AMPLIFIED ENGINEERING

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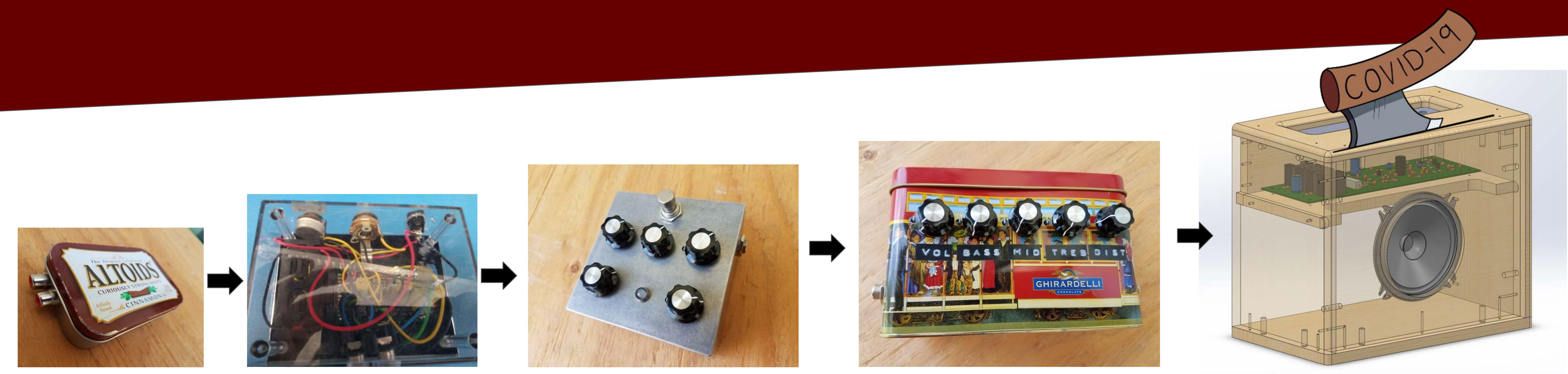
OVERVIEW

A guitar amplifier kit aimed towards high school students, providing an interesting and useful introduction to the world of Electrical Engineering.

Designed to be low cost with high quality sound, the kit strives to fit the budget of high school students and teach them the basics of electrical engineering with an intuitive assembly guide.

