TEXAS STATE®
INGRAM SCHOOL OF ENGINEERING

E2.12 – Software Defined Radio

Purpose

With software defined radio dongles like the RTL-SDR and NooElec providing cheap VHF and UHF software defined radio solutions, there is yet to exist a cheap HF software defined radio for long range communications. Most commercially available HF SDRs run anywhere from $250-$1000. We wanted to produce a replicable radio for under $300 that can provide access to HF bands (80m and 20m).

Project Scope Description

The scope of this project was to deliver a software defined radio capable of receiving and transmitting on the 80m and 20m HF amateur radio bands. Our radio is equipped with the following features:

- Capable of receiving and transmitting HF signals on the 80m and 20m bands
- Capable of processing signals in less than 1ms
- The User Interface contains:
  - LCD for displaying frequency and relevant information
  - Volume control knob (0 dB – 65 dB)
  - Rotary encoder for frequency adjustment
  - Power switch
  - Sideband selector button
  - License level selector button
- Its estimated unit cost is less than $300

Conclusion

The majority off our goals have been completed. Transmit has not been implemented, but it shares the same circuity as the receiving portion of the radio. However, The radio is capable of demodulating sample audio signals through a dummy load. Though we have not had the opportunity to attempt receiving and transmitting signals through an antenna as we do not have access to an 80m or 20m antenna, we expect the results to match our dummy load trials.

Acknowledgements

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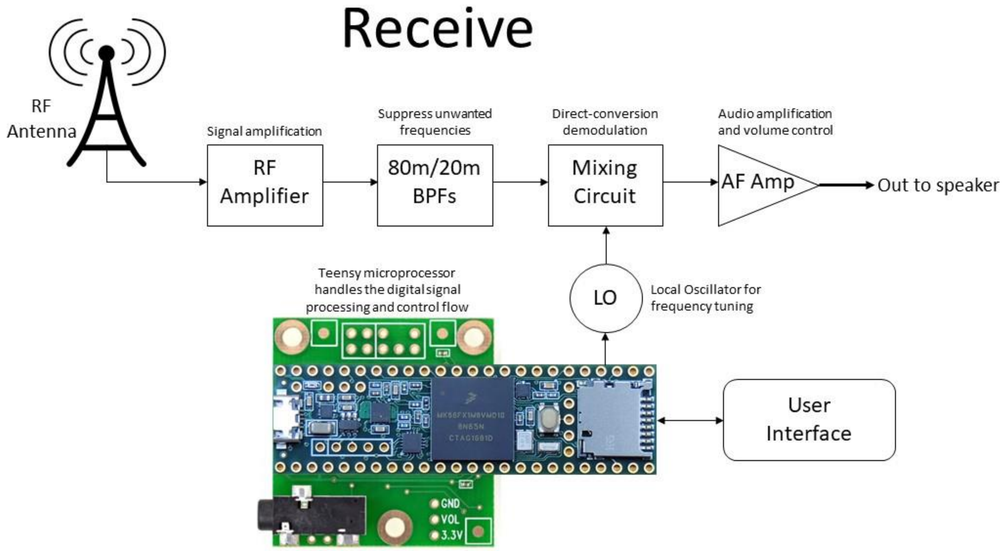
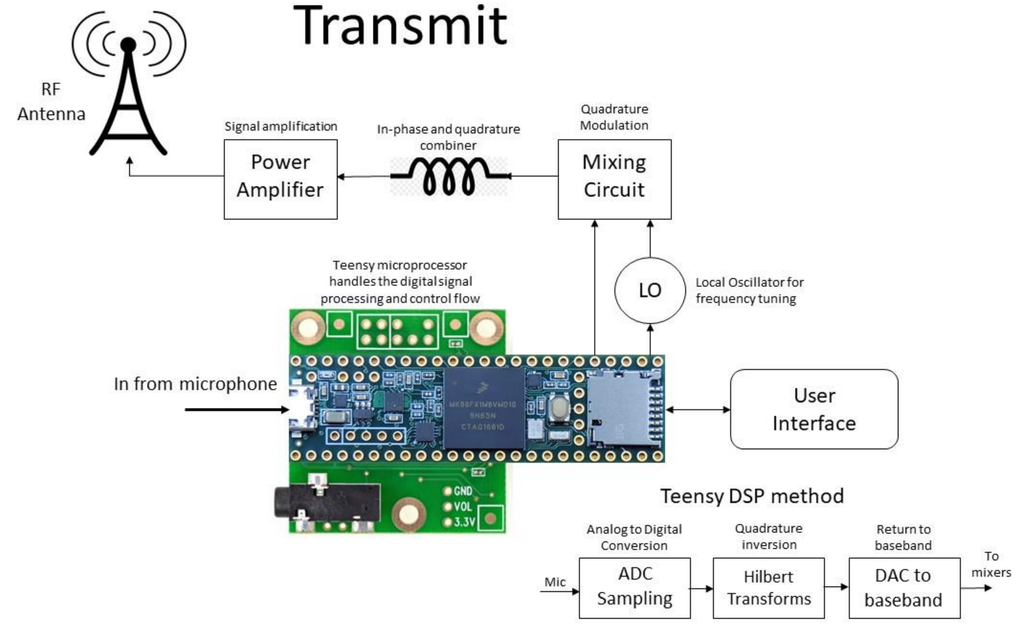
Design





