Practical 630-Meter Operation for the Average Radio Amateur

An experienced antenna builder demonstrates that it doesn't take a massive radiator or powerful transceiver to get on this underutilized ham radio band.

Paul Dobosz, K8PD

Ever since the 630-meter band was opened to US amateur use in March 2017, obstacles to transmitting and receiving have kept many hams from operating on this medium-wave band.

With the 475 kHz wavelength approaching half a mile, a simple end-fed half-wave or conventional dipole for this band would be more than 1,000 feet long, and shorter antennas, while possible, need extensive loading and a sizable tuning network that is well beyond what the typical HF tuner can handle. As for transceivers, the units most amateurs have can't transmit on 630 meters, and this lower power level is insufficient for normal operation, particularly when using a compact antenna with efficiency in the low single digits.

With these challenges in mind, I decided to use my previous experience developing compact vertical transmitting antennas for the AM broadcast band to see if those same design principles could be stretched to work on the 630-meter band.

A Series Resonant Antenna

A compact antenna could open 630 meters to urban and suburban amateurs. Electrically short antennas are not terribly efficient, but the 5 W effective isotropic radiated power (EIRP) limit for 630-meter operation makes an antenna with low efficiency a realistic choice.

Figure 1 — Paul's 22-foot ground-mounted vertical antenna with combined inductive center loading and capacitive top loading.

To operate legally, it is necessary to calculate the station's EIRP, which is highly dependent on the antenna. You'll need to know the transmitter's power output, transmission line loss in dB, and antenna system gain in dBi, or antenna efficiency percentage, to make that calculation. My experiments showed that a 22-foot ground-mounted vertical with inductive center loading and capacitive top loading, with a modest ground radial system of 32 radials 25 feet in length, would be a reasonable compromise between size and performance (see Figure 1). Modeling showed that this antenna had a gain of –15 dBi, equaling about 3% efficiency. The 15 – 20 W output from my modified transceiver resulted in an EIRP of about 0.5 W, well within the legal limit. For more information on how to calculate your station's EIRP, see section 3.3 of *The ARRL Handbook*.

Designing a short series resonant antenna is not without significant challenges. Due to relatively low radiation resistance, the feed-point impedance falls well below the 37.5 Ω of a quarter-wave vertical radiator. Electrically short antennas also have limited bandwidth, and efficiency is negatively impacted by the quality of the ground system and loading coil resistances, which are high compared to the low radiation resistance. The antenna's small size also

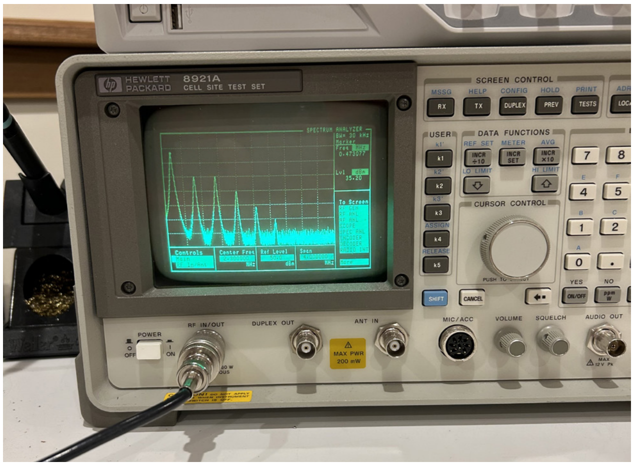

Figure 2 — Spectrum analysis of Paul's modified Icom IC-7300 HF transceiver. Without a low-pass filter, the transmission included harmonics falling both inside and outside of the amateur bands.

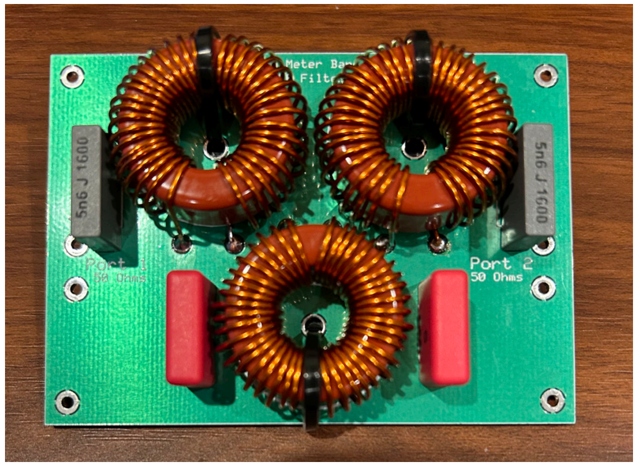

Figure 3 — Paul's assembled external 7th-order low-pass filter.

impacts receiving efficiency, but its narrow bandwidth combined with a low-pass filter improves the signal-to-noise ratio, allowing for decent reception.

While these shortcomings might be dealbreakers on other bands, the 5 W EIRP limit and 7 kHz-wide band make them manageable. With the addition of an efficient broadband impedance matching transformer, an electrically short but resonant antenna can be fed directly with 50 Ω coax and present a reasonably low SWR to the transmitter without a tuner.

Transceiver Options

Many popular HF transceivers have receive capability down to about 100 kHz and can be easily modified to transmit outside of the amateur bands; however, they aren't designed to operate there, and the transmitter's output signal won't come close to meeting the FCC rule that any spurious emissions must be at least 43 dB below the power of the fundamental frequency.

One solution is to use a transverter. The only one currently available for 630 meters is the Mini-Kits EME223-630M Kit from Australia (**https://minikits.com.au/eme223-630m**). The Mini-Kits transverter performs well, but it's a complex kit best suited to more advanced builders, and its output power (5 W) isn't ideal for a compact antenna.

