IC Layout

This figure represents the Pin Package Diagram of M5234 IC

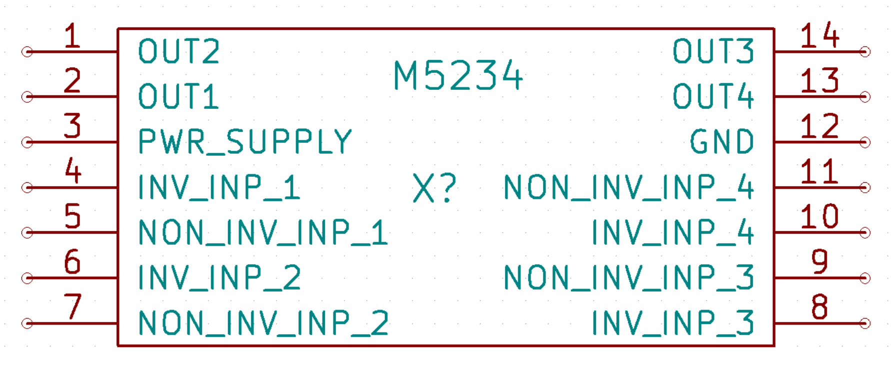


Figure 4.21: Pin diagram of M5234 IC

4.5.2 Subcircuit Schematic Diagram

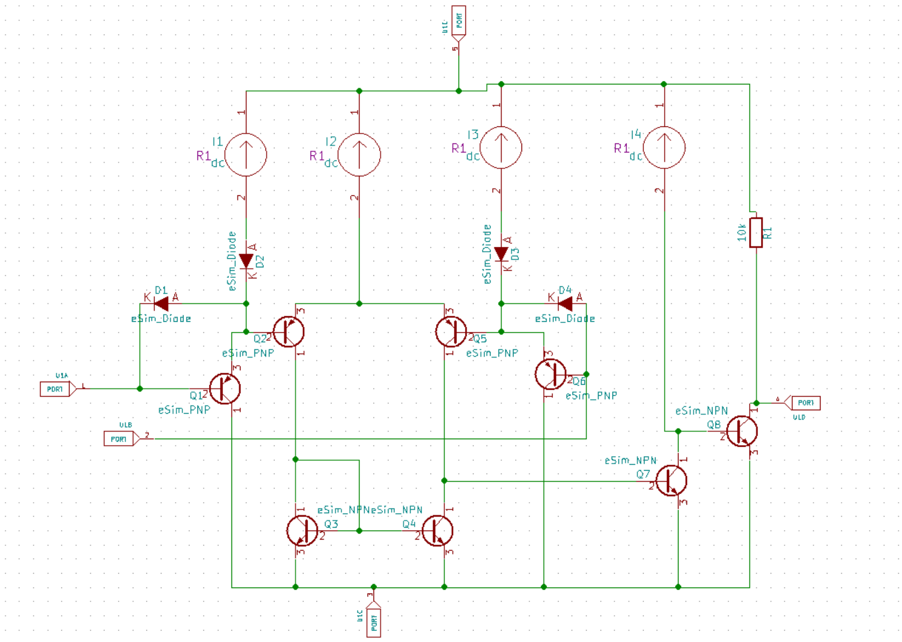


Figure 4.22: Subcircuit Schematic of M5234 IC(1/4th)

4.5.3 Test Circuit

In the test circuit, a **5V sinusoidal input signal** is applied to each of the four comparators in the M5234 IC. This setup allows verification of the response and functionality of all channels under identical input conditions.

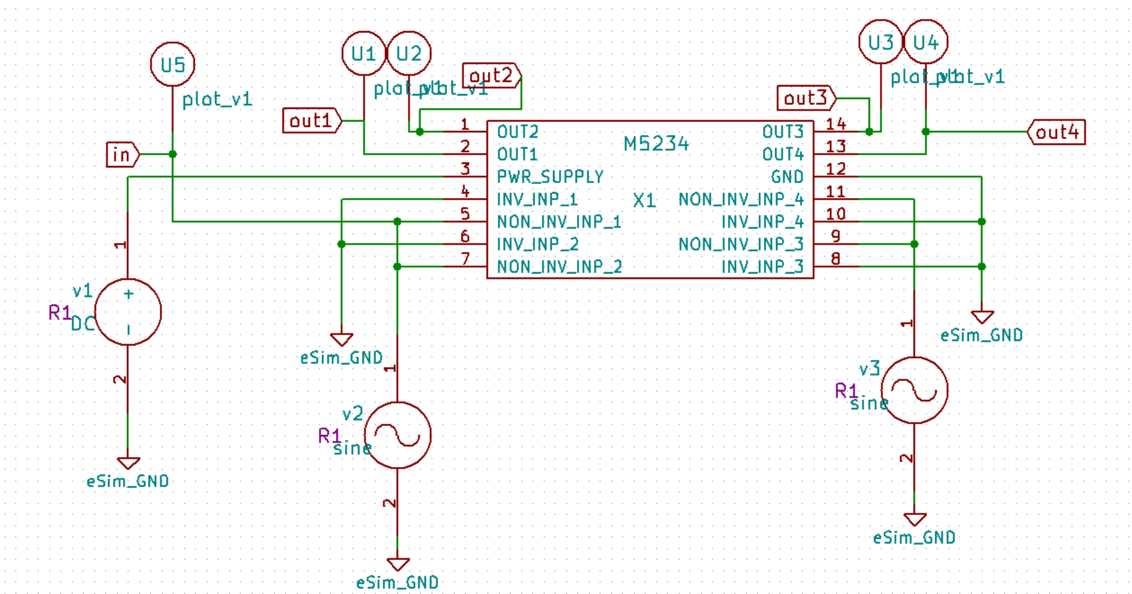


Figure 4.23: Test Circuit of M5234 IC

4.5.4 Input Plots

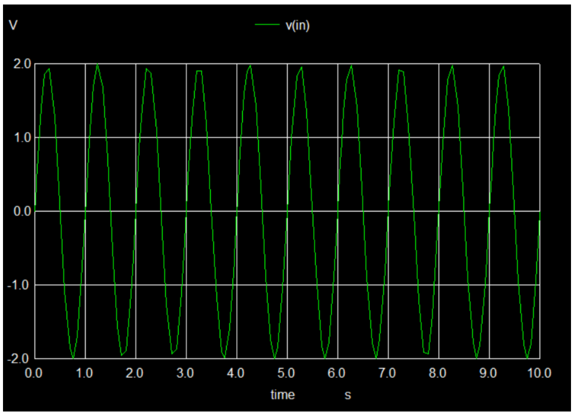


Figure 4.24: Input Voltage Waveform of M5234

4.5.5 Output Plots

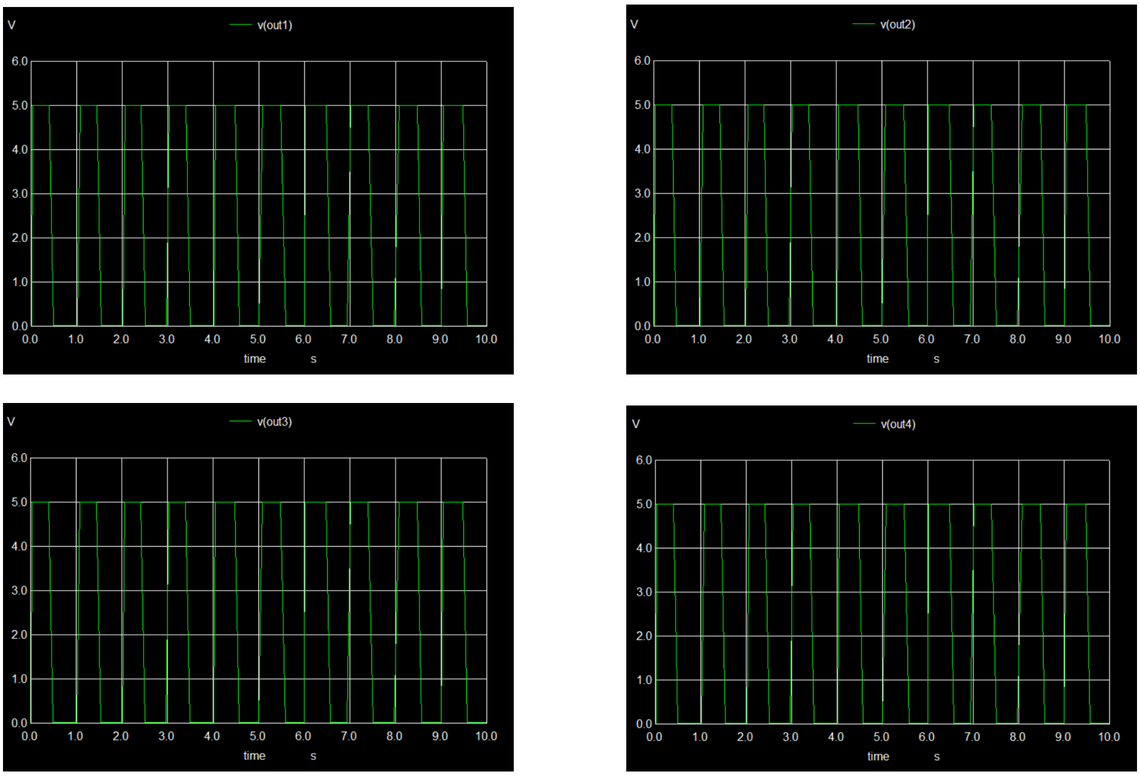


Figure 4.25: Output Voltage Waveform of M5234

4.6 M5228 - Quad Low-Noise Operational Amplifier

The **M5228** is a quad low-noise operational amplifier IC designed for audio preamplifiers and general-purpose analog signal processing. It offers high gain, low distortion, and excellent noise performance, making it ideal for stereo equipment and portable devices. Each IC contains four internally phase-compensated op-amps in a 14-pin DIP or mini flat package.

