W5HN

North Texas NTMS Microwave Society

Microwave Operations

Operating the Microwave Bands and NTMS Activity

Cowtown

January 20, 2018

North Texas NTMS Microwave Society

All licensees except Novices are authorized all modes on the following frequencies:

2300-2310 MHz	10.0-10.5 GHz *	122.25-123.0 GHz
2390-2450 MHz	24.0-24.25 GHz	134-141 GHz
3300-3500 MHz	47.0-47.2 GHz	241-250 GHz
5650-5925 MHz	76.0-81.0 GHz	All above 275 GHz

* No pulse emissions

Microwave Activity

North Texas NTMS Microwave Society

- Microwave Contest
- EME (Earth – Moon - Earth)
- Data Transmission
  - Packet, JT (Joe Taylor) Weak Signal Modes
- Terrestrial weak signal
- Meteor Scatter and Rain/Snow Scatter
- Satellite operations
- Optical Laser

Microwave Operation

North Texas NTMS Microwave Society

- Operation: scheduled, contest or band opening.
- Every operating event is a experiment, learning, and growing experience to prove your equipment and skills.
- Beacons are an key asset. With beacons you can test your radio and antenna. The Beacon list is on the NTMS.ORG Website
- Frequency reference that is stable is best but not essential when SDR technology is used.

Microwave Technology

North Texas NTMS Microwave Society

- Antennas
  - Yagi (PCB) Dish Feed Horns Waveguide
  - Typically smaller higher gain narrow beam angle than HF antennas
  - NTMS guidance with plans and methods
  - WA5VGB and others have many years of experience making and measuring antennas.
  - Every Ham loves to work on antennas
  - Learning with wavelengths that are one HAND in length is easier

Beacons

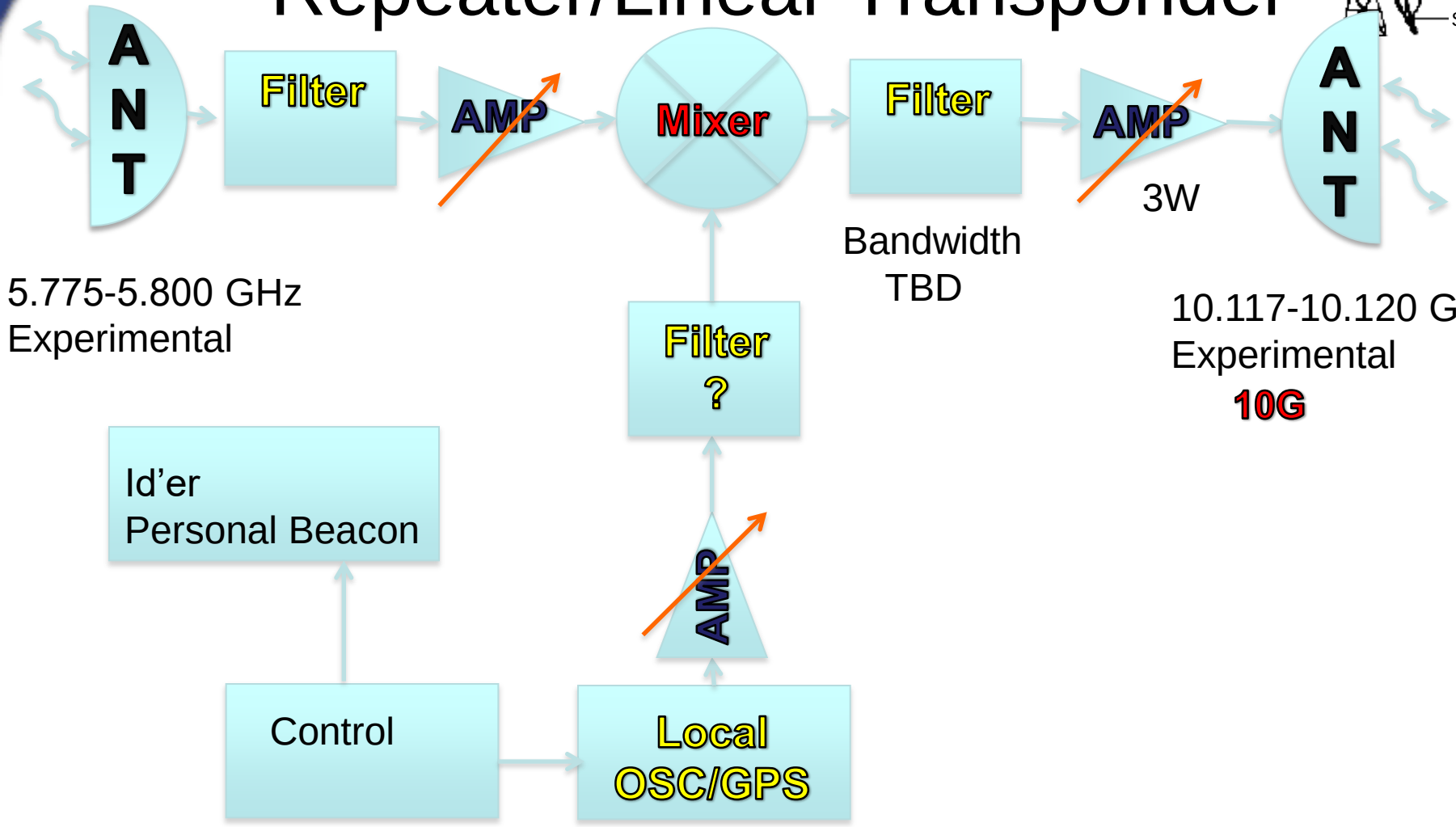
North Texas NTMS Microwave Society

Frequency (MHz)	Call	Grid	Power Output	Antenna	Height Above Ground
50.072	W5HN/B	EM13sj	0.5 W	Halo	180 ft
144.280.2	W5HN/B	EM13sj	1.5 W	Halo	180 ft
222.060	AA5C/B	EM13se	8 W	Folded Dipole	52 ft
432.369	N5PYK/B	DM93bm	50 W	Yagi toward DFW	70 ft
432.380	W5HN/B	EM13kf	0.5 W	Halo	280 ft
902.379.6	W5HN/B	EM13kf	9 W	Alford Slot	280 ft
1296.375	W5HN/B	EM13kf	3 W	Alford Slot	280 ft
2304.367	W5HN/B	EM13kf	4 W	Alford Slot	280 ft
3456.381	W5HN/B	EM13kf	250 mW	Alford Slot	280 ft
5760.363	W5HN/B	EM13kf	158 mW	Alford Slot	280 ft
10368.366	W5HN/B	EM13kf	2.3W	8 Slot WR-90	280 ft
24192.353	AA5C/B	EM13se	500 mW	16 slot WR42	75 ft
47088.300					

