You, Too, Can Work 630 Meters

Use low power and small antennas for practical communications on this new band.

Steve Johnston, WD8DAS

The 2012 World Radio Conference designated a secondary allocation for Amateur Radio stations in the 472 – 479 kHz band. ARRL® has petitioned the FCC for a rulemaking authorizing amateur use of this band in the United States.[1]

It has been almost a hundred years since hams operated in this part of the radio spectrum. The 20th century experience of marine and shore stations' operations below the AM broadcast band offers some historical guidance to what can be expected, but those stations often used antenna systems and power levels that are unlikely to be practical for most amateurs.

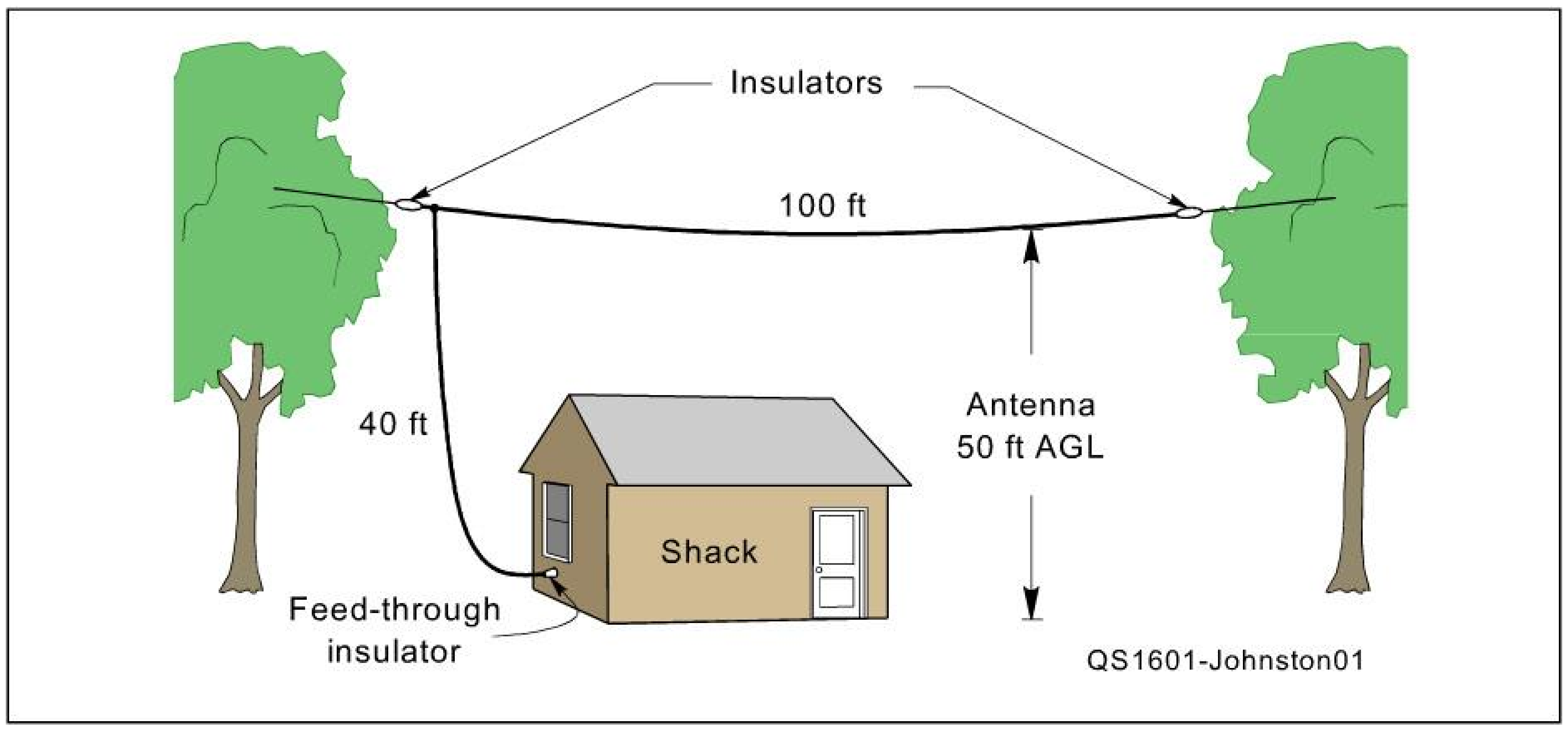

Figure 1 — Sketch of the inverted L antenna for the 630 meter band.

