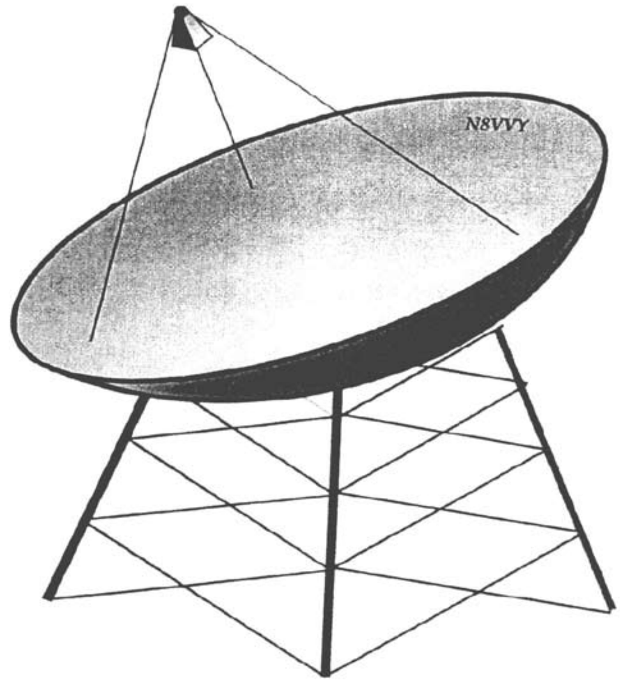
Next Mtg: Fri 6:30 Dec 27 at the MCL Cafeteria in Kettering November 2019.
Meeting is always the 4th Friday of the month.

ANOMALOUS PROPAGATION



Newsletter of the **Midwest VHF/UHF Society**

Editors: Open

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Annual membership is $12.00 newsletter by Email or $16 if newsletter by USPS.
Make checks payable to Joe Muchnij, N8QOD and mail to:1214 Cottingwood Ct. Bellbrook OH 45305

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MIDWEST VHF-UHF SOCIETY

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Beacons: 1296.079 W8KSE EM79ur Dayton, OH---- 2W to Big Wheel at 800' AGL. MVUS Skimmer -. http://www.reversebeacon.net/dxsd1/dxsd1.php?f=0&c=w8kse&t=de

Contents

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De W8RKO

Winter sure hit us in the face with a hammer. I looked over the temperature data my WX station recorded. That Monday I was working outside in the mid 50's. The next day the high only managed to get in the low 20's. Wednesday morning I recorded a low of 8 degrees. If you did not get your antenna work done as I suggested last month, well, spring will be here sometime…..maybe.

After getting my antennas back on the tower thinking everything was good I discovered high QRN on 50 and 144 MHz. Also had spurs in the 432 MHz band. This interference stuff is getting worst every year. I managed to locate the QRN. Turns out I have two sources. The most predominant on 144 is a utility pole five houses to my west. With the antenna pointed in that direction I have S9 QRN on the 2m band. The second, affecting 50 MHz more so than 144, is on the other side of the bike path to my east. Another utility pole. This one has all three 12KV phases on it.

On 432 the issue was mostly from the computer monitor that is on the ham desk running radio apps like WSJT-X. It puts out LOUD spurs in the 432 band. One being right on the SSB calling frequency. The name on the monitor is AOC. I have two of those monitors. I brought in the second and it did the same thing. Replaced it with an ASUS so that noise is gone but I still have spurs in the 432 band. Those appear to be coming from the two computers in the room. One of them does not have any covers on it so shooting myself in the foot there. Those were an easy find because the level got higher when I disconnected the coax lines from the antenna patch panel.

I want to concentrate on MSK144 on 2 and 6 meters this month. What modes/bands are you concentrating on this winter? Come to the meeting on Friday, November 22, 2019, at the usual place (MCL Cafeteria, 4485 Far Hills Ave, Kettering, OH 45429). We can talk about it. We assemble around 6pm and have dinner. Meeting starts around 6:30pm.

