Five Band Audio Equalizer

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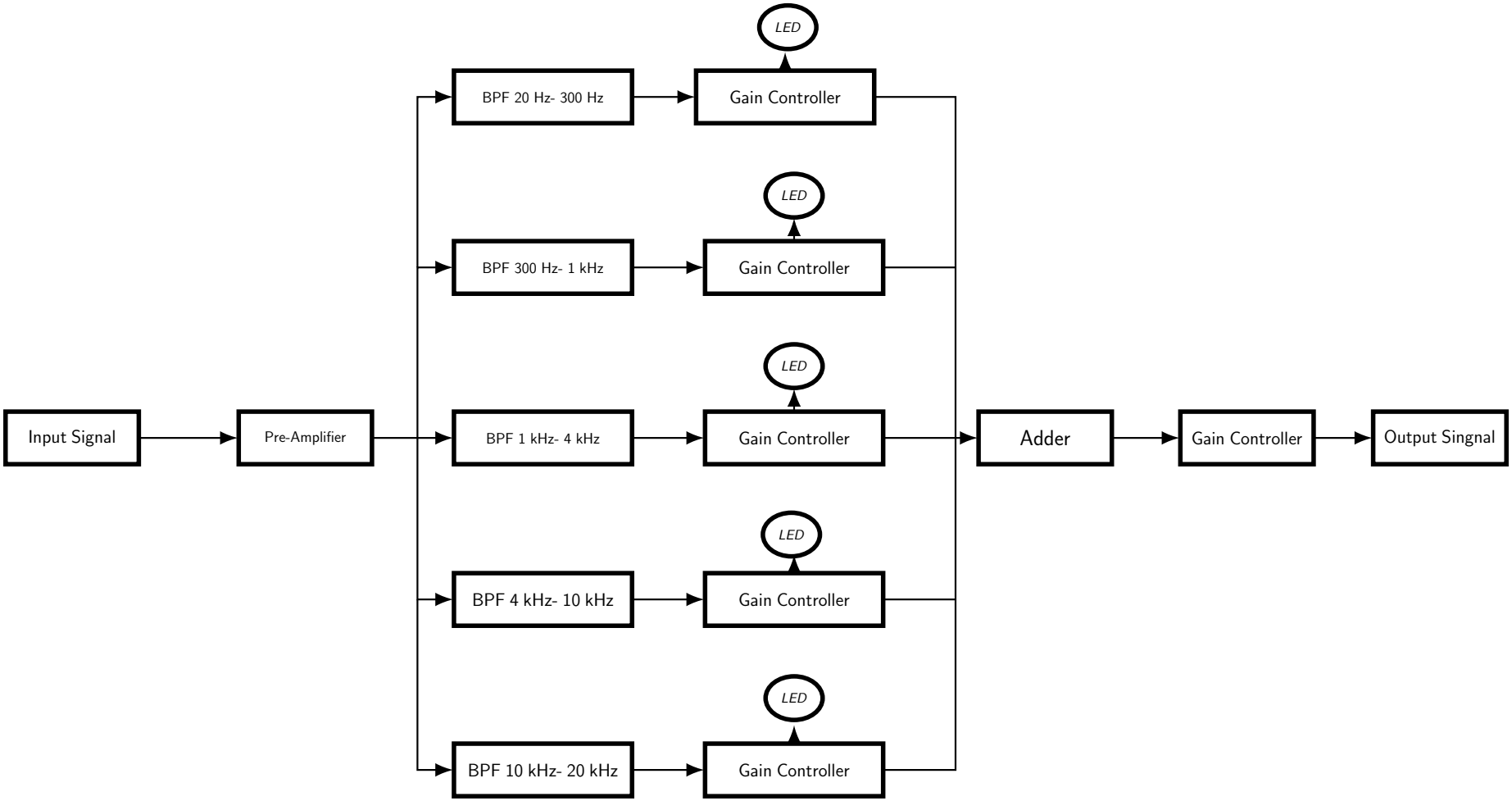
Presentation Structure

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$35V) on input

Component Selection Justification (Contd..)

