Natural Radio

News, Comments and Letters About Natural Radio

March 2015

Early last December, I decided to get my feet wet in Software Defined Radio (SDR) and ordered a NooElec NESDR Mini SDR & DVB-T USB Stick (RTL2832 + R820T) along with a few cables. In case you are not familiar with the DVB-T USB Stick, it is a Digital TV tuner that plugs into your USB computer port and allows you to pick up digital television broadcasts on your computer once you have connected an appropriate antenna. The device looks like and is about the size of a thumb drive and sells for around $20.

Enterprising hams realized that with hacked software drivers the unit could function as a low cost SDR general purpose receiver with a range of about 25-1750 MHz. These particular units are based on the R820 (R820T) tuner IC made by Rafael Micro. This tuner is mated with an RTL2832 (RTL2832U) IC, which acts as the demodulator and USB interface. Devices with other tuner chips are available, but this one is the most popular. The NooElec units are tuned for SDR usage, including upgraded crystal, capacitors and inductors compared to generic devices. There is also a unit available with a very stable 0.5PPM TCXO for about $70.

This unit will work with a variety of free SDR software programs and I chose SDR# (SDR Sharp) and downloaded it and the appropriate driver. I hooked up a short whip antenna to the dongle and was able to receive a variety of signals which appeared on the panoramic and waterfall displays of the program. A quick check of the FM broadcast band made me aware that a simple whip antenna wasn't enough, and that an outdoor Discone or other type of broadband antenna would be required for any serious VHF/UHF listening. Nevertheless, the unit worked and I had a $25 SDR receiver to play with.

I have less interest in VHF and UHF frequencies than shortwave and VLF so I asked for a converter for Christmas and my boys got me a Ham It Up v1.2 - RF Up-converter for Software Defined Radio. This device up-converts the 100 kHz – 30 MHz band to 125 MHz so that you can use the DVB-T USB stick as a VLF and MF receiver.

Of course, I didn't ask for the right cables, so I needed to place another order to Amazon before I could try out the unit. I finally got the setup put together, set the frequency offset in the software to 125 MHz so that the readout was correct and managed to hack the cables so that I could hook up a long wire antenna. I fired up the unit and it worked. I picked up some shortwave stations and a faint WWV signal, but little on 75 meters, so I think more experimentation is in order as the reviews of this up-converter for ham band reception were quite positive.

From what I have read on this device, VLF reception will probably require a preamp and a low-pass filter to get away from the broadcast interference, but that's another project for another day.

One thing I learned from the experience is that technology has marched on and my supply of RF connectors is a bit dated and I really needed to add some SMA connectors and adapters to the collection. Fortunately, the first Hamfest of the year occurred in early January, so I headed off to the DuPage county fairgrounds and met my son Jeff there and found that there were SMA connectors and cables in good supply. I now have a drawer full of various SMA cables and adapters.

Halfway through the morning we went to a seminar on near-space balloons. In addition to the excellent slide show there was an exhibit of balloon hardware. It would certainly be fun to equip one with a Natural Radio receiver. Jeff found a RC Quadcopter for $15, which will keep him from hacking the one his wife got him for Christmas, as he wanted to experiment with a microprocessor based controller of his own design.

The hamfests seem to be getting smaller each year and many of the annual ones I used to attend have disappeared. I guess the easy availability of parts and equipment online has taken its toll. It looks like retail Radio Shack stores will be another casualty. When I first started in electronics and would order a Heathkit or other large item, the shipment was via Railway Express and usually took about 30 days. Parts orders required sending a check and a letter. Delivery was usually a couple of weeks. Now, Amazon delivery is one or two days, and free with Amazon Prime. Digi-Key and Mouser usually ship the same day and there is no minimum order. I miss the old electronics stores, but this new method is sure convenient.

A final hamfest purchase was a copy of an ARRL book by Eric P. Nichols, KL7AJ, *Radio Science for the Radio Amateur*. This book is an extensive overview of much of the science related to radio. Mr. Nichols has a relaxed way of explaining complicated principles in an easy to understand way, and without using a lot of mathematical language or equations. The author has a strong background in Plasma Physics and spent years in Alaska both exciting and probing the ionosphere. The book begins with the basics of physical science and good laboratory and measurement procedures and proceeds through different topics in ionospheric science and radio propagation.

This is definitely and introductory book and the author doesn't go into a lot of depth on any of the topics but he does cover a lot of ground. His simple explanations of the terms and concepts like complex numbers, plasma, Smith Charts, polarization, and the basics of circuit simulation programs like SPICE, will make your reading of in-depth texts a lot less daunting. It's a good jumping off point for areas of study that might spark an interest with you and is great in filling in the blanks on a lot of topics where you just need to know the basics without wading through pages of higher math. I'm glad I bought it.

DSCOVR Launched – After a few weather and technical issues, NOAA's Deep Space Climate Observatory (DSCOVR) was launched on Wednesday, February 11, at 18:03 local time from Cape Canaveral, Florida, aboard a Space-X Falcon 9 rocket. Unfortunately, rough seas prevented another attempt to land the Space-X booster on a barge in the Atlantic. DSCOVR is on its way to the L1 LaGrange point which is he neutral gravity point between the Earth and sun approximately one million miles from Earth. Travel to the LaGrange point will take 115 days. It is hoped that NASA will hand off the satellite to NOAA in mid-summer. At that point ACE will revert to backup status.

