Dwight Look College of
ENGINEERING
TEXAS A&M UNIVERSITY

Team 84: Ultrasonic Radio
Bi-Weekly Update 4

Nathan Cinocca and Jacob Ralls
TA: Omar Mahmood

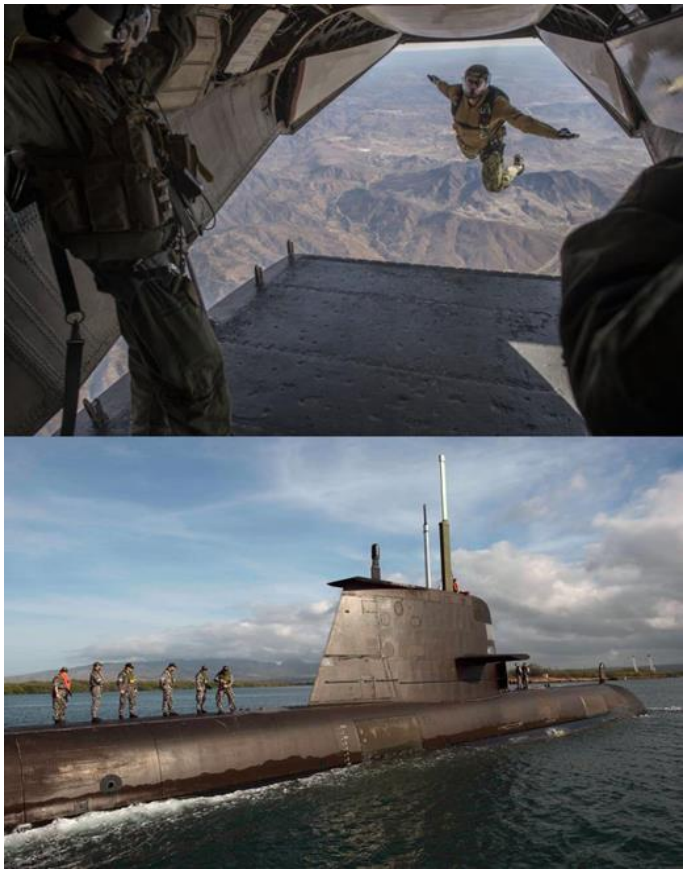
Project Summary

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



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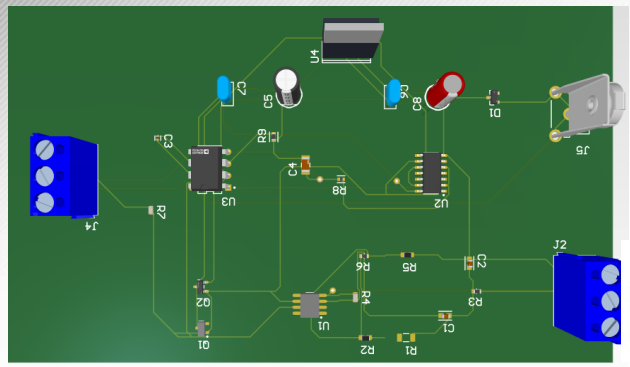
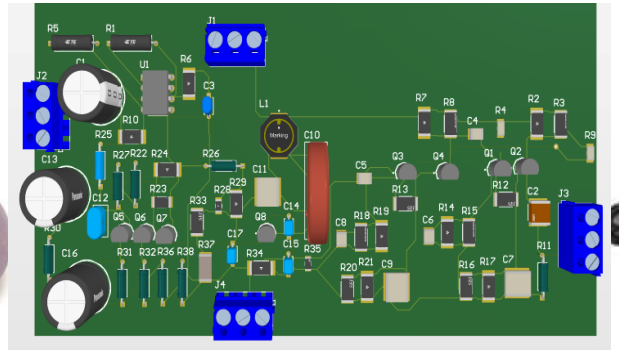
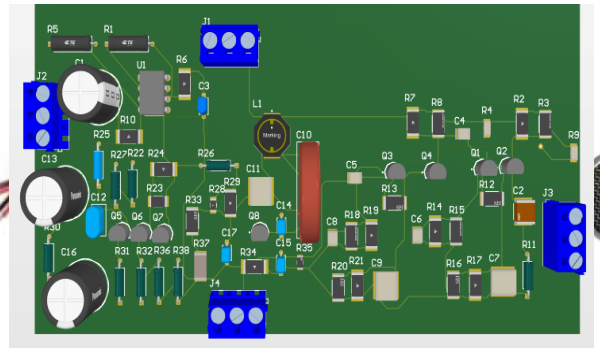
Project/Subsystem Overview

