Dwight Look College of
ENGINEERING
TEXAS A&M UNIVERSITY

Team 84: Ultrasonic Radio
Bi-Weekly Update 2

Nathan Cinocca and Jacob Ralls
Sponsor: Oscar Moreira-Tamayo
TA: Omar Mahmood

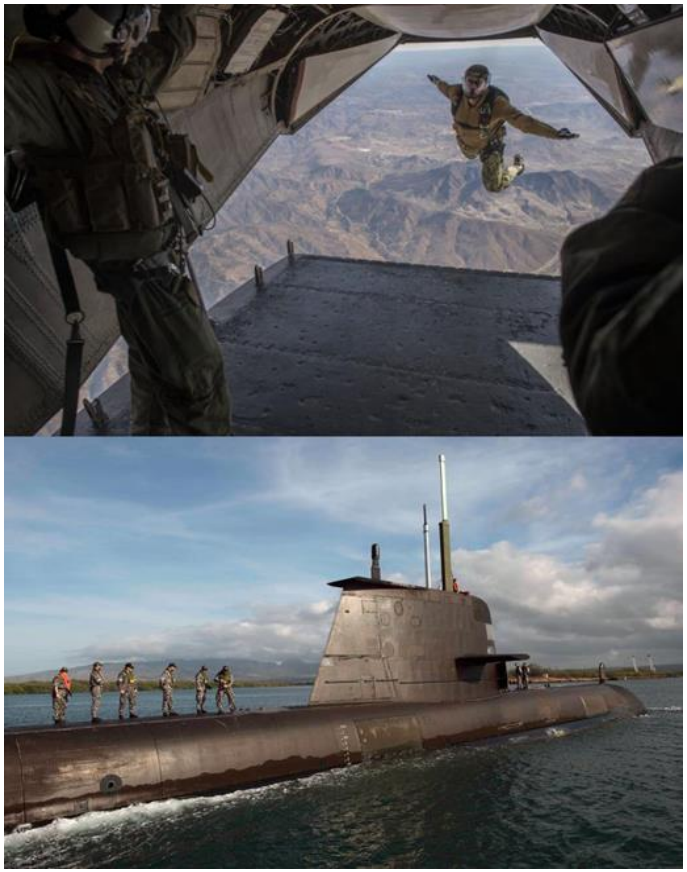
Project Summary

Problem statement:

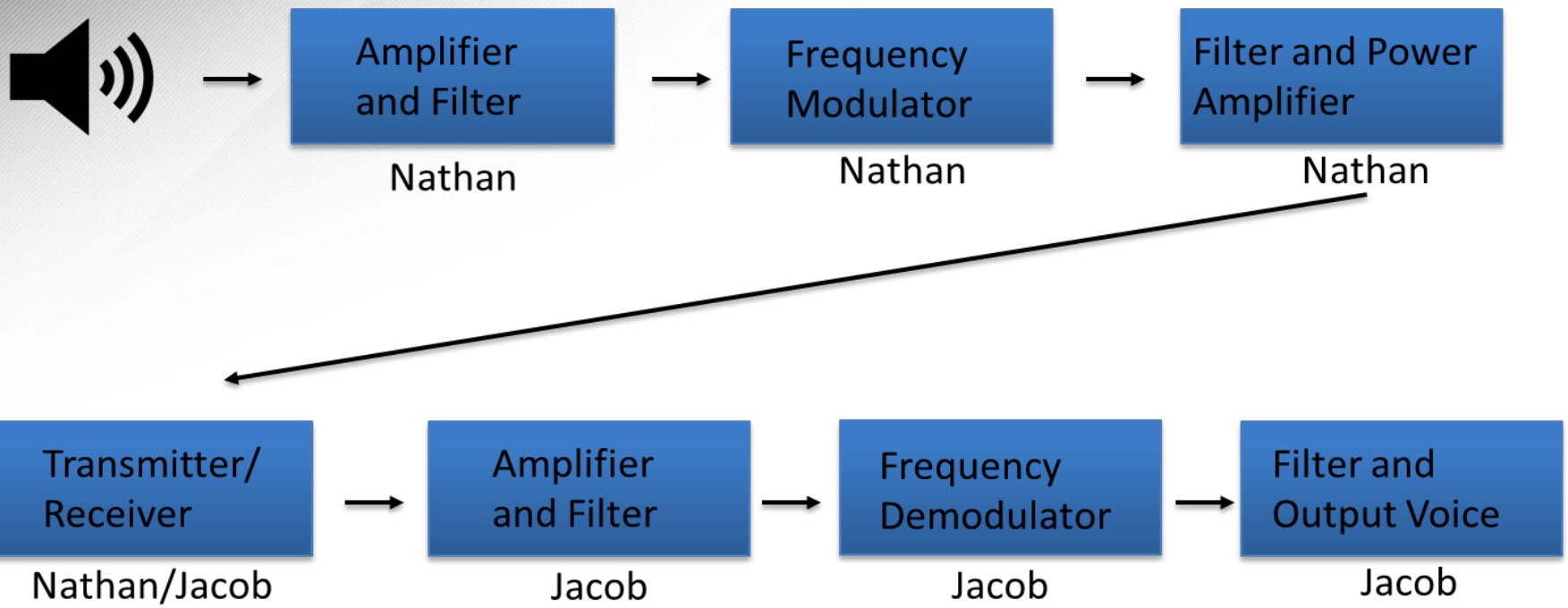
- Communicating information is very important in almost every military operation. However, sometimes sending information through traditional methods is not feasible.

