SDRplay RSP1 Radio Spectrum Processor

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If you've been curious about software-defined radio (SDR), but have been reluctant to dip your toes in the water because of the cost, the SDRplay may be worth serious consideration. At a suggested list price of $149.95, this software-defined receiver — or radio spectrum processor (RSP), as the manufacturer calls it — covers an astonishing frequency range starting at 10 kHz and extending all the way to
2 GHz!

Like most software-defined receivers, the SDRplay RSP1 digitally samples signals as close to the antenna as possible, instantly converting them to data. The data is then streamed to your computer over a USB cable, where the software of your choice manipulates the bits to demodulate any signal you wish. The SDRplay comes with its own software application known as *SDRuno*, but the radio is compatible with a number of other programs. During this review, for instance, I successfully used the SDRplay with the popular *SDR Console* software.

The SDRplay will work with computers running the *Windows, MacOS, Linux,* or *Android* operating systems. You can even attach the SDRplay to a Raspberry Pi microcomputer and create a complete SDR package, leaving your primary computer free for other tasks.

Considering the relatively low cost, you might think the SDRplay is just another low-end SDR "dongle" radio, but you'd be mistaken. The SDRplay offers a 12-bit analog-to-digital converter, an adjustable preamplifier, and a set of front-end filters. Despite having a much better front end compared to the dongles, the SDRplay *can* suffer from overload. More about this later.

The Black Box

On the outside, the SDRplay is about as simple as a radio can be. Everything is contained within a $3\frac{3}{4} \times 3 \times 1$ inch black plastic box. The enclosure is virtually featureless, except for two ports: an SMA connector for the antenna and a Type-B USB socket for the connection to your computer.

The SDRplay does not come with a BNC or SO-239 adapter for the antenna connector, nor does it include a USB cable. However, most retailers offer these as extras. Concerning the USB cable, I strongly recommend the purchase of a cable that includes ferrite cores for RFI suppression. In my initial tests, I used an ordinary USB cable and encountered a substantial amount of interference that was being radiated by the cable itself. The RFI showed up as regularly spaced signals across a large portion of the spectrum. When I swapped in a USB cable with RFI suppression, the interference vanished.

When it comes to connecting the radio, there is little to do except attach an antenna and plug in the USB cable. You won't need a power supply or batteries; the SDRplay gets its power from the host computer.

Enjoying the SDRplay

One of the challenges with reviewing a software-defined receiver is that the functionality of the radio can change substantially depending on the software you are using. For instance, one type of software may include FM stereo reception, while another may not.

The software becomes important when you consider the fact that the SDRplay incorporates a VLNA (very low noise amplifier). If you are using the proper software, you can control the VLNA gain, or switch it off entirely. This is a major asset when you encounter front-end overload. Much of the overload in my area was courtesy of a couple of AM broadcast stations, but even a strong distant signal could sometimes cause images to appear elsewhere in the passband. The ability to reduce the gain of the VLNA proved helpful on those occasions.

Bottom Line

The SDRplay RSP1 software-defined receiver covers a wide frequency range and can serve as an inexpensive introduction to the world of SDR. Some care in adjusting the settings is needed when strong signals are present.

I began my review with the *SDRuno* software (see Figure 7), but after bouncing back and forth between it and *SDR Console*, I found that I preferred *SDR Console* (see Figure 8). *SDR Console* has a much "friendlier" user interface. Both applications provide many of the same features and they function well, and *SDRuno* has the very cool ability to open several receivers simultaneously, but *SDR Console* seemed to offer a more intuitive user experience for me. You'll find *SDR Console* at **sdr-radio.com/Software**.

Whichever software you choose, once the SDRplay is up and running, it is hard to resist cruising through the spectrum. The SDRplay parses its phenomenal bandwidth into 10 MHz segments, and you tune within a sliding 260 kHz window. You can change frequencies by entering them directly, by scrolling with the wheel on your mouse, or by just clicking and dragging the spectrum display. Depending on the software you happen to be using, you can view signals in a wide waterfall display, a spectral display, or both.

Both *SDRuno* and *SDR Console* give you the ability to turn the VLNA on and off. I found that *SDR Console* also provided an easier approach to selecting various levels of attenuation. Most of the time, I simply used the default setting, but there were instances when more attenuation was warranted.

I began by browsing the AM broadcast band, listening to distant stations, and looking for the telltale signs of "HD Radio" digital modulation sidebands. Then, from 1.8 to 30 MHz, I was able to sample everything from SSB, to digital, to CW. Both *SDRuno* and *SDR Console* offer synchronous AM, and it was a rare treat to activate that mode and hear the effect on shortwave broadcast signals.

