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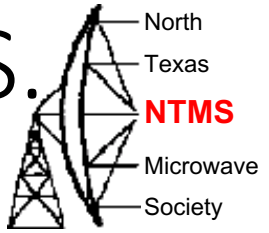
Getting Started with GNU Radio and a simple Beacon

1/18/20

N5BRG

Gnuradio on Windows 10 64-bit OS. NTMS.ORG



- Must be x86_64 type processor (not ARM).
- Prebuilt Windows Installer (MSI file) image.
  - You don't need to compile or build anything, just install.
- From MUD-workshop supplied USB stick.
- Latest version available at:
  http://www.gcndevelopment.com/gnuradio/downloads.htm
- Limitation: Pre-built image only supports radios that the maintainer chose to include.
  - Several widely popular radios are included.
  - You cannot (easily) add new modules or radios.

The GRC Main Window

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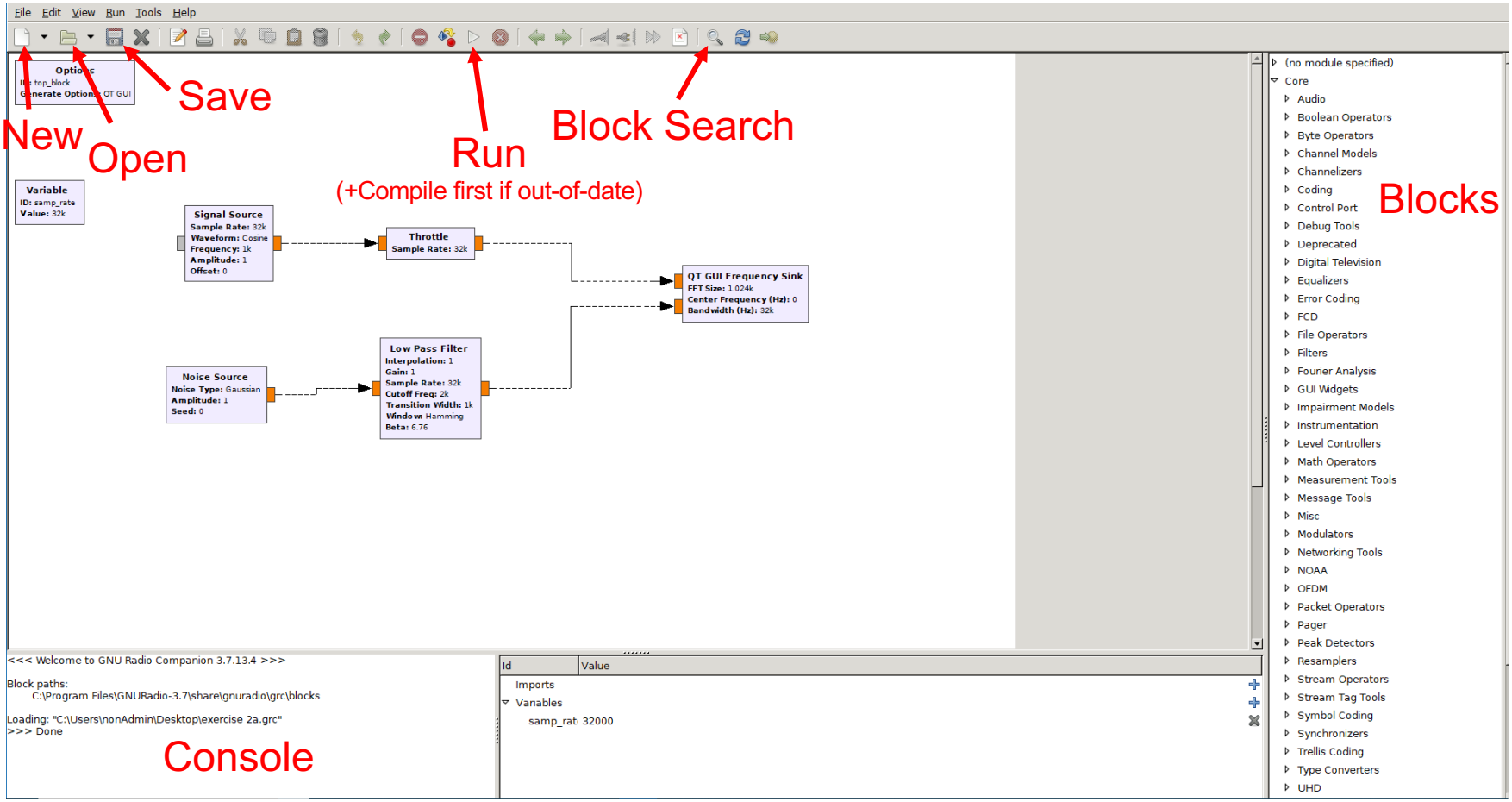