Current proposals and allocations are at the 1 and 5 W effective isotropic radiated power (EIRP) levels — certainly low power by amateur standards, but not as bad a limitation as you might think.

Experimental stations have been operating at these power levels in the 400 – 500 kHz band in recent years, testing ground and skywave propagation using conventional and exotic modulation schemes. Antenna efficiency on these frequencies is very low for small antennas, resulting in low effective radiated power levels — yet the experimental stations have been transmitting across continents.

My interest in medium frequency work led me to suspect that a practical station could be built "amateur-style" using a relatively simple antenna and transmitter. I based my conjecture on these factors:

- My personal observations of system performance during 30 years of experience as a broadcast engineer operating and maintaining AM broadcast stations.
- My personal experience as an Amateur Radio operator for 38 years, working all bands from 160 meters through 70 centimeters.

After a year of operation, I can now report that a typical ham on a suburban property can effectively operate on 630 meters even under the EIRP restrictions associated with the amateur allocation.

My 630 Meter Station

My antenna is a simple random-length wire suspended from trees in an inverted L configuration, worked against ground (see Figure 1). The vertical section does most of the radiating, while the horizontal section provides capacitive top loading. The horizontal portion can be one wire (L style), two wires (T style), or more (a top hat configuration). In my case, the vertical section is 40 feet long and the horizontal section 100 feet long.

In my experience, the performance of an inverted L antenna system on HF relies heavily on the ground system. I assumed the same would be true for MF operation — likely the ground system would be even more important at MF due to the relative "shortness" of the antenna. Losses in the ground system become a greater percentage of the antenna resistance as the length is shortened, decreasing the overall efficiency. Because my experiment was to use ordinary amateur techniques, I didn't want to enhance my ground system with added radials and rods.

In fact, the ground for my antenna is just my regular HF station's ground. The central ground point I've defined is located on a section of basement wall where all the utility service entrances are located. This central ground is a few feet of ½-inch copper pipe with 1-inch copper straps connecting to the power panel ground. The panel is grounded to an 8-foot rod, driven right outside the house, the iron and copper water pipes (before and after water meter), and the metal HVAC ductwork in my house.

To this ground system I had connected (with more 1-inch copper strap) the operating desk star ground, my two converted Gates BC-1T AM transmitters, the 630 meter transmitters, and the shields of all the coaxial transmission lines feeding my other antennas. It's probable that the outsides of the various coaxial cable shields form accidental counterpoises and act as radials to some degree.

So, to be clear, I made no special, improved ground for the 630 meter antenna system. I just made sure the ground side of the inverted L system was well attached to my existing station ground.

Transmitting

I soon came upon an online auction for a MF transmitter built for shipboard use: the Japan Radio Corporation NSC-17M Reserve Transmitter (see Figure 2).

Designed as a backup transmitter for the radio rooms of commercial cargo ships, this crystal-controlled CW transmitter covers 472 – 479 kHz easily and includes a built-in variometer matching network for short antennas.

I based my decision to erect an inverted L antenna partially on a desire to use the kind of antenna that would have been used aboard ship. A front-panel RF ammeter shows current into the antenna — radiated power can be determined by the formula $P = I^2R$, where I is the current flowing into the antenna and R is the radiation resistance of the antenna.

For some time, I'd also been thinking about getting a new main station transceiver. My interest in 630 meter operation was a consideration in my search for a new rig — I wanted very good MF receive performance. When I realized that the Kenwood TS-990S had both good MF receive capability as well as the ability to generate a low power, all-mode signal on the 475 kHz band, I was sold!

The 1 dBm 630 meter signal from the TS-990S DRV jack is amplified for transmission by a modified LPB Carrier Current amplifier. Modifications include the addition of a simple intermediate amplifier using a video op-amp IC to boost the transceiver's 1 mW output on 630 meters to a drive level appropriate for the LPB amplifier. This allows the amplifier to be on the other side of the basement near the feed point of the antenna. A homebrew L-network provides the matching to the inverted L antenna. An internal meter on the amplifier shows relative RF output. I combined this with an external thermocouple ammeter to read the RF current into the antenna (see Figure 3).