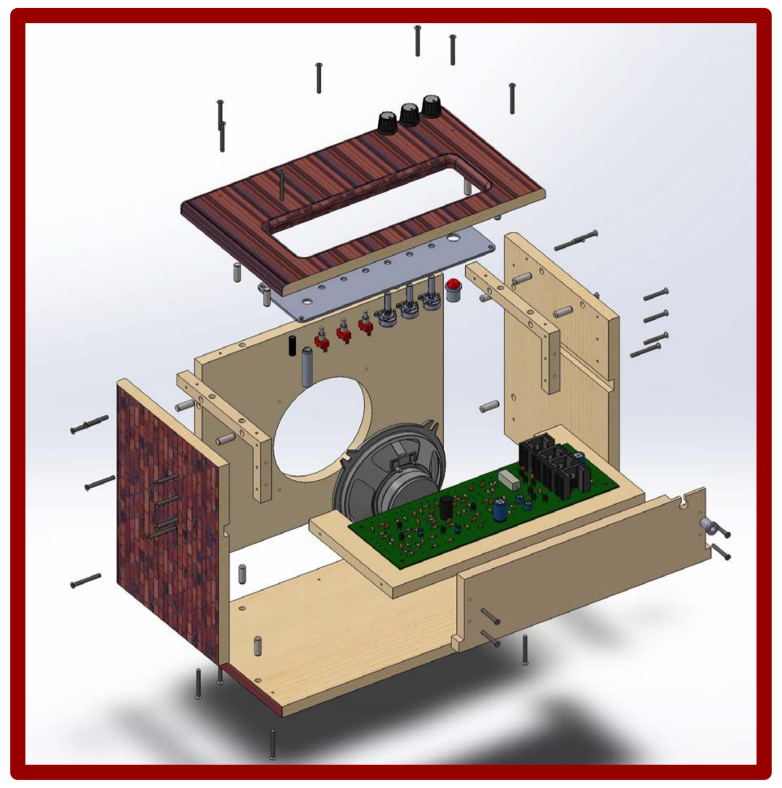


2017 → 2017 → 2018 → 2018 → 2020

COVID-19 EFFECTS

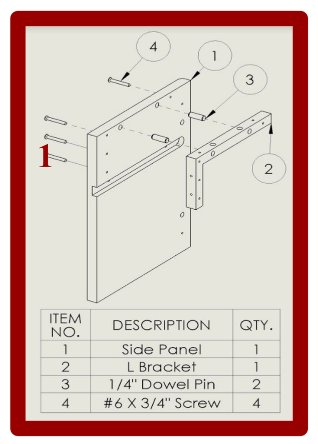
The sudden onset of COVID-19 cases in the US resulted in our inability to meet and test how high school students interact with the difficulties of assembly. We re-evaluated our plans and, despite the additional difficulties, managed to complete the assembly of 8 fully functional units.

MECHANICAL DESIGN

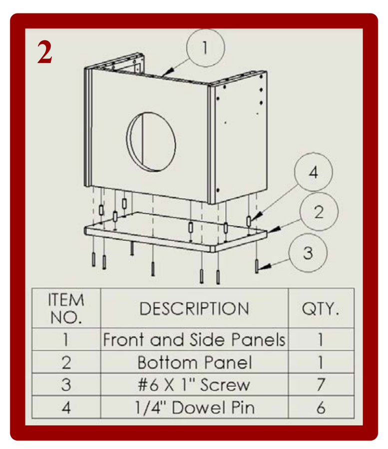


The final design was centered around manufacturability, ease of assembly, portability, aesthetic appearance, and price point. Designed with the assembly process in mind, the kit caters towards high school students with limited mechanical experience. The completed amplifier is constructed of ½" baltic birch plywood wrapped in Tolex. It measures 12" x 10" x 7" and weighs under 15 lbs.

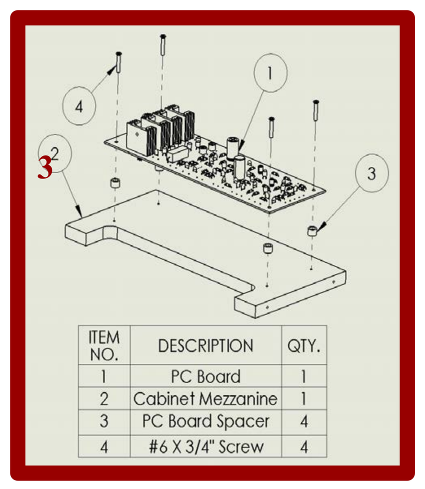
STARTER KIT ASSEMBLY HIGHLIGHTS



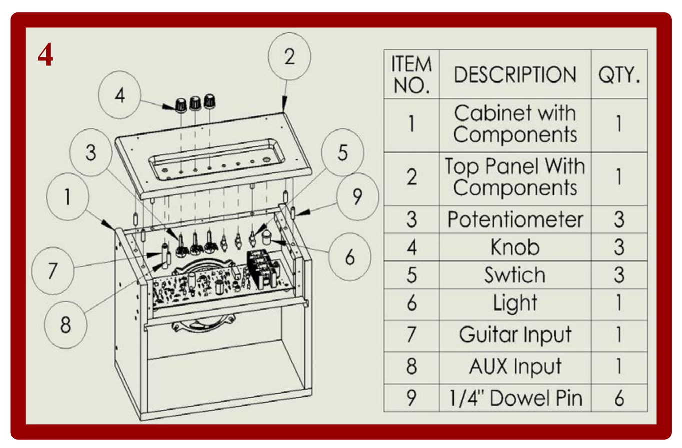
1. Internal brackets attached to the side panels provide an easy way to mate the rest of the panels and route the cabinet edges.