Solution proposal:

- A solution to this issue is to develop an acoustic ultrasonic radio.
  - Acoustic waves and lower frequencies will limit electromagnetic radiation
- This radio will allow for communications over relatively short distances.
- Communication will be slower than devices using electromagnetic waves



Project/Subsystem Overview



- Input microphone covers human voice frequencies (100 Hz to 3 kHz)
- Voice is translated into an electrical signal
- Signal is amplified and filtered to enhance quality and eliminate unwanted noise
- Modulated to ultrasonic frequencies for transmission, with optional additional filtering
- Modulated signal goes through a power amplifier to achieve required gain
- Signal travels to receiving microphone for filtering and amplification for demodulation
- After demodulation, signal is filtered and output through a speaker within the human hearing range

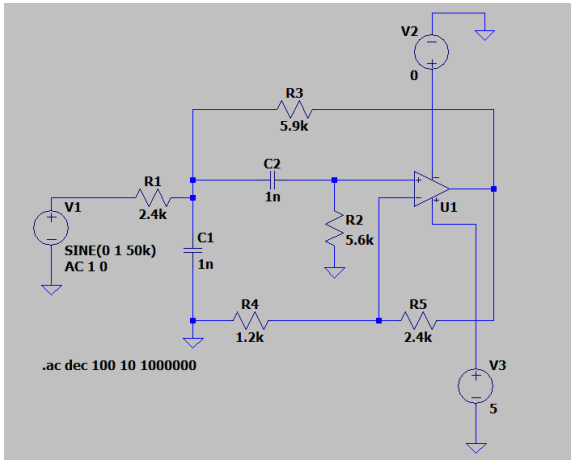
Project Timeline

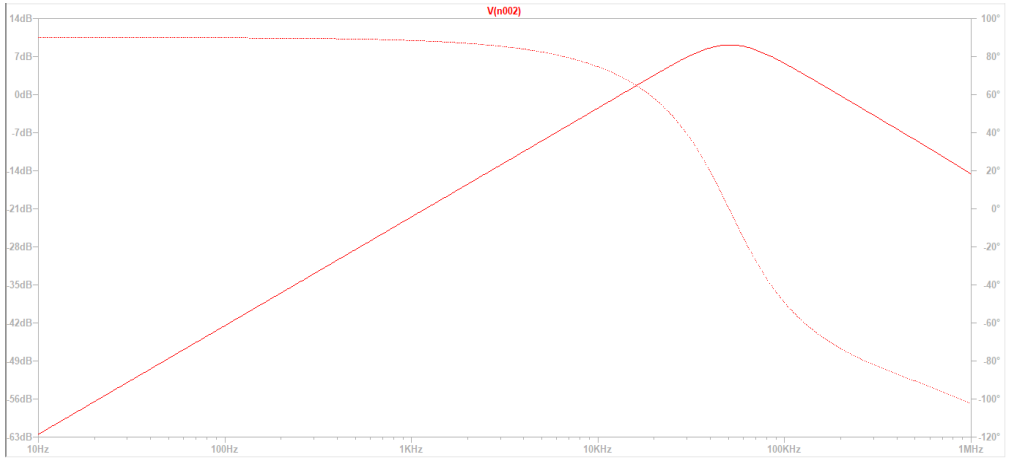
Subsystem Designs and Testing (To complete by 2/9)	Integration of transmitter subsystems (to complete by 2/26)	Integration of receiver subsystems (to complete by 2/26)	Final Integration (to complete by 3/4)	System Test (to complete by 3/25)	Validation (to complete by 4/8)	Demo and Report (to complete by 4/15)

Signal Amplifier & High Freq Filter (Receiver)

Jacob Ralls

Accomplishments since last presentation 18 hrs of effort	Ongoing progress/problems and plans until the next presentation
• Verified issues with circuit • Simulated multiple ideal models • Created and ordered PCB	• Solder and test functionality • Will integrate with the demodulator with tests to be performed on the joint system