If I can get it working I will bring in my KerberosSDR. This is a device that has four coherent RTL-SDR receivers.

Mike

W8RKO

This and That

Complied by Gerd Schrick - WB8IFM

Running.   Avoid running at all time. [Satchel Paige]

Health. Quit worrying about your health. It 'll go away. [Robert Orben]

Profit. It is more profitable for your congressman to support the tobacco industry than your life. [Jackie Mason]

A Fool. Sometimes a fool makes a good suggestion. [Nicolas Boilau, 1636-1711]

Lesson: He went to Europe as a boy, where in Geneva his father arranged for a prostitute. He was so terrified by the experience that he didn't marry until he was 67 years old. [John Leonard on Borges]

Breathing. Keep breathing. [Sophie Tucker (1884-1966]

Women... are being considered as candidates for Vice President of the U.S because it is the worst job in America.It's amazing that men will take it. A job with real power is First Lady. I'd be willing to run for that. As far as the men who are running for president are concerned. They aren't even people I would date.
[Nora Ephron]

REPORT ON THE nano-VNA

By Dana Whitlow K8YUM

I chose the AURSINC version, ordered through Amazon. It came in a nice little plastic carrying case with the VNA,two SMA cables (look about like RG174), and some SMA CAL standards (1 each open, short, load, and thru). And there is a charging/data cable (the nano-VNA uses a type-C USB connector). I was thinking that this device would be very handy to carry around to flea markets for checking the health of attenuators, terminations, coaxial line stretchers, some filters, etc. In principle it could be useful outdoors for antenna checking, although I feel that the display brightness is very inadequate for this purpose.

The unit is substantially unshielded, and it shows. When doing a CAL it's worthwhile to dress the SMA cables (or others that you prefer using) as you would be when you are connecting them to a DUT. Some folks report that attempts to mount the VNA in a shielded enclosure have made the problem worse, not better. Putting the nano into an effective shield would also mean denying the user physical access to the controls (on/off switch and jog lever), so I think it's a moot point.

Sadly the unit came without any form of documentation whatsoever, so I spent a fair amount of time working with it just to learn how the controls work. I've since learned that the documentation is available on the web; see the URL at the very end of this tome.

Note that the VNA can be operated wholly standalone, but without any storage for result traces. It has storage, but only for a few setups (with their calibrations, if applicable).

The nano turns on and boots very quickly- about 2 seconds. On startup, it runs whatever setup you have stored in memory 0. The factory default load in mem 0 is with full-span, all four traces active, so you see a rather busy presentation. You are free to store whatever setups you want- there are 5 registers (memories 0 thru 4).

Connecting a charger while the nano is in use is fine and seems to cause no disruption. However, disconnecting the charger while in use seems to force an immediate restart with reversion to the setup stored in memory 0.

Note regarding port nomenclature: The nano labels its ports as CH0 and CH1. I call them port 1 and port 2 respectively to conform to more familiar VNA terminology Since this is a "single-path" instrument, port 1 always transmits (and receives reflected signals); port 2 just receives transmitted signals from a 2-port DUT but never transmits.

I got interested in some aspects of how this thing works in different frequency regimes, so I made measurements to fill this table:

nano-VNA cont.

CF	Span	Pout (port 1)	LO leak (port 2)	Port 1 Fundamental
1 MHz	1 kHz	-12 dBm	-93 dBm at 1.005 MHz	-12 dBm at 1.000 MHz
10 MHz	1 kHz	-12 dBm	-74 dBm at 10.005 MHz	-13 dBm at 10.000 MHz
100 MHz	1 kHz	-13 dBm	-53 dBm at 100.005 MHz	-13 dBm at 100.000 MHz
299 MHz	1 kHz	-18 dBm	-53 dBm at 299.005 MHz	-18 dBm at 299.000 MHz
301 MHz	1 kHz	-20 dBm	-54 dBm at 301.005 MHz	-10 dBm at 100.333 MHz
450 MHz	1 kHz	-21 dBm	-52 dBm at 450.005 MHz	-10 dBm at 150.000 MHz
599 MHz	1 kHz	-21 dBm	-53 dBm at 599.005 MHz	-10 dBm at 199.667 MHz
601 MHz	1 kHz	-21 dBm	-54 dBm at 601.005 kHz	-10 dBm at 200.333 MHz
750 MHz	1 kHz	-22 dBm	-55 dBm at 750.005 MHz	-10 dBm at 250.000 MHz
899 MHz	1 kHz	-25 dBm	-55 dBm at 899.005 MHz	-10 dBm at 299.667 MHz