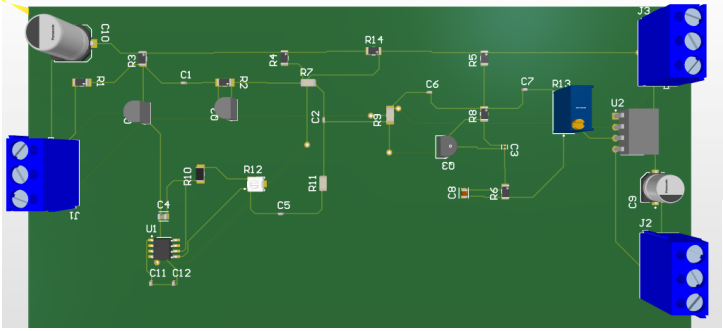


40 kHz





25kHz



- 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

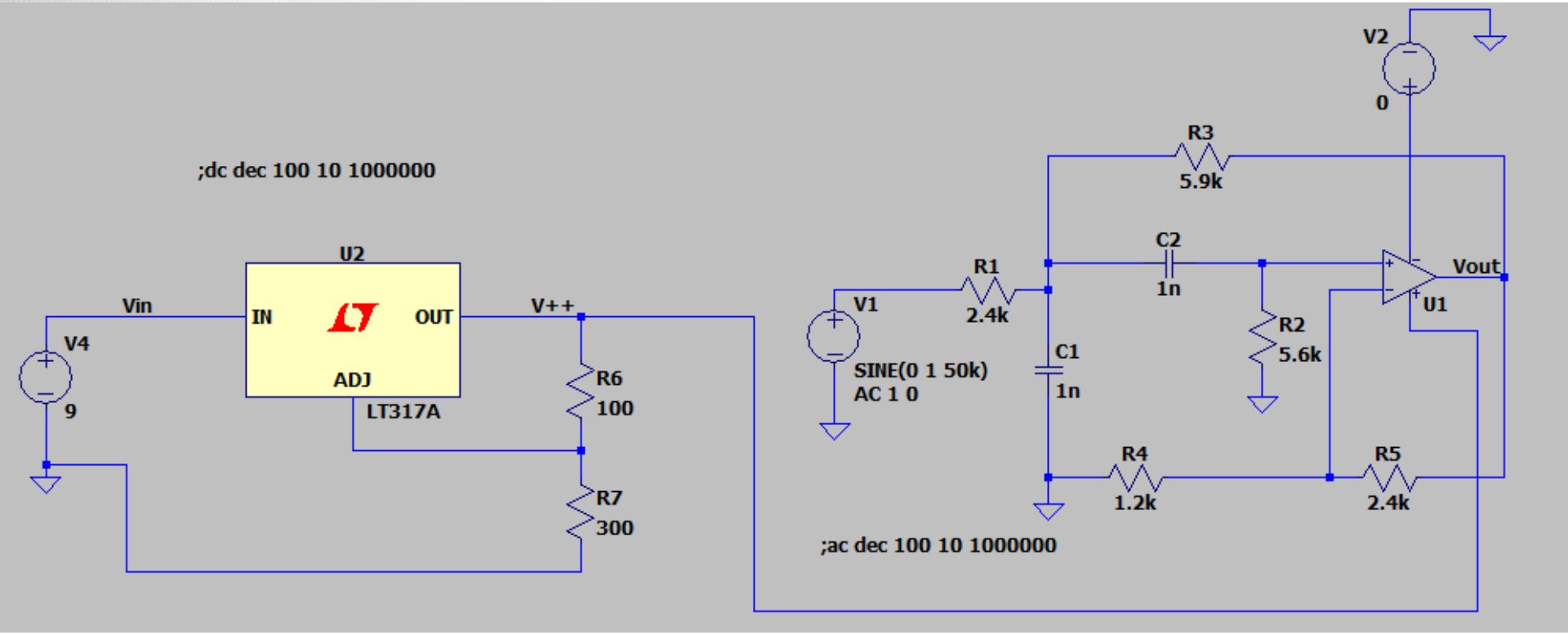
Project Timeline

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)