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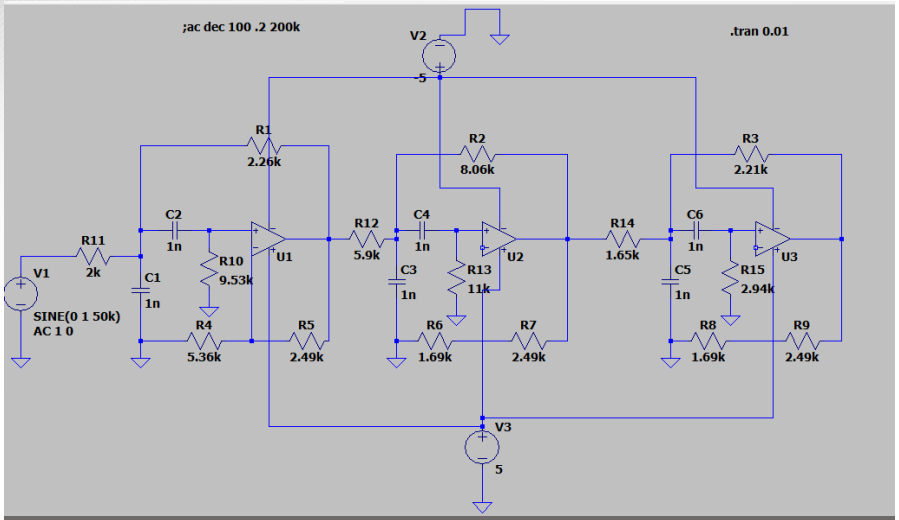
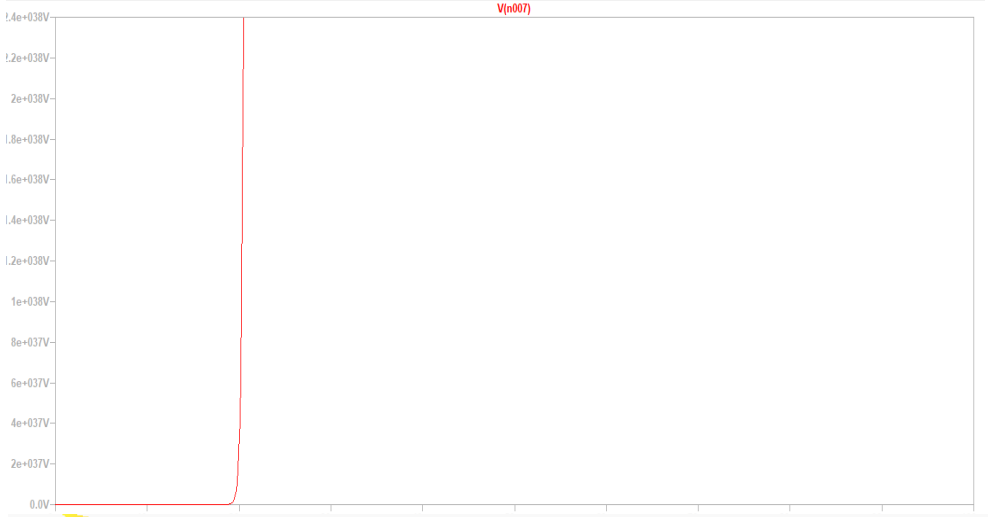
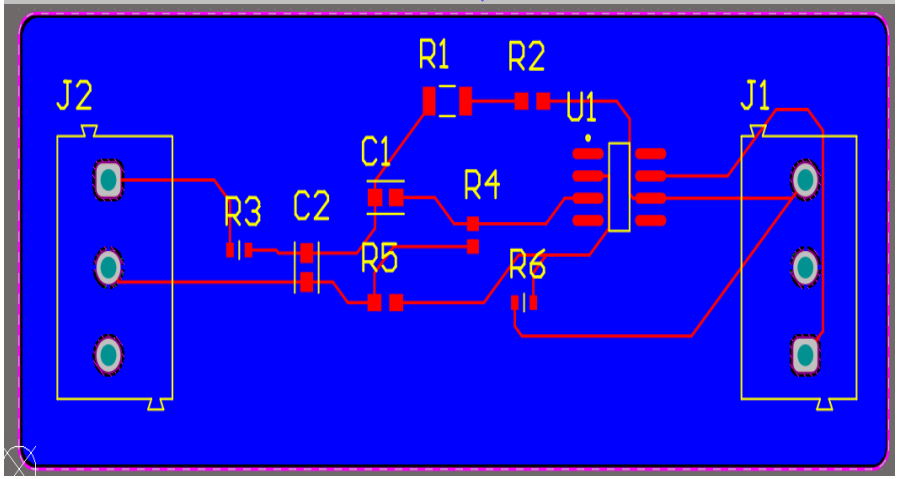
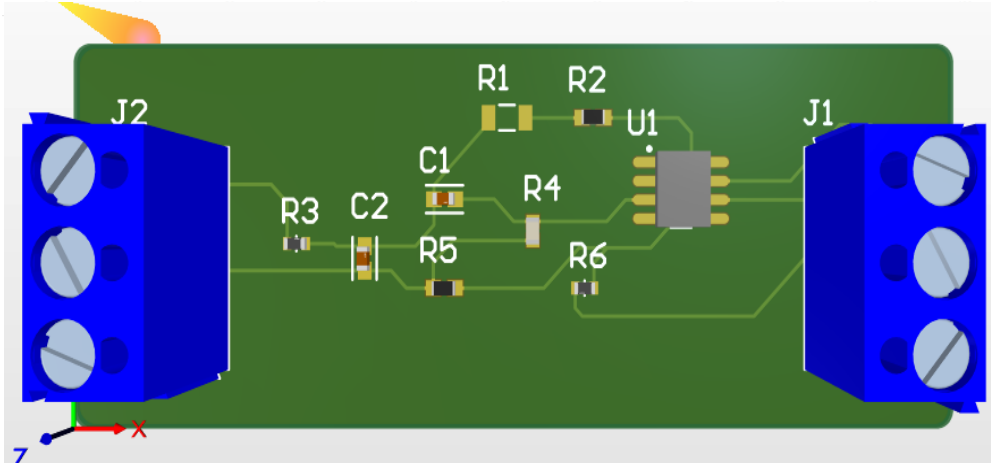
Signal Amplifier & High Freq Filter (Receiver)