On the amateur VHF bands, I made use of the squelch functions while lis-

Table 2
SDRplay RSP1, s/n H070716

Manufacturer's Specifications	Measured in the ARRL Lab
Frequency coverage: 0.01 – 2 GHz.	0.1 – 2 GHz.
Power requirement: USB power only.	As specified.
Modes of operation: SSB, CW, AM, and FM.	As specified.

Receiver	Receiver Dynamic Testing
Sensitivity (MDS): –136 dBm typical (preamp on).	Noise floor (MDS), 400 Hz BW, LNA on: 137 kHz, –121 dBm; 475 kHz, –136 dBm; 3.5 MHz, –139 dBm; 14 MHz, –137 dBm; 14 MHz, –114 dBm (LNA off); 50 MHz, –139 dBm; 144 MHz, –141 dBm; 222 MHz, –144 dBm; 440 MHz, –145 dBm; 902 MHz, –145 dBm; 1296 MHz, –144 dBm.
Noise figure: Not specified.	14 MHz, 10 dB; 144 MHz, 6 dB; 440 MHz, 2 dB.
AM sensitivity: Not specified.	For 10 dB (S+N/N), 6 kHz BW: 1.020 MHz, 3.16 µV; 3.885 MHz, 1.97 µV; 50.4 MHz, 1.97 µV; 120 MHz, 1.02 µV; 144 MHz, 1.24 µV.
FM sensitivity: Not specified.	For 12 dB SINAD, 12 kHz BW: 29 MHz, 0.28 µV; 52 MHz, 0.28 µV; 146 MHz, 0.50 µV; 162 MHz, 0.15 µV; 223 MHz, 0.15 µV; 440 MHz, 0.14 µV; 902 MHz, 0.19 µV; 1296 MHz, 0.22 µV.

		Blocking gain compression dynamic range, 400 Hz BW:*		
Blocking gain compression dynamic range: Not specified.			20 kHz offset	5/2 kHz offset
		14 MHz	59 dB	59/59 dB

Reciprocal mixing dynamic range (400 Hz BW): Not specified.	14 MHz, 20/5/2 kHz offset: 72/72/72 dB**

Two-Tone Third-Order IMD Dynamic Range Testing (400 Hz bandwidth)

Band/Preamp	Spacing	Measured IMD Level	Measured Input Level	IMD DR
14 MHz/Off	20 kHz	–114 dBm	–42 dBm	72 dB
		–97 dBm	–42 dBm	
14 MHz/Off	5 kHz	–114 dBm	–42 dBm	72 dB
		–97 dBm	–42 dBm	
14 MHz/Off	2 kHz	–114 dBm	–42 dBm	72 dB
		–97 dBm	–42 dBm	

Second-order intercept point: Not specified.	LNA off/on, 14 MHz, +23/+21 dBm; 144 MHz, +39/+39 dBm.
FM adjacent channel selectivity: Not specified.	29 MHz, 49 dB; 52 MHz, 49 dB; 144 MHz, 53 dB; 440 MHz, 40 dB.†
FM two-tone third-order dynamic range: Not specified.	LNA on, 20 kHz spacing, 29 MHz, 49 dB; 52 MHz, 49 dB; 144 MHz, 48 dB; 440 MHz, 40 dB.† 10 MHz spacing: 29 MHz, 80 dB, 52 MHz, 78 dB; 144 MHz, 77 dB; 440 MHz, 76 dB.
Squelch sensitivity: Not specified.	29, 52, 144 MHz, 0.12; 440 MHz, 0.09 µV.
DSP noise reduction: Not specified.	26 dB.
Notch filter depth: Not specified.	Auto notch only, 27 dB.
IF/audio response: Not specified.	Range at –6 dB points (bandwidth):†† CW (400 Hz): 298 – 700 Hz (402 Hz) Equivalent Rectangular BW: 397 Hz USB (2.4 kHz): 203 – 2601 Hz (2398 Hz) LSB (2.4 kHz): 203 – 2601 Hz (2398 Hz) AM (6 kHz): 15 – 6004 Hz (5986 Hz)
Signal processing delay time: Not specified.	336 ms.

Size (height, width, depth): 1.1 × 4.2 × 3.1 inches (including protrusions). Weight: 4 ounces.
Price: $149.95.

*Blocking and reciprocal mixing measurements were made with the AGC on; see sidebar.
**No reciprocal mixing occurred up to ADC overload threshold.
†Measurements were phase noise limited at the value indicated.
††Default values; bandwidth and cutoff frequencies are adjustable.

tening to amateur FM repeater activity, commercial aviation traffic, and public service dispatches. And speaking of FM, listening to FM broadcast stations was particularly fascinating. Both software applications decode FM stereo, and offer the ability to decode the RDS (Radio Data System) text streams that many broadcasters transmit these days (see Figure 9).

