The Opposite of DX, p. 65

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COMMUNICATIONS & TECHNOLOGY

JUNE 2021

Take It To The Field Special

On the Cover: Jay Taft, K1EHZ, of Bedford, New Hampshire, with his solar-powered split-level "go-box" that doubles as a home VHF/UHF station. Story on page 10.

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ANNOUNCEMENTS

JUNE

BOGOTA, COLOMBIA — The Libertadores University Foundation and the Bogota Radio Amateurs League will air a special event stations 5J85FJR, 5J39FUL, and 5K48LRB from 0001 UTC, Tuesday, June 1 through 2359 UTC Tuesday, June 8 to promote the 2021 Los Libertadores University Foundation – LRB 2021 Certificate and contest. Frequencies include 80-10 meters using SSB, CW, and Digital. Email: <hk3ecoalfa@gmail.com>. Website: <www.qrz.com/db/5K48LRB>. Also see this issue's Awards column, p. 97.

FAIR LAWN, NEW JERSEY — The Fair Lawn Amateur Radio Club will hold its Hamfest beginning 8 a.m., Saturday, June 5 at the Fair Lawn Recycling Center, 19-25 Saddle River Road. Phone: (201) 791-3841. Email: <fairlawnarc@yahoo.com>. Website: <http://flarchamfest.com>. Talk-in 145.470- (PL 167.9).

HERMON, MAINE — The Pine State Amateur Radio Club will hold the 33rd Annual Hermon Hamfest beginning 7:30 a.m., Saturday, June 5 at the Hermon Mountain Ski Area, 441 Newburg Road. Contact: Jerry, K1GUP, <k1gup@roadrunner.com>. Website: <http://n1me.com>. Talk-in 146.940- (PL 135.5). VE exams.

HUDSONVILLE, MICHIGAN — The Hudsonville Independent Repeater Association will hold the 2021 Hudsonville IRA Hamfest from 8 a.m. to noon, Saturday, June 5 at the Hudsonville Fairgrounds, 5235 Park Avenue. Phone: (616) 541-4090. Email: <hamfest@w8ira.org>. Talk-in 147.16. VE exams.

TEDROW, OHIO — The Fulton County Amateur Radio Club will hold its Summer Outdoor Trunk Swap & Hamfest from 8 am. To 1 p.m., Saturday, June 5 at the Roth Family Woodlot 105 Hill Avenue. Contact: Bryan Patterson, KD8ELG, (419) 250-6694. Email: <kd8elg@hotmail.com>. Website: <www.k8bxq.org>. Talk-in 147.195+. VE exams.

BETHPAGE, NEW YORK — The Long Island Mobile Amateur Radio Club will hold the Long Island Outdoor Hamfest beginning 9 a.m., Sunday, June 6 at the former Briarcliffe College Parking Lot, 1055 Stewart Avenue. Contact Richie, K2KNB, (516) 694-4937. Email: <hamfest@limarc.org>. Website: <www.limarc.org>. Talk-in 146.850 (PL 136.5). DXCC / WAS card checking.

CHELSEA, MICHIGAN — The Chelsea Amateur Radio Club will hold its 41st Annual Ham Radio Swap 'n' Shop beginning 8 a.m., Sunday, June 6 at the Chelsea Fairgrounds, 20501 W. Old U.S. Highway 12. Contact: Michelle Dye, KD8GWX, (734) 717-5660. Email: <michelle-dye@redcross.org>. Website: <www.wd8iel.com>. Talk-in 145.450 (PL 100).

MEDOTA, ILLINOIS — The Starved Rock Radio Club will hold its Hamfest from 8 a.m. to 3 p.m., Sunday, June 6 at the Mendota Tri-County Fairgrounds, 503 1st Avenue. Email: <starvedrockhamfest@gmail.com>. Website: <www.w9mks.org>. Talk-in 147.120+ (PL 103.5). VE exams.

WORLDWIDE — Special event station K6K will be on the air from 6 a.m. to 10 p.m., (HST), Friday, June 11 to celebrate King Kamehameha Day. Any legal frequency may be used. Modes include SSB, FM, FT8, and Winlink. Only digital QSL accepted. Email: <k6khawaii@gmail.com>. Website: <https://sites.google.com/view/k6khawaii>.

CORTLAND, NEW YORK — The Skyline Amateur Radio Club will hold the SARC Summer Hamfest from 7 a.m. to noon, Saturday, June 12 at the Cortland County Fairgrounds, 4301 Fairgrounds Drive. Website: <http://skylineradioclub.org>. Talk-in 147.280+ (PL 71.9).

MANASSAS PARK, VIRGINIA — The Ole Virginia Hams Amateur Radio Club will hold its Ham Radio Tail Gate Party from 8 a.m. to 2 p.m., Saturday, June 12 at Signal Hill Park, 9300 Signal Vuew Drive. Website: <www.w4ovh.net>.

WORLDWIDE — The U.S. Islands Awards Program is sponsoring the First Annual U.S. Islands Special Event Week, which will begin 1200 UTC, Saturday, June 12 and run until 2100 UTC, Sunday, June 20. Chasers and activators are encouraged to activate as many U.S. islands as possible and earn awards and certificates. For more information and rules visit <http://usislands.org>. Email: <w4ybv@yahoo.com>.

KAUKAUNA, WISCONSIN — The Fox Cities Amateur Radio Club will hold the Sunshine Swapfest beginning at 7 a.m., Saturday, June 19 at the Starlite Club, W2091 County Road JJ. Contact: Anthony Mach, AB9IO, (920) 858-6300. Email: <hamfest@fcarc.club>. Website: <http://fcarc.club>.

KNOXVILLE, TENNESSEE — The Radio Amateur Club of Knoxville will hold its 54th Annual Hamfest from 8:30 a.m. to 3:30 p.m., Saturday, June 19 at the Kerbala Temple, 315 Mimosa Avenue. Contact: Lou Dreinhoefer, WB3JKQ, (865) 621-0715. Email: <ldreinho@att.net>. Website: <www.w4bbb.org>. Talk-in 147.300 (PL 100). VE exams.

PLYMOUTH, MINNESOTA — The Twin Cities FM Club will hold its Spring Tailgate Swap Fest beginning 8 a.m, Saturday, June 19 at the West Medicine Lake Community Club, 1705 Forestview Lane North. Contact AJ or Mike, <nopvc@outlook.com> or <trustee.tcfmc@gmail.com>. Website: <http://tcfmc.org>.

MONROE, MICHIGAN — The Monroe County Radio Communications Association will hold the Monroe Hamfest and Computer Show from 7:30 am. to 1 p.m., Sunday, June 20 at the Monroe County Fairgrounds, M-50 at Raisinville Road. Contact: Fred VanDaele, K8EBI, 4 Carl Drive, Monroe, MI 48162. Email: <ka8ebi@yahoo.com>. Website: <www.mcrca.org>. Card checking.

JULY

HARRISBURG, PENNSYLVANIA — The Harrisburg Radio Amateurs Club will hold its 50th Annual Firecracker Electronics Expo and Hamfest and 2021 ARRL Pennsylvania State Convention beginning 8 a.m., Saturday, July 3 at the Harrisburg Postal Employees Picnic Grounds, 1500 Roberts Valley Road, Contact: Terry Snyder, WB3BKN, (717) 896-0256. Email: <wb3bkn1@gmail.com>. Website: <www.w3uu.org>. Talk-in 147.075 (PL 123). DXCC / WAS /VUCC card checking.

PLAINS, PENNSYLVANIA — The Murgas Amateur Radio Club will hold the 42nd Annual Wilkes-Barre, Murgas ARC Hamfest and Computerfest beginning 8 a.m., Sunday, July 4 at the Polish American Veterans, 2 South Oak Street. Contact: Herb, K2LNS, (570) 829-2695. Email: <murgasarc@gmail.com>. Website: <http://hamfest.murgasarc.org>. Talk-in 146.61 (PL 82.5). VE exams.

MENDOTA, ILLINOIS — The Starved Rock Radio Club will hold the Amateur Radio Hobbyist & Collectors Show from 8 a.m. to 3 p.m., Sunday, July 6 at the Mendota Tri-County Fairgrounds, 503 1st Avenue. Email: <starvedrockhamfest@gmail.com>. Website: <www.w9mks.org>. Talk-in 147.120+ (PL 103.5).

INDIANAPOLIS, INDIANA — The Indianapolis Hamfest Association will hold the 50th Indianapolis Hamfest and 2021 ARRL Indiana State Convention from 2-7 p.m., Friday, July 9 and from 6 a.m. to 2 p.m., Saturday, May 10 at the Marion County Fair Grounds, 7300 East Troy Avenue. Phone: (317) 829-6868. Email: <wtakin@gmail.com>. Website: <www.indyhamfest.com>. Talk-in 146.76- (PL 151.4).

AUBURN, INDIANA — The Northeastern Indiana Amateur Radio Association will hold the Auburn Hamfest from 9 a.m. to 2 p.m., Saturday, July 10 at the Auburn Cord Duesenberg Museum, 1600 S. Wayne Street. Email: <w9ou@arrl.net>. Website: <www.w9ou.org>. Talk-in 147.015

CAMILLUS, NEW YORK — The Radio Amateurs of Greater Syracuse will hold the RAGS Hamfest 2021 from 7:30 a.m. to 12:30 p.m., Saturday, July 10 at the Camillus Elks Lodge #2367, 6117 Newport Road. Contact: Roger Hamilton, WA2AEW, <hamfest@ragsclub.org>. Website: <www.ragsclub.org>. Talk-in 146.91- (PL 103.5). VE exams

(Continued on page 110)

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HAM RADIO NEWS

New License Applicants Must Get FRN Before Taking Exam

As of May 20th, everyone taking an amateur radio license exam must provide examiners with their FCC Registration Number, or FRN, *before* taking the test. Current hams and other FCC licensees will already have one, but prospective amateurs must sign up for a number ahead of time. The process is simple: Go to the FCC's website at <https://tinyurl.com/njmmjjbv>, follow the prompts and fill out the form.

The ARRL notes that you will need this number after taking your test to log into the FCC website to print out your license, which the Commission no longer sends in the mail. In addition, as of June 29th, all amateur applications will be required to include a valid email address.

FCC Considers UHF / Microwave Ham Bands for Commercial Space Launch Frequencies

The FCC in April issued a Report and Order allocating spectrum in the 2200-to 2290-MHz range for private space travel and satellite launch companies to use for pre-launch testing and space launch operations. The order creates a non-federal secondary allocation for these uses in spectrum that is currently reserved exclusively for federal government use.

The action also includes a Further Notice of Proposed Rulemaking which seeks comment on possible additional spectrum for private space launch purposes. Among the frequencies specifically mentioned are 420-430 MHz in the 70-centimter amateur band and 5650-5925 MHz, which is the 5-centimeter ham band. Amateur radio has a secondary allocation in each of these bands, and the NPRM made no mention of the bands' current occupants and/or whether they would be displaced. The 5.6-GHz band is already shared widely with home Wi-Fi networks.

FCC Repeats Warning: Don't Use Radio for Illegal Activities

The FCC has reminded amateurs and users of other personal radio services that it is illegal to use radios in those services "to commit or facilitate criminal acts." A similar notice was issued on January 17th in the wake of the insurrection at the U.S. Capitol and in advance of the presidential inauguration on January 20th. There was no indication in the April 20th "reminder" as to what prompted its issuance, as no major national events were scheduled around that time.

Volcanic Eruption Prompts Call for Clear Frequencies

The ongoing (at press time) eruption of the La Soufriere volcano on the Caribbean island of St. Vincent has prompted a request to keep two HF frequencies clear for volcano-related traffic. According to the ARRL, the Caribbean Emergency and Weather Net has been on the air continuously since the eruption began in mid-April, using a combination of linked VHF repeaters and the HF frequencies of 3.815 and 7.188 MHz. The net is asking all amateurs who are not involved with the volcano response to keep these frequencies clear.

ARRL and American Red Cross Renew Agreement

The ARRL's Amateur Radio Emergency Service (ARES) and the American Red Cross have had a close working relationship for decades as ARES members provide communication back-up for the Red Cross during disaster responses. The League and the Red Cross have just renewed their formal *memorandum of understanding* which lays out the parameters of their cooperation for another five years. According to the *ARRL Letter*, the renewed memorandum calls on both parties to "maintain open lines of communication and to share information, situation and operation reports, as allowed to maintain confidentiality." The agreement also calls for local ARES and Red Cross units to jointly discuss plans for local disaster response and relief, for the groups to cooperate in joint training exercises and for Red Cross chapters to participate in ARRL exercises such as Field Day and the annual Simulated Emergency Test (SET). Hams are also reminded that if they wish to become Red Cross volunteers in addition to ARRL volunteers, they must undergo the Red Cross's standard volunteer background check.

Friedrichshafen Goes Virtual

Last month, we reported that the annual "Ham Radio" show in Friedrichshafen, Germany — Europe's largest hamfest — had once again been cancelled due to the ongoing COVID-19 pandemic. The show's sponsors now report that the event will be held online from June 25-27, dubbed "Ham Radio World." It will include presentations and discussions on various ham radio matters. Attendees will be represented as customizable avatars that will be able to move around the convention "grounds," visiting booths and attending seminars. Admission will be free. For more information, visit <www.hamradio-friedrichshafen.de>.

Also cancelled for this year is the European Youngsters on the Air (YOTA) summer camp, planned for Croatia. The YOTA group is instead holding a series of online workshops for young hams. On this side of the Atlantic, plans remain in place to hold a COVID-safe, in-person Youth on the Air camp in Ohio this July. See "News Bytes" on page 9 of this issue for details.

Hara Arena Now Officially a Pile of Rubble

The former home of the Dayton Hamvention has been demolished to make way for redevelopment. The *ARRL Letter* reported in early May that piles of rubble are now all that is left of Hara Arena, which was home to Hamvention from 1964 until it closed in 2016. The buildings were severely damaged by a tornado in 2019 and then considered beyond repair. A YouTube video of the current arena site may be viewed at <https://tinyurl.com/f8ctxusy>.

Milestones: More Work for N9JA, Honors for N1UL

ICOM America has announced that Amateur Division Senior Sales Manager Ray Novak, N9JA, will now be responsible for overseeing the company's Marine and Avionics Division as well. The move comes with the departure of Marine and Avionics senior sales manager David McLain. ICOM says Novak will continue working from the Dallas-Fort Worth area. *Congrats to Ray from CQ.*

Across the Atlantic, the German government has bestowed the Order of Merit of the Federal Republic of Germany on Ulrich Rohde, N1UL/DJ2LR. Rohde, who lives in the U.S., is a pioneer in software defined radio (SDR) and co-owner of the Munich-based Rohde & Schwarz company. *Amateur Radio Newsline* reports that the honor came in recognition of his contributions to the advancement of microwave and high-frequency radio. He is a 2004 inductee into the CQ Amateur Radio Hall of Fame.

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TAKE IT TO THE FIELD SPECIAL: Our Annual Take it to the Field Special celebrates those hams who don't like staying cooped up inside. CQ applauds these intrepid hams who brave the elements and push their equipment to the extreme. Read about their exploits on pages 10, 18, 23, 36, 43, 46, 65, and 70.

FEATURES

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* Photo shows the FTDX101MP

*1 3DSS: 3-Dimensional Spectrum Stream *2 ABI: Active Band Indicator *3 MPVD: Multi-Purpose VFO Outer Dial

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ZERO BIAS: A CQ Editorial

BY RICH MOSESON,* W2VU

Back in the Field and Bands at Risk

As we go to press with our annual "Take it to the Field" special, we are thankful that most of us who wish to can once again look forward to taking our stations "to the field" in places beyond our backyards. With the widespread distribution and incredible effectiveness of the various COVID-19 vaccines, restrictions on outdoor gatherings and outdoor mask-wearing requirements are being loosened and more of us will once again feel comfortable operating from the great outdoors. Guidelines will still vary from place to place, depending on transmission rates and other factors, so the ARRL is extending its temporary OK for home stations to work each other for credit in this year's Field Day, but it's looking right now like many clubs will once again be able to gather in person for ham radio's premier outdoor social event and emergency communications exercise (it's not a contest, per ARRL). We also expect to see more rovers on the air in both the ARRL (June) and CQ (July) VHF contests. In other words, things appear to be starting to return to normal in ham-land.

Even if you haven't tried outdoor operating before, this is a great time to start (haven't you been cooped up inside long enough?). And of course, we're here to help you mix ham radio into your outdoor activities.

KØNEB has a kit in his column this month that can fit in your pocket, and K1JD has a 3-band no-tune antenna that weighs less than a pound. If you aren't planning to go backpacking, check out our cover story on K1EHZ's solar-powered VHF/UHF go-box that's built to function as a home station as well. The gear is attached to two levels of clear acrylic that can just be lifted out of the case and set on a shack table for home use. We also take you to Iowa for a look at a Winter Field Day operation by KØDAS and friends, and on a mini QRPxpedition to an island on the coast of Florida. Plus, we've got projects and a look at using NVIS — near vertical incidence skywave — in a statewide emergency communications drill. And your outdoor fun needn't be limited to HF. VHF/UHF antennas can be small and easily portable, and KOØZ writes this month about a 6-meter loop that can be set up on a tripod if you take it hilltopping to take advantage of summertime sporadic-E on the "magic band."

If operating outdoors isn't your thing, we have the results of the 2020 CQ DX Marathon, a circuit for charging supercapacitors to use as power sources, a look at frequency-selective surfaces, and an introduction to the newest member of "Analog Adventures" editor KL7AJ's "family" (it must get really lonely up in interior Alaska!). There's more, of course, just waiting for you to discover it as you make your way through this issue.

Use It or Lose It …

Amateur radio and the space program have kind of grown up together over the past half-century and the relationship has been pretty close. Many hams have worked for NASA (and still do), and many — if not most — astronauts hold amateur licenses and participate in the Amateur Radio on the International Space Station (ARISS) program while on orbit. But as the space business becomes more commercial, some of "our" UHF and microwave frequency allocations may be in jeopardy. WA5VJB notes in his Antennas column this month that NASA's Ingenuity helicopter that's currently flying around on Mars is communicating on 902 MHz, also known as the 33-centimeter ham band. Not much of a problem in this case, but there's more. In late April, the FCC issued a Report and Order providing an allocation at 2200 MHz for private space travel and satellite launch companies to use for pre-launch testing and launch operations. It also asked for comment on possible additional frequencies for commercial launches, including 420-430 MHz and 5650-5925 MHz. You may recognize these as the 70-centimeter and 5-centimeter ham bands. Well, sort of.

When looking for spectrum to accommodate growing needs of varying interests, the FCC is naturally more likely to go after lightly-used bands than heavily-used ones.

You see, all amateur allocations above 225 MHz are secondary (yes, even 70 centimeters) to federal government users. Generally, there's been "peaceful coexistence" with any potential QRM issues handled locally on an as-needed basis. The FCC said nothing in its Notice of Proposed Rule Making about removing or restricting amateur access to these frequencies, but it's pretty much a given that — at minimum — amateur usage would be very limited within a certain proximity of private launch facilities should these allocations be approved. At worst, we would lose access to these bands altogether, as is the case with the 3.3-GHz (9-centimeter) band, which is in the process of being reallocated for 5G wireless networks and "intelligent" vehicle communications.

There's a reason these frequencies are vulnerable … we don't use them enough. Even on 70 centimeters, the most-used VHF/UHF band after 2 meters, the vast majority of the activity is on the 440-450 MHz repeater segment, followed by weak-signal and satellite activity between 430 and 440 MHz. There is very little action in the 420-430 segment and the FCC knows it. Same goes for 5.6 GHz, despite the fact that we already share portions of it with 5-GHz Wi-Fi and reasonably-priced equipment is available for amateur networking with minimal (or no) modifications.

When looking for spectrum to accommodate growing needs of varying interests, the FCC is naturally more likely to go after lightly-used bands than heavily-used ones. Fewer users will be displaced; fewer people will object. Bottom line: More hams need to make more use of our UHF and microwave bands for more "ham stuff" or we will continue to face threats to these allocations in the future. They're great for "taking it to the field," especially for ad-hoc mesh networks, satellite activity, and EME (or maybe even listening in on the Ingenuity helicopter … after all, Mars IS line-of-sight from Earth).

– 73, Rich, W2VU

*Email: <w2vu@cq-amateur-radio.com>

NEWS BYTES

Youth on the Air Camp 2021 Scheduled to Proceed

After being postponed in 2020 due to the COVID-19 pandemic, the first Youth on the Air Camp in the Americas is on track for mid-July in Ohio. It will provide a wide variety of ham radio experiences for up to 30 young amateurs from throughout North, Central, and South America. At press time, 28 of the 30 slots were already filled. Additional applications were being accepted through June 1st.

The camp is scheduled for July 11-16th at the National Voice of America Museum of Broadcasting outside Cincinnati. It is modeled after the very successful Youngsters on the Air camps in International Amateur Radio Union Region 1, encompassing Europe, Africa, and the Middle East and is supported by IARU Region 2 (the Americas).

Planned activities include workshops on contesting, VHF/UHF digital modes, kit-building, antenna-building, amateur radio direction finding, and satellite operating. Campers will also operate a special event station, K8Y, from the VOA museum.

According to organizers, the camp will comply with COVID-19 restrictions and guidelines as set by the state of Ohio and the Centers for Disease Control, such as requiring the use of masks, distancing, and sanitizing stations. Some scheduled activities may have to be substituted. Attendees may be asked to take a COVID-19 test and/or self-quarantine prior to arrival, depending on the recommended guidelines in effect in July. The entire staff of the camp will have been fully vaccinated by the time it begins. Most volunteers have also indicated that they are fully vaccinated.

The cost of the camp is $100 plus transportation to and from the VoA museum, with scholarships available to those for whom the $100 fee will be a burden. Due to the volatility of the public COVID-19 response, attendees are highly encouraged to avoid non-refundable tickets for transportation to Cincinnati.

Tax-deductible donations from the broader ham community are welcome via PayPal or GoFundMe.

For details about the camp or making a donation, visit <https://youthontheair.org/cincinnati-2020>. For additional information, please contact Camp Director Neil Rapp, WB9VPG, at <director@youthontheair.org>.

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A Split-Level VHF/UHF Go-Box Plus Base Station

BY JAY TAFT,* K1EHZ

Over time, my VHF/UHF go-box has been re-configured according to changes in technology, communication requirements, and operating preferences. As I thought about updating it again, I studied online sources such as <shack-in-a-box.com> to decide how to balance the inevitable trade-offs. I wanted to use it both as a base station at home and as a portable station for Amateur Radio Emergency Service activities in the Greater Manchester, New Hampshire area <http://gmares.org>. I ended up with a split-level arrangement which allows me to just lift everything out for home use when I'm not taking it portable. *Photo A* shows the updated go box (orange box), laptop, and solar panel ready to use.

Photo A. Completed go box with solar power, laptop, and coaxial dipole antenna ready to use. (Photos by the author, except as noted)

Capabilities

I had in mind maximum flexibility for voice, Narrow Band Emergency Messaging System <www.arrl.org/nbems>, Winlink Global email <winlink.org>, cross-band repeating, position reporting, and remote computer access through a Raspberry Pi in the go-box. I also planned to use a laptop computer connected directly to a sound card to function as a Winlink RMS gateway or digital repeater for Winlink packet and VARA FM modes (VARA is a Winlink weak-signal digital mode in HF and VHF versions. It can achieve data rates comparable to Pactor without violating the 300-baud FCC constraint on HF ham bands.). A GPS receiver for the Raspberry Pi provides accurate time and position reporting by Winlink. A separate terminal node controller (TNC) and GPS receiver provide position reporting by the 2-meter Automatic Packet Reporting System.

Equipment On-Hand

A major consideration was using items on-hand as much as possible to manage costs. I had a Kenwood TM-V71A transceiver (3.6 pounds) and a SignaLink sound card for digital modes from the previous go-box. A Byonics TinyTrak4 TNC and GPS receiver for APRS were not otherwise being used. There was Pelican 1450 case (5.5 pounds) from another project. There was also a Raspberry Pi computer with an early version of the Digital Radio Amateur Work Station hat (DRAWS <nwdigitalradio.com>) sitting around unused. These became the core components. A coaxial dipole antenna, a

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folding 100-watt solar panel with a Buddipole Powermini2 charge controller and cables rounded out the portable kit.

Power

The previous go-box had both a 12-volt DC power supply and a heavy 17-amp-hour (Ah) sealed lead-acid (SLA) battery for backup. I explored using a higher capacity lithium iron phosphate (LiFePO4) battery with a small charger to reduce weight and eliminate the 12-volt power supply. LiFePO4 batteries maintain voltage until nearly discharged, and have overall energy efficiency approaching 90% compared to SLA batteries at about 70%. A 20-Ah SLA cost $40 and weighs about 13 pounds. The 20-Ah LiFePO4 battery with charger is half the weight of the SLA. LiFePO4 batteries are said to sustain about 7 times as many charge-discharge cycles as SLA batteries. The long-term cost of 7 SLA batteries would be about $280. I settled on a Bioenno 20-Ah battery (5.5 pounds, $193) with a compatible 14.6-volt 4-amp charger (1 pound, $25), so I came out ahead in the long run.

Case Integrity

The second consideration was whether or not to make holes in the case for antenna and power connections. I decided to maintain case integrity and keep connections inside, since the lid has to be open to operate anyway. This approach has a nice benefit. With no connections to the case, the whole assembly can be lifted out easily for use as a base station at home.

Radio Configuration

Two levels would be needed to fit everything in the case, so the third consideration was whether to separate the control head from the radio, placing the main radio on the lower level and the control head on the upper level. Putting the radio on the lower level creates additional wiring, audio, and cooling complexity. I decided the simpler approach would be mounting the radio on the upper level.

Materials

For the interior platforms, I used acrylic which is easily cut and drilled with my woodworking tools. I chose an 18- x 24- x 0.22-inch sheet ($30) from the local home center which is enough for two levels with some left over to practice drilling. I used the foam liner from the Pelican case lid as a pattern to cut the acrylic. The case is slightly tapered so the upper level was cut first, then the lower level was cut slightly smaller. Edges were trimmed and corners rounded to fit snugly in the case.

The levels were connected at each corner with 6-inch-long 1/4-20 zinc-plated bolts. The 6-inch bolts just fit the case depth, preventing the assembly from shifting when the lid is closed. For initial construction I used regular 1/4-20 nuts for easy adjusting while figuring out exact equipment placement and distance between levels. For final assembly I used 1/4-20 nuts with nylon locking inserts (<boltdepot.com>, 100 for $3) and zinc-plated washers at all acrylic contact points.

I also had a Think Tank lid organizer from a photography case that I wanted to incorporate for holding a clipboard, writing pad, pens and pencils, and other items. The organizer is intended to go inside the lid, but it didn't fit depth-wise with the equipment installed. I mounted it on the outside using the provided tape

Photo B. Equipment placement on the upper level.

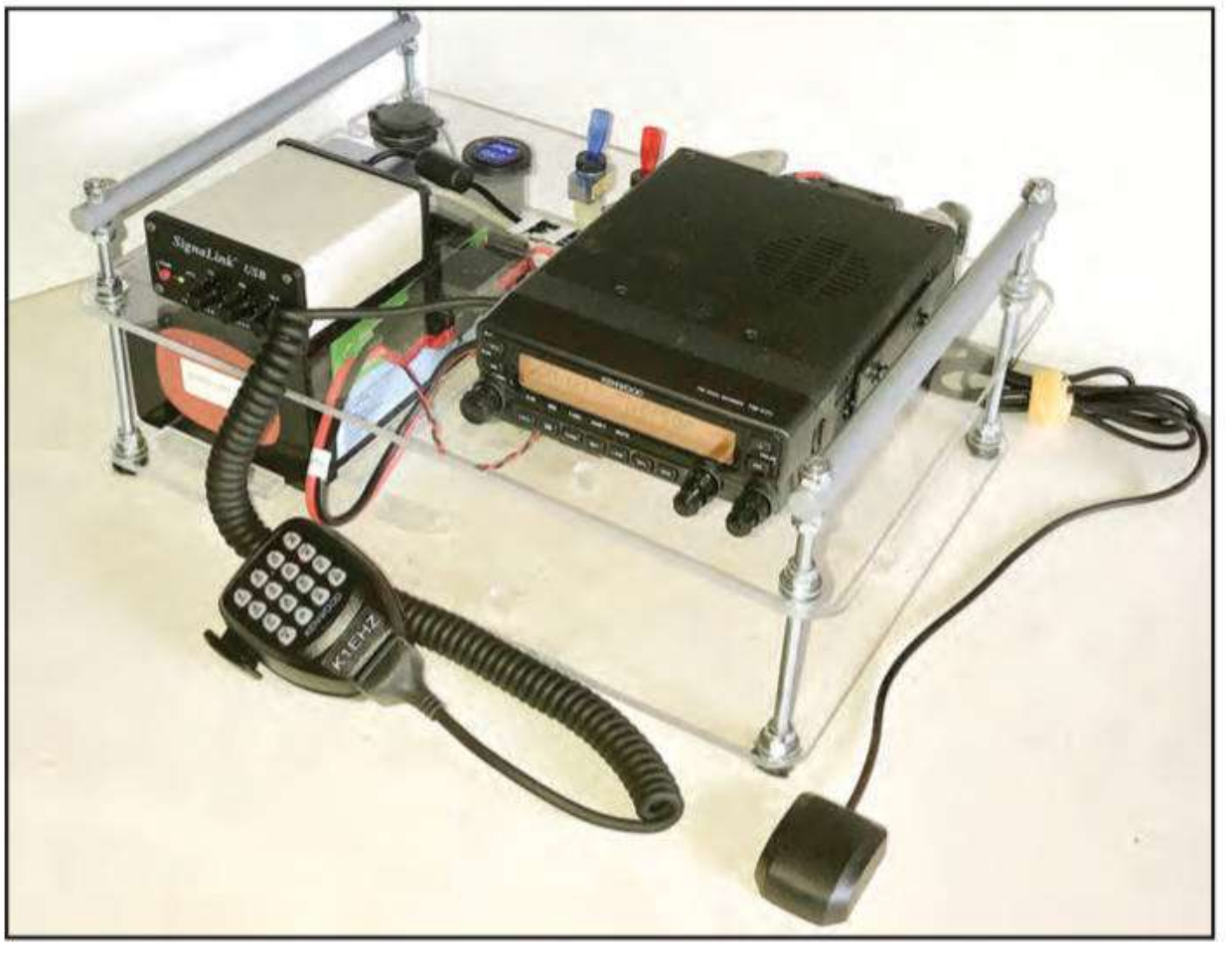

Photo C. Partially completed assembly (Note corner bolt configuration).

Photo D. Wiring on the underside of the upper level.

supplemented with heavy duty Velcro®. Hopefully, it will last if I am not too rough on it.

Layout

Photo B shows the upper-level equipment layout. The radio is secured with aluminum brackets cut from right-angle stock. The SignaLink, Raspberry Pi, TNC, and GPS antennas are fastened with Velcro®. The mic hanger is fastened with 6-32 machine screws and nuts with nylon locking inserts. It is oriented with the prongs pointing forward so the mic is secure when the case is carried by the handle. Powerpole connections are made with a six-position block secured to the underside of the upper level, below the mic, again with Velcro. The radio, Raspberry Pi, and TNC are powered from the six-position Powerpole block.

With the radio on the upper level and the battery below (*Photo C*), it made sense to concentrate power wiring on the underside of the upper level (*Photo D*). This facilitates assembling as well as separating the levels when necessary. Small strips of acrylic were glued to the lower level at each end and inner side of the battery to prevent shifting (*Photo E*). The upper-level platform is snugged down on the top of the battery just enough to stabilize the battery without bending the acrylic sheets. This arrangement leaves enough space between the levels to accommodate the Raspberry Pi, TNC, battery charger, coaxial dipole antenna, and solar panel charge controller.

The battery charging connector passes through a slot in the left side of the top level. The power cable for the radio, the cable from the Raspberry Pi to the SignaLink, and the GPS cables pass through a slot in the back of the top level

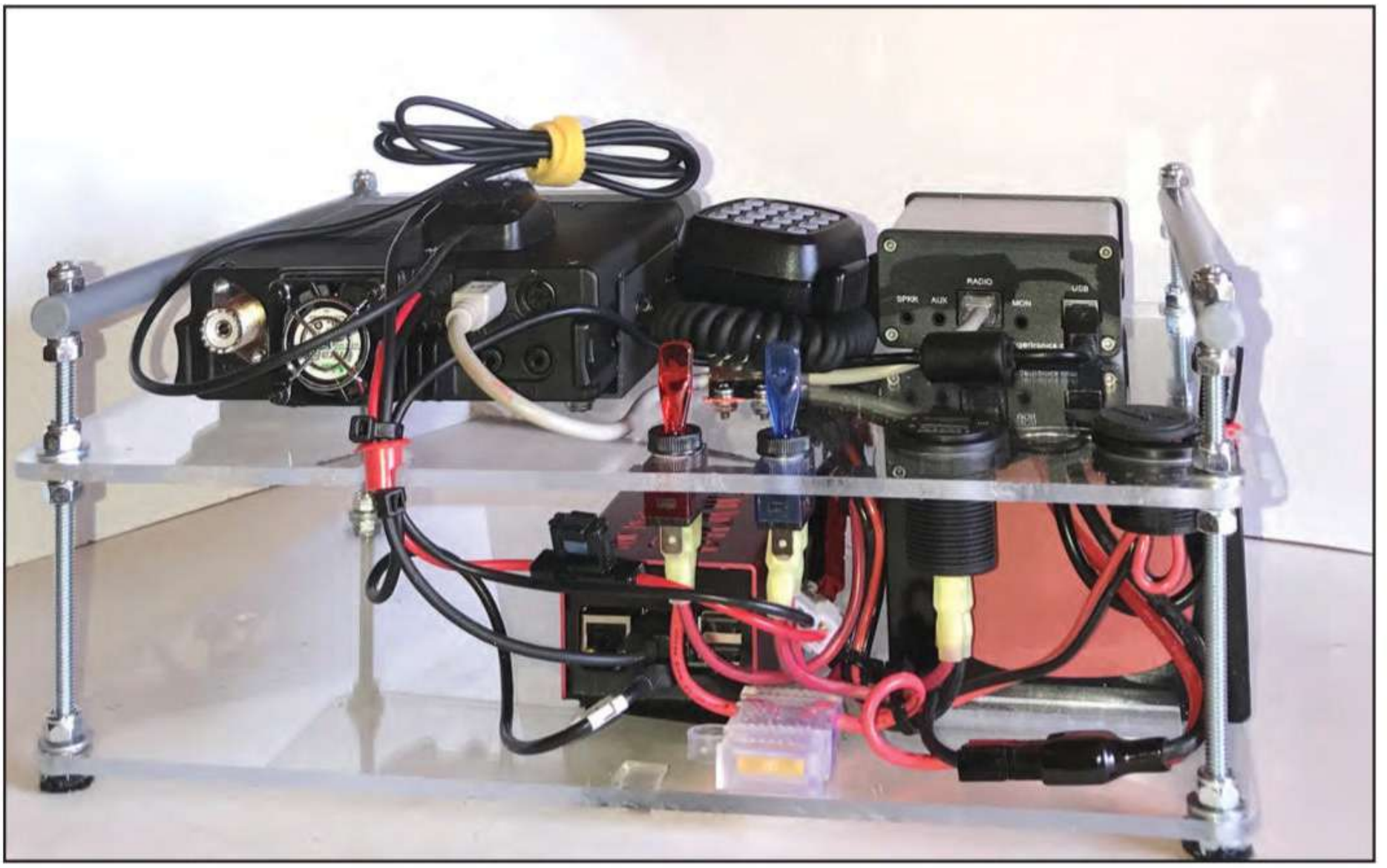

Photo E. Rear view of the assembly.

Photo F. Front view of the assembly showing the battery on the left lower level and radio on the right upper level to help balance the weight for carrying. The battery charger is stowed behind the TinyTrak4 TNC.

(*Photo E*). The two-position Powerpole port on top next to the meter can be used for additional connections and for charging the battery with a solar panel. The red automotive toggle switch is the master power switch for the system. There is a 20-amp fuse in line from the battery positive terminal to the switch. The blue toggle switch controls the volt-amp meter.

One small challenge was making a short cable connecting the SignaLink to the radio. I cut one end from a long cable with 6-pin mini-din connectors on each end. I attached an RJ-45 plug intending to make a standard cable for the TM-V71A radio. Although I studied the pin-outs at both ends, the RJ-45 configuration was wrong and the cable didn't work. A second try was a slight improvement but not 100% successful. So as not to shorten the cable any farther, I re-arranged the jumpers in the SignaLink to correct the configuration. Not totally satisfying but practical.

When the interior assembly was finished, I realized there was space for handles (*Photos E* and *F*). I found a piece of 1/2-inch PVC rod, left over from an antenna project, long enough for two handles. I stuck small squares of loop fabric from Velcro scraps to the bolt heads on the bottom of the assembly to minimize sliding and scratching when the assembly is out of the case. I also

Photo G. Solar controller, battery charger, and coaxial dipole stowed between levels.

added stick-on plastic feet under the battery and elsewhere on the bottom to minimize sagging of the acrylic over time. The battery charger, solar controller, and coaxial dipole antenna fit between the levels (*Photo G*).

Battery Capacity: The TM-V71A consumes 0.5 amps on receive, 8 amps on high transmit power (50 watts), 4 amps on medium (10 watts) and 2.7 amps on low (5 watts) into a dummy load. Typically, the system would be operated on mains with the 4-amp charger connected. Powered by battery alone it lasted almost 40 hours on receive at 0.5 amps with short periodic transmissions on high power (*Figure 1*). These results confirm that 20Ah are available from the Bioenno battery.

Raspberry Pi: The Raspberry Pi computer (Model 3B+) has a DRAWS hat which includes a 12- to 5-volt converter, a real-time clock, a GPS chip, and a quality sound card for 1200 baud and

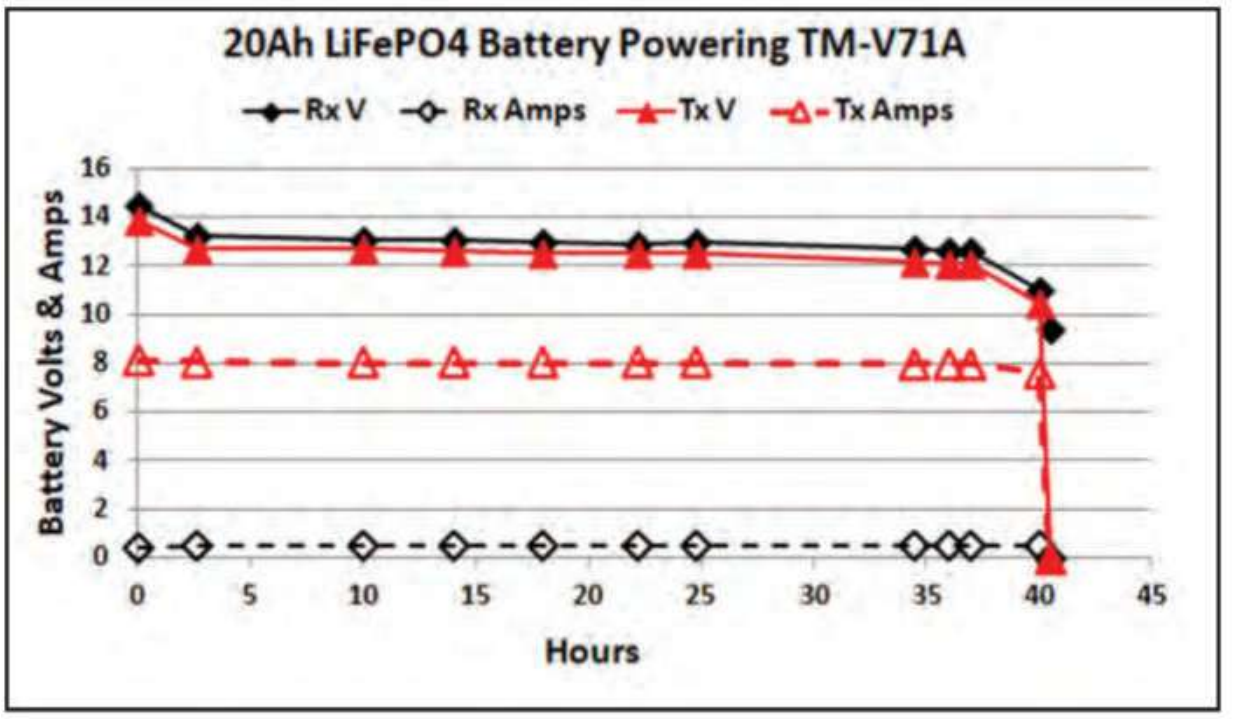

Figure 1. LiFePO4 battery voltage and current measured periodically over 40 hours to confirm 20-Ah battery capacity, using constant receive load at 0.5 amps with periodic transmit load at 8 amps.

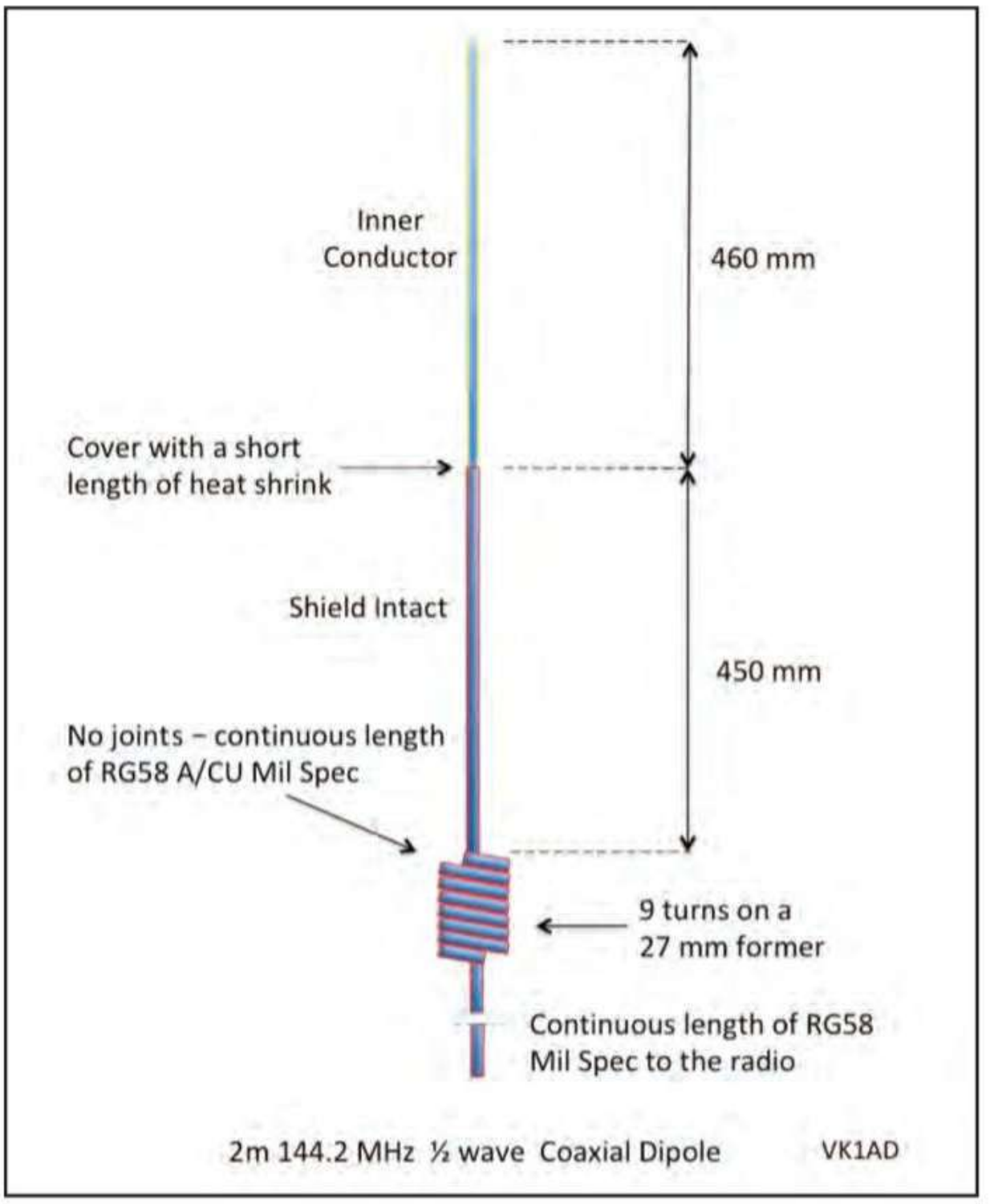

Figure 2. Coaxial dipole for 2 meters by VK1AD. (Source: <https://tinyurl.com/3e5vwkxx>).

9600 baud packet. The DRAWS aluminum case helps with RF shielding. The 12- to 5-volt converter is being used for power. As my Linux skills improve, I plan to take advantage of more DRAWS capability.

For now I am using the excellent Build-a-Pi software package assembled by Jason Oleham, KM4ACK, <https://github.com/km4ack/pi-build>. It contains a variety of programs such as a hotspot, NBEMS software suite, and Pat Winlink with VHF packet and HF ARDOP modes. Many video tutorials are available to help get the system going.

I use a laptop computer with VNC Viewer <www.realvnc.com> to access programs through the Raspberry Pi's built-in W-Fi / hotspot. The VNC Server program is included with the Raspberry Pi OS. The laptop is connected directly to the SignaLink sound card to use Winlink programs not available on the Raspberry Pi OS.

GPS: A small GPS dongle works outdoors. A GPS receiver with a low-noise amplifier (LNA) provides greater sensitivity and a cable for placement flexibility. Alternatively, GPS data from a smart phone can be streamed to the Raspberry Pi with an appropriate app. Online videos by Jason Oleham, KM4ACK, cover these topics. After considering the possibilities, I decided on an LNA receiver for the Raspberry Pi. Byonics.com sells a compatible GPS receiver for the TinyTrak4 TNC.

Portable Antenna

I made a roll-up, half-wave coaxial dipole from the VK1AD design (*Figure 2*) using 20 feet of RG-58 that was lying around <https://tinyurl.com/3e5vwkxx>. Similar to the illustration,nine turns of the coax was wound on a 1-inch OD PVC pipe 3 inches long, starting 18 inches from the point where the center conductor emerges from the shield.

Checking it Out

Coaxial dipole SWR was measured with a Diamond SX-600 SWR/Power meter. SWR is below 2:1 across the 2-meter band (*Figure 3*), and 2:1 or less in the upper part of the 70-centimeter band (*Figure 4*). EZNEC <www.eznec.com> calculations for a simple 2-meter vertical dipole 8 feet above ground shows radiation peaks and nulls for both bands. The most effective radiation for line-of-sight communication would be low-angle peaks such as those at 9° elevation with 2.5dBi — on 146 MHz (*Figure 5*), and at 4° elevation with 7-dBi gain on 446 MHz (*Figure 6*).

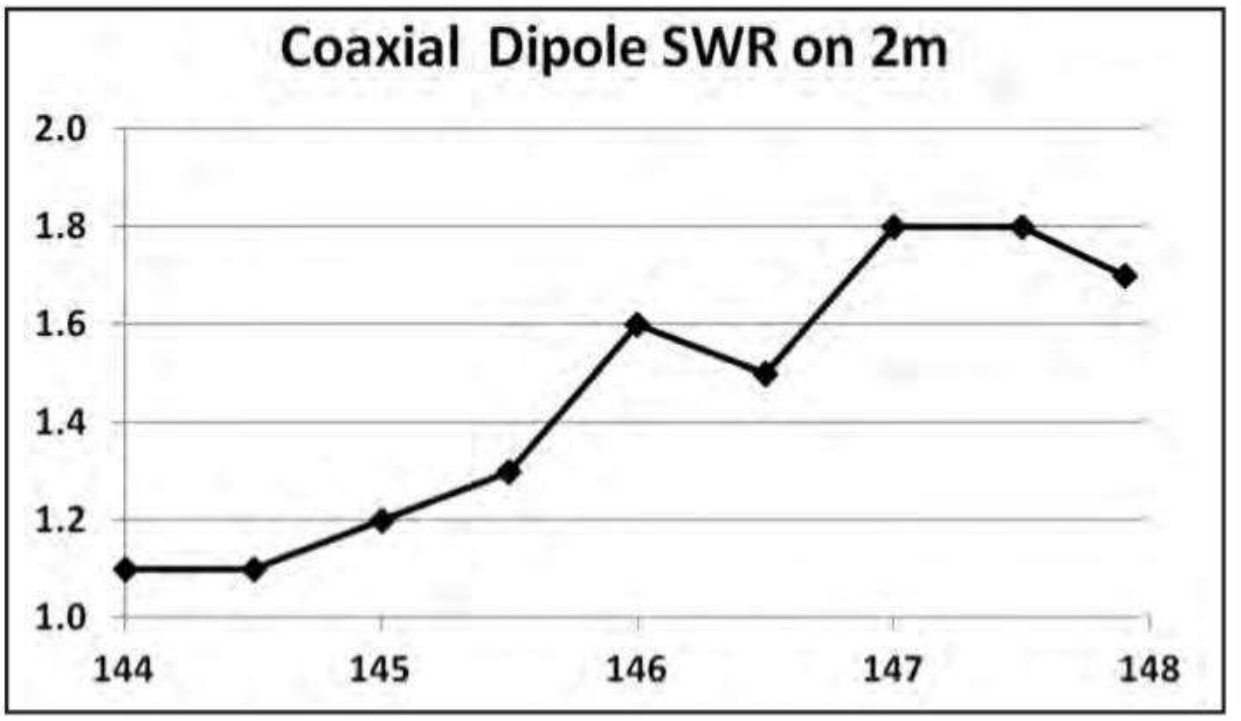

Figure 3. Coaxial dipole SWR measured by transmitting on the 2-meter band.

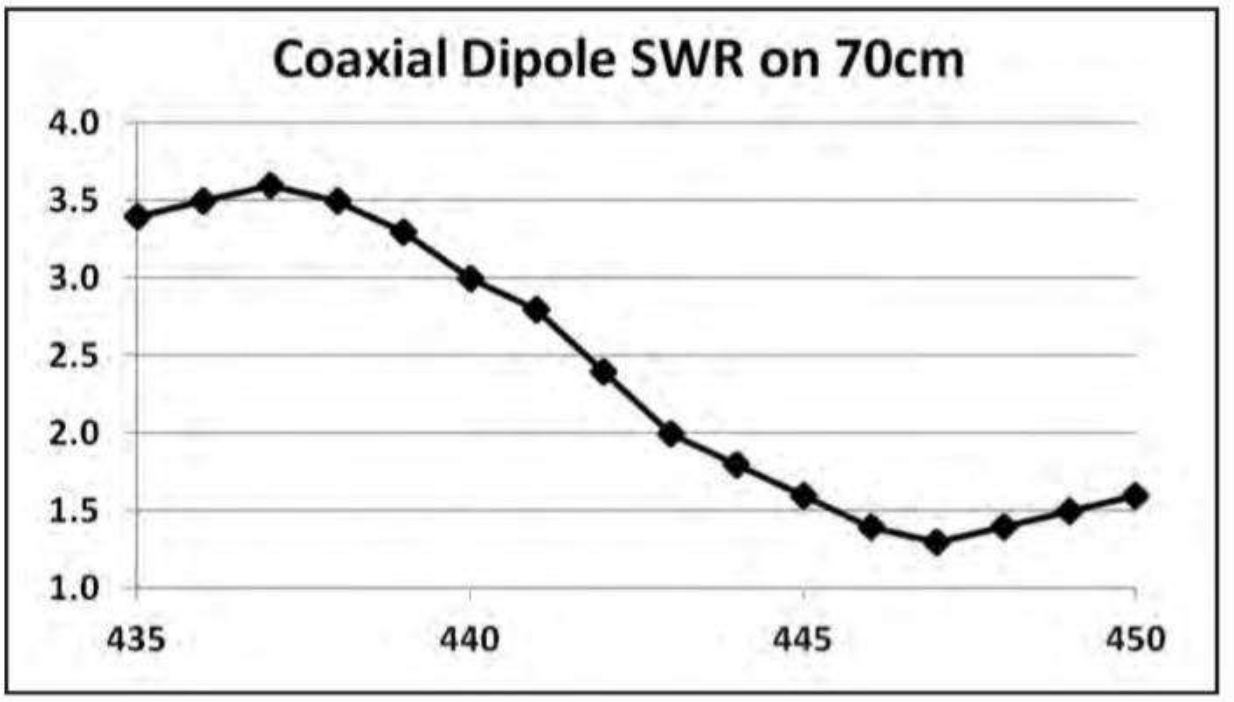

Figure 4. Coaxial dipole SWR measured by transmitting on the 70-centimeter band.

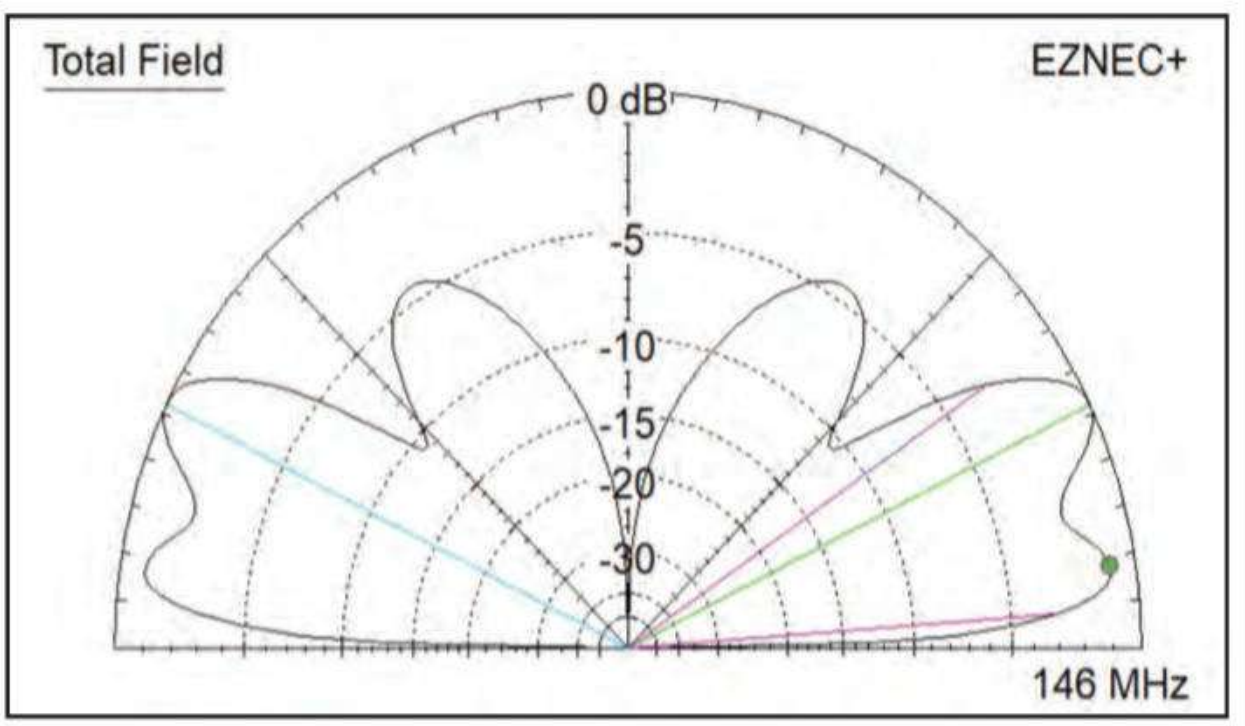

Figure 5. EZNEC model calculation of 146-MHz radiation elevation angles and gain for a simple 2-meter vertical dipole. Lowest radiation angle is 9 degrees at 2.5-dBi gain.

Once the antennas were tested, I moved on to the other station elements. After testing the battery capacity, I tested the entire go-box in the loft over the garage near a south-facing window. A 100-watt fold-up solar panel was placed on the ground below. The coaxial dipole was suspended from a rafter. I accessed the go-box over Wi-Fi from the house. Using 5 watts, I checked Winlink email several times a day through an RMS packet gateway 9 miles away. I also participated in ARES NBEMS simplex training nets using 5 to 50 watts.

The coaxial dipole was tested further by transmitting NBEMS mode MT63-2KL with 5 watts over an 11-mile path. Signal-to-noise ratio at the receiver was +18 dB on 2 meters and +16 on 70 centimeters. A test on 70 through a repeater 20 miles away was also successful. The coaxial dipole cut for 2 meters works on the 70-centimeter third harmonic. These results are consistent with the possibility of peaks occurring at low radiation angles as previously calculated by EZNEC. Many thanks to Steve Nelson, WA1EYF, and Ken Geddes, N1KWG, for assisting with on-air evaluations.

Summary

The updated go box is a functional base station at home. Combined with a laptop computer, coaxial dipole antenna, and compact 100-watt solar panel with a charge controller, it also provides a lot of flexibility as a portable station for ARES. The Raspberry Pi can be accessed remotely by computer, tablet, or smartphone. A small TNC is included for APRS. The go-box came together using mostly on-hand equipment plus a LiFePO4 battery upgrade. The battery charger, coaxial dipole antenna and solar charge controller store easily between the levels. The case is a compact 17 x 13 x 8 inches, and the entire package weighs a manageable 23 pounds with a comfortable handle (*Photo H*).

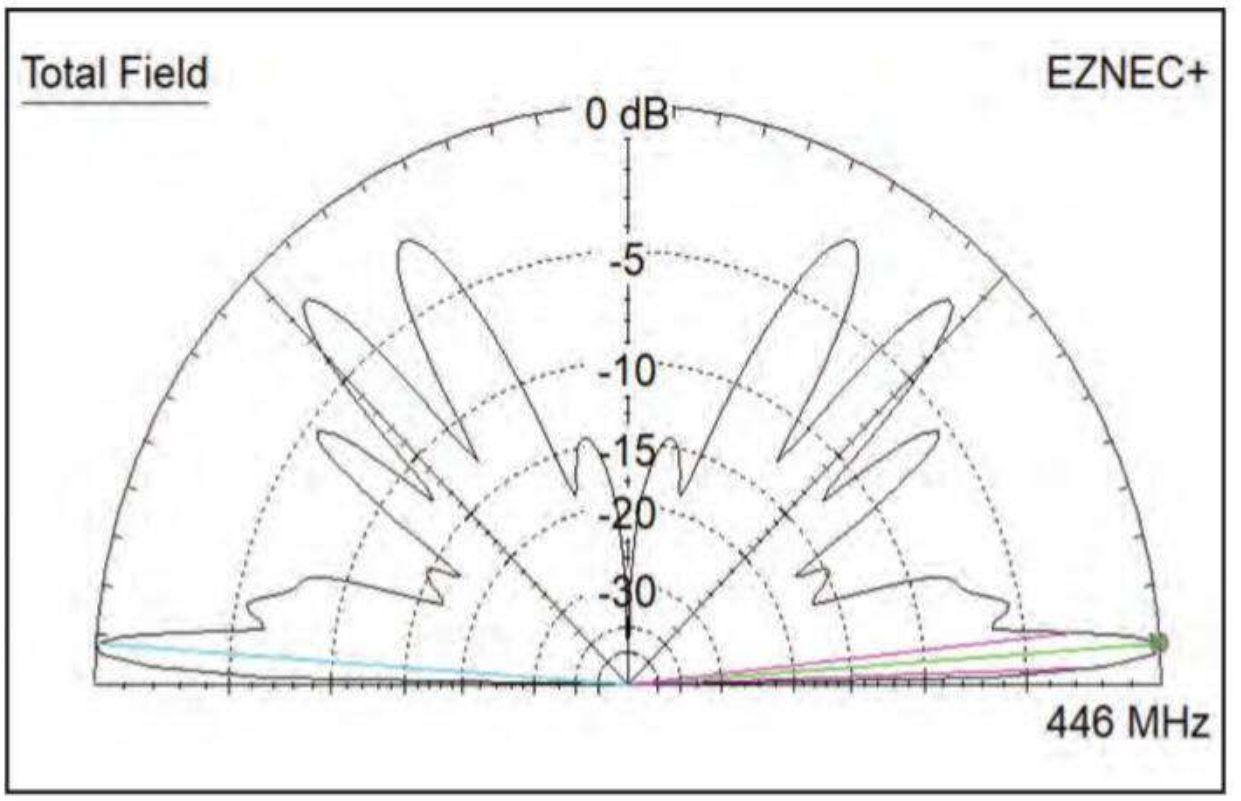

Figure 6. EZNEC model calculation of 446-MHz radiation elevation angles for a simple 2-meter vertical dipole. Lowest radiation angle is 4 degrees at 7-dBi gain.

Photo H. Completed VHF/UHF go box.

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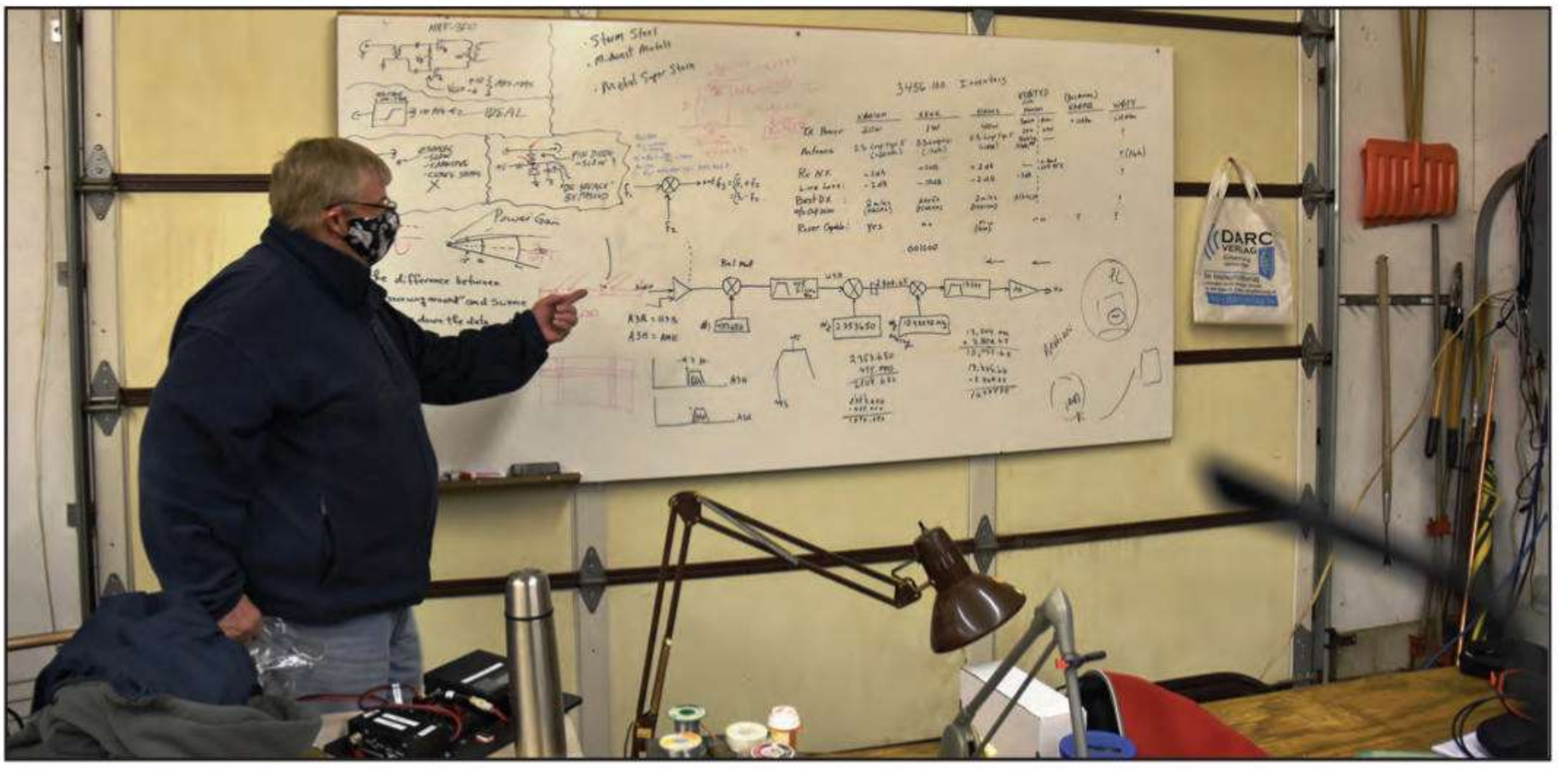

Photo A. We began with careful planning led by Gregg, KCØSKM (Photos by the team members)

Operate outdoors in the middle of winter? That's crazy, right? That's also what Winter Field Day is all about (after all, emergencies and disasters don't always wait for warm weather!). The team at WAØPCC in Cedar Rapids, Iowa, reports on their CW (cold-weather!) adventure earlier this year.

Winter Field Day at WAØPCC

PHOTO ESSAY BY ROD BLOCKSOME, KØDAS; GREGG LIND, KCØSKM; DAVE LAYHER, WAØPCC; STEVE WHITE,* NUØP, AND MARK KOVALAN, K8XK

What could be crazier than operating Winter Field Day[1] in Iowa in a tent outside that was purchased from Fleet Farm to hold a utility tractor? Second, what else should you do to make it even crazier but to run high power? That was our plan for WFD 2021. We're pleased to share our experience with you here through words and (mostly) pictures.

First step was planning (*Photo A*) and working with a power amplifier (PA) that still needed to be repaired and tested. Rod, Steve, and Mark were up for the task. They had three amps to choose from and so they started to look under the covers and determined to work on an Amp Supply LK-500C running two 3-500Z tubes. This meant that the three of them needed to perform a resurrection on a boneyard PA that Steve had purchased for this very purpose (*Photo B*).

KCØSKM had the pleasure of attending a pre-pandemic hamfest with Steve and he knows Steve looks for the broken ham radio toys. Steve hardly ever buys radio equipment in working condition. He is a collector of broken toys, and broken amps are like siren calls of sea creatures.

Steve had two models from Amp Supply and both needed repair. This meant cleaning and repairing any parts and included the spraying Deoxit® on coils and connections. Once the amp was cleaned up to prevent arcing, they then started the process to power it up by checking out plate and grid currents on the tubes. The tubes ended up being a problem in one of the amps, which suffered from "gassy tubes."

If you have not heard of this term, it describes a situation in which oxygen needs to be "cleared" from the tube. Not all tubes have a complete seal so the "getter" in the tube needs to collect and remove the oxygen. This amp would not achieve full RF power, but they luckily had another set of tubes and a backup amp. After some work, the amp was

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Photo B. Another key ingredient: Steve's 1-kilowatt amplifier. We're going QRO!

Photo D. A 450-Ohm "Ladder Line" carried the RF.

Photo C. The center-fed Zepp antenna was erected in Steve's driveway.

eventually putting out its full power of 800+ watts on 20, 40, and 80 meters with about 50-70 watts RF drive from an ICOM-7300 transceiver.

Next was the plan of the antenna system. It was decided that the best bet would be a longwire with an open ladder-line, fed through an MFJ tuner. What could go wrong? The antenna used was "The 'Ideal' Back-up Antenna for 80-20 Meters," by L.B. Cebik W4RNL[2] (*Photo C*). Steve had remembered this as an easy antenna to build and one that would fit the location where we planned to operate. Steve constructed the antenna over a few days.

The antenna was fed from the MFJ tuner using approximately 10 feet of sealed ladder line to get it outside of the tent, and then connected to the open ladder line. The open ladder line (*Photo D*) was routed along the fence while trying to ensure it did not touch any trees or get close to conductive surfaces.

A "Real" Use for a Wouff Hong!

If you notice in *Photo E*, you may recognize the antenna mount on top of the mast. Yes, it is the infamous Wouff Hong. This was a first for all of us, but now you know what a Wouff Hong is used for in amateur radio (other than inflicting unspeakable pain on misbehaving hams!). If you have been to an ARRL Wouff Hong ceremony and taken the oath, you already know that "The Wouff-Hong is amateur radio's most sacred symbol and stands for the enforcement of law and order in amateur operation." Even though Winter Field Day is not an ARRL event, the League does support it and when you go to the ARRL website it directs you to the Winter Field Day website. We planned to operate within the safe standards of the ARRL and the Wouff Hong was a subtle reminder of this.

Ahead of the Storm

We set up the antenna on Friday. This was precipitated by weather that was rolling in. Even though the wet heavy stuff was forecast to be after 5:00 on Saturday afternoon, it was good to have the antenna set up on Friday so we would not have to fight potential weather. On Saturday we focused on putting the system together as the antenna was not yet tested. Further, the system of the ICOM-7300, Amp Supply PA, computer for logging, and the tuner had not been integrated till Saturday.

Mark installed the ground rod in our shack (*Photo F*) and all the components of the system were grounded. Yes, we did run a long line of 220-volts AC directly from the fuse box to run the PA. It was some heavy 12-gauge wire. We ran two additional 110-volt lines to power the radio and laptop, and most importantly, a small space heater that was really, really, nice to have. It was really cold on Saturday evening. Even the glow of the 800 watts being driven on the tubes in *Photo G* was not enough to keep us warm.

After the system was put together, we broke for lunch. We had time to get it all

Photo E. Using the sacred "Wouff Hong" will ensure success (and a high score) … we hoped!

working, right? Starting Field Day on time is overrated. Our thinking was that since we had 800+ watts, we would find a spot on the band!

After lunch, we completed testing and getting the PA and MFJ tuner presets understood (*Photo H*) and the PA plate and grid settings for each band on a check sheet. It looked as if 10 and 15 meters would not be operable, so we focused the operation on 20, 40, and 80 meters.

