

How Can an SDR Help a Ham Radio Operator?

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I have been interested in SDRs (Software Defined Radios) for some time, but have never owned one. Recently, I thought that it would be nice to be able to monitor other bands while operating. This article is obviously not for the "Flex Radio" guys, but for those who operate more "traditional" single-receiver ham transceivers.

It is well-known that 6M is not open very often, but if I was monitoring 6M while chasing contacts on another band, I could see when signals started to appear. The same applies to other bands as well. Another use for a second receiver would be to better chase DX'ers that operate split. By listening to both the DX'er and the callers, I could see where the DX'er is listening and adjust my transmit frequency to improve my chances of breaking the pileup. Other sporadic activity such as 10M FM repeaters and even local VHF / UHF repeaters can be monitored. Many hams use an SDR as a "panadapter" to create a high-resolution waterfall on a large PC monitor. Of course, the SDR with the right antenna can be used to listen to shortwave, AM / FM broadcast stations, air band, maritime stations, etc. Since none of my shack rigs have two receivers (or VHF / UHF), I decided to see if an SDR could work for some of these tasks.

There are two very important points to consider when using an SDR with your transceiver:

First, you need a way to protect the SDR from strong signals when you transmit. This is especially critical if the receiver and transmitter share an antenna. For this case a T/R switch that operates on the PTT signal from your transmitter is the safest method. These can be [expensive](#) and add other functionality, but an effective T/R switch can be made using an appropriate relay and a few components. Beware of the cheap T/R switches that you see on Amazon, ebay, etc. These rely on detecting the RF transmitted, while they can work, any mis-timing can send full transmitter output into the receiver. If you are receiving on a band far from where you are transmitting on a separate antenna, the receiver may not need protection or just a bandpass filter. Most SDRs can be damaged be as little as 1mW. In the excitement of chasing a QSO, you may transmit on "wrong" band and destroy the SDR front-end.

Second, is that if you want to monitor different bands while using the same antenna, you will need a multiband antenna. A Hexbeam would be an excellent choice to operate on 20M – 10M while monitoring 6M (although both bands will have the same directions). A fan dipole, DX Commander, EFHW and full-wave loop antennas can also be effective while being more omni-directional and less inexpensive. I have been trying a small, [receive-only mag loop](#) antenna that claims coverage from 100kHz to 180 MHz. It is mounted about 20' up on a pushup pole outside the shack. Dave Casler [reviewed](#) this loop and found that it worked pretty well compared to his Chameleon loop even though it was mounted at a slightly lower elevation.

Since I was just beginning to investigate SDRs, I started at the bottom end of the price range - \$37 for an [RTL-SDR](#) on Amazon. I later realized that, for the same price, the [nooelec](#) is a better choice. It has slightly better specs and a shape that fits standard USB A spacing. There are many standalone SDRs to choose from ranging up to several hundred dollars. I may eventually choose a more expensive SDR if things work out well. A fully "tricked out" SDR setup can include a splitter, an LNA (Low-Noise Amplifier), variable attenuator and a commercial T/R switch. I am lucky in that my main shack rig has a receive antenna input, built-in splitter (for antenna output) and transmit protection for the receiver attached to the antenna output. Because of this, I could get by with a minimal setup. For a good description of a fully capable SDR system that will share an antenna and work with pretty much any rig, see [this video](#). Many SDR applications can interface with your rig via OmniRig or HamLib and some of these will "deafen" the receiver by reducing the gain by 10's of dB when you transmit. This may not be as safe as a PTT-based T/R switch.

