UHF SDR TRANSCEIVER AND RADIO SYSTEM

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MicroHAMS Digital Conference

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Agenda

- Advanced IC and SDR technology: UHF SDR project description
- SDR project details and performance data
- The journey to a UHF SDR system: perspective from traditional analog systems and opportunities with SDR designs

Advanced IC and SDR Technology

UHF Multi-mode

Direct Conversion SDR Transceiver

Single board solution with open source

DSP software

SDR Project Description

Hardware

Ettus Research B200 SDR transceiver

- single board solution
- highly quality PLL frequency synthesizer
- Tx >5 dBm RF output, RX ~2 dB NF

Software

GNU Radio open source software

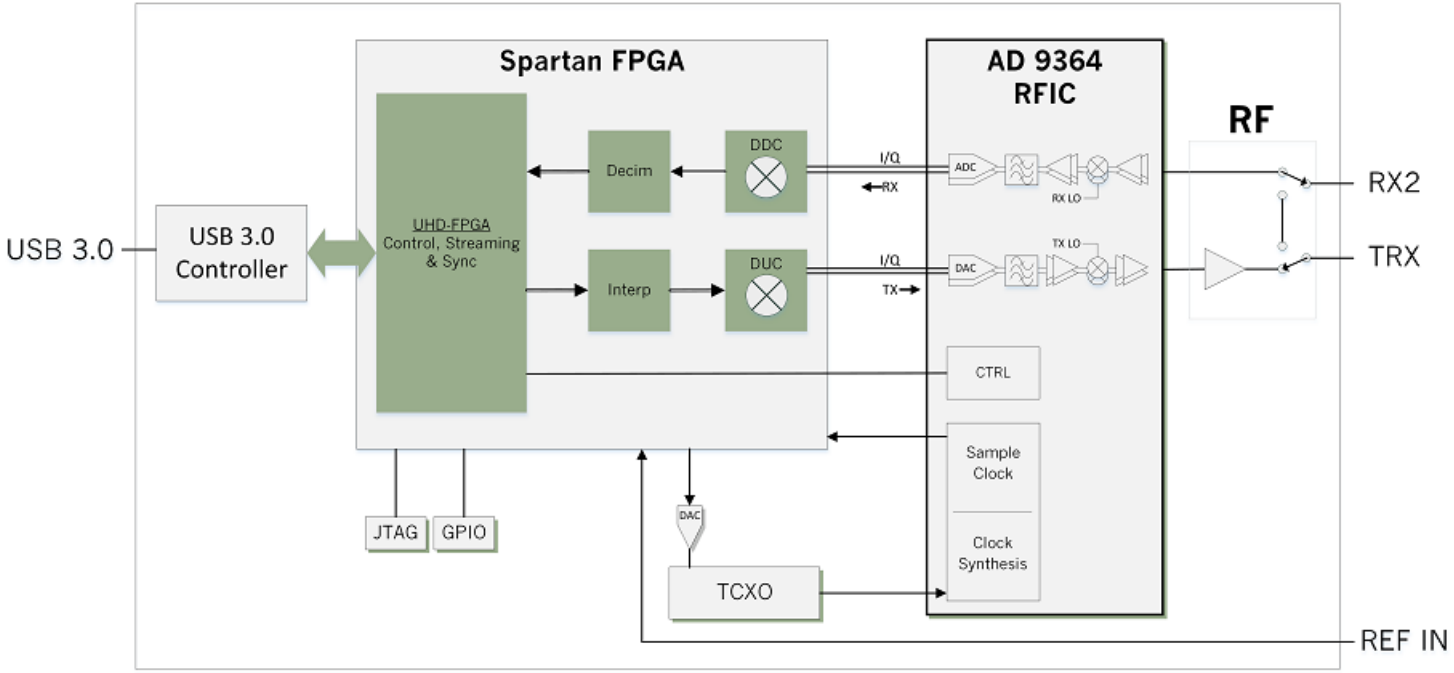
- Linux, Ubuntu OS platform
- Graphical DSP authoring