I was using an HF antenna during my explorations, so it really didn't do justice to the SDRplay above 30 MHz. If you are particularly interested in the VHF+ monitoring, I'd recommend a multiband VHF-and-above antenna, such as a discone.

Extraordinary Flexibility in a Small Package

The SDRplay is more than just a "radio." Calling it a Radio Spectrum Processor might be more accurate after all. You can certainly use the SDRplay as a multifaceted radio to explore the electromagnetic landscape, but it also has a number of specific applications. For example, if your transceiver offers an IF or receive antenna output, you can feed that IF output signal to the SDRplay, and you'll suddenly have an excellent panadapter that will allow you to view signals across broad swaths of spectrum. This can be a major asset when you are trying be heard within a DX pileup that's spread through many kilohertz, letting you spot that "hole" among the signals where your transmissions can be heard.

Or imagine using the SDRplay as a receiver paired with a QRP transmitter. With an RF-sensing transmit/receive switch (such as the Pacific Antenna Easy TR Switch reviewed elsewhere in this issue), you'd have a highly capable QRP setup.

You can even use the SDRplay as a server, allowing others to access it remotely via the Internet. The software applications I used offered server
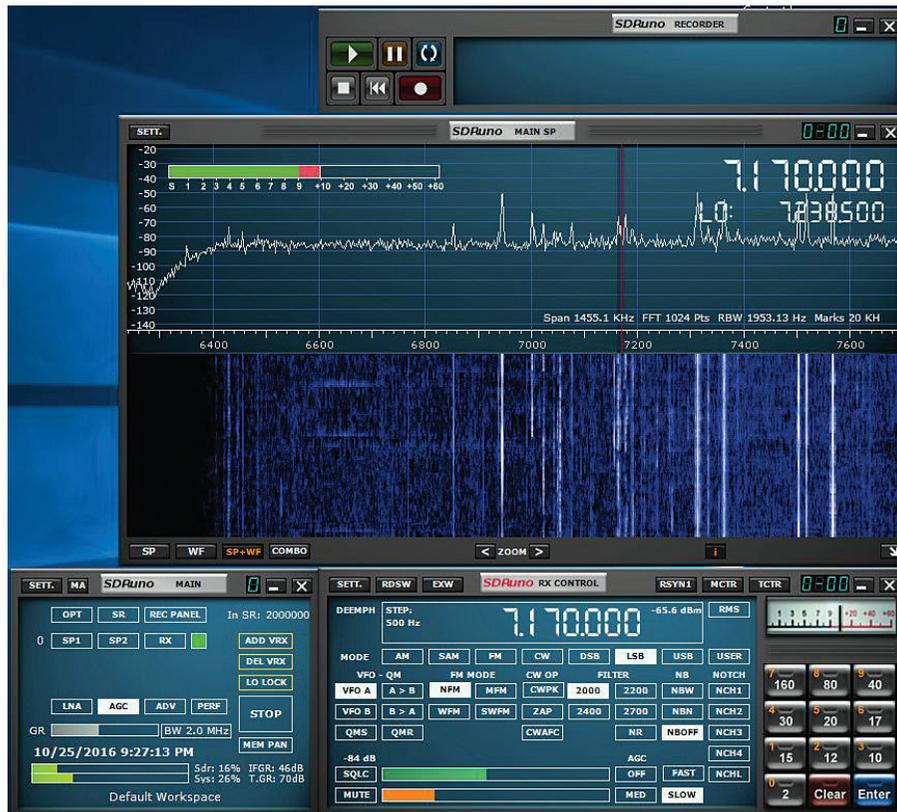
Figure 7 — RSP1 receiving on 40-meter SSB using *SDRuno* software. Only one receiver is shown here, but the application can open several simultaneously.

Lab Notes: SDRplay RSP1

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The SDRplay RSP1 has the ability to receive very weak signals, especially on VHF and UHF frequencies. However, maximum sensitivity doesn't correlate to high dynamic ranges with this receiver. With the LNA (low-noise amplifier) on, maximum measured sensitivity is achieved with the AGC off, RF gain set to –30 dB, and the gain set to 100 dB. The tradeoff for this sensitivity is moderately strong signals (>10 dB over S9) will create an overload condition, resulting in audio output distortion and squealing.

Turning off the LNA and turning on the AGC reduces sensitivity, but increases the receiver's ability to handle strong signals (increased dynamic ranges). Although we normally perform dynamic range measurements with AGC off, both the reciprocal mixing and blocking measurements were made with the AGC on because of the audio distortion with AGC off. Please note the sensitivity measurements are mostly made with the AGC off and the LNA on, with one exception — the 14 MHz LNA off data point (–114 dBm), which is used as reference level for the dynamic range measurements. The lowest dynamic range with the AGC on is blocking. If the received audio is lowered by a strong adjacent signal, the user may wish to turn the AGC off and adjust the gain control for optimum reception.

