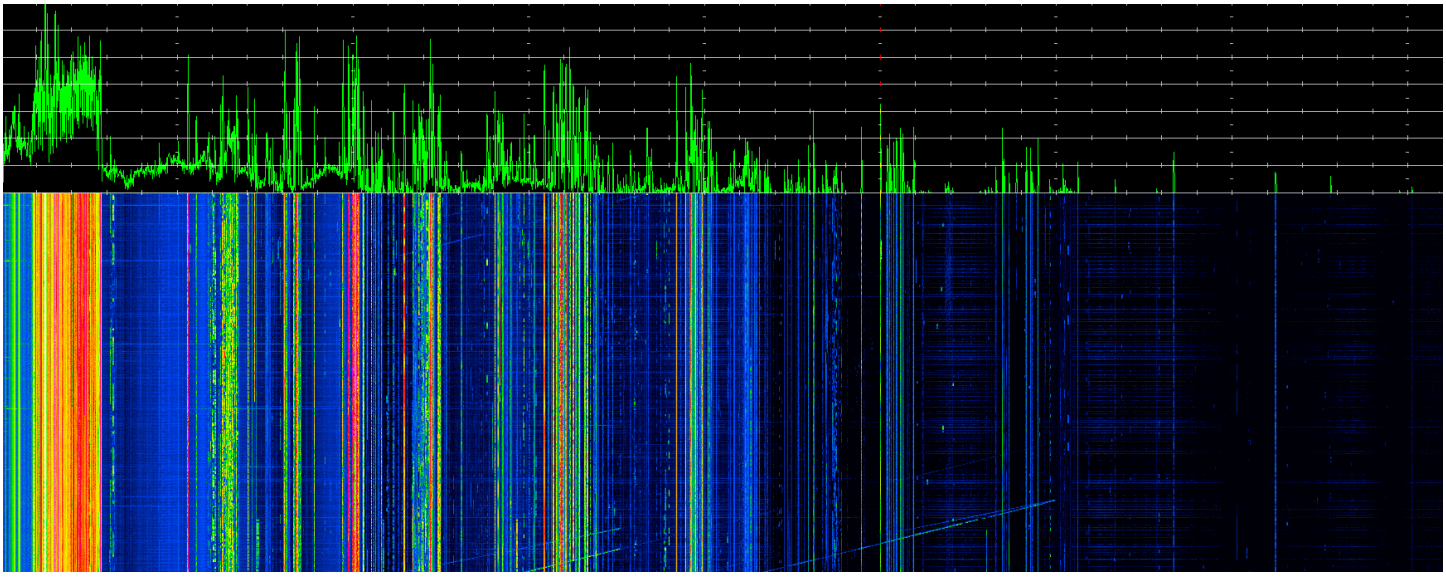
RFSPACE CLOUDSDR

HF/VHF/UHF SDR AND REMOTE RADIO



RFSPACE CLOUDSDR

INTRODUCTION

The RFSPACE CloudSDR is a high performance, direct sampling software radio with an ethernet interface. It offers outstanding low distortion, low noise and low spurious characteristics. The CloudSDR radio was developed for both direct streaming of I/Q data to the PC, as well as, remote radio monitoring anywhere in the world. It performs spectrum analysis, demodulation, and streaming to a computer.

The CloudSDR features two RF inputs. The low frequency port operates from 9kHz to 56 MHz and it is direct sampled at 122.88 MHz by a high performance ADC. The high frequency port uses a wide-band silicon tuner downconverter to cover the 56 MHz to 1.0+ GHz ranges. Both ports have built-in variable attenuation, preselection and surge protection. The CloudSDR is designed to be connected directly to antennas without the need of external amplifiers or extra filtering.

The CloudSDR handles all of the streaming via ethernet. It offers an I/Q streaming mode where the radios sends 24 bit I/Q pairs to the PC for processing. This I/Q mode offers one of the cleanest and highest dynamic range baseband signals that we have seen in any commercial receiver. The I/Q balance, DC spur, IMD and phase noise performance is superb. This mode of operation has a very high ethernet bandwidth utilization which limits the use to direct to PC connections.

In addition to the I/Q streaming mode, the CloudSDR has a low bandwidth, Cloud mode for internet operation. In this mode, the radio will capture spectrum data as well as demodulate the signals of interest. The radio has built in demodulators for AM, SAM, LSB, USB, WFN, FM, CW, ASK, and OOK. The radio will compress the demodulated waveform using the high performance and phase continuous G726 and G711 codecs. The raw 64 kbit/s stream can also be selected if that is preferred.

The CloudSDR's remote mode offers a variable bandwidth spectrum analyzer with adjustable spans up to 10 MHz wide and simultaneous demodulation. The spectrum information update rate can be adjusted up to 10 Hz or turned off to limit the bandwidth utilization. In addition, the built-in squelch can be used to limit data transmission when no signals are present.

Features

- Wideband spectrum analyzer mode offers 56 MHz wide spectral captures in both 2D, 3D and waterfall formats.
- 9kHz low end frequency range allows SONAR, VLF and ultrasound applications.
- External 10 MHz reference input allows multiple radios to be locked to the same frequency reference like Rb, Cs and GPS disciplined oscillators. An internal TCXO takes over when no external reference is detected.
- The CloudSDR has both external and internal triggering modes for synchronization of multiple radios as well as triggering at specified intervals. The internal trigger mode allows the phase to be adjusted, as well as the frequency in steps of 1nHz.
- The built-in remote server allows the CloudSDR to be placed anywhere in the world. A PC running Windows, Linux, Android or MacOS is able to access the radio with very low latency. It does not require a PC at the server side and the server is available within 15 seconds of power on.
- An Android application has been developed to access the CloudSDR in remote mode. In addition, an open source client is available license free for Windows, Linux and MacOS. Programming is extremely easy since all of the DSP, FFTs and display scaling is done server side.
- The demodulated audio is available at the radio side to monitor or record the audio. The audio port switches to a 192 KHz capable analog I/Q output when in I/Q streaming mode.