Jacob Ralls





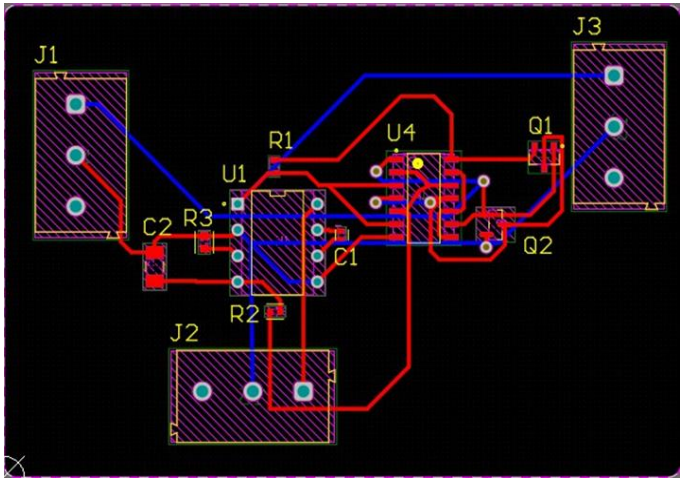


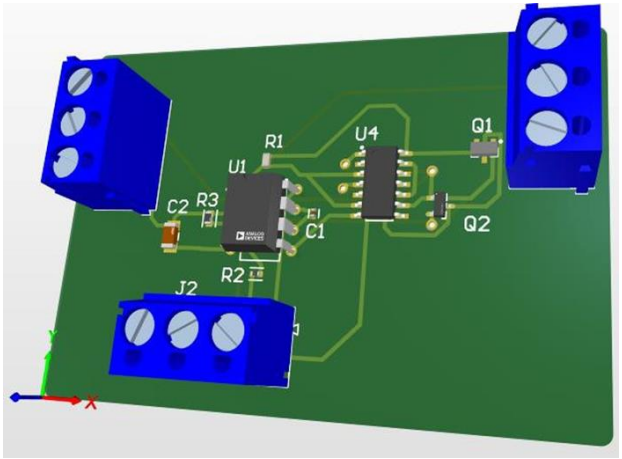


Demodulator (Receiver)

Jacob Ralls

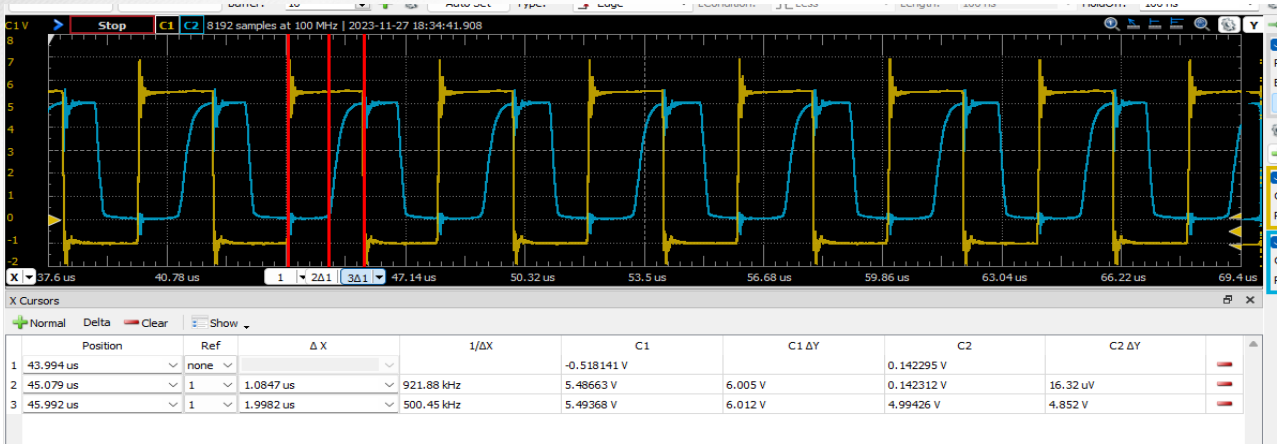
Accomplishments since last presentation 4 hrs of effort	Ongoing progress/problems and plans until the next presentation
• Successfully tested and runs as expected since 403	• Work on implementing this with the Signal Amp & Filter • Run tests to ensure integration process is successful

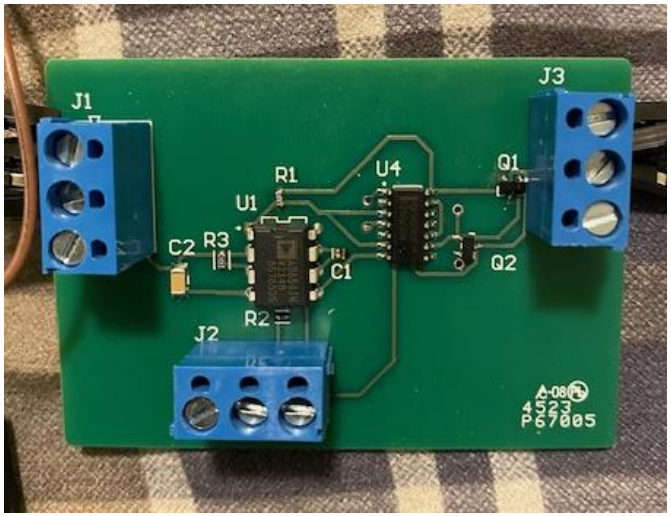




Demodulator (Receiver)

