CLASS D
AMPLIFIER

HIGH EFFICIENCY TOPOLOGY

PROJECT PRESENTATION | AUDIO ELECTRONICS

INTRODUCTION & OBJECTIVE

THE OBJECTIVE

To design and simulate a high-efficiency audio amplifier capable of driving a speaker load with minimal power dissipation.

The goal is to move beyond linear amplification (Class A/AB) to a switching topology.

WHY CLASS D?

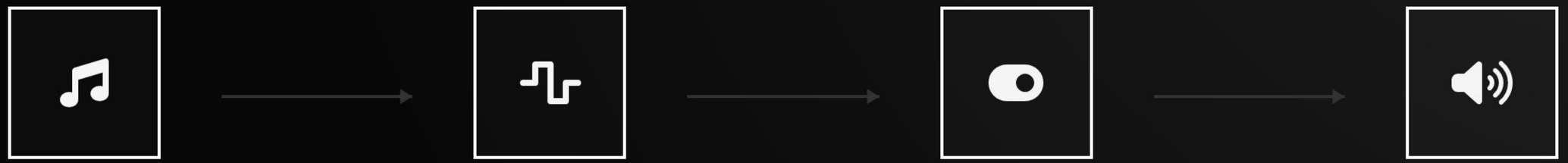
Unlike linear amps acting as resistors, Class D amps act as **switches**.

