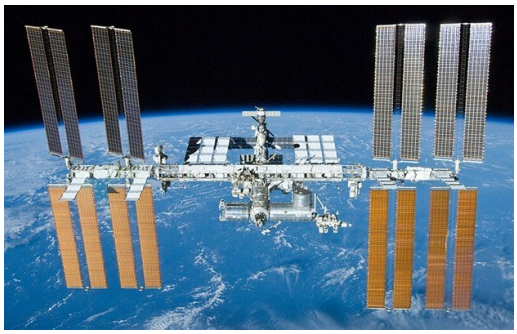
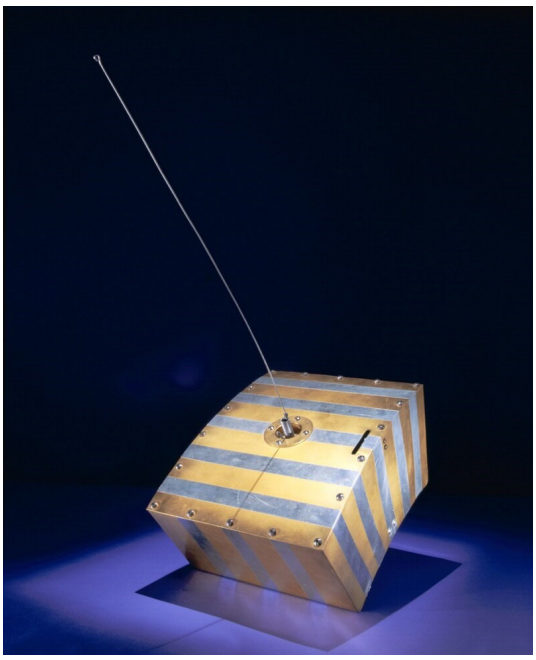
Microvolt

Monthly newsletter of the Utah Amateur Radio Club

April 2025



Extraterrestrial



On 12 December 1961 the Agena rocket *Discoverer 36* blasted off the launch pad at Vandenberg Air Force Base carrying the first non-government and first non-commercial payload, the OSCAR 1 satellite. An acronym for *Orbiting Satellite Carrying Amateur Radio*, OSCAR 1 broadcasted a beacon on 2 meters for 22 days before burning up on re-entry. The fact is, amateurs have not only been interested in space projects since the earliest days of radio, but amateur radio in one form or another has been in space long before that historic launch. Let's explore what that means, and how those might be relevant to us today.

Cover – Amateur radio in space

Actual amateur radio equipment in space is a relatively recent thing, while human-generated radio waves have invaded space outside Earth's atmosphere since the earliest days of radio. Amateurs have placed ham radio on satellites, the ISS (international Space Station), the space shuttle, and even on the Moon. Meanwhile, radio signals by their nature, penetrate space, objects, and even air, depending on the frequency (see the Editorial).

Because electromagnetic radiation (a radio wave or light beam) does not require a traditionally tangible medium, it can travel through space, allowing both sunlight to strike the Earth's surface and a ground station to communicate with space craft. This is what helps your smartphone to communicate with a cell tower so you can speak with a friend or engage the internet from inside your home or a cardboard box.

So, just how far can radio waves travel? In theory, the range is limitless. In fact, we've been able to communicate over 15 billion miles with the Voyager 1 probe. The farthest radio signal ever picked up originated from an object 8 billion light years away. This means we can use radio to communicate with objects in outer space, LEO (low-Earth orbit), and everywhere in between, including the Moon.

On 27 January 1953 Ross Bateman W4AO and Bill Smith W3GKP confirmed the first reliably recorded amateur radio signals transmitted and received by EME (Earth-Moon-Earth, also called *moonbounce*) propagation at 1000 watts on 144 MHz. This event was detailed in the March 1953 issue of QST starting on page 11.

After a couple of years of failed attempts, they successfully used the Moon as a passive reflector on which to bounce a signal, that was then heard by another Earth station. The feat had been achieved by the military a few years prior to that day, but it was on very high power. The lower power limitation of amateur radio rules presented quite the technological challenge for the two, especially since the Moon is a moving target.

On 19 January 2024 the first amateur radio station on the Moon was established by Japanese group JHRC (JAXA Ham Radio Club) JQ1ZVI, and has been transmitting a Morse code signal on 437.410 MHz since the first day.

As we had mentioned, amateurs have installed ham radio equipment on the ISS and satellites. The ones on the ISS serve as regular transceivers, that allow crew members to speak with amateurs on the ground. Those on satellites typically function as repeaters, allowing any two amateurs within view of the same satellite to use it to communicate with each other. Both cases promote interest in STEM (science, technology, engineering, and math) among the interested amateur, especially the youth.