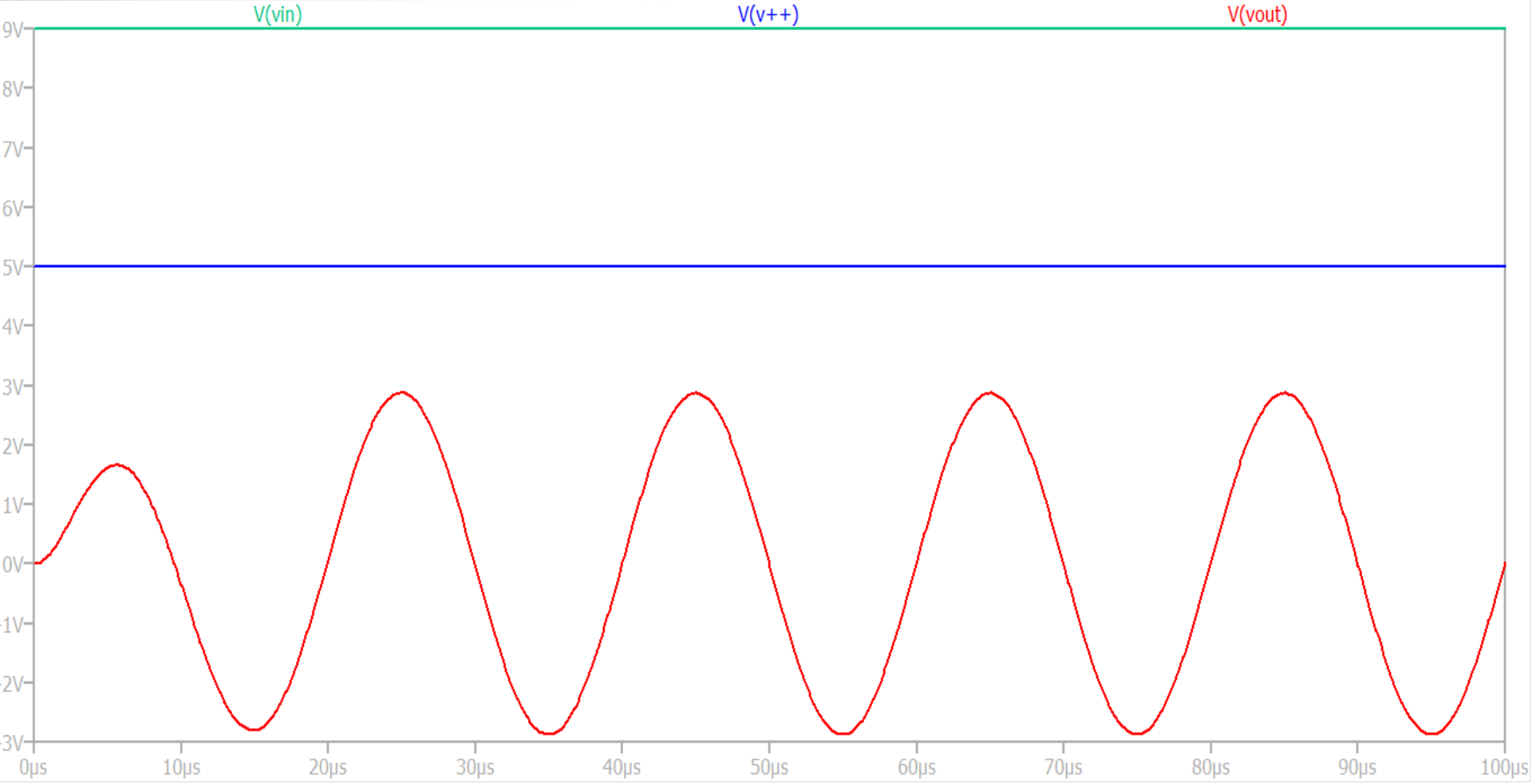
Jacob Ralls

Accomplishments since last update 20 hrs of effort	Ongoing progress/problems and plans until the next presentation
• Power subsystem simulated and tested to be working (50 khz receiver PCB) • Designed and finalized receiver PCB for varying freq from 1 Hz – 500 kHz • Designed and finalized simplified 40 kHz Receiver PCB in case of 50 kHz PCB does not work with 40 kHz transducers	• Once parts received, test my current 50 khz amplifier and demodulator with transmitter components. • If successful run error tests through distance measurements and barriers.

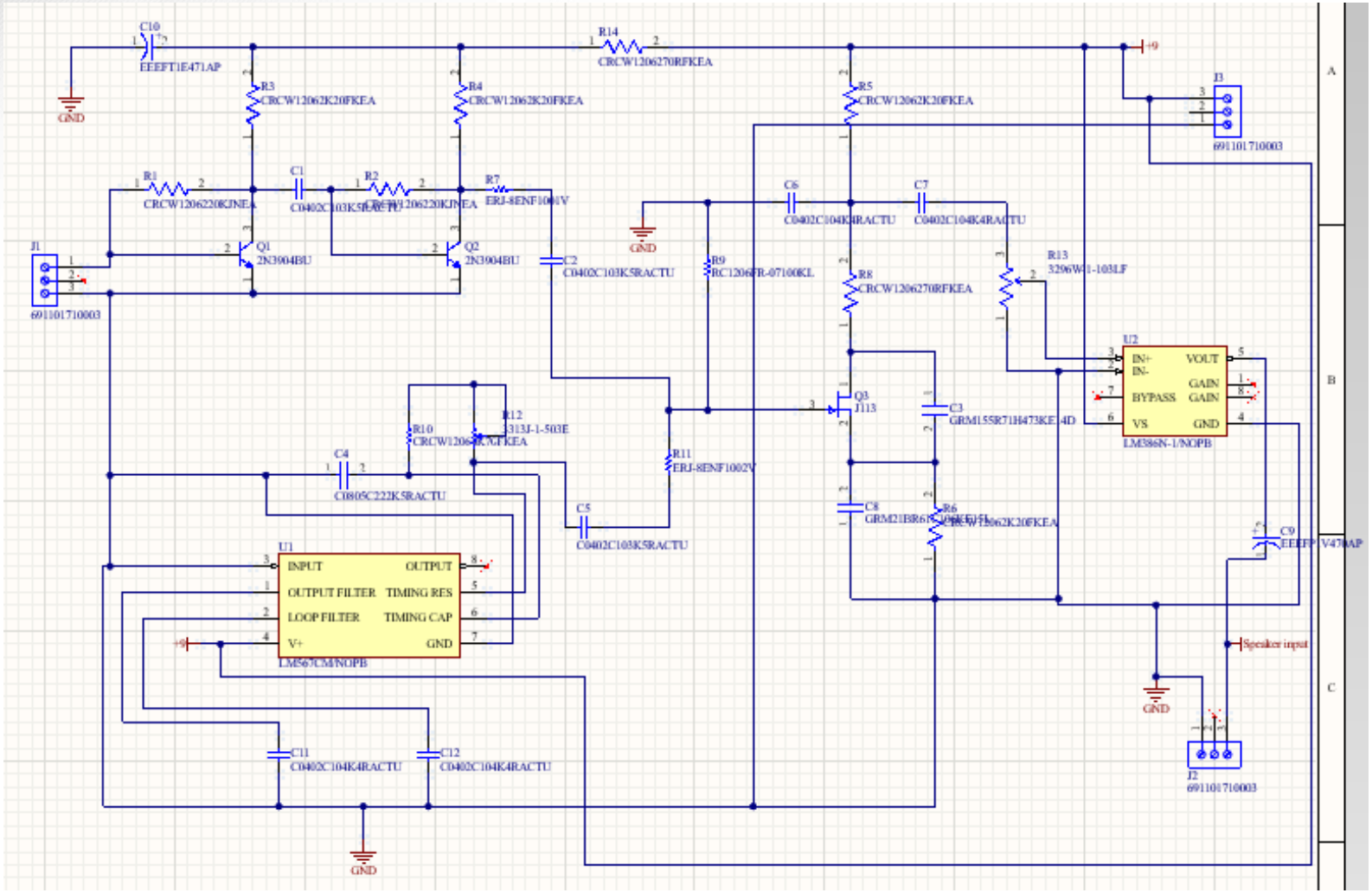
Jacob Ralls


;dc dec 100 10 1000000
U2
Vin
IN
OUT
V++
ADJ
LT317A
V4
9
R6
100
R7
300
V2
0
R3
5.9k
C2
1n
R1
2.4k
V1
SINE(0 1 50k)
AC 1 0
C1
1n
R2
5.6k
Vout
U1
R4
1.2k
R5
2.4k
;ac dec 100 10 1000000