Receiving

My research indicated that effective transmitting antennas for the low and medium frequencies do not always make good receive antennas. My best choices for reception on 630 meters have proven to be my 75 meter inverted V dipole (with the receiver preamp turned on), or my ground-mounted 8-foot active whip with a preamp at the base (preamp off in the receiver). I also tried a 10-foot shielded loop active antenna made of coax inside PVC pipe, which I found too unwieldy and, being directional, needed to be rotated to peak signals or null noise.

The TS-990S provides professional-quality reception on 630 meters. Other receivers worked well too, but beware the many ham and shortwave receivers that may include a filter or attenuator to greatly reduce signals on the AM broadcast band and below. In some cases these stages can be bypassed or modified to restore MF reception, but in other cases, it is not practical.

Testing and Analysis

I found that both of my transmitting systems produced about 1 A of RF current into the inverted L antenna. My calculations indicated that this produces about 0.85 W EIRP, well below the proposed limits of 1 or 5 W EIRP for a future 630 meter band. On my experimental license application I asked for authorization

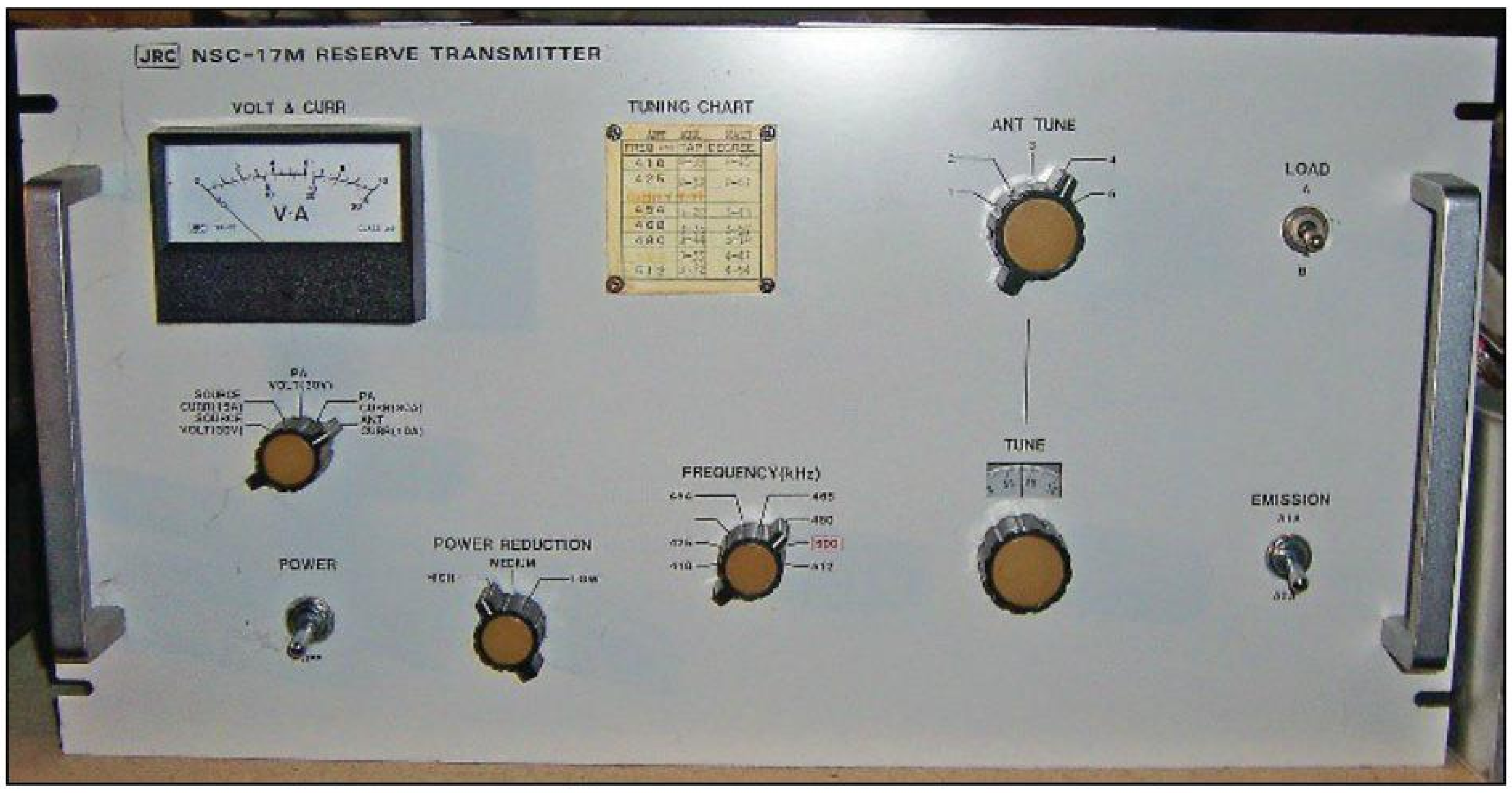

Figure 2 — The Japan Radio Corporation NSC-17M CW transmitter, which was originally used as a backup transmitter on a commercial ship. [Steve Johnston, WD8DAS, photo]

