

VISVESAVARAYA TECHNOLOGICAL UNIVERSITY

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A Synopsis Report

On

“Audio Equalizer”

Submitted in partial fulfillment of the requirements for the award of the degree of

BACHELOR OF ENGINEERING

In

ELECTRONICS AND COMMUNICATION ENGINEERING

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ABSTRACT:

This project aims to design a 5-band audio equalizer circuit using the LM833 operational amplifier, known for its low noise and high audio performance. The equalizer will allow users to adjust five frequency bands: bass, low-mid, mid, high-mid, and treble, offering fine control over sound output. Each frequency band is equipped with a dedicated filter to either boost or attenuate the desired frequency range, improving the overall sound quality. Powered by a 12V supply, the circuit will be designed on a printed circuit board (PCB) for efficient and compact integration. The LM833 ensures minimal distortion and clear audio signal processing, making it ideal for high-fidelity audio applications. This equalizer circuit will provide precise audio adjustments, making it a valuable component for sound systems requiring flexible and optimized audio output.

COMPONENTS:

Centre frequency f_0 (in Hz)	Capacitor value (in uF)	Resistors R_a value (in K)	Resistors R_b value (in K)	Resistors R_c value (in K)	Gain (A)	Quality (Q)
60	$C_4 = C_5 = 0.1$	$R_9 = 11$	$R_{11} = 27$	$R_{10} = 91$	4.1	1.7
250	$C_7 = C_8 = 0.1$	$R_{14} = 2.7$	$R_{15} = 6.3$	$R_{13} = 22$	4.1	1.7
1000	$C_{10} = C_{11} = 0.047$	$R_{18} = 1.5$	$R_{19} = 3.3$	$R_{17} = 11$	3.7	1.6
4000	$C_{13} = C_{14} = 0.0022$	$R_{22} = 7.5$	$R_{23} = 18$	$R_{21} = 63$	4.2	1.7
16000	$C_{16} = C_{17} = 0.0022$	$R_{26} = 2$	$R_{27} = 4.3$	$R_{25} = 15$	4.2	1.7

INTRODUCTION:

An audio equalizer (EQ) is a tool used to adjust the balance of different frequency components in an audio signal. By boosting or reducing specific frequencies, equalizers enhance or modify the sound to suit particular environments or preferences.

- **Frequency Bands:**

Divides the audio spectrum into multiple bands, each adjustable to boost or cut specific frequencies.

- **Types:**

- **Graphic Equalizers:** Fixed frequency bands controlled by sliders, visualizing the EQ curve.
- **Parametric Equalizers:** Adjustable centre frequency, bandwidth, and gain for precise control.
- **Shelving Equalizers:** Affect frequencies above or below a certain point, useful for bass and treble.
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- **Applications:**

- **Music Production:** Fine-tuning tracks for clarity and balance.
- **Live Sound:** Adjusting sound for different venues to prevent feedback.
- **Consumer Audio:** Enhancing personal listening experiences in home or car audio systems.
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- **Evolution:**

- **Analog Equalizers:** Hardware devices using antilog circuits.
- **Digital Equalizers:** Software-based, offering more precision and flexibility.

LITERATURE SURVEY:

An audio equalizer (EQ) is a vital tool in audio processing, allowing for the adjustment of specific frequency bands to enhance sound quality or tailor audio characteristics. The development and refinement of equalization techniques have significantly impacted audio engineering, music production, broadcasting, and consumer audio devices. This survey reviews the historical evolution, technical advancements, and contemporary applications of audio equalizers, drawing on key research and developments in the field.

Historical Evolution

1. Early Analog Equalizers:

1. **Passive Equalizers:** The earliest equalizers were passive circuits used in radio and telecommunication to balance audio frequencies. Notable early designs include the Baxandall tone control circuits introduced in the 1950s, which provided bass and treble adjustment using a simple, low-cost design.
2. **Graphic Equalizers:** Invented by Art Davis in the late 1950s, graphic equalizers became popular in the 1960s. These devices used sliders to adjust fixed frequency bands, providing a visual representation of the EQ curve.

