Voice Keyers for Contesting, p. 104

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COMMUNICATIONS & TECHNOLOGY

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- CQ Reviews: CODAN High Power Amplifier Controller, p. 36

On the Cover: The home of HV0A in Vatican City. Inset: Marija Kostic, YU3AWA, and friend Alex Hajosevic, YT3H, operate from HV0A. Marija was the first YL in more than 20 years to do so. Story on page 8.

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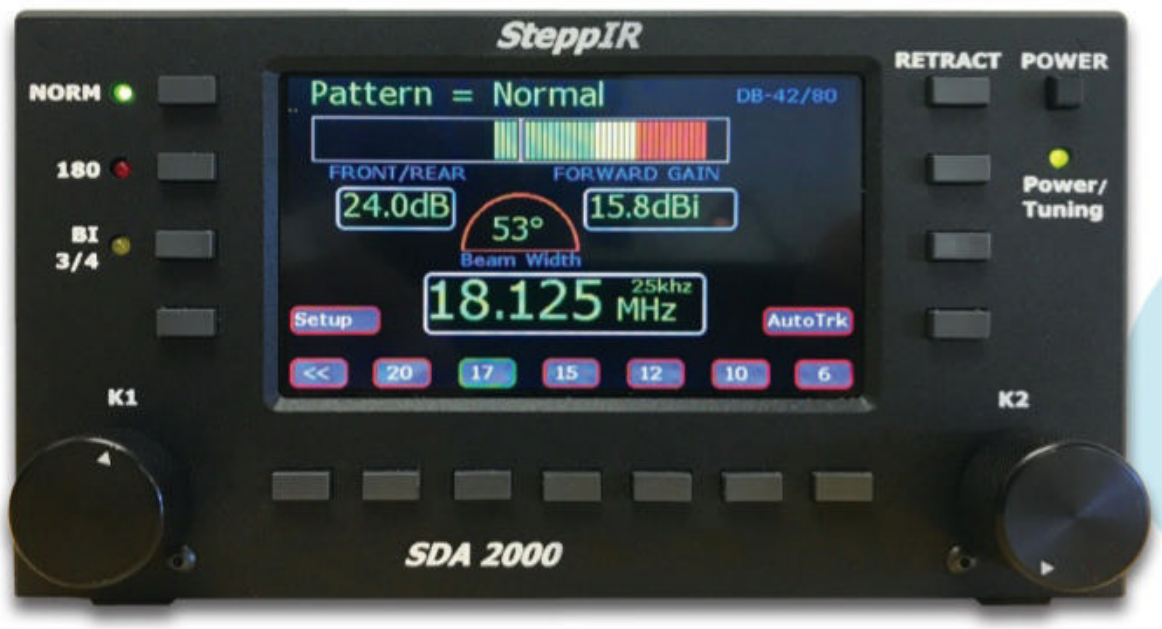

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announcements

JANUARY 2023

LOCUST FORK, ALABAMA — The Blount County Amateur Radio Club will hold Freezefest 2023 from 8 a.m. to noon, Saturday, January 7 at the Locust Fork High School Cafeteria, 155 School Road. Website: <http://w4blt.org>. Talk-in 146.700- (PL 91.5). VE exams. Contact: Jack (407) 443-1963.

GLENDALE, ARIZONA — The Thunderbird Amateur Radio Club will hold the 2023 TBARC Hamfest from 8 a.m. to noon, Saturday, January 14 at the Haven Church, 5902 W. Cactus Road. Website: <http://tbirdfest.org>. Talk-in 147.040+ (PL 162.2).

GREENWOOD, SOUTH CAROLINA — The Greenwood Amateur Radio Society will hold the Greenwood South Carolina Indoor Hamfest beginning 9 a.m., Saturday, January 14 at the Piedmont Technical College-James Medford Family Event Center. Contact: Ted Davison, AI4WN, <w4gwd@arrl.net> or <w4dew@arrl.net>. Website: <www.w4gwd.org>. Talk-in 147.165+ (PL 107.2) or 443.900+ (PL 107.2). VE exams

HARRISBURG, PENNSYLVANIA — The Harrisburg Radio Amateurs' Club will hold its WINTERFEST Electronics Expo and Hamfest from 7-11 a.m., Saturday, January 14 at the Vietnam Veterans of America, 8000 Derry Street. Contact Bab Saber, K3RTS, (717) 574-2608. Email: <k3rts@w3uu.org>. Website: <www.w3uu.org>. DXCC / WAS /VUCC card checking.

LAWRENCEVILLE, GEORGIA — The Gwinnet Amateur Radio Society will hold TechFest from 9 a.m. to 3 p.m., Saturday, January 14 at the Gwinnett County Fairgrounds Expo Center Building, 2405 Sugarloaf Parkway. Website: <www.techfest.info>. VE exams

MARATHON, NEW YORK — The Skyline Amateur Radio Club will hold the SARC Winter Hamfest from 7 a.m. to noon, Saturday, January 14 at the Marathon NY Civic Center, 16 Brink Street. Contact: Patrick Dunn, KC2BQZ, <kc2bqz@gmail.com>. Website: <www.skylinehamradioclub.org>. Talk-in 147.180+ (PL 71.9). VE exams.

ORLANDO, FLORIDA — The K4KDI Winter Tailgate 2023 will be held on 6 a.m. to noon, Saturday, January 14 at the South Conway Road Baptist Church, 6099 S. Conway Road. Website: <https://k4kdi.square.site>.

ST. CHARLES, ILLINOIS — The Wheaton Community Radio Amateurs will hold the WCRA 2023 Mid-Winter Hamfest from 8 a.m. to 1 p.m., Sunday, January 15 at the Kane County Fairgrounds Expo Center, 525 S. Randall Road. Phone: (630) 923-5447. Email: <hamfest@w9ccu.org>. Website: <www.w9ccu.org>. Talk-in 145.31- ()PL 107.2). VE exams.

FORT MYERS, FLORIDA — The Fort Myers Amateur Radio Club will hold the 2023 Southwest Florida Regional Hamfest and 2023 ARRL Southern Florida Section Convention from noon to 5 p.m., Friday, January 20 and from 8 a.m. to 3 p.m., Saturday, January 21 at the Florida Southwestern State College-Building U, 8099 College Parkway. Website: <www.swflhamfest.info>. Talk-in 145.170- (PL 136.5). Free VE exams, ARRL card checking.

LOVELAND, COLORADO — The Northern Colorado Amateur Radio Club will hold its Winter 2023 Hamfest from 8 a.m. to 1 p.m., Saturday, January 21 at the Larimer County Fairgrounds — Thomas McKee 4-H Building, 5280 Arena Circle. Contact: Joe Hawley, KDØTYU, (970) 689-0828. Email: <president@ncarc.net>. Website: <www.ncarc.net>. Talk-in 448.025- (PL 100). Free VE exams.

PONCHATOULA, LOUISIANA — The Southeast Louisiana Amateur Radio Club will hold the SELARC 41st Annual Hammond HamFest from 8 a.m. to 4 p.m., Saturday, January 21 at the Ponchatoula Community Center, 300 N. 5th Street. Contact: Tyrone Burns, N5XES, (985) 687-2139. Email: <wb5net@arrl.net>. Website: <www.selarc.org>. Talk-in 147.000- (PL 107.2). VE exams.

WHITMAN, MASSACHUSSETTS — The Whitman Amateur Radio Club will hold its WinterFest 2023 from 9 am. to 1 p.m., Saturday, January 21 at the Whitman Knights of Columbus, 1195 Bedford Street. Phone: (781) 523-5010. Website: <www.wa1npo.org>. Talk-in 147.225+ (PL 67). VE exams.

QUARTZSITE, ARIZONA — Quartzfest 2023 will be held from Sunday, January 22 through Saturday, January 28 at Bureau of Land Management property outside Quartzsite. Contact Kristyn Weed, KR1SS, <KristynWeed@gmail.com>. Website: <www.quartzfest.org>. VE exams

ROYAL OAK, MICHIGAN — The Hazel Park Amateur Radio Club will hold its 55th Annual Swap & Shop from 8 a.m. to noon, Sunday, January 22 at the Royal Oak Farmers Market, 316 E. Eleven Mile Road. Email: <hazelparkswap@gmail.com>. Website: <www.hparc.org>. Talk-in 146.640 (PL 100).

JACKSON, MISSISSIPPI — The Jackson Amateur Radio Club will hold the Jackson MS Capital City Hamfest 2023 from 5-8 p.m., Friday, January 27 and from 8 a.m. to 3 p.m., Saturday, January 28 at the Trademart on the Fairgrounds, 1200 Mississippi Street. Email: <hamfest@msham.org>. Website: <hamfest.msham.org>. VE exams.

COLINSVILLE, ILLINOIS — The Saint Louis & Suburban Radio Club will hold Winterfest 2023 from 8 a.m. to 1 p.m., Saturday, January 28 at the Gateway Convention Center, One Gateway Drive. Website: <http://winterfest.slsrc.org>.

FEBRUARY

ORLANDO, FLORIDA — The Orlando Amateur Radio Club will hold HamCation 2023 and the 2023 ARRL Southeastern Division Convention from 9 a.m. to 5 p.m., Friday, February 10; 9 a.m. to 5 p.m., Saturday, February 11; and 9 a.m. to 1 p.m., Sunday, February 12 at the Central Florida Fairgrounds and Expo Park, 4603 West Colonial Drive. Phone: (407) 841-0874. Email: <info@hamcation.com>. Website: <www.hamcation.com>. VE exams, special event station K1AA.

DANVILLE, INDIANA — The Hendricks County Amateur Radio Society will hold the Hendricks County Hamfest 2023 from 8 a.m. to 1 p.m., Saturday, February 11 at the Hendricks County 4-H Fair Grounds Conference Center, 1900 E. Main Street. Website: <http://n9hc.org>.

TRAVERSE CITY, MICHIGAN — The Cherryland Amateur Radio Club will hold its 48th Annual Swap-N-Shop from 8 a.m. to noon, Saturday, February 11 at St. Francis High School Gymnasium, 123 E. 11th Street. Contact: Joe Erlewein, N8CN, (231) 668-4223. Email: <swap@cherrylandarc.com>. Website: <http://cherrylandarc.com>. Talk-in 146.86- (PL 114.8). VE exams.

ELKTON, VIRGINIA — The Page Valley Amateur Radio Club will hold its Winter Indoor Mini-Hamfest from 7 a.m., to 2 p.m., Saturday, February 18 at the Elkton VFW Hall, 13958 Spotswood Trail. Email: <pvarccarrie@gmail.com>. Website: <https://tinyurl.com/48cphmha>. Talk-in 146.625 (PL 131.8).

MARLBOROUGH, MASSACHUSSETTS — The Algonquin Amateur Radio Club will hold its Amateur Radio Flea Market from 9 a.m. to 1 p.m., Saturday, February 18 at the Marlborough 1Lt. Charles W. Whitcomb School, 25 Union Street. Email: <fleamarket@n1em.org>. Website: <http://n1em.org>. Talk-in 446.675- (PL 88.5).

BRIGHTON, COLORADO — The Aurora Repeater Association & Rocky Mountain Ham Radio will hold The Swapfest from 9 a.m. to 1 p.m., Sunday, February 19 at the Adams County Fairgrounds, 9775 Henderson Road. Contact: Wayne, NØPOH, (303) 699-6335. Email: <rockymountainham@gmail.com>. Website: <http://rmham.org>.

(Continued on page 103)

ham radio news

Hamvention Selects Innovation as 2023 Theme

Organizers of the Dayton Hamvention® have selected "Innovation!" as the show's theme for 2023. According to an announcement from the Dayton Amateur Radio Association, the theme "encompasses in just one word the world of amateur radio today. There are so many exciting 'Innovations!' worldwide in amateur radio (that) we want to capture the spirit and we expect to see many of these throughout the coming year and presented at Hamvention '23." The 2023 Hamvention is scheduled for May 19-21st at the Greene County Fairgrounds and Exposition Center in Xenia, Ohio.

Japanese Amateur Radio Lunar Satellite Lost in Space

The OMOTENASHI satellite, built by the ham radio club at the Japanese space agency and launched to the moon by NASA's Artemis-1 mission, is missing in action but controllers hope to find and re-establish contact with it in March. According to the club's website, controllers were initially able to communicate with the satellite but determined that its solar panels were facing away from the Sun and it was spinning very quickly. Attempts to stabilize it appear to have worked but the batteries apparently died before they could re-orient the solar panels. They then lost contact with the satellite but hope it will move into sunlight by March, at which time they will try to locate it and re-establish control. Its original mission of landing on the Moon will no longer be viable, but the new hope is to demonstrate the ability to communicate with a CUBESAT beyond Earth orbit.

New Huntsville Museum to Feature Ham Station

The new Museum of Information Explosion in Huntsville, Alabama, has received a grant of more than $16,000 from the Amateur Radio Digital Communications foundation to fund the purchase and installation of a state-of-the-art amateur station to go along with its exhibits of classic ham gear. According to the *ARRL Letter*, the goal is to juxtapose old and new technology "to illustrate the accelerating evolution of amateur radio." The station will also provide licensed hams with an opportunity to try out new digital modes without making a major financial investment. The station will be staffed and maintained by members of local amateur radio clubs. The museum is expected to open this spring.

ARDC Grant Funds RFI-Fighting Efforts

Another ARDC grant, this one of more than $23,000, will help hams in New England track down sources of radio interference. The grant, going to the New England Division of the ARRL, will fund the purchase of RFI kits for each of the division's seven sections. According to *Newsline*, the kits will contain antennas and equipment to detect and identify RFI on HF, VHF, and UHF, as well as "spectrum capture" capability. The grant will also cover the costs of training sessions for each of the seven sections' RFI teams.

Applications Open for 2023 YOTA Camp

Applications are now being accepted for campers interested in attending the 2023 Youth on the Air Camp, scheduled for July 16-21st at Carleton University in Ottawa, Ontario. Licensed amateur radio operators ages 15 through 25 are eligible to apply. Specific numbers of openings are being reserved for campers from North, Central, and South America, although those will be opened to all applicants if not filled. Applications are being accepted through May 31st, but organizers say those who apply by January 15th will have the best chance of being selected. Selection notices will start to go out on February 1st.

Online applications are available at <YouthOnTheAir.org>; additional information is available from Camp Director Neil Rapp, WB9VPG, at <director@youthontheair.org>.

Nominations Open for CWops "Advancing the Art of CW" Award

The CW Operators' Club (CWops) has opened nominations for its annual "Advancing the Art of CW" award, recognizing — according to its website — "individuals, groups, and organizations that have made the greatest contribution(s) toward advancing the art or practice of radio communications by Morse code." A variety of CW-related activities may qualify a nominee. Nominations close on March 10th. For details, visit the CWops website at <https://tinyurl.com/2va7r9x9>.

Milestones: QCWA Turns 75

The Quarter Century Wireless Association is now three-quarters of a century old. QCWA was formed in December 1947 with an initial membership of 34 hams. Membership is open to any currently licensed amateur who was first licensed at least 25 years ago (gaps are permitted). The organization today provides mentorship to newer hams and runs a scholarship program that, according to the 75th anniversary edition of the *QCWA Journal,* has awarded nearly 600 scholarships totaling more than $750,000 since its establishment in 1977. Congratulations to QCWA from *CQ*!

Milestones: WB2MGP Awarded Initial RCA Young Professional Award

Carole Perry, WB2MGP, is a longtime director of both QCWA and the Radio Club of America, two organizations through which she channels her long-standing efforts to bring more young people into amateur radio and more young women into careers in science, technology, engineering, and math. RCA recently established a Young Professional Award, which will be given annually to one of Carole's RCA Young Achievers who goes on to work in the wireless industry. The first award, however, went to Carole, who was taken completely by surprise at the RCA Awards Banquet in November.

Milestones: Rod Linkous, W7OM, SK

Former *CQ* DX columnist and CQ DX Committee member Rod Linkous, W7OM, became a Silent Key at the end of November. According to longtime friend and neighbor Danny Eskenazi, K7SS, Rod was undergoing a medical procedure at the time of his passing. Just the previous weekend, Danny reported, Rod was on the air in the CQWW DX CW Contest. Long a fixture of DXing and contesting in the Pacific Northwest, Rod was *CQ*'s Assistant DX Editor and Assistant DX Manager in the late 1970s and early '80s, frequently writing our monthly DX column over a 5-year period. *(Tnx N3QE)*

contents

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features

FOCUS ON: Happy New Year from your friends at *CQ*! *CQ* enters its 79th year with some New Year columns from NW7US and N2IRZ on pages 90 & 108. We also kick off 2023 with a billion-year-old mystery from space on page 12 and a look back at the dawn of radio astronomy on pages 16 & 18. CQ also wants you to stay warm this winter by the soldering iron with some construction projects on pages 41, 44, 56, and 73. We hope the new years brings loads of happiness and good propagation.

