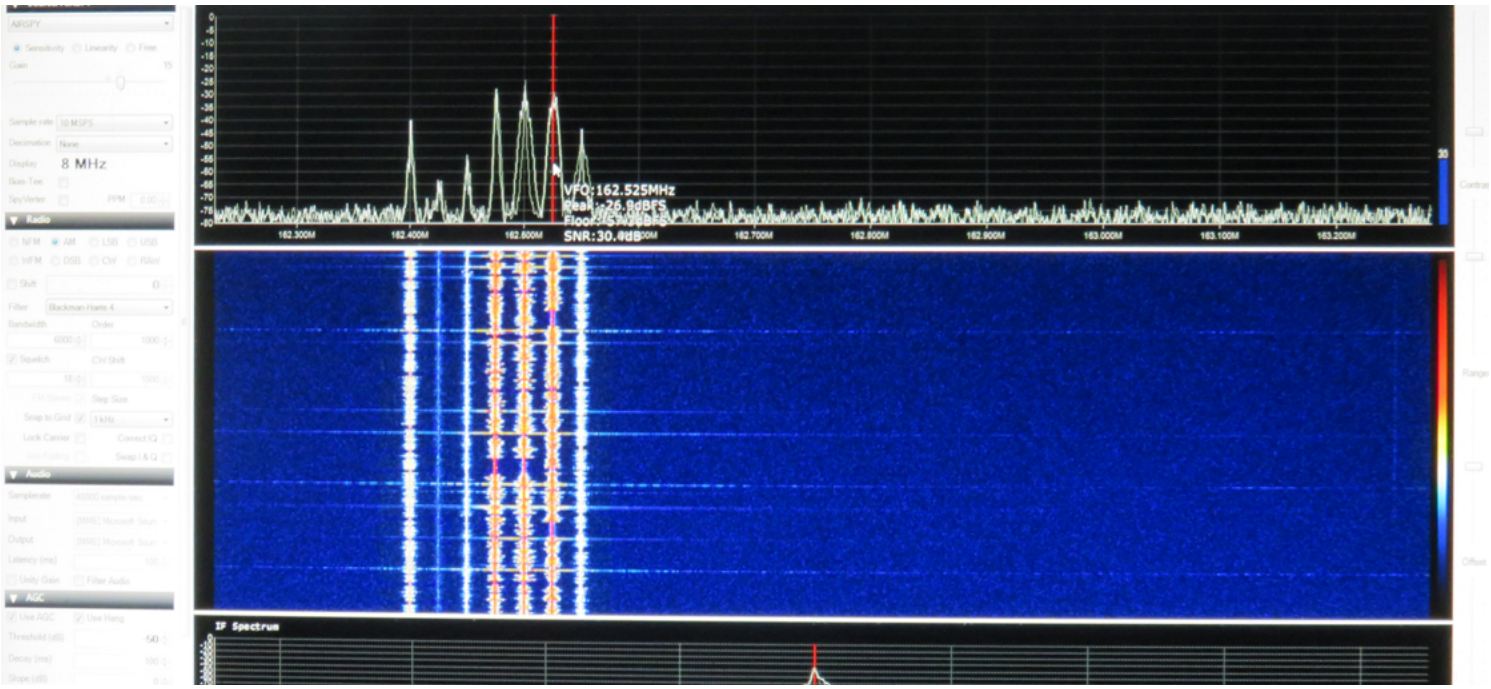


Wide-screen monitor displays can provide up to 8 MHz of panoramic span. A flowing waterfall shows activity over time, and allows an analysis of the monitored signal. (Photo courtesy of the author)

Airspy SDR Receiver System

By Bob Grove W8JHD

The digital revolution began when it became evident that analog computers had limits. It gradually evolved into consumer electronic specialty markets like sound and radio, starting at low audio and IF frequencies, then slowly growing higher and higher with the demand of the marketplace. Penetrating even the toy market, digitization of our lives became most apparent a few years ago when we all learned that our old analog TV sets wouldn't work anymore to receive Over-the-Air TV signals.