With a gain of **110 dB**, slew rate of **2.2 V/μs**, and low input noise, the M5228 ensures superior signal fidelity. It operates with low supply voltages and can drive high load currents up to **50 mA**, supporting power dissipation up to **700 mW** (DIP).

Applications include audio amplifiers, tape decks, active filters, and servo circuits. It is also compatible with popular op-amps like the 741, making it a reliable choice for various analog systems.

4.6.1 IC Layout

This figure represents the Pin Package Diagram of M5228 IC

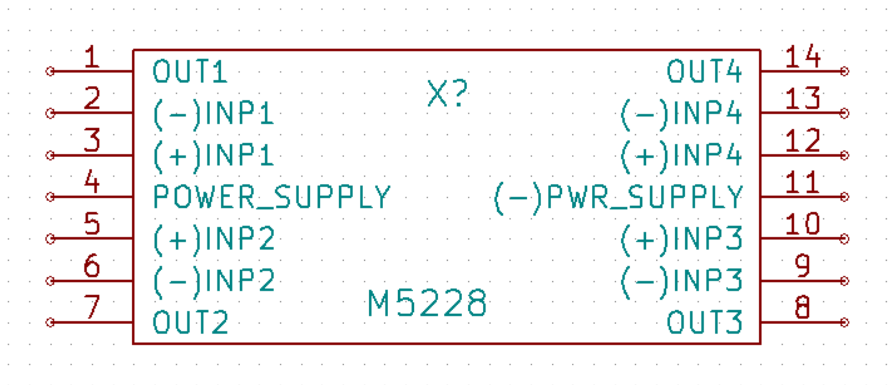


Figure 4.26: Pin diagram of M5228 IC

4.6.2 Subcircuit Schematic Diagram

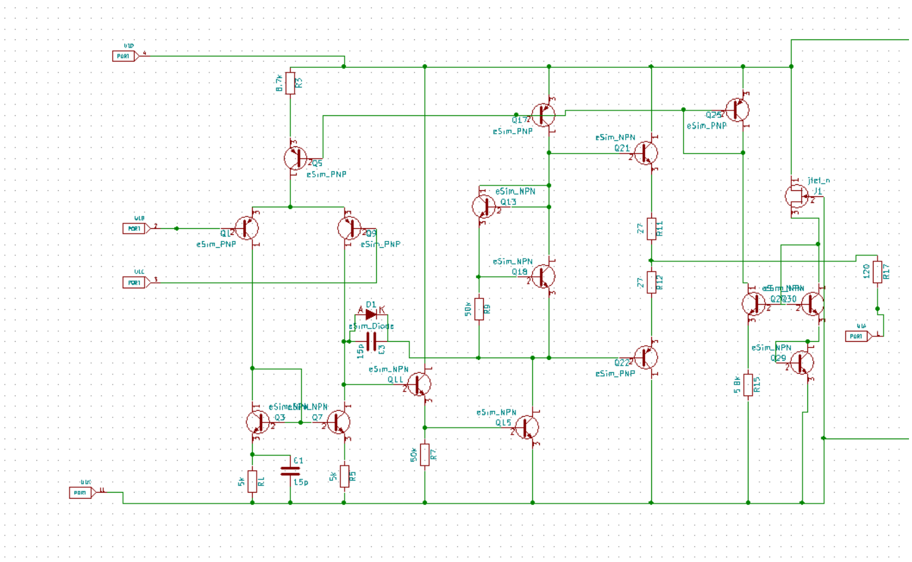


Figure 4.27: Subcircuit Schematic of M5228 IC(1/4th)

4.6.3 Test Circuit

The test circuit is configured as an **inverting amplifier** using one of the op-amps in the M5228 IC. The circuit provides a voltage gain of **-2**, inverting and amplifying the input signal by a factor of 2.

