An Introduction to Software Defined Radio

What is an SDR?

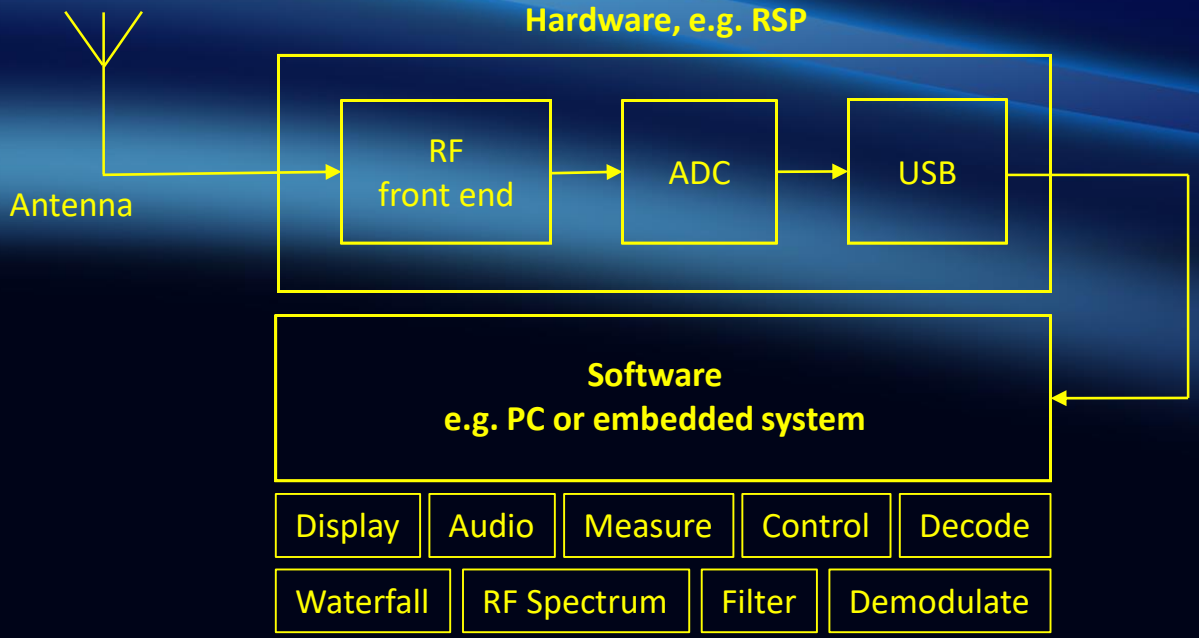
- A radio communication system where many components that have been traditionally implemented in hardware…

  (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

Simplified SDR Block Diagram



Example implementation

Why do I want one?

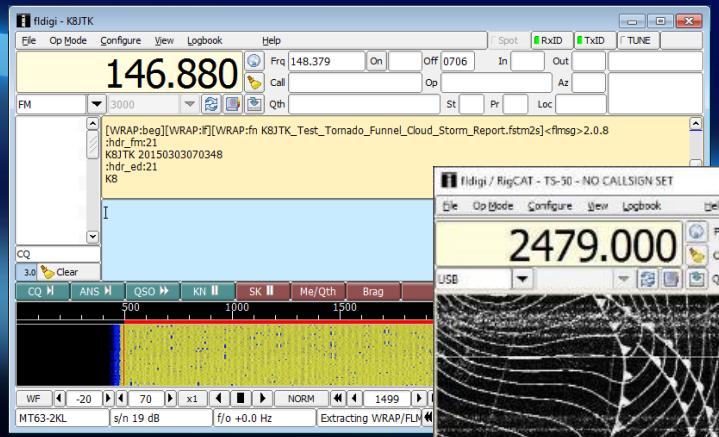
Top Ten List

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

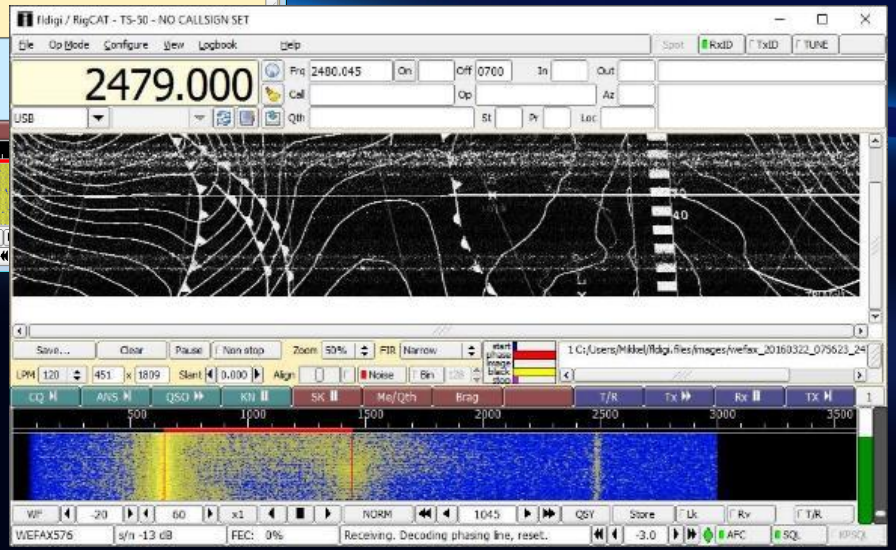
Digital Decoding

Fldigi NBEMS (Narrow Band Emergency Messaging System)



