Product Review

SDRplay RSPdx Software-Defined Receiver

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In recent years, software-defined radio (SDR) technology has become very popular. By transferring processing tasks to software, SDR technology reduces the hardware costs, while often increasing features and performance. It's also easier to upgrade. That's exactly the case with the SDRplay wideband receivers.

This British-based company has been around for a few years. Beginning with the RSP1, all of their product model names have started with RSP, short for Radio Spectrum Processor. In 2016, SDRplay launched the RSP2 and RSP2pro (with metal enclosure), and the RSPdx replaces these receivers. (We reviewed the RSP2pro in the October 2017 issue of *QST*.)

There are many applications for this SDR receiver. It can be used for all-mode listening up to 2 GHz, and it can be used to scan segments of the spectrum. It can be used as a panadapter with your HF transceiver if you have access to IF output signals. You can even use it as a spectrum analyzer with the appropriate software. The SDRplay website features a long list of ham radio, industrial, scientific, and educational application notes.

Overview

The SDRplay RSPdx is a wideband, full-featured, 14-bit SDR that covers the entire RF spectrum from 1 kHz to 2 GHz. Combined with SDRplay's *SDRuno* software, you can monitor up to 10 MHz of spectrum at a time.

The RSPdx shipping box includes only the receiver. You will have to provide a USB cable to connect it to your computer, as well as download the *SDRuno* software and documentation from the SDRplay website.

The RSPdx comes with a metal enclosure. The unit is heavy for its size, and it will stay still on your desk. There are three antenna inputs, an external reference clock input, and a USB connector for the computer connection. Unlike its predecessor, the RSP2, the RSPdx has no external clock output port. If you need

a reference clock output, you will have to move up to the top-end SDRplay device, the RSPduo.

The RSPdx front end has been redesigned for better performance at HF and lower frequencies. The preselector filters and notch filter have been improved, attenuator steps have been added, and there's a new HDR (high dynamic range) mode when used with the companion *SDRuno* software. Compared to the RSP2pro, the ARRL Lab measurements show significantly better sensitivity at 630 and 2200 meters, as well as an approximately 15 dB improvement in third-order IMD dynamic range at HF with the RSPdx AGC level adjusted for best dynamic range. The RSPdx also adds an LF/VLF filter for operation below 500 kHz. This should make this device interesting for medium-wave and long-wave DX hunters.

Antenna ports labeled **ANT A** and **ANT B** are SMA female connectors and can be used from 1 kHz to

Bottom Line

The RSPdx is the latest in SDRplay's line of popular wideband SDR receivers. It offers improved low-band performance and will provide many hours of learning and enjoyment.

Table 1
SDRplay RSPdx, s/n not available

Software: SDRuno, v.1.33

Manufacturer's Specifications	Measured in the ARRL Lab
Frequency coverage: 1 kHz to 2 GHz.	0.1058 MHz to 2.0001 GHz.
Power requirement: USB power only.	As specified.
Modes of operation: SSB, CW, AM, AM Synchronous, FM, FMN, SWFM (stereo decode), WFM.	As specified.