IMPLICATIONS of the TABLE:

NOTE that above 300 MHz the unit uses the 3rd harmonic of the fundamental at port 1. The very high level fundamental component applied to an active DUT seems rather likely to cause troubles with nonlinear distortion, yielding misleading readings at the intended frequency as well as risk of damage. Hence when testing amplifiers at or above 300 MHz the user must take care to use a suitable attenuator between the nano's port 1 and the DUT's input to assure linear operation of the DUT. Start with way-excessive attenuation then reduce it in small steps until something starts to look suspicious, and go no further.

Note that with the above attenuation, readings of the DUT input return loss will be wrong by twice the amount of attenuation used (in dB), and the forward transmission coefficient will be wrong by the amount of attenuation used. One procedure to deal with this is to go ahead and make the measurements desired, then manually compensate for the attenuator's effects. Another option would be to try recalibrating the nano with that attenuator in place, then take the measurement results at face value. If successful in recalibrating with the attenuator in place, that's great. If not, go back and recal with the attenuator absent then reinsert the attenuator and manually adjust the readings accordingly.

I think the above issue may well constitute the Achille's heel of the nano-VNA.

The nature of the port 1 output can be seen as a square wave using a fast o'scope.

The LO leakage backing out from port 2 appears to be a series of very brief pulses when viewed with a fast 0'scope. This may (or may not) suggest that the nano employs sampling techniques in its front end as opposed to a regular superhet architecture.

I have studied what happens if a set span crosses the 300-MHz boundary. My methodology was to view the waveform coming from port 1 with an o'scope set to 5 nsec/dev and triggered from the waveform. As the nano sweeps, the displayed waveform is changing much too rapidly for live interpretation, so I made a video recording of the 'scope screen spanning several complete VNA sweeps. I then examined appropriate areas of the video, frame-by-frame, using 'VLC Media Player'. This enabled me to establish the behavior of the VNA poet 1 signal unambiguously (albeit not with great frequency accuracy). I made three such videos as follows:

> 100M-300M(b).mp4; with the nano-VNA set to sweep 100 MHz to 300 MHz. Finding: the VNA simply sweeps that range with the fundamental of the squarewave signal.

nano-VNA cont.

> 200M-400M(b).mp4; with the nano set to sweep 200 MHz to 400 MHz. Finding:

a) fundamental sweeps 200 MHz to 300 MHz

b) fundamental jumps back to 100 MHz then sweeps to 133.3 MHz (hence 3rd harmonic sweeps 300 MHz to 400 MHz)

> 300M-500M(b).mp4; with the nano set to sweep 300 MHz to 500 MHz. Finding: fundamental sweeps 100 MHz to 166.67 MHz, (hence 3rd harmonic sweeps 300 MHz to 500 MHz).

OTHER ASPECTS OF SWEEP BEHAVIOR:

I set up the nano to sweep from 2.5 MHz to 7.5 MHz and captured port 1's output for a little more than one full sweep with the o'scope, at 20 MSa/s. Note that for this I should have built a sharp cutoff LPF below 10 MHz, but didn't want to take the time. So I used the 'scope's internal BW limit (which has a fairly soft rolloff) set to 20 MHz, and did what I could in the face of many alias products from harmonics of the nano's squarewave output. I found that the nano's step transitions of 50 kHz (for this span of 5 MHz) from frequency to frequency were essentially impossible to locate accurately looking purely in the time domain, so I decided to see what I could do with the deterministic relationship between time domain and freq domain plots. I wrote a program which enabled me to view the wideband spectrum of the entire acquisition and then notch out selected portions thereof, and then view the result back in the time domain.

