EMERGENCY! NEED BACK-UP

Project ID: SDmay21-43
Team Members: Marcelo Abrantes, James Curtis, Caroline Easley, Michael Kuehn, Benjamin Welte, Abbey Wilder, Stepan Zelenin
Faculty Advisor: Dr. Andrew Bolstad
Client: Collins Aerospace - Brendan Getz and Zachary Stout

Introduction:

Pilots rely on an airplane radio for communication, so if it breaks, they can no longer communicate with air traffic control (ATC) or other aircraft. This causes many problems since ATC is no longer able to communicate with the aircraft to coordinate airspace deconfliction. It also means that the airplane pilots cannot communicate any ongoing problems to ATC.

Solution:

Our projects main goal was to design a foundation of a simple emergency back-up radio capable of transmitting and receiving AM signals. A pilot will have the capability to control the radio with a push to talk button and a user interface to change the frequency.

Intended Users and Uses:

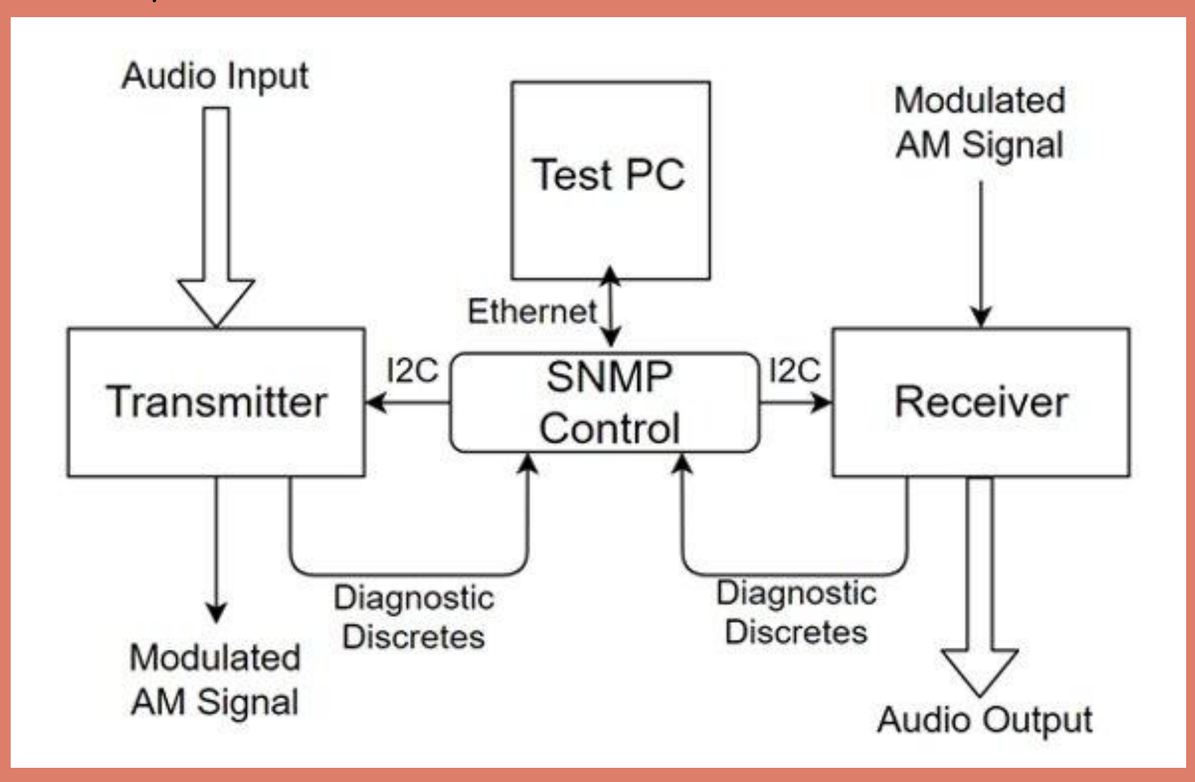
- Uses: Foundational design to be expanded on
- Users: Collins Aerospace Engineers, Pilots