Microvolt editorial staff

Editorial – Atmospheric effects on radio

Not surprising to most, the Earth's atmosphere affects the working and performance of radio signals, whether that's due to weather or the air itself. What might be surprising is that our particular atmospheric composition of nitrogen, oxygen, CO_2 (carbon dioxide), and water vapor can attenuate (reduce the signal strength of) radio signals within specific radio frequency ranges. Other atmospheric gases such as N_2O (nitrous oxide), CH_4 (methane), and O_3 (ozone) also play a part, but their small presence plays an insignificant effect on radio signals.

Most weather events don't affect radio signals under 1 GHz all that much. An exception is temperature inversion, which can noticeably modify the radiation direction and propagation of 2-meter signals. Another is lightning, whose broadband noise can interfere with SSB signals on HF. Rain, snow, and clouds tend not to adversely affect radio propagation below about 2 GHz, yet some have claimed a different experience.

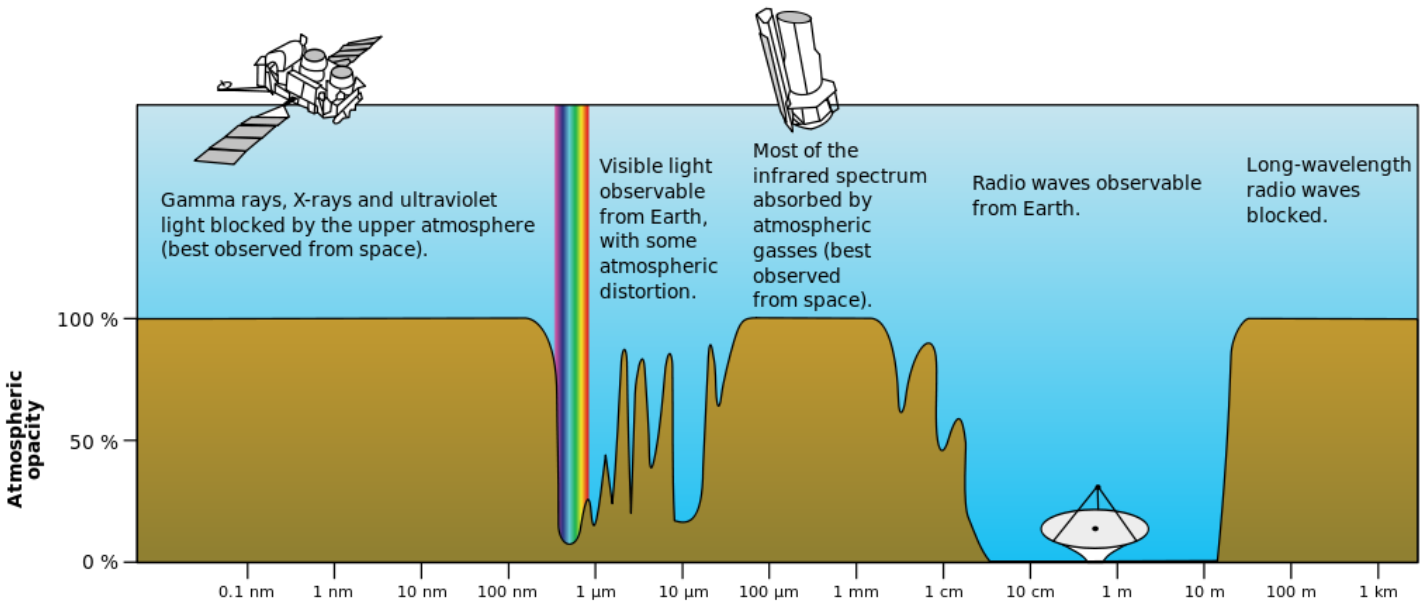
To our great health benefit, our atmosphere filters out much of the UV (ultraviolet), X-ray, and gamma radiation that arrives from the Sun. As you can see from the graphic below, it's also of great benefit to amateurs that our atmosphere also passes radio signals between about 27 MHz through 1 GHz with little attenuation. This allows us to install radio telescopes that can optimally receive signals within this range with little concern for atmospheric attenuation.

The Relevance to amateur radio

The graphic below is attempting to portray the relative attenuation of EM (electromagnetic) signals that originate from outside our atmosphere by the time they arrive on Earth's surface. The reason we're discussing this is because it's possible that amateur radio signals will be affected similarly by atmospheric attenuation, even though they didn't originate extra-terrestrially. If that's the case, then we might be able to select an optimal radio band for crucial communication, all other things being equal.

