

Product Review

Expert Electronics ColibriNANO SDR Receiver

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In recent years, software-defined radio (SDR) technology has become very popular. SDR may sound like a buzzword, but in many ways, it's a radio revolution. In the world of IP networks, there's a technology called SDN (software-defined network). Here, the concept is to keep the local hardware as the "data plane" (fast and simple data processing), while transferring the "control plane" (intelligence) to software. We observe the same phenomenon in Amateur Radio with SDR, and this often means a better radio for a better price. By transferring processing tasks to software, it reduces the hardware costs while increasing performance and the overall capabilities. It's also easier to upgrade. Good hardware in combination with good software will always give great results. This doesn't mean that a PC is needed for all SDRs, as some can be used standalone.

The ColibriNANO is a tiny HF/VHF/UHF SDR dongle manufactured by Expert Electronics (makers of the SunSDR transceivers). Quite a few SDR dongles are available, and the ColibriNANO is probably one of the most expensive in its class. Comparing them is not so simple, because with SDR there is more to consider, such as the software. This radio uses a variant of the same software used by all of the Expert Electronics SDRs: *ExpertSDR2*.

Overview

The hardware is a small stick about the size of a flash drive, with a USB connector on one end and an SMA female antenna connector on the other end. The first thing I noticed is the quality of construction with its all-metal housing (see Figure 1). It gets surprisingly hot when plugged in to

the host computer (powered on), but this does not affect its stability.

This unit is intended for operation on the amateur bands from 160 through 6 meters, with a specified frequency range of 9 kHz to 55 MHz, although sensitivity drops off dramatically below 100 kHz. It receives VHF and UHF signals to 500 MHz or higher in under-sampling mode.

There are two receivers, main and sub. A low-pass filter at the 55 MHz input switches automatically according to the panoramic display center frequency — it's on for the 0 – 55 MHz range, and off when above 55 MHz. The high-speed ADC (analog-to-digital converter) has a 14-bit resolution and a sampling rate of 122.88 MHz. It has a local TCXO (temperature-compensated crystal oscillator) rated at ± 0.5 ppm (parts per million) to ensure frequency stability. The impedance of the antenna port is 50 Ω .

Using the ColibriNANO

Before you can use this receiver, you will need to download the software and user manual from the NSI Communications website. As with other SDRs, the software is updated regularly, so check for the latest version. There are several ways to use the ColibriNANO: the *ExpertSDR2* software on a local PC; remotely with the *ExpertRC* (remote client) software, or remotely with a web client on any PC or device that supports HTML5. The latter two use the

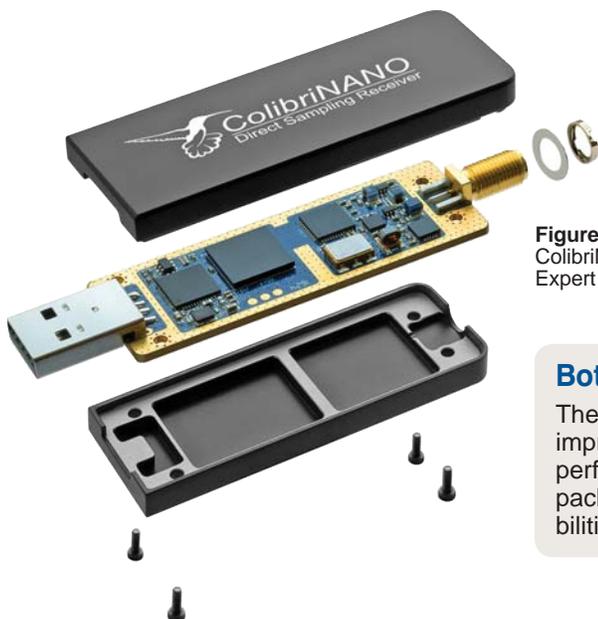


Figure 1 — Exploded view of the ColibriNANO. [Photo courtesy of Expert Electronics]

Bottom Line

The ColibriNANO SDR offers impressive features and good performance in a very compact package. Its remote control capabilities are especially impressive.

ExpertRemote system, and are discussed in detail later in this review.

The ColibriNANO is also compatible with some popular open-source SDR software, such as *HSDR* and legacy *SDRSharp*, via ExtIO libraries that are available for download from the NSI Communications website. For this review, we will focus on the manufacturer's software.