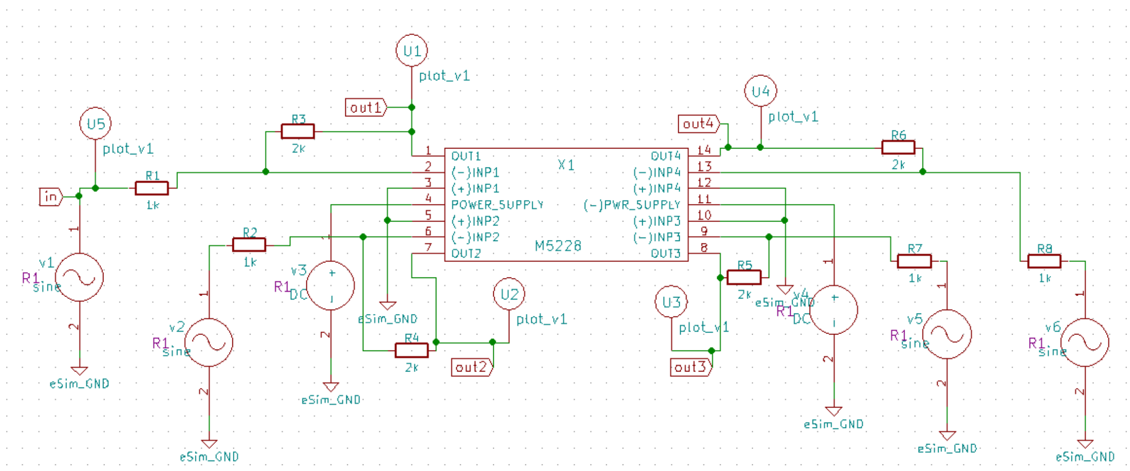


Figure 4.28: Test Circuit of M5228 IC

4.6.4 Input Plots

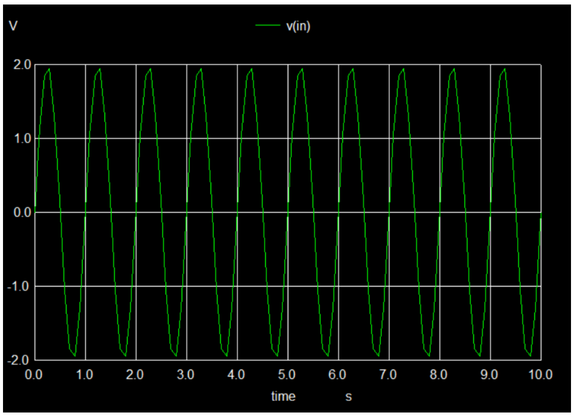


Figure 4.29: Input Voltage Waveform of M5228

4.6.5 Output Plots

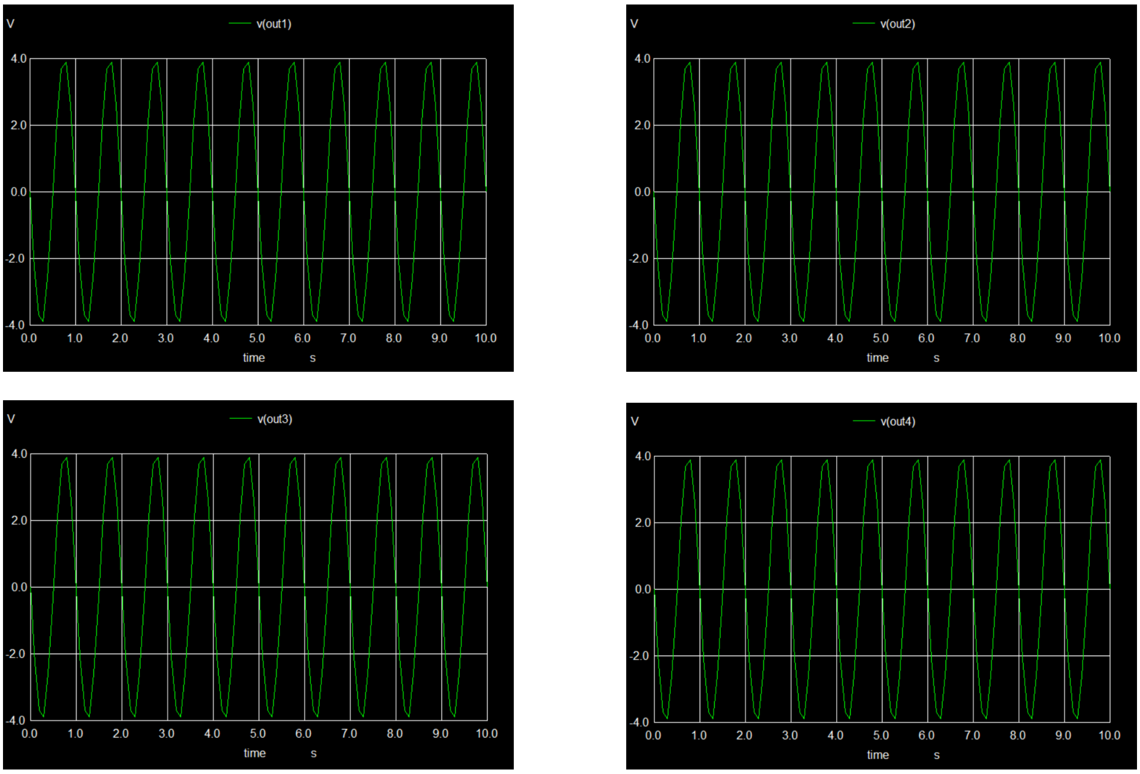


Figure 4.30: Output Voltage Waveform of M5228

4.7 M51206 - Voltage Comparator

The **M51206** is a single-supply voltage comparator IC designed for low-power operation in timing and control applications. With high input resistance and low input current, it is ideal for use in CR timers, electric shutters, and oscillators. It comes in compact 5-pin SIP and 8-pin mini flat packages for ease of integration.

This device features a low input current of **15 nA** and includes a built-in Zener diode to stabilize the internal supply voltage at **5.6V (typical)**. It supports direct driving of lamps or relays due to its high output breakdown voltage of **30V**.

The M51206 is best suited for simple comparator circuits in consumer electronics and control systems. It operates reliably at a recommended supply voltage of **12V (with R_D = 1kΩ)**.

4.7.1 IC Layout

This figure represents the Pin Package Diagram of M51206 IC

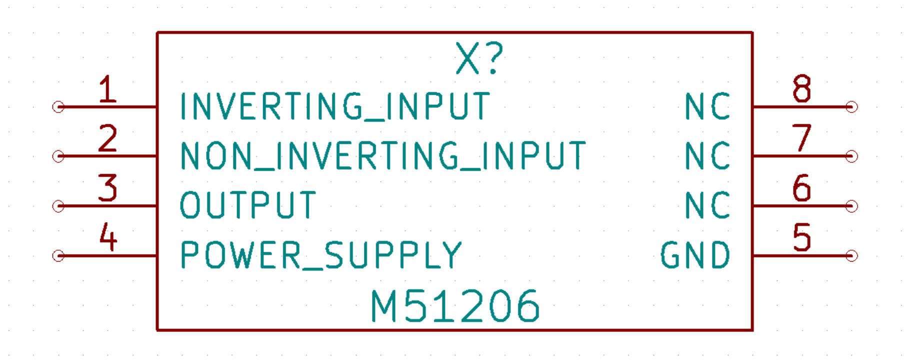


Figure 4.31: Pin diagram of M51206 IC

4.7.2 Subcircuit Schematic Diagram

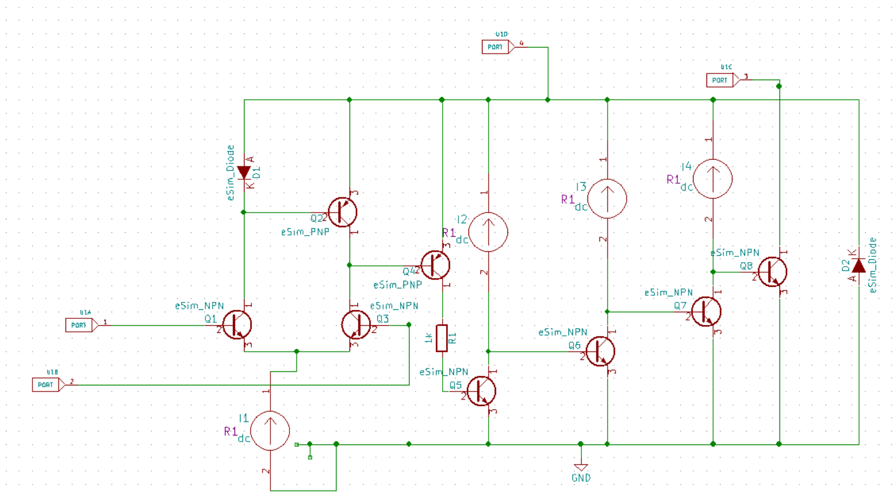


Figure 4.32: Subcircuit Schematic of M51206 IC

4.7.3 Test Circuit

In the test circuit, a **2V sinusoidal input signal** is applied to the comparator input of the M51206. This allows observation of the output switching behavior in response to the varying input voltage.