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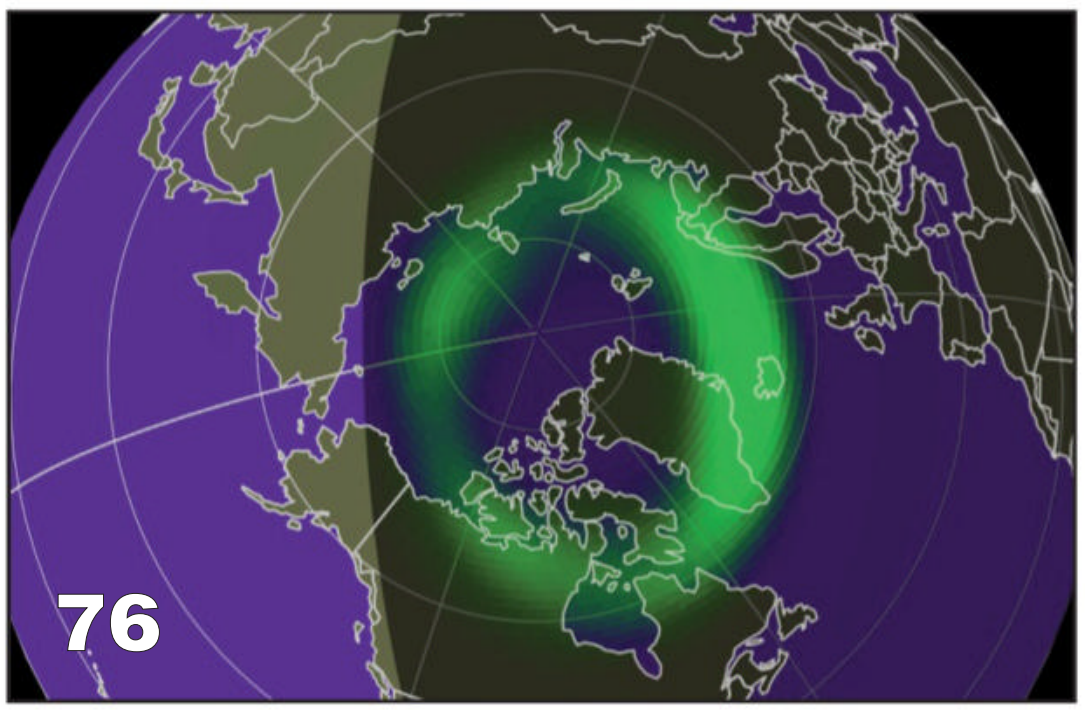
departments

miscellaneous



zero bias: a cq editorial

BY RICH MOSESON,* W2VU

New Year, New Opportunities

Happy New Year! The start of a new year is typically a time of new beginnings and with outdoor radio activities on hold for many of us due to cold and snow (except for Winter Field Day and, of course, antenna work!), winter is a perfect time to begin a new shack project or start planning for station improvements when the weather warms up. For some of us, that might mean building a new kit that appeared under the tree. For others, it could be planning out new antennas or discovering a new band or mode. For still others, it can be a good time for refining emergency communication plans with served agencies or planning springtime exercises (or winter ones, for that matter; emergencies and disasters don't wait for warm weather!).

My plan for keeping warm this winter is to gingerly curl up next to a warm soldering iron and build the Bayou Jumper transmitter / receiver kit I got sometime last year and that has been sitting patiently waiting for me to put it together. I finally got started last weekend by staining the wooden case in which it's going to live. A little more woodworking will be needed before the electronics can start to come together.

Building a kit into a wooden enclosure is kind of retro, but then this kit is an homáge to the Paraset radios used by resistance fighters and Allied spies during World War II. Today, of course, 3-D printers have added a whole new dimension to kit enclosures. But there are other options as well. In fact, we feature one of those in this issue. Frequent contributor Hiroki Kato, AH6CY (who coincidentally has written extensively for *CQ* about Parasets), has repurposed LEGO® blocks left over from now-grown children to build enclosures for several pieces of gear. His article is on page 56.

Of course, it's also a great time to sit down in front of your radio and talk to old and new friends around the world. If you're relatively new to the HF bands and think that FT8 is the only reliable way to work DX, say "hello" to sunspots! The quicker- and steeper-than-predicted rise of Cycle 25 is resulting in great DX openings all the way through 10 meters, on CW and SSB as well as FT8. And on the flip side, if you're a longtime CW/SSB operator, this winter might be a good time to give FT8 a try. DXing highlight of this month: The long-planned 3YØJ DXpedition to Bouvet (see <www.3y0j.no> for updates; the operation was still in the future as this was written in early December).

One of my favorite things about our hobby is the breadth of different interests and activities it embraces. You might be a QRPp minimalist, trying to squeeze the greatest number of miles out of just a few milliwatts; or a big-gun DXer or contester with big amplifiers, big antennas, and big numbers on contest and DX scoreboards. You might also be a dedicated VHFer, pushing the limits on our underused microwave bands or bouncing signals off the moon; or a person dedicated to serving your community through public service and emergency communications. You might be someone who just enjoys chatting with radio friends on your daily commute;

or you might not spend much time on the air at all, preferring to design, build, and experiment with the technological freedom the FCC has given us to advance the state of the art. No matter what your interest in communication and/or communication technology, there's a place for you under this big umbrella we call ham radio.

One of the things we try to do here at *CQ* over the course of each year (and amazingly, this issue begins our 79th year!) is to cover all of these different pursuits to one extent or another. Some, such as DXing, contesting, building and emergency communications, get more ink than others because they are the bedrock of our hobby. Others, such as QRP and microcontrollers, showcase current and future trends, while still others, such as satellites or MF/LF activities, provide a forum to educate each other on the more esoteric branches of the radio hobby. Plus, we like to share your on-air adventures — such as this month's articles on DXpeditions to the Vatican and to Djibouti — and just plain fun stuff, like recent articles on turning a flute into an antenna or powering a radio with potatoes (it all works, though!). These stories help remind us that for all of the important work we do in areas of emergency communication and technology, ham radio at its core is a hobby and 99% of the time, our main goal is to have fun!

So, no matter which of our hobby's many aspects make you happy as we start this new year, we hope you can make the time to enjoy it and/or to branch out into something new for 2023.

– 73, Rich, W2VU

P.S. There's still time to order your 2023-24 *CQ Amateur Radio* and/or Ham Shack Project calendar! They'll take you all the way through until next March.

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

news bytes

WTWW Signs Off Permanently — Some Programming Moves to WRMI

In a surprise move in early November, the owners of shortwave broadcaster WTWW (5085 kHz) abruptly pulled the plug on the station's radio transmissions, moving exclusively to online streaming. However, much of the station's musical and ham radio-related programming, such as Ted Randall's "QSO Radio Show" and Ria Jairam's "Ria's Shack Ham Radio," quickly QSYed to WRMI in Miami, returning to the airwaves on 9455 kHz under the "WRMI Legends" moniker. Additional frequencies have been added at 4980, 5850 and 9395 kHz.

Randall, WB8PUM, was WTWW's Chief Engineer as well as the host of "QSO Radio." He said the decision to shutter the station was a financial one and came from the owners on very short notice, saying he was told, "we can't afford to do this anymore."

"When I signed off WTWW," Randall told *CQ*, "I said the studio was going to cease to operate. I didn't say what was going to happen next because I had no idea myself," adding that WRMI management quickly reached out to him, inviting him to move his programs to their station. The transition was made in a matter of days.

The WRMI Legends programming roster and schedule were still being finalized as this was written. Up-to-date information should be available soon (if not by the time you read this) at <wrmilegends.com>.

← *WB8PUM's "QSO Radio Show" is among several with a new home on WRMI (9455 kHz) after the abrupt shutdown of WTWW (5085 kHz) in November.*

It's been more than 20 years since a YL has operated HVØA, the only amateur station in Vatican City, so the pileups were even bigger than usual when YU3AWA took the mic during a brief visit last September.

Rare DX From the Heart of Italy … YU3AWA's DXpedition to Vatican City

BY MARIJA KOSTIC,* YU3AWA

Thanks to the graciousness of Francesco Valsecchi, IKØFVC, I had the rare opportunity to be a guest operator at the Vatican amateur radio station, HVØA. Accompanying me was my mentor, teacher, and friend Alex Hajosevic, YT3H. Now that I've returned to Serbia and have collected my thoughts, I would like to tell the amateur radio community about my fantastic trip and experience while working the DX pileups from the Vatican at HVØA.

Without the hospitality and assistance from Francesco, none of this would have been possible. From the bottom of my heart, I must thank Francesco for providing me with this tremendous opportunity to operate the much sought-after DX callsign, HVØA. Francesco opened some new doors for me in the hobby.

Perhaps to many readers, this would seem to be a simple DXpedition to organize, but that was definitely not the case. Since spring 2021, when we were first in touch with each other to coordinate and plan my trip, the borders to most countries were closed due to the COVID-19 pandemic. It was unpredictable when they would safely reopen, so it became extremely difficult to plan the travel dates to Rome and the Vatican. We had appointments and plans several times that had to be changed so we were unable to release any information about my planned operation from HVØA.

In September 2021 we were able to enter northern Italy, however we could not continue our journey since it was forbidden to travel from one region to another within the country. Many plans, arrangements, and the logistics for the trip were constantly in a state of flux due to matters that were beyond our control. Francesco deserves much of the credit since he persisted to help both Alex and me, even in light of his limited time and many business obligations. His patience and efforts were critical for us to eventually get the required legal clearances and authority to enter the Vatican and operate from HVØA.

Finally, after almost a year and a half, we were able to announce with certainty that YL Marija, YU3AWA, would be QRV and on the air from HVØA on September 17, 2022, the only YL operator in more than 20 years to operate from this prestigious and much sought-after DX location.

I was extremely excited and could not think about anything other than the honor and experience I was about to have and what was waiting for me in the Vatican. Since Alex and I were already in Monfalcone, in northern Italy visiting Alex's family, we booked a flight to Rome so we could work HVØA.

From the moment I stepped into the HVØA building, I was very excited and full of adrenaline. However, I quickly became very comfortable and relaxed thanks to the hospitality of Francesco and his warm and friendly welcome. Following a short conversation and explanation of the equipment at the station, Francesco handed me the headphones and said to me, "Marija, feel free to start operating when you are ready!" I was elated since this was the opportunity I was

It isn't difficult to spot the building in Vatican City that houses HVØA! (All photos courtesy of the author)

* Email: <yu3awa@gmail.com>

The author (seated), along with host and HVØA station trustee Francesco Valsecchi, IKØFVC

Francesco and the author's mentor and friend, Alex Hajosevic, YT3H, on a nearby rooftop with the HVØA antennas in the background.

looking forward to for so long and finally my dream was coming true.

QRV From HVØA

I started my operation on 40 meters since that was the best band at 07:40 UTC when I logged my first QSO and the upper HF bands were not open yet. Of course, at that hour there were many Italian stations on 40 meters. Imagine what a huge pileup of Italian stations sounds like.

The pileup from just the Italian stations was overwhelming and it was impossible to distinguish one callsign from another, so I immediately began split-frequency operation, listening up 5 to 10 kHz. This was my first time operating split frequency and it worked out extremely well. There were so many Italian stations calling me, it was difficult to hear other stations from outside of Italy. I enjoyed every moment and had a lot of fun working so many stations. It was truly an amazing experience. Eventually I moved to 20 meters, continuing my split-frequency operation. This was heaven since there was much less QRM and noise and the callsigns were much easier to discern and copy. Propagation was excellent now on 20 meters. Although I initially was working many stations from Europe, as time went by, more and more stations from outside of Europe, mainly North America, were calling and I logged hundreds of DX QSOs. More than three hours passed without me stopping for even 1 minute. The pileups were getting bigger and bigger. I really enjoyed it and on all 10 kHz, many stations were calling me.

Next, I moved to 17 meters. The signals on 17 were even more understandable, while continuing my split-frequency operation. After about four hours, propagation changed and I handed the station over to top-notch CW operator Alex, YT3H. Alex also operated split frequency in the CW portion of 17 meters.

I had lunch while I enjoyed watching Alex with his speed and proficiency handling the huge CW pileup. Eventually he moved to 30 meters. However, during this time I wasn't observing Alex since I was enjoying my conversation with Francesco. We both exchanged many stories about our amateur radio activities and some of our interesting life experiences. During my conversation with Francesco, I realized some very important things that I will share with you at the end of my story.

Alex continued to masterfully handle his CW pileup, and it was decided I would take over the station again and continue

to make additional DX contacts on SSB. In our 7 hours and 20 minutes on the air, a total of 964 QSOs were logged, 707 on SSB and 257 on CW. The QSO rate was 2.22 per minute. Since this was not a contest and our first operation with limited operating time from the Vatican, we felt very satisfied with our DX contacts and number of QSOs, and I felt we handled the pileups quite efficiently. We had over 150 spots on the DX cluster which shows the tremendous amount of interest the DX community had following us and trying to contact us.

At times we answered a station with part of their callsign and they would respond, however other stations tried to call at the same time causing QRM which slowed down our QSO rate. This frequently happens to everyone when they operate from a rare DX entity. I am very motivated to learn and further improve my operating skills. We all can strive to become better operators and improve our skillsets while handling the big pileups.

I would also like to mention the incredible collection of both QSL cards and letters that Francesco has received throughout the years. While I was reading the letters from fellow amateur radio operators, I felt I was holding something very valuable and precious in my hands. They are memories and thank-you notes from some very special QSOs with HVØA. I can't tell you how many emails and messages I've received since returning to Serbia. The support, encouragement, and positive comments from so many people, and the wonderful messages on how we managed the pileups were very gratifying. Everyone has made us very proud and happy!

A Few Notes About Francesco

Dear friends and fellow radio amateurs, not everything is always as it seems. There is always another side to the story. Francesco Valsecchi, IKØFVC, is a person who is extremely dedicated and loves what he does. Aside from his professional business commitments and very busy schedule, he puts all his efforts into keeping HVØA in existence and on the air! Vatican City ranks number 111 on the DXCC most-wanted list. He dedicates his free time to working with people to obtain donations, making good deals, and doing whatever it takes to help fund the HVØA operation and keep the station on the air with a great signal. Francesco puts in a lot of his own personal funds to keep the station operational and up to date with excellent equipment. The funds he receives for paper QSL card requests are minimal to cover the cost of the cards and rising postage costs. Francesco is truly a dedicated friend to the amateur radio DX community. His time and devotion to the station are second to none. Time is the most precious thing we have and we can never get it back or be compensated for it. [*It was for this dedication to keeping HVØA active, as well as 1AØKM from the Sovereign Military Order of Malta, another independent enclave in Rome, that Francesco was recognized in 2021 with induction into the CQ DX Hall of Fame. – ed.*]

I am proud and honored to have met Francesco. I was inspired by his work, dedication, positive attitude, and his commitment to our wonderful hobby. I'm very appreciative for everything he provided and made possible for me and Alex. These are fantastic memories I will have for the rest of my life, not to mention a wonderful once-in-a-lifetime experience! Francesco, thank you for everything. I will forever be grateful to you!

All roads lead to Rome, and I threw a coin in the Trevi Fountain. Legend has it that whoever throws a coin into the fountain returns to Rome, so all fellow DXers, be QRV!

Alex looks on as Marija works SSB pileups from HVØA. Alex operated CW and they worked a combined 964 QSOs during a 7.5-hour visit.