Figure: NE5532 Operational Amplifier

Figure: LM3915 Dot/Bar Display Driver

PCB Design

PCB 2D Pathways

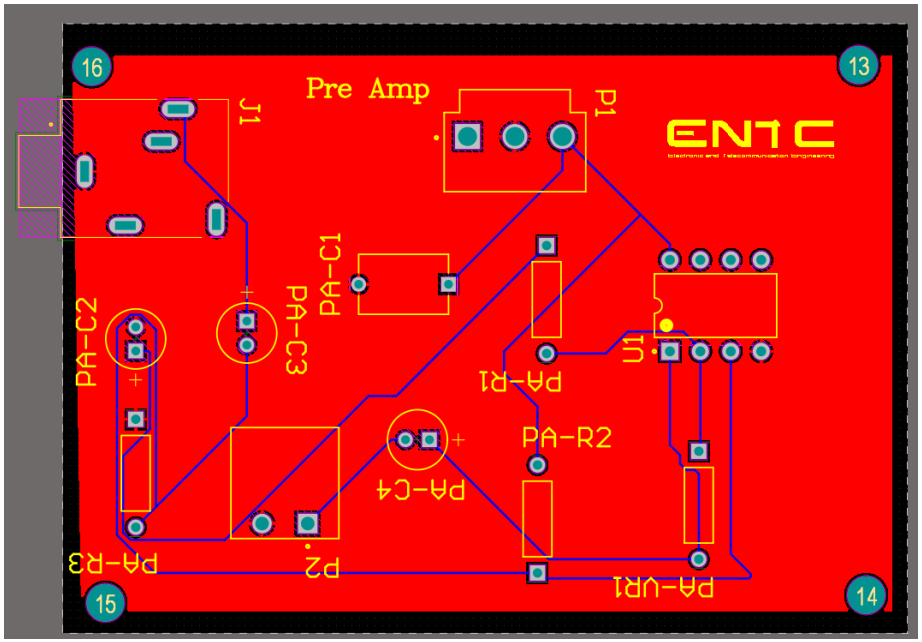


Figure: Pre-Amplifier Circuit

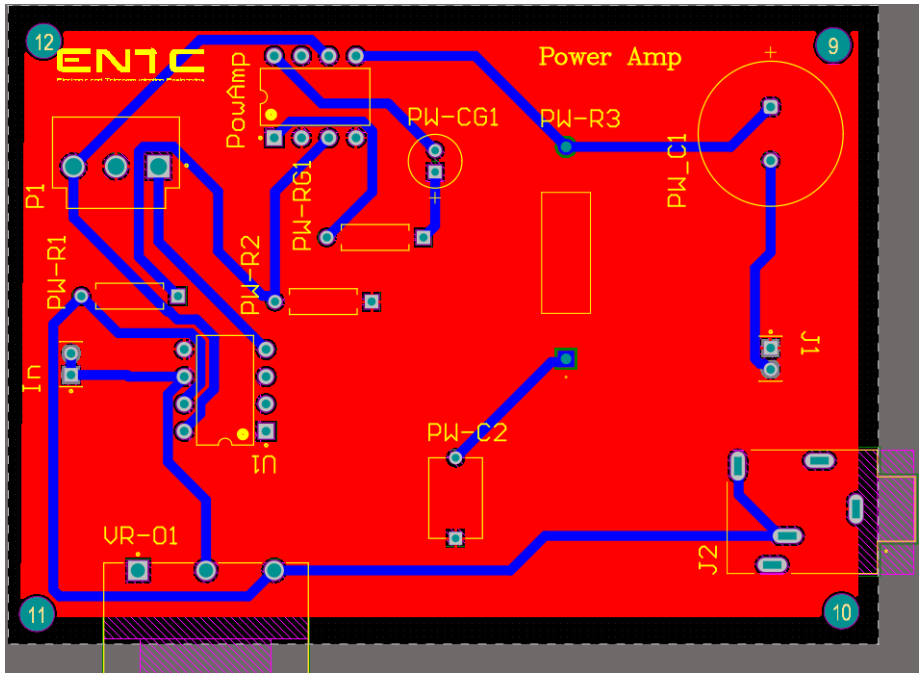


Figure: Power Amplifier

PCB 2D Pathways (Contd...)

