My Journey into Software Defined Radio
&
The next generation of broadband RF interface.

By: Mathison Ott KJ6DZB
Email: mathisonsphone@gmail.com

(DX)
SV2DWQ

Operator
(W/ a Radio)

RF

(QSO‘s)

User /
Operatior

RF Sampling / Exciting

Control Wiget
(GNU Radio Embeded
ARM Controler)

QT GUI
(GHPSDR3, SDR Shell,)

GNU Radio Server
(Running on a Computer)

INTERNETS

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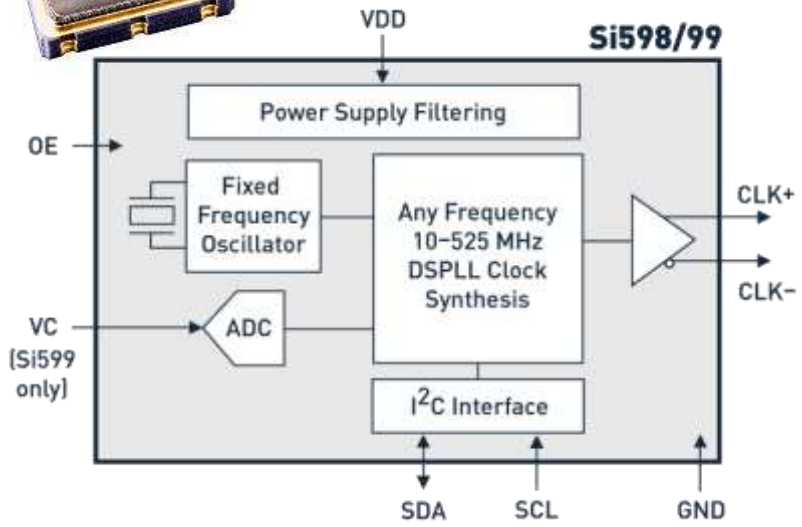
(GHPSDR3, SDR Shell,)

INTERNETS

GNU Radio Server
(Running on a Computer)

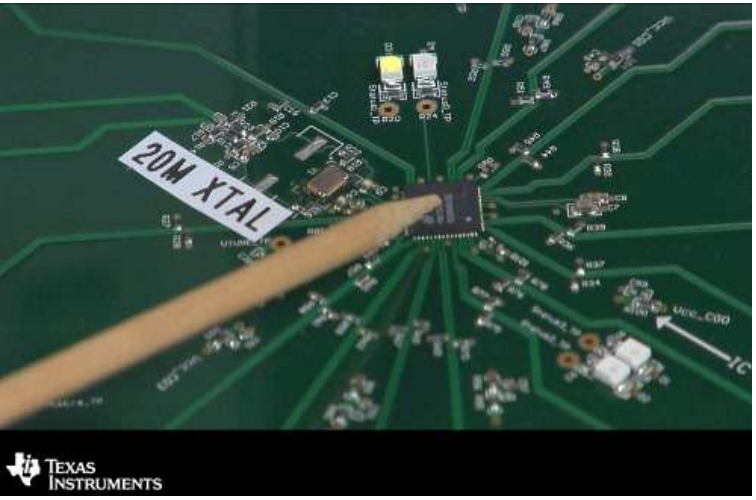
Fixed Cristaled radios...Not any more.



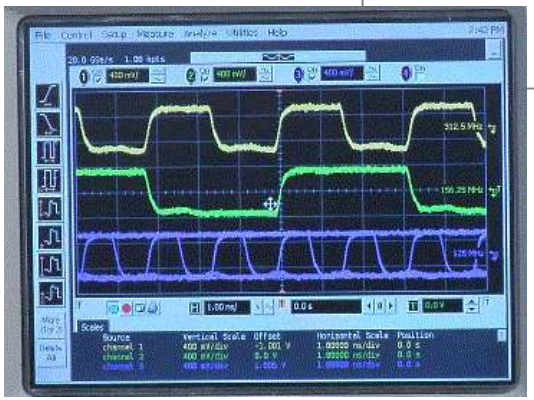
Terms:
-XTAL: Crystal Oscillator
-LO: Local Oscillator
-VCO: Variable Control Oscillator
-VCXO: Voltege Controled Crystal Osillator
-PLO: Phase Locked Oscillator

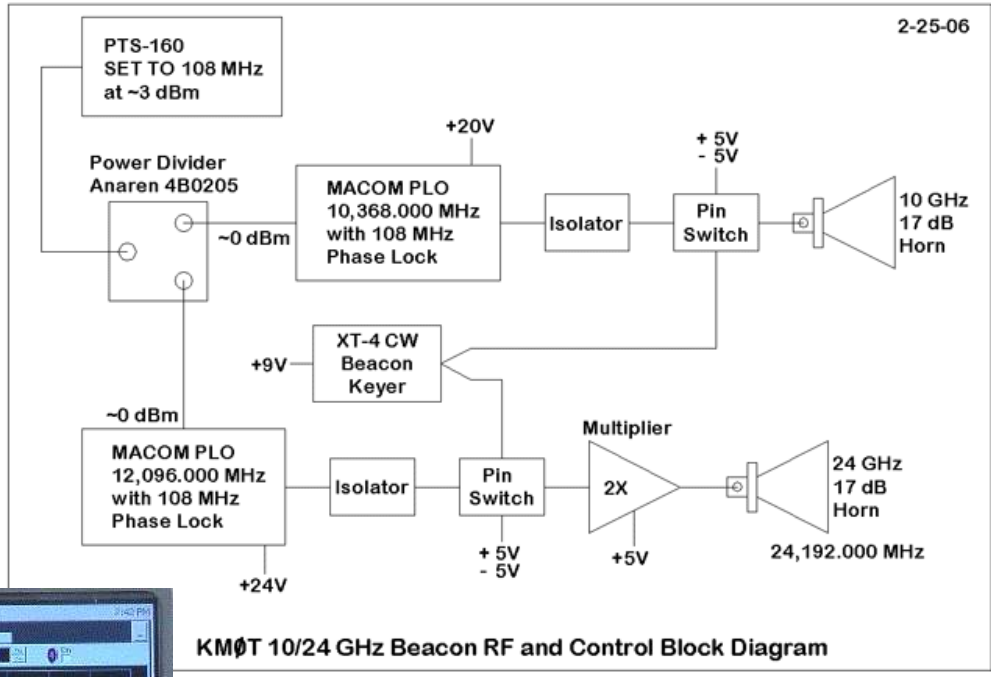
-Models w/ up to 4 programmable clock outputs
100 kHz to 1.4 GHz

LMK03806



-8 programmable clock outputs
up to 12 kHz - 2.6ghz.

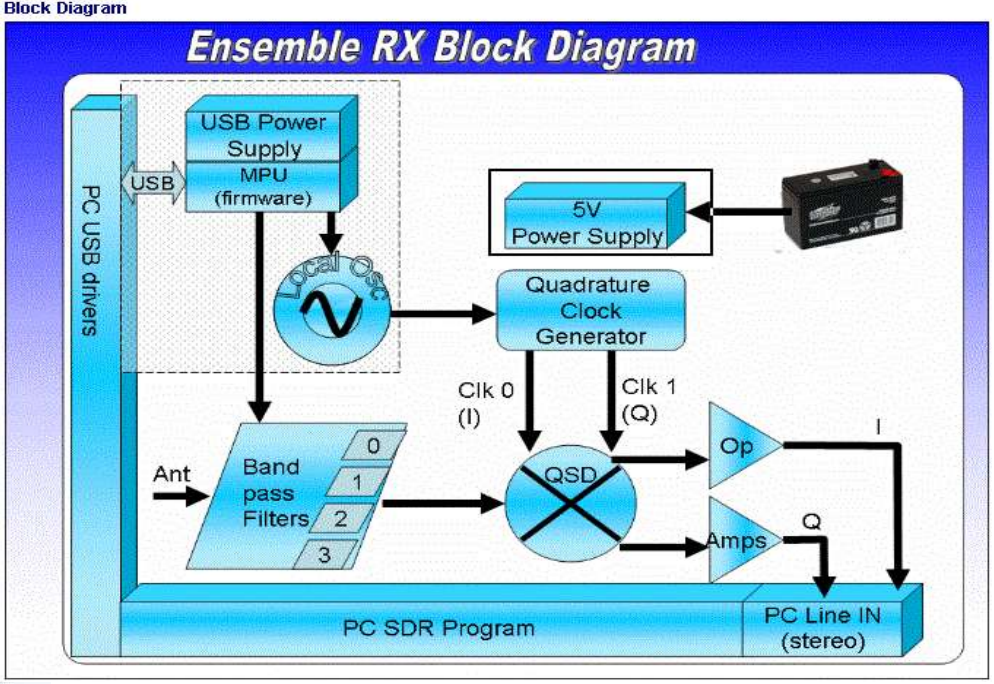




KMØT 10/24 GHz Beacon RF and Control Block Diagram

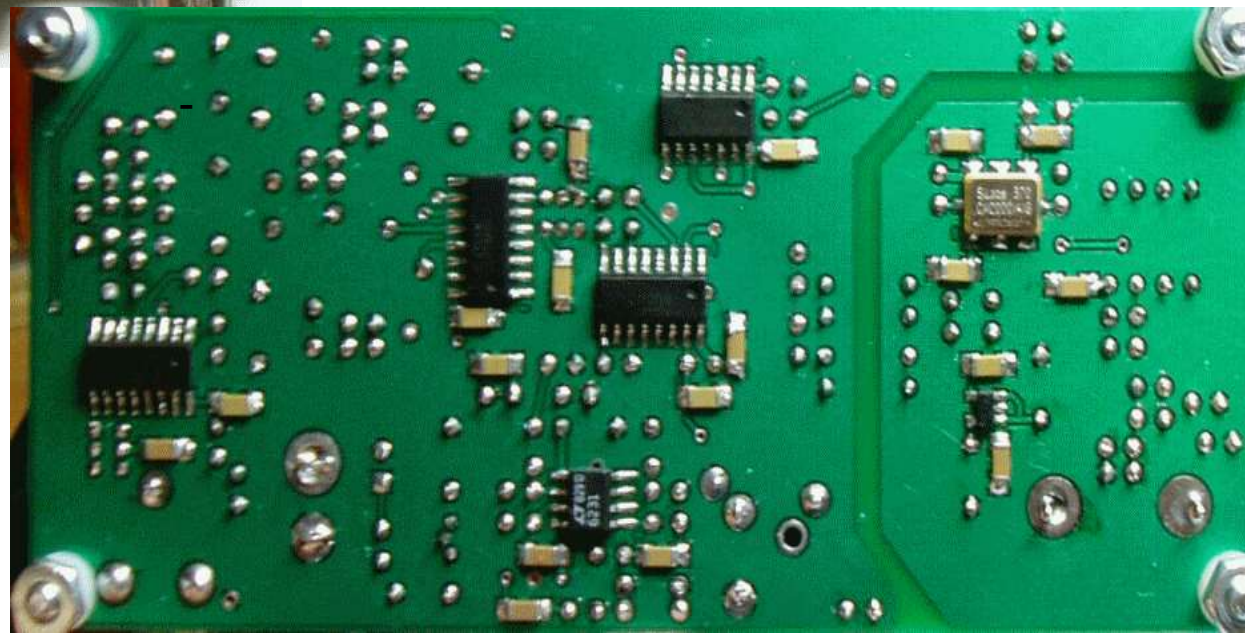
- http://www.ti.com/product/LMK03806
- http://www.silabs.com/products/clocksoscillators/xo/Pages/default.aspx

Block Diagram



SoftRock Ensemble RxTx

-1watt for 1 of the following groups.
(160m),(80m, 40m),(40m, 30m, 20m)
(30m, 20m, 17m),(15m, 12m, 10m)



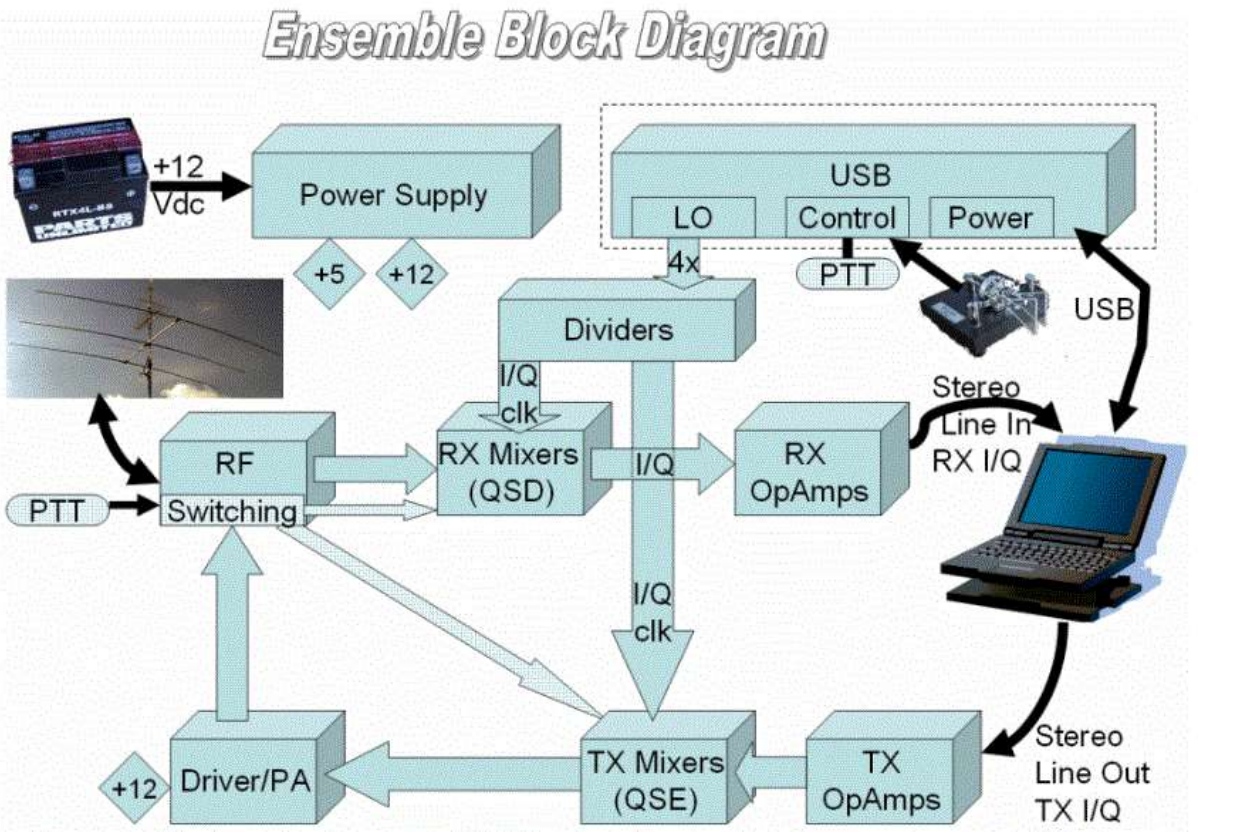
Ensemble Rx 2

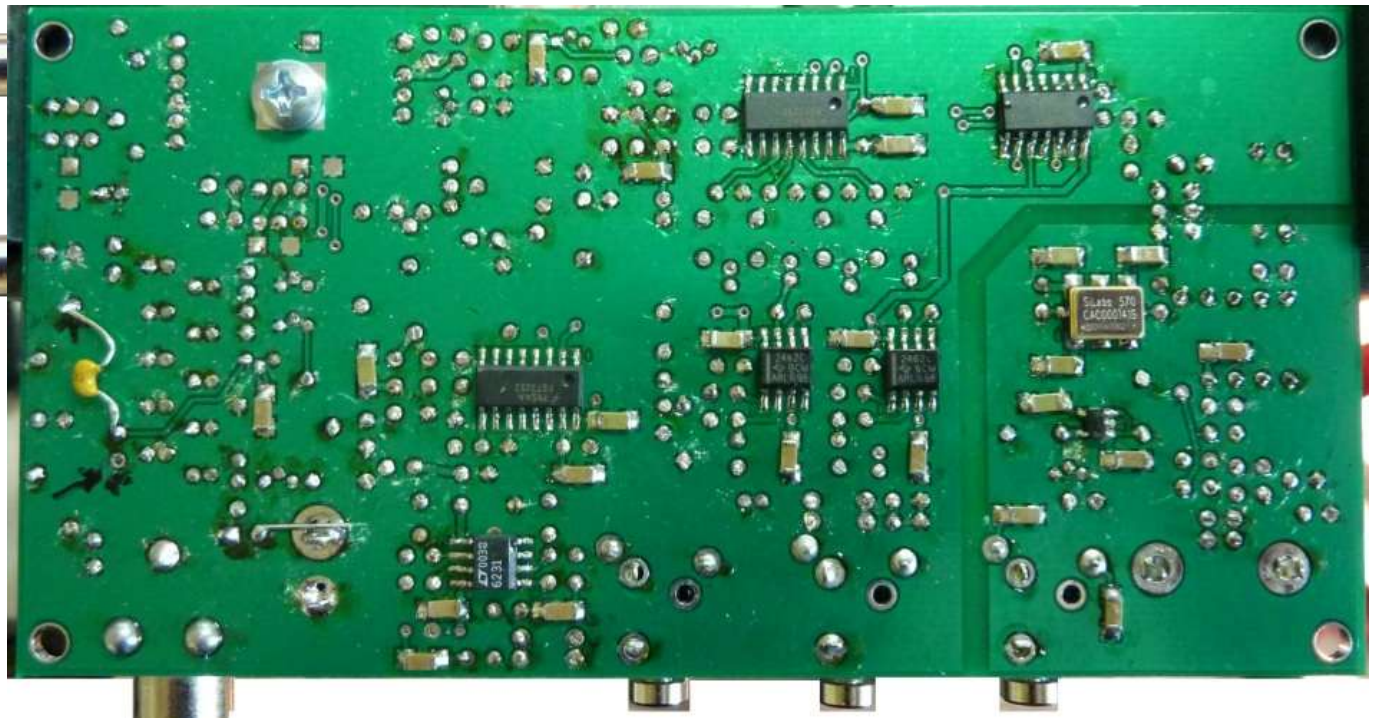
-160-10m Rx

-The Atmel ATTiny85 micro-controller acts as USB device to control the Si570, and switch the "superbands“ (0-3) as the frequency changes.

