

# PWM Generator

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**Abstract** - Pulse Width Modulation (PWM) is a fundamental technique in electronics, enabling efficient control of power, signal modulation, and communication. This work presents a PWM generator designed with a Schmitt trigger oscillator (CD40106) and operational amplifiers. The CD40106 produces a stable sawtooth waveform, which is conditioned through op-amp buffering and fed into a comparator. By comparing the sawtooth with a variable control voltage (CV input), the circuit generates a PWM signal with adjustable duty cycle. The buffered output ensures stability and load-driving capability. The design, simulated in eSim with the IHP SG13G2 PDK, is cost-effective and widely applicable.

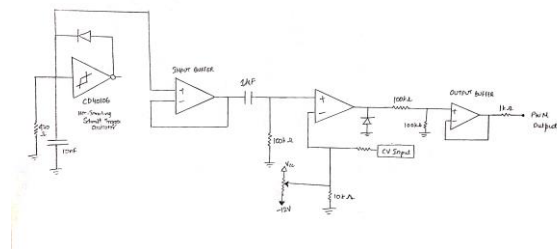
**Index Terms** - Pulse Width Modulation (PWM), Schmitt Trigger Oscillator (CD40106), Operational Amplifier Comparator, eSim, IHP SG13G2 PDK.

## INTRODUCTION

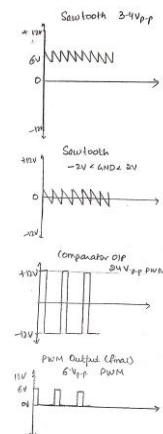
Pulse Width Modulation (PWM) is one of the most widely adopted techniques in electronics, valued for its efficiency in regulating power, encoding information, and controlling systems. It has extensive applications in motor drives, switching power supplies, digital communication, and audio signal processing. The fundamental principle of PWM is the modulation of the duty cycle of a rectangular waveform, allowing precise control of energy delivery without significantly altering the frequency of operation. While microcontroller-based PWM generation offers flexibility and programmability, analog approaches continue to hold significance in scenarios where simplicity, cost-effectiveness, and fast response are required. Among these, the use of Schmitt trigger oscillators coupled with operational amplifiers provides a robust and reliable solution for generating PWM signals. The CD40106 Schmitt trigger is particularly suitable for producing a stable sawtooth waveform, which can be further processed by op-amps to achieve variable duty cycle modulation.

This work implements and validates such a design using eSim with the IHP SG13G2 PDK, supporting the vision of open-source, accessible circuit design practices.

## CIRCUIT DIAGRAM



## EXPECTED WAVEFORMS



## REFERENCES

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