In choosing an SDR, two of the most important factors are the frequency ranges covered and the bandwidth available at one time. Many SDRs are based on chips designed for TV reception and do not tune HF natively. Some of those can tune HF by "direct sampling". One popular model (AirSpy's HF+ Discovery) covers HF up to 31 MHz, then VHF starting at 64 MHz – so no 6M band! Another popular choice, SDRPlay SDRs have continuous coverage without such gaps and can display 10MHz at one time. One SDR (RX-888) with a 16-bit DAC can display a spectrum across 64 MHz at one time! AirSpy and SDRPlay devices are generally 14-bit devices. In contrast, the \$37 SDR is an 8-bit device and can only display 2.4 MHz reliably. That bandwidth is enough for my initial purposes. SDR receivers are extremely sensitive due to built-in LNAs, so sensitivity is usually not a concern. However, this high sensitivity may lead to interference from local strong signals and dynamic range is a more important spec for SDRs. There too many other considerations to go in a short article, so see [this other video](#) for a good overview.

One final thing to mention is software. There are probably as many SDR software applications as SDRs! This is another reason that I went with the cheap route first – to see what software had the features that I needed before committing to a more expensive SDR. I tested five different SDR application and found that SDR# ("SDR Sharp") and SDR Console worked well for my use cases and were fairly easy to learn. SDR# is more basic, but if you are not tuning around a lot, or monitoring multiple frequencies simultaneously, it is very effective. SDR Console is a full-featured application with memories, built-in favorites, multiple independent receivers, and a server for remote operation. It is overkill for what I need, but the interface is easier to use and I prefer it over SDR#.

So far, there has been no activity on 6M or 10M FM repeaters while I have been monitoring, so I have not actually tested the SDR for that. The SDR was helpful in chasing DX operating split mode and I have also used it to monitor HF bands while working a different band. The ability to transfer frequencies between SDR and transceiver has been useful in general HF operating. The operation of the RTL-SDR on the 10M band has been hit or miss. I have had to adjust settings

to eliminate lots of birdies across the band and receive actual signals. I think that this is caused by the cheap SDR.

The RTL-SDR also seems to be less sensitive than my transceiver. I have done some tests to quantify this using FT8. To use wsjt-x with the SDR, you will need to install a virtual audio cable application such as [VAC](#). The free version of VAC creates one Windows speaker and one microphone sound device that you can use just like physical speakers or microphones.

I used wsjt-x in the usual way with my transceiver. I then opened a second instance of wsjt-x using the Windows Run feature. To do this on a Windows PC, right click on the shortcut that you use to open wsjt-x and then click on properties. Copy the "Target" URL using CTRL-C. Press the Windows key and "R" at the same time to get the Run dialog box. CTRL-V the Target URL into the "Open:" text box. Then type a blank space and "--rig-name=xxxx" after the URL. The "xxxx" is arbitrary and need not be the actual rig name. (Each instance of wsjt-x just needs a unique "rig name" so that it can keep the settings straight among instances.) Click on "OK" and a new wsjt-x window will open. Finally, select "No Radio" in the Radio settings and the VAC that you created as a sound input device in the Audio settings of wsjt-x. (The wsjt-x sound output device does not matter since you should not be transmitting!) Select the VAC cable as the output device in your SDR software and you should now see signals on the wsjt-x waterfall. FYI, if you have two transceivers, you can also use this method to listen to wsjt-x on two bands at once.

I did not do an exhaustive scientific test, but observations showed that SDR-based instance of wsjt-x decoded the same or fewer signals that the transceiver-based instance on several HF bands. The SDR-based decodes were typically 25 – 50% lower than those of the transceiver over a 15-second FT8 receive cycle. I then let wsjt-x and Grid Tracker run for about 10 minutes with the SDR and then the transceiver on 15M FT8. In this test, the transceiver roster contained 57 decodes and the SDR contained 50. So the transceiver was only a little better over a longer operating period. The longer time tests were done with the small mag loop mentioned above. I was able to receive signals from the South Pacific, Eastern Europe and Southern Argentina with very good signal-to-noise ratios – pretty impressive for a 2' loop at 20'!

I also noted that it was visually obvious from the transceiver and SDR waterfalls, there were fewer and weaker signals on the SDR. Given the high sensitivity of SDRs, I did not expect this. Maybe I need to learn optimum settings or get a better SDR, stay tuned....