- http://wb5rvz.com/sdr/

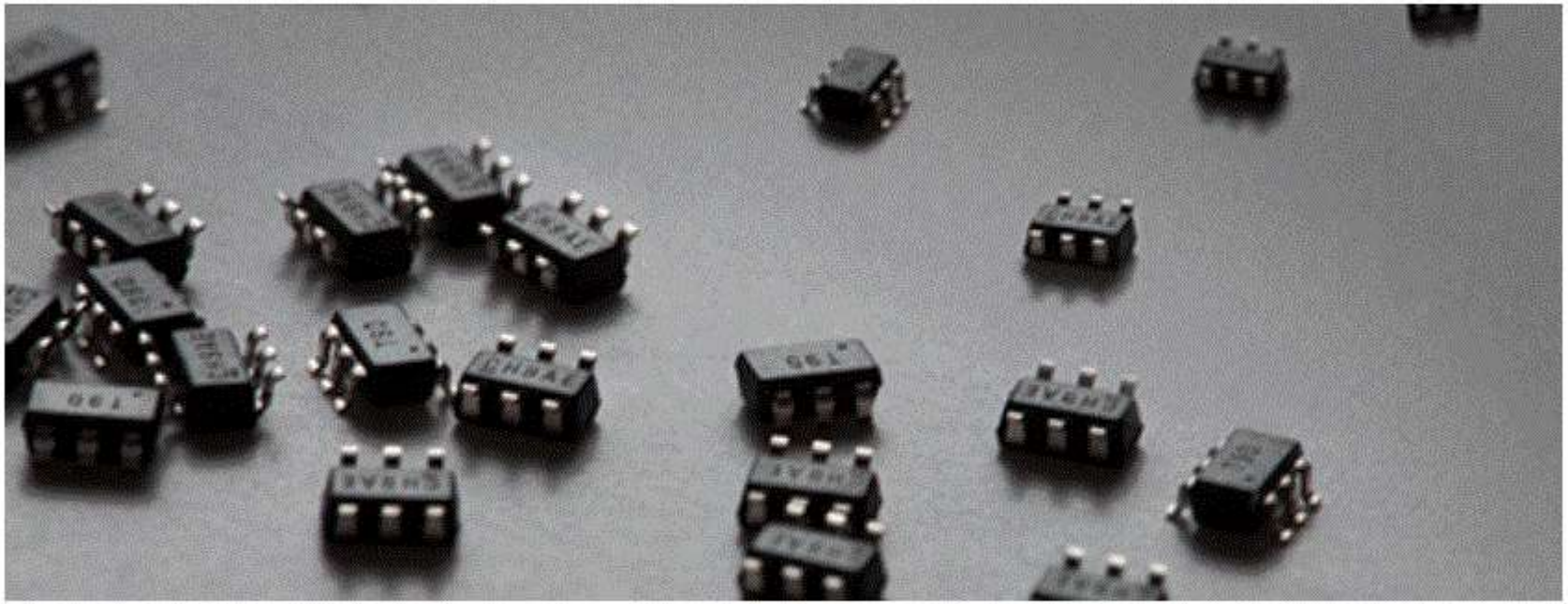
RXTX Ensemble - KB9YIG.com


Ensemble Block Diagram
+12 Vdc
Power Supply
+5
+12
USB
LO
Control
Power
4x
PTT
USB
Dividers
I/Q clk
Stereo Line In RX I/Q
RF Switching
PTT
RX Mixers (QSD)
I/Q
RX OpAmps
I/Q clk
+12
Driver/PA
TX Mixers (QSE)
TX OpAmps
Stereo Line Out TX I/Q



ATtiny85

Overview | Parameters | Tools | Documents | Applications



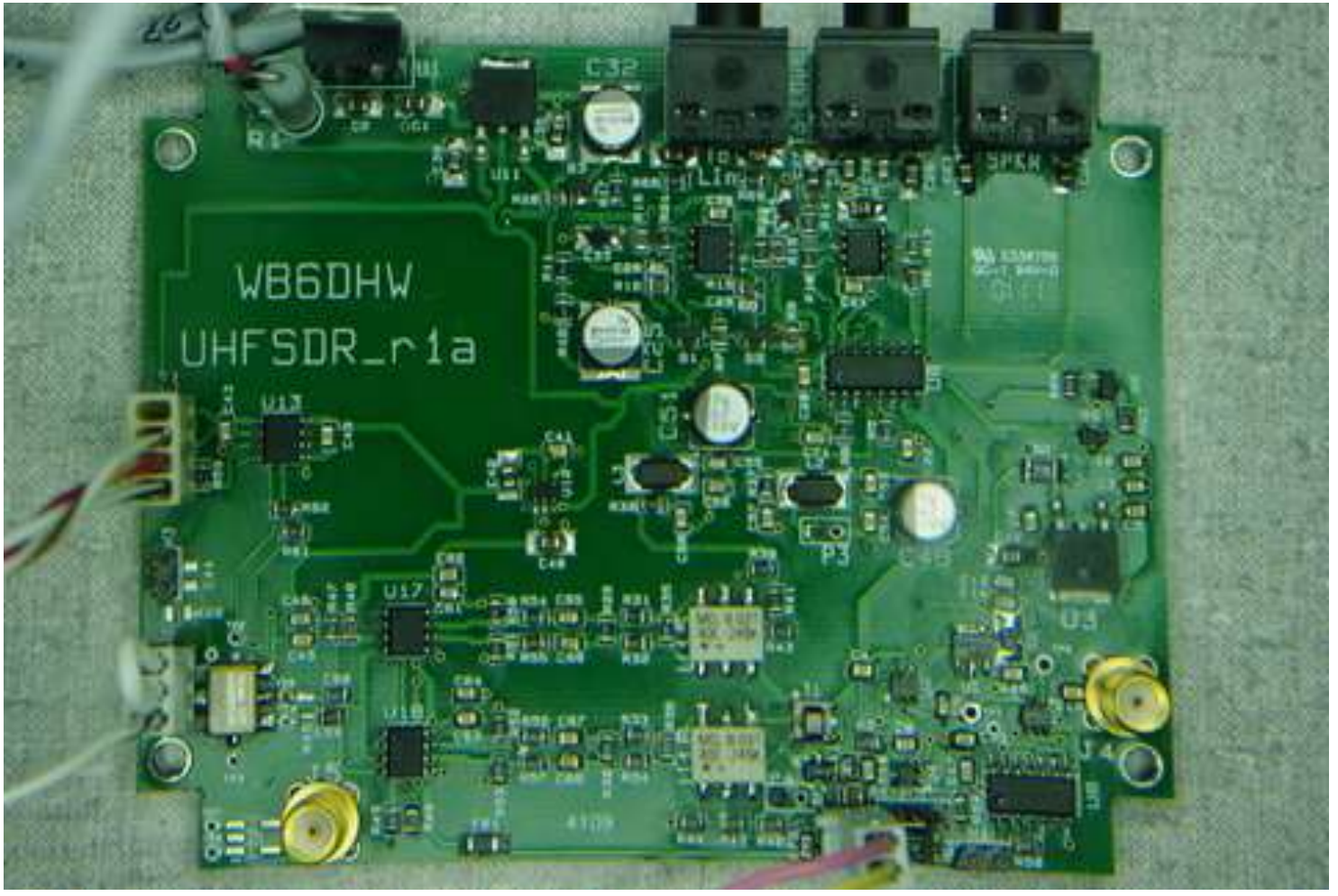
The high-performance, low-power Atmel 8-bit AVR RISC-based microcontroller combines 8KB ISP flash memory, 512B EEPROM, 512-Byte SRAM, 6 general purpose I/O lines, 32 general purpose working registers, one 8-bit timer/counter with compare modes, one 8-bit high speed timer/counter, USI, internal and external Interrupts, 4-channel 10-bit A/D converter, programmable watchdog timer with internal oscillator, three software

UHF-SDR (KIT)
David Brainerd – WB6DHW

Starts to fully utilize the Si570, 1.8 MHz to 700 MHz Transceiver, 100mW Power output.
The UHF-SDR is designed like the Softrock...But with wider coverage.

It doesn't have an Attiny / need one, but you do need a master I2c to tune the board.

- http://wb6dhw.com



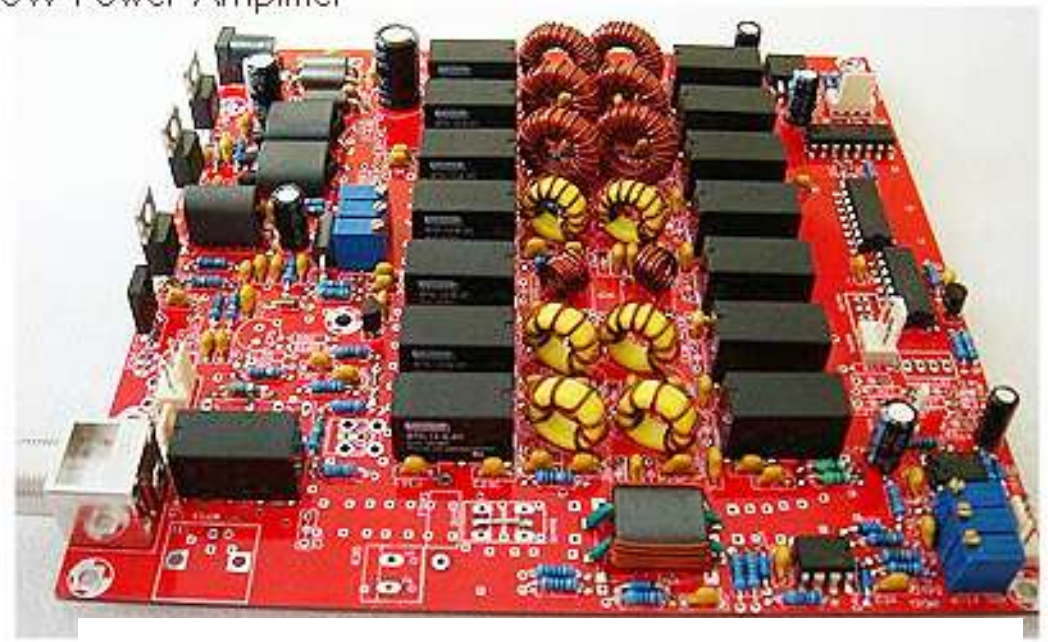
Genesis Series (KIT's)

By Tasa YU1LM/QRP

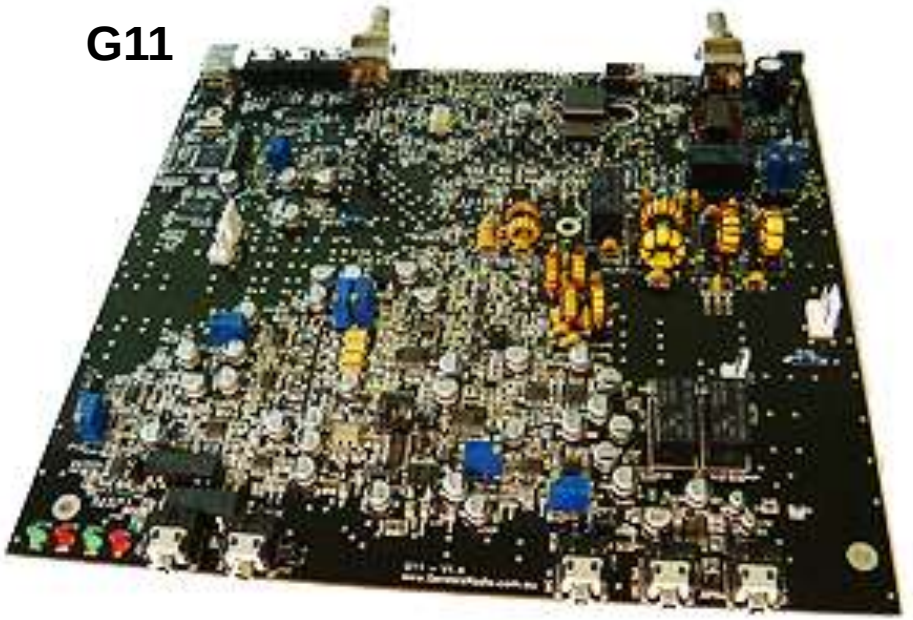
-http://www.genesisradio.com.au/

Genesis GPA10

10W Power Amplifier



G11



-10W+ SDR transceiver buildable your 5 HF bands

(DX)
SV2DWQ

Operator
(W/ a Radio)

RF

(QSO‘s)

User /
Operatior

Sound Card

RF Sampling / Exciting

Control Wiget
(GNU Radio Embeded
ARM Controler)

QT GUI
(GHPSDR3, SDR Shell,)

INTERNETS

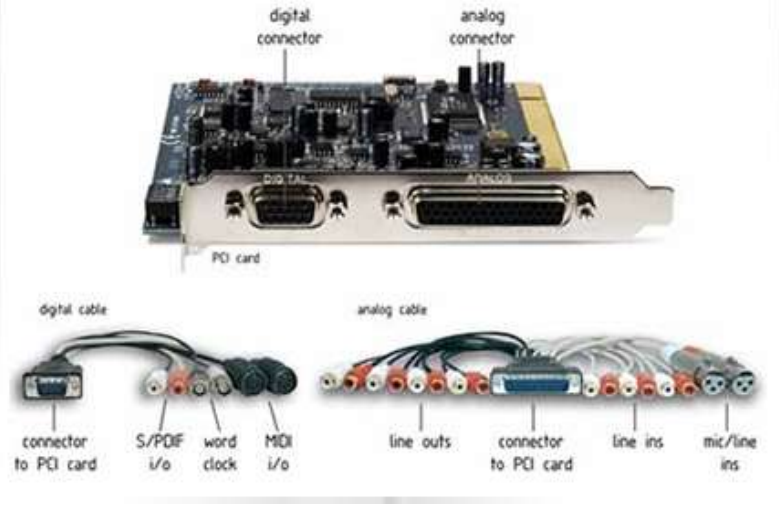
GNU Radio Server
(Running on a Computer)