Credit: Jeff Kopcak, k8jtk

...and WEFAX Decoding

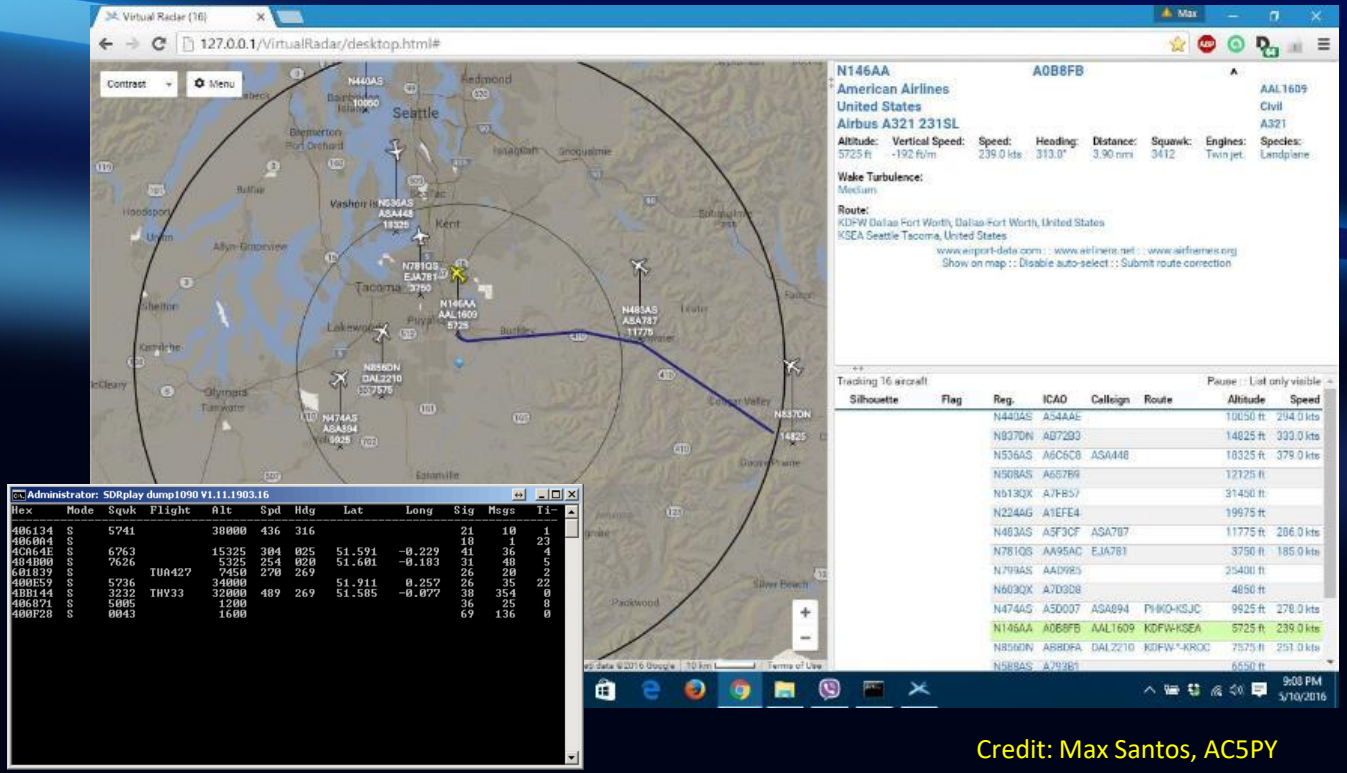


Credit: Erik Mikkel Wied

Fldigi: http://www.w1hkj.com

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

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)

Credit: Jeff Broughton, WB8RJY

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

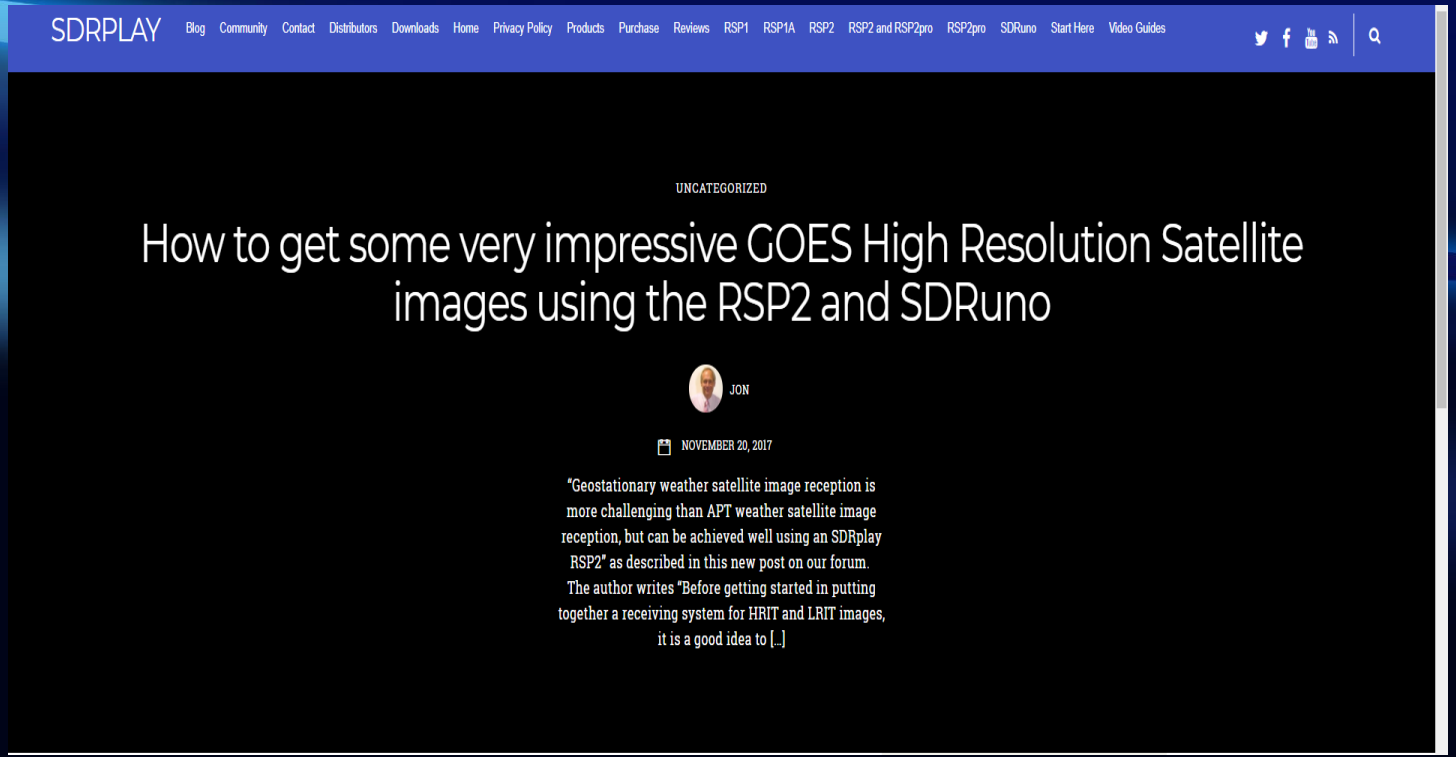
Wxtoimg:
http://www.wxtoimg.com

Credit: Sefi Merkel

High Resolution satellite images (1.7GHz)
RSP2

..including latest GOES-16

SDRplay forum on Sat imaging

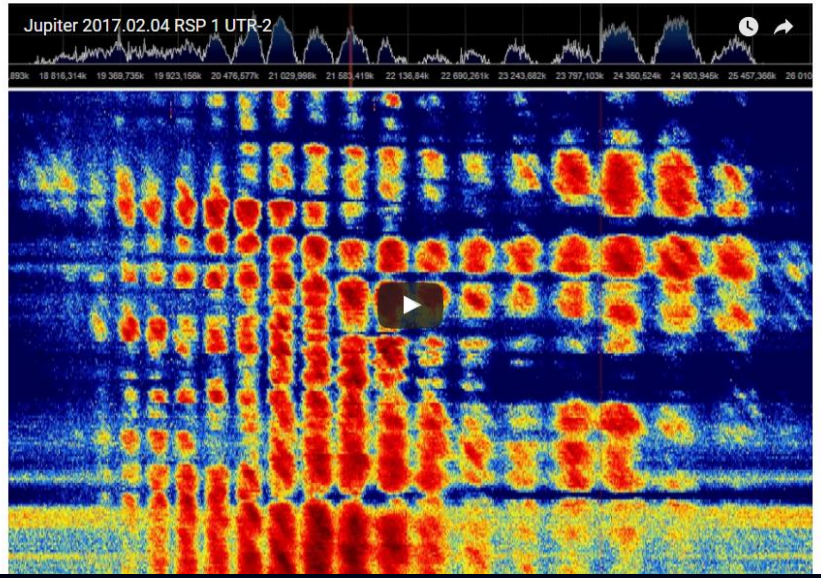


Tune in to Jupiter!