The GRC Main Window

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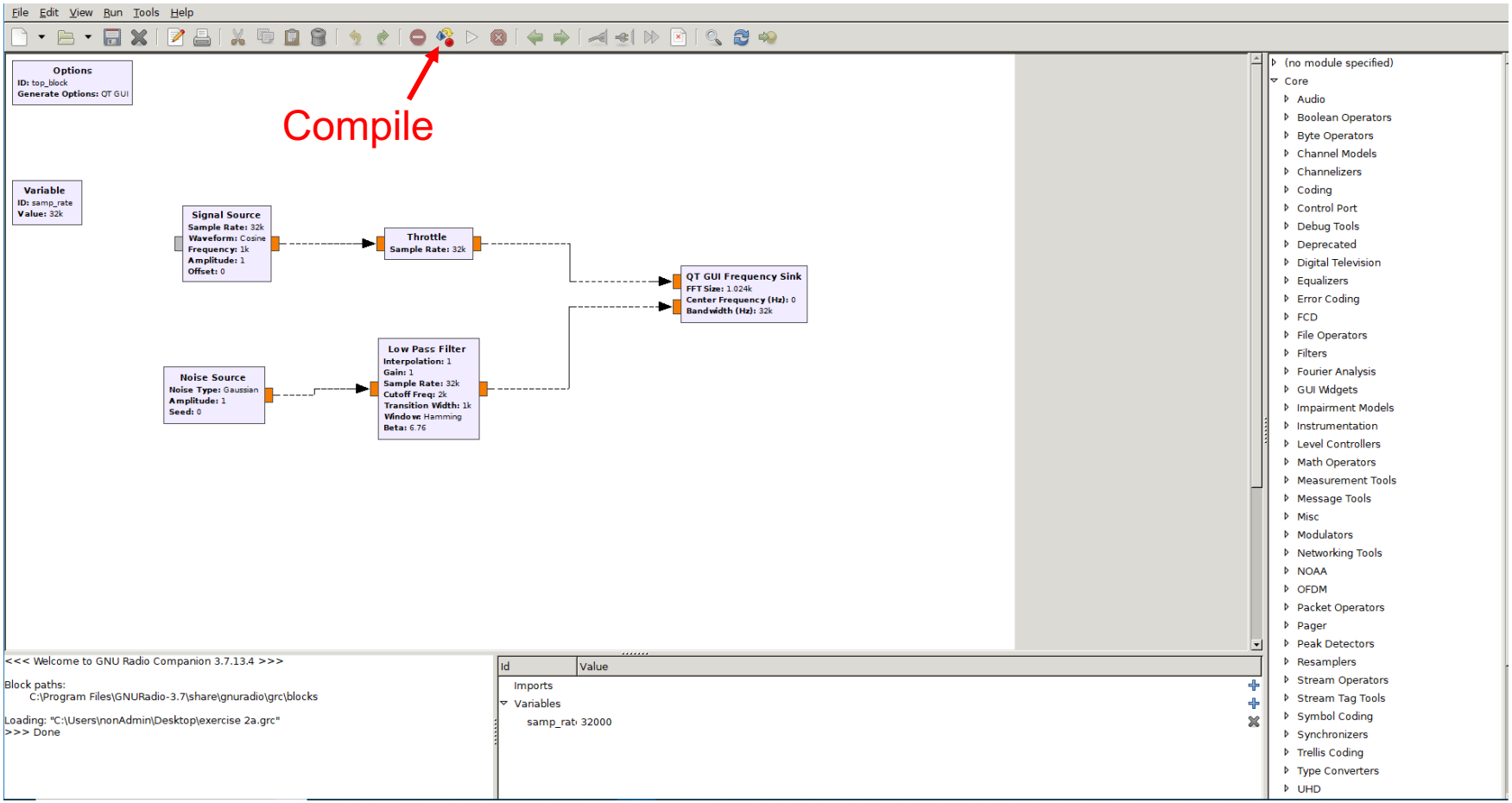

Gnuradio Core Concepts

- Each block must know about the sample rate of the samples coming into it.
- Some blocks can change the sample rate.
  - For example 'decimation'. 'Keep one-in-N'
  - Make sure you low pass filter before decimation or you violate Nyquist !
- Gnuradio creates a default variable samp_rate.
  - If you have interpolation or decimation, you may need multiple sample rate variables because you have several different sample rates at the same time in your flowgraph.
  - Many gnuradio blocks combine some function with decimation.
    - For example Low-Pass-Filter has adjustable decimation.
- Tip: Reduce the sample close to the source in your flowgraph to reduce CPU workload.

Some Key Gnuradio Modules

- Filters. General types: Lowpass, Bandpass, Highpass.
  - Pre-made filter types available.
  - Can make custom filters if necessary.
- Transfer function defined by the taps.
  - Pre-defined filters use pre-created taps. Fast & easy way to implement standard filters.
  - GRC includes a filter designer GUI. Use it to create taps.
    - Tools → Filter Design Tool
  - Large # taps substantially increases computational resources.
  - Real taps → both positive and negative frequency response.
  - Complex taps → single-sided frequency response.

Radios for GNU Radio Use

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Some Key Gnuradio Modules

- Add
  - Adds two signals sample-by-sample.
- Multiply
  - Multiply two signals sample-by-sample.
  - Implements mixer (frequency shifter) or Gain / Attenuate.
- Convertors
  - Float → Complex
  - Complex → Float
  - Stream → Vector
- GUI : scope, spectrum analyzer, constellation, waterfall.
- Many more. Explore on your own.