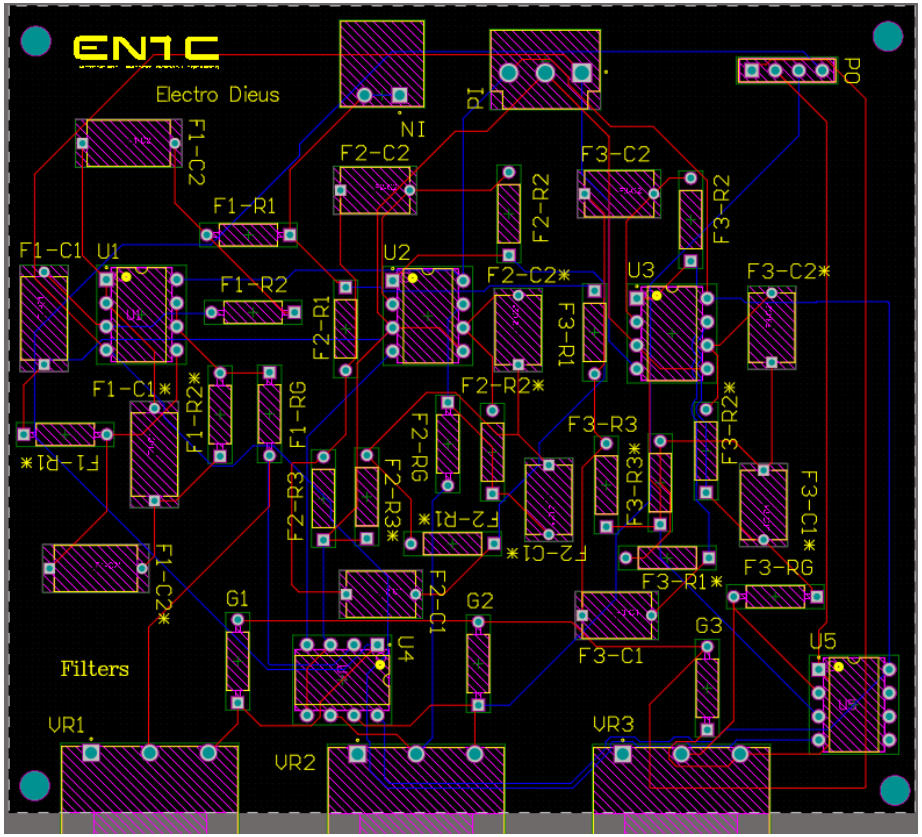


Figure: Filters

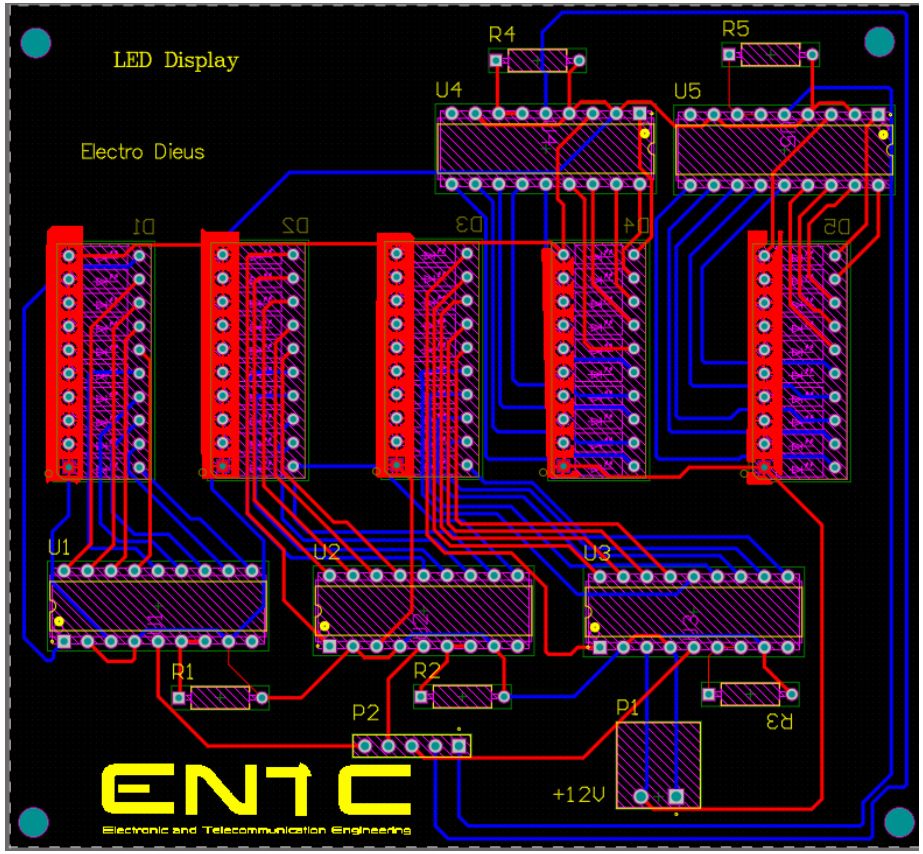


Figure: LED Display

PCB Partitioning: A Cost-Effective Approach

Initial Design: 2 PCBs

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

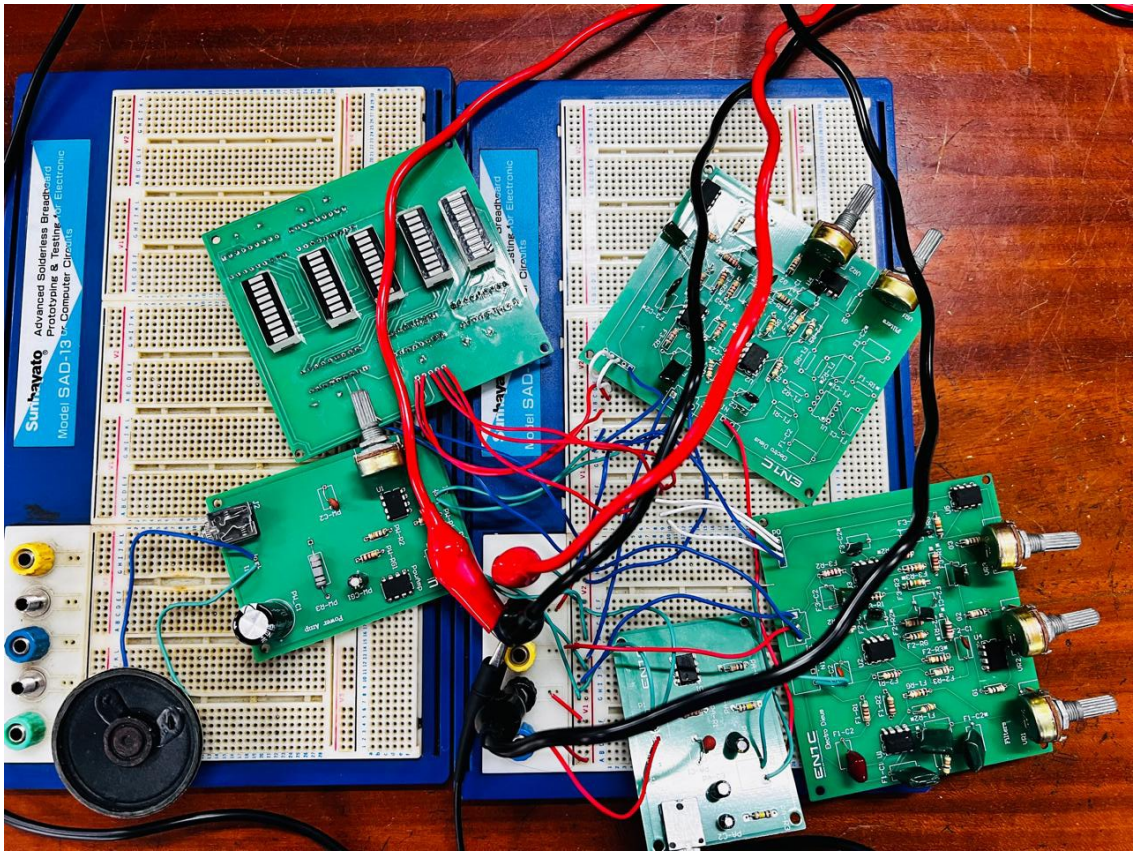
