MCU TNC Design

David Cain, Kobe Keopraseuth, and Kaleb Leon

Design 2 - Final Presentation

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Project Overview

- What is a TNC?
  - A modem for connecting a computer with a HAM radio
  - KISS
  - AX.25

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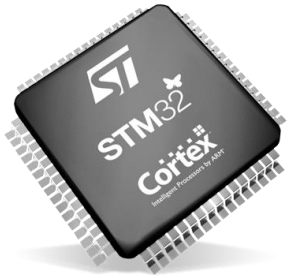
Why every HAMer needs our TNC



Our Solution

VS

Commonly Used Hardware TNCs

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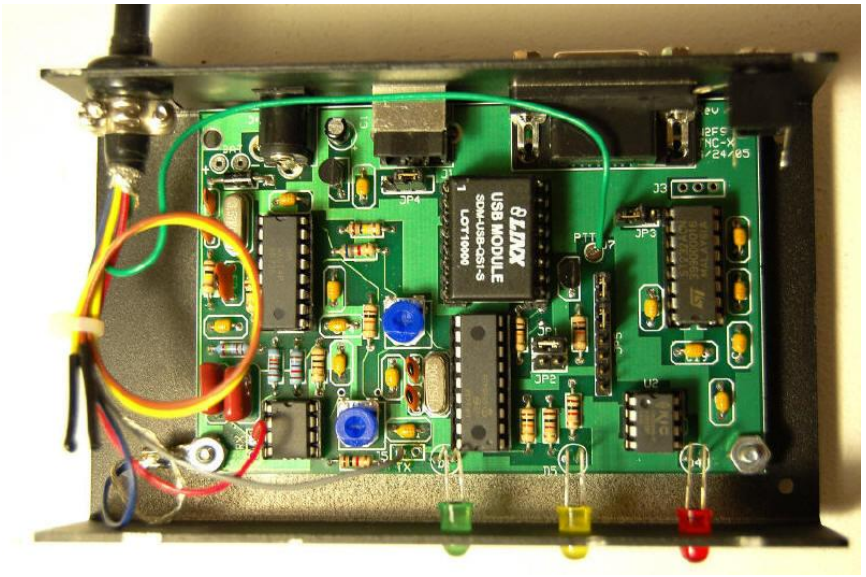
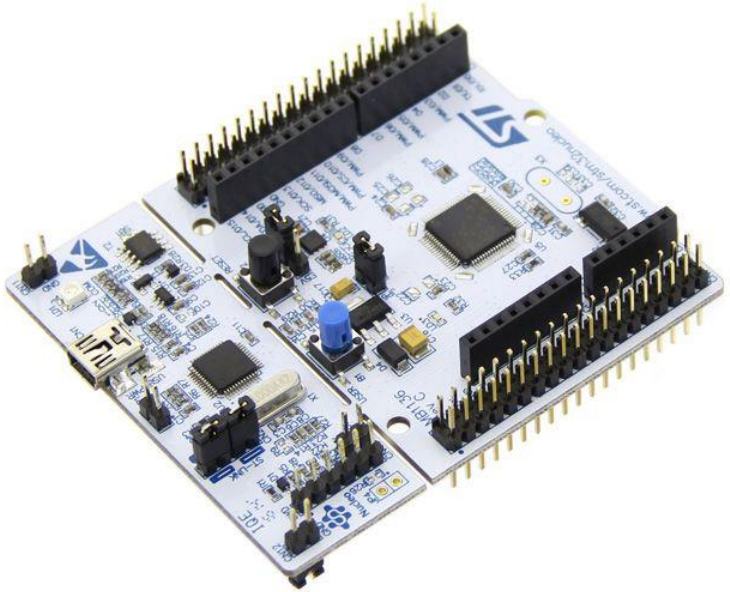
MCU TNC Benefits

- Modular/Adaptable
- Open Source
- Easy to replicate
- Small form factor
- Well Documented
- Increase computational capability
- Cheap





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Design Specifications

Scope of Work:

Design, implement, build, and test a TNC with an STM32 or similar microcontroller. The system must accept a string via UART or a similar interface and generate the necessary HDLC headers/packet data and then produce the correct audio waveform.

Flag	Address	Control	Information	FCS	Flag
8 bits	8 or more bits	8 or 16 bits	Variable length, 8×*n* bits	16 or 32 bits	8 bits

