EOC Trial Antenna In Oak Trees
June 29 2019 Data Capture

Version 1.0
June 29 2019
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SUMMARY

Col. Huckstep (W4JIR) and Gordon Gibby (KX4Z) installed a temporary test antenna hanging from an oak limb in the grassy area on County property just south of the EOC south parking lot, south of the EOC building. [1] The antenna was a home-made clone of a Buckmaster antenna, intended to be as similar as possible to the recently improved roof-antenna at the EOC.[2] That was a successful completion of the second of 2 tests that have been previously proposed.

SWR (standing wave ratio; an indication of the quality of the match provided by the antenna to the transmitter) measurements confirmed that it acted just like a normal Buckmaster antenna, with obvious workable SWRs on 80, 40, 20 meter ham bands-- *much better SWR on 80 meters than the roof-antenna.*[3]

Noise / Signal measurements then demonstrated phenomenally low ambient noise, as much as 20 dB better than the roof-antenna in some bands. Obvious amateur and broadcast signals were strong, with similar amplitudes to what have been recorded fro the roof antenna, indicating the antenna is not just "quiet" (e.g. due to attenuation) – it is *working*.

Connecting the antenna to our test amateur transceiver confirmed very low noise on 80 meters, with readings of S0-S1, interspersed with the expected lightning crashes due to storms in North Florida. Previous measurements on 80 with this exact same receiver at the EOC had been as large as S8 on 80 meters before the antenna was raised—with each S Unit supposedly being 6dB.[4] **Contact was achieved on 80 meter digital with KX4Z, and then with another station on 80 meters. To my knowledge this is the first WINLINK contact <u>ever achieved at the EOC on 80 meters</u>.**

The receiving performance of the antenna was very significantly better than the roof-antenna on 80 meters, and the noise data captured suggest that it will also be better for several SHARES frequencies. This would allow for far better nighttime backup HF radio connections, considerably improving the

1 This test was strongly suggested based on the findings of a May 18th investigation that discovered the HF noise signals from the EOC internal equipment had a rapid "near-field" drop-off in intensity, over relatively short distances from the building itself. See the Summary, https://qsl.net/nf4ac/2019/May18Investigations.pdf

2 See construction information: https://www.qsl.net/nf4rc/2018/OCFCenterBalunInstructions.pdf

3 SWR of roof-mounted antenna at 3.5 MHz 9:1; see https://www.qsl.net/nf4ac/2019/June1Investigations.pdf This is likely due to relatively unavoidable interaction with the EOC roof lightning arrester and structural metal.

4 See page 8 for a table of noise measurements made with the same transceiver in November of 2018: https://qsl.net/nf4rc/2019/EOCInterferenceFeb222019Report.pdf

chance that backup HF amateur or federal SHARES communications would be possible 24 hours per day.

The EOC would be well served by providing a simple coaxial cable disconnect (or switch) in the existing cable for HF antenna, perhaps outside the building, so that a donated HF antenna in the oak trees could be utilized in this newly-documented low-noise location. In the event of damage to that antenna, re-connection of the cable would allow use of the roof-mounted antenna.

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DETAILED RESULTS

Figure 1: *Photo of temporarily installed antenna, with center Balun at approximately 26 feet above ground. Inverted V type clone of a buckmaster antenna. Except for the light-colored RG8X coaxial cable, the antenna is almost invisible.*

Using a slingshot, an 80-lb. Braided fishing line was installed over a branch in the grassy area south of the EOC, and nylon string then placed, to allow temporary raising of the 130-foot long off-center-fed, Buckmaster clone antenna, with a 4:1 voltage Balun and 1:1 current Balun in the suspended center connection. 40 and 90 foot antenna wires were appropriately tied off temporarily to nearby trees to achieve the desired inverted vee shape.

Approximately 70 feet of RG8X coaxial transmission line was utilized to connect the center Balun to measurement equipment or transceiver as needed.

SWR measurements were made using a MFJ 259-B antenna analyzer.