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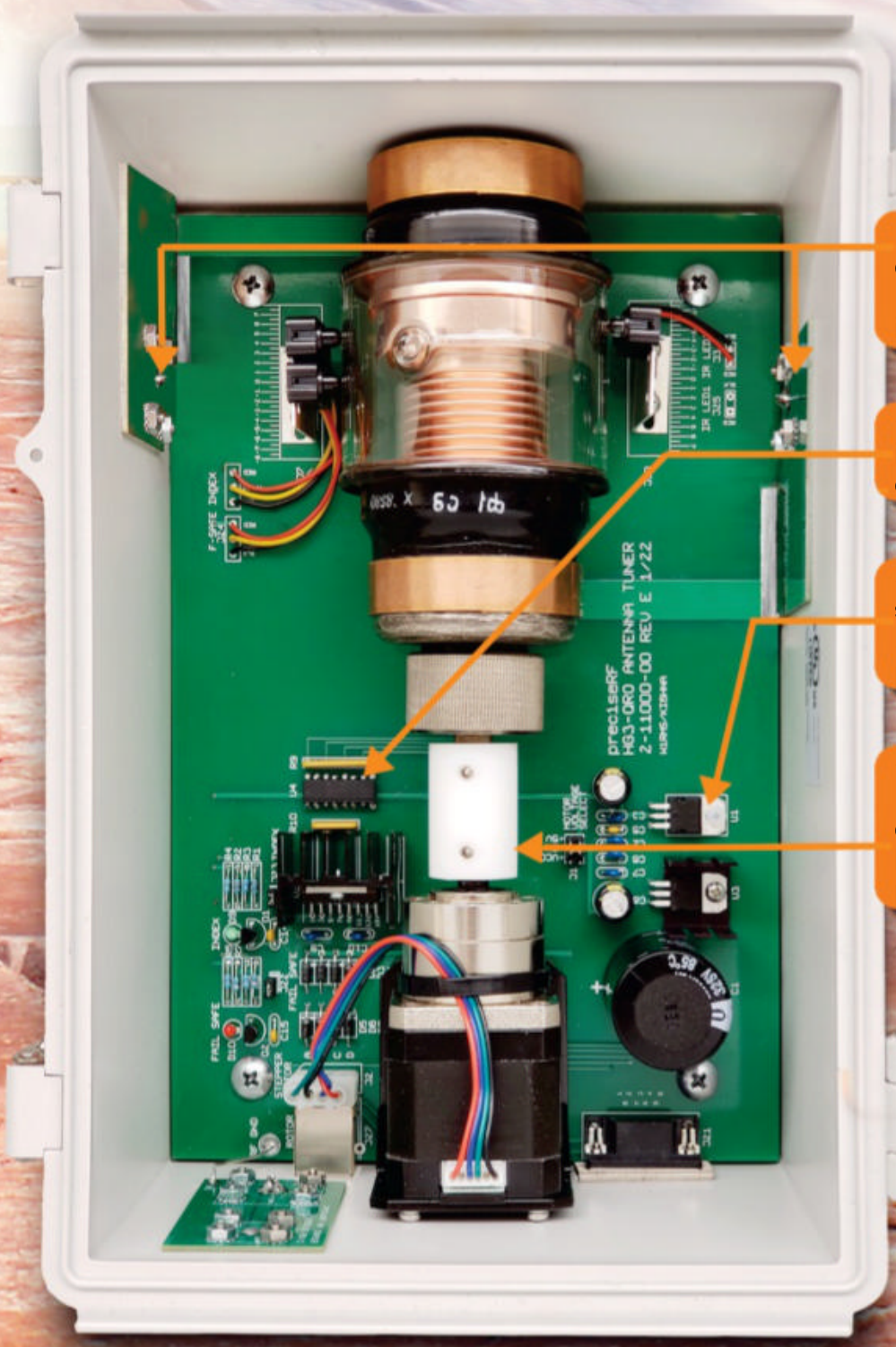

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Now, this is DX — radio signals traveling a billion light years through space — detected by radioastronomers in Canada, a branch of science that has its roots in amateur radio. Contributing Editor At-Large Martin Butera brings us the details.

CHIME and the Billion-Year-Old Radio Signal

BY MARTIN BUTERA,* PT2ZDX/LU9EFO

The international scientific community announced last summer that a mysterious radio burst with a pattern similar to a heartbeat had been detected in space. The signal was detected by the innovative Canadian radio telescope called CHIME (Canadian Hydrogen Intensity Mapping Experiment) (*Photo A*). Scientists and astronomers estimate that the signal came from a galaxy about a billion light-years away, but the exact source and nature of this signal are unknown.

To begin explaining this phenomenon, let's first quickly define what radio bursts are. Fast radio bursts, or FRBs, are intense millisecond bursts of radio waves, which are of as yet unknown origins. The first FRB was discovered in 2007 and since then, hundreds of these fast cosmic flashes from the universe have been detected.

This new signal, discovered in July 2022, was named FRB 20191221A, and it has several distinctive features:

- The radio signal comes from a galaxy at least a billion light years from Earth.
- It is the FRB with the longest duration and with the clearest periodic pattern ever discovered so far.
- The signal "beats," that is, it is issued regularly, and this has surprised the entire scientific community.

The CHIME Radio Telescope

CHIME, the Canadian Hydrogen Intensity Mapping Experiment, is a radio telescope specially designed to answer some of the most important questions in astrophysics and cosmology today. This is different from most other radio telescopes in that it doesn't have any moving parts. The idea was originally conceived to map the most abundant element in the universe, hydrogen. This unusual radio telescope is optimized for high "mapping speed," which gives it a large instantaneous field of view and wide frequency coverage.

The digitized signals collected by CHIME are then processed to form a three-dimensional map of hydrogen density, from which various data can then be observed, including a fast and transient radio emission, which is defined as a "radio burst."

The Antennas of the CHIME Radio Telescope

The radio telescope consists of four adjacent 20-meter by 100-meter cylindrical reflectors oriented north-south. The focal axis of each cylinder is lined with 256 dual-polarized antennas, each receiving radiation from a large swath of sky

** Contributing Editor, CQ*
Email:<martin_butera@yahoo.com.ar>

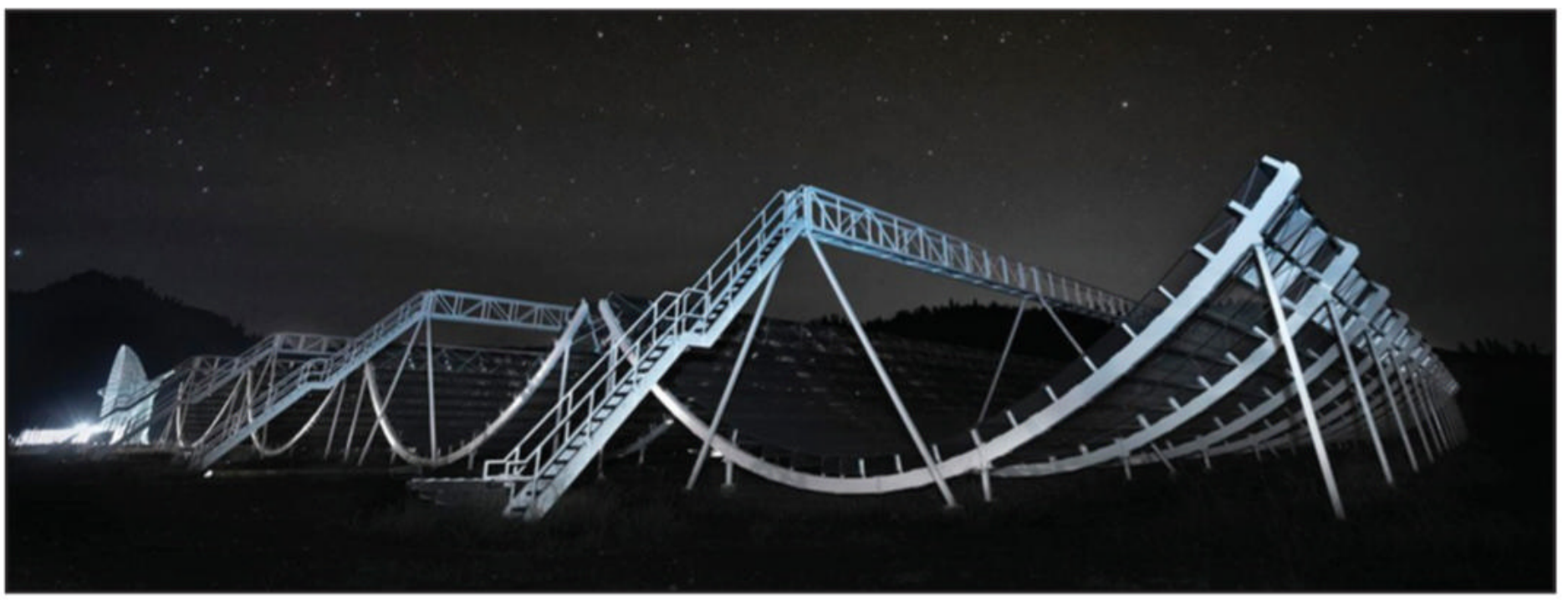


Photo A. The antena array at the CHIME (Canadian Hydrogen Intensity Mapping Experiment) radio telescope. (All images courtesy CHIME)

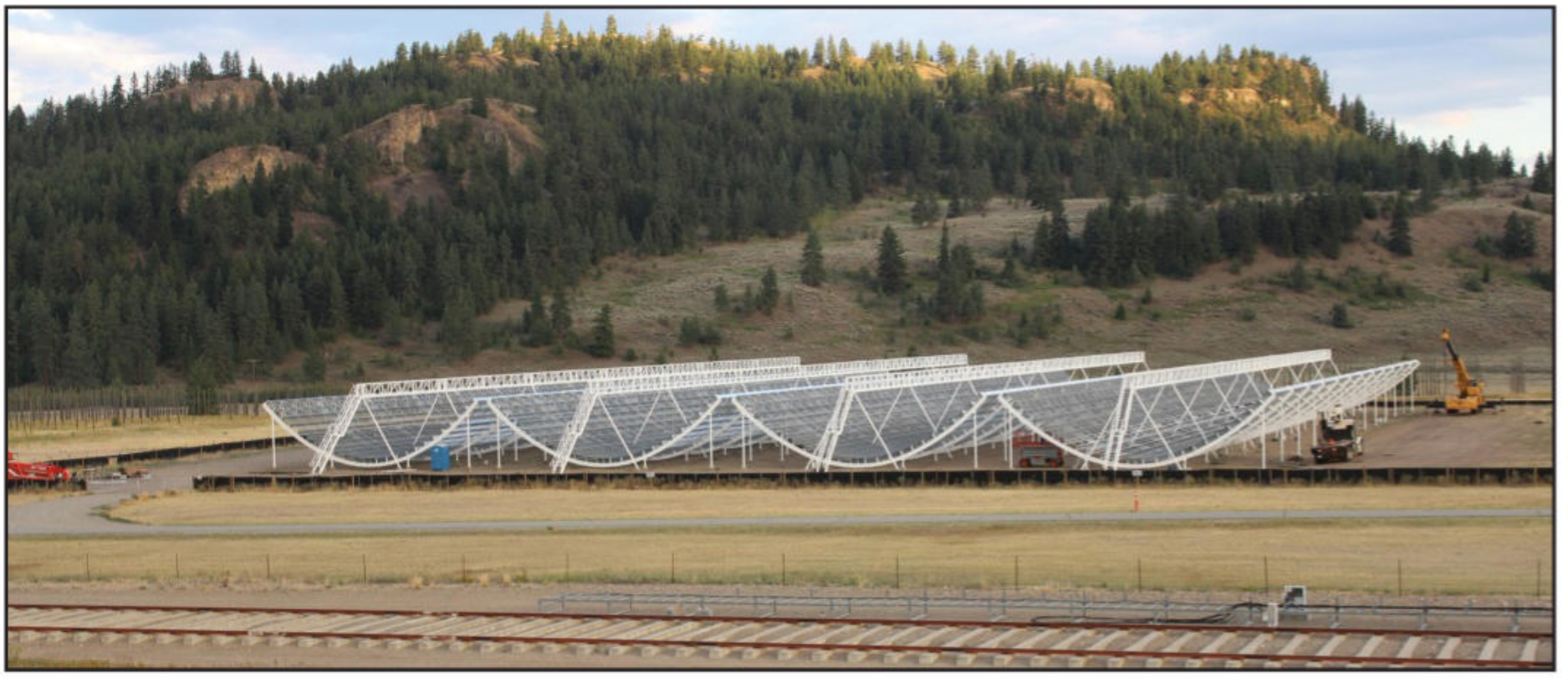


Photo B. A daytime view of the CHIME radio telescope, located at the Dominion Radio Astrophysical Observatory in British Columbia, Canada.

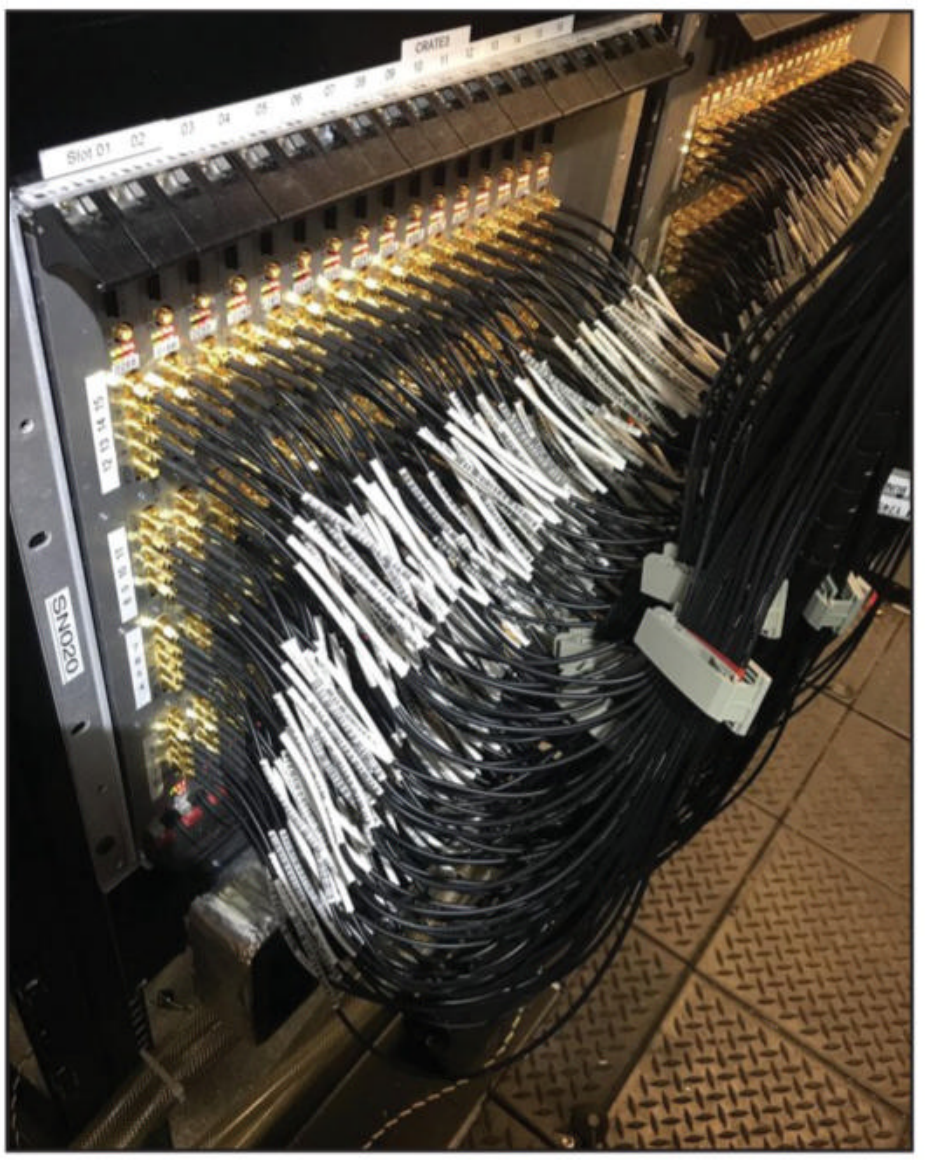


Photo C The CHIME radio telescope's powerful processors are housed in two specially protected 20-foot shipping containers 40 feet underground. In this photo, the "F engine" digitizes each analog signal input 800 million times per second and converts every microsecond of data (2,048 samples) in a frequency spectrum of 1,024 elements between 400 and 800 MHz, with a frequency resolution of 0.39 MHz. The co-located "Engine X" contains 256 computer nodes housed in 15 refrigerator-sized racks. Each node is responsible for processing 4 of the 1,024 frequency bins by collecting its share of digitized signals.

that stretches almost from the northern horizon to the southern horizon.