The launch occurred nearly 15 years after the originally planned launch date. DSCOVR had been in cold storage for 12 years. Formerly named Triana it fell victim to political wrangling and became a casualty in the battle with climate change deniers in the Bush years. Three years ago the satellite was pulled from storage, updated and re-certified and made ready for launch

In addition to its earth imaging capabilities, DSCOVR will succeed NASA's Advanced Composition Explorer's (ACE) role in supporting solar wind alerts and warnings of incoming CME's that could wreak havoc on our power grid and other electronic infrastructure. Ace is still functioning 10 years past its lifetime which is a real tribute to its engineering, construction and operations teams. At the L1 point, these satellites give as a 15 minute to 1 hour warning before the CME collides with the magnetosphere and sparks a geomagnetic storm.

DSCOVR's Earth Polychromatic Imaging Camera (EPIC). For the first time, EPIC can image the whole sunlit side of the earth in a single image. The camera will take images in 10 very narrow bandwidths. By combining images from these different bandwidths, scientists can calculate various physical quantities such as Global Ozone Levels, Aerosol Index and Aerosol Optical Depth, Cloud Height over Land and Ocean, Vegetation Index and Leaf Area Index, UV Surface Radiation and Aerosol and Ozone Plume Tracking.

The National Institute of Standards and Technology Advanced Radiometer, or NiStar instrument developed at Ball Aerospace , "is a cavity radiometer designed to measure the absolute, spectrally integrated irradiance reflected and emitted from the entire sunlit face of the Earth". This data is useful from climate science applications and can help us better understand the effects of changes in the earth's radiation budget caused by human actions and natural phenomenon.

The top-hat electron spectrometer will provide high time resolution (<1 sec) solar wind electron, full 3D distribution function observations.

The Pulse Height Analyzer (**PHA**) monitors effect of high energy particles on spacecraft electronics.

The Faraday Cup will provide an unprecedented 10 vectors/sec time resolution measurement of the solar wind proton and alpha reduced distribution functions. Coupled with the 40 vector/sec vector magnetometer measurements, the identification of specific wave modes in the solar wind will be possible for the first time. This instrument is 100 times faster than ACE.

The fluxgate Magnetometer will provide high time resolution (20 vec/sec), interplanetary magnetic field observations 2 – 3 times faster than ACE and WIND.

"The instruments on DSCOVR will improve upon what we have with ACE, as they will continue to operate even during severe space weather storms. The DSCOVR data will also be used to drive the next generation of space weather models, allowing forecasters to specify where on Earth the storm conditions will be at their worst," said Doug Biesecker, DSCOVR program scientist at SWPC.

"DSCOVR will join two existing vehicles – the aging Advanced Composition Explorer (ACE) and the Solar Dynamics Observatory (SDO). Altogether, a next generation of

monitoring and, as NOAA emphasizes, development of space weather forecasting and a warning system will evolve from addition of DSCOVR."

Real-Time Lightning Monitoring – Lightning is a critical component of most Natural Radio signals, so monitoring global lightning strikes is certainly a useful endeavor.

Steve Ford's *Eclectic Technology* column in the December 2014 issue of *QST Magazine* tipped me off to a non-profit German group, *Blitzortung* (German for lightning location), who is building a global network of VLF receivers that detects the characteristic signals of lightning strikes between 3 and 30 kHz. When such a signal is detected the receiving station uploads the information along with an accurate GPS timestamp to the Blitzortung website for analysis and display on a map.

The group is looking for more members to feed the network, but the hardware is currently being re-designed and they hope to have the new boards available sometime this summer. There is more information and a real-time display of lightning strikes at <blitzortung.org>.

NOAA Space Weather Site Updates – If you are a frequent user of some of the NOAA space weather sites you may have noticed some broken links or 404 messages lately. That is because NOAA launched their new Space Weather Prediction Center site that replaces many of their other sites and acts as an overall entry point for all of their data and products. The site is located at <http://www.swpc.noaa.gov/>

The design of the site is impressive and much thought and care obviously went into the redesign.

Natural Radio Lab Site Updates – The new NOAA Space Weather Prediction Center website required me to do some major updates to the Natural Radio lab website. <http://naturalradiolab.com>. I repaired all the broken links, linking to the new pages as necessary.

Some of the graphical data remains the same, others have a fresher design and some have been completely replaced. The POES site is gone and has been replaced with the Aurora Forecast page which is a considerable improvement over the POES site.

I was sorry to see the HAARP site disappear because of the wealth of information there, but I deleted the link as that site was shut down when funding for HAARP was cut off.

I also added a considerable amount of new material to the History of Natural Radio section, and fixed a few other things. The Natural Radio columns from *The Lowdown* through 2014 are all uploaded to the archive. By the time you read this there will probably be a few more updates as I spend more time with the new NOAA site. However with the new NOAA site it seems almost redundant for me to add many more links as they are all available from the homepage of the new NOAA site.

If there is any other material or information that you think would be useful on the Natural Radio Lab website, please drop me an email.