Project Resources:

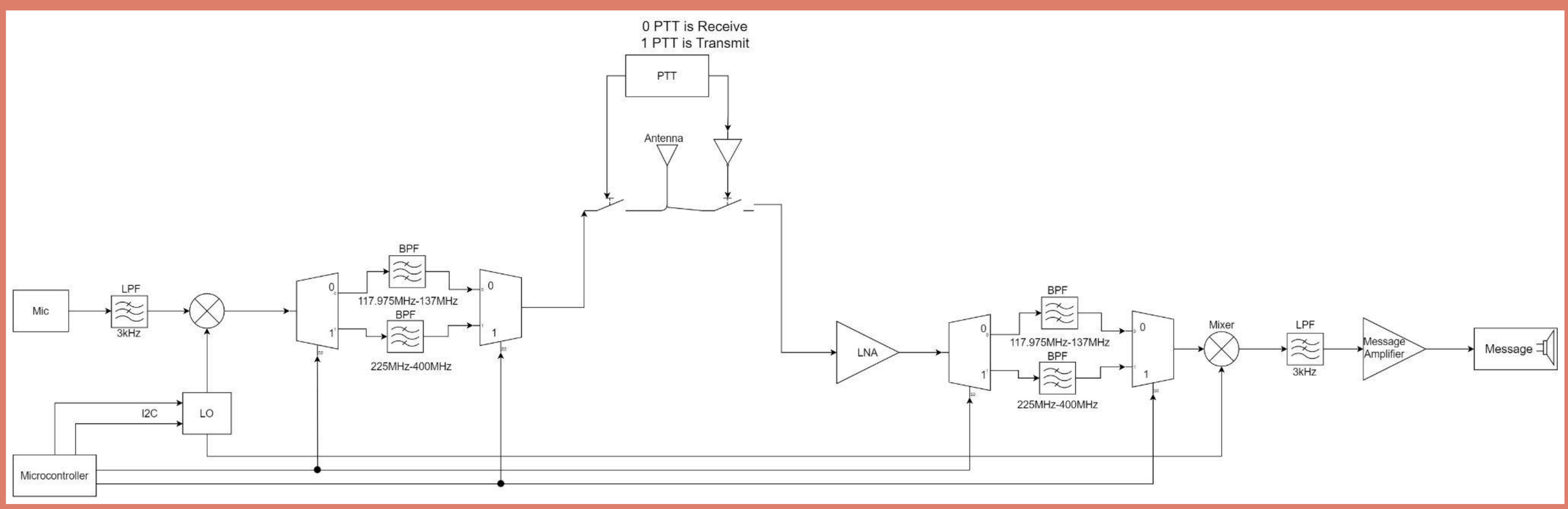
- Physical
  - Coover Hall Transformative Learning Area (TLA)
  - Electronics and Technology Group (ETG)
- Virtual
  - Arduino IDE (Microcontroller)
  - iReasoning MIB Browser (SNMP)
  - MATLAB and Simulink
  - LTspice (Audio Range for Filters)
  - EasyEDA (PCB)

Design Approach:

- Conceptual Sketch



- Block Diagram



Design Requirements:

- Functional Requirements
  - Tx/Rx Frequency Ranges and Tuning Increments:
    - 117.975 to 137 MHz with tuning of 8.33 kHz, 25 kHz
    - 225 to 400 MHz with tuning of 25 kHz
  - Support Amplitude Modulation (AM) only
  - SNMP interface for control and status operations.
  - Push-To-Talk (PTT) for Rx/Tx
  - 150 Ohm +/- 10% narrowband (Input)
  - 600 Ohm +/- 10% narrowband (Output)
- Non-Functional Requirements
  - Detailed and Concise Project Documentation
  - Adhere to Industry Standards
- Constraints
  - Cannot exceed 6 lbs
  - Cannot exceed 6 in. x 6 in. x 6 in.
  - Maximum Cost: $1500
- Standards
  - ED-23C (European Air Traffic Control)
  - DO-254
  - DO-178C
  - IEEE 802.3 (10/100 Base-T)
- Operational Environment - Aircrafts