Per our normal operating procedure, we had the PA and system checkout after the 1 p.m. start time. We thought it only appropriate that Dave start off the contest (*Photo I*) since we were using his call, WAØCPP. The first QSO was logged at

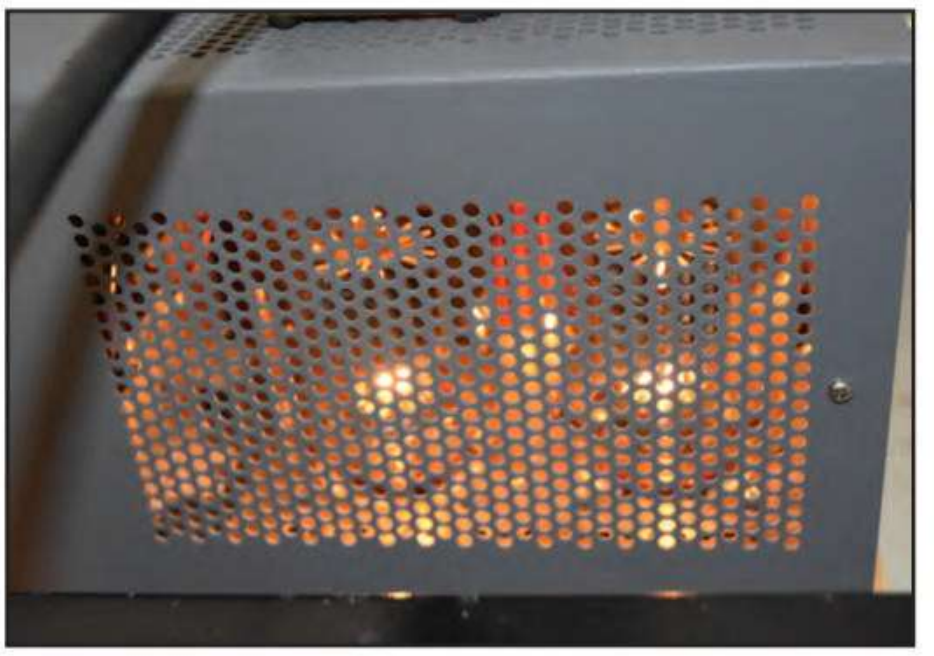

Photo G. The power amplifier also kept us warm — another reason for QRO during Winter Field Day!

Photo F. The Winter Field Day shack.

Photo H. We always tuned for "maximum smoke!" Note the section of insulated ladder line heading out of the tent.

19:36 UTC (1:36 p.m. local). Everything looked good. We started on 20 and then shifted to 40 meters. We completed QSOs on both 20 and 40, but none on 80. Gregg had a good run on 40 and with big power it was fun to operate as we could just call in a pile up on the radio and we would be heard. Gregg and Dave would try to pick out a station in the pile-up to try to complete the QSO. It is fun working a contest with power. It is nice to hear you have a great signal and are very loud.

Outside, the snow was starting to come down fairly hard, and around 6:00 p.m., we noticed the SWR creeping up and the station did not seem to have the punch it previously had. QSOs became extremely hard, even with 800 watts. We started to have less signal and were starting to have a hard time hearing any stations. We assumed it was propagation and later found out that it was ice on the ladder line (*Photo J*) as well as tree branches with ice laying on the ladder line. At 7 p.m. we shut down the operation to warm up and called it a night.

Better in Daylight, Right?

Sunday was not a very good day — everyone was exhausted from just getting their driveways cleared and getting

Photo I. Dave, WAØPCC (foreground), and Gregg, KCØSKM, making Qs in the tent station.

over to the Field Day site (*Photo K*). Steve got his riding snowblower stuck and when Dave tried to pull out the tractor, he got stuck as well. We are sure this put a damper on Sunday field operation and really cut into the operating time. Most of the group was not able to get over until 12:30 p.m. I think only eight contacts were made on Sunday. Our total operating time was about 5-1/2 hours.

We ended Winter Field Day with 166 QSOs — 41 on 20 meters and 125 on 40 meters. All contacts were on SSB

Photo J. The snow caused us to re-tune the antenna several times.

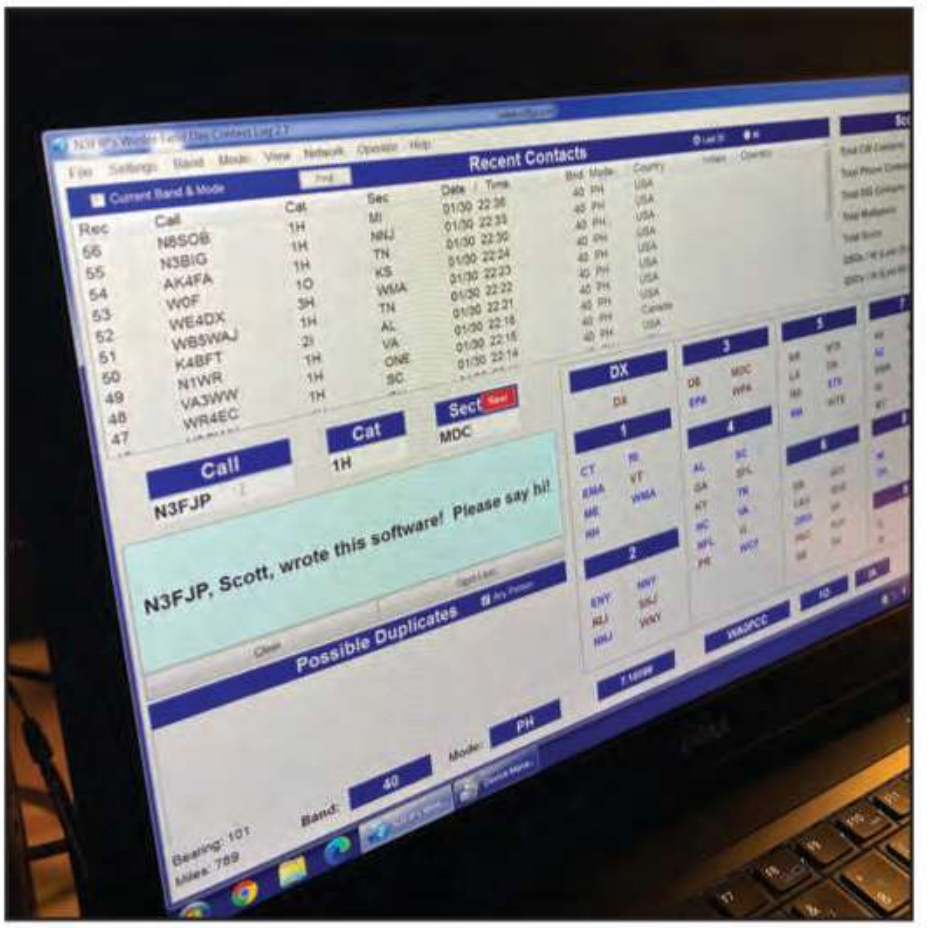

Photo L. N3FJP logging program's message when I worked N3FJP.

Photo K. Sunday put the "winter" into Winter Field Day.

phone for a total score of 1,666 (including 1,500 bonus points).

Lessons Learned

• The Fleet Farm utility tent was watertight and the small space heater made it bearable to operate in it.

• A laptop with a mouse pad may not be the best idea to use as the pad seems to be less than responsive or it could be our cold fingers. Who knows?

• The Wouff-Hong did not protect our antenna system from ice and high SWR. Also, trees with ice leaning on the open-feed ladder line is not a good idea. So, the ideal antenna maybe should have used plastic-coated ladder line.

• It is good to have backups for the PA and radio. The ICOM-7300 was and is a great radio for Field Day operation with nice noise rejection and a waterfall display for scanning for stations.

• N3FJP is great logging software. Bonus: When you contact the developer of the software during Winter Field Day, as we did, you get a message in the software (*Photo L*) that says, "N3FJP, Scott, wrote this software! Please say hi!" (Which, we did).

• Most memorable call was N8SOB. He said he would send a QSL card.

• Do not drive your ICOM-7300 with more than 16 volts as you will damage your radio. (Don't ask how we know that!)

Notes:

1. Sponsored by the Winter Field Day Association <www.winterfieldday.com>

2. <www.antentop.org/w4rnl.001/88.html>

Take It To The Field Special:

"Taking it to the Field" doesn't always require a field … sometimes, a lot of water and a little marshland will do the trick. But Murphy always has poor propagation in his back pocket! W4DNN's tale of woe…

Hams on Hog Island – A QRPxpedition

BY DENNIS LAZAR,* W4DNN

What could be more appropriate than hams activating Hog Island in southwestern Florida for the US Islands award program? My XYL, Ruthie, K4KLQ, and I love to play radio — especially with QRP rigs, simple antennas, and in unusual places. This mostly takes place during our RV adventures, along woodland trails or atop distant mountain summits (SOTA and POTA). But sometimes the best places may be close to home. We live in Port Charlotte on Grassy Point, a small peninsula jutting out into Charlotte Harbor, a bay which includes one of the world's largest protected marine estuaries encompassing 270 square miles with 219 miles of natural shoreline.

Cruising the waters of Charlotte Harbor is always great fun. This area is world-renowned for its great boating and fishing, largely due to its shoreline being completely natural. Long ago, before Charlotte Harbor could become citified, the State of Florida passed laws protecting natural shorelines from development.

Developers and even private landowners are not permitted to cut the mangrove trees that line many of Florida's estuaries. The fines and penalties are enormous. Charlotte Harbor's miles of mangroves guarantee that much of the harbor will remain a pristine fish hatchery and fishery. Fishing tournaments, sailing races and regattas, power boat races, and just fun cruising are what this bay is all about. Due to these regulations, Hog Island remains untouched by developers.

After having had QSOs, even at the bottom of solar cycle 24, with a few U.S. Islands award activators, I had an epiphany: Why not activate an island

Photo A. The Baby Ruth at home port, ready to set sail for Hog Island.

Figure 1. Hog Island is at lower left, home port is the peninsula at upper right. (US Geological Survey map)

* *Email: <w4dnn@arrl.net>*

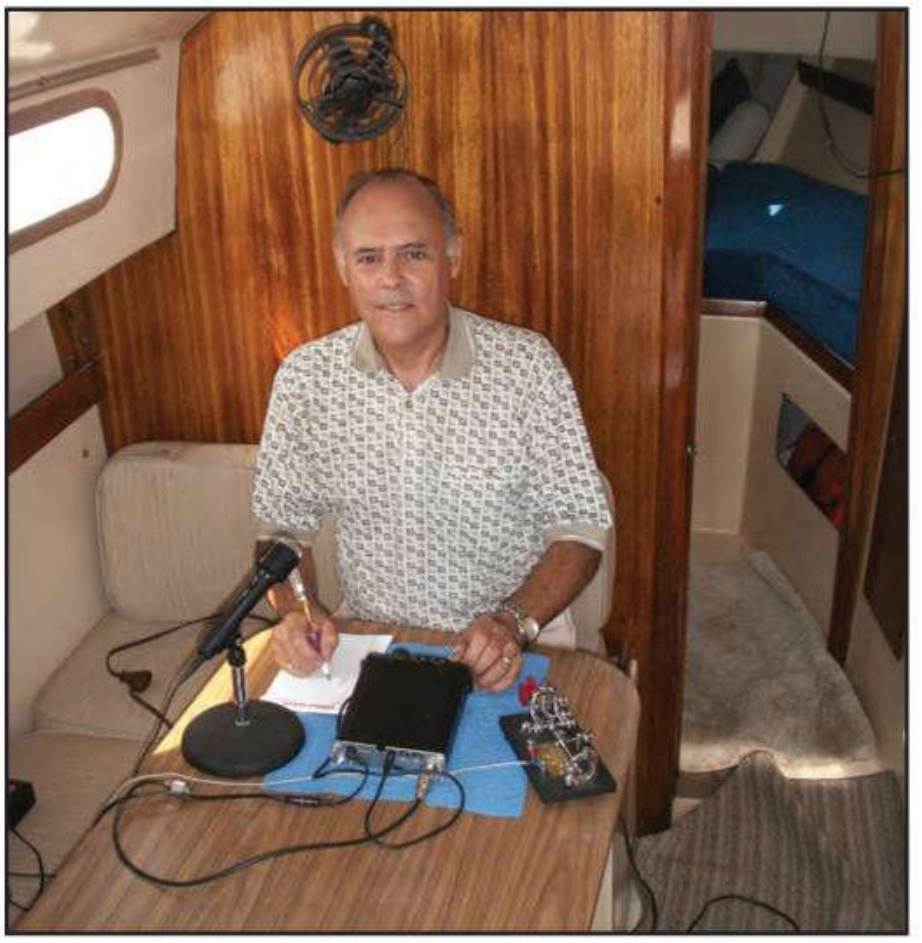

Photo B. Dennis, W4DNN, works all seven QSOs in the cabin of the Baby Ruth.

close to home? Our 26-foot Bristol sailboat, the Baby Ruth (*Photo A*), could take us and our Yaesu FT-817ND QRP transceiver to Hog Island in about an hour (*Figure 1*). There, near the mouth of the Myakka River, in unspoiled isolation, we could activate an island that has a history dating back to early Spanish explorers.

One southwest Florida historian describes an officer of Spanish conquistador Hernando DeSoto's fleet named Anasco. In May 1539, he and his boats were dispatched to route a war party of Native Americans assembled on Hog Island. Anasco first raked them with cannon fire, but could not dislodge them. Fearing that they were retreating to the mainland to regroup, he called for reinforcements to intercept them.

A flanking movement led by General Porcallo encountered shores that were deep marshland and the attack was thrown into disarray. The natives slipped away in the thick mangroves and the general had to be rescued after his horse became mired in the muck. The island's name stems from the hogs brought by DeSoto as a sort of traveling meat market. Today there are more than 100,000 feral hogs in southwest Florida, making it a hunter's paradise as well.

A First Attempt

Getting to the island would involve an easy cruise southward down Charlotte Harbor. Our first attempt was really not fully thought out. It involved going ashore with a small table and chairs, the radio, and a Hustler mobile antenna with ground radials.

We anchored off the beach in very shallow water and waded ashore with the table and chairs. Within minutes of setting foot on land, we heard a humming sound. As it became louder, and being Floridians, we realized that our presence had caught the attention of Florida's state bird, a swarm of blood-sucking mosquitoes. As long as we had been "at sea" off the coast, they did not pick up our scent. But once ashore … dinner was served. As the swarm descended, we made a mad dash for the boat and threw the furniture and ourselves aboard. While I fired up the engine, Ruthie sprayed us down with bug repellant. We made a fast retreat! I could really sympathize with both Anasco and the Native Americans who actually lived on the island. I am sure both forces, even without combat, donated a lot of blood. It was time to rethink our QRPxpedition.

Preparing for Offshore Ops

For our second attempt, we wanted to rethink both our radio gear and our voyage strategy. Our only hope for pulling off this challenge was to operate from aboard the boat (*Photo B*). While we would be slightly offshore, we could run a ground radial to the beach. So, technically, part of our station was actually on land.

One advantage of a sailboat, antenna-wise, is its mast. The mast on the Baby Ruth just happened to be a little over 33 feet high, which is a half-wave on 20 meters.

Photo C. The Baby Ruth station gear, FT-817ND, audio CW filter, tuner, bug, and batteries.

Many sailors who take to the open ocean make a permanent installation by insulating the aft stay (the cable supporting the mast from the stern) and using it as a vertical (almost) end-fed antenna. This permanent installation is a big project. I hoped that simply hoisting a 33-foot wire up the mast and securing the other end to the cockpit rail would do the trick.

At the cockpit end, I used a tiny QRP tuner to get the SWR to 1.3:1. From the tuner, I routed the RG-58U coax into the cabin to the FT-817ND QRP transceiver. Because the boat is of fiberglass construction, it could not be used as a ground plane like a car or an RV. Although the textbooks will tell you that a half-wave vertical does not need radials, in reality, the station does better with a ground.

To form my ground, I ran a wire out the hatchway and coiled it with a large rock attached to the end. Also, from the ground lug, I ran another wire all around the deck along the toe rail. This wire would provide a great ground plane to augment the first wire which, when heaved to the shore, would ground us to saltwater and also provide our "link" to the shore. So a part of us would actually be on Hog Island.

The radio itself was the least of our problems. This QRP rig provides for both CW and SSB operation. To power the rig, which draws 450 milliamps on receive and 2 amps on transmit, two small 5-amp-hour sealed lead-acid batteries would provide us with a day's worth of radio fun.

The Voyage Begins

Friday's sunset was the traditional "red sky at night, mariner's delight." And Saturday was sunny and clear, not the dreaded "red sky in the morning, mariners take warning." We were up with the dawn and loaded the Baby Ruth with enough food, Coke, and beer to last us through the day. The radio gear was already aboard (*Photo C*), checked out with several quick QSOs in the previous days.

We motored down the waterway behind our house and within minutes were in the open waters of Charlotte Harbor. Off went the motor and up went the sails for a fun voyage down this large saltwater bay. The ubiquitous seagulls circling and dipping overhead and a dolphin leaping from the water in our wake seemed good omens of a successful and fun journey.

As we approached the shores of Hog Island, we noted that the tide was high. This allowed us to come close in to the

very narrow beach. We needed to ensure to set the depth sounder alarm to avoid beaching the boat as the tide went out later in the day. I motored in slowly while Ruthie, on the bow, got ready to drop anchor. Once secured at the bow, I threw the ground wire weight onto the shore. Then we moved the boat to a little deeper water and set the stern anchor. This rig would keep us in place and prevent the boat from drifting and pulling our island ground link into the water.

Once secured, it was time to "play radio." I fired up the rig on 20 meters, dialed in the tuner for minimum SWR and began calling CQ. Meanwhile Ruthie got on her cell phone and was able to spot us on QRPspots.com. I was ready for action. "CQ, CQ. CQ DE W4DNN." Nothing! As the morning turned into noon, we chalked up only two QSOs with weak reports at best. Ruthie pulled up QRZ.com on her phone and saw that the bands were listed as "poor" due to a coronal mass ejection on the sun. The solar storm was aimed right towards Earth and was blanking out the bands. In desperation, I called my old friend, Al, W8AJ, near Cleveland, Ohio.

"Can you get on the air right away? I really need you to look for me on 14.061." I explained our situation and he agreed to give it a try. After a half hour of careful listening, he was able to pull me through and we made an exchange. He was 539 with a kilowatt while at best I was 319, just above his noise level. Al called a few of his QRO friends and within the next 30 minutes I was able to log three more QSOs. Thanks, Al!

We spent the rest of the day calling our hearts out on multiple bands but with little success. As the sun sank lower in the sky, we weighed anchor and the Baby Ruth set sail for our home port. With a total of seven QSOs in eight hours, we were, to say the least, disappointed.

During my fruitless quest for QSOs, Ruthie wet her fishing line and netted us a redfish for dinner, so the voyage was not a complete loss.

Could We Qualify?

Did we do a good enough job to go down in the history books as the first call to activate Hog Island? I'll quote from the official U.S. Islands Awards Program rules:

"You've now done the hard work of doing the DX-pedition to the island that you chose to qualify. And, you, or you and your crew, worked hard to make at least the required 25 QSOs, which includes 2 DXCC entities that are needed to qualify the island. Now, comes the paper work.

Oh no! Can it be? We didn't even come close! Perhaps if we had been able to survive the heat, humidity, mosquitos and fickle tides for about a week and with great propagation, we might have fulfilled those requirements. Perhaps next time, with a generator, an air conditioner, and a kilowatt tucked into the cabin, we could go down in history as the official activators. We could someday become the first "Hams on Hog Island."

A "RIB" for DXpeditions

I thought it was a really clever idea to thwart the blood-sucking Florida state birds (mosquitoes) by setting up an antenna on Hog Island and then operating remotely from the boat. But recently I was surprised to learn that the Islands On The Air (IOTA) folks are planning to implement remote operations in the near future.

In addition, three hams, KN4EEI, N6MZ, and AA7JV, have developed a RIB, or "Radio in a Box," to be used for remote operations in DXpedition locations where authorities restrict access for either environmental or safety reasons, or do not allow overnight stays. The RIB can be remotely controlled from the ship, either locally via Ethernet or over the air with a 900-MHz radio link. No need for long coax runs out to the boat at sea, HI, HI.

C6AGU, operating from the Bahamas, is used to test the equipment for DXpeditions by the AA7JV / HA7RY team. The station is set up on several small islands to simulate DXpedition conditions. The Northern California DX Foundation has sponsored the development and building of a number of RIBs to help future DXpeditions to environmentally sensitive locations.

The "Radio in a Box," or "RIB," is a full function kilowatt station in a weather-tight box built around a Flex 6700 transceiver. It is remotely controlled form the boat and can operate unattended for days. The C6AGU group has made over 25,000 QSOs using RIBs, from an uninhabited island under pretty realistic DXpedition conditions, including during major contests. (Courtesy of C6AGU and the Northern California DX Foundation)

Results of the 2020 CQ DX Marathon

BY JOHN SWEENEY,* K9EL/VA3CDX

"A good distraction to the troubles of 2020" – VK4CC
"I really enjoyed the challenge" – MØXLT
"Lots of fun as usual" – KI1U
"Great contest and a lot of fun!" – WD9DZV
"First time CQ Marathon" – AF9W, K2YYY, others
"Considering 2020 was such a lost year, CQ Marathon is always such fun" – N7RD
"A tough year on and off the radio" – ZL2IFB
"Working from home had its advantages this year" – N9TF
"DXpeditions and sunspots were missing this year, but I still enjoyed it" – IK5FKF

The CQ DX Marathon is alive, well, and breaking records! Despite poor band conditions and the lack of DXpeditions after February due to the pandemic and many other problems facing us, the DX Marathon had its biggest year ever in 2020. Many of us stayed home and really appreciated the value of communication through amateur radio. Although there were 19 fewer countries available to work, the average country count was only down by 14 from 2019. Overall participation was up significantly, along with the number of total QSOs, despite the average scores being lower due to lack of DXpeditions. The DX Marathon kept us busy concentrating on DX and was a great way to reduce stress from the pandemic.

The participation graph (*Table 1*) shows the amazing growth in 2020. Total participants in the DX Marathon increased to over 16,400, the highest total in the last five years and a 14% increase over 2019.

We also had a record number of logs submitted and the highest-ever number of total QSOs as shown in *Table 2* and *Table 3*.

DX signals are weaker during low sunspot periods, but the multitude of digital modes with excellent weak-signal capabilities have allowed anyone to work DX and kept activity high in the DX Marathon. Digital modes accounted for 65% of all QSOs in the Marathon — an incredible increase from less than 20% in 2015. The FT4 and FT8 modes accounted for most of those digital contacts. *Table 4* shows the change over the last few years.

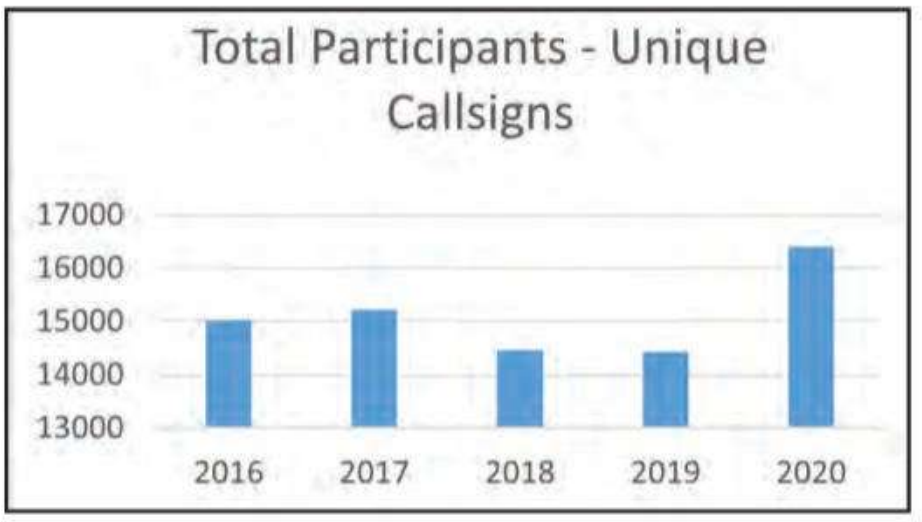

Table 1.

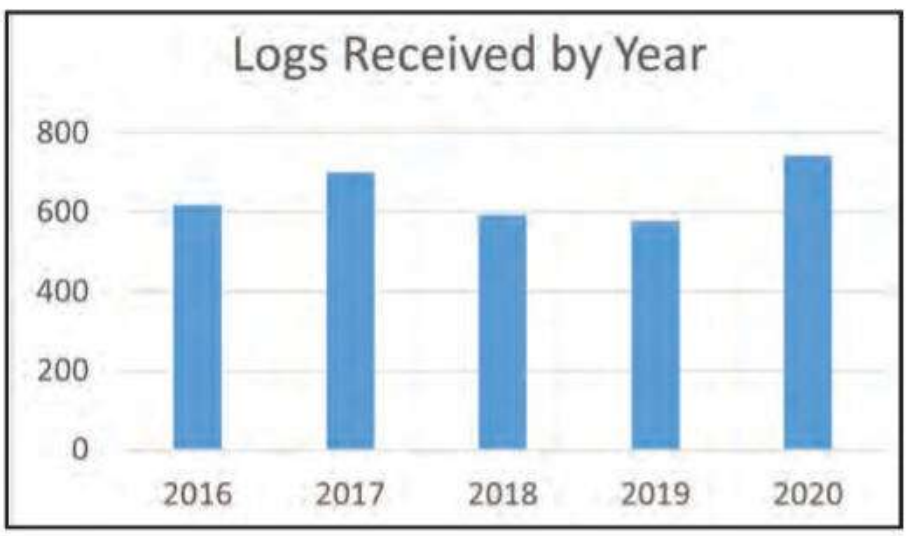

Table 2.

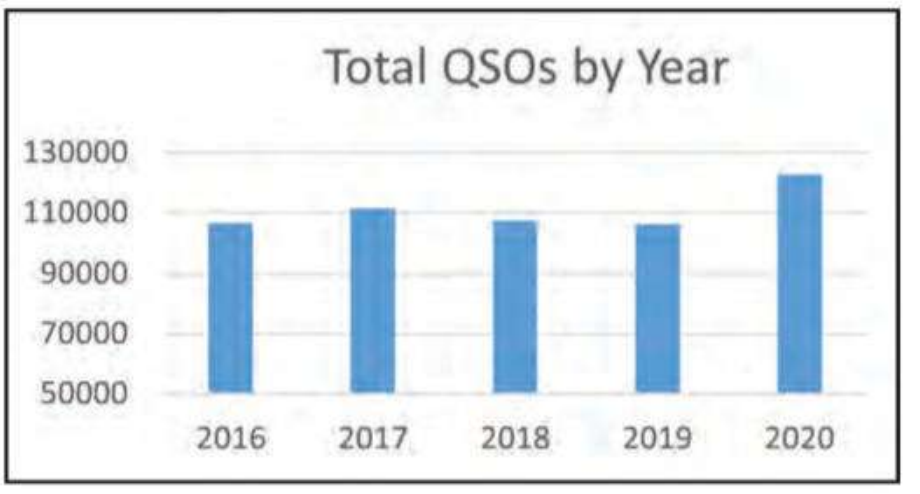

Table 3.

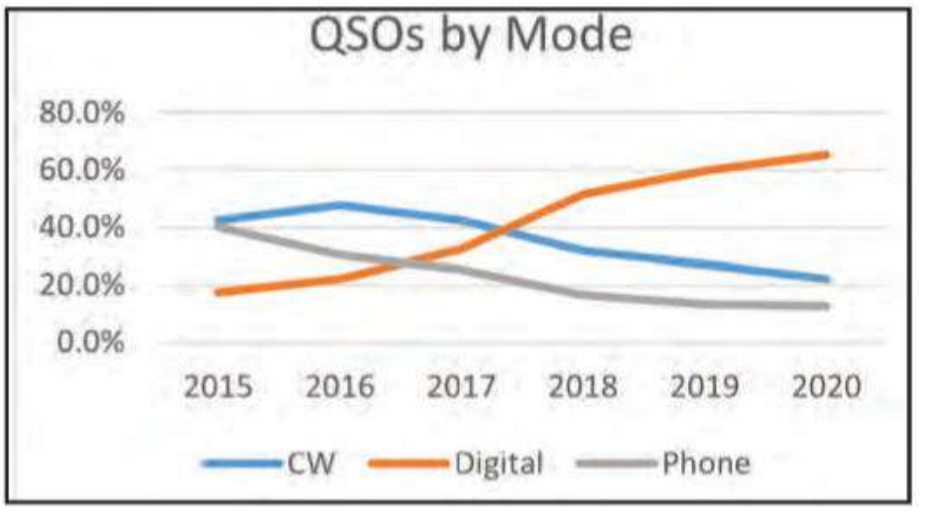

Table 4.

*Email: <john@k9el.com>

The maximum possible score in 2020 was 308, a big drop of 19 entities from 2019, but still very impressive considering the world situation. Not a single person scored over 300 — another unfortunate result of the pandemic. We were surprised to see that ten all-time records were broken! Some happy hams now have their calls in the DX Marathon record books. Setting new records in 2020 is a great accomplishment. In terms of band usage, the higher bands saw big increases in QSOs.

And the Winners Are

For the last few years, John, K2ZJ, has been among the top scorers and placed 5th in 2019. 2020 was a great year for John as he took top honors in Unlimited Class with a score of 297. Competition was tough but John did not make a single error in his log, which put him above his competition. Building on this unusual year, we had a tie for 2nd place from Japan with veteran marathoner JA2NDQ and newcomer JH1AJT tied at 294. Nice to see Zorro, JH1AJT, place so well in his first year of competition. Previous winners PY5EG and R6YY placed 4th and 5th, respectively.

James, K2JL, winner of Formula Class the last two years made the jump to Limited Class in 2020 and came out on top with a score of 267. James installed a new HexBeam for his change to Limited Class. Second and third place positions went to IK2RPE and TA4RC, with scores of 259 and 252, respectively. TA4RC repeated his 3rd place performance from last year. In Formula Class (100-watt option), Karel, OK2FD, was our winner with a score of 263. Armed with a wire antenna, 100 watts, and often poor conditions, this was a great accomplishment. Karel finished 2nd last year. IUØLFQ and YV5OIE finished 2nd and 3rd, respectively. Working the Marathon with wire antennas is a difficult challenge, especially with few or no sunspots. Even more chal-

TOP SCORES

BOLD = Plaque Winners
* = Certificate Winners
Callsign is followed by Score

Unlimited Class

K2ZJ	297
JA2NDQ	294
JH1AJT	294
PY5EG	293
R6YY	293

Limited Class

K2JL	267
IK2RPE	259
TA4RC	252
EA8DHH	241
TA1CM	239

Formula Class - 100w

OK2FD	263
IUØLFQ	249
YV5OIE	237
HA7LJ	232
SV1AZL	232
PP2RON	232

Formula Class - 5w

OK2AP	260
CO2QU	198
IZ3NVR	193
K8ZT	192
W8QZA	175

CW

OK2PAY	274
LY5W	269
KBØEO	266
PA3FQA	254
K5BG	239

Phone

W4HY	240
PY5QW	222
MIØBHX	205
PY4JW	196
KL7KK	194

Digital

HA1RB	270
OM5XX	265
IK2RPE	259
5P1KZX	255
4X4MF	254

Africa

CT3MD	269
EA8DHH	241
ZS2EZ	238
ZS6HON	211
ZS6SKY	119

Asia

JA2NDQ	294
JH1AJT	294
JAØDAI	279
A92GE	266
OD5YA	256

Europe

R6YY	293
DJ3AA	284
CT1IUA	282
MØNKR	280
OM3EY	277

North America

K2ZJ	297
NØFW	288
VE3VEE	287
WN4N	286
K3RA	285

Oceania

YB5QZ	280
VK3GA	279
VK3BDX	265
ZL2IFB	262
VK2PW	249

South America

PY5EG	293
PY5GA	276
PP5JR	263
PY4AZ	261
ZW5B	255

6 Meters

I4EAT*	146
F6GCP	145
LY2IJ	129
IW2CAM	115
LU5FF	50

10 Meters

9A2EU	183
PU2UAF	179
PU5BOY	172
HZ1SK	151
PU5FJR	101

12 Meters

PY2TC	205
PY2TUA	188
PY5DD	121
PU5YDD	66

15 Meters

PY2LCD	247
PU2VLW	239
PU2WSQ	228
PU9OJZ	209
PU5YSV	196

17 Meters

LY5O	241
LY5M	187
PY5IP	182

20 Meters

VE3VEE	287
PY4AZ	261
KC1BB	217
YB2HAF	200
PY4JW	196

30 Meters

DL7JAN	187
KF6MK	155

40 Meters

PP5JR	263
W9KNI	255
K9CJ	182
PP1WW	172
ON6SAT	160

60 Meters

W1NG	183
W4UM	162
OK6DJ	151
AF5CC	64

80 Meters

N3QE	157
YC6JRT/0	110
PU5PGK	4

160 Meters

LA3MHA*	187
K7ZV	156
TCØX	110
PY5XH	31
TC3D	24

CW – Europe

OK2PAY	274
LY5W	269
PA3FQA	254
I2IFT	212
PAØINA	211

CW – North America

KBØEO	266
K5BG	239
W4JS	235
W4QN	232
N7US	221

Zones

1	KL7KK*	194
3	N6WT*	281
4	NØFW*	288
5	K2ZJ	297
8	CM2RSV*	200
9	HK3W*	252
11	PY5EG	293
12	CE7KF*	168
13	CX3AL*	215
14	DJ3AA*	284
15	OM3EY*	277
16	R6YY	293
17	R9AB*	198
20	SV2AEL*	274
21	A92GE*	266
22	VU2AE*	236
24	BV1EK*	202
25	JA2NDQ	294
27	4F3BZ*	187
28	YB5QZ	280
29	VK6DW*	161
30	VK3GA*	279
32	ZL2IFB*	262
33	CT3MD	269
38	ZS2EZ	238
40	TF3JB*	204

Note: Top scorers in some zones received Plaques or Country Certificates.

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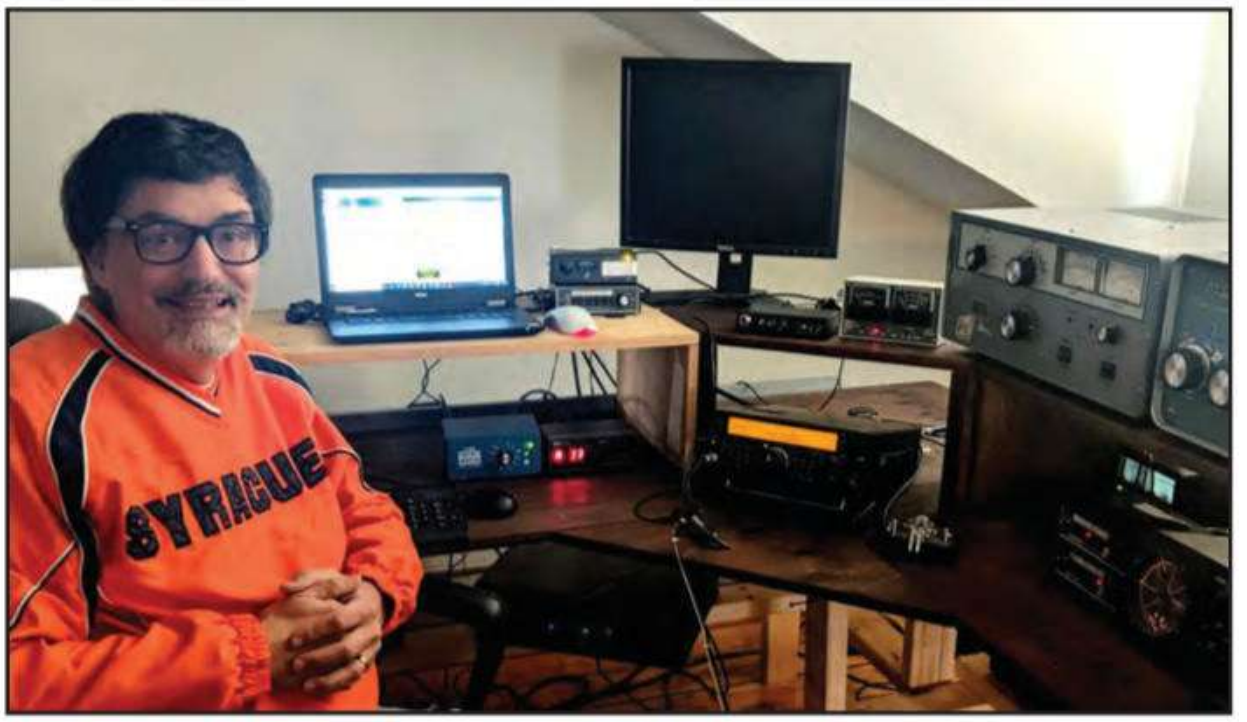
lenging is working DX with QRP power, so congratulations to Milan, OK2AP, for a repeat win in the QRP category with an impressive score of 260 points! CO2QU finished in second place with a score of 198.

Each year about 25% of the DX Marathon participants choose to submit scores for a single mode. In 2020 we saw a slight decrease in digital-only submissions, but a 30% increase in phone-only submissions, reversing phone's downward trend of the last few years. Lada, OK2PAY, continues his love of CW and is now a six-time CW-only plaque winner, topping the world with his CW-only score of 274. Saulius, LY5W, came in second with a very impressive score of 269. The top North American CW score went to Dan, KBØEO, with a score of 266. Both Lada and Dan will soon hold a beautiful DX Marathon CW plaque for their efforts. The digital-only category continues to show big scores with the winner, Janos, HA1RB, finishing just 4 points below the top CW score at 270. DX Marathon veterans OM5XX and IK2RPE finished 2nd and 3rd, respectively, with scores of 265 and 259. A lot of competition for the digital-only plaque. Phone-only submissions were up this year although average scores were far below the CW and digital scores. Julio, W4HY, who finished second last year, moved to the number-one position with a score of 240, while PY5QW came in second at 222. Thanks for keeping phone DX alive.



John, K2ZJ, has been placing better each year in the DX Marathon and now claims the number one spot for 2020! John is shown here in his shack where he spent many hours to win Unlimited Class in 2020. John was licensed in 1973 and recently retired, giving him more time to chase DX. He has an extensive antenna system that he put to good use. John enjoys his rural location where the noise levels are low.

Jose, CT3MD, has been an active DX Marathon participant for many years and provides CT3 QSOs for many hams. Jose is a consistent top performer and is shown here with his plaque for the highest score from Africa in 2019.

In addition to the overall and mode plaques, each year we award plaques to the top score on each continent plus the highest score on each of the 10- through 80-meter bands. Top honors for Africa went to repeat winner CT3MD with his score of 269; second place went to EA8DHH with 241, and 3rd place went to ZS2EZ with 238. In Asia, it was an exciting contest between JA2NDQ and first time DX Marathon participant JH1AJT, with each scoring 294 points. In the case of a tie, the win goes to the participant with the earliest date of their last valid QSO. Congratulations to Hiro, JA2NDQ, for earning the Asia plaque. JAØDAI came in 3rd at 279 points. In Europe, last year's overall Unlimited Class winner, Serge, R6YY, came in first again with an impressive score of 293. DJ3AA finished second at 284. In Oceania, Anton, YB5QZ, once again took top honors with a score of 280, very closely followed by a previous Oceania winner, VK3GA, at 279. The top North American score was by K2ZJ at 297, who was the Unlimited Class plaque winner. Pete, NØFW, came in second at 288. Oms, PY5EG, one of the top DX Marathon winners since the beginning of the Marathon, took home top South America honors with a score of 293.

About 10% of DX Marathon participants submit single-band scores each year and 2020 was no different. For 2020, we added the 60-meter band. However, the band mix was quite different this year. For the 2020 single-band competitions, we saw a big increase in 10-, 15-, and 20-meter-band submissions, while there was a decrease in 30- and 80-meter-only submissions. Clearly the new sunspots were welcomed by all. 9A2EU won first place on 10 meters with an amazing score of 183. PY2TC had the top 12-meter score of 205. The 15-meter winner was PY2LCD at 247 points. Top score on 17 meters was from LY5O with a total of 241 points. Despite the lack of DXpeditions, the top scores on the 10-, 12-, 15-, and 17-meter bands were all significantly higher than in 2019. VE3VEE still reigns as the king of 20 meters with his top score of 287. Twenty meters remained the hot band for 2020,

COUNTRY WINNERS

Callsign is followed by score
* = Certificate Winners

4F3BZ 187	HB9DDZ* 178	R6YY 293
4X4MF 254	HK3W 252	R9AB 198
5P1KZX* 255	HZ1SK* 151	SM6A* 190
9A2EU 183	IT9BLB* 182	SQ8N* 270
A92GE 266	IZ8MXB* 266	SV2AEL 274
BI8CKU* 197	JA2NDQ 294	SV9COL* 197
BV1EK 202	K2ZJ 297	TA1CM* 239
CE7KF 168	KL7KK 194	TA4RC* 252
CM2RSV 200	LA3MHA 187	TF3JB 204
CT1IUA* 282	LU2JCW* 214	UR7FM* 220
CT3MD 269	LY5W* 269	VE3VEE 287
CX3AL 215	MØNKR* 280	VK3GA 279
DJ3AA 284	MIØBHX 205	VU2AE 236
EA1DR* 268	OD5YA* 256	YB5QZ 280
EA8DHH* 241	OE1SGU* 223	YO4AAC* 173
EI7CC* 191	OH2BLD* 249	YV5OIE* 237
EV1R* 264	OK2PAY 274	ZL2IFB 262
F4ESV* 254	OM3EY 277	ZP5DNB* 171
GUØSUP* 206	ON6NL* 260	ZS2EZ 238
GW4EVX* 138	PA3FQA* 254	
HA1RB 270	PJ2/W9VA* 89	Note: Top scorers in some countries received plaques.
	PJ7AA* 94	
	PYØFF* 98	
	PY5EG 293	

as Marvin's 20-meter only score put him in 7th place overall worldwide. DL7JAN took top 30-meter honors with a score of 187. PP5JR once again took the top 40-meter spot with a score of 263. He was followed closely by W9KNI with his score of 255, which was earned without using digital modes — a very impressive accomplishment. Starting in 2020, we are now awarding a single-band plaque for the 60-meter band. This inaugural plaque was won by Ken, W1NG, with a very impressive score of 183. The 80-meter plaque was won by N3QE with a score of 157. Congratulations to all the single-band plaque winners. The impressive 160-meter score of 187 will earn LA3MHA a nice certificate for taking top honors on top band. I4EAT was once again king of 6 meters with his score of 146.

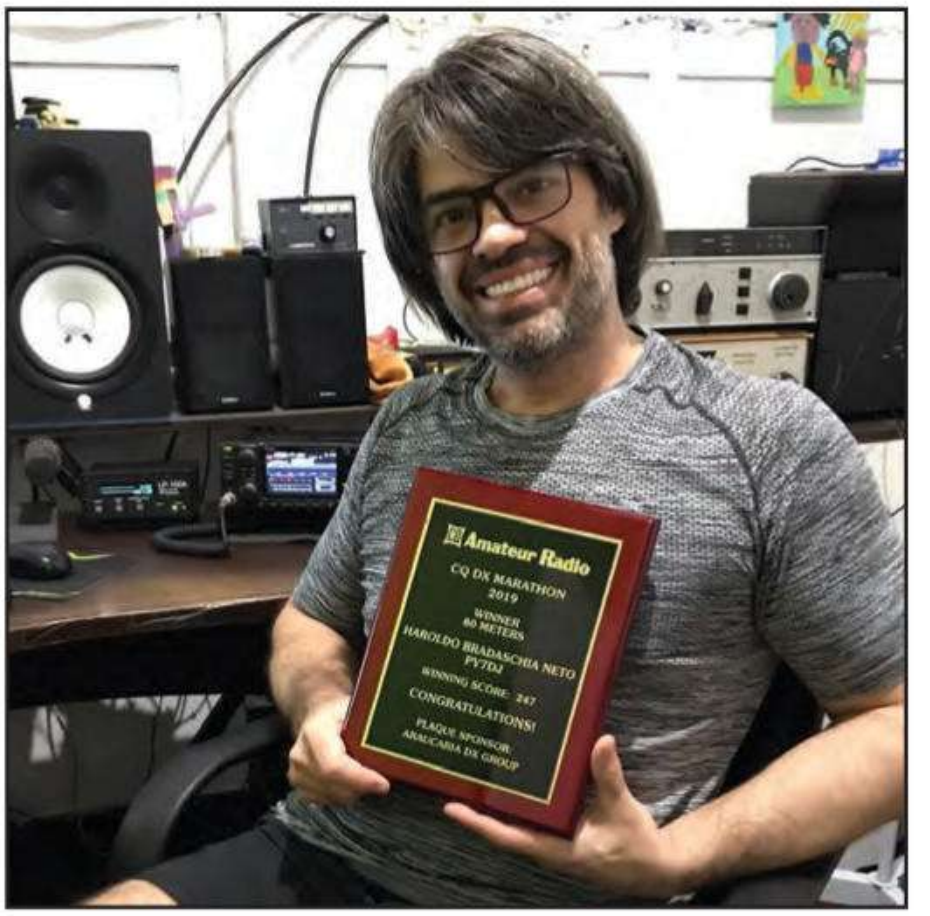
In addition to the 2020 plaque winners, we are awarding 98 Certificates of

CLUB SCORES

Club		Score
CDR Group	Brazil	10557
Northern Illinois DX Association	Illinois, USA	7287
Rio Dx Group	Brazil	7281
Western Washington DX Club	Washington, USA	6267
Araucaria DX Group	Brazil	5631
Willamette Valley DX Club	USA	4444
Mother Lode/DX contest Club	USA	3944
Carolina DX Association	USA	3563
YB Land DX Club	Indonesia	2010
East Tennessee DX Association	Tennessee, USA	1953
Italian Contest Club	Italy	1827
CabreuvaDX	Brazil	1699
Yankee Clipper Contest Club	USA	1574
Society of Midwest Contesters	USA	1301
CMDXGROUP	Brazil	1184
Vytautas Magnus University Radio Club	Lithuania	1138
LU Contest Group	Argentina	998
Arizona Outlaws Contest Club	Arizona, USA	940
NERG (North East Radio Group)	Australia	884
UBRO	Brazil	777
Radio Club Venezolano	Venezuela	771
VU Contest Group	India	771
TRAC	Turkey	758
Florida Contest Group	Florida, USA	734
SCCC	USA	712
Bavarian Contest Club	Germany	684
CDXC	Europe	684
Associacao Dos Radioamadores Do Parana	Brazil	614
Potomac Valley Radio Club	USA	592
Salt City DX Association	USA	564
Southern California Contest Club	California, USA	550
Team Papa	Turkey	535
Metro DX Club	Illinois, USA	509
Bahia Dx Group	Brazil	490
CWOPS	CW ops	486
Lone Star DX Association	Texas, USA	457
Mad River Radio Club	USA	436
ARI	Italy	418
CDXA	USA	415
Central Arizona DX Association	Arizona, USA	411
Clipperton DX Club	France	411
GDXC	Cuba	398
Radios Sportklub Puspokladany	Hungary	387
Lighthouse ARA	USA	363
Black River Radio Ops	USA	357
CADXA	USA	331
Chilean Pacific DX Group	Chile	291
GPDX	Portugal	282
Minnesota Wireless Association	Minnesota, USA	266

Club		Score
Belarus Contest Club	Belarus	264
Baltic Contest Club	Lithuania	262
ARNSW	Australia	249
DUZRAD	Turkey	243
South East Contest Club	USA	242
URE	Canary Islands	241
Hudson Valley Contesters and DXers	USA	229
Mile High DX Association	Colorado, USA	225
FT8DMC	Austria	223
Grand Mesa Contest Club	Arizona, USA	221
Magalies Radio Amateur Klub	South Africa	211
RSGB	Great Britain	211
Icelandic Radio Amateurs	Iceland	204
DARC P30	Germany	200
Mulan DX Club	China	197
Southern AZ DX Association	Arizona, USA	197
Minas Dx Group	Brazil	196
Bolingbrook ARS	Illinois, USA	195
Southwest OH DX Association	Ohio, USA	195
North Coast Contest Club	USA	192
NSRC	USA	192
Valley Radio Club of Oregon	Oregon, USA	192
MDXG	Argentina	191
Nixa Amateur Radio Club	USA	190
SK6HD	Sweden	190
Tennessee Contest Group	Tennessee, USA	188
Ham Society of the Philippines, Inc.	Philippines	187
Northern California DX Club	California, USA	187
Maritime Contest Club	Canada	184
Croatian Contest Club	Croatia	183
ARIPA DX Team	Sicily	182
Mississippi Valley DX/Contest Club	USA	176
WACOM	Pennsylvania, USA	175
Just For Fun Contest Club	Germany	174
Duzce Amateur Radio League	Turkey	173
YO DX Club	Romania	173
SP DX Club	Poland	160
Bradley County DX Association	USA	157
ICC Italian Contest Club	Italy	156
SSA	Sweden	156
REP	Portugal	146
Kentucky Contest Group	Kentucky, USA	145
CRASMO	Brazil	143
Orari Lokal Jakarta Timur	Indonesia	142
Contest Club Ontario	Canada	138
GITRAD	Turkey	129
KARTS	South Africa	119
URAD Hamradio Club	Turkey	63
São Paulo Contest Group	Brazil	47

Jim, K2JL, won the Formula Class plaque in both 2018 and 2019. For 2020, he erected a new Hex Beam and switched to Limited Class. In his first year in Limited Class, Jim took top honors with his score of 267. Jim is shown here in his shack with his 2019 plaque for winning Formula Class.



Neto, PY7DJ, was one of many Brazilian stations to win single-band trophies in 2019. Although active on all bands, Neto concentrated on 80 meters in 2019 and is shown here holding his 80-meter top score plaque.

Achievement for various categories. Please consult the detailed listings for the calls of the certificate winners. Certificates are awarded for the highest 6-meter and 160-meter scores, top continental score for each of the three modes, top score in each country, top score in each CQ zone, top score in each Canadian call district, top score in each USA call area for each of the four DX Marathon classes plus the top single-mode score in the USA. Congratulations to all the 2020 certificate winners!

Despite a big drop in the maximum possible score due to the lack of DXpeditions, 10 all-time records were broken in 2020. New records included two new country records, four new USA call area records, two new continental mode records, and new records on the 6- and 60-meter bands. Even with reduced DX activity, breaking records is still very possible.

In the popular club competition, the CDR Group in Brazil once again took top honors with an aggregated score of 10,557. The battle for second place was remarkably close, with the Northern Illinois DX Association moving into second place by beating the Rio DX Group by just 6 points. NIDXA is the sponsor of the top three DX Marathon plaques. Don't forget to include your club's name on your 2021 DX Marathon submission.

Some Operating Advice

Each year the DX Marathon website publishes a large amount of information to help participants minimize errors in their submissions. The Helpful Hints page can be accessed from the DX Marathon home page. In 2020, we published over 1,000 callsign exceptions and notes to help every participant reduce the number of errors in their submissions. We also recommend that you regularly update your logging program callsign database if it has one. Unusual callsign prefixes seem to multiply every year, so updating your program's database is critical to properly determine the DX location and/or zone.

In 2020, the number of participants with no errors increased to 25% from 22% in 2019. We were happy to see the improvement, but 75% of our entrants made at least one error. Unfortunately, the overall error rate for those who did make mistakes increased to 1.7% from 1.5% in 2019. The highest

TOP SCORES: CONTINENTAL MODE, USA & CANADA CALL AREA

Phone

AS	VU2DED*	111
EU	MIØBHX*	205
NA	W4HY	240
OC	VK2BY*	178
SA	PY5QW*	222

CW

AS	TA4MA*	116
OC	ZL1BBW*	182
SA	PY4XX*	187

Digital

AF	ZS2EZ*	238
AS	4X4MF*	254
EU	HA1RB	270
NA	W4UWC*	225
OC	YB2TS*	207
SA	PY5HOT*	230

USA Unlimited

WØ	KBØEO	266
W1	KX1X*	229
W2	K2ZJ	297
W3	K3RA*	285
W4	WN4N*	286
W5	W5IF*	273
W6	N6WT	281
W7	WO7R*	275
W8	NØFW	288
W9	N2BJ*	283

USA Limited

WØ	KDØWUQ*	71
W1	KI1U*	174
W2	K2JL	267
W3	WA3WZR*	175
W4	AA4R*	190
W5	K5DC*	218
W6	K7QDX*	203
W7	AF7NX*	192
W8	WT8E*	204
W9	W9RF*	238

USA Formula 100W

WØ	AD1C*	225
W1	W1NG	183
W2	W2VU*	44
W3	AI3KS*	86
W4	W4UWC	225
W5	NE5W*	219
W6	W7PC*	187
W7	WV7S*	73
W8	KM8V*	214
W9	KW9U*	211

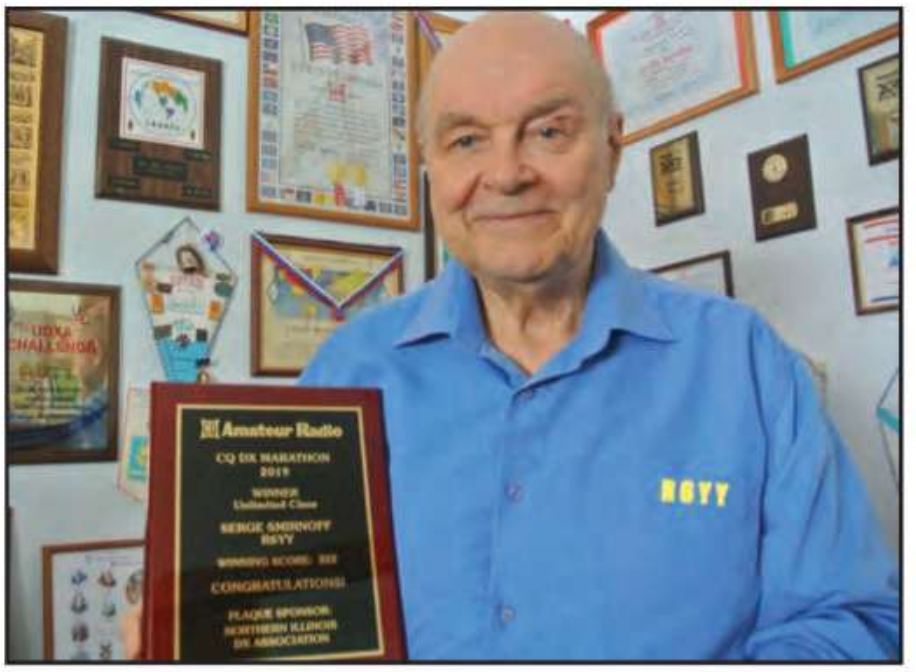
USA Formula 5W

W1	KA1PPV	23
W3	KZ3I*	132
W5	KG1GEM*	61
W6	W8QZA*	175
W8	K8ZT*	192

Canada

VE1	VE2BR*	250
VE3	VE3VEE	287
VE7	VA7CRZ*	189
VE9	VE9VIC*	184

* Certificate Winners



Serge, R6YY, has been scoring in the Top 5 for many years, but 2019 was the first year he took home top honors in the DX Marathon, a feat he repeated in 2020. Serge has been chasing DX since 1968 and is very active on the bands and is shown here with his winning plaque for Unlimited Class in 2019.

error category was once again "wrong zone," which accounted for a third of all errors made. The wrong zone error rate continues to increase each year. Confusion with USA zones is one of the biggest sources of zone errors. It is especially important to note that USA callsign numbers are no longer required to match their QTH. A W6 could be in New York, or a KL7 could be in Puerto Rico. In addition to the USA, there are many special callsigns in Russia that do not follow the traditional callsign mapping, thus creating many errors in zones 16, 17, 18, and 19. Zone 2 also continues to be a problem. Very few VE2 stations are in Zone 2 — most are in Zone 5. The DX Marathon website does list the most active Zone 2 stations. The next highest category was "invalid callsigns" — callsigns that were entered by participants, but do not actually exist. These accounted for 25% of all errors. Wrong country accounted for 23% of all score reductions. Busted call errors dropped from last year to 16%. There were many unique callsigns used in 2020 so it is critical to review your DX Marathon submission carefully. The number of bad spots on the DX Clusters remains a big problem.

When logging a QSO from a DX spot, listen carefully to the DX station to make sure the callsign is logged correctly. 41% of all point subtractions were due to busted or incorrect callsigns. Some invalid callsigns may have been busted calls that were so bad that we could not determine the real callsign. Once again, there were many mix-ups between "Ø" (zero) and "O" (oh). The computer is not forgiving, so check your log carefully! The database that is used for scoring the DX Marathon includes start and end dates for all major expeditions, so please ensure that dates and times are properly logged along with the callsign, country, and zone for each QSO. NIL (Not In Log) reductions more than doubled in 2020. With more logs being posted online, it is easy to check if you are in the log before entering that QSO in the DX Marathon. We do publish a lot of helpful information on the DX Marathon website <https://dxmarathon.com>, but there is nothing we can do to ensure you are in the log.

As part of this article, you will find a complete listing of all scores plus a listing of the top scores in all available categories. The DX Marathon website will include additional information and details on the 2020 results plus photos of plaque winners as they become available. For any questions or comments about the DX Marathon, please contact the author at <comments@dxmarathon.com>.

Special Thanks

The DX Marathon would not be possible without incredible assistance from so many people. The team effort makes the DX Marathon possible. I want to first thank *CQ* magazine for developing the Marathon and providing continuing support. One of the first hams to jump in was Alex, VE3NEA, who has created the DX Marathon scoring software. He continues to provide updates as required. Without his software, there would not be a DX Marathon. A special thanks goes to Jim, AD1C, who has created the very popular ADIF-to-DX Marathon software used by nearly 70% of all entrants. I also want to thank our many plaque sponsors who make our winners incredibly happy each year. Mike, ND9G, wrote our online submission and log-checking tool for which we are grateful. Dave, AA6YQ, has created powerful DX Marathon tracking tools in his DX Labs software that we really appreciate. John, W9ILY, creates the DX Marathon certificates — thank you, John. A special thank you goes to W9KNI and PY5EG for their incredible support of the Marathon and their constant encouragement over the years. Bernie, W3UR, has also been a tremendous supporter by including lots of DX Marathon in his *Daily DX* newsletter. I also thank Laurie, VK3AMA, for including DX Marathon support in his popular JT Alert software. Of course, none of this would be possible without you — our valuable readers and participants in the DX Marathon. Thank you for your participation in 2020 and best of luck in 2021!

UNLIMITED CLASS

Callsign	Countries	Zones	Score
K2ZJ	257	40	297
JA2NDQ	254	40	294
JH1AJT	256	38	294
PY5EG	253	40	293
R6YY	253	40	293
NØFW	249	39	288
VE3VEE	247	40	287
WN4N	246	40	286
K3RA	245	40	285
K5EK	244	40	284
DJ3AA	244	40	284
K4ZO	243	40	283
N2BJ	243	40	283
CT1IUA	242	40	282
N6WT	241	40	281
K9NU	241	40	281
W9ILY	240	40	280
YB5QZ	240	40	280
MØNKR	241	39	280
JA0DAI	239	40	279
VK3GA	239	40	279
OM3EY	237	40	277
PY5GA	239	37	276
WE9V	237	39	276
WO7R	235	40	275
K9NB	235	40	275
OK2PAY	234	40	274
SV2AEL	234	40	274
W5IF	233	40	273
K7BV	234	38	272
HA1RB	230	40	270
SQ8N	230	40	270
LY5W	230	39	269
CT3MD	229	40	269
EA1DR	228	40	268
A92GE	226	40	266
KBØEO	227	39	266
IZ8MXB	226	40	266
OM5XX	227	38	265
VK3BDX	225	40	265
SV2HXX	225	40	265
EV1R	225	39	264
PP5JR	223	40	263
K6RO	222	40	262
AA9A	222	40	262
ZL2IFB	222	40	262
LY7Z	222	40	262
PY4AZ	222	39	261
ON6NL	220	40	260
NI3P	220	40	260
K9KE	220	40	260
W9MK	219	40	259
IZ5CML	220	39	259
NV9L	219	40	259
WØRIC	221	38	259
OD5YA	216	40	256
DJ9ZB	216	40	256
5P1KZX	216	39	255
ZW5B	218	37	255
W9KNI	216	39	255
PA3FQA	215	39	254
F4ESV	214	40	254
4X4MF	215	39	254
SV1CNS	216	37	253
IK5FKF	213	40	253
PC3T	213	40	253
W6OAT	212	40	252
HK3W	212	40	252
IKØXBX	211	40	251
PY6HD	211	39	250
N6RV	210	40	250
VE2BR	211	39	250
NU8Z	210	40	250
PY4OY	212	38	250
OH2BLD	211	38	249
VK2PW	210	39	249
W1AJT	208	40	248

PY2LCD	208	39	247
K9RR	207	39	246
DL1NKS	208	38	246
W7CD	207	39	246
WY7W	210	35	245
WB9Z	206	39	245
PY2KNK	208	37	245
W4PNY	205	40	245
K3WA	204	40	244
W9JJB	204	40	244
TA2LG	203	40	243
PY2COY	203	40	243
VK3KTT	202	40	242
AA5JF	203	39	242
W9ZCL	203	39	242
N6JV	201	40	241
LY5O	202	39	241
W7YAQ	200	40	240
W4HY	201	39	240
PY6TS	200	40	240
WD9DZV	200	40	240
K5BG	200	39	239
W6XK	198	40	238
NK7I	199	38	237
W1YY	201	36	237
K7PI	196	40	236
VU2AE	197	39	236
W4JS	197	38	235
N4PQX	195	40	235
N4MIK	197	37	234
VU2IBI	194	40	234
W4QN	193	39	232
VE3UTT	193	39	232
WX6V	194	38	232
AK6A	193	37	230
N7QT	191	39	230
R2ARR	193	37	230
PY5HOT	194	36	230
PY2CP	191	38	229
KX1X	192	37	229
K4RUM	194	35	229
PY2DPM	190	39	229
PY1VOY	198	31	229
PU2WSQ	189	39	228
K9CT	187	40	227
W4HG	188	39	227
ND9G	188	39	227
PP1CZ	188	39	227
CT1ILT	187	39	226
W3GQ	185	39	224
PY2YS	187	37	224
YV4BCD	185	39	224
OE1SGU	185	38	223
K6YK	184	39	223
PY5QW	184	38	222
PY2BEK	185	37	222
PY2DMZ	184	38	222
KY7M	183	39	222
W9II	184	38	222
W7WM	182	39	221
N7US	184	37	221
K5ZD	181	40	221
PS8RV	179	40	219
PY2XC	182	37	219
LY2MM	179	39	218
PY2IQ	179	39	218
KA6BIM	177	40	217
K5YE	178	39	217
KC1BB	177	40	217
VE3ZZ	180	36	216
W1HS	184	32	216
WA4JQS	176	39	215
SV1HEP	174	40	214
YC7YGR	179	35	214
PY2OKB	176	38	214
LU2JCW	176	38	214
PY2VM	176	37	213
KZ2I	173	40	213
K8YC	175	37	212
I2IFT	173	39	212
N9LQ	173	39	212
GØYCE	174	37	211
ZS6HON	174	37	211
PAØINA	172	39	211
K1ESE	172	38	210
K8AJS	174	35	209
PU2MVE	170	39	209
PY2AB	172	37	209
YB2TS	170	37	207
K9ARZ	177	29	206
K9MM	167	39	206
KD4RH	166	40	206
WS7L	167	38	205
MIØBHX	169	36	205
PS8CW	167	38	205
W9VA	165	39	204
NC6R	165	39	204
W8AV	165	38	203
PY2JG	166	37	203
NQ7R	164	39	203
SQ9V	162	40	202
BV1EK	163	39	202
PY4FD	164	38	202
PY2KS	174	28	202
WC3W	161	40	201
PU2SWR	165	36	201
W1NK	165	36	201
K7ACZ	163	37	200
VK3VT	160	39	199
K2UF	164	34	198
K4XU	160	38	198
R9AB	162	36	198
PY2GZ	161	37	198
N7WS	159	38	197
W3DQS	161	35	196
PY4JW	161	35	196
K2YYY	158	38	196
TA1CQ	161	35	196
N6MZ	156	40	196
KZ1W	156	39	195
W9CY	159	36	195
PY2GIG	159	36	195
AJ8B	160	35	195
KL7KK	155	39	194
K1VMT	157	37	194
K9IR	156	37	193
PS2T	153	39	192
YV4ABR	160	32	192
LU7HN	156	36	192
K9RE	154	38	192
EI7CC	155	36	191
PY5ZHP	154	37	191
NK7Z	152	39	191
TA3ST	153	38	191
VU2PTT	152	38	190
AL7KC	152	38	190
PY2WND	156	34	190
K9IO	151	39	190
WAØJZK	157	33	190
VA7CRZ	152	37	189
NU7J	150	39	189
PY2NF	149	40	189
KC7V	151	38	189
IU4FNO	150	39	189
TA4Q	151	37	188
AF4T	152	36	188
NA6O	151	37	188
W2TT	155	33	188
PY2TUA	155	33	188
K6UM	150	37	187
PY4XX	150	37	187
LA3MHA	149	38	187
WB2NVR	152	35	187
LY5M	153	34	187
WA7CPA	152	35	187
DL7JAN	150	37	187
K7RL	150	36	186
K6OK	148	38	186
F4HJO	149	37	186
SQ3MZM	151	35	186
PY2VZ	148	37	185
W6UB	149	34	183
9A2EU	146	37	183
IT9BLB	144	38	182
PY5DC	145	37	182
K9JU	149	33	182
K9CJ	146	36	182
ZL1BBW	145	37	182
PY2LPM	146	36	182
PR8KW	147	34	181
PY2UD	148	33	181
PU2UAF	144	35	179
YB2BNN	145	33	178
KN7K	144	34	178
W3OA	142	36	178
DL6DH	146	32	178
VK2BY	143	35	178
KD8NYP	144	33	177
AG7N	138	39	177
PY5AMF	147	30	177
W6RS	143	34	177
NIØC	140	36	176
W7RM	142	33	175
KD8NYO	142	33	175
WA9LEY	145	30	175
WI7N	138	37	175
W2FV	136	38	174
K1GU	140	34	174
K6TQ	138	35	173
PP1WW	136	36	172
W4GEH	134	36	170
PY4BZ	138	31	169
K6MM	132	37	169
PY2ADR	138	31	169
CE7KF	135	33	168
KT7E	133	34	167
N3CDA	135	32	167
WE6Z	131	36	167
N7BV	131	35	166
WX7HS	128	38	166
PU9OAA	130	36	166
AD7Z	129	37	166
N1MGO	132	34	166
TA2XX	133	33	166
PU2SDW	134	32	166
K7RF	132	33	165
PR4T	137	28	165
N7TK	128	37	165
W9PDS	130	34	164
K7ZS	130	34	164
K1SND	131	33	164
PU2LRZ	130	34	164
WR7T	127	36	163
PY4ARS	133	29	162
PY4LH	136	26	162
VK6DW	124	37	161
OD5UI	127	33	160
W6RKC	123	37	160
W6DE	125	34	159
TF3DC	130	29	159
IK1JJM	126	33	159
AJ4HW	131	28	159
N3QE	125	32	157
TA7OYG	126	31	157
TA7TC	122	34	156
KV3T	124	32	156
IUØDZA	122	34	156
K7ZV	123	33	156
W4UW	128	28	156
BH3DHE	121	35	156
AF6SA	122	34	156
KX7DX	118	37	155
WC7Q	117	38	155
TA7AEK	123	32	155
KF6MK	119	36	155
N5CR	119	35	154
W1RH	121	33	154
VK4CC	118	35	153
PY2OAL	123	30	153
PT7ZT	121	31	152
CT7AKW	122	30	152
N9LAH	119	33	152
K7EG	117	33	150
N4KW	118	32	150
K7MH	114	35	149
NE7D	115	34	149
PU2MXU	117	30	147
PT4A	111	36	147
PY2ZZ	116	31	147
TA3LHH	120	27	147
W6BRY	114	33	147
PY1ZV	115	32	147
PY2XZ	117	30	147
I4EAT	120	26	146
K7VIT	111	35	146
F6GCP	119	26	145
NJ6G	107	37	144
W1SRD	110	34	144
W7VAS	112	32	144
K7BTW	107	36	143
WD6T	109	34	143
PP5DZ	113	30	143
AB8M	110	33	143
KB2S	108	34	142
PU2YXB	112	29	141
W9IXX	107	34	141
N9OK	108	32	140
PY2HJ	108	31	139
GW4EVX	107	31	138
PU2XMY	105	33	138
K7EKD	104	33	137
W9ZJ	105	31	136
K7HV	104	32	136
KB7BTO	101	33	134
PY5ZD	99	33	132
K7PAX	97	34	131
PY2ZEA	106	25	131
KX7YT	104	26	130
LY2IJ	103	26	129
PY2MIG	101	28	129
W7VO	98	30	128
CT7ANO	100	28	128
K6KR	95	32	127
W6DCC	96	31	127
PT2AW	96	30	126
TA5BS	97	28	125
K9QJS	90	34	124
CE4WT	95	28	123
PR1G	97	25	122
PP2CC	93	29	122
WØJW	92	29	121
N7JP	91	30	121
KJ9B	92	27	119
PY3NA	85	34	119
TA1SOR	91	28	119
ZS6SKY	89	30	119
K4NWX	95	24	119
PU2VJI	91	26	117
NL8F	86	31	117
W6RC	93	23	116
N7PHY	83	33	116
IW2CAM	97	18	115
TA3OKK	88	27	115
PU2MBO	90	25	115
PY7GB	88	26	114
PP5AO	84	28	112
PU2MST	86	26	112
TA7LZB	92	19	111
VU2DED	83	28	111
TA7LDU	87	23	110
TCØX	87	23	110
W7ZB	76	34	110
ZW2T	85	24	109
N9EP	84	25	109
VU2TMP	85	24	109
PR2N	80	28	108
TAØTA	84	23	107
PY3BEG	81	25	106
TC3SAV	83	23	106
K7VAP	76	29	105
K7EMI	74	30	104
WW7E	74	28	102
KE8LXN	80	22	102
PU5FJR	78	23	101
PYØFF	73	25	98
K7BVT	70	28	98
TC3A	77	19	96
TA4IGN	73	23	96
PU4CEP	70	24	94
N6VH	65	29	94
TA2NC	75	19	94
PY2MP	71	22	93
PY2DSA	68	25	93
PP1KV	70	22	92
PY9TW	63	28	91
PJ2/W9VA	64	25	89
W7NP	60	29	89
LY2AE	65	24	89
K9UQN	67	22	89
TC3B	67	17	84
TA2TC	64	20	84
PY5AKW	66	17	83
PY2AXH	56	24	80
PY2RKG	61	18	79
PU2VAV	57	21	78
KB7HDX	53	24	77
PY1FOX	56	20	76
TA3LUX	58	16	74
PY2NFT	56	18	74
W7SLS	46	26	72
AD7UZ	47	25	72
TC114PTR	55	16	71
KU4NY	50	21	71
TA3LKJ	52	19	71
PU1MIL	50	20	70
PU2OPV	53	16	69
N7DX	45	24	69
PU2MEA	49	18	67
TA8BZ	54	13	67
YM1KM	51	12	63
W9KMP	44	16	60
K6SZQ	34	24	58
PY1ROE	44	11	55
TC3H	42	11	53
LU5FF	36	14	50
ZZ2J	33	16	49
PU2LFU	34	15	49
PY2SR	33	14	47
JO7KMB	30	13	43
PY1CG	29	11	40
PU2MBY	27	11	38
PY1CDR	23	13	36
ZY1F	24	11	35
PR3CDR	23	10	33
PY1SGT	22	11	33
PY5XH	19	12	31
WB6BET	17	13	30
PR1T	13	10	23
PY2KEY	15	8	23
PY2TTN	13	8	21
TA4HQ	14	4	18
PT9BM	9	6	15
PU2RXA	8	7	15
KI6YYT	5	5	10
PU5PGK	2	2	4