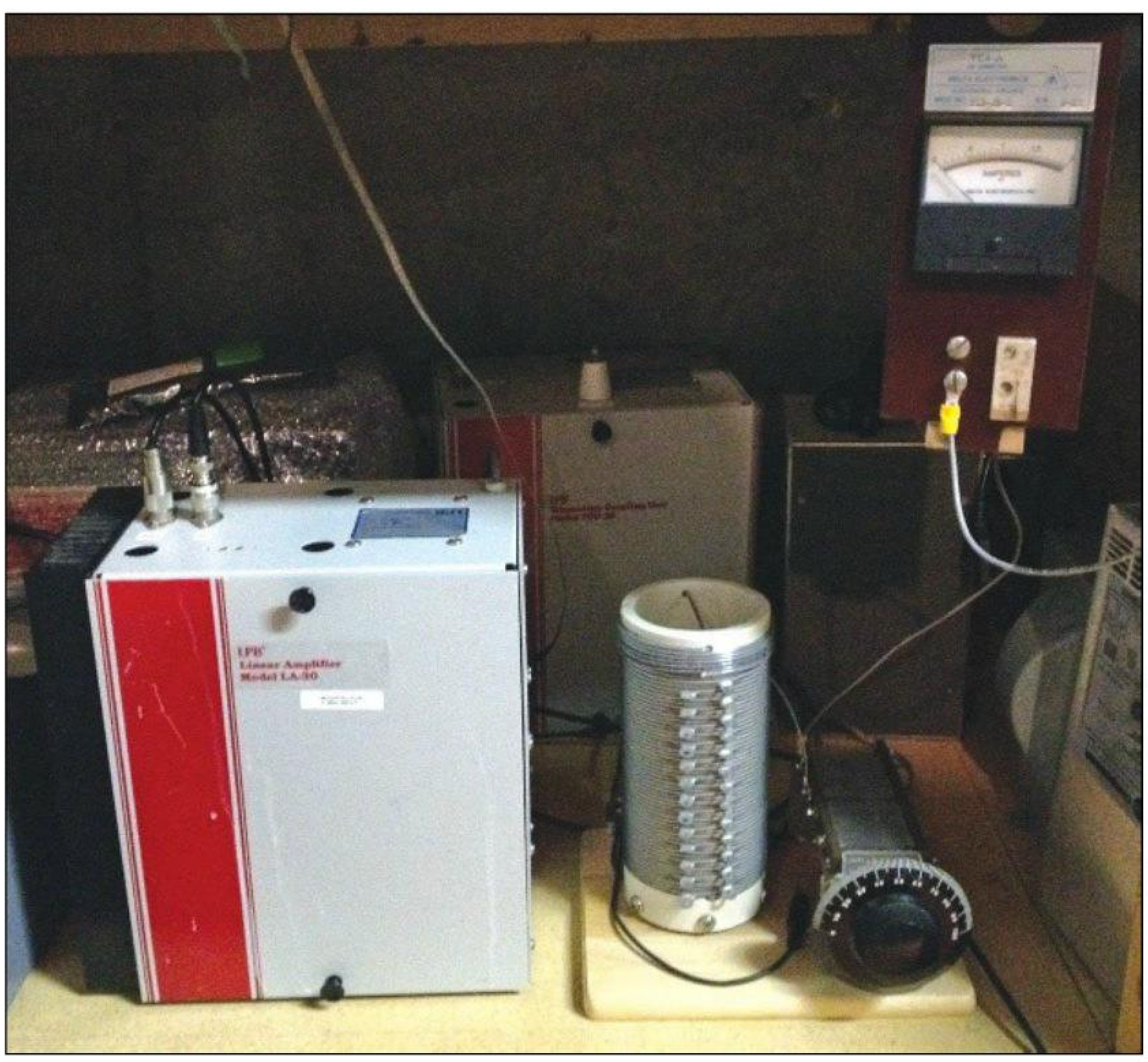

Figure 3 — The LPB Carrier-Current Broadcast Amplifier and homebrew matching network used to drive the inverted L. [Steve Johnston, WD8DAS, photo]

to run up to 20 W EIRP. I doubt I will ever have a transmitter and/or antenna strong enough to approach that value, but knowing that antenna efficiency estimation is not perfect I didn't want to cut it too close. It was granted without question — call sign WH2XHY.

I operated my experimental station using common amateur emission modes such as CW, SSB, PSK, RTTY, Feld-Hell, and *WSPR* modes. I gathered listener reports of one-way CW and *WSPR* beacon transmissions, and established two-way communications with other experimental stations operating in this band.

WSPR mode is very popular with the amateur and experimental stations on 630 meters. The automatic reporting function using the **wsprnet.org** website is a great resource. The Weak Signal Propagation Reporter Network is a group of operators using K1JT's MEPT_JT digital protocol to explore propagation conditions on many amateur bands. Figure 4 shows a typical day of operation of my experimental 475 kHz station in *WSPR* mode. Figure 5 shows all the North American *WSPR* activity that day — you can see there were lots of reception reports even with only experimental stations transmitting in the United States.

Is 630 Meters Practical for Ham Use?

My experiments seem to indicate that a typical ham on a suburban lot can operate effectively on 475 kHz under the power restrictions planned. A medium power transmitter and a short antenna can produce reliable CW statewide coverage during the day and regional coverage at night. Continental coverage would be possible using more elaborate, computerized, negative signal-to-noise ratio modulation techniques.