Jacob Ralls



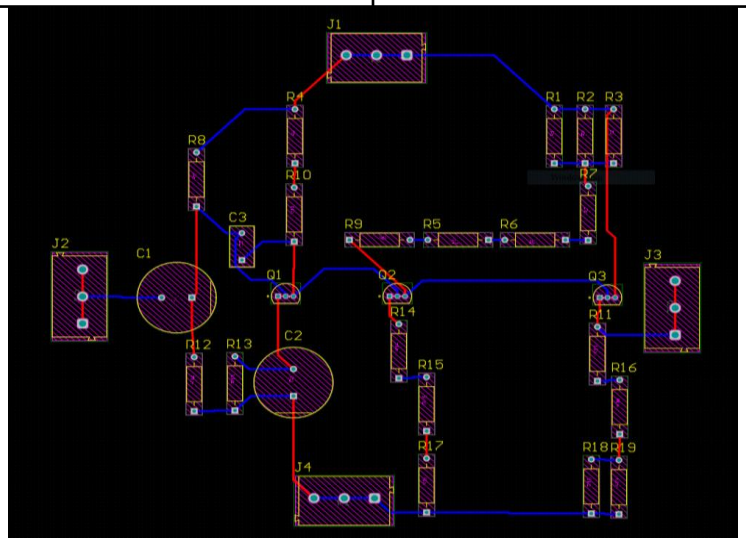


- On the scope screen the two square waves are stable (this indicates that they are locked)
- Voltage of the square wave is shifted approximately 90 degrees with respect to the reference frequency.

Signal Amplifier (Transmitter)

Nathan Cinocca

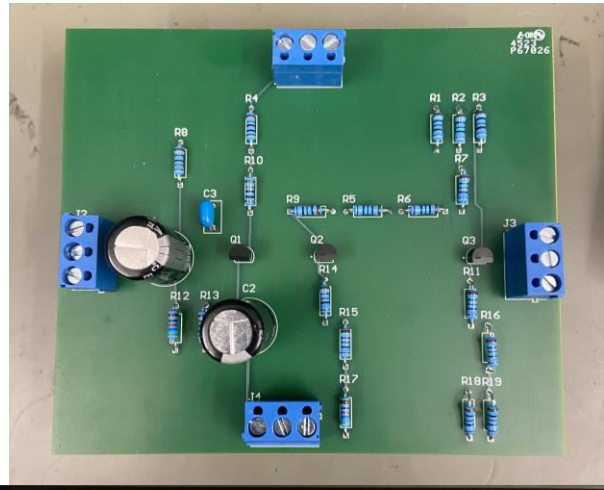
Accomplishments since 403 — 7 hrs of effort	Ongoing progress/problems and plans until the next presentation
• Resoldered entire PCB • Tested system responses on multimeter	• Begin integration with other transmitter subsystems



Signal Amplifier (Transmitter)

Nathan Cinocca

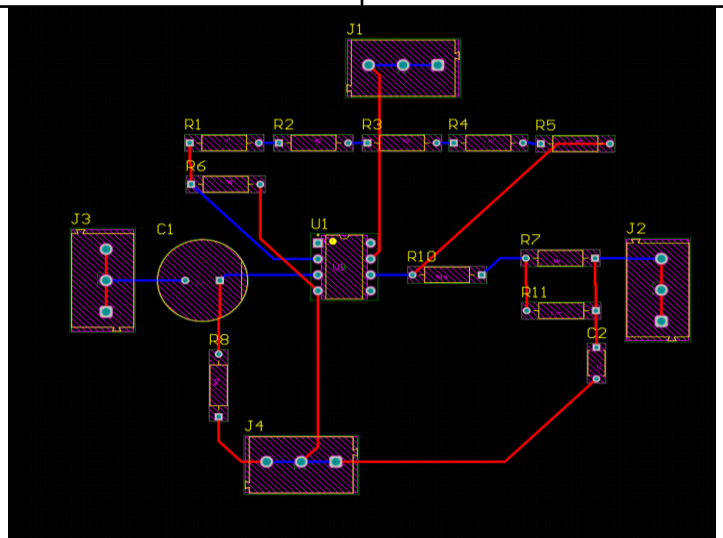
- Signal amplifier had a peak gain of around 26 dBs centered at 1k Hz with 3 dB frequencies at 3.1k Hz and 300 Hz
- The gain and operational frequencies are correctly placed according to simulations



Low Frequency Filter (Transmitter)