W5HN

Feb 2017
Repeater/Linear Transponder

North Texas NTMS Microwave Society

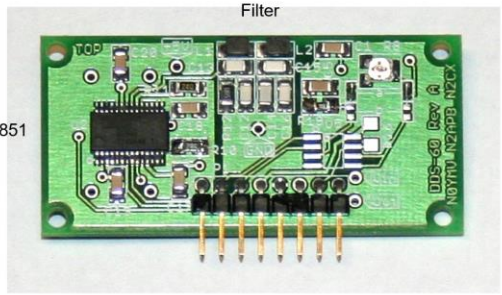


3/17 AA5C Greg

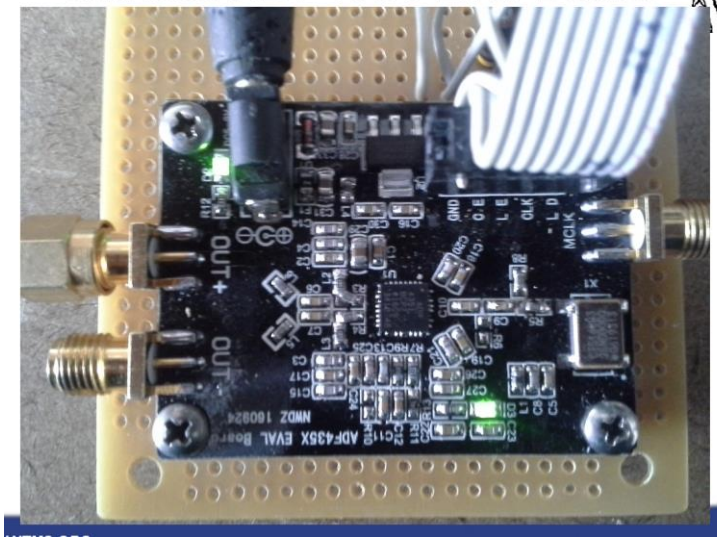
DDS-60 Top Side

Filter

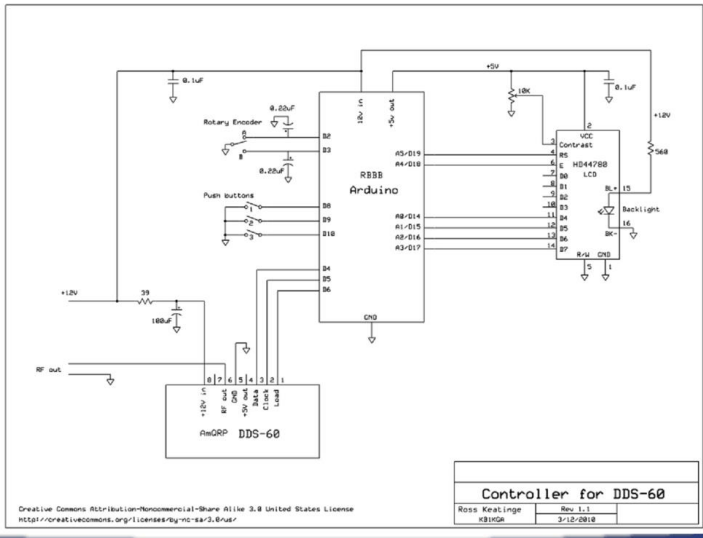
AD9851



Chinese ADF4351 Eval Board



Arduino Controls and Connections to the DDS-60 and LCD



3/17 G4FRE Dave Robinson

North Texas NTMS Microwave Society

Construction Projects

AQRP VNA
PiHPSDR
Triband Amplifier
FT817 Band Decoder

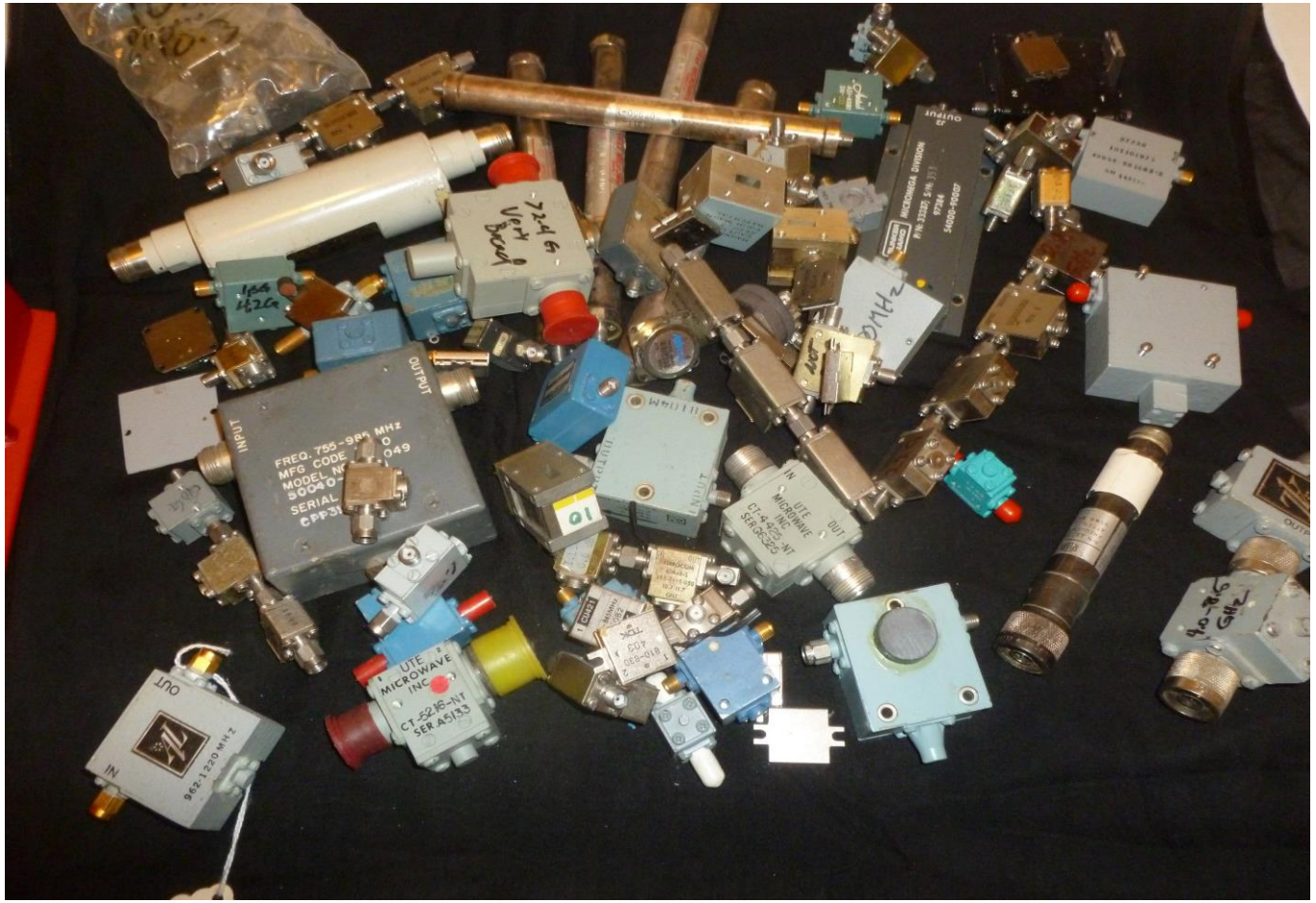
UK Activity

1.3GHz UKAC
SHF UKAC
VHF NFD

4/17 WA5VJB Kent

North Texas NTMS Microwave Society

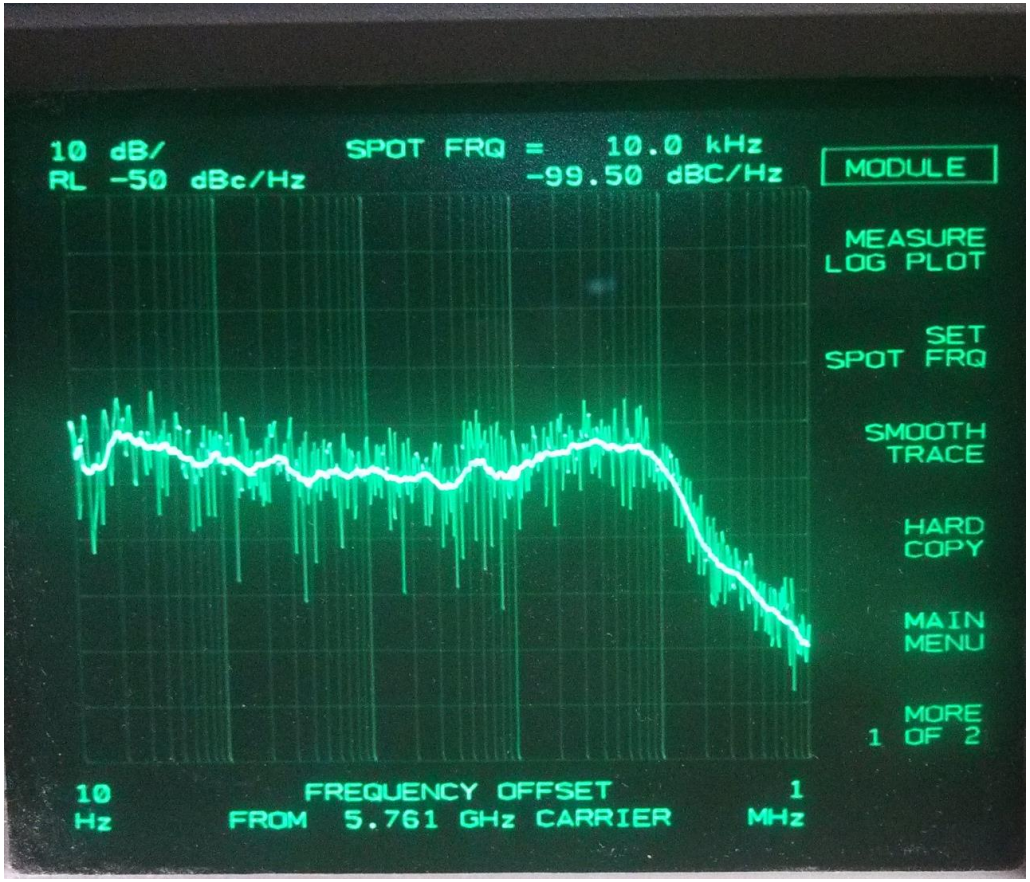
Talk on filters, circulators, isolators and mixers.



Second talk on TWT Theory and Operation with examples.

North Texas NTMS Microwave Society

5/17 W5LUA Al
DB6NT Oscillator Phase Noise



-90 dBc/Hz
@ at 10 Hz spacing

Followed up with:
ADF4351 Phase Noise

6/17 Hamcom
AA5C Greg

North Texas NTMS Microwave Society

- Background
- The Arduino Uno and LCD Button Shield
- DDS-60 Controller
- ADF4351 Controller
- ADF4351 3312 MHz LO
- ADF4351 NTMS 432.380 MHz beacon
- ADF5355 Controller