One of the challenges many hams will face on 630 meters is receive interference from the "electronic pollution" all around us.[2] Consumer electronics produce noise across the spectrum, but the issue seems at its worst on the low and medium frequency bands. Switching power supplies running computers, cell phone battery chargers, and network routers are among the worst offenders, but in both my amateur and professional work, I've seen noise problems from nearly every sort of electronic and electric device at one time or another.

A portable, battery-powered AM broadcast receiver can be a very handy tool for tracking down such interference. For some years now I've been very diligent about keeping noise sources in my house to a minimum, but new noise sources appear regularly and sometimes the search has to be expanded to the larger neighborhood area to consider other homes and power lines.

Figure 4 — A typical day of *WSPR* mode operation of WH2XHY on the 630 meter band. [**WSPRnet.org**]

Figure 5 — All North American 630 meter *WSPR* mode activity on a typical day. [**WSPRnet.org**]

Summary

I've tried to keep the techniques I've used for this experiment very basic and not exceeding what would be "typical" for ham installations. My experience with experimental station WH2XHY in the 630 meter band has demonstrated that ham operation using practical rigs and suburban antennas *will* work on this band. Hopefully, an amateur allocation will soon be forthcoming from the FCC.

Notes

[1]S.K. Keane, K1SFA, "Happenings," *QST*, Feb 2013, p 82.

[2]S. Johnston, WD8DAS, "Local Radio Noise," *QST*, Mar, 2010, p 55.

Steve Johnston, WD8DAS, an ARRL member, started taking radios apart as a youngster and became a ham at age 13. He holds a BA in History and a Master's in Business Administration. A broadcast engineer for the past 30 years, Steve is Director of Engineering and Operations for Wisconsin Public Radio. In the rare hours not spent with radio and electronics, he pursues his other avocation as a writer and historian. He has been a ham for 38 years and lives in Madison, Wisconsin with his wife Christy, and two children, Kaitlin and Noah. You can contact Steve at **sbjohnston@aol.com**.