ExpertSDR2 — Local PC Installation

There is a specific version of the *ExpertSDR2* software for the ColibriNANO. At the time this article was written, it was available only for Windows. The minimum PC requirements are an Intel Core i3 CPU or equivalent, 4 GB of RAM, and a high-speed USB 2.0 controller.

The software detected the ColibriNANO instantly. In a few minutes, I was receiving signals. The software is particularly easy to use. At first, I didn't understand some features in the menu, but quickly found answers in the manual. I was impressed by the receiver performance — it's better than I expected.

I particularly liked the software's 4K video option. It made the *ExpertSDR2* screen fit perfectly on my 40-inch 4K monitor, without having to play with the font size or other display parameters. I wish more software had this option (see Figure 2).

The *ExpertSDR2* software with the ColibriNANO directly connected on a local PC will allow you to get the most out of this receiver. There are a lot of features available, so I will try to summarize.

Supported modes are LSB, USB, DSB, CW, AM, synchronous AM, and narrow and wide FM. It supports additional modes with third-party software. There is a menu where you can select your "Amateur Region" (ITU region) band plan, which affects the way the amateur bands are shown in the software. I selected Region 2 (North and South America). You can

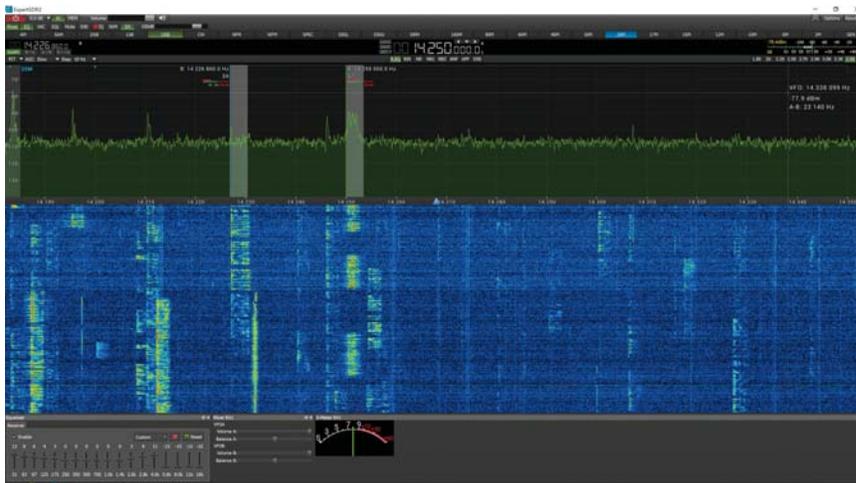


Figure 2 — The *ExpertSDR2* software, running on a local computer and receiving on the 20-meter band.

Lab Notes: ColibriNANO Software-Defined Receiver

Bob Allison, WB1GCM, Assistant Laboratory Manager

The tiny ColibriNANO turns any digital computing device into a flexible, wide-band receiver when used with *ExpertSDR2* or other compatible software. Listening to the ColibriNANO is pleasurable, and the automatic notch filter does a great job of removing heterodynes or sounds from operators tuning up on the bands.

Referring to the data in Table 1, the receive sensitivity is at a level considered "rural quiet" on HF: -123 dBm, which is more than adequate for most HF reception. The Lab measures receiver sensitivity by connecting a signal generator to the antenna port, injecting a signal, and increasing the signal level until it is 3 dB above the background noise as measured on a relative audio meter. All noise does not sound the same, and the audio meter does not react the same with all receivers. In this case, even though our measurements indicate an MDS (minimum discernible signal) of -123 dBm, a user can still hear, by ear, a CW signal at the -130 dBm level. The three dynamic ranges presented in Table 1 are based on the measured MDS.

With the **PREAMP AUTO** feature enabled, the ColibriNANO with *ExpertSDR2* software can raise the attenuation level automatically when one or more strong signals are present at the antenna jack. For our tests, the **PREAMP AUTO** function was disabled, and the gain was set to 0 dB (no attenuation, no preamp). I did note that the receiver sensitivity (MDS) measured the same with the preamp set to +0 dB or +6 dB.