What worked well was to choose a particular frequency step to retain, then notch out everything else in the frequency domain, then Fourier transform back to the time domain. The primary result was a short burst of 8 msec duration, along with a handful of lower amplitude bursts at different points in the sweep as various alias products landed in the selected retained frequency.

So, I can say that for this sweep setup on the nano, the RF sweep occupies 800 msec out of 1000 msec total sweep time, with the remainder of the sweep period occcupied by the nano's other processing needs such as formatting and plotting curves, etc. I've not seen any indication that this general behavior changes for other spans, but confess to not having really looked closely.

One thing I did notice, however, was when I increased the span to the point that the twin IF response peaks merged. Then I saw variable results, in that some times the response was much lower, as if the peaks were canceling. I don't yet understand this effect.

It's interesting to note that the above information, obtained with a $900 o'scope, was ultimately more useful in understanding the behavior of the nano than what I was able to obtain with a $10,000 RTSA. Ya live & learn... But I do wish I had a much faster 'scope with storage for very long records as well (sample rate of at least about 4 GHz with enough storage to accommodate one full second at the maximum sample rate, and an analog BW of at least 1 GHz).

IF FREQUENCY & FILTER BANDWIDTH DETERMINATION:

I examined the signal coming out of port 2 (even thought there isn't supposed to be any), and found a little bit of leakage of the port 1 transmitted signal and some LO leakage from port 2's receiver. From these I deduced that the IF frequency is apparently 5 kHz.

In order to ascertain the IF BW of the nano I fed a fairly weak CW signal into port 2 and set up the nano for a span of a few 10's of kHz (initially). Then I observed the logmag response on the nano's own display, and discovered a dual peak, with the peaks being separated by 10 kHz (double the IF frequency). One of these peaks occurred at the frequency of the externally-applied CW signal, the other 10 kHz away. Clearly this was an image response. Awful as this may sound, the image is essentially irrelevant to the normal use of a VNA. The

extra response mainly adds a little extra noise in the IF channel. I zoomed way in on the nano's span to take a closer look at the shape of the IF response curve. At a span of 10 kHz, the shape of each response turns out

nano-VNA cont.

to be the shape of the sinc function expressed in log mag terms, with the inner two nulls being 2 kHz apart. This is consistent with a filter impulse response being a rectangular pulse of 1 msec duration, which perhaps gives some insight into how the designer is processing the IF signal. Note that is only a fairly small fraction of the time duration of each frequency step (8 msec), yielding quite a bit of tolerance for measuring components (sucn as long delay lines) without losing part or all of the signal from the delay.

SPECTRAL PURITY:

Looking close-in at 900 MHz, the spectrum is not great, but really not all that bad considering the price. It looks like most of the energy is contained within about a 1 Hz bandwidth. When warmed up the frequency (on my nano) is about 100 Hz above 900 MHz and is slowly drifting downward at roughly 1 Hz per minute. This is the combined effect of error in my SA's reference and that in the nano's reference; I believe the SA is contributing the lesser part of this.

FURTHER WORK PLANNED:

1. Still want to get some idea of what level applied to port 2 leads to overload issues, especially in the presence of the strong fundamental component present when looking at frequencies above 300 MHz.

FURTHER INFO:

See: https://drive.google.com/open?id=1-JViWLBOIzaHTdwdONX2RP8S4EgWxoND

for an instruction manual, a menu tree chart, etc. These may be somewhat specific to the AURSINC brand, or they may not. A little perusal of the menu tree should yield a fairly good understanding of what all capabilities the nano-VNA has (and does not have).

