Software and Software-Defined Radio

Part 2 – Current Offerings

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June 20, 2017

Current SDR Receivers, Transceivers and Software

- Receivers
  - General Purpose
    - Not an exhaustive list as there's so many with new ones coming out all the time
    - Not covering kits in this presentation
    - Many also support Linux and Mac
  - Amateur Radio Focused
- Transceivers
  - Amateur Radio Transceivers
- Third Party Software Offerings

Receivers (HF/VHF/UHF)

- Airspy (http://airspy.com/)
- AFEDRI SDR (http://www.afedri-sdr.com/)
- Cross Country Wireless SDR-4+(http://www.crosscountrywireless.net/sdr-4.htm)
- DX Patrol MK3 (http://www.dxpatrol.pt/)
- ELAD FDM-S1 (http://ecom.eladit.com/FDM-S1/en)
- FUNcube Dongle Pro+ (http://www.funcubedongle.com/)
- NetSDR (http://www.rfspace.com/RFSPACE/NetSDR.html)
- Perseus (http://microtelecom.it/perseus/)
- RTL-SDR R820T2 (http://www.rtl-sdr.com/tag/r820t2/)
- SDRPlay RSP2 (http://www.sdrplay.com/)
- Cloud-IQ (http://rfspace.com/RFSPACE/CloudIQ.html)
- WinRadio WR-G31DCC (http://www.winradio.com/home/g31ddc.htm)

AirSpy R2

- 24 – 1800 MHz (down to DC with SpyVerter R2 option)
- 12-bit ADC @ 20 Ms/s (2.5 Ms/s output for Raspberry Pi)
- 0.5 ppm, low phase-noise clock
- External 10 MHz reference clock input
- Tracking RF filters
- +35 dBm IP3 RF front end
- No drivers required for Windows 7 through 10
- Tightly integrated with popular SDR# program
  - Also supports SDR-Radio, HDSDR, GQRX, GNURadio and more
- $169 (at https://v3.airspy.us/)
  - $49 for SpyVerter R2

AFEDRI SDR

- 100 kHz – 35 MHz (1.8 MHz process bandwidth)
- Direct Sampling DDC (Digital Down-Conversion)
- 12-bit 80 Ms/s
- MDS: -136 dBm at 500 Hz BW
- USB 2.0 and LAN interface for remote access
- Powered from USB or external supply (7-10VDC)
- Works with Linrad, Winrad, HDSDR, Studio1, SDR Console by SDR-radio, CuteSDR, SdrDX, Quisk and PowerSDR_mrx
- Output data format: Two 16-bit I/Q channels (stereo stream emulation)
- $259

Cross-Country Wireless SDR-4

- 0.85 – 70.5 MHz
- Relay-switched bandpass filtering
- Internal 16-bit stereo ADC (89 dB dynamic range)
  - Maximum frequency display: 48 kHz
  - 3.5mm I/Q audio socket allows connection to higher resolution sound cards
    - Frequency displays up to 192 kHz
- +16 dBm IP3
- Aluminum case for full RF shielding
- Windows-based, includes driver
- Compatible with HDSDR, SDR-Radio, and many other programs which accept analog I/Q data streams
- Approximately $200 after currency conversion from GBP to USD

DX Patrol MK3

- 100 kHz to 2 GHz
- USB 2.0 connection
- Multiple band filters
- 3.2 Ms/s
  - 40 Mhz LO for HF downconversion
- Double-balanced diode ring mixer
- Separate HF and VHF antenna inputs
  - SMA connectors
- LED power and band indicators
- Supported by many Windows-based and Android SDR applications
- Approximately $115 after Euro-USD conversion

ELAD FDM-S1

- 20 kHz – 30 Mhz
  - 61.44 Ms/s
    - 3072 kHz I/Q channels at 32-bits/sample
    - 6144 kHz I/Q channels at 16-bits/sample
  - Direct Conversion
- USB 2.0 interface
  - Powered from USB interface
- Comes with FDM-SW1 all-mode Windows software
  - CW, LSB, USB, DSB, AM, SAM, DRM, FM and WFM
- Approximately $415 after Euro-USD conversion

FUNcube Dongle Pro+

- 150 kHz to 1.9 GHz (gap from 240 – 420 MHz)
- No drivers required
  - Native OS support on Windows, Linux and Mac OSX, both 32 and 64-bit versions
- Currently being used by a sea of volunteers to create ground stations to record and forward CubeSat telemetry
- More sophisticated than RTL-SDR dongles
  - Much lower noise floor
    - Preamplifier is often needed with RTL-SDRs
  - Better selectivity

- Software supported includes SDR#, SDR-Radio, CuteSDR and HDSDR
- Approximate $140 after EURO exchange