My hope was to use the Icom IC-7300 HF transceiver I already owned without major modifications. While I used the IC-7300 for my experiments, it is likely that popular HF transceivers from other manufacturers would work in a similar manner. Because the 7300's receiver has coverage below 500 kHz and can transmit there with MARS modification, I decided to try it for both transmit and receive directly on the 630-meter band. The transmitter produced 10 to 20 W of RF output, but it included harmonics falling both inside and outside of the amateur bands, including the 160- and 75-meter bands and several places in the AM broadcast band (see Figure 2).

The resulting signal's ugly spectrum was not surprising, given the transceiver was operating well below the bottom of its design limits and without an internal low-pass filter following the final power amplifier. I experimented with filtering and found that adding an external 7th-order low-pass filter between the transceiver and the antenna dropped the unwanted harmonics into compliance with FCC requirements for spectral purity (see Figure 3). Above the second harmonic, the filter eliminated all spurious emissions. Component values for the filter were carefully chosen to present minimal SWR to a 50 Ω transceiver and antenna with negligible insertion loss and provide the FCC-required attenuation of harmonics (see Figure 4). An additional benefit of the filter was an added 40 dB of AM broadcast band receiver overload protection, as the attenuator, which normally switches on by default for overload protection below 1,800 kHz, needs to be turned off for 630-meter operation.

Putting It All Together

Daytime ground-wave contacts are possible on 630 meters, but most of the action happens just after dark and just before sunrise, taking advantage of nighttime skywave propagation. While most contacts — especially those made with compact antennas — will be with stations in North and Central America, stations with large antennas capable of reaching the full 5 W EIRP can contact stations in Europe, Japan, and Australia.

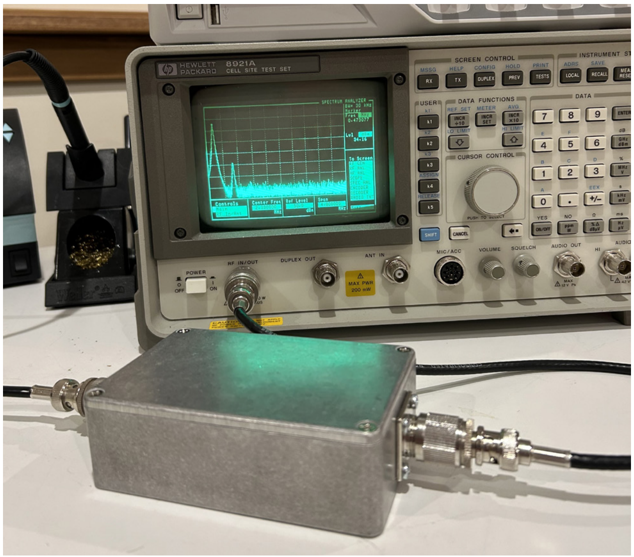

Figure 4 — Spectrum analysis of Paul's modified transceiver with the external low-pass filter installed. Note the attenuation of spurious emissions above the second harmonic.

Operation on this band is almost exclusively CW or digital (primarily FST4 and WSPR). The entire band is only 7 kHz wide; there simply isn't enough room for wider bandwidth modes.

I conducted a real-world test of my compact 22-foot vertical antenna, low-pass filter, and MARS-enabled IC-7300 transceiver on a summer evening. During a 2-hour operating session from my location in western Michigan, I completed 12 FST4 contacts, including contacts as far as New Mexico to the west, New York to the east, and Grand Cayman 1,650 miles to the south. There were no active stations on 630 meters that evening that I was unable to contact. Reception was also reported by stations that automatically monitor 630 meters and post their results on PSK Reporter.

Operation Is Within Reach

My experience shows that it doesn't take a huge antenna or homebuilt transmitter, amplifier, or transverter to enjoy operating on this underused amateur radio band — you can do it using much of what you already own. There isn't much activity on the 630-meter band currently, but I'm hopeful that will change. A commercial manufacturer has taken my experimental designs and now manufactures and sells the antenna, filter, and matching transformer (**https://theradiosource.com/products/antenna-630pd.htm**).

You don't need a powerful station to have a lot of fun on this band. Nobody on the band runs more than 5 W EIRP, so you're competing on a relatively level playing field. Operation on 630 meters is within reach.

UTC Registration

Note that, because the 630-meter amateur radio allocation is shared with electrical utilities that use 472 – 479 kHz or adjacent frequencies for power-line monitoring and control, registration with the Utilities Technology Council (UTC) is required before transmitting on the band. This is done by filling out a short form on the UTC website (**https://utc.org/plc-database-amateur-notification-process**). If the UTC does not respond within 30 days, the amateur station may begin transmitting on the band.

Visit **https://youtu.be/43TP3NHfXxU** to watch W1AW Station Manager Joe Carcia, NJ1Q, and ARRL Lab Digital RF Engineer John McAuliffe, W1DRF, walk through W1AW's experimental 630-meter station.

See *QST* in Depth for More!

Visit www.arrl.org/qst-in-depth for the following supplementary materials and updates:

- ✓ A schematic for the external 7th-order low-pass filter K8PD used in his build

All photos provided by the author.

Paul Dobosz, K8PD, was first licensed as a Novice in 1963 before earning his Amateur Extra license in 1978. He retired after a 37-year career as a member of General Motors' Engineering staff, and as a design engineer and advanced engineering manager for Delphi/Delco, working on antenna design and development, receiver design, electromagnetic compatibility engineering, and telematics design. Paul was inducted into Delphi's Innovation Hall of Fame in recognition of numerous design patents, intellectual property contributions, and awards received. He can be reached at **k8pdpaul@gmail.com**.

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