Jacob Ralls


V(vin)
V(v++)
V(vout)
9V
8V
7V
6V
5V
4V
3V
2V
1V
0V
-1V
-2V
-3V
0µs
10µs
20µs
30µs
40µs
50µs
60µs
70µs
80µs
90µs
100µs

Jacob Ralls


C10
EEEFT1E471AP
R14
CRCW1206270RFKEA
+9
J3
691101710003
R3
CRCW12062K20FKEA
R4
CRCW12062K20FKEA
R5
CRCW12062K20FKEA
GND
R1
CRCW12062208JNEA
C1
C0402C103K5RACTU
R2
CRCW12062220JNEA
R7
ERJ-8ENF1001V
C6
C0402C104K4RACTU
C7
C0402C104K4RACTU
J1
691101710003
Q1
2N3904BU
Q2
2N3904BU
C2
C0402C103K5RACTU
R9
RC1206FR-071100KL
R8
CRCW1206270RFKEA
R13
3296W-1-103LF
U2
IN+
IN-
BYPASS
VS
VOUT
GAIN
GAIN
GND
LM386N-1/NOPB
Q3
J113
C3
GRM155R71H473KE14D
R10
CRCW1206
R12
3313J-1-503E
C4
C0805C222K5RACTU
R11
ERJ-8ENF1002V
C5
C0402C103K5RACTU
C8
R6
C9
EEEFP1V470AP
U1
INPUT
OUTPUT
OUTPUT FILTER
TIMING RES
LOOP FILTER
TIMING CAP
V+
GND
LM567CM/NOPB
Speaker input
C11
C0402C104K4RACTU
C12
C0402C104K4RACTU
J2
691101710003
A
B
C