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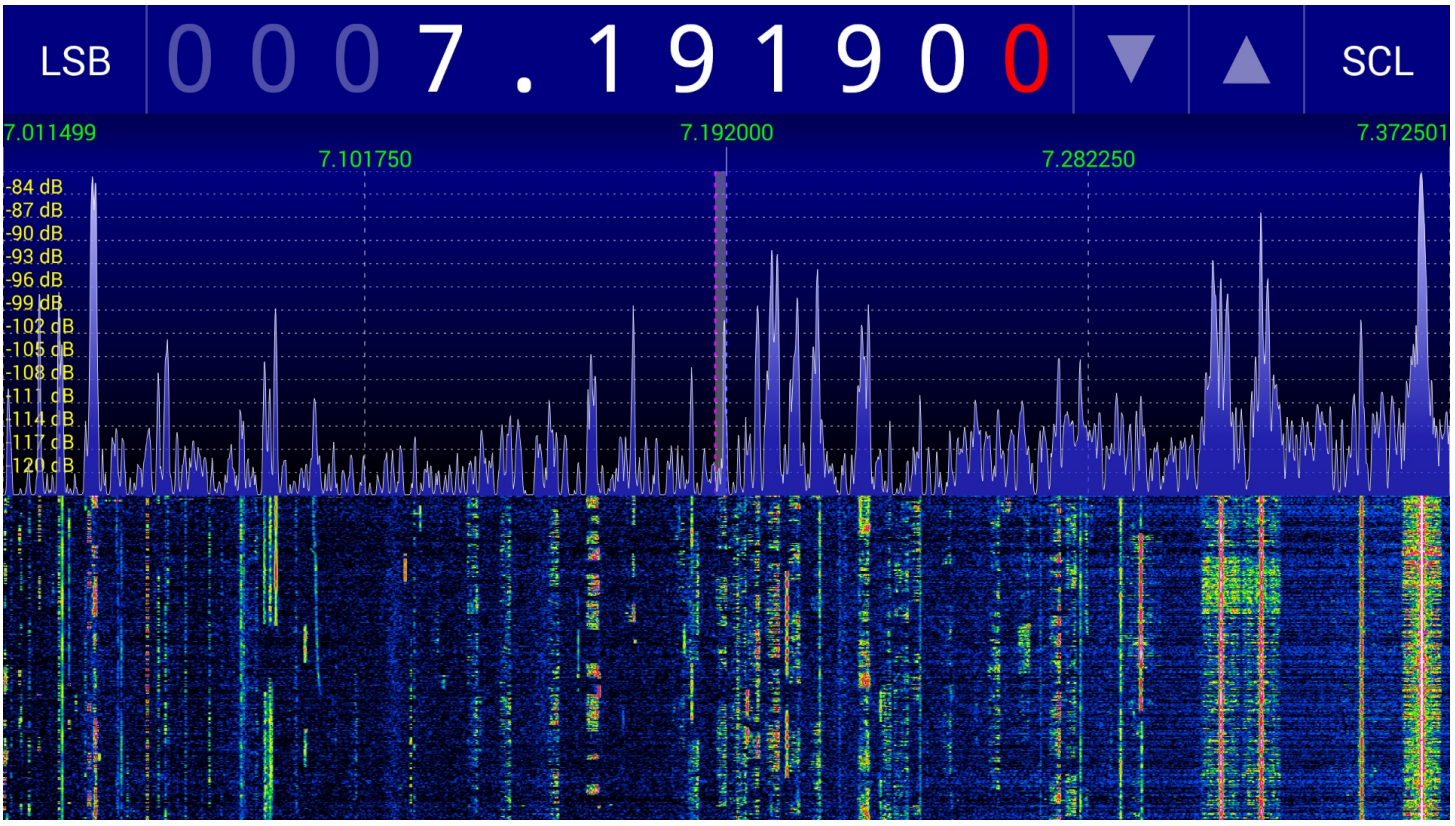
REMOTE OPERATION

The RFSPACE CloudSDR is designed for streaming I/Q spectrum data to a PC or to be remotely located anywhere on the internet. The built-in remote server allows the CloudSDR to serve as a remote receiver node or receive gateway anywhere in the world. The fact that the CloudSDR does not require a computer, makes it a highly reliable. During remote operation, the radio handles all of the demodulation, compression, directory listing, spectrum FFT processing and packetizing. The client application just sends the center frequency, demod mode and other settings and gets the formatted audio and spectrum packets. All of the DSP is handled server side. In order to make custom application development easy, RFSPACE supplies an open source and license free RemoteSDRClient application using the QT framework. It can be compiled for Windows, Mac OS and Linux. RFSPACE also supplies an Android client that has been optimized for 3G and LTE connections.

The CloudSDR also includes an RS-232 port on the back. This port is accessible remotely from the client application. This port can be used to control remote, bidirectional devices anywhere in the world. User can access remote RF antenna switches, GPS receivers, temperature and humidity sensors, transmitters or even Arduino boards from the client.



Spectrum display screen of the SDRanywhere Android application used with a remote CloudSDR.

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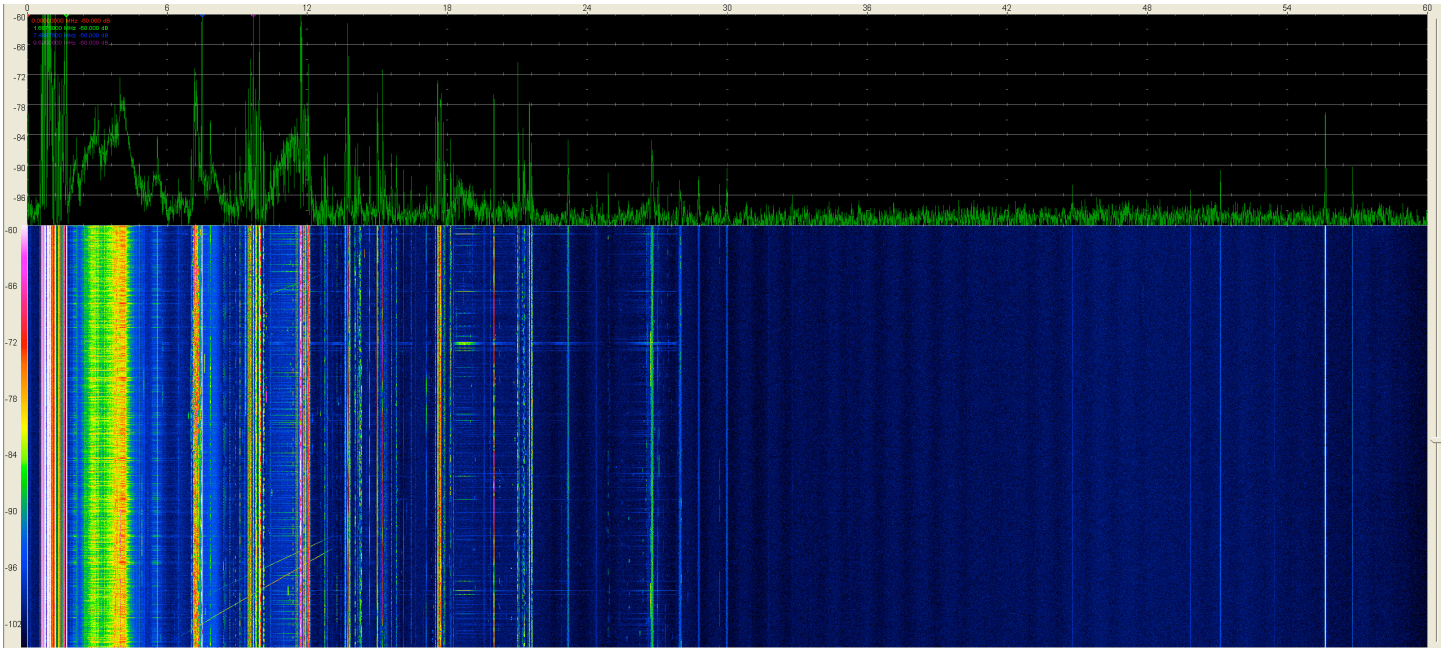
SPECTRUM DISPLAY