Final Design: 4 PCBs

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

PCB Testing



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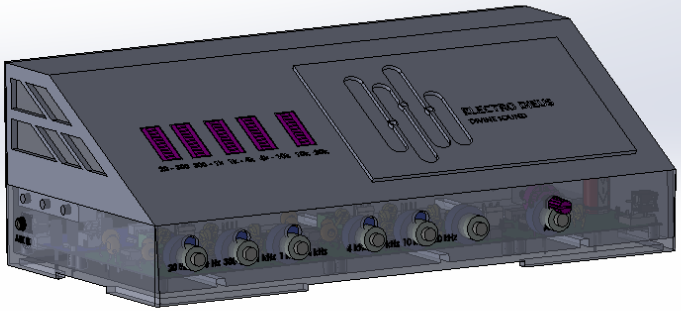
Enclosure Design

Enclosure Design



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Final Product

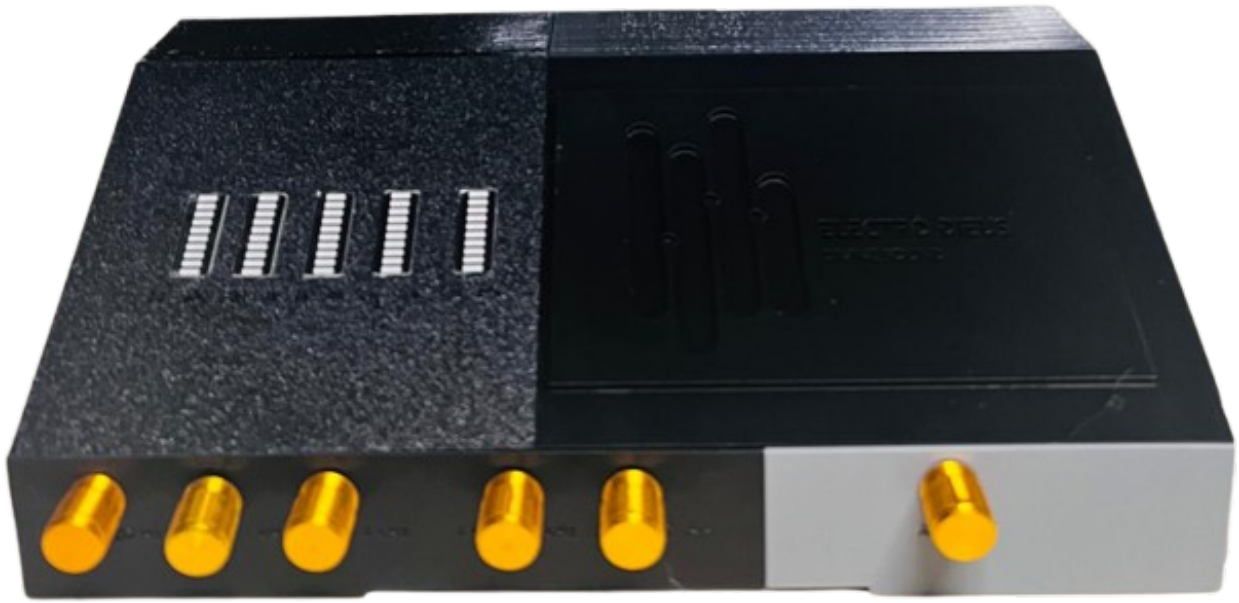

Figure: Five Band Audio Equalizer

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, Testing
Dissanayake R.K.T. (230164K)	LED display circuit design & breadboard implementation, Testing, Assembling

Thank You!