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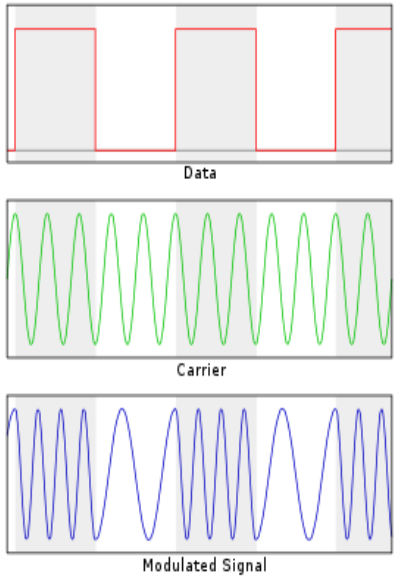
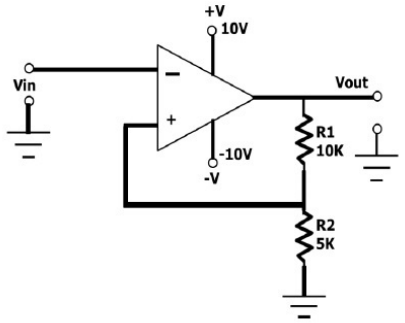
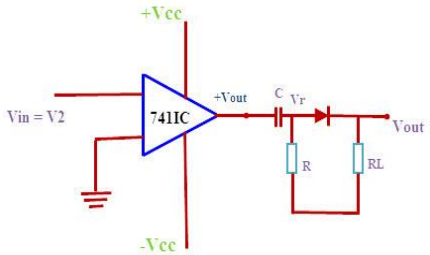
Methodology

Previous Assumptions

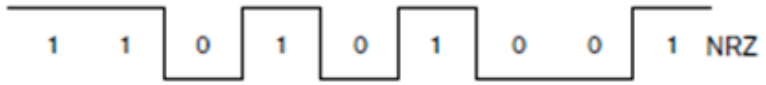




Schmitt Trigger



Zero Crossing



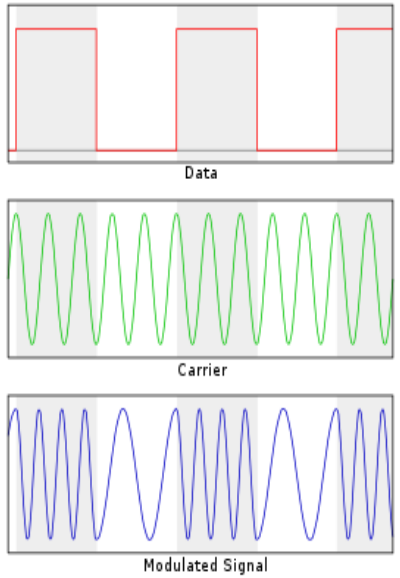
Actual Functionality

