

2023-08-15 Hamlet Net - Amplifiers

Announcements:

- Test Session Info
 - Next VE session is Saturday, August 26th in the Clover Building at the Boulder County Fairgrounds, and starts at 10 am. It is an ARRL VEC exam session, so there will be a \$15 fee to take the exam. For more info, see the Licensing/Testing page on the club web site, <https://w0eno.org/>, under the Education menu.
- Tomorrow is the normal August LARC General meeting date, but unfortunately, the meeting has been canceled this month.
- Thanks to all who attended the DX Commander antenna building session this past weekend. Chuck Poch and Chuck Lucas brought their DX Commander Classic antennas to the Clover Building, where attendees got to gain experience assembling, raising, and tuning this tunerless, multi-band HF vertical antenna.
- There are two contests coming up this weekend that may be of interest. The first is the North American QSO Party which is voice on single sideband. The second is the ARRL Rookie Roundup for RTTY. For more information on these and other upcoming contests, go to <https://www.contestcalendar.com/>
- Chuck is putting together a special event to celebrate the 105th anniversary of the Peak-to-Peak highway involving multiple area radio clubs on September 30th. They're currently looking for volunteers to work this special event. They will be operating HF SSB voice, CW, and FT8 stations from 8am to 4pm with three operators at each station. There is a signup link on the club web page at <https://w0eno.org/>, or contact him for more information!
- We have some volunteer opportunities available where you can help out LARC:
 - Photographer / videographer - record team activities and upload to web site / YouTube
 - LARC Fest Coordinator -
 - Newsletter Editor - put together the monthly Splatter newsletter
 - Activities Chairperson - member of the Board of Directors
- 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 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: Amplifiers

- One piece of equipment that is less common in the average ham shack, but which many amateurs wish they had is an amplifier
- There are a few different types of amplifiers that can be used in a ham station

Audio Amplifier

- A kind that probably everyone is familiar with (but which typically isn't used in home stations) is an audio amplifier
- This device will amplify the audio signals coming out of your radio
- Many times, these amplifiers are contained inside "powered speakers" - the power is required to drive the amplifier
- Some such speakers include digital signal processing functionality or filtering to further refine the audio signal, such as the West Mountain Radio CLR-SPKR ClearSpeech DSP speaker, which sells for \$220

- Some are just amplified speakers, such as the MFJ-383 amplified mobile speaker, which costs \$50
- Some are external devices that do not have speakers built-in - you must supply your own, such as the Heil Sound PRAS-EQ, which retails for \$270.
- There are also a number of unamplified external speakers. These are typically used in mobile installations where the base part of the radio is installed under a seat or in the trunk somewhere. Motorola makes some good mobile voice speakers that you can usually find used on eBay.
- You can also connect the audio output of your radio to a soundcard input on your computer, and then use software to transform the output by performing amplification, noise reduction, and other functions

RF Pre-Amplifier

- Another type of amplifier found in amateur setups is an RF pre-amplifier. These devices are installed in the antenna system and serve to amplify received RF signals before they hit the receiver
- A frequent use for these pre amplifiers are on VHF and UHF systems used for working satellites
 - a. In these applications, they are ideally installed close to the antenna.
 - b. This is because they will generally amplify both the signal and the noise received by the antenna. By placing them near the antenna feedpoint, they can be used to compensate for signal that is lost due to the feedline back to the radio. This is especially helpful for UHF signals, which are attenuated more as they pass through the feedline.
- There are two other issues with these devices.
 - a. The first is that they must be powered. Some devices have what's called a bias tee, which is a circuit that allows DC voltage to be sent over the same feedline as RF. Capacitors and inductors are used to separate the DC voltage from the AC RF signal.
 - b. The amplifiers can also be powered directly, but this requires an additional cable to be run from the shack to the amplifier.
 - c. The other issue is that these amplifiers generally do not tolerate RF being transmitted through them. If you are using them on a receive-only antenna, this is not a problem, but if you are also transmitting on the antenna, you have to take this into account.