Receiver	Receiver Dynamic Testing
Sensitivity (MDS): Not specified.	Noise floor (MDS), 500 Hz bandwidth. AGC level = 60.[†] 0.137 MHz, −120 dBm; 0.475 MHz, −116 dBm; 1.8 MHz, −127 dBm; 3.5 MHz, −128 dBm; 14 MHz, −133 dBm; 50 MHz, −136 dBm; 144 MHz, −142 dBm; 223 MHz, −144 dBm; 440 MHz, −144 dBm; 902 MHz, −144 dBm; 1296 MHz, −142 dBm.
Noise figure: 20 dB (2 MHz), 17 dB (12 MHz); 15 dB (40 MHz); 2.1 dB (200 MHz); 6.0 dB (340 MHz); 3.1 dB (660 MHz); 4.4 dB (1.5 GHz); 5.0 dB (1.8 GHz).	14 MHz, 14 dB; 144 MHz, 5 dB; 223, 440, and 902 MHz, 3 dB; 1296 MHz, 5 dB.
AM sensitivity: Not specified.	For 10 dB (S+N/N), 6 kHz BW: 1.020 MHz, 3.83 µV; 3.885 MHz, 4.57 µV; 29.0 MHz, 1.78 µV; 50.4 MHz, 1.84 µV; 120 MHz, 0.68 µV; 144 MHz, 0.70 µV.
FM sensitivity: Not specified.	For 12 dB SINAD, 12 kHz BW: 29 MHz, 0.53 µV; 52 MHz, 0.60 µV; 100 MHz (WBFM), 0.56 µV; 146 MHz, 0.21 µV; 162 MHz, 0.20 µV; 223 MHz, 0.16 µV; 440 MHz, 0.16 µV; 902 MHz, 0.18 µV; 1296 MHz, 0.22 µV.
Two-tone, third-order IMD dynamic range: Not specified.	Preamp off: 79 dB at 20, 5, and 2 kHz spacing.[†]
Second-order intercept point: Not specified.	14 MHz, +37 dBm; 21, 50, 144, and 440 MHz, +35 dBm.
FM adjacent channel selectivity: Not specified.	29 MHz, 48 dB; 52 MHz, 49 dB; 144 MHz, 48 dB; 440 MHz, 49 dB.
FM two-tone, third-order dynamic range: Not specified.	20 kHz spacing: 29 MHz, 48 dB; 52 MHz, 49 dB, 144 MHz, 48 dB.* 440 MHz, 49 dB. 10 MHz spacing: 29 MHz, 83 dB, 52 MHz, 84 dB; 144 MHz, 72 dB; 440 MHz, 75 dB.
Squelch sensitivity: Not specified.	29 MHz, 0.63 µV; 52 MHz, 0.56 µV; 146 MHz, 0.25 µV; 440 MHz, 0.18 µV. SSB, 0.19 µV
DSP noise reduction: Not specified.	15 dB.
Notch filter depth: Not specified.	Auto notch only, 70 dB.
IF/audio response: Not specified.	Range at −6 dB points:** CW (500 Hz BW): 450 – 950 Hz; USB (2.8 kHz BW): 94 – 2796 Hz; LSB (2.4 kHz BW): 94 – 2796 Hz; AM (6 kHz BW): 45 – 2915 Hz.
Signal processing delay time: Not specified.	430 ms.
ADC clip level: Not specified.	At maximum RF gain, 14 MHz, −34 dBm; 50 MHz, −35 dBm, 144 MHz, −56 dBm; 432 MHz, −59 dBm; 1 GHz, −44 dBm.

Size (height, width, depth): 1.0 × 3.6 × 4.6 inches (including protrusions). Weight: 12 ounces.

AGC could not be disabled for blocking and reciprocal mixing dynamic range tests. See "Lab Notes" sidebar.

[†]AGC level was adjusted to maximize dynamic range performance.
*Measurements were phase noise limited at the value indicated.
**Default values; bandwidth and cutoff frequencies are adjustable.

2 GHz. The BNC socket for the third antenna port (**ANT C**) is for 200 MHz and below. All three antennas are software-selectable.