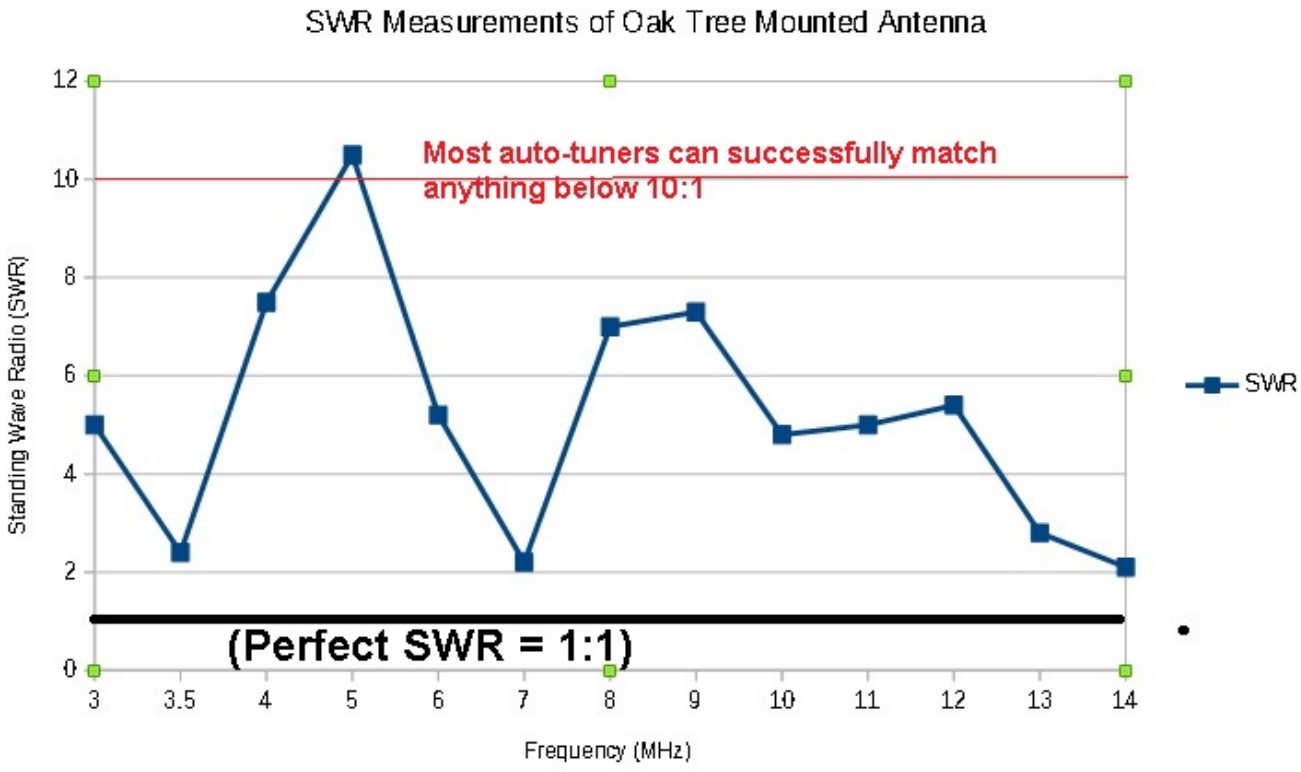


Figure 2: *Simple SWR plot (connected lines between actual measured points) of oak-tree mounted antenna shows obvious matching at 80, 40 and 20 meter amateur radio bands, as expected.*

Unlike the roof-mounted antenna, the antenna among the oak trees shows the expected better matching on 80 meters (SWR 2.4 @ 3.5 MHz), since there are no large metallic structures nearby to interfere with the antenna.