RECEIVING JUPITER NOISE BURSTS WITH AN SDRPLAY RSP1

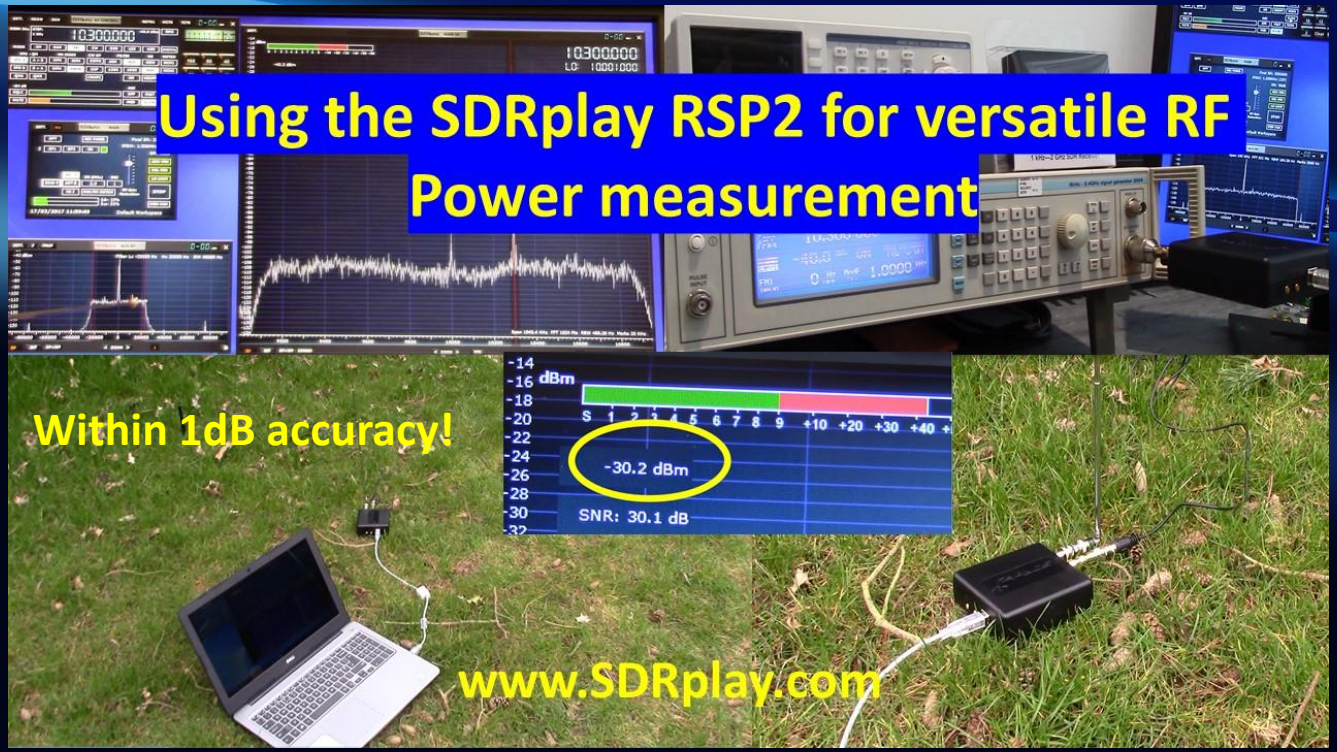
Over on YouTube user MaskitolSAE has uploaded a video showing him receiving some noise bursts from Jupiter with his SDRplay RSP1. The planet Jupiter is known to emit bursts of noise via natural 'radio lasers' powered partly by the planets interaction with the electrically conductive gases emitted by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

In his video MaskitolSAE shows the 10 MHz of waterfall and audio from some Jupiter noise bursts received with his SDRplay RSP1 at 22119 kHz. According to the YouTube description, it appears that he is using the UTR-2 radio telescope which is a large Ukrainian radio telescope installation that consists of an array of 2040 dipoles. A professional radio telescope installation is not required to receive the Jupiter bursts (a backyard dipole tuned to ~20 MHz will work), but the professional radio telescope does get some really nice strong bursts as seen in the video.



Doubles as a new piece of RF lab kit:

an RF Power meter – get one for work or play!



SDR hardware

SDR Variety

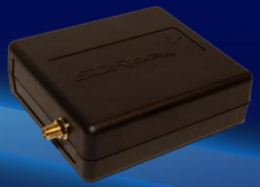
Performance

Price

- $10 – 100
- Low performance
- Introductory

8-bit Dongles

Small cost adder
Big performance gain



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

General Purpose

Large cost adder
Modest performance gains

High End

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

www.sdrplay.com

SDRplay

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

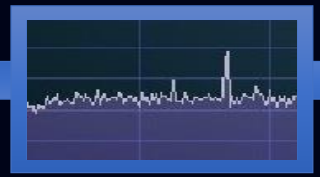
- Continuous SDR receiver coverage from VLF to 2 GHz
- All the amateur radio bands from VLF to 23cm
- High performance ADC technology (not another compromise SDR!)
- Built-in high performance front-end filters
- Use as a stand-alone general coverage receiver, or as a high resolution panadapter
- Visualize all the signals in multiple bands simultaneously
- SDRuno Windows SDR software provided free-of-charge
- Also works with other platforms (Mac, Linus 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!

Instantaneous bandwidth illustration

RSP1 RSP2 RSP2pro RSP1a

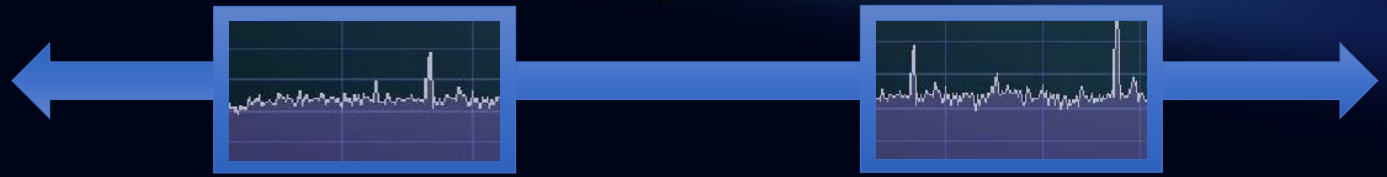
10 MHz visibility

1kHz *2GHz*



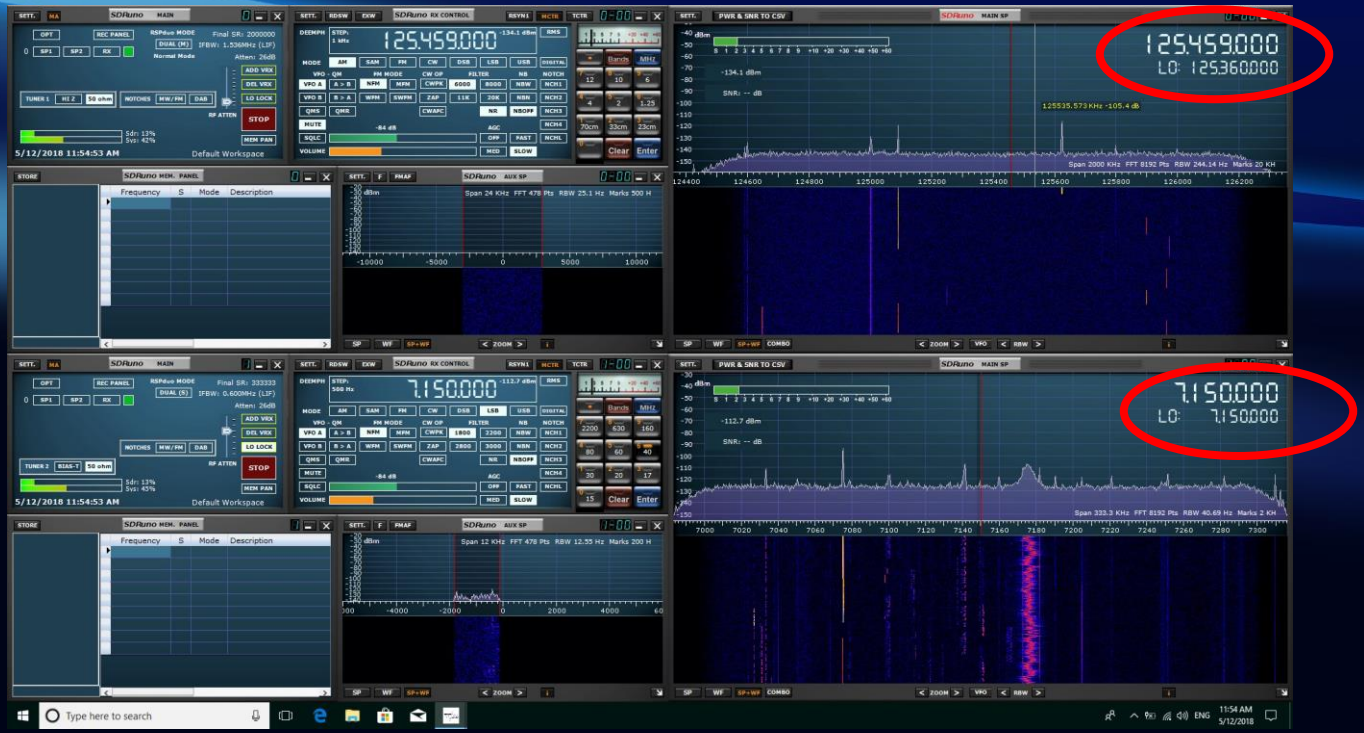
Introducing the RSPduo - Dual independent tuners!