Project Background

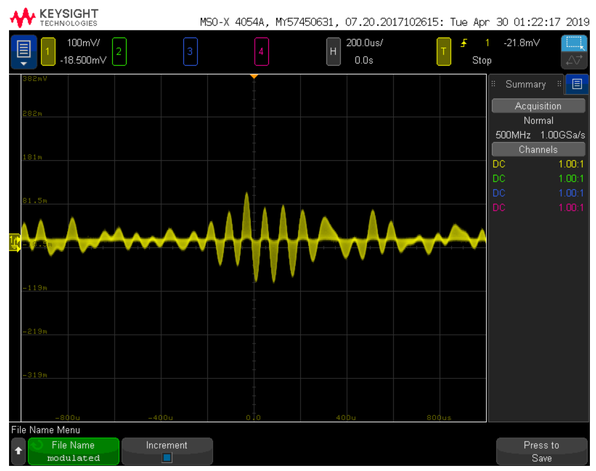
A Software Defined Radio is a radio that is primarily controlled and implemented in software. Some of the benefits to this design include:

- The signal modulation and demodulation is modified more easily, as it only requires change in software.
- They are more expandable and flexible.
- Less expensive to buy and create yourself than an analog radio of the same quality

We have been asked to create a software defined radio, based on a pre-existing design created by a radio enthusiast who posted the design online, named Charlie Morris. We are basing our project on his design, with modifications to include some sponsor requirements, and some improvements of our own design, for students and radio enthusiasts to use and learn more about radio on campus.

Test Results

Parameter	Min	Max	Result	Method
Source Voltage	10.0V	15.0V	12.2V	Measure power supply output
5V Regulator Voltage	3.3V	6.0V	4.998V	Measure regulator voltage output
7V Regulator Voltage	6.2V	7.4V	7.06V	Measure regulator voltage output
RF Amp Gain	25 dB	28 dB	26.2 dB	Compare input to output voltage
80m BPF Loss	0 dB	2.5 dB	0.9 dB	Compare input to output voltage at center freq.
20m BPF Loss	0 dB	4.5 dB	4.3 dB	Compare input to output voltage at center freq.
Speaker Volume	0 dB	70dB	65 dB	Calibrated decibel meter at speaker
Signal Processing Latency	0 ms	1 ms	451 us	Measure signal input to output time on scope



Above: Modulated audio signal. Below: Demodulated signal