In electronic communications, software defined radio (SDR) is becoming dominant. For radio hobbyists, a niche product is gaining momentum: the SDR dongle. Only slightly larger than a memory stick, when plugged into a USB port and connected to an antenna, it converts your computer into a flexible, wide-frequency-coverage receiver.

Mass produced in China, these dongles were originally intended for the European and Asian TV market—turn your computer into a TV set— but radio hams quickly discovered that these low cost, software configurable devices had great hobby applications around the globe as we've covered before in the pages of *TSM*.

The Hobby is Flourishing

The concept has also spawned a number of commercial ventures. With a typical 24-1700 MHz frequency span and a cost of just a few dollars, eBay is loaded with sources of SDR dongles and offshoot products employing the dongles' clever circuitry, mostly centered around the device's R820T2 and RTL2832U chips. Prices vary widely from a few tens of dollars into the hundreds of dollars; the better the circuit, the higher the price.

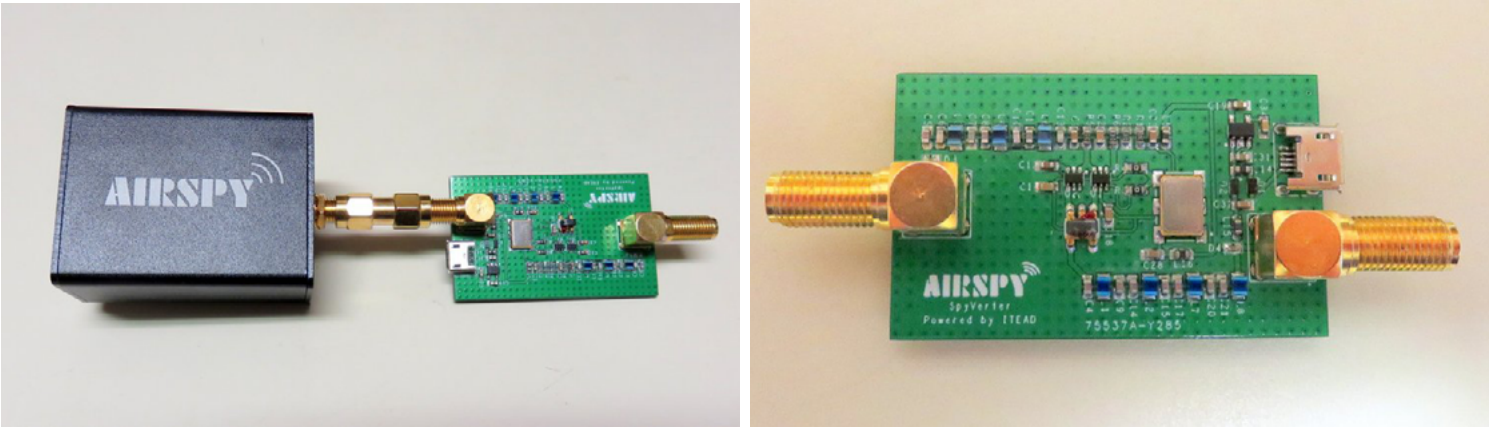
Recently, electronic entrepreneurs have redirected the dongle chips toward upgraded circuitry for more demanding radio reception applications. An early entry was the FunCube Dongle, now improved as the FunCube Dongle Plus, which tunes from 150 kHz to 240 MHz, and 420 MHz-1.9 GHz, currently selling for $140.

The software driving the low cost TV dongles shows a panoramic display of 2-3 MHz, but only about 200 kHz for the FunCube which was originally directed toward amateur radio satellite tracking; the "hamsats."

Enter: the Airspy

Most recently produced and receiving well-deserved attention is the Airspy, with 24-1750 MHz continuous frequency coverage. And, if you'd like frequency coverage all the way down to audio (about 1 kHz depending on the bandwidth setting), their accessory SpyVerter provides just that. Its typical image-free span is about 8 MHz, a nice spread for active frequency hunting.

The software of choice is SDR# (pronounced "SDR sharp"), downloaded for free from airspy.com; an accompanying download of a Zadig USB driver is recommended as well.