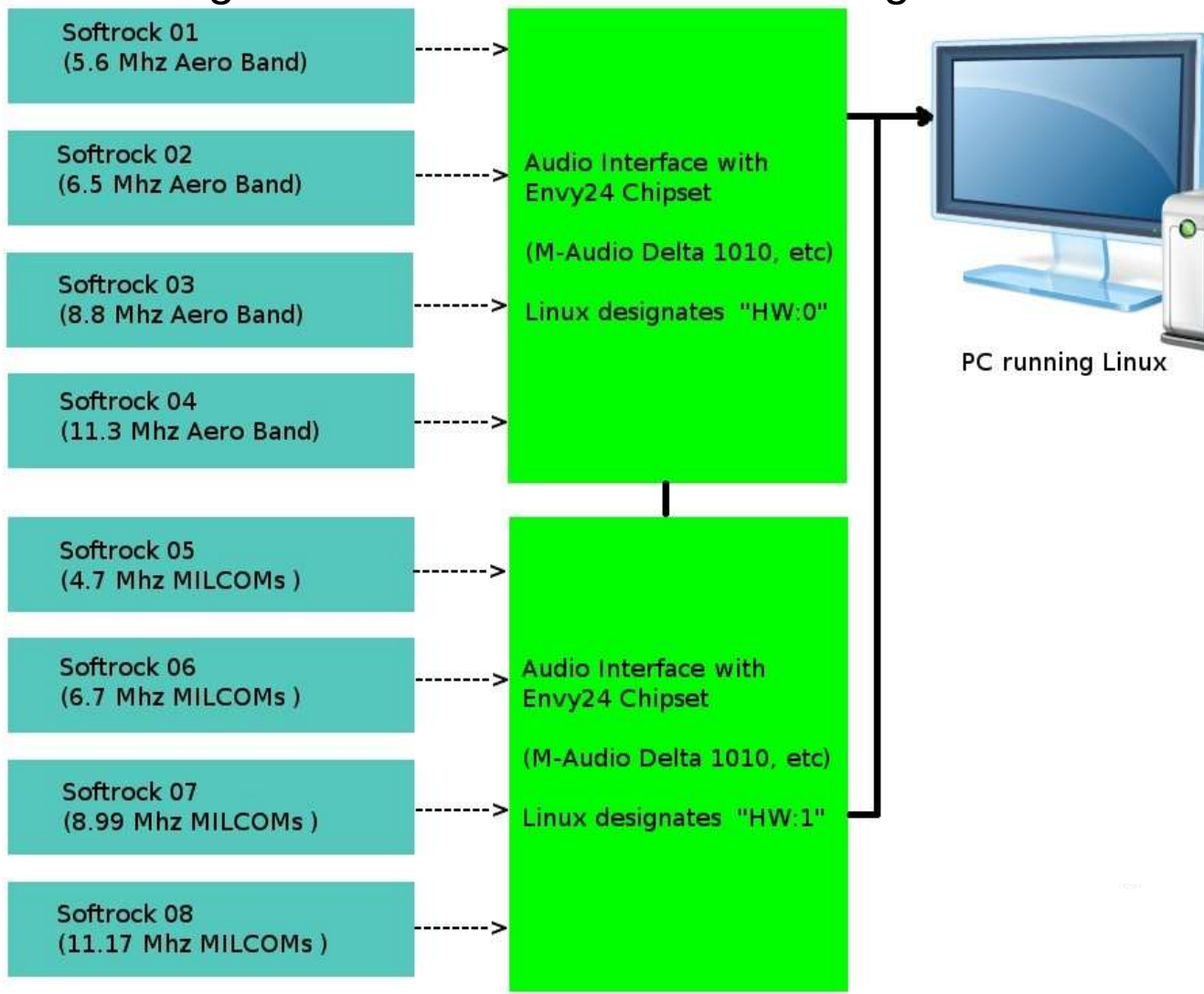
The Sound Card

-Digitaly sampling audio from 20 Hz up to 20 kHz
-Up to 192kHz bandwidth and with 24bits of resolution.
-Each stereo pair is fed the I/Q from the sampling board/circuit.
-This is the methed of SDR we‘ve looked at so far.
-$$$ to repourpused equipment thats for Pro Audio recording!

Cool things come out of this... websdr.org

Delta1010lt



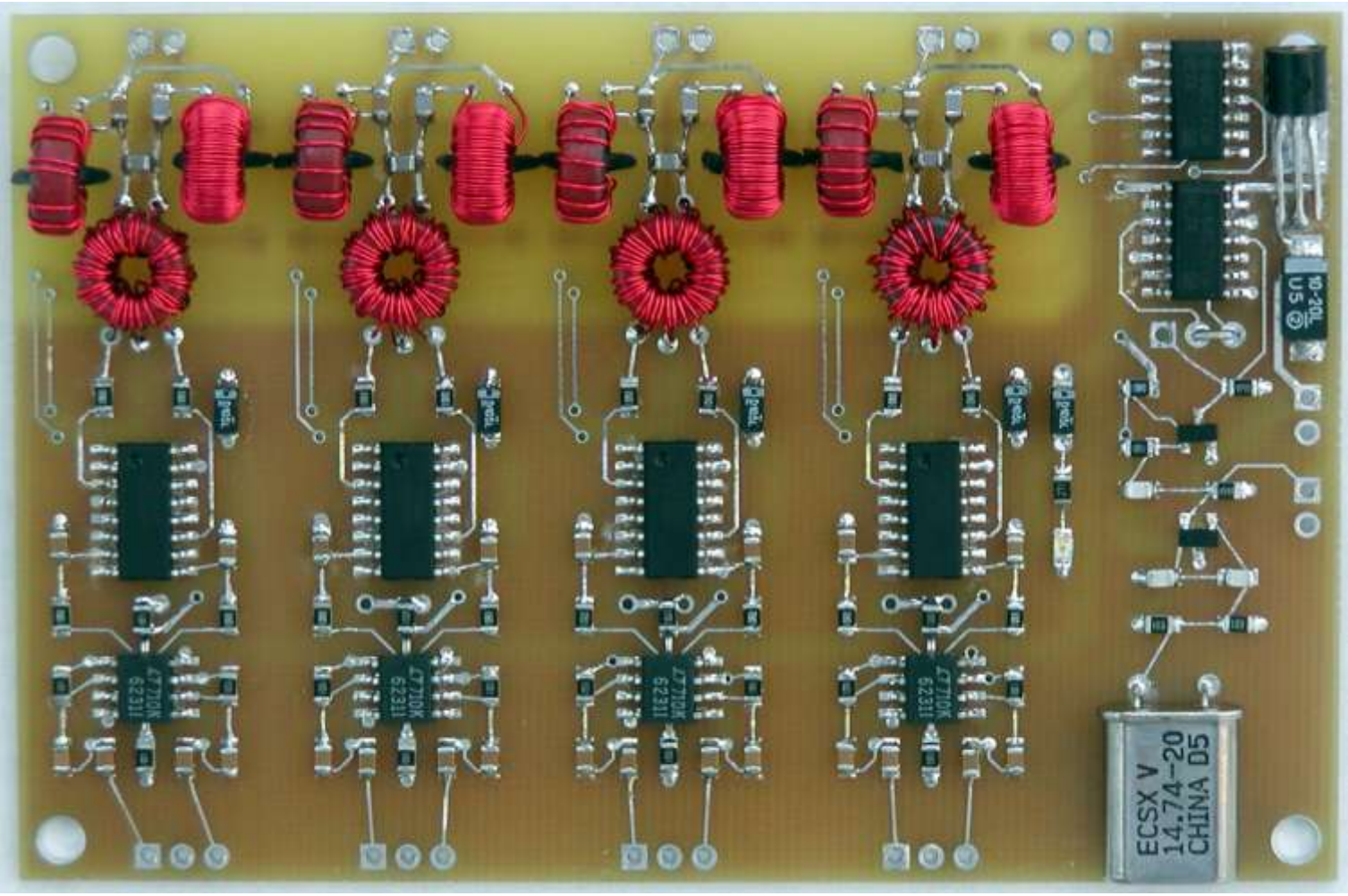


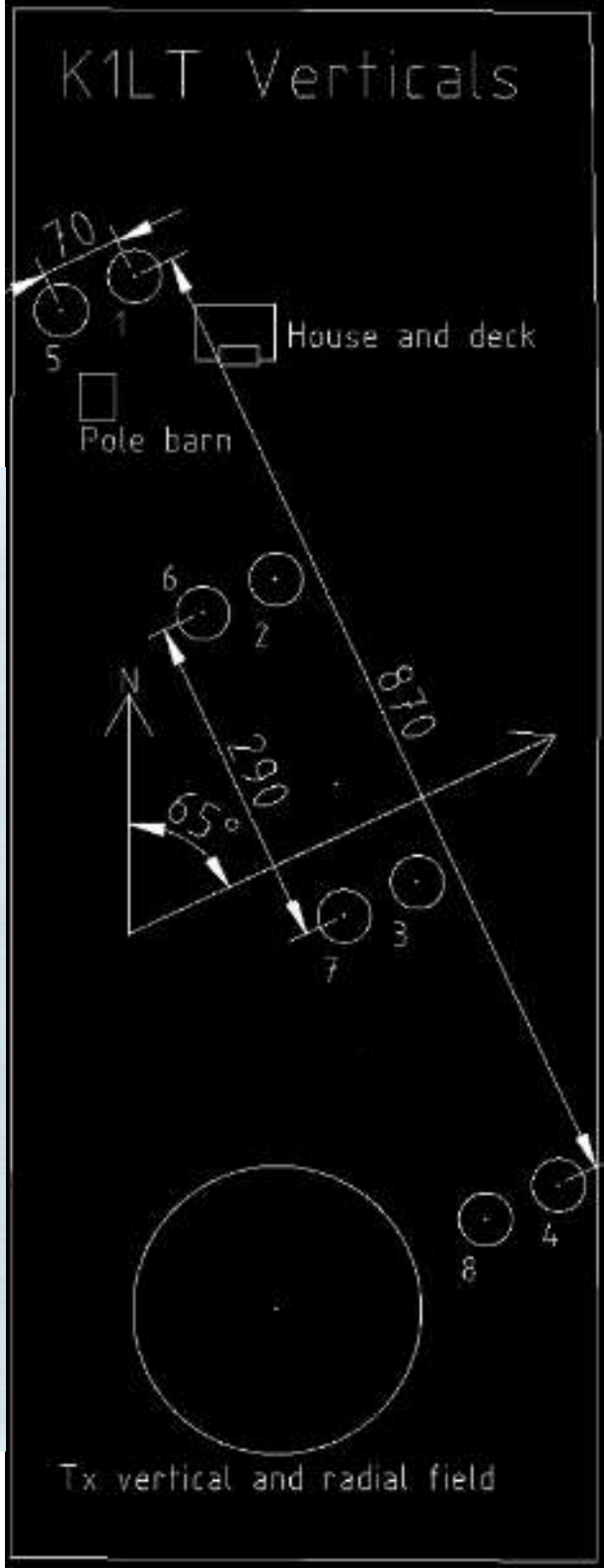
K1lt's Phased Array

-14mzh phased Array
-4 parallel Softrock V6 recevers on one board
-locked 1 XTAL

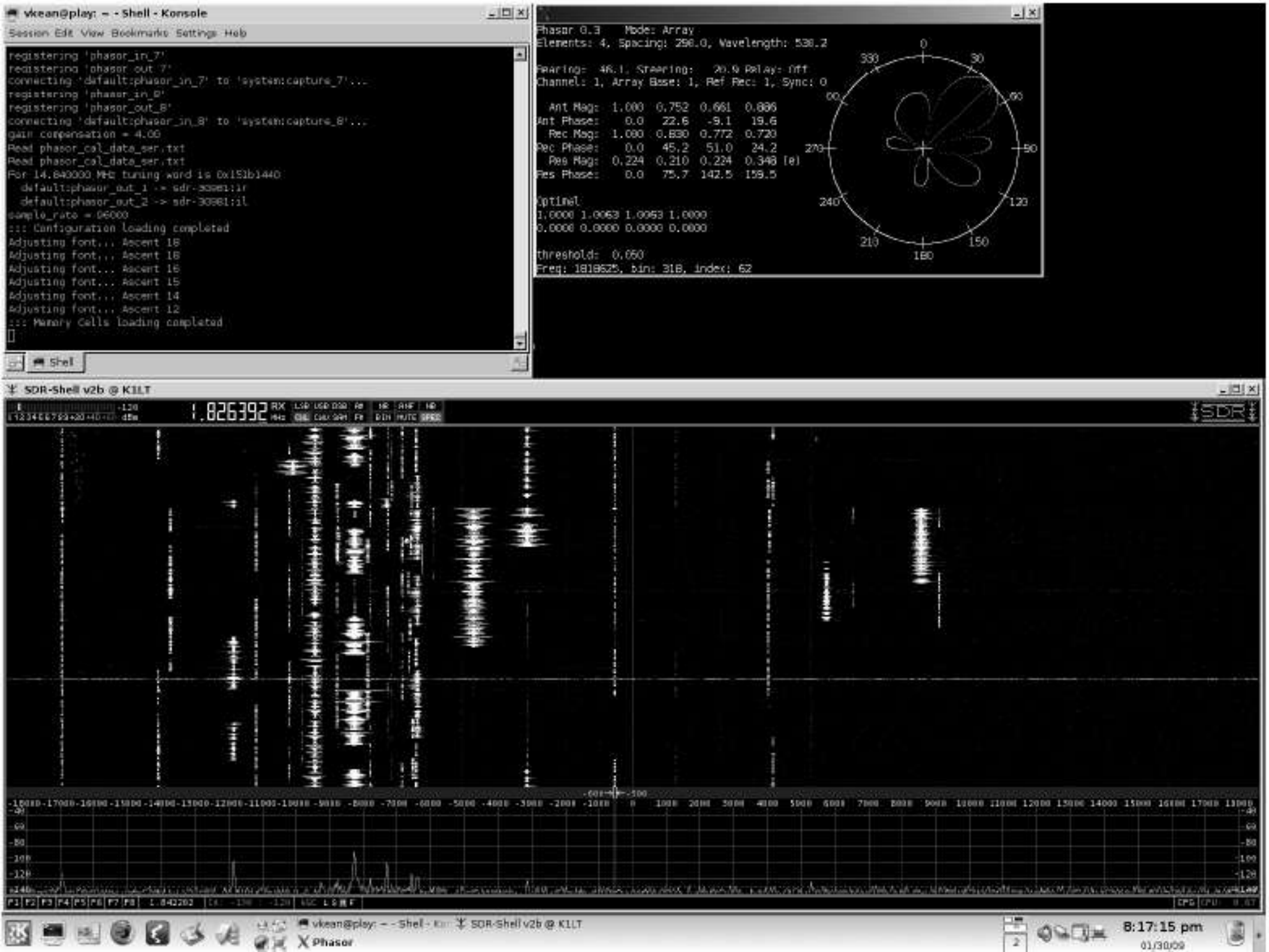
phasor

Phased Array Processing for Software Defined Radio





- http://www.k1lt.com - http://code.google.com/p/phasor/


vkean@play: ~ - Shell - Konsole
Session Edit View Bookmarks Settings Help
registering 'phasor_in_7'
registering 'phasor_out_7'
connecting 'default:phasor_in_7' to 'system:capture_7'...
registering 'phasor_in_8'
registering 'phasor_out_8'
connecting 'default:phasor_in_8' to 'system:capture_8'...
gain compensation = 4.00
Read phasor_cal_data_ser.txt
Read phasor_cal_data_ser.txt
For 14.040000 MHz tuning word is 0x151b1440
default:phasor_out_1 -> sdr-30981:ir
default:phasor_out_2 -> sdr-30981:il
sample_rate = 96000
::: Configuration loading completed
Adjusting font... Ascent 16
Adjusting font... Ascent 16
Adjusting font... Ascent 16
Adjusting font... Ascent 15
Adjusting font... Ascent 14
Adjusting font... Ascent 12
::: Memory Cells loading completed
Shell
Phasor 0.3 Mode: Array
Elements: 4, Spacing: 296.0, Wavelength: 530.2
Bearing: 46.1, Steering: 20.9 Relay: Off
Channel: 1, Array Base: 1, Ref Rec: 1, Sync: 0
Ant Mag: 1.000 0.752 0.661 0.886
Ant Phase: 0.0 22.6 -9.1 19.6
Rec Mag: 1.000 0.830 0.772 0.720
Rec Phase: 0.0 45.2 51.0 24.2
Res Mag: 0.224 0.210 0.224 0.348 [e]
Res Phase: 0.0 75.7 142.5 159.5
Optimal
1.0000 1.0063 1.0053 1.0000
0.0000 0.0000 0.0000 0.0000
threshold: 0.050
Freq: 1810625, bin: 318, index: 62
0
30
60
90
120
150
180
210
240
270
300
330
SDR-Shell v2b @ K1LT
1.826392
vkean@play: ~ - Shell
SDR-Shell v2b @ K1LT
Phasor
8:17:15 pm
01/30/09

SDR MK1.5 Andrus

-5kHz to 30MHz frequency range
-Dule Rx front ends, acting in antenna diversity mode.
-10/100Base Ethernet alowing 400kHz sampling.
-It's an audio device via the USB!