CHIME antennas are custom designed to have good sensitivity from 400-800 MHz, in both linear polarizations. This gives CHIME its great frequency coverage.

Fast Radio Burst Detector

To search for FRBs, CHIME continuously scans 1,024 separate points or "beams" in the sky 24 hours a day, 7 days a week. This data is analyzed in real time, then that collected data is packaged and sent over a high-speed network to FRB's back-end search engine, which is housed in its own specially designed shipping container, 40 feet underground (*Photo C*).

The FRB search engine consists of powerful CPU cores and large RAM memory. This powerful computer processes and combines the information from all 1,024 beams to determine location, distance, and features once an FRB event has been detected (*Figures 1* and *2*).

Unique Aspects of FRB 20191221A

While the CHIME radio telescope has detected many FRBs with different properties, there is a fundamental difference between the new signal and the radio emissions previously detected: FRB 20191221A is more than a million times brighter.

There are many powerfully bright bursts expelled in an exceptional way and the radio telescope was lucky enough to capture this one before the emitting object returned to normal. It is still unknown what could be the mechanism that drove this sudden activity.

Now, astronomers just have to stay tuned so they don't miss the next periodic burst from FRB 20191221A. Perhaps in this way they will be able to understand the origin of this intriguing signal, even stranger than conventional FRBs.

Radio Astronomy is a Direct Descendant of Radio Amateurs

Of course this will be a quick summary, to explain the common link between radio astronomy and radio amateurs.

As some already know, radio astronomy is a branch of astronomy that studies celestial objects and astrophysical phenomena by measuring their emission of electromagnetic radiation in the radio region of the spectrum.

Following Guglielmo Marconi's successful transatlantic communications in 1901, the commercial use of radio boomed. Outside of the commercial use of frequencies, we radio amateurs exist. In 1921, radio amateurs began to try to communicate across the Atlantic using the shortwave frequencies.

In December 1921, an amateur station in Connecticut was heard by an American radio amateur who was sent specially to Scotland with innovative receiving equipment.

On November 27, 1923, hams in the U.S. and France made the first two-way transatlantic contacts, on HF. In the following two months, 17 radio amateurs from Europe and America made two-way transatlantic contacts on HF.

These insights proved that ionospheric refraction could allow good global communication with shortwave (HF) radios. Further experiments by amateur radio showed that by using various frequencies in the HF area, wide-field communications could be maintained during the day and at night. It should be noted that these communications were carried out with low-power transmitters.

Once radio amateurs demonstrated the value of the HF band, many commercial firms became interested. One of

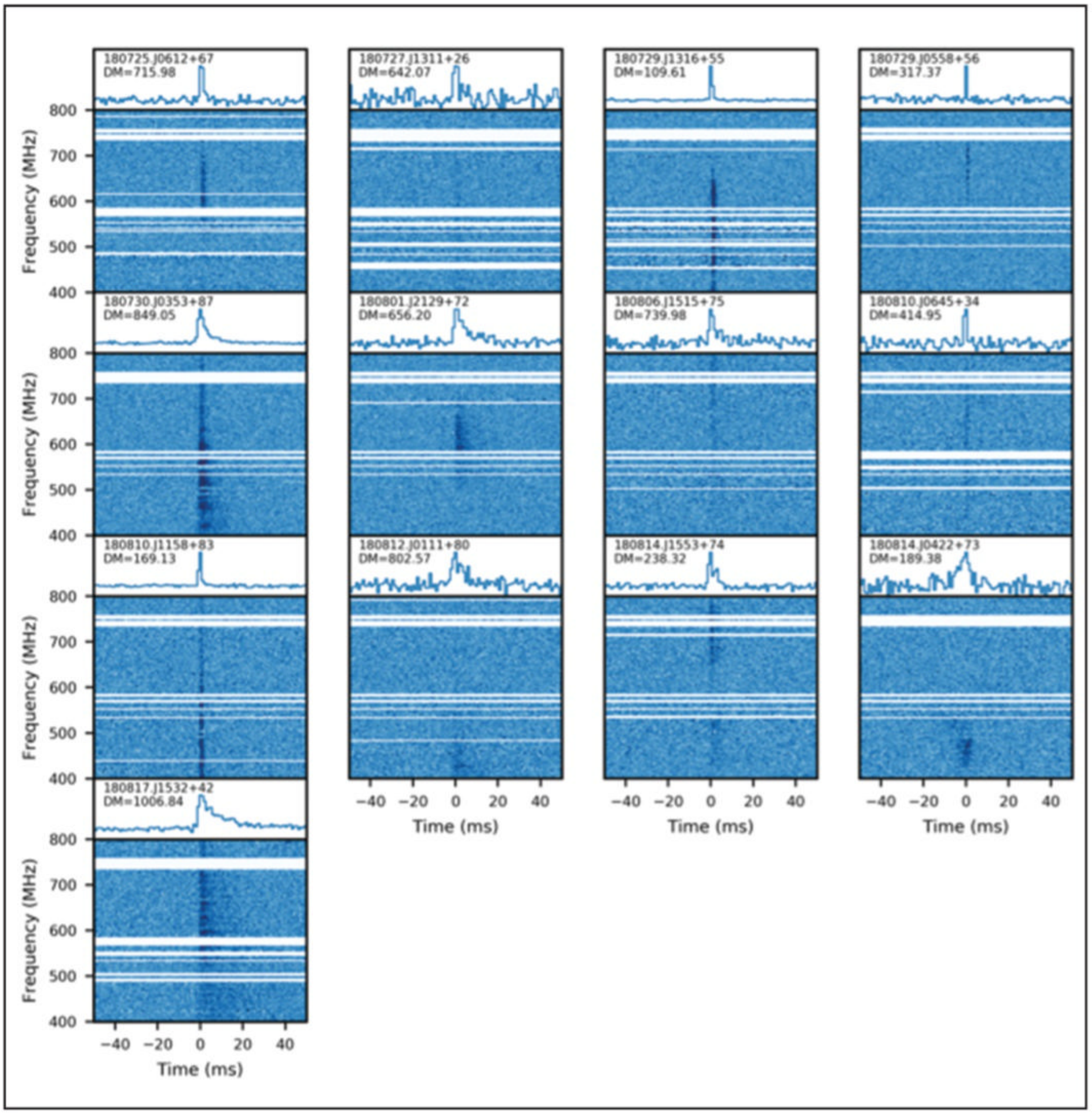


Figure 1. The first FRBs, or fast radio bursts, found by CHIME.

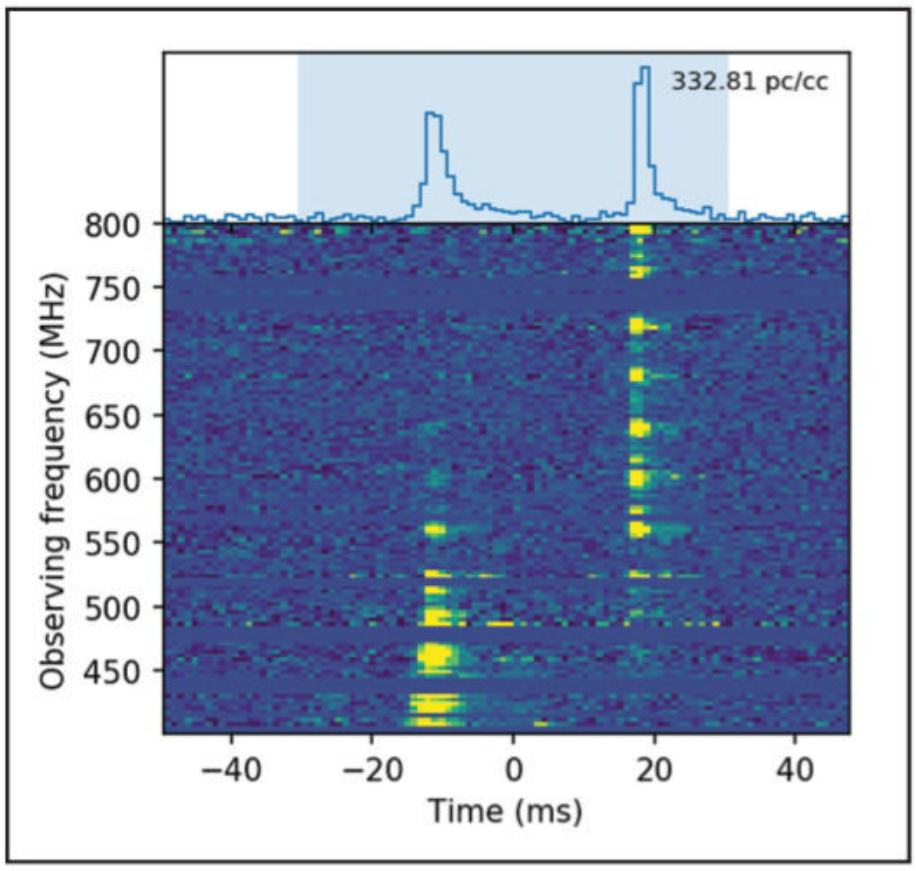


Figure 2. The waterfall image of galactic magnetar SGR 1935+2154 detected by CHIME. This bright pulse suggests that the magnetars could be repetitive FRB parents.

them was the famous phone company, AT&T, which thought that HF connections could be used to carry intercontinental phone calls, saving the cost of cable on the seafloor. However, as any radio amateur or shortwave listener knows, HF communications can be quite noisy.

At AT&T Bell Laboratories in New Jersey, a young radio engineer named Karl Jansky was given the task of identifying the sources of noise on the HF bands. He built a highly directional antenna and began systematic listening and observation. As expected, he found that most of the noise was due to thunderstorms and other terrestrial causes.

However, he then found a source of noise that seemed to be caused by something else. What Jansky found ended up being radio noise emitted directly from the center of our Milky Way galaxy. Jansky discovered this in 1932 and announced it in 1933. His announcement was published on the front page of the *New York Times* on May 5, 1933.

For most professional astronomers, Jansky's discovery was a simple curiosity, and they decided not to continue with it. In Wheaton, Illinois, the news finally reached Grote Reber, another radio engineer, who was also an avid radio amateur, callsign W9FGZ.

In 1937, Reber built his own 32-foot-diameter dish antenna in his backyard to search for radio transmissions from space. Let us remember that artificial satellites were only a dream at that time and the process of inventing television had just begun. So Reber's dish was quite advanced for the time.

In the spring of 1939, he was able to detect cosmic radio emissions with his antenna. In 1941, he made his first survey of the sky in radio wavelengths. Reber continued to work on radio astronomy for many years, and his results were published in the "Proceedings of the Institute of Radio Engineers," the "Astrophysical Journal" and the "Journal of Geophysical Research."

The accidental discovery of cosmic emissions and Reber's development of radio astronomy meant that there will always be a direct connection between radio amateurs and radio astronomy.

Many prominent radio astronomers first became interested in science as radio amateurs as youngsters. Among these astronomers is the winner of the 1993 Nobel Prize in Physics, Dr. Joseph Taylor, K1JT, creator of the famous weak-signal communication software known as WSJT.

The Future of Looking Into the Past

Radio astronomy is still a relatively new area of astronomical research, promising many more exciting discoveries. Currently, in addition to CHIME, there are several other gigantic radio telescopes, allowing observations of a resolution impossible at other wavelengths.

Sources and Additional Information

This article is based on a paper published in the July 2022, issue of *Nature,* one of the world's most prestigious scientific journals.

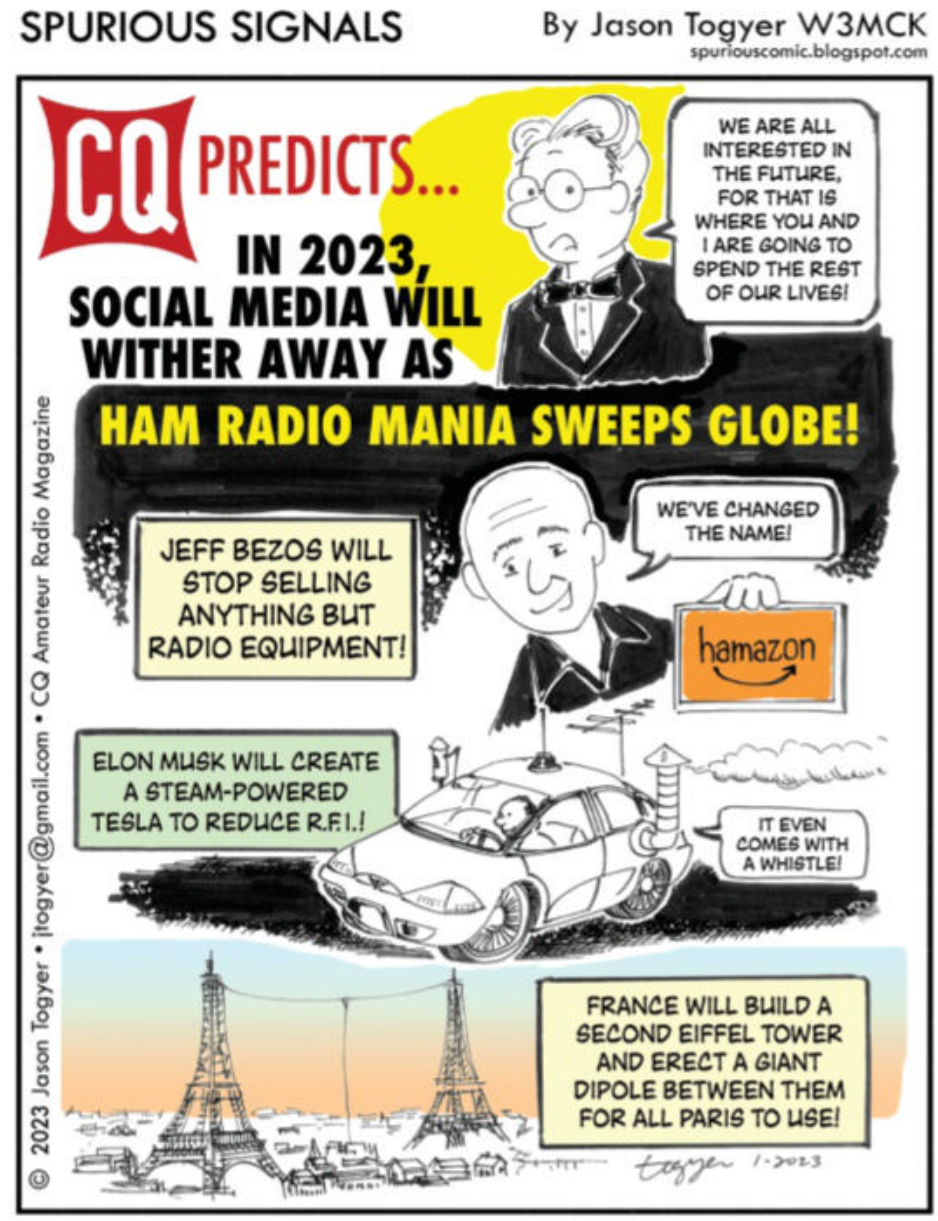
Additional information is also available from the following sources:

CHIME (Canadian Hydrogen Intensity Mapping Experiment) - <https://chime-experiment.ca>

CIRADA (Canadian Initiative for Radio Astronomy Data Analysis) - <https://cirada.ca>

Canada's national public broadcaster, through "The National", CBC News' flagship nightly newscast, shares a brief report on CHIME radio telescope on YouTube at <https://youtu.be/Zf64RZq4rXA>.

CQ Editor Rich Moseson, W2VU, interviewed Joseph Taylor, K1JT in the October 2009 issue. A supplement to the print interview was posted online at <https://tinyurl.com/2p92zc67>.



Since this issue's offering from Contributing Editor-at-Large PT2ZDX/LU9EFO is about a billion-year-old signal detected by a radiotelescope in Canada, we thought it would be fun to go back in time (not quite a billion years, just 20) to reprise W5FG's November 2003 report on visiting the father of radioastronomy — Dr. Grote Reber, ex-W9GFZ — in Tasmania shortly before Reber passed away in late 2002.

Back in the 1930s, Grote Reber, W9GFZ,[1] used his ham radio skills to build an unusual antenna to pick up even more unusual signals—radio signals from outer space. Today Dr. Reber is recognized as the father of radio astronomy. In late 2002, Jack Najork, W5FG, visited Dr. Reber just a few days before his death. Here is Jack's story, based on his visit and additional information from Dr. Reber's friend, Jim Davis, VK70W.