The RFSPACE CloudSDR has three different spectrum analyzer modes. These are the realtime complex and FIFO real and complex modes. These modes are all supported by the SpectraVue software. The first mode is a realtime complex mode. This mode offers adjustable spans between 10 kHz and 2 MHz wide. The FFT size is adjustable between 2048 and 2097152 points. At the lower sample rates, resolution bandwidths (RBW) of less than 1mHz are supported. At the 2.048 MHz sample rate, the minimum RBW is 0.98 Hz. This mode is supported by both the internal trigger and external trigger functionality. The second mode of operation is a real data mode that offers a display that is 61.44 MHz wide. The usable spectrum is limited by the antialias filter to about 56 MHz. This mode offers a very fast display with up to 262144 point FFTs. The minimum RBW in this mode is around 234Hz. This mode can be used to monitor the whole HF/6m band at once. When used at frequencies above 56 MHz, this mode becomes 8 MHz wide due to the downconverter IF filter width. This allows, the monitoring of 8 MHz wide spectrum analysis anywhere in the 56 - 1000 MHz+ range. The third mode is an adjustable bandwidth complex mode with 131072 point FFTs. This mode allows spectral scans from 2-10 MHz wide with resolution RBW of less than 100 Hz at 10 MHz wide. This mode is also supported by the triggering functionality to allow the capture of repetitive, wideband radar signals for example.



Spectral scan of the whole 0-60 MHz HF spectrum showing ionospheric sweepers around 9 MHz.

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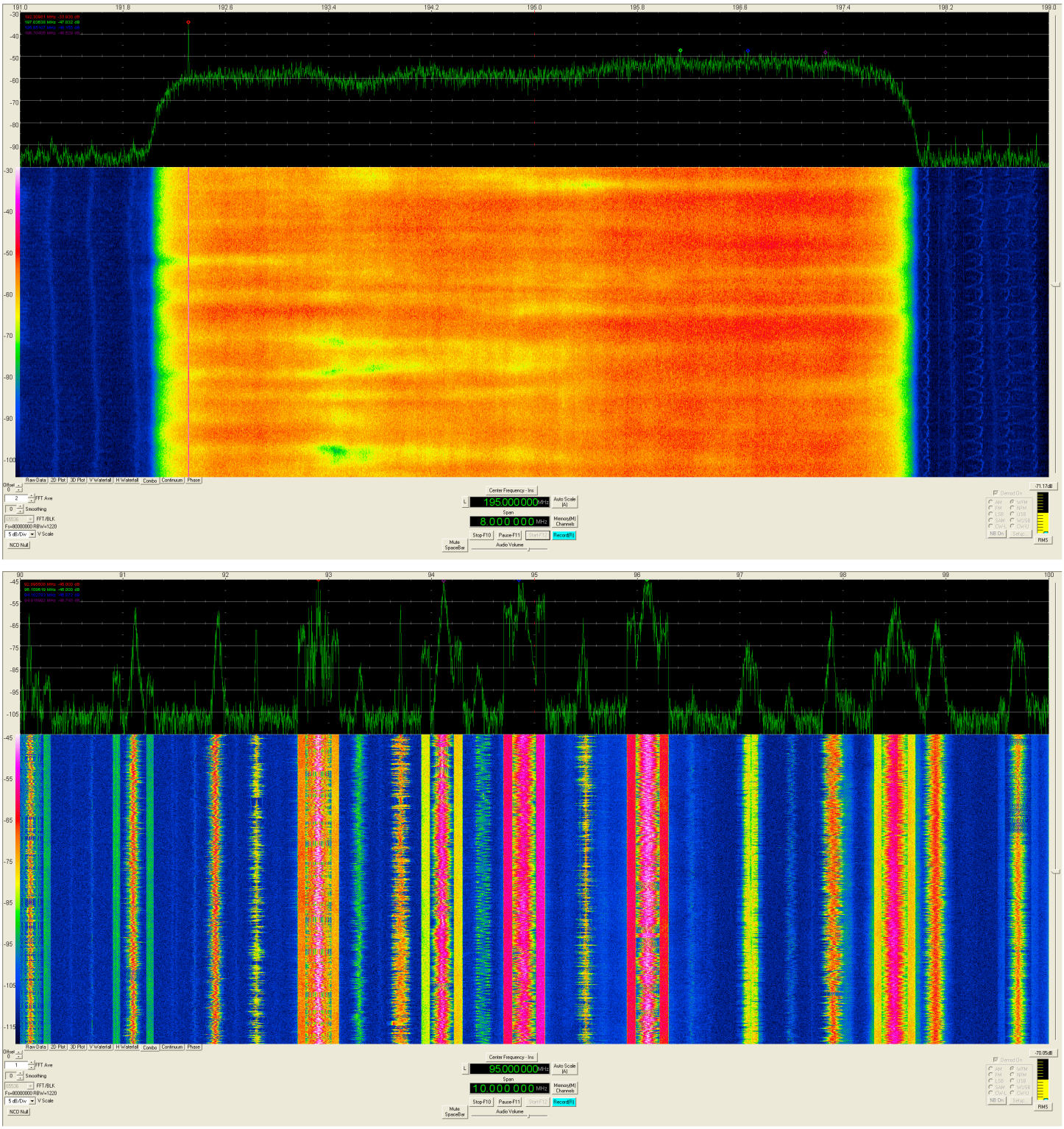

Spectral scan of an ATSC TV signal and the FM broadcast band, 10 MHz wide using the non-realtime real mode.