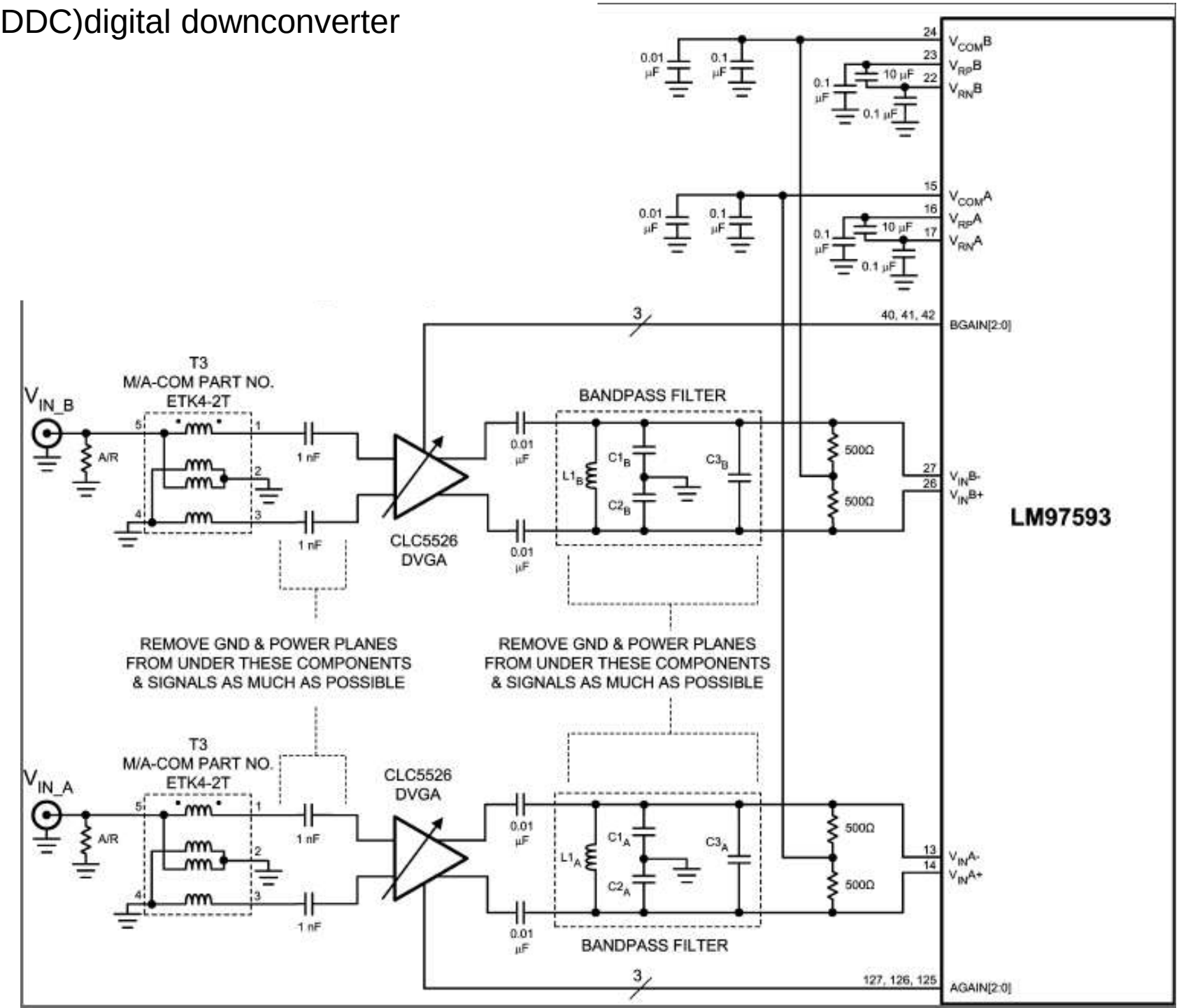
AT32UC3B0256

-high-performance low-power 32-bit microcontroller
-256KB flash memory, 32KB SRAM,
-12 Mbps USB Device + Mini-host with I2S.
-runs @ 60MHz

- http://uvb-76.net/p/sdr-mk15-andrus.html

SDR MK1.5 Andrus

-Two channel (DDC)digital downconverter



USRP

Universal Software Radio Peripheral

-Samples signals up to 100 MHz wide.
-Streaming sampled signals up to 50 MHz wide
-Interchangeable RF RX/TX boards.
-Internal field-programmable gate array (FPGA)
-10Gbit Ethernet
-ARM CPU w/ HDMI
.

OpenBTS in Unix

A GSM 2G handset standard that patches SIP softswitch or PBX calls.

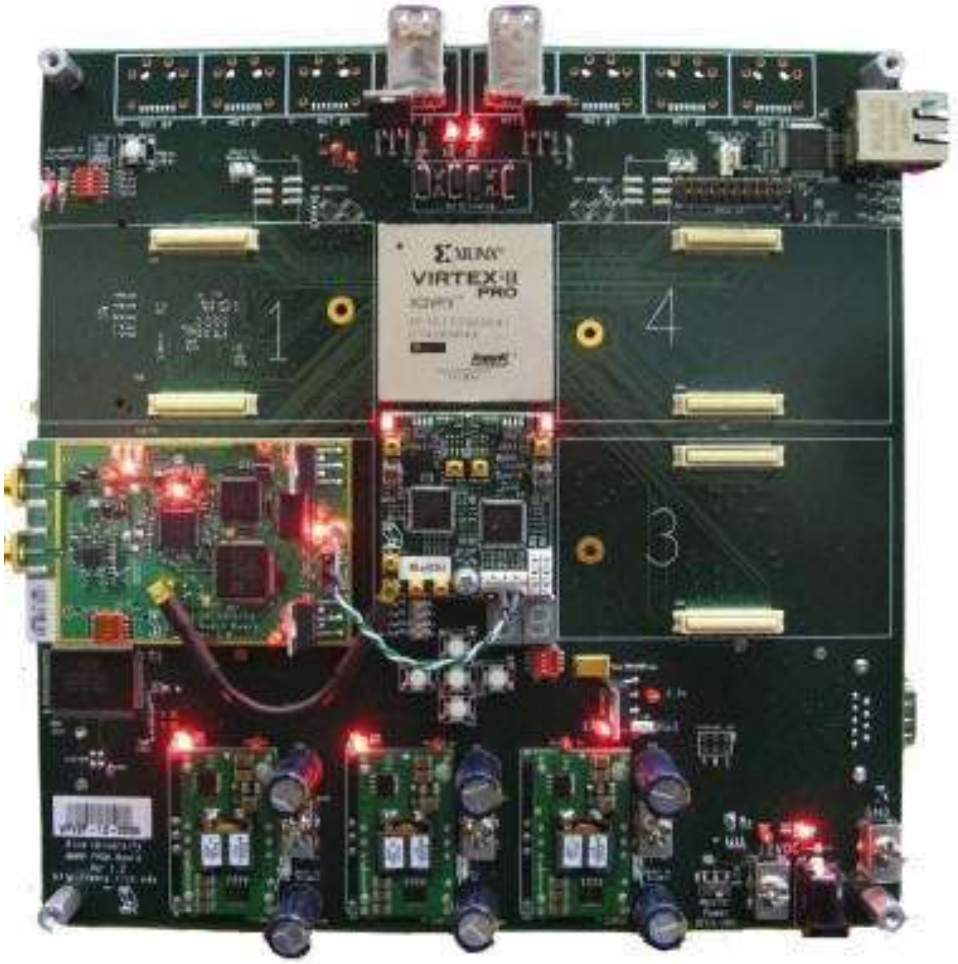
- http://www.ettus.com
- http://www.fh-kl.de/~andreas.steil/Projekte/OpenBTS/index.html

Rice University's Wireless Open-Access Research Platform (WARP)

-$9,750.00 for a 2.4 GHz and 5 GHz ISM bands (SISO)
-$12,000.00 for the (MIMO)
-Why? So much$ Its a 11.1 Gb/s serial transceiver FPGA w/ CPU

industrial, scientific and medical (ISM) radio bands

Frequency range		Center frequency	Availability
6.765 MHz	6.795 MHz	6.780 MHz	Subject to local acceptance
13.553 MHz	13.567 MHz	13.560 MHz	
26.957 MHz	27.283 MHz	27.120 MHz	
40.660 MHz	40.700 MHz	40.680 MHz	
433.050 MHz	434.790 MHz	433.920 MHz	Region 1 only and subject to local acceptance
863.000 MHz	870.000 MHz	866.500 MHz	Region 1 only and subject to local acceptance
902.000 MHz	928.000 MHz	915.000 MHz	Region 2 only
2.400 GHz	2.500 GHz	2.450 GHz	
5.725 GHz	5.875 GHz	5.800 GHz	
24.000 GHz	24.250 GHz	24.125 GHz	
61.000 GHz	61.500 GHz	61.250 GHz	Subject to local acceptance
122.000 GHz	123.000 GHz	122.500 GHz	Subject to local acceptance
244.000 GHz	246.000 GHz	245.000 GHz	Subject to local acceptance