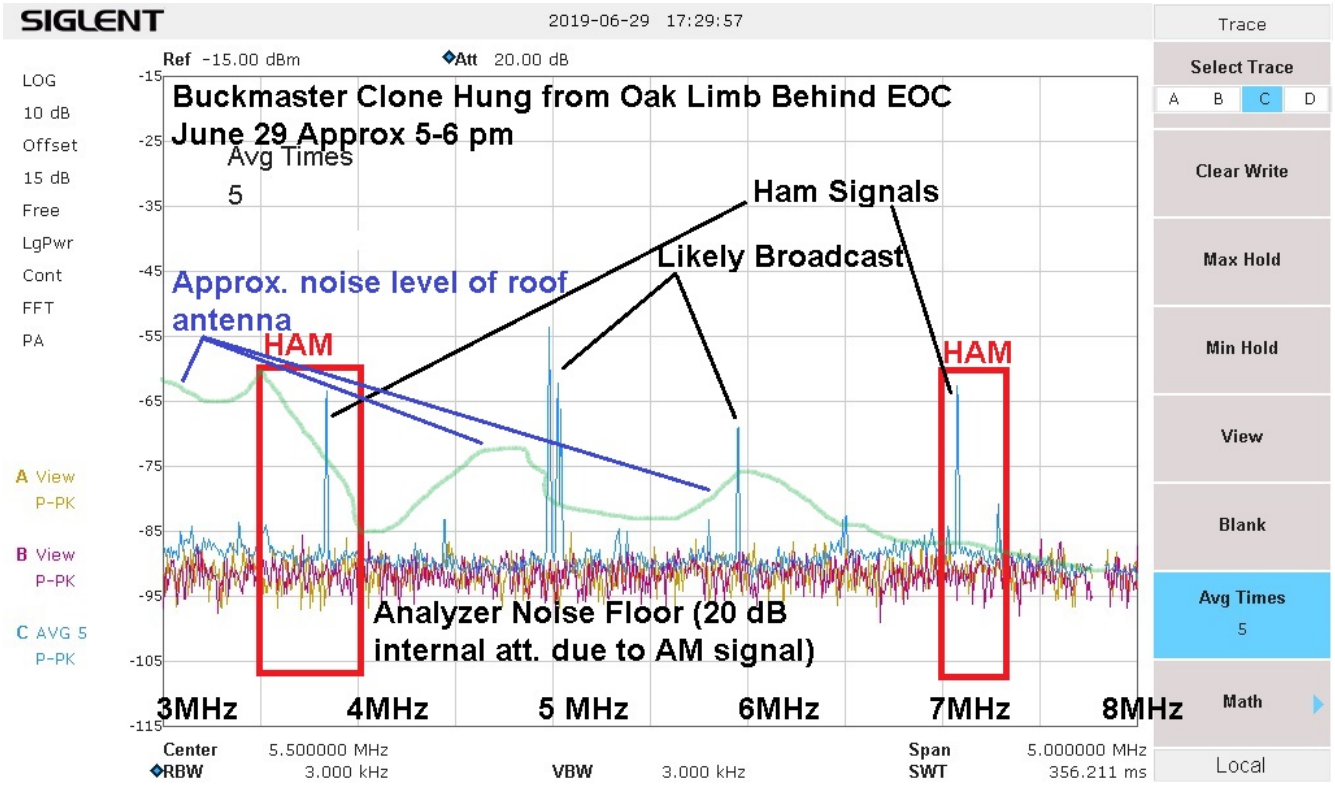
NOISE MEASUREMENTS

Signal/noise measurements were made using a recently purchased Siglent spectrum analyzer, with 15 dB of external attenuation, 3 kHz bandwidth (both RBW and VBW) in the range from 3 MHz to 8 MHz, attempting to exactly duplicate the measurements made previously on the roof-mounted and on other residential antennas.[5] Those previous measurements have typically used an internal attenuation

5 See, for example, Figure 5 of https://www.qsl.net/nf4ac/2019/June1Investigations.pdf

of 10dB.[6] However, a **strong local AM radio station at 1430 kHz[7] overloaded the analog to digital converters of the spectrum analyzer**, necessitating an increase in internal attenuation to 20 dB, and a resultant degradation of the low-signal measurement capability of the analyzer to approximately -95 dB from its usually -105 dB under the measurement settings. This internal noise floor is almost the ambient noise found on the antenna, but thankfully still adequate for our tests.