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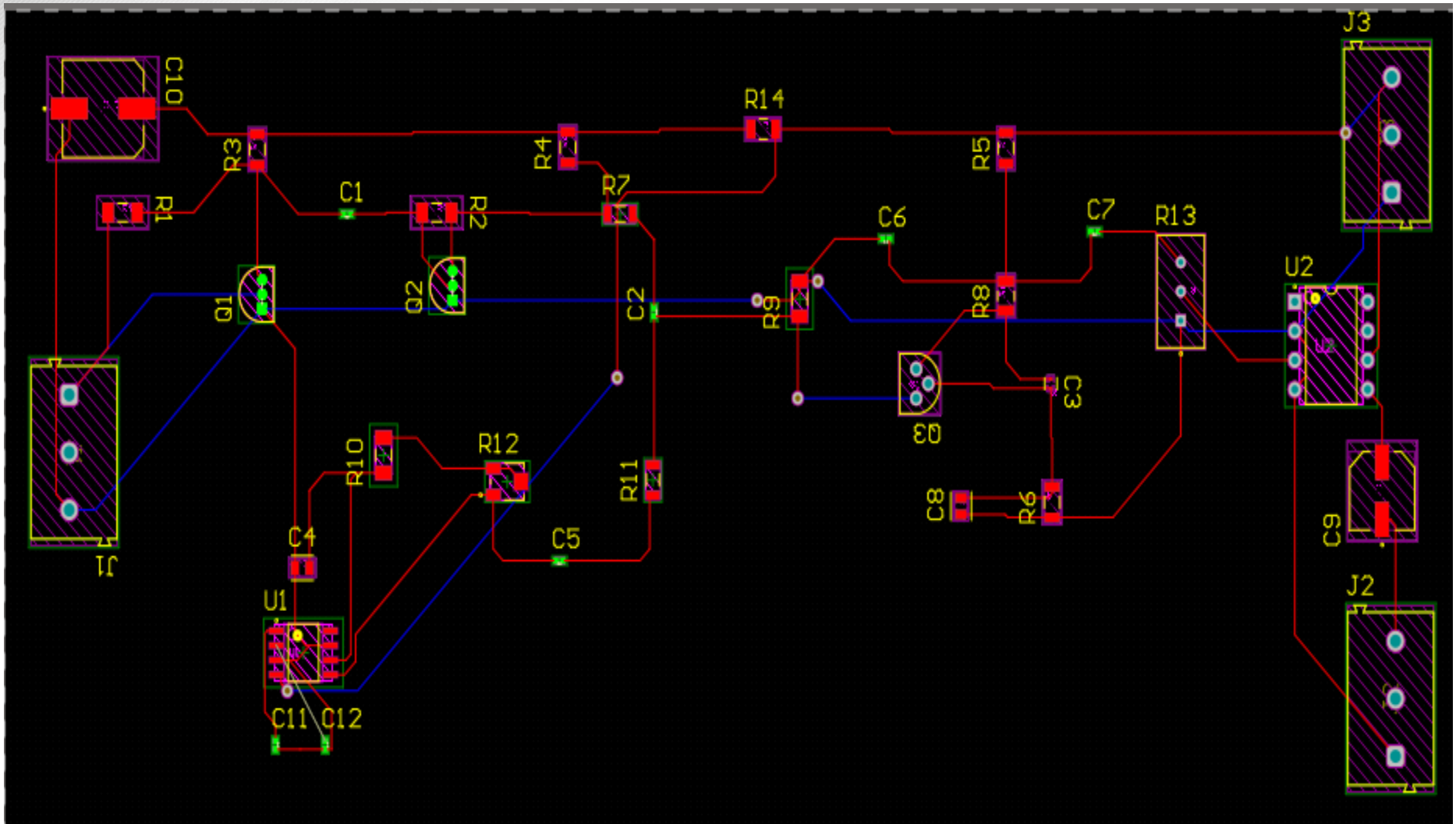