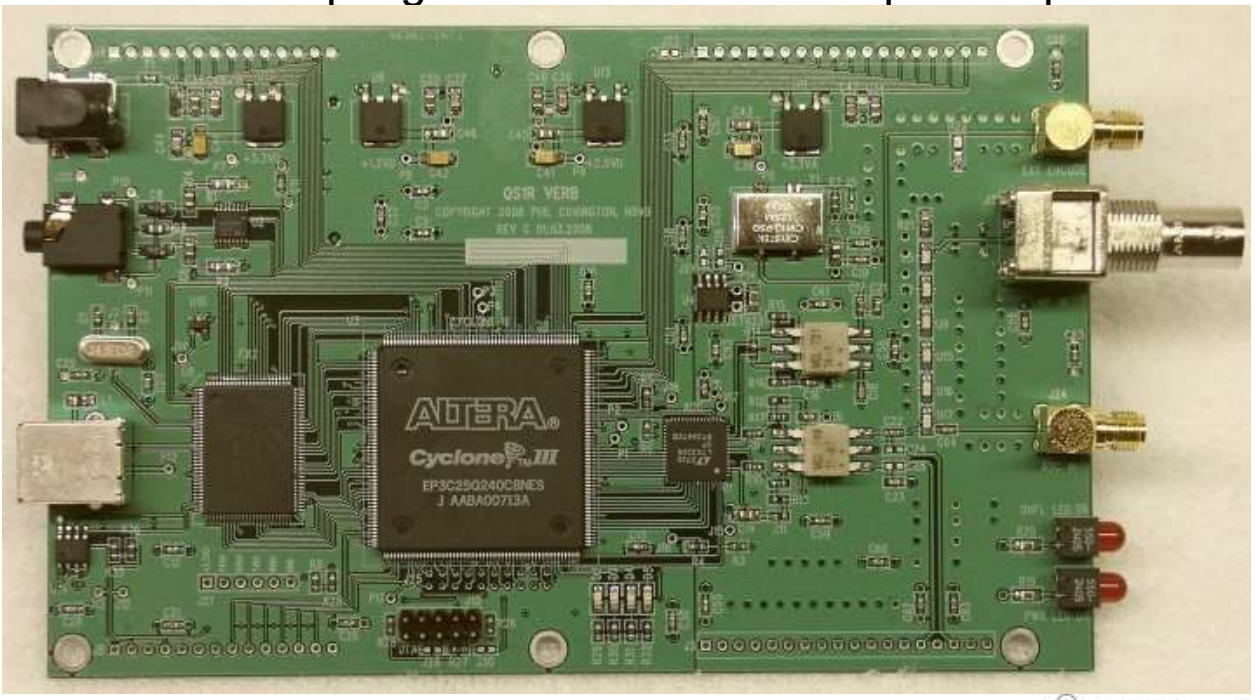


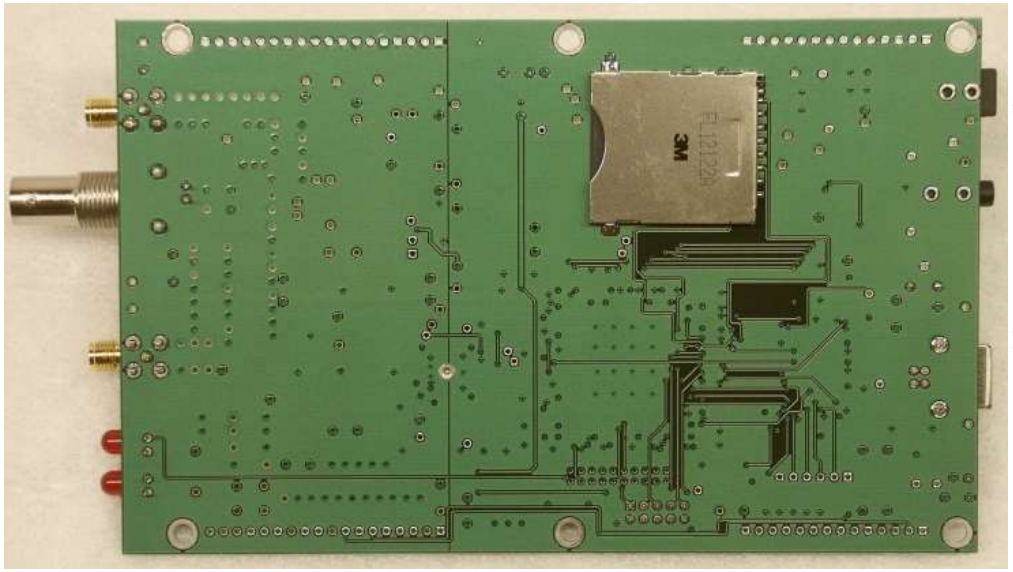
- http://warp.rice.edu/

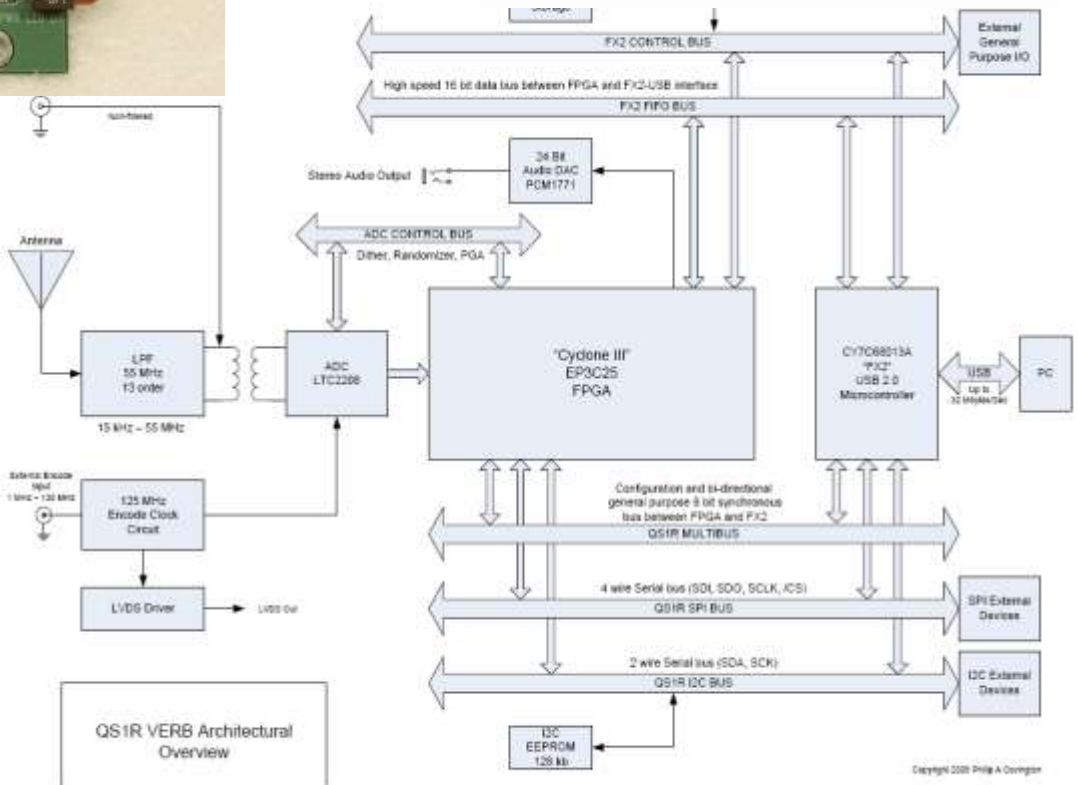
QS1R Software Radio Laboratory LLC

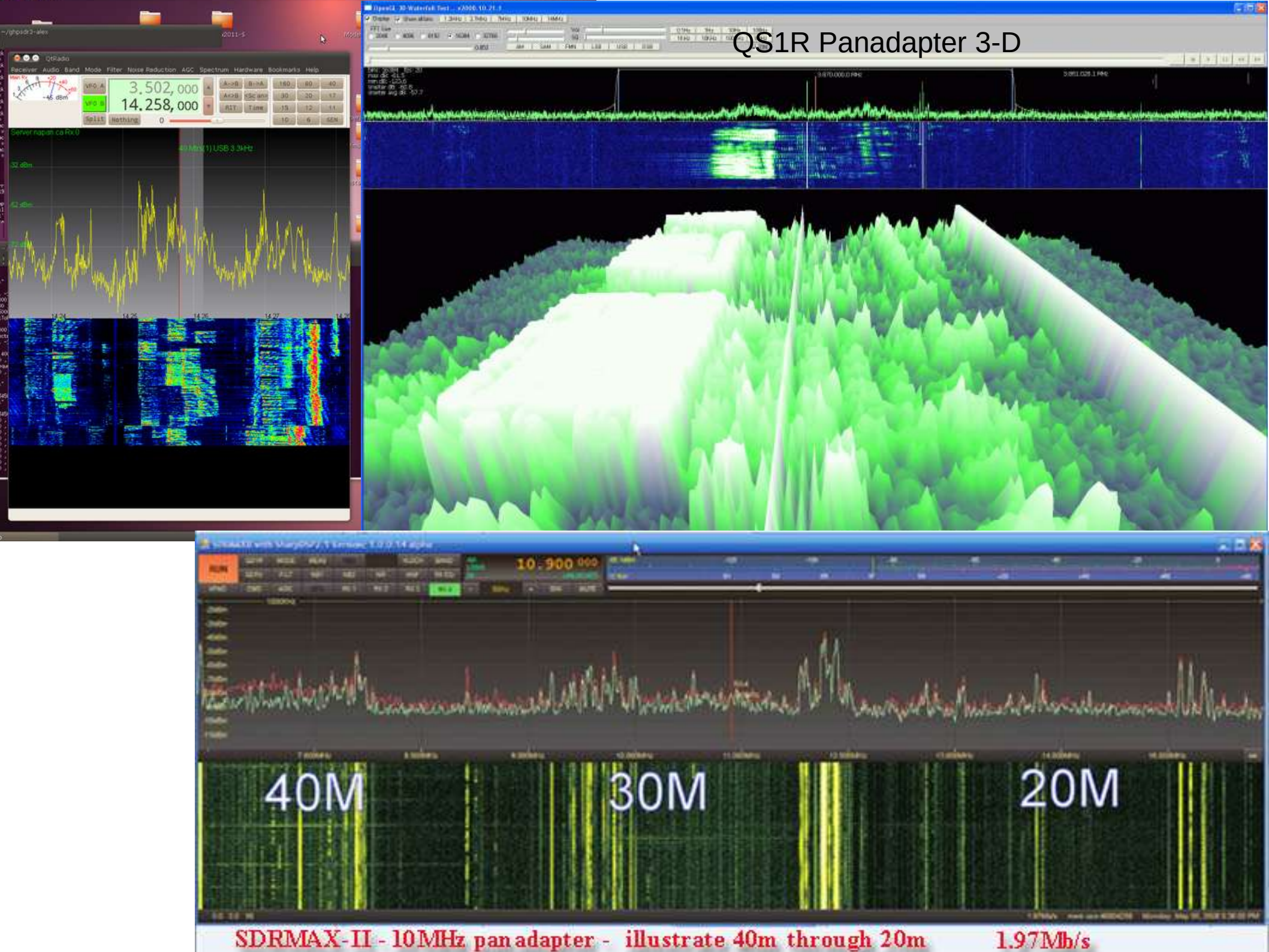
-10kHz to 62.5 MHz receiver @ 2 MHz bandwidth.

- 50MHz sampling bandwith W/ a USB panadapter .





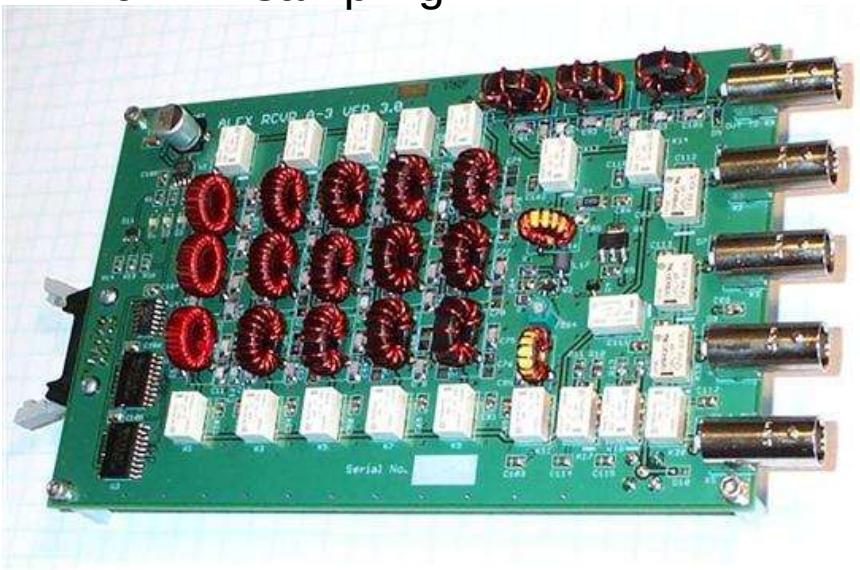


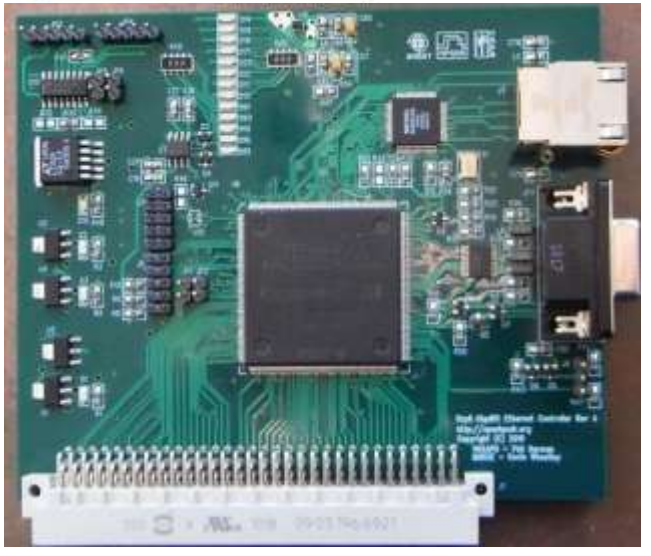

QS1R Panadapter 3-D
40M
30M
20M
SDRMAX-II - 10MHz pan adapter - illustrate 40m through 20m
1.97Mb/s

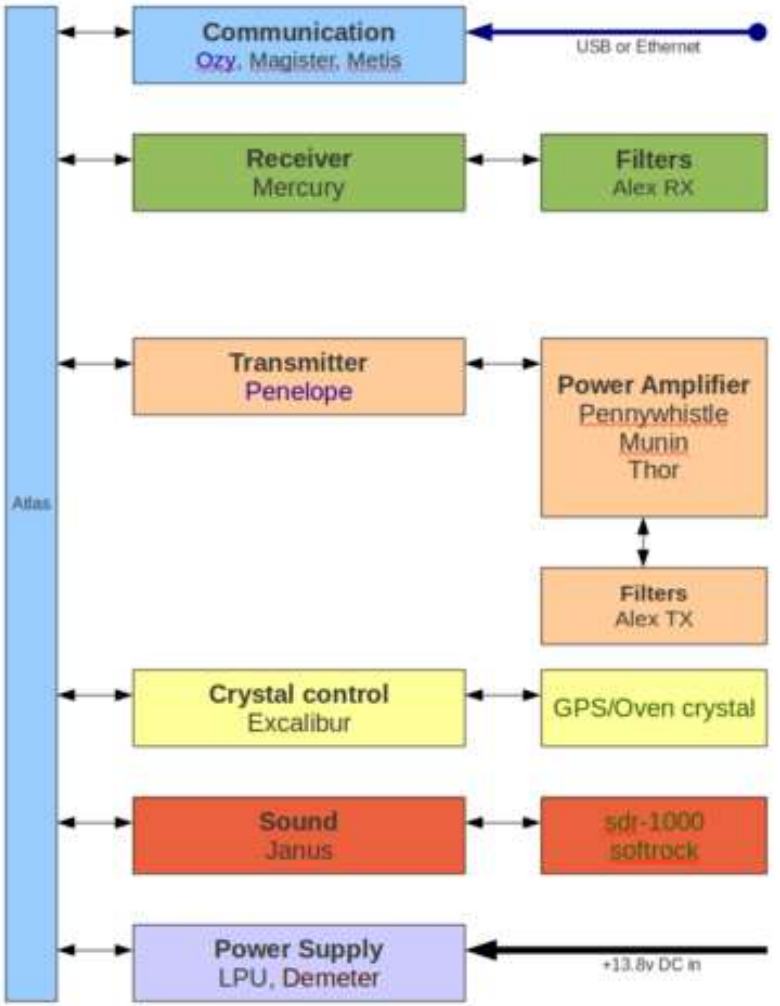
HPSDR

- http://openhpsdr.org/wiki/index.php?title=Main_Page

-1/2-watt transmitter/exciter
-Direct sampling 0-65 MHz
-192khz sampling





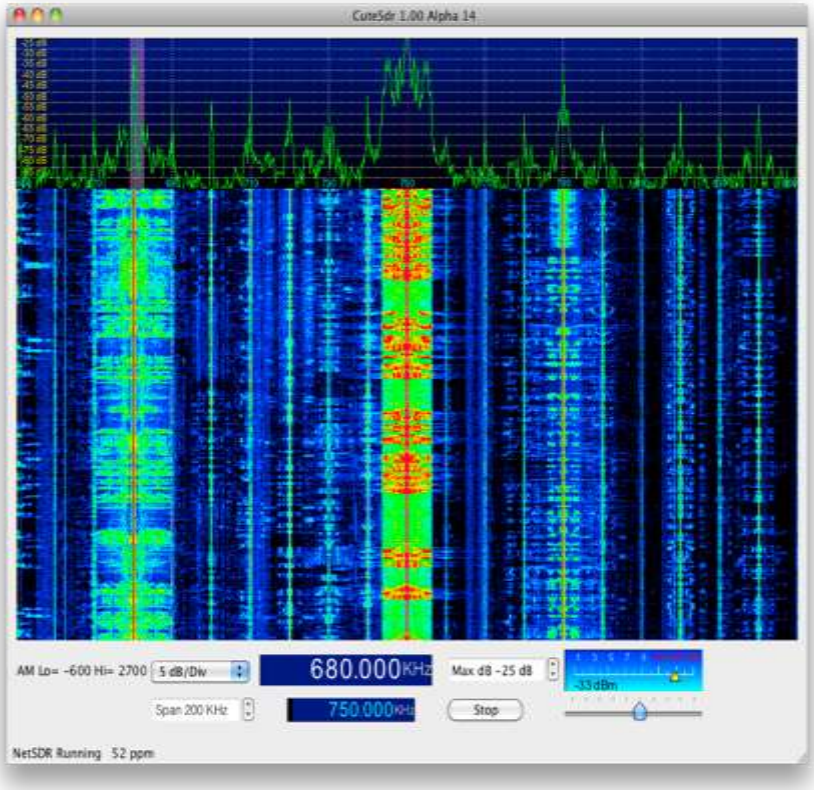


The NetSDR and SDR-IP

high performance networked radio recevers

-10 KHz - 32 MHz and 0.01 - 34 MHz modles.
- 1.6 MHz sample bandwidth
-100 baset Ethernet
-X2 board adds a second input streem.
- a 10 MHz PLO reference to both ADCs and a filter bank
- Alows beam steering/forming and antenna polarization

CuteSDR

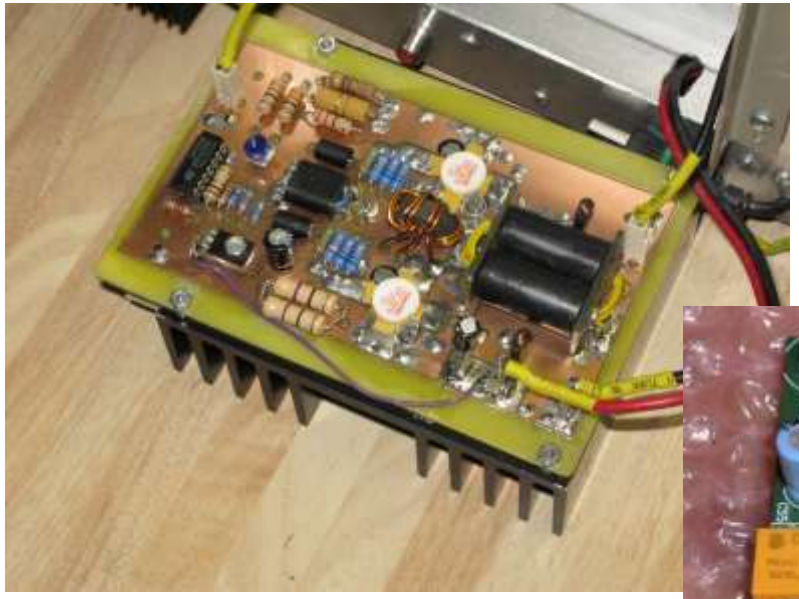


Starts @ $1999

- http://rfspace.com/RFSPACE/Home.html

Sorry...
Your still going to need an Amplifier!
In order to get 100W or even that KW or Output.

Bipolar 120w PA - using G6ALU's board design .
Uses a matched pair of 2SC2879 transistors.



PennyWhistle - 20 Watt Power Amplifier.