Nathan Cinocca

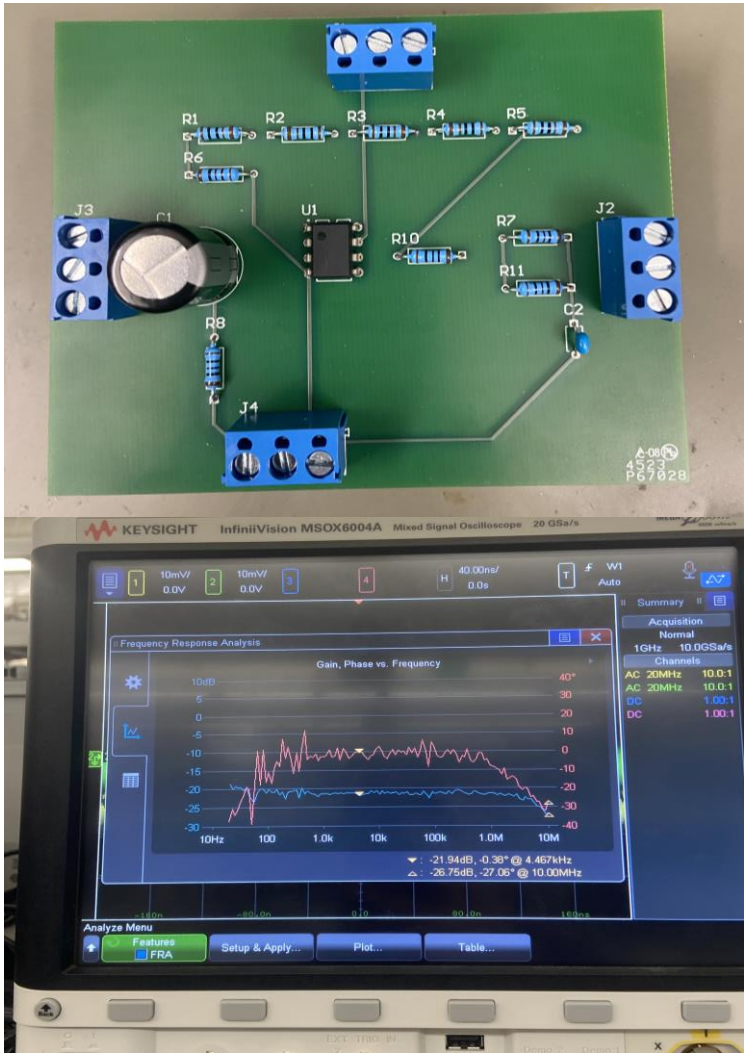
Accomplishments since 403 — 7 hrs of effort	Ongoing progress/problems and plans until the next presentation
• Resoldered entire PCB • Retested system response on multimeter	• Continue testing and attempting to determine circuit issues • Order a new PCB if unable to fix issues



Low Frequency Filter (Transmitter)

Nathan Cinocca

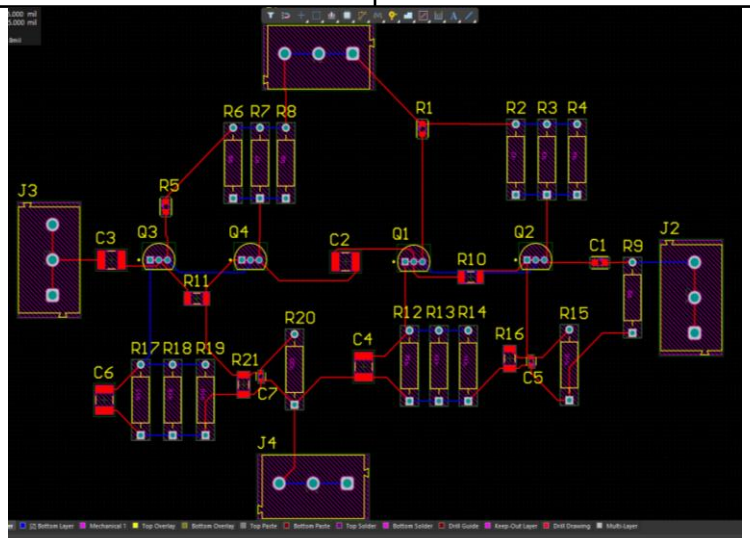
- Frequency response of the low frequency filter shows a much lower gain than anticipated with a shape that does not resemble a filter.
- The response is also very noisy
- These issues indicate that there may still be some part of the PCB incorrectly soldered



Power Amplifier (Transmitter)

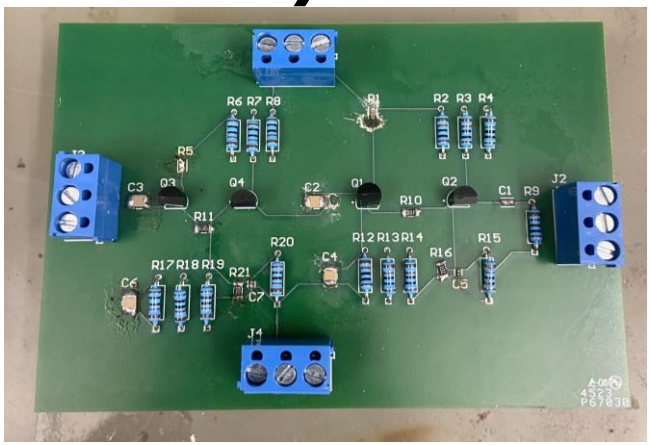
Nathan Cinocca

Accomplishments since 403 — 7 hrs of effort	Ongoing progress/problems and plans until the next presentation
• Resoldered entire PCB • Tested system responses on multimeter	• Begin integration with other transmitter subsystems

