SDRplay Radio Spectrum Processor 2 Pro

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In the February 2017 issue of *QST*, I reviewed the SDRplay Radio Spectrum Processor 1, better known as the RSP1. The RSP1 is a remarkably powerful software-defined receiver (SDR) offering coverage from 10 kHz all the way to 2 GHz. With the equally capable *SDRuno* software, or any other compatible software of your choosing, the RSP1 is a bargain radio for a variety of applications.

The SDRplay Limited folks have also introduced the RSP2 and RSP2pro receivers. These radios are electrically similar to the RSP1, but they offer additional features with the science and engineering community in mind.

Unlike the RSP1, which is housed in a plastic case, the RSP2 is sheltered within a plastic case with internal conductive shielding. The RSP2pro takes this idea a step further by enclosing the radio in an all-steel case, hence the surprising heft when you first pick it up. As I mentioned in my previous review, shielding is critical for the RSPs. I had also recommended the use of a shielded or otherwise RF-suppressed USB cable to connect the RSP to your computer, and that is still the case with the RSP2 and RSP2pro, although the Pro's steel enclosure goes a long way toward keeping RF at bay.

How They Are Different

The differences between the RSP1 and the RSP2 (and pro), are mostly in the front ends of the radios, and the manner in which the radios connect to the outside world. See the key feature comparison in Table 2.

Bottom Line

Building on the success of the RSP1, the SDRplay RSP2 adds a number of useful features.

Table 2
Key Feature Comparison: RSP1 and RSP2/RSP2pro

	RSP1	RSP2
Frequency coverage	10 kHz to 2 GHz	1 kHz to 2 GHz
Preselector filters	8	10
Low-noise preamplifier	On or off	Selectable levels
SMA antenna inputs	1	2
High-impedance antenna input	No	1
Selectable MW/FM notch filters	No	Yes
Reference clock inputs and outputs	No	Yes
High-stability TCXO	No	Yes
DC on antenna port	No	Yes, Port B; switchable
Enclosure shielding	No	Yes, internal (RSP2) Yes, all-steel enclosure (RSP2pro)

Table 3
SDRplay RSP2pro, s/n 1704008A10

Manufacturer's Specifications	Measured in the ARRL Lab
Frequency coverage: 1 kHz – 2 GHz.	1.5 MHz – 2 GHz on antenna ports A and B (50 Ω). 1 kHz – 30 MHz on high-impedance antenna port. Sensitivity falls off below 100 kHz.
Power requirement: USB power only.	
Modes of operation: SSB, CW, AM, AM Synchronous, FM, FMN, WFM.	As specified.
Receiver	**Receiver Dynamic Testing**
Sensitivity (MDS): not specified.	Noise floor (MDS, dBm), 400 Hz BW, maximum RF gain setting: At high-impedance port: 10 kHz, –115; 137 kHz, –125; 475 kHz, –130; 1.2 MHz, –133. At SMA connector: 3.5 MHz, –140; 14 MHz, –144; 50 MHz, –147; 144 MHz, –147; 222 MHz, –147; 440 MHz, –147; 902 MHz, –147; 1296 MHz, –141 dBm. Sensitivity when adjusted for best dynamic range, 14 MHz, –123 dBm.*
Noise figure: 2.0 dB (10 MHz), 1.6 dB (20 MHz), 1.5 dB (40, 100 MHz), 1.9 dB (200 MHz), 5.0 dB (360 MHz), 2.5 dB (600 MHz), 3.5 dB (1,300 MHz), 4.0 dB (1,800 MHz).	14 MHz, 3 dB; 144, 223, 440, and 902 MHz, 1 dB; 1296 MHz, 3 dB. Measured with maximum RF Gain setting.
AM sensitivity: Not specified.	For 10 dB (S+N/N), 6 kHz BW: 1.020 MHz, 1.0 µV; 3.885 MHz, 0.63 µV; 50.4 MHz, 1.1 µV; 120 MHz, 0.39 µV; 144 MHz, 1.0 µV (max RF Gain setting).
FM sensitivity: Not specified.	For 12 dB SINAD, 12 kHz BW (maximum RF Gain setting): *FM* / *FM narrow* 29 MHz 0.13 µV 0.11 µV 52 MHz 0.13 µV 0.11 µV 100 MHz 0.21 µV (WBFM) 146 MHz 0.13 µV 0.11 µV 162 MHz 0.15 µV 0.15 µV 223 MHz 0.62 µV 0.52 µV 440 MHz 0.14 µV 0.14 µV 902 MHz 0.19 µV 0.15 µV 1296 MHz 0.25 µV 0.22 µV
Blocking gain compression dynamic range: Not specified.	Blocking gain compression dynamic range, 400 Hz BW:* *20 kHz offset* / *5/2 kHz offset* 14 MHz 80 dB 80/80 dB

Figure 5 — The rear panel of the SDRplay RSP2pro has the USB port for connection to the host computer and input/output for the 24 MHz reference signal.