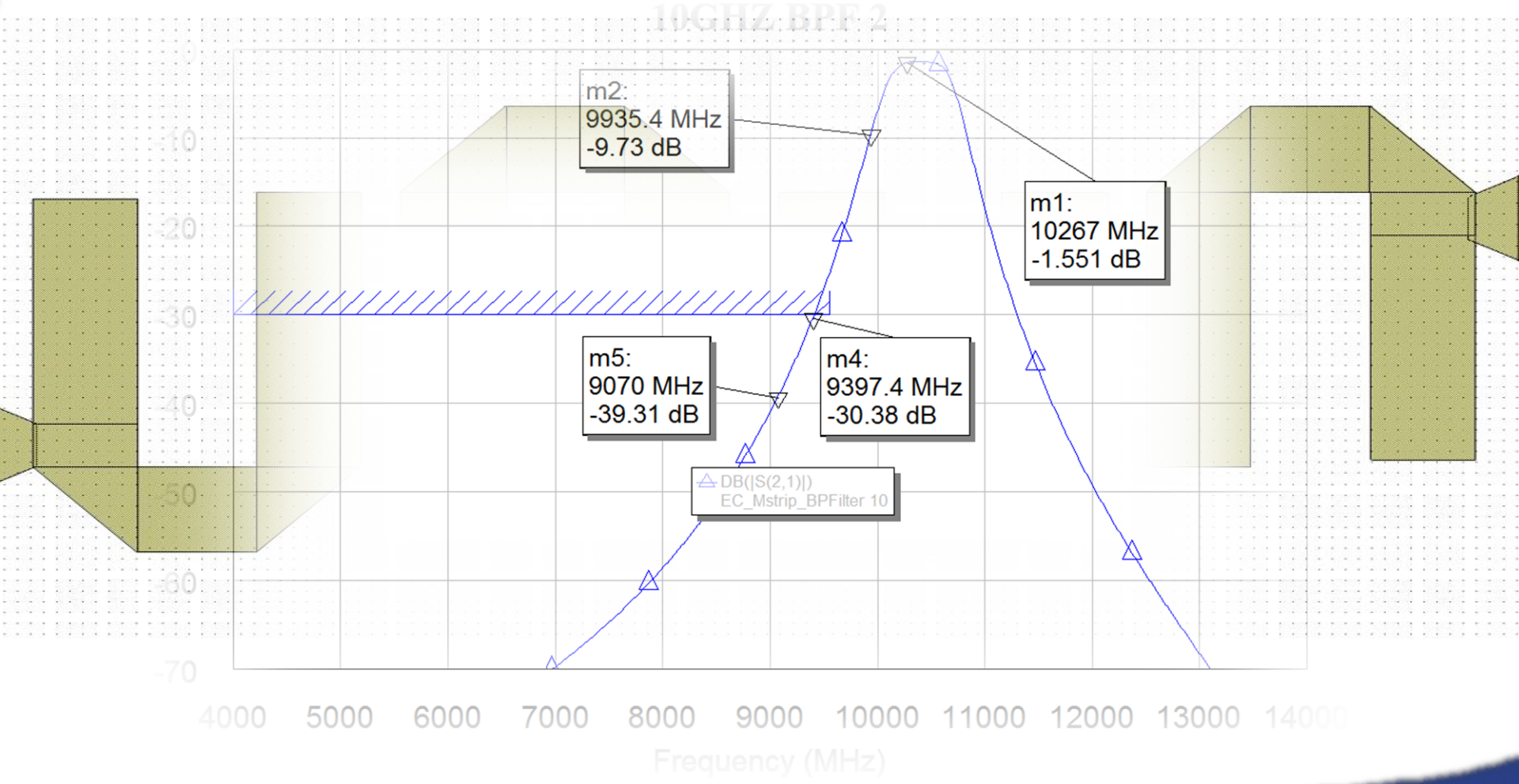
7/17 Group
10 GHz ARRL Contest Planning

North Texas NTMS Microwave Society

- 19-20 Aug **10 GHz & Up – Round 1**
- 16-17 Sep **10 GHz & Up - Round 2**

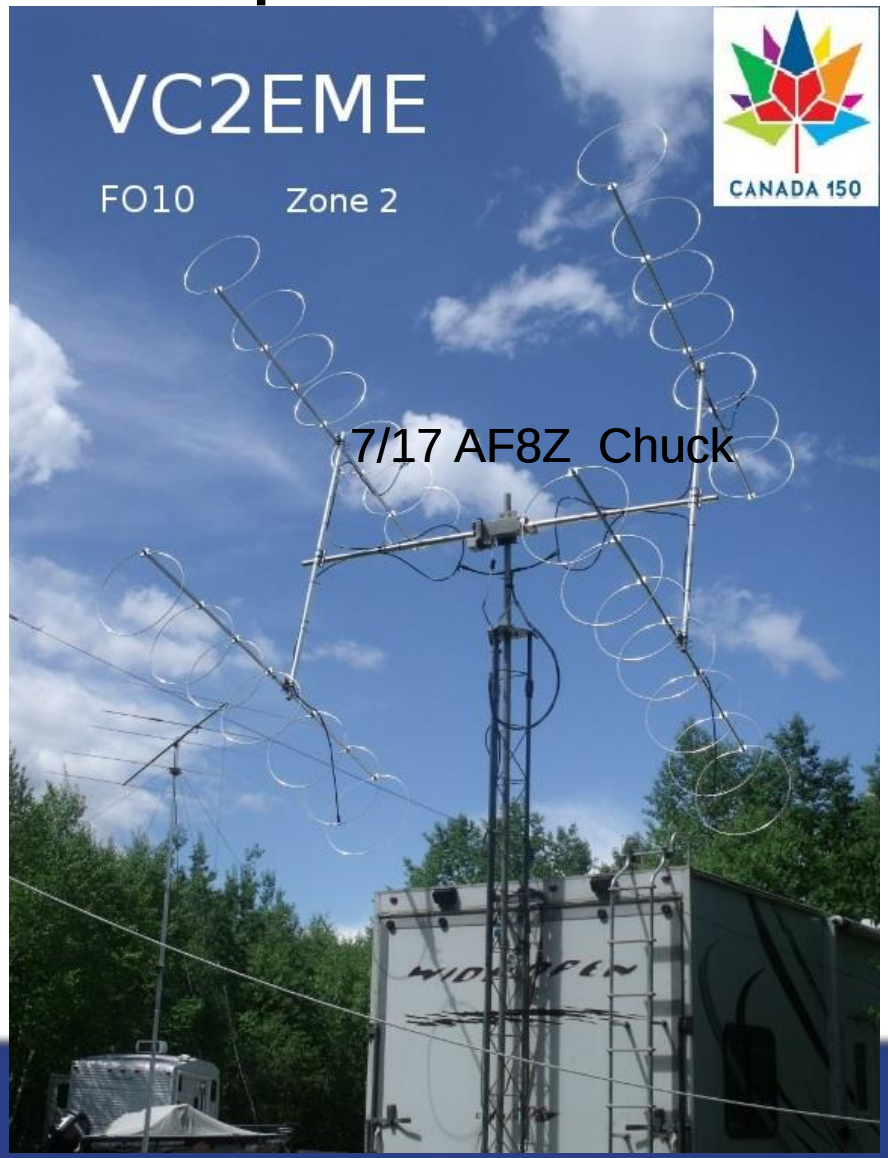
7/17 AF8Z Chuck Filter Design

North Texas NTMS Microwave Society



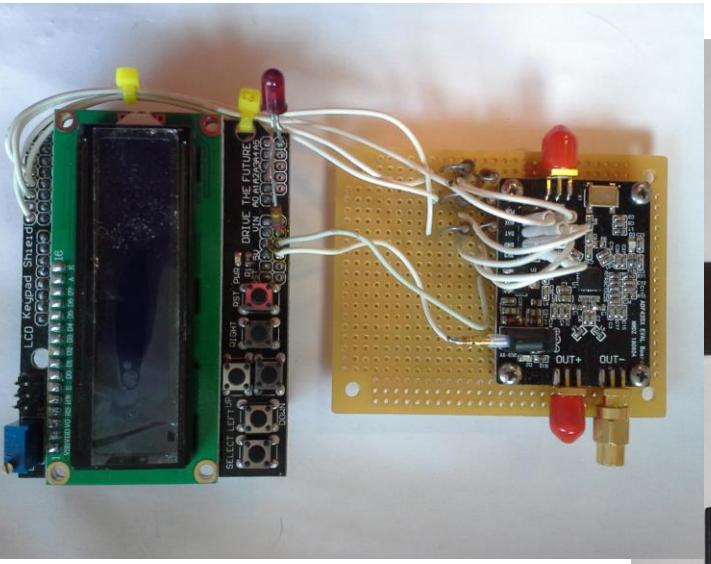
7/17 AF8Z Chuck Expedition Results

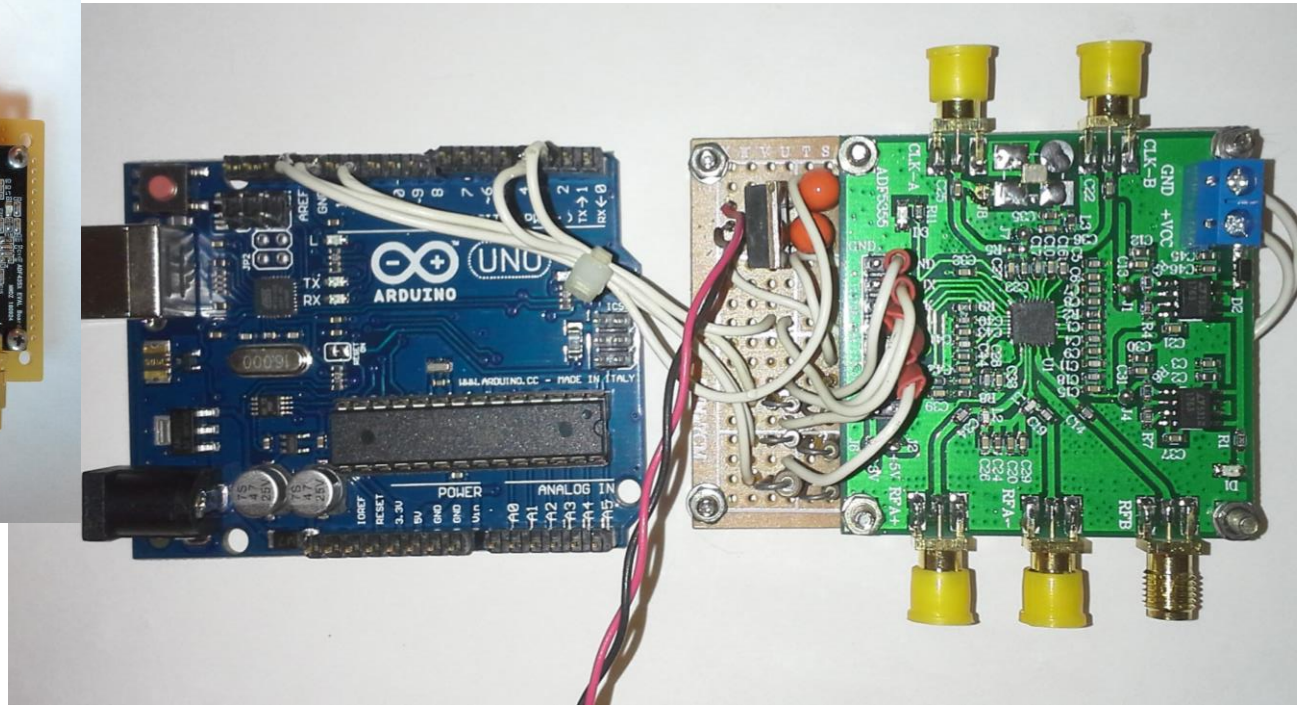
North Texas NTMS Microwave Society



9/17 AA5C Greg
432 MHZ Beacon LO & Keyer
Updates on Frequency Synthesizer

North Texas NTMS Microwave Society





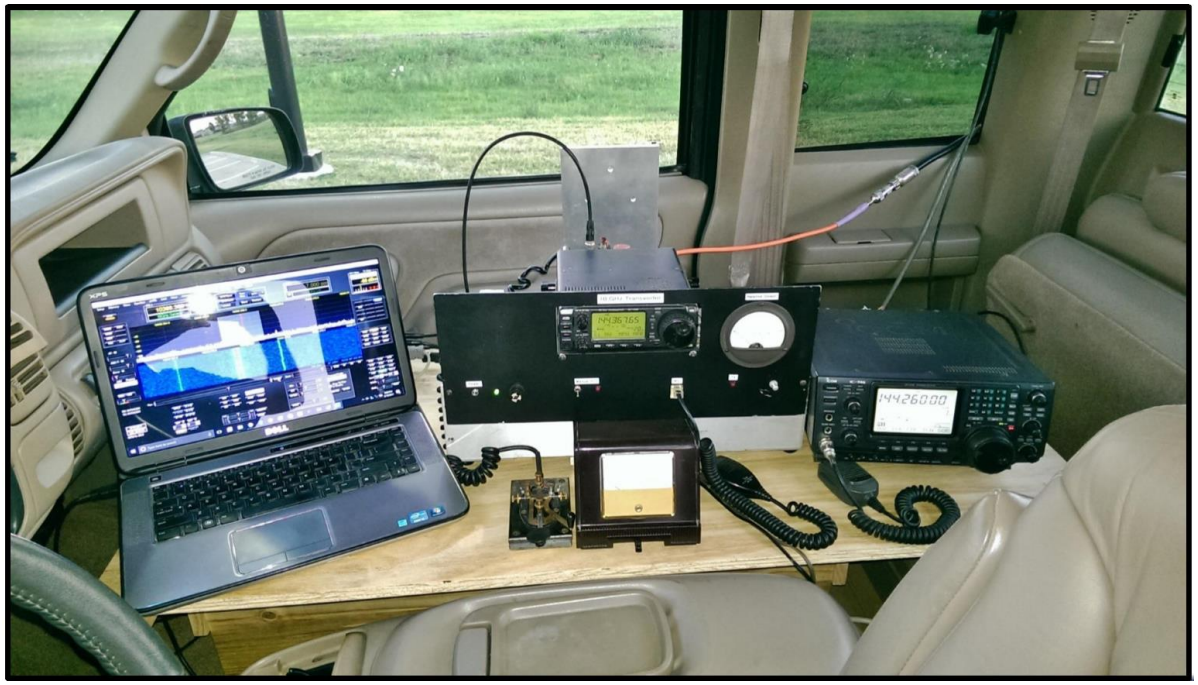
9/17 W5LUA Al - Contest Results
W5LUA August (blue) /September (red) 2017 10 GHz Log

North Texas NTMS Microwave Society

- WA5YWC/R – EM12qn, EM12qj, EM12oe, EM13ni, EM13hj, EM13ff, EM12fr, EM12mw, EM14kj, EM14fe, EM14ad, EM04te, EM04of, EM04ib, EM03kq, EM2lc, EM11ks, EM11ib, EM12nk,
- AA5C – EM13se
- N5WCO – EM12mo
- NO5K – EM10cm
- W3XO/5 – EM00kd
- WA5VJB – EM12lq
- W5RLG/R – EM13ne, EM13ei, EM03xe, EM13qm, EM13oi
- K5ZSJ/R – EM13ne, EM13ei, EM13na, EM3qm, EM13oi, EM13qe
- AA5AM – EM13sg
- N5BRG/R – EM13il
- K5LLL – EM10kf
- K5VH – EM00xe
- K5SOP/R – EM22fm
- K5AND – EM00xh
- K8ZR/R – EM24tq, EM24qq, EM14kj, EM13jg, EM12gj, EM01wv, EM01vf
- K5TRA – EM0bf
- WQ5S/R EM13ef, EM03xe, EM13if
- 52 QSOs on 10 GHz, 17 unique call signs, a great showing from the NTMS and RMG area.

North Texas NTMS Microwave Society

9/17 WA5YWC Bob

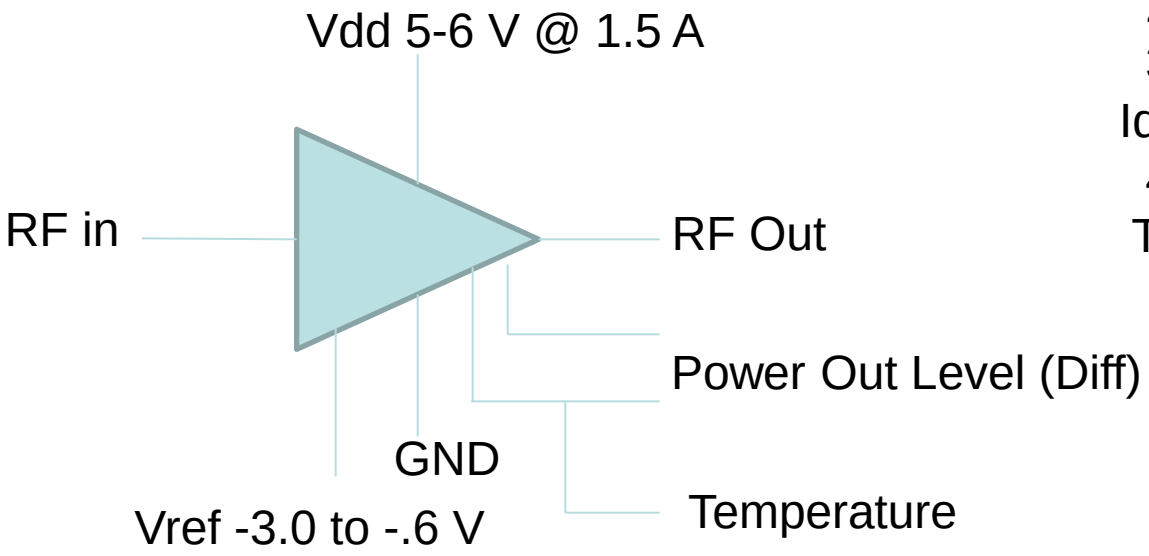


W5HN

10/17 N5BRG Bob
10 GHz Power Amp

North Texas NTMS Microwave Society

Analog Devices
HMC952A



Power Sequence Critical
Turn On:
1. Vreg -3 V
2. Vdd +5V
3. Vreg adj for Idd 1.2 A
4. RF on