NetSDR by RFSpace

- 10 kHz to 32 MHz with 16-bit ADC at 80 Ms/s
- Digital Down Converter on Xlinx FPGA
- Optional 10 MHz Reference input
- Ethernet 100 base-T interface
- Multiple input filters
- Output I/Q sample rate: 12.5 kHz to 2 MHz
- Output I/Q bandwidth: 10 kHz to 1.6 MHz
- MDS: -128 dBm
- Software: SpectraVue (included), SDR#, SDR-Radio, SdrDX and OsmocomSDR
- $1449

Perseus by microtelecom

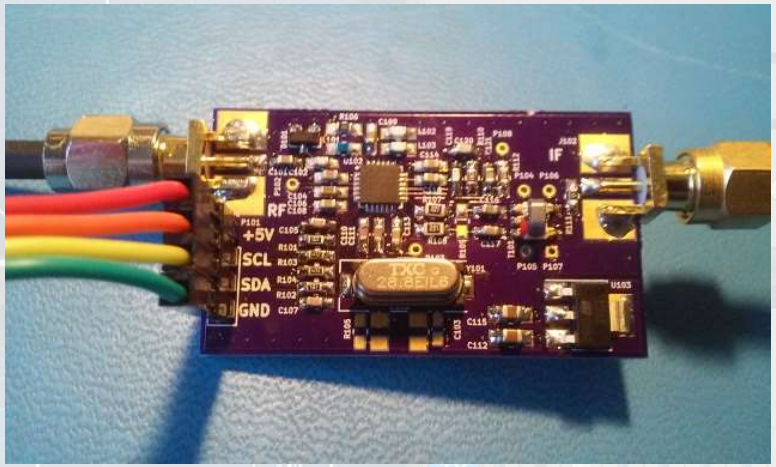
- 10 kHz – 40 MHz; 87.5 – 108 MHz FM downconverter
  - Can be used as a 10 kHz-40 MHz spectrum analyzer with 100 dB dynamic range and 10 kHz RBW (Normal display is up to 1600 kHz)
- Direct sampling at 80 Ms/s, 14-bit ADC
  - FPGA-based digital down converter
- 10 band preselection filters
- +30 dBm IP3; 3rd order dynamic range of 100 dB (SSB)
- USB 2.0 interface
- Included software allows the radio to be operated remotely over the Internet or user LAN
- $960

RTL-SDR

- Originally used for reception of DVB
  - 75 Ohm impedance, but only 0.177 dB loss due to mismatch
- 2.4 – 2.8 MS/s
- 8-Bit ADC
- Best value at http://www.rtl-sdr.com/buy-rtl-sdr-dvb-t-dongles/
  - $24.95 ($20 w/o antenna)
  - USB connection
  - 1 PPM TCXO
  - Aluminum case
  - Includes antenna
  - 24-1766 MHz using down conversion
  - 500 kHz-24 MHz direct sampling
  - 3.2 MHz RX bandwidth

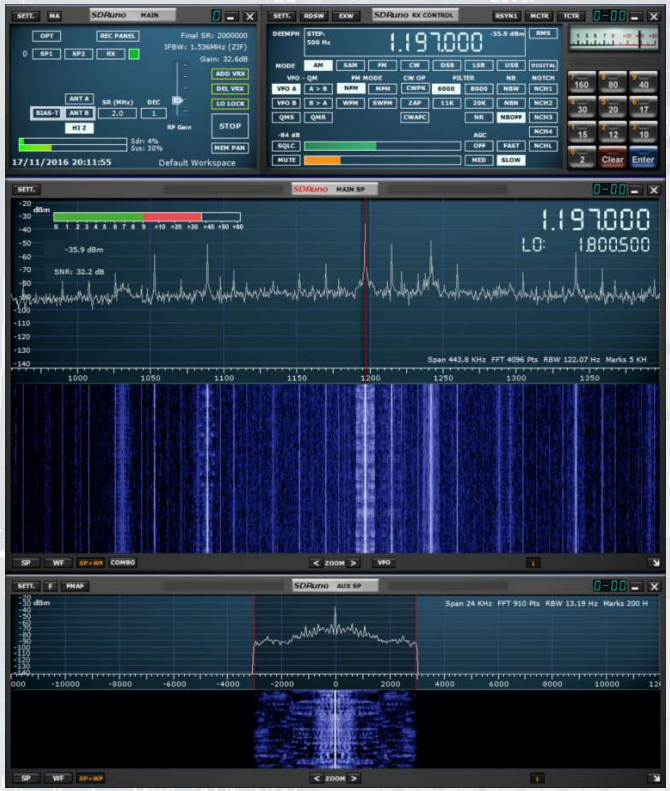
RTL-SDR R820T2 Breakout

- $20-25
- 1-1766 MHz
- USB Interface
- R820T2 is the tuner chip used in most RTL-SDR type dongles
  - Same chip is used in AirSpy
- Uses RTL2832U 8-bit ADC
  - AirSpy used a higher resolution and faster ADC
- SMA connectors
- 1 PPM TCXO
- Supports external ADC