"...the biggest change to SDR since the RSP1!"

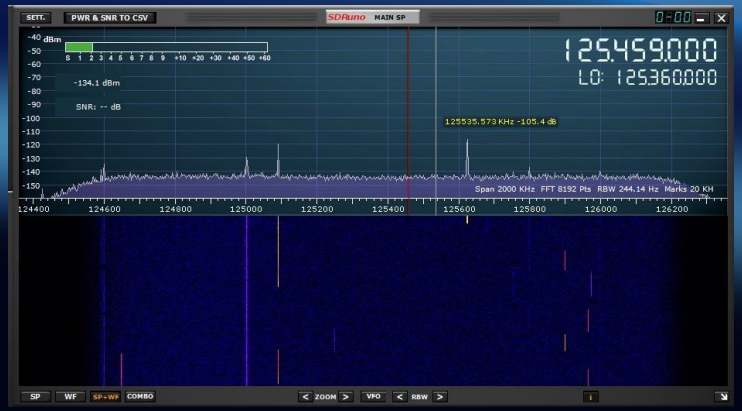


Two independent "slices" anywhere in the coverage range

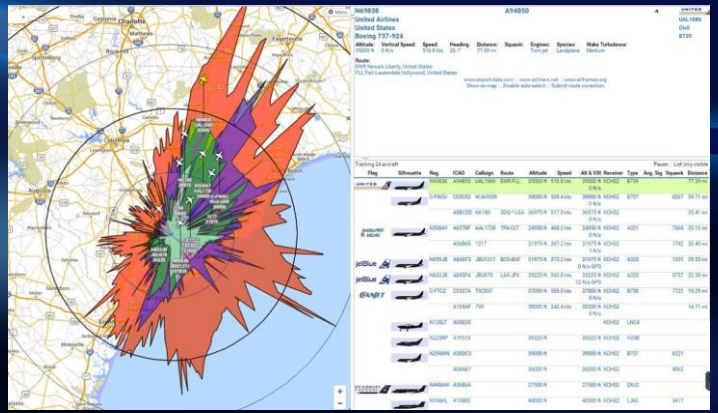
Monitor two widely spaced bands



Mix and match applications, simultaneously



ATC



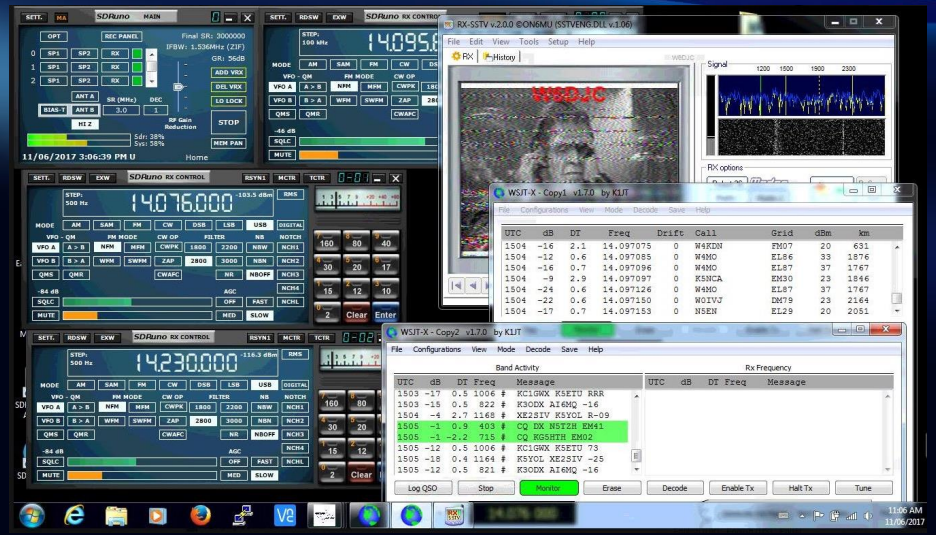
ADSB

Software

Software

- SDRplay offers Multi-platform support for Windows, Mac, Linux, Android, Raspberry Pi 2/3 via 3rd party software including:

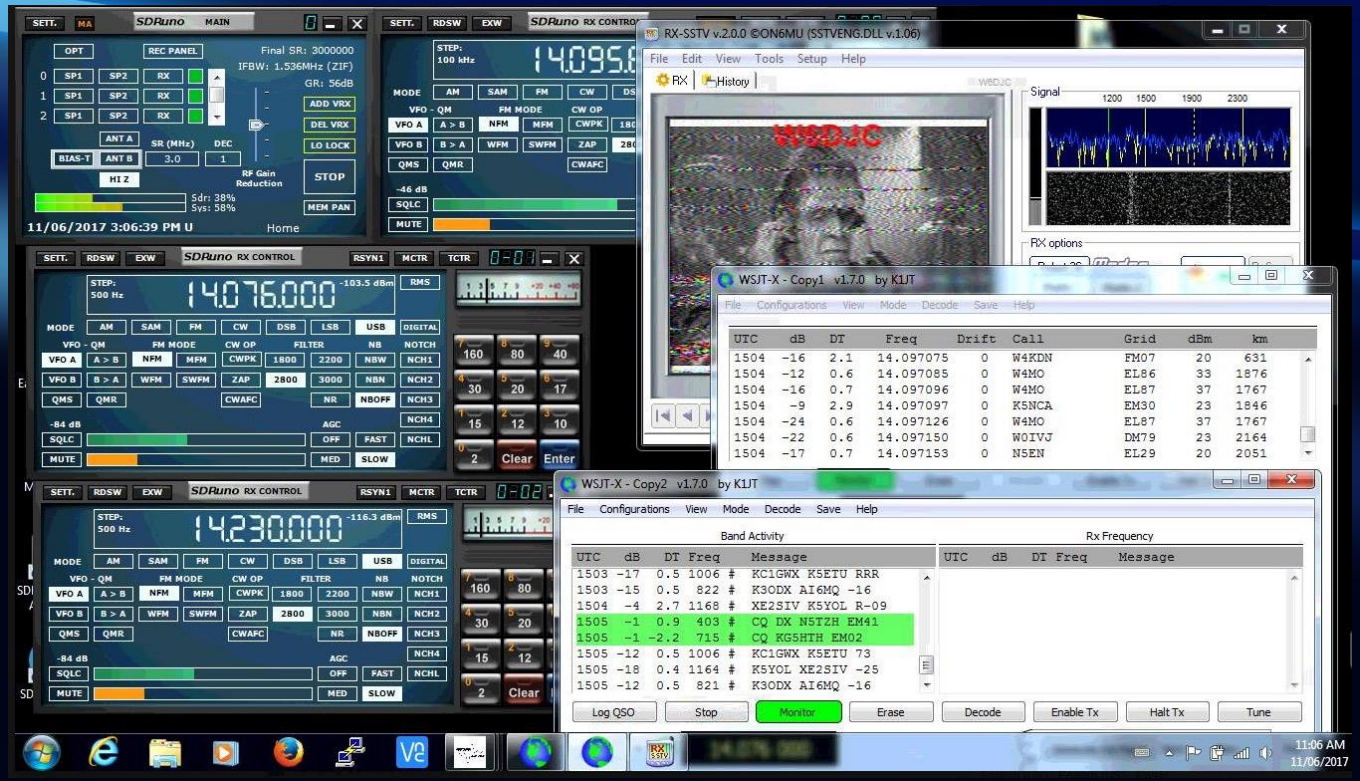
- In addition SDRplay owns and develops our own software, SDRuno (Windows only) for the RSP family:
  - Based on Studio1 which cost $179
  - Software upgradeable for future standards
  - API provided to allow demodulator or application development