120 Dipoles on 400 Acres: Grote Reber's Final Legacy

BY JACK NAJORK * W5FG

As a young ham in 1937, Dr. Grote Reber built one of the world's first radio telescopes in his back yard in Wheaton, Illinois. Dr. Reber died last December 20 in Tasmania, two days shy of his 91st birthday.

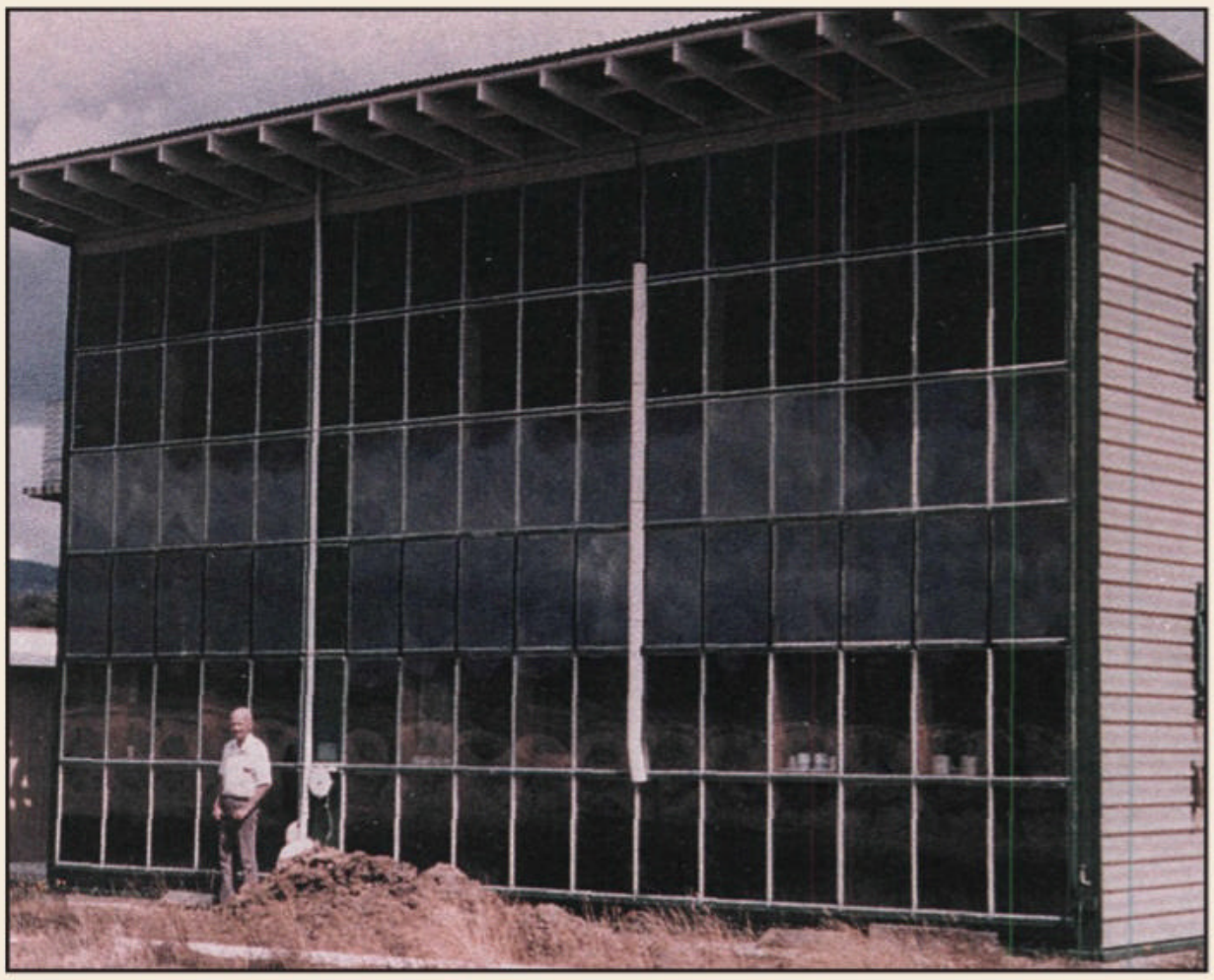
Born in Chicago, Reber studied radio engineering and worked for various radio manufacturers from 1933 to 1937. During this time, he applied for a job with Karl Jansky at Bell Labs. In 1932 Jansky had discovered that radio waves were originating in the vicinity of the Milky Way, and Reber was anxious to explore this field. However, America was in the midst of the Great Depression, and jobs were not easy to find. He struck out with Jansky.

Reber decided to explore radio astronomy on his own. In 1937, using half a year's savings from his radio manufacturing jobs, he built his radio telescope. The radio mirror, which was made of sheet metal and had a diameter of 31.4 feet, was first used with a receiver tuned to 3300 MHz, but failed to detect signals. A second receiver, at 900 MHz, also failed. Finally, in 1938, a receiver tuned to 160 MHz detected radio emissions from the Milky Way, confirming Jansky's discovery.

Reber began surveying radio radiation from the sky and displayed this data as contour maps, with the brightest parts toward the Milky Way galaxy in the south. Other bright radio sources, such as Cygnus and Cassiopeia, were recognized for the first time.

From 1938 to 1943, Reber published his results in both engineering and astronomy journals. His work ensured that radio astronomy became a major field of research

Jim Davis, VK70W, Dr. Reber, and William Howe (left to right) outside Reber's radio shack in Tasmania in 1984. Howe was with the US Naval Research Lab in Washington, D.C., and worked with Dr. Reber for many years. (Photos courtesy VK70W)



Dr. Reber in front of his solar-heated house in Bothwell, Tasmania.

following the end of World War II. Research groups in many countries began building bigger and better antennas and receivers to follow up on Reber's discoveries.

Reber went to work on new radio telescopes worldwide. From 1957 to 1961, he worked at the National Radio Astronomy Observatory at Green Bank, West Virginia, where he donated his original dish in the early '60s. It remains there as a historical monument.

Later in the 1960s, Reber turned his attention to the lower-frequency spectrum—1 to 2 MHz. At these frequencies, outer space radiation has difficulty penetrating the ionosphere, except over certain parts of the Earth and at times of low solar activity.

One such location was "down under," in the region of Australia. Nearby Tasmania offered a view of the southern sky and the middle of the Milky Way galaxy. There, on 400 acres of sheep-grazing pasture, Reber erected a huge array of over a hundred 80 foot poles strung with 120 dipoles resonating near 143 meters, fanning out like spokes on a bicycle wheel.

From 1963 to 1967, Reber gathered enough data to map almost the entire southern sky.

Despite the favorable Tasmanian location, the ionosphere still shielded some radiation from Reber's array. According to Australian newspaper reports, Reber was able to call on NASA for help. On a pass over Tasmania, the space shuttle Challenger reportedly ejected ionospheric dispersants from a pre-arranged payload, thereby giving Reber's array a clear, unobstructed view of space at 143 meters.[2]

Last year on a tour of New Zealand, Australia, and Tasmania, I visited Dr. Reber in the hospital just a few days before he died of cancer. Although very feeble, Reber was still mentally alert, and he joked that sudden old age had stopped his work. When asked what happened to his huge array, Dr. Reber smiled and said that those seasoned wooden poles had been cut up for firewood and had kept most of Tasmania warm for several winters.

Dr. Reber was cremated in December 2002. In accordance with his wishes, his ashes were scattered over two locations. The first was Mt. Rumney, where he first successfully probed for LF space radiation. The second was the site of his antenna farm in Bothwell. Both locations are in Tasmania, where he lived for 30 years.

Often described as a "loner," Dr. Reber never married and left no family.

Notes

1. Although Reber dropped out of ham radio as his career progressed, his old call, W9GFZ, is in use today as a memorial by the National Radio Astronomy Observatory Amateur Radio Club in Socorro, New Mexico.
2. This report could not be confirmed in the United States.

Since we're already looking back at Grote Reber and radioastronomy, we thought it would be fun to also take a look back — this time only about 10 years — to a circuit design by WØXI that combined elements of radio telescope technology with the work of another radio pioneer, Edwin Howard Armstrong, to create a very effective CW filter. This article first appeared in the November 2012 issue of *CQ*.

WØXI has token some of the earliest radio technology and merged it with radio astronomy techniques to help make your CW listening more comfortable on a noisy band.

An Audio CW Regen Filter Combining Aspects of Armstrong's Regenerative Receiver with Reber's Radio Telescope

BY PHIL ANDERSON,* WØXI

In college I had a professor who insisted that all of our projects include at least two disciplines. In one project on traveling waves he had us combine our efforts with a home-economics class. We had to assist the gals in producing a Baked Alaska and they had to assist us in measuring the time it took for the heat in the oven to reach through the meringue and cake and melt the ice-cream core. Multiple rewards followed this effort, as you can imagine. Ever since then I seem to automatically compare a project at hand with anything remotely related.

Soon after obtaining a new Yaesu FT-450D last year, which has a good receiver and DSP filtering, I found that the ever-present galactic and manmade noises on 40 meters still partially masked readable but weak CW signals. Having recently reviewed Grote Reber's fundamental work in measuring star noise and Edwin Howard Armstrong's classic regenera-

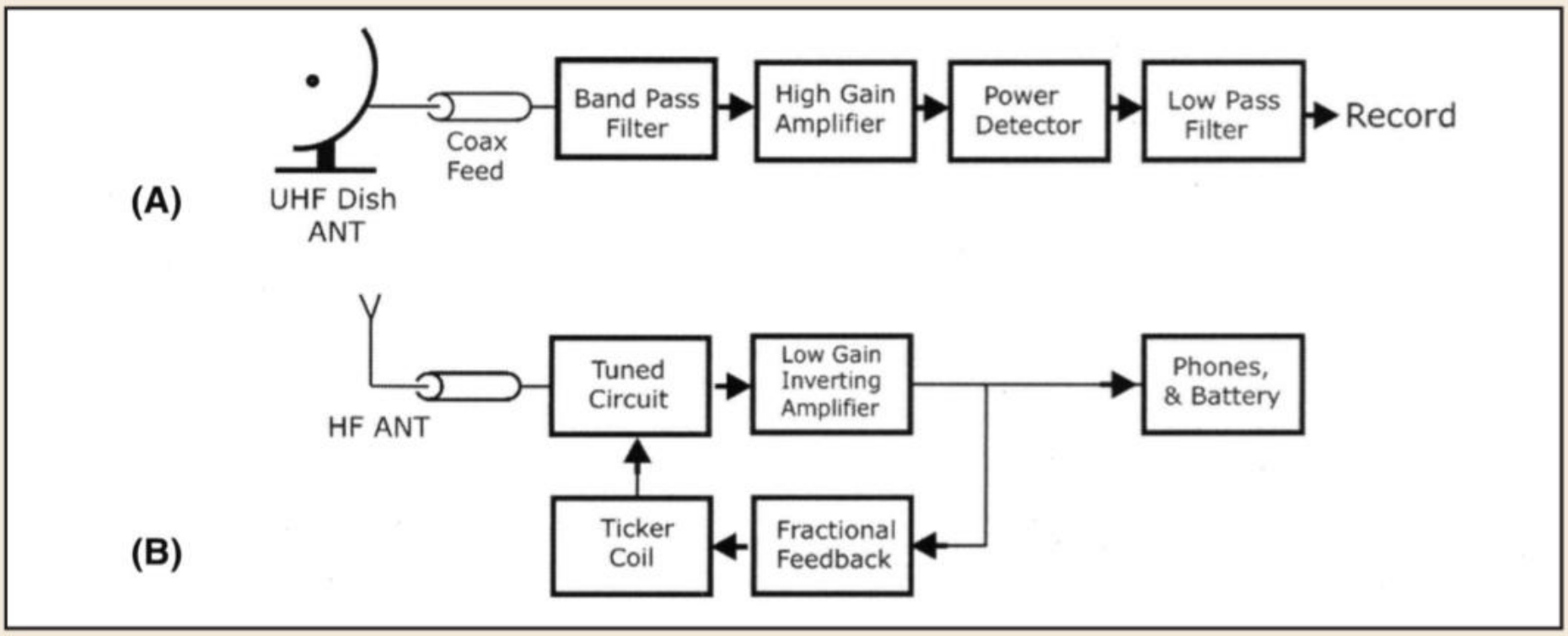


Fig. 1- Block diagrams of the basic technologies behind this circuit, the radio telescope and the regenerative receiver.

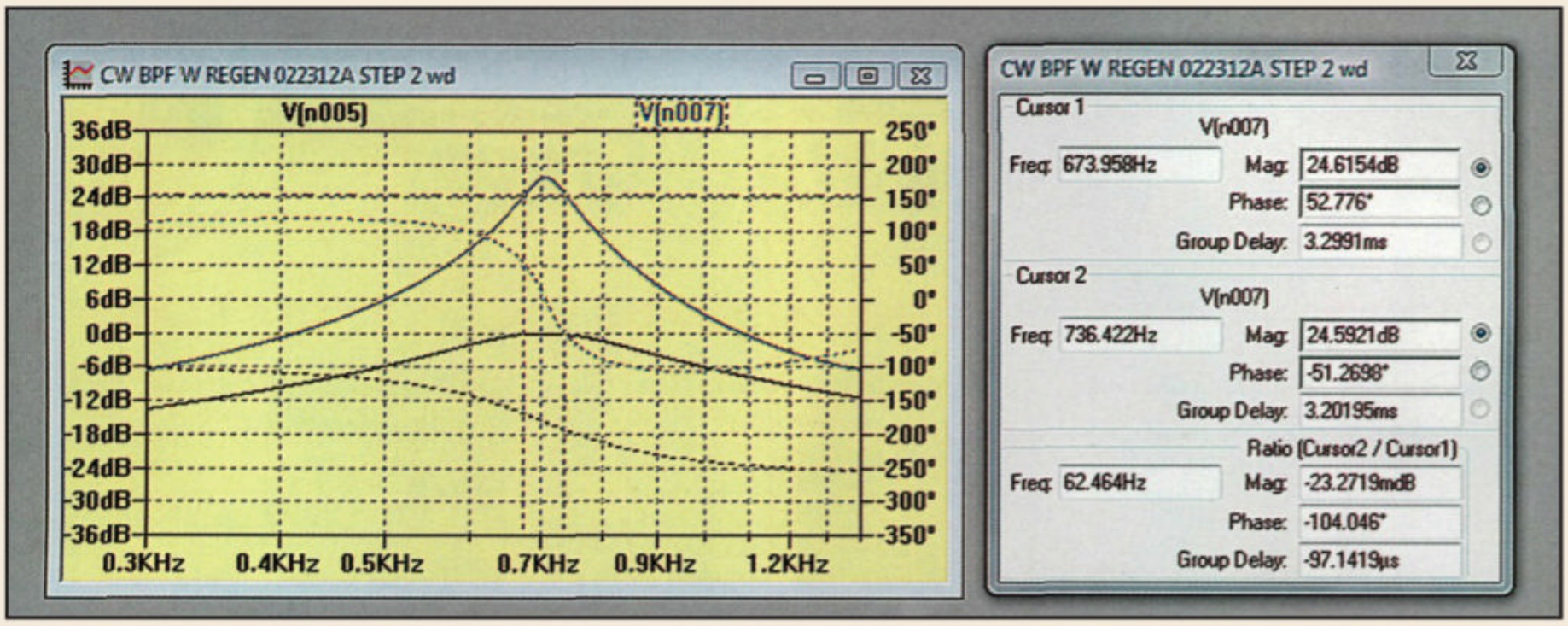


Fig. 2- Audio regen reduces band-pass filter width with regenerative gain.

tive receiver, a favorite of mine, I wondered if their techniques of measuring weak noise signals and boosting coherent signals might be combined to scrub away some of the noise still reaching my headphones. The answer seemed to be yes, in certain situations, using signal integration and audio regeneration. We'll review the architecture of Reber's radio telescope and Armstrong's early radio receiver and then describe my audio regen CW filter[1]. First, however, who were Grote Reber and Edwin Armstrong?

Grote Reber and His Radio Telescopes

Grote was a radio amateur (W9FGZ) and engineer who lived in Wheaton, Illinois. In 1937, he became interested in discussions of the day on the electrical disturbances apparently coming from extraterrestrial sources, known to amateurs as static. This led him to construct a large parabolic dish and a series of receivers to catch this noise. Reber's work led to the development of the field of study known today as radio astronomy.