Exercise #4 Play pre-recorded file (SSB)

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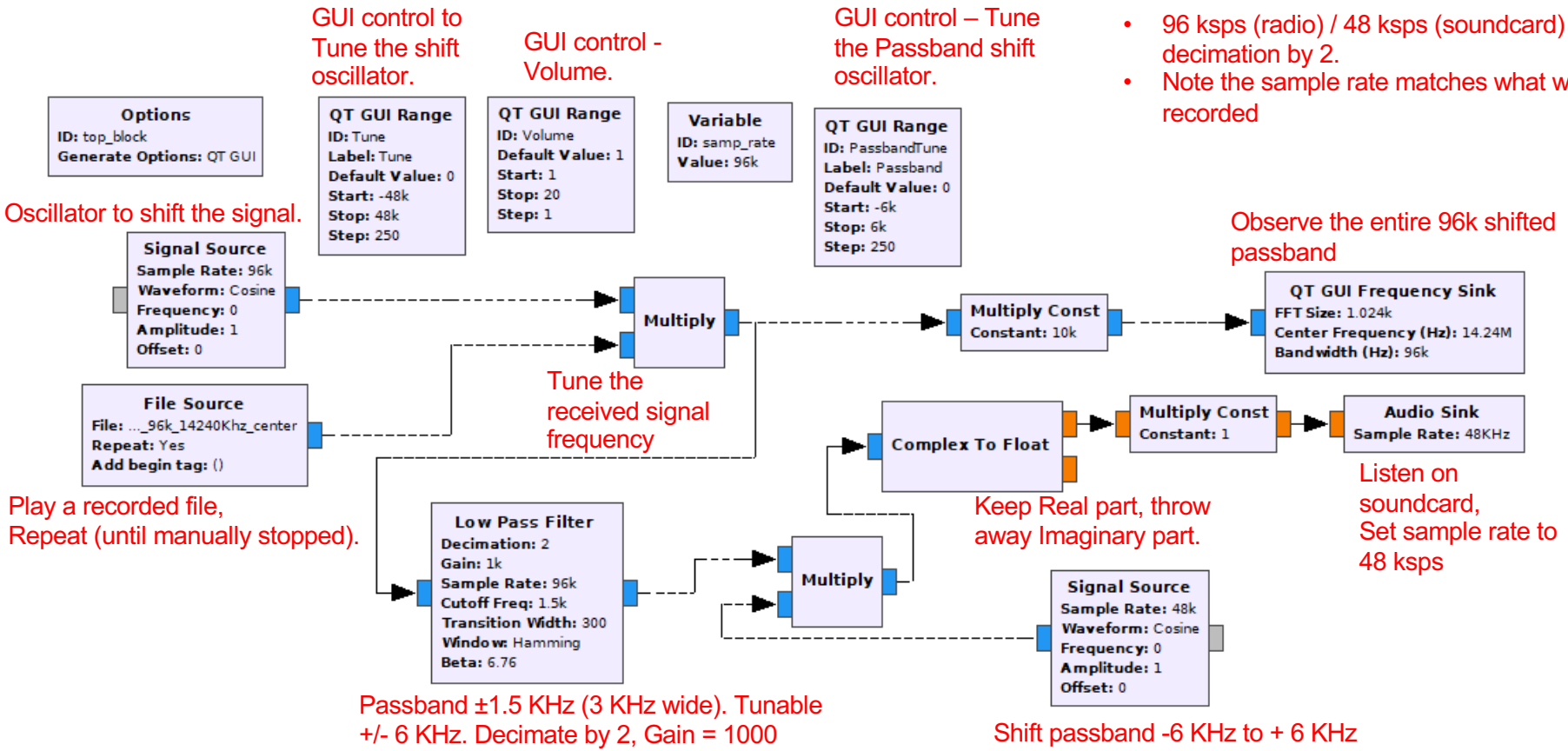

- 96 ksps (radio) / 48 ksps (soundcard) = decimation by 2.
- Note the sample rate matches what was recorded

Example of Beacon + Echo

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- Loop
  - Transmit Recorded File (Call Sign and Beacon Info)
  - Wait 2 Seconds
  - Receive Mode and Record to File for 20 Seconds
  - Wait 2 Seconds
  - Transmit Recorded File (Call Sign and Beacon Info)
  - Transmit Recorded File (Rx Recorded File)
  - Wait 2 Seconds

GNU Radio GUI Example:

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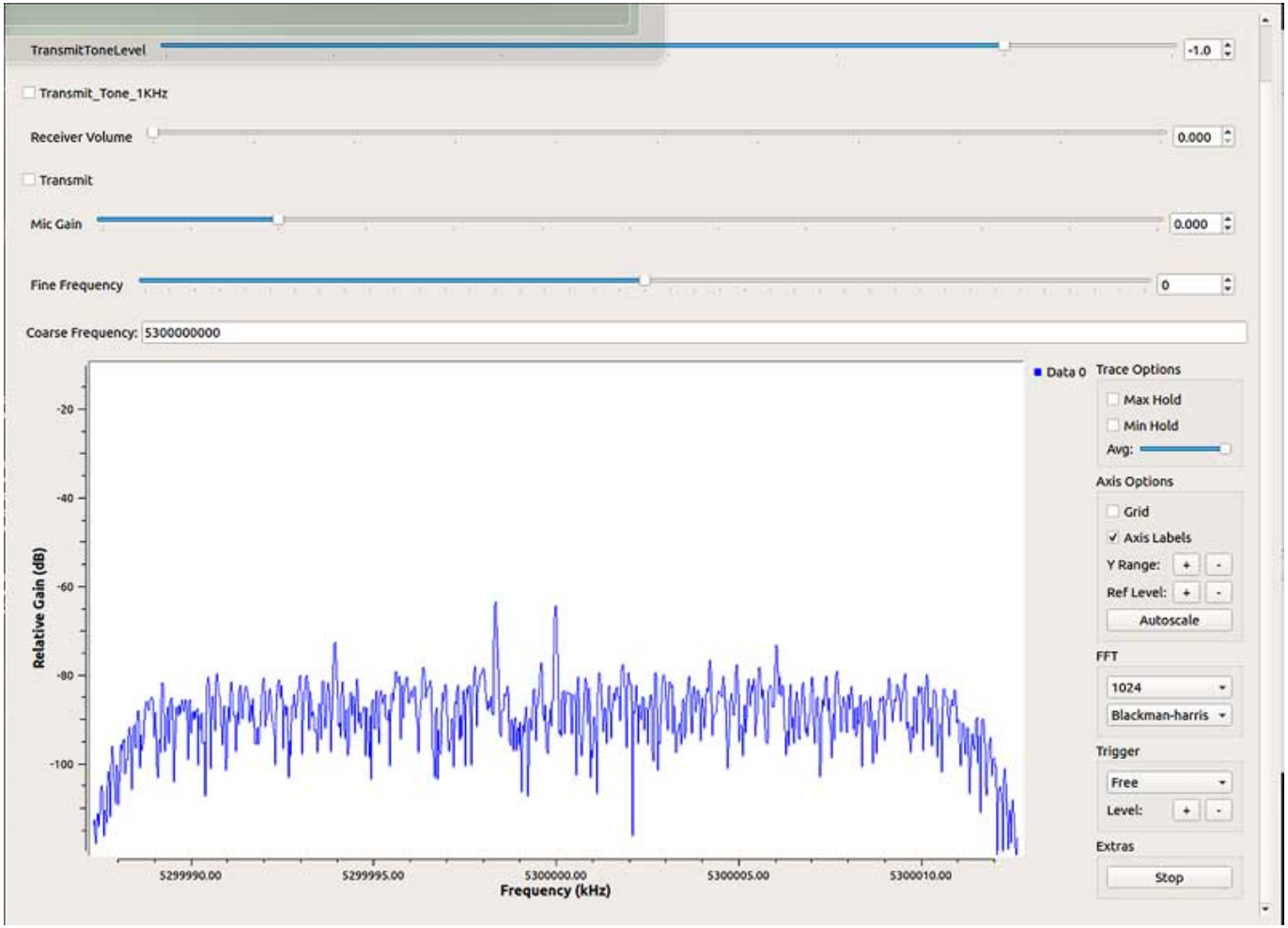

Measuring Loss vs. Frequency

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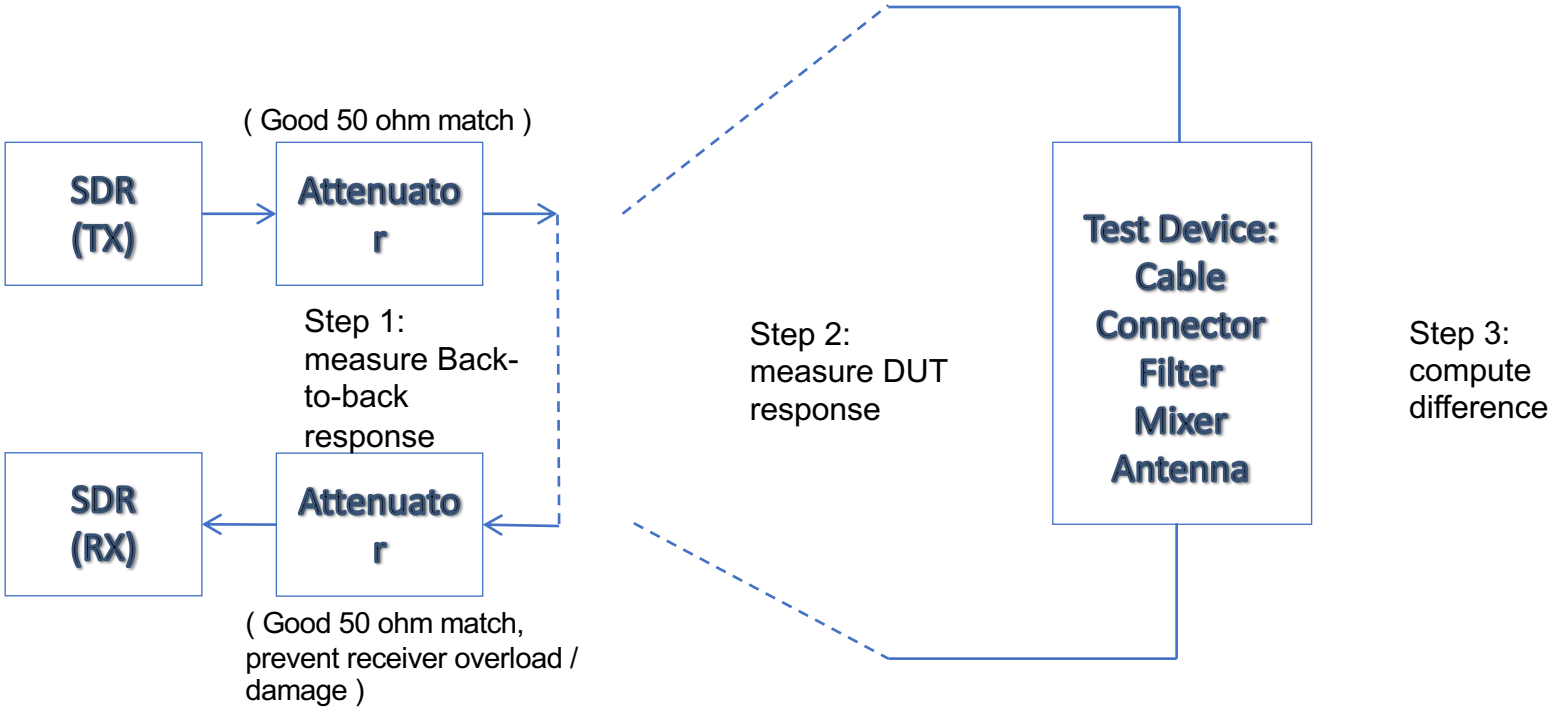