The resulting signals and noise measured from the test antenna are shown in Figure 3.



.Figure 3. *Received signals from the test antenna. Purple and yellow traces at the bottom are the internal noise floor of the configured device, taking into account the required 15 dB external attenuation, and 20 dB internal attenuation to protect the device from a strong AM broadcast station at 1430 kHz (WTMN-AM 1430, 10kW)* ***The approximate noise floor of the roof mounted antenna is marked in the wavy light blue line. The baseline noise on this antenna is comparable or better to an antenna in residential Gainesville (Figure 5).***

Observations from Figure 3:

- **Noise in the cw/data end of the 80 meter band (and in a nearly SHARES set of frequencies) is below -85 dBm – an amazing 20dB lower than measured with the roof-**

6 See, for example: https://qsl.net/nf4ac/2019/GibbyAntennaBaselines042232019/GibbyHouseAntenna181540metertune04232019.jpg which shows results of a measurement at a residential antenna in the Jonesville area.

7 That station is WTMN-AM 1430, licensed to operate at 10 kW. We were able to tune it in and actually listen to the station. using an amateur radio transceiver

mounted antenna, even after its improvements – meaning stations that are 100 times weaker can be received by the oak tree antenna.

- Noise in SHARES bands in the 4-6 MHz range is generally 5-10 dB lower, so SHARES stations that are 4 to 10 times weaker could be received.
- Noise in the 40 meter amateur band is similar to the roof mounted antenna.
- Both broadcast short wave stations AND amateur radio stations in both the 80 and 40 meter bands were clearly visible on the spectrum.

ACTUAL RADIO CONTACT

Using a portable amateur transceiver we proceeded to make two digital connections in the 80 meter band using WINLINK, **a feat that has never been accomplished with the roof-mounted antenna**.

Figure 4 displays the equivalent signal reception from the roof mounted antenna for comparison:

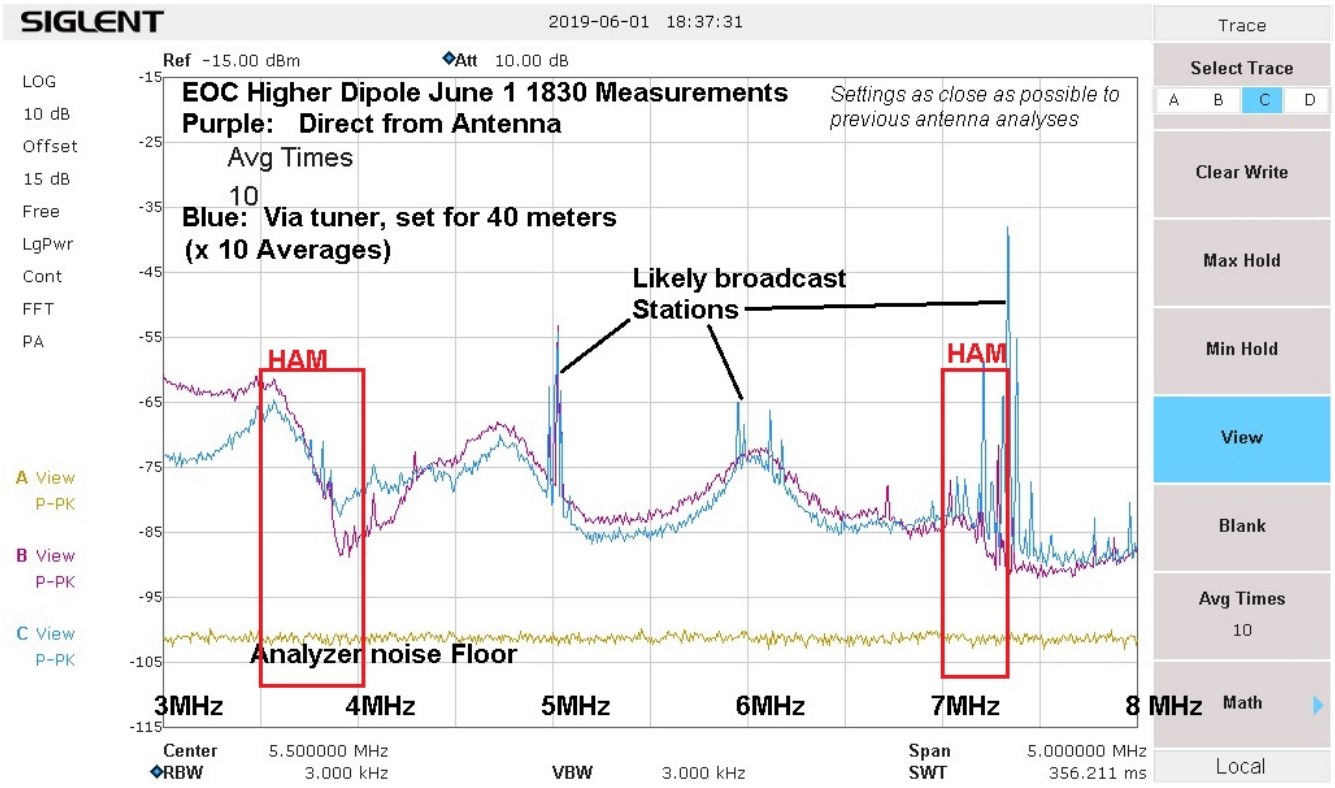


Figure 4: *EOC roof mounted antenna data collected with a very similar configuration, on June 1, 2019 (but apparently not affected by the AM radio station on that day). Broadcast and amateur signals are observed, but the baseline noise level is significantly higher on most frequencies below 5 MHz: an amazing very poor -65 dBm at the lower end of 80 meters.*

Comparison to Residential Antennas

Figure 5 is a noise measurement from a NW Gaineville residential location of a commercially manufactured Buckmaster antenna. At this location, there was no interference from the 1430 kHz AM station, so the spectrum analyzer was able to tolerate lower input attenuation. The noise level at this residence is very comparable to that observed in a previously scanned residence (see: https://qsl.net/nf4ac/2019/GibbyAntennaBaselines042232019/GibbyHouseAntenna181540metertune04232019.jpg) but the oak-tree mounted antenna behind the EOC is comparable, if not slightly better.