The obvious side-effect to all of this, however, is that with less attenuation of desirable signal comes less attenuation of undesirable noise, meaning you're likely to hear more noise on the optimally unattenuated frequencies (27 MHz through 1 GHz).

Anything to add? Email ***editor@utaharc.org***



Atmospheric attenuation of EM waves, by wavelength (27 MHz through 1 GHz are best)

Letters to the editor

Dear Editor:

I'm really grateful to the people who grade ham radio exams, because they're friendly and yet get paid nothing, as far as I know. But I'm interested in giving back, so what does it take to become one of these exam givers?

Sarah in Bluffdale

Dear Sarah:

You are correct, that VEs (volunteer examiners) are not compensated for their time spent administering amateur radio exams. If you're interested in becoming one of them, there are a few requirements that you'll need to satisfy once you contact the VE team lead, called the Session Manager or Contact VE. First, you need to be 18 years old. Second, you must hold a General Class or higher license to administer an exam to a Technician license candidate, an Advanced Class or higher license to administer an exam to a General license candidate, or an Extra Class license to administer an exam to an Extra license candidate. Third, your amateur radio license must never have been suspended or revoked, even if you were later reinstated. Furthermore, you must promise to *read* the VE Manual and *review* Part 97 Subpart F (in other words, just the portion that applies to administering exams, sections 97.501 through 97.527). Once those are satisfied, the VE team lead will submit your application to the appropriate organization, known as the VEC (volunteer examiner coordinator), and the organization will accredit you and snail your badge and accompanying paperwork to you. Then, you'll become one of an elite few.

Der Editor:

I'm a woman, and I just recently got my Technician license. I've heard since then that ham radio is mostly a "big boys" club. How true is that?

Toni in Millcreek

Dear Toni:

In many parts of the US the amateur radio circles and clubs of participants are indeed still dominated by the "good-ole boys club" of yesteryear. But that's improving rapidly thanks to three events : the removal of the Morse code requirement (it's about time), the introduction of the Baofeng handheld, and the renovated VE program, which includes the posting of amateur radio exam pools online. These have resulted in a shift in amateur radio from 1) a mostly hobby to a mostly EmComm (emergency communication) emphasis, and 2) a white, male, misogynistic and homophobic clique into a more all-inclusive culture. We encourage you to attend the club activities and a) witness this change for yourself over time and b) to become part of that change.

Dear Editor:

I would like to access the Intertie from Utah County, but all I have is an HT, and I just don't seem to be able to reach the 147.120 or 147.180 repeaters, which are my closest links to it. When will they install a repeater that's linked to the Intertie?

Paul in Springville

Dear Paul:

First, funny you should ask, because an Intermountain Intertie link just came online recently with the **449.575– MHz** (100.0 Hz tone) repeater, and we encourage you to try it. Second, you should be able to reach the 147.120– MHz (100.0 Hz tone) repeater from many places in Utah County using an outdoor antenna mounted up on your roof. That being said, we recognize that many amateurs live in HOAs, apartment complexes, or other antenna-restricted locations, preventing ideal operating ability. Even indoors, however, a longer or better antenna can help tremendously.

Send your thoughts to ***editor@utaharc.org***

Club news

Unlike our typical monthly gathering, the UARC leadership decided that the March 2025 meeting would be replaced by a potluck dinner. It was a fun and very chill eyeball QSO, with good people, good food, and a good location. We held this first one at the Salt Lake County Facilities Management cafeteria, about 2001 S State Street, and hope to make it a tradition going forward. Marv Match KA7TPH kicked it off, and James Bennett KK7AVS ended it with door prizes. We believe that the snowy weather had discouraged a few of you from attending, and that it could only have turned out better ***if you were there***.

You can view past club meeting presentations on our YouTube channel.

(Photos courtesy Noji Ratzlaff KNØJI)

Next up: Field Day 2025

Before you know it, Field Day will be right on our doorstep. It's not too late to join the fun and help us regain our rightful place as ***Utah's Field Day leader*** after that Utah County club unseated us a few years ago. We're going to need to rally your muscle, your time, and your volunteer attitude up at Payson Lakes from noon Saturday June 28 through noon Sunday June 29. If you'd like to help out (***of course you would!***) or learn more about Field Day, please contact James Bennett KK7AVS at secretary@utaharc.org as soon as you feel the itch.

For your information

Field Day 2025

Saturday noon 28 June through Sunday noon 29 June **near Payson Lakes**. We plan to start setting up Thursday night about 6:00 pm.

Steak Fry 2025

Our annual fun get-together is planned for Saturday 19 July 2025 at the Spruces Campground, site GRP7 starting around 3:00 pm. (Spruces is approximately ten miles up Big Cottonwood Canyon.) Cost is $15 per person. Details are posted on our website.