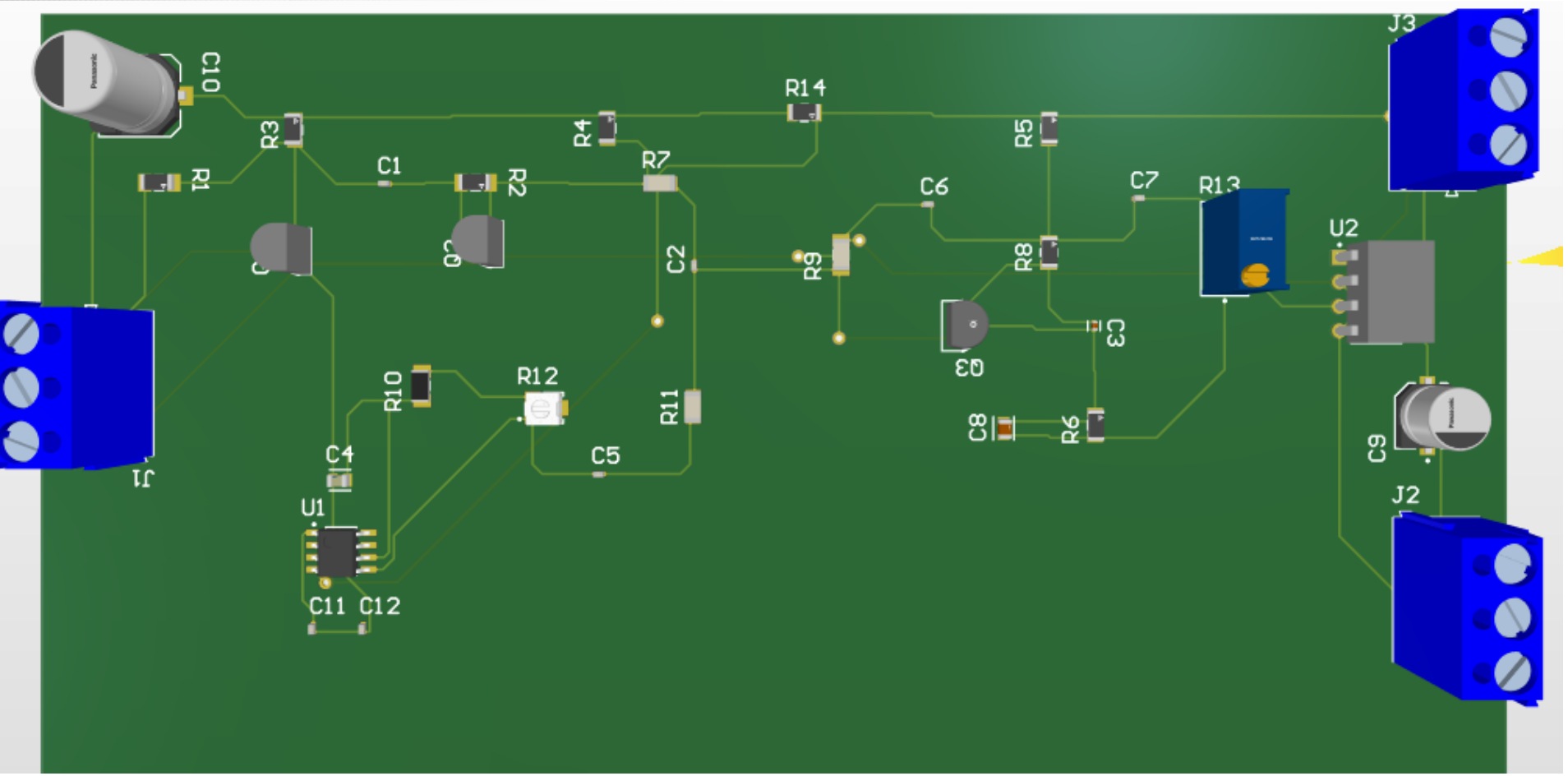
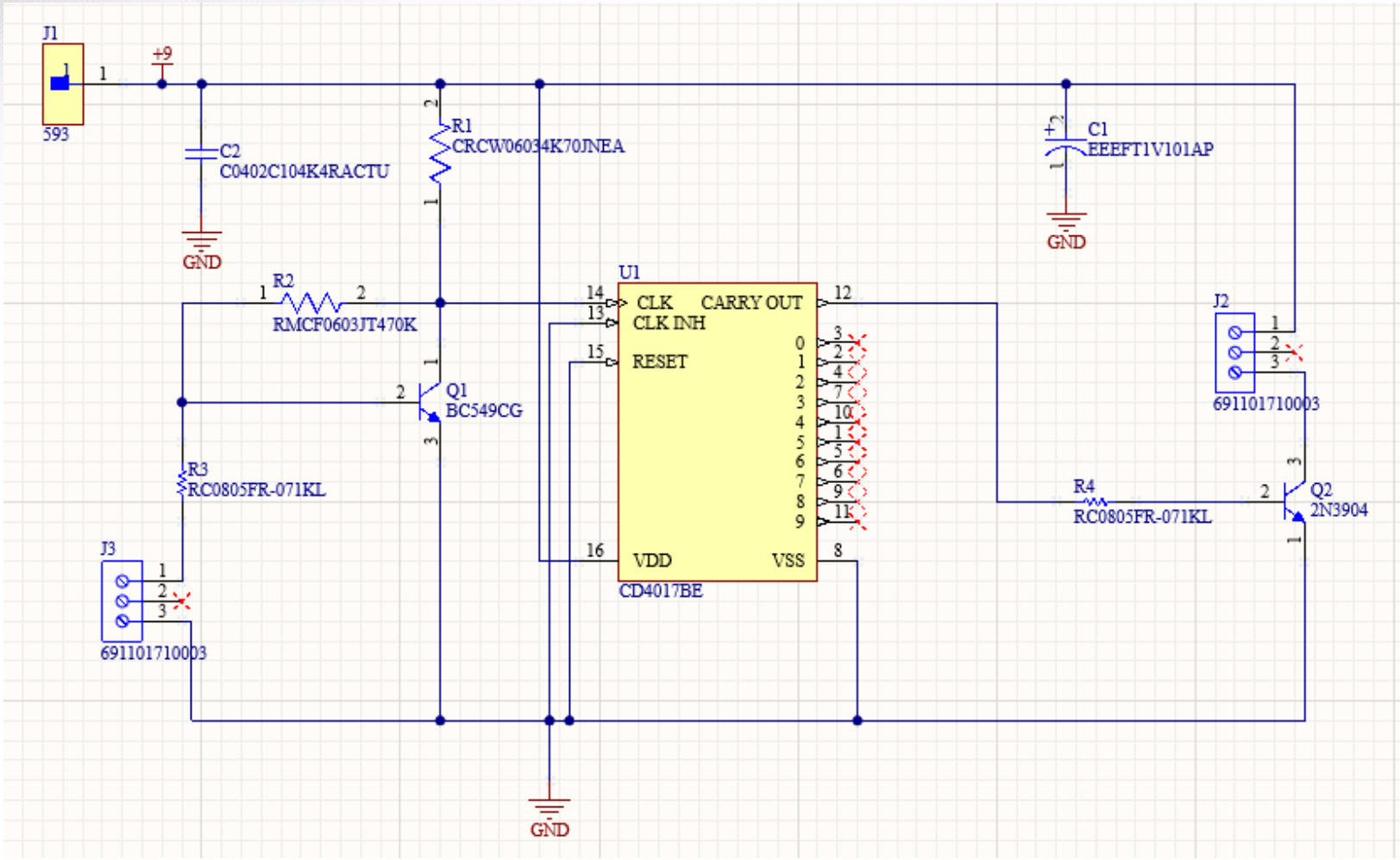