2. Cabinet panels have pre-drilled pilot holes and contain dowel pins to properly to guide the 1" screws.

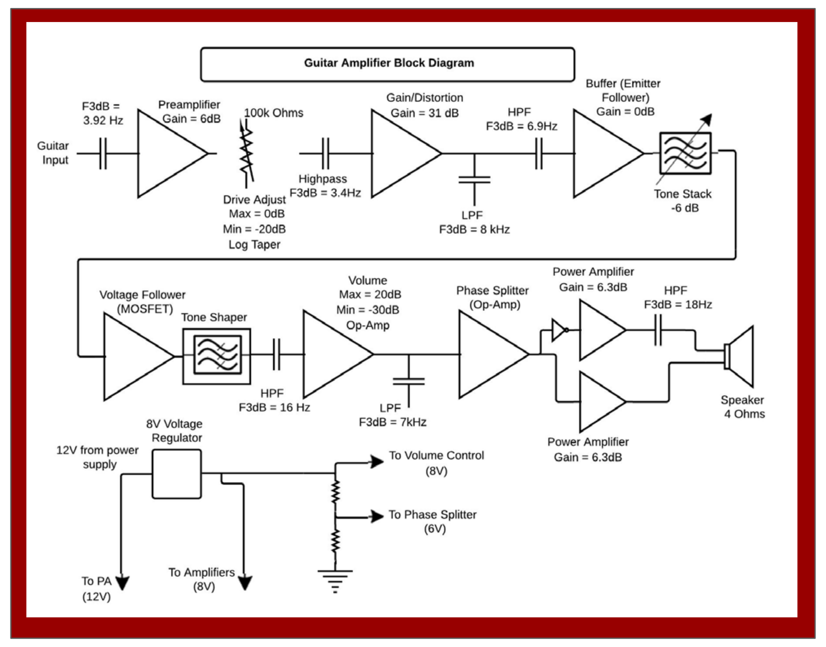


3. Mezzanine feature allows for simple assembly of PCB and control panel components before being inserted in the cabinet.



4. The mezzanine, complete with the PCB mounted and control panel components connected, slides into the grooves routed on the side panels. Next, the top panel is secured to the brackets with dowel pins. Finally, the interface components are inserted into the specified holes and secured from the top.

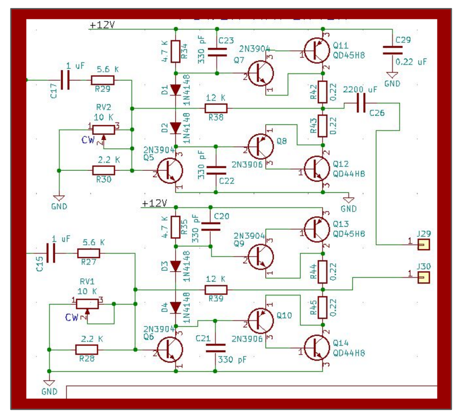
ELECTRICAL DESIGN



The design follows the general composition of a guitar amplifier with the following stages: preamplification, distortion, tone adjust, volume, gain, and power amplification

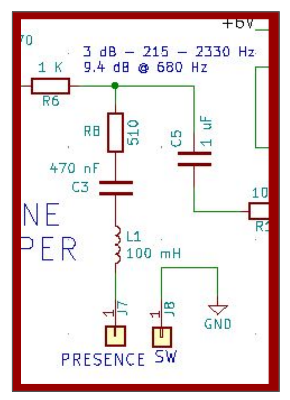
The circuit is designed to operate on 12V from a DC supply in order to ensure safety during construction. Previous iterations involved assembling an AC to DC converter, which could be dangerous to the students assembling the units.

KEY DESIGN COMPONENTS



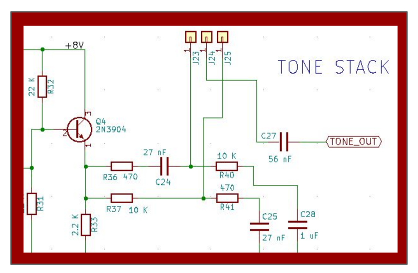
POWER AMPLIFIER

Complementary Darlington transistors in push-pull arrangement for maximum output voltage range and efficiency



PASSIVE NOTCH FILTER

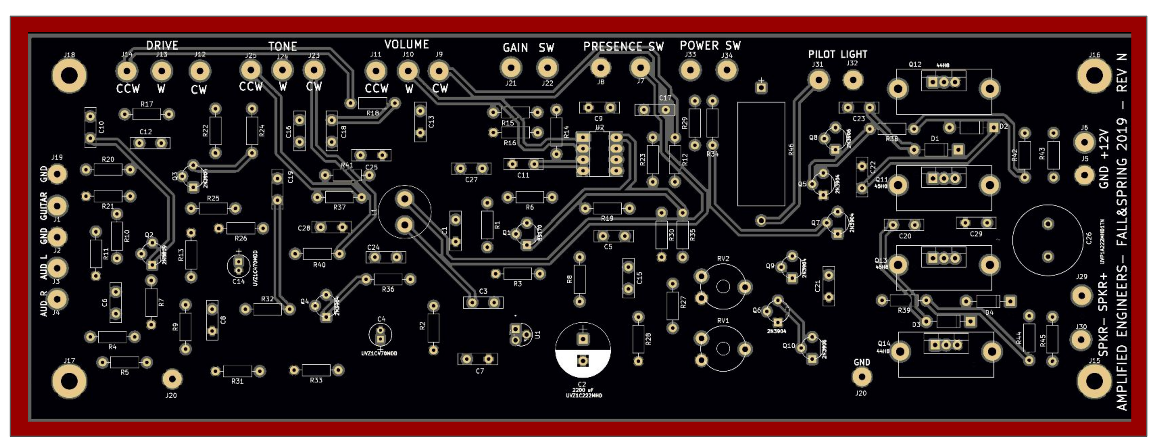
This series RLC segment of the circuit provides a dip in the 600Hz - 1kHz range to create a "brighter" sound