License classes

Salt Lake:

General : Tuesdays 7:00 pm to 9:00 pm
147.160+ MHz (127.3 Hz tone)

Provo:

Technician : Saturday, 8:00 am to 1:00 pm
Sat 19 Apr
Visit **HamStudy.org/sessions** to register (free)
Provo Fire Station #2, 2737 N Canyon Rd
Email **nv7vham@gmail.com** for info

Orem:

Technician : 4 Tuesdays, 6:30 to 8:30 pm
Sep 16, Sep 23, Sep 30, Oct 07
Visit **psclass.orem.org** to register ($10)
Orem Traffic Training Room, 95 E Center St
HamStudy.org account required
Email **nojiratz@hotmail.com** for info

Eagle Mountain:

General : 5 Thursdays, 7 to 9 pm
May 8, May 15, May 22, May 29, Jun 12
Email **ki6oss6365@gmail.com** to register (free)
Eagle Mountain City Hall, 1650 Stagecoach Run

Exam sessions

Salt Lake County:

- Email Garth Wiscombe W7PS **w7ps@arrl.net**
  Apr 28, May 19, Jun 30, Jul 28, Aug 25, Sep 29, Oct 27, Nov 24
- Email Rick Morrison W7RIK **w7rik@arrl.net**

Utah County:

- Wed 16 Apr 7:00 pm : **Provo** : **signup**
- Sat 19 Apr 2:30 pm : **Provo** : **signup**
- Sat 14 Jun 10:00 am : **Eagle Mtn** : **signup**

Club repeaters

Farnsworth Peak : 146.620– MHz (no tone)
Scott Hill : 146.620– MHz (no tone)
Lake Mountain : 146.760– MHz (no tone)

SDRs and beacons

Northern Utah WebSDR : **sdrutah.org**
KK7AVS SDR : **k7xrd.club**
N7RIX SDR : **https://sdr.n7rix.com**
K7JL beacon 28.2493 MHz

HF remote and club transceiver stations

If you'd like to learn how to get started using the remote stations, visit the **HF Remotes link** on **the club website**:
https://user.xmission.com/~uarc/HFRemote.html

How can I help?

Reach out to the club leadership by sending an email to **uarc@xmission.com**. Also, add to this page by emailing **editor@utaharc.org**

Spotlight – Greg Gibson KI7VWJ

I've always loved tinkering with machines and electronics, even from an early age. Growing up I would often take discarded equipment and make it work or repurpose it into something I wanted. Through high school and early adult years, I played with CB and what I now know as FRS and GMRS radios.

Early in 2018, a good friend, Ross Wille N6SJD, asked if I wanted to attend a ham radio class he was about to teach. I told him about my fears of the dreaded Morse code requirement, but was excited to learn that it was no longer required. Over several weeks, I attended the class and then went to the BYU Law building to take my test. Although nervous, I remember the joy I felt when Noji KN0JI, graded my test and congratulated me as a new ham. Within a few days I made my first contact with the aid of Ross, to Alan Rasmussen AJ9R, on the ERC Lindon VHF net. It turned out that Ross' motive for inviting me to his class was to slide me into a position as an Emergency Communication Specialist for our stake. Soon I bought my first HT, a Yaesu FT-70D, and attended the New Ham Net often.

Almost a year later, Ross came knocking again and asked if I had ever considered moving up to a General Class license. In quick succession with his help, I advanced to General and then Extra Class. Since then, I've been involved with the ERC Lindon net almost every week, often as net control, but usually the assistant net control, acting as a spotter. Besides helping run our stake net, I love attending other nets such as the 76ers, the UCARES Net, and others as often as my schedule permits, and am grateful for the encouragement I receive from them.

I love EmComm and am always tinkering with my portable shack. I also love encouraging others to take the leap into ham radio and helping new hams get started. I'm ever grateful to my Elmer and friend Ross for guiding me into what has become my favorite hobby. Late next year I plan to semi-retire and take my shack on the road to try my hand at POTA.

Currently in my home shack I have an Icom IC-7300 HF transceiver, and an Icom IC-2730A mobile transceiver. Occasionally I break out the old Cobra 25 CB. In my portable shack I have an Icom IC-2730A, a Yaesu FT-891, and a Midland MXT-115. Among my emergency gear I still have my trusty Yaesu FT-70D and several Baofengs and Midland GMRS radios, for which I'm licensed as WREL268.