Turn Off
Reverse

November 17 Gathering
Testing - Show and Tell - Build

North Texas NTMS Microwave Society

November 17 Gathering Testing - Show and Tell - Build

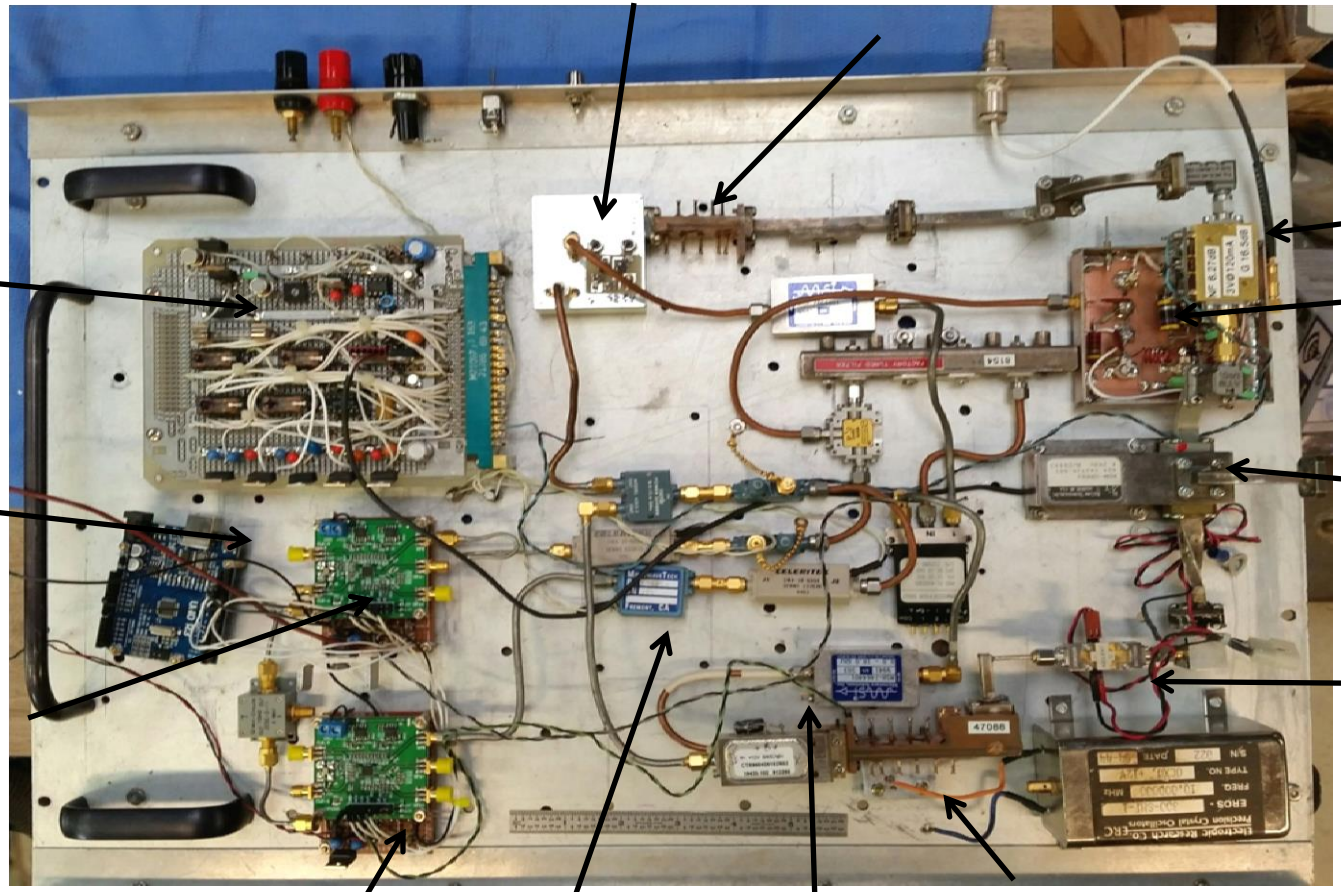
North Texas NTMS Microwave Society

November 17 Gathering
Testing - Show and Tell - Build

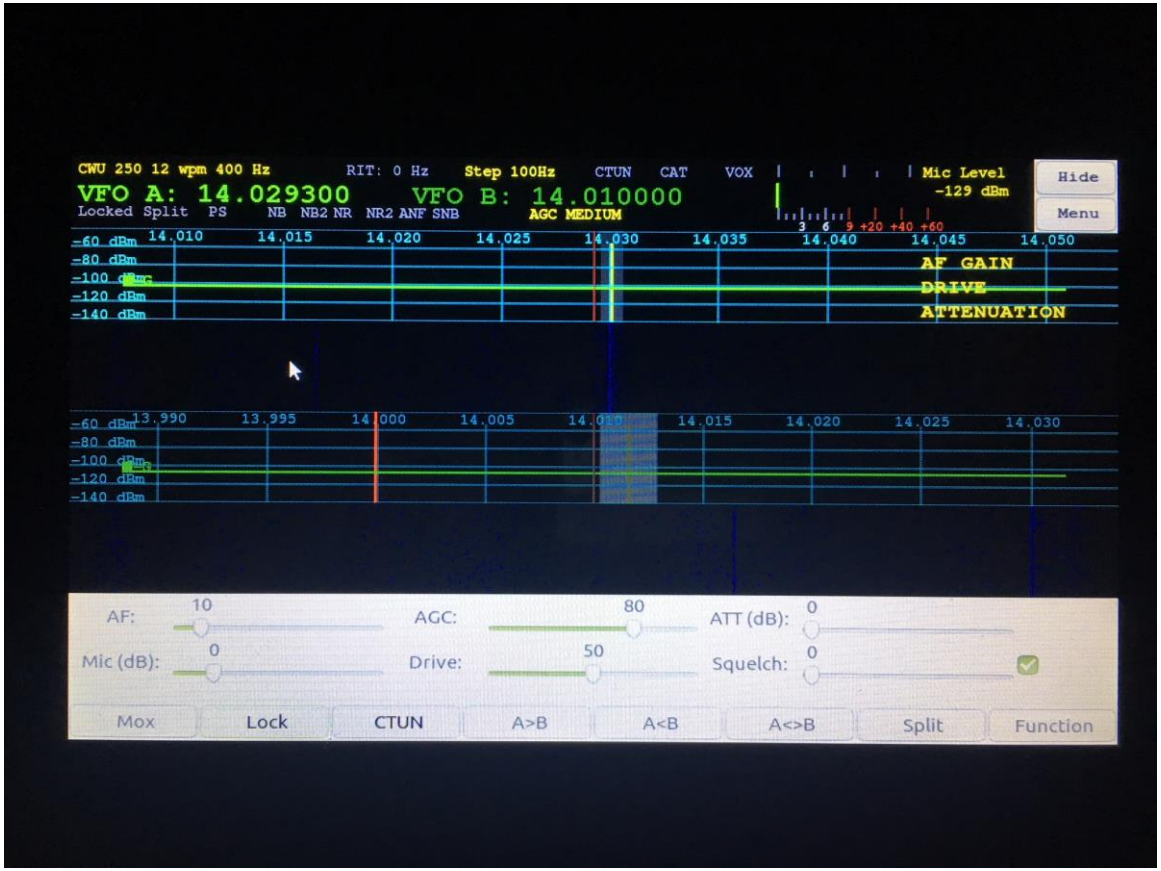
North Texas NTMS Microwave Society

12/17 AA5C Greg
47 GHz "Cookie Sheet"

North Texas NTMS Microwave Society



North Texas NTMS Microwave Society



PiHPSDR

Program runs on Ubuntu and other Raspberry Pi operating systems. Connects to a Software Defined Radio - HPSDR – Hermes – Many Others

Credit John Melton G0ORX/N6LYT

Getting the RF into your Pi

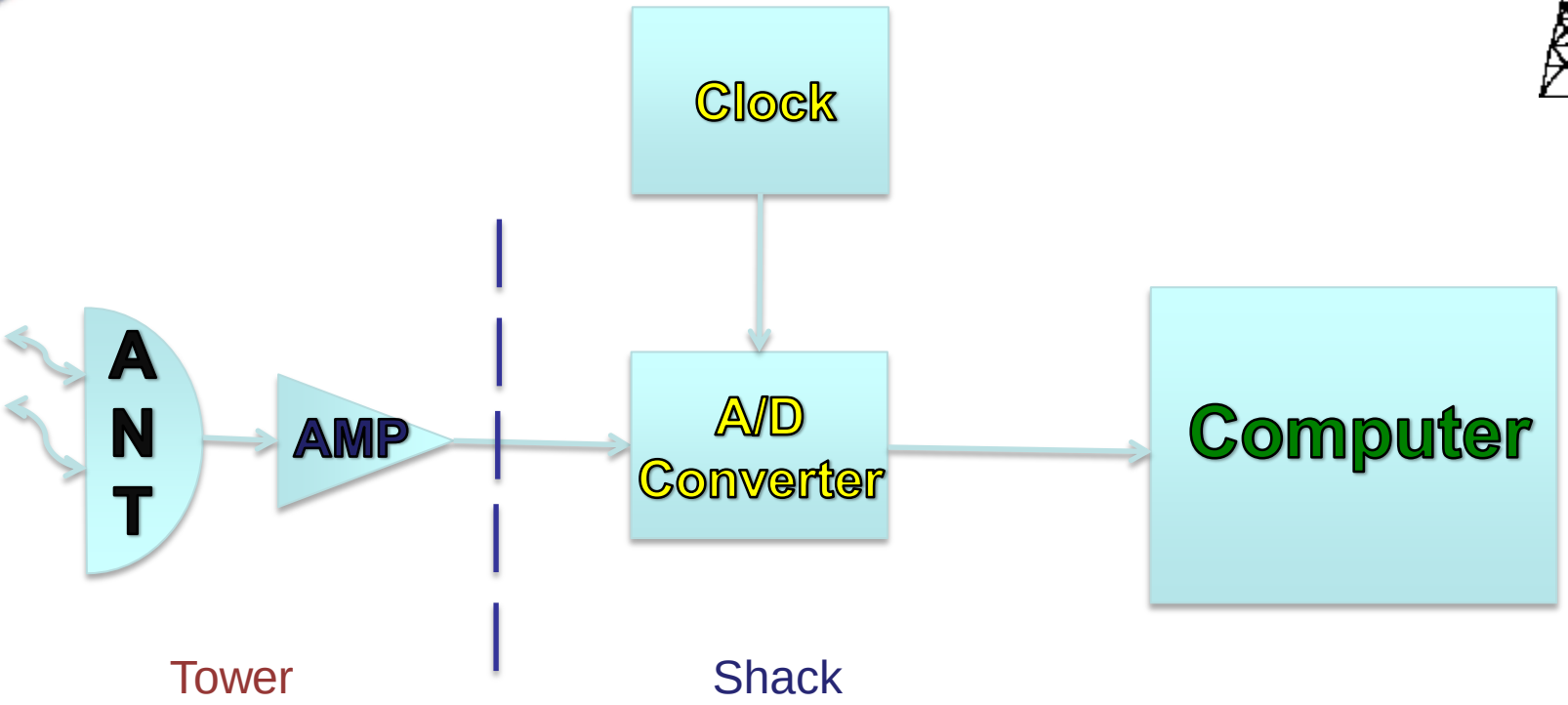
SMA Connector

USB Connector

Dongle Example

Note: SMA connector with a Bias Tee option for preamp power.