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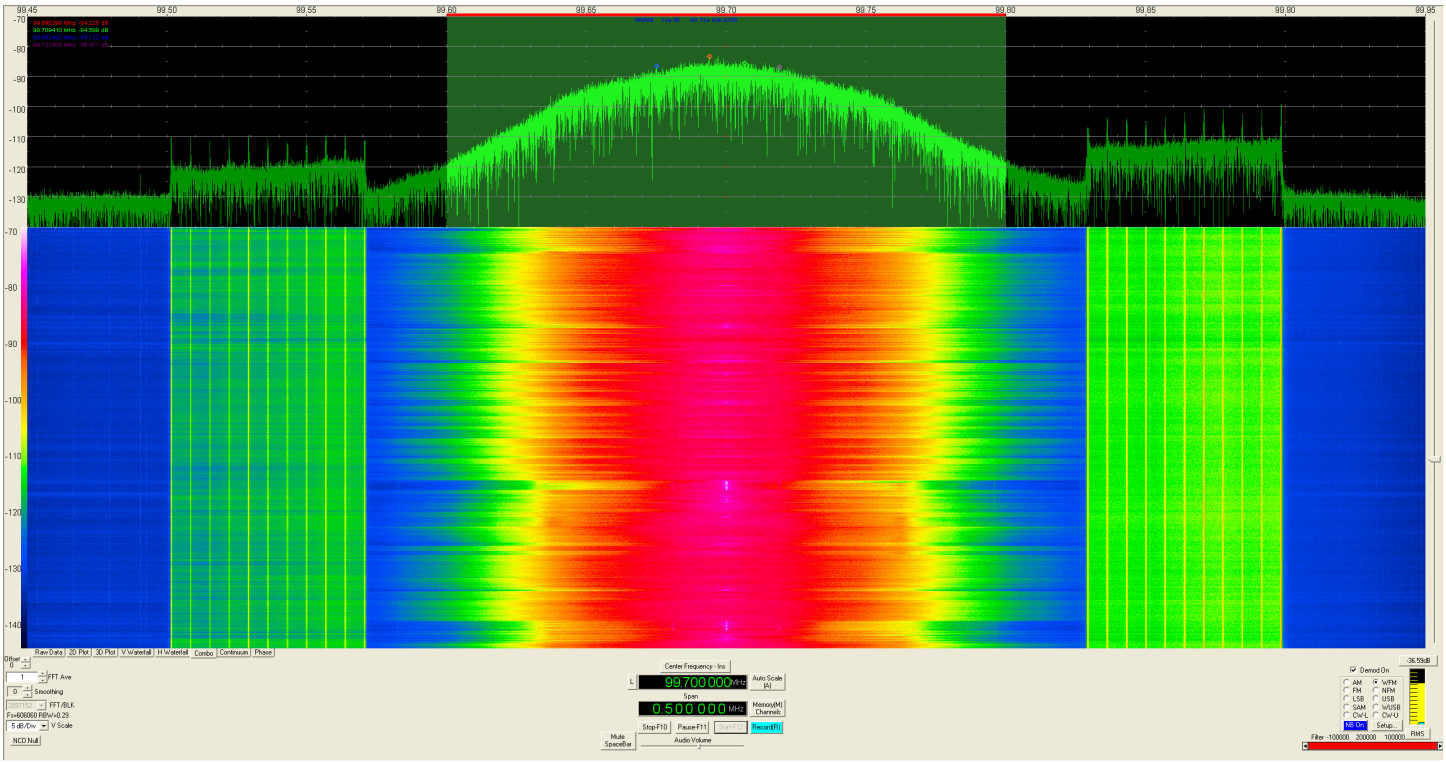

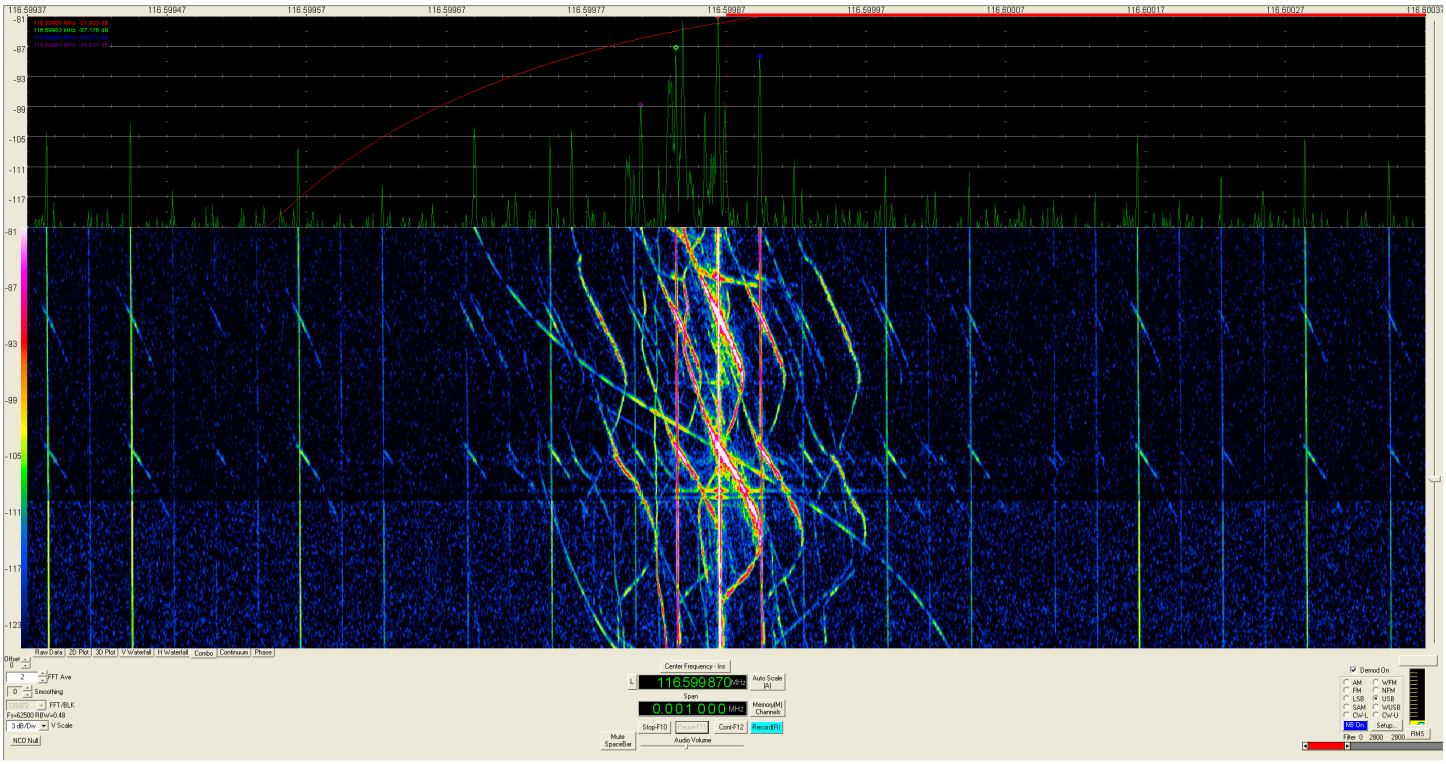

Spectral scan of an FM broadcast station (top) using the realtime complex mode with 2097152 point FFT and 0.29 Hz RBW. Spectral scan of aircraft scatter on a VOR signal (bottom) at 116 MHz with a RBW of 0.48 Hz and locked to GPS.