Advanced SDR Hardware

Ettus USRP B200 SDR Transceiver

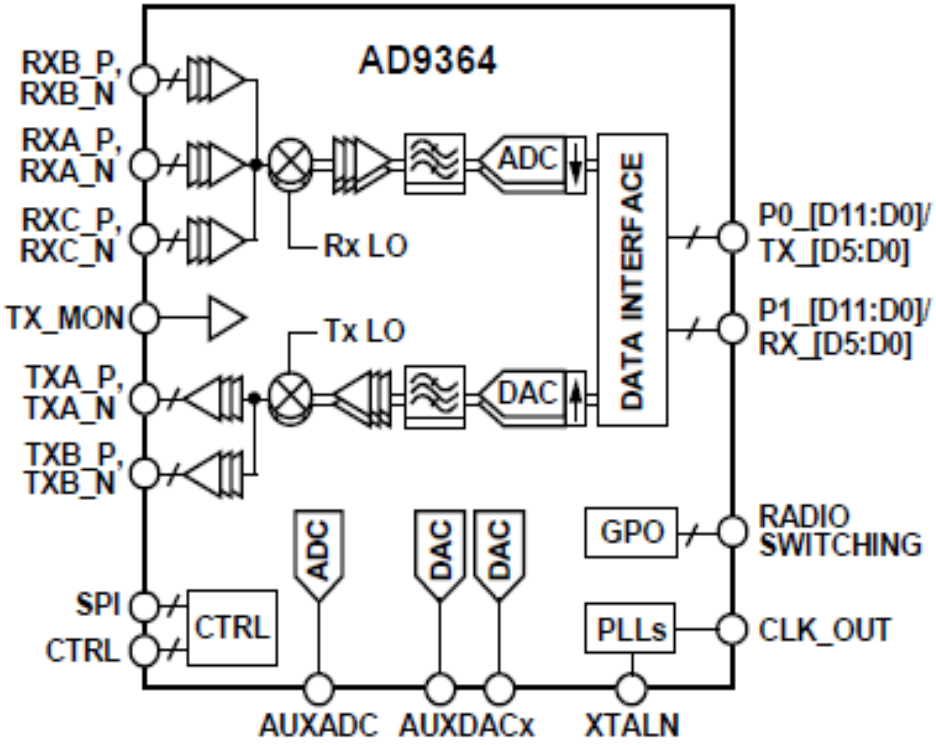
Advanced SDR Hardware

Ettus USRP B200 SDR Transceiver



Advanced SDR Hardware

Analog Devices 9364 RFIC



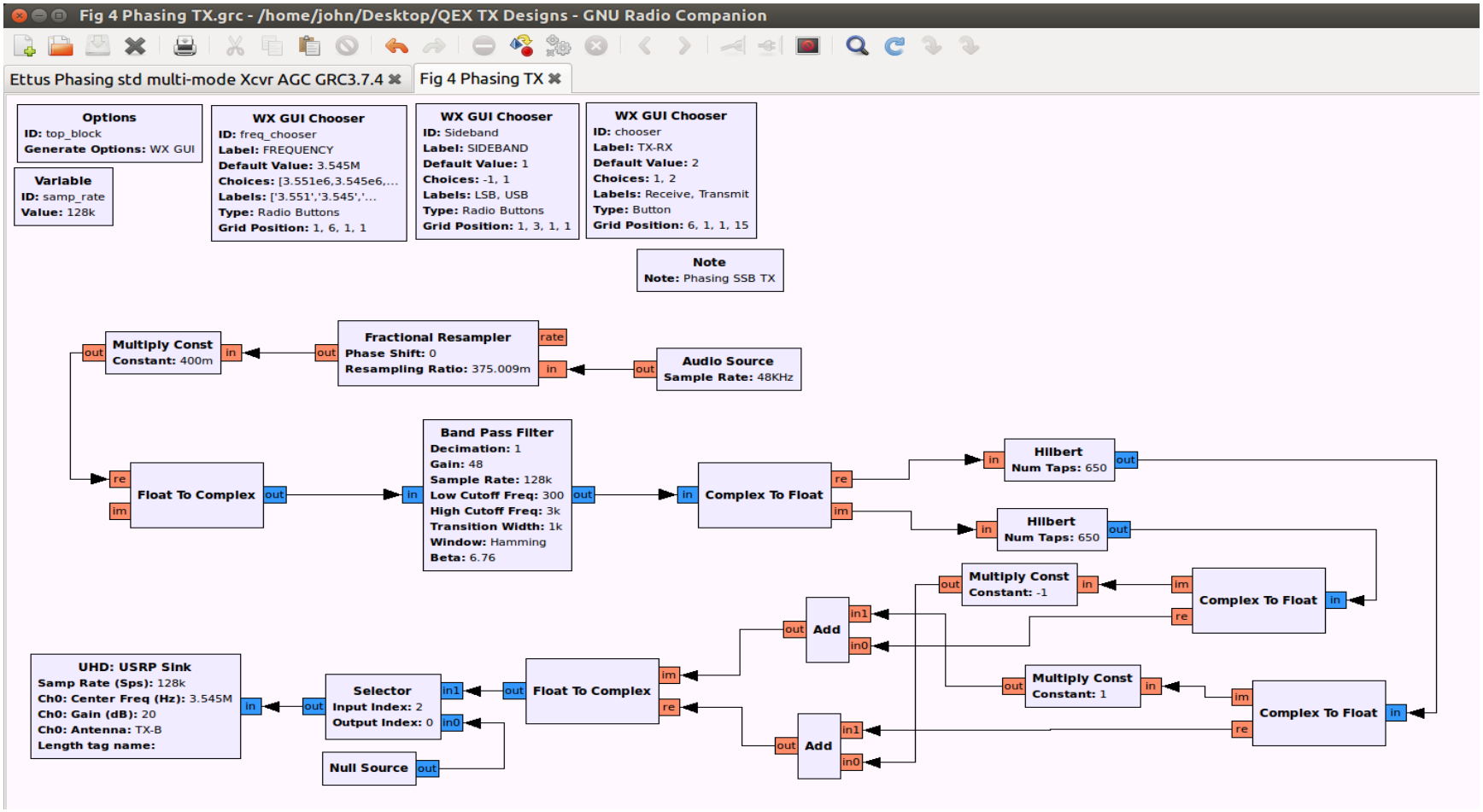
‘Advanced’ DSP Software

GNU Radio

