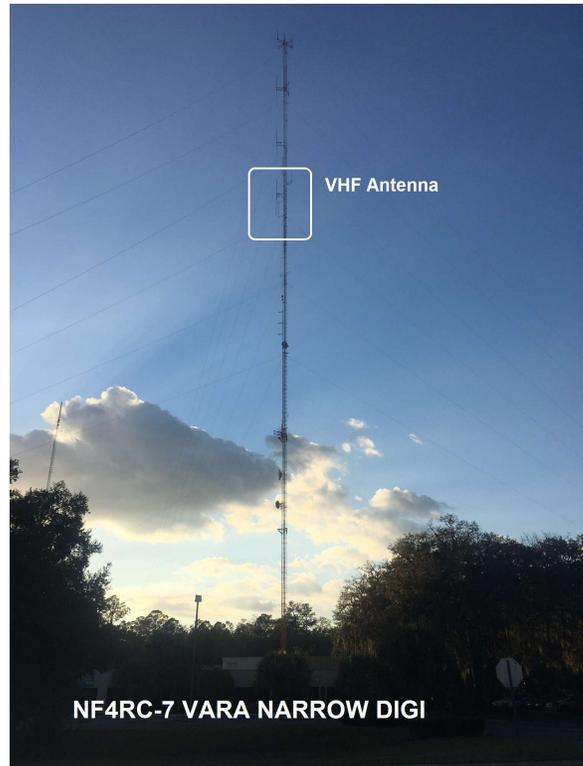


New Alachua County VARA Digipeater

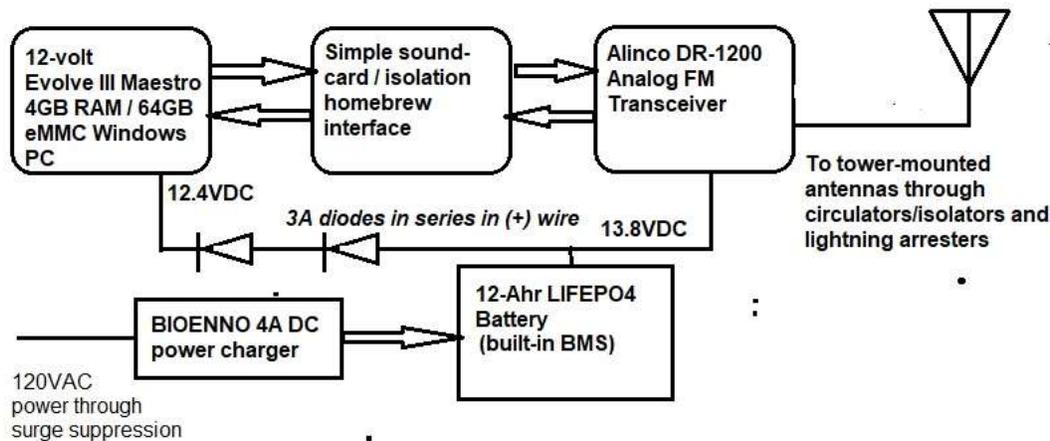
by Gordon Gibby KX4Z

Thanks to the generosity of tower space on the TV-20 tower from Jim Carr KC4MHH and the TV station, Alachua County ARES(R)/NFARC have been provided a connection to a set of VHF antennas above 500 feet. We decided to put up a VARA digipeater, NF4RC-7 on 144.990, since we already have a 1200-baud packet AX.25 system in our county and beyond

VARA-FM¹ is a recently-developed modulation, comprised of as many as 58 audio carriers spread throughout the audio bandpass.² Each carrier of "narrow" VARA-FM is individually modulated with 256QAM, with a symbol rate of 42/second. As a result, data moves VERY rapidly, up to 12.75Kbps. This is similar to the way that most advanced ham radio data modulations have been going for some years and similar to cell-phone signals. We settled on "narrow" VARA, which still uses the entire 3kHz audio bandpass, but works with just about any Signalink or homebrew sound system and simple analog FM transceivers, even Baofengs.



Most of our county can now digipeat through just one station, NF4RC-7, and reach more than one local Winlink RMS Server.³ Further, we can use this asset for test-messaging conversational VarAC, for "nets" and/or data transmission. (See: <https://www.varac-hamradio.com>). This "digipeating" capability was added in VARA-FM 4.01, Nov 28, 2020 and makes a huge difference for community groups such as ours, spread out over large distances. Already Reid Tillery K9RFT on the far eastern side of the county, has found he can now make VHF WINLINK connections.



1 <https://rosmodem.wordpress.com/> This is a commercial proprietary product developed by an amateur operator.

2 See TechNite Lecture Slides, <https://qsl.net/nf4rc/2022/AX25Part1.pdf> and <https://qsl.net/nf4rc/2022/AX25Part2.pdf> which provide information and contrasts / comparisons between AX.25 Bell 202 and VARA FM.