Software

This receiver needs a computer and software for operation. You can download the Windows-based *SDRuno* software (see Figure 1) from the SDRplay website. The software is free, and it only works with the SDRplay products. The SDRplay website also offers plug-ins to use the RSPdx with third-party software. There are a number of drivers for using various RSP models with Windows, macOS, Android, Linux, and Raspberry Pi platforms.
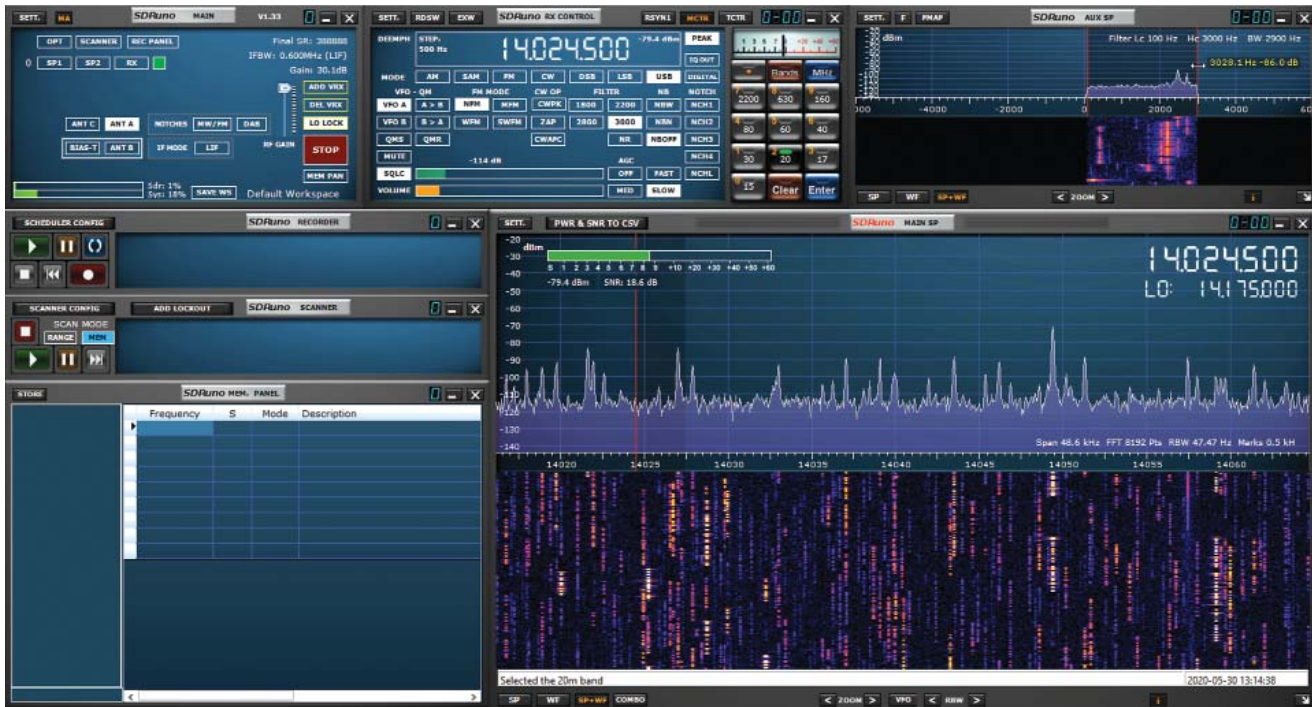
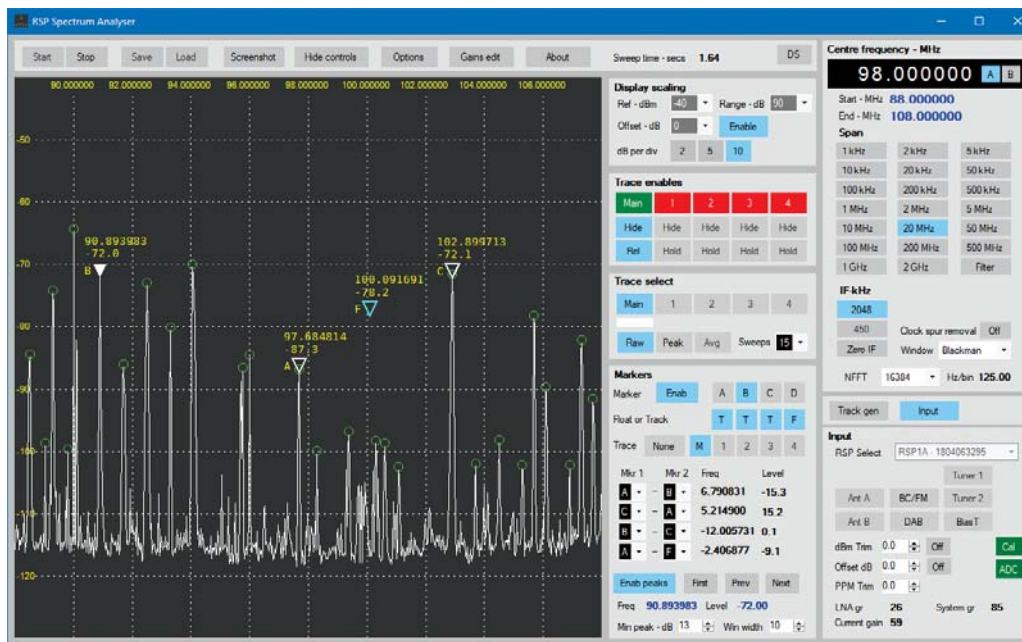**Figure 1** — SDRplay *SDRuno* software.

Figure 2 — *RSP Spectrum Analyser* software. [Photo courtesy of SDRplay]

One feature I find remarkably interesting is the Spectrum Analyzer software for the RSP products that you can download for free from their website as well (see Figure 2). If you add an external reference clock input, you will have a capable piece of workshop equipment for a very low price.