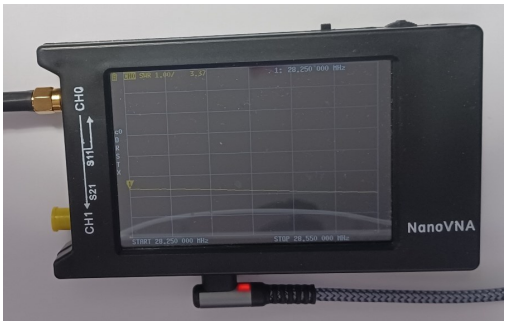
Greg is a member of UARC, UVARC, UCARES, the 76ers, and the Lindon Bishops' Storehouse ERC.

– 73 and God bless, Greg

Tech corner – NanoVNASaver

One of the most indispensable tools in my bag is the *NanoVNA*, a scaled-down and inexpensive version of a full-blown VNA (vector network analyzer). A traditional VNA, such as the KeySight 8753C or Siglent SSA3021X can cost $1600 (used), but can provide valuable two-port readings like network frequency response, reflections (SWR), phase noise, return loss, and TDR (time-domain reflectometry), all in real time. Mine is the NanoVNA-H4, which cost me $95, and sports many of the same features as an expensive VNA, according to a May 2020 *QST* (pages 39 — 43) article.

The biggest problem with the NanoVNA is its tensy-tiny screen, which can be difficult to read. Its second biggest drawback, in my opinion, is its keypad, which can be touchy, finicky, and small, making it easy to fat-finger. To overcome some of these obstacles, Rune Broberg developed a Windows desktop application called NanoVNASaver to display the tiny screen contents on your desktop or laptop screen. But that's not all. The software also allows for control, view selection, and capture of the data.



Parts list

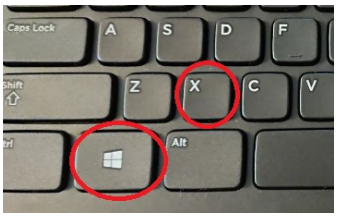
One NanoVNA-H4

One SMA-Male to SO-239 jumper

One high-quality USB-A to USB-C cable

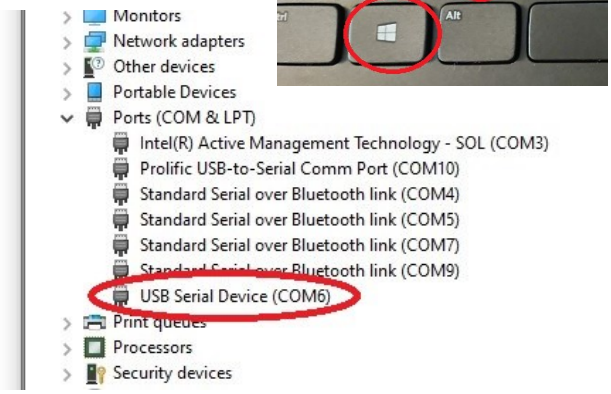
Hardware installation

Connect the SO-239 connector of the jumper cable to the PL-259 connector of your antenna coax. Connect the SMA-Male connector of the jumper cable to the "CHØ" (S11) port of the NanoVNA. Connect the USB cable between the NanoVNA and a USB socket of your computer. ***Note: not all USB-A to USB-C cables support data transfer; some are for charging only***. Furthermore, many data transfer cables are not adequate for the data integrity or speed required by the software, so just click the above link and buy this USB cable, unless you're certain yours works.



Turn on your NanoVNA, and right away your Windows computer should alert you that a new device has come online. Press <Windows-x> on your keyboard. (While holding the Windows key, press x)

Click Device Manager. In the Device Manager window, click the little greater-than sign (>) in front or "Ports (COM & LPT)" to display the COM port numbers. The NanoVNA should appear under the Ports list as "USB Serial Device" or similar. Record (write down or remember) your own COM port number listed after the driver name. In my case, it's COM6.