2. Transition to Digital Equalizers:

- **Digital Signal Processing (DSP):** The advent of DSP in the late 20th century transformed equalizers, allowing for more precise and flexible manipulation of audio signals. Digital equalizers offered greater accuracy, repeatability, and complex filtering capabilities that were impractical with analog technology.
- **Parametric Equalizers:** Introduced in the 1970s, parametric equalizers provided control over frequency, bandwidth (Q factor), and gain, offering more versatile and precise adjustments compared to graphic equalizers.

PROPOSED OUTCOME:

The outcomes of using an audio equalizer are multifaceted, impacting various aspects of audio production, playback, and user experience. Here are the primary outcomes of employing an audio equalizer:

1. Improved Sound Quality

Enhanced Clarity and Balance:

- Adjusting frequency bands allows for the enhancement of specific aspects of the audio signal, leading to clearer vocals, more defined bass, and crisper highs.
- Balancing frequencies can help reduce muddiness and create a more polished and professional sound.

Noise Reduction:

- Equalizers can be used to attenuate unwanted noise and hum by reducing specific frequency ranges that contain the noise.

HARDWARE USED:

1. **Filter Networks:** Resistors, capacitors, inductors.
2. **Operational Amplifiers (Op-Amps):** Key for active filter designs.
3. **Variable Resistors:** Analog and digital potentiometers.
4. **Switches and Selectors:** For changing filter types and presets.
5. **ADCs and DACs:** For digital equalizers.
6. **Digital Signal Processors (DSP):** For advanced audio processing.
7. **Control Interface:** Knobs, sliders, and displays.
8. **Power Supply:** Stable power delivery for all components.
9. **Connectors and Jacks:** For input/output and control.
10. **Enclosure and Chassis:** Protects components and provides interface.

These components collectively enable the functionality of audio equalizers, allowing for the precise adjustment of audio frequencies to enhance sound quality and tailor audio output to specific needs and preferences.