A block diagram of one of Reber's scopes, circa 1940, is shown in fig. 1A. It consists of a 9.5-meter parabolic dish, band-pass filter, six RF stages with a gain of 128 dB at 8-MHz bandwidth, a power detector, a low-pass filter, and a recorder. His dish was adjustable in height above the horizon but fixed to look due south, thus configured as a meridian-transit telescope. He used the rotation of the Earth to scan the sky, adjusting declination (launch angle) each day. Combining these data with his recording times, he was able to produce celestial maps of radio-emission intensity. To detect the level of the noise in each given direction he had to integrate the signal over a short period in order to distinguish that portion of the noise received from all background noise. He was not comparing a coherent signal against noise—as we do with HF radio—but targeted noise in a portion of the sky against all other noise. This requires the addition of a power detector and low-pass filter. As you'll see, our audio project also seeks to reduce as much unwanted noise as possible.

A	α	G	A	α	G
3	0	3.00	6	0	6.00
3	0.050	3.50	6	0.050	8.57
3	0.100	4.30	6	0.100	15.00
3	0.150	5.50	6	0.150	60.00
3	0.200	7.50	6	0.153	73.17
3	0.250	12.00	6	0.165	600.00
3	0.300	30.00	6	>	osc
3	0.310	42.90			
3	0.320	75.00			
3	0.330	300.00			
3	>	osc			

Table I- In a regenerative circuit keeping the basic gain of the amplifier (A) low—as in the left-hand column—provides finer control when adding feedback (α) to achieve the same overall gain (G) than starting with higher amplifier gain, as in the right-hand column. Compare the bold entries in each column. See text for formula by which these figures were derived. Regeneration values above the maximum levels shown results in self-oscillation.

Edwin Armstrong and His HF Regenerative Receiver

Edwin Howard Armstrong was an engineer and inventor born in 1890 in New York City, NY. He has been called the father of radio by many. His works and patents advanced commercial AM and FM radio and included innovative military uses in both World Wars. He is perhaps best known in amateur radio circles for his regenerative detector, using one Audion tube yet producing large signal gain. See the schematic and some comments in the sidebar. *(Armstrong also invented FM and the superheterodyne receiver, which today re-mains the basis of all analog receiver design— ed.)*

A block diagram of a generic regenerative receiver is shown in fig. 1B. It consists of a tuned circuit front end, inverting low-gain amplifier, inverting fractional feedback network, and audio amplifier. The gain of any RF or audio regen can be calculated as follows:

$$G = \frac{A}{(1 - \alpha A)}$$

where G is the overall gain, A is the gain of the amplifier alone, α is that fraction

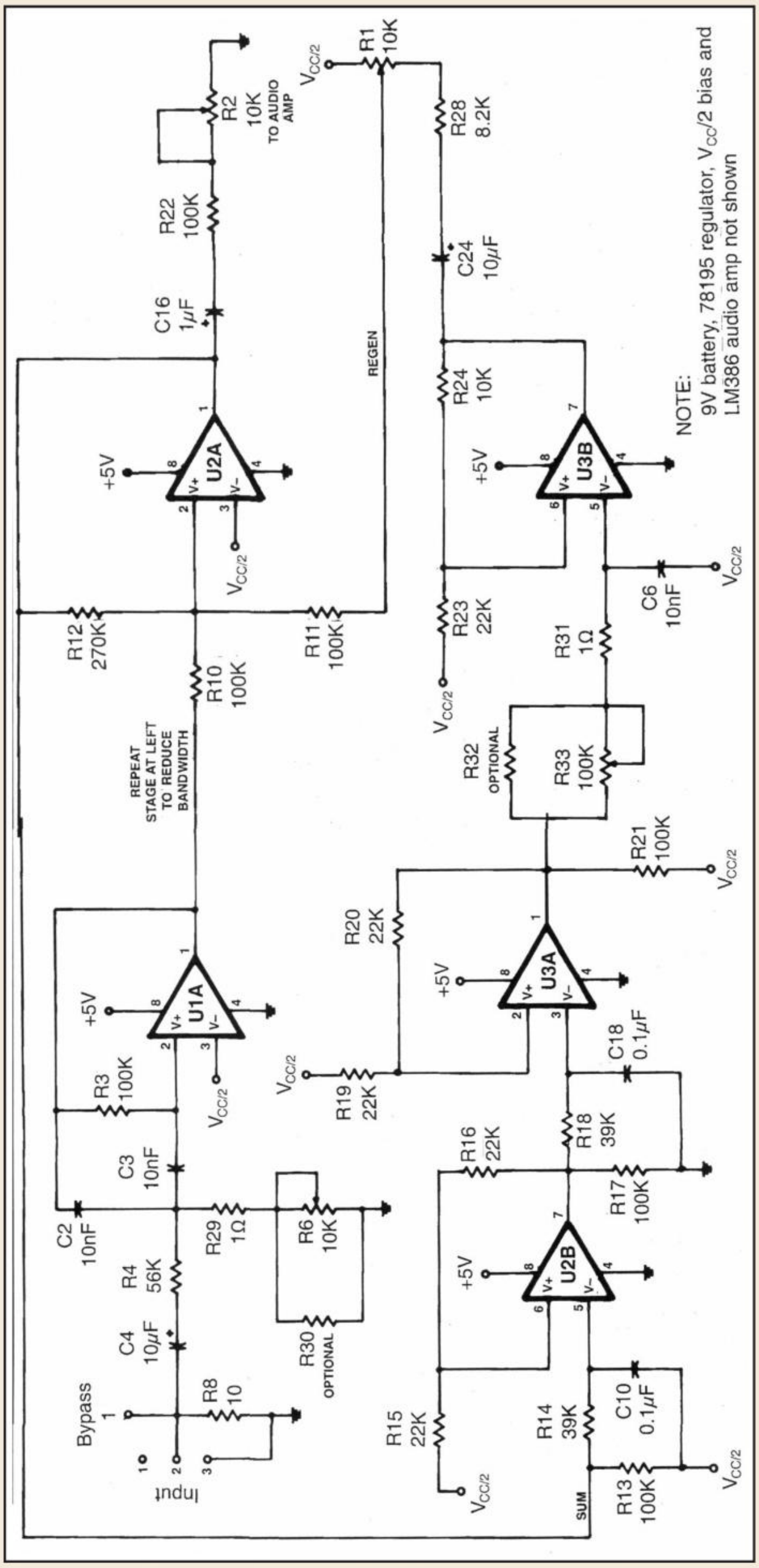


Fig. 3 - Audio regren schematic. Note that U1b is part of the power supply, which is not shown here. See text for circuit explanation and additional details.

of the output fed back to the input, and α A is called the *loop gain*.

Playing with the equation a bit, we can determine the regen's overall gain for different amplifier gains and feedback. Consider the cases shown in Table I. For A = 3 and α = 0% feedback, the gain of the regen is simply the gain of the internal amplifier, or 3. With a feedback of 32% (see highlighted line on left column of table), the regen gain reaches roughly 75. Now consider a regen with an internal gain of 6, as shown in the right-hand column. The total gain then reaches roughly 75 when the feedback is just a bit over 15%. Thus, if A is increased, the range of control—i.e., the percentage fed back—is smaller. For this reason, practice is to keep the gain of a regen low so the feedback control can be finer.

RF versus Audio Regeneration

As one would expect, the block diagram for an audio regenerator can be the same as that for RF. It turns out that moving a regen from RF to audio is easier than the other way around. At audio, we don't have to deal with coils or a throttle capacitor, and our choices for the amplification are expanded to the transistor, JFET, or operational amplifiers, the latter being the most versatile. One thing is certain, however; we must incorporate a band-pass filter somewhere in the audio regen in order to create the ability to reduce the bandwidth with an increase in gain through regeneration. I simulated these aspects using LTspice (see References). The results are displayed in fig. 2. The top trace displays the bandwidth with gain and regeneration in operation. The bottom trace simply measures the bandwidth of the band-pass filter. Clearly, with increased gain the overall bandwidth at the output of the regen narrows. We can use this characteristic to some extent to reject the noise coming from excessive bandwidth. With slow or moderate speed CW, 50 Hz of bandwidth is sufficient for a CW tone to get through, while at the same time rejecting all noise that would have come from a wider bandpass filter. Therefore, our strategy in scrubbing out the noise is to increase the gain of the audio regen until the bandwidth reaches a minimum that will still allow the CW note through.

One question remains: Shall we sum the input and feedback first and then use the regen filter, or shall we filter first and then sum? Although not obvious to me at first, it turns out that either method works. The traditional RF regen sums up front using input coils; it then adds a small amount of gain and feeds a portion back in phase by inverting the phase of the tickler coil. For audio I found that I liked placing the band-pass filter first, followed by a summing operational amplifier. This arrangement requires the addition of a 1/2-cycle delay in the feedback but is compensated for by the fact that the feedback control can use a pot for finer tuning control. Keep in mind either method works. The delay, at audio, can be had by connecting three RC 60-degree phase-shift net-

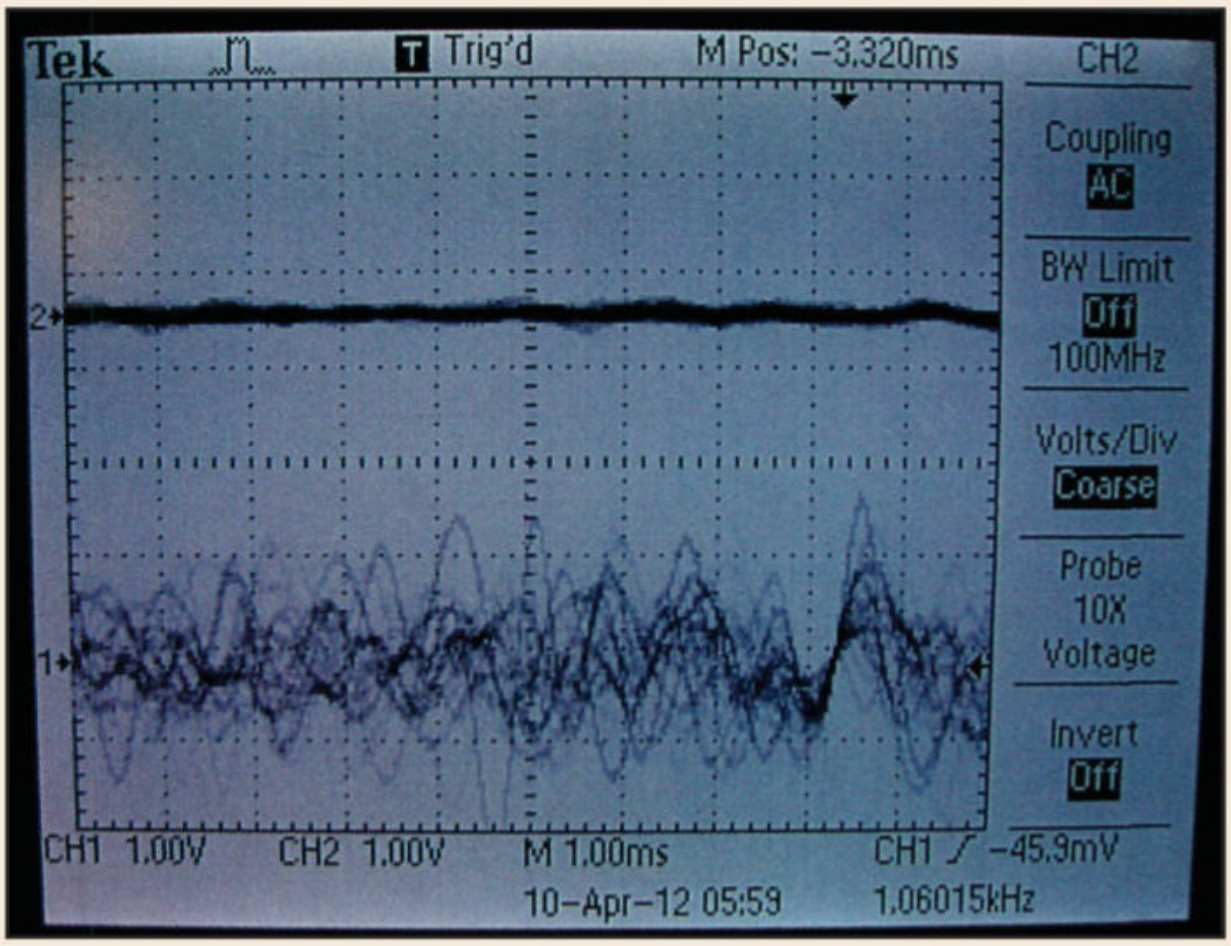


Fig. 4- Oscilloscope trace comparing noise from the regen circuit (channel 1) with the channel 2 trace of the rig's headphone output.

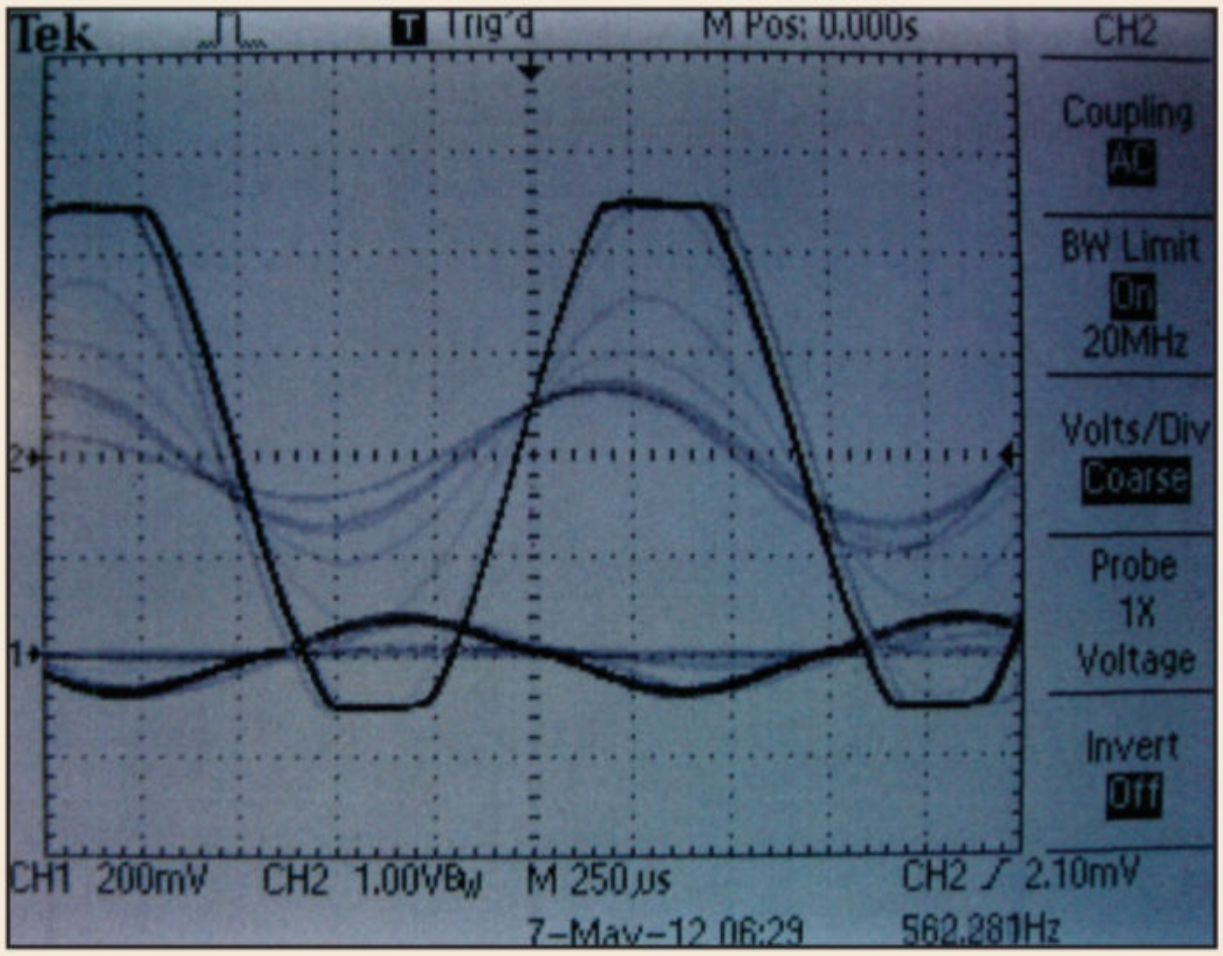


Fig. 5- A trace of the output of the regen and the accompanying input signal. Here the output is displayed on the channel 2 trace and the input on channel 1.