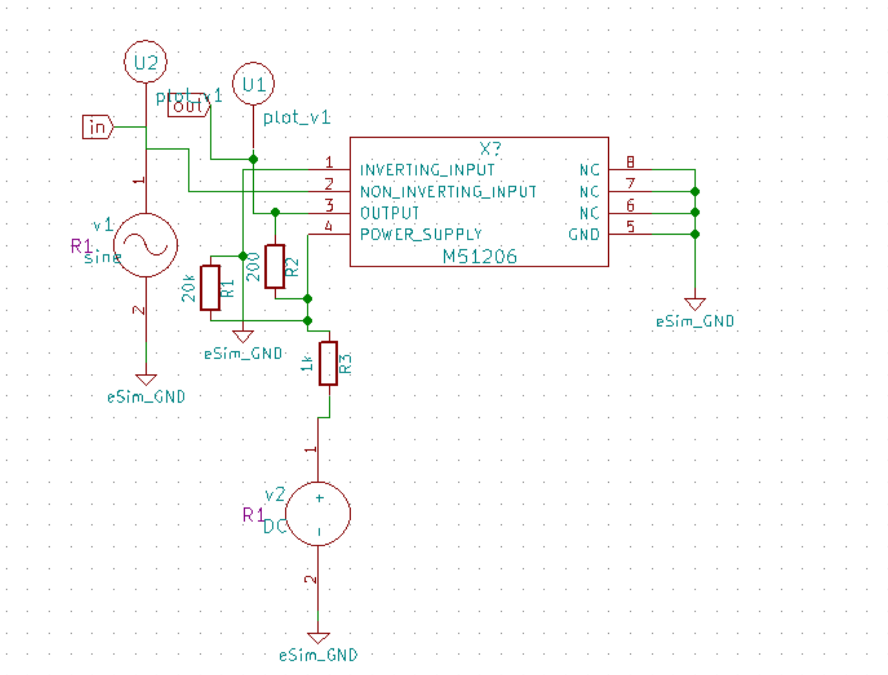


Figure 4.33: Test Circuit of M51206 IC

4.7.4 Input Plots

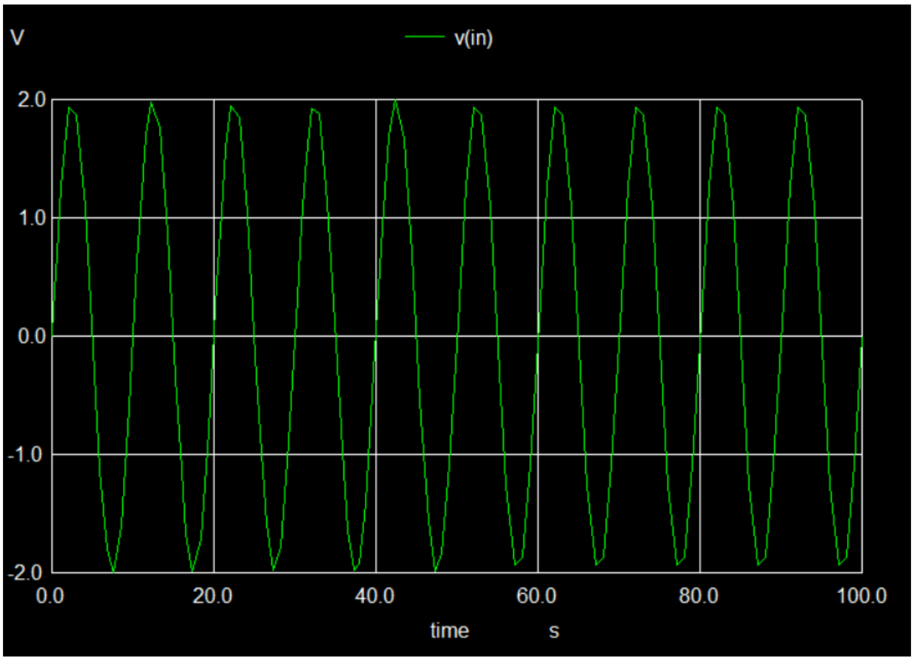


Figure 4.34: Input Voltage Waveform of M51206

4.7.5 Output Plots

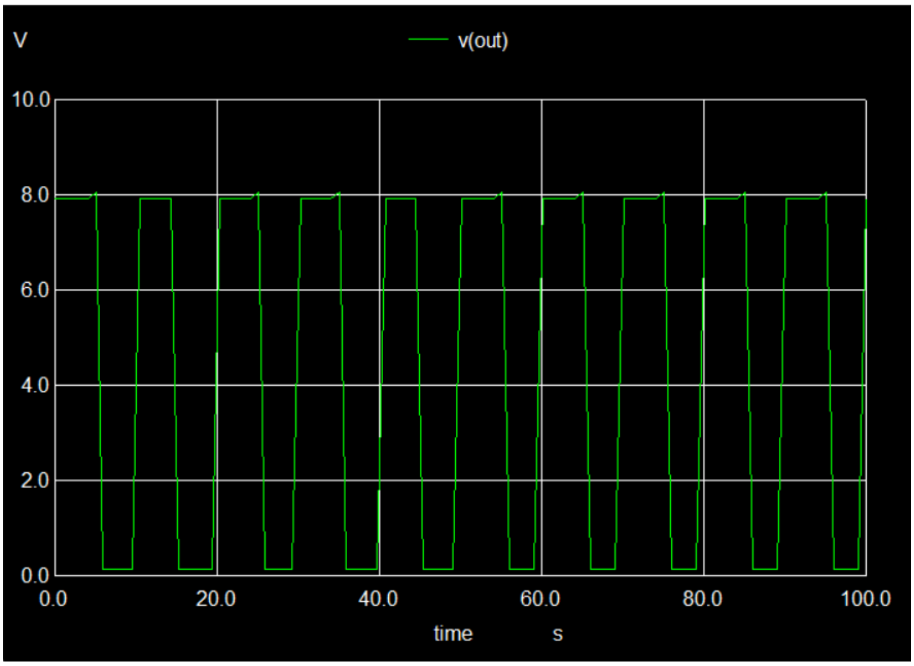


Figure 4.35: Output Voltage Waveform of M51206

4.8 MC14572UB - Hex Gate

The **MC14572UB** is a hex functional logic gate IC built using complementary MOS (CMOS) technology. It integrates four inverters, one NOR gate, and one NAND gate in a single chip, designed for low power consumption and high noise immunity applications.

It operates over a wide supply voltage range of **3V to 18V** and offers single-supply operation with diode protection on all inputs. Convenient pin configurations allow the NOR and NAND gates to be easily used as inverters. It can directly drive TTL and low-power Schottky TTL loads.

This IC is ideal for general-purpose logic applications, offering versatile digital functionality in compact 16-pin DIP, SOIC, and SOEIAJ packages. It is suited for use in industrial, consumer, and educational logic circuits.

4.8.1 IC Layout

This figure represents the Pin Package Diagram of MC14572UB IC

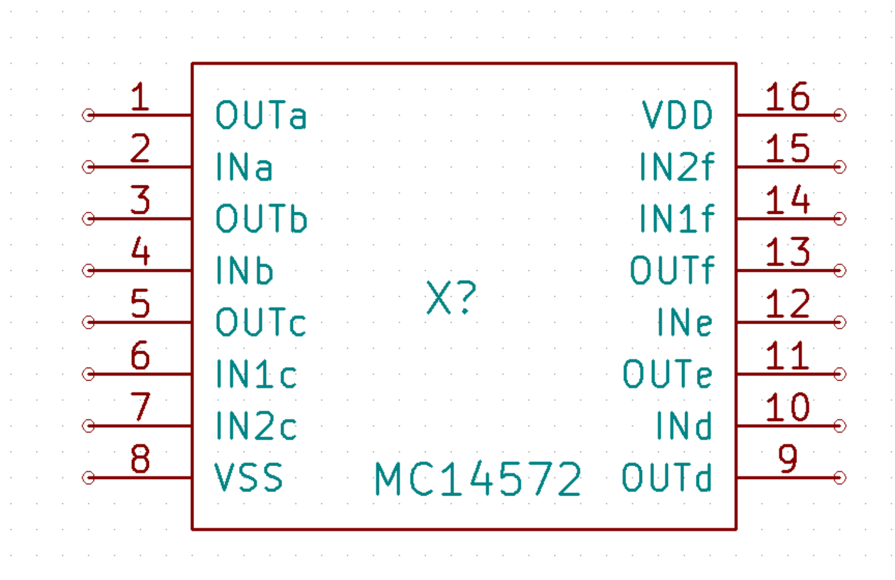


Figure 4.36: Pin diagram of MC14572UB IC

4.8.2 Subcircuit Schematic Diagram

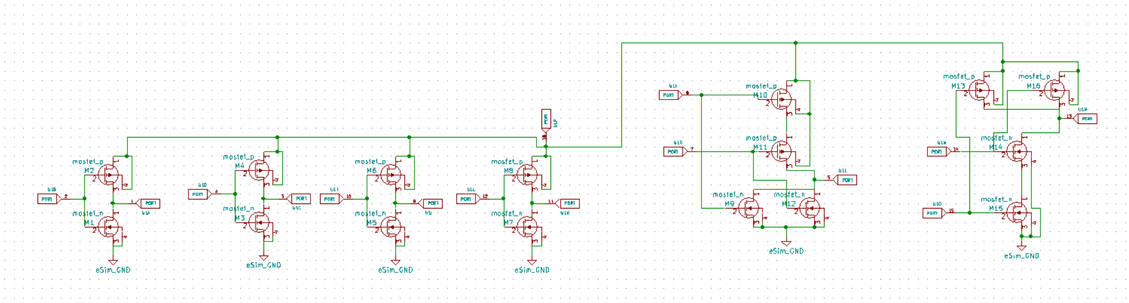


Figure 4.37: Subcircuit Schematic of MC14572UB IC

4.8.3 Test Circuit

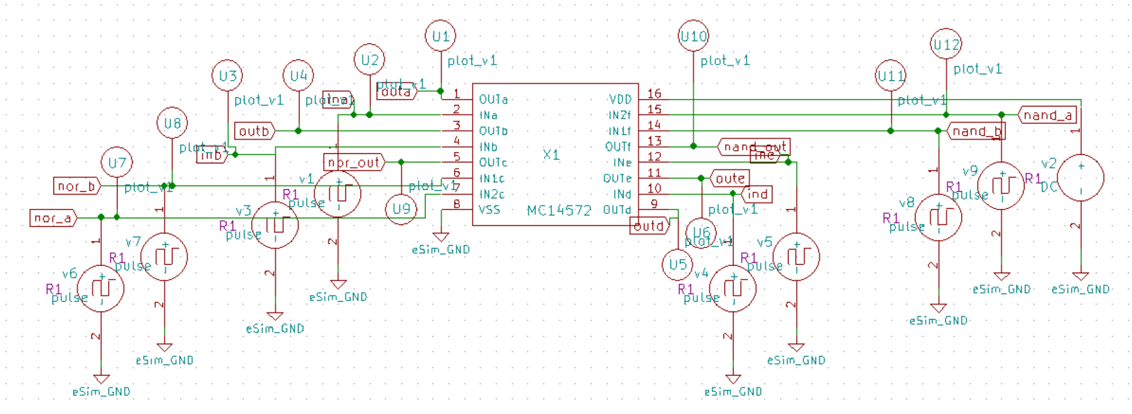
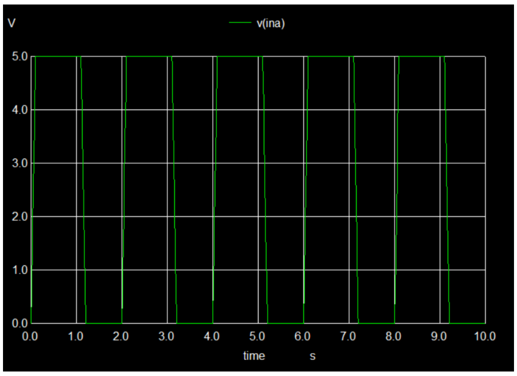
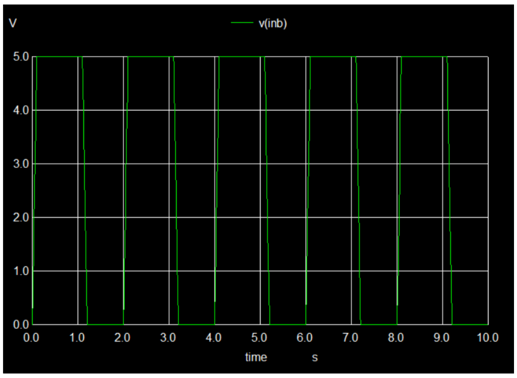