As measured with similar SDRs, there was no blocking or reciprocal mixing from signals with levels up to the threshold of ADC overload (-11 dBm at 14 MHz, for example). That's pretty good. The two-tone, third-order IMD dynamic range (3 IMD DR) is only 49 dB at 14 MHz during quiet band conditions (no other signals present). Add a single S-9 +30 dB signal at the antenna jack (to simulate a busy band), and this dynamic range jumps to 84 dB. As with some of the other SDRs measured in the ARRL Lab, the 3 IMD DR is a moving target, based on the level of signals arriving at the antenna jack. In the case of the ColibriNANO, the strong signal from a single AM broadcast station at S-9 +30 dB will increase the 3 IMD DR in the amateur bands to busy band levels — there are no band-pass filters at the front end. (See the February 2010 issue of *QST*, page 52, for a detailed explanation.) I expect that most users would not experience the effects of IMD with this receiver.

Figure 3 — The ColibriNANO and Raspberry Pi 3 set up for remote server operation.

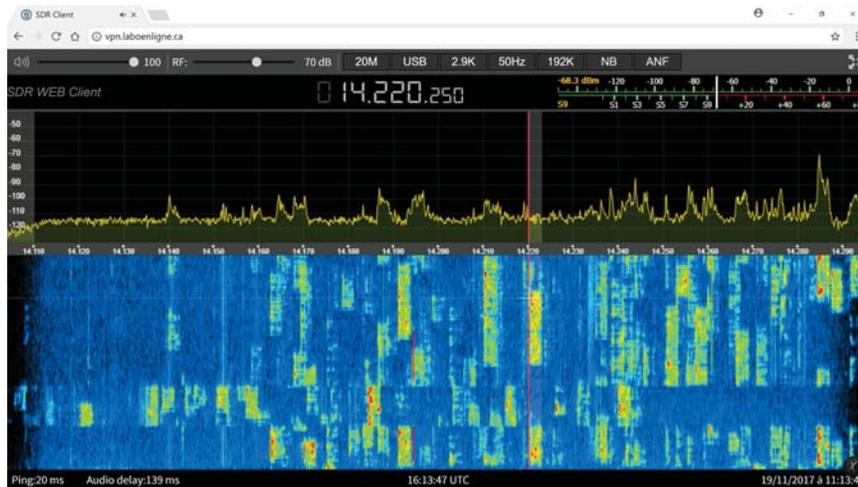


Figure 4 — Controlling the ColibriNANO from a remote PC using the HTML5 web client via the remote server shown in Figure 3.

also add the 60-meter band by checking that option.

There are two noise blankers (NB1 and NB2), noise reduction (NR), an audio equalizer (RX EQ), automatic notch filter (ANF), and more. You can select preprogrammed filter bandwidths or easily customize them as you want.

If you have a transceiver that can be controlled by a PC via an RS-232 port (CAT), this SDR is a good choice to use to add a spectrum scope with waterfall to your station if your radio doesn't have one. You can synchronize the ColibriNANO with your HF transceiver using *RigSync* (www.qrv.com/rigsync.html) or *OmniRig* (www.dxatlas.com/omnirig/). These choices can be selected directly in the *ExpertSDR2* software.

The maximum visual spectrum sampling rate (span) with the local software is 3 MHz. The sub receiver frequency must be in the same span as the main receiver to see its spectrum and waterfall displays. If the second receiver is outside the span, it will work, but you will not see signals from it on the spectrum displays.

If I could hear a signal on any of my HF transceivers, then I could hear it on the ColibriNANO, sometimes even better. The noise blanker is very effective — one of the best I've seen — and it doesn't destroy the received audio quality.

ExpertRemote System

Before you can use the remote software (*ExpertRC*, remote client) or web client access, you must install

the remote server (*ExpertRS*). When this article was written, the only version available was for the Raspberry Pi 3 (not compatible with Pi 2). As we were going to press, Expert Electronics indicated that they were about to release a new *Windows* version of *ExpertRS* with support for the ColibriNANO and additional features and improvements. It should be available by the time you read this. There's an easy way to get started with the Raspberry Pi 3 by downloading a pre-made image from the Expert Electronics website. That's what I used for my server (see Figure 3).