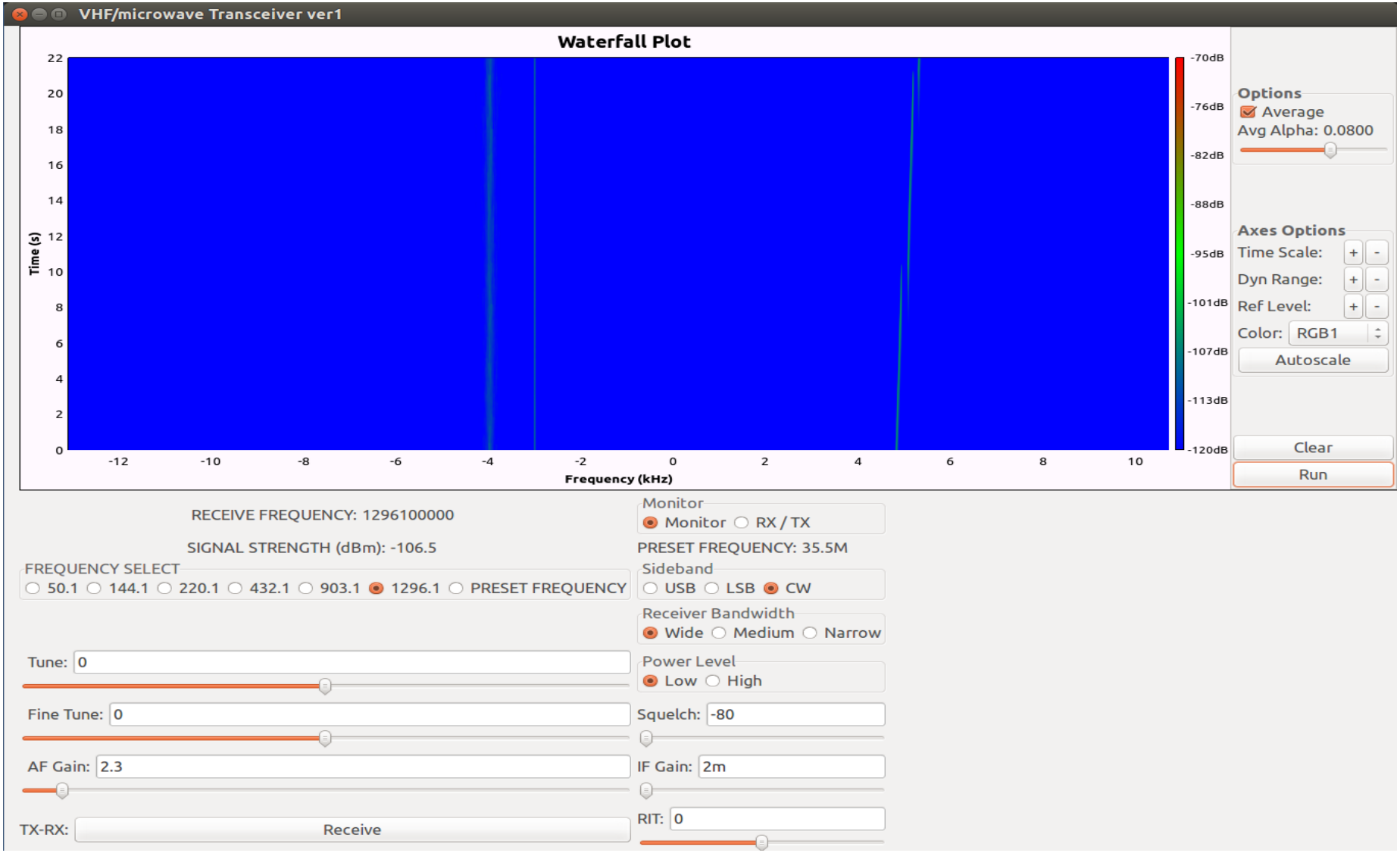
- Open source DSP library, (Linux, Ubuntu OS)
- Graphical DSP authoring
- Optimized for ‘real time’ signal processing (VOLK, C++)
- Supports transmit and receive DSP
- Developed and maintained in conjunction with Ettus USRP via UHD (Universal Hardware Driver) interface