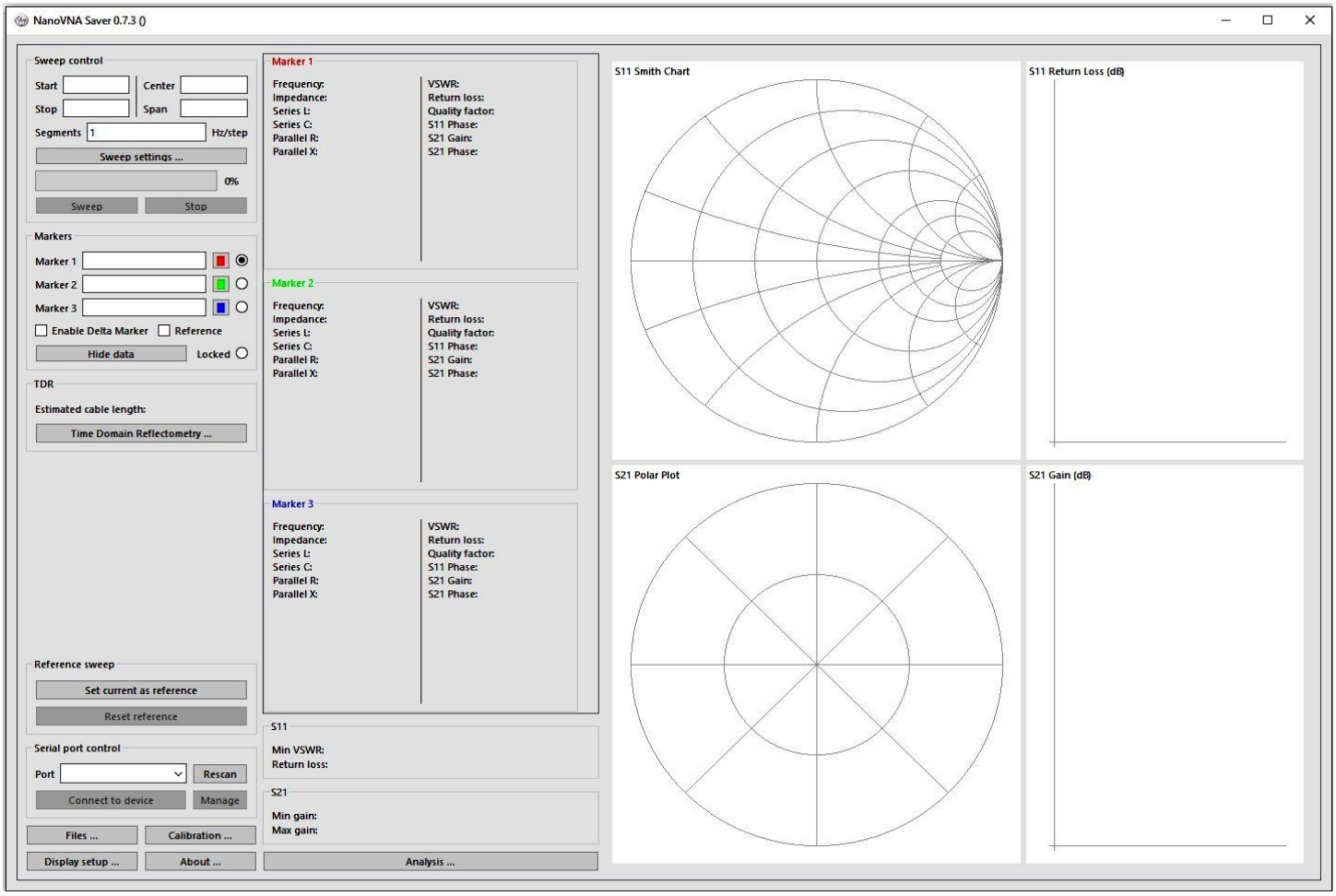
Software installation

There's no need to install the NanoVNASaver software; simply download it from here, unzip it, and run the .exe file. The next page shows the opening screen, which can be a bit difficult to read, due to its small default font size and thin lines. In the upper left click the **Sweep settings** … button, then enter the **Sweep name** if you want (I set mine to "Noji's 10" for fun.) Select **Continuous sweep**, then scroll to the bottom and select the **10 m** band, and to pad the band limits by **None**, then exit the **Sweep settings** window.

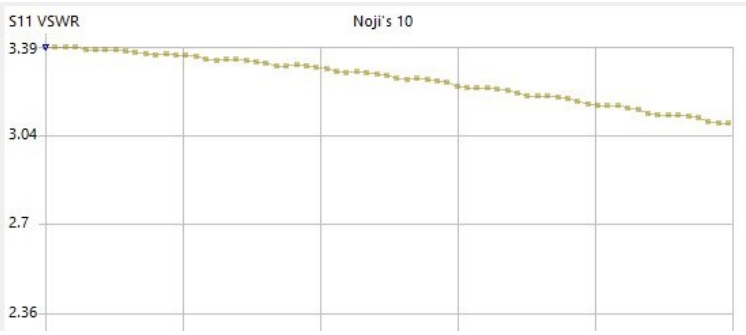
Tech corner – NanoVNASaver, cont'd

Next, near the lower left of the main window, click the **Display setup** … button. Scroll down to the **Displayed charts** box and for the top middle button select **S11 VSWR**. Change the Point size to **4 px**, the Line thickness to **2 px**, and the Marker size to **10 px**, to make them more visible. Exit the **Display settings** window.