The server requires more advanced computer skills, but the effort is worth it. I have done all kinds of remote IP projects in the past, and all of them had their flaws. That's not the case with this one. It's resilient. I can remove the ColibriNANO server, and as soon as I reconnect, it works — no reboot necessary. If you are connected remotely and you lose the connection, you reload the page, and it becomes available again. The server has been running for a few months without any crashes.

ExpertRC — Remote Client (via the Remote Server)

The *ExpertRC* software has the same appearance as the local *ExpertSDR2* software, although some features are grayed out and are not available. With *ExpertRC*, there's only one noise blanker, no noise reduction, no secondary receiver, and unfortunately for me, no 4K video function in this version. The automatic notch filter is available. The maximum visual spectrum sampling rate (span) with the remote client is 384 kHz.

The *ExpertRC* remote software offers more options than the web client described next. You can have memory channels and you can sync your HF transceiver and use it as a pan-adaptor. I was able to use *OmniRig* to sync my TS-2000 (COM port speed 57,600 bps) over the internet and it works, but with a considerable delay.

Table 1

ColibriNANO, s/n EED02091700133

Tested using *ExpertSDR2 V1.2.0*

Manufacturer's Specifications	Measured in the ARRL Lab
Frequency coverage: 0.01 – 500 MHz.	0.120 – 800 MHz.*
Power requirement: USB power only.	As specified.
Modes of operation: SSB, CW, AM, SAM (synchronous AM), FM, FMN, WFM.	As specified.
Receiver	Receiver Dynamic Testing
Sensitivity (MDS): 1.9 MHz, –131 dBm; 7.1 MHz, –130 dBm; 52.5 MHz, –127 dBm.	Noise floor (MDS), 500 Hz filter, preamp set to +0 dB:** 0.137 MHz, –121 dBm; 0.475 MHz, –124 dBm; 3.5 and 14 MHz, –123 dBm; 50 MHz, –122 dBm; 144 and 222 MHz, –124 dBm; 440 MHz, –122 dBm.
Noise figure: Not specified.	14 MHz, 24 dB; 50 MHz, 25 dB; 144 MHz, 23 dB; 440 MHz, 25 dB.
AM sensitivity: Not specified.	For 10 dB (S+N/N), 6 kHz BW: 1.0 and 3.8 MHz, 5.07 μV; 50.4 MHz, 6.16 μV; 120 MHz, 5.3 μV; 144 MHz, 4.73 μV.
FM sensitivity: Not specified.	For 12 dB SINAD, 16 kHz BW: 29 MHz, 1.58 μV; 52 MHz, 2.02 μV; 100 MHz, 2.24 μV (WBFM); 146 MHz, 1.44 μV; 440 MHz, 2.16 μV.
Spectral sensitivity: Not specified.	Matches specified (MDS) sensitivity.
Blocking gain compression dynamic range: 110 dB.	Blocking gain compression dynamic range, 500 Hz BW: <i>Offset</i> <i>20 kHz</i> <i>5/2 kHz</i> 3.5 MHz 110 dB 110/110 dB 14 MHz 112 dB 112/112 dB 50 MHz 111 dB 111/111 dB 144 MHz 112 dB 112/112 dB 430 MHz 113 dB 113/113 dB
Reciprocal mixing dynamic range Not specified.	14 MHz, 500 Hz BW: 20/5/2 kHz offset: 112/112/112 dB
Two-tone, third-order IMD dynamic range: 95 dB.	Quiet band/busy band:** 3.5 MHz, 72/89 dB; 14 MHz, 49/84 dB; 50 MHz, 46/65 dB; 144 MHz, 45/72 dB.
Second-order intercept point: Not specified.	14 and 21 MHz, +53 dBm; 50 MHz, +75 dBm; 144 and 440 MHz, +63 dBm.
FM adjacent channel selectivity: Not specified.	29 MHz, 83 dB; 52 MHz, 81 dB; 144 MHz, 74 dB; 440 MHz, 66 dB.
FM two-tone, third-order dynamic range: Not specified.	20 kHz spacing (quiet/busy band):** 29 MHz, 31/69 dB; 52 MHz, 28/61 dB; 144 MHz, 36/86 [‡] dB; 440 MHz, 32/81 [‡] dB. 10 MHz spacing, 29 MHz, 88 dB; 52 MHz, 85 dB; 144 MHz, 86 dB; 440 MHz, 81 dB.
Squelch sensitivity: Not specified.	SSB: 14 MHz, 0.29 μV. FM: 29 and 52 MHz, 0.53 μV; 146 MHz, 0.82 μV; 440 MHz, 0.76 μV.
DSP noise reduction: Not specified.	10 dB.
Notch filter depth: Not specified.	Auto notch; notches two tones >60 dB.
IF/audio response: Not specified.	Range at –6 dB points, bandwidth: [†] CW (500 Hz BW): 400 – 907 Hz; Equivalent Rectangular BW: 494 Hz; USB: (2.5 kHz BW): 40 – 2,554 Hz; LSB: (2.5 kHz BW): 40 – 2,539 Hz; AM: (6 kHz BW): 20 – 3,082 Hz.
Signal processing delay time: Not specified.	252 ms.
Size (height, width, depth): 0.4 × 0.9 × 3.5 inches (including protrusions). Weight: 1.5 oz.	