LIMITED CLASS - 100W OPTION

Callsign	Countries	Zones	Score
K2JL	227	40	267
IK2RPE	219	40	259
TA4RC	214	38	252
EA8DHH	201	40	241
TA1CM	201	38	239
PU2VLW	199	40	239

ZS2EZ	198	40	238
W9RF	198	40	238
PY2MSR	189	39	228
TA5FA	191	35	226
K9GA	186	39	225
PU5KGB	183	40	223
PY2CAT	184	38	222
PY2CX	183	39	222
UR7FM	183	37	220
N9TF	180	39	219
K5DC	181	37	218
TA2L	175	37	212
LU5HA	175	36	211
SV1CIF	174	37	211
PU2RTO	171	39	210
PY2GTA	171	38	209
PU9OJZ	171	38	209
PS8MT	171	37	208
PY2VA	169	39	208
PY4EP	169	38	207
PP5XA	169	38	207
TA7I	167	39	206
GUØSUP	167	39	206
YC1RKT	170	35	205
PY2TC	168	37	205
WT8E	167	37	204
PY2QT	166	37	203
G4AYU	166	37	203
K7QDX	166	37	203
YB2HAF	162	38	200
CM2RSV	165	35	200
LU6FOV	169	30	199
SV9COL	162	35	197
BI8CKU	160	37	197
PU4GOD	162	35	197
SV1CKZ	162	34	196
PY1SX	156	38	194
PY4ZO	156	37	193
AF7NX	155	37	192
LW5DR	152	39	191
SM6A	151	39	190
AA4R	156	34	190
N7RD	152	37	189
PU2STZ	151	35	186
IK2WXQ	154	32	186
VE9VIC	148	36	184
PY4BK	141	38	179
HB9DDZ	140	38	178
OZ8FTDM	139	36	175
WA3WZR	142	33	175
KI1U	144	30	174
KG5RJ	140	34	174
YO4AAC	136	37	173
YM2KD	138	35	173
PU5BOY	141	31	172
NA8W	136	35	171
PP5TG	140	31	171
ZP5DNB	141	30	171
TA4PR	139	31	170
TA2LP	136	33	169
W4UM	132	30	162
ON6SAT	123	37	160
IKØALT	127	33	160
TA2FE	124	35	159
PU2YMH	125	33	158
HAØIV	126	29	155
YM4KT	120	33	153
PY2BS	119	33	152
YB7XYO	122	30	152
YC7UBK	115	36	151
HZ1SK	119	32	151
AE4WG	122	28	150
PU1SKS	118	31	149
VK5DG	114	34	148
PY1IR	114	33	147
IZ2BHQ	118	28	146
K4IE	116	29	145
TA2E	113	30	143
WB9VRQ	111	28	139
WZ8T	106	32	138
YC7YDB	108	30	138
KK9H	102	33	135
TA4ORZ	101	33	134
LU6UBM	99	33	132
K9QVB/9	102	28	130
TC5OCK	99	30	129
YB1UUN	94	34	128
K7VZ	96	32	128
K4AR	99	29	128
N8YXR	102	25	127
PU4TPM	101	26	127
KR7X	91	36	127
KE4QCM	97	30	127
PT8DX	101	24	125
ON2AD	98	27	125
PY1SAD	97	27	124
TA4CS	96	28	124
IK2ULV	102	20	122
AE7U	90	31	121
PY1CC	91	27	118
TA4MA	91	25	116
AF9W	84	30	114
WB4OMM	86	23	109
W7DGP	79	30	109
YE4IJ	82	25	107
PY4CCL	83	23	106
LY4K	84	21	105
PU2NAX	82	22	104
TA2OLS	82	20	102
YC7UVB	76	23	99
YC7UAH	70	26	96
IU2JWF	72	22	94
TA1API	73	19	92
TA4BU	73	18	91
TC3STAYHOME	71	19	90
PU5OEB	63	26	89
VK6HG	63	25	88
TA7AL	69	19	88
TA3X	69	18	87
PP5EI	67	20	87
K6PDL	60	27	87
N7JI	63	23	86
PV7M	64	16	80
PY3ZZR	59	21	80
TA2UMH	57	22	79
ZW1P	59	18	77
W7TMT	49	25	74
PU8NOW	52	20	72
KDØWUQ	51	20	71
9A5MPV	59	10	69
TA1LFU	52	14	66
TAØACL	57	7	64
TC4A	47	11	58
YB7WBC	35	22	57
TC1KESAN	42	11	53
PY1EI	35	16	51
WK6I	24	21	45
PU5JDA	27	16	43
PT7APM	24	14	38
PU9DCB	26	12	38
PY1MK	23	11	34
PY1PTS	23	9	32
ZW1M	20	11	31
TC3D	20	4	24
ZZ5BR	12	9	21
PU5RSL	10	8	18
TA3NTI	7	4	11
PR1M	5	5	10

FORMULA CLASS - 100W OPTION

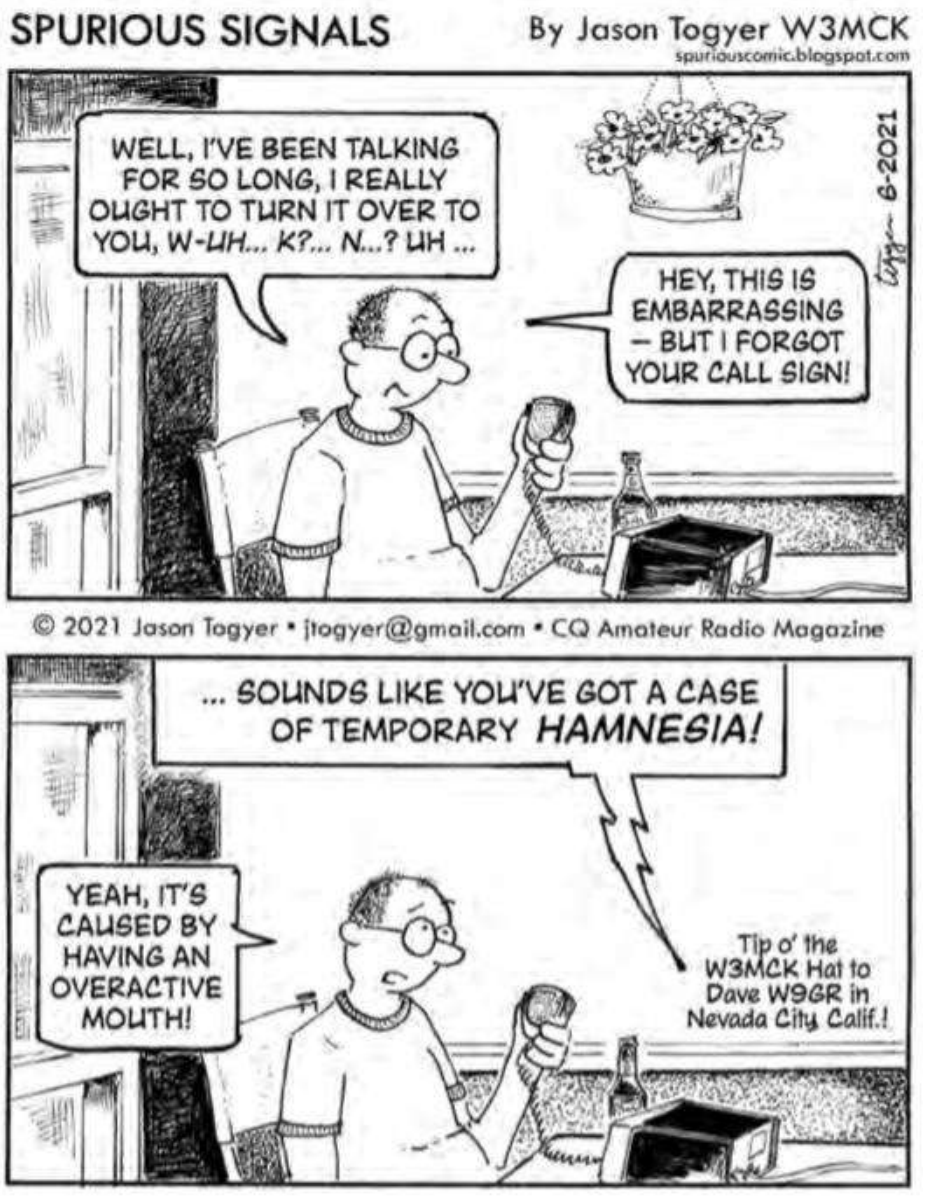
Callsign	Countries	Zones	Score
OK2FD	223	40	263
IUØLFQ	210	39	249
YV5OIE	197	40	237
HA7LJ	192	40	232
SV1AZL	196	36	232
PP2RON	195	37	232
W4UWC	186	39	225
AD1C	187	38	225
F4GYM	186	39	225
NE5W	179	40	219
F4FCE	179	39	218
LY2PAD	179	37	216
CX3AL	179	36	215
PY3KN	177	38	215
KM8V	176	38	214
KW9U	175	36	211
TF3JB	167	37	204
PP2CS	165	38	203
DL5SFC	161	39	200
AC7P	164	36	200
PU5YSV	162	34	196
N9LJX	157	36	193
TAØS	155	38	193
KG5THG	154	36	190
PY5CC	151	39	190
W7PC	150	37	187
4F3BZ	148	39	187
W7FKI	148	36	184
N9ATD	145	38	183
W1NG	151	32	183
PY5IP	147	35	182
VA3VF	148	34	182
4X1ST	145	35	180
PU2GTA	143	36	179
AB1J	142	33	175
DL7PJ	144	30	174
EI3CTB	138	36	174
IN3FHE	141	32	173
DU7EYG	133	40	173
PY1NX	135	37	172
WB4RA	139	29	168
PU8YPL	135	32	167
PY2UGO	129	36	165
YV6BXN	132	32	164
JA1IRH	127	36	163
N6TCE	127	36	163
PY1AX	131	31	162
SQ9S	128	32	160
CT7AIX	129	31	160
CO2AJ	129	30	159
AB9YC	124	33	157
W4JUU	128	29	157
8S9J	125	31	156
PU3LYB	119	36	155
SP2TQQ	123	31	154
N1RDN	123	30	153
OK6DJ	125	26	151
W9TD	116	34	150
CT1END	117	29	146
YY5AEP	119	27	146
KM8L	116	29	145
OK1BLU	112	30	142
YCØSJA	106	36	142
PY1FI	110	28	138
PY5WD	111	27	138
TA7UHS	106	32	138
VE3TG	111	27	138
PU2XYT	111	26	137
K9OR	101	34	135
CO2VE	105	29	134
TC1ØØTBMM	104	28	132
PP5BT	101	28	129
TA1HZ	100	29	129
PU4HUD	90	32	122
PY5DD	92	29	121
MØXLT	102	18	120
VA3IDD	94	23	117
PU5MFI	89	27	116
K9WIS	86	29	115
DB5DY	94	20	114
PY5JAP	78	33	111
YC6JRT/0	82	28	110
PU1JPY	88	17	105
N8FYL	79	21	100
PY1KB	77	20	97
TA2UTA	74	22	96
PJ7AA	69	25	94
N6NFB	66	26	92
PG1R	72	18	90
AI3KS	67	19	86
PY2MIA	63	22	85
PY1NS	59	20	79
PY1AN	50	25	75
PR5J	56	18	74
WV7S	50	23	73
KE7AUB	46	21	67
PU5YDD	45	21	66
K5EM	42	24	66
AF5CC	46	18	64
TA1HF	50	11	61
PY1CD	54	5	59
TA1NAC	45	12	57
AA8MA	38	19	57
PY1RI	33	15	48
PU1JDU	37	10	47
W2VU	31	13	44
PY1DX	32	10	42
WQ9F	22	13	35
PU5NAO	20	14	34
PU1NIO	13	6	19
PY5FNB	10	8	18
PY5DU	9	6	15
PU1VFO	10	5	15
PY1PL	2	2	4

FORMULA CLASS - 5W OPTION

Callsign	Countries	Zones	Score
OK2AP	221	39	260
CO2QU	161	37	198
IZ3NVR	159	34	193
K8ZT	158	34	192
W8QZA	138	37	175
PU5IKE	107	30	137
KZ3I	106	26	132
VA3AMX	85	25	110
DF5WW	79	17	96
HK4KM	65	19	84
KG1GEM	44	17	61
N5ER	38	16	54
KA1PPV	16	7	23

LATE, SWL and CHECK LOGS

Callsign	Countries	Zones	Score
K9EL	248	40	288
KC6AWX	235	39	274
K9EL-Digital	215	40	255
HAØØØØ1	202	38	240
4Z4UO	119	24	143
PY5IN	76	27	103



Take It To The Field Special:

Many of us have gear sitting around our shacks that's just waiting to be "repurposed" for a new use. N4RLI did, and applied some ham ingenuity to build a beacon transmitter for both location tracking (APRS) and finding hidden transmitters (foxhunting).

stayPRS and FOXmtr

Build an APRS / Foxhunt Beacon with an HT and an Arduino

BY RALPH L. IRONS,* N4RLI

I have a Baofeng UV-5R handheld that no longer sees much use. I also have an idle Arduino microcontroller. I wanted to find a way to put them both to work, but I couldn't decide whether to make a foxhunt transmitter or an APRS beacon.[1] There are excellent articles online describing various ways to make one or the other. I decided to try to combine both applications in a single project. You can see short video demos of this project in APRS mode at <https://youtu.be/_zuubDFbyZM> and in foxhunt mode at <https://youtu.be/SvAG6S0d3hE>.

One of my goals was to avoid having to use an MP3 player with a pre-recorded audio foxhunt message to play into the Baofeng mic input. Before I retired from teaching at a STEM[2] magnet school, I helped students use Arduinos in some of their hands-on school projects. One assignment required writing an Arduino sketch[3] that could send Morse code messages to a piezo buzzer. As a result, I already had the code for an MCW (Modulated Continuous Wave) foxhunt beacon. Just feed the Arduino audio output into the Baofeng mic input instead of into a piezo buzzer! I decided to give that a try.

The Arduino coding for an APRS beacon, on the other hand, is beyond my skill level. Luckily, a web search turned up Arduino code written by a young Indonesian ham who is now an engineer — Han Gesang, YC1SDL. He has generously made his Arduino sketches available to all under the GNU General Public License. However, his code was written to include a GPS receiver. I just wanted a simple beacon for a fixed position, like my home QTH. The miracle is that his code still works after my editing.

The Arduino Sketch

The Arduino sketch for APRS uses square waves to do audio frequency shift keying (AFSK). In early testing of my project, I was surprised to find that audio square waves work well for APRS (see *Photo A*). But the square-wave MCW for the FM foxhunt transmitter sounded awful. If you've never heard the difference between sine wave audio and square wave audio, check out the examples at this website: <https://tinyurl.com/yytrymcd>. My foxhunt CW note

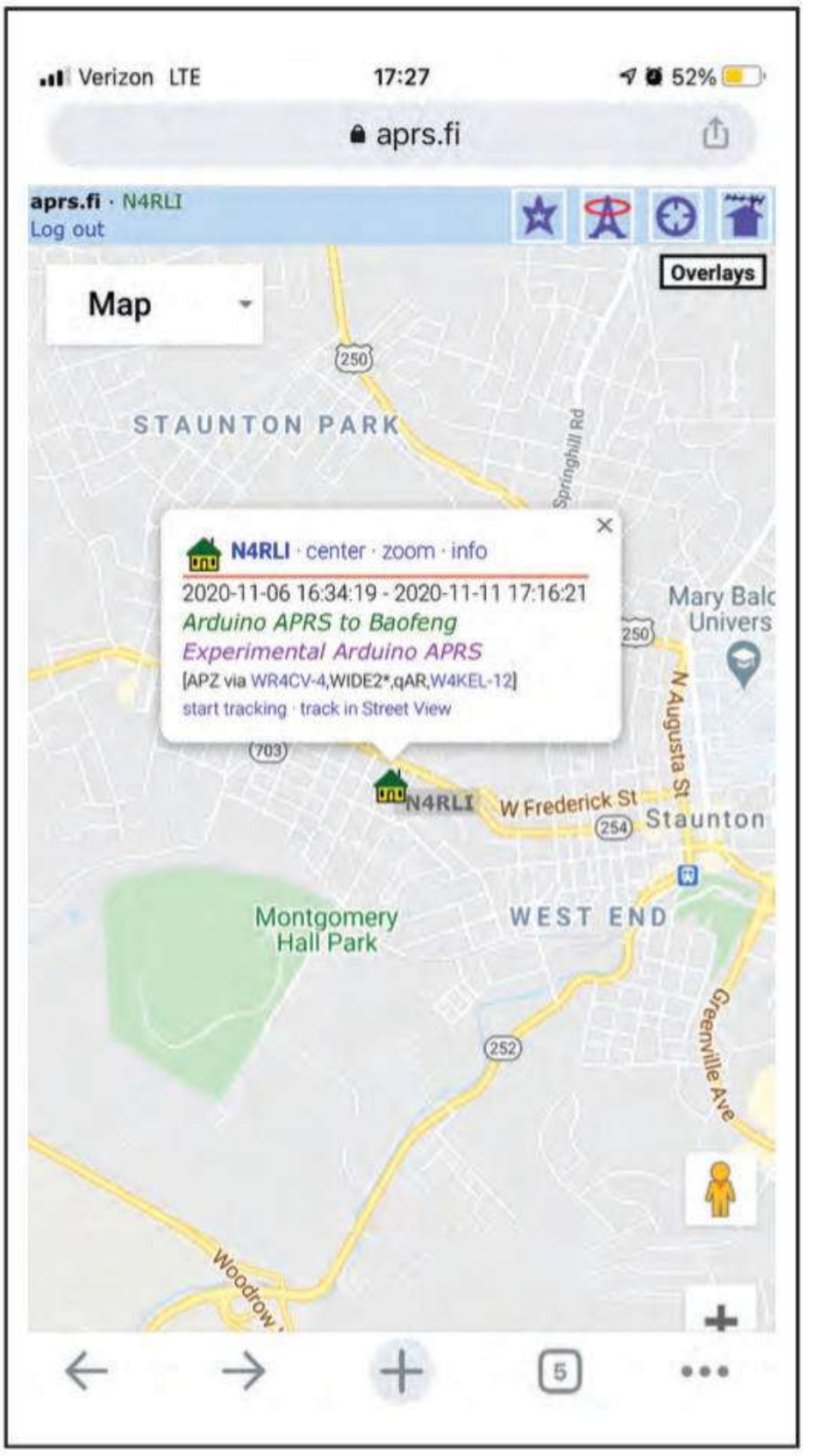


Photo A. My QTH in Staunton, Virginia, as beaconed to <aprs.fi> using this project in APRS mode.

** 1119 Stoneburner St.*
Staunton, VA 24401
Email: <ralphirons@gmail.com>
Web: <www.n4rli.net>

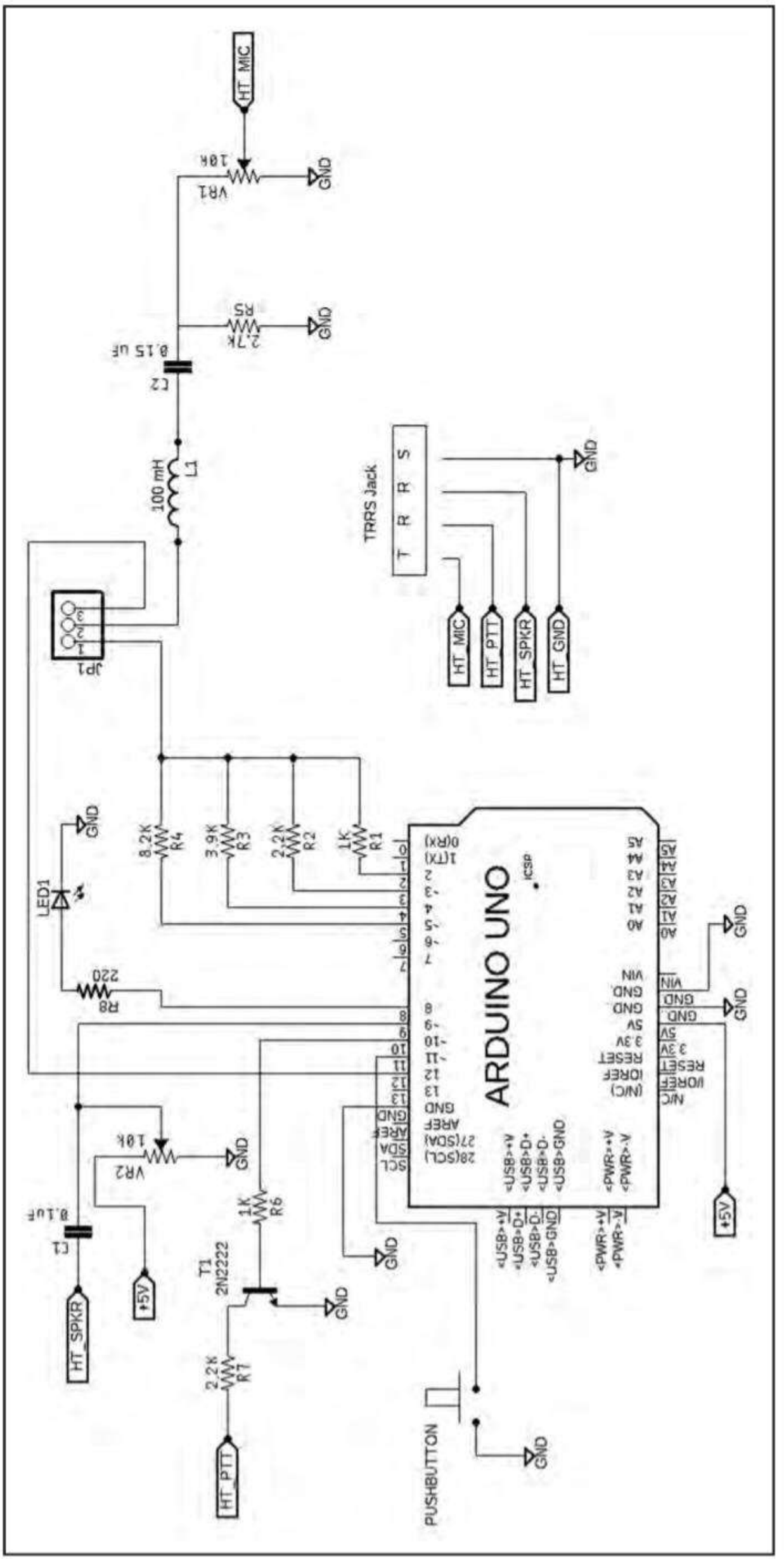


Figure 1. Schematic for the stayPRS and FOXmtr project.

sounded pretty much like the raspy square wave at that website. Back to the drawing board…

More online research led me to add a simple digital-to-analog converter (DAC) using four resistors, which you can see in a "ladder" configuration just above the Arduino Uno in *Figure 1*. I modified the sketch to apply voltage to different combinations of those resistors, gradually ramping up the total voltage to nearly 5 volts, then back down to 0, in a crude approximation of a 700-Hz sine wave. Crude it may be, but it sounds much better to my ear than the square wave audio.

The Arduino sketch for this project is available at <www.n4rli.net>. Click the *stayPRSandFOXmtr* link. You will need to download the zip file containing the sketch, extract the Arduino sketch from the zip file, and open it in the Arduino Integrated Development Environment (IDE). If you have never used the Arduino IDE, there are many tutorials available online.

Editing the Sketch

There is some editing that must be done before you use this project either in APRS mode or foxhunt mode. With the sketch open in the Arduino IDE, click *Edit > Find* and do a search for "variables to edit". For the APRS beacon, you will want to edit the values of *mycall, myssid, comment, mystatus*, *lati* and *lon*, *sym_ovl,* and *sym_tab*.

Here's an example:

```
char mycall[8] = "N4RLI";
char myssid = 0;

char comment[128] = "Arduino APRS to Baofeng";
char mystatus[128] = "Experimental Arduino APRS";

char lati[9]="3809.05N";
char lon[10]="07905.20W";
int coord_valid;
const char sym_ovl = '/';
const char sym_tab = '-';
```

Enter your callsign only in *mycall* (no additional prefixes or suffixes). For example,

```
mycall[8] = "N4RLI"
```

is good, but

```
mycall[8]= "N4RLI/7"
```

is not.

An SSID (secondary station identification) is used if you will have more than one APRS beacon in operation. You

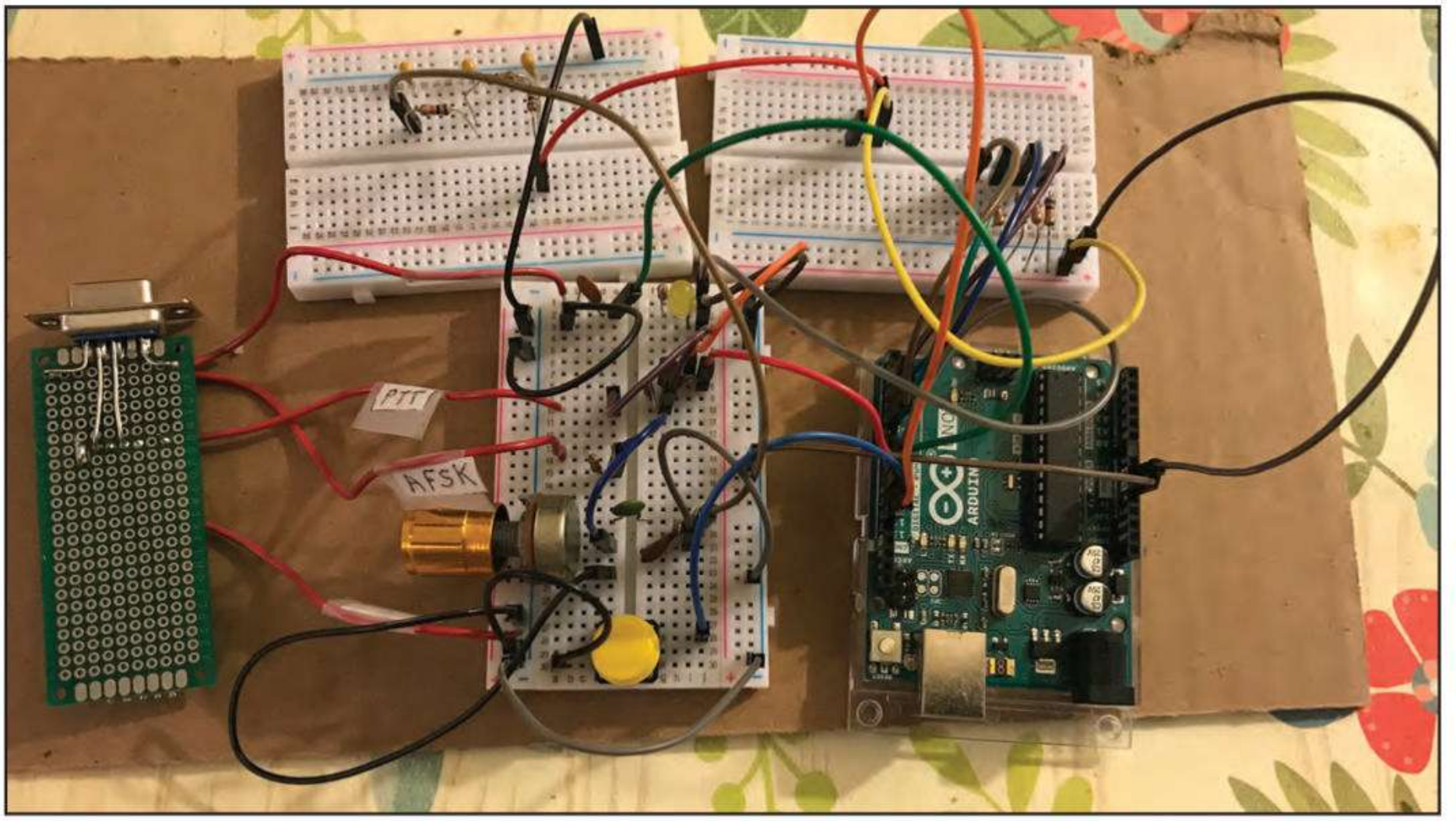


Photo B. Breadboard version of the project.

might have one in your house, another in your car, and one in your four-wheeler. For me, these could be N4RLI, N4RLI-1 and N4RLI-2. Since I don't have multiple beacons, I use ssid = 0, so that no ssid is added to my callsign in APRS map displays like the one at <www.aprs.fi>. (See *Photo A* for an example). For detailed recommendations on which ssid to use for various purposes, see the document by APRS developer Bob Bruninga, WB4APR, at <www.aprs.org/aprs11/SSIDs.txt>.

You may add a comment and / or a status report of up to 127 characters. (The 128th character is reserved for an end-of-string character automatically added when the code is compiled). If you don't want to add a comment or status report, use

```
comment[128] = "";
```

or

```
mystatus[128]="";
```

Note that each line of code in an Arduino sketch must end with a semicolon.

Latitude and longitude of your fixed location are entered in degrees (D) and decimal minutes (M), in exactly the format shown in the example. Latitude is given as DDMM.MMN or DDMM.MMS, and longitude as DDDMM.MMW or DDDMM.MME. Don't forget the leading zeroes in your longitude or latitude if your values don't use up all the available digits.

The graphical symbol displayed at your location on APRS maps is determined by the values you specify for *sym_ovl* and *sym_tab*. Using the values in the example, my symbol is a house with a vertical antenna on top, as seen in *Photo A*. If I change the value of *sym_ovl* from '/' to '\', my symbol will change to a house with a Yagi on top. I wish! For a complete list of *sym_ovl* and *sym_tab* values, and the resulting graphical displays, see <https://tinyurl.com/z45nfbb>.

For the foxhunt beacon, you will need to edit the fox message itself. Currently

Table 1

Parts List

L1	100 mH inductor
R1, R6	1K resistor
R2, R7	2.2K resistor
R3	3.9K resistor
R4	8.2K resistor
R5	2.7K resistor
R8	220-ohm resistor
VR1, VR2	10K potentiometer
	VR1 should be a multiturn pot, e.g., Digikey 490-2875-ND
C1	0.1-µF capacitor
C2	0.15-µF capacitor
LED1	Yellow LED
T1	2N2222 (or comparable) NPN transistor
PUSHBUTTON	Simple pushbutton for PCB
TRRS	Female 3.5-mm TRRS[4] jack for PCB
Arduino Uno	Arduino Uno or clone with USB cable
Not shown	Male 3.5-mm TRRS[4] plug
Not shown	Arduino shield prototyping PCB
Not shown	Baofeng UV-5R and speaker-mic
Not shown	Two clip-on ferrite beads
Not shown	Male headers for mating the shield to the Arduino

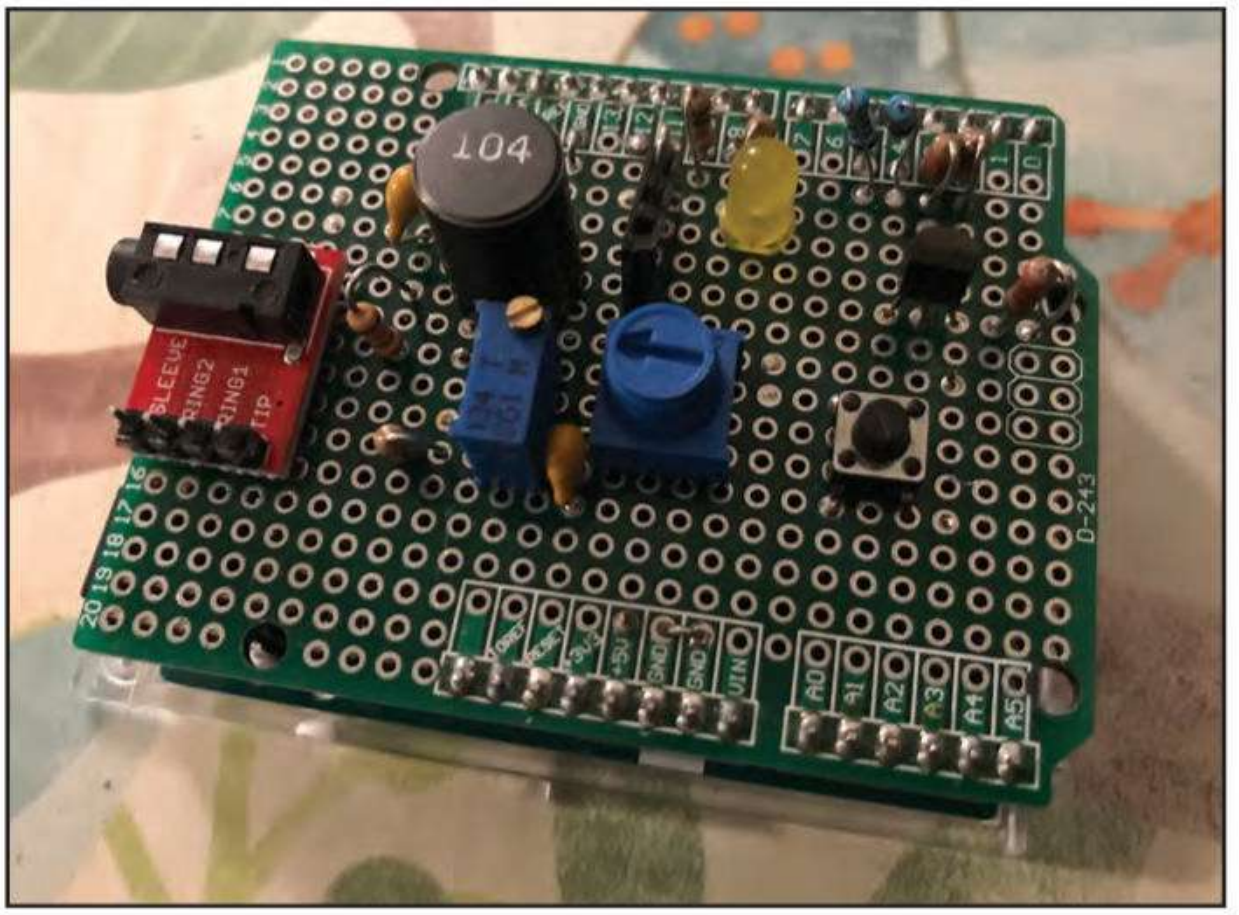


Photo C. A closeup of the completed Arduino shield.

the message is “MOE MOE MOE DE NØCALL NØCALL NØCALL”. “MOE” is a standard CW foxhunt message for a single-transmitter foxhunt, according to Joe Moell, KØOV, at <www.hominginc.com/intlfox.html>. For multiple CW transmitter foxhunts, “MOI”, “MOS”, “MOH”, and “MO5” are added for second, third, fourth, and fifth transmitters, etc. To edit the message in the Arduino IDE, click on *Edit > Find* and search for “foxhunt message.”

You may also want to edit the values of *FoxReps* (the number of times the Fox message is repeated during each fox transmission), and *FoxQuietTime* (how long the fox is quiet between transmissions). By default, the number of repetitions of the foxhunt message is set to 3 for each transmission, with a

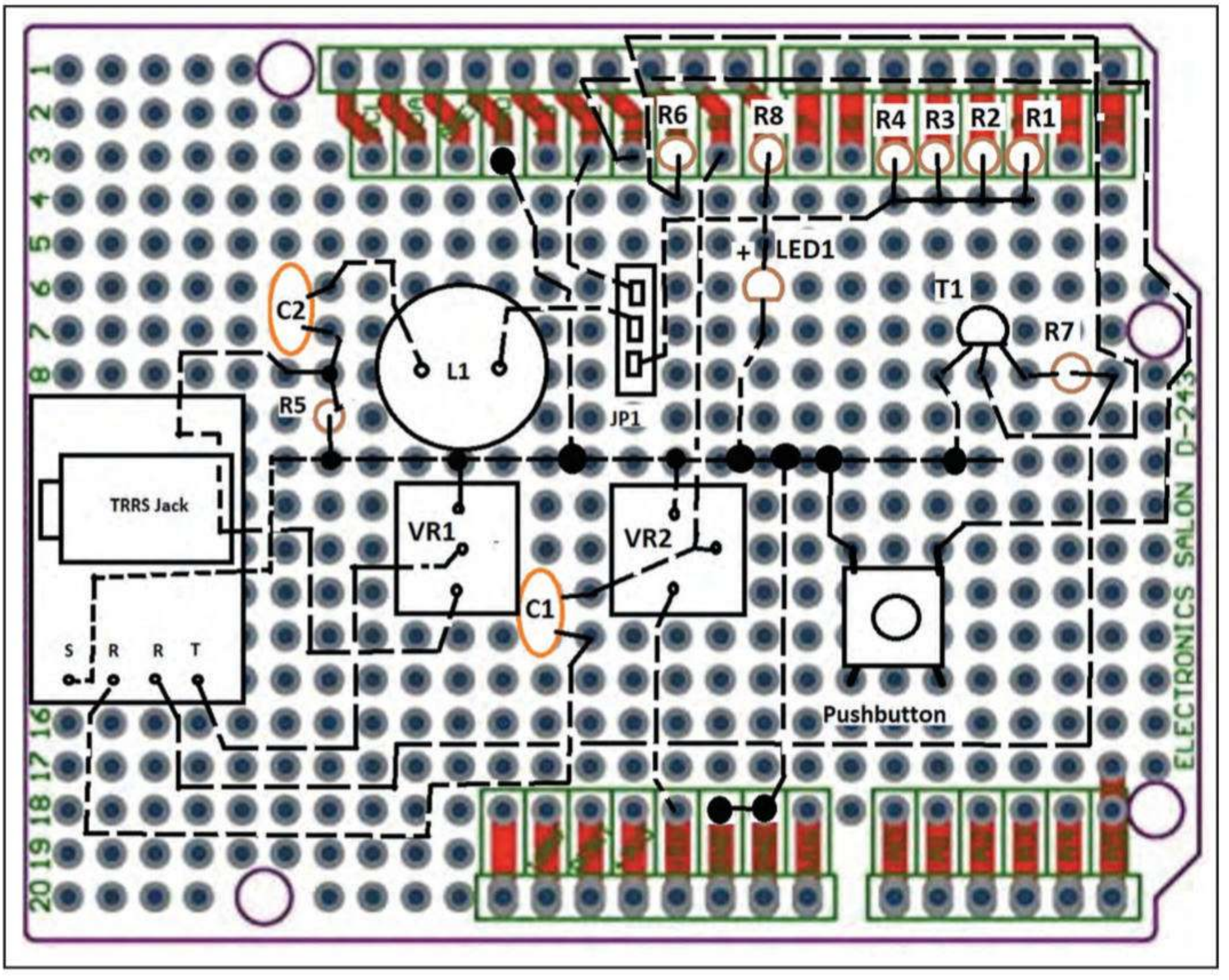


Figure 2. Parts layout and interconnections on Electronics-Salon Prototype PCB.

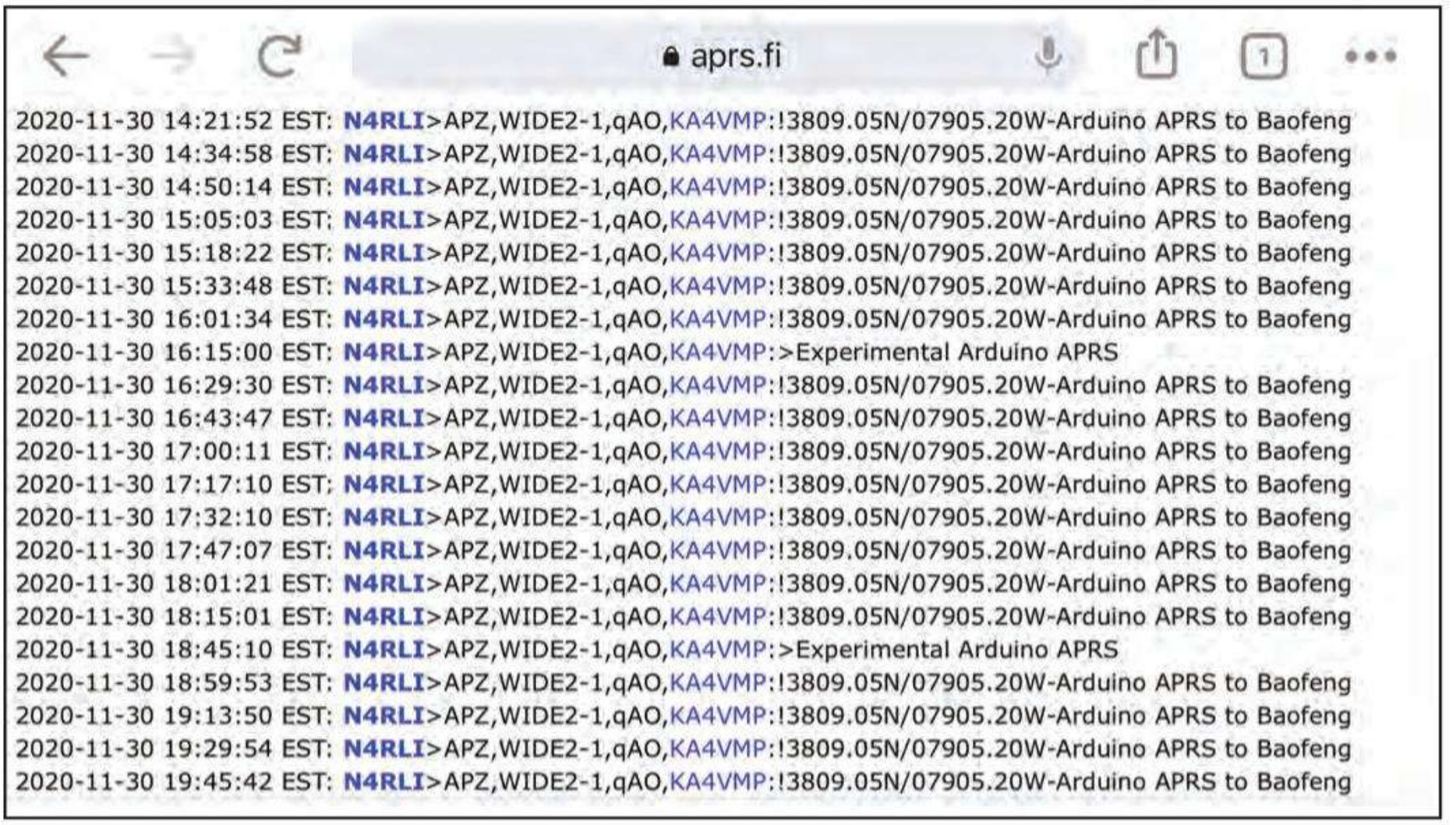


Photo D. Decoded packets from <aprs.fi>. Packets were sent every 13-17 minutes.

3-minute quiet time between transmissions. *FoxQuietTime* is specified in milliseconds.

NOTE: I strongly recommend that you do NOT increase the number of repetitions (*FoxReps*) above 3. The Baofeng's final amplifier transistor may overheat and self-destruct. You can feel the heat from the final amp at the base of the antenna, which already becomes fairly warm at three repetitions. Plus, if you choose to reduce the *FoxQuietTime* below three minutes, be sure to test the radio for overheating.

Once you have finished editing the Arduino sketch, you must connect the Arduino to your computer, and upload the sketch to it. Consult online tutorials to help with this process if it is new to you.

If you have questions about editing the Arduino sketch, or about any other aspect of this project, please feel free to email me at <ralphirons@gmail.com>. The more information you can provide about any problem you are having, the more likely it is I will be able to help. If you have edited the sketch and it is not working, please attach a complete copy of the sketch to your email.

More can be done to tailor the Arduino sketch to your needs. Visit my website at <www.n4rli.net>, click the *stayPRSandFOXmtr* link, then *Project Details* for more information.

Construction

I first built this project on a breadboard (see *Photo B*). I rebuilt it on an Electronics-Salon Prototype PCB from CZH-LABS (see *Photo C*). While the breadboard version is fully functional, the shield version is much more compact and durable. The first step in preparing the shield is soldering the male header pins. What works best for me is inserting the male headers into the Arduino's female headers, laying the shield onto the protruding pins, and soldering them in place. This guarantees that the shield's male headers will fit nicely into the Arduino's female headers. For the shield PCB itself, I used the prototype board mentioned above. They may be purchased from Amazon individually, or in a 10-pack <https://tinyurl.com/y6bqklqm>. Adafruit and Sparkfun also make Arduino shield prototype PCBs. Male headers are available from Amazon at <https://tinyurl.com/y2lxd33q>.

Figure 2 shows the parts layout for the shield. The dashed lines show interconnections, not necessarily actual wiring routes. All wiring was done under the shield, taking care that wires and solder joints would not touch any components on the Arduino Uno itself. If you do all your Arduino programming through the USB port using the Arduino IDE, you may remove the six ICSP (In Circuit Serial Programming) pins next to the USB port to make more room for wiring under the shield. The one wire which is shown in *Figure 2* in its actual position is the central ground bus, to which all ground connections were made, including the TRRS[4] shield and the three Arduino ground pins. The ground bus, together with clip-on ferrite beads at both ends of the speaker-mic cable, helps prevent the feedback loops which can haunt Arduino + Baofeng projects. Clip-on ferrite beads are available from Amazon at <https://tinyurl.com/y4d8d4su>.

For me, the most difficult part of this project was modifying the Baofeng speaker-mic cable that comes with the UV-5R. The earpiece and mic were cut away, and the outer sleeve of insulation was removed. This revealed four extremely thin wires coated with insulation which was difficult to remove without breaking the wires. Also, I would have to remove insulation twice — once to identify the wires and again after trimming them to length for soldering to the lugs in the male TRRS plug. To remove the insulation, I immersed the end of a wire in a blob of molten solder and waited for it to stop smoking. Careful scraping with a pocket knife finished the job, which was verified by using a multimeter in continuity test mode. The conductors in the cable were identified by again using a

multimeter in continuity mode, together with *Figure 3*. In my cable, the M (mic) wire was red, the P (push-to-talk) wire was orange, the S (speaker) wire was green, and the G (ground) wire was blue. Your cable may differ — use a multimeter to be sure.

To trim the wires to length, I held them against the male TRRS plug and snipped them, allowing a little extra length for soldering. After a second round of insulation removal, mic, PTT, speaker, and ground wires in the cable were soldered to the Tip, first Ring, second Ring, and Shield lugs of the male 3.5-millimeter TRRS plug, respectively.

I hope to avoid modifying Baofeng cables in the future. I found a commercially made Kenwood-style cable online at <https://tinyurl.com/y4fsvl9o>. It's no accident that my project design uses the same TRRS connections as this cable.

On the shield board, I used a matching 3.5-millimeter female TRRS jack from Sparkfun at <www.sparkfun.com/products/11570> designed for breadboards and PCBs.

The completed shield atop the Arduino Uno is seen in *Photo C*. A complete parts list is in *Table 1*. All the resistors are 10% 1/4-watt carbon. (Higher precision resistors shown in the photo were used only because they were on hand.) The capacitors were all ceramic. L1, the 100-mH inductor, was obtained from Digi-Key at <https://tinyurl.com/yyxntya4>. L1, together with C2 and R5, form an audio bandpass filter designed to allow the MCW and AFSK frequencies to pass through to the Baofeng mic input, while filtering out things like 60-Hz hum and harmonics created by the AFSK square waves.

Operation

Selecting APRS Mode or Foxhunt Mode

Switching between APRS and foxhunt beacon mode is a three-step process:

1. A jumper selects either APRS or foxhunt output. A 3-pin female header (JP1 in *Figure 1*) is used for this. Connecting pins 1 and 2 of JP1 selects the foxhunt output. Connecting pins 2 and 3 selects the APRS output.
2. Reset the Arduino by pressing its reset button, or by removing and re-connecting power to the Arduino.
3. Finally, the pushbutton shown in the schematic (*Figure 1*) must be given a short press to start APRS, or a long press to start the foxhunt transmitter. LED1 gives two short flashes to confirm that APRS has been selected, or one long flash to confirm foxhunt selection.

Adjusting VR1 and VR2

In APRS mode, VR1 must be adjusted for the MINIMUM output that will produce audible packet tones in a receiver tuned to the Baofeng's transmit frequency. Using a multiturn pot for VR1 will make this adjustment easier.

One of the major causes of failure of APRS packet transmissions is excess audio. I experienced this myself. With VR1 set at its middle position, I was perplexed because only about 15% of my transmitted packets were successfully decoded and relayed by local digipeaters. With audio output cut back to just enough to hear in a receiver, I now have a success rate of about 80% (see *Photo D*). A useful tool in evaluating APRS transmitter performance is <www.aprs.fi>. I can watch for my symbol to appear, click on my symbol, click "info" and then "raw" to see how many of my packets have been heard. The website keeps two days' worth of your packets. Each received packet is time-stamped and includes a list of digipeaters and IGates (internet gateways) which successfully decoded the packet and passed it on.

This setting for VR1 is also good for

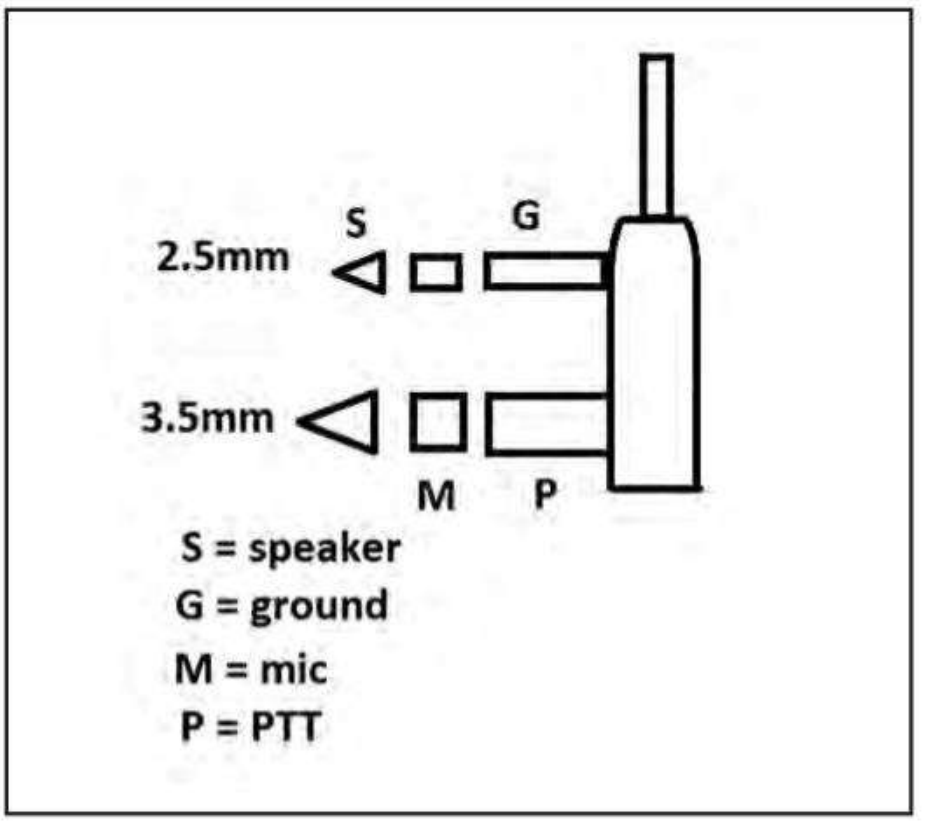


Figure 3. The Baofeng speaker-mic connector.

Photo E. The stayPRS and FOXmtr project in operation in APRS mode at my QTH.

The stayPRSandFOXmtr project combines two Arduino + Baofeng applications into one: A fixed position APRS beacon for your shack, Field Day, or EmComm deployment — and an MCW beacon for practicing your foxhunting skills

foxhunt mode. Once set, VR1 should not need further adjustment.

In APRS mode, VR2 should be turned up until LED1 turns on and stays on, then back off until LED1 only turns on when incoming signals break the Baofeng's squelch (its display lights up, as does the green receive LED).

In APRS beacon mode, LED1 will flash to show that the Arduino has detected an incoming signal through the Baofeng speaker output. The Arduino will not beacon while an incoming signal is detected. VR2 should not need to be adjusted again.

Using APRS Mode at my Home QTH

In *Photo E*, you can see this project deployed atop an unused tall kitchen trash container, with RF going through an antenna switch and out the kitchen window to a Diamond X50A antenna at a height of about 12 feet. The Arduino is powered by a 12-volt computer-type power supply, and the Baofeng is in its charging cradle. The antenna can be switched to a base station on the kitchen table, which gives my wife Kim, KG4YYL, easy access to VHF for doing her Winlink emergency communications drills.

Using Foxhunt Mode

Locally, foxhunting is enjoying a revival. I am sorely in need of practice with simple techniques, like using an attenuator and tuning off frequency as I get closer to the fox, and avoiding being fooled by reflected signals. My daughter has kindly volunteered to drive while I try to locate my own foxhunt transmitter. This should provide me with the boost in confidence I need before I jump into one of the local foxhunts.

Packaged in a waterproof container and accompanied by a portable omnidirectional antenna (like a ladder line J-pole suspended from a tree branch), this project could easily be deployed outdoors. A fresh 9-volt battery will power the Arduino for many hours. The limiting factor will be the Baofeng battery. The UV-5R does not accept an external DC power source.

Summary

The stayPRSandFOXmtr project combines two Arduino + Baofeng applications into one: A fixed position APRS beacon for your shack, Field Day, or EmComm deployment — and an MCW beacon for practicing your foxhunting skills. You can breadboard it or make your own Arduino shield for a more compact and durable unit. More detailed information and updates will be available at <www.n4rli.net>. Any questions you have about the project should be emailed to me at <ralphirons@gmail.com>.

Notes:

1. APRS = Automatic Packet Reporting System; see <www.aprs.org>
2. STEM = Science, Technology, Engineering and Math
3. "Sketch" is Arduino-speak for a special-purpose program
4. TRRS = Tip / Ring / Ring / Shield

Take It To The Field Special:

CQ CLASSIC

Take it to the Field, 1945-Style

Operating from "the field" is nothing new for hams, even though today's technology makes it much easier than in the past. Elsewhere in this issue, Kit-Building Editor KØNEB writes about building a transceiver that can fit in your pocket, but 76 years ago, operating portable was a completely different story. We have two examples from our June 1945 issue, exactly 76 years ago this month. The cover shows two U.S. Army Signal Corpsmen operating a direction-finder "in the field" in New Guinea during World War II. And our featured "CQ Classic" article from the same issue is about a "Two-Tube Walkie-Talkie Pack Set," by Preston Youmans, W2OHE/WNYJ9. WNYJ9 was Preston's callsign in the War Emergency Radio Service, or WERS, which was a way that many hams who were not deployed overseas managed to stay on the air despite the wartime shutdown of amateur radio. WERS operated primarily on the 2-1/2-meter band, 112-116 Mc (no MHz yet). WNYJ9 was one of some 250 stations authorized under a general WNYJ license issued to New York City.

Preston's radio was portable in the sense that it was battery-operated and had a built-in antenna. But it certainly wouldn't have fit into anyone's pocket! So read this article, and then go read KØNEB's Kit-Building column to see how far we've come!

Two-Tube Walkie-Talkie Pack Set

WNYJ9 is easy to build and performs beautifully

PRESTON C. YOUMANS, W2OHE

TODAY AFTER nearly three years of successful WERS operation, the need for compact, versatile pack sets is still with us. Their utility has been amply demonstrated, and with our constantly expanding WERS activities these little self-powered two-way communicators are in demand. Of prime importance is their ability to be down front where things are happening—to establish communications from the scene of action. WERS unit WNYJ9 has proven itself in many hypothetical and real emergencies, including the hurricane of September, 1944. After almost three years of faithful service it still performs faithfully.

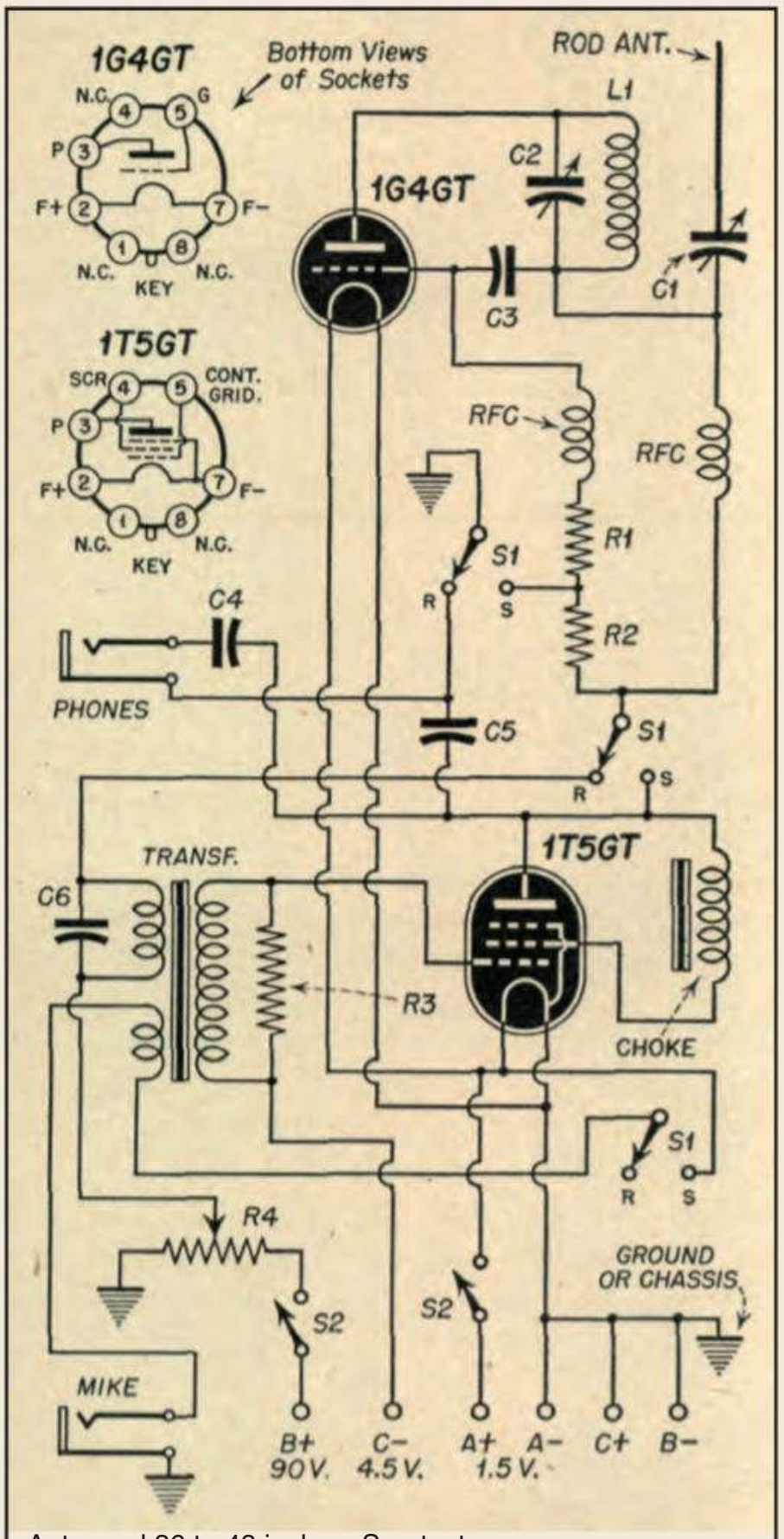
Basic Requirements

The basic requirements of a walkie-talkie pack set designed for WERS operation are that it must be light, easily portable, self-powered (preferably with batteries), sturdily constructed, easy to operate under adverse conditions by one operator and with a minimum number of adjustments to be made in the field. WNYJ9 was constructed with these considerations in mind. Although this unit is a transceiver the usual shortcoming of the transceiver, its inability to receive and transmit on the same frequency, has been overcome to a large extent by making the coil big and the condenser small providing a rather large bandspread for the WERS frequency allocation of 112 to 116 megacycles. This makes it unnecessary to retune when switching from receive to transmit.

The circuit of WNYJ9 is conventional and requires no trick parts. Even when it was built, components were rapidly disappearing from the dealers' shelves. The only part a bit hard to find now is the transceiver transformer, which is nothing more than a regular audio transformer with a mike input winding. If you can't buy one ready-made it is easy to improvise from an audio transformer that has enough space for a third winding. Removal of some of the excess paper around the original winding will often make room for the additional primary. From 50 to 60 turns of No. 24 to 30 enameled wire will do. I have made several such transformers and the difference in performance between the home-made and commercial products cannot be detected.

Constructional Notes

The junk-box is relied upon for most parts. The schematic diagram (Fig. 1), parts list and photographs tell the story of construction better than the proverbial thousand words. Try to keep the r-f leads short and well insulated with the best high frequency materials obtainable. The whole unit, including batteries, is housed in a homemade wooden box (Figs. 2 and 3). Leave plenty of room for batteries since



Ant.—rod 36 to 48 inches. See text
C_1—3-30 µµf mica trimmer
C_2—2-plate midget
C_3—100 µµf mica
C_4 and C_5—.1 µf 200 volts d.c.
C_6—.003 µf mica
Choke—30-henry a.c.-d.c. midget type
L_1—3 turns No. 14 wire 1/2 inch diameter
R_1—30,000 ohms 1/4 watt
R_2—1.5 meg. 1/4 watt
R_3—100,000 ohms
R_4—100,000 ohms volume control used as regeneration control.
RFC—Ohmite 21
S_1—3-pole D.T. switch
S_2—D.P.S.T. switch
Trans.—transceiver transformer

Fig. 1. Transceiver wiring diagram of WNYJ9. Phone jack must be insulated from chassis. Most of the parts will be found in the junk box

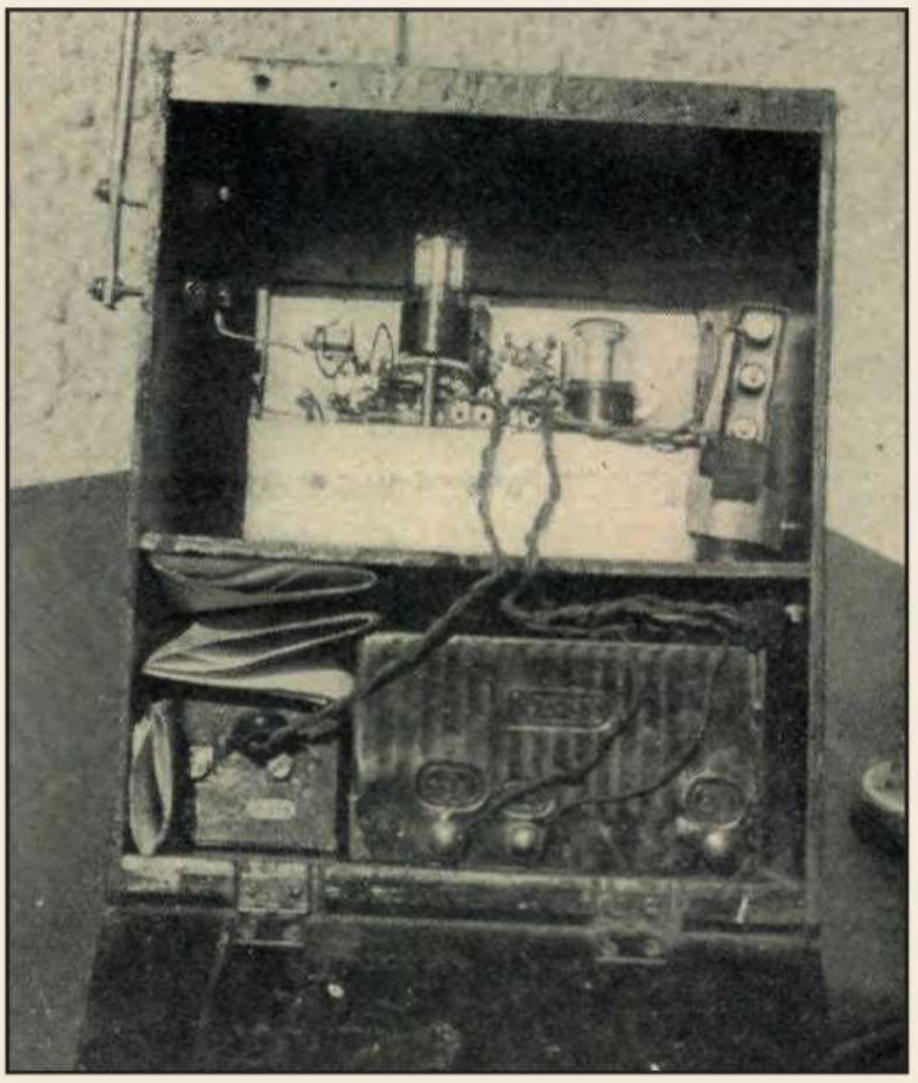


Fig. 2. Rear view of pack set. There is plenty of room for batteries of various sizes

sizes obtainable vary considerably. Remember, too, that this unit must be used in all kinds of weather—snow, rain and come what may—so tight joints adequately waterproofed and solid construction should be of prime consideration.

Preliminary Checks

After the construction is completed it is wise to make some preliminary checks before hooking up the batteries and throwing the switch. The tubes, using only 1.5 volts of A supply, cannot stand any overload. It is good policy first to connect the A battery only to see if the filaments light when the power is turned on. (These filaments barely glow so look very carefully before making any decision.) If OK, disconnect the A battery and reconnect it *to the B battery posts*. If the filaments light, look for trouble and thank your lucky stars you didn't connect 90 volts across the filaments. Repeat this check, connecting the A battery to the C battery terminals. If everything seems safe, connect the three batteries to their respective posts and turn on the transceiver. For preliminary testing use a piece of heavy wire about 48 inches long for the antenna and when the correct size is found a permanent aerial may be installed. Loosen the antenna trimmer condenser as far as it will go toward minimum capacity. With the regeneration control turned about three quarters of the way to full on, the characteristic super-regeneration hiss should be heard. If the coil and condenser are close to the values given in the parts list you should be very near the WERS band. But since a small variation in either the coil or condenser will make a large difference in frequency and bandspread, it may be necessary to remove or add a turn of

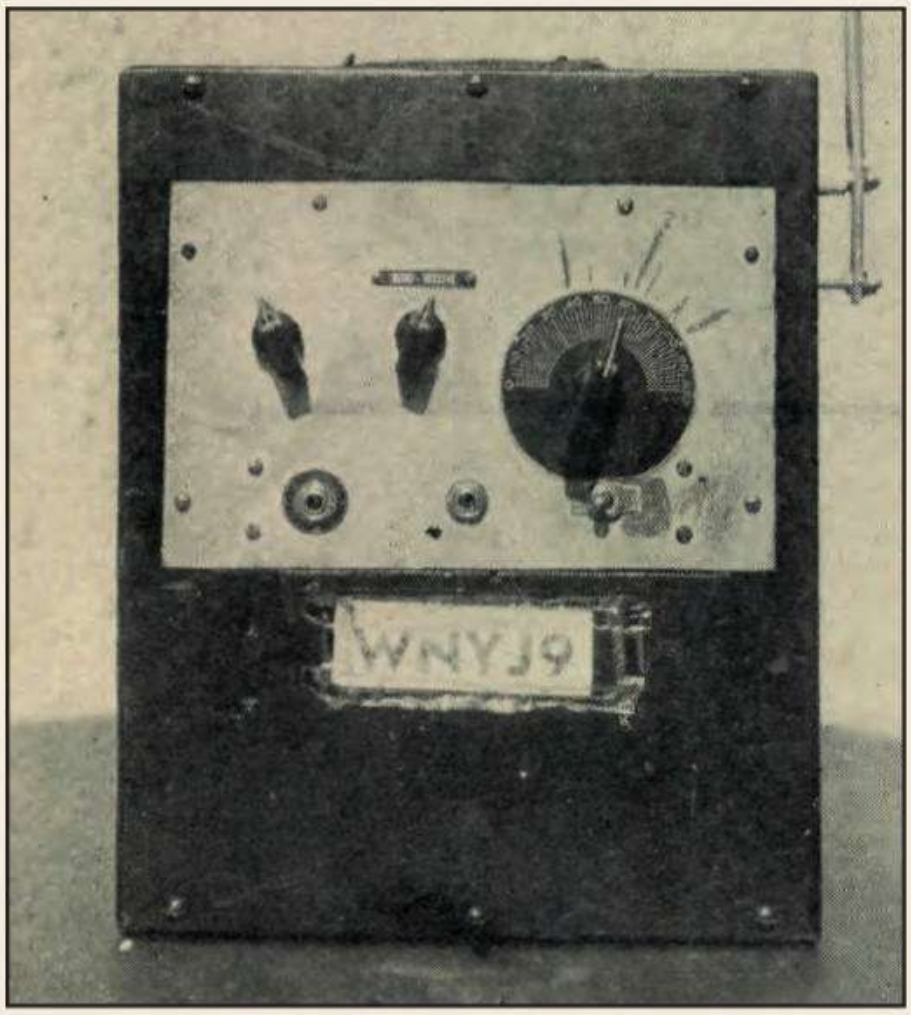


Fig. 3. Front panel or WNYJ9. The rod antenna is permanently affixed to the side

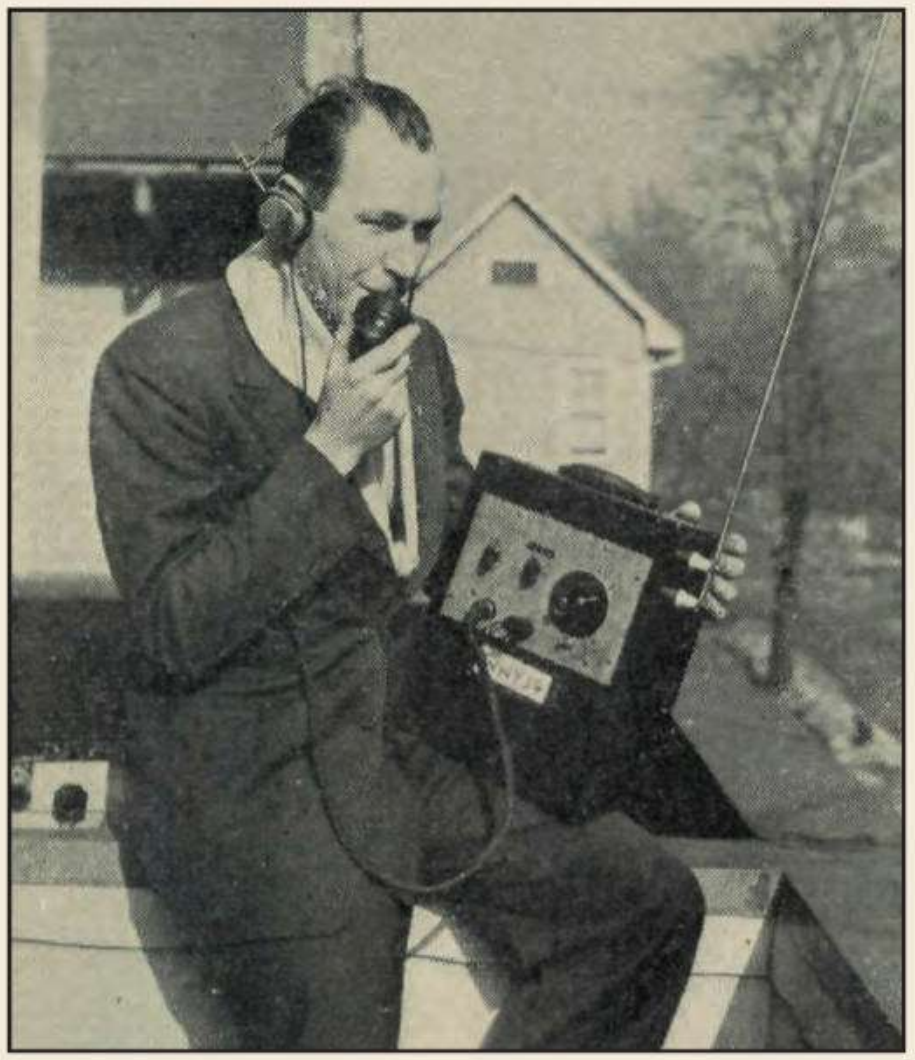


Fig. 4. The author at the controls of WNYJ9

wire to the coil or perhaps just squeeze or stretch it out a bit to hit the WERS band. It is best to make these adjustments when the WERS net is on the air (Monday and Wednesday from 9:00 P.M. to 11:00 P.M., and Sunday from 5:00 P.M. to 7:00 P.M., EWT). For the New York City builder there is an experimental radio station just above the 116-megacycle end of the dial (seemingly on the air 24 hours a day) which may also be used for check. When making receiver adjustments during a regular WERS operating period, should you hear a station complain about a receiver in the vicinity, remember you may be causing the interference and it would be best to shut down. A super-regenerative receiver acts as a miniature transmitter, so be careful not to interfere with regular WERS traffic.