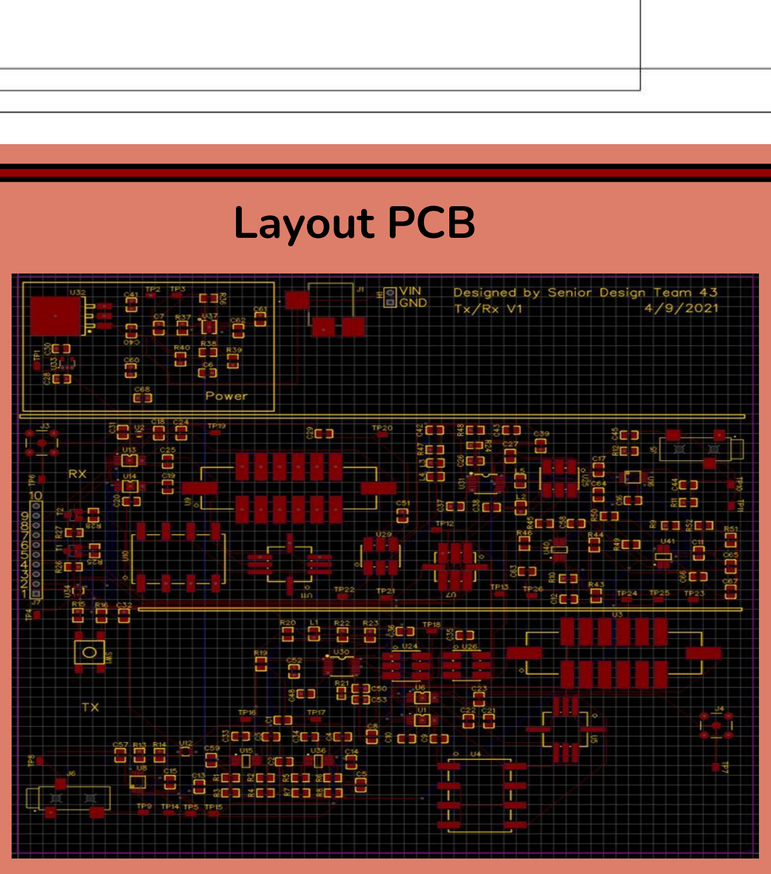
Technical Details:

- Receiver:
  - Demultiplexer and Multiplexer used to decide which frequency range is needed
  - Receive an Input at a desired frequency when PTT button is low
  - Input passed through Band Pass Filter and Low Noise Amplifier to eliminate outside signals and attenuation
  - Local Oscillator will shift the frequency of the signal and passed through a Low Pass Filter to insure the signal is restricted to the proper bandwidth
  - Amplified and sent to a speaker for broadcasting
- Transmitter:
  - Microphone captures sound when PTT button is high
  - Low Pass Filter for human voice
  - Signal is then sent to a mixer with the Local Oscillator frequency
  - Demultiplexer and Multiplexer used to decide which frequency range to be filtered and transmitted
- Controller:
  - Arduino Microcontroller via I2C is used to change the desired frequency for the Local Oscillator
  - Ethernet SNMP will be used to allow the user to send and receive the desired frequency to and from the microcontroller

Testing Strategy:

- Test individual components
  - PC to SNMP
  - I2C and LO
  - Transmitter
  - Receiver
- Assemble and test breadboard prototype
- Integrate and test all components
  - SNMP to LO
  - LO to Transceiver
- Assemble and test PCB prototype

Layout PCB



Final PCB