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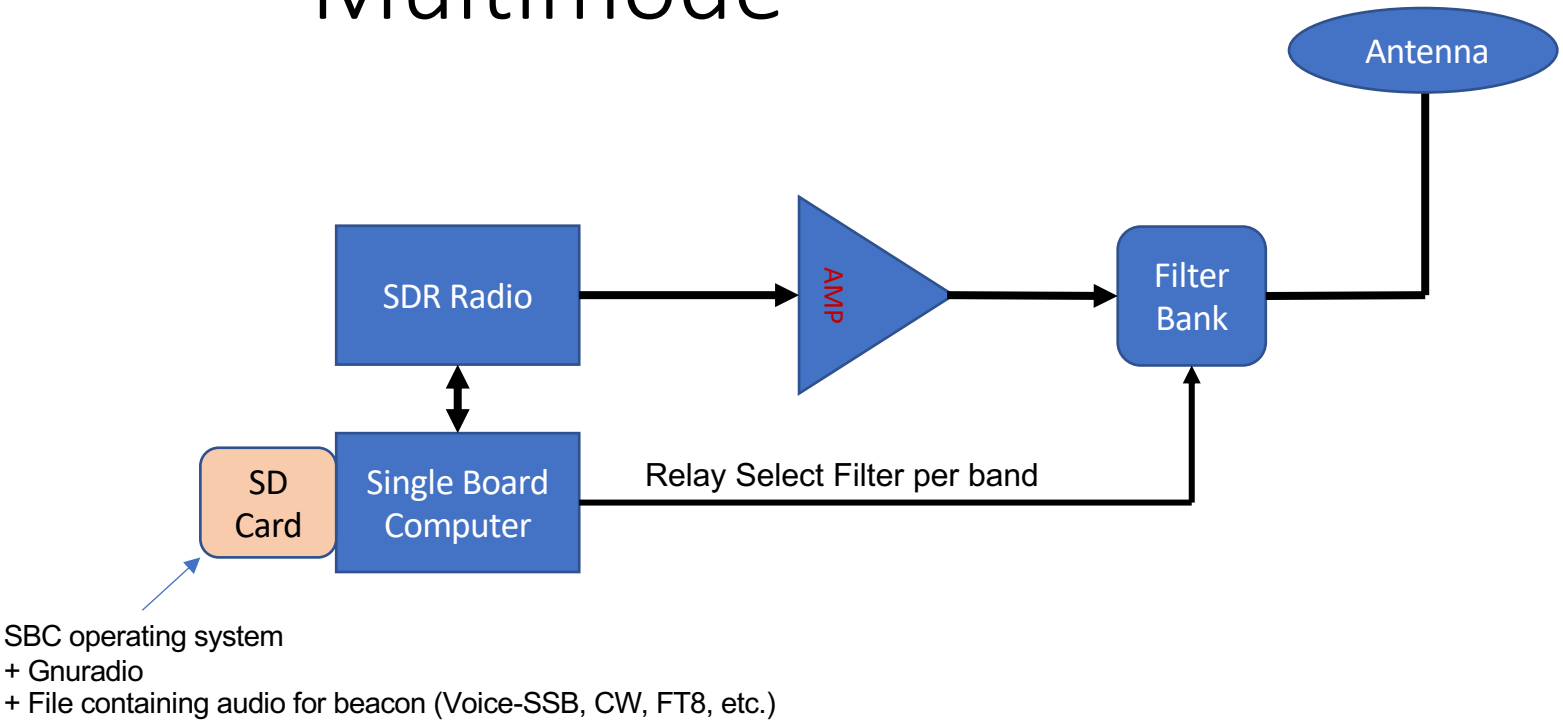
Automated Low Cost Beacon: Multiband, Multimode



SBC operating system
+ Gnuradio
+ File containing audio for beacon (Voice-SSB, CW, FT8, etc.)

