

2024-04-16 Hamlet Net - Test Equipment - Antenna Analyzers

Announcements:

- Test Session Info
 - Next VE session is April 27th in the Clover Building at the Boulder County Fairgrounds, and starts at 10 am. ~~It is a PVET session, so there is no fee to test.~~ For more info, and to pre-register, see the Licensing/Testing page on the club web site, <https://w0eno.org/>, under the Education menu.
- Tomorrow, April 17th is the April General Meeting. Axl Reising with Innovation Center is presenting on what they do there, and how our club is planning to help them. The meeting will be held
- We have some volunteer opportunities available where you can help out LARC:
 - Photographer / videographer - record team activities and upload to web site / YouTube
 - Newsletter Editor - put together the monthly Splatter newsletter
 - Social media manager
- There are several Board positions that will be available in October. Currently, the Treasurer and Secretary are planning to make this their last year of service. If you are interested in serving on the board of a 501(c)3 non-profit, please consider running for one of these positions. The current members would be more than happy to "show you the ropes" during the year, so you wouldn't start with zero experience.
- Our sister club up in Nederland is looking for some help with events they are running. They have a weekly Monday night net with no predetermined agenda, so you can lead it however you want. They are also planning a Field Day site at Golden Gate State Park and are welcoming anyone who wants to participate. Finally, they are looking for operators for the Ned Gravel run on July 8th. They have signup links for all these events, so head over to their web site <https://w0ned.org/> for more information!
- You can start earning your 2024 membership or future renewal by acting as NCS for at least 5 nets this year. You can run either this Tuesday night net or the Thursday night net (or both). We have scripts available for both, so all you need is a good connection into the repeater, and somewhere to keep track of names and call signs as people check in. If you're going to be on the net anyway, why not save some dough at the same time! There are four free memberships available for 2023, so don't wait to get started!
- Chuck has set a goal for the Club of running at least one activity a month. This can be a hands-on construction activity, an operating activity like Field Day, a fox hunt, or a special event station. The goal is to get people together to have fun with amateur radio!

We have multiple locations at our disposal, as well as lots of Club equipment, so if you have an idea for something you think others hams would like to do, please let us know, and if you're willing to run it, even better!

- The Club is also looking for presentation topics for 2024. If you have any ideas, or better yet, would like to present, please let Chuck know and we'll get you on the schedule!
- All club activities are open to anyone - members and non-members. If you have questions, ask them on a net or **send email to elmer@w0eno.org**

Presenter: Bryan, AF0W

Topic: Test Equipment - Antenna Analyzer

- This week, I'm continuing with my discussion of test equipment for amateur radio.

Antenna Analyzer

- I'll be talking about antenna analyzers
- An antenna analyzer is a device that provides many useful readings that aid in the tuning and troubleshooting of an antenna system.
- The first generation of analyzers were merely portable SWR meters, but with the advent of microprocessors, modern devices typically provide a low-power, variable frequency signal to the antenna system, and then measure the impedance magnitude and standing wave ratio, and possibly the full complex impedance.
 - a. Because almost all antennas and antenna systems will have some reactance in addition to resistance, and the effects of this reactance depends on the frequency being transmitted through the system, you can't just use a multimeter to make system measurements
- This is important because just knowing the SWR does not tell you the whole story. For example, antenna systems with 25 ohms impedance and one with 100 ohms impedance will both give an SWR of 2:1
 - a. So will antennas with varying amounts of reactance, either capacitive or inductive, in addition to straight resistance.
- The low power signal reduces interference to other users of the spectrum, but also makes the analyzer susceptible to nearby strong RF signals
- They can also provide information such as antenna bandwidth (SWR across a frequency range), feedpoint impedance, coax cable loss, ground loss, impedance of transmission lines, and balun loss among others, depending on the features of the analyzer

- Can be used for things like:
 - a. Checking your antenna against manufacturer's specs
 - b. Comparing your antenna system before and after events such as rain, snow, hurricanes, or squirrels
 - c. Tuning an antenna, feedline, radial, or phasing stub
 - d. Determining electrical length, velocity factor, and characteristic impedance of a feedline
 - e. Finding the location of a break or short in your feedline
 - f. Finding the turns ratio of an RF transformer (to figure out whether you have a 4:1 or 9:1 balun)
 - g. Measuring the value of an inductor or capacitor
 - h. Measuring return loss in a transmission line (amount of RF energy lost in the transmission line)
 - i. Act as a dip meter to measure an antenna trap
 - j. Identifying the material used in a ferrite
- They can be used by connecting directly to the antenna at its feedpoint, or connected to an antenna system, which may include the antenna, feedline, lightning protection, and antenna tuner.
- Another measurement device is a vector network analyzer, which is used to characterize the frequency response of a component by measuring its effect on the phase and amplitude over a range of frequencies.
- These have traditionally been very expensive devices (many thousands of dollars), but recently, the introduction of the NanoVNA has brought this analysis into the hands of us cheap amateurs!
- The original NanoVNA was about the size of a credit card and about as thick as a cell phone. It has a built-in color LCD touch screen, and a battery and charging system that runs off USB which also allows the analyzer to be controlled by software running on a PC.
- The VNA analyzer is more complicated to use than a traditional antenna analyzer, but it does provide a lot more functionality.