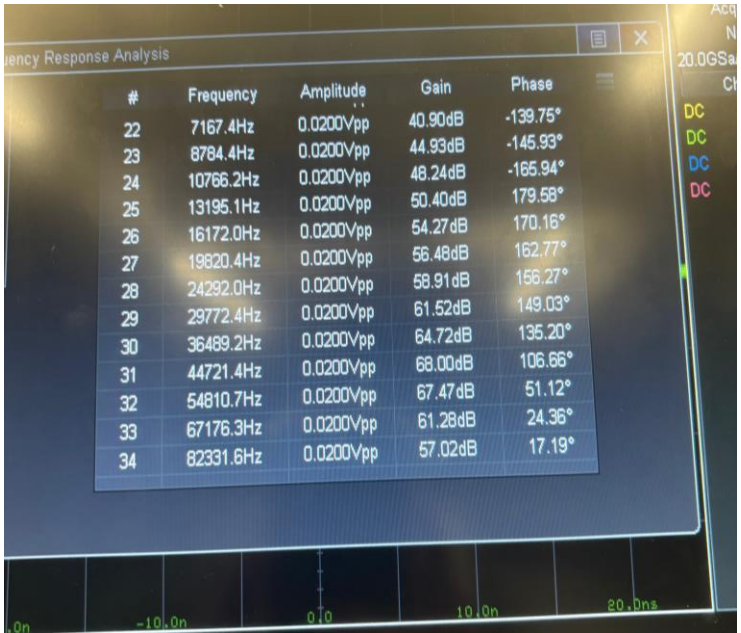


Power Amplifier (Transmitter)

Nathan Cinocca



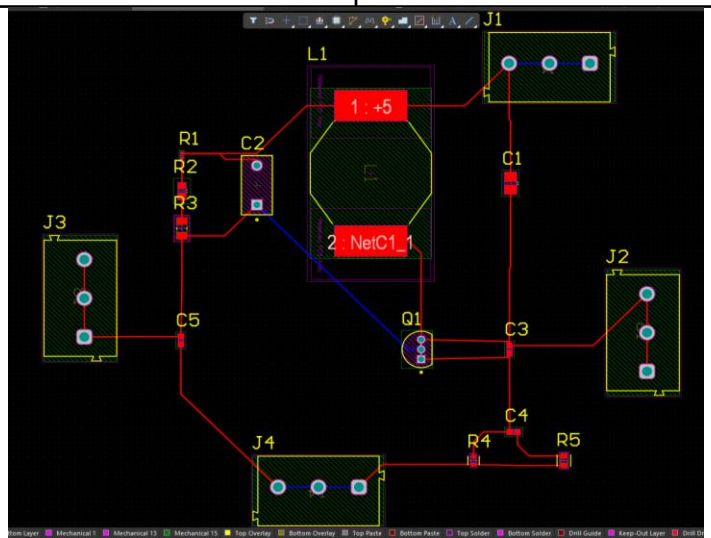
- The power amplifier has a maximum gain of about 68 dBs centered at 45 kHz
- The amplifier has 3 dB frequencies at approximately 60k Hz and 35 kHz
- The operation of the power amplifer is within expectation according to simulations



Frequency Modulator (Transmitter)

Nathan Cinocca

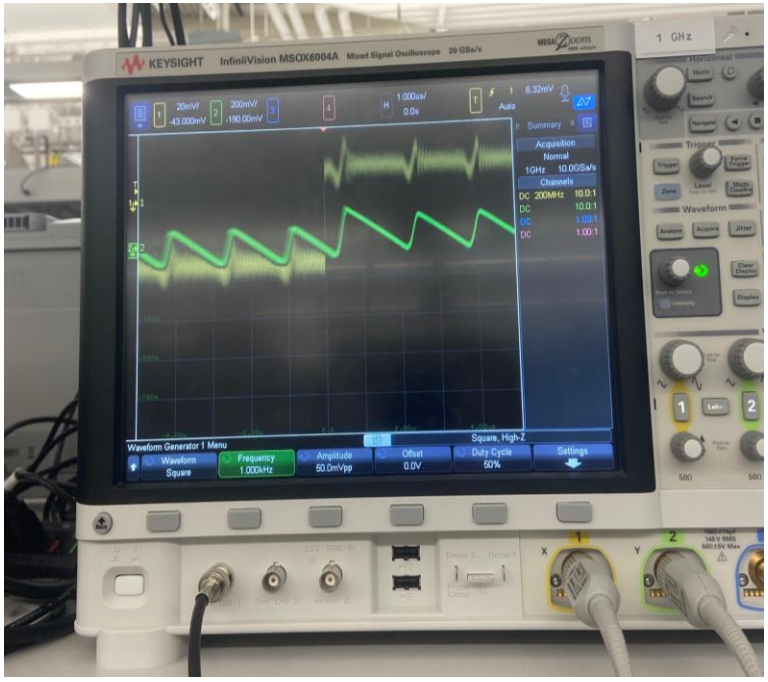
Accomplishments since 403 — 3 hrs of effort	Ongoing progress/problems and plans until the next presentation
• Resoldered entire PCB • Tested system responses on multimeter	• Begin integration with other transmitter subsystems