Bandspread Adjustment

After the WERS frequencies are spotted they can be bandspread or condensed to fit the dial by squeezing or stretching the coil. About 50 dial divisions for the entire WEES network is a good bandspread. Next adjust the length of the antenna for maximum signal strength. This is best accomplished by starting with an antenna about 48 inches long and reducing the length in 1-inch steps until the size is reached which gives the best response. While making these adjustments the antenna trimmer condenser must also be varied each time for peak signal strength. Adjustment of the antenna trimmer will also effect the regeneration control. After some experimenting with antenna length and trimmer adjustment, it will be found that the receiver will super-regenerate smoothly over the entire band and provide maximum signal strength. When making these adjustments, it is wise to use a station that doesn't come in too strongly, so as not to block the receiver and result in an improper adjustment. After the optimum antenna length is found, a permanent rod (Fig. 4) can be made to replace the heavy wire used for preliminary checks. The two and three-section whip antennas used for regular car radios make excellent aerials, and can be picked up at most any radio store cheaply since the lead-in cable isn't necessary.

As yet, nothing has been said about adjustment for the transmitting side. Why? Remember, and this is extremely important, that unless you are a duly licensed WERS radio operator and the unit you are building has been granted a WERS license by the Federal Communications Commission, you cannot transmit even for test purposes. But if the unit has been carefully adjusted for receiving you can be almost assured that it will function equally well as a transmitter. When the unit becomes a part of WERS, final adjustments can be made for the best all 'round performance during the regular test periods. License requirements for both yourself as an operator and your unit are easily secured and further information can be obtained from your local Office of Civilian Defense.

The case history of WNYJ9 in WERS operation shows successful operational tests, both in receiving and transmitting, with the unit down in the subway, from a subway train in motion, from the inside of buildings of all types of construction, and from ambulances and street cars in travel— truly a remarkable record for a pack set of such low power. This unit was also used in the author's home as a receiver, with the output connected to a receiving amplifier and recorder to make records of WERS operation for future reference.

Take It To The Field Special:

Reduce your backpack weight on hiking activations with this 3-band end-fed half-wave (EFHW) antenna for 40, 30, and 20 meters that's resonant on all three bands without a tuner through the use of tiny traps that you build yourself. The whole package weighs in at just over 5 ounces!

A 3-Band Trap End Fed Half Wave (EFHW) Antenna for QRP Portable Operation

BY JOHN G. DEPRIMO,* K1JD

Tiny, portable QRP radios available today are very capable but often lack a built-in antenna tuner, providing the impetus for a resonant multi-band QRP antenna. Back in 2016, I acquired a KD1JV MTR-5B that inspired development of a considerably more complex 5-band trap end-fed half-wave (EFHW) antenna.[1] The three-band antenna described in this article came about when a SOTA (Summits On The Air) activator friend, Jerry Kirshenbaum, KØES, acquired a new MTR3-LCD covering the 40, 30, and 20-meter bands. He mentioned buying an external antenna tuning unit (ATU) to match the radio to a random wire. Based on my unfavorable external ATU experiences that include extra weight and complexity, as well as less reliability,[2] this project was offered as an alternative.

The fabrication techniques used in this antenna system have been proven in multiple 3- to 5-band trap EFHWs over four years and on hundreds of SOTA activations. The four objectives that were used to guide earlier development efforts also apply here:

- Provide an effective multi-band antenna that presents a matched load using a single broadband transformer. An ATU is not required for the band segments included in the antenna design.
- Provide a sufficient, low SWR bandwidth for the operating mode chosen. The MTR is a CW-only radio, so adequate bandwidth is relatively easy to satisfy over the range of QRP frequencies on each band.
- Be robust enough to withstand the rigors of portable operations while being lightweight and taking up minimal space in a backpack. Strength-to-weight tradeoffs should be considered in the physical design.
- Be physically shorter than a full size EFHW to reduce wind-load. Being able to quickly deploy and retrieve a shorter antenna system can be important since weather can deteriorate rapidly, especially at higher elevations.

Photo A. Deploying an EFHW and support pole above the tree line on the summit of Jicarita Peak, 12,835 feet above sea level (ASL) in northern New Mexico. (Photos by the author)

Arguments for an EFHW Wire and Telescoping Support Pole

- Although an EFHW has a very high feedpoint impedance, a small lightweight broadband impedance transformer will match it.
- A lightweight telescoping fishing pole extending to about 20 feet makes a suitable support while convenient to carry in your pack when collapsed to 18-28 inches.
- A simple but effective EFHW antenna geometry places the low-current feedpoint lower on the pole near the rig and operator, runs the wire up to the tip of the pole, raising the max current point in the antenna's center higher, and then fastens the far end to a support (shrub, rock, etc.) where the current is also low.
- EFHW deployment with a support pole works well both below the tree line where you could bungee to a tree or shrub, and above, where a rock pile may be the only option. In *Photo A*, hik-

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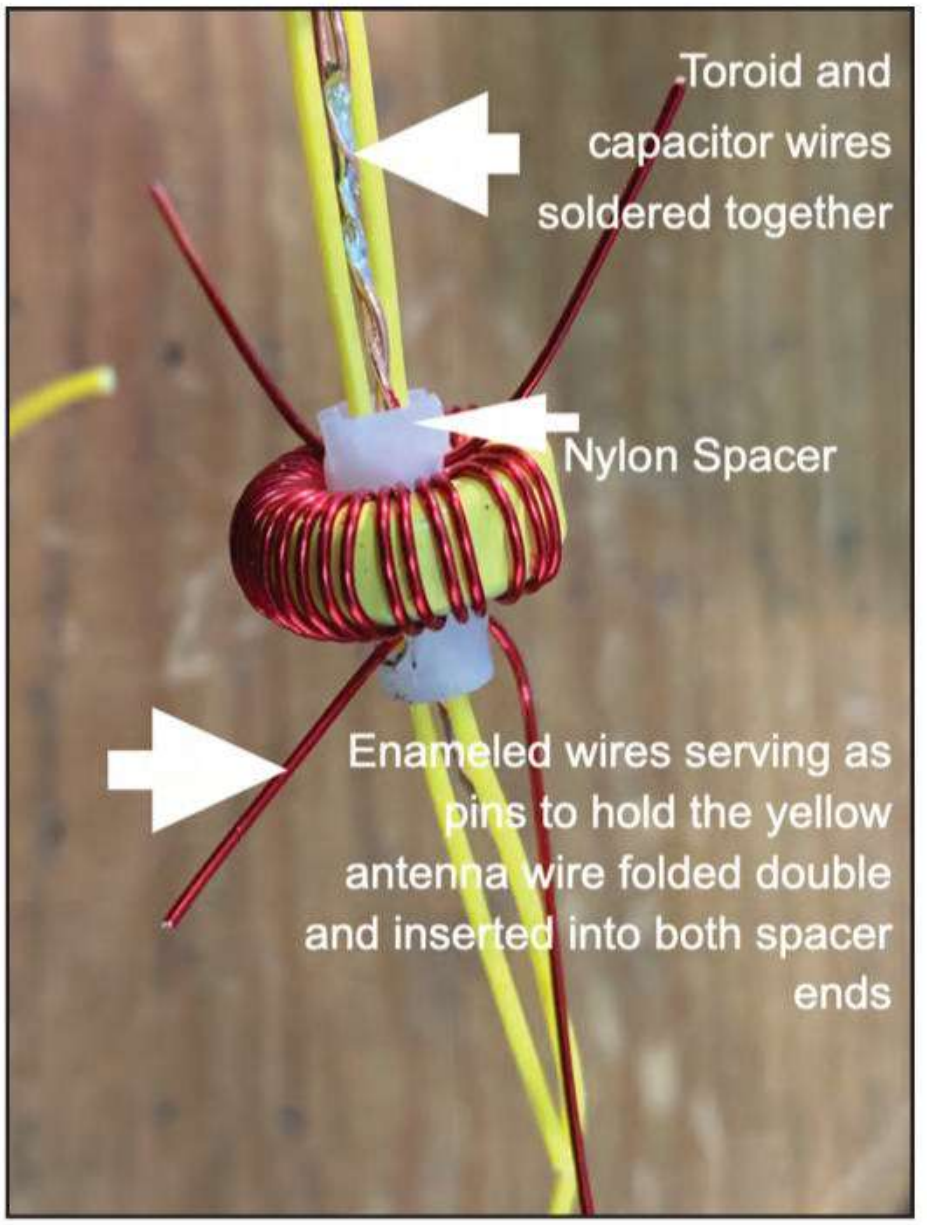


Photo B. Trap assembly nearing completion

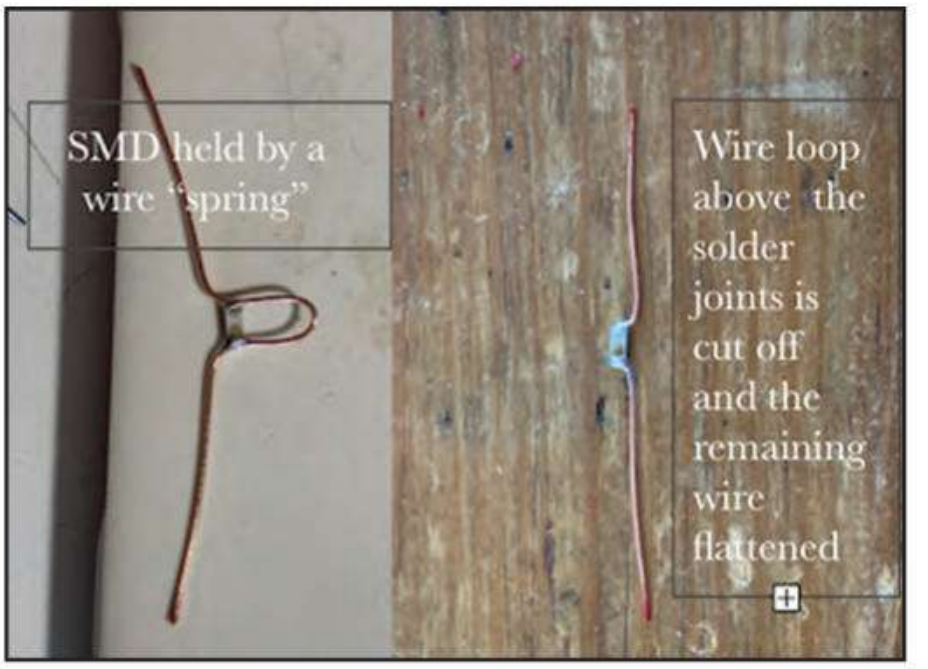


Photo C. Trap SMD capacitor and wire

ing pal Fred Maas, KT5X, is using gaps in the rock wall to secure his EFHW support pole during a SOTA operation on the summit of Jicarita Peak in northern New Mexico. Alan Shapiro, NM5S, and I activated with our own gear as well.

• Unlike random wires, an EFHW does not require an additional wire serving as a counterpoise.[3]

Multi-Band EFHW Antenna Design Options

One way to implement a multi-band full-sized EFHW is with manually-connected and disconnected links for setting the appropriate wire length on each band. The matching impedance transformer could be the same as described herein. I had such an antenna circa 2014-2015, but it often proved difficult to manage in the field. To change bands, I would put down the radio, lower the support pole, scamper over an often-difficult loose rock footing and around cacti, choose the link configuration selecting the desired band, and then back to raise the pole and pick up the radio. Not impossible to do, but certainly time consuming and inconvenient.

After dealing with linked EFHWs, it became apparent that building a trap antenna would be well worth the effort: Just change bands on the radio and you're ready to go! This three-band trap EFHW antenna requires two traps, one each for 20 meters and 30 meters. The 40-meter band is covered by adding a length of wire beyond the 30-meter trap extending to the far end of the antenna. A trap's purpose is to present a high impedance at and around its design frequency so a single wire antenna tunes with low SWR within a range of frequencies on each band. Traps also can be designed to help physically shorten the antenna as described in the next section.

Designing and Building Small Traps

Antenna traps are made using a parallel inductor (L) and capacitor (C). For technical detail beyond the scope of this article (theory, equations, Quality Factor "Q", etc), the reader is referred to the *ARRL Antenna Book* or similar publication, but this much is should be intuitive:

1. If handling full legal limit, a trap's L and C components must be much heavier-duty than for QRP applications; and
2. For decent trap Yagi performance, traps need to perform far better than for a single wire because achieving accurate electrical lengths of a Yagi's driven and parasitic elements is key to maximizing antenna gain.

It is much easier to achieve good trap results with a single-wire trap antenna than a Yagi. Tiny 1/2-inch toroid-based

Trap Frequency	Operating SOTA Frequency	Capacitance (C) 1KV SMD - Mouser links below	Inductance (L)	Turns #26 enamel wire
10.090 MHz	10.111 MHz	47pf	5.3uH	32 turns on Amidon T50-2 core
14.020 MHz	14.061 MHz	33pf	3.9uH	31 turns on Amidon T50-6 core

Table 1. Trap component values

traps are fine for QRP and help create the inductance needed without much weight, wind resistance, or wire resistance. Combining these inductors with tiny surface-mount capacitors oriented through the toroid core's central hole and in line with the antenna wire (an "axial trap" configuration[1]) results in low weight and wind resistance while achieving the LC values needed for these traps. Amidon makes T50-2 red core and T50-6 yellow core toroids for lower and higher frequencies respectively. One of each is used for this antenna.

We can physically shorten the antenna, one of our objectives listed above, by making the trap more inductive than capacitive. We achieve this in two ways. The first is by placing our traps' resonant frequencies below the intended operating frequencies.[4] Second, although a typical online trap calculator provides lower inductance and higher capacitance in their recommended values, we also increase the traps' inductance somewhat and lower the capacitance. Increasing inductance in a trap is frequently associated with trap losses[5] due to increased resistance in the inductor windings contributing to a lowering of a trap's Quality Factor, or "Q". In this case, the DC resistance "penalty" imposed by a few more inches of #26 AWG copper wire is insignificant, so the Q of the inductor remains high in either case.

Starting with a combination of LC resonance and Amidon inductance calculators,[6] and forcing the L:C ratio to be higher as described above, we arrive at the values in *Table 1*. The table also includes the intended operating frequencies and the traps' resonant frequencies to be set in the next section. Capacitance values used in both traps are standardized and readily available. The 1-kilovolt SMD capacitors used here can be obtained from Mouser.[7]

Axial Trap Implementation

The 20-meter axial trap for this antenna was nearing completion in *Photo B*. Although a little involved, these traps have been successfully duplicated by others. The figures and descriptions that follow in this section should clarify the various assembly steps. The author has used this construction technique for the last four years in various 3- to 5-band trap EFHW antennas without failure. The perfect reliability record is due in part to a design that protects the traps' solder connections from tensile and bending forces.

As specified in *Table 1*, trap inductors are wound with #26 copper enamel. The number of turns indicated in the table will be a snug fit along the smaller inner toroid circumference. After winding the inductors, a 3/4-inch long #4 nylon spacer[8] is introduced into the design. Passed through the toroid, the nylon spacers barely clear the inner windings of the two traps. The spacer has multiple uses: It supports each toroid, contains within it the SMD capacitor, routes wires, provides strain relief, and anchors the wire pigtails connected at both ends. The spacer can be trimmed to about a 5/8-inch length, as shown in *Photo B*, reducing trap size without compromising reliability.

Two small-diameter (#51 drill bit) end holes are drilled completely through the spacer perpendicular to its axis and about 3/32-inch from the ends. Please see photos later in this section. Dimpling the nylon spacer slightly at each end with a hot soldering station pencil will keep the drill bit from slipping on the curved surface. The end holes provide routing for the toroid windings from the outside of the spacer to the inside and then out the ends. The end holes are also for passing through enameled wire "pins" that catch and restrain antenna wire "pigtails" folded double and inserted into the spacer at each end.

The soldering described here is best done with a good soldering station, such as the Hakko FX-951 in use for years in my workshop. To facilitate using the tiny SMD trap capacitors in the trap, they will be soldered to a short length of #26 copper wire fully stripped of its enamel (e.g., by carefully scraping with an X-Acto® knife) and bent into an "omega" configuration. The bent wire serves as a miniature spring or vice (*Photo C*, left) where the objective is to compress the wire loop enough to securely hold the SMD. This procedure is best done on a smooth flat surface such as a ceramic tile. With the capacitor held in place, it can more easily be soldered to the wire but take care to apply just enough heat to the SMD / wire to achieve a good connection. After soldering both ends and examining the connections, use flush cutters to carefully cut the excess wire loop above the solder joints, then flatten the wire slightly with needle nose pliers (*Photo C*, right).

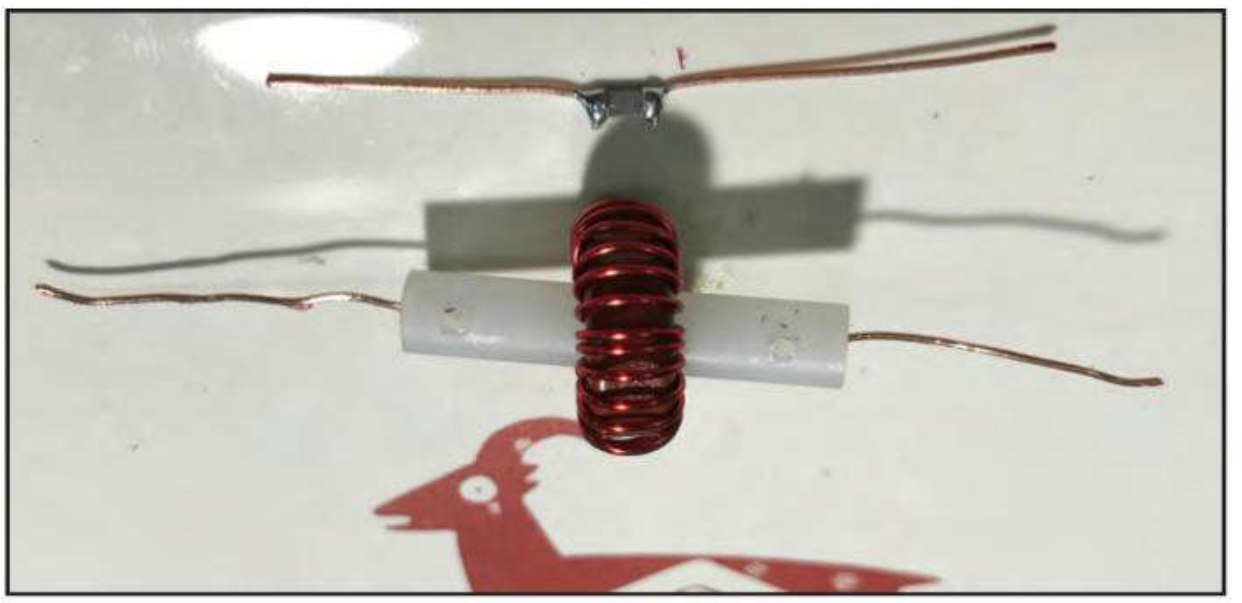


Photo D. SMD cap ready to insert into the spacer

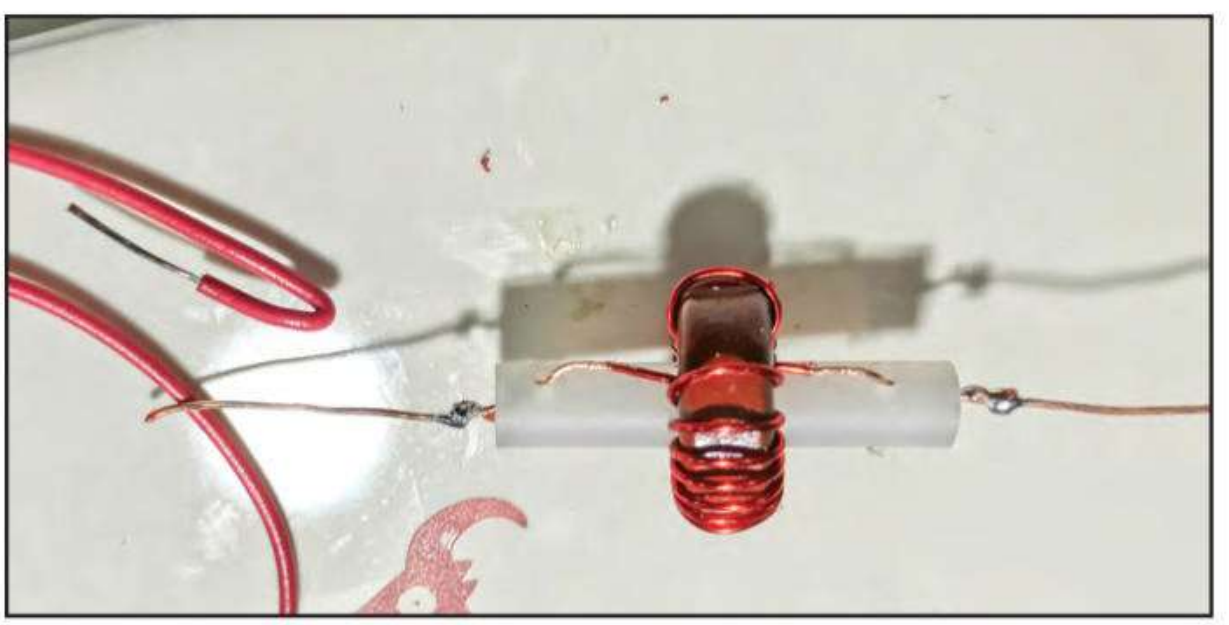


Photo E. SMD cap in spacer, pigtail folded double and ready to insert

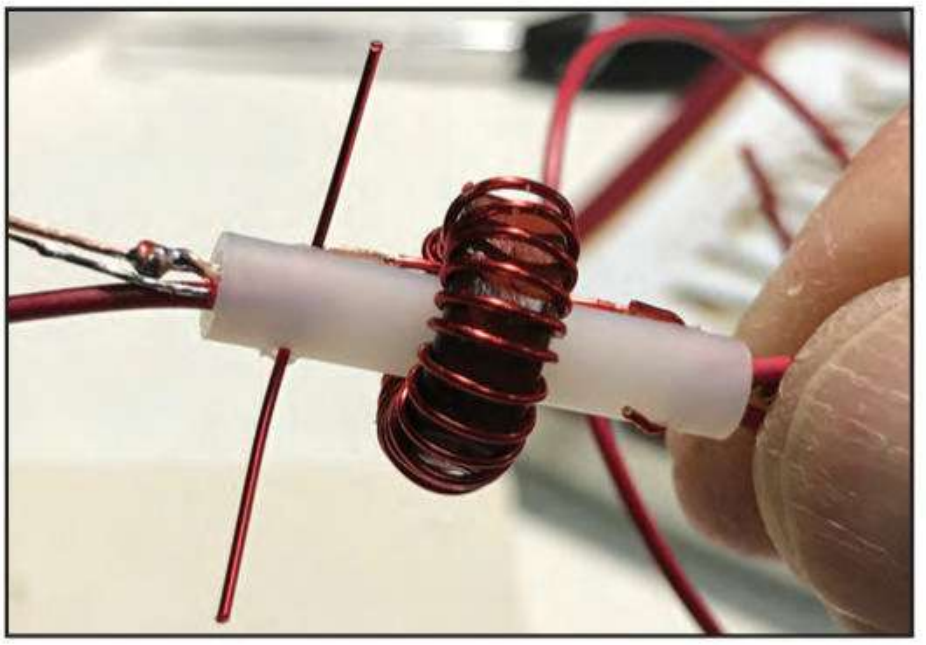


Photo F. Wire pin inserted through the end holes to secure the pigtail wires

Photo G. Completed trap assembly (without shrink tubing)

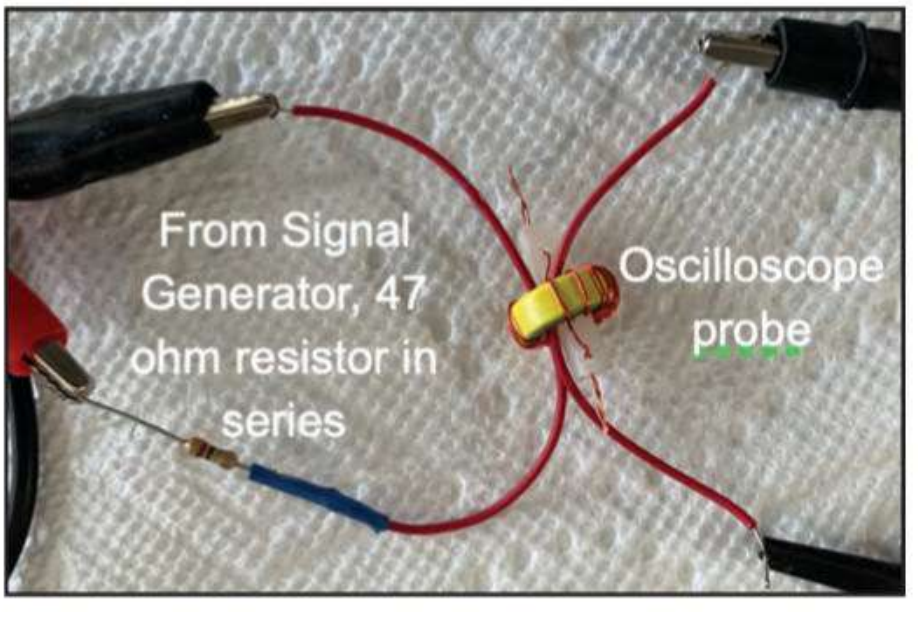


Photo H. Measuring trap resonant frequency setup

The remainder of the photos used in this section are from previous prototype efforts: The spacer is longer and the wire is different but the processes are the same. Note that the drilled end holes described above are visible in *Photos D-G*.

The SMD and its wires are then ready to insert and center inside of the nylon spacer as shown in *Photo D*. The capacitor leads can then be soldered to the toroid wires to complete the parallel LC trap circuit. Antenna wire "pigtails" about 6 inches long are folded at the end as shown in *Photo E* and inserted into the spacer with the shorter end (about 1/2-inch) stripped of insulation. Short pieces of #26 enamel wire are inserted into the end holes and through the bend in the pigtails to prevent them from pulling out, and the stripped end is soldered to the LC wires on both sides of the spacer (*Photo F*). Excess wire is trimmed from both the solder connections and the wire pins. A trap assembly with 6-inch pigtails but without shrink tubing is shown in *Photo G*. These pigtails will later be soldered to the antenna wire segments to make the complete antenna, but first we must set each trap's resonant frequency.

Setting Trap Resonant Frequency

Setting trap resonance can be accomplished several ways. Equipment on hand in my workshop includes an old HP 8601A RF signal generator and a Rigol DS1102E oscilloscope that reads RF frequency. When properly set up as

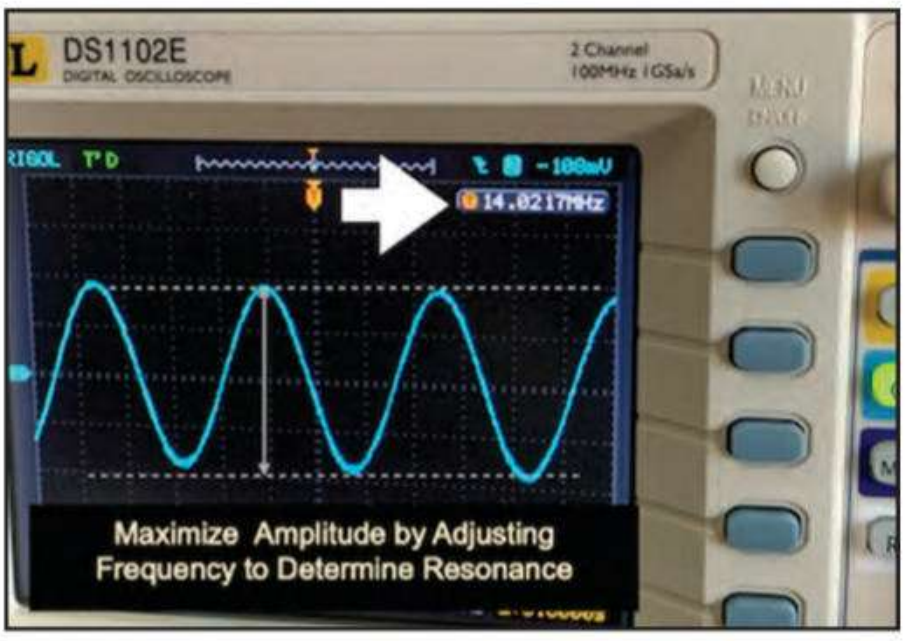


Photo I. Oscilloscope reading resonant frequency at maximum amplitude

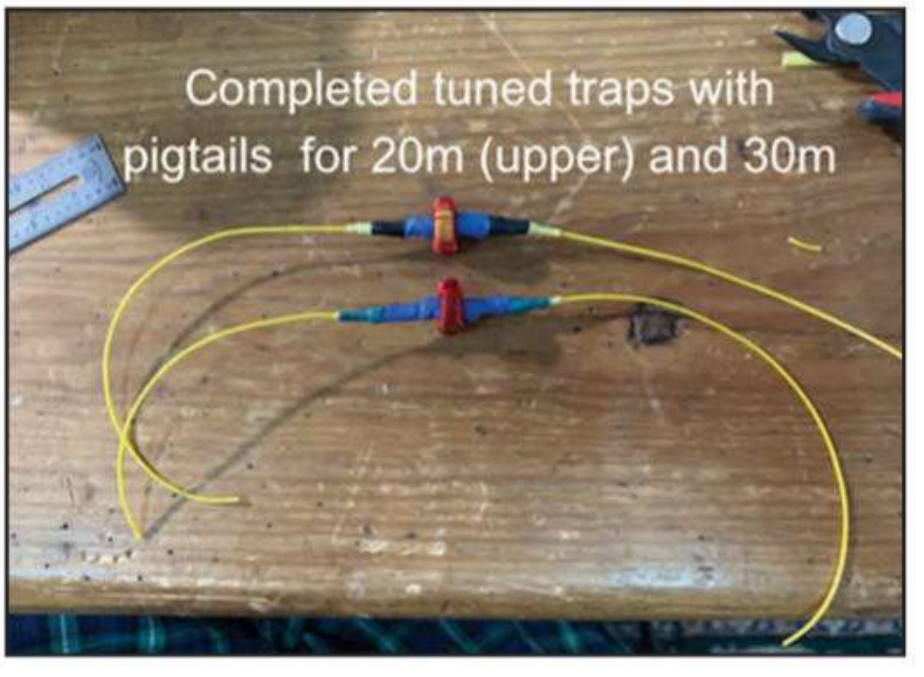


Photo J. Completed traps with 6-inch pigtails

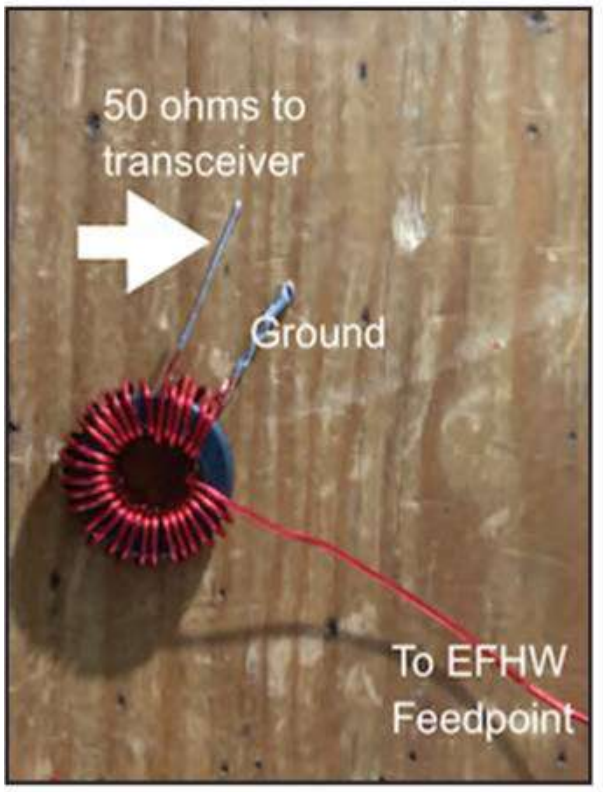


Photo K. Transformer winding details

Photo L. Transformer packaging

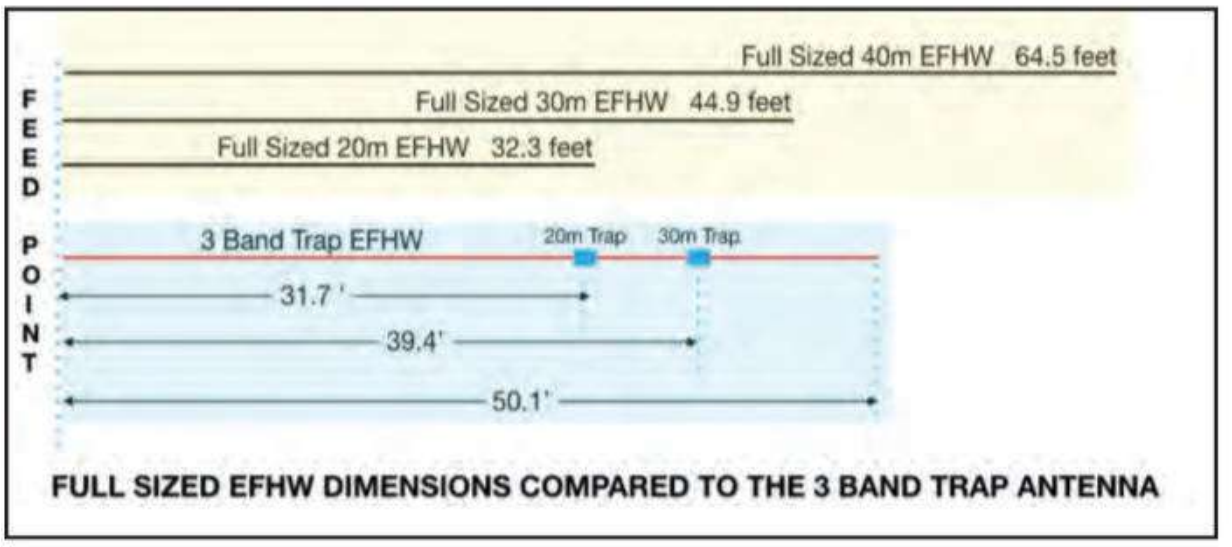


Figure 1. Antenna dimensions to scale

described below, the amplitude of the RF from the signal generator, when tuned from below to above the trap design frequency, will peak on the oscilloscope at the trap's actual resonant frequency. This is because the trap's impedance at resonance is theoretically infinite, absorbing little energy, but off resonance the opposite occurs and the observed amplitude decreases. Since the traps' capacitor values are fixed, resonant frequency is adjusted by expanding or compressing the toroid windings to fine tune the traps closer to the desired frequencies in *Table 1*. Expanding the windings raises the resonant frequency by decreasing inductance whereas compressing the windings lowers it by increasing inductance. If this method fails, the number of turns can be decreased or increased to get things back within adjustment range.

The best way to measure and tune a toroid trap (with or without pigtails attached) is by passing two wires, one each for signal and sensing, through the small gap between the spacer and the toroid as shown in *Photo H*. This method avoids connecting anything to the trap leads directly which can produce inaccurate readings. The left side wire in *Photo H* carries the signal generator's RF output terminated with a load resistor, and on the right side are the oscilloscope's signal probe and ground connected together. The yellow T50-6 core trap shown is for 20 meters. While tuning the signal generator from below the 20-meter band to about mid-band, *Photo I* captures the amplitude peak at resonant frequency; in this case, at 14.0217 MHz which is very close to the target value of 14.020 MHz in *Table 1*. No further adjustment is needed. The same procedure is exercised for 30-meter trap tuning using the target resonant frequency of 10.090 MHz in *Table 1*.

Once both traps are tuned, they and their 6-inch pigtails should be dressed with layers of shrink tubing, as shown in *Photo J*. Later, when the antenna is tuned and confirmed to function well on all bands, large-diameter shrink tubing is applied over the toroid windings along with a little clear silicone caulking around the inside of the toroid and on both sides. This final procedure should maintain the traps' tuning over years of use.

A Broadband Impedance Matching Transformer

The transformer design is not my own, but results from an accumulation of online research. Steve Yates, AA5TB, suggests from modeling that the ideal counterpoise length for an EFHW is only 0.05 wavelength[3] (generally satisfied on HF by a short feed line, earbuds, portable rig, and the human holding it), but with this small counterpoise, the feedpoint impedance shifts downward from 5,000 ohms to around 2,000 ohms. He further shows that, on average over multiple counterpoise lengths, a 64:1 impedance ratio does a good job. I've experimented with multiple turns ratios, 49:1, 64:1, and 81:1 and have never observed much difference, but you must commit to one of these before tuning your antenna. Stated differently, you may get away with using a 64:1 transformer on an antenna tuned using an 81:1, but as expected, the SWR will be higher.

For this antenna, I chose to use an 81:1 impedance ratio since I have used that with many end-fed antennas over the years. The antenna described here is matched to this transformer, so be aware that redesigning the transformer means making adjustments to the antenna's segment lengths. I would not expect that any changes to the traps' tuning would be necessary.

Some folks choose to add a tuning capacitor across the hi-Z transformer output but in my experience operating CW only, the additional tuning range isn't required, despite wide differences in operating environments.

An 81:1 impedance ratio is the square of the transformer's turns ratio, so the turns ratio is 9. We have been winding these transformers for years using a 3-turn primary (to the transceiver) and 27-turn secondary (to the EFHW) on a T50-43 core, *Photo K*. While testing on my workbench some years ago, I discovered that the transformer's transfer function is significantly sloped across my trap antennas' wide bandwidths. To flatten the response so the transformer performs nearly the same on all bands, a 100- to 150-pF, 500-volt silver mica

capacitor is added across the 3-turn primary winding as seen installed in an empty dental floss container in *Photo L*.

Most QRP radios have a female BNC output, so we typically use a 6-foot small-diameter coax (e.g., RG-172) with a male BNC on one end, and solder the other end across the transformer primary and capacitor. Purchasing a 12-foot BNC-BNC RG-172 coax jumper, you can cut it in half and reserve the spare for your next project.

To connect the transformer to the antenna feed point, we use 2-millimeter male and female connectors.[9] A female connector is installed on the antenna input of the transformer and a 2-millimeter male connector on the EFHW feed point. These connectors make excellent electrical contact and push together fairly easily while requiring some force to pull apart.

Inside the transformer's container, glue will hold the coax and 2-millimeter female connector in place. After the glue sets, plenty of clear silicone caulking will help weatherproof the transformer while securing the toroid, capacitor, wires, and solder connections.

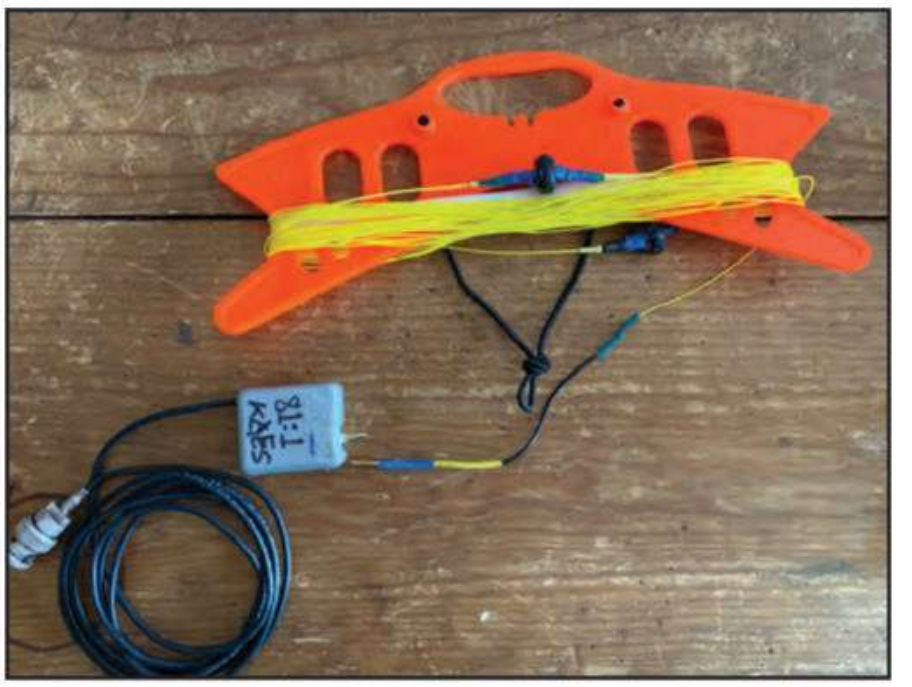


Photo M. Completed antenna and transformer

Physical Antenna Dimensions

Now that the traps with pigtails are tuned and ready, we will discuss embedding them into the antenna wire. The final trap antenna's physical measurements (measured to the center of the traps) are shown to scale in *Figure 1* below the full-size counterparts. The traps are clearly not to scale; they are less than 2 inches long (with shrink tubing) by about 9/16 inches in diameter.

A full sized EFHW for each of the three bands has the physical dimensions shown. A "velocity factor" (VF) of 0.97 has been applied. The VF shortens the physical length of the wire slightly and has been confirmed empirically over time for the Teflon®-coated and silver plated #28 AWG wire used here.[10] Ohmic losses for #28 AWG are not significant for lengths less than a half-wave on 40 meters, about 66 feet, and rest assured this wire is very strong and has never broken over years of hard use.

I was able to rapidly converge on the trap antenna segment lengths from experience building similar antennas in the past. In the lower part of *Figure 1*, we observe that the trap antenna is only 78% of the length of the 40-meter full-sized EFHW so the objective to physically shorten the antenna has been achieved. From quantitative performance tests on my 5-band trap EFHW in 2018, this physical shortening relative to a full-sized EFHW combined with the presence of traps does not significantly reduce the trap antenna's performance.[1]

Antenna Assembly

Assembling the various pieces above to complete the antenna system plus a few more details will be discussed here. *Figure 1* has the final dimensions of the antenna, so splice the traps' pigtails to the antenna wire segments to achieve the proper lengths measured to the center of the traps. To splice, strip about 1/2-inch from the wire ends to be joined, twist them together, solder and apply snug shrink wrap over the splice. This simple technique has never broken, even with strong winds and over hundreds of SOTA activations. During assembly, keep track of which is the feed point end vs. the far end of the antenna.

As shown in *Photo M*, the antenna wire feed point has a male 2-millimeter connector soldered to it, and connects to the matching 2-millimeter female on the transformer. I recommend a short length of heavier wire, such as the 4 inches of #24 AWG black wire shown, spliced to the #28 AWG antenna wire. This step will make the solder connection to the 2-millimeter male far less likely to break, and snug shrink tubing will add some strain relief. On the far end of the antenna, attach about 35-40 feet of light line and tie it to a kite winder. Attach the end of the antenna wire to the line (bowline knots work well), and wind the line and antenna in a figure-8 pattern, taking care to keep the traps clear of the bends around the winder by leaving more slack if necessary. The photograph of the completed antenna in *Photo N* was taken just before sending it to its new home with KØES. The antenna and the transformer assembly as shown weigh only 5.2 ounces, hardly noticeable in your backpack.

Prior to applying heat shrink tubing over the toroid windings (already installed in *Photo M*), we should check the antenna system's tuning as described in the next section.

Preliminary and Final Tuning

Given that you have set the traps to your chosen resonant frequencies and duplicated the wire segment lengths provided, one would expect that very little in the way of tuning adjustments will be required. You can fine tune the resonant frequency up or down if needed by trimming or adding to the wire segments to respectively raise or lower the resonance for a particular band. Just be aware that adding or subtracting length to/from the 20-meter or 30-meter wire segments will affect, to some degree, the tuning on the lower band(s) since the higher frequency wire segments and traps make up part of the lower frequency antennas. As stated previously, some telescoping poles affect tuning more than others. This antenna was tuned using a carbon fiber pole[11] that has a significant influence on tuning. By standing the antenna off from the pole; i.e., the transformer is taped to the pole and not the wire, the effects of the carbon fiber pole are minimized.

Before proceeding with this testing, there is a "lesson learned" step you should take in advance. The flimsy top section of your telescoping pole will NOT last long, so nest the top two sections together and glue them. This shortens the mast a little but makes it so much stronger. A small ground lug can be super-glued to the top of the nested sections, providing a loop the for the antenna's feed point to pass through. The Teflon® wire used has never shown any abrasion from passing through the loop.

The tuning measurements for this and many previous trap antennas were accomplished in my backyard, where the setup is shown in *Photo N*. The Jemez Mountains, home to SOTA peaks we've activated many times, are in the distance about 40 miles away. This setup is pretty close to how we

set up on peaks: From the transformer, the antenna runs up the pole and through the loop at the very top, then over to a support where the far end is tied off. The obvious exception is the center hole patio table used as the telescoping pole support. Securing the pole to a shrub with bungee cord or inserting it into a rock pile is typical.

For preliminary tuning, I used a Sark 110 analyzer. An antenna analyzer is a good first step to make sure antenna tuning is in the ballpark. The top graph (*Photo O*) is a broadband scan from 6.5-15 MHz. The green curve is the VSWR and the red is the Impedance Magnitude |Z|. Where the red curve intersects the SWR minimum, |Z| is about 50 ohms. The reader can easily see the three SWR minima that identify the bands covered by this antenna. We're off to a good start.

Photos P-R narrow the focus to within the 20-, 30-, and 40-meter band segments of interest, respectively. The three minimum SWR readings from the SARK, where the yellow dotted vertical lines intersect the green curves, are a few kHz off from the intended operational frequencies but this is not important. However, verifying that the antenna plays well with the actual setup to be used in the field most certainly is important!

For this reason, the final tuning step replaces the SARK analyzer with a KX2 (ATU bypassed), including paddle and earbuds as it would be used in the field. The KX2 was initially used because it conveniently reads SWR directly. The SWR readings measured by the KX2 were:

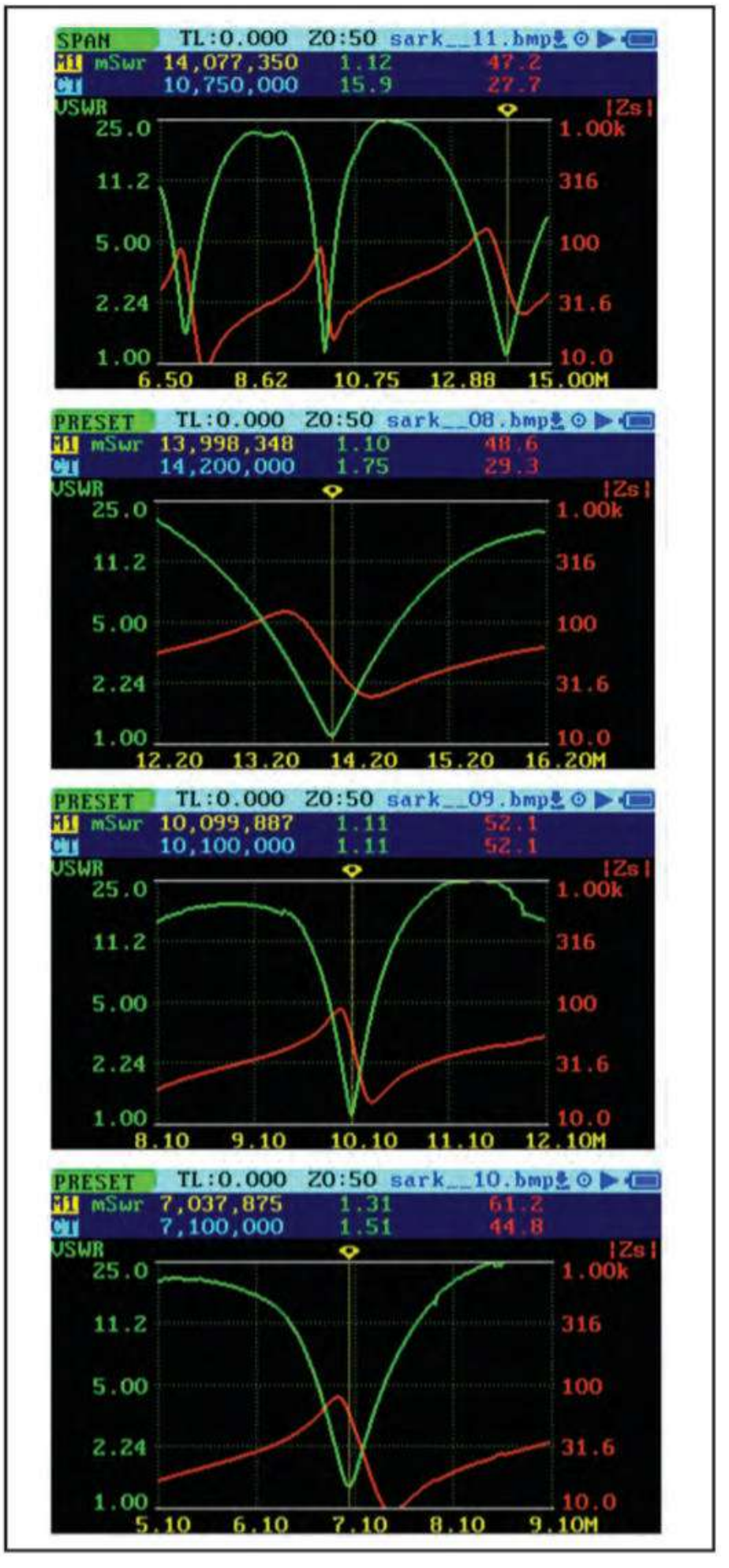
Freq.	SWR
14.061	1.0:1
10.111	1.0:1
7.033	1.3:1

These SWR readings were verified using my MTR-5B with battery, paddle and earbuds plus an outboard SWR meter. As an aside, a DK3IT TinySWR has been built into the MTR-5B so approximate SWR and with it, the presence of RF, can be monitored on a peak.

Photo N. Backyard antenna test setup

It is not unusual for 40-meter SWR to be a little higher in my backyard than on a mountain peak. On a rocky summit with less ground conductivity, the antenna's SWR is typically lower; i.e., behaving like it is higher above ground.

To drive this point home one last time, measuring your antenna system's SWR with the setup that you actually use should be the final test. When I'm satisfied that an antenna is complete, I always take a little time to tune around the bands and make a QSO or two. This last step should further whet your appetite for an outdoor adventure! Jerry, KØES, received this antenna a few days later, and has confirmed



Photos O-R. Sark 110 antenna analyzer 3-band trap EFHW readings

the SWR readings obtained here in his own back yard.

Summary

This article began with a list of four objectives, all successfully realized. This 3-band trap EFHW system has been presented with sufficient detail for the reader to replicate it. The antenna system's performance has been validated through the measurements described here, with KØES's confirmation of exact SWR measurements in his Colorado QTH's backyard, and with his use on several SOTA activations. Jerry has also successfully duplicated the traps described as has Mike Crownover, AD5A, who is building a similar antenna. At 5.2 ounces for the antenna, winder, and transformer, you will hardly notice it in your backpack.

The trap fabrication methods described here have been applied to a number of 3-, 4-, and 5-band trap EFHW antennas since 2016. There have been no failures since axial trap design and fabrication commenced in 2016.

Summits on the Air is a great way to combine love for the great outdoors and ham radio. A lightweight, compact, and effective antenna such as this one will contribute to years of fun. I've had many wonderful DX surprises on SOTA activations, but one that sticks in my mind is consecutively working ZL1BYZ and GMØGAV on the same band from a summit here in New Mexico. Not bad at all for QRP and a trap EFHW antenna wire!

Because building, tuning, deploying, and enjoying your own antenna creations is immensely satisfying, it can be addictive. You may find yourself with more test gear on your workbench and a desire to read more about antenna theory and to experiment. No need to ask how I know this.

References & Footnotes

1. *Design, Development and Implementation of a 40m-15m Five-Band, 4-Trap End Fed Half Wave (EFHW) Antenna,* presented by John DePrimo, K1JD, on 9/22/18 at the ARRL Rocky Mountain Convention / Duke City Hamfest. <https://tinyurl.com/9epwkn2x>

2. *Evolution of a Portable Summits on the Air (SOTA) Station,* authored by John DePrimo, K1JD. <https://tinyurl.com/zjtnzh42>

3. EFHW antennas can get by without a separate wire counterpoise, just you holding your radio, earbuds etc., is enough. This excellent article by Steve Yates, AA5TB, and his conclusions have been continuously verified over years of SOTA activations both with and without counterpoises. <www.aa5tb.com/efha.html>

4. Setting the resonant frequency below the desired operating frequencies makes a parallel resonant trap more inductive than capacitive. In this case, the inductive reactance is less than the capacitive reactance, so the inductor branch dominates; e.g., see Part 2 in this reference: <https://tinyurl.com/8kutrc53>

5. This and other W8JI references offer a lot of information for those interested in antenna traps. A notable excerpt from this reference is "trap loss has been greatly exaggerated through advertising hype". <www.w8ji.com/traps.htm>

6. Useful online calculators for designing traps:
- Amidon inductance calculator: <https://tinyurl.com/spn65way>
- Resonance Calculator: <www.1728.org/resfreq.htm>

7. The 1KV SMD capacitors used here are available from Mouser: <https://tinyurl.com/rn3xv2zr>, <https://tinyurl.com/5xeyfjh7>

8. Ace Hardware #4 nylon spacer. Alternative sources exist, such as McMaster-Carr unthreaded nylon spacer for #4 screw, 3/16" OD x 3/4" long with inner diameter of 0.115".

9. 2-mm connectors are available at: <https://tinyurl.com/v7nzj2ud>

10. #28 Silver plated PTFE coated copper wire, for example: <https://tinyurl.com/w43r3xhc>

11. Carbon fiber poles are strong, light and compact but do affect tuning of an EFHW wire that runs up the pole. When building this EFHW 3-band system, recognize that you should tune it using your full portable setup, including the actual pole you expect to use for the antenna.

Here's how hams have been solving problems for the past hundred years … if you can't find awhat you're looking for in a book or online, design your own solution — and then share it with others!

DC-Over-Coax Three-Way Antenna Switch

BY JERRY CLOUATRE,* AG5AY

One of the things I enjoy in ham radio is experimenting with homebrew antenna designs. I currently have an off-center-fed dipole (OCF) and a vertical antenna, and I wanted to easily swap between those two and a third experimental antenna. My shack is located on the opposite side of my house from the antennas, with about 125 feet of coax running through my attic just to get to my antenna connections. I would have to go outside to swap coax connectors between the OCF and vertical antenna leads, or to connect to my test antenna. It would be nice to have three different runs of coax, but with the bulk and length of the coax, not to mention the expense, I started looking for something that would switch between the three antennas and could

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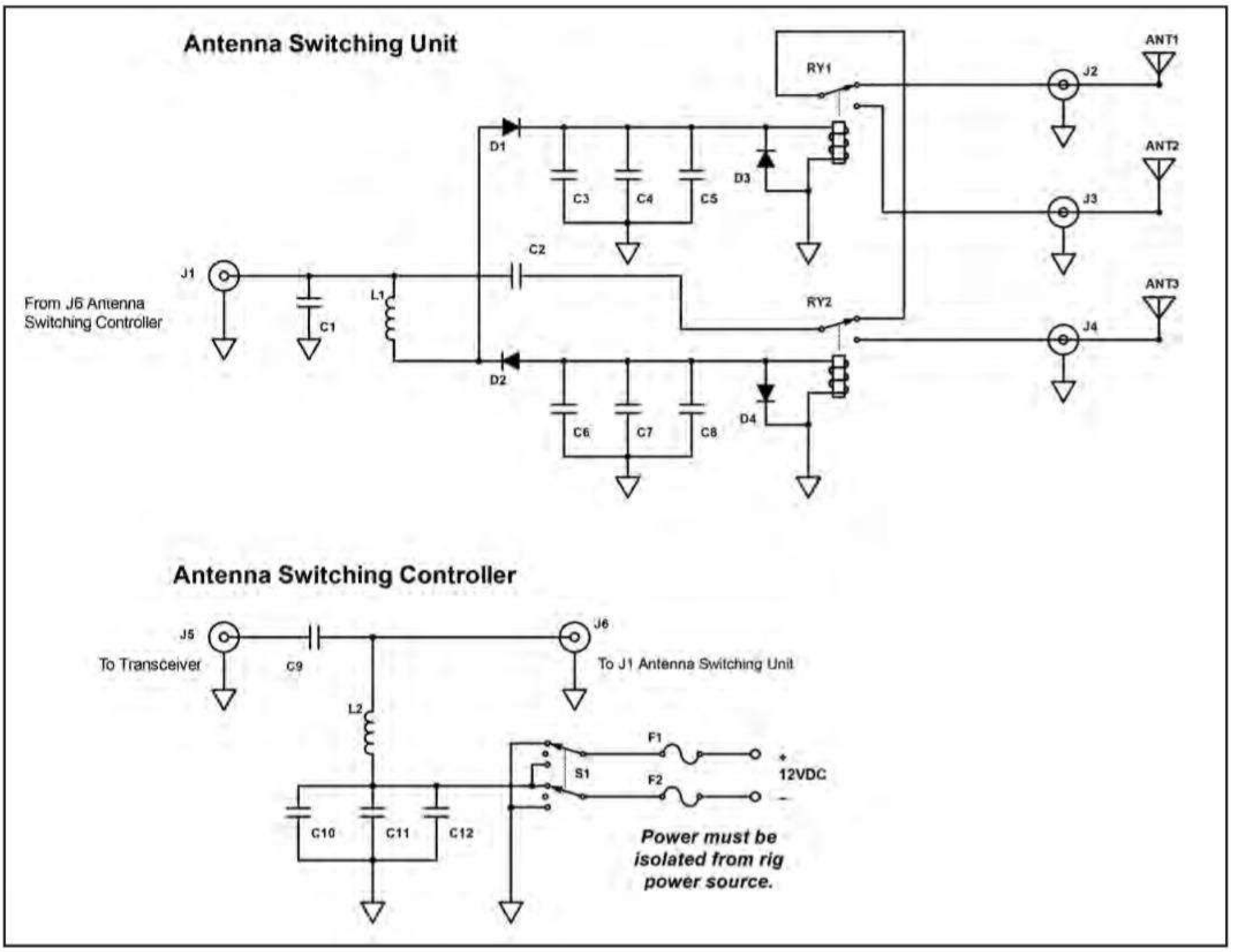

Figure 1. Using DC-over-coax and diode logic to control the switching relays, the DPDT switch S1 can remotely select any one of three antenna feeds into the shack.

Photo A. Antenna switching controller.

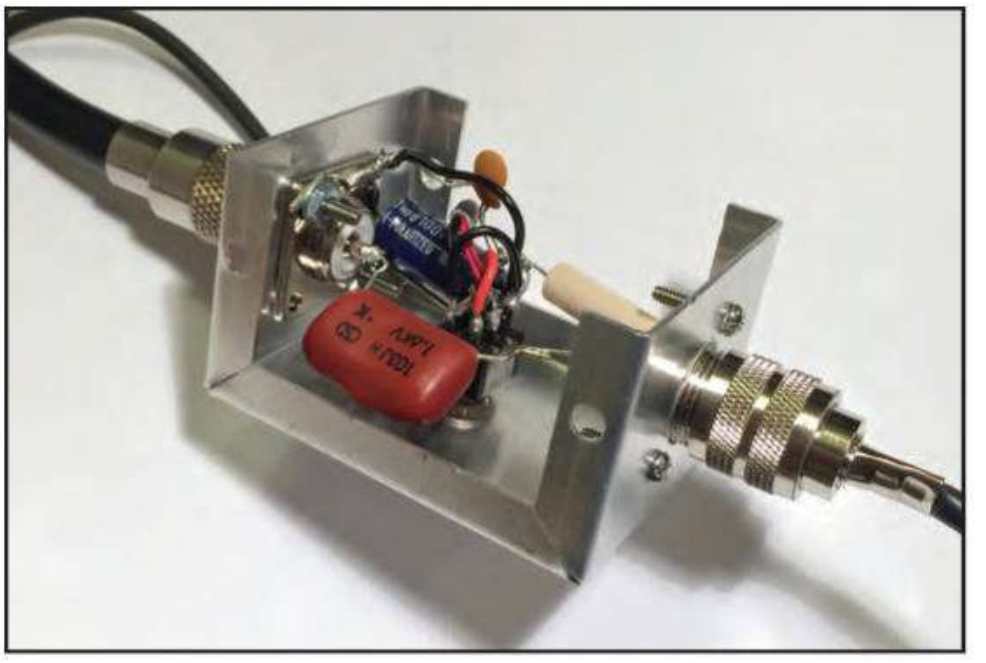

Photo B. The antenna switching controller built using point-to-point wiring.

be controlled from in the shack. I was also looking for something I could build using parts I had on hand.

To reduce the cost and effort of running a separate cable to control the antenna switch, I decided to use DC power over the coax to switch the antenna relays. It's pretty easy to do with two antennas, but adding a third was a bit of a challenge. I searched the internet and various antenna project books but only found two-position antenna switches and no simple solutions for three antennas.

A Modest Solution

What I came up with was a pretty modest solution for this simple, one-evening project (see *Photo A*). After a short search on the internet, DC over the coax was easy to do. Capacitors C2 and C9 (See parts list, *Table 1*) pass RF from the transceiver to the antenna while blocking the DC (see *Figure 1*). The two chokes, L1 and L2, block the RF from the relays and power supply while allowing the DC to pass. The other capacitors filter any RF to ground. Using diode logic with two relays, three-way control can be easily accomplished. With no voltage applied from the controller (S1 in the center position), the normally closed contacts on RY1 and RY2 bring the RF signal to ANT 1. With a positive voltage applied from the controller (S1 in the down position), diode D1 allows relay RY1 to energize, connecting ANT 2. With a negative voltage applied from the controller (S1 in the up position), diode D2 allows RY2 to energize, connecting ANT 3.

Any style of construction can be used to build the switching unit and the controller. As you can see in *Photo B*, I simply connected the parts directly to the switch and SO-239 UHF chassis mount connectors using point-to-point construction. For the remote switching unit (*Photo C*), I decided to use a perf board to mount the two relays and components, just to keep things a little neater inside the enclosure. The enclosure for outdoors is a weatherproof aluminum electrical box. For indoors, I used a small BUD box left over from another project.

Using a 5/8-inch spade bit, it was easy to drill through the aluminum BUD box and weatherproof box. Holding them secure in a vise helped keep them steady and safe while slowly drilling the holes for the SO-239 connectors using my drill press.

One important precaution: Because the switching works by reversing the control signal polarity with reference to ground using the DPDT switch, you cannot use the same power supply that is used to power your transceiver. It

what's new

bhi Noise Cancelling Headphones

bhi has just released its newest addition to its noise-cancellation product line, the NCH, or Noise Cancelling Headphones. This is an over-ear style headphone that uses active noise-cancelling, which provides 12-15 dB of active noise cancellation and a sensitivity of 110 dB.

The NCH features a miniature microphone in the earpiece that picks up ambient noise (such as traffic noise or aircraft cabin noise). The electronics in the earpiece invert the ambient noise 180° out of phase with the external ambient noise. This has the effect of cancelling out the annoying ambient noise without diminishing the audio you are listening to, resulting in a much-improved listening experience.

The adjustable headband and soft over-ear pads ensure that the headphones are a comfortable fit. The NCH headphones require one AAA alkaline battery (supplied) and the active noise cancellation can be easily switched on and off with a simple switch. A green LED indicates whether it is active or not. The supplied AAA battery has a 45-hour life. Connectivity is supplied by a 4-foot detachable cable with a 3-millimeter jack plug.

bhi's NCH is available now at DX-Engineering.com or GigaParts.com and has a suggested retail price of $55.94 in the U.S. For more information, contact bhi Ltd, P.O. Box 318, Burgess Hill, RH15 9NR England. Website: <www.bhi-ltd.com>.

Features
- Impedance 32 Ohm
- Magnet: Neodymium
- Frequency Response: 20 - 20,000 Hz
- Maximum Input: 40 mW
- Weight: 190g/7oz (incl' battery)

C1	5 pF
C2, C9	0.01 µF, 1.6 KV
C3, C6, C10	0.01 µF
C4, C7, C11	0.1 µF
C5, C8, C12	4.7 µF non-polarized
D1-D4	1N4003
RY1, RY2	SPDT 12 volt relays
S1	DPDT switch, on-off-on
F1, F2	1A fuse
L1, L2	25 mH
J1-J6	SO-239

Table 1. Parts list

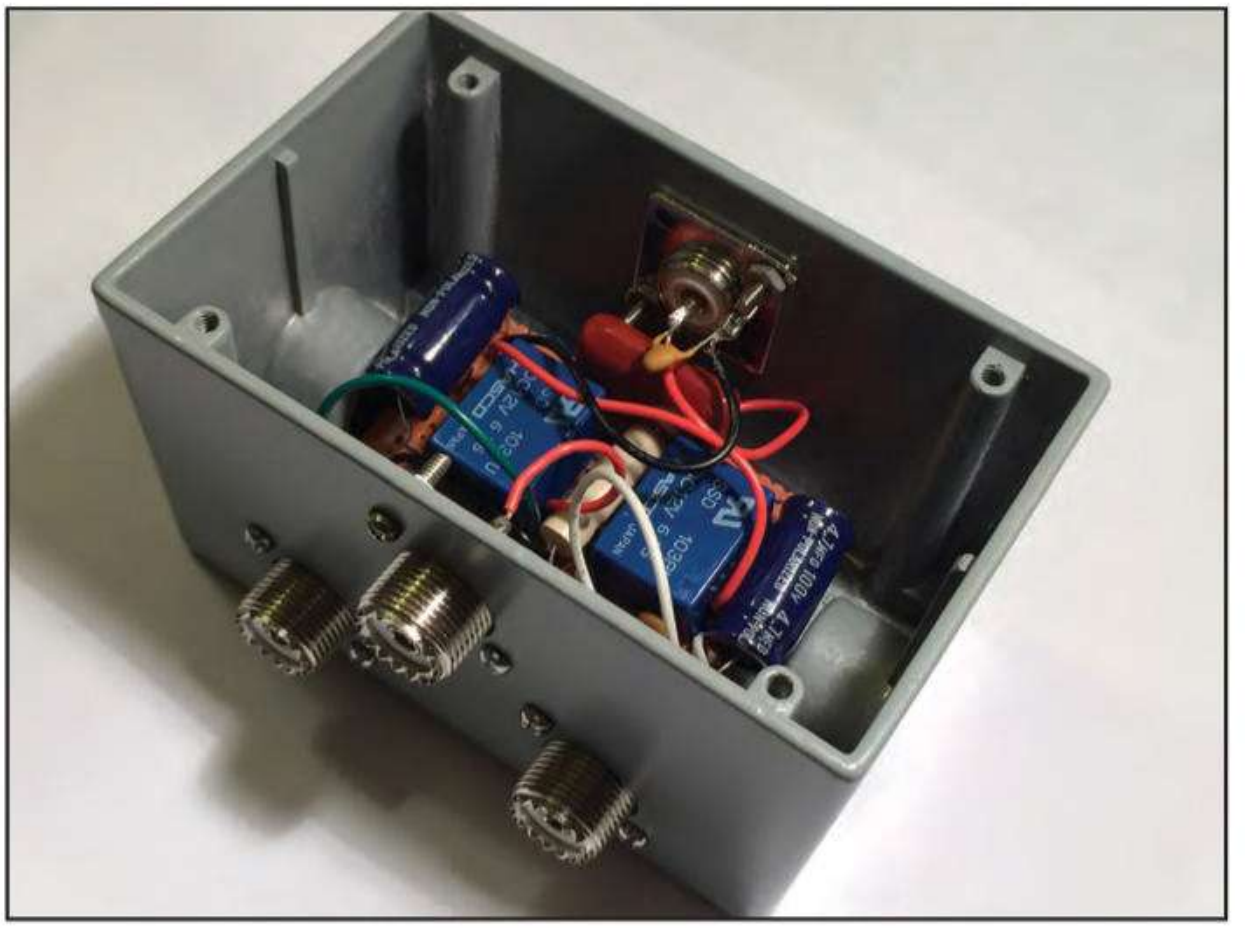

Photo C. The remote antenna switching unit, located in the field, was assembled inside a weather-resistant enclosure.

must be isolated to prevent shorting the rig supply's positive lead to ground. I simply used a wall-wart type 12-volt supply I had on hand. Both legs of the input power should be fused to protect from accidently shorting the power supply to the common ground.