North Texas NTMS Microwave Society



Most Basic Software Defined Radio - SDR

Using Raspberry Pi + RTL To View RF Spectrum

North Texas NTMS Microwave Society

- After installing necessary programs to run rtl_power_fftw the following command line will give you a spectrum view of the band selected:

```
rtl_power_fftw -f 900M:950M -n 10 -b 512 -c -q |   sed -u '/rtl-power-fftw/s/.*/
plot "-"/;/^$/{N;s/^\n$/e/}' |   gnuplot
```

- The frequency range here is 900 MHz to 950 MHz.
- The output of rtl_power_fftw is piped to sed and then piped to gnuplot for display.

Logging Spectrum Activity

North Texas NTMS Microwave Society

- Rtl_power can be used to log RF power in a defined band of spectrum to a comma delimited file. The resulting file can be studied later of viewed as a JPG or PS file by processing the data with a program called heatmap.py. Use the Ubuntu Mate Graphics Application ‘Eye of MATE Image Viewer’.
- Be careful about filling up your system memory with large data files. Save data to an externally mounted thumb drive to be safe.

Examples of commands needed:

North Texas NTMS Microwave Society

```
rtl_power -f 900M:930M:100k /media/users_name_here/UBUNTU_1/900mhz_$mytime.csv -i 1
```

Stop data collection with CTRL C then process file with:

heatmap.py 900mhz_time.csv 900mhz_time.jpg

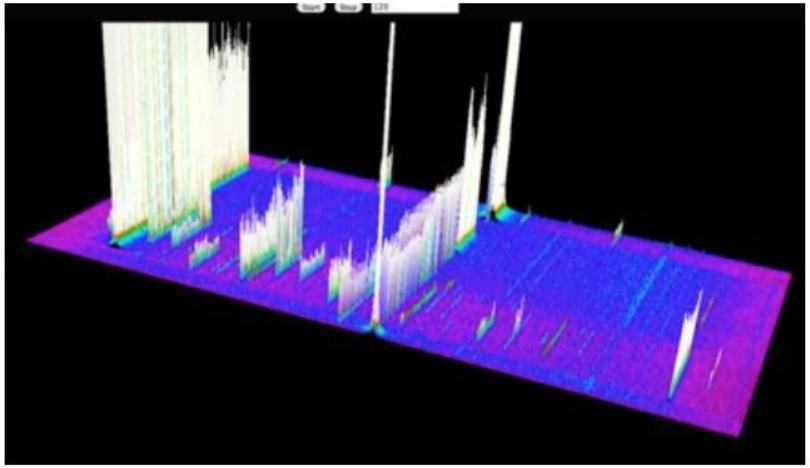
Then use the Application ‘Eye of MATE…’ to view the waterfall type image.

North Texas NTMS Microwave Society

Using RTL to log RF

Example of logging

Threejs-Spectrum (Chrome) (Free) (Related Post)