A pair of TO-220 "16 Watt" Mitsubishi RD16HFF1

- http://openhpsdr.org/wiki/index.php?title=PENNYWHISTLE

- http://www.m0rzf.co.uk/styled-3/

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Control Wiget
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QT GUI
(GHPSDR3, SDR Shell,)

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GNU Radio Server
(Running on a Computer)

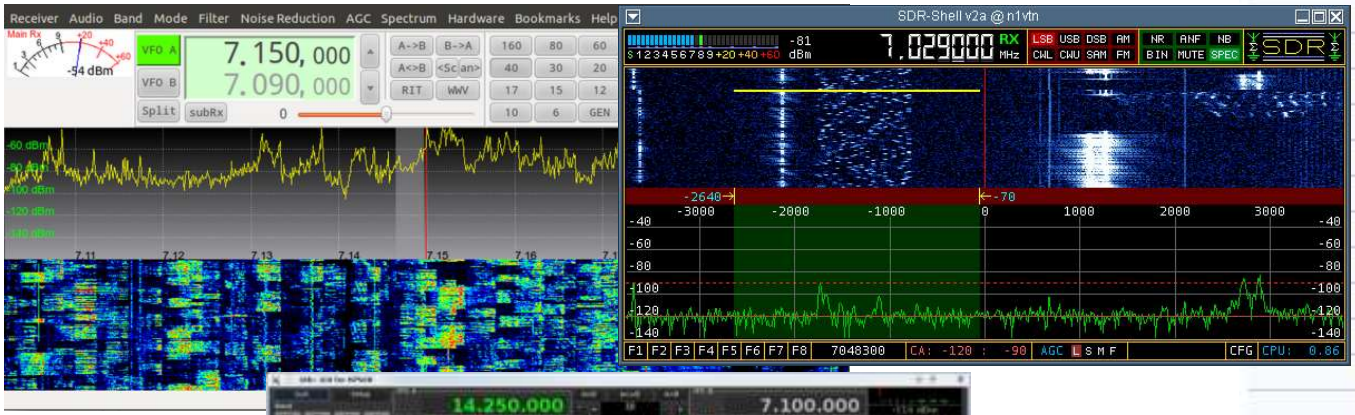
Nokia's Qt Development Framework

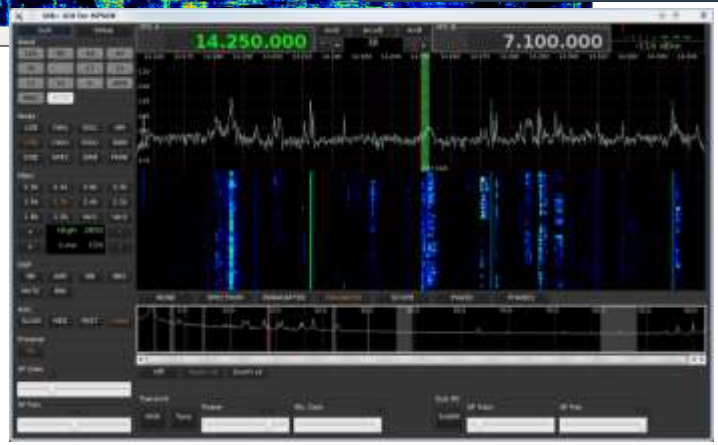
- A cross-platform Meta Object Compiler
- Found inSkype, VLC media player, Photoshop Elements
- SDR Shell
- ghpsdr3-alex

GNU Radio

GNU Radio 3.5.0 C++ API

-Writen in C++ &Python languages





Modules

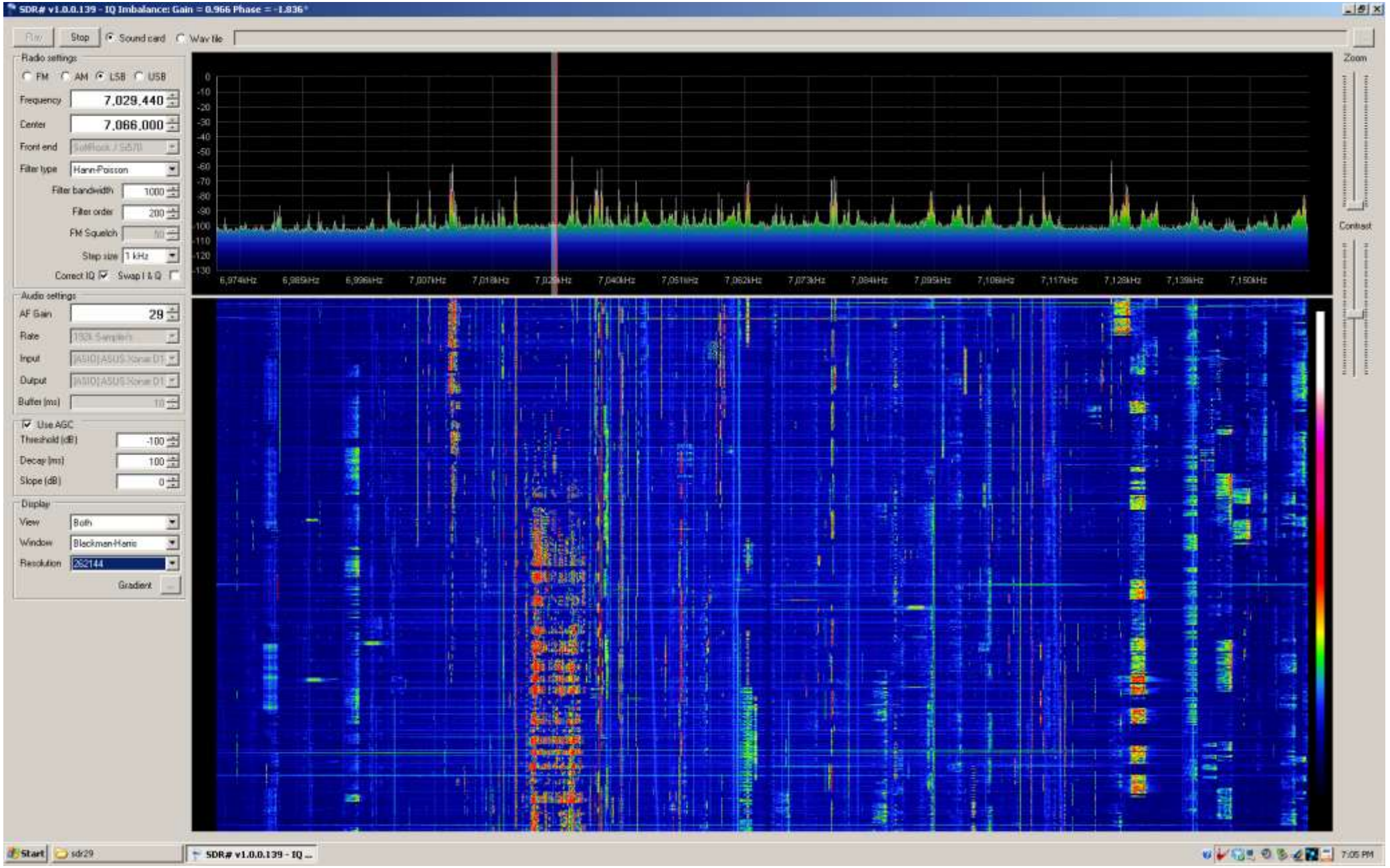
- Top Block and Hierarchical Block Base Classes
- Signal Sources
- Signal Sinks
- Filters
- Mathematics
- Signal Modulation
- Signal Demodulation
- Information Coding and Decoding
- Synchronization
- Equalization
- Type Conversions
- Signal Level Control (AGC)
- Fourier Transform
- Wavelet Transform
- OFDM Blocks
- Pager Blocks
- Miscellaneous Blocks
- Slicing and Dicing Streams
- Voice Encoders and Decoders
- Digital Modulation Blocks
- QT Graphical Interfaces
- UHD Interface
- Audio Interface
- Polyphase Filterbank
- Base classes for GR Blocks

All C++ blocks are derived from these base classes.

http://gnuradio.org/redmine/projects/gnuradio/wiki - http://qt.nokia.com

Sdrsharp a C# implementation of Software Defined Radio

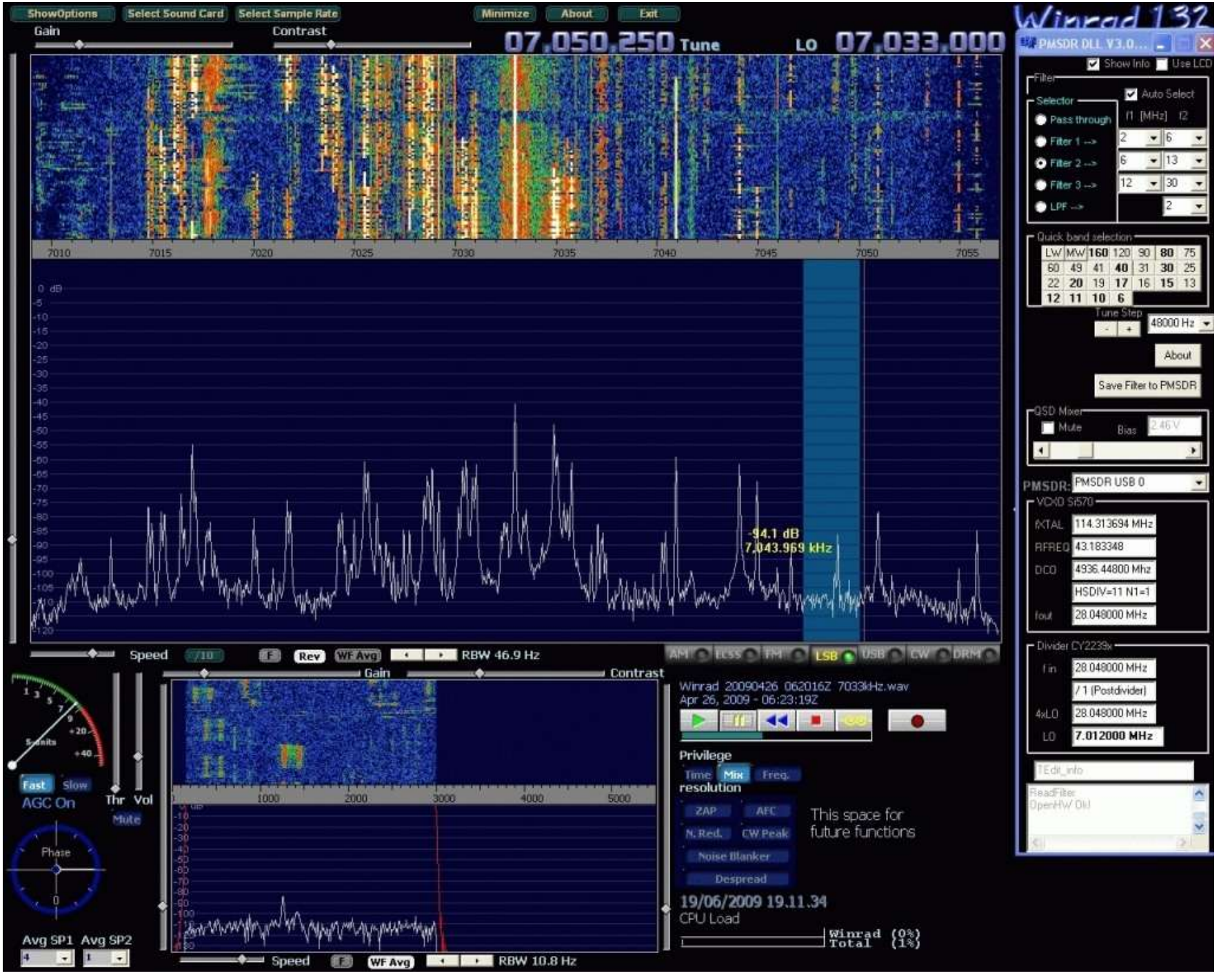
-This recever supports the SoftRock, FiFiSDR and FUNcube Dongle with the appropriate plugin.



- http://code.google.com/p/sdrsharp/

Winrad Release v1.6.1 (22 Feb. 2010)

-http://www.winrad.org/

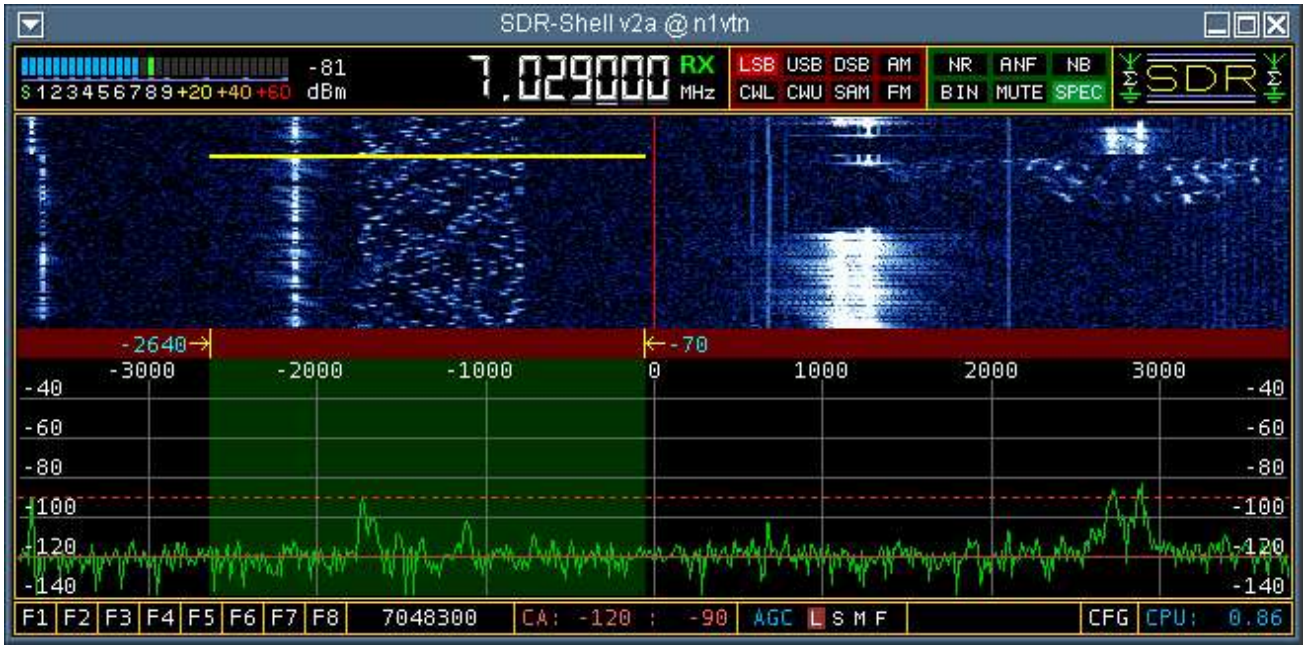


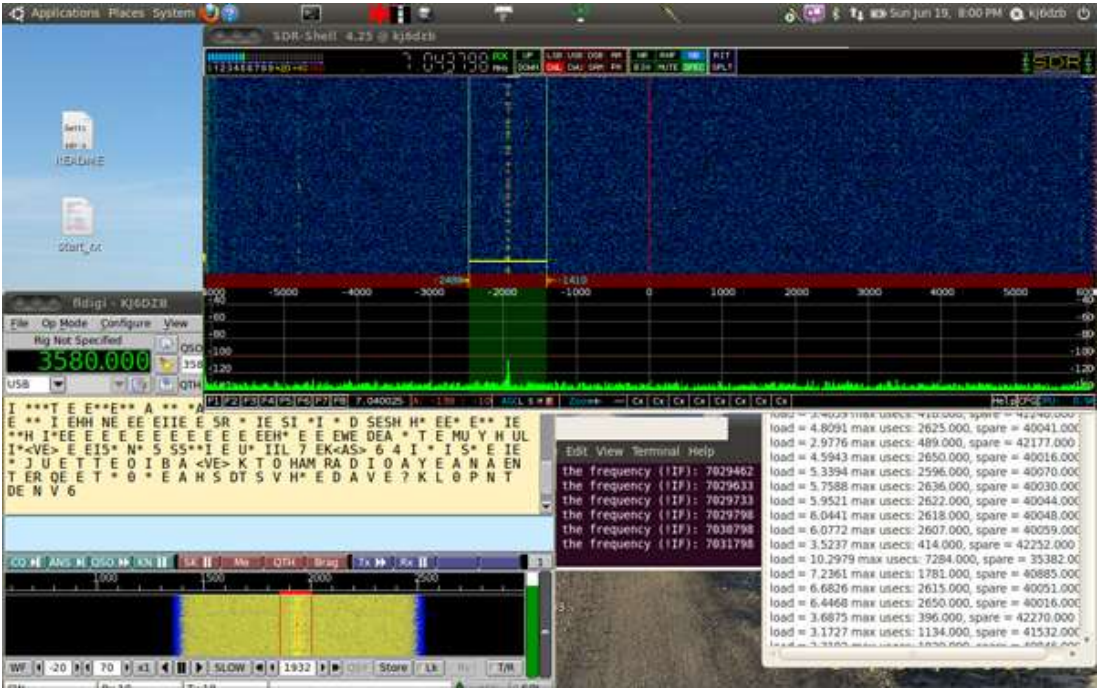
SDR-Shell

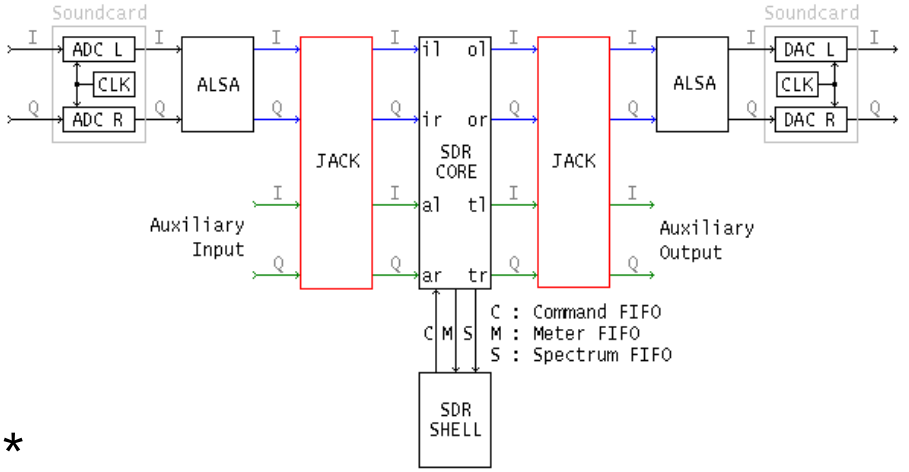
-Based on the GNU Radio
-Dificult to compile/setup
-Dificult to operate.