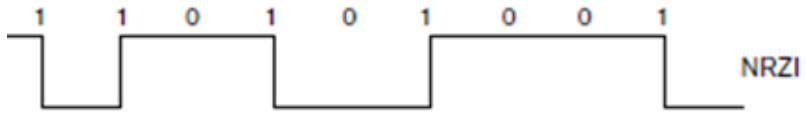
$A_{t0} \triangleq Amplitude\ at\ time\ t0$

$\varphi_{t0} \triangleq Phase\ at\ time\ t0$

$$\varphi_{t0} = \sin^{-1}(A_{t0})$$

$$\omega = \frac{\varphi_1 - \varphi_2}{t_1 - t_2}$$





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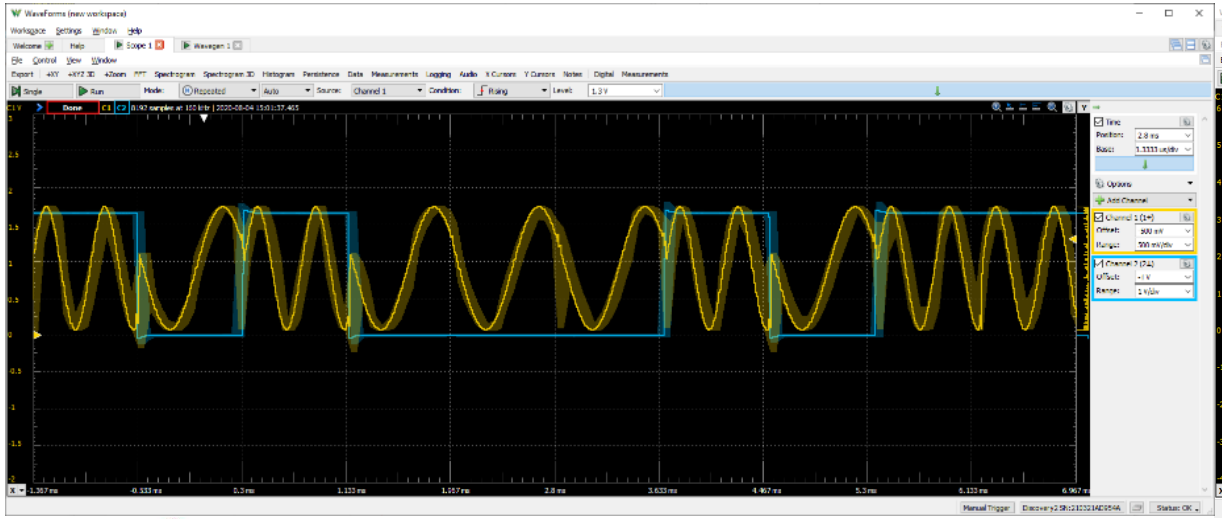
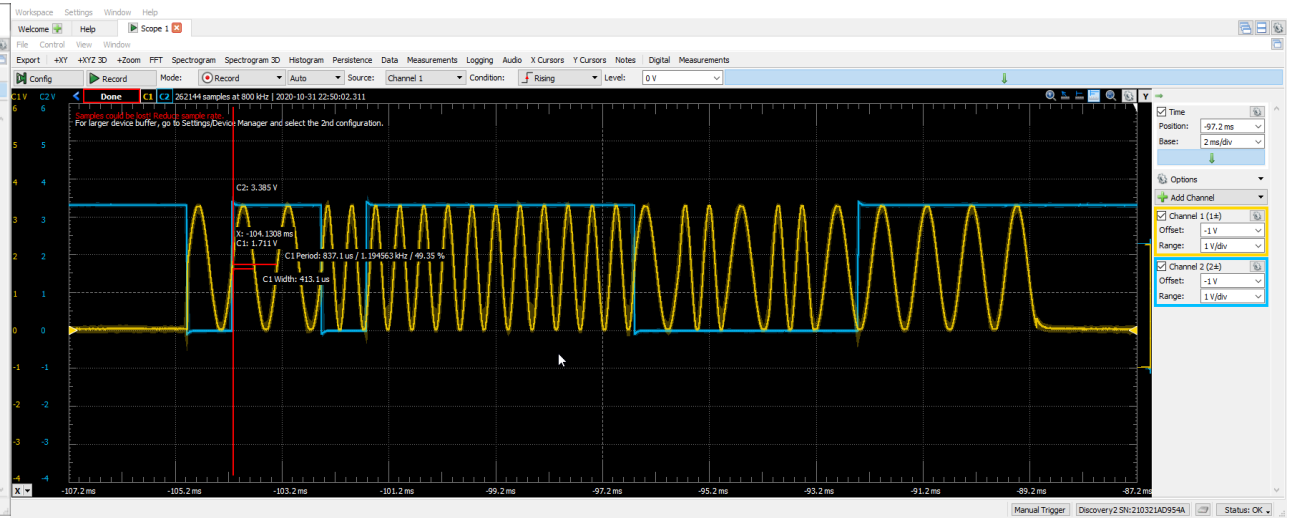
Testing and Validation