The values used in this project are not super critical and were what I had on hand. If running an amplifier, please ensure the components have sufficient voltage rating and power handling capabilities.

Excellent Results

I've been running this three-way coax switch for a couple of years and it's still serving me well (see *Photo D*). It was well worth the couple of hours to put it together. It can always be fancied up a bit with LED indicators to show the connected antenna, but that's for another time.

Photo D. Even after a few years of service, the remote switching unit is still ready to connect to a test antenna, allowing a quick comparison of different antennas' performance.

ANALOG ADVENTURES

BY ERIC P. NICHOLS,* KL7AJ

A Pressing Matter

A while back, I mentioned how I liked to peer over the top of my figurative cubicle partition and see what my fellow CQ columnists are up to. Of course, I'm not the only one to do this. In fact, just a couple of months back, our all-seeing "office manager," Rich Moseson, W2VU, did a fair bit of cubical-peering in his excellent April (no fooling!) editorial. He eloquently showed how flexible the partition walls are between the countless subsets of amateur radio specialties.

If there's one thing in common with most, if not all, of CQ's writers, it's this: We like building stuff. The maker mentality is alive and kicking within the relatively small community of radio amateurs. However, if we're brutally honest, we need to acknowledge that the maker mentality is somewhat of a rarity among American society at large. In my book, "The Opus of Amateur Radio Knowledge and Lore" several years back, I somewhat (but not too) humorously, addressed this issue in Chapter Nine, "How to do Stuff." I rather lamented that certain basic competencies that those of us "of a certain age" took for granted were not to be found amongst vast numbers of our youth. I regularly encounter high school kids who have never used a drill or a wrench, something that would have been unheard of in my own childhood or adolescence. Even the most mechanically un-inclined kids of my age at least had some clue about just plain "doing stuff." And, by "doing stuff," I don't mean punching buttons on a smart phone. I mean working with real physical materials with sharp, pointy objects that can poke you, hot pointy objects that can burn you, or small pointy parts you can choke to death on.

All of which brings me to the main character of this particular article: Grizzly the Drill Press (*Photo A*).

I've somewhat needed a decent drill press for quite a while, but a recent contract I landed forced — or at least accelerated — the issue. A couple of weeks ago, I was wandering the aisles of one of our friendly local industrial supply houses, and Grizzly beckoned me from the showroom floor. I brought Grizzly home the same day, and with the help of a couple of my dedicated proteges, we got Grizzly assembled and up and running in an hour.

After an initial safety check, I stood before Grizzly, offered him a snappy salute, and proceeded to drill some holes in some scrap aluminum I had lying around. A couple of days later, I had our 14-year-old granddaughter, Leila, do the same. No progeny of mine is going to go through life not knowing how to use a drill press!

Now, while Leila made it known that she had no intention of becoming a machinist, she did admit that she liked the sense of power that Grizzly gave her, at least for the moment.

But that's not where the story ends. On the counter where I picked up Grizzly was a book, "A Bad Case of Capitalism", written by a fellow, Shiraz Balolia, who created Grizzly tools (see <https://tinyurl.com/29v9s3sf>).

Photo A. "Grizzly," the drill press … the newest member of the Nichols family.

I figured I should give the book a shot, since I didn't know much about Grizzly tools before, and even less about Shiraz. So I bought the book along with a few drill press accessories, like some T-slot nuts and a decent vise. I was not disappointed, to say the least.

Shiraz is the epitome of someone who knows how to "do stuff," and this book should be required reading by every American. It is a true Horatio Alger type story, and incredibly inspiring. It is just what I needed to read during this lockdown period (or dare I say, era).

It is good to see some other encouraging signs along the maker front. Mike Rowe of Dirty Jobs fame is doing a great job of encouraging the trades in high school and beyond, and astutely questions the wisdom of our young people going to college merely by default … or even worse, to go to college to "find oneself," while accumulating hundreds of thousands of dollars in student debt. I will restrain myself from waxing too profusely on this particular matter.

At any rate, I am more than delighted to have Grizzly in the family, and I'm sure we'll be hearing more about him, if you will indulge me an occasional digression. Now to find more stuff to drill!

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MATH'S NOTES

BY IRWIN MATH,* WA2NDM

Working With Supercapacitors

This month I would like to introduce you to a relatively new family of unique components that are "ripe" for experimentation. These are the so-called "supercapacitors" that are now readily available from most of the standard electronic component distributors. These capacitors are components with capacitances in the range of farads, not microfarads. I am also sure that many of you are familiar with the fact that a capacitor can be charged quickly and remain charged for a period of time. That is why shorting the terminals of a charged capacitor (particularly a high-voltage one) before working on a circuit is a good and safe practice.

The main problem with using a common high-value electrolytic capacitor as a source of voltage in portable equipment instead of a battery is that most capacitors (in the microfarad range) quickly lose their charge into significant loads. Supercapacitors in the farad range, however, have such a great deal of capacitance that the length of time they can hold a charge can be magnitudes longer than conventional ones. In fact, it is often so long that its voltage capability can equal batteries in some instances. In addition, a supercapacitor can be charged and discharged numerous times without failure.

Now to the Details…

The so called "*discharge time constant*" of any capacitor (measured to 37% of its initial charged level) is called the "one time constant." It is technically equal to R x C where C is the capacitance value in farads and R is the resistance of the load across the capacitor in ohms. but does not include some small self-leakage current which, in most cases, can be ignored. The value of R is determined by the voltage divided by the current required by the load. To make things a little more difficult, most conventional supercapacitors have a maximum working voltage of only 2.7 volts. If this voltage exceeds its stated working voltage, it can be easily damaged resulting in reduced life or actual failure. Even a few tenths of overvoltage is not allowable in this case. So to charge such a capacitor is not quite so simple.

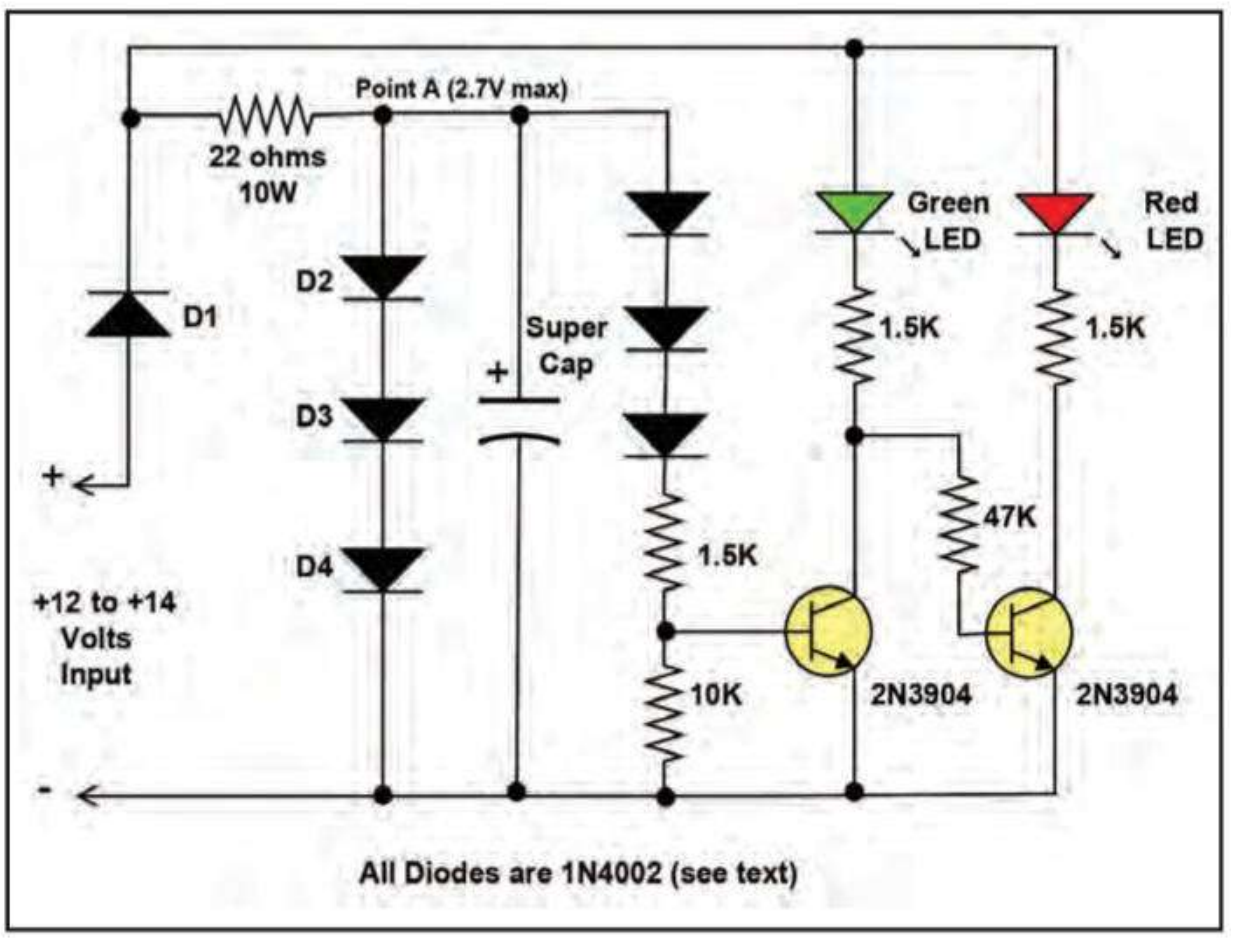


Figure 1. A simple supercapacitor charger circuit. See text for details.

The schematic in *Figure 1* is a simple and inexpensive charger that can be easily built by the experimenter; but a bit of selection effort will be needed before it can be completed and used. As you can see, three silicon diodes are connected across the capacitor to be charged. All such diodes are fairly equal in specifications but the common, very low-cost 1N4002 variety must each have a forward voltage drop of less than 0.8 volts. This means that the maximum voltage that can appear across the capacitor is 3 x 0.8 volts or 2.4 volts, a safe value to not exceed 2.7 volts. According to the data sheet this is not a problem at the current level that will pass through them *but it must be double checked* to protect the supercapacitor being charged. Initial testing is as follows:

With *no* supercapacitor connected to the circuit, apply a 12-volt input (which should be capable of providing at least 0.5 amperes) which can come from an inexpensive wallwart for testing purposes if you wish, or any other similar source. Note that the first diode, D1, is used to prevent a reversed-polarity input. Diodes D2, D3, and D4 are connected in series and will conduct and pass approximately 0.5 amperes, limited by the 22-ohm resistor. Next connect your DVM between point A on the schematic and the common negative input or return. Ensure that the voltage you read is actually less than 2.7 volts. If it is not, select or replace diodes D2, D3, or D4 until it is. According to the data sheet for the 1N4002 the drop across each of the first three diodes should be (typically) 0.8 volts per diode for a total of 2.4 volts for the string but it may be slightly higher, which is OK as long as it does not equal or exceed 2.7 volts (even by a little). The green LED should also light at this point. Now short the terminals where the supercapacitor will go and note that the green LED will go out and the red LED should light. If this occurs, then all is OK and you have just demonstrated that when the supercapacitor is connected across the diodes, and is fully discharged, its resistance will be at zero ohms and the full current (limited by the 22-ohm resistor to 0.5 amperes) will be applied to the capacitor since the diodes will not be conducting. At this point, the voltage across the capacitor being charged will

*c/o CQ magazine

be at zero and as the capacitor charges, the voltage across it will slowly rise until the diodes conduct and then limit the maximum voltage that can be applied to less than (or equal to) somewhat less than 2.7 volts. The transistors, three additional diodes, and associated components are simply used to turn the indicator LEDs on and off when the 2.7-volt point is reached since they will then also conduct at this point. In conclusion, remember that the red LED means either charging (or discharged) and the green LED means fully charged. During the charging cycle, the green LED may light very dimly to show that charging is going on but will gradually brighten as the capacitor charges.

For proper operation, the input voltage of this circuit should not go much below around 12 volts, so any common 12-volt DC wallwart (with at least a 0.5-amp capacity) to the typical automotive 14-volt source can be used. As mentioned, the 22-ohm resistor is used to limit the charging current to the capacitor as well as the diodes so that none of them exceeds their maximum rating of 1 ampere.

At any voltage from 12-14 volts, a 10-farad capacitor will take about 220 seconds or 3.5 minutes to fully charge. A 100-F capacitor will take 2,200 seconds (about 35 minutes) to charge. At 12 volts, the initial charging current will be about 0.5 amperes and at 14 volts it will be about 0.6 amperes. As the capacitor charges, the current will gradually decrease. Keep in mind that these values are approximate so please do not "nitpick" my rough estimates. They are close enough for the purposes of this example.

The limit to the maximum charging current used is the value of the 22-ohm resistor. In this example, we have assumed that with 12 volts applied, the power in the 22-ohm resistor will be about 5.7 watts, leaving a safety margin of 4 watts, which is why we chose a 10-watt resistor. If you use the automotive value which can rise to 14 volts, then the dissipation of the resistor will increase to 8.5 watts, which still leaves a safety margin of about 2 watts. Depending on the voltage you plan to use, however, you might consider the heat that could be produced by the resistor — especially at higher input voltages — and mount it so this is not a problem.

The cost for all common components in this circuit is probably less than $5 depending on your "junk box," where you shop, and what type of enclosure for the circuit you use, but the supercapacitors are a different case. The 10-farad capacitor we mentioned would cost around $2.50 (Mouser Electronics part number 594-MAL222551013E3) while the 100-farad capacitor would cost around $7 (Mouser 581-SCCW45B107SSB). While Mouser Electronics is used as an example, keep in mind that other distributors should have these capacitors and they should be similar in price. Higher values do exist but will cost significantly more. If you search on the internet you may find other supercapacitors with lower prices, but when purchasing such devices from unknown sources, be sure you never exceed the rated voltage of the particular device.

Once you are familiar with and can charge supercapacitors, you will still be limited to circuits that can only work at approximately 2.7 volts. Next month, we will look at ways to produce higher voltages with these devices.

– 73, Irwin, WA2NDM

THE LISTENING POST

BY GERRY DEXTER

"Brother" Stair Succumbs to Heart Attack

Plus, Remembering George Zeller

~ A major shortwave "loss" was the passing of Ralph (Brother) Stair, who died of a heart attack in early April at age 84. He was in hospice care and still due to face trial on sexual abuse charges. His programs remain on the air via several outlets.

~ This one especially hurts. My SWBC colleague and friend George Zeller died in a fire at his Cleveland home in late March. Zeller was a widely known expert on Ohio economics; he was frequently interviewed or quoted in local and national media — and much admired for his knowledge of pirate radio. His many SWBC friends would occasionally spot him at a Cleveland Indians game sitting next to his drummer friend or donating time as an auctioneer at an SWBC DX gathering, attired in a cheese-head hat (complete with goggles). He'd even confirm his TV sightings. R.I.P. George!

~ I'll bet you've never heard Radio Bukavu in the Democratic Republic of Congo. Not just because it's been off the air since lightning struck the transmitter a couple of years ago, but also due to its unfortunate schedule (0600-1500 UTC) on 6210 kHz using a mere 800 watts. The Christian religious station does plan to be back, though the station did not indicate when. So, there's always hope!

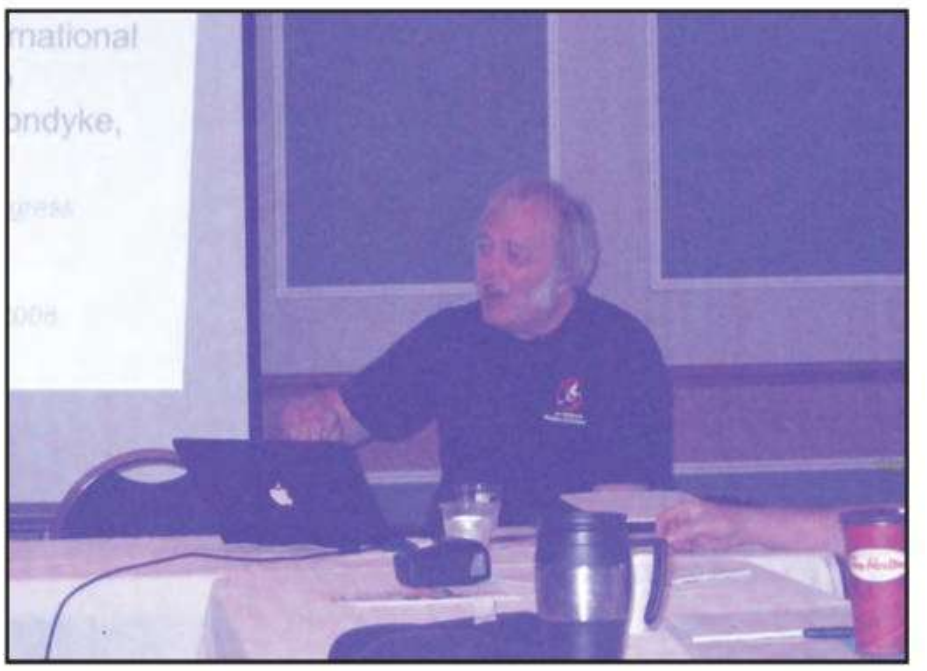
~ Arnie Coro of Radio Havana Cuba (RHC), he of the unkept promises of sending Radio Progresso QSLs (*any day now! –GLD*), has been unwell — it seems — and consequently the "DXers Unlimited" program, which he hosts, has suffered. The program started using fill-in hosts, but it has now disappeared from the RHC schedule.

~ Italy's Marconi Radio International, which has been silent for a time, is back in testing mode and says it is installing new antennas, a new transmitter, and repairing other equipment. With the station improvements, it should include a resumption of QSLing, so they say. Later information has the station back on the air at 0900-1030 UTC, repeating from 1600-1730 UTC using 250-270 watts on 11390 kHz. You can send your reports to: <marconiradiointernational@gmail.com>.

~ The state media in Myanmar is off the air, though I still see reception mentions on other sources, so it does get confusing, especially considering the turmoil in that country.

~ China Radio International must be up to something. It has mysteriously dropped some of its European languages, replacing them with Chinese music. Although the changes are supposedly temporary, the latest World Radio TV Handbook (WRTH) update notes the situation has been going on for "quite some time." Maybe we should get Miss Marpole or Nero Wolfe to tackle this one.

**c/o CQ magazine*



The late George Zeller giving a presentation at a SWBC meeting.

~ Trans World Radio-Africa is now using the Ascension Island relay from 1730-1800 UTC on 17745 kHz Monday through Friday.

Listener Logs

Your shortwave broadcast station logs are always welcome. Please ensure to double- or triple-space between the items, list each logging according to the station's home country and include your last name and state abbreviation after each. Also needed are spare QSLs, station schedules, brochures, pennants, station photos, and anything else you think would be of interest. The same holds for you amateur radio operators who also listen to shortwave broadcasts ... I know you're out there! There may not be call letters with my name but you, too, are also most welcome to contribute!

Here are this month's logs. All times are in UTC. If no language is mentioned, English is assumed.

ALASKA—KNLS from Anchor Point on 9730 at 1515 in Russian with Christian music in Russian and English; on 9795 in English at 1215 with an interview. (Taylor, WI).

ALGERIA—Radio Algerienne on11985 via France at 1954 in Arabic. (Brossell, WI)

ARGENTINA—AD149 on 6934.9 USB (u) to 0038 to close around 0047, power said to be 1 kilowatt for this pirate. Transmitter site unknown. (Robbins, KB8QBF) [Jason - shouldn't this be with pirates??]

ASCENSION ISLAND—BBC on11660 at 1950 with talks. (Brossell, WI) On 11810 at 1927 interviewing an African musician; on 12095 at 2055 in English, station ID at the top of the hour, into program on democracy in the U.S. (Taylor, WI)

AUSTRIA—Adventist World Radio on 11880 at 2030 with English station ID, into French. (Sellers, BC) On 11955 via Moosbrunn at 1530 in Punjabi. (Brossell, WI)

Radio Kahuzi in the Democratic Republic of Congo is almost never heard here.

Italy's only shortwave voice has returned.

AUSTRALIA—Reach Beyond on 9590 from Kuunurra at 1248 with man and woman speaking in English and Hindi; on 11900 at 1253 in Hindi. (Taylor, WI)

BOTSWANA—VOA Relay on 19525 at 0306 with African news; on 7460 in Kinyarwanda at 0330 with possibly the news. (Sellers, BC) On 5580 from Moepeng Hill at 2003 on government problems in Azerbaijan. (Brossell, WI)

BRAZIL—(*All in Portuguese – GLD*)

Voz Missionaria from Camboriu on 5939 at 0151 with a man talking, later in phone call; on 9665 at 0108 with preaching. (Taylor, WI) At 2308 with an apparent sermon. (Brossell, WI)

Radio Aparecida from Aparecida on 6135 at 0042 with light ballads. (Taylor, WI)

Radio 9 de Julho from Sao Paulo on 9818.7 at 2315 with talks amidst audio spikes and fade outs. (Brossell, WI)

Radio Nacional Brasilia from Brasilia on 11780 at 0259 with station IDs, frequencies, off at 0304. (Sellers, BC)

Radio Inconfidencia from Belo Horizonte on 15190 at 2258 with station ID by a woman, frequencies, romantic music. (Taylor, WI)

CANADA—CFRX on 6070 from Mississauga at 0234 with interview of Toronto mayor. (Sellers, BC)

Bible Voice on 11790 via Germany at 1753 in Amharic, Christian message, closing English service at 1758 giving a Newmarket, Ontario address plus an email address. (Sellers, BC) On 11900 in English at 1428 with contemporary Christian music. (Taylor, LFP)

CHINA—China Radio International on 7255 from Shijiazhuang at 1309 with talks in Russian; on 9830 from Jinhua at 2304 in Cantonese; on 15125 via Mali at 1719 in Swahili. (Brossell, WI) On 13630 from Mali at 2104 with news; also on 11640. (Sellers, BC)

CNR-1 (Greater Bay Area) on 9570 from Kashi at 0014 in Cantonese, station ID sequence at 0045 followed by a program on COVID. (*Mark notes this is a relatively new service for the Pearl River Valley* - GLD). (Taylor, WI)

CNR-8 on 9785 at 1234 in Korean and CRI-Kunming in Lao, both creating a mess. (Taylor, LFP)

CNR-17 from Lingshi on 9630 at 1324 in Kazakh with local instrumental music. (Taylor, WI)

PBS Nei Menggu on 9520 from Huhhot at 1158 with male and female announcers speaking in Mandarin, 4+1 time pips at 1200. (Taylor, WI)

COLOMBIA—La Montana Colombia from Maicao on 4940 at 0110 with a man speaking Spanish briefly, variety of big band jazz, interview of a woman. (Taylor, WI) At 0240 in Spanish. (Figliozzi, NY)

CUBA—Radio Havana Cuba on 15140 from Bauta at 1949 on Japan to 1952 then station ID. (Sellers, BC)

ENGLAND—BBC on 5930 via Austria at 0102 with man speaking in Pashto, instrumental music, some sort of drama, several people conversing, man giving the station ID and contact info, off at 0128. (D'Angelo, PA) On 7485 via Moldova at 0327 in Persian and sports comments, closedown announcements in English at 0329. (Sellers, BC)

Encompass Digital Media on 6090 via Woofferton at 0100 with a test, asking for reports to <transmissiontest@gmail.com>. Retired Woofferton engineer G4OYX explained that Network Rail there had a problem on a line running near the 300-kilowatt Woofferton site. Later noted about 0230. (Robbins, KB8QBF) At 0047-0105 with instrumental music. (Taylor, WI)

ESWATINI (Swaziland)—Trans World Radio on 11660 signing on at 1628 with IS and station ID repeating until half past then into Oromo. This is Sundays only; language use varies depending on the day. (Sellers, BC) At 1717 with man speaking in Amharic, dead air at 1729, back at 1730 with instrumental music, announcements, HOA music. (D'Angelo, PA) On 15105 at 1527 in Lingala. (Brossell, WI)

FRANCE—Radio France international on 11995 from Issoudun at 1902 with news in French, current events program. (D'Angelo, PA)

GERMANY—Deutsche Welle on 15215 via France at 1353 in Hausa. (Brossell, WI)

GREECE—Voice of Greece from Avlis on 9420 at 0210 in Greek with guitars. (Sellers, BC)

GUAM—Adventist World Radio on 12085 from Agana at 1431 in Kannada language; also at 1546. (Brossell, Taylor, WI)

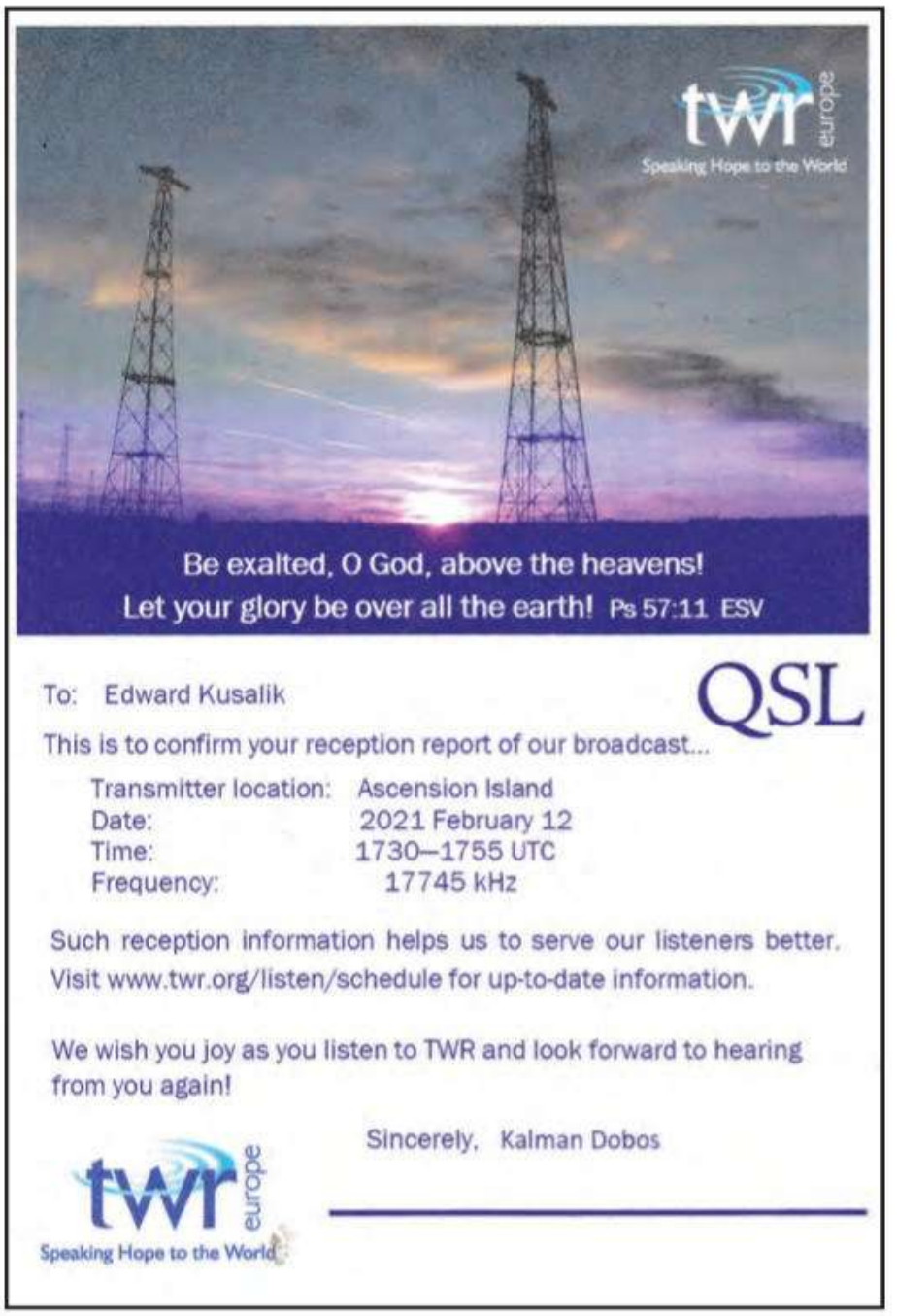
GUATEMALA—On 4055 from Chiquimula at 0047 in Spanish with tinkly piano, couple of days later came word the transmitter had "burned out." (Taylor, WI)

INDIA—All India Radio on 9580 from Bengaluru at 1224 in Tibetan, (but badly QRM'd by CRI via Cuba) man with orchestral background music, then man and woman speaking in Tibetan. (Figliozzi, NY) On 11560 from Bengaluru with sub-continental songs at 1323, listed in Dari. (Brossell, WI)

Trans World Radio India on 7590 via Moldova at 0047 with man giving religious talk in Dzonka, then woman gave contact information, closed at 0059 with IS. (D'Angelo, PA) On 9290 via Amenia in Mundari with woman and Southeast Asian music. (D'Angelo, PA)

IRAN—VOIRI on 11670 from Sirjan at 1248 in Dari with high-voiced man alternating with lower voice man. (Sellers, BC)

JAPAN—Radio Japan on 6105 via France at 0159 in



Trans World Radio has added Ascension Island to its outlet line up.

Japanese, IS, station ID, news. (Taylor, WI) On 6185 via Austria at 0458, closing at 0500 closing with man speaking in English; on 15130 via France with Japanese interview at 1903. (Brossell, WI)

Radio Nikkei One on 3925 at 1325 in Japanese under ARO QRM. (Brossell, WI)

KUWAIT—Radio Kuwait on 15540 from Kabd at 1736 with Arabic talks. (Brossell, WI)

MADAGASCAR—African Pathways Radio on 13670 from Majahanga at 1812 with station IDs, pop music, talk, email addresses, and Bible teaching. (Sellers, BC)

World Christian Broadcasting on 6180 at 0340 in Spanish. (Sellers, BC) On 9880 in Russian at 1805 with female host, music, and Christian program. (Sellers, BC)

MALI—Radio TV du Mali from Bamako on 5995 at 2307 with man speaking French with Afropop music. (Taylor, WI)

MALAYSIA—RTV Sarawak on 9835 from Kujang at 1257 with man and woman talking in Malay, Malay music, possible station ID, and march music. (Taylor, WI)

NEW ZEALND—RNZ Pacific on 9700 from Rangitaiki at 1238 relaying RNZ National service. (Sellers, BC) At 1250 relaying ABC Wontok in Tok Pisin. (Taylor, WI)

NORTH KOREA—Voice of Korea on 6185 from Kujang at 1149 in French with hybrid Asian / Western classical music, also on 6170. (Taylor, WI) On 13670 from Kujang at 2142 with a man introducing a song. (Sellers, BC)

KCBS on 9665 from Pyongyang at 1227 with operatic choir, female announcer. (Taylor, WI)

All India Radio's studio at Aligarh. Thanks, Ron Howard.

OPPOSITION—Radio Ndarasson International (via England to Chad) on 9635 at 1842 with station ID sequence with theme, announcer speaking in Kanuri with brief sound bites. (Taylor, WI) Dominating WEWN at 1848 in French into possibly Kanuri at 1900. (Sellers, BC)

Voice of Tibet (via Tajikistan to China) in Tibetan with man talking at length, also on 9864 with slightly better reception. (Taylor, WI)

Sound of Hope (Taiwan to China) on 11100 at 1233 in Mandarin. (Brossell, WI)

Echo of Hope (South Korea to North) on 9100 at 1141 with a woman giving a lecture. (Taylor, WI)

Voice of Tigre Media House (via France to Eritrea) on 15160 at 2518 with HOA, woman talking, station ID, talk by a man. (Taylor, WI) at 1627 with an interview in Tigrinya. (Brossell, WI) At 1121. (Taylor, WI)

Dimtse Wagahta (via France to Eritrea) on 15340 at 1705 with man speaking in Tigrinya under heavy jamming. (D'Angelo, PA)

Fusato No Kaze (via Taiwan to North Korea) on 9705 at 1343 in Japanese with Korean pop music. (Taylor, LFP)

National Unity Broadcasting (via Taiwan to North Korea) on 7200 with Korean folk song, male and female announcers. (Taylor, WI)

Radio Tamazuj (via Madagascar to South Sudan) on 7315 (via Vatican to Sudan) at 0344-0428* with male and female announcers in Juba Arabic, instrumental music at close. (D'Angelo, PA) On 11705 at 1556 in Sudanese Arabic. (Brossell, WI)

Radio Dabanga (via Bulgaria to Sudan) on 11640 at 1621 in Sudanese Arabic with man and slow talk. (Taylor, WI)

Denge Welat (via France to Turkey) on 9525 at 2155 with man reciting over dramatic music, off at 2200. (Taylor, WI) On 11540 at 1309 in Kurdish. (Brossell, WI)

Radio Dap Loi Song Nui (via Taiwan to Vietnam) on 9670 in Vietnamese with male announcer and a sort of hymn, Vietnamese grind jammer underneath. (Taylor, WI)

Republic of Yemen Radio (Saudi Arabia to Yemen) on 11860 at 1318 in Arabic. (Brossell, WI)

PERU—Radio Tarma from Tarma on 4775 at 1152 with fanfare, station ID, man talking again. (Taylor, WI)

PHILIPPINES—Raydo Pilipinas on 12120 from Tinang at *1730 with NA, schedule, station ID, then into Tagalog. (Sellers, BC)

Radio Liangyou on 9275 from Bocaue at 1309 with man speaking in Mandarin giving a sermon. (Taylor, LFP) On 9400 at 1248 in Mandarin with man giving a sermon, not //9275. (Taylor, WI)

Far East Broadcasting on 12055 from Bocaue at 0017 in Lahu (mainly spoken in China / Myanmar), hymns, and a man giving a short sermon. (Taylor, WI)

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PIRATES—WEZL on 6933u at 2342 with weak pop music, occasional ute buzz, more pop music at 0020. Ballsmacker Radio on 4030 at 0226 weak under pop music, station ID with sound of bowling pins being hit. Wolverine Radio on 4045u at 0115 with country rock, progressive rock, then rock and a Slow-Scan TV (SSTV). XFM on 4075 at 0159 with address in Peoria, then Batavia, Illinois then Barrington Hills email. WTF Radio on 6925u at 2159, progressive rock and Beach Boys at 2220. Outhouse Radio on 6930u at 2126 with man giving station ID, song by a female, CW thing, and was testing and apparently went off. Radio Mushroom on 6930u at 2318 and seeming comedy act, station ID with bagpipe, email to <radiomushroom@gmail.com>. (Hassig, IL)

Syco Radio on 3185u at 0103 barely audible, some honky-tonk, hard rock, and SSTV. Ballsmacker Radio on 4030 at 0222 with "together" songs, lost them at 0257. KIND on 6933u at 0046 with mellow '60s things, off at 0056. Worldwide Basement Radio on 6880 with old style DJ and stuff from the '50s, '60s. Damn Skippy on 6930 at 0038 with end of SSTV song, contemporary instrumental music, more SSTV. WEZL on 6927u at 2215 with '50s stuff, two SSTVs, and sign off at 2309. WEAK Radio via Outhouse Radio on 6933u at 2143 with punk rock, several station IDs, SSTVs. WDOG at 0027 with music, barking dogs, rock. Outhouse Radio on 6830u at 0027 with jazz piano, Pacman SFX. Two Dog Radio on 6930 at 0045 with dog songs. Wolverine Radio on 6935u at 0008 with stop or don't stop songs. Cry Baby Fat Man Radio on 6925u at 2323 with SSTVs. Radio Doomsday via Pirate Relay on 5165u at 0025 with sketches, music, and station IDs. (Taylor, WI)

ROMANIA—Radio Romania International on 11700 from Galbeni in Arabic at 1223. (Brossell, WI) On 11850 from Tiganesti at 2032 with woman reading the news, //9740 fair, also on 13650 with good reception. (Sellers, BC)

SAO TOME—VOA Relay on 6080 from Pinheira with African news, //5925. (Sellers, BC)

SAUDI ARABIA—Holy Quran Radio on 1371 from Riyadh at 1639 with Arabic singing. (Sellers, BC)

Al-Azm Radio on 11745 from Jeddah at 1423 with Middle-Eastern-style music and man talking between songs. (Taylor, LFP)

SINGAPORE—BBC-Far East Relay on 7355 from Kranji at 1653 in Korean with seeming English lessons. (Sellers, BC)

SOUTH KOREA—KBS World Radio on 11880 at 0122 with man and woman speaking in Spanish, closing with a station ID. (D'Angelo, PA)

SPAIN—REE on 11685 at 2108 with soccer play-by-play in Spanish, IS at 2203 to close at 2205; same on 11940. (Sellers, BC)

SRI LANKA—SLBC on 11905 from Trincomalee noted for the first time this year after weeks of trying, sign on at 0030 with IS, choral anthem, and the plucked strings / metal reeds, audio was at or near noise level, only carrier noted by 0045. (Pearson, AA8MI)

TAIWAN—RTI on 7430 from Kouhu at 1242 in Mandarin. (Brossell, WI) On 9735 from Paochung in Hakka at 1246. (Figliozzi, NY) On 9490 from Tamshui at 1153 in Russian, man giving an interview. (Taylor, WI)

THAILAND—Radio Thailand on 9940 from Udon Thani at 1343 in Thai; at 1234 in English with bells, station ID, music, and more bells. (Taylor, WI) On 15580 at 0000 sign on with station ID, they are back on their "A" season frequency. (Pearson, AA8MI)

TURKEY—Voice of Turkey on 7275 from Emirler at 0355 in Turkish, //6165 weak under Cuba. (Sellers, BC) On 9635 from Emiler at 1945 in French. (Brossell, WI)

UNITED STATES—Voice of America on 7470 from the Thailand Relay at 1246 in Mandarin; on 12040 from the Lampertheim Relay. (Brossell, WI) On 9825 from the Philippine Relay at 1250 in Chinese battling a Chinese jammer. (Figliozzi, NY) On 15600 from Woofferton at 1421 in Kurdish with man and woman talking alternating. (Taylor, LFP)

Radio Free Asia on 11550 from the Northern Marianas Relay at 1559 and discussion in Korean. (Brossell, WI)

Radio Marti on 13820 from Greenville at 1642 in Spanish. (Sellers, BC)

Radio Liberty on 15640 via Vatican at 1419 with woman speaking in Dari. (Taylor, LFP)

Adventist World Radio on 11720 via Madagascar at 1705 in Swahili, off at 1728. (Sellers BC) On 11985 via France at 2054 in Yotoba, contact info, and off at 2100. (Sellers, BC) Via Madagascar at 2103 in Nigerian English with Bible teaching. (Taylor, WI)

World's Last Chance on 9820 via England at 1853, station ID with website, Bible lesson. (Taylor, WI)

VATICAN—Vatican Radio on 9705 at 2002 on the church, African news at 2000; on 13830 at 1643 on COVID vaccinations in their African service. (Sellers, BC)

VIETNAM—Voice of Vietnam on 9635 from Son Tay with news in Vietnamese; on 9840 at 1250 with Overseas Service in English, then into listed Indonesian. (Figliozzi, NY) On 9839.8 from Sontay at 2125 in Japanese with a Vietnamese vocal and female announcer. (Taylor, WI)

ZAMBIA—NBC Radio One on 5915 at 0128 in vernacular, local singing and drumming. (Taylor, WI)

I keep neglecting to inform readers that all of the abbreviations used in this column are available on request at <gdex@wi.rr.com>.

QSL Quests

~ Radio Free Asia's (RFA) A.J. Janitschek, with whom I've shared a few evenings, notes that staff members there have stumbled on their QSL responsibilities lately, but he thanks you for your patience and assures us the situation is being corrected and the backlog being reduced. A.J. notes that all is well at RFA.

~ Radio Exterior de España reports that COVID-19 has caused delays in its QSL responses. Once the pandemic has passed, they expect to resume QSLing activity.

Back in the Day

Zimbabwe Broadcasting Corporation, Gweru, newly on the air with 100 kilowatts on 3306 kHz at 0318 UTC on September 27, 1995 with its vernacular domestic service.

Just Sayin'

I keep neglecting to inform readers that all of the abbreviations used in this column are available on request at <gdex@wi.rr.com>. By the way (BTW), have you noted that the abbreviation "nf" (new frequency) is actually wrong (technically)? That "new" frequency has been there since God was a toddler; it wasn't put into use until very late in the game!

Thanks For Your Logs

Congrats and high fives to: John Figliozzi, Half Moon, NY; Mark Taylor, Madison, WI and Lake Farm Park near there; William Hassig, Mt. Pleasant, IL; Gene Pearson, AA8MI, OH; Rich D'Angelo, Wyomissing, PA; Andy Robbins, KB8QBF, Kalamazoo, MI; and Bob Brossell, Pewaukee, WI.

Thanks to all and, until next month ... Keep on keepin' on, and ... Celebrate Shortwave!

Take It To The Field Special:

EMERGENCY COMMUNICATIONS

BY STAN BROADWAY,* N8BHL

The Opposite of DX

NVIS and How It's Being Used in Emergencies Today

There are times when we need an HF antenna that will allow us to reach stations that are near to us. It might be simple, such as a state QSO party or even Field Day. It might be life critical, such as dealing with the devastation of a major hurricane or a large-scale power outage. In either case, the ability of the ionosphere to "bounce" our signal around the earth is not productive.

In the early days of amateur radio, the old heads and Elmers all had this advice: Get your antenna as high as possible! Anything too low they derisively called a "cloud burner." Well, it turns out that's exactly what we need for regional emergency communication. This type of close-in propagation even has a name: Near-Vertical Incidence Skywave, or NVIS.

NVIS Basics

The basics are simple (*Figure 1*): Low antenna height, taking advantage of ground reflection, sends the signal nearly straight upward. The RF wave bounces back down to earth much closer to the station than if it had been launched by a higher antenna at a lower "take-off" angle to be reflected much farther away and possibly make multiple "hops" to reach a faraway station. With the shorter NVIS "one-hop" reflection from the ionosphere, we're able to reach stations within our own state or within a closer geographic region. Sounds simple! But there is a place where antenna theory and "real life" must meet; in the case of NVIS antennas, that happens to be a moving target.

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Different Antenna Configurations

Perhaps the simplest design is the basic half-wave dipole. In our case we want that dipole to be close to the ground, perhaps only 10 feet above the Earth. The antenna can also be configured as a gently-sloping "inverted-V" with the center at 10 feet, and the ends anchored lower to the ground. A military example is the AN/GRA-50 doublet (*Figure 2*). This came as a kit, with spooled wire on either side of a center conductor. Coaxial feedline was attached, and the antenna was supported about shoulder height above ground. This was configured as a half-wave dipole. Elegantly simple, and it works well.

One popular and proven configuration is based on the military "2259" type antenna. It's simply two antennas, crossed at the center and fed at that center point. One antenna (east-to-west) would be cut for band A (perhaps 75 meters) and the other antenna (north-to-south) would be cut for band B (say, 40 meters). The center point is 10-15 feet high, with all four legs terminating close to the earth in an inverted-V style. The example in *Figure 3* comes from DX Engineering, which suggests measurements between 25 and 38 feet. However, with enough room, I have constructed this with full-length, half-wave dipoles for 40 and 75.

One of the easiest to deploy is the simple long-wire antenna. Connect a length of wire to one side of your tuner, hang it out there and you're on the air. Sounds simple, right? No

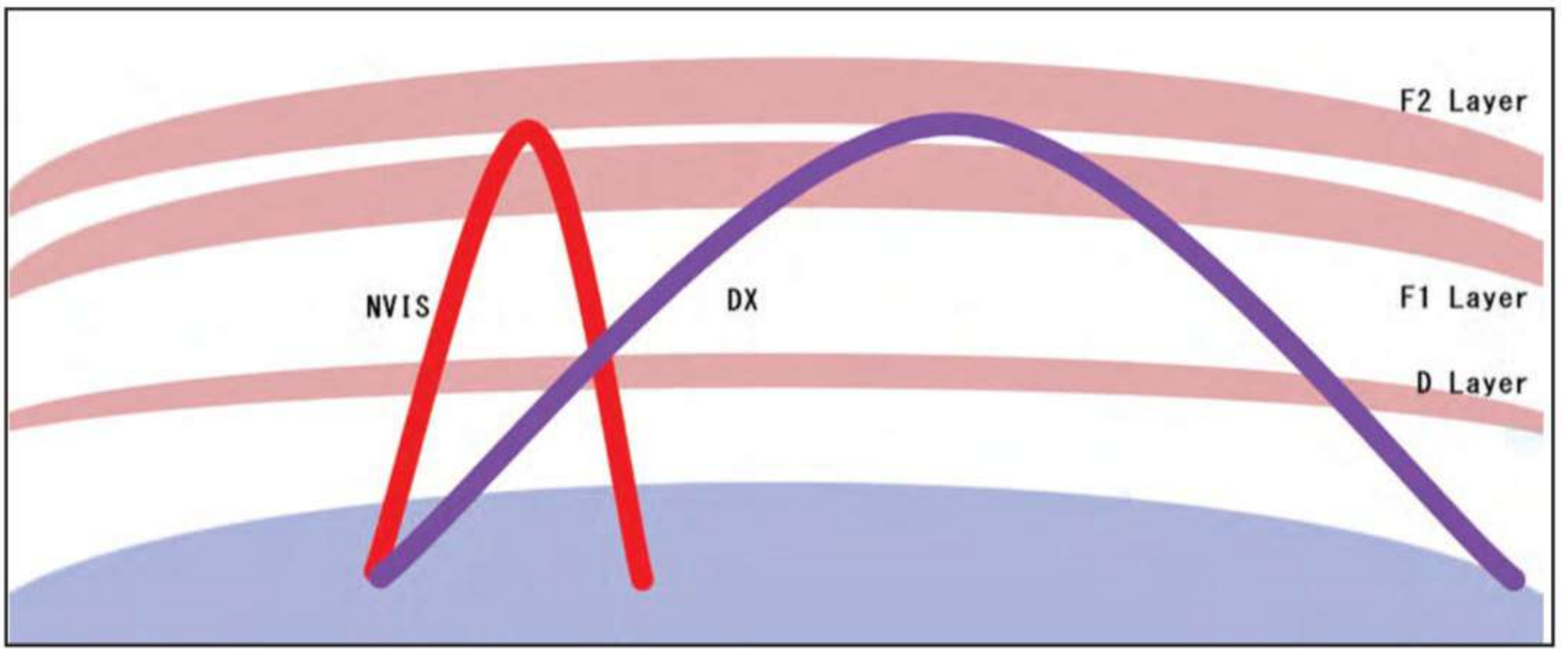

Figure 1. Comparison of near-vertical incidence skywave (NVIS) signal (red) with DX-focused signal (violet).

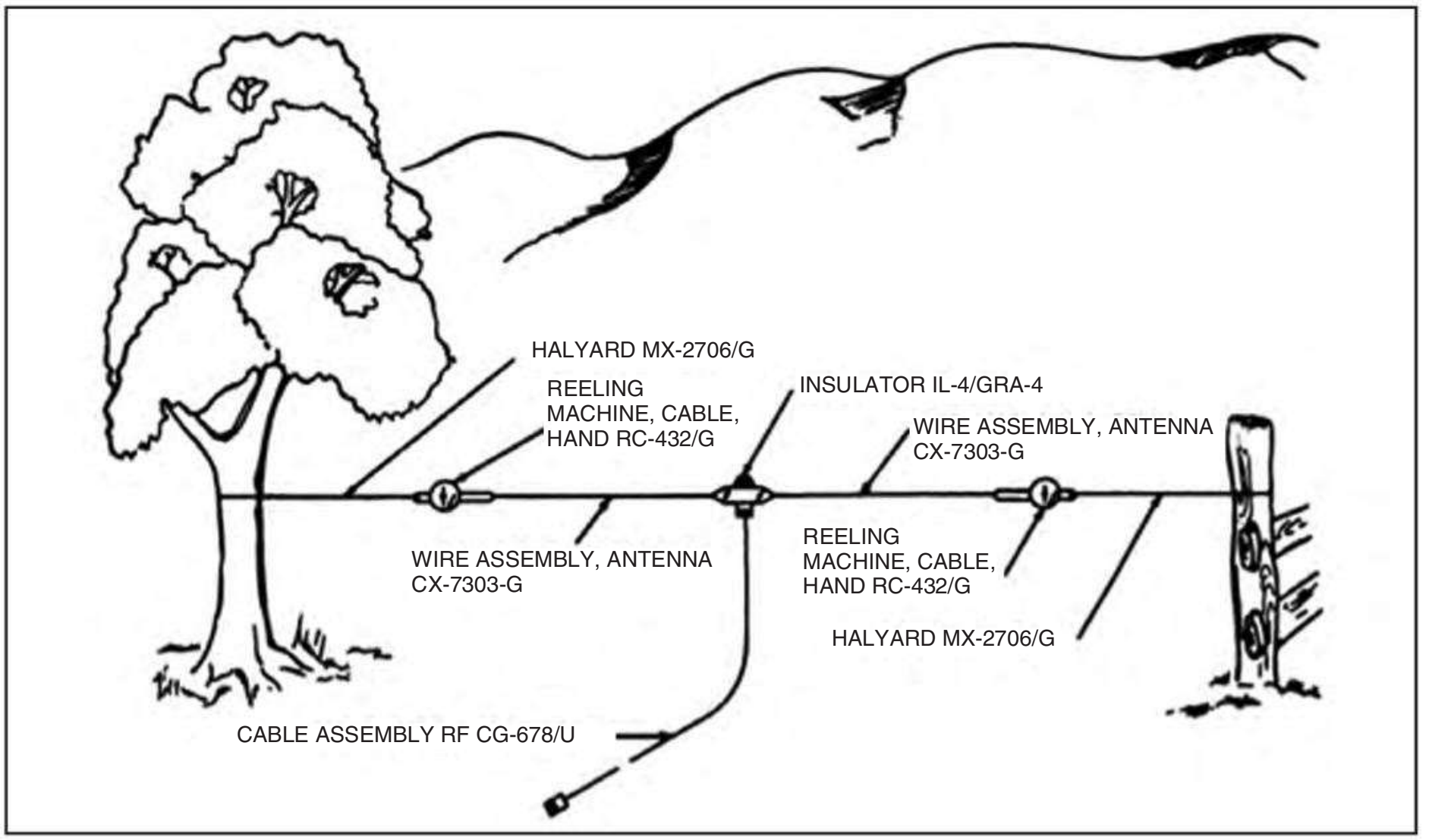

Figure 2. Illustration from a military manual of the AN_GRA 50 doublet antenna mounted low to the ground to function as an NVIS antenna. NVIS antennas are easy to set up and take down and ideal for short-range communication from portable locations.

known documentation exists but rumored reports of injury from banging heads in frustration (just kidding) show that it may not be that simple to get one of these to work. Here's what goes wrong. Jack, VE3EED (SK) spent hours — days — testing to find out that for the tuner to "see" an acceptably low SWR, the end-fed had to be NOT A HALF WAVE on any frequency that's desired to be used. He painstakingly constructed a chart of lengths to avoid (Google it) but later was able to put together a list of "good lengths" that should help get this antenna working. And here they are (in feet):

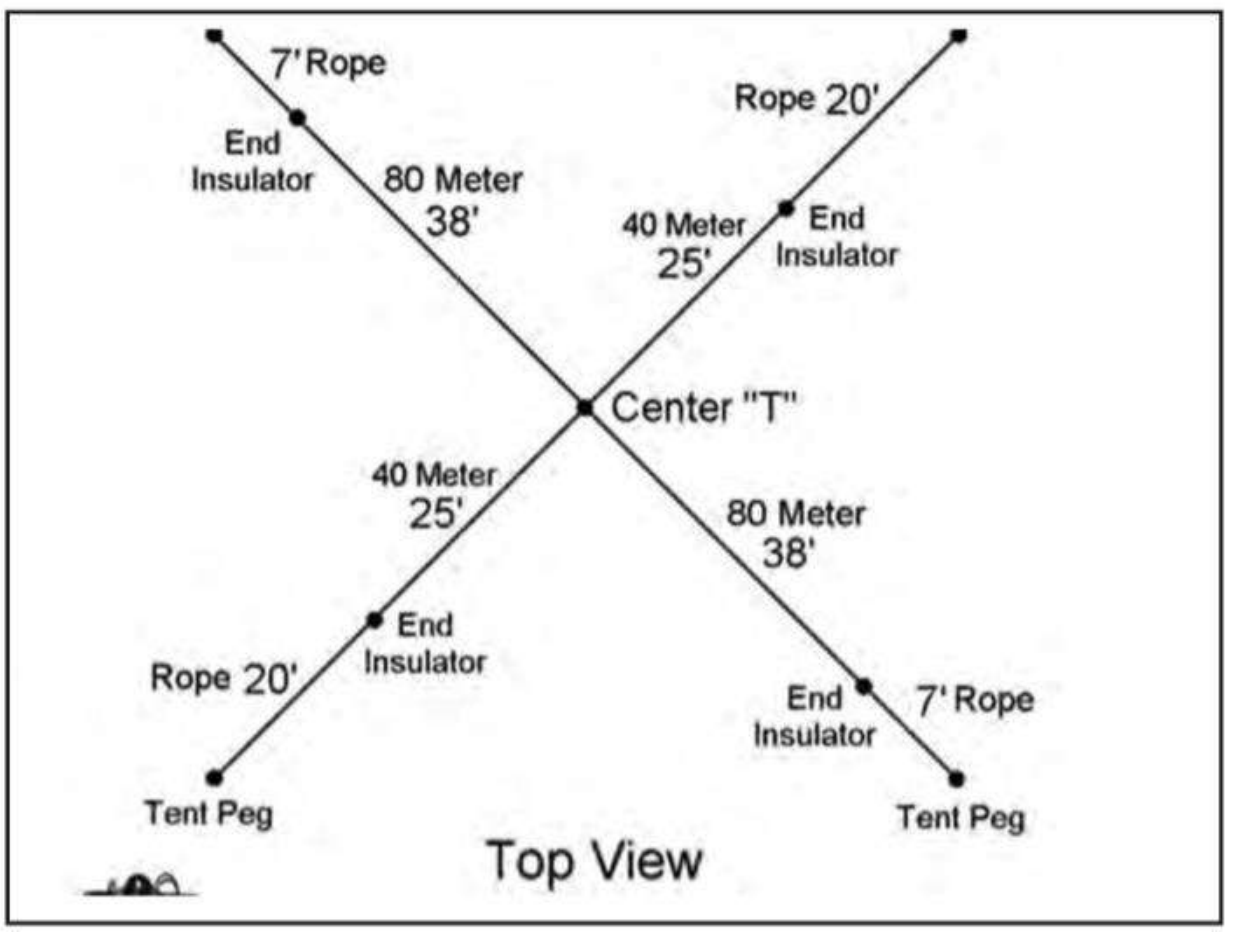

Figure 3. A dual-band (80/40-meter) NVIS antenna offered by DX Engineering.

29, 35.5, 41, 58, 71, 84, 119, 148, 203, 349, 407, and 423

There are even more possibilities. One I recently learned was the "Shirley Array" (*Figure 4*). In this interesting setup attributed to GØTJD <http://arrl-ohio.org/SEC/nvis/nvis.pdf>, two halfwave doublets are 0.65 wavelengths apart, fed with one common feedline split to each antenna. The result is a much stronger radiation straight upward with a much higher concentration of RF into your desired zone.

It Works, or it Doesn't — the Variables

This is where theory meets the ground — all types of ground — to introduce a lot of variables. Indeed, the very type of dirt under your NVIS antenna has a lot to say about whether you'll be happy with its performance. Moisture is your friend; sandy and dry soil is not. There are some things you can do to enhance

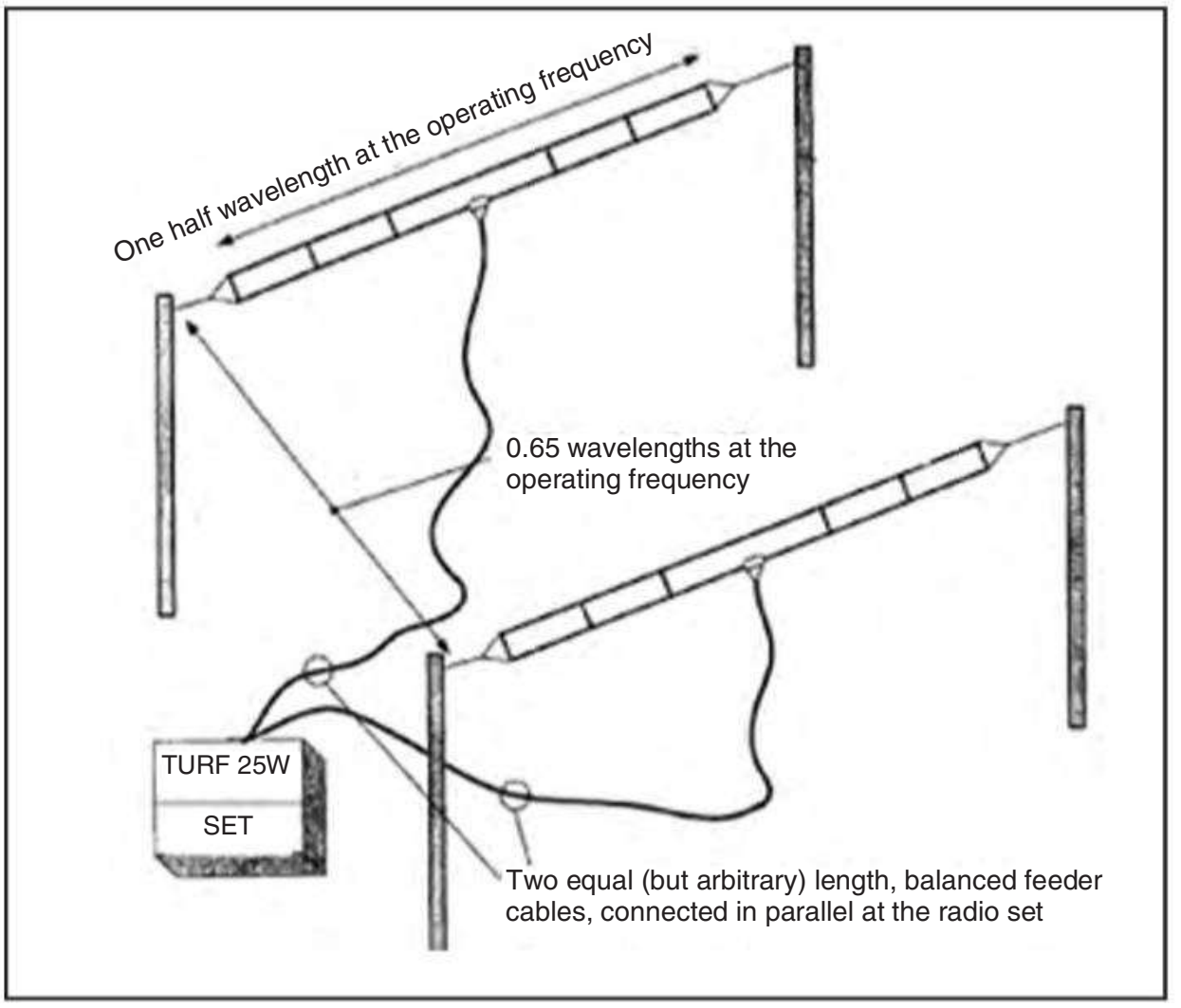

Figure 4. The Shirley Array is two halfwave doublets 0.65 wavelengths apart, fed with one common feedline split to each antenna. (Courtesy of ARRL Ohio section webpage)

the effect. Most common is to deploy a reflector element (run a piece of wire equal to or slightly longer than your antenna length) either directly on the ground, just above or even just below. This enhances the reflection of the ground and can direct more RF upward where you want it to go.

Another variable is the exact height above ground. Be ready to experiment with these variables — move them up and down to see if your received signals improve and your transmitted signal can be heard. You can angle the antenna for better propagation (the more open, higher end of the antenna is where your signal will be stronger). Some suggest a terminating resistor to ground at the far end.

Even more influences can be present: the overall terrain, surroundings, antenna construction, nearby buildings / towers.

Beyond the Antenna

There's even more involved than just the antenna. Consider the time of day you wish to operate. Look also at the MUF (Maximum Usable Frequency). Know where you want to reach — what direction and distance are involved. And

Ohio NVIS Antenna Day 2021 – the "Next Step"

Wearing his Ohio Section Emergency Coordinator hat, N8BHL reports on a statewide field exercise featuring NVIS antennas this past April. – W2VU

Beginning in April 2014, Ohio ARES has sponsored "NVIS Antenna Day" in Ohio. The activity has several goals: Experiment with NVIS antenna construction, determine which is best for your location, have fun. Stations (either groups or individuals) tried different antenna configurations, made contacts with other stations to test signal strength and coverage. Operators of W8SGT, "The Sarge," were able to confirm coverage from the Ohio state Emergency Operating Center (EOC) to all areas within the state.

For 2021, we took one step further to answer the question, "When and how would we really use these?" Stations were instructed to operate "off-grid" to simulate a wide-area power loss. In such a scenario, the 10 Ohio ARES districts would spin up district-level nets to coordinate their counties. NVIS stations were instructed to send a message to their district net advising of their location and operation. They were also instructed to send a message to the Ohio EOC station either by direct contact on the HF 75-meter net or by using digital messaging through either the Ohio Digital Emergency Net (OHDEN) or Buckeye Net's multi-mode operation. In this scenario, we would be able to prove our ability not only to simply make contact, but to actually transmit meaningful messaging from any county in Ohio to other counties or the state EOC.

Despite the traditional threat of rain on April 24th, Ohio stations turned out eager to participate. Fifty-four of Ohio's 88 counties were either in direct contact with The Sarge or were able to send a message successfully during the six-hour period. Well over 100 messages were received. Band conditions wavered but, in general, signals were strong and messages could be transmitted.

Antennas were on average between 5- to 10-feet high and most fell into the broad category of long-wire, inverted-V, or the "2259" crossed-dipole types. This was another fun day, showing that ARES can get the message through successfully.

– Stan Broadway, N8BHL

be aware of the ionospheric layer you need. The D layer is the closest to Earth and it can be your friend or your enemy. During the daytime, the attenuation of the D layer reduces atmospheric noise and reduces the area that the transmitted signal can reach. These are actually good things for NVIS communication. Consider where you're aiming your signal. Sunlight fades from the east so if you're aiming in that direction, you'll need to lower frequency as the D layer dissipates.

What Have We Learned?

• A lower-height antenna radiates straight up and provides coverage within a 400-mile range — usually — but then sometimes a "regular" antenna will do just as well in practice.

• Your success will vary based on several elements, including: Type of antenna, band used, time of day, geography, type of soil, artificial reflectors, and operating mode.

Taking all that into consideration, you will need to be flexible in how and where you set one of these up. But they DO work, and they work well. It's well worth your time to build and try different types of antennas to see which works best in your particular situation.

Who Came Up With This Whole Idea?

NVIS was first used in the 1920s in early ionospheric research and then by both sides in World War II. The short range made it possible to communicate with troops in a limited area without being monitored by the enemy. NVIS is still used by the military today. One of the simplest forms of an NIVS antenna is a long vertical antenna that's bent over and tied to the front bumper of a Jeep.

Practical Examples

When Hurricane Michael screamed across the Florida Panhandle in October 2018, it flattened *everything* (*Photo A*). All communications (search-and-rescue, ham repeaters, public safety, and more) were literally gone. Amateur radio operators used 75-meter NVIS nets to pass local traffic for weeks following the storm.

In early April of this year, amateur operators from the Caribbean Emergency and Weather Net (CEWN) used both 75- and 40-meter NVIS to cover the volcanic eruption of La Soufriere on Saint Vincent and the Grenadines. Ira Harris, VP2EIH, said up to 50 ham radio operators were involved in HF nets that were started soon after the first eruption. As of our conversation (while eruptions were continuing) over 13,000 people had been displaced to shelters, private homes and hotels. Amateur nets continued on HF, all making use of NVIS characteristics, to channel agency messages, health and welfare inquiries, and other important traffic during the event. These nets, along with eruptions and recovery, promised to continue for a long period of time.

Events like these come at us fast! When they're here, it's too late to experiment and scrounge around looking for that pair of insulators. Take advantage of your time now to re-engage with one of the most fun aspects of amateur radio — building antennas! Have your NVIS setup ready to go before it's needed.

Photo A. Hurricane Michael flattened nearly everything in its path when it made landfall in Florida in 2018, including virtually all communications infrastructure. Hams providing emergency communications relied on NVIS on 75 meters to pass traffic. (National Weather Service photo)

Take It To The Field Special:

KIT BUILDING

BY JOE EISENBERG,* K0NEB

QRP Labs QCX Mini: A Field Radio in your Pocket!

When looking for a small kit for a field radio, most tend to be a bit more than pocket-sized. The QCX Mini from QRP Labs is truly a pocket-sized CW transceiver that is ready to go into the field. The difference between other "mint tin"-sized CW transceiver kits and the QCX Mini is that this kit is digitally synthesized and has a host of features usually found only in much bigger and more expensive portable QRP radios and kits. The LCD display on the QCX Mini is easily read in sunlight.

When making a kit this small, the use of numerous surface-mount components is essential. When I unpacked my kit, I discovered that there were no resistors at all. The reason for this is that all the resistors are pre-mounted on the top and bottom of the main board, as are most of the capacitors. There are capacitors that need to be mounted, but many are already done. These and other components being pre-mounted make the QCX Mini what I like to call a hybrid kit, having just through-hole parts to assemble. The manual is about the largest and most extensive I've seen recently in kit building and is well-illustrated and very thorough. Once again, having access to full duplex color laser printers that I am fixing at work helps as I printed out the manual. An inkjet printer will work as well, but you will consume a lot of ink to print this manual.

The manual goes into detail about the winding of the toroids as these are often the source of problems for builders. The QCX Mini has five toroids to wind with the first being T1. T1 has four different windings on the same core. Because of the complexity of this toroid, it is the very first part called for in the manual. The best advice I have for the challenge of T1 is to take your time, carefully count your turns and ensure that all four windings go in the same direction. I think by far, the most time-consuming part of the assembly of this kit is T1. The good news is that no other parts (except the pre-mounted, surface-mount parts) are placed on the board before T1. The wire supplied is also easy to prepare using the hot solder blob method, which burns off the insulation

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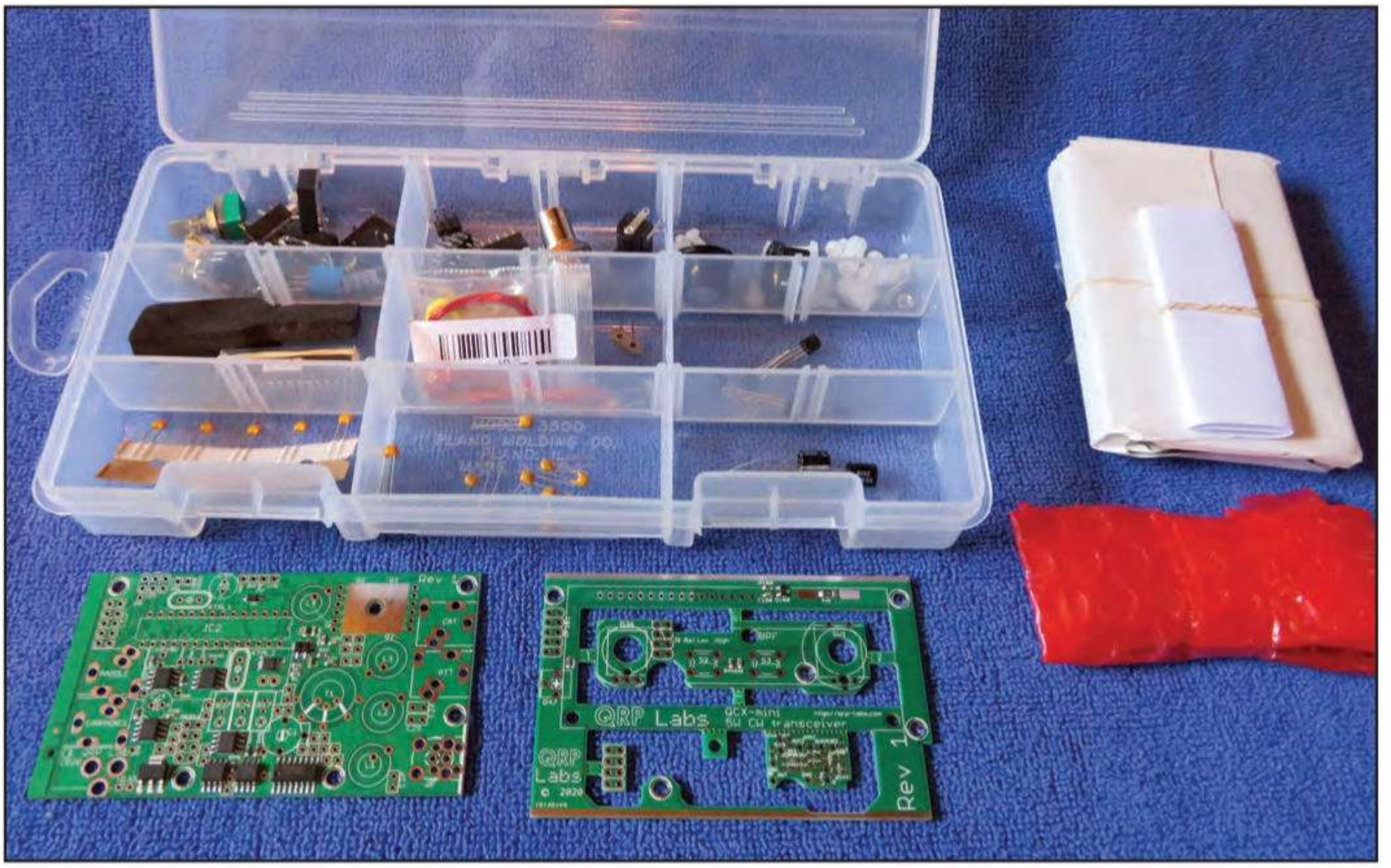
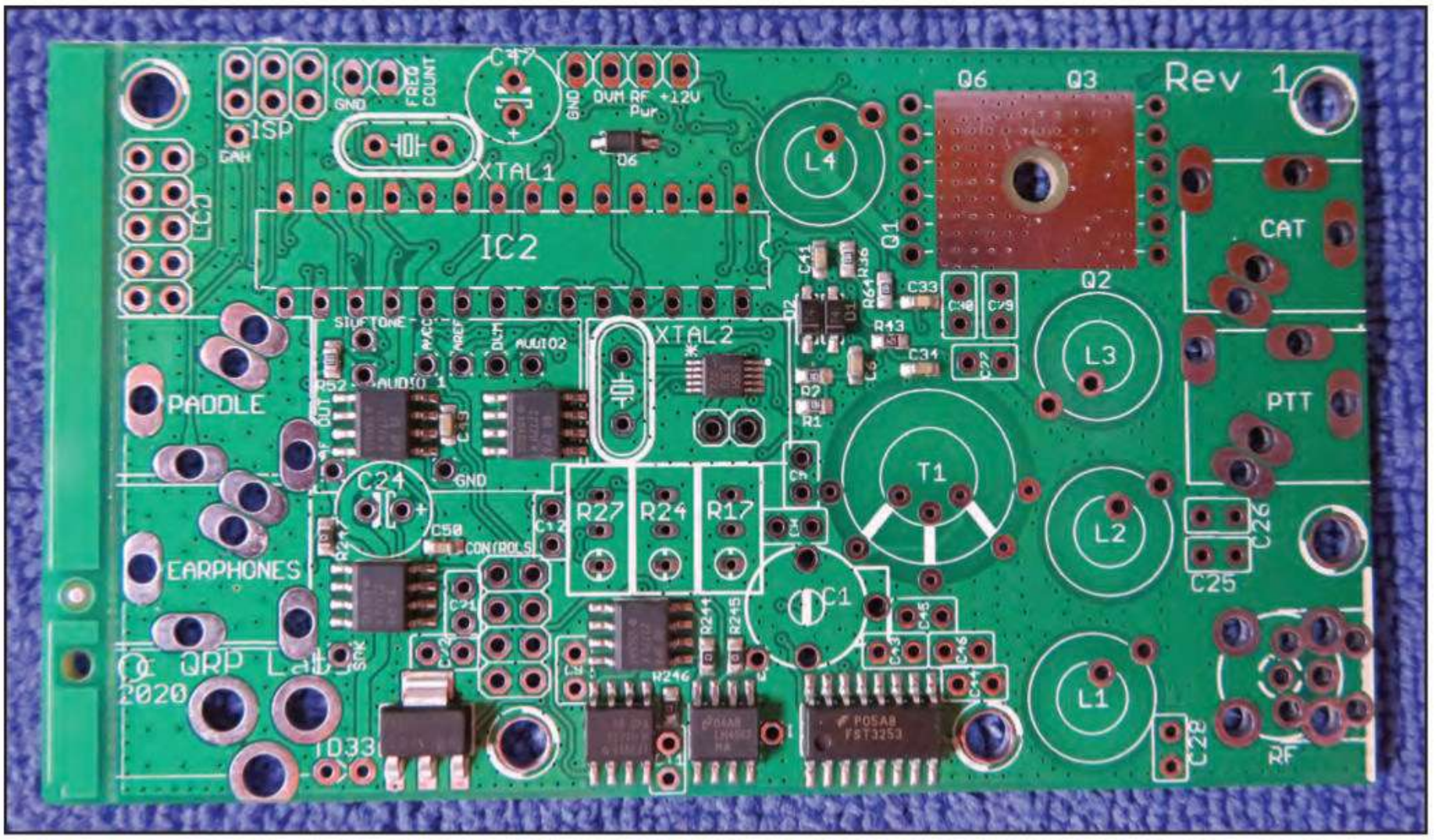
Hamfest Hotline #5855



The two boards and the parts for the QCX Mini all sorted out. Notice there are no resistors!