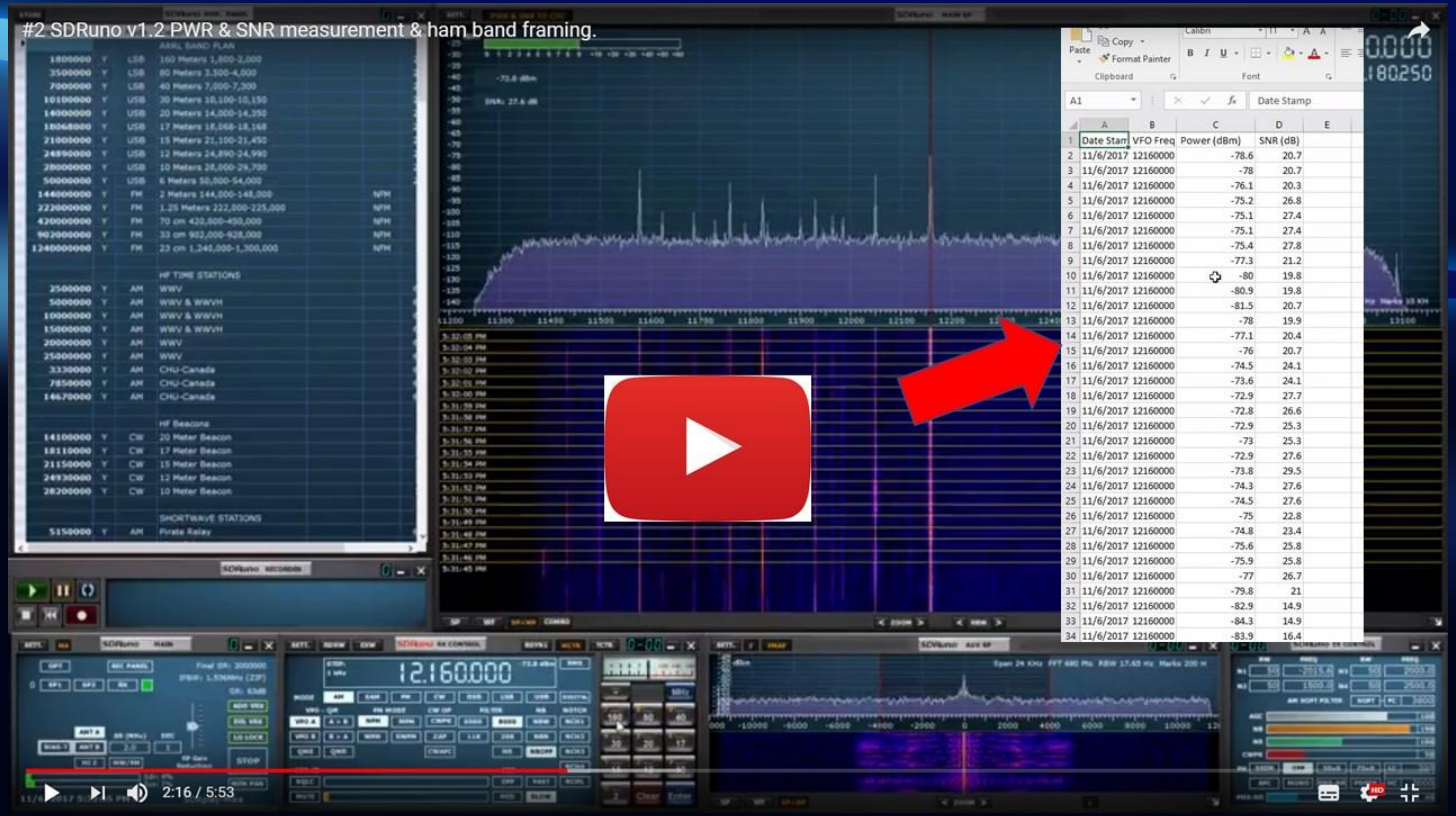
- All the above software packages are available ***free of charge!***

www.sdrplay.com

Multiple VFOs & different decode modes simultaneously!