Extending Frequency Range – Microwave Applications

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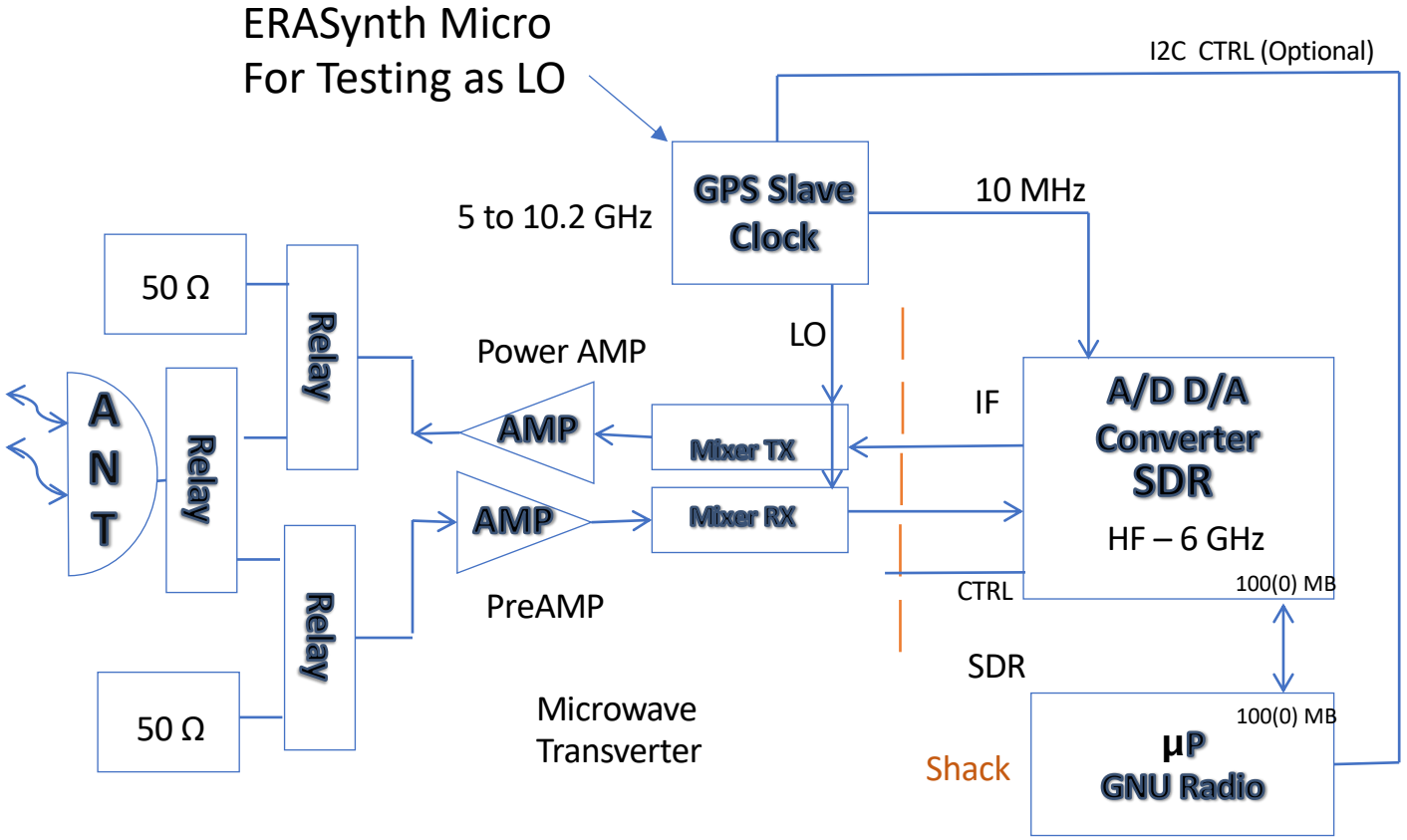