J3
C10
R14
R3
R4
R5
R1
C1
R2
R7
C6
C7
R13
U2
Q1
Q2
C2
R9
R8
C3
Q3
J1
R10
R12
R11
C8
R6
C9
C4
C5
J2
U1
C11
C12

Jacob Ralls


C10
R3
R14
R4
R5
J3
R1
C1
R2
R7
C6
C7
R13
U2
C2
R9
R8
C3
J1
R10
R12
R11
C8
R6
C9
C4
C5
J2
U1
C11
C12

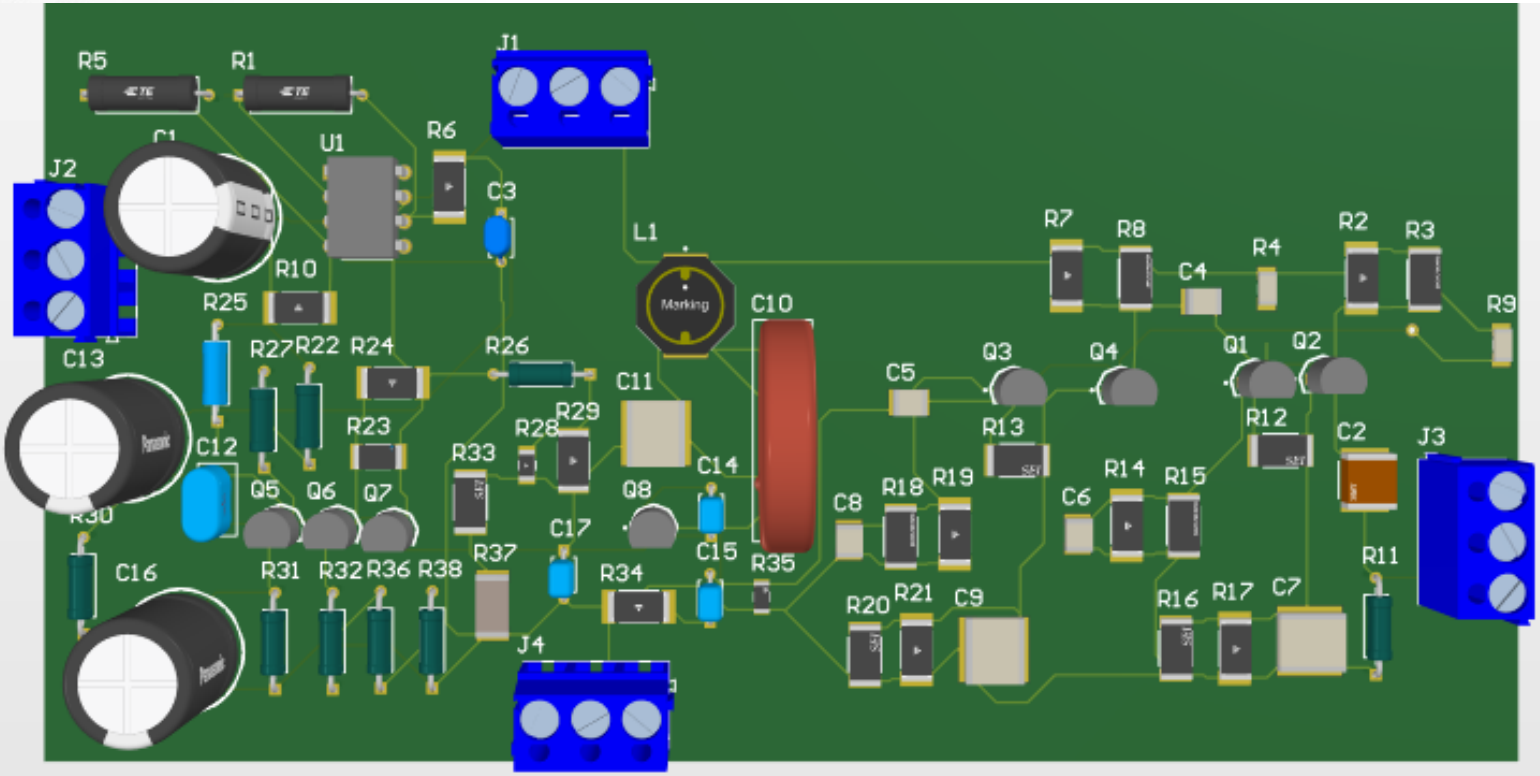
Jacob Ralls


J1
593
+9
C2
C0402C104K4RACTU
GND
R1
CRCW06034K70JNEA
R2
RMCF0603JT470K
Q1
BC549CG
R3
RC0805FR-071KL
J3
691101710003
U1
CLK
CLK INH
RESET
CARRY OUT
VDD
VSS
CD4017BE
C1
EEEFT1V101AP
GND
J2
691101710003
R4
RC0805FR-071KL
Q2
2N3904
GND