GNU Radio DSP Flow Graph

Phasing Transmitter DSP



GNU Radio DSP GUI



Typical Analog UHF System

- High performance HF transceiver
- Outboard Linear Upconverter per band
- Custom per band antenna ‘interface’

Transition from Analog to SDR

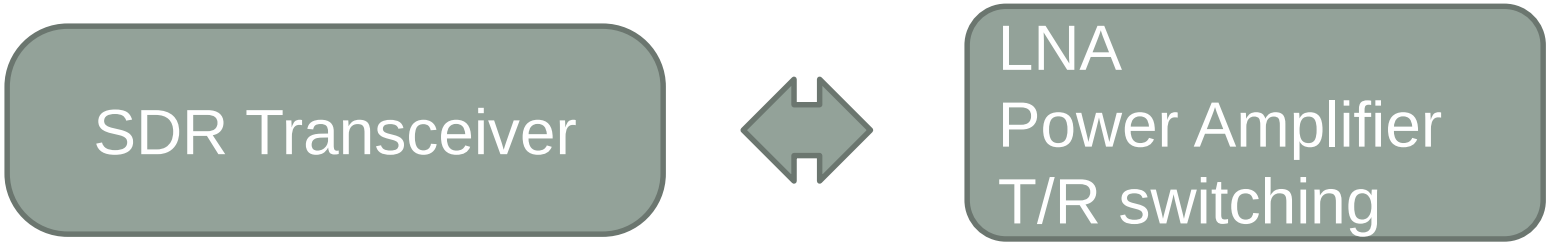
The analog system leverages highly developed,

- high performance HF transceivers
- sophisticated UHF filter, LNA, and power amplifier technology
- and proven overall system design

Question ?

- Why not improve transceiver performance and operating flexibility with SDR?
- Why not build on the proven analog system approach with SDR?