Bit Transitions FAIL



Bit Transitions PASS



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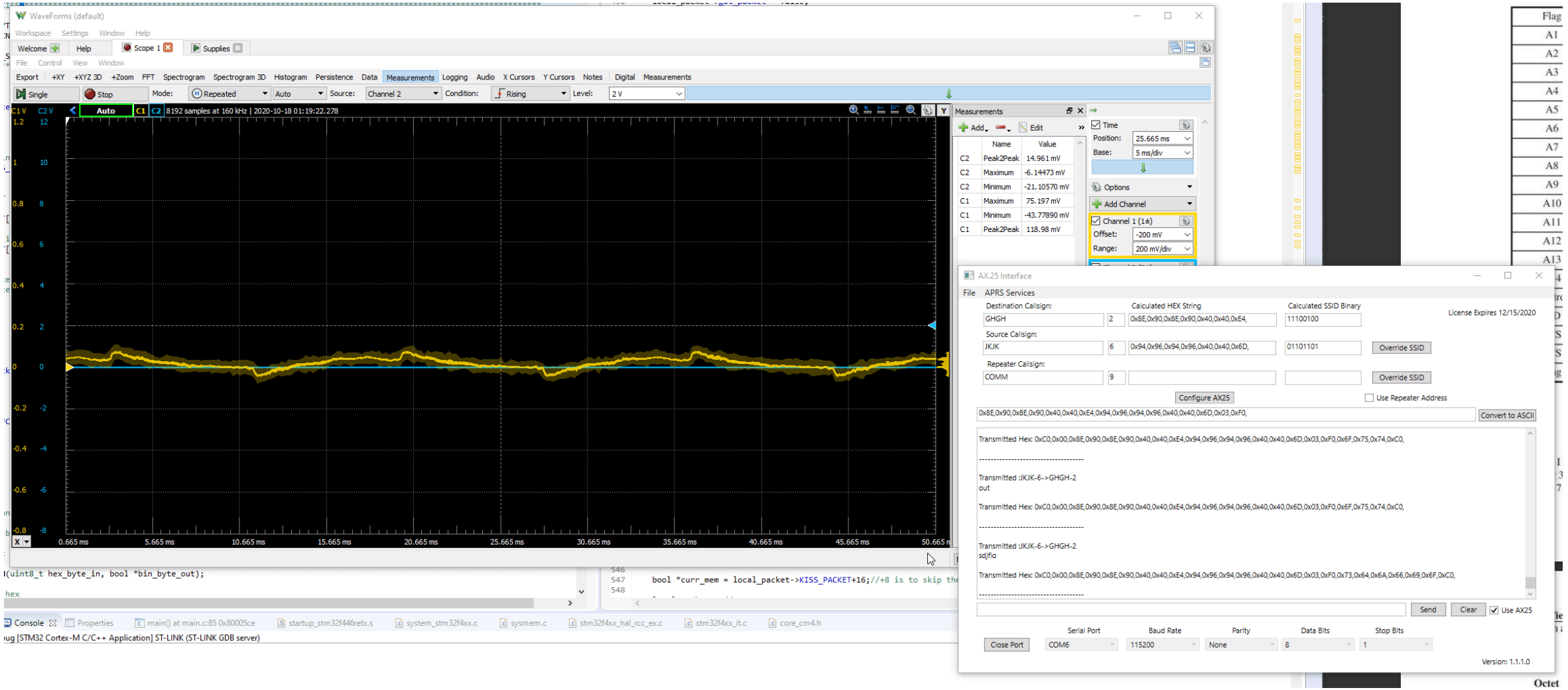
Packet Generation