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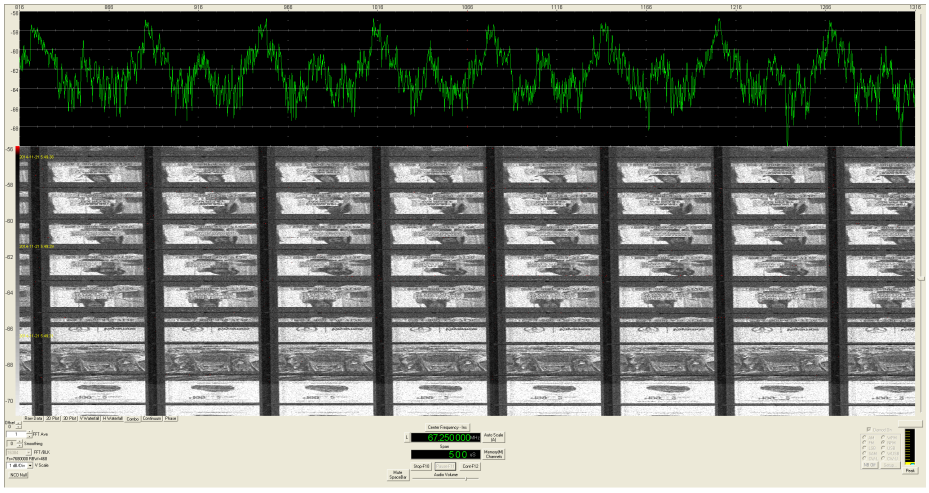
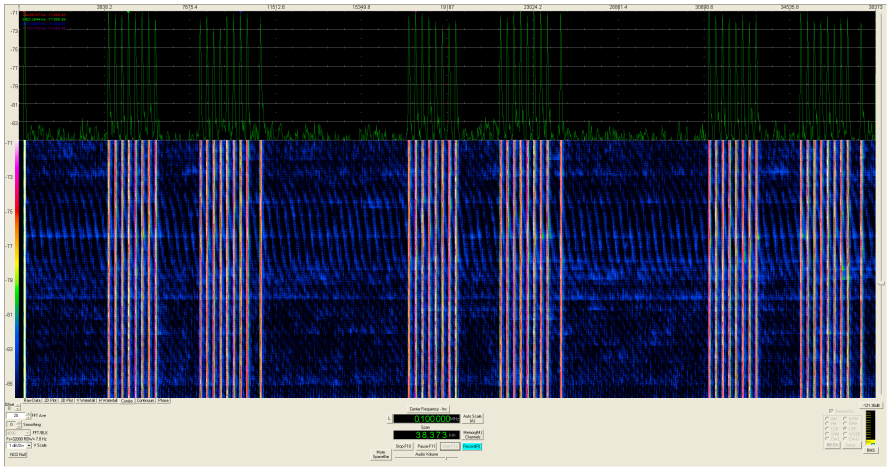
TRIGGER, REFERENCE INPUT AND PULSE OPERATION

The RFSPACE CloudSDR includes a highly versatile trigger circuitry. It offers both an external trigger input and internal generated trigger modes. The internal mode is adjustable from 1nHz to 100 Hz in steps of 1nHz and includes adjustable phase offset. This mode coupled with the pulse mode (I/Q magnitude over time) allows for the detection and display of time varying waveforms like radar, ASK and line rate interference. The pulse mode also includes the ability to pulse compress chirped or other linear FM waveforms by entering the correct chirp rate in MHz/s. This is done in the supplied SpectraVue application by using fast correlation. The CloudSDR also includes a 10 MHz reference input that phase locks the internal ADC and downconverter clocks. This features allows the synchronization of many CloudSDR radios in systems that require multiple synchronized antenna inputs. The ethernet ports of all the radios can be combined using regular ethernet routers or switches and sent to a single PC for processing.



6 MHz wide NTSC signal internally triggered.



Loran-C signal at 100 kHz synchronized to the correct GRI in the pulse mode of SpectraVue.