SDRPlay RSP2

- 10 MHz of bandwidth covering 1 kHz to 2 GHz
- 3 software-selectable antenna inputs
- Powered over USB 2.0 interface
- 12-bit ADC; 10.66 Ms/s; 60 dB SNR
- 10 preselection filters
- Low noise software enabled/disabled preamp
- +15 dBm IP3 @ 3 MHz
- 0.5 PPM TCXO
- Datasheet:
  - http://www.sdrplay.com/docs/RSP2_Datasheet.pdf
- $169 with included SDRuno software

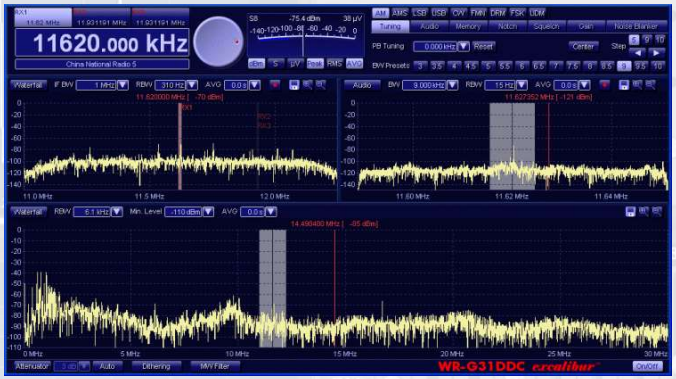


Cloud-IQ by RFSpace

- 9 kHz to 56 MHz direct sampling
- 24-bit I/Q streaming to PC over Ethernet
  - ADC: 122.88 MHz; 91 dB dynamic range
  - Built-in Internet server sends out demodulated information
    - Cloud mode audio rate: 16 kb/s to 64 kb/s
  - 1.8 Mhz I/Q sample rate
  - 56 Mhz wideband spectrum analyzer mode
  - MDS: -137 dBm/Hz
  - All mode: AM,FM,WFM,SSB,CW,SAM,DSB,ASK,OOK,PSK31,RAW IQ
- 2 Antenna input ports
- 2.5 ppm TCXO
- Software: RFSpace SpectrVue, SDR-Radio, SDR# and GNURadio
- $629

WinRadio WR-G31DCC (‘*EXCALIBUR*‘)

- 9 kHz to 50 MHz direct sampling, digital down-conversion (DDC) radio
  - Real-time 50 MHz-wide spectrum analyzer
    - 1.5 kHz RBW
  - 16-bit, 100 Ms/s ADC
  - +31 dBm IP3
  - 107 dB dynamic range
  - 2 MHz processing bandwidth
  - 0.5 ppm frequency stability
- USB 2.0 interface
- Includes proprietary application software for PC
  - Windows XP, Vista, 7, 8 and 10
- $850



SDR Transceivers

- Apache Labs ANAN-100B (https://apache-labs.com/)
- Apache Labs ANAN-100D
- Apache Labs ANAN-200D
- Apache Labs ANAN-8000DLE
- Crimson TNG (http://www.pervices.com/)
- ELAD FDM-DUO (http://ecom.eladit.com/)
- Elecraft KX3 (http://www.elecraft.com/elecraft_products_page.htm)
- Flex-5000/3000/1500 (http://www.flexradio.com/)
- Flex-6300/6500/6700
- Flex-6400/6400M/6600/6600M
- HackRF One (https://www.sparkfun.com/products/13001)

SDR Transceivers

- Icom IC-7300 (http://www.icomamerica.com/en/products/amateur/hf/7300/default.aspx)
- Icom IC-7610 (http://www.icomamerica.com/en/products/amateur/hf/7610/default.aspx)
- Odyssey TRX (http://ody-sdr.com/)
- SunSDR2 Pro (https://sunsdr.eu/product/sunsdr2-pro/)
- Zeus ZS-1 (http://www.ssbusa.com/ZEUSWEB.html)
- Lunaris-SDR (http://ceda-labz.com/main/productdetail/30)

Apache Labs ANAN-100B – HF + 6M

- $1995
- 100W MOSFET PA w. PureSignal feedback network
- 7 LPF; 5 HPF on front end
- 6M LNA
- 2 fully independent receivers
  - Up to 384 kHz of displayed spectrum
- Low level TX for transverter applications
- Very low phase noise (-132 dBc/Hz @ 1kHz)
  - 10 MHz GPSDO reference input
- Ethernet Interface