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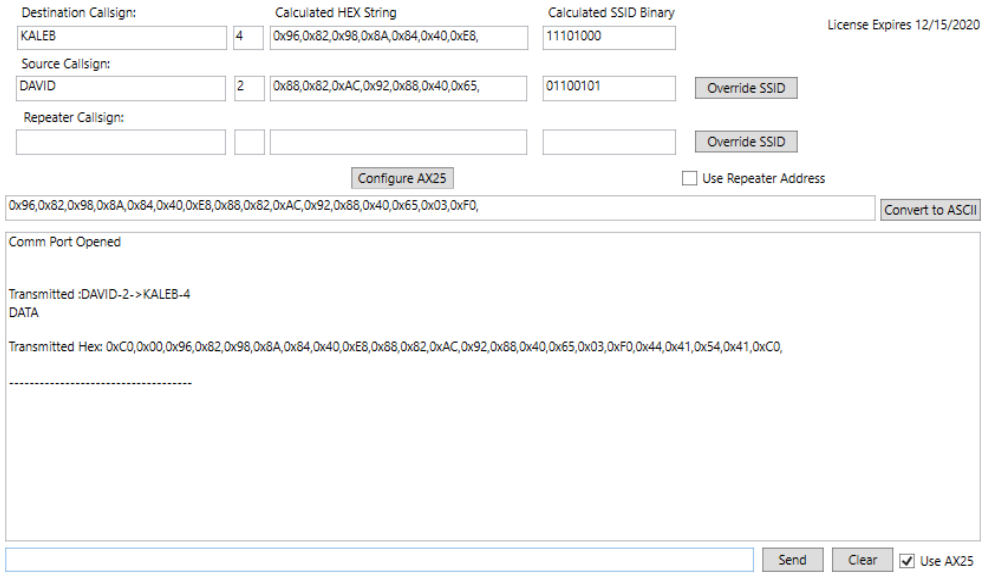
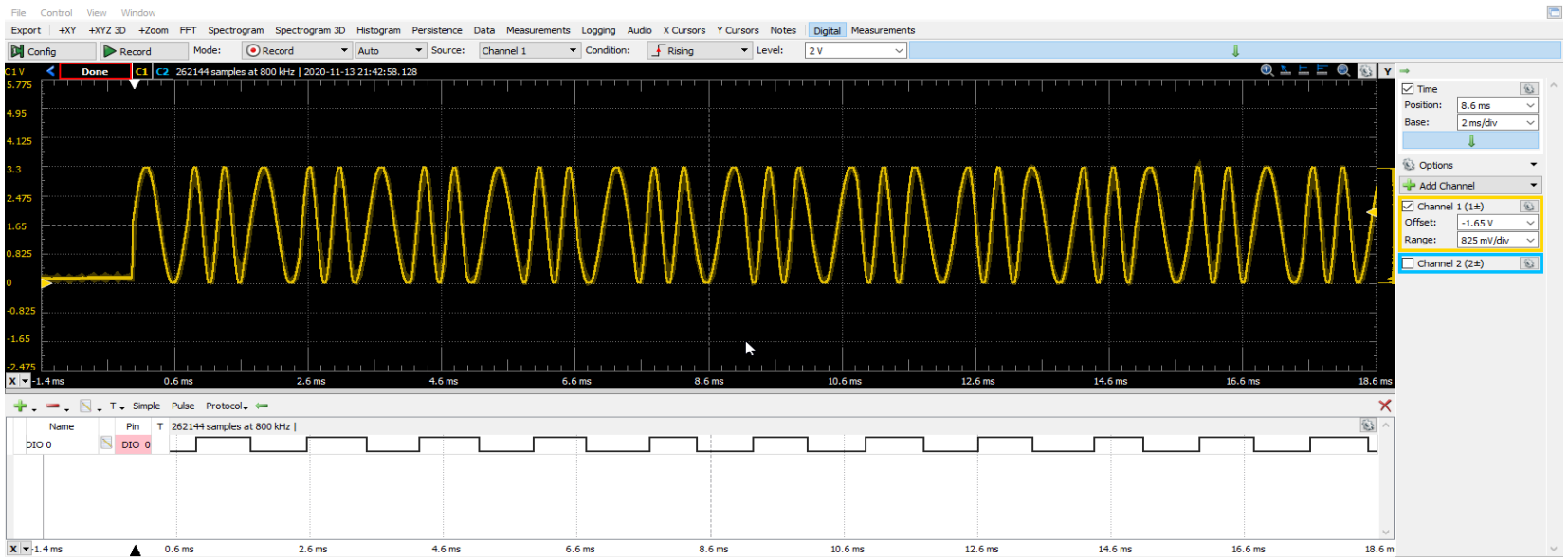
Bit Formatting Validation




```
Printing AX25_PACKET being sent to radio
Address Field 1 = 1  0  1  0  0  1  1  0
Address Field 2 = 0  0  0  0  0  0  1  0
Address Field 3 = 0  0  0  0  0  0  1  0
Address Field 4 = 0  1  0  1  0  0  0  1
Address Field 5 = 0  0  1  0  0  0  0  1
Address Field 6 = 0  1  1  1  1  0  0  1
Address Field 7 = 0  1  1  0  1  0  0  1
Address Field 8 = 0  1  0  0  0  1  1  1
Address Field 9 = 0  0  0  0  0  0  1  0
Address Field 10 = 0  0  0  1  0  0  0  1
Address Field 11 = 0  1  0  0  1  0  0  1
Address Field 12 = 0  0  1  1  0  1  0  1
Address Field 13 = 0  1  0  0  0  0  0  1
Address Field 14 = 0  0  0  1  0  0  0  1
Address Field extra =
Control Field   = 1  1  0  0  0  0  0  0
PID Field       = 0  0  0  0  1  1  1  1
Info Field =  0  1  1  1  1  1  0  1  0  0  1  1  1  1  1  0  1  0  0  1  1  1  1  1  0  1  0  0  1  1  1  1  1  0  1  0
FCS Field     = 1  1  1  1  1  0  0  1  1  0  1  0  0  0  0  0  0  0
```