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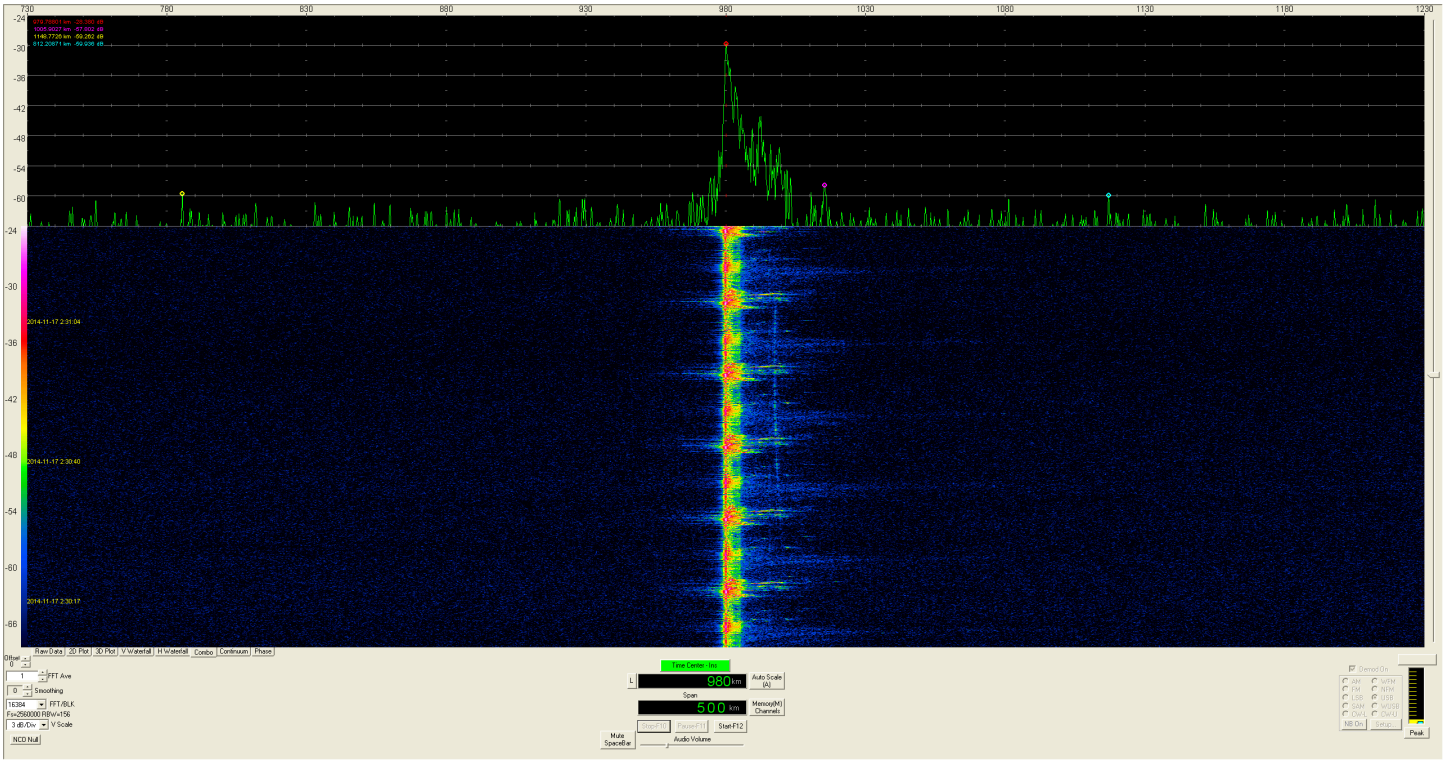
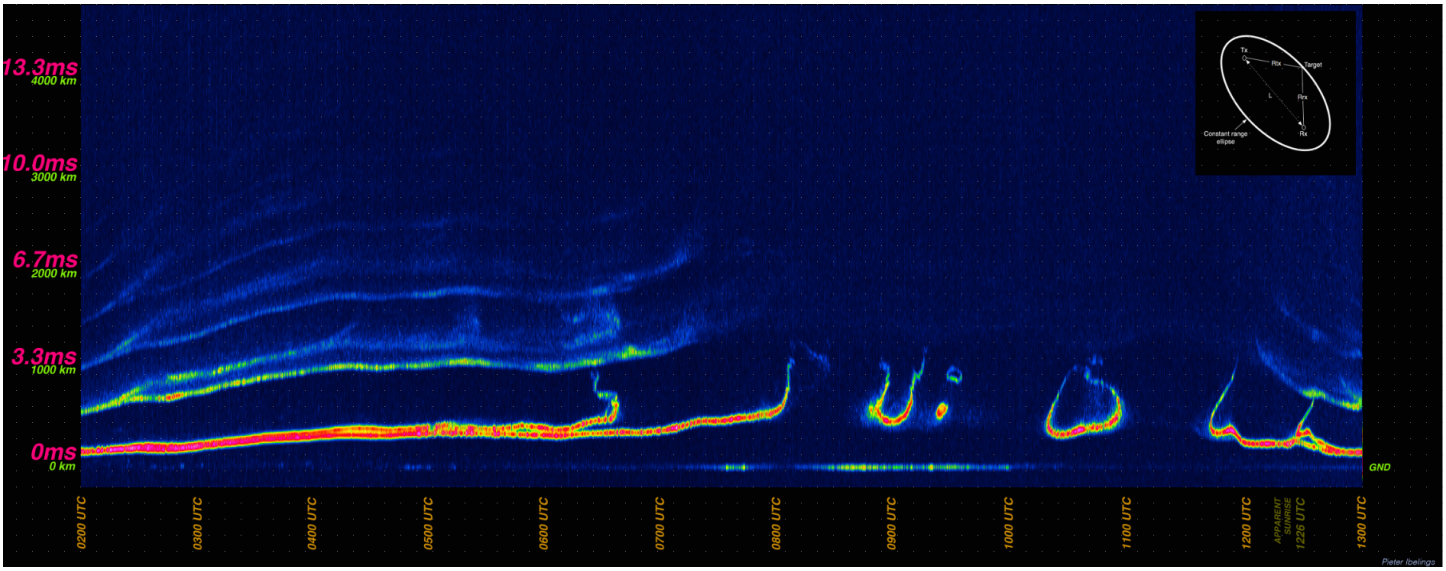


An air traffic ARSR-4 radar at 1271.5 MHz, synchronized using the internal trigger and pulse compressed with the de-chirp functionality in SpectraVue. Once the pulse is compressed, it is easy to see an airplane scatter about 50 km away.



This image shows a CODAR LFM-CW signal at 4.543 MHz synchronized to 1 Hz PRF and de-chirped using SpectraVue. The direct path is seen as a faint line on the bottom while all of the ionospheric paths are shown above. The plot range is 5000 km in the vertical axis and 11 hours in the horizontal axis. This was a passive radar reception.

