

# Five Band Audio Equalizer

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# Presentation Structure

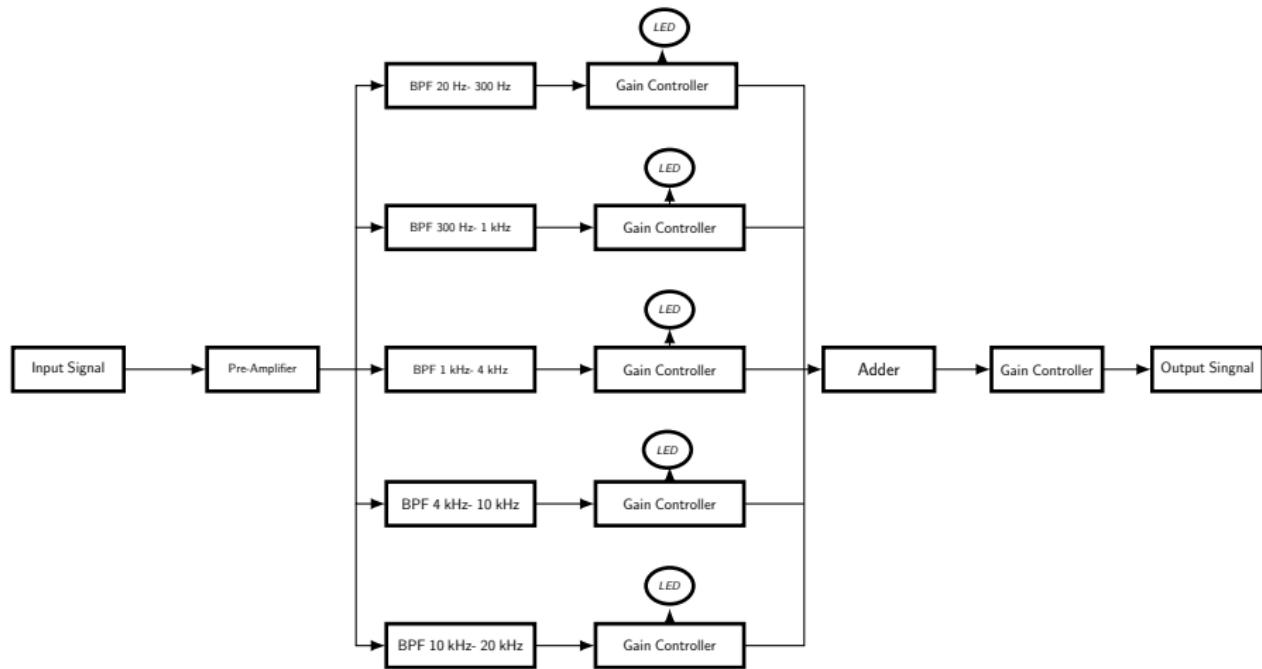
① Introduction

② PCB Design

③ Enclosure Design

# Introduction

# System Architecture



# Component Selection Justification

## ① NE5532 Operational Amplifier

- **Low Noise:**  $5 \text{ nV}/\sqrt{\text{Hz}}$  suitable for high-fidelity audio
- **Bipolar Input:** Ensures low offset and distortion in precision audio
- **Dual Channel:** Two op-amps per IC for compact design
- **High Slew Rate:**  $9 \text{ V}/\mu\text{s}$  supports wide dynamic range
- **Wide Bandwidth:** 10 MHz gain-bandwidth product for audio applications
- **Wide Supply:**  $\pm 3 \text{ V}$  to  $\pm 20 \text{ V}$  operation for design flexibility
- **High Drive Capability:** Can directly drive  $600 \Omega$  loads

## ② LM3915 Dot/Bar Display Driver

- Logarithmic 3 dB/step response for audio
- Direct LED drive without current-limiting resistors
- Simple setup with minimal external components
- Over-voltage protection ( $\pm 35\text{V}$ ) on input

## Component Selection Justification (Contd..)



Figure: NE5532 Operational Amplifier



Figure: LM3915 Dot/Bar Display Driver

# PCB Design

# PCB 2D Pathways

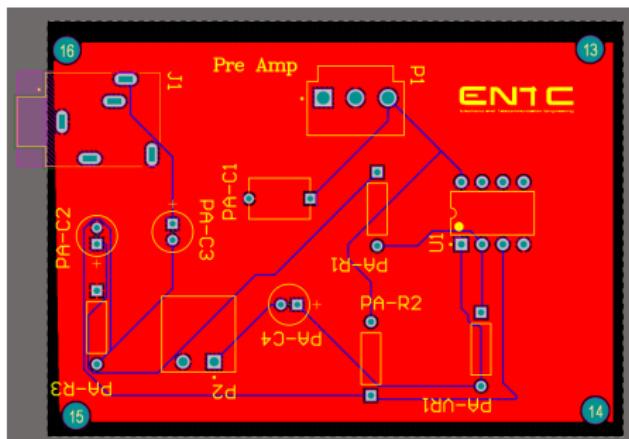
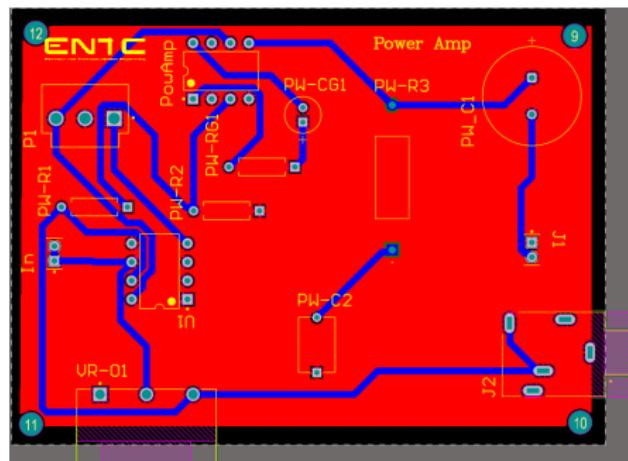


