Department of Electronic & Telecommunication Engineering

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EN2143 - Electronic Control Systems

Sinusoidal Wave Generator

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1 Introduction

Analog signal generation is crucial in many electronic applications such as audio processing and instrumentation. This project focuses on designing a Sinusoidal Wave Generator that utilizes a Wien Bridge Oscillator to generate a precise sine wave. An integrated Class AB amplifier boosts the signal to drive practical loads. Importantly, the design incorporates adjustable controls that allow users to fine-tune the oscillation frequency, waveform amplitude, and overall amplification, providing enhanced flexibility in signal conditioning.

2 Project Scope

The project is divided into two primary stages:

- **Oscillator Stage:** Develop a Wien Bridge Oscillator using an RC network with adjustable components (potentiometers) to control the oscillation frequency and amplitude.
- **Amplifier Stage:** Design a Class AB amplifier that not only amplifies the oscillator's output but also allows adjustable amplification to suit different load requirements.

3 Design Approach

3.1 Circuit Design

- **Wien Bridge Oscillator:** Utilize first and second order RC filter networks. Incorporate potentiometers to enable adjustment of both frequency and amplitude, thereby allowing fine-tuning of the sine wave output.
- **Automatic Gain Control:** Implement an AGC mechanism to stabilize the amplitude against component tolerances and environmental variations.
- **Class AB Amplifier:** Develop a push-pull amplifier configuration that provides efficient amplification with low distortion. Include adjustable gain control to vary the amplification level and optimize performance for different applications.
- **AC Coupling and Impedance Matching:** Use coupling capacitors to block any DC offsets between the oscillator and amplifier stages, ensuring proper impedance matching and minimizing signal degradation.

3.2 PCB Design

- **Layout Optimization:** Design the PCB with short, well-organized analog traces, a solid ground plane, and proper placement of decoupling capacitors.
- **Adjustable Component Integration:** Ensure that potentiometers and other adjustable elements are easily accessible on the PCB for fine-tuning.

- **Thermal Management:** Provide sufficient heat dissipation for the amplifier components to maintain stability during prolonged operation.

4 Methodology

The project will follow these steps:

1. **Design and Simulation:** Create and simulate the circuit schematics for both the oscillator and amplifier stages using LTspice or Multisim.
2. **Prototyping:** Build the circuit on a breadboard to test the adjustable controls and overall performance.
3. **PCB Fabrication:** Design the PCB using KiCad or Eagle, focusing on layout optimization and integration of adjustable components.
4. **Testing and Evaluation:** Validate performance parameters (frequency accuracy, amplitude stability, THD, and efficiency) with an oscilloscope and multimeter.

5 Expected Outcomes

The final deliverable will be a fully functional Sinusoidal Wave Generator that:

- Produces a low-distortion sine wave with adjustable frequency and amplitude.
- Integrates an adjustable Class AB amplifier for controlled amplification.
- Demonstrates robust performance through thorough simulation, breadboard prototyping, and PCB implementation.
- Provides comprehensive documentation including schematics, PCB layout, and testing data.

6 Resources

- Simulation Tools: LTspice, Multisim, or Proteus.
- PCB Design Software: KiCad or Eagle.
- Testing Equipment: Oscilloscope, Multimeter, Signal Generator.