Efficiency > 90%

Low Heat Generation

Compact Footprint

SYSTEM ARCHITECTURE



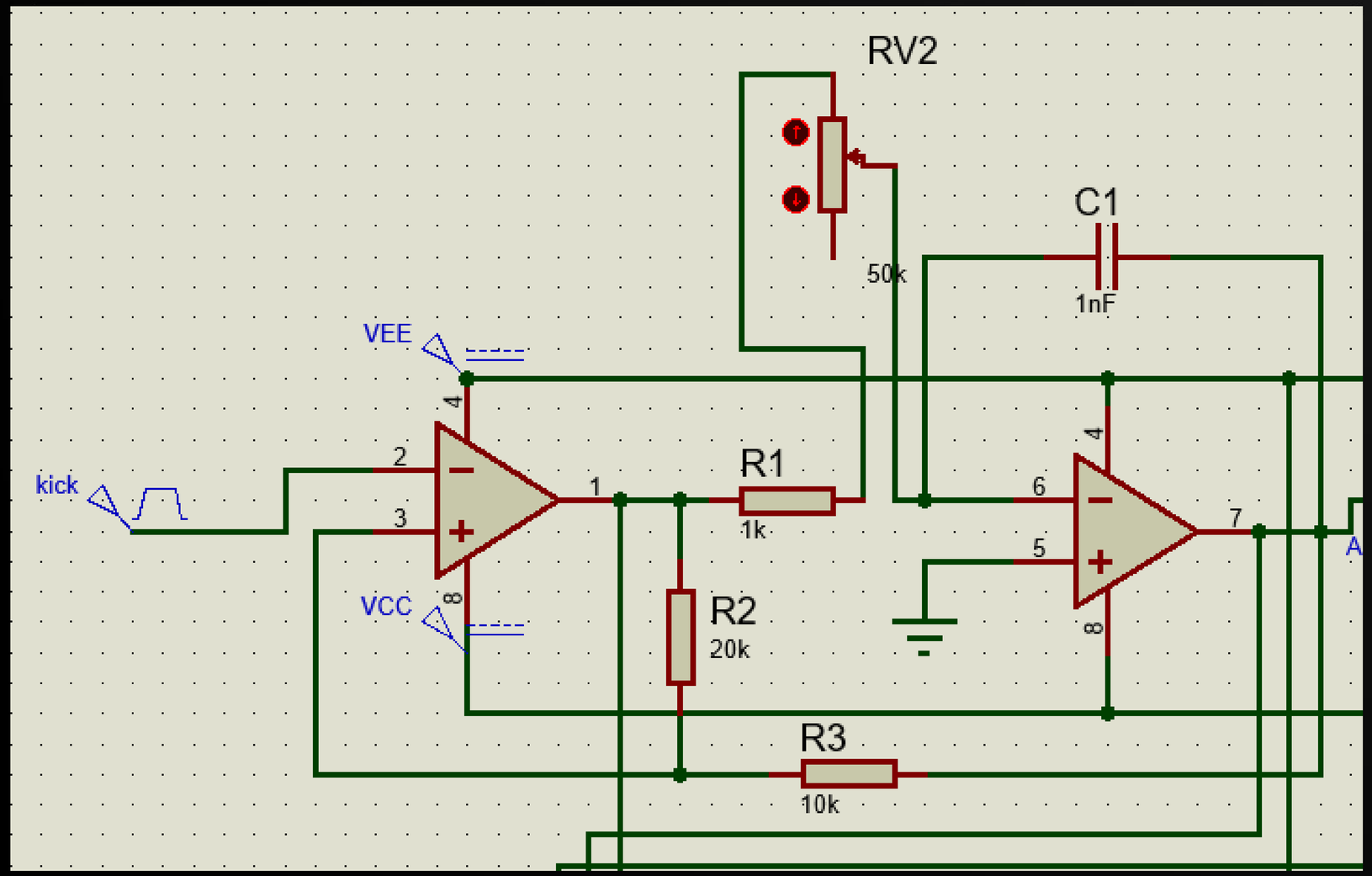
STAGE 01: CARRIER GENERATOR

TRIANGLE OSCILLATOR

Generates the high-frequency reference signal required for Pulse Width Modulation.

Design:

- Op-Amp 1: Schmitt Trigger (Square Wave)
- Op-Amp 2: Integrator (Triangle Wave)