Advanced SDR UHF Radio System



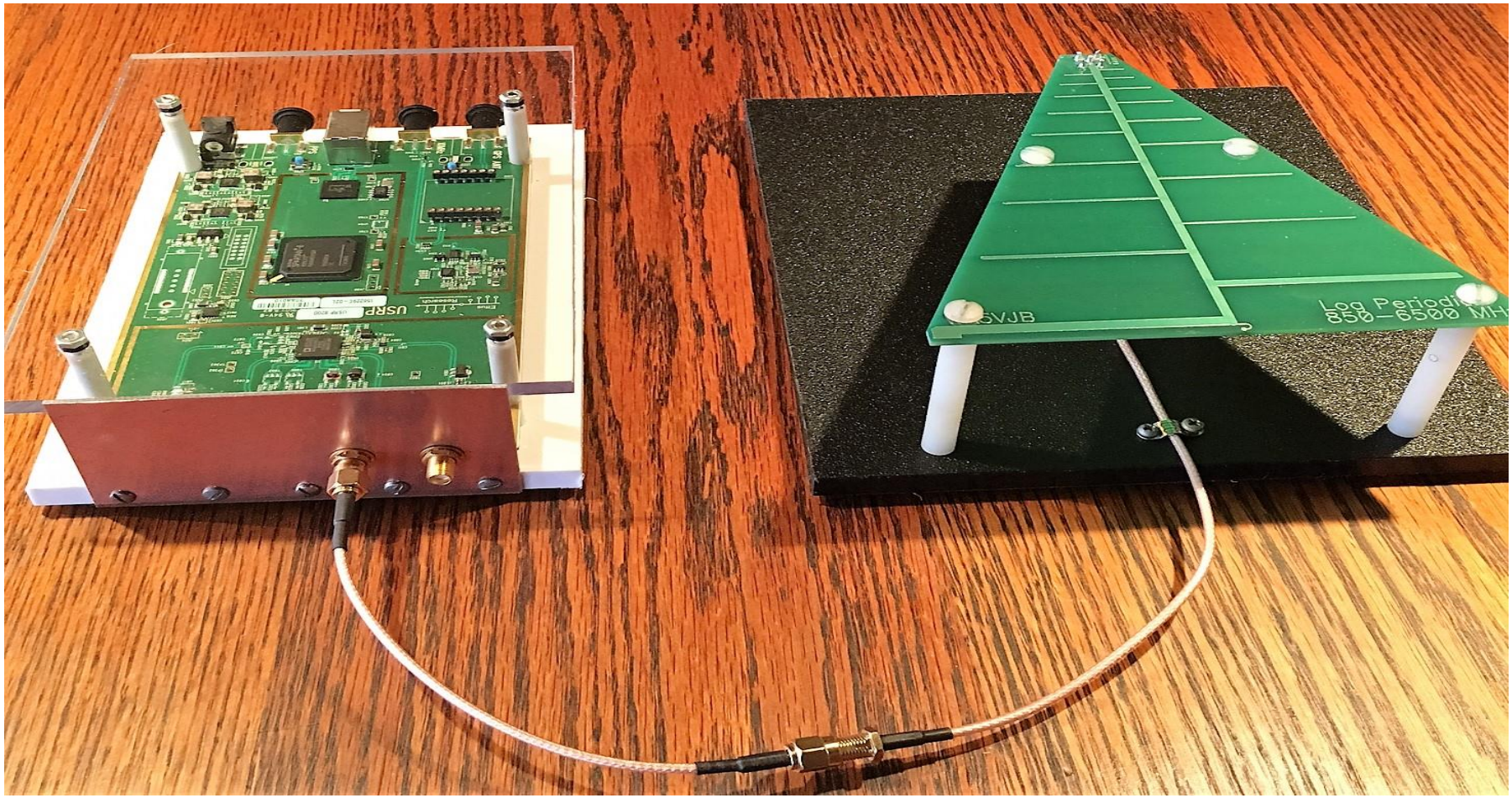
- High performance direct conversion SDR transceiver
- Custom per band antenna ‘interface’

