

2023-05-09 Hamlet Net - Test Equipment - Antenna Analyzers

Announcements:

- Antenna building class this Saturday, May 13, at the Clover Building at the Boulder Fairgrounds. There will be two classes - one for building your own Yagi antenna (there will be \$10 charge for this, but you will go home with your very own handmade antenna), and the second for wire antennas to be used by the club for Field Day.
- May 20th, 1-5pm - ARES will be running a simulated emergency test. They will be using LARC repeaters.
- Chuck putting together a special event to celebrate the 100 year anniversary of Peak-to-Peak involving multiple area radio club. Contact him if you'd like to help plan and participate!
- This Saturday at 8am, will be having breakfast at Hidden Cafe in Longmont. Berthoud is having a 7a breakfast at Grandpas.
- Once you have your Yagi antenna, LARC is running Fox Hunt where participants hunt for a hidden transmitter. The hunt will be Saturday, May 27th at 9AM until 12PM. The Fox will be located somewhere in Golden Ponds Park at and will be transmitting on 146.565 MHz. For more info, check out the club web site at w0eno.org (<https://w0eno.org/another-larc-fox-hunt/>)
- The SMSGTE service that is used to exchange SMS messages over APRS is currently down as a result of tightened government regulations in the US and Canada as well as some recent spam activities using the service. They are currently looking for a solution that would comply with the new regulations. For more info, see: <https://smsgte.org/>
- May 27th - Doug Sharp (K2AD) has invited the club to his house in Firestone to participate in the W1AW/0 event. This is part of the ARRL VOTA (volunteers on the air) event that is going on all year. Doug will have one of the RMHAM vans and other setups for hams to participate. Please contact Doug at doug@dougsharp.com for more info and to RSVP.
- The ARRL is running a survey regarding increasing their dues. If you are an ARRL member, you can provide your input at: <https://www.arrl.org/take-dues-survey>
- Field Day is coming up in June, and the club is starting to work on planning for this event. See the Club website for more information.
- You can start earning your 2023 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 2023. 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 make 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.
- 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.
 - a. 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
 - b. 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.
- I'm sure there will be at least one antenna analyzer at the LARC antenna-building activity this Saturday. Drop by and learn how to use one to adjust an antenna!

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 but 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=LU4G8GtZgz0>
- 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

Notes:

- 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. K0DBL - Don - Mead
2. K0ITP - Chuck - Firestone
3. KE0EE - Don - N Longmont

4. NA0A - John - Boulder.
5. AE0DO - John - N of Longmont
6. WA7EM - Ed - Erie
7. KM6SJA - Steve - Longmont
8. W0PPC - Steve - Lyons
9. AF0W - Bryan - Echolink from El Paso
10. AF4BY - Fred - Longmont
11. K2GEP - Greg - Spokane, WA visiting Ed
12. KV0N - Raman - Lafayette
13. KC0RRT - Liz - Longmont

K0ITP - This weekend (on the 13th) is the annual armed forces Day crossband test. Different frequencies on different bands.