Chrome 3D Frequency Spectrum for RTL-SDR

To log to a CSV file:
Rtl_power –f 904M:908M:100K /log/filename.csv -I 1

North Texas NTMS Microwave Society

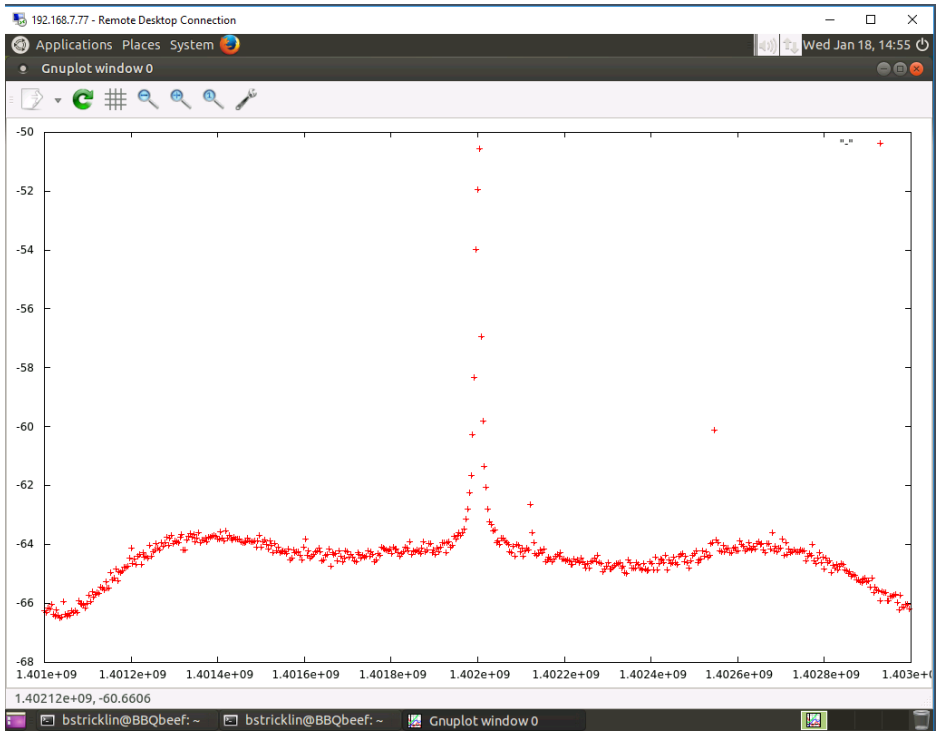
RTL-SDR + Pi

W5HN

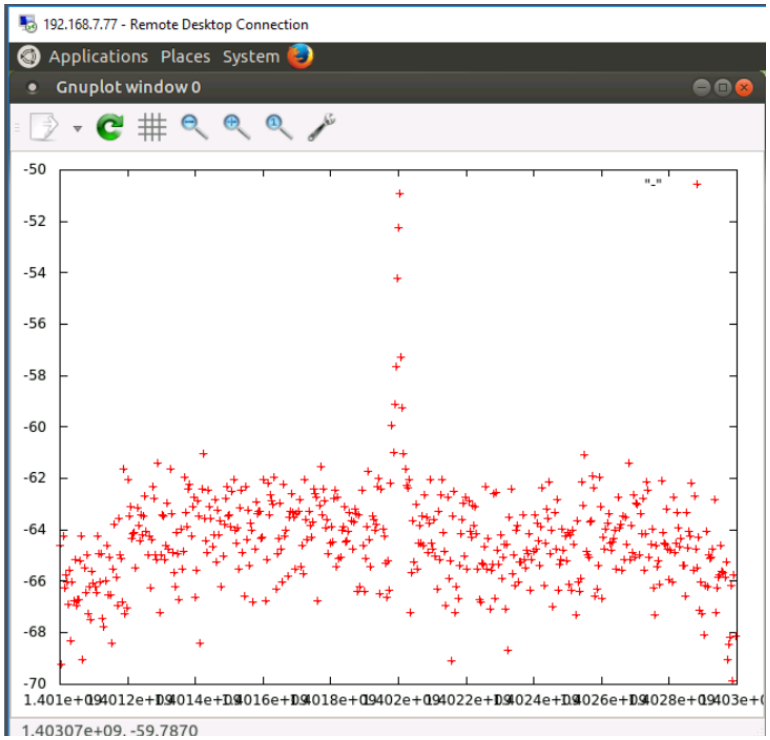
Spectrum 1.401 GHz to 1.403 GHz

North Texas NTMS Microwave Society

N=100

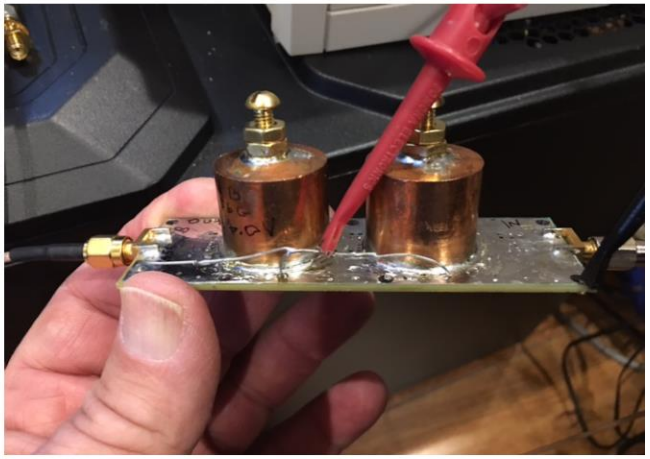


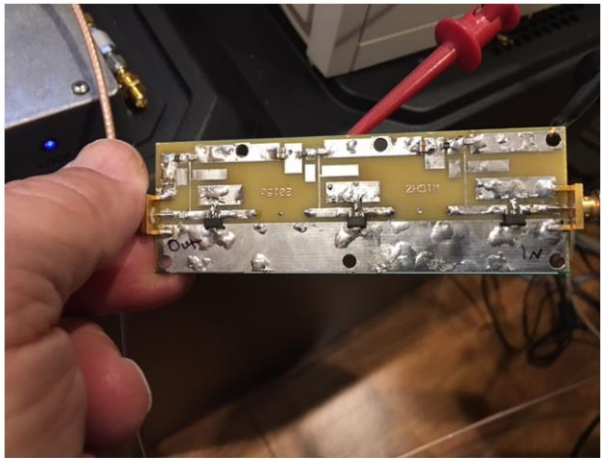
N=10

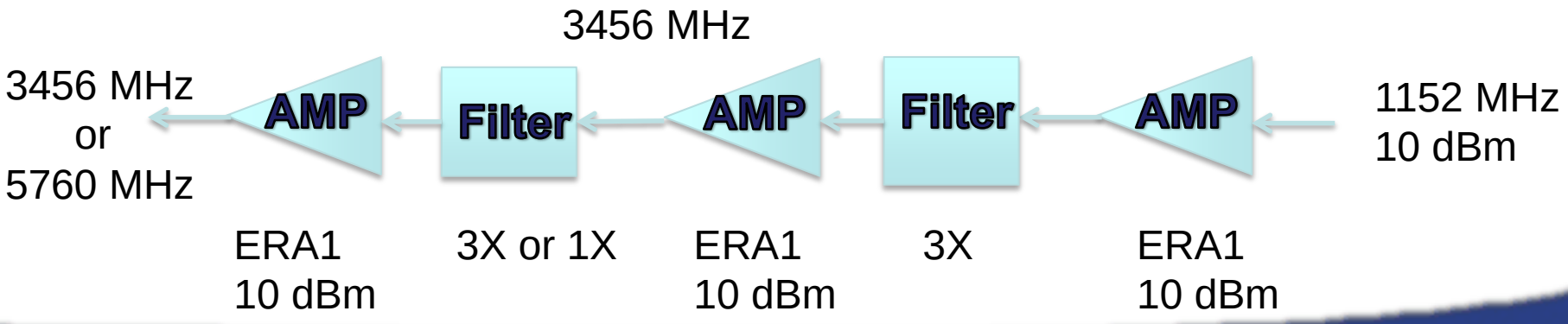


North Texas NTMS Microwave Society

W1GHZ Personal Beacon

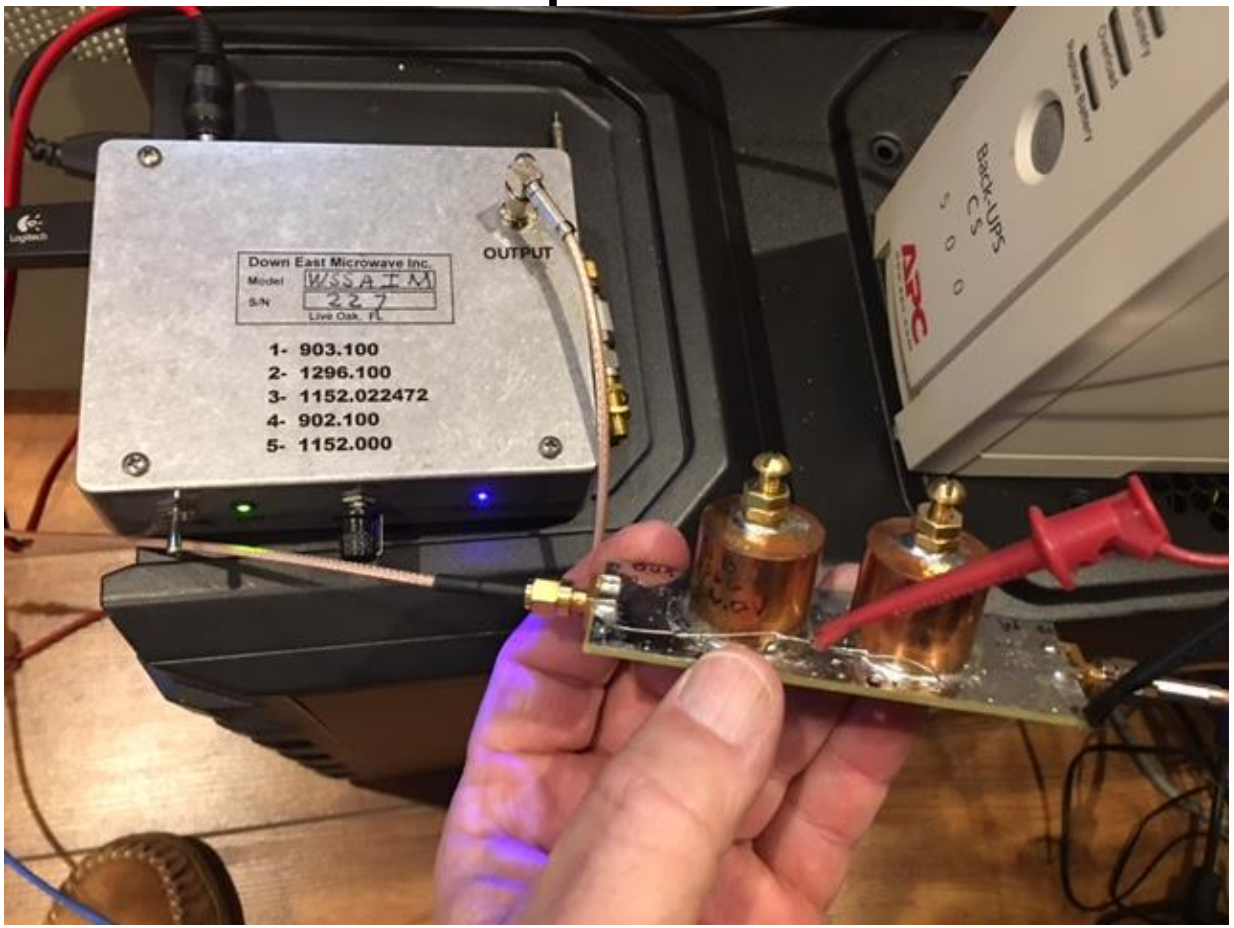






Down East Microwave Frequency Reference - Steve Hicks N5AC ApolLo

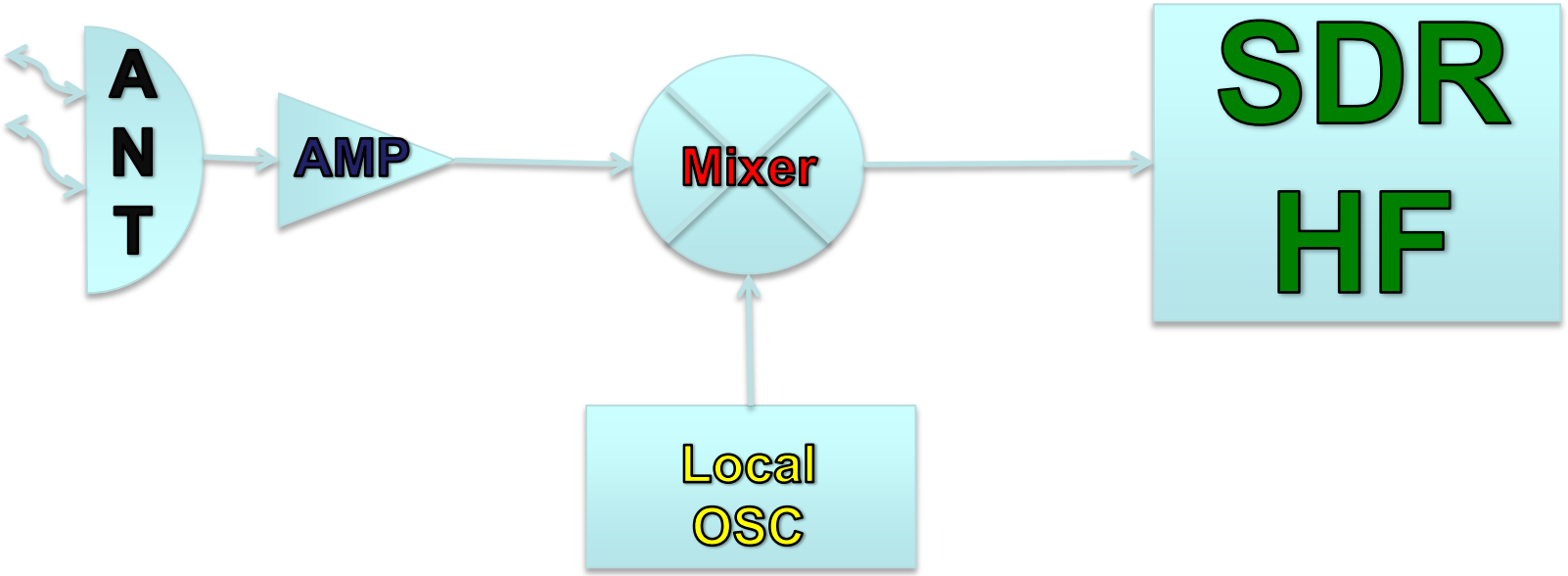
North Texas NTMS Microwave Society



http://01895fa.netsolhost.com/PDF/Manuals/VHFApolLO_Operation.PDF

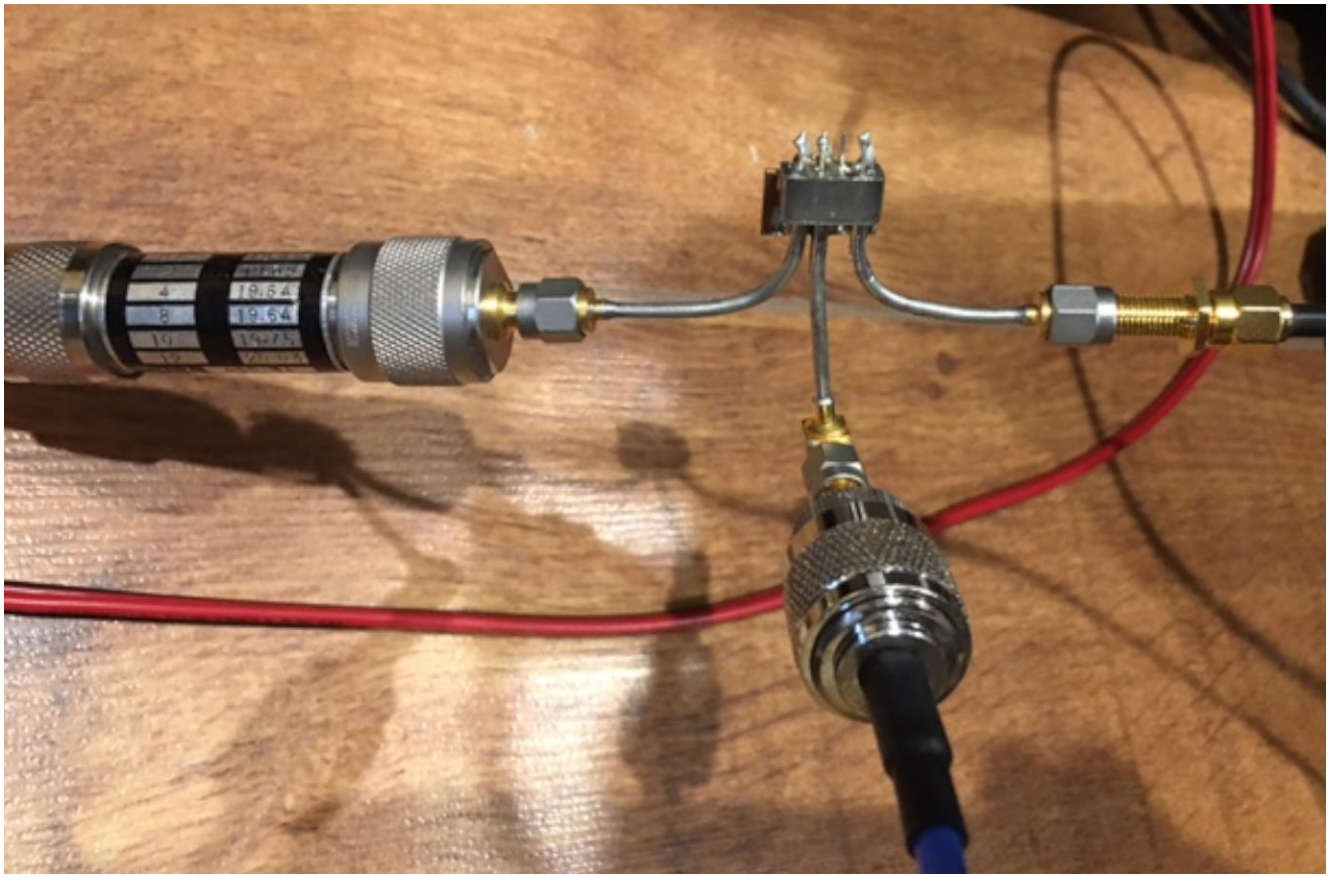
Microwave Radio Receiver

North Texas NTMS Microwave Society



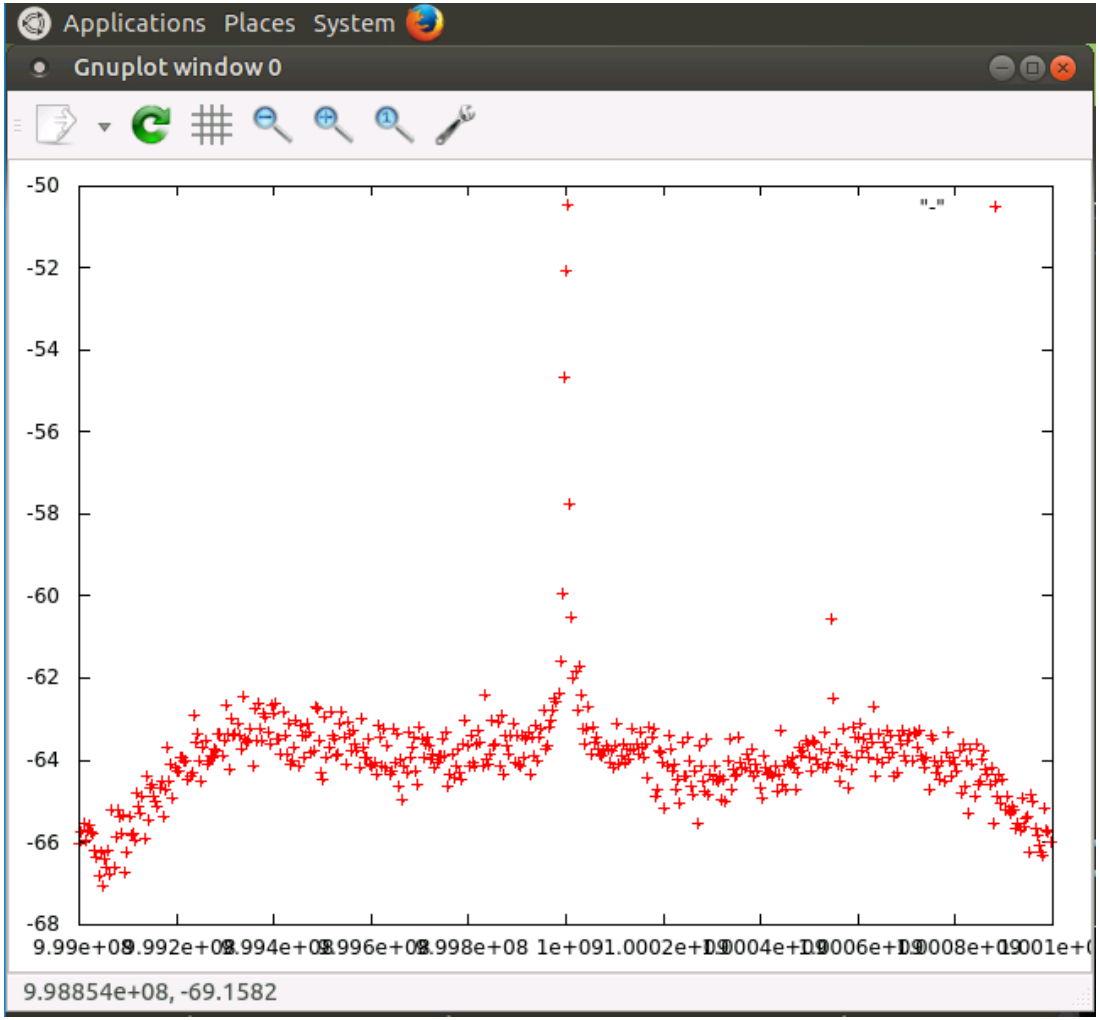
Mixer LO + RF = IF - 20 dBm

North Texas NTMS Microwave Society



Using Mixer and 3456 Beacon
LO = 2456 → IF = 1000 MHz

North Texas NTMS Microwave Society



10.368 GHz Personal Beacon

North Texas NTMS Microwave Society

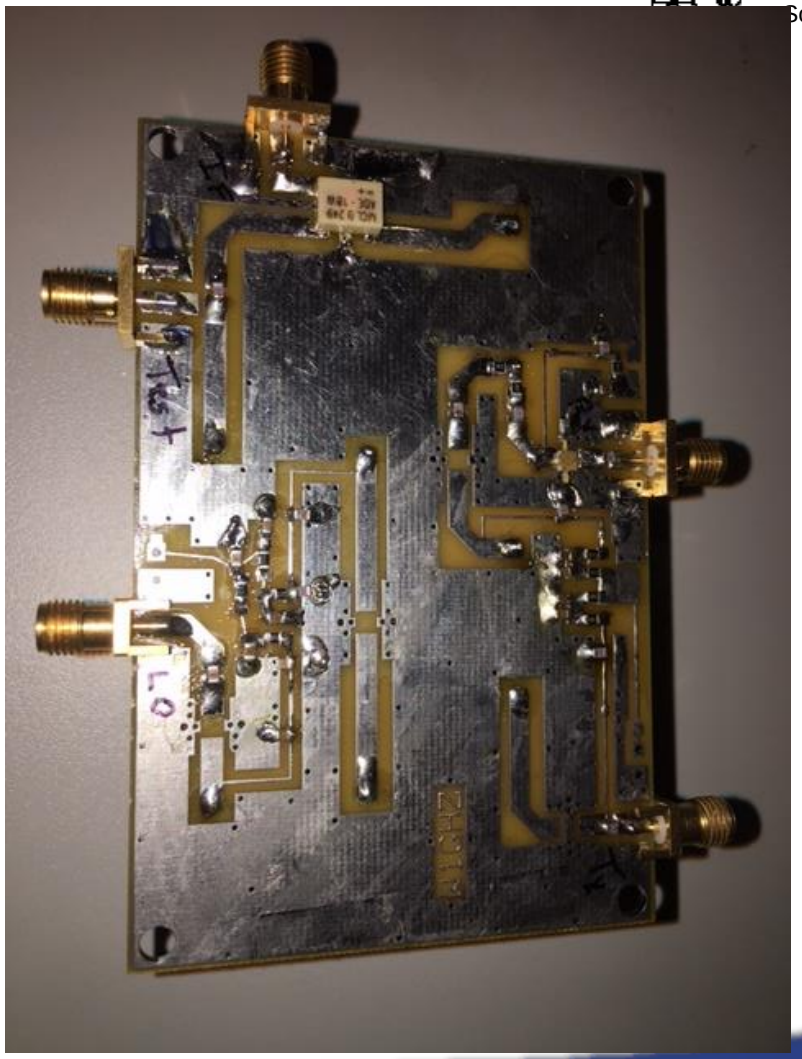
K5SOP Jerry found this LO ebay:**PLL 23cm SHF band LO transverter beacon**

North Texas NTMS Microwave Society

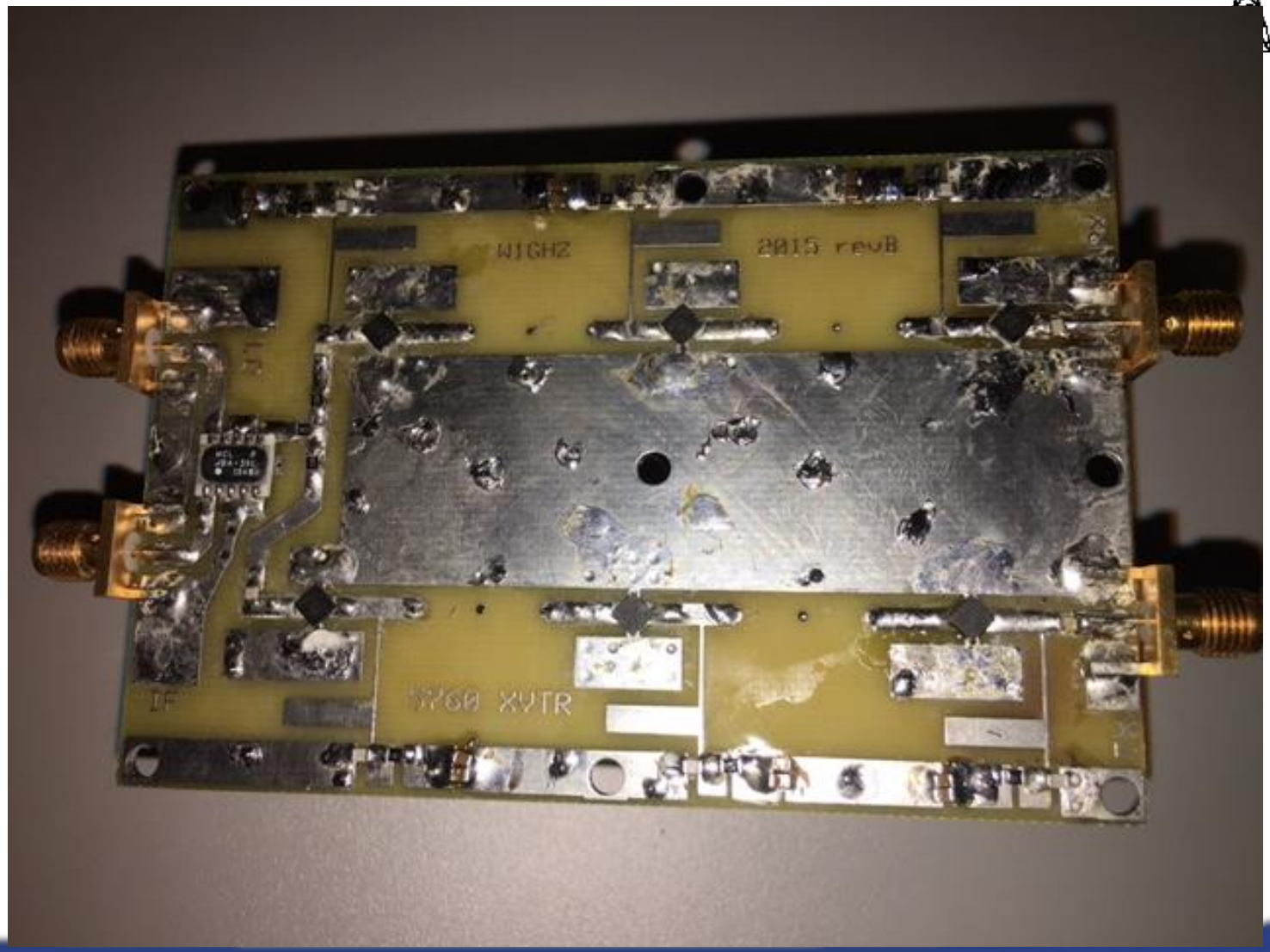
$59 on ebay

North Texas NTMS Microwave Society

Transverter Example



5760 Transverter



W5HN

Paul Wade W1GHZ PCBs

North Texas NTMS Microwave Society