VHF/UHF SDR System

VHF/UHF SDR Transceiver and ½ W Interface

UHF/Microwave SDR System

UHF/Microwave SDR Transceiver and Antenna



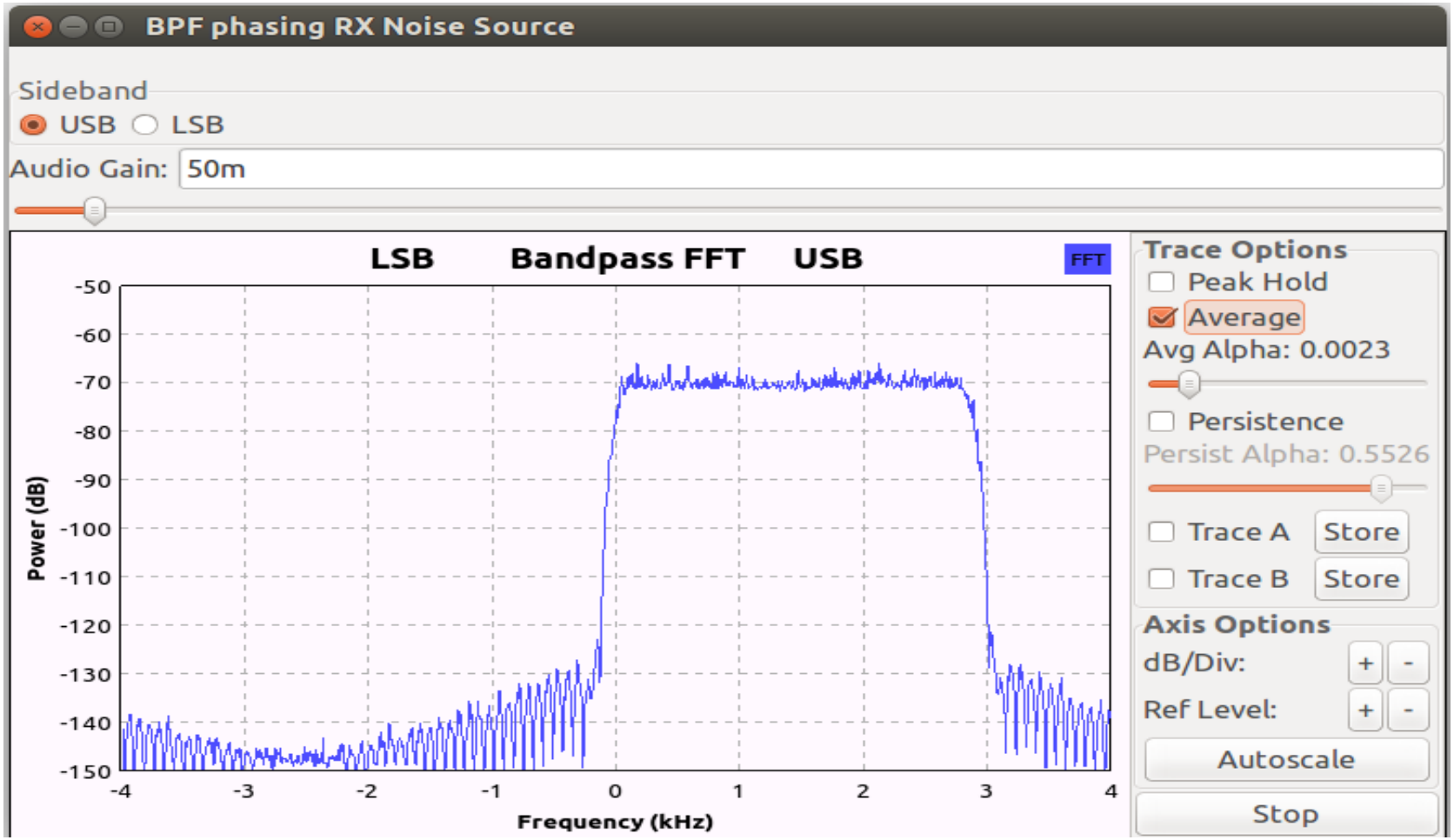
Performance Measures

Receiver Filter Bandwidth optimized for UHF operation

Transmitter Spurious Output and Phase Noise

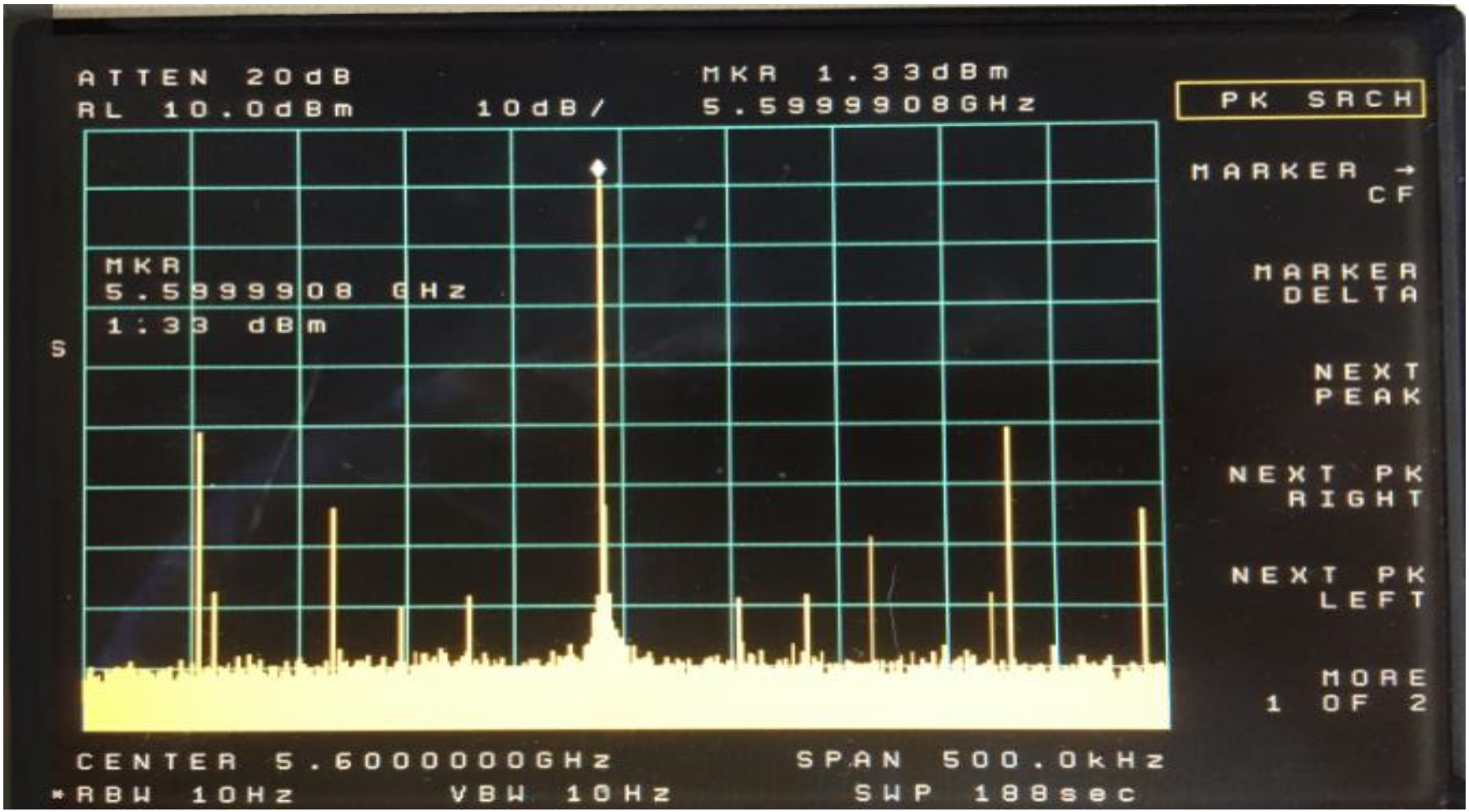
Receiver Bandwidth Spectrum

Receiver Bandwidth 3 kHz



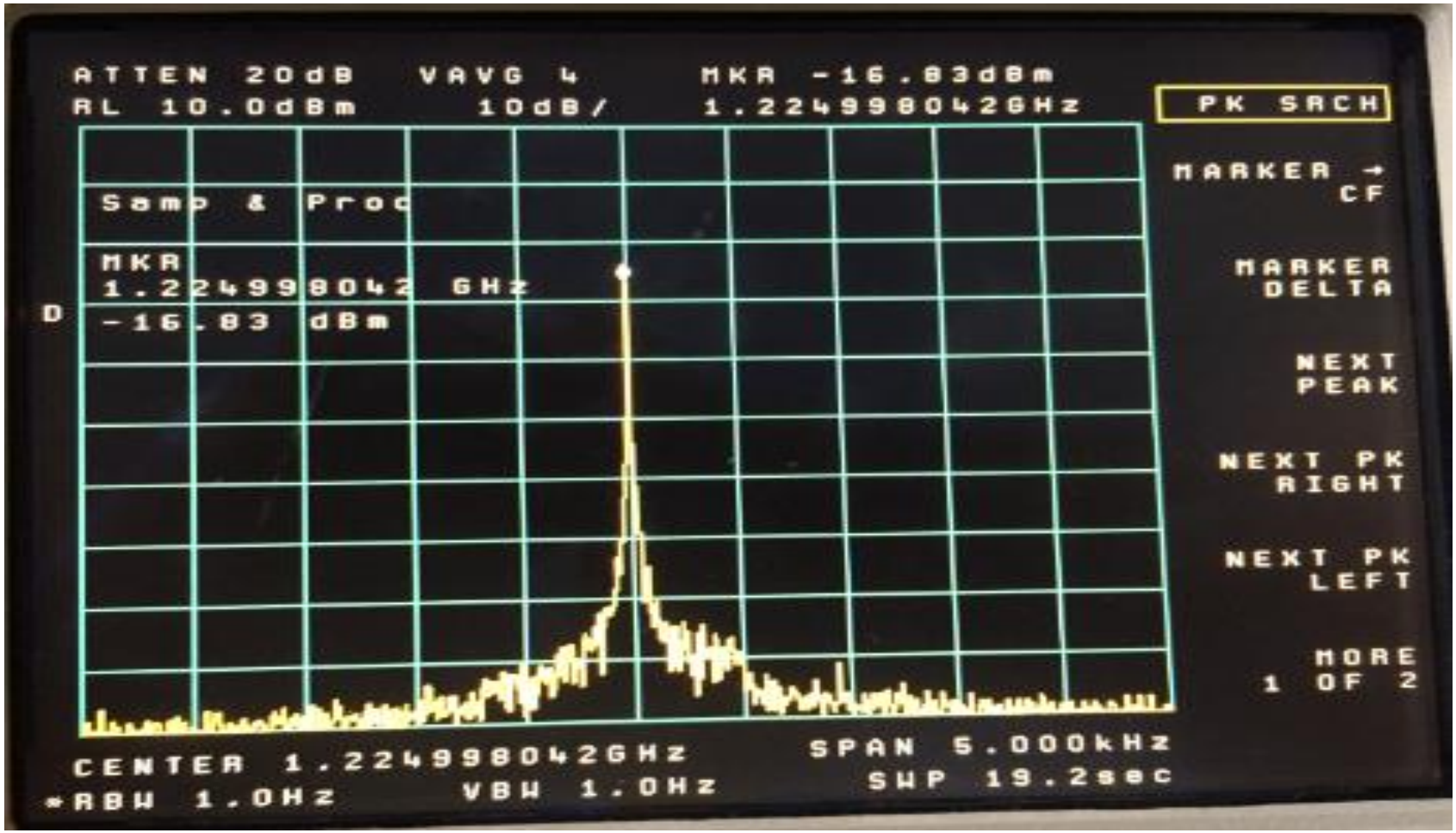
Microwave Spectral Purity

Transmit Spectrum at 5.6 GHz



Microwave Phase Noise

Transmit Phase Noise at 1.2 GHz



SDR: The New Normal?

- Near ideal signal processing ability: ‘digital determinism’
- Unlimited design flexibility
- Integrates well with existing RF systems
- Compact and light weight

In Conclusion

I want to thank