Proper Frequency Detection



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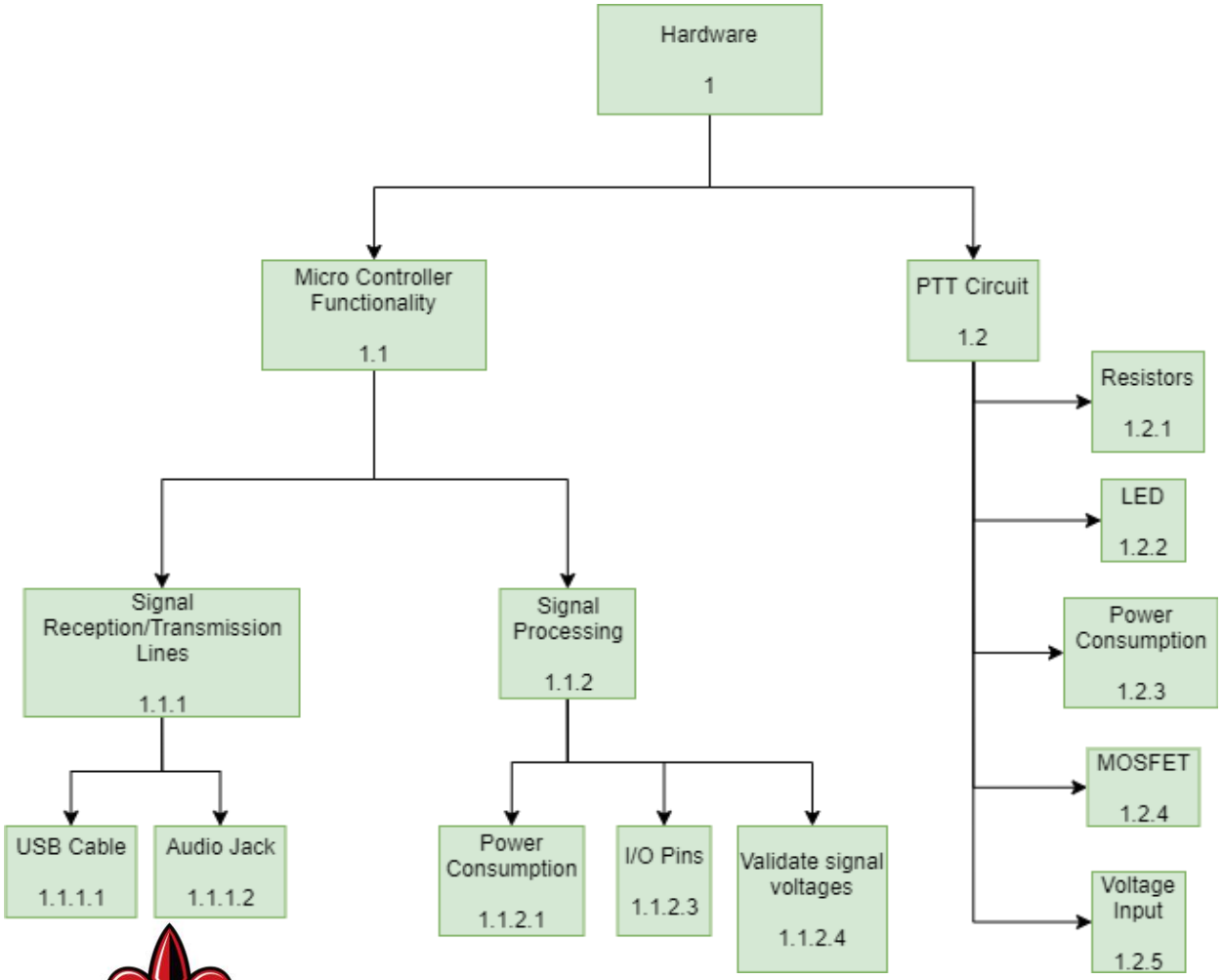
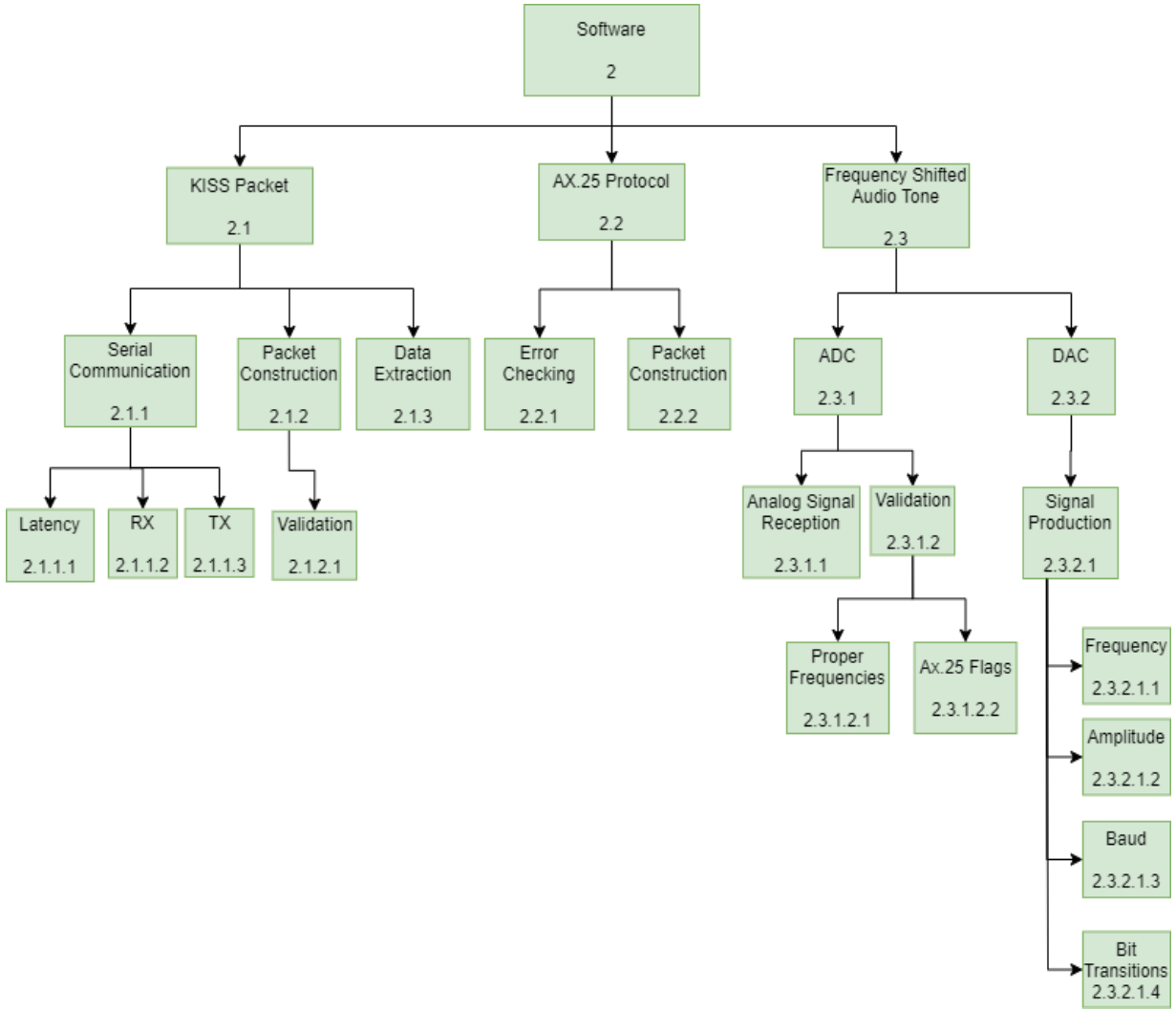
Modular Build, Testing, and Implementation Plan