Next, set up the NanoVNA as follows:
Tap the right edge of the NanoVNA screen, then tap **DISPLAY**, then **TRACE**, then disable all but **TRACE 0**.
Tap **BACK**, then **FORMAT**, then **SWR**. Tap the right edge again, then **BACK**, then **BACK**, then **STIMULUS**, then **START**, then **2**, **8**, **.**, **2**, **5**, **M**, then **STOP**, then **2**, **8**, **.**, **5**, **5**, **M**. The NanoVNA is now ready to present the 10-meter SSB section for the software.



On the NanoVNASaver software main window, click the **Port** and select your **COM** port reported by Device Manager, then **Connect to device**. The software should now be displaying your settings, including the SWR (in both the frequency graph and the Smith chart), in real (1-second sampling) time. As you can see from the **S11 VSWR** chart on the right, my 10-meter antenna has seen better days!

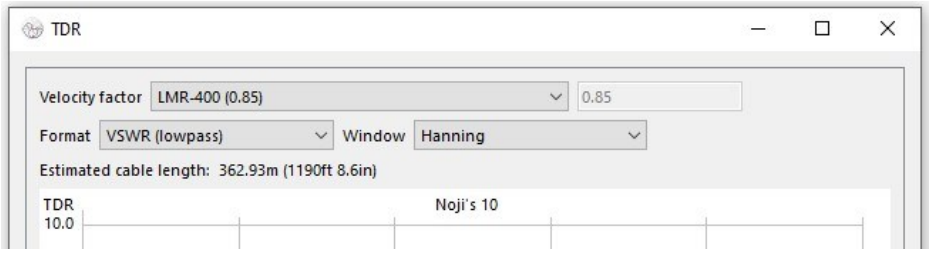


Tech corner – NanoVNASaver, cont'd

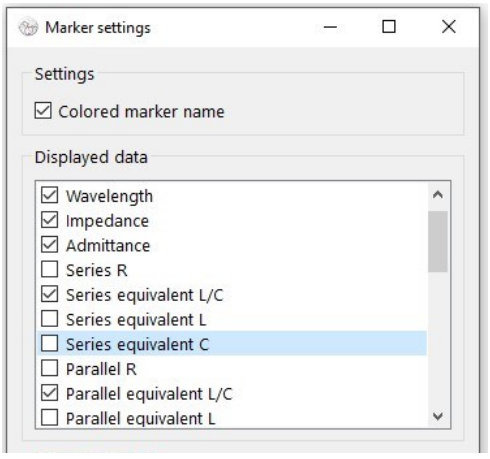
On the left end of the NanoVNASaver main window, two more items might be of some interest to you, markers and TDR. You'll need to experiment with them to determine how they'll be of use to you. A marker is simply a user-settable flag you can set at a particular frequency to observe specific two-port data that occurs there. TDR (time-domain reflectometry) observes the time difference between the release (send) and return of the low-voltage pulse from a reflected voltage wave. With this, the device can determine places in the cable where the impedance is inconsistent, such as at a bend, short, open, or the end of the cable.

If you do not hide the data, the NanoVNASaver will display marker data. In this example, I've set a marker at 28.457 MHz, where the SWR is shown to be about 3.1:1. Meanwhile, the TDR has determined that my LMR-400 coax is over 1100 feet long. Well, I guess I'll need to read up on how to improve that calculation, which brings me to calibration.

To make the best use of your NanoVNA, you must calibrate it, something I don't want to spend time doing in this article. You can view this video to go through the complete motions of an accurate NanoVNA calibration.



You can use the NanoVNASaver software to control the NanoVNA as well. For example, to change the display from 10 meters to 40 meters, click the **Sweep settings** … button and change the band to 40 m, then click the **Set band sweep** button and exit the **Sweep settings** window and click the **Sweep** button. All the sweep windows and the marker data will change to 40 meters.



Finally, in the **Display settings** window you can customize many of the display properties such as the font size of the tiny default letters and numbers, marker colors, and whether the return loss should be displayed as positive or negative value. It's also here that you can take advantage of the real power of the NanoVNA by having the markers display many transmission line properties, such as series and parallel equivalent R, L, and C circuits, admittance, gain, and phase.

Summary

The NanoVNA is a wonderful and inexpensive test and analysis instrument, and can easily replace a full-fledged VNA for the average amateur. But its small screen can be difficult to read, making for a less-than-pleasant experience. The NanoVNASaver software is made to run on your Windows desktop, to help you more easily observe and control the readings presented by your NanoVNA. But making the most of this device requires you to also calibrate the NanoVNA prior to using it.