- They have two RF ports, and can be used for either testing reflection characteristics with one port, or using two ports to test both the transmission and reflection characteristics of devices like filters
- One important point is that the NanoVNA must be calibrated for the frequency range you are using and any cables or adapters you are using to connect your device to be tested.
 - a. This is done by running a calibration process and connecting an open, shorted, and 50 ohm load to the location where you plan to attach your device under test. This location is called the reference plane.
 - For example, you could perform the calibration directly at the RF connectors on the NanoVNA to measure the characteristics of an antenna system that you then connect to those same connectors
 - You could also run the calibration from the far end of your feed line to measure just the characteristics of your antenna (and not the feedline itself)
- There are now multiple variations of the NanoVNA, with different screen sizes, RF connectors, and capabilities
- Analyzers range in cost from around \$60 for a NanoVNA to \$1000 for a RigExpert AA-2000 ZOOM
- Some characteristics that impact pricing are:
 - a. Frequency range (HF, VHF, UHF+)
 - b. Display (analog, digital, color or monochrome, size - or even none, whether it includes graphics such as SWR plots and Smith charts)
 - As I mentioned last week, while analog meters are older technology, they can make it easier to find the lowest SWR while sweeping across a range of frequencies manually
 - Digital analyzers, on the other hand, will draw a graph of SWR versus frequency, allowing you to see where your antenna system is resonant, or at least how low the SWR can go
 - c. Ability to store results on analyzer
 - d. Ability to connect to a computer system to control the analyzer and/or download measurements
 - e. Size and weight of analyzer

- f. Battery and charging systems
- g. Ability to indicate the sign of the complex impedance (which indicates whether it is inductive or capacitive) versus just the magnitude
- h. Your intended use may play an important part as well - will you be using the analyzer on an antenna on a 40 foot tower, or just at your workbench when constructing antennas? Will you need to read the display outside in bright sunlight?

Warnings

- One thing you must never do is to transmit into an antenna analyzer. Since they are made to operate off of fairly weak signals, this will damage or destroy them
- You should also make sure there is not any high voltage on your antenna or feedline when connecting your analyzer
 - a. Storms, snow, and wind can create a large static charge on your antenna. You don't want to connect this directly to your expensive analyzer!
 - b. Ideally, you should have a lightning protection device installed that will drain this charge, but if not, you can simply short the center pin on your coax to the shield.
 - c. I've got some links to Youtube videos showing arcing across feedline connectors.

Summary

- An analyzer is not a required piece of equipment, but if you are building or troubleshooting antenna systems, you'll find it indispensable
- A benefit of being a member of LARC is that we have some tools and equipment that are available to be borrowed by Club members, including an MFJ-269 HF/VHF/UHF SWR Analyzer.

Questions:

- **The question for the week is:** Have you ever used an antenna analyzer? If so, what did you use and what did you think of it, and if not, is this something that would interest you?
- **In my case,** I've got both a RigExpert and a Nano VNA. I got the RigExpert first - it's a model AA-200, which means it goes up to 200 MHz, making it good for HF and VHF, but not UHF. I've used it to check my HF antenna installation, to tune a VHF antenna by adjusting its length, and for making a chart of antenna tuner settings for my manual HF antenna tuner.

I've not used the Nano VNA for anything "real" yet. It is a lot more complicated to configure and use, but it provides more information than the RigExpert. The one I bought does not have any sort of case, so it's not very well-protected for use "out in the field."

More Info:

- Static electricity on antennas:
 - <https://www.youtube.com/watch?v=Ukt351SpmdM>
 - <https://www.youtube.com/watch?v=LU4G8GtZqz0>
- Field Day dipole with static protection: <https://www.youtube.com/watch?v=dYA38KO2tVQ>
- A short review of antenna and network analyzers: <https://old.rigexpert.com/a-short-review-of-antenna-and-network-analyzers/>
- RigExpert antenna and cable analyzers; <https://rigexpert.com/>
- MFJ-269D SWR Analyzer: <https://mfjenterprises.com/products/mfj-269d>
- Nano VNA: <http://nanovna.com/>
- Nano VNA v2: <https://nanorfe.com/nanovna-v2.html>
- Nano VNA vs. RigExpert: https://www.youtube.com/watch?v=WN_bW5eaqq8

- If you have ideas for net topics or general meeting topics / presenters, please let us know! Tell us on a net, or send email to k0itp@w0eno.org

Email to elmer@w0eno.org

1. K0ITP - Chuck - Firestone
2. AE0DO - John - N of Longmont
3. WA0JJC - Bob - Boulder
4. WB4FAW - Charlie - E Longmont
5. W7PGF - Will - Boulder
6. KF0PQQ - Mike - Loveland
7. AF0W - Bryan - El Paso via Echolink
8. KF0MXH - Art - Longmont

WA0JJC - Mike, Chuck, and Art coming in really scratchy

End: 7:50pm