_____ Simple, yet "Fool-Resistant" Sequencer, RevisionB $5

_____ Simple Low-cost 5760 MHz Transverter for Rover $11

_____ MBA-591 Mixer for 5760 Transvert $10

_____ LO or Personal Beacon for 5760 or 3456 MHz $6

_____ VCXO lock for Microwave LO - flexible version $6
with prescaler good to 1.1 GHz
_____ 80 MHz version for Multiband Transverter $3

_____ Flexible VCXO Lock (GPS or other reference) $6
Low frequency version (<30 MHz)

_____ Modest Power Amplifier (GVA-84) $3.00
two for $5
_____ ADL5324 Power Amplifier and PGA-103 preamp $3.50
three for $10

_____ Panadapter for FT-817 and Funcube Dongle $3.50

_____ Miniverter-F tiny 144M transverter for Flex-1500 $6
see kits below
_____ ADE-2 for VHF and UHF $5

_____ Personal Beacon for 10 GHz $6

Multiband Microwave Transverter for the Rover:
see http://www.w1ghz.org/new/Multiband_Rover_Transverter.pdf

_____ Local Oscillator Board 720 or 756 MHz $12

_____ Transverter Board for 2304 or 3456 MHz $10
_____ ADE-18W mixer for 2304 and 3456 $5

_____ Transverter Board for 1296 (right side up only) $10
_____ uses Power Splitter (Minicircuits TCP-2-25x) $3
_____ ADE-5 mixer for 1296 or 902 $5

_____ Local Oscillator Board 1152 MHz $12

_____ Transverter Board for 902 $10

_____ LO Board + one transverter board (choice) $20

_____ LO Board + two transverter boards $29

_____ LO Board + three transverter boards $37

_____ Relay board (pin and surface mount) out of stock

Mixers from Minicircuits (only available with boards):