Operation on the Air

During operation, the look and feel of the RSPdx is very similar to the RSP1 and RSP2 receivers, as they all use the *SDRuno* software. Some features are only available if the hardware is compatible. For example, if you have the high-end RSPduo, you can operate two separate receivers on two different antenna ports. On the RSPdx, you will have better low-band filters and performance below 2 MHz, but the software is the same as for the other units.

I spent some time listening to signals on the air with the RSPdx and comparing reception to my HF transceivers. Any signals I could hear on my HF trans-

ceivers, I could also hear on the RSPdx. I loved the fact that it can be used as a wideband scanner, for listening on the HF, VHF, or UHF ham bands, or for listening to the many frequencies used by other services.

Lab Notes: SDRplay RSPdx

Bob Allison, WB1GCM,
ARRL Laboratory Assistant Manager

The SDRplay RSPdx has plenty of sensitivity, especially in the VHF and UHF region of the RF spectrum. Though sensitive, the receiver's behavior in the presence of strong signals needs a bit of explanation.

Strong nearby signals may cause a reduction in the speaker volume level while listening to a desired signal (this is called blocking). Overall, the RSPdx exhibits minimal undesirable effects when using a modest antenna system, but you may notice some blocking if signals are strong. For example, an S-7 signal, 20 kHz away, will cause speaker volume to drop by 1 dB. The blocking effect lessens as an offending signal moves away from the desired frequency. For example, an S-9 +20 dB signal 1 MHz away is at the threshold of blocking the desired signal. In the presence of strong adjacent signals, the solution is to adjust the volume appropriately.

The dynamic range measurements we regularly report are made with the receiver AGC turned off. Though the RSPdx can indicate AGC off, the blocking behavior does not change whether the AGC setting is off or on. Because of this effect, I could not measure either blocking gain compression dynamic range or reciprocal mixing dynamic range for the RSPdx. A more detailed explanation is available from **www.arrl.org/qst-in-depth**.

Receive processing delay time (the time between when a signal enters the antenna jack and when it is heard in the speaker) measured 430 milliseconds. If this receiver is paired up with a transmitter, the delay is long enough that you will need to use a separate sidetone for CW operation rather than trying to listen to your own sent CW transmissions.

I found the software operation complicated at first because there are many features, and some are labeled differently than on a typical ham transceiver. I had no difficulty with the most common features, such as mode selection, noise blanker, multiple notch filters, or noise reduction. There is a quick ham band selection that lets you switch easily between bands with the correct default modes.

The first thing you need to master within the *SDRuno* software is the use of preselectors from the **BANDS** menu in the **SDRUNO RX CONTROL** window. There are four band types: Ham Lower, Ham Upper, Broadcast, and the HDR bands for below 2 MHz (see Figure 3). Mastering this menu improves your experience from the start, and you can move on to more complex adjustments.

Where it gets complicated is when you want to fine tune, as there are endless adjustments you can make depending on the receiving conditions. I spent a few minutes talking to Mike Ladd, KD2KOG, who represents SDRplay and provides technical support in the US. He showed me some tricks that helped me to remove unwanted noise using several careful adjustments. For every situation, there is a tool to improve reception or to pull small signals out of the noise by improving the signal-to-noise ratio (SNR). You can find Mike's tips on his YouTube channel at **www.youtube. com/c/SDRplayHamGuides/videos**.

Conclusion

The RSPdx with *SDRuno* software offers a good performing, wideband, multimode receiver at an attractive price. I like the fact that this radio can be used for many applications. For someone newly interested in shortwave listening and ham radio, the SDRplay receivers offer a good starting point. The RSPdx allows someone to check out many aspects of the hobby without breaking the bank. If they do get licensed and move up to a transceiver, the RSPdx will still be useful for general listening/scanning, as a panadapter, or as a spectrum analyzer.

Figure 3 — Preselectors are available for various frequency ranges.

Larger versions of the illustrations in this review are available from **www.arrl.org/qst-in-depth**.

Manufacturer: SDRplay Limited, 21 Lenten St., Alton, Hampshire, GU34 1HG, United Kingdom; **www.sdrplay.com**. Distributed in the United States by Ham Radio Outlet; **www.hamradio.com**. Price: $199.95, including the *SDRuno* software.