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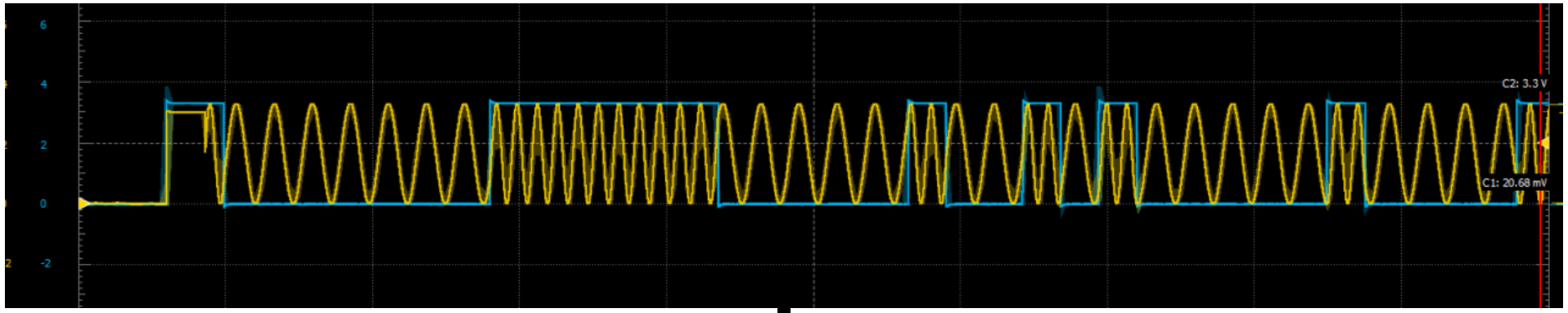
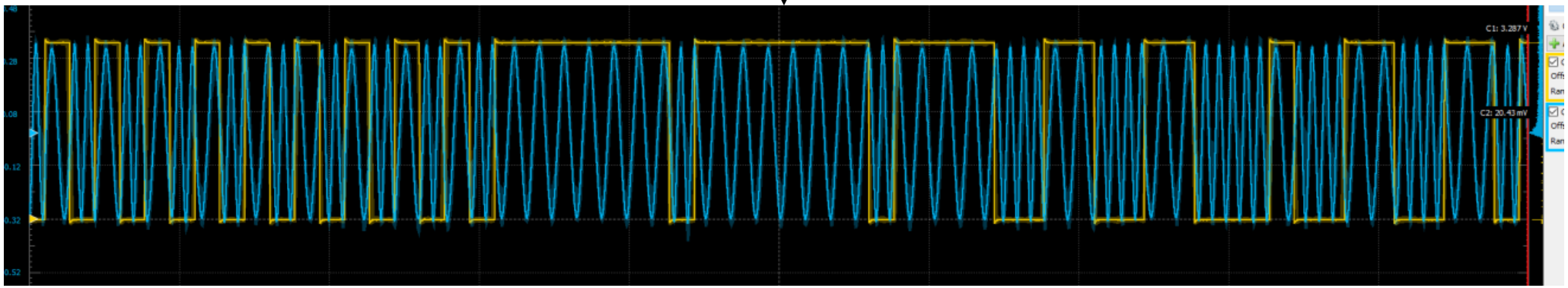
Design Modifications

NRZ



NRZI



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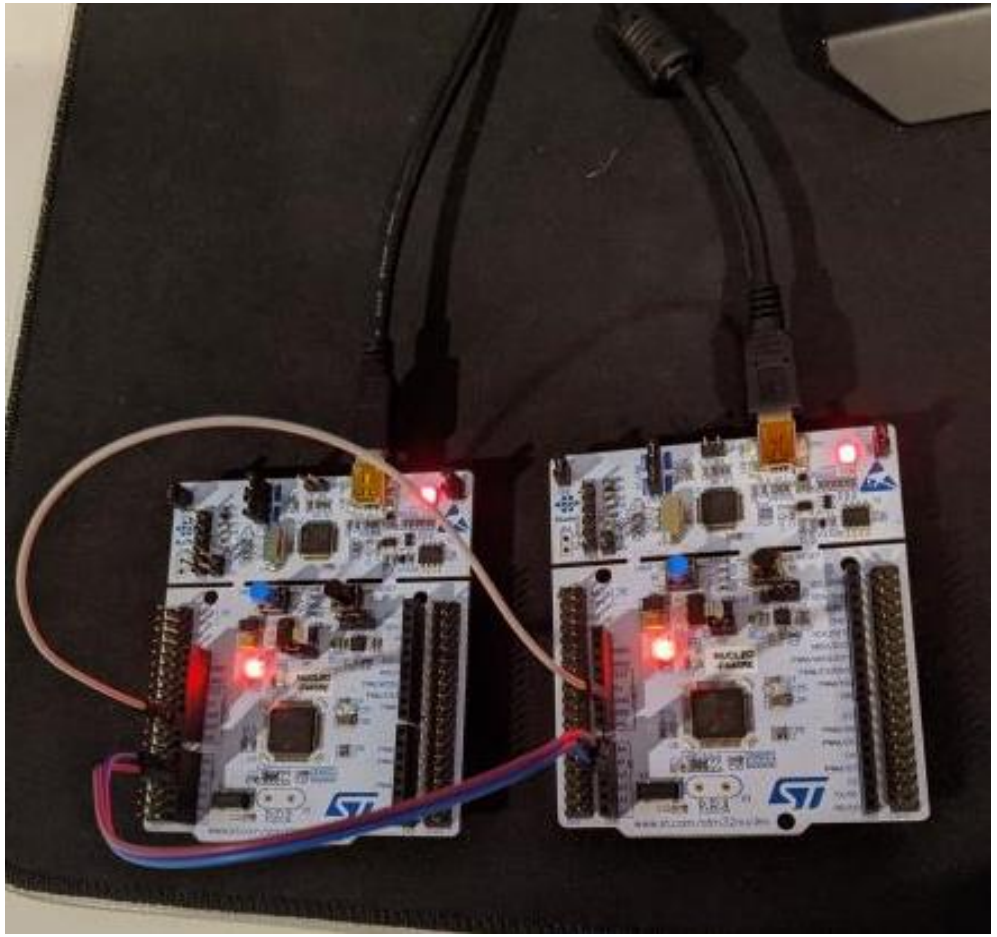
As Built Design



