Class-D Audio Amplifier Using PWM (LTspice Simulation Report)

1.Project Overview

This project focuses on the design and simulation of a Class-D audio amplifier using the PWM (Pulse Width Modulation) technique. The circuit is designed and simulated in LTspice to demonstrate efficient audio amplification.

2.Working Principle

The audio signal is converted into a PWM signal by comparing it with a high-frequency carrier generated using an NE555 timer. The PWM drives a MOSFET, and an LC filter reconstructs the audio signal.
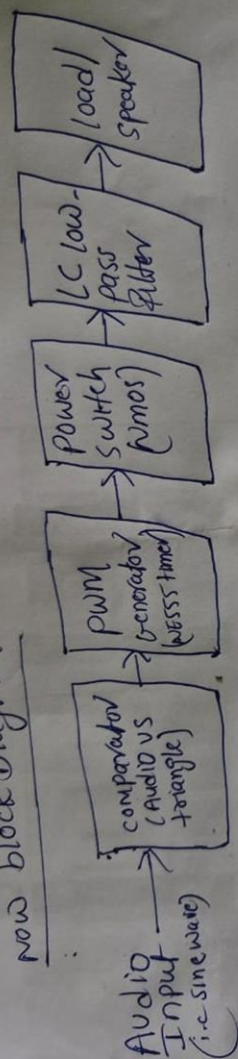
3.Circuit Explanation

The circuit consists of a carrier generator (NE555), comparator, MOSFET switching stage, LC low-pass filter, and an 8-ohm load.

4.Block Diagram

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now block diagram

Audio Input (i.e sine wave) → Comparator (Audio vs triangle) → PWM generator (NE555 timer) → Power switch (MOS) → LC low-pass filter → load/speaker

5.Theory

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Theory

class-D Amplifier —

A class-D amplifier is a high efficiency amplifier that uses pulse
-width modulation, pwm, instead of linear amplification.

In this method, the audio signal is converted into a PWM
signal by comparing it with a high frequency carrier
waveform.

In this circuit, the NE555 timer is configured in astable
mode to generate a high frequency triangular waveform.
The carrier signal is compared with low frequency audio signal
using ideal comparator. The comparator output is a pwm
signal whose duty cycle varies accordingly to audio amplitude.

The pwm signal drive NMOS transistor operating as high-speed switch.
The switching output contain high frequency component, which are removed
using an LC filter low pass filter. This filtered output reconstructs
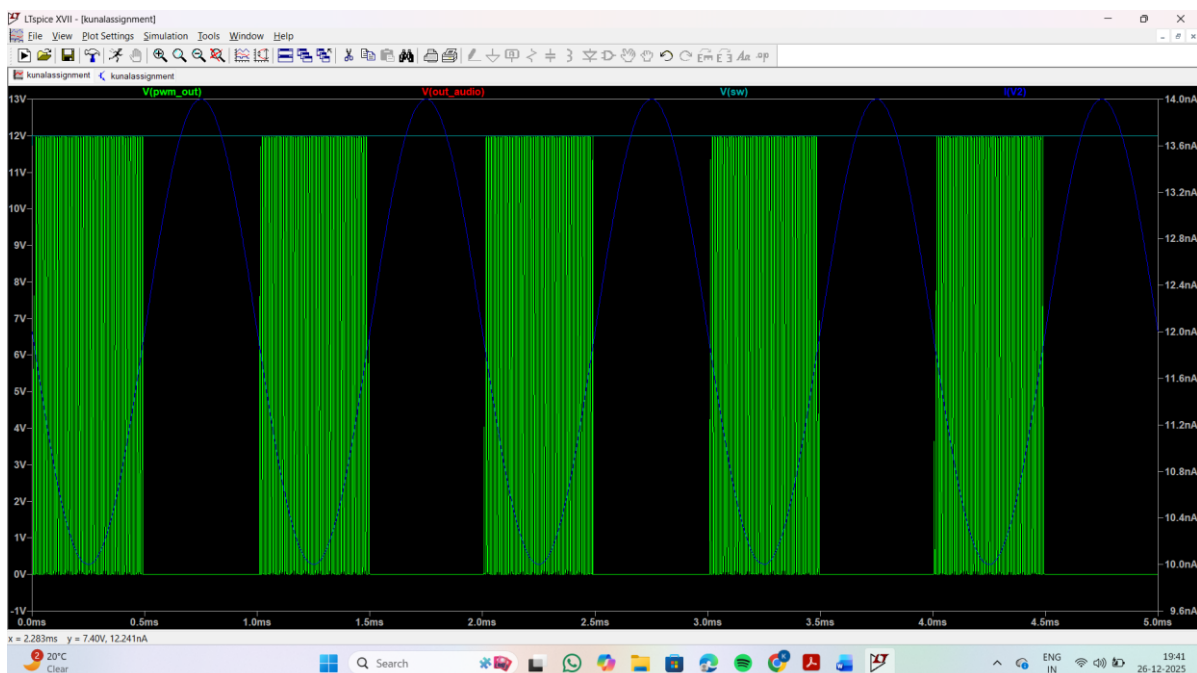the original audio signal across the load.