Manufacturer's Specifications — Measured in the ARRL Lab

ARRL Lab Two-Tone IMD Dynamic Range Testing (400 Hz bandwidth)*

Band	*Spacing*	*Measured IMD Level*	*Measured Input Level*	*IMD DR*
14 MHz	20 kHz	–123 dBm –97 dBm	–59 dBm –44 dBm	64 dB
14 MHz	5 kHz	–123 dBm –97 dBm	–59 dBm –44 dBm	64 dB
14 MHz	2 kHz	–123 dBm –97 dBm	–59 dBm –44 dBm	64 dB

Second-order intercept point: Not specified.	14 MHz, +21 dBm; 21 MHz, +17 dBm; 50 MHz, +19 dBm; 144 MHz, +13 dBm, 440 MHz, +39 dBm. Measured with RF gain = 0 (preamp off).
FM adjacent channel selectivity: Not specified.	29 MHz, 50 dB; 52 MHz, 49 dB; 144 MHz, 50 dB; 440 MHz, 40 dB. Measured with maximum RF gain setting.
FM two-tone third-order dynamic range: Not specified.	20 kHz spacing: 29 MHz, 50 dB†; 52 MHz, 49 dB†, 144 MHz, 50 dB; 440 MHz, 40 dB†. 10 MHz spacing: 29 MHz, 61 dB, 52 MHz, 64 dB; 144MHz, 57 dB; 440 MHz, 59 dB. Measured with maximum RF gain setting.
Squelch sensitivity: Not specified.	0.17 µV typical.
DSP noise reduction: Not specified.	24 dB.
Notch filter depth: Not specified.	Auto notch, 25 dB. (No manual notch.)
IF/audio response: Not specified.	Range at –6 dB points (bandwidth)** CW (400 Hz): 284 – 682 Hz (398 Hz); USB (2.4 kHz): 201 – 2603 Hz (2402 Hz); LSB: (2.4 kHz): 201 – 2603 Hz (2402 Hz); AM (6 kHz): 20 – 3001 Hz (5962 Hz).
Signal processing delay time: Not specified.	546 ms.

Size (height, width, depth): 1.2 × 3.3 × 4.2 inches (including protrusions). Weight: 10.4 oz.

Price: RSP2pro, $193. RSP2, $170.

*RF gain adjusted for maximized dynamic range performance (gain = 5); see Lab Notes sidebar.
†Measurements were phase noise limited at the value indicated.
**Default values; bandwidth and cutoff frequencies are adjustable.

The RSP2 expands low-end frequency coverage from 10 kHz down to 1 kHz and offers 10 front-end preselector filters as a robust defense against strong signals, such as nearby broadcast stations. This is often a problem with sensitive software-defined receivers, but it looks like the "signal wall" erected by the RSP2 has firmly put this issue to rest in all but the most extreme cases. That said, the instructions caution against using the RSP2 in an antenna system that is shared with a transmitter; plenty of port-to-port isolation in that configuration is a must. These radios are exquisitely sensitive and easily damaged by stray transmit RF.

The low-noise preamplifier in the RSP2 is a selectable multi-level design rather than being strictly on or off as it is in the RSP1. This is a helpful addition, and I noticed the benefits immediately. I live in an area with strong RF sources, and being able to select the preamplification levels was ideal.

The most visible differences are the antenna ports. While the RSP1 features a single female SMA antenna port, the RSP2 offers three ports: two female SMAs for 1.5 MHz through 2 GHz, and one high-impedance balanced port for long-wire antennas for 1 kHz through 30 MHz. The high-impedance input uses a plug with screws to secure the wires.

You could connect a long-wire antenna for low-frequency reception, another antenna for HF listening, and still another antenna for VHF+. You can even command the RSP2 to apply 5 V