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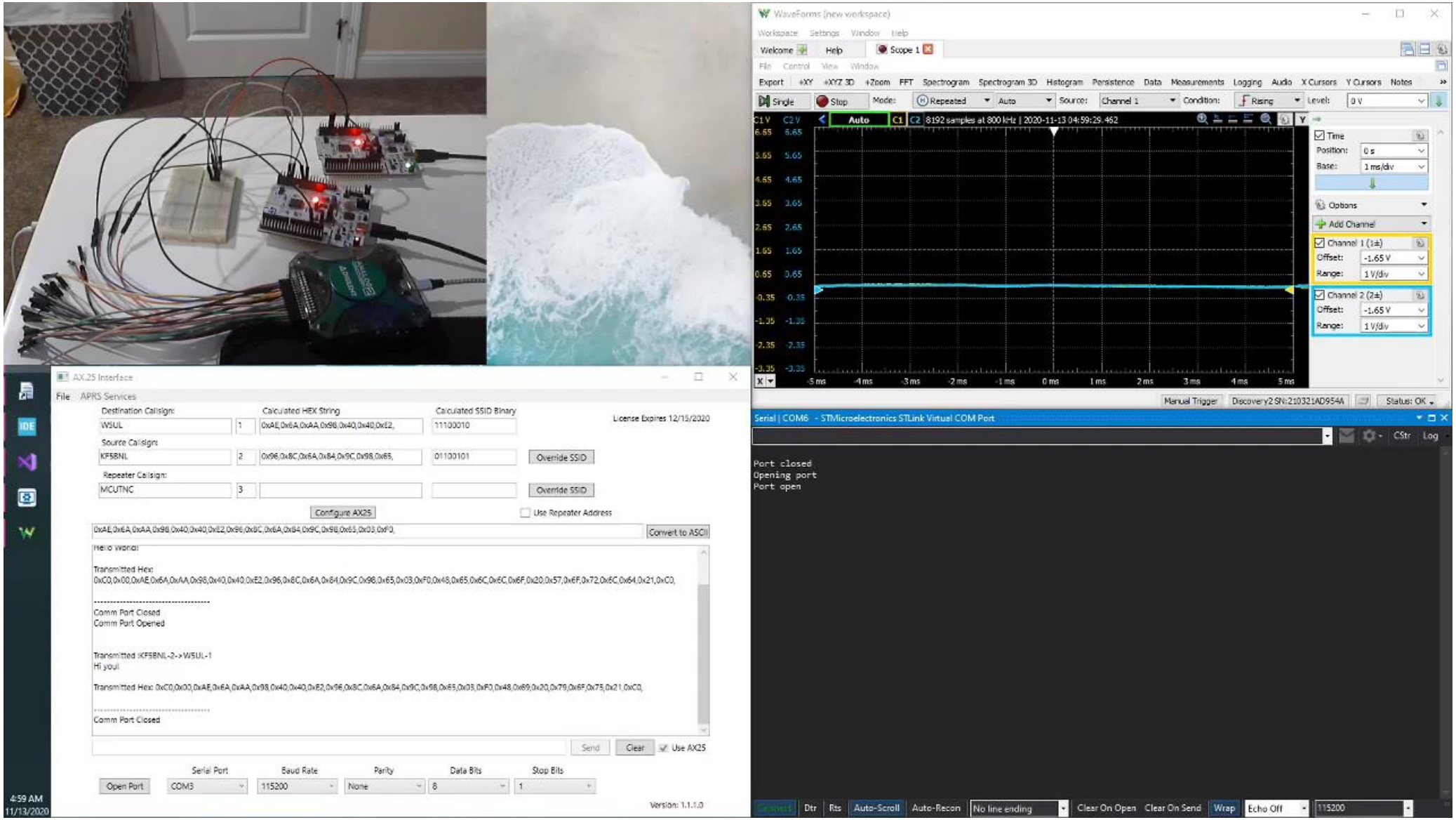
Final Demo



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Significance

Future Work

- APRS - an amateur radio-based system for real time digital communications of information of immediate value in the local area. Data can include object Global Positioning System (GPS) coordinates, weather station telemetry, text messages, etc..
- Distinguish between different types of packets
- Sending and receiving signals over radio

Lessons Learned

- Document Thoroughly
- Cannot trust just one resource
- There is no easy way
- One change can cause many changes in your design
- Plan ahead for life inconveniences

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Acknowledgements

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Nolan Edwards

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Special Thanks

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Questions?

General Information

[1] What is the Baud Rate?

1200

[2] How are we detecting the frequencies?

Basing it off of change in phases over time where we can obtain the phases by performing inverse sine on amplitudes of the signal using the ADC.

[3] How would a normal user interface with your TNC?

Through a dumb terminal that sends KISS packets over UART.

[4] What does KISS stand for?

Keep It Simple, Stupid

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Why is our project relevant?

- Cost affective
  - Basic cost of a micro controller
- Modular
  - Code is easily adaptable to add more functionality
- Easy to replicate and repair
  - Grab code off the GitHub and upload to controller
- Well documented
  - Compared to many other TNCs and info about them, ours is very open source

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