Apache Labs ANAN-100D – HF + 6M

- $3489
- DDC/DUC architecture
- Dual ADCs
  - Permits phase coherent receiver operation
    - Dual phase-synchronous 16-bit ADCs
    - Beam-forming; diversity reception
  - 7 independent receivers per ADC
- Cyclone IV FPGA
  - Room left for SW for standalone operation
- 128 MB flash
- 32 Mbit synchronous RAM

Apache Labs ANAN-200D – HF + 6M

- $4289 Limited Time: **$2999.9**
- Two independent phase-coherent 16-bit DDC front ends
  - 125 dBm Receiver Dynamic Range
  - 1.152 MHz of display spectrum with .732 Hz resolution
- PureSignal built-in (-48dB IMD3 @ 14.2 MHz, 100W)
  - DUC transmitter
- 10 MHz, 100 ppb reference oscillator
  - Phase noise: -149 dBc @ 10 kHz
  - External reference input
    - Auto detection
- Four user-configurable analog inputs
  - ALC, SWR, etc.

Apache Labs ANAN-8000DLE – HF + 6M

- $3995
- 200W LDMOS transmitter
  - Ultra-linear: transmit IMD below -70 dB
- RMDR (Reciprocal Mixing Dynamic Range) 116 Db @ 1 kHz
- TCXO +/- 0.1 ppm
- Frequency resolution: 1 Hz
- 10m & 6m LNAs
- DDC
- Dual 16-bit ADCs
  - 7 receivers per ADC
- Front panel informational display

Crimson TNG

- Price: Don’t ask
- DC to 6 GHz
- DDC/DUC on FPGA
- 1200 MHz RF display bandwidth
- Two quad-channel 16-bit DACs
  - 2500 Ms/s
- Four dual-channel 16-bit ADCs
  - 370 Ms/s
- Altera Arria V FPGA SoC
- 20 Gbps transfer rate

ELAD FDM-DUO

- $1285
- 10 kHz to 54 MHz
- Direct sampling DDC (122.88MHz ADC: LTC2165 16-bit)
- 5W transmitter
- Firmware upgradable
- USB control interface
- Standalone operation
- 10 MHz reference input
- Dual VFOs

Elecraft K3S/KX3 – HF + 6M

- K3S assembled price: $2850 (K3S/100-F); $2250 (K3S/10-F)
  - DDC architecture
  - Dual 32-bit DSPs
  - Excellent receiver specs
  - Many options available
- KX3 assembled price: $1025
  - Quadrature down-sampling mixer
    - Compatible with many SDR applications
  - 10W transmitter
  - Built-in key
  - Internal 8 - AA battery holder
  - 1 Hz tuning resolution
  - 32-bit DSP

Flex-5000/3000/1500

- Discontinued
  - Used pricing on ebay
    - Flex-5000A: $900-1500
    - Flex-3000: $700-900
    - Flex-1500: $350-450
- HF + 6M (VHF/UHF optional in 5000A)
- 5000A: 100W, Firewire connection
- 3000: 100W, Firewire connection
- 1500: 5W, USB connection
- PowerSDR control software

Flex-6300 HF + 6M Transceiver

- Flex-6X00 Signature Series are Flex Radio Systems' first SDR transceivers with ALL processing done in the radio
  - First for Amateur Radio transceivers
- Recently discontinued
- Receiver has one Spectral Capture Unit (SCU)
  - Direct Digital Sampling
    - 122.88 Ms/s, 16-bit ADC
  - 2 Slice Receivers
- Transmitter 1-100W
  - Direct Digital Up-conversion
- Ethernet interface
- SmartSDR control software

Flex-6400/6400M HF + 6M Transceiver

- $2000/$3000 – “M” version has color LCD control head built-in
- 2 independent receivers (“Panadapters”)
  - Up to 7 MHz in each spectrum/waterfall display
- Digital mode operation w/o sound cards, cables
  - Standard in all 6000 Signature Series radios
- 1920 x 1200 Color LCD
  - HDMI output on “M” model
- SmartSDR control software
- Options:
  - ATU: $299
  - Extended TX Coverage (e.g., MARS): $399
  - Internal GPSDO: $699

Flex-6500 HF + 6M Transceiver

- $4000
- Direct Digital Sampling
  - One SCU
    - 4 Slice Receivers
  - Wide frequency range: 30 kHz to 72 MHz
  - Maximum Panadapter Width: 14 MHz
  - 16-bit ADC; 245.76 Ms/s
  - Frequency resolution: 1 Hz
- Direct Digital Up-conversion transmitter; 1 - 100W
- 0.5 ppm TCXO with 10 MHz reference input or internal GPSDO
- Built-in automatic antenna tuner
- Ethernet control interface with SmartSDR software