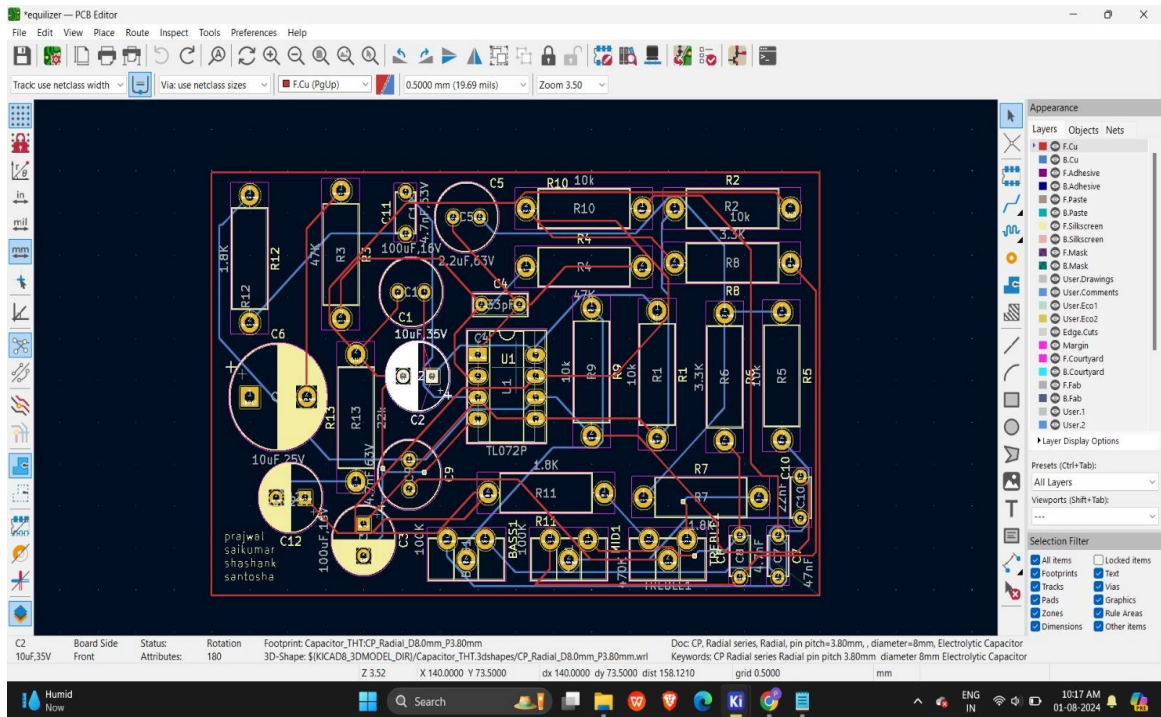


Figure 1:Audio equalizer Layout

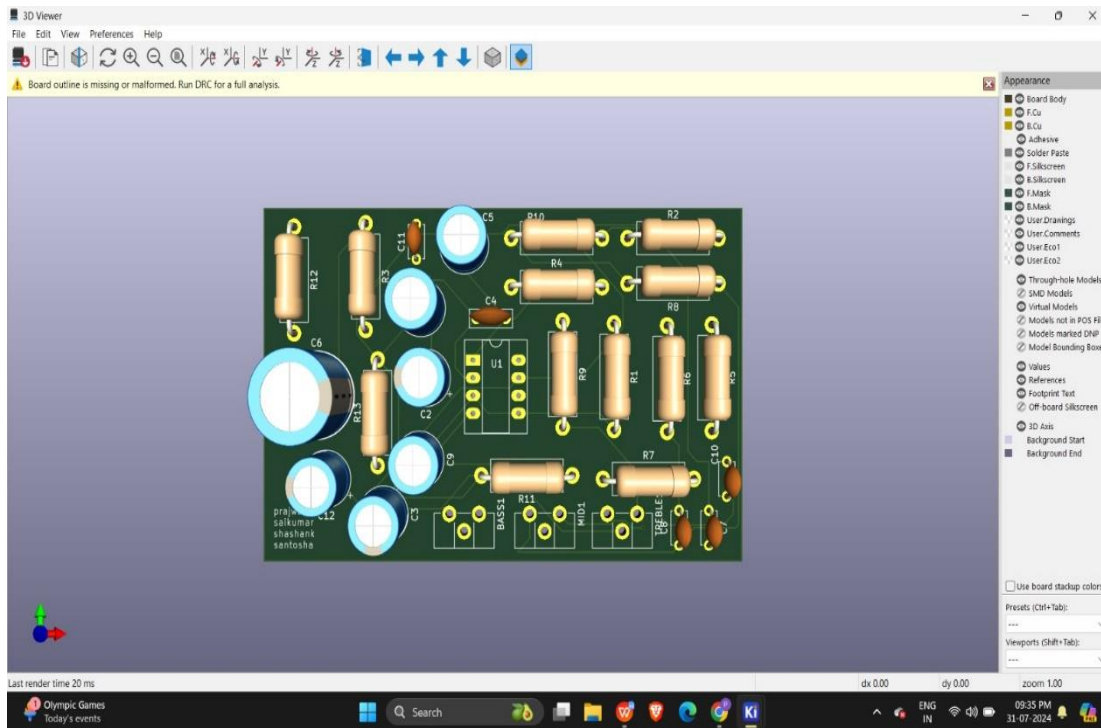


Figure 2:Audio Equalizer 3D View

Audio Equalizer Circuit Diagram:

The complete **bass treble circuit diagram** is shown in the image below. The major component in this circuit is the Op-Amp. The Op-Amp TL072 is a popular operational amplifier that has two individual operational amplifiers in a single monolithic package.