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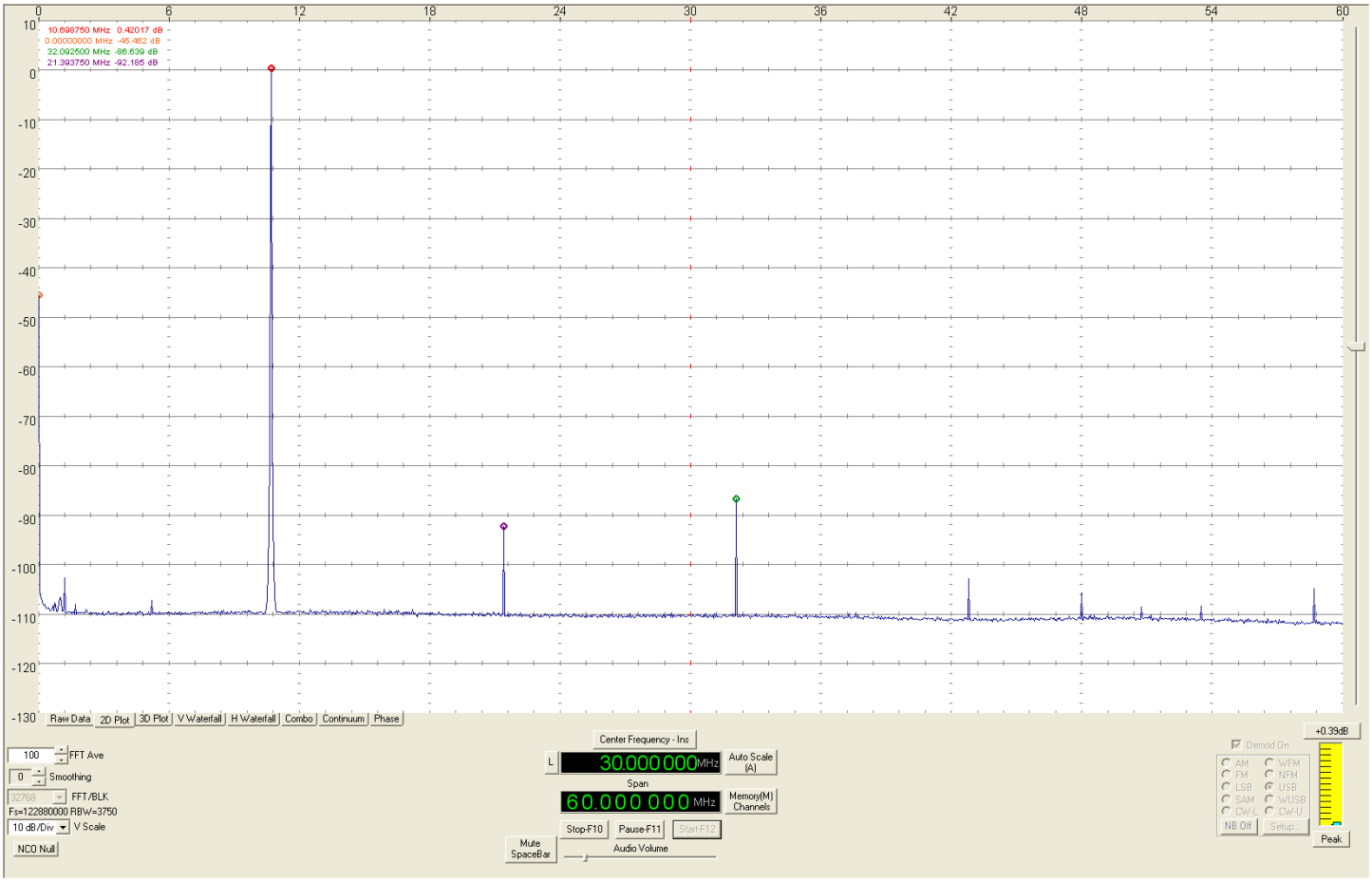
PERFORMANCE PLOTS

The RFSPACE CloudSDR has a highly optimized input front end coupled with a 14 bit ADC. The performance is superb. At an input level of -1dB below clipping and with a 10.7 MHz test signal, the HD2 components are typically -92 dB down while the HD3 components are -87 dB down. The minimum discernible signal at 10 MHz is -138 dBm typ. with the ADC in the high gain setting (PGA=on).



HD2 and HD3 performance with a 10.7 MHz input signal at -1dB from clipping point.

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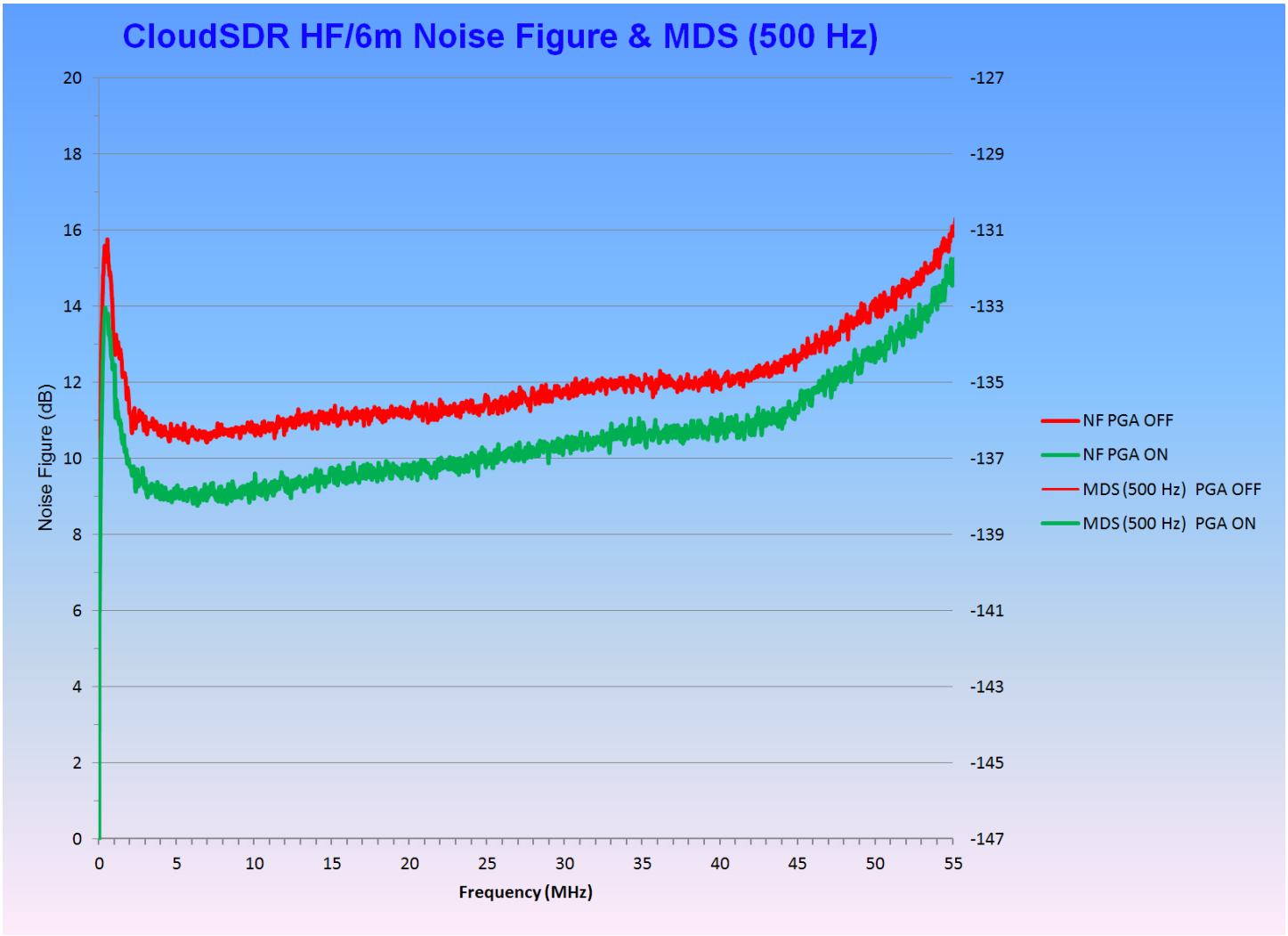
The CloudSDR is designed with a heavily shielded aluminum enclosure around the RF sections. This minimizes noise and other internally generated spurs. In addition, the coupling of the digital ADC data back to the input is kept to a minimum. The ADC data is randomized at the ADC and de-randomized at the FPGA so that no digital leakage shows up as IMD products. The CloudSDR direct sampling port has very low spurious over the whole .009 MHz - 56 MHz range.