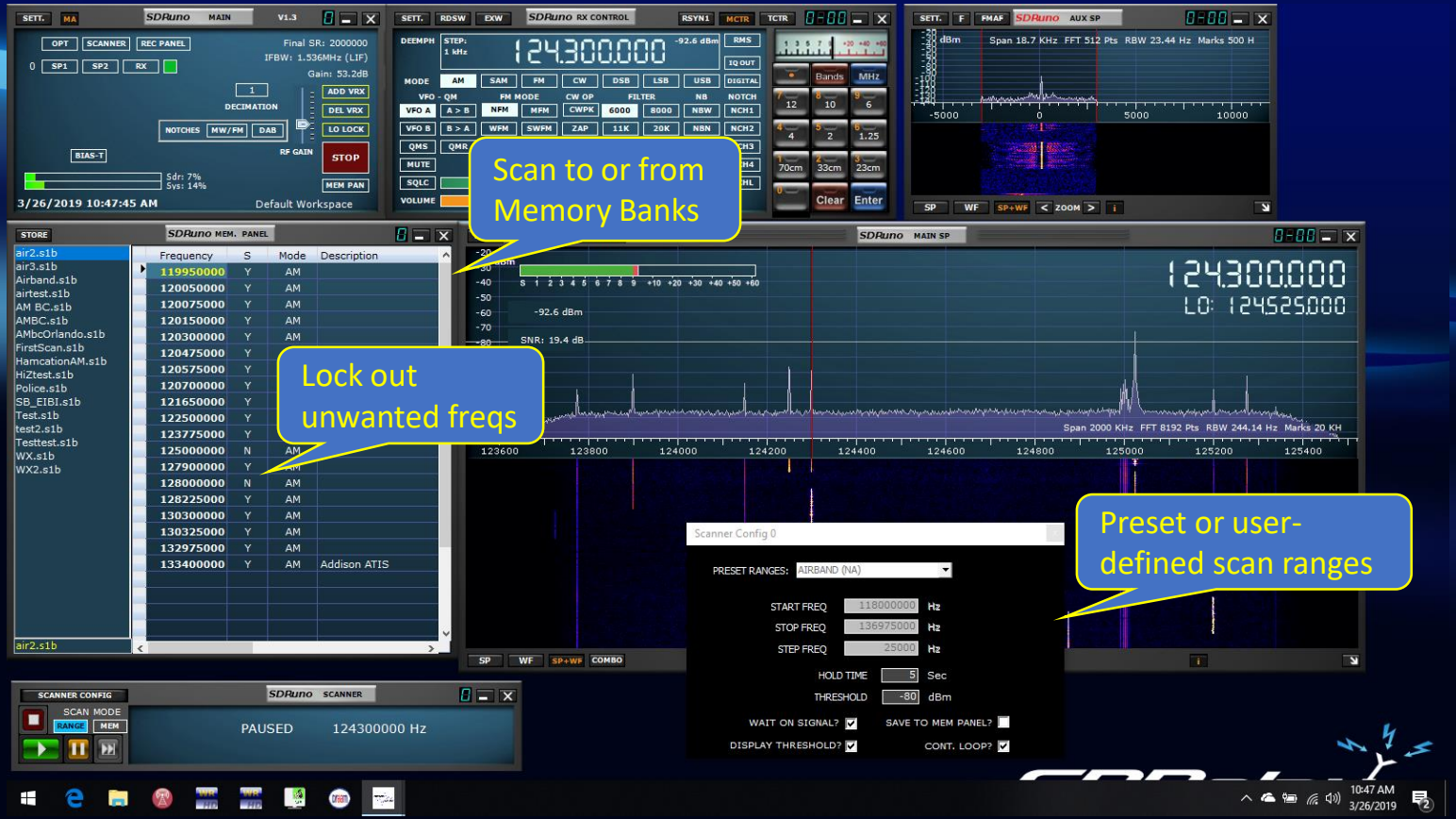


Ham Band Framing + RF power level + SNR measurement & logging

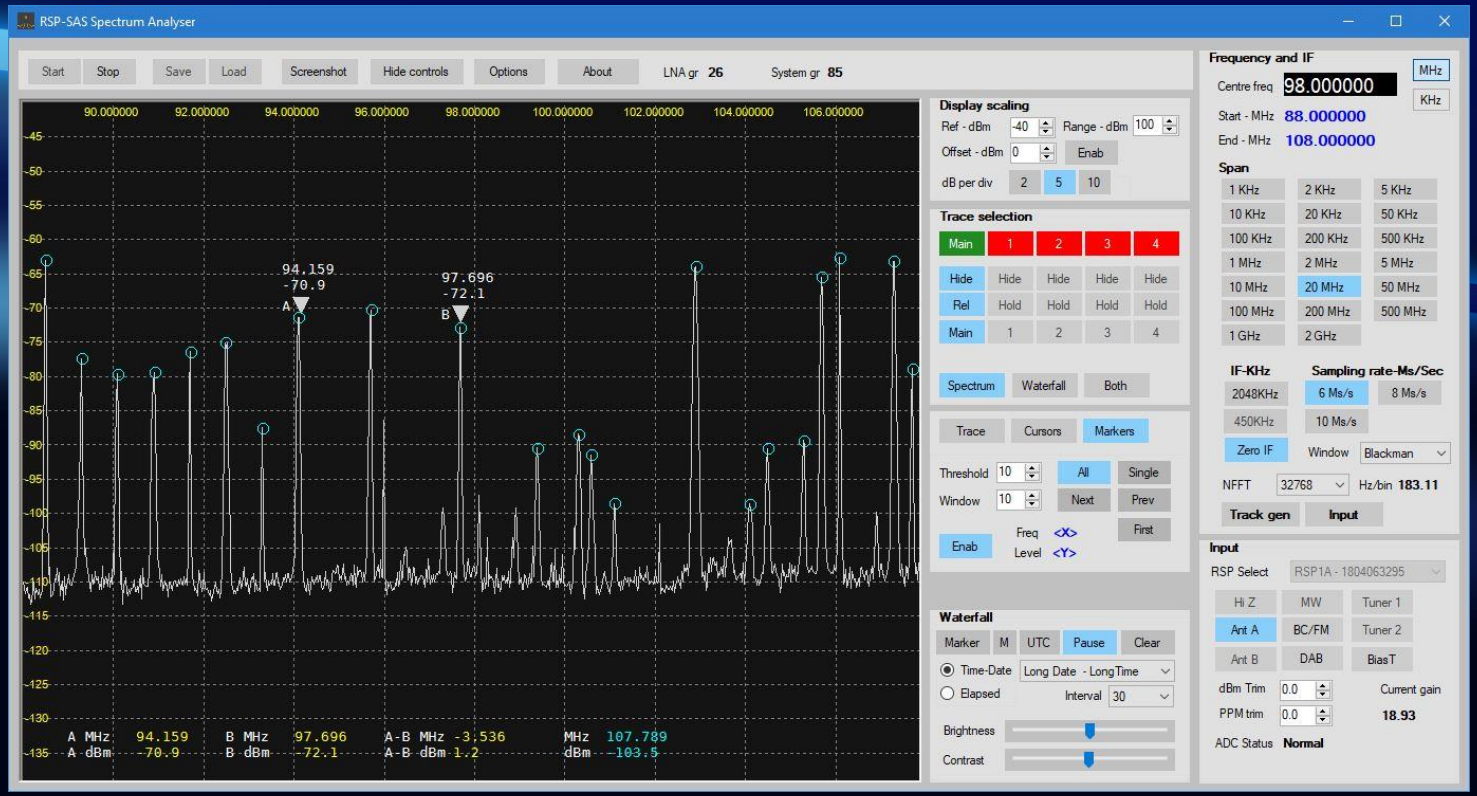


www.sdrplay.com

SDRuno 1.3 – Scanning and IQ out!

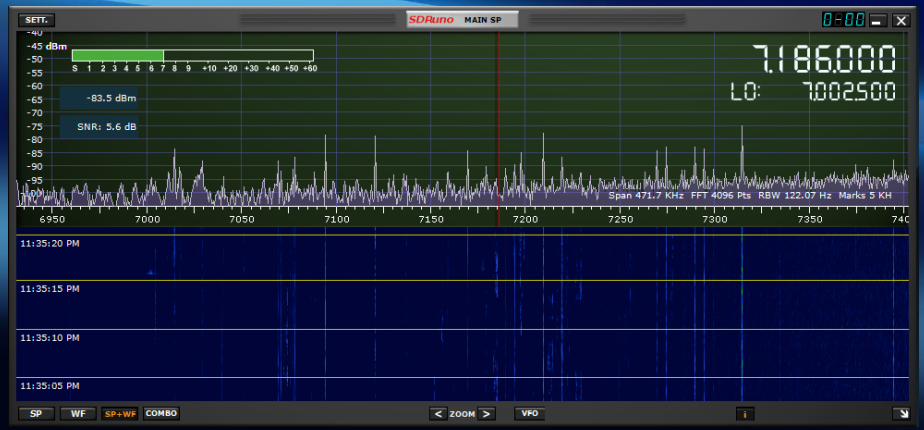


SAS Spectrum Analyser – Make your RSP into a Spectrum Analyser!



Panadapters

What is a Panadapter?



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

- "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/

Why panadapter?

- Add new capabilities / visibility to any rig
- Synchronize the 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

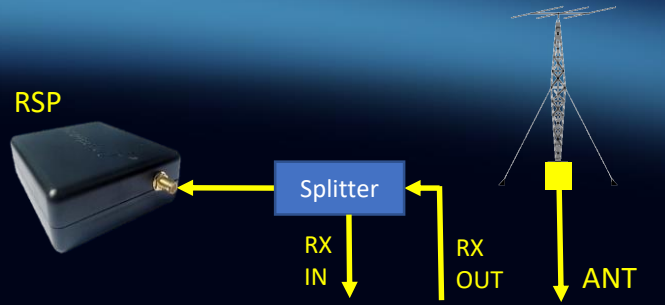
SDRplay

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, SDR Console and CubicSDR have built-in capabilities for CAT and other add-on software, to allow for communication between the SDR software and the transceiver.
- OmniRig is commonly used for synchronization/control between the TRx and SDR Rx, but other control software, e.g. HRD, DXlab etc. can be incorporated using SDRuno's CAT capability
- App notes and videos available from sdrplay.com

Use a T/R switch if not using protected transceiver IF or RF out!