_____ ADE-18W for 2304 and 3456 $5

_____ ADE-5 for 1296 or 902 $5

_____ ADE-2 for VHF and UHF $5

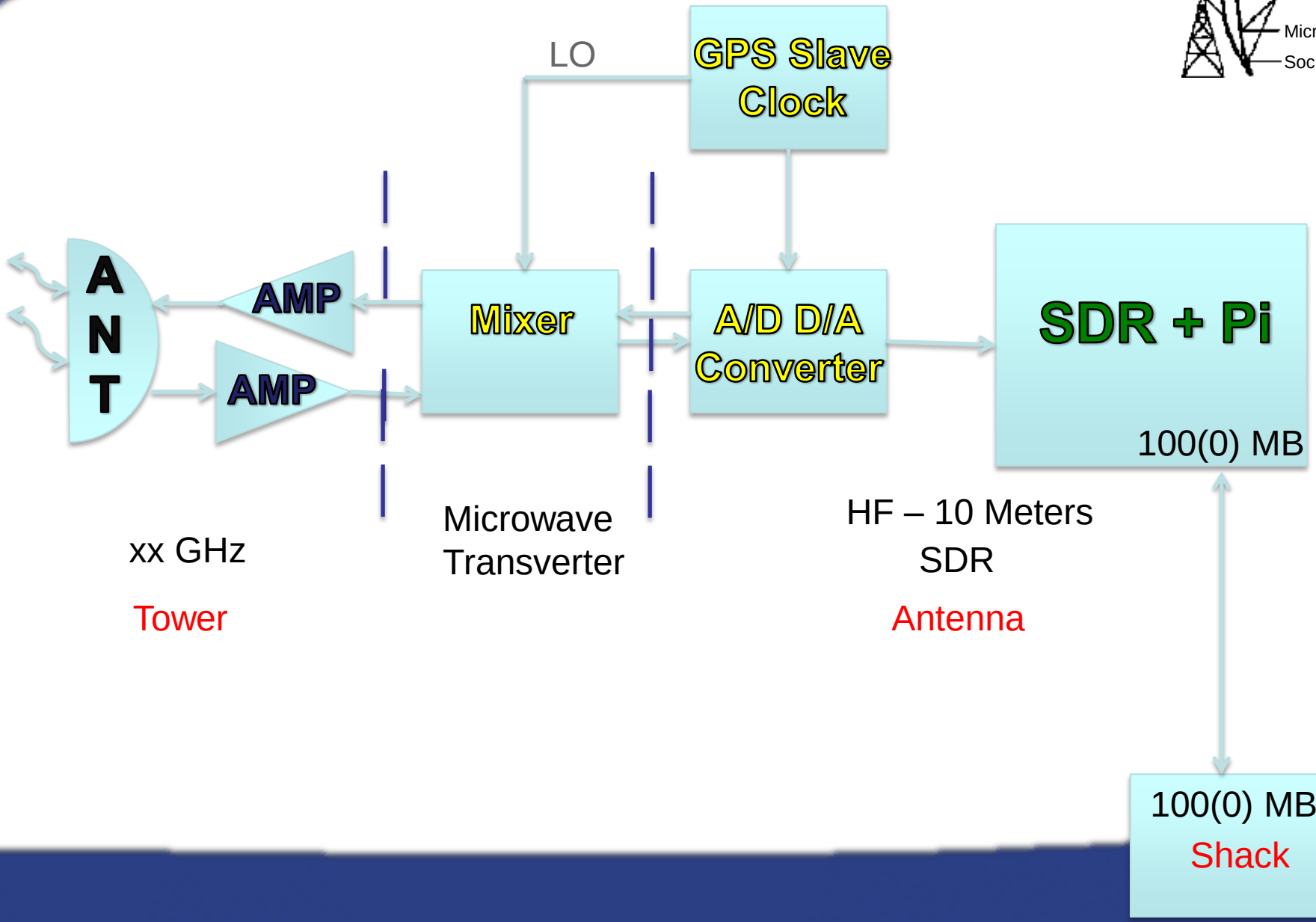
_____ MBA-591 for 5760 $10

Check w1ghz.org for availability pricing and shipping cost.

W5HN

Microwave Radio using Software Defined Radio - SDR

North Texas NTMS Microwave Society



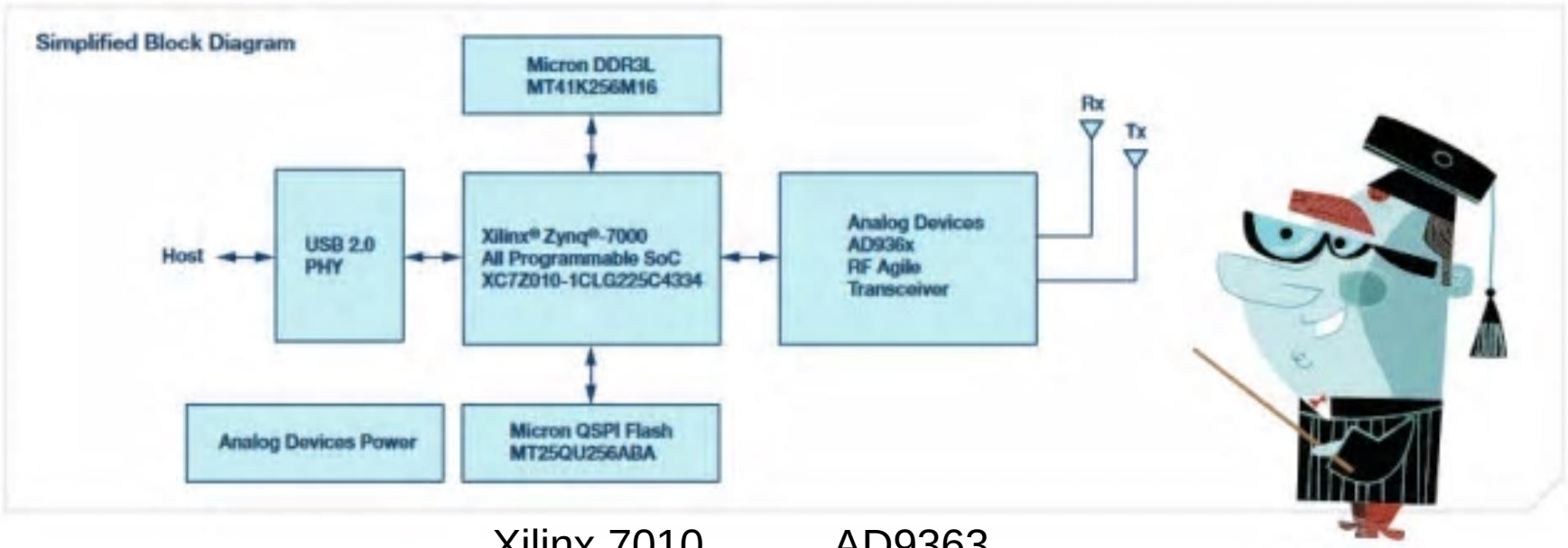
North Texas NTMS Microwave Society

$100 @ Mouser

We are shipping (Yeah!). We are sold out. (Boo, bad on us). We are in process of building more.

Analog Devices Description:

Associated Product



Xilinx 7010 AD9363

AD9363 Highly Integrated RF Agile Transceiver combines an RF front end with a flexible mixed-signal baseband section and integrated frequency synthesizers. The design provides a configurable digital interface to a processor. The AD9363 operates in the 325MHz to 3.8GHz range to cover most licensed and unlicensed bands. The transceiver supports channel bandwidths from less than 200kHz to 20MHz.

Specifications:

North Texas NTMS Microwave Society

Analog Devices ADALM-PLUTO SDR Active Learning Module

ADALM-PLUTO SDR Active Learning Module | Specifications | Associated Product

Power
- DC Input (USB): 4.5V to 5.5V

Conversion Performance and Clocks
- ADC and DAC Sample Rate: 65.2kSPS to 61.44MSPS
- ADC and DAC Resolution: 12bits
- Frequency Accuracy: ±25ppm

RF Performance
- Tuning Range: 325MHz to 3800MHz
- Tx Power Output: 7dBm
- Rx Noise Figure: <3.5dB
- Rx and Tx Modulation Accuracy (EVM): –34dB (2%)
- RF Shielding: None

Digital Specifications
- USB: 2.0 On-the-Go
- Core: Single ARM Cortex®-A9 @ 667 MHz
- FPGA Logic Cells: 28k
- DSP Slices: 80
- DDR3L: 4Gb (512MB)
- QSPI Flash: 256Mb (32MB)

Physical Specifications
- Dimensions: 117mm×79mm×24mm or 4.62"×3.11"×0.95"
- Weight: 114g
- Temperature: 10°C to 40°C

AD9363

Analog Devices AD9866 Mixed-Signal Front End (MxFE®)

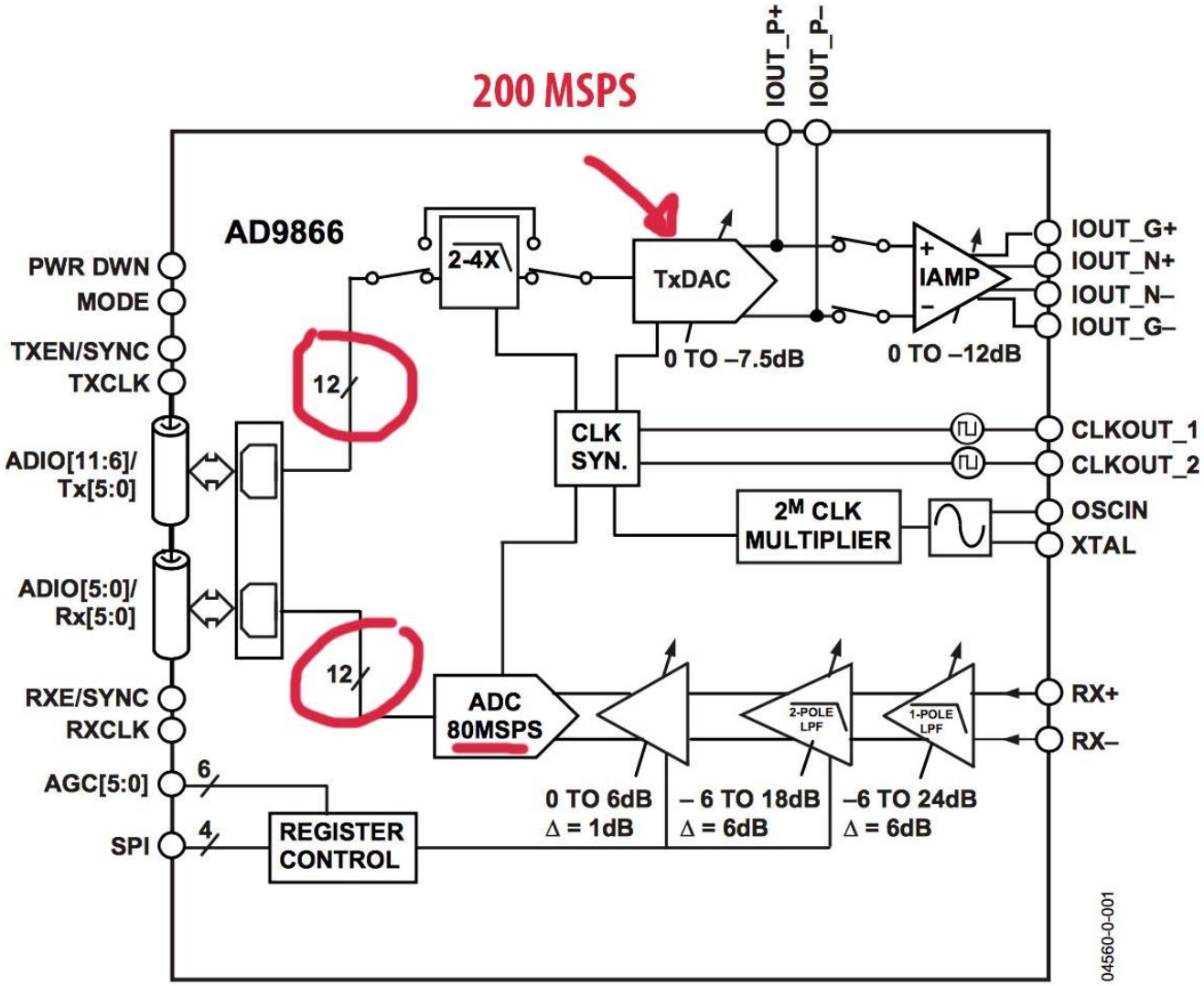


Figure 1.

North Texas NTMS Microwave Society

Links for more info:

- http://kmkeen.com/rtl-power/
- http://www.rtl-sdr.com/tag/rtl_power/
- http://www.rtl-sdr.com/tag/r820t2/
- http://sdr.osmocom.org/trac/wiki/rtl-sdr
- http://www.hermeslite.com
- http://www.rtl-sdr.com/big-list-rtl-sdr-supported-software/
- https://sites.google.com/site/g4zfqradio/installing-and-using-hdsdr

Microwave Information Resources

North Texas NTMS Microwave Society

- NTMS.org ARRL.org W1GHZ.org
- Dubus Magazine
- UK Microwave Group
- Ham-Radio.com/SBMG SLAM