TONE CONTROL

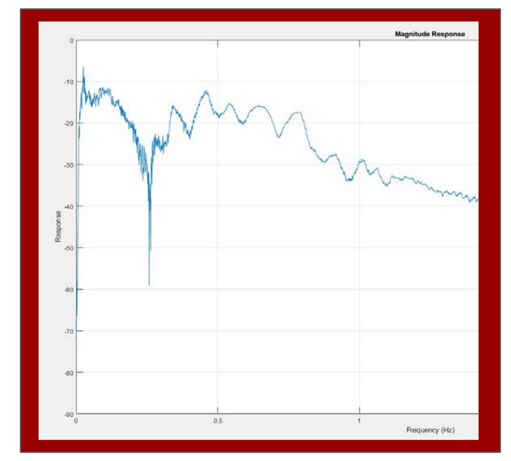
This elegant design allows tone control with the use of just one potentiometer

PCB DESIGN



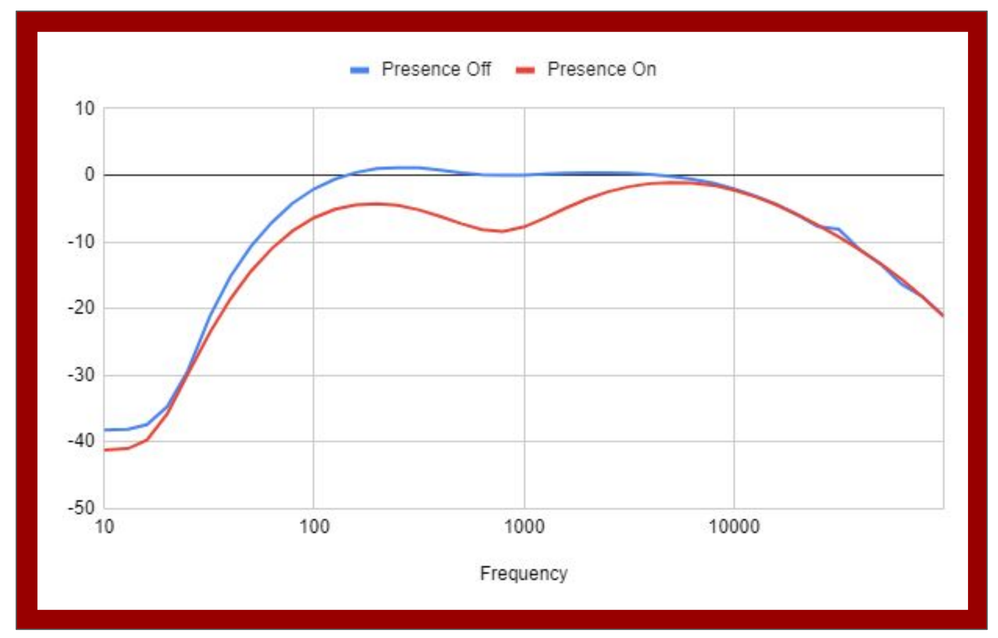
The PCB layout was designed in conjunction with the ME team in order to ensure a proper fit with the final cabinet design. Some of the components are rather tall and could have resulted in collision without careful planning.

TESTING/RESULTS



ACOUSTIC TESTING

By testing the acoustic characteristics of the various cabinet designs in a semi-anechoic room, we were able to compare different mechanical designs and optimize the cabinet for the best possible sound. We measured the acoustic response with an adaptive filter, allowing us to plot the amplitude at different frequencies



FREQUENCY RESPONSE TESTING

In order to create the option for a "brighter" sound, we implemented a passive notch filter that provides a dip from 600 - 1kHz. The plot above shows the measured frequency response with (red) and without (blue) the presence switch enabled.

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