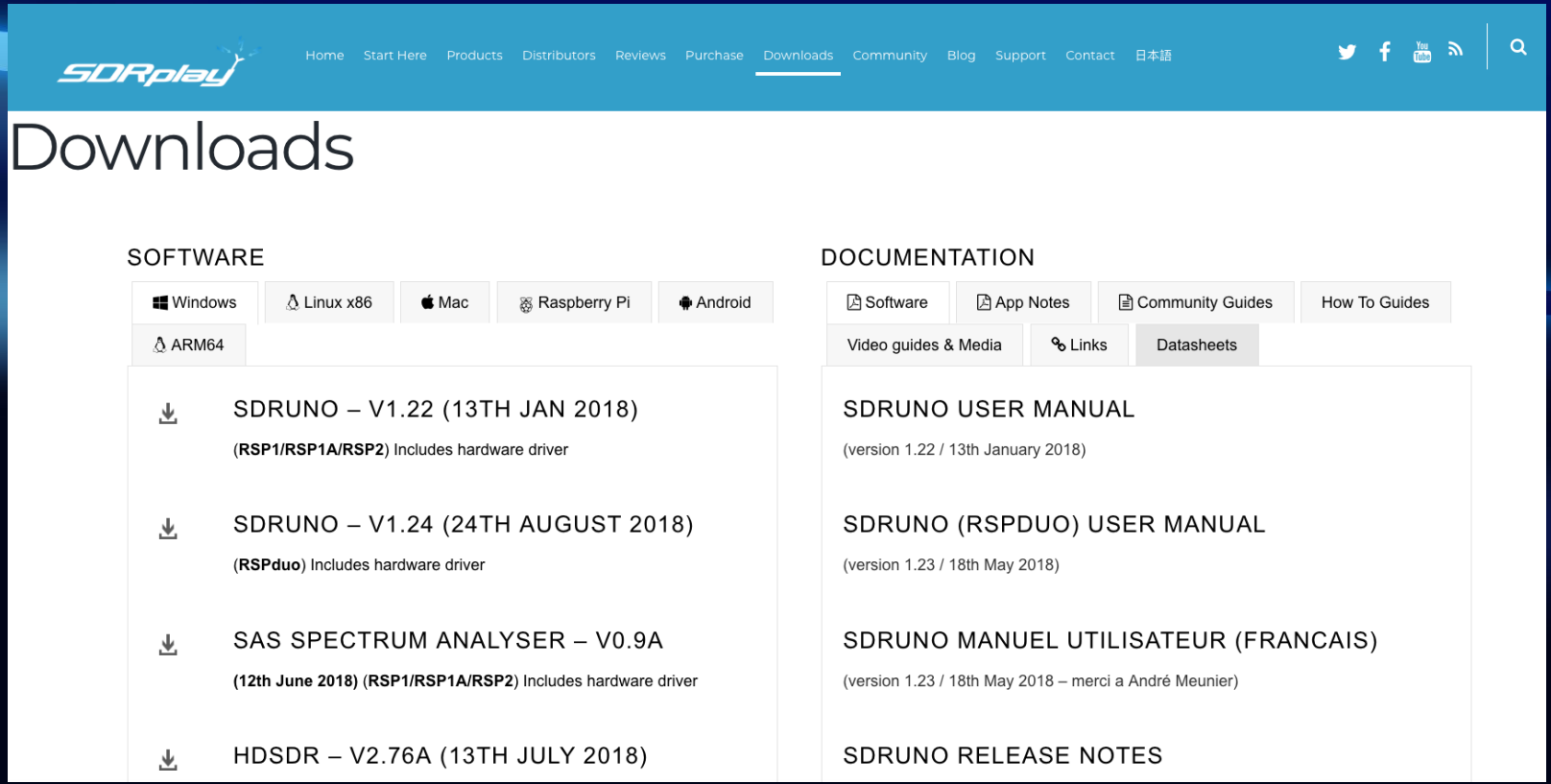
- RSP protected by T/R
- T/R shares signal
- Widest RX bandwidth
- *Always connect PTT!*



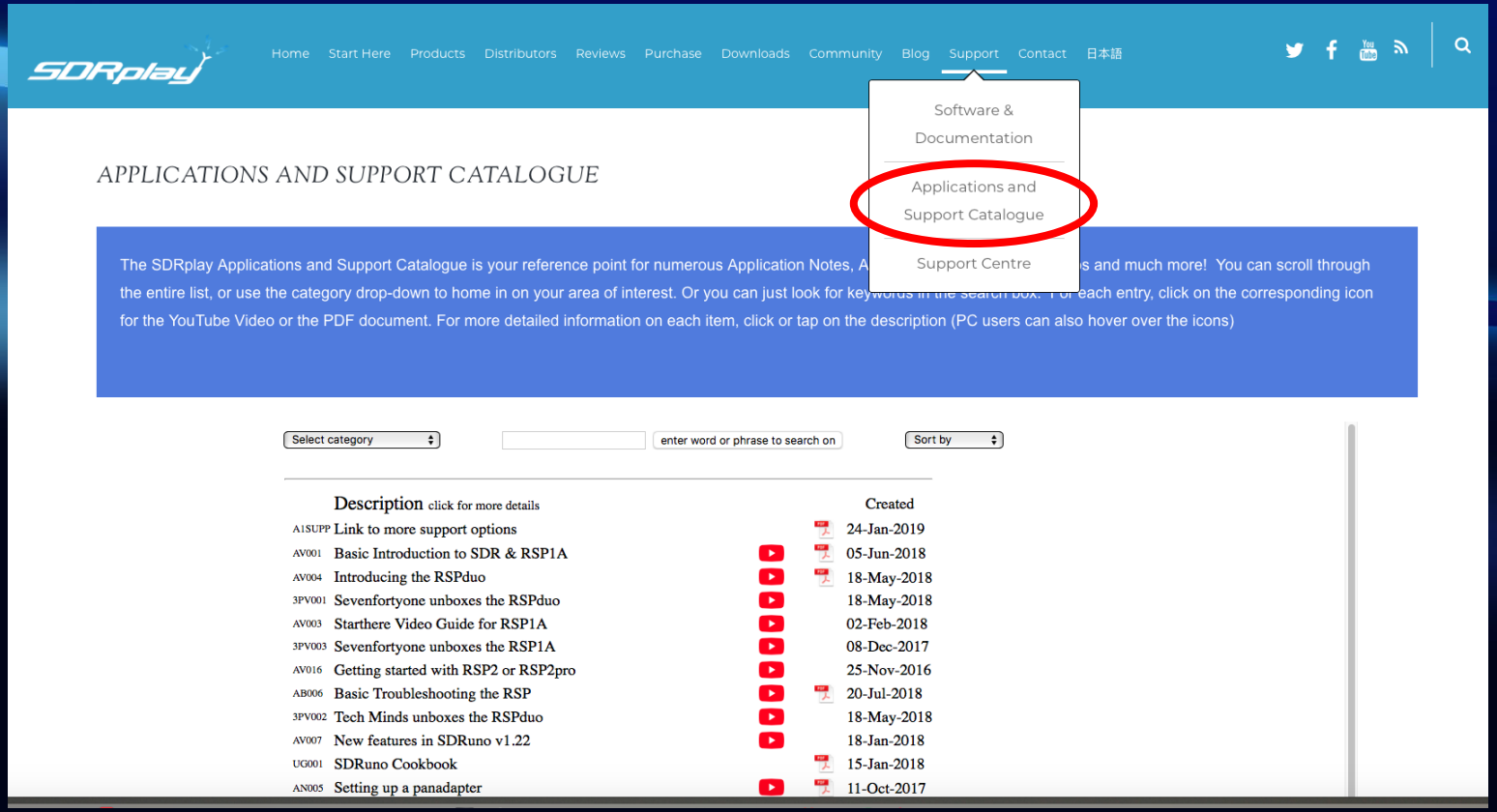
- RSP protected by rig's internal T/R
- Splitter if required (e.g. Yaesu)
- RX BW limited by IF