both class D Amplifier offer high efficiency and low power dissipation
also widely use

6.Circuit Diagram
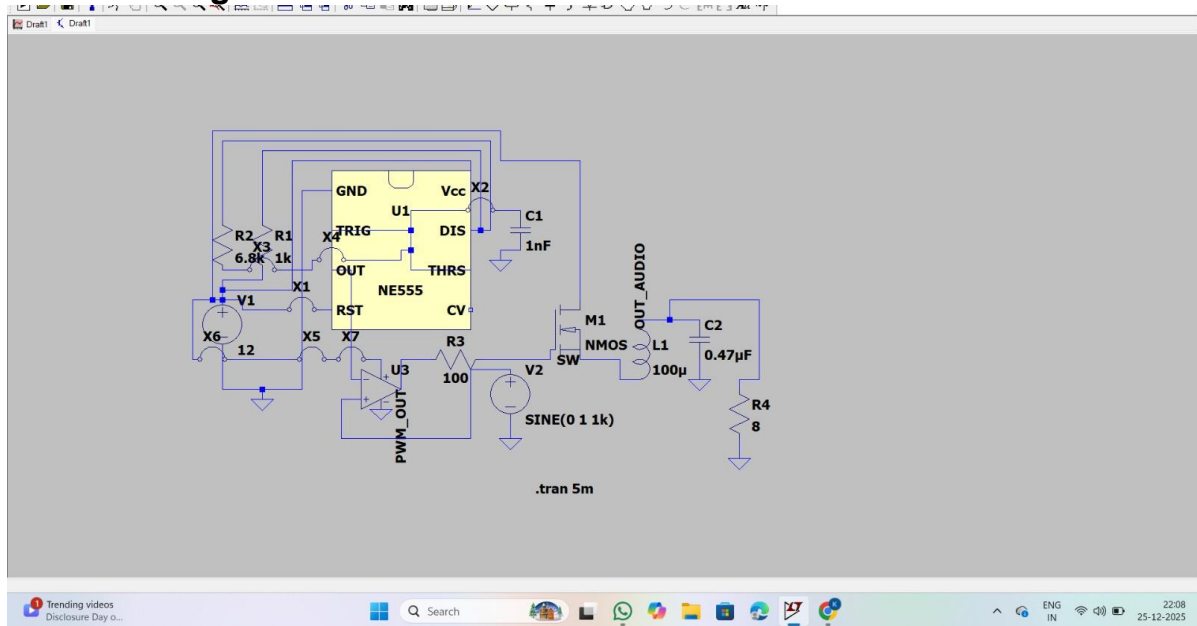
7.Simulation Results

Simulation results show proper PWM generation, MOSFET switching, and smooth audio output after LC filtering.

8s.Conclusion

The Class-D amplifier was successfully simulated, demonstrating high efficiency audio amplification using PWM technique.