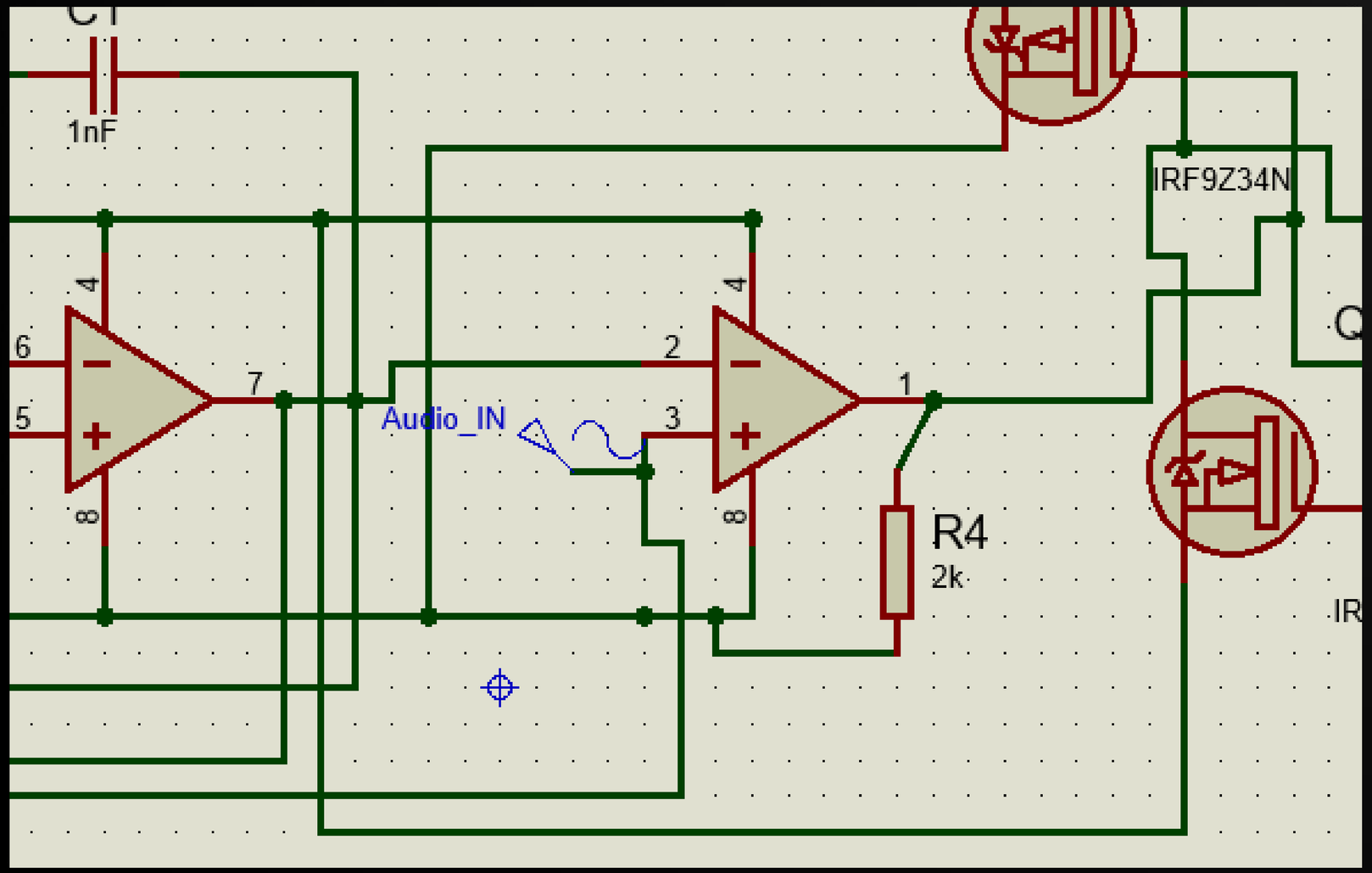
STAGE 02: PWM MODULATOR

THE COMPARATOR

The core logic of the Class D topology.

It compares the incoming audio signal against the high-frequency triangle carrier.

> $V_{audio} > V_{carrier}$: HIGH
> $V_{audio} < V_{carrier}$: LOW



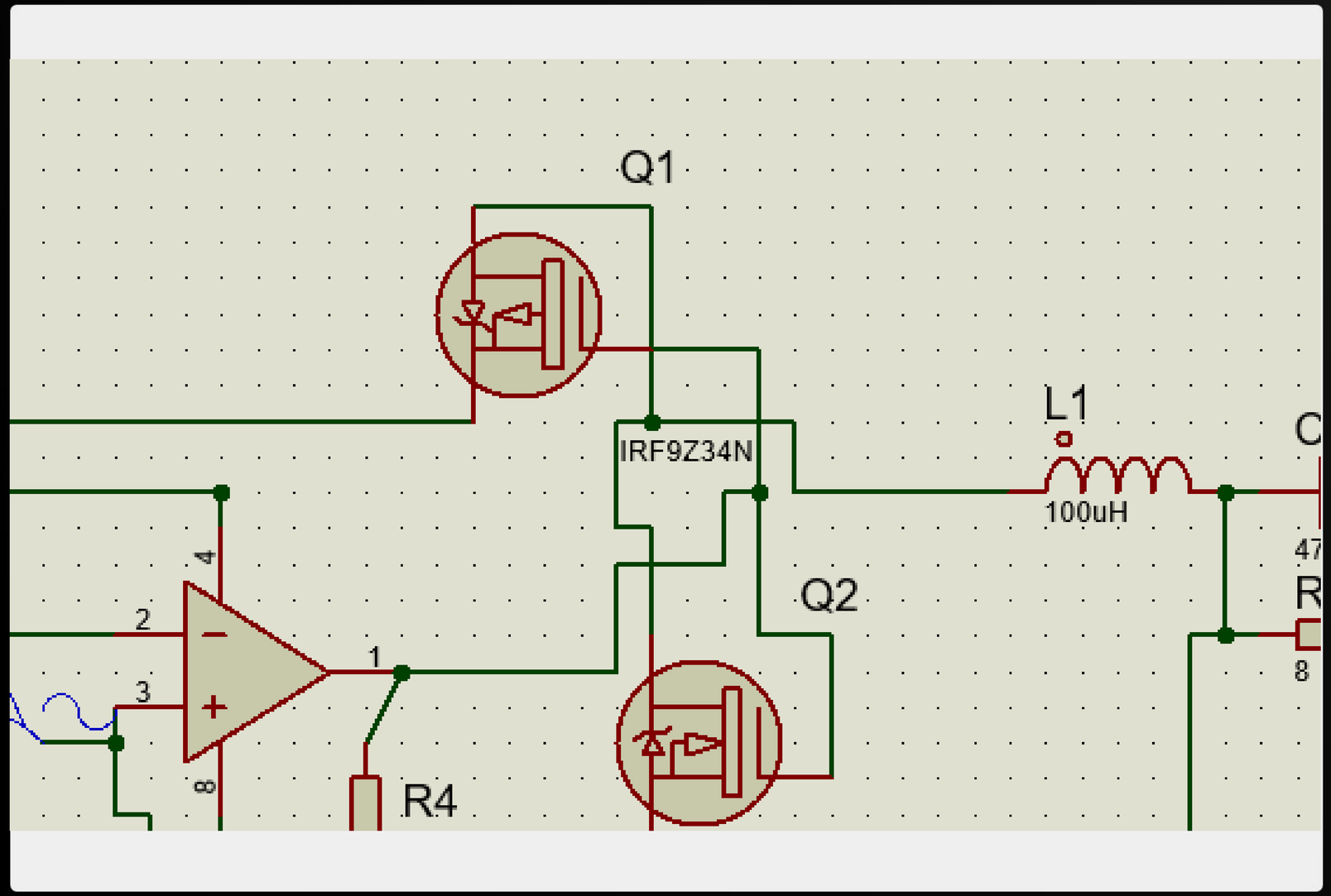
STAGE 03: POWER SWITCHING

MOSFET HALF-BRIDGE

Amplifies the current of the PWM signal using complementary MOSFETs.