...Oh and its no HRD.

-A Basic! Rx / Tx QT App for LSB,USB, AM,CW, AM, FM, Dig* modes







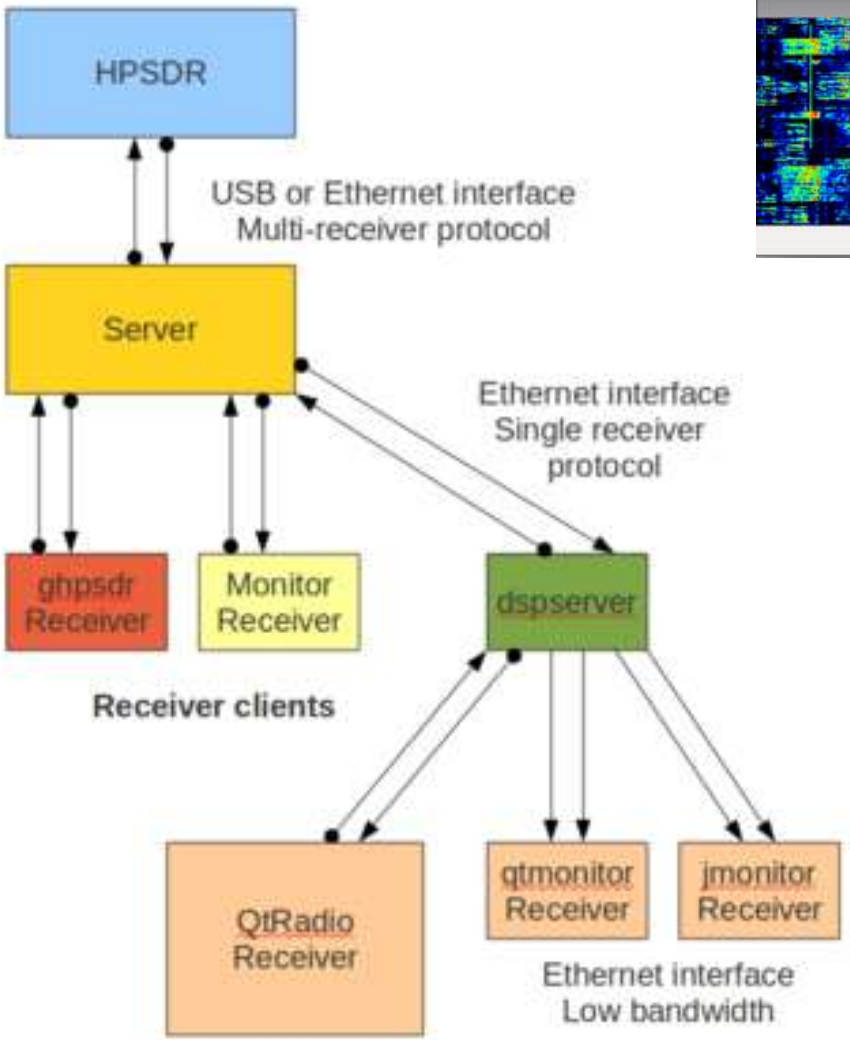
Dig*

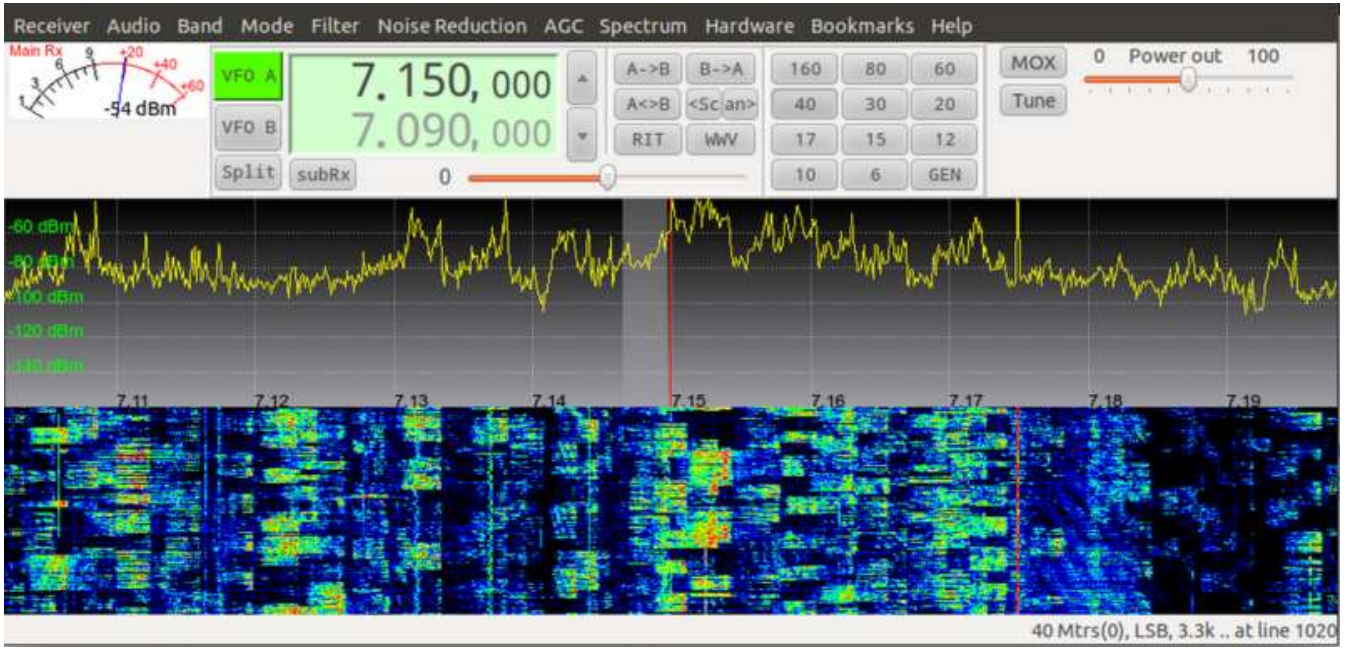
-The audio routing method (Jack) dosent alow for FEC natively found in Digital modes like PSK. The external program(s) would need to generate the digital I/Q to create the signal.
-PSK apps do directly generate & receive I/Q.

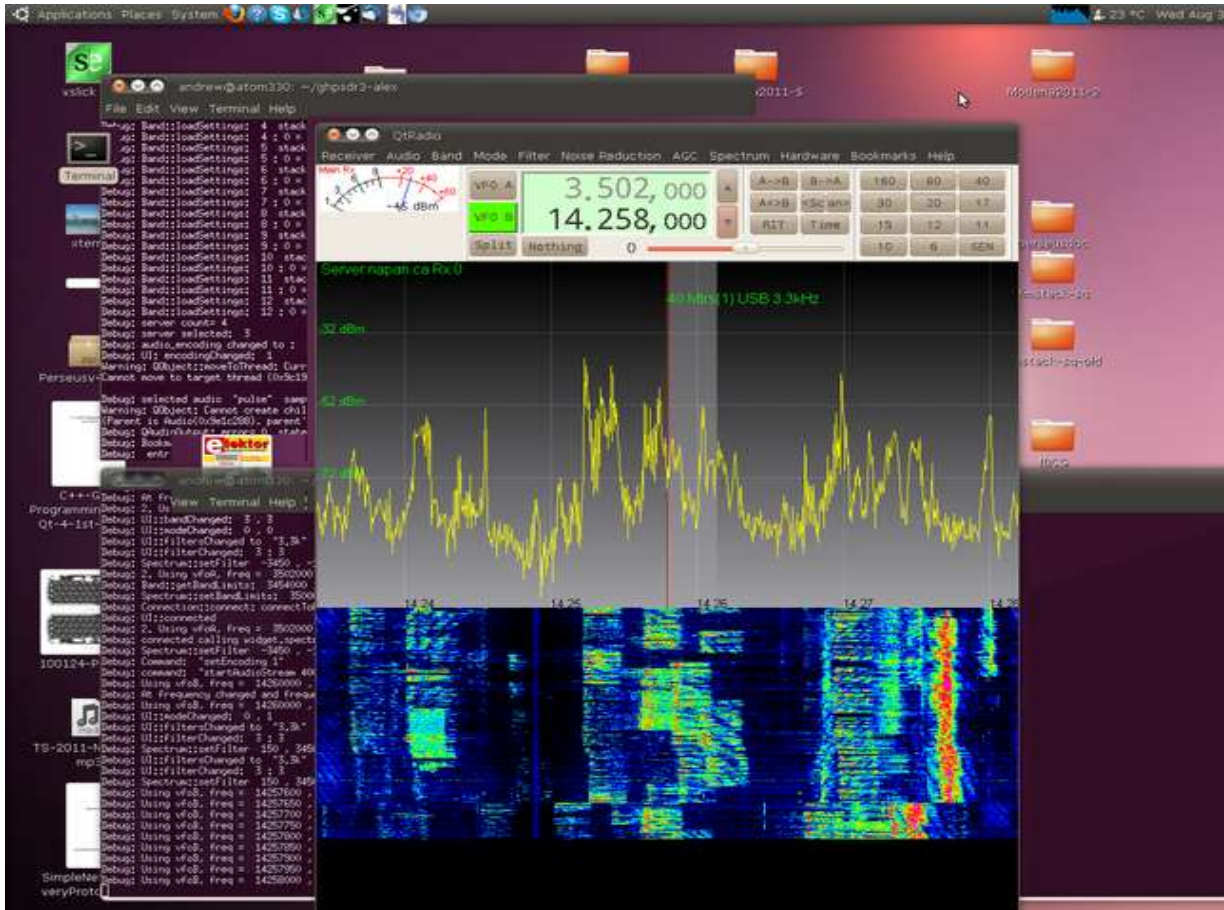
- http://ewpereira.info/sdr-shell/ - http://qsl.net/kj6dzb/sdr%20makin.html

GHPSDR3

Server~Client Framwork for Rx/Tx
-Windows: Client
-Linux: Client /server
-Android: Client





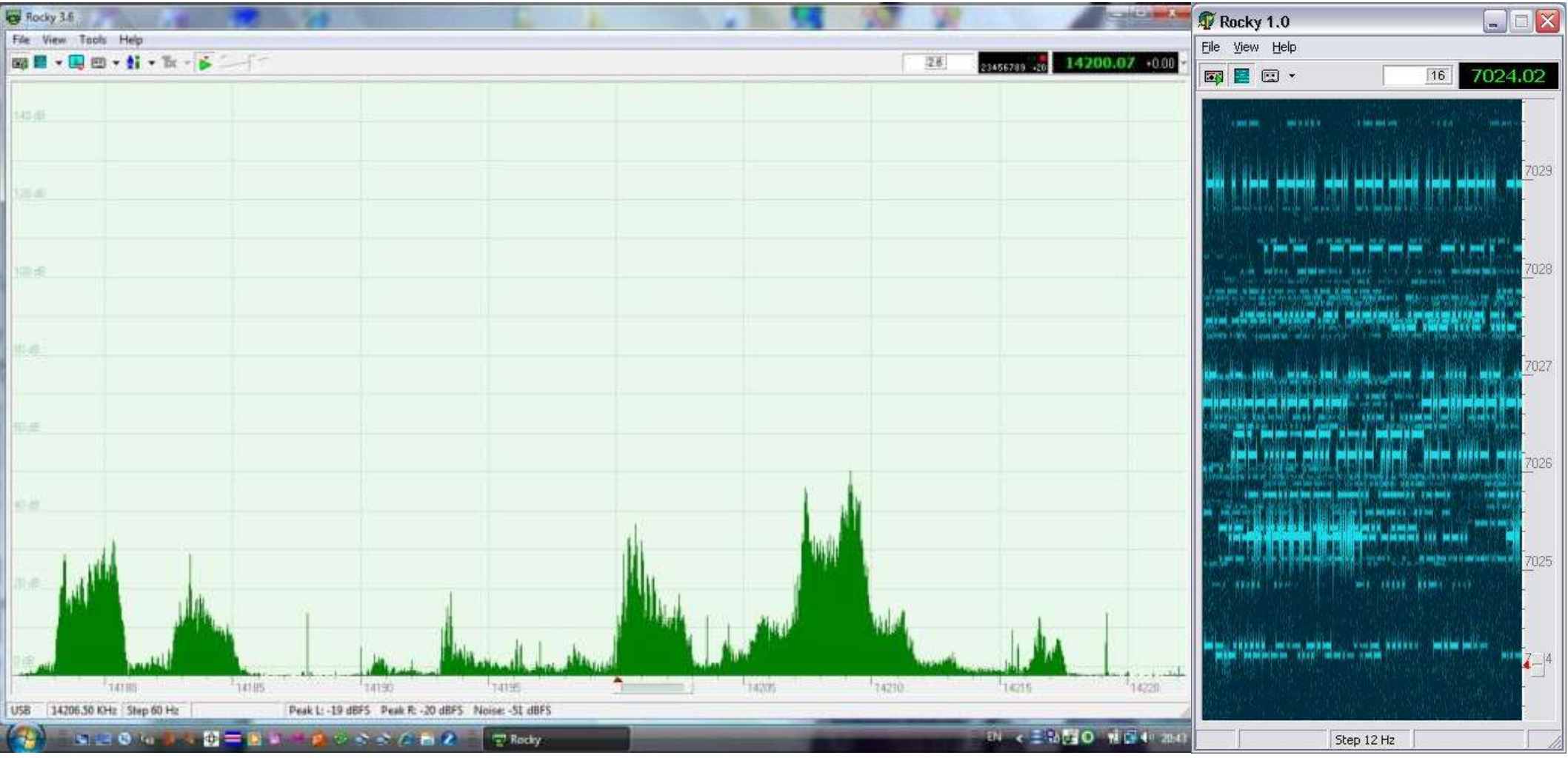


DEMO TIME

Rocky *By Alex Shovkoplyas, VE3NEA*

- A simple Si570 control application used to calibrate Si570 VCO.
- Allows sound you to record the IQ stream and it playback.
- Receive & transmit CW, BPSK31 w/ error correction.
- Vector Network Analyzer with a Softrock(see links)