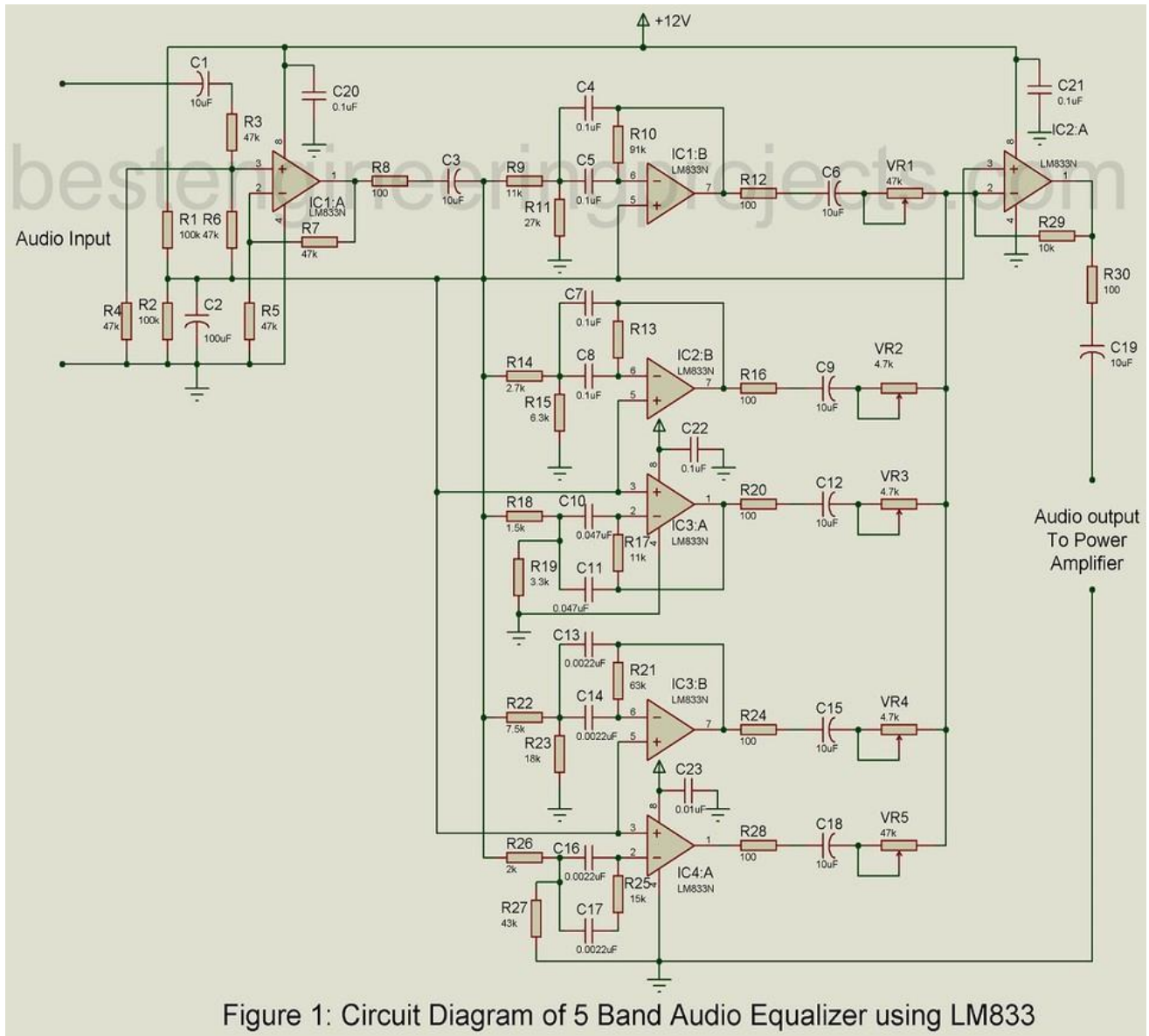


Figure 1: Circuit Diagram of 5 Band Audio Equalizer using LM833

The explanation of the circuit is as follows, but you can also skip to the video at the end of this page which also explains how the circuit works. The below image shows the **pinout of LM833 Op-Amp**. These two operational amplifiers are depicted in the schematic as IC1A and IC1B.

CONCLUSION:

The audio equalizer successfully demonstrates the practical application of audio signal processing principles. By designing and implementing an equalizer, we have explored key concepts such as filter design, frequency response, and user interface development. The project highlights the importance of audio equalization in various domains, including music production, broadcasting, and consumer electronics, showcasing its ability to significantly enhance sound quality and user experience.

Technical Proficiency:

- Gained hands-on experience with both analog and digital signal processing techniques.
- Developed a functional equalizer with adjustable frequency bands, enabling precise control over audio output.

Practical Skills:

Utilized components such as operational amplifiers, resistors, capacitors, and digital signal processors to build the equalizer.

Implemented user interfaces with knobs, sliders, and displays for intuitive control and visualization.

Enhanced Understanding:

Deepened our understanding of how different frequency bands affect audio perception.

Learned to balance and optimize sound quality for various applications and environments.

Innovation and Adaptability:

- Explored adaptive equalization techniques and the potential for integrating machine learning for intelligent audio adjustments.
- Considered future advancements in immersive audio and smart device integration.

Real-World Applications:

- Recognized the role of equalizers in professional audio engineering, live sound reinforcement, and consumer audio devices.
- Appreciated the importance of equalization in creating accessible audio experiences for individuals with hearing impairments.