Figure 4.38: Test Circuit of MC14572UB IC

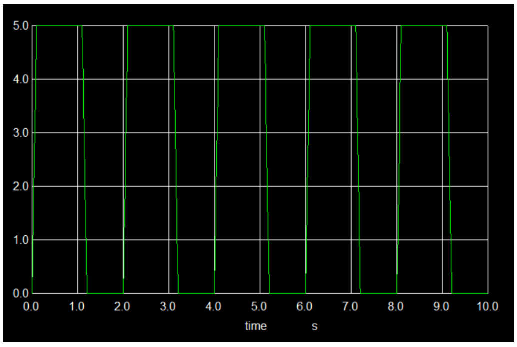
4.8.4 Input Plots



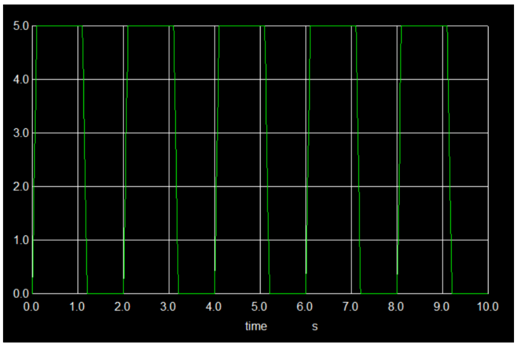
(a) Input of inverter A



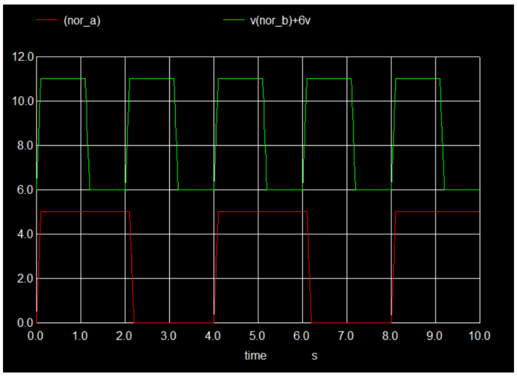
(b) Input of inverter B



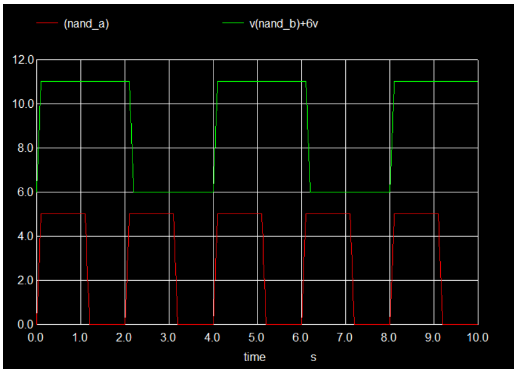
(c) Input of inverter C



(d) Input of inverter D



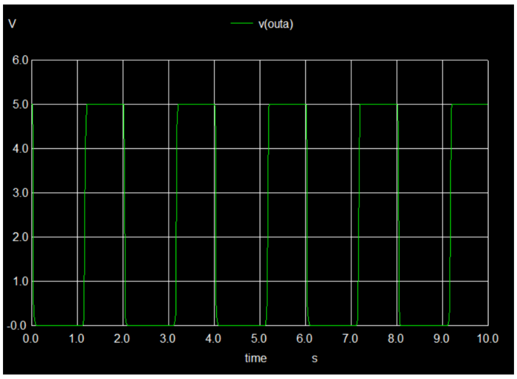
(e) Inputs of NOR



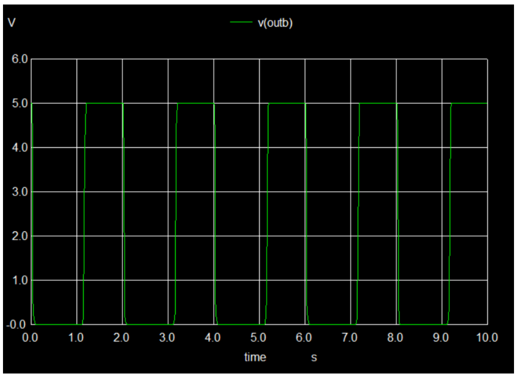
(f) Inputs of NAND

Figure 4.39: Input Voltages Waveform of MC14572UB

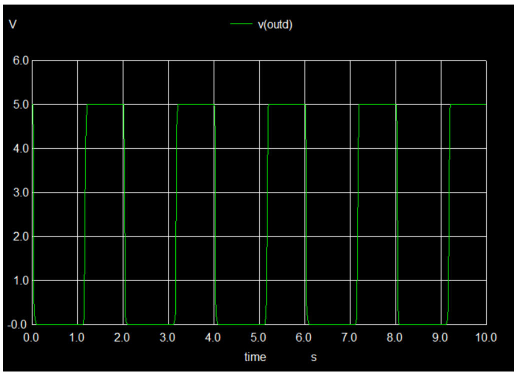
4.8.5 Output Plots



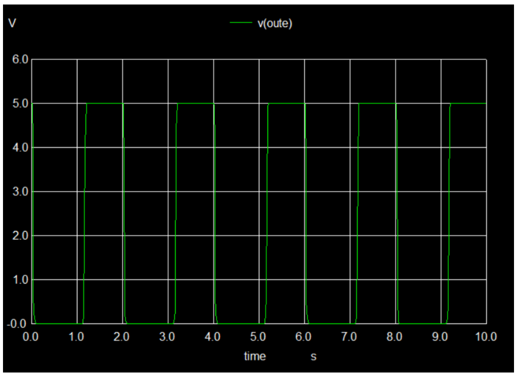
(a) Output of inverter A



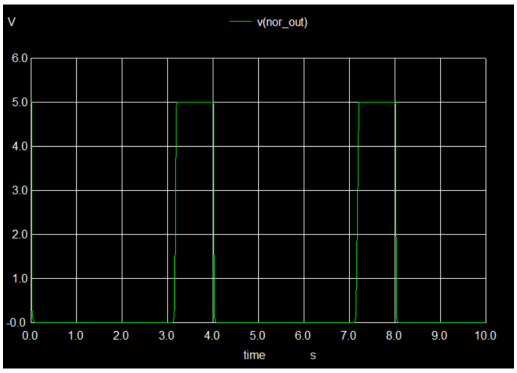
(b) Output of inverter B



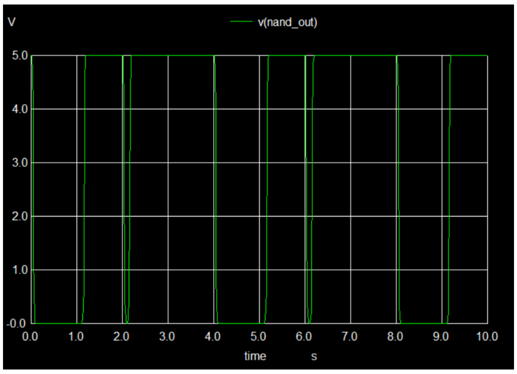
(c) Output of inverter C



(d) Output of inverter D



(e) Output of NOR



(f) Output of NAND

Figure 4.40: Output Voltage Waveforms of MC14572UB

4.9 MC14501UB - Triple Gate

The **MC14501UB** is a CMOS logic gate IC integrating 2-input NOR/OR gates and an 8-input AND/NAND gate. Constructed using P-channel and N-channel enhancement-mode MOS devices, it is optimized for low power dissipation and high noise immunity in digital systems.

This IC operates over a wide supply voltage range of **3.0V to 18V** and features diode protection on all inputs. It supports TTL or low-power Schottky TTL loads, with consistent logic swing performance regardless of fan-out. A special feature allows external pin configuration to switch between AND and NAND functions.

Commonly used in logic design and control circuits, the MC14501UB comes in plastic, ceramic, and SOIC packages, making it ideal for versatile applications in both consumer and industrial electronics.