The following URL should be of interest to nano-VNA owners:

https://groups.io/g/nanovna-users/wiki/home

NanoVNA-Notes

Along with Dana and maybe others, I signed up to the nanoVNA mailing list. There is a huge amount of traffic!

One thing that I've learned is that there are several different versions of the device sold by a few "genuine" providers and a bunch of counterfeiters -- all located in China.

In the beginning, "edy555" designed the original unit but never manufactured it. "Hugen" made a version called the nanaoVNA-H that has gone through several rounds of improvements. It seems to be the "standard" version currently. It's been cloned by a bunch of counterfeiters, and there are some versions that have bad RF shielding (called "the worse clone") and some that are pretty good.

Then BH5HNU did a similar device with a larger 4.3 inch screen and a different processor. It's sort-of compatible with the nanoVHA-H but the firmwares is apparently a little less featureful.

It is very hard to figure out who to buy from, but it appears that this is a reputable source for the latest "nanoVNA-H", with some goodies like proper USB-C wiring that prevents it from blowing up when you plug it into a charger:

https://www.amazon.com/Leiyini-Analyzer-Portable-Shortwave-50KHz-900MHz/dp/B07YV96ZK8/ref=sr_1_13?keywords=nanovna-h&qid=1574344159&s=electronics&sr=1-13

Here's some additional info I've learned; links to much of this are available at https://groups.io/g/nanovna-users/wiki/home:

There is a nanoVNA-H V2 in the works by Gabriel Tenma White that looks to offer better dynamic range, higher frequency range, and may also have 4.3 inch as well as 2.8 inch screen options. It's supposed to be available after the first of the year, and might be worth waiting for.

Speaking of firmware, there are several different versions out there, so it's good to check what your unit has. There is one version with an "A" or "AA" in the name that provides larger fonts and a more readable screen at the cost of only displaying only two (instead of four) traces at a time and losing a couple of other minor features. That looks like it could be very useful for field use.

The world seems to have settled on the "nanoVNA-Saver" software for running on a PC. It's under active development and runs on Windows/Linux/Mac with only modest cursing (the biggest pain is that it requires Python 3.7, which is not yet universally installed).

One thing that might be an interesting project for us is to characterize the open/short/load calibration standards that come with the unit, and/or make a bunch of our own that could well be better. Some Youtube videos have shown that the supplied standards range widely in quality. That becomes more important the higher in frequency you go.

73,

John

N8UR

KerberosSDR 4-Channel Coherent RTL-SDR

By Mike Suhar, W8RKO

Many of us have used the dongle type SDR receivers. A common one is the RTL-SDR that has good performance. There are applications where multiple receivers need to be used. The problem is the receivers need to be "phase coherent". Trying to do this with individual receivers can be difficult. RTL-SDR.COM and Othernet. is have gotten together and developed this product. It contains four RTL-SDR receivers that share a common clock. By using the on-board noise source they can be synced together.

The package costs $149 and includes:

- Four RTL-SDR R820T2 Receivers
- Wideband noise source that can be turned on/off in software
- USB hub so only one USB connection is required
- Shielded enclosure

The package does not contain antennas or a power supply (5 volt micro USB connection). Note that the first run of these used a USB-C connector for power. That was changed to a micro USB for the second run. You will also need a Raspberry Pi 3B+ or a version 4. A Tinkerboard computer can also be used.

For application software you would be on your own for the most part. The downloaded images available provide a direction finding application. It is intended to be used with an Android application. Sorry no IOS application available. It would appear the direction finding application can be run directly from the Rasbperry Pi if you VNC into it. The intended way to use the application is from the Android. The Raspberry Pi will connect to the Android's hotspot and you run the application from there.

What else can you do with this? The suggested applications are direction finding, passive radar, beam forming. You could use it just for the four receivers running independently.

Check out the following web sites:

- http://kerberossdr.com/
- https://www.rtl-sdr.com/ksdr/ (setup information)
- https://youtube.com (search for "kerberosSDR" there are Several videos)