Figure: Pre-Amplifier Circuit



# PCB 2D Pathways (Contd...)

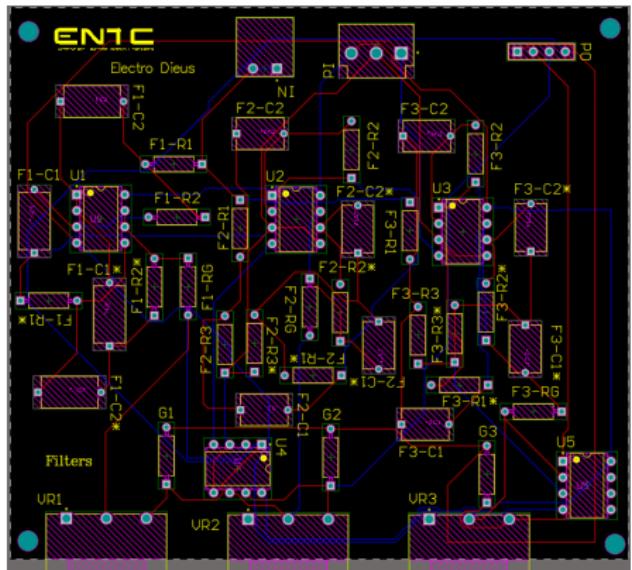


Figure: Filters

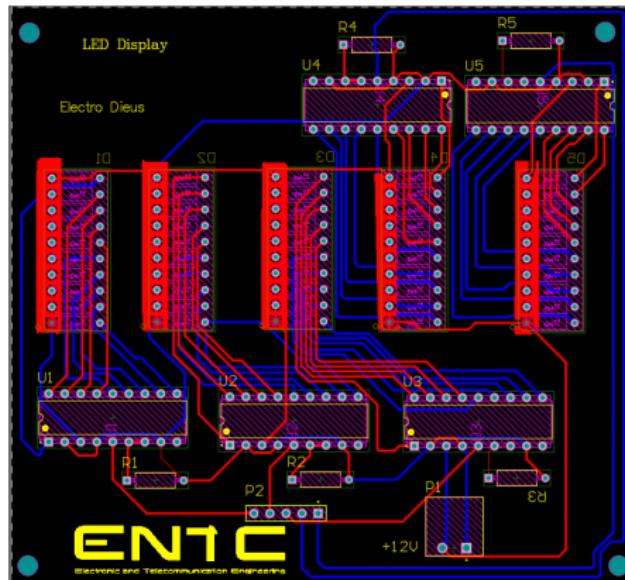


Figure: LED Display

# PCB Partitioning: A Cost-Effective Approach

## Initial Design: 2 PCBs

- **Main Circuit PCB:** 162.94 mm × 112.52 mm
- **Display PCB:** 119.63 mm × 58.67 mm
- **Total Estimated Cost:**  $\approx \$20$

## Final Design: 4 PCBs

- Four smaller, modular boards, each under **100 mm × 100 mm**
- Standard size qualifying for low-cost prototyping services
- **Total Cost:** 4 boards × \$2 = **\$8**

## Key Outcome: 60% Cost Reduction

By splitting the design into four smaller, standardized panels, we achieved a significant **60% reduction in manufacturing cost** without compromising system functionality or performance.

# Enclosure Design

# Enclosure Design



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# Conclusion

# Technical Challenges & Solutions

## Op-Amp Signal Distortion

- **Problem:** TL072 op-amps caused severe distortion at high frequencies
- **Solution:** Upgraded to NE5532 for better slew rate and bandwidth
- **Result:** Clean signal across all frequency bands

## Filter Component Mismatch

- **Problem:** Theoretical resistor values didn't match practical performance
- **Solution:** Recalculated values and verified -3 dB points with oscilloscope
- **Result:** Precisely tuned filters meeting all specifications

# Contribution of Group Members

<b>Student's Name (Index No.)</b>	<b>Contribution</b>
Tennakoon U.G.R.B. (230629R)	Filter calculations, PCB design, Testing & debugging, Soldering
Ratnayake R.M.S.H. (203548R)	PCB design, Circuits design, Circuits simulation, Soldering
Shehan M.N.N. (230613M)	Breadboard implementation, Enclosure Design
Dissanayake R.K.T. (230164K)	Breadboard implementation, Testing

# Thank You!