Support and further information

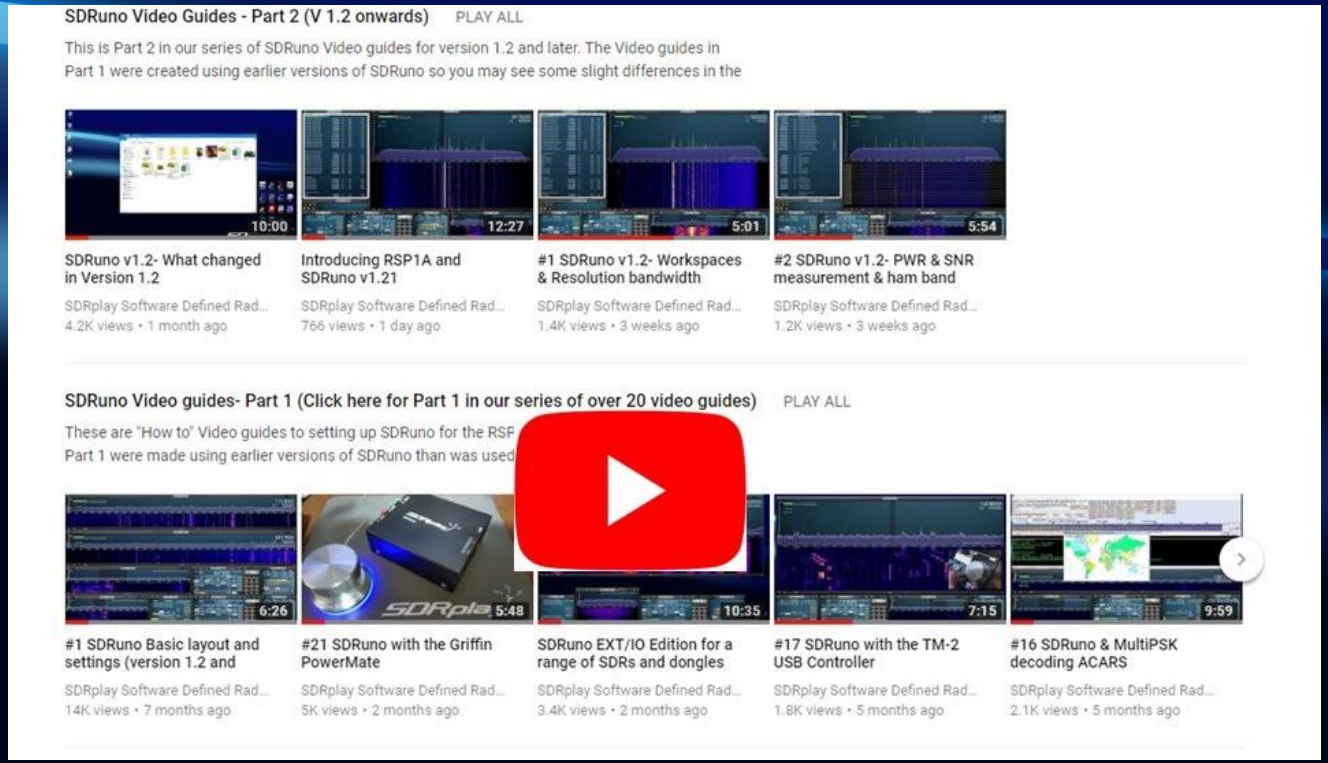
Software and documentation – Software Downloads



Software and documentation – Applications and Support Catalog



How-to videos: SDRplay YouTube Channel



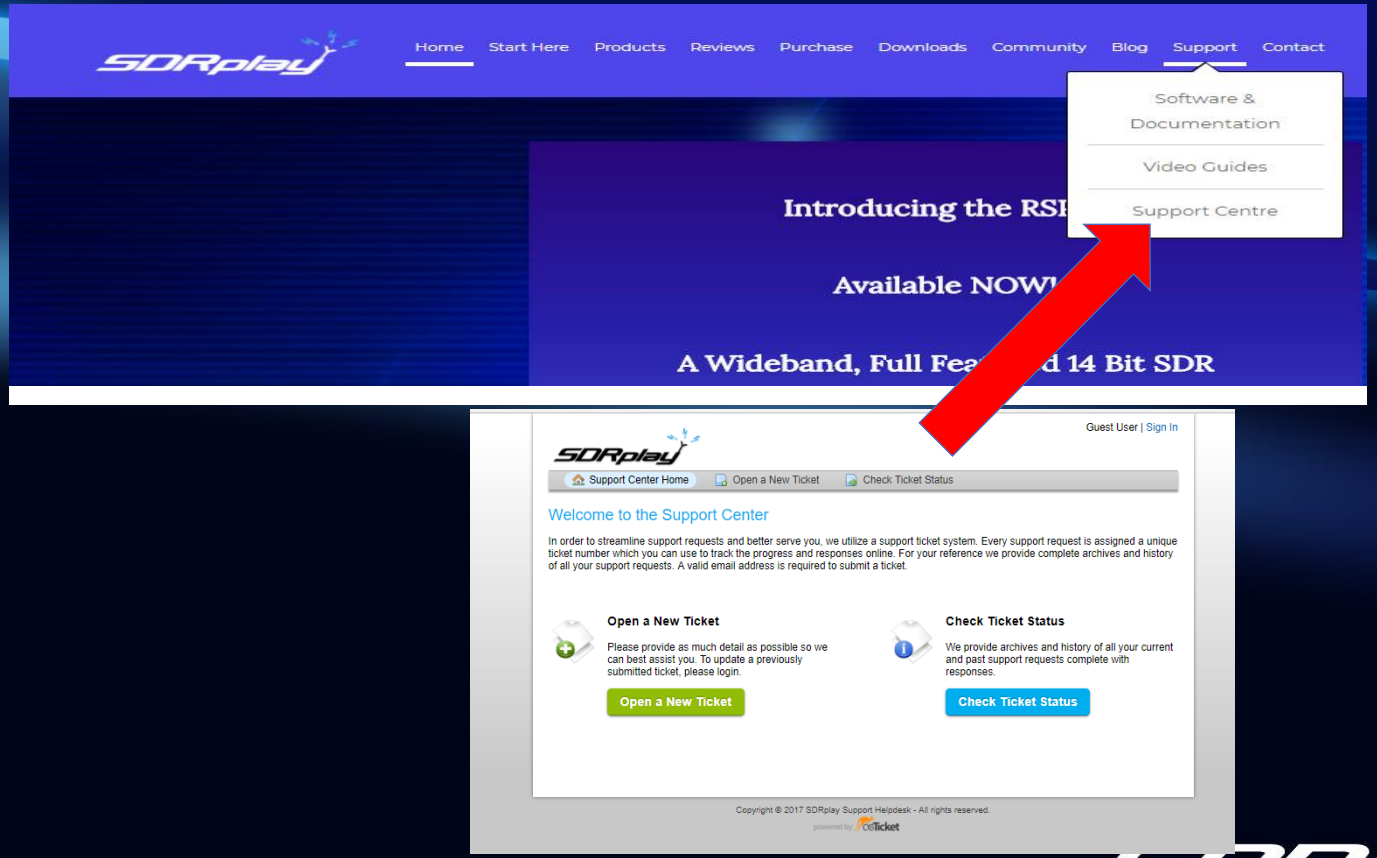
www.youtube.com/c/SDRplayRSP

www.sdrplay.com

Facebook Groups

Nearly 10,000 users helping each other!

Direct support from SDRplay



Hardware + Software + Community =

For more information

- Company website: www.sdrplay.com
  - Check out our new ***Applications & Support Catalog*** at: https://www.sdrplay.com/apps-catalogue/
- 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**