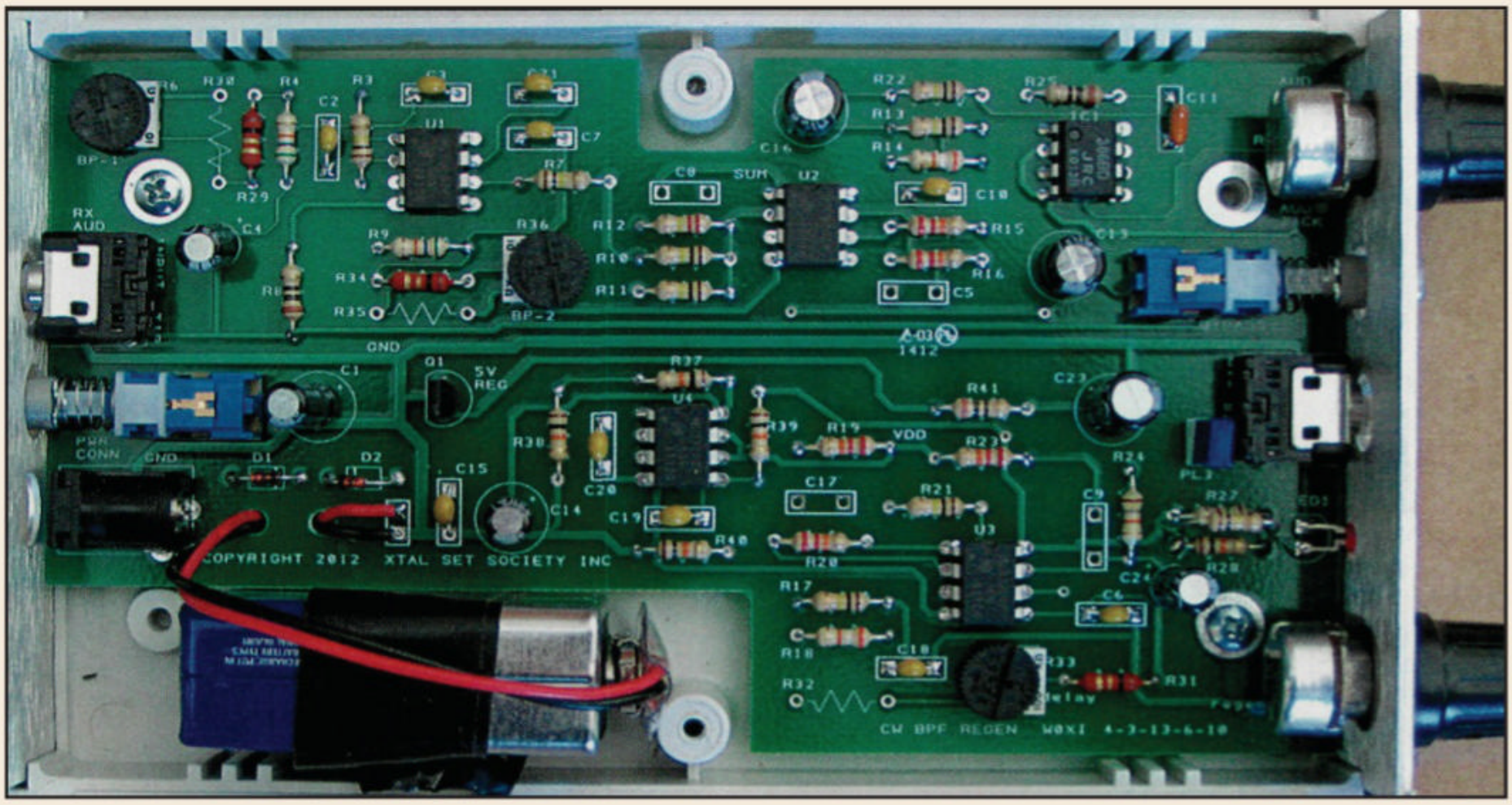


Photo 4 - The audio regen CW filter, available from the Xtal Set Society as the CW Scrubber Kit. Options include board, parts list and schematic only, board and and parts with no case, and a full kit.

Armstrong's Regenerative Detector

Armstrong's detector is shown in the schematic in fig. SB. It was 1912 when Edwin conceived the idea of coupling the plate voltage of the triode tube back into the input or grid circuit. Hobbyists today think of a detector as a diode, as in a 1N34 detector for a crystal set. With Armstrong's detector the RF is not stripped off at the headphones but simply bypasses them via a capacitor and a portion is returned to the input of the tube via a coupling coil, L3, called the tickler.

Let's walk through this circuit. An RF signal arrives at the antenna. It then is magnetically coupled into the grid of the tube from L1 via L2 (like a transformer). As the RF signal there reaches its peak, the current in the diode will reach its minimum. In effect, the voltage at the drain is inverted relative to the input signal. The plate signal is then applied to the tickler coil, L3, and because it is wound backward relative to L2, it flips the voltage again and adds it to the grid via the L3-L2 coupling (a second transformer). This process causes the signal at the plate to build up and the gain achieved is dependent upon the gain of the tube, the turns ratio of the L3-L2 combination, and the position of L3 relative to L2. Large gains are achievable.

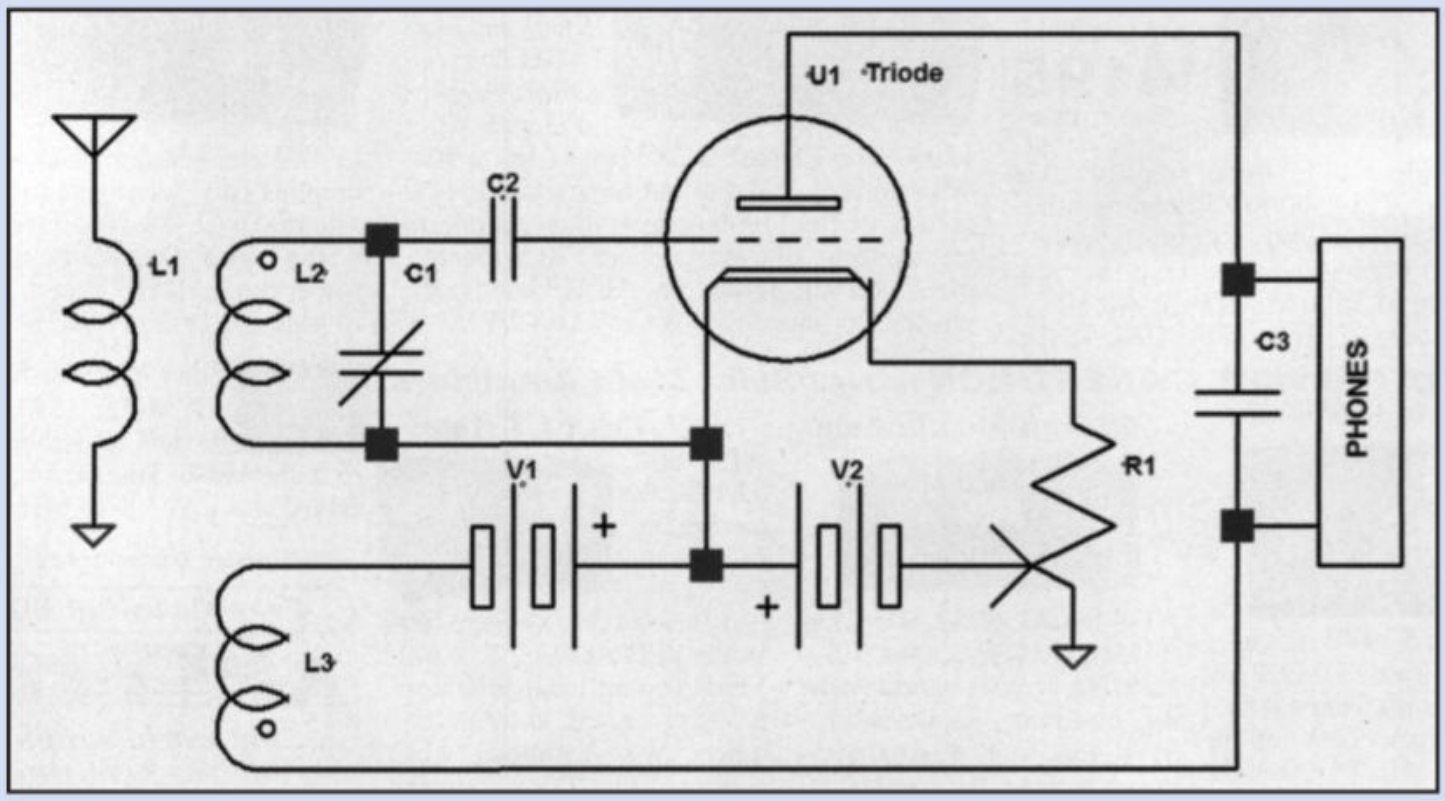


Fig. SB- LTspice simulation of an audio regen circuit. (See References for more about LTspice)

works in series as you'll see in the circuit described below.

Here is the final secret of the project: The regen builds up the desired signal to a much higher level than that arriving from the rig's headphone jack. At the same time, it limits the buildup of the noise due to its reduced bandwidth with gain. The result is then scaled down to limit the increased audio level to a comfortable level.

The Audio Regen

The resulting design is shown in the schematic, fig. 3. Note that all active devices are op-amps except for the output LM386 audio amplifier not shown, which accommodates an 8-ohm pair of headphones or a small speaker. Let's walk through the circuit.

The headphone jack of your rig plugs into the input of this filter at left. Two stages of a multiple-feedback bandpass filter complete the input. You can use just one. A pot is included in each stage to adjust the center frequency. I used 700 Hz, but the pot can be adjusted for anything from 600 to 800 Hz. The summing amplifier follows at U2a, collecting the signal from the band-pass filter and feedback path. As you can see, the gain of the amp is set at 2.7 (270k/100k). The output feeds both the pot going to the LM386 and the threestage feedback network at bottom left. Each stage of the feedback provides for a unity gain amplifier with a 60-degree phase shift. A pot at the input to that third stage was added to calibrate the network for a half-cycle delay of from 600 to 800 Hz. The output of the third stage feeds the regen pot, which feeds the summing amplifier. A low dropout regulator was used to provide the +5V supply required, and one of the unused op-amp sections was used to provide the bias for this single-supply circuit. These common circuits are not shown in the figure.

Operational Results

When listening to HF CW, particularly in the presence of inhibiting galactic and man-made noise, many CW OPS turn the AF volume fully on and manage noise and signal volume with any internal rig filters and the RF gain knob. Even with these techniques, band-limited static that is ever-present reaches the headphones along with the desired signal, particularly at 40 meters. There isn't much one can do to copy CW notes that are simply too weak, but indeed one can scrub away a portion of the static with the audio regen. Thank you, Mr. Armstrong! With my Yaesu FT450D set in USB-CW mode, the IF bandwidth set to a minimum, and the frequency tuned to a quiet spot on 30 meters, the channel 1 noise trace of the regen compares favorably with the channel 2 trace of the rig's headphone output, as shown in fig. 4. A trace of the output of the regen and the accompanying input signal are shown in the second scope trace, fig. 5. Here the output is displayed on the channel 2 trace and the input on channel 1. Note that the regen is producing a full rail-to-rail signal at U2a given a 200 mVpp (millivolts peak-to-peak) input, showing a gain of over 25. At this setting the bandwidth of the regen will be approximately 30 to 40 Hz.

Note

1. A PCB, full schematic, and parts list are available at <www.midnightscience.com>. The W0XI audio regen CW filter is also available commercially as the CW Scrubber Kit from the Xtal Set Society. See ads in CQ or visit <http://www.midnightscience.com/kits.html#kitcwregen>.

References

How to Build Your First Vacuum Tube Regen Receiver, T.J. Lindsay, Lindsay Publications, 1997.

An Introduction to Amateur Radio Astronomy, Phil Anderson, W0XI, 2011, Xtal Set Society.

Secrets of Homebuilt Regen Receivers, by C.F. "Rock" Rockey, Lindsay Publications.

LTspice. It's a software package that enables circuit analysis and is supplied free via the web by Linear Technology <http:// www.linear.com/designtools/software/>.

Results of the 2022 CQ World Wide VHF Contest

BY JOHN "JK" KALENOWSKY,* K9JK

Wow ... hard to believe that this is already my fourth year as director for this contest. Just as I think I'm starting to get the hang of my duties as director: Monitoring log submissions and responding to questions from participants, doing the log checking, compiling the results, writing this article, some things happen and best laid plans encounter difficulties — more on that later in the article.

This year's third full weekend of July was another active year for the CQWW VHF Contest, though the impact of world events was definitely felt in the number of log submissions received from Europe. The total count of logs received in 2022 dropped from last year, with 850 received (plus another 14 classified as checklogs), but that is still the fifth-highest log count in the recent history of the contest.

A total of 49,996 QSOs were reported in this year's 864 logs, yielding an average of just over 50 contacts for each log. For 6 meters, 40,261 QSOs were reported in the 755 logs that included QSOs on that band versus 9,735 QSOs in the 430 logs that reported QSOs on 2 meters. The percentage of QSOs by band in 2022 is consistent with recent years — 80.5% of QSOs reported were on 6 meters and 19.5% were on 2 meters, as compared to an 82% / 18% split in 2021 and a 79% / 21% split in 2020.

Digital mode usage grew (again) in 2022. According to the two letter MOde reported on the Cabrillo QSO: Lines in the submitted logs, 38,738 of all QSOs were completed using "DG" or "RY", 77.4% overall. By band, it was 33,256 of 40,281 6-meter QSOs (82.6%) and 5,482 of 9,735 (56.3%) of 2-meter QSOs that were completed using digital modes this year. This is the first year in which more than half of the 144-MHz QSOs reported using "DG" or "RY".

If you made a 50-MHz contact with EN95, it was likely with XM3A, operated by Igor Slakva, VE3ZF, operating from the top of Mt. McLean on Manitoulin Island. (Credit: Igor Slakva, VE3ZF)

USA

The log count from the contiguous 48 U.S. states increased this year to 515 (plus four checklogs), an approximately 5% increase over the count from 2021. The Single-Operator, Single-Band category using 6-meters (SOSB6) continues as the most popular category overall in this contest. Nearly half of the logs from the U.S., 242, were SOSB6. Single Operator All-Band continued as the second most popular category with 202, a shade under 40%. The count of Rover logs grew by five from last year to 27. Single-Operator All-Band QRP matched the count from 2021 with 16. The Single-Operator, Single-Band, 2-meters (SOSB2) category was a little more competitive in 2022 with 13 entries. There were 10 Multi-Operator and five Hilltopper entries rounding out the U.S. total. The 4th call area continued its reign as the log submission leader with 118. The 5th call area was second busiest with 62, taking that spot away from 7th call area which finished in third place for 2022 with 54 logs.

After claiming the top score in the SOSB6 category in 2021 (and top Rover category scores in prior years), Wyatt, ACØRA stayed in the one spot again for 2022 but added 2 meters to his equipment array to achieve the top score in the Single Operator, All Band category. Wyatt's final QSO / Multiplier counts were: 353/164 on 6 meters and 139/72 on 2 meters for a final score of 144,904.

There was some competition in the U.S Multi-Operator efforts with the team at K5QE leading the scores in the category. Within 20% of Team Marshall's final score were the scores from teams at N4SVC and W8ZN. Final Scores, QSO, and Multipliers counts by band for these three competitors are summarized in the table below.

Team	Final Score	6m Qs	6m Mults	2m Qs	2m Mults
K5QE	113,096	343	151	100	60
N4SVC	99,182	379	171	59	31
W8ZN	92,070	278	114	146	51

* Email: <k9jk.cq@gmail.com>

The U.S. winner of the SOSB6 category was Dan, K1TO. Dan kept himself very busy on the 50-MHz band with 420 QSOs and 168 Multipliers for a final score of 70,362. Dan did have some competition in the category from a fellow Floridian: Larry, N6AR. Larry almost matched Dan's multiplier count with 166 but had 35 fewer QSOs (385) for a final score of 62,748.

