

Five Band Audio Equalizer

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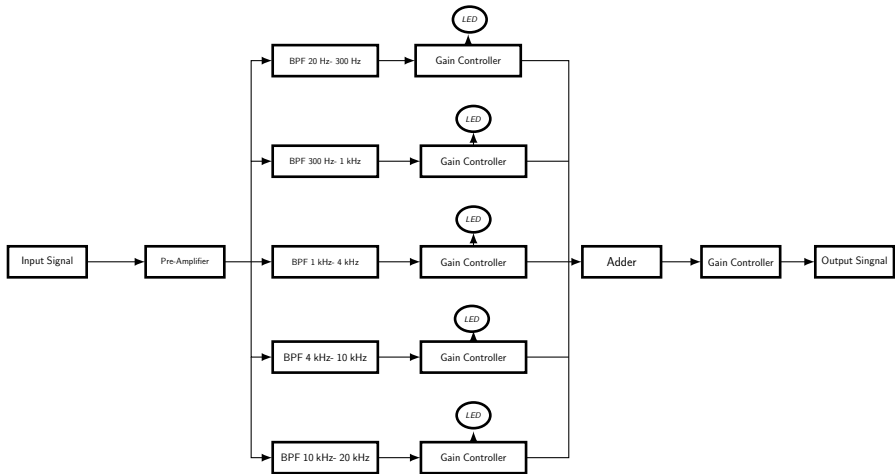
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Presentation Structure

- 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 600Ω 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

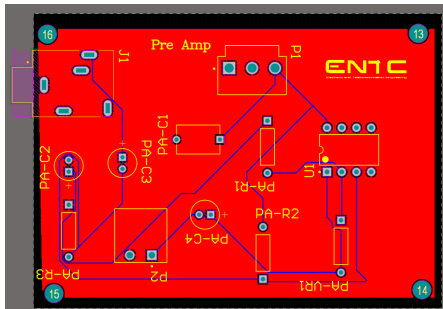


Figure: Pre-Amplifier Circuit

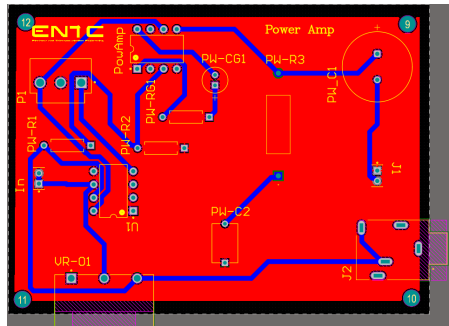


Figure: Power Amplifier

PCB 2D Pathways (Contd...)

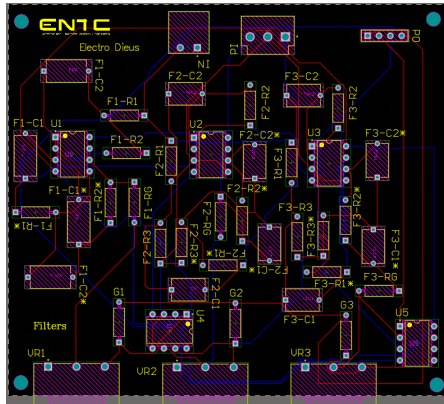


Figure: Filters

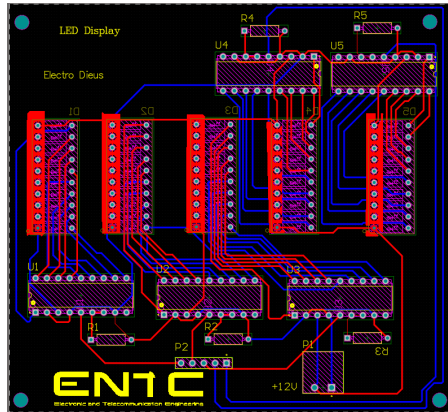


Figure: LED Display

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:** ≈\$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

Student's Name (Index No.)	Contribution
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!