Noji Ratzlaff KNØJI

Strays – Geomagnetic indices

One of the best-known hallmarks of amateur radio is the activity of directly contacting another station around the globe. It's not only fun but demonstrates the value of radio in the event of a large-scale incident that requires reaching outside your state or country. Unfortunately, several natural phenomena can disrupt that communication, and one of them is unsettled or large geomagnetic activity.

In the interest of predicting adverse geomagnetic conditions, NOAA (National Oceanic and Atmospheric Administration) and IAGA (International Association of Geomagnetism and Aeronomy) have devised several measurably quantifiable indicators to warn systems that are potentially affected by geomagnetic disturbances. Each is known as an index, and collectively we refer to them as geomagnetic indices (indexes).

Earth's magnetic field is affected by regular solar radiation changes, often due to the interaction between the solar wind and the magnetosphere, and by interactions between the magnetosphere and the ionosphere. The most popular geomagnetic indices that seem interesting to amateur radio operators are the A-index and the K-index, which reflect these interactions.

Band conditions banner showing A_P and K_P

The A-index is the average ***long-term (24-hour) stability*** of Earth's magnetic field relative to a predetermined "quiet" value. We often refer to the **A_P-index**, in which the "P" means *planetary*, or averaged from several key measurement points across planet Earth. It values from 0 to 400, and values over 100 generally indicate an unfavorable condition for amateur radio propagation.

The A_P-index is measured relative to the current geomagnetic storm, and provides the maximum effect of the storm during the past 24 hours. Considered over the span of many years, the A_P-index provides a *maximum disturbance measure* of geomagnetic activity over time.

The K-index is similar to the A-index, but is the daily average ***short-term (3-hour) stability*** of Earth's magnetic field compared with what is regarded as "quiet" activity. Just like with the A_P-index, we often refer to the **K_P-index** for the *planetary averaged value*, from 0 to 9.

Relevance

Ok, so, what does all this techno-babble mean to you, the average amateur? Bottom line is, ***the higher these numbers, the worse the band conditions due to elevated levels of geomagnetic disturbance***. If A_P is over 100 or K_P is over 5, HF SSB propagation might not be your friend, and you might have better luck with either FT8 or local repeaters.

Geomagnetic storms, measured by the indices, disrupt radio propagation by significantly altering the density and structure of the ionosphere. This leads to unpredictable signal variations, absorption of frequencies that are normally not absorbed, and irregular propagation paths. According to SpaceWeather.com, March has the most geomagnetically active days during the year, with October running a close second place, and it's no coincidence that these maxima are near the equinoxes.

Noji Ratzlaff KNØJI

Microvolt is the official publication of the Utah Amateur Radio Club, Inc. (UARC), 3815 S 1915 E, Salt Lake City, UT 84106, and is published monthly. Copying is allowed with proper credits to *Microvolt*, UARC, and authors. Online versions located at **https://user.xmission.com/~uarc/Microvolt**

We encourage you to submit original pictures (highest resolution), articles, software and hardware descriptions, appropriate humor, and responses to editorials. Email the content, pictures attached, to the editor at **editor@utaharc.org** by the 20th just prior to the target month.

The **Utah Amateur Radio Club** was organized under its present name in 1927, although its beginnings may date back as early as 1909. In 1928, it became affiliated with the American Radio Relay League (club #1602) and is a 501(c)(3) non-profit organization. It holds a club station license with the call sign W7SP, a memorial to Leonard "Zim" Zimmerman, amateur radio pioneer in the Salt Lake City area.

The club meets each month except July and August. The meetings are usually held on the second Thursday of the month at 7:30 PM in the University of Utah's Warnock Engineering Building, room 2230.

Club membership is open to anybody interested in amateur radio; a current license is not required. Dues are $20 per year. Send dues to club secretary James Bennett, 4960 W 5400 S, Kearns, Utah 84118. Email address changes to **kk7avs@gmail.com**

Tax-deductible monetary contributions are gladly accepted. Send directly to club treasurer Shawn Evans, 1338 S Foothill Dr, #265, Salt Lake City, Utah 84108-2321. For in-kind contributions, please contact **uarc@xmission.com** to make arrangements.

UARC maintains the 146.620– and 146.760– repeaters, which are administered by the UARC Repeater Committee. Direct comments and questions to any committee member. The 146.760– repeater is on IRLP node 3352.

Call the **UARC Ham Hotline** at **801-583-3002** for amateur radio information, including club, testing, meeting, and membership information. Leave a message, and we'll make an effort to return your call.

UARC 2025 Board

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For-late breaking news listen to the UARC Information Net, Sundays at 8:30 pm on 146.620– or visit the announcement page.

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