10 GHz Transverter Testbed Pluto Requires Linux

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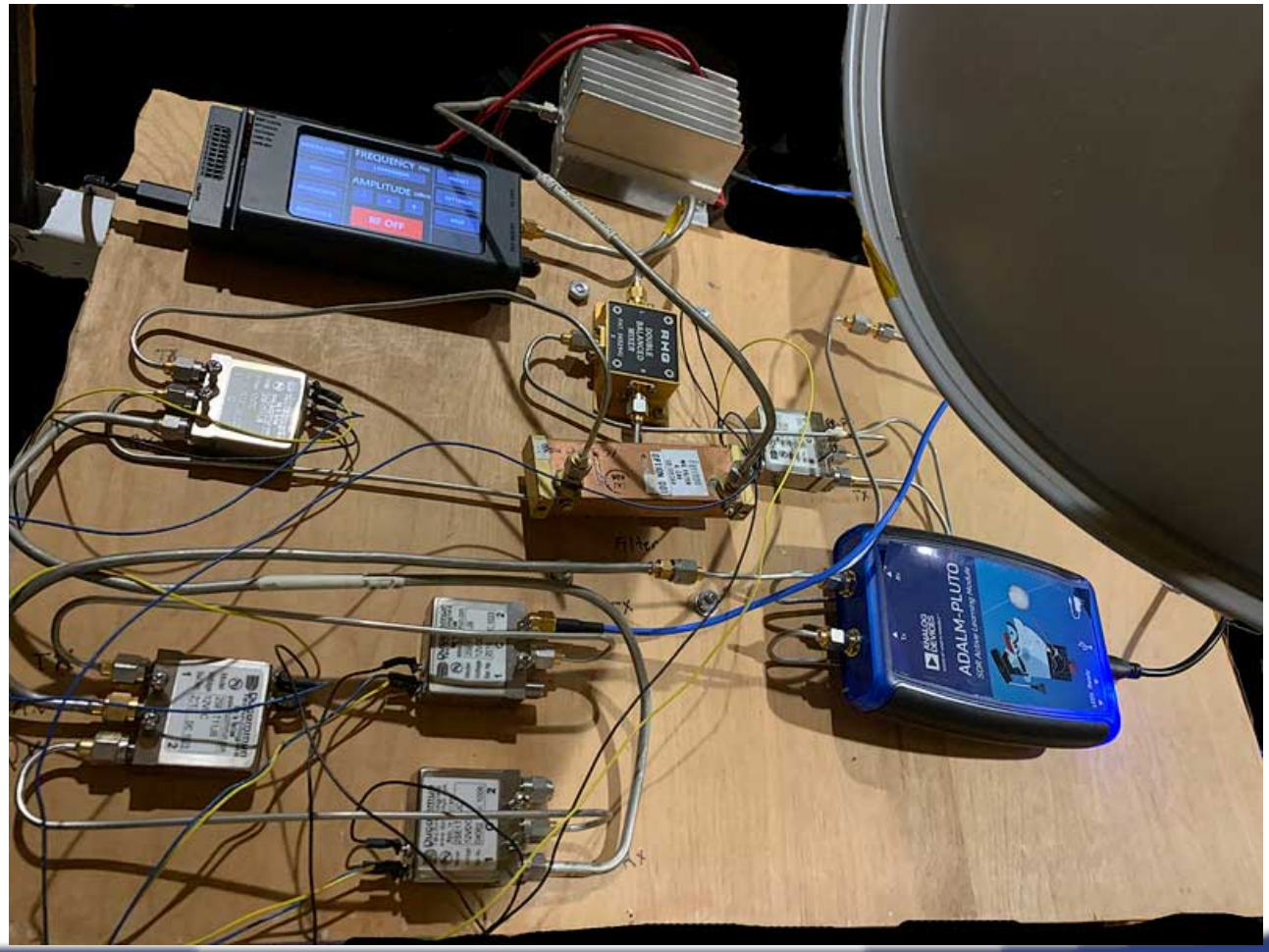

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QRadioLink

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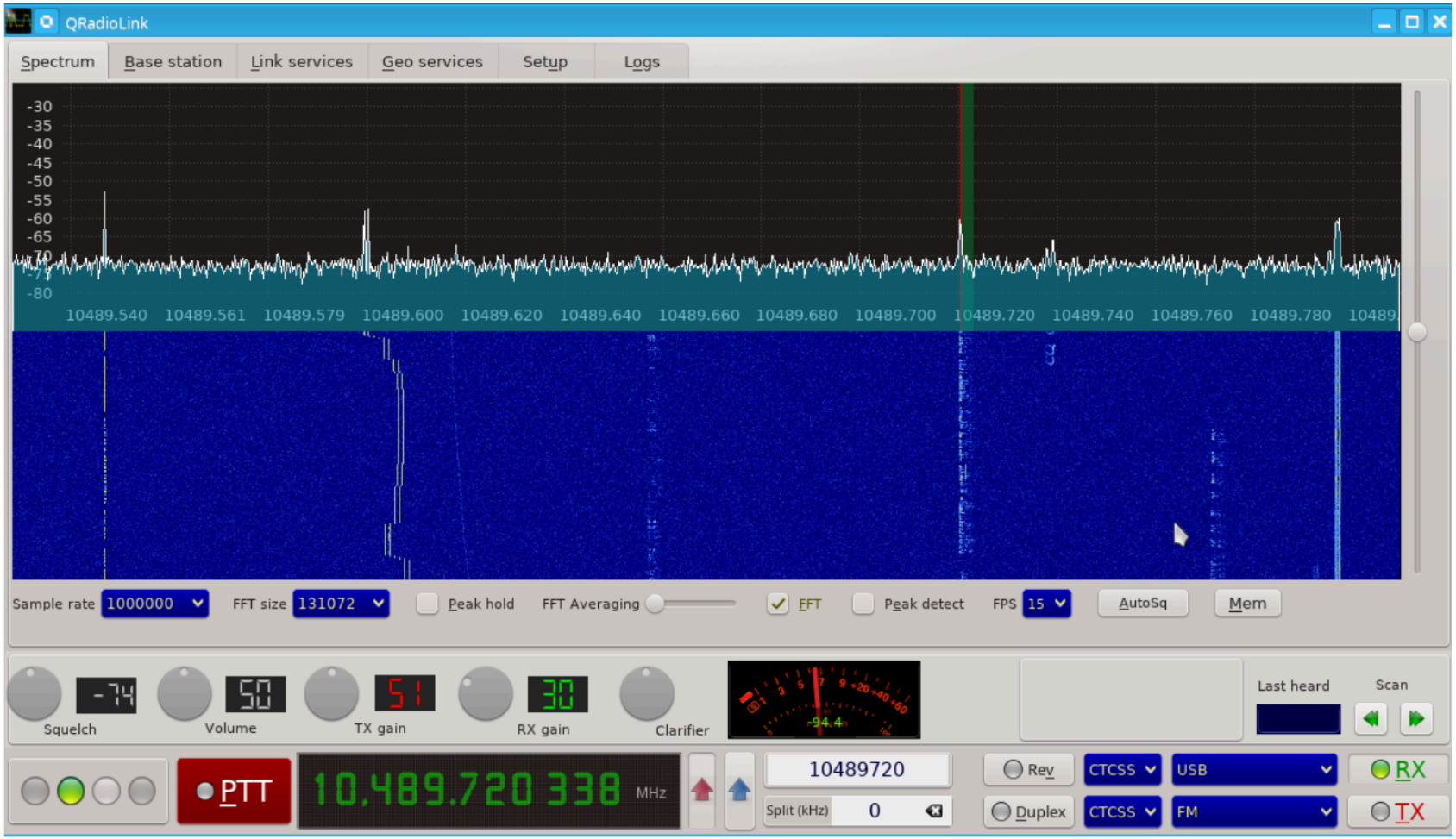