4.9.1 IC Layout

This figure represents the Pin Package Diagram of MC14501UB IC

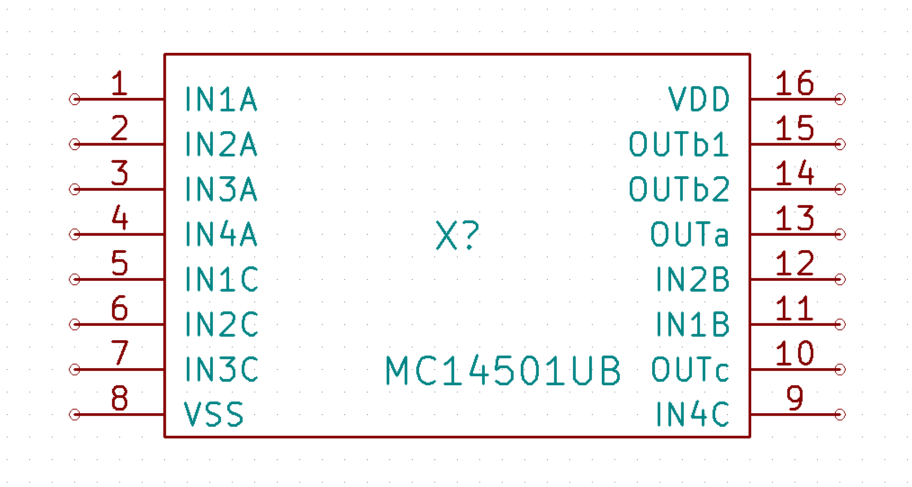


Figure 4.41: Pin diagram of MC14501UB IC

4.9.2 Subcircuit Schematic Diagram

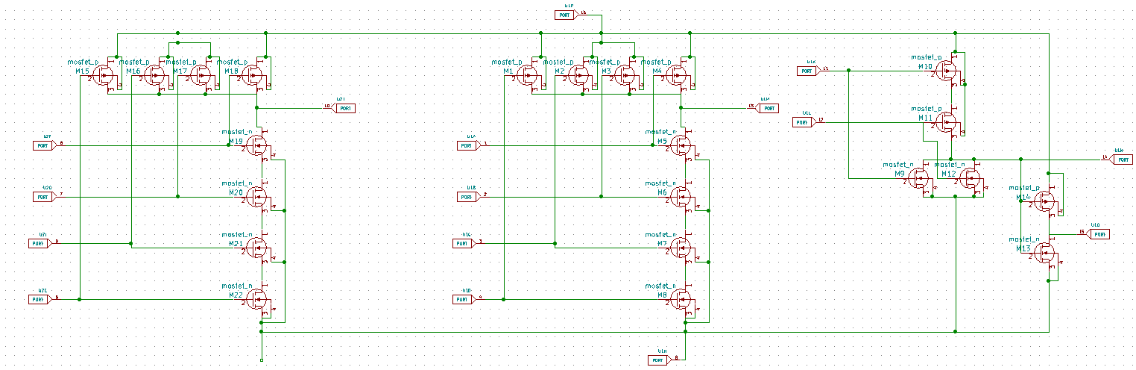


Figure 4.42: Subcircuit Schematic of MC14501UB IC

4.9.3 Test Circuit

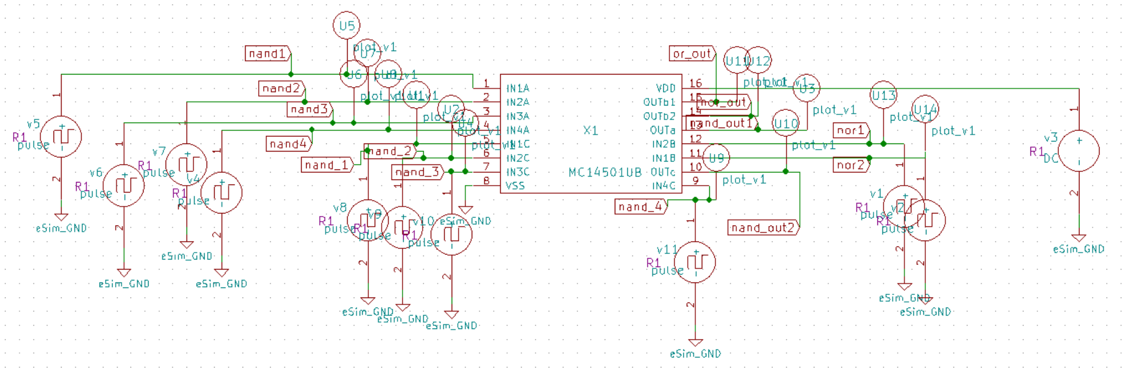


Figure 4.43: Test Circuit of MC14501UB IC

4.9.4 Input Plots

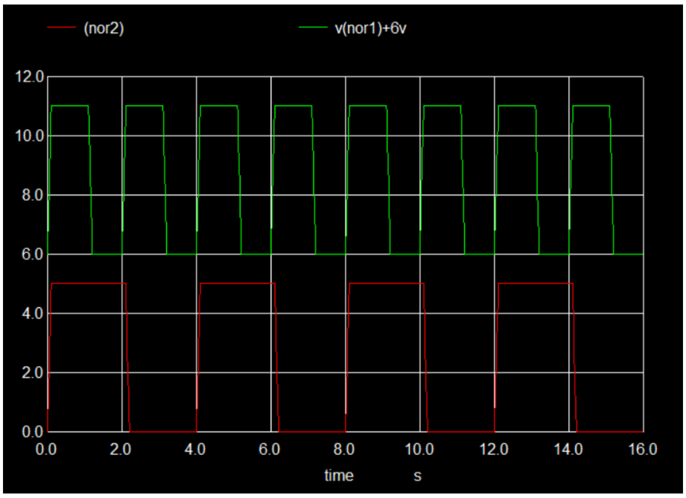


Figure 4.44: Input Voltage Waveform of MC14501UB NOR and OR

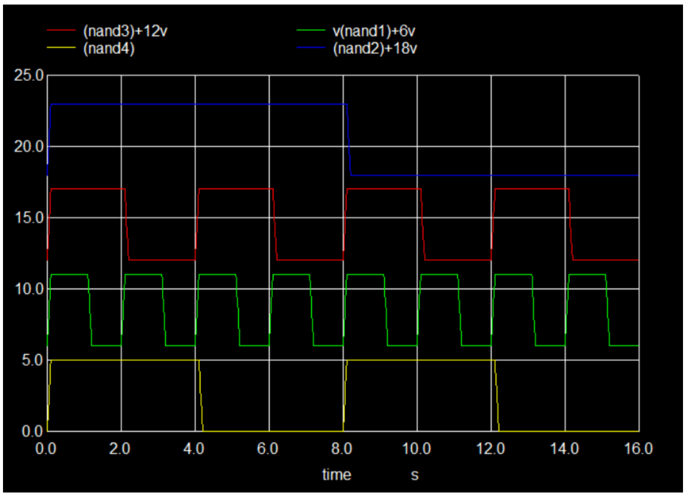
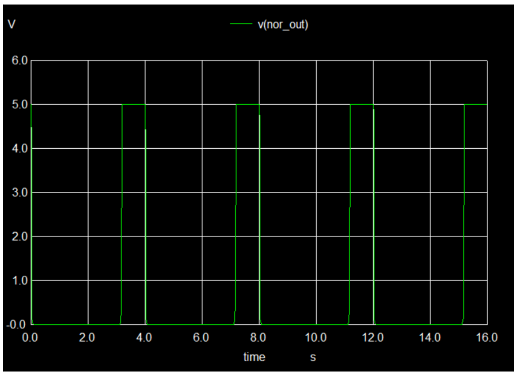
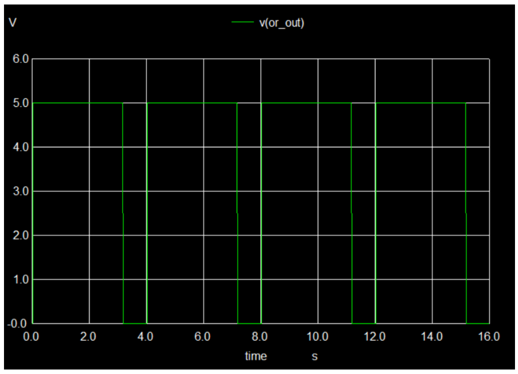


Figure 4.45: Input Voltage Waveform of MC14501UB NAND

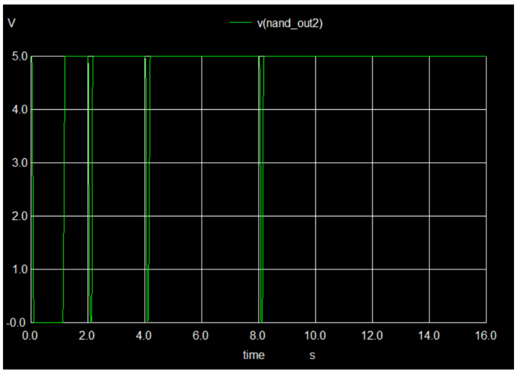
4.9.5 Output Plots



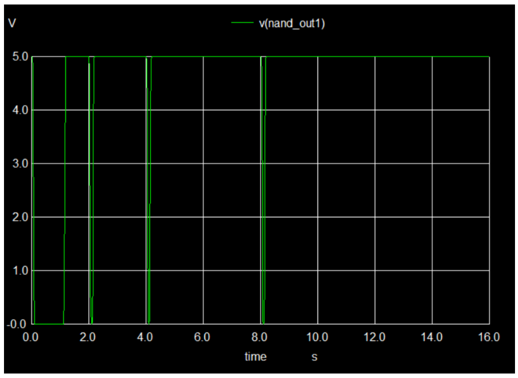
(a) Output of NOR



(b) Output of OR



(c) Output of NAND1



(d) Output of NAND2

Figure 4.46: Output Voltage Waveforms of MC14501UB

4.10 SN74LVC1G0832 - Single 3-Input Positive AND-OR Gate

The **SN74LVC1G0832** is a single 3-input positive AND-OR gate designed for low-voltage, high-speed logic applications. It supports a supply voltage range from 1.65 V to 5.5 V and implements the Boolean function:

$$Y = (A \cdot B) + C$$

providing combined logic in a single compact device.