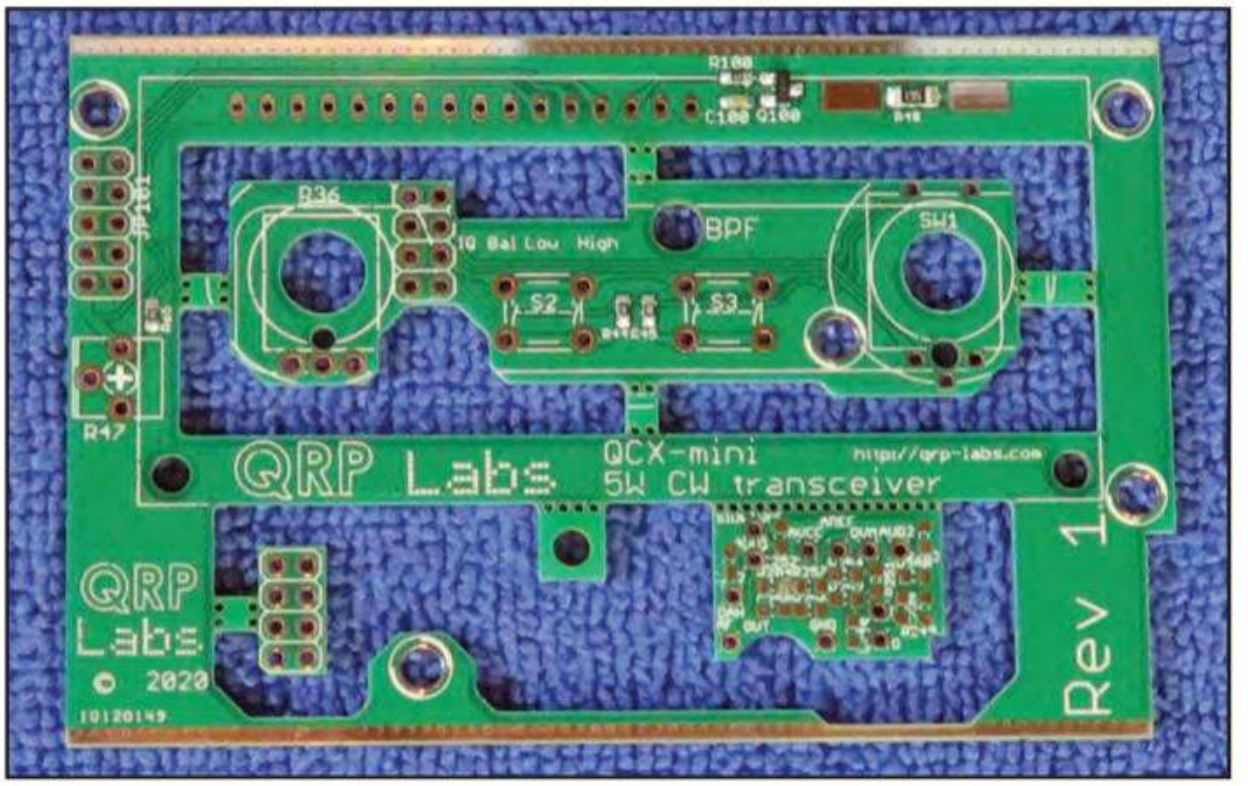


The main board with several surface-mount components already mounted. There are many resistors and capacitors pre-mounted on the bottom of the board as well.

and tins the wire as described in the manual. I recommend following the suggestion of checking the continuity of each of these four windings when mounting T1 to the board. Correcting any problems with this toroid at this point will save a lot of troubleshooting later.

The other four toroids in the kit are not transformers, so they are a lot simpler to wind. Be sure to wind the prescribed number of turns for the band of your kit. The number of turns for your band (my kit was 40 meters) are on the page for that step. Each manual page also has the installed components highlighted in red so it is easier to find the proper placement of the parts in that step. The instructions are explicit in dealing with the four jacks to be mounted on the main board. They must be installed exactly straight in order for the case kit to fit properly. Follow the examples they show to get the best fit. There is little or no tolerance, so ensure each jack aligns with the board markings.

In addition to the main board, there is a display board used to work with the LCD display. There are breakaway parts on this board that serve as standoffs as well as the control board that must be separated. I used my sharp flush cutters to separate these parts, and I urge caution when doing this to

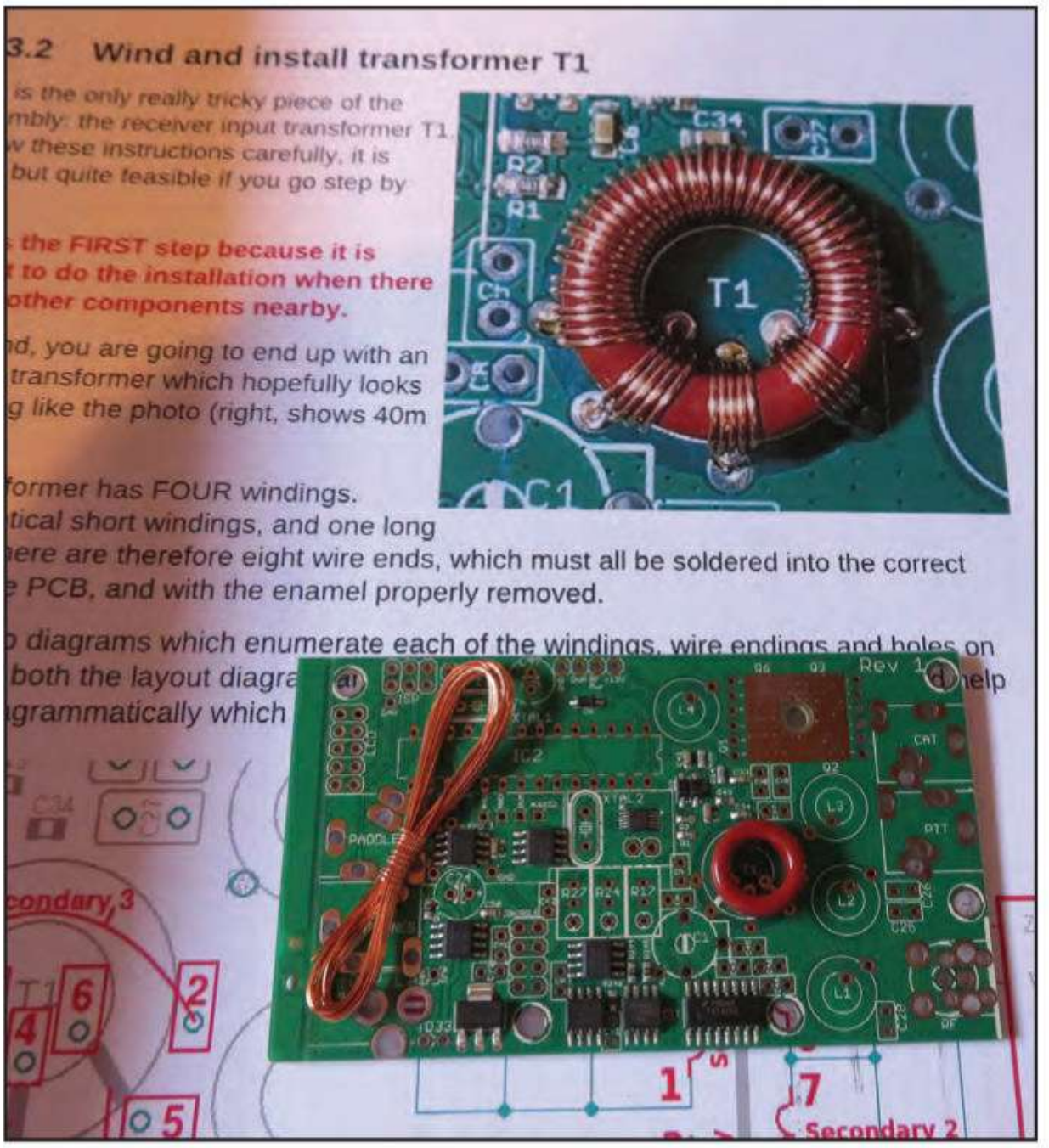


The display board with all the removable pieces still in place, including the control board.

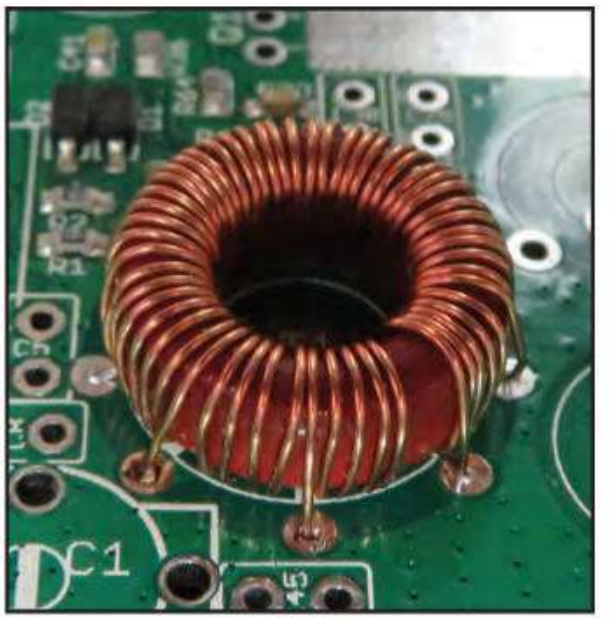
avoid breaking the thin outer frame of this board as it is used as well. Using a small file and an emery board to remove the burrs remaining on each removed piece, as well as at the remaining frame, is essential to the whole assembly fitting together in the case. Make sure these rough spots left from separation are filed and sanded smooth for everything to fit as there is very little tolerance when the kit is placed in the case. It is well worth the extra expense to order the matching case as I have found it to be essential to the final appearance and finish to this kit.

Alignment and Adjustment

When I got to the alignment part of the assembly, I discovered why this kit is so popular. The QCX Mini is a very smart

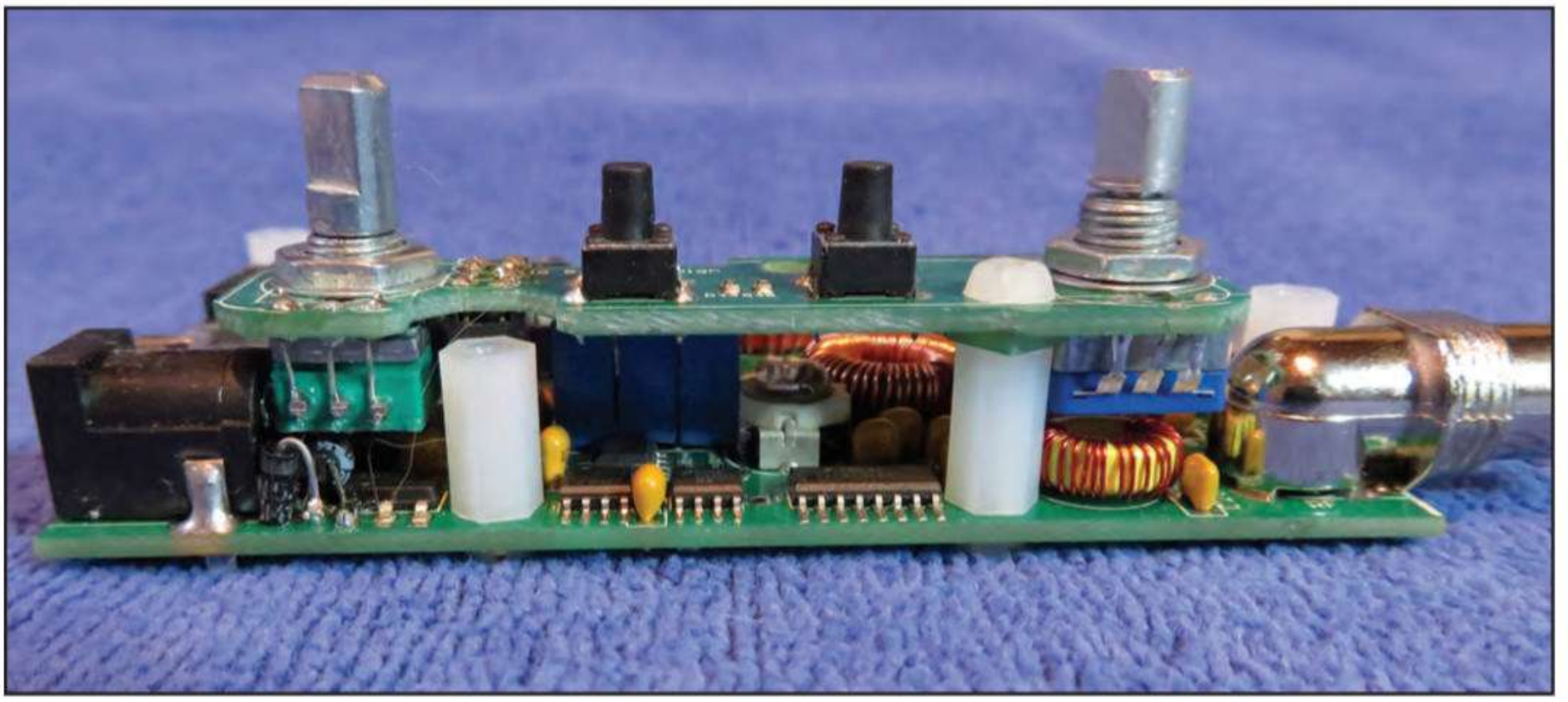


T1 is the most complex part of this kit and is done first to ensure it is done correctly. The manual is very thorough in explaining the correct way to wind and mount T1.



T1 completed and mounted on the board. This kit was the 40-meter-band version. The values of each toroid are different for each band.

radio, having such features as two VFOs, digital RIT, a keyer, CW reader, and preset CW messages, such as CQ, contest exchanges, or beacon messaging. The alignment takes advantage of the built-in signal generator and measurement capabilities to peak the bandpass filter as well as set the opposite sideband rejection. There is a trimmer capacitor used in the receive bandpass procedures and I recommend using a properly insulated tuning tool instead of a metal screwdriver. There are also three multi-turn trimpots used to handle nulling out the opposite sideband and those can be turned using a tiny straight screwdriver. Following the manual, the alignment procedure consists of follow-



A side view of the mostly completed QCX Mini. Notice the very tight tolerances when assembling the boards together. As long as the parts are installed according to the manual, everything will fit correctly.

The QCX Mini without the LCD display mounted and ready for the display and testing.

The completed QCX Mini ready to go on the air! In this mode, the copied CW can be read on the lower line of the display.

ing the steps and using the radio's menu to go through the procedure.

I found myself repeating the adjustment of the three trimpots several times as the settings of each affect the others until the best possible settings have been made. Once the alignment is completed, the selectivity of the receiver becomes apparent, and the filtering it offers makes for easy CW reception. I measured 3.9 watts of output into a 50-ohm dummy load, which seems to be about average for this kit when powered by a 12-volt power supply. This kit also has an RF output measurement function, but I used a more accurate external wattmeter to make my measurements.

Since there is no internal antenna tuner, ensure that your antenna is tuned properly for lowest SWR. For field use, try using a compact tuner like the 4SQRP 4S-Tuner or the Elecraft T1. The QCX Mini has serial CAT capabilities and uses the Kenwood TS-480 command set for most commands. There is even a PTT output useful for keying a small external RF amplifier, like the 50-watt PA kit QRP Labs offers to complement this kit. The QCX-mini can be ordered from QRP Labs at <www.qrp-labs.com> for $55 plus $20 for the case. There are options offered, including a TCXO for higher VFO stability as well as a GPS receiver for more precise calibration and clock display.

Take your time and enjoy this compact field-capable CW transceiver kit. I plan on being at the Huntsville Hamfest in August, so be sure to say hi and enjoy the first major convention in many months!

– Until next time, 73 de KØNEB –
Hamfest Hotline #5855

QRP: Low-Power Communications

BY R. SCOTT ROUGHT,* KA8SMA

A Hodgepodge of QRP Updates

A slew of items to discuss this month including reader input from February's "Please Copy" QRP debate, one reader's thoughts on the ethics of power output, a new logging program that gets it done for Parks on the Air activations, and an update on the return of the Four State QRP Group's Bayou Jumper QRP radio kit. A lot to say with little space, so onward we go!

"Please Copy" – Readers' Views

In the February column, I explained how I was denied a contact by a station in California during ARRL's SSB November Sweepstakes for saying "Please Copy" at the beginning of my exchange. For those who may not recall or missed the February column, I was on 80 meters around 0730 UTC when I tuned into a small pileup working a station in San Joaquin Valley (SJV), a needed multiplier and one of two remaining sections I needed to work all of 6-land. After tossing my callsign into the pileup the SJV station responded back to me with his exchange. I replied with my information and began my exchange with "Please Copy…" The SJV station responded back to me saying "I don't work hams who say 'Please Copy,'" then called QRZ and moved on to the next station giving him the serial number (contact number) he had given me. For those fans of the television show "Seinfeld," it was little reminiscent of the "No Soup for You" episode.

I am familiar with both sides of the "Please Copy" argument and understand the exchange should be kept as short as possible; however, as a QRP operator working Sweepstakes, a contest that has five parts to the exchange (serial number, precedence, callsign, check, and section), I like to begin my report with "Please Copy" to provide the other station a half second to focus on my QRP signal (whether strong or weak) prior to sputtering out my exchange.

In the February issue, I asked readers to let me know their thoughts on the use of "Please Copy" in contests with longer

*<ka8sma@cq-amateur-radio.com>

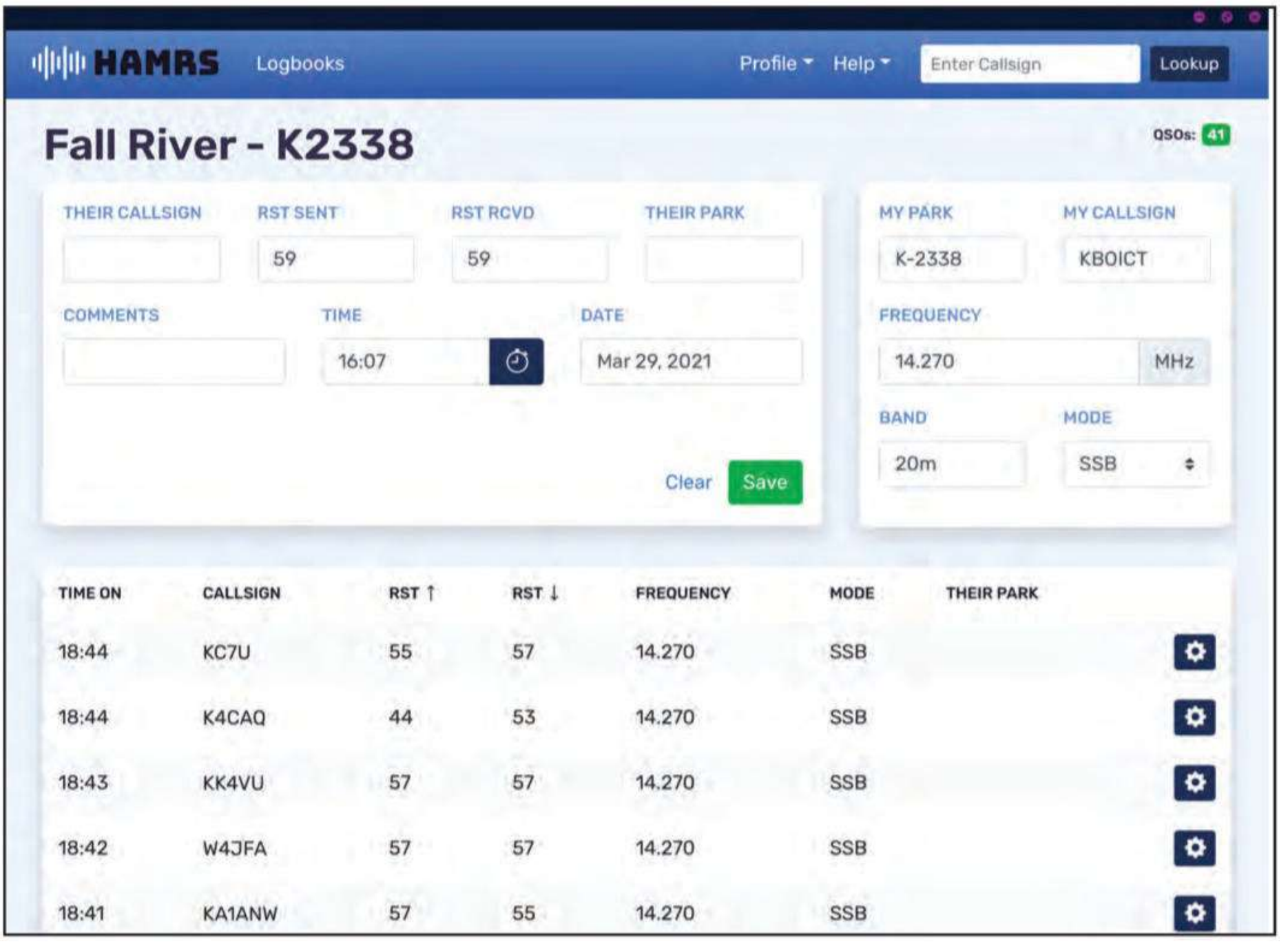


Photo A. Screenshot of HAMRS POTA Logging Software. (Courtesy of KBØICT)

exchanges. After this issue was published I received a lot of emails from contesters on the use of "Please Copy." Results were about 50/50, pro vs. con. Below is a taste of some of the comments I received (callsigns withheld).

• A running station knows he needs to be ready to copy the caller's exchange immediately after finishing his transmission. If not, he should not be running. So, "please copy" is entirely unnecessary at best and interferes with or prevents completing the QSO at worst. Many, many times I have needed a fill, copied several extraneous words perfectly, then miss the fill because it was obliterated by QRM, QRN, or QSB. Your argument, "a longer exchange makes 'please copy' helpful," makes no sense to me whatsoever. A longer exchange makes its use even more detrimental. I have never refused a contact because the other op said "please copy." I do not begrudge the SJV op who did, however, especially if you were weak. I think you do a disservice to QRPers by asserting there are valid arguments pro and con on the issue.

• Regarding "please copy." That struck a nerve. Shame on the guy who wouldn't work you, he did take the time to tell you that he wouldn't so that added more time to the QSO in any case. I was taught by a Field Day Elmer years ago to use "please copy" because, well, it's polite and leaves a little breathing room. However, at our FD site one year the station captain strongly advised against using it — strongly. Why? Because it was a waste of time. It's so built-in now with me that I use it in every contest and Field Day. I know I'm not going to win contests nor is my station going to place in Field Day, so why not add a little dignity to the contact?

• I dislike the "please copy" habit. On rare occasions, I have told the other op, "please don't say 'please copy.'"

• Having used Please Copy as a cadence separator between the callsign or confirmation of the received exchange for over 25 years of contesting, it is so ingrained that it would be virtually impossible to quit now. I have had several lids snidely remark back, "lose the 'Please Copy'" and I sometimes will return with "lose the attitude" to an unkeyed mic while I am logging and making a comment in the log. If I had someone kill the QSO like happened to you, I would immediately send an email to the sponsor of the contest calling for disqualification due to unsportsmanlike conduct. The same should occur if they are running and they go dozens of contacts without giving their callsigns.

After reviewing all the responses (especially the response printed in the first bullet), I questioned whether I am doing a disservice to the QRP contest community by advocating the use of "Please Copy." Having worked both sides of a pileup, I know what it is like to copy only a portion of an exchange and miss information due to QSB, QRM, QRN, etc. As such, I will make an earnest attempt to drop "Please Copy" from my exchange. Admittedly this will take some effort and like others, these two words are ingrained in me after many years of contesting. Perhaps if I am unsuccessful in this venture, I will resort to my computer to make the exchange for me (as I have heard some doing during SSB contests) but fear several will question whether this is truly contesting.

Power Ethics

Aside from the emails I received about "Please Copy," I received one email regarding ham ethics and why some hams do not reduce their power when they receive an exceptionally strong signal report.

When I tell a station they are "40 over," why don't they turn down the power? Isn't it — at the very least — the ethical way to operate, reducing interference from the QSO elsewhere in the world hence allowing the frequency to be used elsewhere ... when the solar cycle picks up, will the other station need 1,500 watts to reach Philly from Ohio?

Sometimes I believe only we QRPers understand what the FCC meant under Part 97.313 (Transmitter power standards) that states, "an amateur station must use the minimum power necessary to complete the desired communication." Granted, the FCC was not implying that stations should reduce their power to QRP levels, but when your signal report is "40 over," cranking down the power to an output that can still sustain the contact is in order.

As solar cycle 25 further intensifies, hams need to remember that a QRP signal is about two S-units less than a 100-watt signal, which is not a lot of difference. I do not advocate that any ham use QRP unless they want to, but reducing power to 100 watts or less will lower QRM and may provide a satisfying experience in knowing what can be done with less. Now, try explaining that to some QRO operators! – *hi*

HAMRS Logging Software – Easy!

Last October we covered the growing popularity of the Parks on the Air (POTA) program and how it provides any QRP operator the opportunity to be a highly sought-after station (focus of a pileup) after setting up a portable operation in one of the 23,000 registered entities (national and state parks, wildlife management areas, designated scenic sites, etc.) worldwide. Now that summer is here, I find it difficult to stay away from nearby Traverse City State Park (POTA entity K-1547) and have been working my share of pileups with only a few watts. One of my goals for 2021 is to obtain the coveted Kilo Award (QRP style), a POTA award for those who activate and make 1,000 or more QSOs from the same entity.

In late March, I stumbled across a new, very user friendly, POTA logging program that should make logging all my contacts for the Kilo Award easier. The program is called HAMRS and was developed by Jarrett Green, KBØICT. I reached out to Jarrett who informed me that HAMRS (pronounced like hammers) is a mash of the words "Ham" and "Radio Software". The program was released publicly (free download) for desktop operating systems on February 6, 2021. Jarrett, a software engineer, is a newer ham (licensed in June 2020) with a passion for POTA. A good combination (in my opinion) for developing a ham radio logging program. Jarret told me that, "as a new ham, entering the world of logging software was daunting to me — there's a lot of great software out there that have far more features than HAMRS, but I find them a bit clunky and bloated, and certainly not the type of modern app experience I'm used to using or building," Jarrett continued. "It does a few things, does them well, and leaves other needs to the larger logging applications."

I have used the HAMRS program twice thus far for logging POTA contacts on my laptop and can attest to its user-friendly layout. I have used other programs for logging POTA contacts but needed to perform a little magic to get the screen layout setup the way I like it. The HAMRS POTA template (*Photo A*) has a simple, clean layout and focuses on information required for the POTA exchange, and nothing more. It also creates an .ADIF file for upload to the POTA website with a click of a button. Jarret said that, "HAMRS focuses on providing purposeful templates for each type of event. I wanted the input flow to match the type of QSO you're making so you could simply tab through fields and not spend time hunting around for the field you're looking for."

I saved the best for last. The program is being developed for use with a variety of other operating systems including Mac OS, Ubuntu, Raspbian, and Android. So what does this mean? For a few dollars you can download this logging software as an app from the Apple App Store or the Google Play Store for use on smart devices. As soon as the Android version becomes available from the Google Play Store, I'll be one of the first in line to download it onto my Android devices. The ability to reliably log POTA contacts on a smartphone or tablet while in the field and then email the log to the POTA group before leaving my operating location (as long as I have cell service) means one less item (laptop) I need to take into the field. Or for those times I log with pencil and paper in the field, one less chore when I get home since I will not need to enter my log into my laptop's logging program and then email it to the POTA group. As a QRP'er who appreciates the simple / minimalist approach, this logging software has found a home as part of my POTA activations.

Lastly, HAMRS is just not for POTA. Templates for Winter Field Day, Summits on the Air, and ARRL's Field Day are currently being developed and should be available soon — Thank You, Jarrett!

Bayou Jumper – It's Back

In the February issue I reviewed "The Paraset Radio: The Story of a WWII Spy-Radio and How to Build a Replica," by Hiroko Kato (AH6CY), which is available on Amazon for download onto a Kindle or another device. This book highlights the history of the Paraset radio and inspired me to build one, in kit form, as my junk box is low on parts. I recalled that the Four State QRP Group sold The Bayou Jumper (a QRP transceiver kit that pays homage to the famous spy radios of WWII) several years ago but it had been discontinued. When I contacted Group representatives to find out if the kit was to be offered again, I learned that it was being reintroduced in 2021 — great timing, indeed. The kit is now available on the Four State QRP Group's website <www.4sqrp.com/index.php>. The cost is $90 (at the time of this writing) plus shipping. One of the unique items about the Bayou Jumper is that it can be fitted into a wooden box (available from Hobby Lobby, order details on the Four State QRP Group's website) and stained / decorated to provide an authentic look (*Photo B*).

The kit covers the 40-meter CW band and has a single receiver / transmitter design with a built-in chicken head knob for hand switching between receive and transmit (reminiscent of my Novice days when I used a T/R switch between my Knight T-50 transmitter and Drake 2-B receiver). The regenerative receiver reportedly has a tuning range greater than 140 kilohertz and the transmitter (nearly 5 watts at 13.8 volts) is crystal controlled and has a socket for FT-243 crystals (widely available at hamfests). If you do not have a handful of crystals already on hand, crystals for 7.030 and 7.122 MHz are included with the kit. A straight key is built into the front panel (like an original Paraset) and includes a jack for connecting an external straight key, if desired.

I have ordered a Bayou Jumper and plan to use it for POTA activations. I can see the headlines now, "Local Man Accused of Espionage – Found Secretly Communicating from Park with a Spy Radio" – *hi!*

– Until August, 73

Photo B. Four State QRP Group's Bayou Jumper mounted in its optional wooden case. (Courtesy of 4SQRP Group)

MICROCONTROLLERS IN AMATEUR RADIO

BY JACK PURDUM,* W8TEE

Going from RDC to PGC

A Coding Primer

This month, Arduino guru Jack Purdum, W8TEE, sits in as Guest Columnist. Working with microcontrollers often requires more than a soldering iron … while many microcontroller projects use computer code already written by someone else, it is sometimes necessary to modify that code or write your own. So when you see someone at a club meeting or a ham-fest wearing a "Know Code" button, it may not apply only to Morse code! Jack offers us a primer on code-writing, with a focus on doing it right the first time! – W2VU

This article is an experiment. All hams come from varying backgrounds. Some of you have a more direct path to ham radio: you're EEs, electronic technicians, ex-TV repair people, or perhaps had some other electronics-related career. I sincerely envy your talents. Others are software engineers, developers, and programmers who see the software synergy that's taken place in our modern software-defined radios and other ham-related hardware products. I envy you as well because there are likely fewer holes in your training than in mine. Me... I have a Ph.D. in cliometrics[1] and no formal training in software or hardware and I *know* there are huge holes in my understanding of both. Still, I truly enjoy everything about both aspects of our hobby ... I just happen to understand a little more about software. And that's where you become part of the experiment.

Your Part in the Experiment

I want to write some articles to introduce you to a newer aspect of our hobby, one that is growing at a very fast rate: Software. Before you move to the next article, I know a bunch of you are saying: "But I don't know how to program!"

Don't care.

First, how many of you knew what a Colpitts oscillator was before you started studying for your license? How many of you could tell me the length of a half-wave, center-fed, dipole on 40 meters before you became a ham? At one time, all such things were foreign to me. Yet, if I hadn't pushed through a sea of things I literally knew nothing about, I would have totally missed out on the safe harbor this great hobby affords me now.

On to the experiment. The remainder of this article presents examples of actual software that either my students submitted or were (still are?) in commercial applications. The experiment is for you to read the rest of this article and then decide whether you enjoyed reading it or not. More carrot-dangling at the end of the article.

The Problem

I did a consulting job once for a banking company. Simply stated, the company had delegated various data maintenance tasks to be spread out over each month. We simply assume that each task-per-day is serviced by something called a *software function*. A *function* is nothing more than a set of program instructions designed to accomplish a specific task. We can write the function statement for the task to be done on Day 1 of the month as: TaskDay1( );

The parentheses after the task name can be filled with variable names if the function needs some outside information to complete its task. We assume there are no other variables needed to service the task at hand, hence the empty set of parentheses. I asked my "Introduction to Programming" students how they would solve the month's worth of daily tasks. Several students turned in solutions like this:

```
if (today == 1)
  TaskDay1( );
if (today == 2)
  TaskDay2( );
if (today == 3)
  TaskDay3( );
     // some omitted days here...
if (today == 30)
  TaskDay30( );
```

Okay, so let's assume you know zilch about programming, but I'll bet you can read this program code. Evidently, there is a variable named *today* and a series of *if* program statements that test the current value of *today* against 30 different values to see which one is a match. That is, the program statement:

```
if (today == 1)
  TaskDay1( );
```

is verbalized: "If *today* is equal to 1 (the test for equality is a double equal sign [==] in the C programming language), then find the function named *TaskDay1( )* and execute the program statements in that function, thus completing the Day 1 task."

If *today* is day 29, the *if* test above that asks if *today* is day 1 is false, so the call to *TaskDay1( )* is skipped, as it should be. The program code eventually finds the *if* test that asks if today equals 29 and, because it does, *TaskDay29( )* is executed.

If you think about it, if *today* equals 29, the program must perform 28 logical false *if* tests before the *if* test becomes true. When that happens, the *TaskDay29( )* function is called and its task performed. The code then still asks if *today* is day 30 even though we know it isn't. The test that asks if *today* is 30 obviously fails, but the way the code is written we must still make that test.

The type of code presented above is what I refer to in my books as RDC: *Really Dumb Code*. Why is it RDC? The reason is because the students were presented a better plan of attack (i.e., an algorithm) to address the problem at hand. To

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illustrate, suppose *today* is the first day of the month. The very first test is true, so we call the *TaskDay1( )* function and perform its task. Now here's where the code goes stupid: Even though we know *today* cannot possibly be true for the subsequent 29 *if* tests, the code above still performs the 29 "impossible" tests anyway. This means that every day, regardless of which day it is, there will always be 29 unnecessary *if* tests performed. If the bank has a million customers, 29 million unnecessary tests each day start to add up over time and mainframe computer time isn't cheap.

The students had been introduced to a better way. (*Obviously, some of them didn't remember it! –JP*) The technique uses what's called a *cascading if/else statement block*. Taking the same problem but using a cascading *if/else* block, we would get:

```
if (today == 1)
   TaskDay1( );
else
 if (today == 2)
   TaskDay2( );
else
 if (today == 3)
   TaskDay3( );
       // some omitted days here...
 else
  if (today == 30)
   TaskDay30( );
```

The advantage is that, with a cascading *if/else* statement block, once any *if* test is true, the *else* expression means that all of the remaining *if* tests are skipped. On average, this means that we reduce the code stupidity by half. That is, the "average" value for *today* is 15, so we skip 15 unnecessary steps over time. Indeed, our program code solution has progressed from RDC to SDC ... *Sorta Dumb Code*.

Sadly, this example is not made up. I was hired as a consultant to evaluate some banking software and they used a cascading *if/else* block for some batch processing at the end of each day. Their programming staff should have known better. (*I think they did know better, but fell prey to the "If-it-ain't-broke-don't-fix-it" syndrome. –JP*)

The reason the cascading *if/else* is a bad choice is because a *switch/case* statement block is much more efficient. A *switch/case* statement block looks like this:

```
switch (today) {
   case 1:
    TaskDay1( );
        break;
   case 2:
    TaskDay2( );
        break;
   case 3:
    TaskDay3( );
        break;
       // some omitted days here...
   case 30:
    TaskDay30( );
        break;
}
```

In terms of lines of program code, it's not much different from the cascading *if/else* block. At the top of the block, the *switch* expression determines the value of *today* and immediately transfers program control to the matching *case* statement. No *if* tests on redundant values are made.

However, the reason a *switch/case* approach is a better solution is a result of the way the *case* statements are processed. Once *today* is known, the code "jumps" to the correct memory address for the corresponding *case* statement and immediately executes the correct function call. That is, the code can completely ignore the 29 other *case* statements when the program executes. It is so efficient because the executable code produced for the program generates a table of memory addresses for each of the *case* statement blocks. So, when *today* is, say, the 15th of the month, the program jumps to the memory address stored in the 15th element in the jump table. There are no *if* tests. The value of *today* serves as an index to the proper entry in the jump table. On average, this means that this block of code executes almost 15 times faster than with the cascading *if/else* statement block. I think we have progressed from SDC to PGC ... *Pretty Good Code*.

When I found this code block in the banking software, I brought it up at their monthly code walk-through meeting. A code walk-through is where all of the programmers assemble to review a specific program or piece of code. I brought up this code block and, since these were professional programmers, I referred to it as one of the best examples of RDC I had ever seen. Everyone in the room winced, as they should ... they should know better.

As it turned out, I misread their wince. The person who wrote the RDC in the first place was the same person who hired me, and everyone in the room but me knew it. I was fired later that afternoon. I'm sure there's a lesson for me in there somewhere, but I've yet to see it.

Beyond PGC

Actually, the *switch/case* is still not the ultimate solution to the banking problem, which is why I call it PGC. The better technique involves a C programming construct called a *function pointer*. We could define it as:

```
void (*whichTask[30])();
```

This is a bit of showing off, but it's really not hard to figure out what this data definition for *whichTask[]* is. We can verbalize this data definition as: "Variable *whichTask* is a 30-element array of pointers to functions that return *void*." Unwinding complex data definition is easy when you use the "Right-Left Rule." (*Even though I developed the rule almost 40 years ago, it's still very useful today. If you want more details, do an internet search on "Purdum Right-Left Rule" –JP*) That's one of the beautiful things about the C language: You have the flexibility to create the type of data that best fits the solution.

I would call the use of the array of pointers to function solution RGC: *Really Good Code* because it's hard to think of an easier way to solve the problem. The PGC *switch/case* solution involves more than 120 program statement lines. The RGC pointer solution only uses two program statements. Usually, the fewer the number of statements in a program, the better. Truth be told, I think most of my code is PGC and only rarely RGC.

What's the Point?

So, why did I take the time to write this article? The first thing I wanted to accomplish was to convince you that, just because you haven't done any programming *yet* does *not* mean you

Photo A. Homebrew projects that use a microcontroller.

can't learn to program! My guess is that all of you who read this far were able to understand what the problem was doing and how the program iterations improved the solution. I honestly believe that, if you can fog a mirror, you can write your own programs.

The next obvious questions is: *Why* would I want to learn how to program? Really? How many of you have a rig with a fan in it that generates just enough noise so that it is jumping on up and down on that last nerve-ending in your brain? You know it doesn't need to run continuously, but the rig would overheat without it. Well, with about $5 worth of parts, you could write a program that would turn the fan on only when needed and only for as long as needed to cool things down.

Surely all of you are in compliance with the FCC rule as stated in Section 97.119(a). You know, the rule that says you must identify yourself every 10 minutes. Again, less than $5 and you'll never go to jail for breaking that rule. How about building some stuff for around the shack like the projects shown in *Photo A*? Everything you see in that photo is a homebrew project that uses a microcontroller. The cost of making those devices is a very small fraction of what a commercial device would cost, plus there's an immense level of satisfaction from building your own "stuff." In fact, some projects have features commercial versions don't have. That's the beauty of software: You can do what you want, not what someone else wants.

Finally, making hardware dance to the tune of your own software can be intoxicating. You can do fun stuff with the electronics / software combination with a very modest time investment. As to the actual cash outlay, the programming tools used in all the projects shown in *Photo A* were written using the Arduino IDE, which is free. You can buy an Arduino Nano for under $2. Throw in some LEDs and other stuff from your junk box and your cash investment can be under $5.

Books and programming learning tools? I know of one book I'd recommend, but I'm a little biased.[2] However, there are about a bazillion free tutorials online that you can use to learn C. (*C is arguably the most popular programming language for microcontrollers. –JP*) For the cost of that morning latte you may find a new element of our wonderful hobby. Why not give it a try?

Notes:

1. Cliometrics is the application of mathematical and statistical techniques to the study of history, particularly economic history.

2. Purdum, *Beginning C for Arduino, 2nd Edition*, Apress 2015

Did This Catch Your Interest?

We would like to have feedback from readers on this article and whether you would like to see more articles similar to this one. Please let the author know at <jack52443@yahoo.com>.

LEARNING CURVE

BY RON OCHU, KOØZ

Loops Anyone?

A year ago, I moved from central Illinois to eastern Missouri. Or to put it another way, I switched grid squares from EM59ck to EM48qs, So, "What is a grid square?" you may ask. The ARRL offers this explanation:

An instrument of the Maidenhead Locator System (named after the town outside London where it was first conceived by a meeting of European VHF managers in 1980), a grid square measures 1° latitude by 2° longitude and measures approximately 70 × 100 miles in the continental U.S. A grid square is indicated by two letters (the field) and two numbers (the square), as in FN31, the grid square within which W1AW, ARRL's Maxim Memorial Station, resides. <www.arrl.org/grid-squares>

Grid squares are frequently used by ham operators to transmit location. For example, digital modes like FT8 use grid squares as do VHF (very high frequency) operators. They are also used in radio contests (radio sport) and to earn operating awards such as VUCC.

I switched grid squares to be closer to my grandchildren and to assist them with their remote learning. The COVID-19 pandemic wreaked havoc with our nation's educational system. Teachers were forced — literally overnight — to switch from in-class teaching to offering instruction via the internet. Not an easy task and a very daunting undertaking, but teachers and school districts stepped up to the plate. Of course, having a grandfather who is a retired public-school teacher offers some advantages. For the past year, my ham shack (radio room) has been a virtual classroom. I'm slowly putting the ham part of the shack back together. A year later, I am now fully vaccinated and I'm freer to move out and about to "play ham radio." Hopefully, next school year, my grandchildren will be in the classroom full-time, which will free up some more "ham radio time."

An advantage of moving back to EM48, besides being nearer to my grandkids, is access to excellent, nearby hospitals. A disadvantage is that I returned to city-imposed antenna restrictions. I am limited to one 40-foot tower, while at my prior QTH (location) in EM59, I had two towers. One was dedicated to HF (high frequency) and the other to VHF, UHF (ultra-high frequency), and SHF (super-high frequency). I was spoiled living in central Illinois with no tower or antenna restrictions.

So, What's the Problem?

Ham radio is all about choices. I still love HF. But I also love VHF. I am only three DX (long distance) entities (countries / islands / territories that count for DX awards) away from being on top of the DXCC Honor Roll. I plan to get my tri-band Yagi (directional beam antenna) back up on my tower. I'm also planning to put a 2-meter Yagi, 70-centimeter Yagi, and a 23-centimeter looper on the same mast. It's a configuration that worked before when I lived here.

My problem is that I would also like to install my 4-element, 6-meter Yagi.

Photo A. M² Antenna Systems Inc.'s 6M HO Loop ready for parts identification and inventory. All parts were included and easy to identify. (All photos by author)

Photo B. The 6M HO Loop comes disassembled in a relatively small package.

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However, I am worried that the 6-meter Yagi will interact with the 10-meter portion of my HF Yagi. I don't wish to forego the HF Yagi, but I do love operating the magic band (6 meters). An option would be to point the 6-meter Yagi 90° off from the HF Yagi's heading. For example, if my HF Yagi is pointing north, then my 6-meter Yagi would point east. That would minimize interaction between the antennas. But I'm concerned that I will be overloading the mast, which would not be good.

6-Meter DX

A great deal of 6-meter operation, other than 6-meter repeaters, uses horizontally-polarized antennas. Horizontal

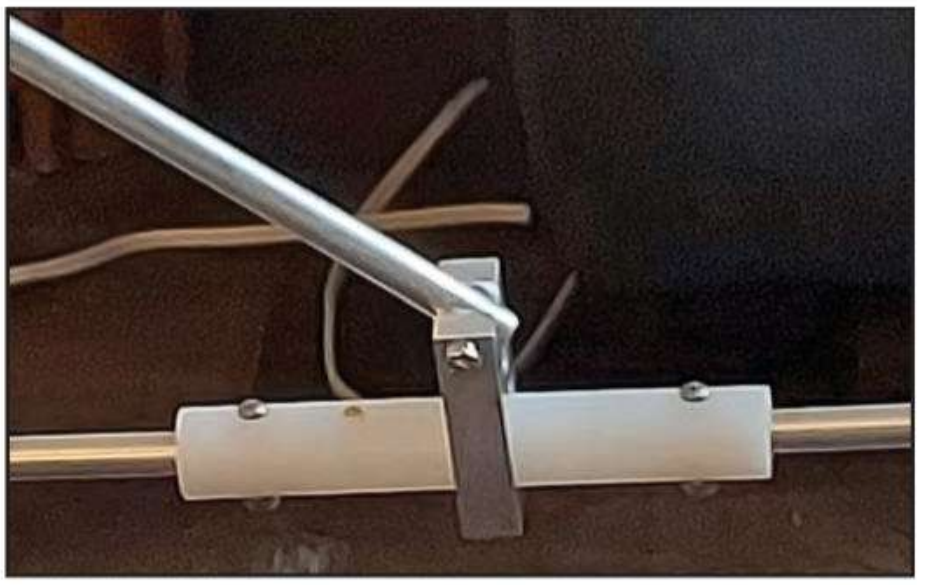

Photo C. An insulator separates each end of the 6M HO loop's tubing.

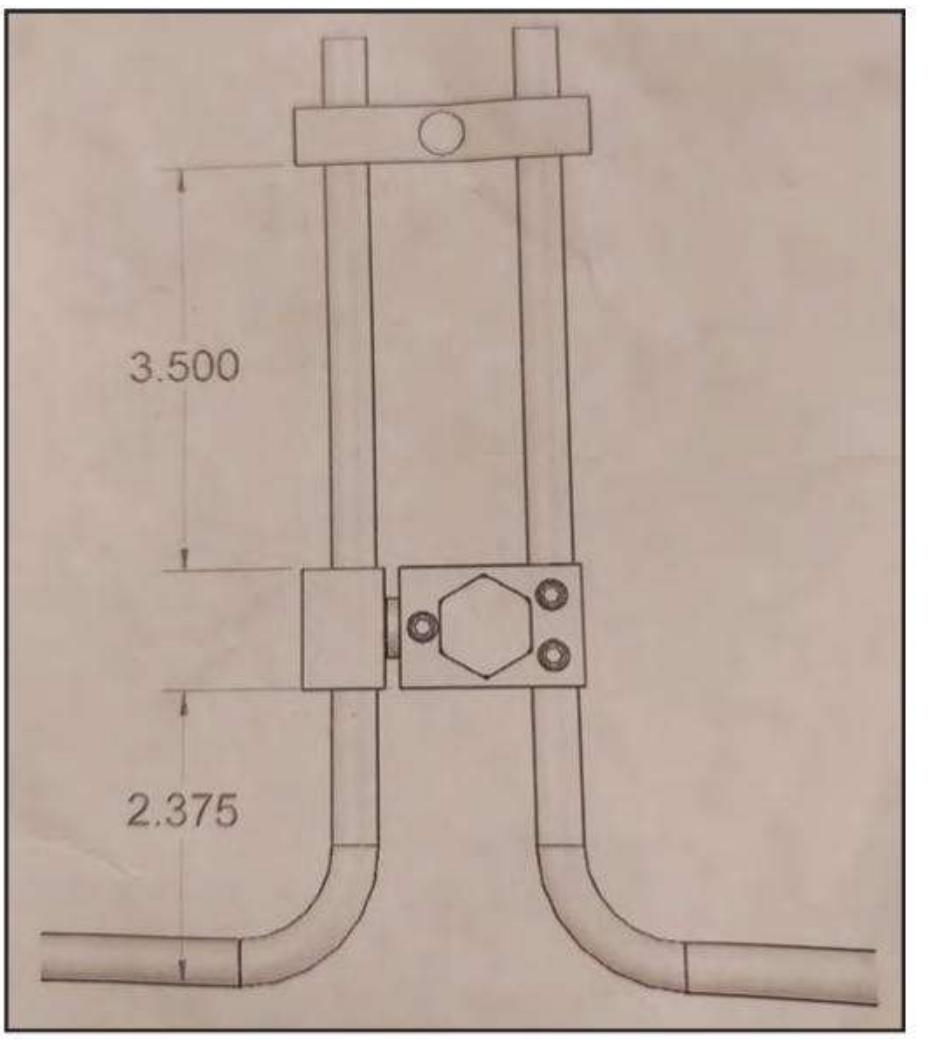

Photo E. M² Illustration detailing the feed block assembly and the shorting bar. The feed block assembly determines the antenna's resonant frequency, and the shorting bar affects impedance.

Photo D. The 6M HO loop aluminum feed block. It is easily identified because it has the UF SO-239 coax connector.

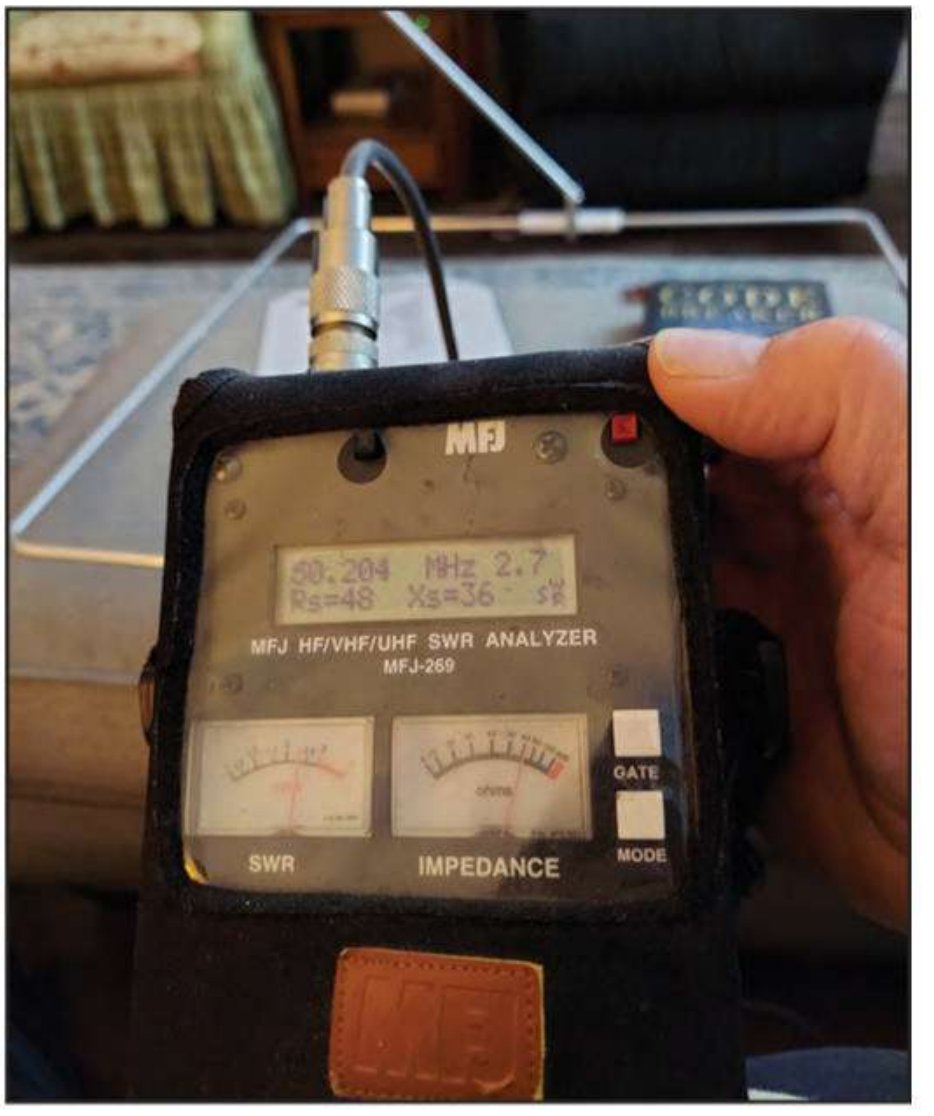

Photo F. My initial measurement after constructing the loop on top of my ottoman at a frequency of 50.204 MHz revealed a SWR of 2.7:1, too high for my liking.

Photo G. For grins, I wanted to see just where my loop was resonating with my initial test and it was "happy" at 50.776 MHz with a SWR of 1.0:1. Better but not perfect. But wait, ground effects were at play here.

Photo H. I took the antenna outside, mounted it on top of a plastic trash can to gain more elevation and my resonant frequency shifted downward to 49.709 MHz with a SWR of 1.2:1. Height above ground does make a significant difference!

polarization occurs when the antenna's radiating elements are parallel to the ground. A vertical antenna's radiating element is perpendicular to the ground. Using antennas with different polarizations often results in much weaker signals at both ends of a contact.

I pondered this problem for a while and suddenly a solution entered my mind. Why not erect a 6-meter horizontal loop antenna? It's horizontally polarized and it's omnidirectional (receives and transmits in all directions). In my younger days, I would have gone to the hardware store and purchased copper tubing, but I'm now less inclined to go scrounging for parts. In my "golden years," I prefer to have a kit with all the parts ready to go, although I still enjoy putting an antenna together and tuning it. After a little internet perusing, I opted to purchase M^2 Antenna Systems Inc.'s, model 6M HO LOOP antenna (*Photo A*). I plan to install this small antenna on a mast just below my home's rear elevation roof line. The mast is already there. All I need to do is to install the antenna, run some low-loss coax and feed it to my shack. The loop will not be directive or have as much gain as my 4 element 6-meter Yagi, but I will be QRV (back on the air) on the magic band.

M^2 6M HO LOOP Antenna

It only took a few days for my loop antenna to arrive after I ordered it (*Photo B*). The first order of business was to take a parts inventory. All the parts were there and M^2 includes a straightforward, easy-to-read instruction pamphlet. The illustrations are very helpful. Before long, my loop began to take shape. I took my time and assembled it over a few days. It took me a few days, not because the assembly was challenging; rather, I would be called away to the next room to assist my grandkids with a perplexing math, writing, or social studies problem. Nonetheless, despite the schooling interruptions, I easily returned to where I left off and resumed with ease.

The loop antenna can be thought of as two quarter-wave sections forming a square. M^2 includes an insulator between the two quarter-wave sections and an impedance matching block with SO-239 coax connector for the other end. This antenna is designed to have an omnidirectional pattern (receives and transmits in all directions). Serious 6-meter contest operators usually have an omnidirectional loop antenna along with their stacked 6-meter Yagis as part of their station "arsenal." The loop offers some insurance that a magic band opening (sporadic-E) isn't missed when a Yagi isn't pointed in the direction of the opening.

Loop Construction and Tuning

After identifying and inventorying all the parts, the directions call for putting the HO Loop tubes into the center insulator (*Photo C*). The insulator "insulates and separates" each half of the loop. Next in line is to place the feed block assembly (the aluminum block with the SO-239 coax connector and

Photo I. Resetting the feed block assembly netted me a resonant frequency of 50.112 MHz and a SWR of 1.2:1!

the shorting bar (*Photo D*) on the remaining loop ends (*Photo E*). M^2 provides a support tube that attaches to the center insulator at one end and a mast U-bolt clamp at the other. This support tube gives extra stability to the mast-mounted antenna and is especially useful for mobile / rover operations.

M^2 tuning directions are straightforward. The directions remind us that horizontally-polarized antennas are affected by the ground. This is a very important point to keep in mind. The higher the loop above ground, the better in terms of tuning and antenna radiation patterns. I find that elevating the antenna at least a 1/2-wavelength above ground (roughly 9 feet for 6 meters) will get you into the ballpark. Frequency tuning is determined by placement of the feed block assembly. The shorting bar is used to set the feed point impedance once the correct, resonant frequency is set.

Initial Results

For example, I assembled my loop on the ottoman in my living room. My ottoman is not far off the ground and measuring a 6-meter antenna inside the house in not ideal. For grins, with my antenna analyzer, I wanted to see just how close my initial frequency and SWR settings were to a frequency of 50.200 MHz. I set my feed block assembly and the shorting bar to the instruction dimensions. I found that at 50.204 MHz, my SWR (standing wave ratio) was 2.7:1 (*Photo F*). So where is my loop resonant? It turns out that I had an SWR of 1.0:1 at 50.776 MHz (*Photo G*). My antenna appears to be too short. But wait, it is too close to the ground. I moved it outside and placed it on top of a plastic trash can. My resonant frequency shifted from 50.776 MHz with a SWR of 1.0:1 down to 49.709 MHz and a SWR of 1.2:1 (*Photo H*). Now my antenna appeared to be "too long." Height above ground does make a big difference. After a few adjustments to the feed block assembly, I obtained a 1.2:1 SWR at 50.112 MHz (*Photo I*). In fact, the SWR was flat well into the CW and SSB portion of 6 meters. Nice!

Ready to Mast-Mount

My granddaughter was happy to model my assembled loop antenna (*Photo J*). The only thing more satisfying than building an antenna kit and getting it to work is to put it on the air and to make Qs (ham jargon for QSO — a two-way radio contact). Sure, I'd prefer putting my 6-meter Yagi up on my suburban lot tower. But for now, HF is taking precedence over my 6-meter profile. With my new M^2 loop, I plan to once again be active in the VHF contests and to add aggregate points to a FB (fine business) club I belong to, the Society of Midwest Contesters. You can check out M^2 antenna here <www.m2inc.com/FG6MHOLOOP>. Thank you for reading *CQ* and 73.

– Ron, KOØZ

Photo J. My granddaughter, Maya, posing with my newly assembled M^2 6M HO Loop omnidirectional, horizontally polarized antenna.

ANTENNAS

BY KENT BRITAIN*, WA5VJB

Frequency Selective Surface

We are going into a bit of a niche topic of antennas, but certainly cutting edge. I remember when the very words *frequency selective surface* and the initials *FSS* were classified. Of course, today there are textbooks on the topic, so I guess I'm free to cover at least what's in those books.

Let's take that chain link fence in *Photo A*. To keep the math simple, let's just say those open squares are 10 centimeters by 10 centimeters. When an opening is less than 1/10th of a wavelength, very little of the radio wave gets though the opening. So at 1 meter, or about 300 MHz, and lower, a radio wave sees that fence as a sheet of metal. But as we approach a half wavelength, or 50 centimeters, the openings are pretty porous. The waves pass right though the fence. Above 600 MHz or so, the fence is pretty much not there. So that fence is a frequency selective surface with the characteristics of a 300-MHz high-pass filter.

Have a look at *Figure 1*. On the left we have that chain link fence type pattern and its high-pass filter characteristics. On the right is the exact opposite. Metal where the other had space, and space where the other had metal, and we will again use that 10-centimeter spacing. Now we have a surface that behaves as a low-pass filter. The metal squares are too small to block long waves. But at as we approach their diagonal one-half wavelength of about 14 centimeters, or just over 2 GHz, they become reflectors. So, on the right we have a free-space, 2-GHz low-pass filter.

Now for *Figure 2*. By using resonant elements, we can make the surface reflect just a specific frequency. So it's a bandpass or band-notch filter, depending on how it is used. The plus signs, circles, and cutouts in a solid surface are only a few of the shapes than can be used.

So what do we do with these things? They have already been popular on several NASA satellites. When you put several feeds at the focus of a dish, they all reflect off the surface of the dish at different angles. Yes, there are multiband feeds, but try to talk on one frequency while listening on another frequency. Not impossible, but very difficult with wideband digital signals. In *Figure 3*, there is another option. In this case, we have an FSS designed just for frequency 2. The feed in the center of the dish is using frequency 2, and the feed at the normal focus of the dish is using frequency 1. In each case, the feed thinks it has the dish focus all to itself and both beams are on the same boresight.

It is also possible to have the 2nd or even 3rd feeds off to the sides of the dish and a flat FSS reflecting the signal back into the dish.

We have gone over only a few of the dozens and dozens of published designs for an FSS. High-pass, low-pass, and passband designs are available.

Photo A. A frequency selective surface or FSS. No, you're not missing anything — it's the fence!

Photo B. NASA's Ingenuity helicopter is transmitting data to the Perseverance rover on 902 MHz! Have any of you picked up its signals yet? And does the FCC have jurisdiction on Mars? (NASA photo by Perseverance)

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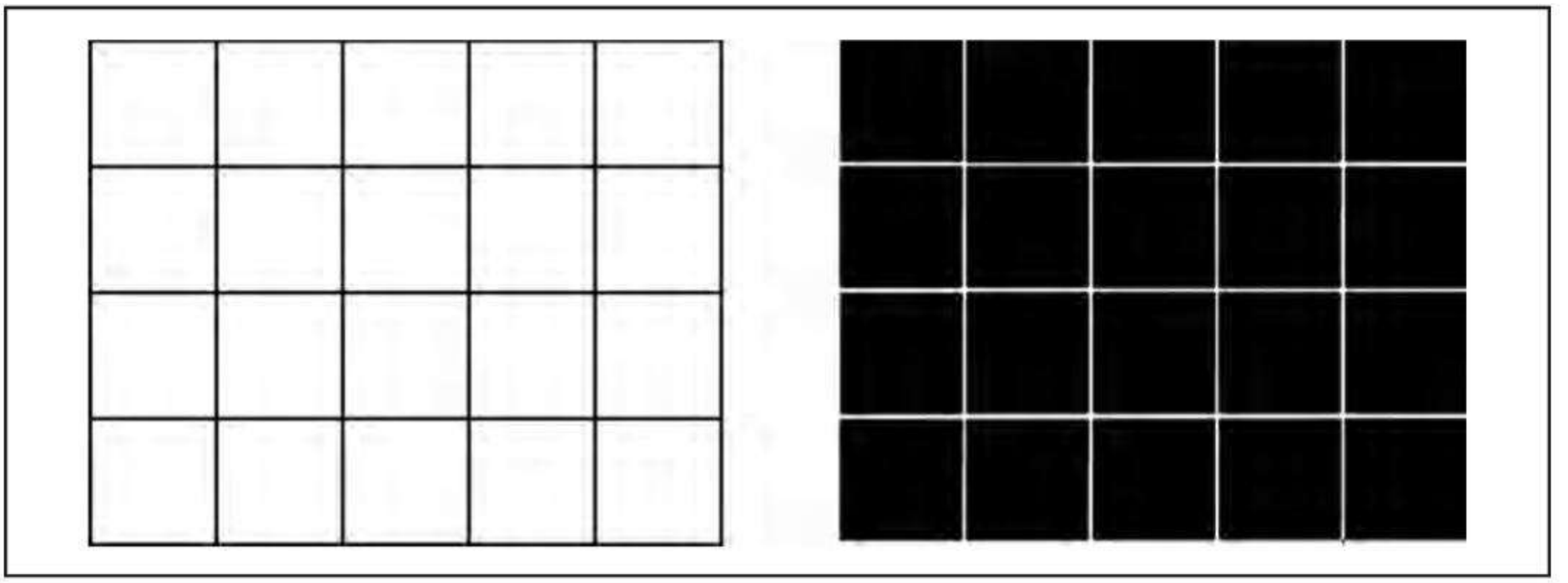

Figure 1. Left: Frequency selective surface high-pass filter; Right: FSS low-pass filter.

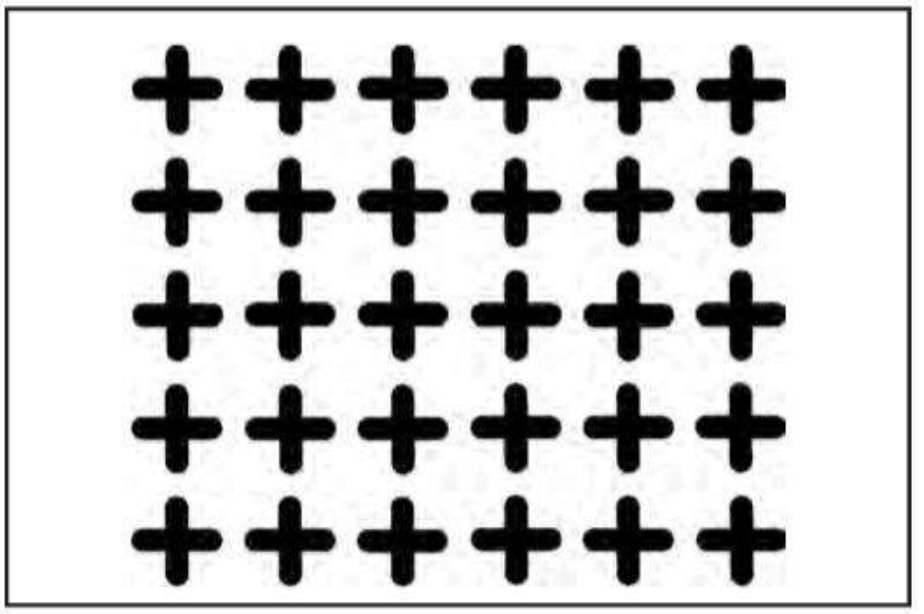

Figure 2. FSS single-frequency surface.

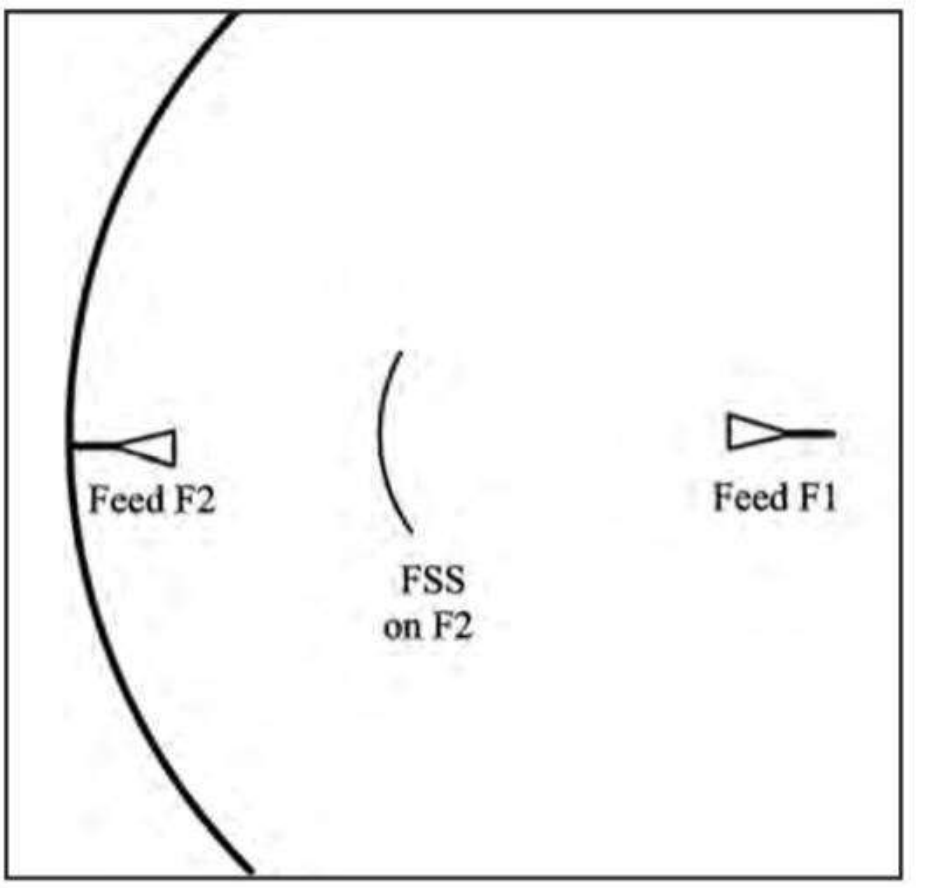

Figure 3. Prime focus and Cassegrain feeds on the same dish.