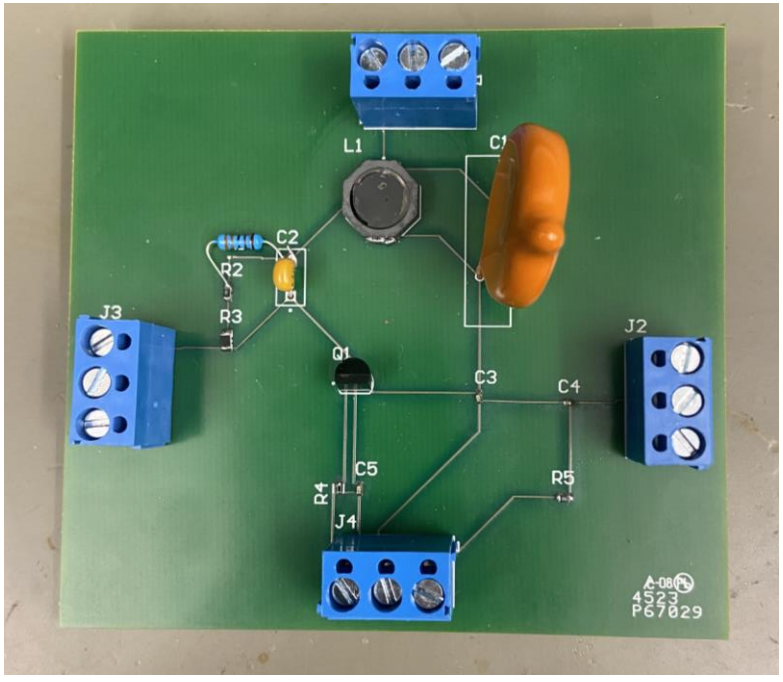


Frequency Modulator (Transmitter)

Nathan Cinocca

- Frequency modulator modulates a 1k Hz signal to around 40k Hz
- This frequency is within expectations from simulations





Execution Plan

	January 29th	February 5th	February 12th	February 19th	February 26th	March 4th	March 18th	March 25th	April 1st	April 8th	April 15th
Finish Validating and Testing all Subsystems (ALL)											
Order New PCB if Needed (ALL)											
Order Ultrasonic Microphones and Speakers (ALL)											
(Transmitter End) Connect/Validate Signal Amplifier and Filter (NC)											
(Transmitter End) Connect/Validate Power Amplifier With Other Transmission Subsystems (NC)											
(Transmitter End) Connect/Validate Frequency Modulator With Other Transmission Subsystems (NC)											
(Receiver End) Connect/Validate Signal Amplifier and Filter (JR)											
Connect/Validate Both Transmitter and Receiver Parts of Radio (ALL)											
Final Validation and Testing of Radio (ALL)											

Completed Pending Not Started Behind Schedule

Validation Plan

Paragraph #	Test Name	Success Criteria	Methodology	Status	Responsible Engineer(s)
3.2.1.1	Signal to Noise Ratio	The transmission signal from the transmitter to the receiver should have >= 60 dB signal to noise ratio	Test gain with an oscilloscope at the output node of the receiver	UNTESTED	Full Team
3.2.1.2	Transmission Distance	The signal should be able to transmit and be received at 15 meters or more	Send the signal and measure the maximum distance with a tape measure	UNTESTED	Full Team
3.2.1.3	Total Harmonic Distortion	The output signal should have a total harmonic distortion less than or equal to 5%	Test the output total harmonic distortion at the output node of the radio with an oscilloscope	UNTESTED	Jacob Ralls
3.2.2.1	Mass	Have the entire ultrasonic radio be less than or equal to 10 kilograms	Weigh all PCBs that make up the radio on a scale	UNTESTED	Full Team
3.2.3.1.1	Power Consumption	The maximum peak power of the system shall not exceed 4.5 watts	Use multimeter to check power consumption of ultrasonic radio	UNTESTED	Full Team
3.2.3.1.2	Input Voltage Level	The input voltage level for the ultrasonic radio shall be +5 VDC	Use multimeter to check voltage levels of ultrasonic radio	UNTESTED	Full Team
3.2.3.1.3	Input Current Level	The input current for the ultrasonic radio shall not exceed 900 mA	Use multimeter to check current levels of ultrasonic radio	UNTESTED	Full Team
3.2.3.1.4	Voice Input	The ultrasonic radio shall take user voice input that operates from 100 Hz to 3 kHz	Test input microphone with different voice frequency recording within the 100 – 3kHz range	UNTESTED	Nathan Cinocca
3.2.3.2.1	Voice Output	The ultrasonic radio shall output the voice input up to 15 meters away at frequencies 100 Hz to 3 kHz	Test output speaker with different voice frequency recording within the 100 – 3kHz range	UNTESTED	Jacob Ralls
3.2.4.1	Pressure (Altitude)	The ultrasonic radio may be able to operate up to 2.5 atm of pressure	Use ultrasonic radio in a container with higher pressure	UNTESTED	Full Team
3.2.4.2	Thermal	The ultrasonic radio may be able to operate at thermal temperatures ranging from 55 degrees Fahrenheit to 95 degrees Fahrenheit	Use ultrasonic radio outside or in a temperature-controlled area such as oven	UNTESTED	Full Team
3.2.4.3	Humidity	The ultrasonic radio should be able to function in 0-95% relative humidity	Use a container with controlled humidity to test ultrasonic radio	UNTESTED	Full Team
3.2.5.1	Recovery	The Ultrasonic radio should provide a way to reset the entire system	Test reset button to see if it turns off and resets the ultrasonic radio	UNTESTED	Full Team

Thank you for your attention.
Any questions?