This IC offers functional versatility. By tying one input to either GND or V_{CC}, it operates as a 2-input logic gate. For example, when $C = 0$, it behaves as an AND gate: $Y = A \cdot B$. When $A = 1$, it functions as an OR gate: $Y = B + C$.

With NanoFree™ packaging, low power consumption, I_{OFF} support, and strong ESD protection, the SN74LVC1G0832 is ideal for portable and power-sensitive logic circuits in compact systems.

4.10.1 IC Layout

This figure represents the Pin Package Diagram of SN74LVC1G0832 IC

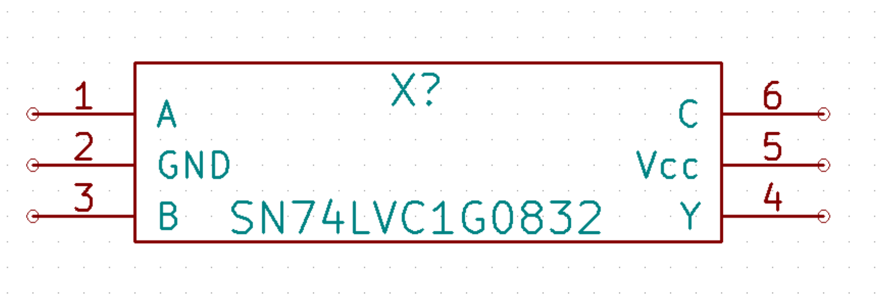


Figure 4.47: Pin diagram of SN74LVC1G0832 IC

4.10.2 Subcircuit Schematic Diagram

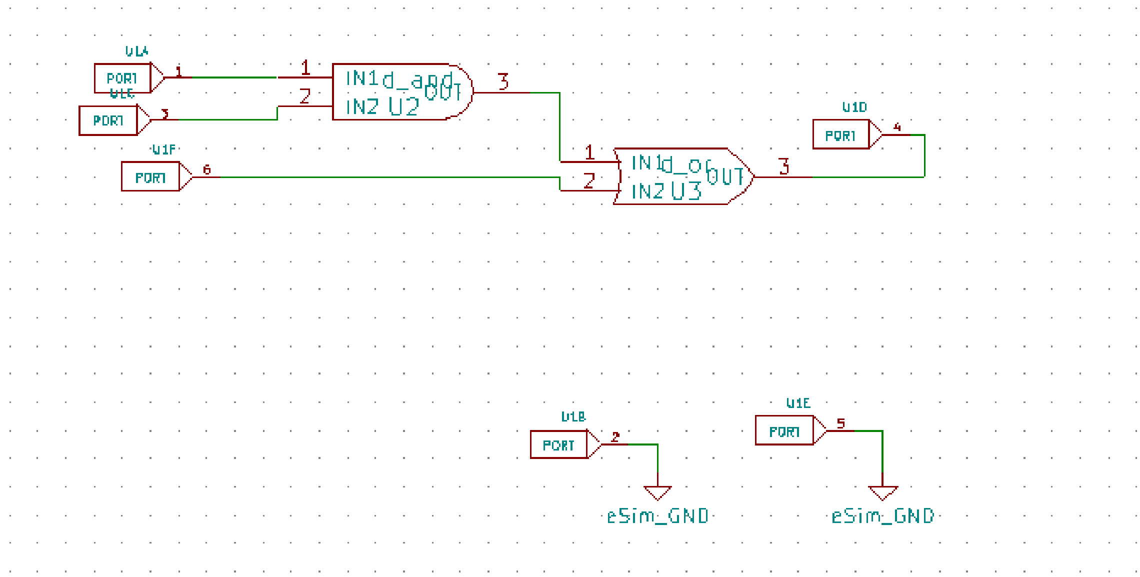


Figure 4.48: Subcircuit Schematic of SN74LVC1G0832 IC

4.10.3 Test Circuit

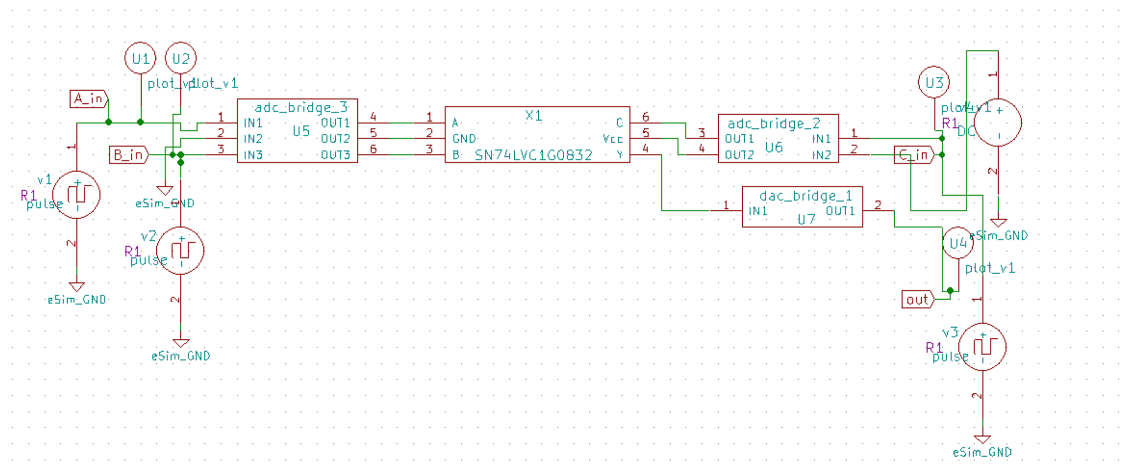


Figure 4.49: Test Circuit of SN74LVC1G0832 IC

4.10.4 Input Plots

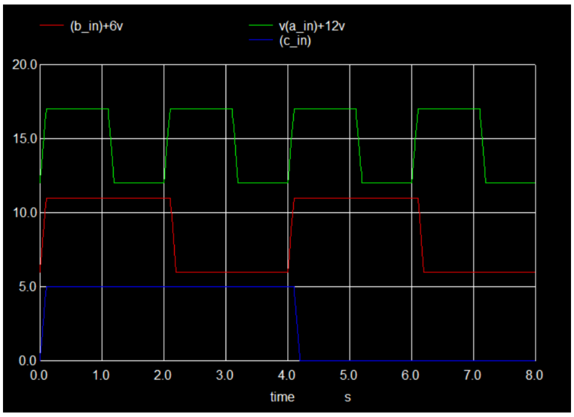


Figure 4.50: Input Voltage Waveform of SN74LVC1G0832

4.10.5 Output Plots

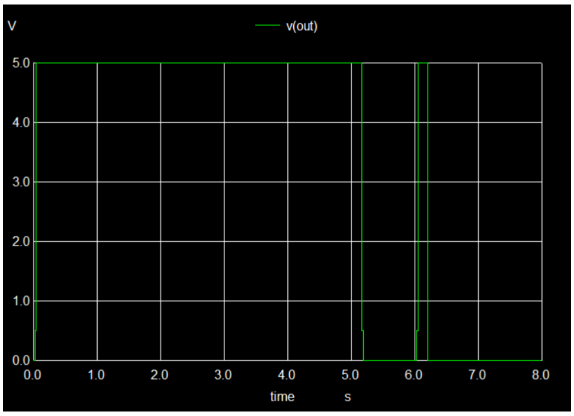


Figure 4.51: Output Voltage Waveform of SN74LVC1G0832

4.11 SN5425 - Dual 4-Input Positive NOR Gate with Strobe

The **SN5425** is a TTL logic IC containing two independent 4-input **positive NOR gates with strobe control**. Each gate performs the Boolean logic function:

$$Y = \overline{A + B + C + D \cdot G}$$

where the output is enabled only when all inputs are at a low logic level and the strobe input (G) is high.

This IC is part of the SN54xx series, characterized for **operation across the full military temperature range** of −55°C to 125°C, making it ideal for high-reliability and defense applications. The logic gates are internally structured to provide consistent performance under harsh conditions.

With its dual-gate configuration, wide operating conditions, and compact 14-pin DIP package, the SN5425 is well-suited for use in mission-critical logic circuits requiring gated NOR operations.