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Adrian Musceac YO8RZZ
FT8 on 2M with GNU Radio
http://qradiolink.org/ft8-plutosdr-2meters.html

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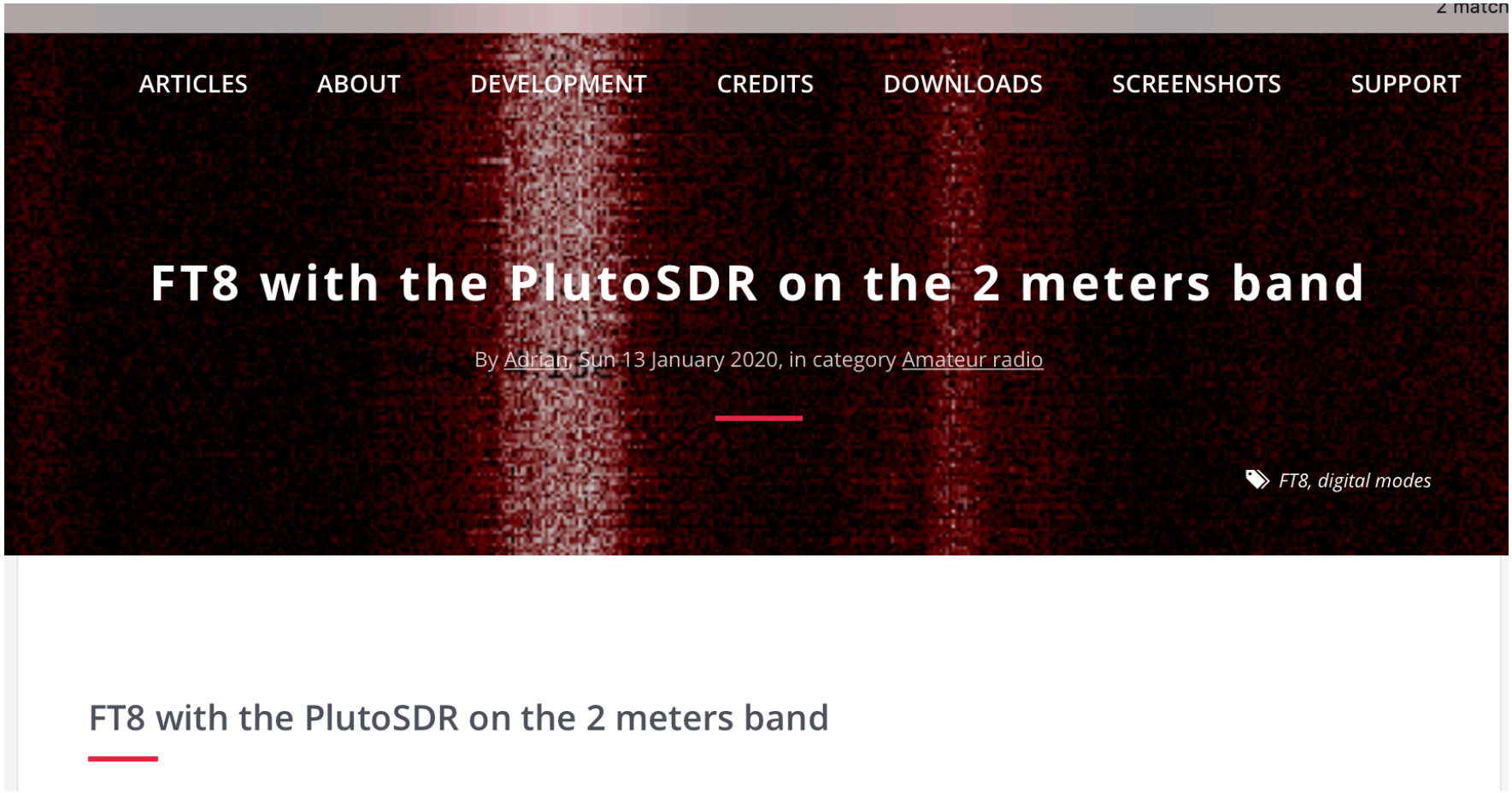

FT8 with the PlutoSDR on the 2 meters band