*Sensitivity decreases significantly below 120 kHz. Some spurious signals were observed below 500 kHz.

**See "Lab Notes" sidebar.

‡Noise limited at the values shown.

†Default values; bandwidth and cutoff frequencies are adjustable.

Web Client — Remote Web Access

Because the web server is based on HTML5, you can access it with any modern browser on any device (Windows, Linux, macOS, iOS, Android), as shown in Figure 4. There is no need to install a plug-in, such as Flash or Java. It's a smart initiative from Expert Electronics, and I love it. I often use the web client to check the band conditions and for listening. It's easier and faster than turning on my HF transceiver, and I don't even have to be in my station. With my setup, I can be anywhere there's internet access. As with *ExpertRC*, the sampling rate of the maximum visual spectrum (span) with the web client is 384 kHz.

The interface is fluid, even on a 3G cell phone connection. Operation of the automatic notch filter and noise blanker are just as good as with the local software. The noise blanker is an important feature for my location in the suburbs. One day last winter, the temperature was well below zero and the air very dry, and I had a bad electrical noise on HF. I activated the ColibriNANO noise blanker via the web client, and it did a good job. I made a quick video that day, showing how it worked (www.youtube.com/watch?v=bd9Bv3QjFa0&t=88s).

Conclusion

At first, I was not expecting too much from this tiny receiver, but it really exceeded my expectations. What I like most about this SDR should come as no surprise — the remote capabilities and especially the web client that I can easily use with my iPhone. I also appreciate the software interface and the overall radio performance. It's a very good receiver that you can count on in difficult conditions, as demonstrated with the noise blanker video.

This unit does work above 54 MHz (VHF and UHF), but it is best suited for HF (6 to 160 meters). Although the noise figure is high, as shown in Table 1, it's not too bad on VHF using the *ExpertSDR2* software on a local PC. It works best with the preamp at

Try the ColibriNANO Remotely

For a limited time, my server is available to the public. Please be patient, because it's only one user at a time, and for that reason, try to be brief so that others can try it too. If you do not have reception, I may be using my antenna with other radios and the unit is probably grounded, so try again later. Usually, the ColibriNANO is connected to my triband Yagi antenna (beaming south) during the day, and at night, it's on my 40/80-meter dipole. Sometimes I forget to switch it back to the beam for the next day.

For the web client, use this link on any browser/platform: vpn.laboenligne.ca. (The link is not used as a virtual private network [VPN] — it's only a sub-domain name of [Laboenligne.ca](https://laboenligne.ca).)

If you install the *ExpertRC* software on your PC, access the receiver with the IP address 69.70.160.68 directly.



Visit <https://youtu.be/jvtW0TX00eE> to see our review of the Expert Electronics ColibriNANO SDR Receiver on YouTube.

its maximum setting and the spectrum scope reduced to less than 192 kHz. For serious VHF/UHF work, an external preamp would help a lot. If you operate the ColibriNANO remotely, keep in mind that, for the web client, there is no 2-meter band selection. If you use the general-coverage mode to access those frequencies, it seems to be quite deaf.

See the sidebar, "Try the ColibriNANO Remotely," for more information on testing it for yourself.

Manufacturer: Expert Electronics, Taganrog, Russia; eesdr.com/en/. Distributed in North America by NSI Communications, 11410 NE 124th St., Suite 343, Kirkland, WA 98034; tel. 800-977-0448, www.nsiradio.com. Price: \$290.