Michael Garrett, AC9LM

Barry Hansen, K7BWH

For their generous assistance with this project

Thanks also to the MicroHAMS for the opportunity to present this project at the 2016 MHDC

Down the Slippery Slope…

More information about DSP and SDR

www.w7fu.com

Additional learning opportunity with the SDR-SIG

Meets on the odd month, third Tuesday 6:00-7:30

Facebook: PNW SDR SIG

(SDR-SIG information)

FAQ's: Hardware

Q: Are there UHF/ Microwave SDR transceiver hardware alternatives?

A: Yes, a number of them with more to come: http://www.Ettus.com and http://www.Nuand.com

Q: Isn't the Ham Shield Arduino (VHF/UHF transceiver) a SDR?

A: Yes, by all means. Wonderful design, with a different purpose, not compatible with GNU Radio

FAQ's: Software

Q: Does GNU Radio function with a Windows OS?

A: "Sorta", hard work with significant limitations. They are working on it. The GNU Radio developers are primarily oriented to Linux OS.

Q: How do I get started with GNU Radio?

A: That is what www.Gnuradio.org/ and www.w7fu.com is all about. GRC DSP information oriented to beginners.

FAQ's: General

Q: What about homebrew UHF SDRs?

A: Yes. You can make the software and analog interface system. The FPGAs and RFICs require automated assembly.

Q: Where do I turn for more information on VHF/ Microwave opportunities in our area?

A: PNW VHF Society is very active locally, sponsors a wide range of operating activities, and a source of good technical information:

http://www.pnwvhfs.org/

Additional Questions ?

Hardware ?

Software ?

Other related topics ?