4.11.1 IC Layout

This figure represents the Pin Package Diagram of SN5425 IC

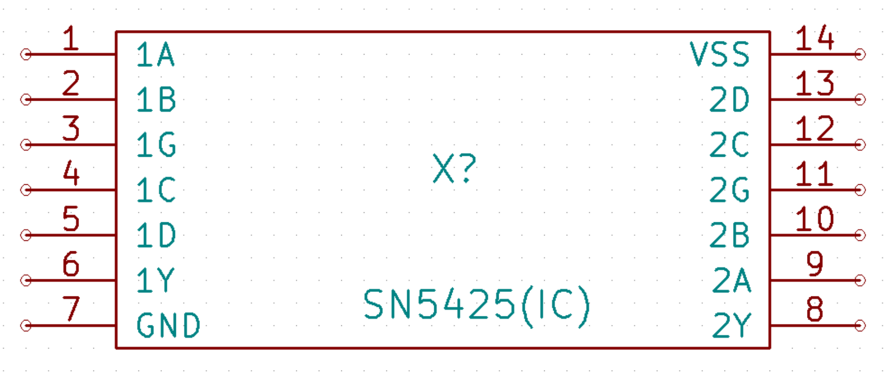


Figure 4.52: Pin diagram of SN5425 IC

4.11.2 Subcircuit Schematic Diagram

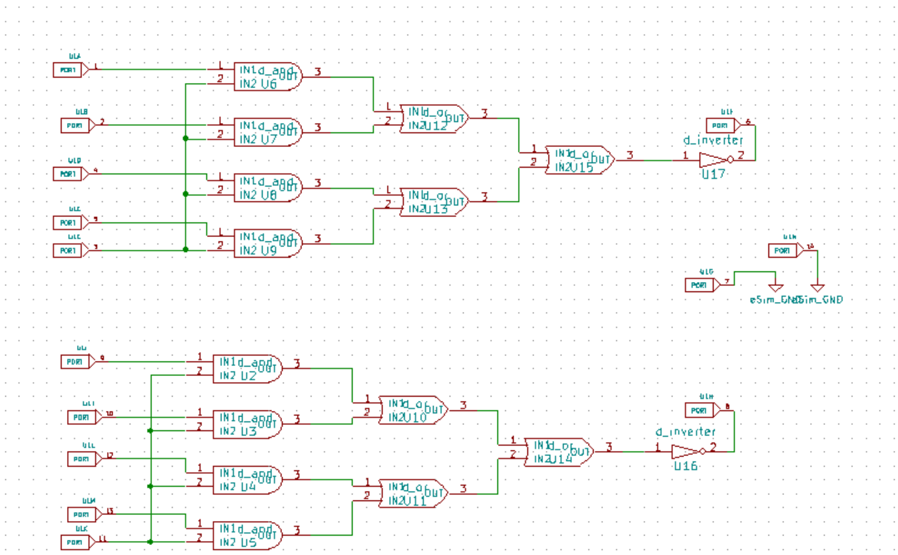


Figure 4.53: Subcircuit Schematic of SN5425 IC

4.11.3 Test Circuit

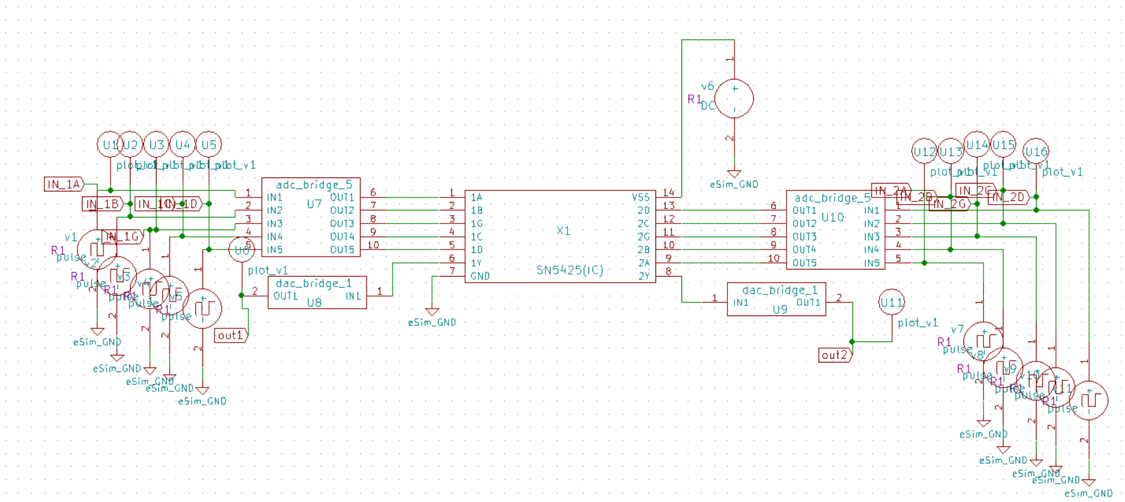


Figure 4.54: Test Circuit of SN5425 IC

4.11.4 Input Plots

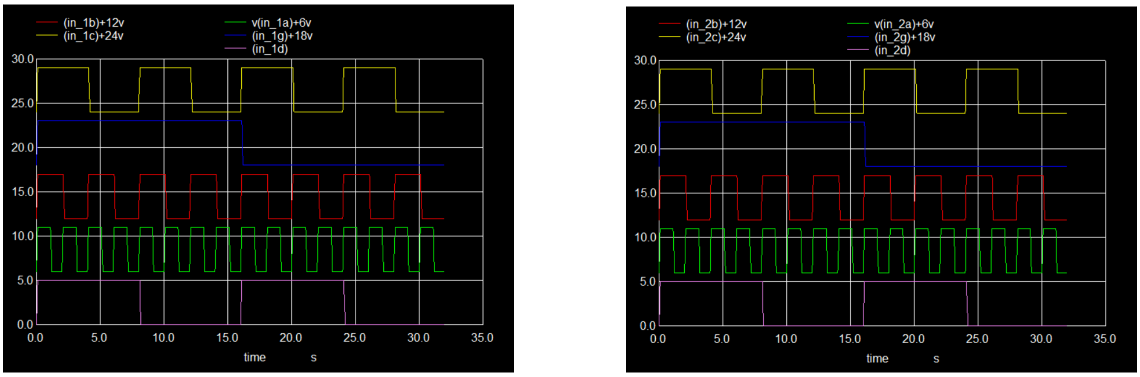


Figure 4.55: Input Voltage Waveform of SN5425 IC

4.11.5 Output Plots

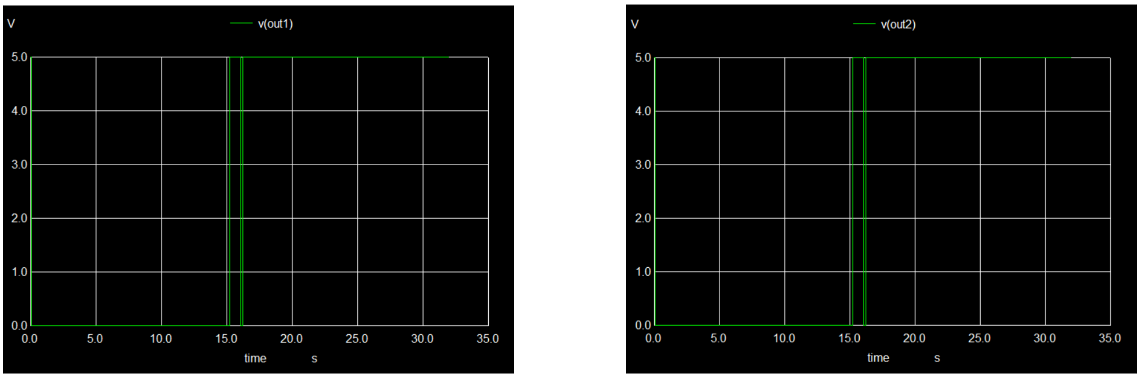


Figure 4.56: Output Voltage Waveform of SN5425 IC

Chapter 5

Conclusion and Future Scope

We were successful to achieve the target of developing various subcircuits for both Analog and Digital Integrated Circuits. Each Integrated Circuit Model was developed strictly according to the information contained in their official data-sheets. The output of each IC was verified and tested successfully with the help of their test circuits. All of these IC Models, developed under this Fellowship are very basic circuit units, such as Op-Amps, Voltage Regulators, Precision Rectifier, Schmitt Trigger, Differential Amplifier, Instrumentation Amplifier, Comparator, Multiplexer, DeMultiplexer and various Logic gate ICs. Each of these ICs is ready to be integrated in the subcircuit library of eSim. Developers and Students can use these ICs in their projects and circuit models as units. With the development and expansion of the device model library in eSim, We expect more such ready to use IC models be developed to be used in eSim.

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