An Introduction to Software Defined Radio

• What is it?
• Why do I want one?
• How do I choose one?
What is an SDR?

• A radio communication system where many components that have been traditionally implemented in hardware...
  
  (e.g. mixers, filters, amplifiers, modulators/demodulators, detectors, etc.)

...are implemented by software on a PC or embedded system.

• The hardware portion consists of pre-selection filters, possibly some IF filtering and a Analog-to-digital converter
Why do I want one?

Top Ten List

1. True general coverage
2. Work one frequency and still monitor the band (or another band!)
   - Panadapter (suddenly your eyes can do 1000X what only your ears could do previously, one signal at a time!)
3. Filters! (brick-wall envelopes... improving all the time with s/w upgrades)
4. Audio and IF Digital Signal Processing (DSP)
5. Harness the power of your existing Computer
6. Multiple VFOs and/or virtual receivers
7. Record large bandwidths of the spectrum and tune later!
8. Record/playback of audio from a specific signal
9. Allows you to explore new applications:
   - Digital modes, WX satellites, radio astronomy, aircraft monitoring, digital stations, TV, DAB, Ionosondes! etc etc
10. Can you ever have too many receivers?
Application Examples
Digital Decoding
Fldigi NBEMS (Narrow Band Emergency Messaging System)

Credit: Jeff Kopcak, k8jtk

Fldigi: [http://www.w1hkj.com](http://www.w1hkj.com)

Also supports DSD, DSD+, MultiPSK, DM780 and more via VAC and CAT control

...and WEFAX Decoding

Credit: Erik Mikkel Wied

www.sdrplay.com
ADS-B decoding example using Dump1090 and VRS

Credit: Max Santos, AC5PY
Satellite working

WD9EWK VHF crossed dipole & Tablet + RSP for telemetry
NOAA Weather satellite (137 MHz) - Wxtoimg (RSP1)

User pictures from the facebook group:
www.facebook.com/groups/sdrplay/

Wxtoimg:
http://www.wxtoimg.com

Credit: Jeff Broughton, WB8RJY

Credit: Sefi Merkel
High Resolution satellite images (1.7GHz)
RSP2 ..including latest GOES-16
SDRplay forum on Sat imaging

How to get some very impressive GOES High Resolution Satellite images using the RSP2 and SDRuno

*Geostationary weather satellite image reception is more challenging than APR weather satellite image reception, but can be achieved well using an SDRplay RSP2 as described in this new post on our forum.

The author writes: "Before getting started in putting together a receiving system for HRRT and LRTI images, it is a good idea to..."
Tune in to Jupiter!

RECEIVING JUPITER NOISE BURSTS WITH AN SDRPLAY RSP1

Over on YouTube user MakingNoise has uploaded a video showing him receiving some noise bursts from Jupiter with his SDRplay RSP1. The planet Jupiter is known to emit bursts of noise via natural radio (seem) powered partly by the planet's interaction with the electrically conductive gases emitted by, one of the the planets moons. When Jupiter is high in the sky and the Earth passes through one of these radio layers the noise bursts can be received on Earth quite easily with an appropriate antenna.

In his video MakingNoise shows the 10 kHz of waterfall and audio from some Jupiter noise bursts received with his SDRplay RSP1 at 2319 kHz. According to the YouTube description, it appears that he is using the UTRA-2 radio telescope which is a large Ukrainian radio telescope installation of an array of 2640 dipoles. A professional radio telescope installation is not required to receive the Jupiter bursts (a backyard dipole tuned to ~20 kHz will work), but the professional radio telescope does get some really nice strong bursts as seen in the video.

Jupiter 2017.03.04 RSP 1 UT1-2
Doubles as a new piece of RF lab kit: an RF Power meter – get one for work or play!

Within 1dB accuracy!

Using the SDRplay RSP2 for versatile RF Power measurement

www.SDRplay.com
SDR hardware
**SDR Variety**

- **8-bit Dongles**
  - $10 – 100
  - Low performance
  - Introductory

- **General Purpose**
  - $100 – 200
  - Good performance
  - Wide Coverage
  - RSP, Airspy etc

- **High End**
  - $500 – 1000s
  - High performance
  - Specialized functionality
  - RF Space, Flex, ELAD etc

- Price
  - Small cost adder
    - Big performance gain
  - Large cost adder
    - Modest performance gains

www.sdrplay.com
Review of SDR receivers – what to consider:

• **Frequency Range:** The range of frequencies the SDR can tune.

• **ADC Resolution:** Higher is better. More resolution means more dynamic range, less signal imaging, a lower noise floor, more sensitivity when strong signals are present and better ability to discern weak signals.

• **Instantaneous Bandwidth:** The size of the real time RF chunk available.

• **RX/TX:** Can the radio receive and/or transmit?

• **Preselectors:** Analogue filters on the front end to help reduce out of band interference and imaging.

• **Software:** Is your favourite package supported? Does manufacturer provide?