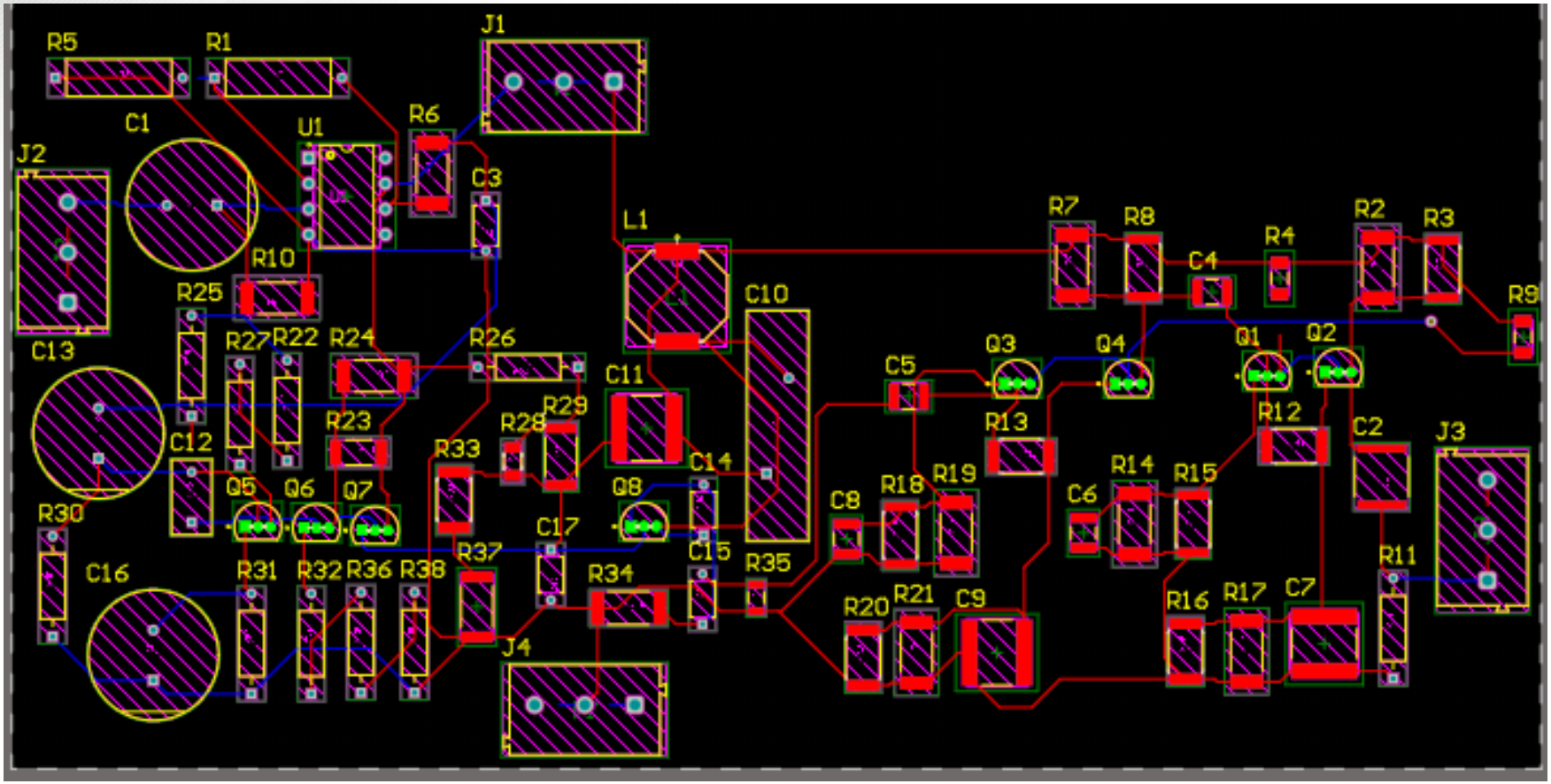
Nathan Cinocca

Accomplishments since last update 14 hrs of effort	Ongoing progress/problems and plans until the next presentation
• Modified filter design • Finished PCB for 50kHz transmitter • Modified circuits to create 25kHz transmitter and finished the PCB for the transmitter	• Order PCBs with integrated receiver, transmitter, and power system systems. • Solder the new PCBs and test for functionality • Test current transmitter and receiver pair.

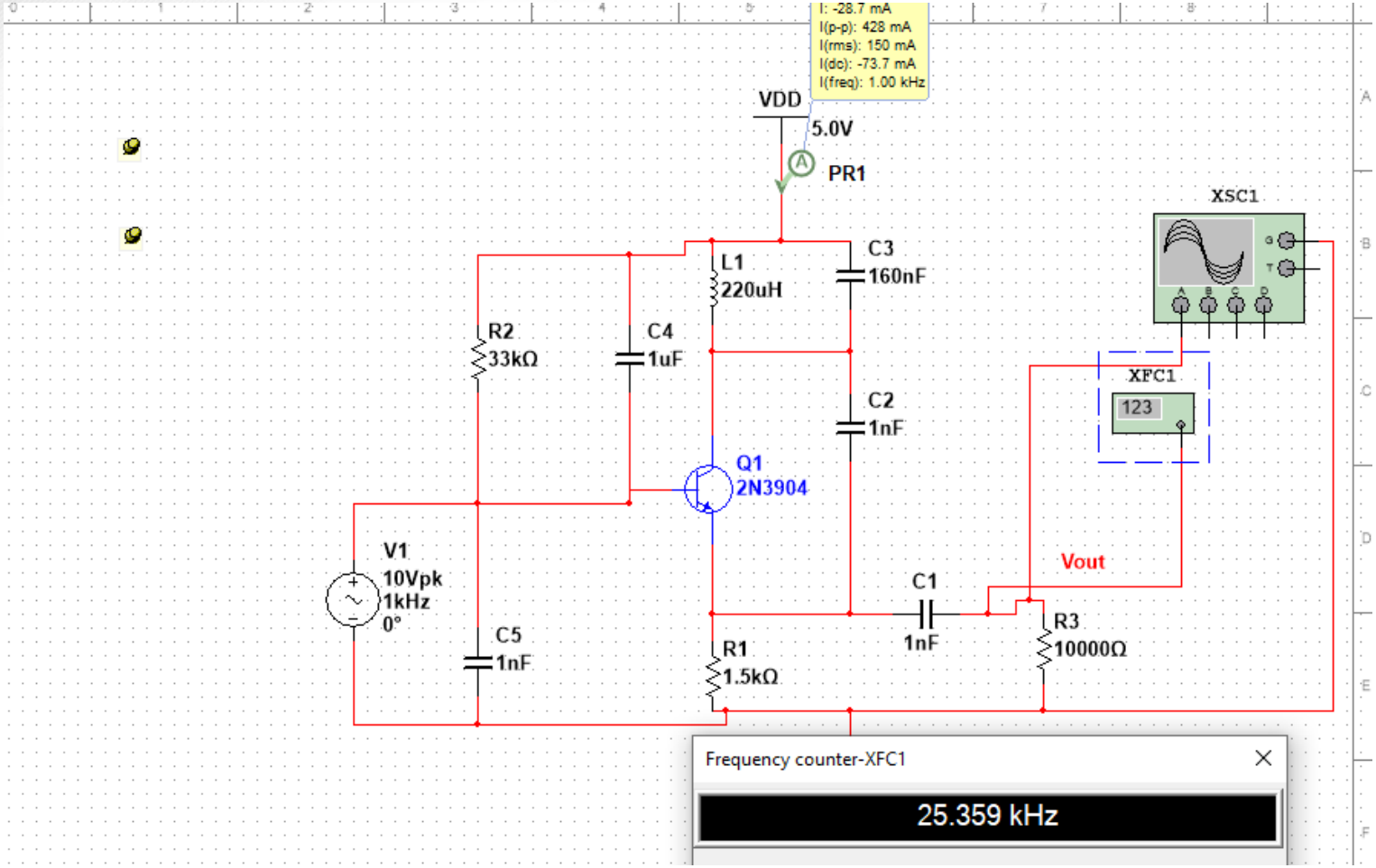
Nathan Cinocca



Nathan Cinocca



Nathan Cinocca



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 Signal Amplifier and Filter (NC)											
(Transmitter End) Connect Power Amplifier With Other Transmission Subsystems (NC)											
(Transmitter End) Connect Frequency Modulator With Other Transmission Subsystems (NC)											
(Receiver End) Connect 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?