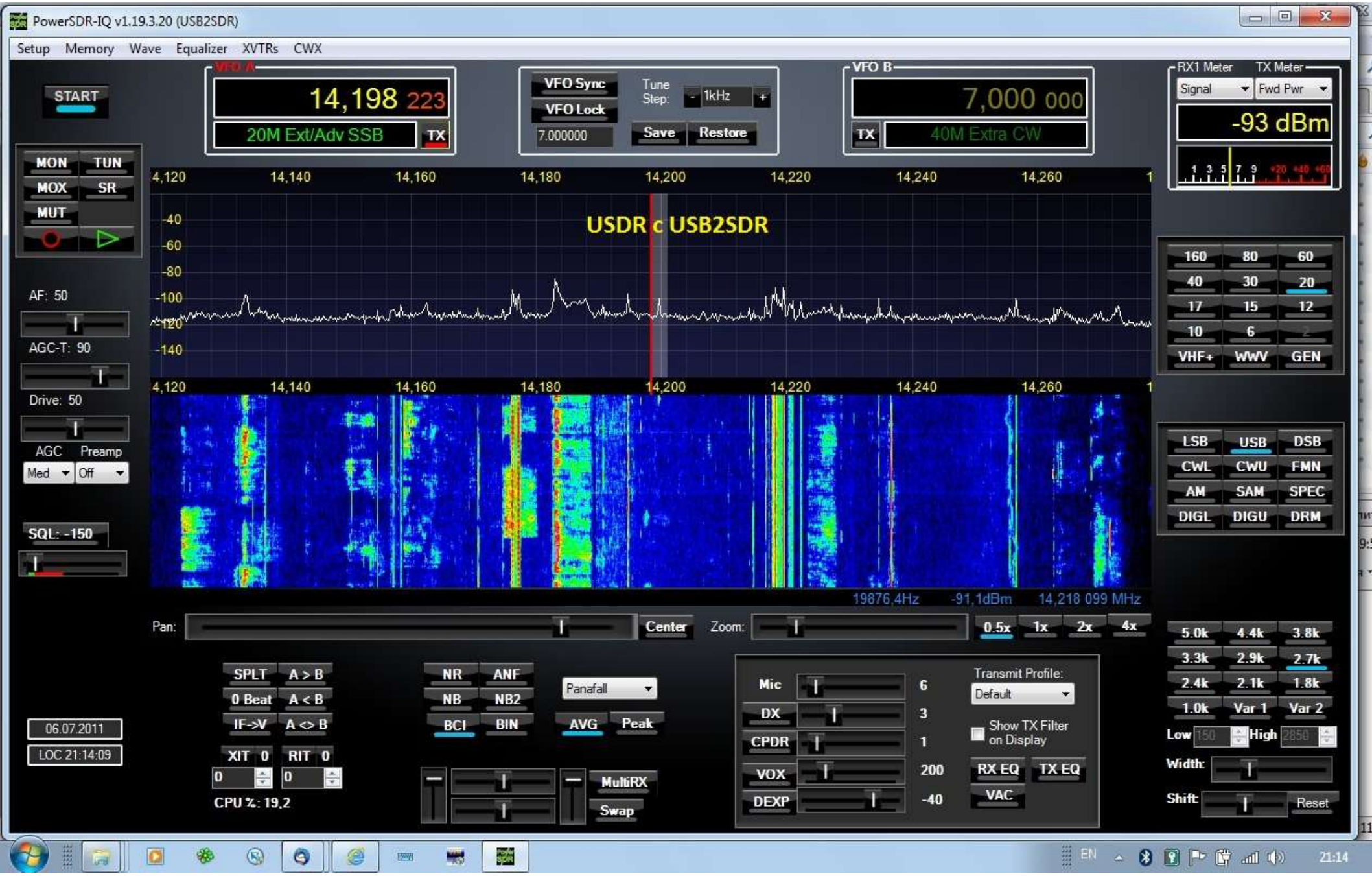
Look for :DX Atlas, CW skimmer/server, DX bulletin, Voice shaper, IonoProbe, Band Master, Faros, Ham CAP



- http://www.dxatlas.com/Rocky/Files/Rocky_VNA_v1c.pdf - http://n2pk.com/ - http://www.dxatlas.com/Rocky/

PowerSDR-IQ

Homebrew program for various SDRs –Flexradios, Uhfsdr, Softrock - Open source.



- http://code.google.com/p/powersdr-iq/

(DX)
SV2DWQ

Operator
(W/ a Radio)

RF

(QSO‘s)

User /
Operatior

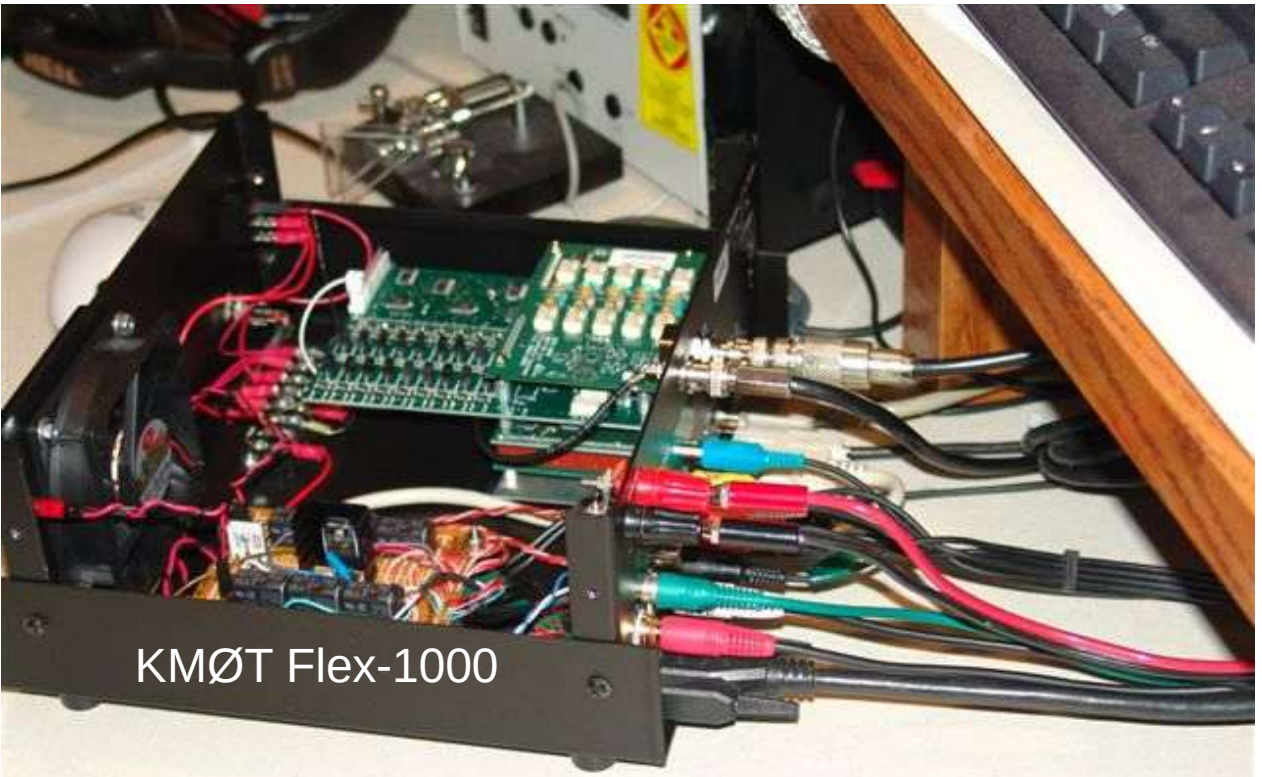
RF Sampling / Exciting

Control Wiget
(GNU Radio Embeded
ARM Controler)

QT GUI
(GHPSDR3, SDR Shell,)

INTERNETS

GNU Radio Server
(Running on a Computer)



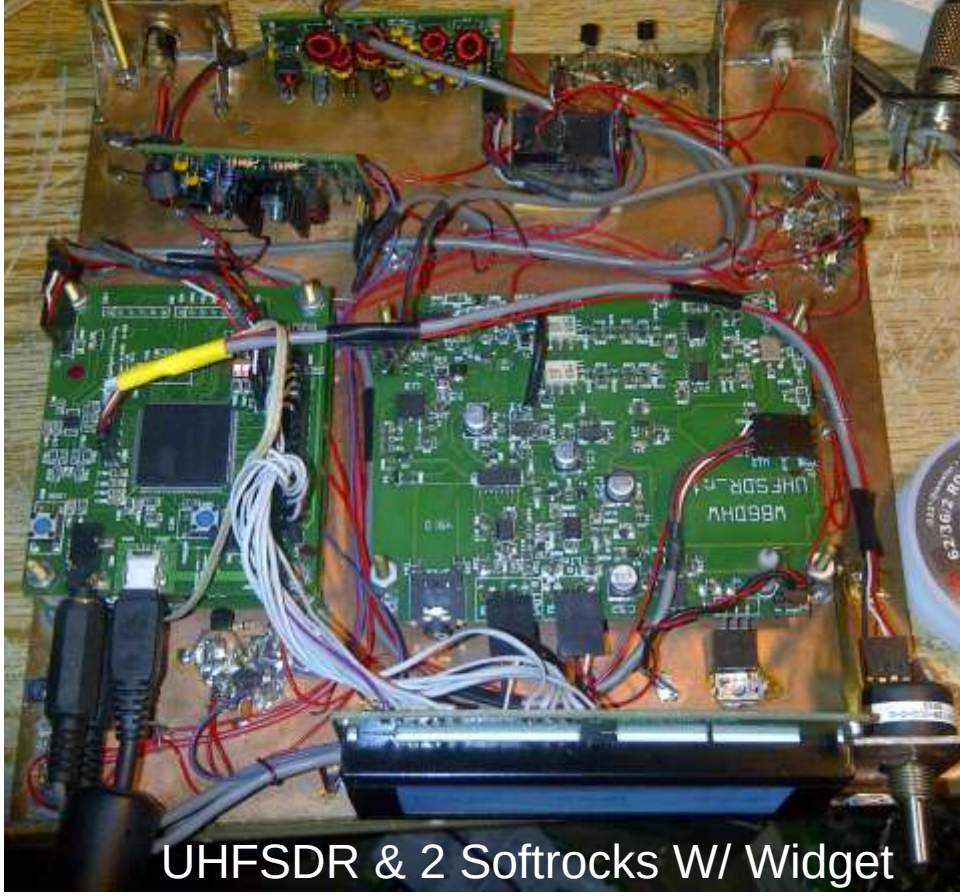
Flex Radio

User Group designed HF SDR

-Internal BPF, RF Tx/Rx 5w or 100w options and 60w uhf&Vhf add on, firewiresound card. Filter & antenna switching.

- http://www.km0t.com/pages/sdr.htm - http://www.flex-radio.com/

You Still NEED a computer!!!
The FLEX-5000C has a PC with it!



SDR Widget

-High quality 48/96/192khz 24bit Rx using HPSDR protocol ?why not ethernet?
-PTT control
-Si570 control
-SWR metering
-PWR metering
-PA Heatsink Temperature metering
-PA bias adjustment
-LCD display
-Rotary Encoder Input
-Filter bank switching control
-CW paddle

- http://code.google.com/p/sdr-widget/

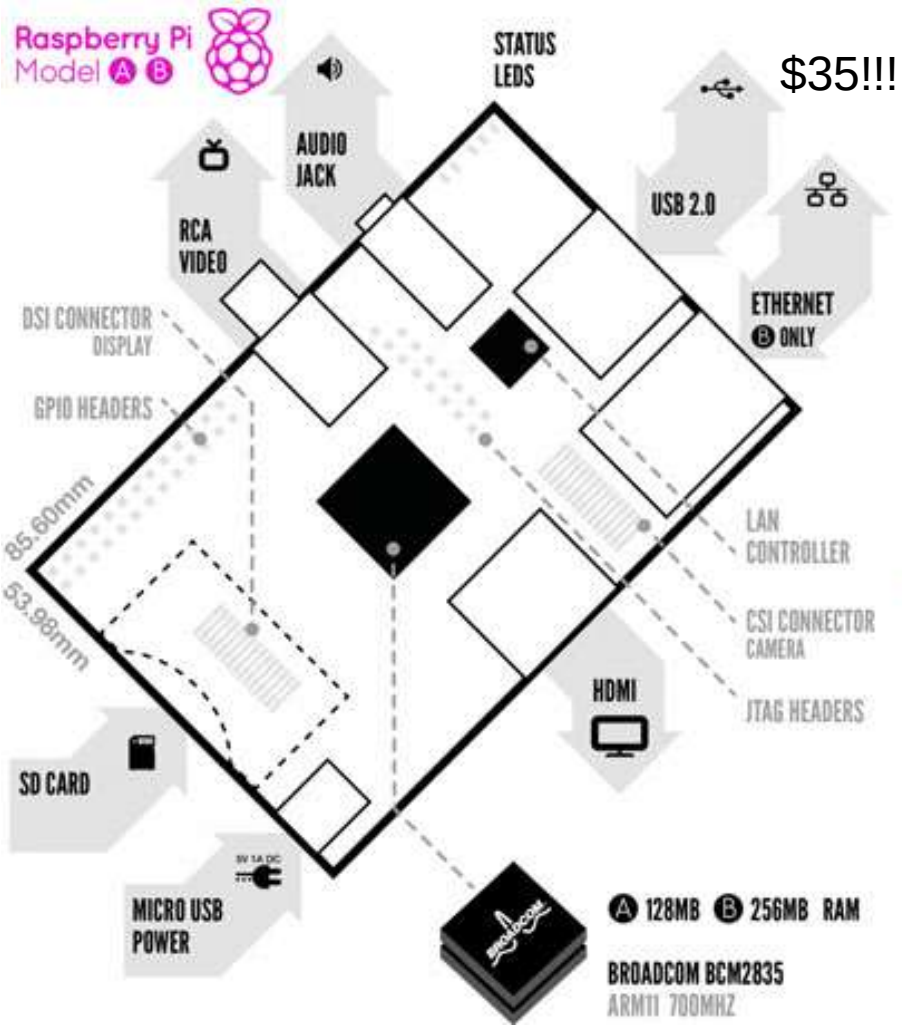
USB2SDR

-2 st. ch I/O @ 192khz
-I2c and 8 IO lines
-CW key
-rj-45 MIC jack!!
-USB device
-Only supported in PowerSDR-IQ

Idont think much of SV1EIA who made it...

- http://www.wb5rvz.com/usb2sdr/

Eric Haskell
KC4YOE



$35!!!

What's in for the Future of SDR's…

-Embedding DSP servers on smaller devices.
-Boards that sample from kHz to GHz.
-Multiple wide bandwidth streams of spectrum or phased signal processing.
-Exciting circuit to match the sampling streams.
-Combine the DSP device, Rf board, control widget, and GUI into a line of devices.

- http://www.raspberrypi.org/

Source in order of appearance:

- http://wb5rvz.com/sdr/
- http://www.ti.com/product/LMK03806
- http://www.silabs.com/products/clocksoscillators/xo/Pages/default.aspx
- http://www.ti.com/product/LMK03806
- http://www.genesisradio.com.au/
- http://www.k1lt.com
- http://www.genesisradio.com.au/
- http://www.ettus.com
- http://www.fh-kl.de/~andreas.steil/Projekte/OpenBTS/index.html
- http://uvb-76.net/p/sdr-mk15-andrus.html
- http://warp.rice.edu/
- http://rfspace.com/RFSPACE/Home.html
- http://openhpsdr.org/wiki/index.php?title=Main_Page
- http://gnuradio.org/redmine/projects/gnuradio/wiki
- http://qt.nokia.com
- http://www.winrad.org/
- http://code.google.com/p/sdrsharp/
- http://napan.ca/ghpsdr3/index.php/Main_Page
- http://www.dxatlas.com/Rocky/Files/Rocky_VNA_v1c.pdf
- http://n2pk.com/
- http://www.dxatlas.com/Rocky/
- http://code.google.com/p/powersdr-iq/
- http://code.google.com/p/sdr-widget/
- http://www.km0t.com/pages/sdr.htm
- http://www.flex-radio.com/
- http://www.wb5rvz.com/usb2sdr/
- http://www.wb5rvz.com/usb2sdr/
- http://www.raspberrypi.org/

THE END