- d. Some preamps have built-in switches that take the amplifier out of the signal path when RF is detected in the feedline. Others require a signal to perform this operation. This may require a cable back to the transmitter to signal the amp that a transmission is beginning.
- Some pre-amps may also include filtering capabilities - sometimes referred to as "band selectors." Instead of amplifying the entire range of RF presented at the input, these devices only amplify signals that are in the selected band, which can filter out a lot of the noise in the incoming signal

RF Power Amplifier

- The amplifier that most people probably think of in an amateur radio context is an RF power amplifier, sometimes called a linear amplifier.
- If you remember from your Technician licensing material, except for a few limitations, amateurs are allowed to transmit up to 1500 watts of peak envelope power on frequencies above 30 MHz, and General and Extra class licensees can use 1500 watts on HF frequencies as well
 - a. The exceptions are on the 2200, 630, 60, and 30 meter bands
- Note that even though we are allowed to use that much power, there is still an overall rule that we should use the minimum power necessary to carry out the conversation.
 - a. This means that if you are able to hit the repeater with your 5 watt HT, you should not connect that HT to a 100 watt amplifier just for fun.
 - b. One problem with using excessive power is that your signal will propagate farther than is necessary, perhaps interfering with amateurs that you may not even be able to hear.
- This brings up one saying I've heard, and that's an "alligator station." This means "big mouth, small ears," or a station that is using an amplifier so that it has a strong outgoing signal, but which has a compromised antenna system, so they are not able to hear far away signals.
- This is why a common saying is that you should spend as much as (or much more than) you spend on your radio on your antenna system, because a good antenna system will work both ways - for transmitting and receiving.
- Another saying is "you can't work 'em if you don't hear 'em" - a huge amplifier won't help you if you can't hear the other stations!
- I mentioned that these amplifiers are also referred to as "linear amplifiers," but what does this mean?

- a. It means that the waveform of the input signal is preserved on the amplifier output signal
 - b. A non-linear amplifier may distort the waveform, which impact signals carrying amplitude-based modulation such as SSB, and would definitely impact digital transmissions and likely create splatter
 - c. Note that this does not affect FM or CW transmissions.
- The first thing to look for in an RF power amplifier is the bands that it supports
 - The most common amplifiers are used for HF (or maybe HF and 6 meters), and are typically fairly large and heavy devices
 - In the "old days," they contained one or more vacuum tubes, along with high-voltage power supplies to run them (in the 2-3 kV range) which used either 220 or 110V AC. These amplifiers may be manually or automatically tuned, and can generally tolerate antenna system mismatches.
 - a. The high voltages inside these amplifiers can be lethal, so more care is needed when working on them
 - Nowadays, we also have solid state amplifiers, which use transistors and other semiconductors instead of tubes to amplify the RF signal
 - Most VHF and UHF amplifiers are single-band devices, sometimes with built-in pre-amplifiers. These devices typically operate off of 12 volts DC, and are frequently designed for mobile use.
 - There are also high-power VHF and UHF amplifiers that are used for things like moonbounce communications which can operate at full legal limit
 - The next characteristic of the amplifier is the output power. Some tube and solid-state amplifiers are rated for 600 or 1000 watts, while some are rated at 1500 watts or above.
 - Many HF base stations radios are rated at 100 watts output. The difference in going from 100 watts to 1500 watts represents a gain of nearly 12 dB.
 - a. This may sound like a lot, but keep in mind that the points on a radio's S meter represent about 6 dB per S unit, meaning such an amp would theoretically take a received sign at S5 up to S7.
 - As a 1500 watt amplifier, such as the tube-based MFJ AL-800H may run around \$5400, you can see where it begins to make sense to evaluate antenna system upgrades as well.