• **Price**
SDRplay Receivers – RSP Family

- Continuous SDR receiver coverage from VLF to 2 GHz
- All the amateur radio bands from VLF to 23cm
- High performance ADC technology (not another compromise SDR!)
- Built-in high performance front-end filters
- Use as a stand-alone general coverage receiver, or as a high resolution panadapter
- Visualize all the signals in multiple bands simultaneously
- SDRuno Windows SDR software provided free-of-charge
- Also works with other platforms (Mac, Linux etc) and popular SDR Software (e.g. HDSDR, SDR-Console & Cubic SDR)
- Run on a Raspberry Pi3 – download our SD Card image
- Ideal for portable operation (powered via USB)
- Can be used as a Spectrum Analyzer or an RF Power Meter
- Backed by the world’s biggest and best SDR support community!

www.sdrplay.com
Instantaneous bandwidth illustration

RSP1
RSP2
RSP2pro
RSP1a

10 MHz visibility

1kHz

2GHz

www.sdrplay.com
Introducing the RSPduo

...the biggest change to SDR since the RSP1!
RSPduo - Dual independent tuners!

Two independent “slices” anywhere in the coverage range

www.sdrplay.com
Monitor two widely spaced bands
Mix and match applications, simultaneously

ATC  +  ADSB

www.sdrplay.com
Software
Software

- Popular 3rd Party **free** software includes:
  - Manufacturer provided software, e.g. SDRuno for the RSP family

![SDRConsole](https://www.sdrplay.com)
![HDSDR](https://www.sdrplay.com)
![Cubic SDR](https://www.sdrplay.com)
RSP Software availability/compatibility

- Multi-platform support for Windows, Mac, Linux, Android, Raspberry Pi 2/3
- SDRuno Windows SDR s/w (based on Studio1 which cost $179) provided free of charge
- ExtIO compatibility
- Supports CubicSDR for MAC, Linux and Raspberry Pi3 users
- Software upgradeable for future standards
- API provided to allow demodulator or application development
- Works well with 3rd Party free software including:

  - SDRConsole
  - HDSDR
  - Cubic SDR

www.sdrplay.com
SDRuno provides a rugged and flexible, high performance SDR receiver capability, featuring:

- Multiple ‘Virtual Receivers’ which allow for simultaneous reception and demodulation of different types of signals within the same receiver bandwidth
- A selectivity filter with an ultimate rejection greater than 140 dB
- A unique distortion-free double stage AGC with fully adjustable parameters
- Multiple notch filters with BW adjustable down to 1 Hz, Notch Lock feature
- A unique synchronous AM mode with selectable/adjustable sidebands, dedicated PLL input filter, and selectable PLL time constants
- Record and playback an entire amateur band!
- 29 pre-set amateur and broadcast bands
Multiple VFOs & different decode modes simultaneously!
Ham Band Framing + RF power level + SNR measurement & logging

www.sdrplay.com
Panadapters
What is a Panadapter?

"Panadapter is short for Panoramic Adapter. The simple answer is that it allows us to see a panoramic display of the band our radio is tuned to. We can see every signal"*.

Early implementations used a PC soundcard to achieve this function but were therefore limited to 200 kHz of bandwidth because they rely on the sound card.

The advent of affordable SDR hardware such as the RSP1A has allowed implementations with much greater bandwidth, and hence much more usefulness.

Combined with readily available, and capable, SDR software Panadapters are now an affordable and easy to implement reality!

* Definition courtesy KA9MOT http://mypanadapter.com/

"Go-to" choice for Kenwood, Yaesu, Icom, Elecraft etc!
Why panadapter?

• Add new capabilities / visibility to any rig
• Synchronize the rig to the software if it has a CAT port
• Work one frequency while monitoring the whole band
• Monitor multiple bands in addition to the one you’re working
• Arbitrarily large spectrum scope
• Less cost, more features than factory add-ons,
Monitoring 3 bands with SDRuno
The perfect Panadapter companion for your rig

• Any of the SDR Software programs that support RSP can be used to provide a basic spectrum display.
• SDRuno, HDSDR and SDR Console have built-in capabilities for CAT and other add-on software, to allow for communication between the SDR software and the transceiver.
• Ham Radio Deluxe and OmniRig are commonly used for synchronization/control between the TRx and SDR Rx.
• App notes and videos available from sdrplay.com
Use a T/R switch if not using protected transceiver IF or RF out!

www.sdrplay.com
Support and further information
Software and documentation, app notes, how-to guides
How-to videos: SDRplay YouTube Channel
Facebook Group

8000 users helping each other!

www.sdrplay.com
Direct support from SDRplay
Hardware + Software + Community =

So many reasons to get one!

Recommended by authors of both HDSDR and SDR-Console
Backed by the world's biggest & best SDR support community!

www.SDRplay.com
For more information

- Company website: www.sdrplay.com
  - We have distributors located worldwide
  - US Distributor: Ham Radio Outlet

- Community Forums: www.sdrplay.com/community/

- Email:
  - North America: support-usa@sdrplay.com
  - Rest of World: support@sdrplay.com

- Facebook: SDRplay and SDRuno specifically
  - Independent groups run by enthusiastic users!

- Google / YouTube
  - Many videos covering how to use the various software packages, implementing panadapters and much more. Use the Google search function!
  - SDRplay channel: www.youtube.com/c/SDRplayRSP

See the RSP family at the HRO booth!

www.sdrplay.com