

## DESIGN NOTES

### Explore Software Defined Radio on a Budget

Many engineers and other technology-minded individuals are using their amateur radio hobby to explore software defined radio (SDR). The results of their work include creative front-end hardware design, using baseband interfacing with high performance personal computer sound cards, supported with signal processing, decoding and display software.

For a very small investment (and a good personal computer) it is possible to obtain a receive-only SDR system, with several options for monitoring and decoding software. Typically, the radios are configured as I and Q direct-conversion demodulators, with the two baseband output channels fed to the inputs of a high quality, high sampling rate audio sound card. Currently, sound cards are readily available with a 96 kHz sampling rate, with 192 kHz sampling rate cards available at slightly higher prices. The bandwidth that can be processed is approximately one-half the sampling rate, so a 192 kHz sound card can be used for digital processing of a 96 kHz slice of the radio spectrum.

### Resources

A very economical means of exploring SDR is to build the popular “SoftRock” receiver kit, originally developed by the American QRP Club, and continued by other interested experimenters. The SoftRock receiver is essentially a USB port module that is a fixed LO receiver at the user’s choice of frequency. The demodulated I and Q outputs go to the PC sound card for processing. SDR software is not part of the radio package. The SoftRock kit will cost from US\$30 to US\$50, depending on shipping requirements and a few options. [www.softrockradio.org](http://www.softrockradio.org) is the Web address of the providers of these radios.

Another collaboration on radio design can be found at <http://hpsdr.org>, where the name is an acronym for High Performance SDR. According to the Web site, “The HPSDR is an open source (GNU type) hardware and software project intended as a ‘next generation’ Software Defined Radio (SDR) for use by Radio Amateurs (‘hams’) and Short Wave Listeners (SWLs). It is being designed and developed by a group of SDR enthusiasts with representation from interested experimenters worldwide.”

One company providing a complete solution, including the DAC (no sound card required), is RF Space ([www.rfspace.com](http://www.rfspace.com)). Their SDR-IQ model samples the 100 kHz to 30 MHz spectrum and delivers data for any 190 kHz bandwidth for processing. The company’s proprietary demodulation software pro-



**The SoftRock receiver is a popular and inexpensive way to explore SDR techniques, typically using public-domain, shareware or freeware software written by various individuals or groups of experimenters**

vides a number of spectral analysis and demodulation capabilities. This unit is priced at US\$499. The higher performance (mainly resolution bandwidth) model SDR-14 has additional features, including external input to the ADC. This unit is priced at US\$1099.

The RF Space products are marketed to both hobbyists and to professionals for analysis of ultrasound, RF/IF and other signals in the frequency and bandwidth ranges they support.

### SDR Software

As noted above, RF Space has its own software package, and HPSDR is developing software as well as hardware. One of the most popular SDR packages is the “Rocky” freeware from Alex Shovkopyas ([www.dxatlas.com](http://www.dxatlas.com)), which is often used with the SoftRock radio for a very low cost introduction to SDR.

Other software authors or groups include Duncan Munroe ([www.m0kgk.co.uk/sdr/](http://www.m0kgk.co.uk/sdr/)), whose “KGKSDR” is under constant development and improvement, and TAPR (Tucson Amateur Packet Radio, [www.tapr.org](http://www.tapr.org)), which is developing the “Penelope” SDR software in conjunction with HPSDR. TAPR deserves a special historical note. This organization of amateur radio enthusiasts, many of whom are also hardware or software professionals, has been in existence since 1981. It was originally formed to develop packet data communications and is credited by some observers as launching what is now a continuing phenomenon of digital communications over radio. For example, some of the original “laptop in a police car” data communications systems were based on the amateur packet protocols developed by the members of TAPR.

Other resources for investigation can be found via links from the above Web sites, or by intelligent searching using your favorite search engine.