The SpyVerter is directly attached to the Airspy via a double-male SMA barrel connector or an SMA-equipped coax jumper cable. For convenience, DC is available from the Airspy directly through the SMA connector, so the entire power requirement is met once the USB cable is attached to your computer port. (Courtesy of the author)

Available elsewhere (not available from Airspy) is a free app called DSDPlus, which permits decoding unencrypted digital voice systems such as P25 Phase 1, MotoTRBO and NXDN. It can be used with a computer's audio input connected to an audio tap on a receiver or scanner.

The Airspy offers reception quality comparable to a VHF/UHF communications receiver or high-end scanner. The product tech spec list (see below) provides admirable details of the latest version, the R2, introduced on October 1, 2015. This new model also corrects original concerns for the R1's electrical noise and electrostatic discharge vulnerability on its connection ports, and offers better interference shielding, filtering and improved thermal stability.

Airspy specifications:

Operates with SDR# software
24 – 1750 MHz frequency range with no gaps
3.5 dB NF (as measured from 42-1002 MHz)
Tracking RF filters
35dBm IP3 RF front end
80 dB dynamic range
64 dB SNR, 10.4 ENOB
12 bit ADC @ 20 MSPS; up to 80 MSPS for custom applications
Cortex M4F up to 204 MHz with multi-core support (dual M0)
1.5-ppm high precision, low-phase-noise clock
RTC clock for packet time stamping
External clock input for phase coherent radios (10-100 MHz via MCX connector)
10 MHz panoramic spectrum view (9 MHz alias/image free)
IQ or real, 16 bit fixed or 32 bit float output streams
No IQ imbalance, DC offset or 1/F noise at the center of the spectrum like other SDRs
Extension ports: 16 x SGPIO
1 RF Input (SMA)
1 RF Output (Loop-through U-FL)
2 high-speed ADC inputs (up to 80 MSPS, U-FL)
4.5 VDC software-switched bias tee to power LNAs and frequency converters

The SpyVerter

Since all of the USB TV sticks and upgraded dongles begin at 24 MHz as their lowest frequency, listeners who wish to listen to shortwave stations, medium wave AM broadcasts or VLF beacons will find frequency conversion necessary. Thus, the SpyVerter, which allows downward frequency extension of the Airspy to virtually zero.

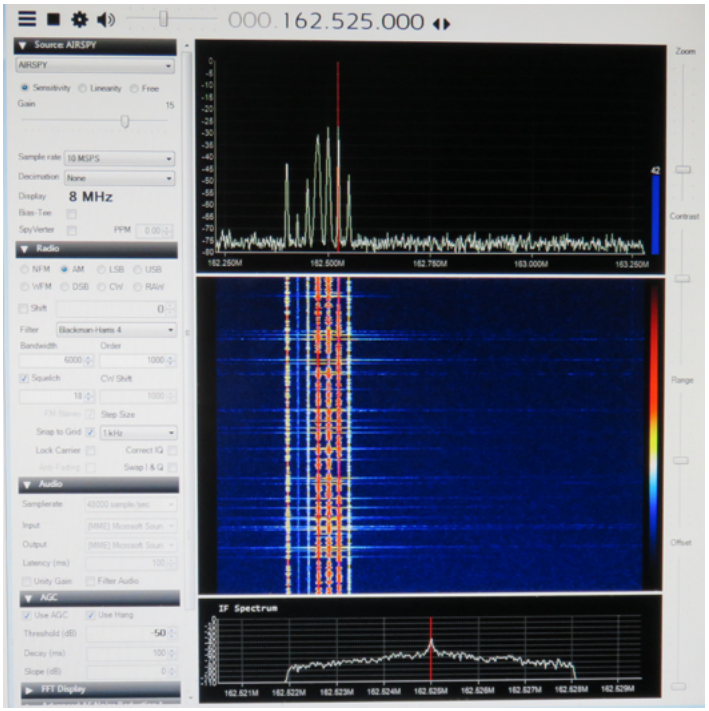
As shown in the accompanying photograph, the SpyVerter is directly attached to the Airspy via a double-male SMA barrel connector or an SMA-equipped coax jumper cable. For convenience, DC is available from the Airspy directly through the SMA connector, so the entire power requirement is met once the USB cable is attached to your computer port.