The CloudSDR direct sampled port uses low noise, low distortion circuitry designed for direct connection to antennas. The port is protected against surge and ESD events. There is current and voltage limiting circuits, as well as, a spark gap and a clip indicator LED. When the radio is not in use, the attenuators are engaged for protection. The input circuitry also uses high quality relays to increase reliability in surge environments and to minimize distortions.



The direct sampled 0.009 MHz - 56 MHz port sensitivity.

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WINDOWS, MAC, LINUX AND ANDROID APPLICATIONS

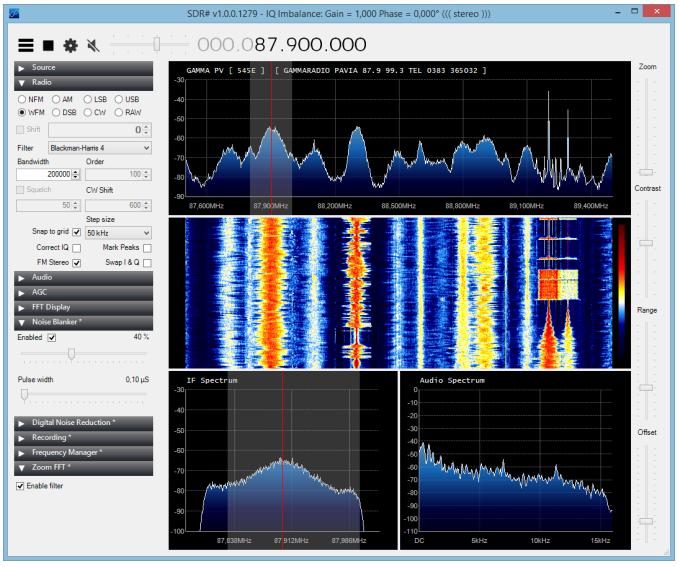
The CloudSDR is supported by many cross platform applications. The radio ships with the latest version of the RFSPACE SpectraVue software for Windows. SpectraVue allows the processing, recording and display of the I/Q data stream. In addition, it includes the latest triggering functionality for triggered captures. The pulse compression functionality for radar processing is also included. The SpectraVue application supports high resolution spectral analysis up to 2 million point FFTs and mHz resolution BWs.

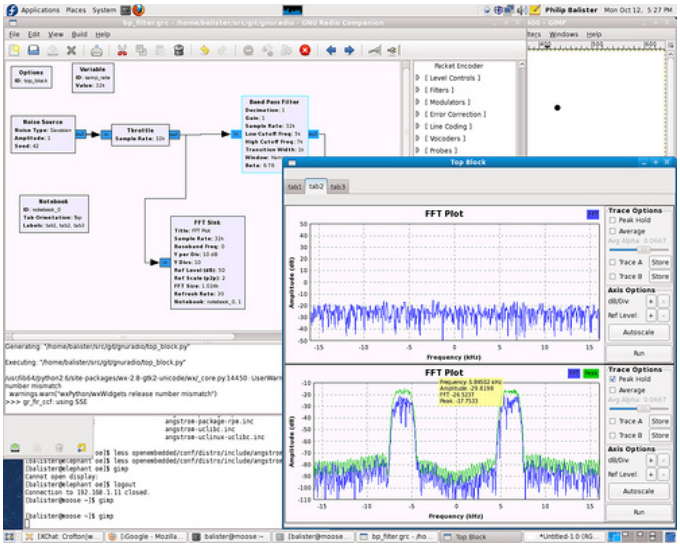
RFSPACE supplies an open source CuteSDR application for direct IQ access to the IQ data stream in Linux, MacOS and Windows. This application is open source.

For remote access, the radio includes the open source RemoteSDRClient application written in QT. This application is available compiled for Linux, Mac OS and Windows. This application is a great starting point for users writing their own custom client applications.

The Android application SDRanywhere is available for download. It allows the remote operation of the CloudSDR using an Android phone or tablet for RX applications.

The CloudSDR is supported by popular third party applications like SDR-Radio, SDR#, and GNUradio.





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SPECIFICATIONS

KEY SPECIFICATIONS		
Direct sampling frequency range	0.009 - 56 MHz	
Silicon tuner frequency range	56 MHz - 1000 MHz	*usable to 1600 MHz*
ADC Fs / SNR / SFDR	122.88 MHz / 77.3dBFS / 98 dB	*12.55 bits ENOB*
I/Q mode output sample rates	0.01 MHz - 1.288 MHz	*24 bit resolution*
Spectrum analyzer I/Q modes	2.458 MHz - 12.288 MHz	*16 bit / 16384 FFT points*
Spectrum analyzer real mode	56 MHz wide / 122.88 MHz sample rate	*16 bit / 32768 FFT point*
Minimum discernible signal DS port	-137 dBm/Hz / -135 dBm/Hz	*in 500 Hz BW PGA on/off at 15 MHz*
Minimum discernible signal tuner port	-139 dBm/Hz	*in 500 Hz BW max gain at 500 MHz*
Remote mode audio compression	G726,G711, Raw	*phase continuous*
Remote mode demodulation	AM,FM,WFM,SSB,CW,SAM,DSB,ASK,OOK	
Remote mode audio rates	16 kb/s - 64 kb/s	audio is 8 KHz sample rate
Remote mode spectrum display	0.001 MHz - 10 MHz wide / 4096FFT points	*with simultaneous demod*
Audio line output	1Volt p-p	I/Q output in realtime modes
10 MHz frequency reference input	0.8 Volt - 3.3 Volt p-p	1.0 V typical
TCXO	<2.5ppm over 0-40 °C	*auto-detect with no ext reference*
Trigger input level	3.3 Volt LVCMOS/LVTTL	*1kOhm input impedance*
Remote server boot time	15 seconds	*availability online after power cycle*
Power comsumption	5 Volts - 1.3 Amps	radio with rx only configuration
Compliance	CE, FCC, IC	
Dimensions	6.3 x 5.0 x 1.2 inches	
MSRP	$1499	US pricing. International pricing may vary.
Warranty	1 year parts and labor.	