- For example, the MFJ TH-7DX tri-band 7-element beam supports 10, 15, and 20 meters, and runs around \$1600, leaving plenty of room for purchasing a tower and related equipment. This antenna has an advertised gain of 27 dB - over twice that of the 1500 watt amplifier!
- Even upgrading your wire dipole to a full-wave horizontal wire loop antenna can improve your signal by 2 to 10 dBi for not much cost, or replace your dipole's coax feedline with 450 ohm window line back to an antenna tuner with a balanced output.
- A more reasonable choice might be the MFJ ALS-600, which is a 600 watt solid state amplifier, retailing for around \$2300.
 - a. 100 watts to 600 watts is a gain of almost 8 dB, which translates to an increase of just over 1 S unit on the far side. Not too big of a difference on the S meter for a \$3100 savings!
- There are a few 12 volt HF power amplifiers meant for mobile use, such as the MFJ ALS-500MX solid state amplifier for \$1200.
- Another consideration for any amplifier is the input power - most amplifiers will not want the full 100 watts into their inputs!
- If you purchase an amplifier that puts out 500 watts or more, you'll likely need to run it off of a 220 volt circuit. If you don't already have such a circuit in your ham shack, you'll have to add the cost of installing one to your amplifier purchase price.
- In addition to base station use, some hams use their HTs along with a mobile 2m or 70 cm amplifier and mag mount antenna to allow them to effectively operate from places like a spouse's vehicle or rental or work vehicle, where there isn't an option to install a more permanent setup.
- High powered amplifiers do generate some issues. You may need to run a dedicated 110 or 220 volt circuit to your ham shack to handle their power requirements
- You also need to make sure that all devices in your antenna system after the amplifier are able to handle the increased power. This means that your cheap 100 watt manual tuner will also have to be upgraded, as might your external SWR or power meter.
- You must also make sure that your station and antenna system still comply with FCC RF exposure regulations. It's probably not a good idea to run an attic-mounted dipole at 1500 watts right over occupied living space, for example!
- Higher power also means a higher chance of introducing RFI into your or neighbor's household electronics.
- Finally, many older, tube amplifiers use a high voltage on their keying circuits

- a. The keying circuit in the amp is connected to your radio to let the amp know when your transceiver is in transmit mode
 - b. This only requires a simple contact closure to activate, but older amps have this circuit switching high voltages that can damage contemporary radios
 - c. The workaround is to purchase some sort of relay buffer interface that sits on the keying line between your radio and your amplifier
- Amplifiers don't have to be high power - there are lower power RF amplifiers that can be driven from the output of a QRP radio, to bring that 1 watt signal up to 20 watts, for example.
 - a. As they require far less power than larger amplifiers, they can be run on battery power, making them candidates for Parks on the Air and Summits on the Air use.
 - Some terminology you might hear on the air in reference to amplifiers is "barefoot" and "QRO."
 - a. "Barefoot" refers to operating without the use of an amplifier. You might still have an amplifier, but just not be using it at that time.
 - b. "QRO" refers to high power - this can mean 100 watts (when compared to QRP power levels), or 1500 watts.
 - You may also hear "full gallon" - this refers to a 1000 watt amplifier.
 - So in summary, amplifiers are just another tool for us hams. They can be very useful in some situations, but they are also not a "cure all" for every issue

Questions:

- **The question for the week is:** Do you have any sort of amplifier in your radio setup, or are you considering getting one?
- **In my case,** I have three different amplifiers.
 - a. The first is a fairly old 500 watt Yaesu tube amplifier for HF. I got a good deal on it at a hamfest (I bought it as the vendor was packing up to leave - it weighs a bit over 40 pounds, and he didn't want to haul it back home).
 - b. The second is a pair of mast-mounted amplifiers for satellite use. I have a set of eggbeater antennas in my attic, and since these are omnidirectional antennas, I figured they could use a little help. These amps were another hamfest purchase, and were much easier to get home than the HF amp!

- c. The final amp I have is a Radio Shack 2 meter amp that runs off of 12 volts. I purchased this one to use with an HT and mobile mag mount antenna for voice and APRS communications. I haven't had a chance to try it out yet - Chuck borrowed it and said it did not work, so I may have some work to do there (or a paperweight). Unfortunately, that's the risk of buying on eBay!

More Info:

- Bias Tee (wikipedia): https://en.wikipedia.org/wiki/Bias_tee
- Amplifiers: <https://newhams.info/2019/03/01/transmit-power/#more-7650> and https://www.electronics-notes.com/articles/ham_radio/amateur-equipment/linear-amplifier.php
- HF Amplifiers vs. Antennas: <https://www.arrl.org/files/file/Technology/tis/info/pdf/9811054.pdf>
- 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

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1. AF0W - Bryan - Longmont -
2. AE0DO - John - N of Longmont -
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4. KM6SJA - Steve- Longmont -
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