Some Whimsy

On a wry note, I suspect that you could attach a microphone to the antenna input and the entire system would constitute a convoluted audio amplifier at its lowest frequency setting. More practical, however, would be the simple attachment of an ultrasonic mike to find gas or water leaks, or to listen to sounds of nature like bat calls in the ultrasonic range; a parabolic dish would help here. Perhaps instead you could even attach a short pair of metal prods to make a compact dipole and listen to hydronic chirps from fish in their marine environment.

The Specs

OK, getting back to practicality, the performance specs for the SpyVerter are very impressive, on par with pricey communications receivers. Keep in mind, however, that the addition of a SpyVerter doesn't make the Airspy a continuous-coverage 0-1750 MHz receiver; it merely supplies the



The primary allure of the Airspy is its multifaceted spectrum display. The user may view separately or combined on-screen displays of the following: signals in a span of frequencies; a dynamic waterfall of all the signals being viewed over time; the IF spectrum of a selected frequency; the multiplex signals on an FM transmission; and the audio spectrum of that recovered signal. That's spectrum-analyzing power! (Courtesy of the author)

Relative size of Aisapy compared to the very popular NooElec DVB=T dongle. Detection modes include NFM, WFM, AM, LSB, USB, DSB, CW and RAW. AGC timing is custom selectable, and there are three ways to suppress noise interference: AF noise reduction, IF noise reduction and the traditional noise blanker. Of the three—all of which work fine—the IF noise reduction is one you have to hear to believe! (Courtesy of the author)

missing first 24 MHz of spectrum coverage. To listen to the 24-1750 MHz range, you have to disconnect the SpyVerter.

SpyVerter specifications

Extends reception down to 1 kHz
NF: >8dB
I P3: >+30dBm
Minimum RF Input: 1 kHz
Maximum RF Input: 60 MHz
IF frequency: 120-180 MHz
Phase noise at 10 kHz: -122 dBc/Hz

Let's take a Listen

Hookup is simple, but you'll need appropriate connectors and adapters for the SMA RF ports, and a USB-micro-equipped cable to attach to your computer.

The current SDR# is available as a free download from Airspy.com. It is adaptable to a wide variety of SDR receiving equipment as well as the Airspy; you can choose your SDR model from a menu. The custom settings afford enormous flexibility for personal operational preferences.

Detection modes include NFM, WFM, AM, LSB, USB, DSB, CW and RAW. Each mode has its own assignable bandwidth and squelch setting. AGC timing is custom selectable, and there are three ways to suppress noise interference: AF noise reduction, IF noise reduction and the traditional noise blanker. Of the three—all of which work fine—the IF noise reduction is one you have to hear to believe!

Sensitivity is excellent, with weak signal detection on par with much more expensive receivers and scanners.

Assuming that the adjustable IF, mixer and LNA gain controls are not overdriven, spurious signals like images and intermod products from strong-signal overload can be kept to a minimum. After all, this is a $200 instrument, not a professional spectrum analyzer or communications receiver

The primary allure of the Airspy is its multifaceted spectrum display. The user may view separately or combined on-screen displays of the following: signals in a span of frequencies; a dynamic waterfall of all the signals being viewed over time; the IF spectrum of a selected frequency; the multiplex signals on an FM transmission; and the audio spectrum of that recovered signal. That's spectrum-analyzing power! SDR# is primarily a Windows program, but techies can also run it on Mac and Linux using Mono. The instructions are here: **http://rtlsdr.org/softwarelinux**.

At this writing the company is anxiously awaiting a fresh shipment of the latest model since their previous inventory is depleted. Good news travels fast. The Airspy ($199) and SpyVerter ($49 when bought with the Airspy) and connectors are available by contacting info@airspy.com. For more information go to: **http://airspy.com**