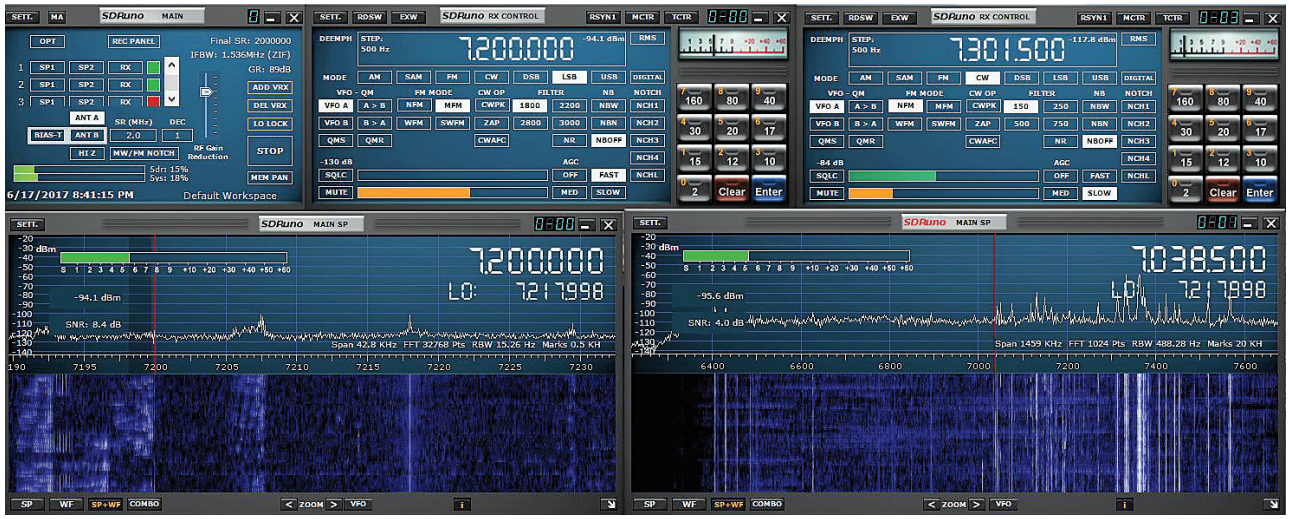

Figure 6 — Running two simultaneous receivers with *SDRuno* and the RSP2pro receiver. If your computer can handle the load, you can display up to 16 simultaneous receivers.

to the antenna on Port B to power an external device, such as an active receive antenna or external preamplifier. The antenna ports are selectable through the software, and one of the most versatile software packages designed to exploit this capability to the fullest is *SDRuno*.

The RSP2 also includes features that advanced users will appreciate. Its highly stable 0.5 parts per million (ppm) temperature-compensated crystal oscillator (TCXO) is trimmable down to 0.1 ppm. (The semi-annual frequency measuring tests come to mind as an application for the RSP2.)

The RSP2 even provides 24 MHz reference signal input and output on the rear panel (see Figure 5). This capability, combined with its high-stability TCXO and shielding offered by the RSP2pro, takes these receivers into the realm of laboratory instruments. Even so, at $192.95, the cost is still within the reach of the average Amateur Radio operator. (The regular RSP2 is $169.95.)

Using the RSP2pro

Although the RSP2pro can be used with a variety of software, including *HDSDR* and *SDRConsole*, I settled on *SDRuno* for this review. *SDRuno* is a free download from the SDRplay website.

With *SDRuno*, I had the ability to see signals across enormous swaths of spectrum. For instance, I could see all activity across the entire 40-meter band in a single window, either as a spectral display, waterfall display, or both. With a mouse click, I could even overlay the spectral and waterfall displays for a very interesting effect.

As I described in my review of the RSP1, with *SDRuno* I had the ability to open multiple receivers simultaneously. During one experiment with the RSP2pro, I had 10 receivers running at the same time. (It's a good thing my station PC has a powerful CPU and lots of memory!) In most cases, I ran two simultaneous receivers (see Figure 6).

If you're not a *Windows* user, the SDRplay website includes links to free downloadable software for *MacOS*, *Linux*, *Android*, and even a pre-built image file for the Raspberry Pi 3.

With the RSP2's broad coverage and sensitivity, it is easy to lose yourself, spending hours browsing everything from 1 kHz to 2 GHz. With *SDRuno*, I could select from several notch filters, gain settings, and demodulation modes. Listening to shortwave broadcasts, for example, was a pleasure with *SDRuno*'s synchronous AM function.

It is important to point out that you can share *SDRuno*'s audio output with

Figure 7 — Sharing the audio output of *SDRuno* with *WSJT-X* to decode JT65 signals on 20 meters (see text).

other software applications by using a virtual audio cable, such as the free *VB-Audio Cable* (**vb-audio.pages-perso-orange.fr/Cable/**). In Figure 7, you can see *WSJT-X* receiving 20-meter JT65 signals. The *SDRuno* receiver output was configured for *VB-Audio*, while *WSJT-X* was configured to "look" for its input audio from *VB-Audio*.

Sliding up to 851 MHz, I was able to use a digital voice decoding application called *DSD+* (**www.dsdplus.com**), once again combined with *SDRuno* and the *VB-Audio* virtual cable, to eavesdrop on our local police dispatch that was using APCO 25 Level 1 protocol.

With our new MW and LF bands, the RSP2pro may come in handy. Noise levels on those bands can often be quite high, but with *SDRuno*, I was able to use the noise-reduction functions and filtering to reduce the noise to a manageable level. The RSP2pro's high-impedance input really shines in this application. The 1 kΩ impedance presents a higher terminal voltage at the input, so it works well with long, random-length wire antennas.

A Lot of Capability in a Small Package

I greatly enjoyed the RSP1, and my review reflects my enthusiasm for the receiver. With the RSP2, however, SDRplay Limited has kicked it up several notches. They obviously listened to feedback from their customer base and designed the RSP2 and RSP2pro accordingly.

The RSP2 is likely to have the greatest appeal to those who have different antennas for HF, VHF+, and possibly MW and LF, and who want to have the ability to switch seamlessly between them. Also, the RSP2's front-end preselector filters and the ability to select preamplifier amplification levels offer a major enhancement for those grappling with challenging RF environments.

Add the advanced functionality, such as the reference clock inputs and outputs, as well as robust shielding (particularly in the RSP2pro), and you have a software-defined receiver that is a serious contender for science and engineering applications.

Manufacturer: SDRplay Limited, 6 Thornes Office Park, Monkton Rd., Wakefield WF2 7AN, United Kingdom; **www.sdrplay.com**. Distributed in the United States by Ham Radio Outlet; **www.hamradio.com**.