I used *SDR Console* software for test purposes and general listening. An operational problem occurred when the receiver was tuned above 2 GHz, out of its specified range. Doing so made the receiver stop and the only solution was to restart *SDR Console*. This was a minor issue and overall, *SDR Console* was easy to use and worked well. At the other end of its specified frequency range, I found the receiver sensitivity dropped off quickly below 100 kHz to the point of being unusable.

Used in combination with the Lab's test PC, the signal processing delay time is 336 ms. Keep that figure in mind if you wish to consider using a CW transmitter in combination with the SDRplay. CW signals monitored off air with the SDRplay will be heard ⅓ of a second after the key is pressed.
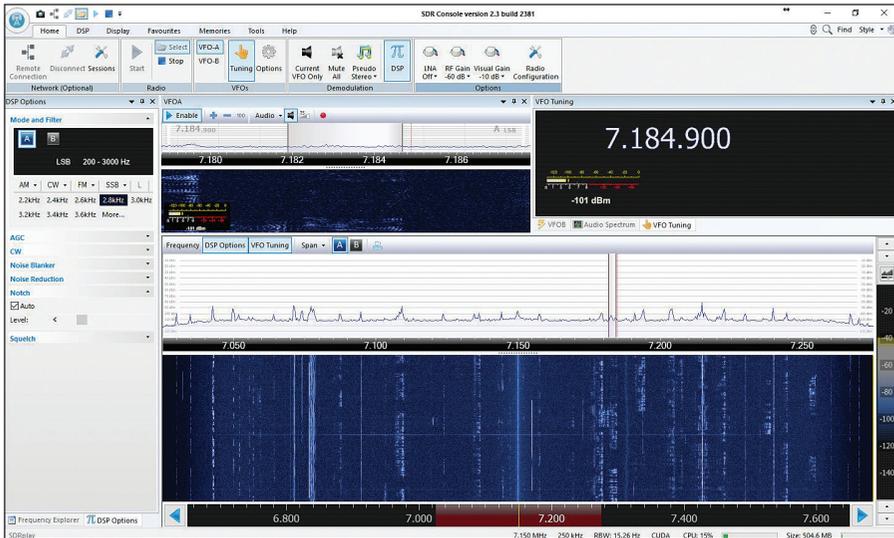
Figure 8 — RSP1 receiving on 40-meter SSB using *SDR Console* software.
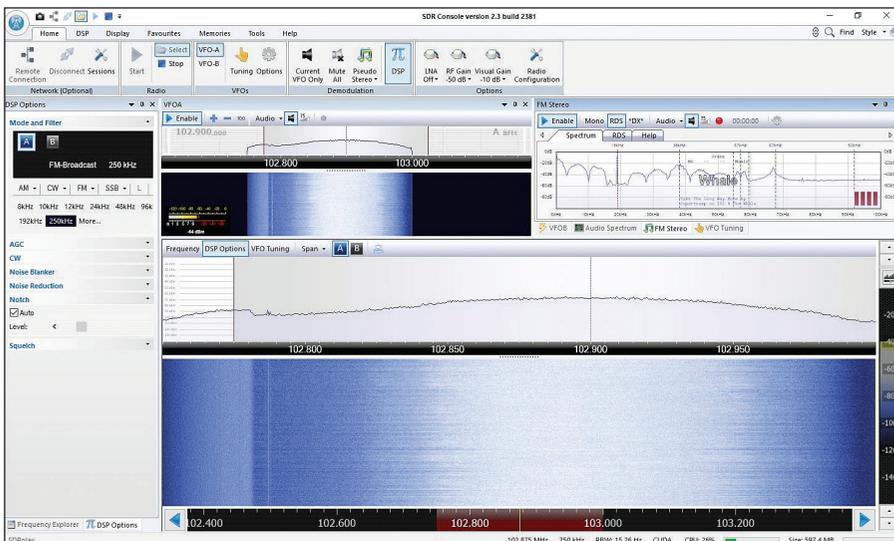
Figure 9 — In addition to decoding FM stereo, *SDR Console* decodes the RDS (Radio Data System) text streams.

functions, although I did not test those features for this review.

And like all software-defined radio technology, as the software evolves, you'll enjoy new features and improved performance. The SDRplay you purchase today is limited only by its processing hardware; the rest is up to the software, and that software is constantly changing. As we wrapped up this review, the manufacturer announced two new models with additional features — the RSP2 and RSP2pro.

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