Because MOSFETs have very low $R_{DS(on)}$, voltage drop is minimal when conducting, leading to minimal power loss.

IRF9540 / IRF540 Pair



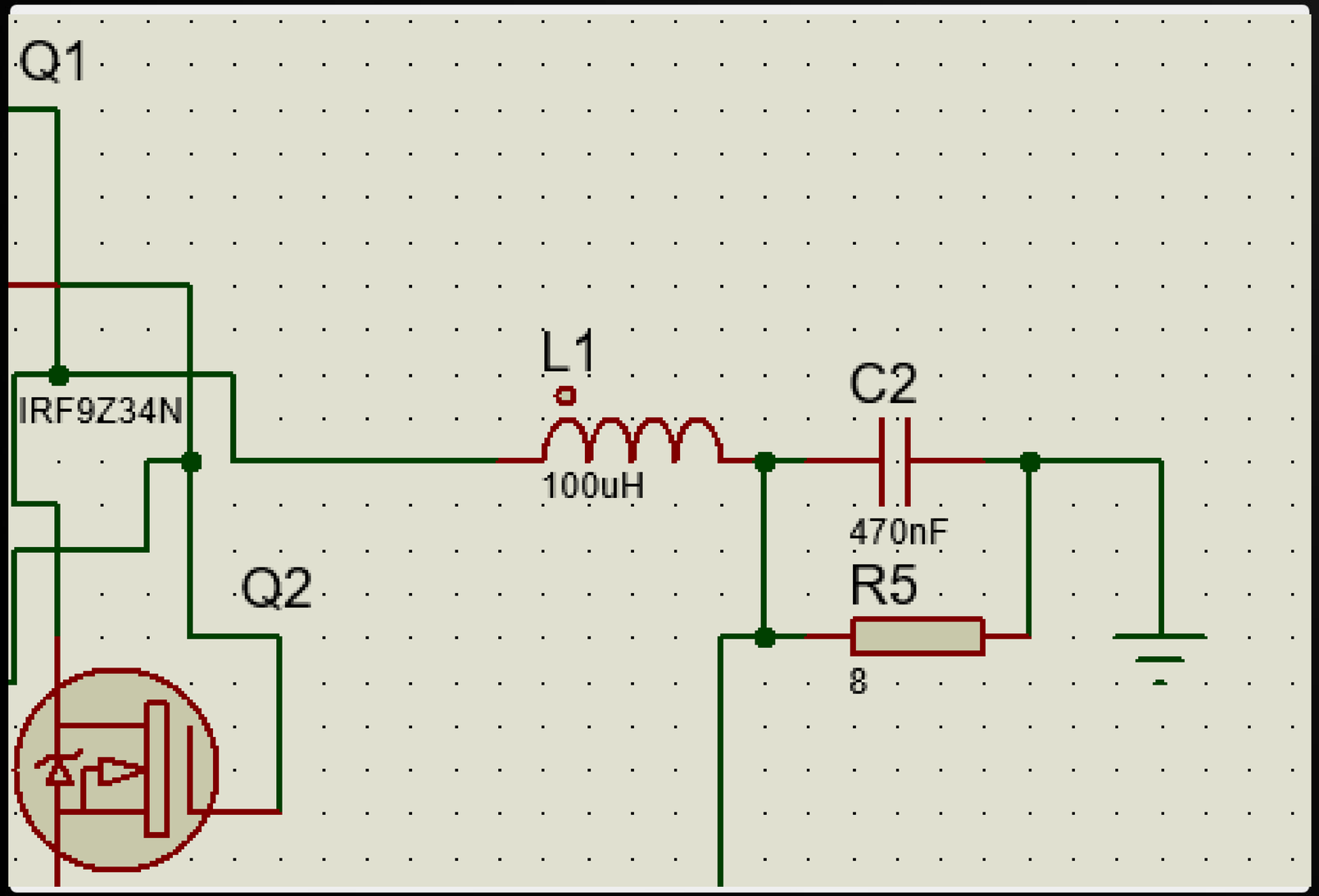
STAGE 04: OUTPUT FILTER

LC LOW-PASS FILTER

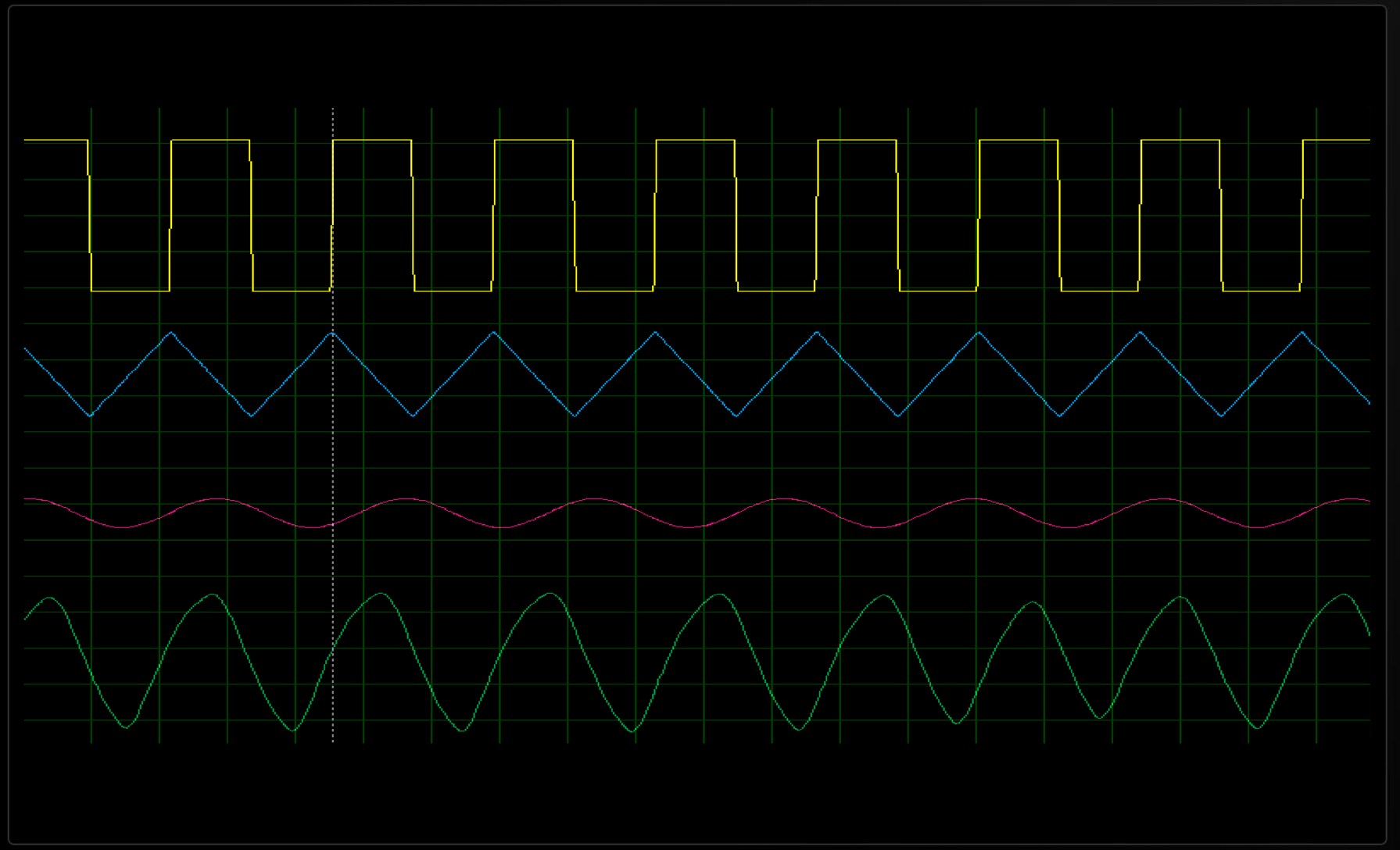
Demodulation: Removes the high-frequency carrier component from the amplified PWM signal.

Restores the original analog audio waveform for the speaker load.

- L1: Inductor stores energy
- C2: Capacitor smooths voltage



SIMULATION RESULTS



TRACE LEGEND

Yellow
Square Wave Gen

Blue
Triangle Carrier

Pink
Audio Input

Green
Amplified Output

PROJECT SUCCESSFUL

The Class D amplifier demonstrated high-efficiency switching operation with accurate signal reconstruction.

THANK YOU