What about the hush-hush stuff? If you look at the photos of the now decommissioned and mothballed F-117 stealth fighters, you can see that the antennas were like a submarine periscope. Up when they needed to talk, down when they were not. Antennas reflect radio waves nicely. That's an undesirable characteristic for low observables. What happens if you cover them with a FSS and thus the opposition's radar doesn't see those other frequencies? Or perhaps a radome that only *your* radar can see though?

Underground Antennas

Back in the late '40s and early '50s, the ham mags had quite a few articles about burying HF antennas. Seems running the wire in old garden hoses was popular. And military installations that could be targets for a nuclear attack have had underground HF antennas for decades. But these articles have little performance information.

My quandary is I have a Russian book on underground HF antennas. There are quite a few online sites that will translate a Russian PDF into an English PDF. But this one is PDFs of scans. So it needs to go OCR, to text, to PDF. The book can be downloaded from my website at <www.wa5vjb.com/references.html>.

Just imagine telling that nosy neighbor who is chairman of your local homeowners association you are just working on your sprinkler system, but you're really installing a new 40-meter dipole. That dipole just under the grass might work better than your current antenna tuner to the rain gutter. If you can help me get this book translated to English, this could make a great series of columns!

Paging Marvin the Martian…

With whom do we file a complaint? Ingenuity, that little helicopter making test flights on Mars (*Photo B*), is using our 33-centimeter ham band for the data link! (*For those of you without a sense of humor, yes, we are aware that a) the amateur allocation at 902 MHz is secondary; b) there is virtually no chance of QRM in either direction; and c) the FCC has no jurisdiction on Mars. – ed.)*

As always, you guys and gals are a great source of column topics. If you have any antenna question or a possible column topic, you can use snail mail to my QRZ.COM address. For email, use <wa5vjb@cq-amateur-radio.com>. For many additional antenna projects, have a look at <www.wa5vjb.com>.

COMMUNICATIONS HORIZONS

BY ROB DE SANTOS*, K8RKD

AM Radio Still Lives – For Now

It has been some time since this column checked in on the state of AM broadcast radio in the U.S. AM lives on, but for how long? Recently the FCC gave stations an option that previously did not exist. They can forsake any analog service and go entirely digital using the "HD radio" option.

The situation for AM station owners in the U.S. has not been good for a long time. The numbers of stations in the U.S. on AM has declined every year for a decade or more. The latest count, at the end of March 2021, is 4,546 according to the FCC. That is down about 10% in the past 30 years. Not a precipitous decline but a steady one. At the same time, educational and low-power FMs are at or near all-time highs.[1]

The FCC has debated and fielded numerous proposals for saving or revitalizing the AM band over the past decade. Several were approved and implemented, but none of them had much impact on the long-term trend. Many station owners have publicly indicated that their stations are barely able or not at all able to pay for themselves. Advertising dollars spent on AM radio have declined even faster than the station count.

There is much concern inside the radio industry that the AM band could disappear completely from car dashboards as two automakers have already dropped it. If it disappears, then the remaining AM stations would be in serious trouble. This might take 15 or 20 years, but the threat is seen as genuine. Listeners and DXers should be concerned too, since if stations start closing at an accelerated pace, the worry will not be interference with DXing but the complete lack of anything to DX on AM.

WFAS-AM outside New York City is one of only three AM radio stations so far to convert to all-digital following FCC permission for any station to do so. (Image from <WFASAM.com> website)

Go All Digital?

As noted above, the FCC recently authorized AM stations to go all-digital and drop their analog signal entirely.[2] It is voluntary, and stations need only notify the FCC 30 days prior to the switch that they plan to do so. No separate FCC authorization is needed. (*The FCC does not seem inclined, nor do owners want it, to create any mandatory change anytime soon. –RDS*). As of presstime, only three stations have made the switch: WWFD (Frederick, Maryland), WMGG (Tampa, Florida), and WFAS (White Plains, New York). The owner of WMGG said that he plans to switch WTMP in Tampa soon as well. Several other owners are still evaluating their options. One station switched and then switched back after listener complaints.

I can hear the moaning already from DXers who remember "IBOC" — so what is the difference here? The original mode allows for HD signals piggybacked on the analog signal. This works reasonably well on FM due to the higher bandwidth and better signal separation. HD radio has succeeded reasonably well on FM and is now in about 25% of the cars on the road. Unlike on AM, it is probably here to stay. In major markets, the vast majority of FMs already have HD channels associated with them. Some are standalone with different formats, some feed translators, and many are sublet for profit to other entities.

No Static at All

On AM, piggybacked digital has largely disappeared, with a few exceptions, and the FCC has indicated it is not inclined to authorize any new "dual-mode" stations. The dual mode is formally known as MA1 and the IBOC term is considered obsolete. The digital signal is added to the outer part of the bandwidth in MA1 and is prone to cause adjacent channel and skywave interference. The all-digital mode (or MA3) dispenses with the analog signal entirely and is centered on the carrier frequency. Tests have indicated a much lower interference risk and better signal coverage. The same chipset in radios that handles FM and handled MA1 also handles MA3.

The new digital mode is not about getting people to buy new radios but rather to take advantage of the HD radios already available, primarily in vehicles. Is it enough to save the band? Probably not on its own. If, however, you are an AM station owner with negligible ratings or poor coverage, and you have or can reasonably upgrade to HD radio, you might be tempted. If the owner needs to upgrade antenna facilities or replace the transmitter itself because it is too old to just add a HD unit and pay the license fee to Xperi (owner of the HD patents), then he/she will probably take a wait-and-see approach to this new option.

Whatever decision is made, it will be made for business reasons, and hobbyist listeners such as AM DXers will not matter. (*Truth be told, station owners stopped caring about DXing at least 60 years ago –RDS*). If the number of HD-capable radios increases significantly, that might persuade more owners to switch to all-digital. The question about whether the AM band can survive will continue to hang over the industry and listeners for some years yet.

Thanks to all of you who wrote in response to recent columns. For those readers who are new, I want to be clear that my writing in this column is very future-oriented and should not be interpreted to mean that I do not appreciate current societal or economic issues with new technologies. Keep the emails coming as I am always interested in your thoughts and feedback.

References:

1. "U.S. Commercial FM Station Count Is Down", RadioWorld, <https://tinyurl.com/3d43wwme>

2. FCC Report and Order 20-154, 10/28/2020: <https://tinyurl.com/2vjk343a>

* *<commhorizons@gmail.com>*

VHF PLUS

BY TRENT FLEMING,* N4DTF

April TEP and an Early Start for Sporadic-E

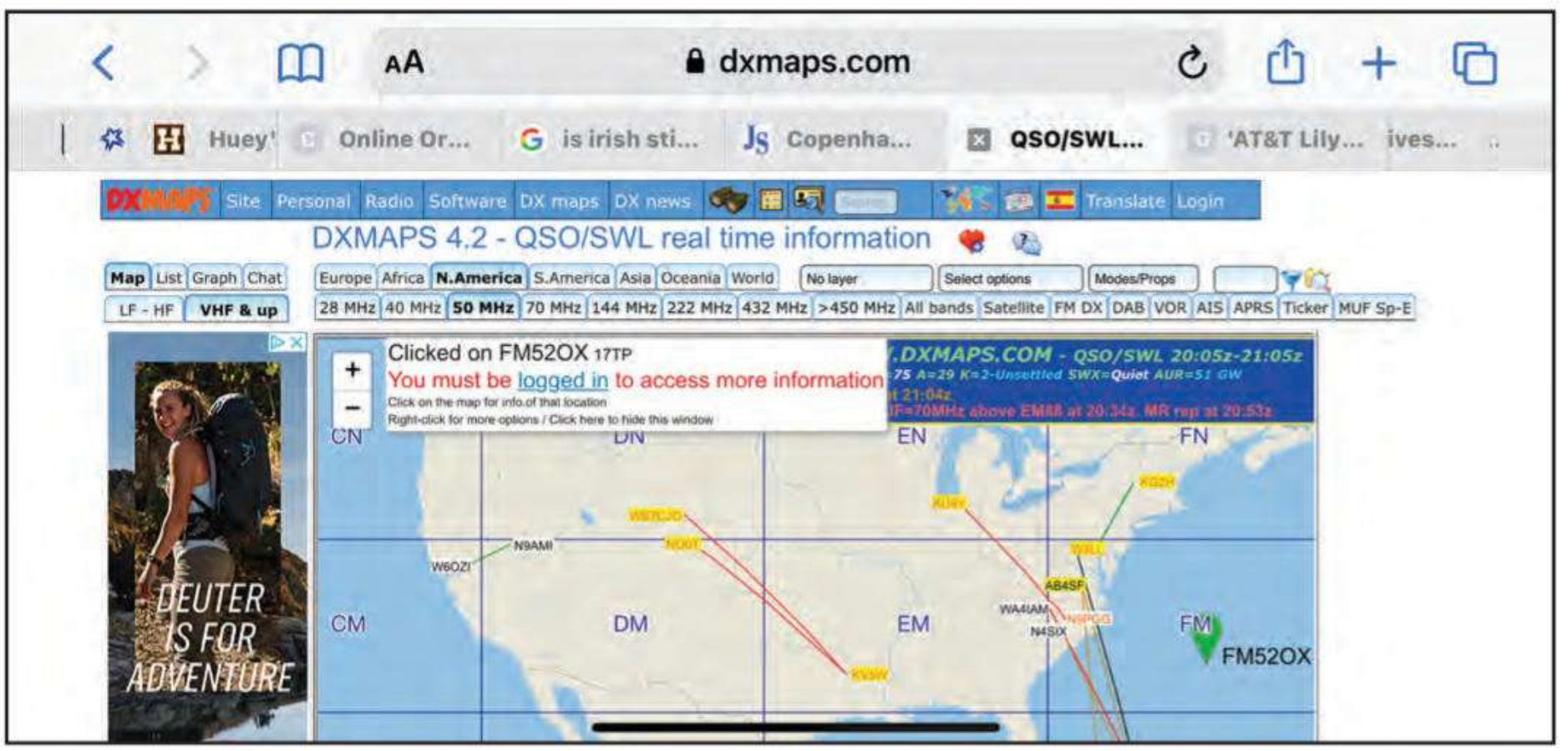

Figure 1. See lower right for North American ends of several TEP (transequatorial propagation) contacts on 6 meters on April 19th. (Courtesy of DX Maps)

Last month we discussed getting the most from your Technician license, and talked a lot about two popular bands, 6 meters and 2 meters. Almost as if in response, 6 meters has come to life early and as I write this in mid-April, we are seeing interesting activity via multiple propagation modes. As you'll hear me say over and over, "they don't call it the Magic Band for nothin'."

On Monday, April 19th (see *Figure 1*), stations along the eastern seaboard worked into the Caribbean and South America, the latter via TEP (transequatorial propagation) a mode that supports communication across the magnetic equator (similar to, but not the same as, the geographic equator) for distances of 2,500-5,000 miles. This mode was apparently first observed in the 1940s and has been responsible for some exciting DX for hams in both hemispheres. While not completely understood, clearly the high ionization levels in sunlight along the equator provide such opportunities, in a type of "two-hop" transmission. Most common during the late afternoon, TEP openings are often supported on one or both ends by linkages to traditional sporadic-E (E_s) openings, lengthening the distance over which contacts can be made. As you will see from the following reports, being there when the action happens is critical. Listening, calling CQ, and watching the propagation maps are critical to taking advantage of these openings.

Wray Dudley, AB4SF, offers the following reports on activity from his QTH in FM17, in Virginia:

On Sunday (4/18) between 2100z and 2130z (3-3:30 p.m. EDT), I began to copy signals from South America on 6 [meters] running FT8. Over the course of that half-hour, I worked two in Chile and two in Argentina. I recall copying a few in Brazil also but as I already have confirmed QSOs with stations in Brazil (and Argentina) on 6 [meters] from past years I concentrated on the two stations in Chile first.

Virginia is a bit far north for TEP but, as I understand it, if there is strong E-skip from here to Florida or into the Caribbean where TEP is much more common, we can (use) E-layer reflections to get to the TEP area and then second-hop into the TEP propagation. I am certain that was the case Sunday afternoon because, at the time, HH2AA in Haiti was extremely strong to me. WSJT-X was reporting +38 to +40. His signal was S9 on my receiver.

Through May-June-July, it is not unusual for the mid-Atlantic to have strong E-skip into the Gulf Coast and over into Texas as well as up the Mississippi River as far north as Minnesota. That was the case this past Monday the 19th. I worked a number of stations in Texas and Mississippi. At 1640z I worked two stations in Mexico (both in grid DL44), which was probably double-hop [propagation] as the Texas stations were still strong at that point.

Yesterday (4/20), I was home only in the morning but did work several stations in the Caribbean running FT8 and then V31MA in Belize on CW, though his signal was very light and had deep and fast QSB (fading). Later in the afternoon when I was not at home, I got a text alert from a friend that he was seeing South American stations.

Most of my WSJT-X QSO on 6 [meters] have been using FT8, though I have made a few running Q65. It appears that, for now at least, most people are sticking with FT8.

* <n4dtf@cq-amateur-radio.com>

Photo A. K1FJM managed to capture not only the trapped air of a temperature inversion (dark area along the horizon), but also a breaching whale in the foreground! (Courtesy of Peter Heins, K1FJM)

By the way, yesterday morning (April 20th), I heard some meteor pings on 6 [meters]. The Lyrids meteor shower is currently going on. The E-skip was so strong that it was overshadowing the occasional bursts of signal.

In the deep south, Christopher Arthur, NV4B, made two TEP QSOs from EM64 on Tuesday: CX6DRA (a new one on 6 meters) and LU5VV. He reported battling an S7 noise level in that direction but managed to hear several

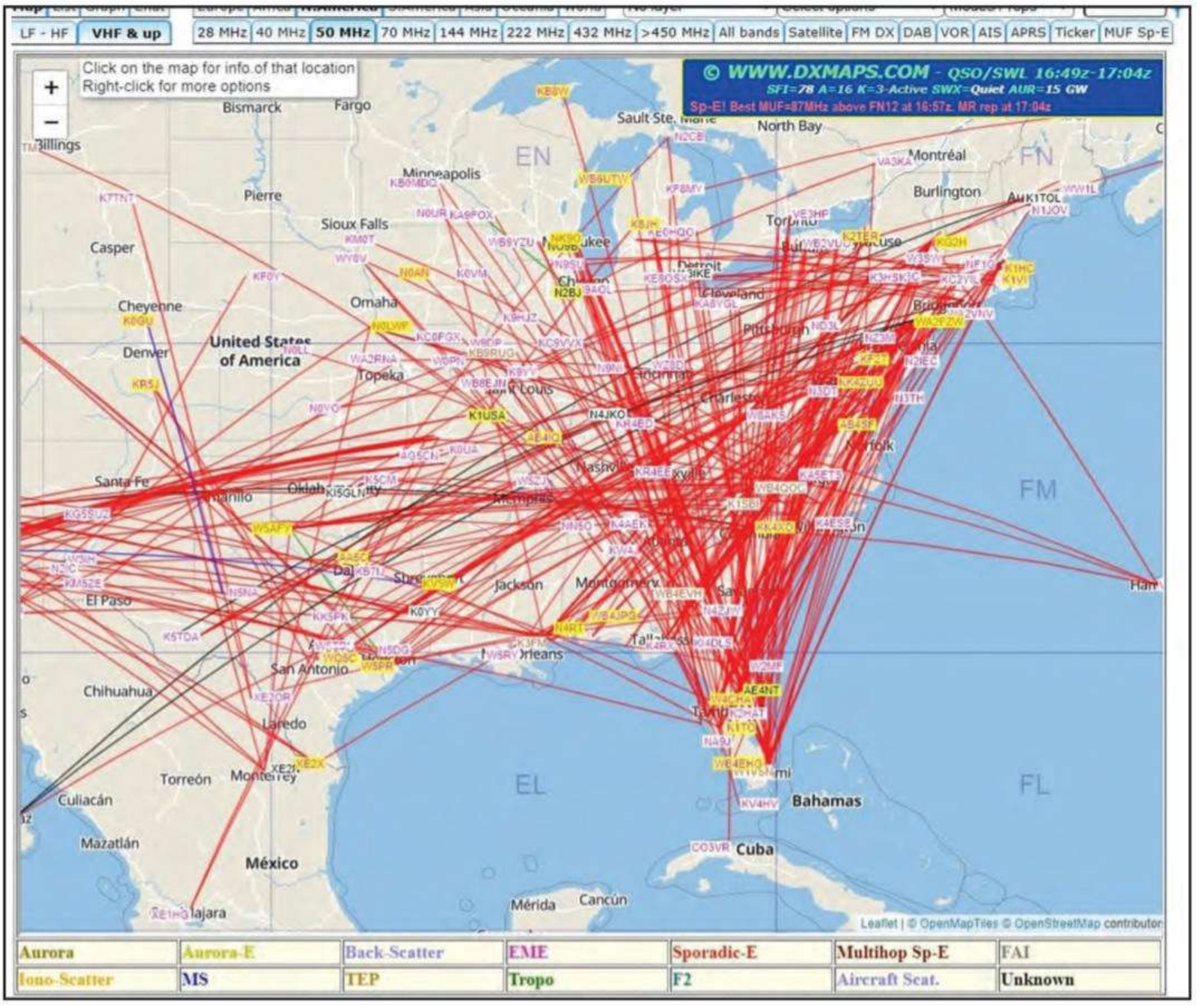

Figure 2. An early E_s opening on April 20th provided lots of great 6-meter contacts throughout much of North America. (Courtesy of DX Maps)

CXs (says Christopher, "I was stunned at how much activity there was from there!") plus a couple of PYs and another LU. This opening was flakier and shorter-lived than the TEP openings of April a year ago, but he thinks his high noise level contributed to that. Finally, he reported a good early-season E_S opening to the north northwest into Minnesota and Wisconsin that evening, and a shorter opening farther west that netted him a new grid (DN72). First really solid E_S opening he's seen this season from EM64. (See *Figure 2* for the April 20 E_S opening.)

While much of the activity seemed to be on FT8, our friend Howard Runions, W4HLR, reports strong phone activity on Tuesday the 20th:

I worked several LUs via TEP today, as well as V31MA on Sporadic-E. After the V31 contact, the LUs came in about 1950 UTC and then the CXs after that. Fun all day on SSB!

Howard reminds us of the meteor scatter group that is on 50.145 MHz phone every morning around 7 a.m. central time, as well. Give it a try!

Charles Bischoff, N4GCD, worked Connecticut and Minnesota, as well as Belize, with 100 watts and a 3-element M2 beam at 33 feet.

All of the activity was not limited to the eastern and southern U.S., however. Hams in southern California worked into 3D2 (Fiji, Rotuma, and Conway Reef), VK (Australia), and ZL (New Zealand) during this same time period. I do not have official reports but saw some postings. Feel free to update us if you were one of the lucky ones.

Hams in Texas got in on the action as well. Lamar Denby, KD5HLB, worked KA2ABA in New York on Monday the 19th, using a rotatable dipole at 50 feet. His contact was also on 50.125 MHz using SSB.

Korey Chandler, WA5RR, worked into the northeast and Canada on FT8 from EM04 in north central Texas.

Dan Dantzler, WØJMP, reported working lots of stations, but was not able to work either of the two states he needs for Worked All States: North Dakota and Hawaii. Congratulations to Dan on being this close. Perhaps someone in North Dakota can help him out this season! Hawaii might take a few more sunspots … what do you think?

Flying Inverted

Peter Heins, K1FJM, sends us two great shots, *Photos A* and *B*, of a temperature inversion off Zuma beach in southern California. One even includes a breaching whale! Such inversions can support long-distance communications to Hawaii when conditions are right. Just another example of the variety of propagation modes we enjoy on VHF and higher bands. Note that "Zuma" was the inspiration for a great Neil Young album by the same name.

As promised, I've been working on station improvements and additions, including a new-to-me 432 antenna and a Downeast Microwave (DEMI) 222-MHz transverter (*Photos C* and *D*) that will give me five bands for now, with a

Photo B. Temperature inversions such as this one at Zuma Beach, California (minus the whale this time) can result in very long-distance tropospheric ducting on VHF and UHF, including regular openings between southern California and Hawaii. (Courtesy of Peter Heins, K1FJM)

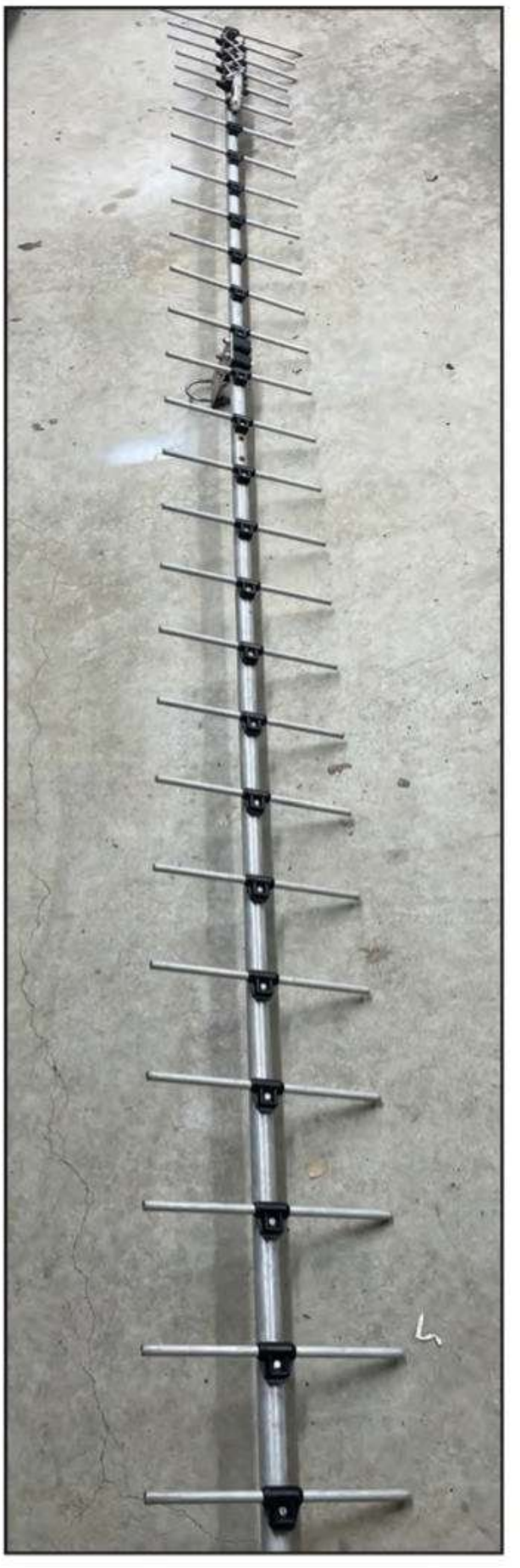

Photo C. N4DTF's "new-to-him" Yagi for 432 MHz.

Photo D. Trent has also recently come into possession of a 222-MHz transverter from Downeast Microwave (underneath the wattmeter).

transverter for 903 also in the mix. I'm using the IC-9100 for 2 meters, 432 MHz, and 1.2 GHz, while the IC-7700 at 200 watts drives 6 meters and the 222-MHz transverter. Stay tuned for reports on my activity, and if you hear me on the air, please do say hello.

Mailbag (We Get Letters!)

As an experienced HF DXer, mainly on CW, Norm Briggs, KK6DW, writes to ask about DX opportunities on 2 meters. He is hearing very little 2-meter activity locally, and wonders what the fuss is about. My May column will have some of the answers for Norm, but I also sent him a note to ensure he got involved now. In my answer to Norm, I tried to break 2 meters down into three areas: FM (repeaters and simplex), weak signal, and digital / satellite modes. Something for everyone, which is our mantra around here. As far as DX, working other countries via direct contacts is very difficult from the U.S., except of course Mexico, Canada, and the occasional Caribbean station. Active weak signal operators in the U.S. focus on grid chasing (there are 488 1° x 2° grids in the continental U.S.) or worked-all-state chasing. Both are satisfying, and will try your operating skills, your equipment, and your patience. One thing I told Norm is that is his experience with CW will really help when conditions are only marginal. I look forward to hearing from Norm as he explores the world of weak signal activity.

Get On the Air!

By the time you read this, the current E_s season will be in full swing, including the CQ World Wide VHF contest on July 17 and 18th, so hopefully you are working from last month's suggestions and getting a horizontally-polarized antenna up in the air to take advantage of these exciting openings. Peter West, VE3HG, reports that he had so much fun last year on 6 meters that he's ordered a Moxon antenna for this year. Hope to hear his signal on the bands. Write and let me know how what equipment you are using and how it is going for you on the Magic Band, and elsewhere on VHF.

– 73, N4DTF

Looking Ahead ...

Here are some of the articles we're working on for upcoming issues of *CQ*:

- Restoration Mini-Special:
  - Heathkit DX-60 Transmitter
  - Heathkit K1 Receiver
- Converting an SB-220 to 6 Meters
- My Dipole Has Gain!

Plus…

- Results: 2020 CQWW RTTY WPX Contest
- 2021 Inductees: CQ Amateur Radio, Contesting, and DX Halls of Fame

Upcoming Special Issues

October: Emergency Communications
December: Technology
February: QRP

Do you have a hobby radio story to tell? Something for one of our specials? *CQ* now covers the entire radio hobby. See our writers' guidelines on the CQ website at <http://bit.ly/2qBFOdU>.

BY BOB SCHENCK, N2OO

Announcing the 3YØJ DXpedition to Bouvet Island

This month, I will be turning over the keyboard to Paul Ewing, N6PSE, who, on the behalf of The Intrepid DX Group, has announced a DXpedition to Bouvet Island for early 2023. As many of you already know, two recent attempts to activate Bouvet were unsuccessful. Doing a successful Bouvet DXpedition requires three things. One is to plan and collect funds for a big enough activity that will give out plenty of QSOs for the deserving, so a full-time activation will require a full team of experienced and physically capable operators, as well as an enormous amount of advance funding. Two is actually getting there. Three is actually getting on the island and operating in a very difficult environment. To this end, Paul has teamed up with Ken Opskar, LA7GIA, to activate Bouvet in the January 2023 timeframe. I encourage all of you to consider donating to this project. Full information can be found at <https://3y0j.com> and <https://tinyurl.com/dsc6ahr8>. Now, turning over the keyboard to Paul, N6PSE. – N2OO

Beginning with a Vision

Every DXpedition starts out as a vision. Our vision for Bouvet started during the VP8STI-South Sandwich and VP8SGI-South Georgia DXpeditions in 2016. We worked extremely hard over a period of years and we were met with success in those activations. Based on our success, we began to think where we would go next.

Making the difficult landing and activation at South Sandwich and then again 10 days later at South Georgia gave us the confidence that we could activate Bouvet in much the same manner and style.

In the following years, there were multiple efforts and we channeled our energy into trying to gain permission for Johnston Atoll, Kure, Scarborough Reef, and San Felix, among others.

We researched Bouvet extensively and made contacts at the Norwegian Polar Institute (NPI). Bouvet is Norwegian territory and NPI controls access to the island. We looked for ways to make a shore landing without the need for a helicopter. Jason Rodi, a Canadian filmmaker, brought a mountaineering team to Bouvet a few years earlier and he was most helpful. He told us that even his group of experienced mountaineers found Bouvet quite challenging. Jason also stated that bringing generators and fuel cans onto the glacier would be extremely difficult. We continued our research as several other teams made efforts to land with and without helicopters.

In the fall of 2020, Intrepid DXer Kenneth Opskar, LA7GIA, had to cancel his planned activation of Jan Mayen. It was then that he and I began exchanging ideas about Bouvet. Once we realized that we both had similar goals, we decided to form a partnership and work toward activating Bouvet, which is the #2 most wanted DX entity.

Unlike many of the rare entities, getting permission to land on Bouvet is rather easy. A permit is required to land a helicopter and there is a large, restricted area on the west side of Bouvet called Nyroysa. This is the location of the NPI's science base. Most difficult is to find transportation to bring a radio team to Bouvet and back. Very few ships are willing and able to make the voyage to Bouvet. The seas are known to be very rough and unforgiving and the mean time between storms is very small.

Having had a very good experience with the RV Braveheart and her crew in 2016, I recommended to Ken that we begin the process to engage with them. We were happy to learn that the Braveheart was available in January 2023 and we began to target that time

The Northern California DX Foundation and the International DX Association (INDEXA) are the premier donors to the 3YØJ Bouvet DXpedition.

*email: <n2oo@comcast.net>

frame. As with most things, the cost of this charter would be significantly more than our last DXpedition. There is no safe anchorage at Bouvet and the Braveheart will be in constant motion, fighting the wind and the seas to stay near the radio team. This constant motion will require engines to be running at all times leading to excessive fuel consumption. This adds to our cost considerably.

Translating the Vision to a Plan

Our vision is to land in small boats and climb up onto the glacier where we have permission from the NPI to setup a camp. We will devise systems to allow us to lift our equipment and supplies as well. We will lay out our camp with the Yagi antennas along the ridge to make best use of the rugged terrain towards the sea.

We will use generators for power and special polar-rated tents, able to withstand winds of 110 mph or more, for our shelters. All of this is designed to be lightweight and easy to set up.

We will establish a low-band antenna field away from the Yagi antennas. Receive antennas will be deployed. We plan to make use of the new Starlink System to make daily uploads to Club Log and our QSL manager. Our Pilot

The RV Braveheart will provide transportation for the 3YØJ team to and from Bouvet. The ship's captain and crew have ferried so many DXpeditions to remote locations in the Southern Ocean that Captain Nigel Jolly (now K6NRJ) and his crew were inducted into the CQ DX Hall of Fame in 2016. (Photo courtesy Intrepid DX Group and EY8MM)

5 Band WAZ

As of April 15, 2021
2302 stations have attained at least the 150 Zone level, and 1079 stations have attained the 200 Zone level.

As of April 15, 2021
The top contenders for 5 Band WAZ (Zones needed on 80 or other if indicated):
CHANGES shown in BOLD

Callsign	Zones	Zones Needed
AK8A	199	17
DM5EE	199	1
EA5RM	199	1
EA7GF	199	1
H44MS	199	34
HAØHW	199	1
HA5AGS	199	1
I5REA	199	31
IKØXBX	199	19 on 10M
IK1AOD	199	1
IK8BQE	199	31
IZ3ZNR	199	1
JA1CMD	199	2
JA5IU	199	2
JA7XBG	199	2
JH7CFX	199	2
JK1AJX	199	2 on 10M
JK1BSM	199	2
JK1EXO	199	2
K1LI	199	24
K4HB	199	26
K5TR	199	22
K7UR	199	34
K9KU	199	22 on 15M
KZ4V	199	26
N3UN	199	18
N4NX	199	26
N4WW	199	26
N4XR	199	27
N8AA	199	23
N8DX	199	23
N8TR	199	23 on 10M
RA6AX	199	6 on 10M
RU3DX	199	6
RWØLT	199	2 on 40M
RX4HZ	199	13
RZ3EC	199	1 on 40M
S58Q	199	31
SM7BIP	199	31
VO1FB	199	19
W1FJ	199	24
W1FZ	199	26
W3LL	199	18 on 10M
W3NO	199	26
W4LI	199	26
W6DN	199	17
W6RKC	199	21
W6TMD	199	34
W9OO	199	18 on 10M
W9XY	199	22
9A5I	198	1, 16
EA5BCX	198	27, 39
F5NBU	198	19, 31
F6DAY	198	2 on 10M & 15M
G3KDG	198	1, 12
G3KMQ	198	1, 27
HB9FMN	198	1 on 80M & 10M
I1EIS	198	1 & 19 on 10M
JA1DM	198	2, 40
JA3GN	198	2 on 80M & 40M
JA7MSQ	198	2 on 80M & 10M
JH1EEB	198	2, 33
KØDEQ	198	22, 26
K1BD	198	23, 26
K2EP	198	23, 24
K2TK	198	23, 24
K3JGJ	198	24, 26
K3LR	198	22, 23
K4JLD	198	18, 24
K5OT	198	18, 23
K9MM	198	22, 26
KI1G	198	24, 23 on 10M
KZ2I	198	24, 26
N4GG	198	18, 24
NXØI	198	18, 23
ON4CAS	198	1, 19
OZ4VW	198	1, 2
UA4LY	198	6 & 2 on 10M
UN5J	198	2, 7
US7MM	198	2, 6
VK3GA	198	12 & 13 on 10M
W5CWQ	198	17, 18
W6RW	198	2 & 22 on 10M
W9RN	198	26, 19 on 40M
WC5N	198	22, 26
WL7E	198	34, 37
Z31RQ	198	1, & 2 on 10M
ZL2AL	198	36, 37

The following have qualified for the basic 5 Band WAZ Award:

Callsign	5BWAZ #	Date	# Zones
WS5W	2297	2021-03-22	188
UR7TT	2298	2021-03-24	150
DJ4DN	2299	2021-03-25	159
HB9CQK	2300	2021-04-10	184
HB9RYZ	2301	2021-04-10	160
VO1HP	2302	2021-04-12	184

Updates to the 5BWAZ list of stations:

Callsign	5BWAZ #	Date	# Zones
K2AU	1859	2021-03-30	195

New recipients of 5 Band WAZ with all 200 Zones confirmed:

5BWAZ #	Callsign	Date	All 200 #
None			

Rules and applications for the WAZ program may be obtained by sending a large SAE with two units of postage or an address label and $1.00 to: WAZ Award Manager, John Bergman, KC5LK, 125 Deer Trail, Brandon, MS 39042-9409. The processing fee for the 5BWAZ award is $10.00 for subscribers (please include your most recent *CQ* mailing label or a copy) and $15.00 for nonsubscribers. An endorsement fee of $2.00 for subscribers and $5.00 for nonsubscribers is charged for each additional 10 zones confirmed. Please make all checks payable to John Bergman. Applicants sending QSL cards to a *CQ* checkpoint or the Award Manager must include return postage. KC5LK may also be reached via email: <kc5lk@cq-amateur-radio.com>.

*Please note: Cost of the 5 Band WAZ Plaque is $100 shipped within the U.S.; $120 all foreign (sent airmail).

Team will keep us informed as to our performance and help us take advantage of any band openings.

We will do everything possible to work the farthest regions and fulfill the need for 3Y contacts.

Given the high costs and the deep personal sacrifices away from home and family, we must do everything we can to maximize our impact. Each team member will contribute a minimum of $20,000.

We have carefully selected a relatively young and fit team. Our landing will be very physically demanding and will be done without a helicopter. The team will be exhausted before

The WPX Program

CW

4112	DK1MCS
4013	KW2A

SSB

4350	F6JSZ
4351	DG1SGW
4352	KB1UIF
4353	IZ6FXS
4354	DL1MP
4355	AA8SW
4356	M1VPN
4357	KP4VET
4358	WU9D
4359	UC5C

Mixed

4211	DG1SGW
4212	KB1UIF
4213	HB9ECS
4214	MØHIH
4215	DL1MP
4216	AD4K
4217	CT1EFT
4218	WB4CW
4219	M1VPN
4220	KP4VET
4221	K5PAR
4222	KB2YCW
4223	JK1CEK
4224	UC5C
4225	KG4FVR
4226	VA3OKG
4227	KZ4A
4228	VR2VGM

Digital

1488	KB1UIF
1489	HB9ECS
1490	KB1SEQ
1491	OE1CGS
1492	AD4K
1493	M1VPN
1494	JK1CEK
1495	MØHIH
1496	KG4FVR
1497	KFØAIJ
1498	KZ4A
1499	N7MWL
1500	W7DGP
1501	KC4VKG
1502	VR2VGM
1503	CT1EFT

CW: 350: KW2A. 400: WU9D. 500: F6JSZ. 750: NF7D. 950: JAØEOK.

SSB: 350: M1VPN. 400: KB1UIF. 450: W5IOO, UC5C. 500: DL1MP. 550: W7SLS. 800: JH7QJK. 850: DG1SGW. 1650: HB9MXY. 3450: PY5EG.

Mixed: 450: K5PAR. 500: VK4COZ, DL1MP, KP4VET. 550: AJ6X, UC5C, DG2PX. 600: K4NWX, KZ4A, SM6STI. 650: KK6YYF. 700: N3YAZ, W7DGP. 800: DK1MCS, AD4K, KB1UIF. 850: NC3C, M1VPN. 900: DG1SGW. 950: NA5WH, VR2VGM. 1000: HB9ECS. 1050: W7SLS, W4DWS. 1150: PU4MMZ. WU9D. 1200: WB4CW. 1300: F6JSZ, NF7D. 1600: W1FNB. 2100: HB9MXY. 3350: HB9BIN. 4100: PY5EG.

Digital: 350: KFØAIJ, N7MWL. 400: KG4FVR. 450: K4NWX, KZ4A. 500: W7DGP. 550: AJ6X, DG2PX, KB1UIF. 600: SM6STI. 650: DK1MCS, KK6YYF. 700: M1VPN, N3YAZ. 750: AD4K. 800: NF7D, W7SLS, WW5XX. 850: HB9ECS, NC3C. 900: WU9D. 950: F6JSZ, NA5WH, VR2VGM. 1100: PU4MMZ. 1200: W1FNB, HB9MXY. 1750: PY5EG. 2300: HB9BIN.

160 Meters: DK1MCS, DL1MP, W4DWS, M1VPN, K5PAR, KB1UIF
80 Meters: M1VPN, WU9D, DG2PX, N3YAZ, KB1UIF
60 Meters: DG2PX
40 Meters: WB4CW, M1VPN, K4NWX, HB9MXY, K5PAR, KF0AIJ, DG2PX, KZ4A, SM6STI
30 Meters: M1VPN, N3YAZ
20 Meters: W7SLS, HB9ECS, AD4K, WB4CW, M1VPN, K4NWX, HB9MXY, UC5C, KG4FVR, SM6STI, W7DGP, VR2VGM
17 Meters: WW5XX, JK7QJK, VR2VGM
15 Meters: WW5XX, HB9MXY, WU9D, VR2VGM
12 Meters: JK7QJK

Africa: DG1SGW
Asia: DG1SGW, W7SLS, HB9ECS, NC3C, DK1MCS, AJ6X, WB4CW. JK1CEK, KK6YYF, UC5C, W7DGP, VR2VGM
Europe: F6JSZ, DG1SGW, KB1UIF, HB9ECS, MØHIH, IZ6FXS, DL1MP, OE1CGS, AD4K, CT1EFT, WB4CW, M1VPN, KP4VET, UC5C, MØHIH, VA3OKG, W7DGP, VR2VGM
Oceania: W7SLS, JK1CEK, VR2VGM
North America: KB1UIF, HB9ECS, KB1SEQ, AD4K, AA8SW, WB4CW, KW2A, KP4VET, K5PAR, WU9D, KC2YCW, KG4FVR, KFØAIJ, KZ4A, VA3OKG, N7MWL, W7DGP, KC4VKG
South America: HA9PP, W7SLS

Complete rules and application forms may be obtained by sending a business-size, self-addressed, stamped envelope (foreign stations send extra postage for airmail) to "CQ WPX Awards," P.O. Box 355, New Carlisle, OH 45344 USA. Note: WPX will now accept prefixes/calls which have been confirmed by eQSL.cc. and the ARRL Logbook of The World (LoTW).

*Please Note: The price of the 160, 30, 17, 12, 6, and Digital bars for the Award of Excellence are $6.50 each.

the first QSOs are made. Small boats will be used to ferry the team and thousands of pounds of equipment onto a small landing place. The team will then need to climb a near vertical face to reach our camp area. This landing is even more challenging than what we faced upon our arrival at South Sandwich in 2016.

Every critical component that we plan to use will have several layers of redundancy. We will have backup tents, backup generators, backup antennas, backup radios and computers.

We are doing everything possible to achieve a high level of success from Bouvet. We will even bring emergency military rations in case the Braveheart cannot replenish our on-island food supply.

Probably one of the most important members of our team is Dr. Mike Crownover, AB5EB. Mike is a Texas-based emer-

CQ DX Awards Program

No Update

The basic award fee for subscribers to *CQ* is $6. For non-subscribers, it is $12. In order to qualify for the reduced subscriber rate, please enclose your latest *CQ* mailing label with your application. Endorsement stickers are $1.00 each plus SASE. Updates not involving the issuance of a sticker are free. All updates and correspondence must include an SASE. Rules and application forms for the CQ DX Awards may be found on the <www.cq-amateur-radio.com> website, or may be obtained by sending a business-size, self-addressed, stamped envelope to CQ DX Awards Manager, Please make checks payable to the Award Manager, Keith Gilbertson. Mail all updates to Keith Gilbertson, KØKG, 21688 Sandy Beach Lane, Rochert, MN 56578-9604 USA. We recognize 341 active countries. Please make all checks payable to the award manager. Photocopies of documentation issued by recognized national Amateur Radio associations that sponsor international awards may be acceptable for CQ DX award credit in lieu of having QSL cards checked. Documentation must list (itemize) countries that have been credited to an applicant. Screen printouts from eQSL.cc that list countries confirmed through their system are also acceptable. Screen printouts listing countries credited to an applicant through an electronic logging system offered by a national Amateur Radio organization also may be acceptable. Contact the CQ DX Award Manager for specific details.

The WAZ Program

SINGLE BAND WAZ

20 Meter CW

665 .....DL6USA

30 Meter Digital

13 .....IV3GOW

40 Meter Digital

16 .....JA8UIV

40 Meter RTTY

2.....N4BAA

80 Meter Digital

7.....N4BAA

160 Meter

671 .....DL1VDL, 33 Zones

160 Meter Update

542 .....DL7BA, 39 Zones
596 .....UT5EL, 38 Zones
366 .....K6FG, 36 Zones

ALL BAND WAZ

CW

1140.....DF1ZN
1141.....9A5JV
1142 .....JA8XOD
1143.....DF3EK

Digital

231 .....CU3HN
232.....WA9WFA
233 .....JH1KKT
234 .....JA4FCV
235.....JA4NIJ
236.....DF2UA
237 .....JA7VXB
238 .....K4JOM

Mixed

10016 .....KØSON
10017.....KB2ZPB
10018.....WA2QAU
10019 .....DL1DCT
10020.....URØIG
10021 .....WRØU
10022.....DF3EK
10023.....HB9CQK
10024 .....KØEZW
10025 .....DB4BU
10026.....DL6GBM

SSB

5506 .....WS5W
5507 .....DJ4DN
5508.....IK7EOT

Rules and applications for the WAZ program may be obtained by sending a large SAE with two units of postage or an address label and $1.00 to: WAZ Award Manager, John Bergman, KC5LK, 125 Deer Trail, Brandon, MS 39042-9409. The processing fee for all *CQ* awards is $6.00 for subscribers (please include your most recent *CQ* mailing label or a copy) and $12.00 for nonsubscribers. Please make all checks payable to John Bergman. Applicants sending QSL cards to a *CQ* checkpoint or the Award Manager must include return postage. KC5LK may also be reached via e-mail: <kc5lk@cq-amateur-radio.com>.

gency physician and he is well-prepared to address any medical issues that might arise.

An injury or illness such as a broken hip or appendicitis can be fatal at Bouvet without proper medical care. Providing the best medical care possible in this type of environment can greatly mitigate this inherent risk. It should be a requirement that any team going to this remote island must provide a physician for the care of their team. I believe it is foolhardy not to do so.

Upon arrival, our plan is to set up our tents, stations, and antennas and fill the bands with our signals. We have very experienced and strong operators who will use proven techniques to maximize rates and the number of contacts in our logs. As each day begins, we will close out our low-band activity and move to the high bands. We will turn our Yagis as propagation moves from east to west across the face of the earth.

We will use CW/SSB and the digital modes of FT4/FT8 and RTTY. Perhaps there will be an exciting new digital mode by 2023, FT2 perhaps?

Of particular interest to us is our desire to satisfy amateurs who need Bouvet for an ATNO (all-time new one) and to work the many young amateurs and small stations, and as such, they will need us to listen closely for their signals. We urge everyone to use good operating practices and to fine-tune their station and audio for best performance.

We are very excited to have the support of Elecraft, which will provide us with the finest transceivers available. We know that it is very important to have equipment that all works well together in a closed-in, high-RF environment.

In closing, we are working very hard to make an epic DXpedition. Our fundraising is off to a good start. We have received significant support from the Northern California DX Foundation (NCDXF), which announced a $100,000 donation in early April, and the International DX Association (INDEXA). The team is excited and energized. We will use our website: <https://3Y0J.com> and our Face-book page to keep you informed as our plans evolve. We are delighted to invite you along for this journey.

– See you in the pileups!
Paul Ewing, N6PSE
3YØJ Team Co-Leader

CQ DX Honor Roll

The CQ DX Honor Roll recognizes those DXers who have submitted proof of confirmation with 275 or more ACTIVE countries. With few exceptions, the ARRL DXCC Countries List is used as the country standard. The CQ DX Award currently recognizes 340 countries. Honor Roll listing is automatic when an application is received and approved for 275 or more active countries. Deleted countries do not count and all totals are adjusted as deletions occur. To remain on the CQ DX Honor Roll, annual updates are required. All updates must be accompanied by an SASE if confirmation of total is required. The fee for endorsement stickers is $1.00 each plus SASE. (Stickers for the 340 level and Honor Roll are available.) Please make checks payable to the Award Manager, Keith Gilbertson. Mail all updates to Keith Gilbertson, KØKG, 21688 Sandy Beach Lane, Rochert, MN 56578-9604 USA.

CW

DL3DXX....339
HB9DDZ....339
K4IQJ.....339
K9MM.....339
N4MM.....339
WB4UBD...339
WS9V.....339
EA2IA.....339
F3TH.....339
K2FL..... 339
K2TQC.....339
K3JGJ.....339
K3UA.....339
K4CN 339
K4JLD 339
K4MQG.....339
K5RT.....339
K7LAY.....339
K7VV.....339
K8LJG.....339
N4AH 339
N4CH 339
N4JF 339
N4NX 339
N5ZM 339
N7FU.....339
N7RO.....339
NØFW 339
OK1MP 339
W3GH 339
W4OEL 339
W5BOS 339
W7CNL 339
W7OM.....339
W8XD.....339
WK3N.....339
WØJLC 339
WØVTT 339
YU1AB 339
K8SIX.....338
KA7T.....338
WA5VGI 338
W9RPM.....338
G3KMQ.....337
KØKG.....337
W7IIT 337
K8ME 336
W1DF.....336
W6OUL 336
JA7XBG 335
F6HMJ 334
K1FK.....334
K9OW 334
PY2YP 334
WG5G/QRPp 334
WD9DZV...334
K2OWE.....333
K5UO 333
N6AW.....333
W4MPY.....333
K6LEB.....331
N7WO 331
OK1DWC ..331
K6YK.....329
W9IL.....329
IKØADY 328
OZ5UR.....328
AB4IQ 327
K6CU 326
KE3A.....326
EA5BY 325
KA3S.....325
K7CU 324
N3RC 324
N7W0.....324
KEØA.....322
YT1VM.....322
4Z5SG.....321
N2LM 321
ON4CAS ...321
W2OR 320
HB9DAX/QRPp 319
W6YQ 319
HA1ZH 318
N6PEQ.....318
CT1YH 316
EA3ALV 315
RA1AOB ...313
WA4DOU ..312
YO9HP.....312
W6WF 309
KT2C..... 307
K4DGJ 307
W4ABW 306
K7ZM 305
HA5LQ 301
RN3AKK....300
WA9PIE 298
K4IE 295
YU1YO.....295
WA2VQV...292
4XIVF.....286
K6YR.....284
PP7LL 282
WR7Q 282
N2VW.....280
K4EQ 280
W8BLA.....280
WB5STV ...277
YO6HSU ...275

SSB

AB4IQ 340
DJ9ZB.....340
DL3DXX....340
DU9RG 340
EA2IA 340
EA4DO.....340
HB9DDZ....340
I8KCI.....340
IK1GPG.....340
IN3DEI 340
K2FL 340
K2TQC.....340
K3JGJ 340
K4CN 340
K4IQJ.....340
K4JLD 340
K4MQG.....340
K4MZU.....340
K5OVC.....340
K5RT.....340
K5TVC 340
K6YRA 340
K7VV.....340
K8LJG.....340
K8SIX.....340
K9MM.....340
KE5K.....340
KZ2P.....340
N4CH 340
N4JF 340
N4MM 340
N5ZM 340
N7BK.....340
N7RO 340
NØFW.....340
OK1MP 340
OZ3SK 340
OZ5EV 340
VE1YX 340
VE2GHZ....340
VE2PJ.....340
VE3MR.....340
VE3MRS ...340
VE3XN 340
VK2HV 340
W3AZD 340
W3GH 340
W4ABW 340
W5BOS 340
W6BCQ.....340
W6DPD 340
W7BJN.....340
W7OM.....340
W8ILC.....340
W9SS.....340
WB4UBD...340
WK3N.....340
WS9V.....340
XE1AE 340
YU3AA 340
JA7XBG 339
KØKG.....339
W2FKF.....339
W4UNP.....339
W9RPM.....339
EA3EQT....338
K3UA.....338
K7LAY.....338
K9HQM 338
N4NX 338
YU1AB 338
4Z4DX.....338
K1UO 338
N7WR 338
WA5VGI 338
W2CC 338
W7FP 338
W9IL.....338
N4FN.....337
IØZV.....336
K3LC.....336
K8ME 336
EA3BMT....335
F6HMJ 335
HB9DQD ...335
IKØAZG 335
IW3YGW ...335
OE2EGL....335
VK2HV 335
W4WX.....335
WB3D.....335
AA4S.....334
EA5BY 334
K9OW 334
PY2YP 334
VK4LC.....334
W8AXI.....334
XE1J 334
CT3BM.....333
IK8CNT 333
K8LJG 333
N6AW.....333
OE3WWB..333
WD9DZV...333
AA1VX 332
KE3A.....332
N2VW.....332
N5YY.....332
K5UO 331
KC2Q 331
SV3AQR ...331
WØROB 331
W6OUL 331
XE1MEX ...331
KD5ZD 330
WA4WTG..330
W1DF.....330
WØYDB 330
ZL1BOQ....330
AD7J 329
IK8CNT 329
N3RC 329
VE7SMP ...329
WØULU.....329
CT1AHU....328
N1ALR 328
N2LM 328
AE9DX 327
K7HG 327
K6GFJ.....326
KE4SCY....326
KF4NEF 325
W6WF.....325
W9GD 325
VE7EDZ....324
WA5UA 324
F6BFI 323
ON4CAS ...323
VE6MRT ...323
W5GT.....323
N6PEQ.....322
W4MPY.....322
K8IHQ 321
KW3W.....320
TI8II.....320
YO9HP.....320
XE1RBV....317
N7YB.....315
IV3GOW....312
N8SHZ 312
K7CU 311
OK1DWC ..311
KU4BP 310
W6NW.....310
I3ZSX.....309
G3KMQ.....308
KA1LMR....308
RA1AOB ...308
XE1MEX ...308
IK5ZUK 307
IØYKN.....306
XE1MW.....305
K4IE 304
K4ZZR.....304
K7ZM 303
4Z5FL/M....302
K7SAM.....301
KA8YYZ 301
4X6DK.....298
K2HJB.....295
F5MSB.....293
W9ACE 291
N3KV.....289
W6MAC.....289
N5KAE 283
IZ1JLG 282
WA9PIE 282
WD8EOL...281
IWØHOU...277
AKØMR.....276
NØAZZ.....275
SQ7B 275

RTTY

NI4H 338
WB4UBD . 338
WK3N 338
N5ZM 338
OK1MP . . . 337
K4CN 334
K8SIX 334
W9RPM . . 334
W3GH. . . . 333
K3UA 332
AB4IQ 323
K4WW . . . 323
N4MM 302
K4IQJ 300
K8ME 278
IN3YGW . . 275

AWARDS

BY STEVE MOLO,* KI4KWR

Bogota Amateur Radio League's LRB 2021 Special Event

This month I am taking the opportunity to cover an annual event that is held by the Liga Radio Bogota (Bogota Amateur Radio League) in Colombia that honors three professors from the Los Libertadores University Foundation.

The three illustrious and renowned scientists, academics, and hams are Dr. Jorge Reynolds Pombo, HK3RJ; Dr. Luis Hernán Linares Ángel, HK3AMU (SK); and Dr. Italo Amore, HK3IE (SK), who each made significant contributions to science and the academy.

Beginning 0001 UTC, Tuesday, June 1st and running through 2359 UTC Tuesday, June 8th, the Los Libertadores University Foundation – LRB 2021 event has a few objectives: One is to encourage activity on the HF bands. The second is promote the university as a leading educational institution and the forefront of ham radio experimentation in Colombia. And the third objective is to promote the Bogota Amateur Radio League during its 48th anniversary.

The LRB 2021 will consist of two events: During the 8 days of activation a group of Colombian amateurs will activate special event stations 5K48LRB, 5J39FUL, and 5J85FJR on the 10-, 12-, 15-, 17-, 20-, 30-, 40-, and 80-meter bands using SSB, CW, and digital modes FT8, FT4, and RTTY. In addition, there will be a contest for stations in North and South America on the 20- and 40-meter bands for a period of 18 hours starting on Saturday, June 5th at 18:00 UTC until Sunday June 6th at 12:00 UTC. For full rules, visit the QRZ.com page for 5K48LRB.

Three Levels of Award

There are three levels of awards available for all stations. The top prize is the Gold Certificate named in honor of Dr. Jorge Reynolds Pombo, HK3RJ, followed by the Silver Certificate named after Dr. Luis Hernán Linares Ángel, HK3AMU, and the Bronze Certificate named after Dr. Italo Amore, HK3IE.

To earn the Gold certificate, stations in the Americas (outside of Colombia) will need 8 contacts with Colombia. In this case, each of the 5J39FUL, 5K48LRB, and 5J85FJR stations will be valid by 2 contacts. European stations need 6 contacts with Colombia, with contacts made with each of the 5J39FUL, 5K48LRB & 5J85FJR stations will be valid by 3 contacts. And Asia, Africa, and Oceania will need 4 contacts with Colombia, each of the 5J39FUL, 5K48LRB, and 5J85FJR stations will be valid by 4 contacts.

Colombian stations will need 16 contacts including each of the 5J39FUL, 5K48LRB, 5J85FJR stations will be valid by 4 contacts for Gold. Silver will need 12 contacts with Colombia including each of the 5J39FUL, 5K48LRB, and 5J85FJR stations will be valid by 3 contacts. And the Bronze Certificate will need 8 contacts with Colombia including each of the 5J39FUL, 5K48LRB, and 5J85FJR stations will be valid by 2 contacts.

General Rules

The general rules are as follows:

- To request the certificate and / or diploma, QSOs may be made and accredited in any of the bands and modes described.
- QSOs in other bands, frequencies, or crossed modes will not be valid.
- All the QSOs that are accredited to request the diploma must be validated in at least one of the three confirmation platforms: LoTW, QRZ.com, and / or eQSL.
- San Andrés y Providencia (HK0) will only be valid as a contact with Colombia.

To request any of the certificates and/or diplomas, the interested party must send a list in Excel format with all the pertinent information: Callsign of the station contacted, date, time, band, and mode. All requests must be sent to <hk3lrb@gmail.com> before July 31, 2021.

The coordinator and QSL Manager of this operation is Francisco Javier Monroy, HK3EA, and may be contacted by email at <hk3ecoalfa@gmail.com>.

*Email: <KI4KWR@cq-amateur-radio.com>

The three QSL cards from the three special event stations 5K48LRB, 5J39FUL, and 5J85FJR. (Courtesy of Liga Radio Bogota)

CONTESTING

BY TIM SHOPPA,* N3QE

Operating Multi-Distributed and Picking RTTY Frequencies

The contesting boom continued in March 2021, with a near-record number of logs submitted for the CQ WPX SSB contest. More than 7,270 logs were submitted, an increase of 32% over 2019, and just a few percent behind the 2020 high water mark of 7,605 logs.

A new feature in 2021 for all WPX contests is the Multi-Op Distributed category, where multiple stations can coordinate their usage of a single callsign. Twenty-eight entries were made in the Distributed category for 2021 WPX SSB, making it a more popular category than the 18 stations that entered the traditional Multi-Op Multi-Transmitter category (*the number of multi-multi operations continues to be depressed due to COVID-19 restrictions on travel and group gatherings – ed*).

A very notable entry into the new Distributed category in WPX SSB was the WW1X team of 26 operators — 10 of them young ops — wielding the power of eight stations distributed across CQ Zone 5 in the U.S., and almost all the operating done remotely. Ray Higgins, W2RE, shows the WW1X team and stations in an online photo gallery at <https://bit.ly/2PxDpyI>.

Connor Black, W4IPC, is shown in *Photo A* in a selfie taken while operating remotely as WW1X. In the month prior to WPX SSB, Connor coordinated the schedules of the 26 WW1X operators using a shared Google spreadsheet that laid out each operator, station, and band time slots on a chart. I also asked Connor about his audio chain while operating SSB remotely. Connor emphasizes, "my whole setup is on a budget." The bright red Heil Pro 7 headset on his head in *Photo A* is shown in the upper right of *Figure 1* as being fed through a mixing console from either or both of two computers, important when operating SO2R remotely. The transmit audio starts with a Heil PR20 microphone. "This mic has lots of lows," Connor explains, so he uses a Xenyx 502 not only as a pre-amp, but to cut the low frequency response, which "gives me a pretty good equalization." From there the audio feeds into both computers when operating SO2R.

There were 140 DX entities submitting logs in CQ WPX SSB 2021, an increase over the 136 countries active in 2020. One returning entity was the effort of Jim Jordan, K4QPL, and Eric Wagner, NR4O, who activated the VP5M station at Harbor Rock in the Turks and Caicos Islands. Jim, shown in *Photo B*, writes, "Because of Covid, CQWW CW 2019 and ARRL DX CW 2020 were single-op efforts by me. Eric was the first to join me in reopening VP5M as a multi-op." *Photo C* shows Eric at the controls during the contest. Eric writes this was his "first trip to VP5, and it's been 30 years since my last multi-op." The 2021 VP5M WPX SSB effort resulted in the top claimed North American M/S score in low power category, with 1,865 QSOs and 3.6 million points between Eric and Jim.

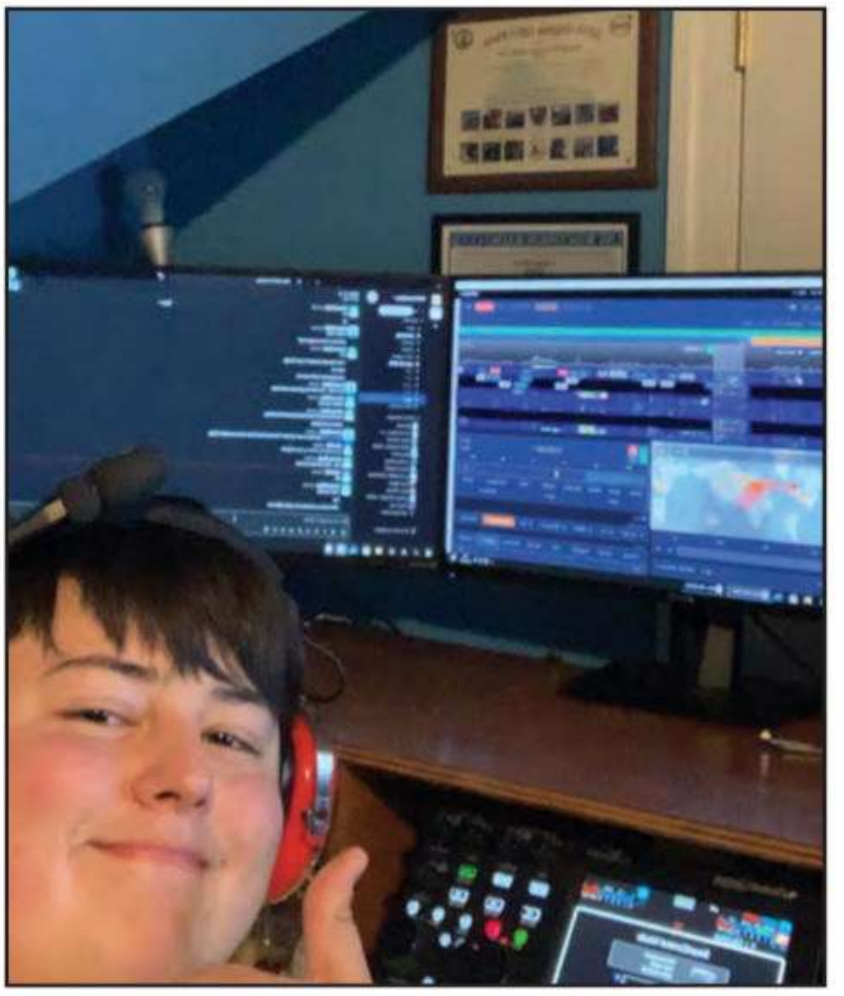

Photo A. Connor Black, W4IPC, operating WW1X during WPX SSB.

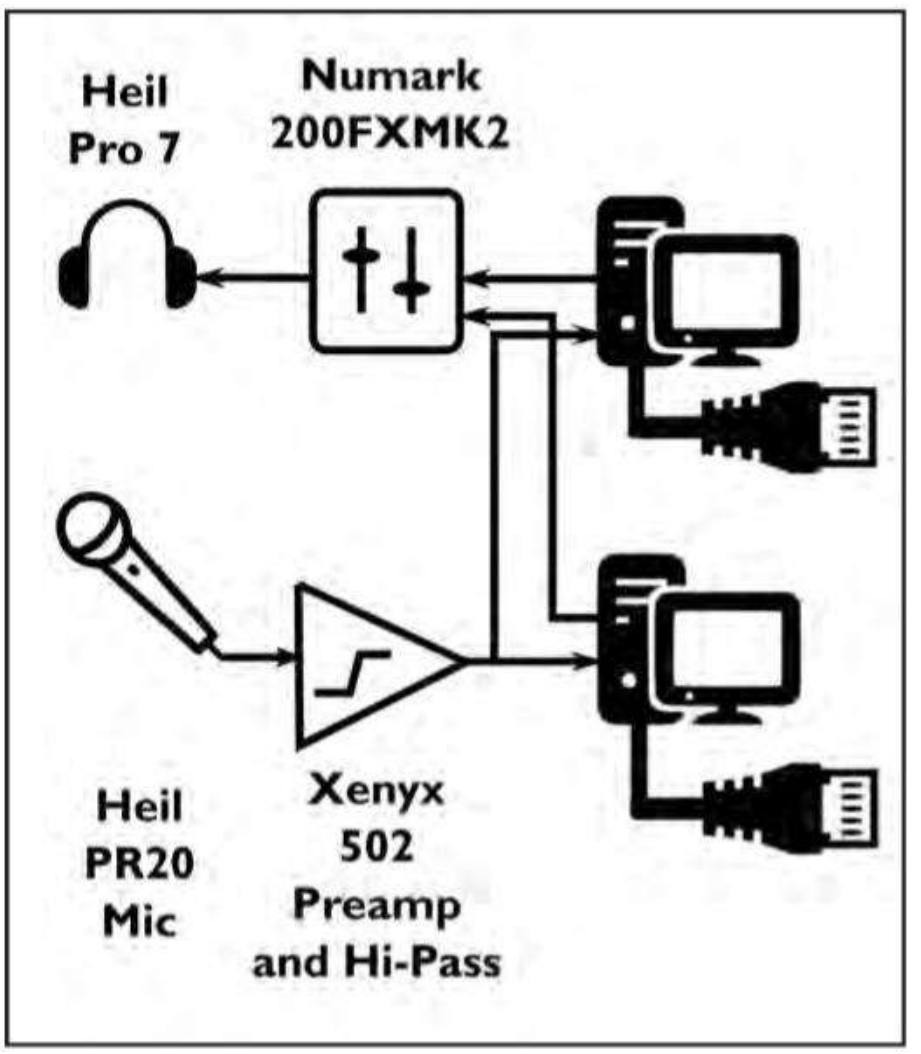

Figure 1. Audio flow at W4IPC's remote operating position.

NAQP RTTY Frequency Usage is Different Than in Global RTTY Contests

In the January 2021 Contesting column, I presented RTTY frequency usage charts as a guide to spectrum awareness

email: <n3qe@cq-amateur-radio.com>

Photo B. Jim Jordan, K4QPL, at VP5M for WPX SSB.

during the ARRL RTTY Roundup and CQ WPX RTTY contests. These two contests have major international components, and even U.S. hams make extensive use of IARU Region 1 (Europe) and IARU Region 3 (Asia) digital band plans to maximize their points (*which are higher for DX contacts than for domestic contacts in these two international contests. –ed*)

Frequency usage in the RTTY mode of the North American QSO Party has substantial differences from those two contests, especially on the 40-meter and 80-meter bands. I used skimmer data from reversebeacon.net to analyze frequency usage during the July 2020 NAQP RTTY, and the result is shown in *Figure 2*.

In the ARRL RTTY Roundup and CQ WPX RTTY contests, multipliers are once-per-contest, so little attention is paid to the bands with fickle propagation. The NAQP contests use states and provinces as per-band multipliers. Operators looking to maximize their NAQP scores will plan their Saturdays to include both daylight and evening hours across all five HF contest bands.

When the starting bell of the NAQP RTTY contest rings at 1800Z, it is mid-day across North America and the initial minutes are a great opportunity to test the waters on the 10-meter band by calling CQ. If the band isn't open for any good skip, locals can still be worked via ground wave and provide important multipliers. At my QTH in Maryland, the initial minutes on 10 meters in an NAQP contest result in local ground wave QSOs yielding up to five 10-meter multipliers in Virginia, DC, Maryland, and sometimes West Virginia and Pennsylvania. No matter how low the sunspot count, in the summer there can be E-skip openings on the 10-meter band throughout the daylight hours, so occasionally call CQ or at least take a quick listen for RTTY activity all the way through sunset. The bottom histogram in *Figure 2* shows us that there is not much frequency contention on the 10-meter band at solar minimum, and you'll be doing fine if you scan from 28.080 to 28.100 MHz with the VFO and your ears while looking for action.

The next histogram up in *Figure 2* shows the 15-meter RTTY activity. In the first few hours of 2020 NAQP RTTY, the 21.080 MHz to 21.100 MHz area was congested enough that operators looking for a free frequency were calling CQ up to 21.110 MHz. The 15-meter band will be reliably open somewhere in the summer, and sometimes E-skip action may

Photo C. Eric Wagner, NR4O, at VP5M for WPX SSB.

result in closer in states or provinces to be briefly available all the way through sunset.

The 20-meter band is the bread and butter of daylight operations in NAQP contests at solar minimum, as shown by the large amount of green ink in the middle histogram of *Figure 3*. While the densest activity is between 14.083 and 14.100 MHz, about half of the 20-meter action in the NAQP RTTY contests is above 14.100 MHz, so be sure to spin the VFO knob to explore the stations higher in the band. Unlike the big international RTTY contests, where competition for a run frequency is intense all the way up to 14.150 MHz, you will almost always be able to find a run frequency in the 14.110 to 14.130 MHz area in NAQP RTTY. This upper part of the band is an excellent opportunity for newer RTTY contesters to call CQ in a less-congested area.

Between 14.080 MHz and 14.083 MHz is 20-meter FT4 activity. Frequencies in this area might briefly sound unoccupied, but as FT4 makes its odd / even cycle you may will find that what sounded empty is in fact occupied by FT4 users transmitting 15 seconds later. As you tune below 14.080 MHz you will hear a variety of other digital modes.

In a major international RTTY contest, the 40-meter band between 7.040 MHz and 7.065 MHz is ideal for transcontinental contacts, as the Region 1 and Region 3 band plans emphasize RTTY activity in this part of the spectrum. In a contest like NAQP, in which North America is the target area, the bulk of action on the 40-meter band is between 7.080 and

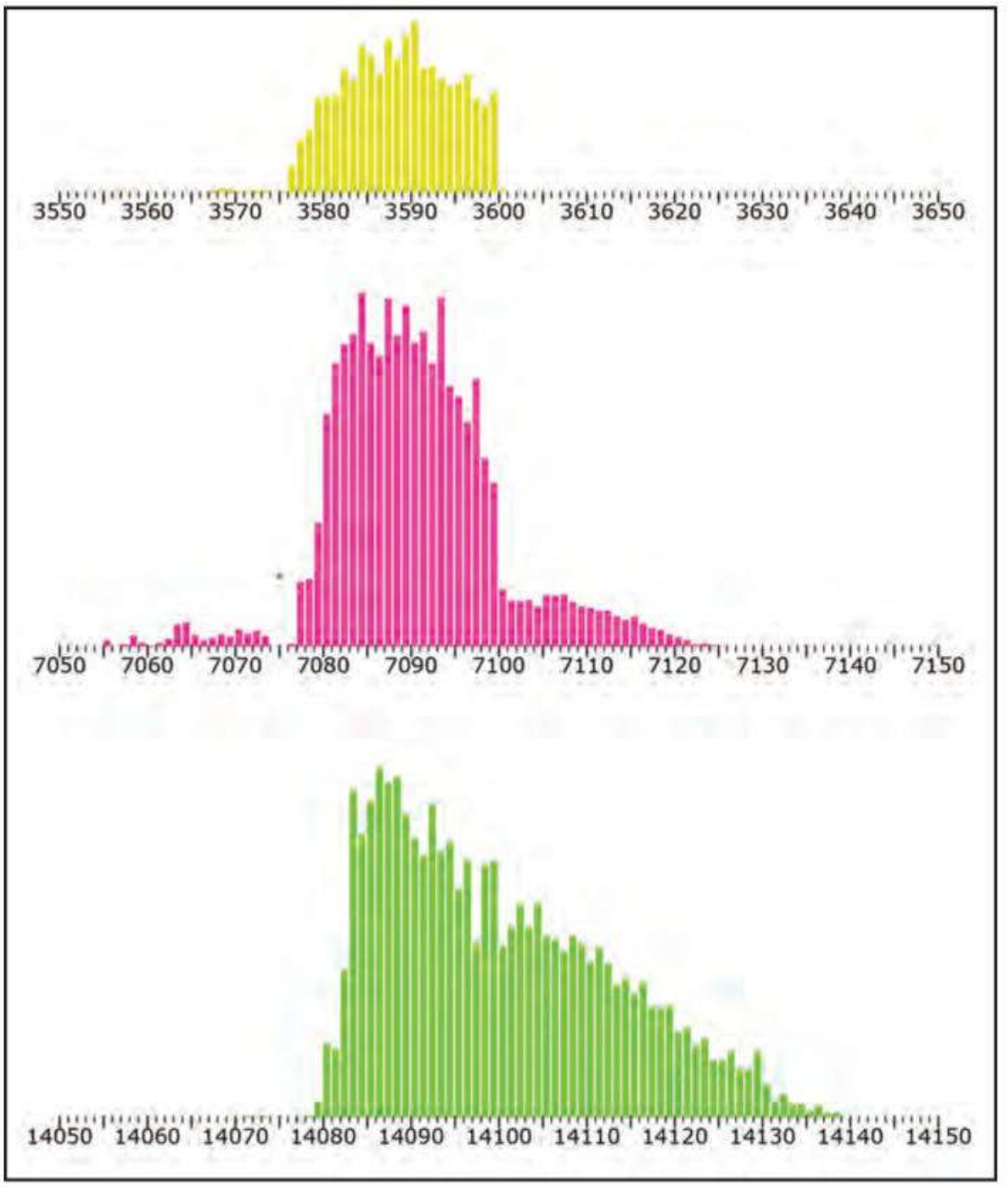

Figure 2. RTTY spectrum usage during NAQP RTTY July 2020. Skimmer data from the Reverse Beacon Network.