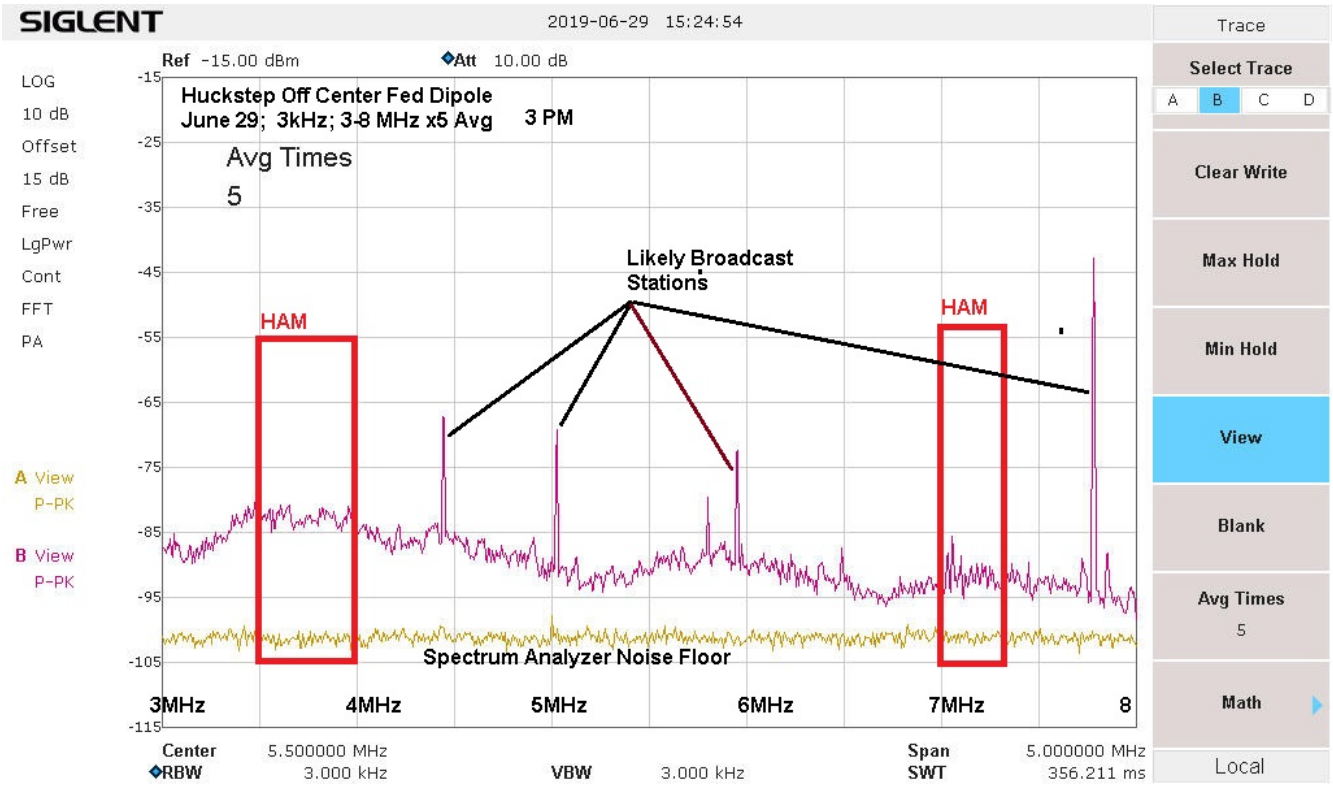


Figure 5. *Comparison plot from Buckmaster Antenna in NW Gainesville Residential Area. Antenna noise baseline generally -85 dBm to -95 dBm. The Oak Tree mounted antenna in Figure 3 is actually quieter than this at some points.* Analyzer noise floor is different from Figure 3 due to the lack of interference from the AM station.

CONCLUSIONS

Far better night-time backup communications would be obtained with the antenna hung from the Oak Tree, as it will be a far better performer below 5 MHz. Frequencies below 5 MHz are the useful frequencies during the nighttime when there is no solar radiation to the ionosphere, and the critical frequency typically drops as far as 3 MHz. The critical frequency gives an indication of the frequency range required for communications to geographically "near" stations, in our case, the Tallahassee State EOC.[8] Typical ionosonde measurements of critical frequencies are made available by federal authorities.[9] SWR matching will be much easier on 80 meters with the oak-tree mounted antenna.

Day time communications on frequencies of 7 MHz and higher are expected to be similar on both antennas.

The roof-mounted antenna is likely to be sturdier against high winds.

To gain the advantages of both, providing a coaxial cable disconnect (or coax switch) in the existing wall penetration for the HF antenna coaxial cable, that allows either an Oak Tree mounted antenna to be preferentially utilized, or the roof antenna should the oak-mounted antenna be lost, would provide a better all-around backup antenna situation, helping to provide 24-hour backup HF communications.

A suitable buckmaster clone [similar to the one utilized in this study] can be inexpensively created by the local ARES group and donated to the County to reduce expenses of adding this antenna to the backup capabilities of the EOC.

8 See discussion at: https://www.electronics-notes.com/articles/antennas-propagation/ionospheric/maximum-lowest-critical-optimum-usable-working-frequency.php

9 See for example: https://region6armymars.org/resources/solarweather.php