3 See maps of our VARA-FM and AX.25 resources here: <https://qsl.net/nf4rc/VHFPacketInterconnections.html>

Although the inexpensive Evolve III PC (currently more available and cheaper than a Raspberry pi!) likely includes a switching regulator between its 12.0VDC power adapter and internal circuitry, a diode pack of 2 series diode sets rated at 3A, was utilized to avoid over-voltage when the LIFEP04 charger reaches peak voltages. With a charged internal PC battery, the total current drain during receive was measured with a hall-effect sensor at approximately 0.52A, well within the capabilities of the 4A charger. During transmit, the 25W transmitter likely draws from the combination of the charger and the 12-Ahr LIFEP04 battery.

With lead-acid storage batteries, our team has used this sort of power supplies for VHF AX.25 digipeaters in remote locations quite successfully for several years.

The setup of the PC included:

- Installation of VARA-FM version 4.2.7 (compatible with current Var-AC)
- Using the included AUTO-TUNE to assist in setting RX and TX gains on homebrew sound-card interface⁴ (A Signalink or equivalent could just as easily be used).
- Setting digipeater checkbox and assigning callsign NF4RC-7 within the VARA-FM Soundcard setup
- Inserting the startup icon for VARA-FM into the STARTUP folder of Windows (ensuring it will be automatically started on each reboot)
- Inserting a Basic Task into the Windows Task Scheduler to perform a shutdown -r at 2359 each day (or suitable alternate time). (See any suitable web instructions on performing this task.)
- Adjusting the Windows power/sleep settings so that the PC stays "on" forever with power provided, and does not turn off or sleep with the lid closed

The PC-radio setup was test-connected to the tower antenna to measure the background noise in the environment and verify that it was not "desensed" by existing high power FM and TV transmitters. The professional antenna management at the site includes complicated circulators/isolators⁵ that are more capable than setups we have experienced before. Our transceiver perceived no interfering signals and easily made distant VARA "pings" to our existing KX4Z-12 VARA RMS, with full-scale received signals off the side of KX4Z-10's beam aimed at the EOC. No desensing was observed during our visit. Before final connection, the assembly was tested and monitored at home, for several days, including direct observation of the automatic shutdown/reboot sequence.

Although the digipeater itself does not have to possess VARA registration (it does, however); users wishing to utilize it do have to make a commercial payment to obtain the registration.

Frequency Selection

VARA-FM digipeaters are not "repeaters," because they do not simultaneously repeat, but rather store and forward data transmissions.⁶ VARA-FM does not have the multi-user-channel listen-before-transmit capabilities of AX.25. As a result, users must observe proper etiquette and avoid transmissions when the frequency is busy. With the rapid packet re-transmission by a VARA digipeater, it is easy to detect usage of the frequency. However, some amateur data users don't build their stations so that they can hear the received signals, and thus might inappropriately transmit over existing communications. Due to the lack of listen-before-transmit, VARA-FM does not properly co-exist on an AX.25 packet frequency.⁷ Several discussions were held among north central Florida data leaders to pick a digipeater (and related Winlink RMS) frequency. 145.01 / .03 / .05 / .07 are frequently

4 See: <https://qsl.net/nf4rc/2019/SmallBoxSoundCardInterfaceManual2.2.pdf>

5 See for example: <https://www.militaryaerospace.com/directory/blog/14059676/what-are-rf-isolators-and-rf-circulators>

6 FCC Part 97.3(a)(40) See <https://www.ecfr.gov/current/title-47/chapter-I/subchapter-D/part-97>

utilized for AX.25 packet operations according to the ARRL Band Plan documents.⁸ There is a disadvantage to having too many VARA digipeaters too geographically "close." Examination of the WINLINK RMS list⁹ suggested that 144.990 was frequently chosen, and that we were sufficiently far from the nearest users. Time and monitoring will determine whether there is any significant interference (other than rare tropospheric ducting). Because of FM's characteristic take-over of a frequency by stronger signals, it may well work out fine.

Radio Assets

VARA-FM digipeaters are not cataloged or listed on the channel selection charts within WINLINK. As a result, local knowledge of useful digipeaters is important. We maintain maps and tables of existing VHF architecture pertinent to Alachua County at:

<https://qsl.net/nf4rc/VHFPacketInterconnections.html> and attempt to keep the rapidly-changing data current.

7 Note the very candid warnings to that effect in this how-to document:

https://www.winlink.org/sites/default/files/RMSE_FORMS/rms_packet_dual_mode_single_radio_setup_0.pdf

8 See <http://www.arrl.org/band-plan>

9 See: <https://winlink.org/RMSChannels>