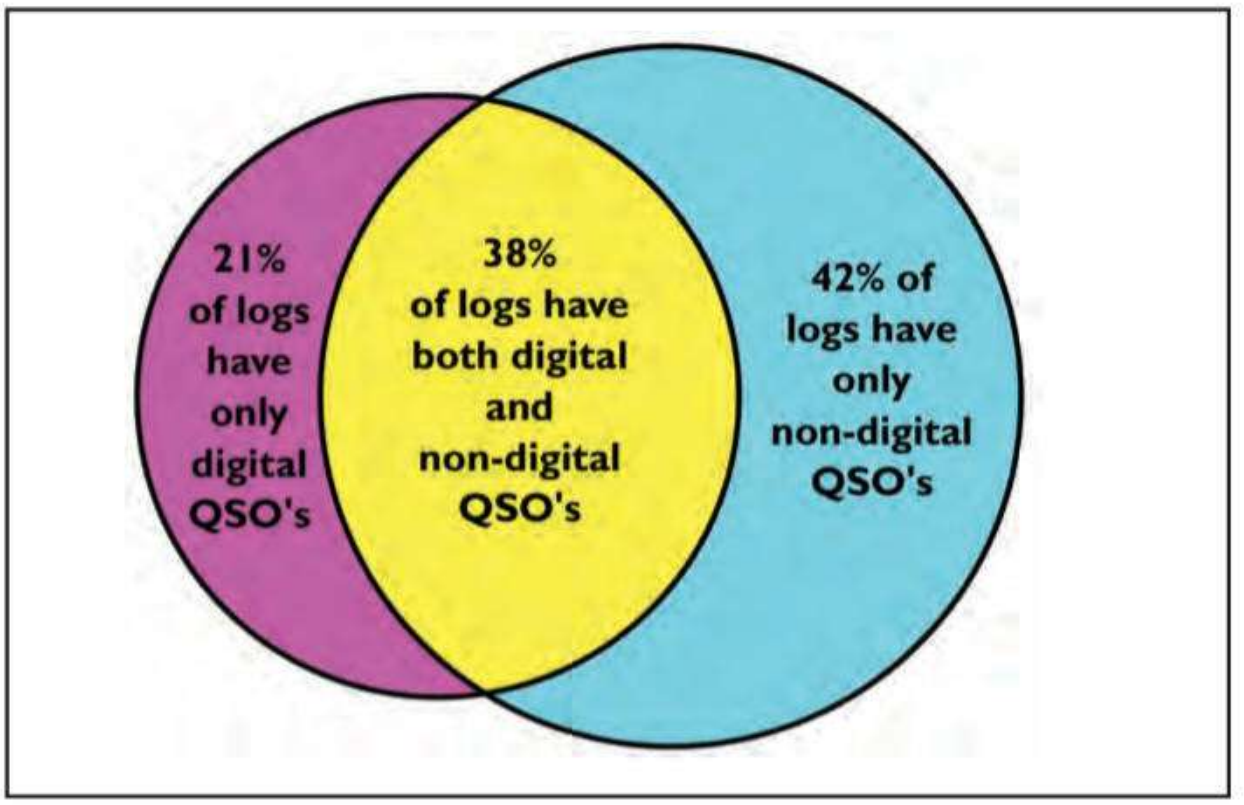

Figure 3. Area-proportional Venn diagram of modes used in 2020 ARRL June VHF Contest logs.

7.100 MHz. An often-ignored opportunity in NAQP RTTY is to call CQ in the lesser used area between 7.100 and 7.125 MHz where the FCC authorizes digital emissions for U.S. amateurs. If you find intense congestion between 7.080 and 7.100 MHz, make productive use of the full frequency allocation by tuning past the mental barrier of 7.100 MHz and using the full extent of spectrum where RTTY is allowed.

Because the 40-meter band often "goes long" around sunset, it is wise to make use of this band at least occasionally in late afternoon to work close-in stations and multipliers.

RTTY contesters in the United States face a unique challenge for spectrum on the 80-meter band. As the sharp cutoff in the top histogram of *Figure 3* shows, digital emissions above 3.600 MHz are not allowed for U.S. hams by the FCC amateur frequency allocations, and as you go below 3.580 MHz you hear a variety of digital modes. The FT8 activity between 3.573 MHz and 3.577 MHz is most obvious, but if I start calling CQ just above or below that I'm often informed by the presence of a non-RTTY signal that this isn't the best place for me to be calling in the contest. In the very big DX RTTY contests, RTTY action often picks up again in the 3.555 to 3.570 MHz region but even this area has contention with various digital modes.

Note that if you are operating RTTY using audio-frequency shift keying (AFSK), your rig's dial frequency shows the suppressed carrier frequency, and not the actual frequency of your emissions. If you are using standard 2125- / 2295-Hz AFSK tones and the radio is in LSB mode, your rig dial may read 3.601 MHz, but your actual mark and space frequencies are both below 3.599 MHz so you are in the allowed U.S. band for RTTY emissions.

Rather than do the AFSK math in your head based on radio dial frequency, there is a very useful feature almost hidden in the N1MM+ contesting program. By turning on the "Turn Auto TRX Update On" option in the Digital Input window, the frequency display in the logging program will be your RTTY transmission's mark frequency. This and many other digital operating details are well documented on the N1MM+ website, at <https://bit.ly/3dZyC2p>.

Use Non-Digital Modes for Maximum Rates in June and July VHF Contests

In my March 2021 column, I presented tables showing the growth of digital

Calendar of Events

All year	CQ DX Marathon	http://bit.ly/vEKMWD
June 2	VHF-UHF FT8 Activity Contest	www.ft8activity.eu/index.php/en
June 4-6	PODXS 070 Club Three Day Weekend Contest	http://bit.ly/2Srdp8A
June 5-6	10-10 Open Season PSK Contest	http://bit.ly/1FrFeBc
June 5-6	IARC Region 1 Field Day	http://bit.ly/3cC0HKf
June 5-6	KANHAM Contest	https://bit.ly/323yzf0
June 5-6	Kentucky QSO Party	www.kyqsoparty.org
June 5-6	RSGB CW Field Day	http://bit.ly/2OKdymu
June 5-6	Tisza Cup CW Contest	https://tinyurl.com/kp7tf3hy
June 6	Cookie Crumble QRP Contest	https://w3atb.com/cookie-crumble
June 7	RSGB 80m Club Championship, Data	http://bit.ly/3avHbk3
June 9	VHF-UHF FT8 Activity Contest	www.ft8activity.eu/index.php/en
June 12	AGCW VHF-UHF Contest	https://bit.ly/3lw91PK
June 12	Asia-Pacific SSB Sprint	http://jsfc.org/apsprint
June 12-13	Portugal Day Contest	https://tinyurl.com/42avrtp8
June 12-13	REF DDFM 6M Contest	http://concours.r-e-f.org/index.php
June 12-13	GACW WWSA CW DX Contest	www.contest.com.ar/gacw-wwsa
June 12-13	DRCG Long Distance Contest (RTTY)	www.drcg.de
June 12-13	SMIRK Contest	www.smirk.org/contest.html
June 12-13	VK Shires Contest	https://tinyurl.com/2ues5y44
June 12-14	ARRL June VHF QSO Party	www.arrl.org/june-vhf
June 16	RSGB 80m Club Championship, CW	http://bit.ly/3avHbk3
June 16	SARL Youth Sprint	http://bit.ly/H0IqQf
June 19	ARRL Kids Day Contest	www.arrl.org/kids-day
June 19	FIRAC VHF Contest	www.firac.de/index.html
June 19-20	All Asian CW DX Contest	www.jarl.org/English/0-2.htm
June 19-20	Stew Perry Topband Challenge	www.kkn.net/stew/stew_rules.html
June 19-20	Ukrainian DX Classic RTTY Contest	http://urdxc.org/rtty
June 19-20	West Virginia QSO Party	https://tinyurl.com/6ds23vzb
June 20	WAB 50 MHz Phone	http://bit.ly/31yE4kT
June 24	RSGB 80m Club Championship, SSB	http://bit.ly/3avHbk3
June 26-27	ARRL Field Day	www.arrl.org/field-day
June 26-27	His Maj. King of Spain SSB Contest	http://bit.ly/1cKAR5V
June 26-27	Ukrainian DX DIGI Contest	www.izmail-dx.com
June 28	RSGB FT4 Contest Series	http://bit.ly/3mCNXXH
July 1	RAC Canada Day Contest	www.rac.ca/contesting-results
July 2-4	Original QRP Contest	www.qrpcc.de/contestrules/index.html
July 3-4	Marconi Memorial HF Contest	www.arifano.it/contest_marconi.html
July 3-4	DL-DX RTTY Contest	www.drcg.de
July 3-4	PODXS 070 Club 40 Meter Firecracker Sprint	http://bit.ly/2FUmeOL
July 5	RSGB 80m Club Championship, CW	http://bit.ly/3avHbk3
July 7	VHF-UHF FT8 Activity Contest	www.ft8activity.eu/index.php/en
July 10-11	10-10 Int. Weak Signal QSO Party	http://bit.ly/1FrFeBc
July 10-11	IARU HF Championship	www.arrl.org/iaru-hf-world-championship
July 10-11	Veron SLP Contest	http://bit.ly/2L9eT1L
July 11	QRP ARCI Summer Homebrew Sprint	www.qrparci.org/contests
July 14	VHF-UHF FT8 Activity Contest	www.ft8activity.eu/index.php/en
July 14	RSGB 80m Club Championship, SSB	http://bit.ly/3avHbk3
July 17-18	CQWW VHF Contest	www.cqww-vhf.com
July 17-18	North American RTTY QSO Party	http://ncjweb.com/NAQP-Rules.pdf
July 18	CQC Great Colorado Gold Rush	https://tinyurl.com/4accen2c
July 18	RSGB International Low Power Contest	https://tinyurl.com/cy7u4ynp
July 22	RSGB 80m Club Championship, Data	http://bit.ly/3avHbk3
July 24-25	RSGB IOTA Contest	https://tinyurl.com/29m8jb3z
July 25	ARS Flight of the Bumblebees	http://arsqrp.blogspot.com
July 26	RSGB FT4 Contest Series	http://bit.ly/3mCNXXH
July 31-Aug. 1	Missouri QSO Party	https://tinyurl.com/fbfcw8r3
July 31- Aug. 1	Russian WW MultiMode Contest	http://bit.ly/2CMbWOM
Sept. 25-26	CQWW RTTY DX Contest	www.cqwwrtty.com

BEHIND THE BYLINES ...

Jay Taft, K1EHZ ("A Split-Level VHF-UHF Go-Box Plus Base Station," p. 10), was first licensed in 1960 but had a 40+ year gap before returning to the hobby after retirement. He enjoys QRP and portable operating, as well as experimenting with different antennas. In addition to ham radio, Jay enjoys wildlife photography. You can see a few of his favorites on his QRZ.com page.

Rod Blocksome, KØDAS (co-author, "Winter Field Day at WAØPCC," p. 18), is active on all bands from HF to 2.3 GHz, including moonbounce on 6 meters, 2 meters, and 70 centimeters. He is retired from a career as an engineer and manager with Collins Radio / Rockwell Collins and more recently has been involved in the search for Amelia Earhart's lost aircraft. He has so far participated in three deep-sea sonar searches for the plane. He is also a past ARRL Midwest Division Director and Vice Director.

Dennis Lazar, W4DNN ("Hams on Hog Island – a QRPxpedition," p. 23), has had a varied career, which has included working with a NASA subcontractor on the Apollo moon project, as a magazine editor and publisher and hobby radio columnist for the daily *Palm Beach Times*. He was president of Palm Beach Publishing Co. and later served as QRP editor for *CQ* magazine. Changing career paths, Dennis became a naturopathic physician and certified registered nurse therapist. Now retired from that career, he loves QRP, trail-friendly radio, vintage, and SDR radio gear. He can be reached at <w4dnn@arrl.net>.

Ralph Irons, N4RLI ("stayPRS and FOXmtr," p. 36), was first licensed in the 1960s as KN7YEM in Billings, Montana. After obtaining a master's degree in mathematics from the University of Virginia, he taught at a magnet school for STEM and the arts. This gave him the opportunity to help highly-motivated students with hands-on math and programming projects, including microcontroller applications. Now retired, he finds that ham radio helps him keep his interest in mathematics, programming, and technology. He lives with his wife Kim, KG4YYL, in Staunton, Virginia, where they are members of the Valley Amateur Radio Association.

John DePrimo, K1JD ("A 3-Band Trap End-Fed Half Wave Antenna…" p. 46), has activated peaks for the Summits On The Air (SOTA) program in both the United States and Australia. He has over 5,000 SOTA activator points and has North American "Mountain Goat" award #12 from the group. He is also a member of the First-Class CW Operators Club (FOC) and trustee of High Desert Telegraphy Club station N5FOC. John is retired from an engineering career spent mostly working on U.S. Navy submarine combat systems. He lives in Santa Fe, New Mexico.

Jerry Clouatre, AG5AY ("DC-Over-Coax Three-Way Antenna Switch," p.54), is another ham who became licensed in his youth, then drifted away for many years before returning to active hamming. His main interest currently is chasing DX and special event stations using SSB, CW, and digital modes. In addition to ham radio, Jerry enjoys hiking and backpacking, flying, scuba diving, and bluegrass music. He lives in Baton Rouge, Louisiana.

OUR READERS SAY ...

Editor, *CQ*:

The statement in your April editorial, "More than anything else, though, this is an illustration of an essential element of ham radio — no portion of our hobby exists in a vacuum, whether it's contesting, kit-building, QRP, or even crystal-grinding," is not true since QSOs with the International Space Station do exist (in part) in a vacuum.

– 73, Steve Barryte, KI6GUY
Rancho Palos Verde, California

W2VU responds:

Interesting observation, Steve. However (since we're being concrete), the inside of the International Space Station is pressurized, so neither the on-board ham station nor the crew members are in a vacuum. I would refer any further inquiries along these lines to Professor Heisseluft, who is an expert in this subject (along with just about everything else!). *– 73*

No Free Lunch

Editor, *CQ*:

I received this demand for $125 from (an internet-linked repeater) system in California.

I am now blocked from their system because I refused to pay it. It's a hobby, not a business.

I hope we never follow the Americans where you are forced to pay to use some of their repeaters. I think they are the only country in the world to do this pay as you go. It would be illegal in the UK. I do contribute to support my local repeater, GB3DV.

– 73, Ian Abel, G3ZHI
Maltby, England

W2VU responds:

While I sympathize with your plight, and agree that amateur radio is a hobby, not a business, it costs serious money to build and maintain a repeater system and that money has to come from somewhere. Often, the costs are supported by club members' dues, but in this case it appears that the repeater system in question is not affiliated with a particular club and is supported by its users. I note that only regular users of this system are asked to contribute, which seems quite fair. This may be a hobby, but there ain't no free lunch.

modes in VHF / UHF contesting that has occurred since 2018 when the WSJT-X program introduced the FT8 mode. In *Figure 3*, I show the mode analysis I made for the 2020 ARRL June public logs, as an area-proportional Venn diagram. The biggest missed opportunity last year was that the 21% of contesters who operated only the digital modes could never work the 42% who only operated the non-digital modes.

If you are operating in the digital modes during a VHF contest and the waterfall starts showing congestion from non-local signals, this is a great opportunity to switch to higher-rate conventional modes. The theoretical maximum rate of FT8 contest mode is 40 QSOs per hour, and in congested conditions digital contesters will average much less than that. Much higher rates during an opening are easily achieved in the non-digital modes.

For summer 2021, the ARRL June VHF contest takes place June 12-14th, and the CQ VHF contest is July 16-17th. In 2020, both contests hit record high levels of participation.

June and July Contest Highlights

In addition to ARRL June VHF, CQ VHF, and NAQP RTTY contests detailed above, I will highlight two more summer contests.

For the 2021 running of ARRL Field Day, the ARRL has already announced a waiver that will allow Class D (home stations) to work all other stations (including other Class D stations) for points. The same aggregate club score that was used in 2020 will also be extended to 2021. A new modification to the rules for 2021 limits Class D and Class E stations to low power (150 watts). If you take a contester's view of maximizing points, keep in mind that CW contacts count twice as much as phone contacts, and low-power stations have an additional multiplier of two. QRP stations using a power source that is not commercial have a multiplier of five. Field day is June 26th and 27th this year, and full details are at the ARRL website: <www.arrl.org/field-day>.

The IARU HF World Championship is a 24-hour contest, using both CW and SSB modes, that is held July 10-11. The multipliers are per band and include ITU zones, IARU HQ societies, and four IARU official multipliers. The IARU contest has allowed the use of "distributed stations" for the HQ society stations and many of the larger HQ efforts activate all bands and modes.

PROPAGATION

BY TOMAS HOOD,* NW7US

June and Field Day

Quick Look at Current Cycle 25 Conditions:
(Data rounded to nearest whole number)

Sunspots:
Observed Monthly, March 2021: 17
12-month smoothed, September 2020: 10

10.7-cm Flux:
Observed Monthly, March 2021: 74
12-month smoothed, September 2020: 71

ONE YEAR AGO:
(Data rounded to nearest whole number)

Sunspots:
Observed Monthly, March 2020: 1
12-month smoothed, September 2019: 2

10.7-cm Flux:
Observed Monthly, March 2020: 70
12-month smoothed, September 2019: 70

The annual ARRL Field Day is always the fourth full weekend in June. This year, that means Field Day is June 26th and 27th. Operations begin at 1800 UTC Saturday and end at 2059 UTC Sunday. Refer to the official ARRL Field Day Packet for full rules and details. The packet can be downloaded by browsing to <http://g.nw7us.us/2021FDpack> for the file, 2021 Field Day Packet.pdf. The introduction to Field Day, found on the Field Day webpage at ARRL <www.arrl.org/field-day> states,

Field Day is ham radio's open house. Every June, more than 40,000 hams throughout North America set up temporary transmitting stations in public places to demonstrate ham radio's science, skill and service to our communities and our nation. It combines public service, emergency preparedness, community outreach, and technical skills all in a single event. Field Day has been an annual event since 1933, and remains the most popular event in ham radio.

The official Field Day 2021 introduction states that the goal of this year's field day is, as for every year's field day, "to learn to operate in abnormal situations in less than optimal conditions." This year, the abnormal situations include the COVID-19 pandemic, just as they did last year. As of presstime, the ARRL is maintaining a vigil on the situation, "paying close attention to all of the information and guidance being offered by the Centers for Disease Control and Prevention (CDC) <https://tinyurl.com/tbaap76s>."

ARRL defers to local clubs and members to adhere to their local government and health officials as to the safety of gathering in groups, As per the ARRL's Field Day website:

Local club officials are the most appropriate people to be making decisions about their specific Field Day programs. We are all concerned about protecting the health and safety of those participating in or attending Field Day activities, and so we trust local club officials to take the appropriate steps to monitor local conditions and make decisions in the best interest of their communities.

ARRL officials strongly believe that following the guidelines of local, state, and national health care professionals will help ensure everyone's safety in the coming weeks and months.

For full and updated details, visit the ARRL Field Day Webpage at <www.arrl.org/field-day>.

Field Day Propagation Outlook

We learned an important pragmatic fact about high-frequency propagation during the solar cycle minimum period between Sunspot Cycles 23 and 24 — a solar cycle minimum period that was unusually longer than previous recent minimums. It was revealed that during periods of quiet solar activity, radio communications can still occur worldwide on the high frequencies, with voice, CW, and digital modes. This

LAST-MINUTE FORECAST

Day-to-Day Conditions Expected for June 2021

	Expected Signal Quality			
Propagation Index	(4)	(3)	(2)	(1)
Above Normal: 3, 22, 27, 30	A	A	B	C
High Normal: 2, 4-8, 15-16, 23-25, 29	A	B	C	C-D
Low Normal: 18, 21, 26	B	C-B	C-D	D-E
Below Normal: 9, 14, 17, 20	C	C-D	D-E	E
Disturbed: 1, 10-13, 19, 28	C-D	D	E	E

Where expected signal quality is:
A--Excellent opening, exceptionally strong, steady signals greater than S9
B--Good opening, moderately strong signals varying between S6 and S9, with little fading or noise.
C--Fair opening, signals between moderately strong and weak, varying between S3 and S6, with some fading and noise.
D--Poor opening, with weak signals varying between S1 and S3, with considerable fading and noise.
E--No opening expected.

HOW TO USE THIS FORECAST

1. Using the Propagation Charts appearing in "The CQ Shortwave Propagation Handbook, 4th Edition" by Carl Luetzelschwab, George Jacobs, Theodore J. Cohen, and R. B. Rose.

a. Find the *Propagation Index* associated with the particular path opening from the Propagation Charts.

b. With the *Propagation Index*, use the above table to find the expected signal quality associated with the path opening for any given day of the month. For example, an opening shown in the Propagation Charts with a *Propagation Index* of 2 will be non-existent on June 1st, but fair on June 2nd, then good on June 3rd, and fair from June 4th through June 8th, and so forth.

2. Alternatively, you may use the *Last-Minute Forecast* as a general guide to space weather and geomagnetic conditions throughout the month. When conditions are *Above Normal*, for example, the geomagnetic field should be quiet, and space weather should be mild. On the other hand, days marked as *Disturbed* will be riddled with geomagnetic storms. Propagation of radio signals in the HF spectrum will be affected by these geomagnetic conditions. In general, when conditions are *High Normal* to *Above Normal*, signals will be more reliable on a given path, when the ionosphere supports the path that is in consideration. This chart is updated daily at <http://SunSpotWatch.com> provided by NW7US..

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is proving true this time around as well, and as we move out of the minimum period between Cycle 24 and this new cycle, Sunspot Cycle 25, we are witnessing a wealth of opportunity to enjoy the hobby, on the air (*meaning, not just building great projects, and learning more about electronics, and so on, but making two-way contacts around the world –TH*). This year, the ARRL Field Day is one weekend sure to be filled with fun.

Digital modes such as FT8 are remarkably effective for getting a signal from your location to a far distant station's location. Using the same power level as a single-sideband (SSB) station, your digital signal will "make it" farther than that SSB signal, by quite a difference. (*Be careful, however, not to exceed your transmitter's duty cycle rating, as some transceivers cannot operate at a 100% duty cycle for any length of time such as is needed for one transmit period in an FT8 cycle –TH*).

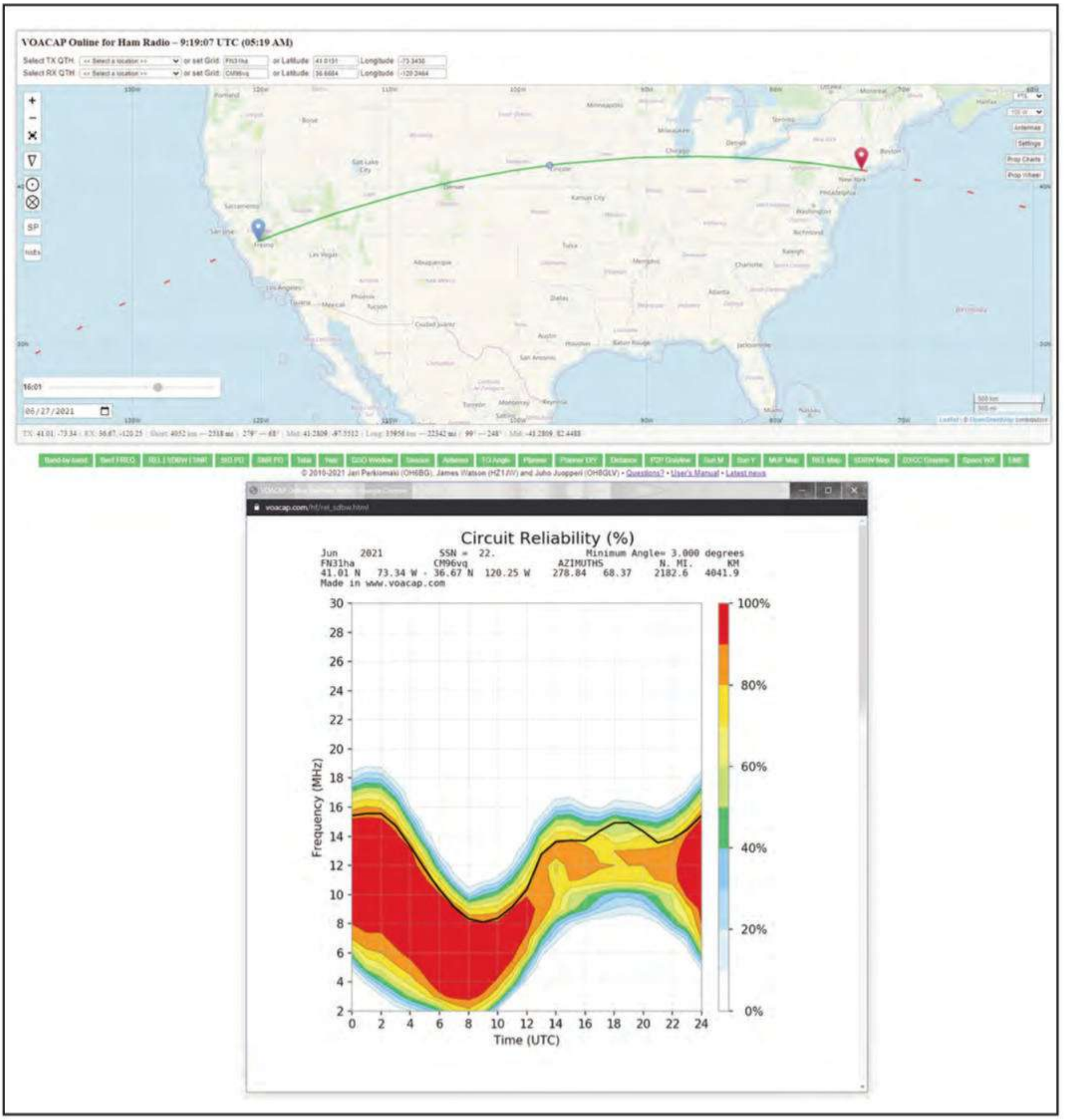

Figure 1. A map plotting the radio signal path between an example Field Day site somewhere in the northeastern region of the U.S., and a location somewhere in California. The circuit reliability (in percent) plot is by frequency over the 24 hours on a day in June 2021, with the expected sunspot count of 22. The antenna at the transmitting site is a dipole with an elevation of 50 feet, and the plot is made with the input variables set to 80 watts of FT8 signal. (Courtesy of VOACAP Online for Ham Radio, <www.voacap.com/hf>)

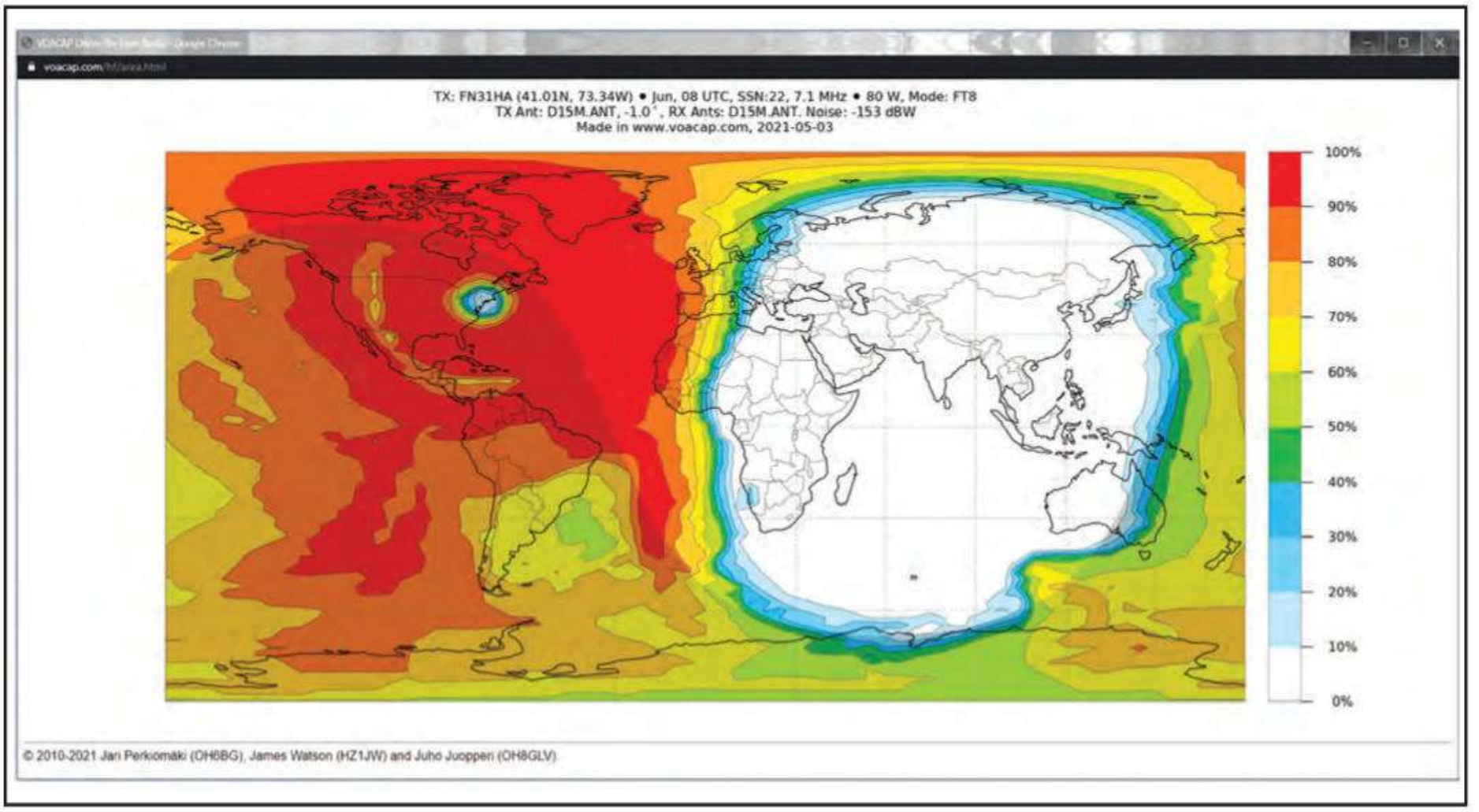

Figure 2. A reliability area plot on a world map, showing the radio signal footprint with colorized reliability information. The transmitter is an example Field Day site somewhere in the northeastern region of the U.S. The circuit reliability (in percent) plot color of red indicates a 90-100% reliability of the FT8 transmission, at 0800-0859 UTC, at 7.1 MHz on a day in June 2021, with the expected sunspot count of 22. The antenna at the transmitting site is a dipole with an elevation of 50 feet, and the plot is made with the input variables set to 80 watts of FT8 signal. (Courtesy of VOACAP Online for Ham Radio, <www.voacap.com/hf>)

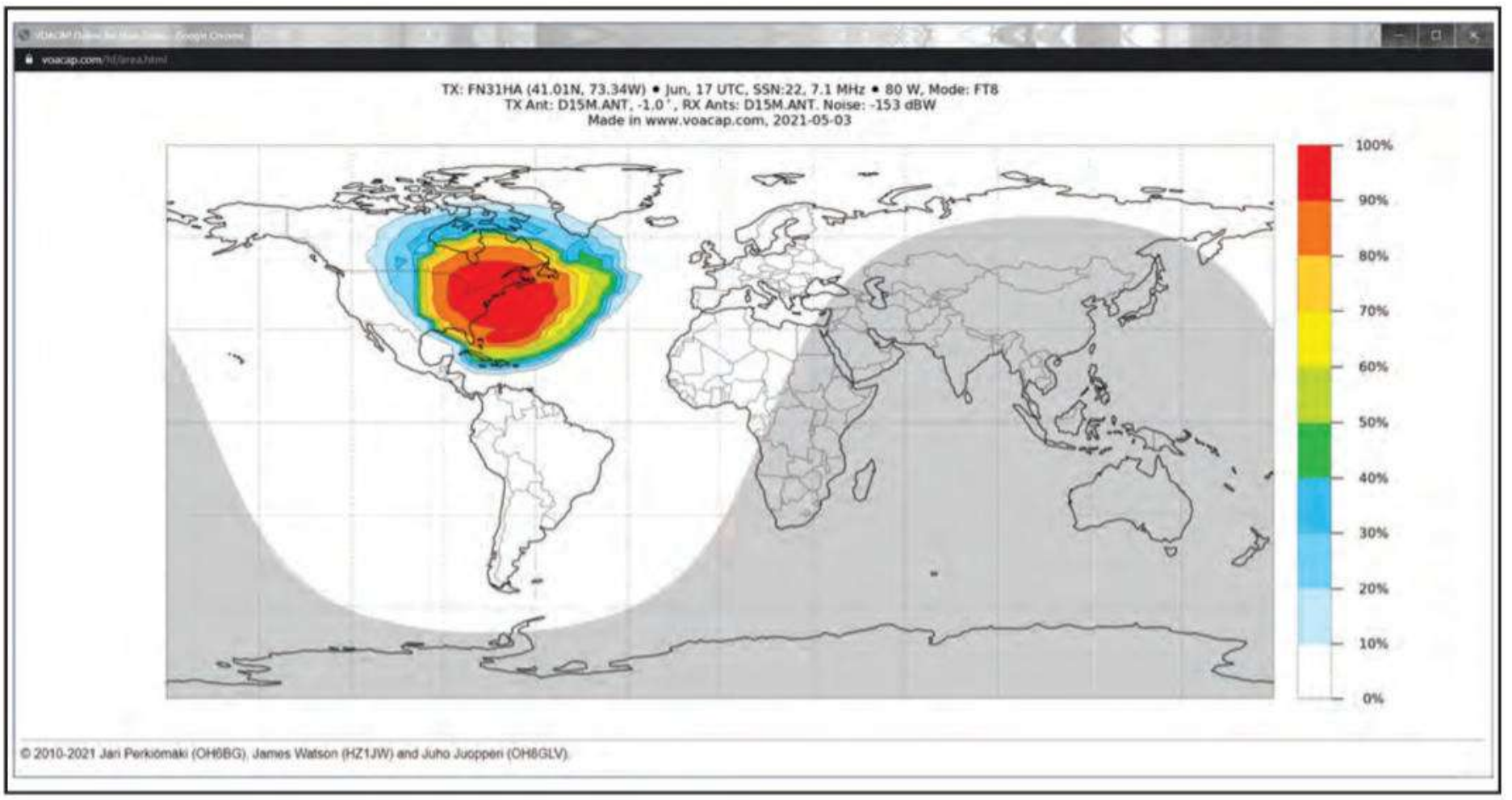

Figure 3. With all things being the same as in Figure 2*, this map plots the footprint at 1700-1759 UTC. It is obvious that the 40-meter band is not the best choice for FT8 operation if the goal is worldwide DXing, or even North American coverage. (Courtesy of VOACAP Online for Ham Radio, <www.voacap.com/hf>)*

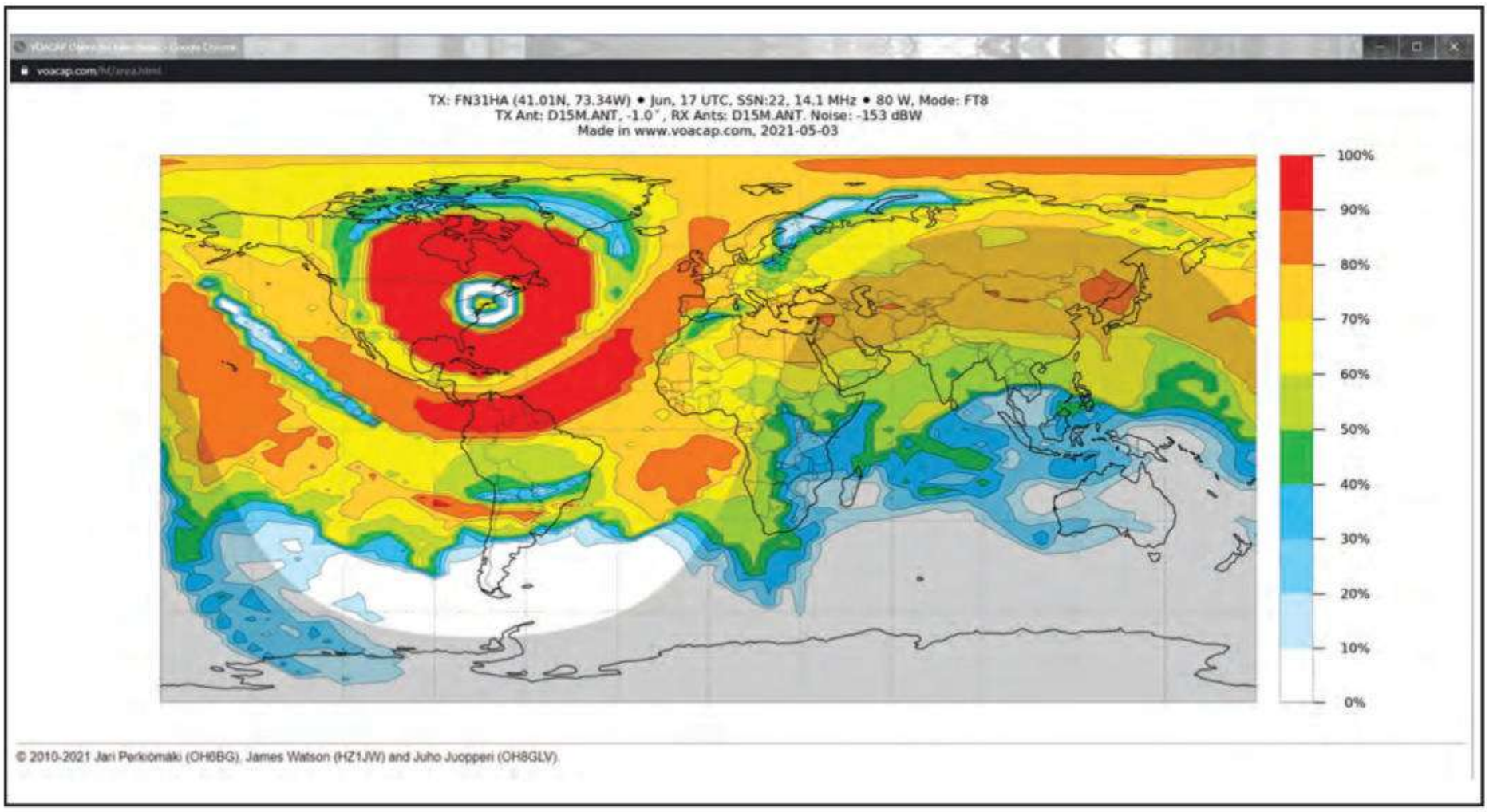

Figure 4. With all things being the same as in Figure 3*, except frequency, this map plots the footprint at 1700-17:59 UTC of a 20-meter FT8 transmission. This band is a better choice than 40 meters at this time of day. (Courtesy of VOACAP Online for Ham Radio, <www.voacap.com/hf>)*

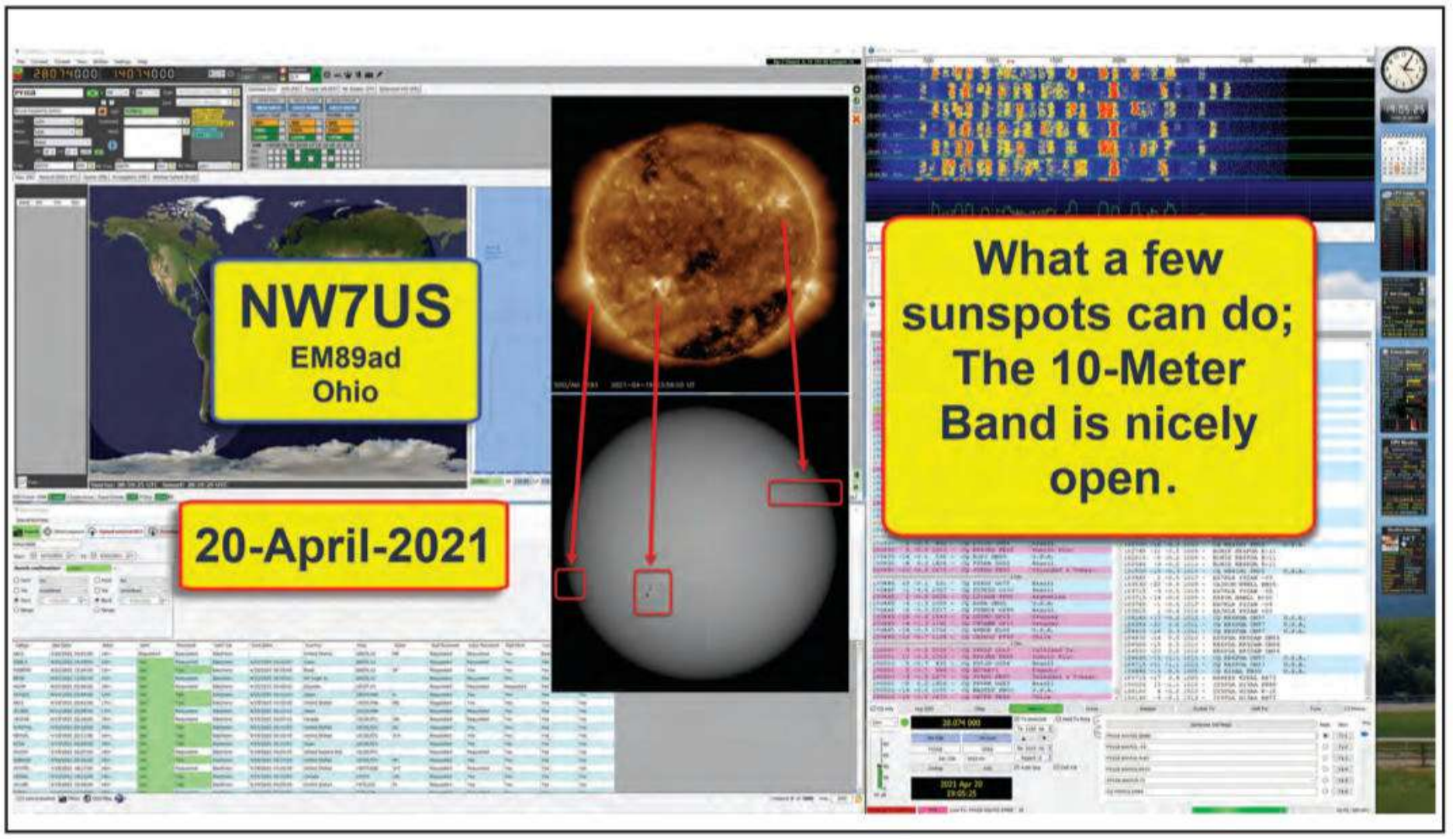

Figure 5. What a few moderately-active sunspots can do to propagation on the 10-meter band. On April 20, 2021, the sun produced a small number of sunspots in several regions. These were moderately active, even producing a moderately-strong flare. This energy increased the Maximum Usable Frequency over many paths, and the result was a very busy FT8 activity on 10 meters. It could happen at any time, and that includes during Field Day weekend in June. (Courtesy of SDO / NASA / SWPC / NW7US>

Day one of the Field Day weekend is expected to present fair propagation for most stateside contacts. Great improvement is expected by nightfall, and into day two, when propagation should be good over most paths.

Figure 1 is an example map made with the propagation modeling software online at VOACAP Online for Ham Radio <www.voacap.com/hf>, plotting a path between a transmitter somewhere in the northeastern U.S. and a Californian receiver. With the input variables set to 80 watts of FT8 signal, and both ends sporting a dipole at a height of 50 feet, we obtain a sample reliability plot over the 24 hours, by frequency (*for a good tour of how you can use this VOACAP toolset, digest the content at <https://g.nw7us.us/3vAye0e> –TH*). This plot indicates that it would be productive for the Field Day operator using FT8 to concentrate on the 20-meter band starting at about 2300 UTC, and that window to California on 20 meters should last until about 0400 UTC. The plotted area that is colored red represents the frequencies that should prove 100% reliable. Switching to the 40-meter band at 0400 UTC should be productive in catching stations in California.

Figure 2 is an area coverage map plotting an 80-watt FT8 transmission's footprint from a station in the northeastern US, using a dipole up at 50 feet. The transmission is on the 40-meter band, at 0800 UTC. The red area is a plot of those areas where the signal level should provide a 90-100% reliability during that hour. This indicates that 40 meters provides good coverage of North America.

Another map, *Figure 3*, is a reliability area plot of the same station's 40-meter transmission, same dipole, same output power, but at 1700 UTC. It is pretty clear that 40 meters will not provide widespread propagation outside of the northeastern area of North America. Switching to the 20-meter band at least by 1700 UTC would be a much better choice of spectrum, as can be seen by the reliability area plot shown on the map in *Figure 4*.

You can plan your Field Day operation by using this propagation prediction toolset. Create plots for all of the applicable HF bands (160, 80, 75, 40, 20, 15, and 10 meters), with the transmitter set to your Field Day location. Be sure to select the antenna that most closely matches your station. Set the power level and select the mode you expect to use. Compare these reliability area maps and select a schedule that best leverages the highest reliability expected.

Running VOACAP models for numerous locations that are set on the 10-meter band gives you a dismal forecast. For a few short windows, the forecast on 15 meters is better than the forecast for 10 meters. Even with digital modes, the F-layer mode propagation models on these upper HF bands indicate limited openings, if any (*and at these higher frequencies, the openings are likely oriented north / south –TH*).

Of course, this year will be like most years, in which sporadic-E (E_S) propagation will enable openings on 10 and 6 meters, providing short-range and North American paths. However, there might be a surprise in store if new sunspot activity develops through the Field Day weekend. *Figure 5* is a collage showing the sunspots on April 20, 2021. Just a few moderately active sunspot regions and the 10-meter band woke up and FT8 operators noticed nice openings for hours. The screen captures in this collage are of WSJT-X reception of FT8 signals at this columnist's QTH in Ohio (at locator EM89ad).

One of the best available methods to predict HF propagation conditions in advance is the 27-day recurrence ten-

dencies of geomagnetic, solar, and ionospheric conditions. It is not an absolute method, but it does give an exceptionally good indication of what is expected. This column is being written in May, about two 27-day solar rotation cycles away from the start of the Field Day weekend. Based on a study of the patterns expected during the next three rotational periods of the Sun, it looks as if conditions for Field Day on June 26-27th, will be fair to good with low geomagnetic activity.

Predictions for one 27-day rotational period are far more accurate than for three 27-day rotational periods. Be sure to carefully check conditions on May 29th and May 30th since these two days are one rotational period before the Field Day weekend. There is better than a 90% chance that conditions observed on those days will recur during the event weekend. Remember, also, that short-skip propagation - often by the E_s mode - is a big part of Field Day on-air activity, especially on the higher HF bands and even on low VHF bands.

If you wish to maximize your on-air efforts, you'll want to check out the Last-Minute Forecast. Use these charts, as well as a good forecasting and analysis

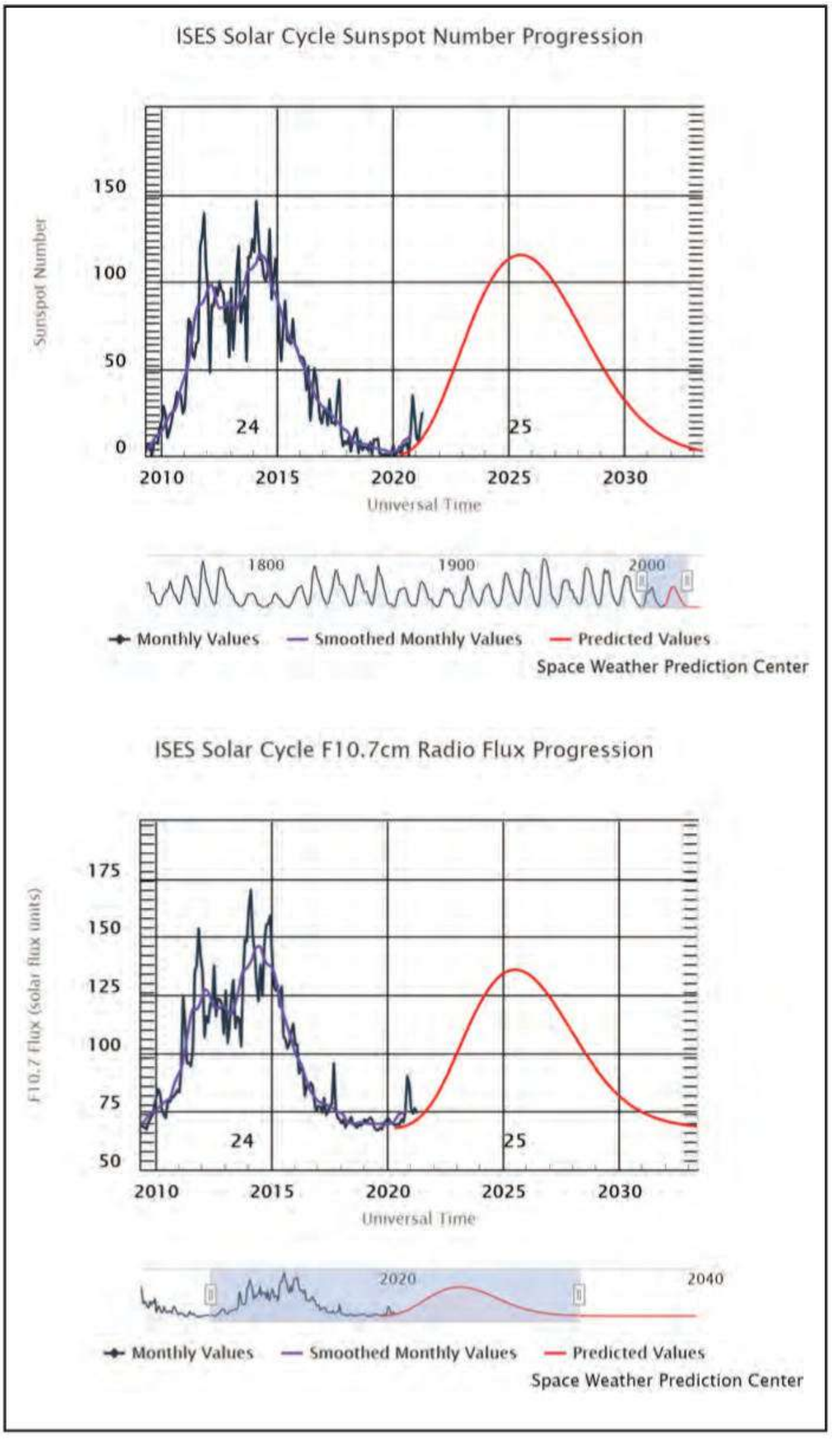

Figure 6. The recent solar cycle (Cycle 24) is represented in several ways. At the top is the sunspot number; in the bottom plot, the F10.7-cm radio flux. In all of the plots, the black line with data points represents the monthly averaged data and the purple line represents a 13-month smoothed version of the monthly averaged data. For the sunspot number and F10.7-cm, the forecast for the rest of the solar cycle is given by the red line. As is clear, we are witnessing the very start of the new sunspot cycle, Sunspot Cycle 25. The next 24 months will likely see a lot of growth, to at least the peak level equal to Cycle 24. Some predict higher activity. Stay tuned! (Courtesy of SWPC / NOAA)

software tool (as described, above) to help you prepare operating guides for your Field Day operations. For the very latest update on conditions, take a look online at my up-to-the-day Last-Minute Forecast chart, available on my Space Weather and Radio Propagation Center at <http://SunSpotWatch.com>.

June Propagation

June marks the changeover from equinoctial to summertime propagation conditions on the shortwave bands (*HF; 3-30 MHz*). Solar absorption is expected to be at seasonally high levels, resulting in generally weaker signals during the hours of daylight when compared to reception during the winter and spring months.

When using the Last-Minute Forecast chart, realize that the column you should use is either the (3) or (2) column, as we are in the very beginning of the new solar cycle. Use the (2) column if the flux is averaging around 80 or higher for a few days or more, but to be conservative, use the (3) column for the rest of the period. Since we've not seen a flux higher than 86 this year, the forecast in the (2) column is somewhat unrealistic.

Ten-meter propagation to DX locations far to the east and west are a rare event during the peak of summer. With the low solar activity, don't expect much on 10 meters except by E_s short-skip propagation. Solar activity just won't create a high-enough Maximum Usable Frequency (MUF) on most F-layer DX paths. North and south paths on 10 meters may present opportunities for limited and short-lived DX, especially around sunrise and sunset. If the sun wakes up and presents sunspots that are active, we could see the F-layer supporting 10-meter propagation on east / west paths and over the polar regions.

Seventeen and 15 meters will be just a bit more reliable than 10, holding some promise. But these will still be a challenge with the low solar activity.

Twenty meters is poor to fair during the hours of darkness, and are good to fair during daylight hours. The best openings on 20 will be the hours around sunrise and sunset.

Thirty meters is a great band this month and could be open to somewhere throughout the entire day and night, especially when sunspot activity is increased. FT8 and other digital modes, plus Morse code (CW), are great options for DXing, and this band supports these modes very well.

Recurring coronal holes will cause occasional periods of geomagnetic storminess during June, degrading higher latitude signal paths more than middle- and low-latitude paths. Coronal holes and the associated high-speed solar winds containing clouds of plasma released by the coronal holes are the bane of propagation during the solar minimum. These geomagnetic storms will play rough on HF propagation. In addition, noise from electrical storms increases considerably during June and the summer months. These higher static levels will make DXing on 40, 60, 75/80, and 160 meters more of a challenge.

The 40-meter band should offer good DX conditions during the early morning, late evening, and during the night despite higher static. Look for Europe and Africa as early as sunset. After midnight, start looking south and west for Pacific, South America, and Asia. Short-skip propagation should be possible out to about 750 miles during the daytime.

Expect some openings on 80 meters, similar to how 40 meters will be acting. Fairly frequent short-skip openings up to 1,000 miles are possible during darkness, but expect very few daytime openings with all the static and absorption.

E_s propagation starts to peak during June. Expect an increase in the number of short-skip openings on HF, and often on 6 and 2 meters, with paths open between 50 and 2,300 miles.

VHF Conditions

The summertime E_s season for the Northern Hemisphere begins in force in May. By June, things could well be hot on the 6-meter band, and there might even be openings on 2 meters. During the late spring and summer months, a sharp increase at mid-latitude of E_s propagation occurs. Through June, you can expect to see 20 to 24 days with some E_s activity. Usually these openings are single-hop events with paths up to 1,000 miles, but June's E_s openings are often double-hop. Europe can often be worked from the East Coast throughout June.

During the daylight hours, monitor 6 meters for transcontinental openings, as well as between Hawaii and the western states, and the Caribbean and Central and South America. The best time to look for these is during the afternoon hours, especially when the geomagnetic activity levels are quiet, and the sunspot activity is higher.

There is usually a seasonal decline in transequatorial propagation (TEP) during the summer months, but some 6-meter openings may still be possible during June. The best time to catch an opening across the geomagnetic equator is between 8 and 11 p.m. local daylight time.

Check out < https://tinyurl.com/hp8smu2v > for a complete calendar of meteor showers in 2021.

If you use Twitter.com, you can follow <@hfradiospacewx> for hourly updates that include the K-index numbers. You can also check the numbers at <http://SunSpotWatch.com>, where this columnist provides a wealth of current space weather details as well as links. Please report your observations of any notable propagation conditions, by writing this columnist via Twitter, or via the Space Weather and Radio Propagation Facebook page at <https://fb.me/spacewx.hfradio>.

Current Solar Cycle Progress

The Royal Observatory of Belgium reports that the monthly mean observed sunspot number for March 2021 is 17.03, a nice bump up from the previous 8.36 in February, and from 11.13 in January. The 12-month running smoothed sunspot number centered on September 2020 is 10.0. A smoothed sunspot count of 18, give or take about 7 points is expected for June 2021.

The Dominion Radio Astrophysical Observatory at Penticton, BC, Canada, reports a 10.7-cm observed monthly mean solar flux of 74.42 for March 2021. The 12-month smoothed 10.7-cm flux centered on September 2020 is 74.51. The predicted smoothed 10.7-cm solar flux for June 2021 is 76, give or take 7 points.

Geomagnetic activity this month is expected to vary greatly sometimes from day to day. Overall, expect mostly active to minor storm level activity, leading to dismal propagation at times, but yielding consistently good propagation conditions during other periods this month (*remember that you can get an up-to-the-day Last-Minute Forecast at <http://SunSpotWatch.com> on the main page –TH*).

I welcome your thoughts, questions, and experiences regarding this fascinating science of propagation. You may email me, write me a letter, or catch me on the HF amateur bands. If you are on Facebook, check out <https://fb.me/spacewx.hfradio> and <https://fb.me/NW7US>. Speaking of Facebook, check out the *CQ Amateur Radio* magazine fan page at <https://fb.me/CQMag>. *– 73, Tomas, NW7US*

ANNOUNCEMENTS *(from page 2)*

CAVE CITY, KENTUCKY — The Mammoth Cave Amateur Radio Club will hold the **45th Annual Cave City Tailgate Hamfest** beginning 8 a.m., Saturday, July 10 at the Cave City Convention Center Parking Lot, 502 Mammoth Cave Street. Contact: Larry Brummett, KN4IV, (270) 651-2363. Email: <lbrummett@glasgow-ky.com>. Website: <http://ky4x.org>.

ERIE, PENNSYLVANIA — The Wattsburg Wireless Association will hold the 2021 NW PA Hamfest beginning 7 a.m., Saturday, July 10 at the Greene Township Municipal Building, 9333 Tate Road. Email: <hamfest@wattsburg-wireless.us>. Website: <http://wattsburg-wireless.us>. Talk-in 147.315 (PL 186.2). VE exams

MANSFIELD, OHIO — The InterCity Amateur Radio Club will hold the **2021 Mansfield Mid-Summer TrunkFest** on Saturday, July 10 at the Richland County Fairgrounds, 750 North Home Road. Website: <iarc.club>.

NORTH BEND, NEBRASKA — The Pioneer Amateur Radio Club will hold its 23rd Annual Flea Market from 9 a.m. to 12:30 p.m., Saturday, July 10 at the North Bend Auditorium, 741 N. Main Street. Contact: Rich Mehaffey, KØEFC, (402) 652-3410. Email: <4randjme@futuretk.com>. Talk-in 146.61-. VE exams.

PISCATAWAY, NEW JERSEY — The Raritan Valley Radio Club will hold the **W2QW – Hamfest** from 8 a.m. to noon, Saturday, July 10 at Piscataway High School, 110 Behmer Road. Contact: Marv, K2VHW, (732) 887-0875 or Rich, W2PQ, (732) 752-0580 (Before 9 p.m.). Website: <http://w2qw.org>. Talk-in 146.625- (PL 141.3) or 442.250- (PL 141.3). VE exams, DXCC / VUCC / WAS card checking.

OAK CREEK, WISCONSIN — The South Milwaukee Amateur Radio Club will hold the **WI9SM 2021 Swapfest** beginning at 6:30 a.m., Saturday, July 10 at the American Legion Post 434, 9327 South Shepard Avenue. Contact: Karen, KC9WQJ, (414) 578-0492. Email: <kc9wqj@gmail.com>. Website: <http://south-milwaukeearc.org>. Talk-in 146.91 (PL 127.3).

ROSEVILLE, MINNESOTA — The Minnesota Amateur Group of Independent Communicators will hold the MAGIC Tailgater from 8 a.m. to noon, Saturday, July 10 at the Galilee Lutheran Church, 145 N. McCarrons Boulevard. Website: <http://magicrepeater.net>. Talk-in 145.170- (PL 100). VE exams.

TEXAS CITY, TEXAS — The Tidelands Amateur Radio Society will hold the **Annual Texas City Hamfest** from 8 a.m. to 2 p.m., at the Charles T. Doyle Convention Center, 2010 5th Avenue North. Website: <http://tidelands.org>. Talk-in 147.14 (PL 167.9) or 442.025 (PL 103.5). VE exams.

ESSEX, MONTANA — The 87th Annual Glacier – Waterton International Peace Park Hamfest will be held from Friday, July 16 through Sunday, July 18 at the Glacier Meadow RV Park, 15735 U.S. Highway 2 East. Email: <directors@gwham-fest.org>. Website: <http://gwhamfest.org>. VE exams, T-hunt.

ATHENS, TENNESSEE – The McMinn County Amateur Radio Club will hold its **17th Annual MCARC Hamfest** beginning 7 a.m., Saturday, July 17 at the McMinn County Expo Center. Phone: (423) 829-7264. Email: <stephenrickerson@bellsouth.net>. Website: <www.mcminnarc.com>. Talk-in 147.060- (PL 141.3). VE exams.

CHIPPEWA FALLS, WISCONSIN — The Chippewa Valley Amateur Radio Club will hold its **HamFest / Tailgater** from 9 a.m. to 2:30 p.m., Saturday, July 17 at the Eagle's Banquet Center and Conference Hall, 2588 Hallie Road. Email: <hamfest@w9cva.org>. Website: <http://w9cva.org/hamfest>. Talk-in 147.375+ (PL 110.9).

ELYRIA, OHIO — The Northern Ohio Amateur Radio Society will hold **NOARSfest 2021** from 9 a.m. to 1 p.m., Saturday, July 17 at Loraine County Community College - Spitzer Conference Center, 1005 North Abbe Road. Contact: Carl Rimmer, W8KRF, (215) 256-9624. Email: <noarsfest@noars.net>. Website: <http://noars.net>. Talk-in 146.700- (PL 110.9).

KIMBERTON, PENNSYLVANIA — The Mid-Atlantic Amateur Radio Club will hold the **2021 MARC Hamfest** beginning 8 a.m., Saturday, July 17 at the Kimberton Fire Company grounds, 742 Pike Springs Road. Email: <n3jiz@marc-radio.org> or <k3ds@marc-radio.org>. Website: <http://marc-radio.org>. Talk-in 145.13 (PL 131.8). VE exams.

WARRENSBURG, MISSOURI — The Warrensburg Area Amateur Radio Club will hold its **Hamfest 2021** beginning 8 a.m., Saturday, July 17 at the Johnson County Fairgrounds, 386 NW 145th Road. Contact: Kristl Thompson, KRiSTL, <hamfest@waarci.org>. Website: <http://waarci.org>. Talk-in 146.88 (PL 107.2).

AUGUSTA, NEW JERSEY — The Sussex County Amateur Radio Club will hold the **2021 SCARC Hamfest** beginning 8 a.m., Sunday, July 18 at the Sussex County Fairgrounds, 37 Plains Road. Contact: Dan Carter, N2ERH, (973) 862-8197. Email: <hamfest@scarcnj.org>. Website: <www.scarcnj.org>. Talk-in 147.30+ (PL 151.4). VE exams.

CHAMBERSBURG, PENNSYLVANIA — The Cumberland Valley Amateur Radio Club will hold the **CVARC Hamfest 2021** from 8 a.m. to noon, Saturday, July 31 at the Cumberland Valley Engine & Machinery Association Show Grounds, 1501 Criders Church Road. Email: <hamfest@w3ach.org>. Website: <http://w3ach.org>. Talk-in 147.120 (PL 100). VE exams.

LEBANON, TENNESSEE — The Wilson Amateur Radio Club will hold **Hamquest 2021** from 8 a.m. to 3 p.m., Saturday, July 31 at the James E. Ward Agricultural Center, 945 E. Baddour Parkway. Email: <reservations@midtnhamquest.com>. Website: <http://midtnhamquest.com>.

WINCHESTER, INDIANA — The East Central Indiana Hamfest will be held from 8 a.m. 4 p.m., Saturday, July 31 at the Randolph County 4-H Fairgrounds, 1855 U.S. Highway 27. Phone: (765) 383-0011. Email: <inhamfest@gmail.com>. Website: <http://inhamfest.com>.

AUGUST

PEOTONE, ILLINOIS — The Hamfesters Amateur Radio Club will hold the **Hamfesters Hamfest** beginning 8 a.m., Sunday August 1 at the Will County Fairgrounds, 710 S. West Street. Contact Jim Riley, W9JPR, <w9jpr@gmail.com>. Talk-in 442.450 (PL 114.8).

CENTRAL CITY, IOWA — The Cedar Valley Amateur Radio Club will hold the **CVARC Hamfest** and **2021 ARRL Iowa State Convention** on Saturday, August 7 and Sunday, August 8 at the Linn County Fairgrounds, 201 Central City Road. Contact David Cripe, NMØS, <nm0s@arrl.net>. Website: <http://w0gq.org/ham-fest>. Talk-in 146.745- (PL 192.8).

FAYETTEVILLE, NORTH CAROLINA — The Cape Fear Amateur Radio Society will hold the CFARS SwapFest from 8 a.m. to noon, Saturday, August 14 at the Cumberland County Shrine Club, 7040 Ramsey Street. Contact: David KI4W, <kr4oe@nc.rr.com>. Website: <http://cfarsnc.org>. Talk-in 146.910- (PL 100). VE exams.

FORT PIERCE, FLORIDA — The Fort Pierce Amateur Radio Club will hold the **Fort Pierce Hamfest** from 8 a.m. to 1 p.m., Saturday, August 14 at the Indian River State College, 3209 Virginia Avenue. Contact: Pete, KD4SPW, (772) 465-5204. Website: <www.fparc.org>. Talk-in 147.345+ (PL 107.2).

EAST GREENBUSH, NEW YORK — The East Greenbush Amateur Radio Association will hold its Hamfest 2021 from 8 a.m. to 1 p.m., Saturday, August 21 at the East Greenbush Town Park, Town Park Road. Contact: Bryan Jackson <w2rbj@outlook.com>. Website: <http://egara.club>.

HUNTSVILLE, ALABAMA — The Huntsville Hamfest and **2021 ARRL Southeastern Division Convention** will be held from 9 a.m. to 4:30 p.m., Saturday, August 21 and from 9 a.m. to 3 p.m., Sunday, August 22 at the Von Braun Center, 700 Monroe Street SW. Email: <info@hamfest.org>. Website: <www.hamfest.org>. Talk-in 146.94 (PL 100). VE exams.

LEXINGTON, KENTUCKY — The Bluegrass Amateur Radio Society will hold the Central Kentucky Hamfest on Saturday, August 14 at 2319 Woodhill Drive. Website: <http://bluegrass.org>.

MILWAUKEE, WISCONSIN — The Milwaukee Radio Amateurs' Club and MAARS will hold the **MCARC & MAARS Interclub Swapfest** from 8 a.m. to noon, Saturday, August 28 at the Elks Lodge #46, 5555 W. Good Hope Road. Phone: (414) 459-9741. Email: <swapfest@w9rh.org>. Website: <www.w9rh.org>. Talk-in 145.390 (PL 127.3) or 145.130 (PL 127.3).

OWENSVILLE, OHIO — The Cincinnati Hamfest and **W8DXCC Convention** will be held from 8 a.m. to 2 p.m. (hamfest) and from 2-6 p.m. (convention), Saturday, August 28 at the Clermont County Fairgrounds, 1000 Locust Street. Email: <info@cincinnatihamfest.org>. Website: <http://cincinnatihamfest.org>. Talk-in 147.345+ (PL 123.0) or 443.450+ (PL 123.0). VE exams.

NEW KENSINGTON, PENNSYLVANIA — The Skyview Radio Society will hold its **2021 Swap N Shop** Sunday, August 29 at its club grounds, 2335 Turkey Ridge Road. Contact: John Italiano, WA3KFS, (724) 339-3821. Website: <www.skyviewradio.net>. Talk-in 146.640- (PL 131.8).

NEWTOWN, CONNECTCUT — The Candlewood Amateur Radio Association will hold the **Western CT Hamfest** beginning 8 a.m., Sunday, August 29 at the Edmond Town Hall, 45 Main Street. Contact: John Morelli, W1JGM, (203) 417-0160. Email: <hamfest@cararadioclub.org>. Website: <http://cararadioclub.org>. Talk-in 147.300+ (PL 100).

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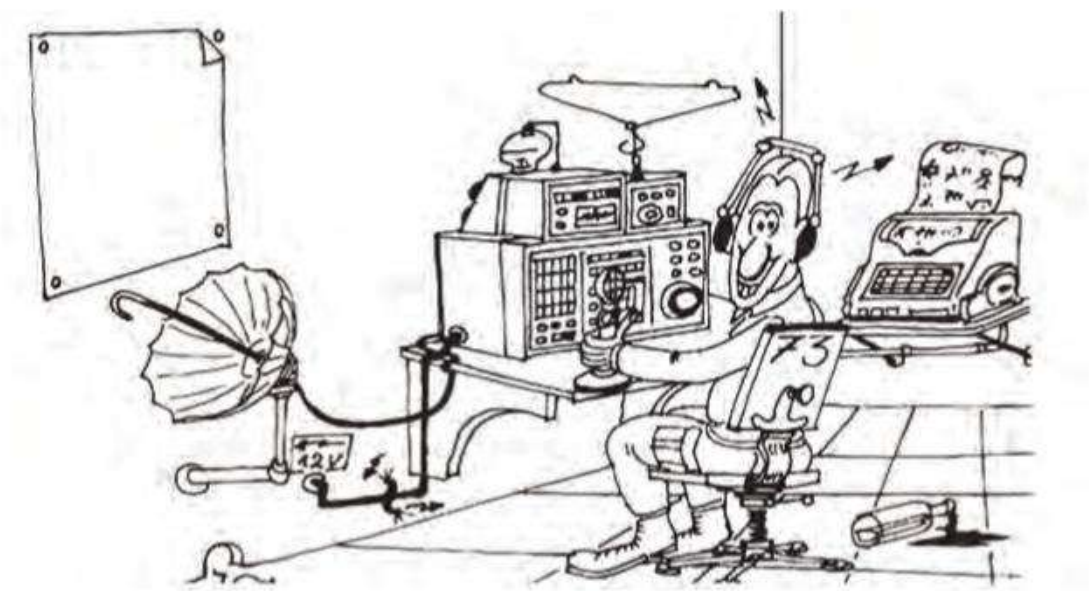

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