The SOSB2 category also found some notable efforts in the U.S. this year. Paul, AA4ZZ, who had hosted the W4VHF Multi-Operator effort in 2021, focused his North Carolina station on the 144-MHz frequencies for 133 QSOs and 53 Multipliers, yielding a final score of 14,098. Stan, KA1ZE, piloted his W3XTT remote station in FN01 to find a few more multipliers than Paul did (57) but fell shy of Paul's QSO total with 110 for a final score of 12,426.

Jim, KO9A, continued his streak of being the top U.S. scorer in the Single-Operator, All-Band QRP category, now for a fourth straight year. Jim's 2022 score was a bit lower than last year's, with final QSO/Multiplier counts of 171/76 on 6 meters, and 58/29 on 2 meters for a final score of 29,820.

An excellent roving adventure was reported by Christopher, NV4B, resulting in a score of 52,752 to achieve the top score among this year's 27 U.S Rover category entrants with a trek through six grids in Alabama, Mississippi, and Tennessee. Christopher logged 222 QSOs on 6 meters and 47 on 2 meters with multiplier counts of 131 and 47 on the two bands, respectively.

In the U.S. Hilltopper category, Pete, K9PW, has rePETEd as the top scorer for the third year in a row. Pete's efforts resulted in a final score of 7,638 more than doubling his score from 2021. He logged 111 QSOs (88 on 50 MHz and 23 on 144 MHz) and contacted 47 different grid locators on 50 MHz and 10 on 144 MHz.

Among 32 U.S. clubs from which three or more logs were received in 2022, congratulations to the Potomac Valley Radio Club for the top club score of 357,237 from 38 submitted logs. Two very strong Multi-Operator efforts by teams at W8ZN and W3SO really boosted the club's total and Don, N3MK, was the top Single-Operator contributor.

DX

The 335 logs received from outside the U.S. for this year's contest was only half of last year's DX log count. The breakdown by continent is shown in the table below:

Continent	Logs	# of different DXCC Countries
Africa	1	1
Asia	95	12
Europe	100	29
Oceania	23	1
South America	45	4
North America (other than U.S.)	71	6 (other than U.S.)
Total	335	53

A "QTH selfie" by Ricardo, PY2QB, who operated from Lavrinhas Ranch in GG77, approximately 150 kilometers northeast of Sao Paulo, Brazil. (Credit: Ricardo Benedito, PY2QB)

TOP SCORES

WORLD

All Band

EA8DBM.....94,612
I1JTQ.....13,176
IC8TEM 9,040
SF6F.....7,497
E74SL.....7,260

6 Meters

ISØBSR.....28,495
XE2JS.....27,816
SX2I.....24,592
6D5C 18,768
SV1NZX.....12,282

2 Meters

S56P.....22,620
YO5LD.....7,000
YO2LSP.....4,758
IZ7UMS 4,672
YO2LLZ 4,536

Hilltopper

E7ØAA.....4,068
XM3A.....3,710
JJ1WWL 3,520
YC3AHD 48
PY2TDB.....16

QRP

VA2VT 6,405
XE2YWB.....4,160
SV3AUW 4,104
M5W 2,420
SP9SDF.....1,980

Rover

JG3DHN/R....3,036
BG5BAA/R....1,512
VA3OGG/R.....924
VA7OTC/R.....735
VE3WVA/R.....440

Multi-Op

IR9K.....82,256
4O6BLM 75,543
HG6Z.....58,548
OK1RDO 31,230
4X2M 22,230

USA

All Band

ACØRA....144,904
K2DRH 101,920
W5PR 50,370
N3MK.....49,368
K9KLD 47,995

6 Meters

K1TO 70,392
N6AR 62,748
W5LO 34,846
K5PI.....31,354
N5RZ 30,888

2 Meters

AA4ZZ 14,098
W3XTT 12,426
KD8ZEI 3,196
WA3EOQ.....1,452
WE7L.....988

Hilltopper

K9PW 7,638
KEØMHJ.....551
K3GD.....551
AA6XA 108
K7ATN.....39

QRP

KO9A 29,820
WAØMN 3,735
W5UHQ 1,215
K4CF 1,060
K3TW.....396

Rover

NV4B/R.....52,752
KG9OV/R...39,064
AA5PR/R ...21,090
N6GP/R 16,470
N2SLN/R ...10,428

Multi-Op

K5QE 113,096
N4SVC.....99,182
W8ZN 92,070
W3SO 62,181
W3RFC.....16,936

View toward the horizon from PY2QB's operating location. (Credit: Ricardo Benedito, PY2QB)

CLUB COMPETITION

(Minimum of 3 entries required for listing)

UNITED STATES

Club Name	# Entries	Score
Potomac Valley Radio Club	38	357,237
Society Of Midwest Contesters	20	267,226
Florida Contest Group	12	183,841
Dfw Contest Group	6	142,584
Mt Airy VHF Radio Club	9	131,929
Yankee Clipper Contest Club	17	115,360
Florida Weak Signal Society	4	97,950
Arizona Outlaws Contest Club	16	94,139
Texas DX Society	6	90,413
Central Texas DX and Contest Club	4	82,462
Southern California Contest Club	16	54,642
North East Weak Signal Group	6	52,876
Pacific Northwest VHF Society	20	45,868
Rochester VHF Group	5	43,808
Northern California Contest Club	8	34,822
Carolina DX Association	4	28,234
New Mexico VHF Society	4	26,672
Arizona VHF Society	3	22,475
South East Contest Club	4	19,073
Frankford Radio Club	5	17,180
Northern Lights Radio Society	9	16,292
South Jersey DX Association	4	11,258
Grand Mesa Contesters of Colorado	6	5,904
Willamette Valley DX Club	3	4,816
Metro DX Club	3	4,805
North Coast Contesters	3	4,368
Central Ohio Operators Klub	3	3,585
Portage County Amateur Radio Service	6	2,024
Kentucky Contest Group	4	1,368
Minnesota Wireless Assn	6	1,240
Hudson Valley Contesters and DXers	4	745
Tennessee Contest Group	3	144

DX

Club Name	# Entries	Score
Italian Contest Club	3	45,889
Club De Radio Experimentadores De Occidente	3	20,852
QSO Banat Timisoara	4	19,744
Contest Club Ontario	10	19,556
Manitoulin Amateur Radio Club	12	7,830
Rhein Ruhr DX Association	3	7,202
Contest Group du Quebec	4	6,810
Cabreuva DX	9	697
Radiofarol DX Group	12	665
Orari Lokal Kediri	10	408
Lu Contest Group	4	91
Rio DX Group	3	36

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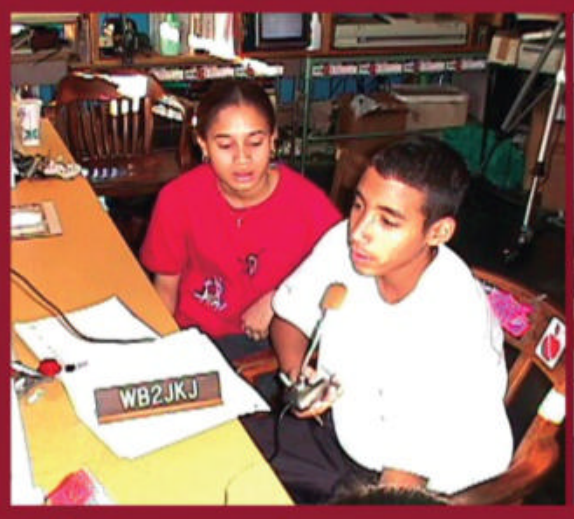

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The drop in "DX" log submissions in 2022 was fairly consistent for all continents, except for non-U.S. parts of North America. Operators from Canada submitted 53 logs this year, claiming the top spot for logs submitted from countries outside the U.S. The log count from Brazil was second overall by country, leading the South American contingent. Significant log counts from Japan (31) and China (25) brought the total count from Asia to 95, only five behind the total count of logs from Europe. The country leaders for Europe's 100 logs were Italy (15), Romania (13), and Germany (11). The ongoing conflict in eastern Europe appears to have had a significant impact on European participation. Indonesia was the only country in Oceania from which logs were received in 2022, with 23 logs, and the single log from Africa was from the Canary Islands.

Among the World/DX participants, the ranking of the top two categories matched that of U.S. log submitters with Single Operator, Single Band, 6 meters (SOSB6) winning the category popularity contest with 106 logs, followed by Single Operator, All Band with 85. The Single Operator, Single Band, 2 meters (SOSB2) was next in World popularity with 59 entries received. Fourth in world popularity was Single Operator, All Band, QRP, with 47 logs. There were 26 Multi-Operator, 8 Rover, and 6 Hilltopper submissions, which rounded out the category choices among DX stations.

The top score of any entry from outside the U.S. was from EA8DBM in the Canary Islands (IL18) in the Single Operator, All Band category. The 6-meter conditions appear to have been very favorable for Aleksandr to record 358 QSOs and 195 Multipliers on the band, plus another 41 QSOs and 23 Multipliers on 144 MHz for a final score of 94,612.

Grid JM67 in Italy was the place to be to win the Multi-Operator category. A crew of nine operators at IR9K amassed a final score of 82,256 with QSO / Multiplier totals of 311/158 on 6 meters and 58/25 on 2 meters. A final score of 75,543 from the Multi-Operator team at 4O6BLM in Montenegro (JN92) is also notable, less than 10% behind IR9K's score.

Once again, Bostjan, S56P, was the DX leader in the SOSB2 category from his station in Slovenia (JN76) with a final score of 22,620 from 195 contacts among 58 different Grid Locators.

Propagation was likely quite different in Sardinia (JN40) and Mexico (DL68), but just 679 points (less than 3%) separates the final scores of Marco, ISØBSR, and Julian, XE2JS, among DX entrants in the SOSB6 category. Julian's QSO total was 235 (26 more than Marco) but Marco's 139 multipliers (17 more than Julian) gave Marco the top score of 28,495.

Canadian operator Nicolas, VA2VT, achieved the world group's top score in the Single-Operator, All-Band, QRP category, with 98 total QSOs and 61 Multipliers for a final score of 6,405. Nicolas operated from grid locator FN45 in the province of Quebec, the same spot where he had operated as VE2NCG (his prior callsign) and claimed the top score in the Hilltopper category in 2021.

ROVERS & GRIDS OPERATED

AA5PR/R DM74 DM75 DM76 DM86
ABØYM/R DM78 DM79 DM89 DN70
AC1JR/R FN31 FN32 FN41 FN42
AG6RS/R DM03 DM04 DM05
BG5BAA/R OL99 OM90 PL09 PM00
JG3DHN/R PM95 PM96 PM97 QM06 QM07
KØBAK/R FN10 FN20
KØDAS/R EN30 EN31 EN32 EN40 EN41 EN42
K6LMN/R DM03 DM04
K9JK/R EN50 EN51 EN52 EN60 EN61 EN62
KA7RRA/R CN87 CN88 CN97 CN98
KD6EFQ/R DM12 DM13
KD6HOF/R CM88 CM98 CM99
KD8RTT/R EM28 EM29 EM38 EM39
KE4WMF/R FM07 FM16 FM17 FM18 FM26
KF2MR/R FN03 FN13
KG9OV/R EM59 EM68 EM69 EN50 EN51 EN60 EN61
KI5FIQ/R EM11 EM21 EM22
N2SLN/R FN12 FN21 FN22 FN23
N6GP/R DM03 DM04 DM13 DM14
N6LB/R CN88 CN98
N6UTC/R DM03 DM04 DM05
N9GH/R EN51 EN52 EN53 EN61
NV4B/R EM43 EM44 EM54 EM55 EM64 EM65
VA3OGG/R EN86 EN96
VA7OTC/R CN88 CN89
VE2GT/R FN35 FN36
VE3LDE/R EN86 EN95 EN96
VE3WVA/R EN85 EN95 EN96
WØETT/R DN62 DN70 DN71 DN72
W3DHJ/R DM77 DM78 DM87 DM88
W9YOY/R EN51 EN61
WB2SIH/R FN32 FN33
WD9EXD/R EN54 EN55 EN56 EN57 EN66
YD3AXD OI51

QSO & GRID LEADERS

6-Meter QSOs	
K1TO	420
N6AR	385
N4SVC	379
EA8DBM	358
ACØRA	353
K5QE	343
IR9K	311
W5PR	301
K2DRH	300
WA2FGK	287
W8ZN	278
W5LO	264
K5PI	261
WA4GPM	253
XE2JS	235
N5RZ	235

2-Meter QSOs	
S56P	195
HG6Z	189
HS1AN	181
E24ZPX	181
HSØEDP	164
OK1RDO	152
W8ZN	146
ACØRA	139
AA4ZZ	133
HS1AB	124
W3SO	121
E27IHO	121
JF1RYU	120
E24QND	120
K2DRH	115

6-Meter Grids	
EA8DBM	195
N4SVC	171
IR9K	169
K1TO	168
N6AR	166
ACØRA	164
K5QE	151
ISØBSR	139
W5PR	136
W5LO	133
N5RZ	132
K2DRH	131
NV4B/R	131
WA4GPM	123
KC4PX	123

2-Meter Grids	
ACØRA	72
K2DRH	65
KG9OV/R	63
HG6Z	62
K5QE	60
OK1RDO	59
S56P	58
W3XTT	57
AA4ZZ	53
W3SO	52
W8ZN	51
4O6BLM	50
N2NT	44
YO2LSP	39
N2JMH	38

PY2QB's antenna farm — a 7-element LFA Yagi and an omni vertical. (Credit: Ricardo Benedito, PY2QB)

In the world Hilltopper category. Zoran, E7ØAA was the top scorer from grid JN93 in Bosnia-Herzegovina. He had 69 total QSOs (25 on 6 meters and 44 on 2 meters) and 36 multipliers (18 each on 6 and 2 meters) earning Zoran a category-leading score of 4,068.

The top non-U.S. score in the Rover category was achieved by Masaki, JG3DHN, who travelled through five grids in Japan. Masaki logged 28 QSOs and 16 grid locators on 50 MHz and 32 QSOs and 17 grid locators on 144 MHz for a final score of 3,036.

The lower count of logs from DX participants is reflected in the lower number of clubs represented. Twelve clubs met the minimum requirement of three log submissions with the Italian Contest Club claiming the top aggregate total of 45,889 points from three logs. Marco, ISØBSR, was the top individual contributor to the club's total score.

Digital Modes

Digital modes, largely FT-8 (but there are others), continue to be a factor in this and other radiosport events, both VHF and High Frequency (HF). When propagation conditions are marginal, the ability of a computer to detect and decode exchange information from a signal in the receiver passband that is below the "noise" and not decodable by the human operator is quite an advantage and most of the higher scoring participants avail themselves of that capability in their operating strategy.

For 2023, the rules will not see any substantial changes but there may be an option to specify whether contacts were all completed using "Digital" (FT-8 and other modes in the digital "family" where a computer decodes the call and exchange sent by the other station), all "Analog" (SSB / CW / FM, where the human operator decodes the call and exchange sent by the other station) or "Mixed" (where both "Digital" and "Analog" are used). The present seven category structure will remain and there will NOT be any sub-categories by these sub-modes.

I also received a report of a station that appeared to be operating as a robot using digital modes as some of the software packages for digital modes are capable of doing. The callsign of this station appears in a number of logs but the no log was submitted for the callsign. For 2022, no contacts were removed from any other logs but since I feel such activity is not in the spirit of the CQWW VHF contest, I may also address this in the rules for 2023 and take action in the log checking.

Apology From the Director

As I alluded in the opening paragraph of this article, despite having been director for this contest for four years, I still have a lot to learn and room to improve in fulfilling my duties as contest director. One significant area in need of my attention and improvement is the award plaques program, which have not been ordered / processed since past CQWW VHF

Contest Director Steve Bolia, N8BJQ, handled that for my first year as director in 2019. I did manage to collect the funds for plaques from the sponsors for 2020 and 2021, but I am delinquent in getting those plaques ordered and sent to the winners. For 2022, I have totally "dropped the ball" and that is why there is no listing of award plaques for 2022 in this article. I am working to get caught up for 2020 and 2021 and plaques for 2022 will follow (presuming that sponsors are still willing to continue their sponsorships despite MY poor performance). Going forward, I will be working to make the process for plaque sponsorship and distribution to the winners more like the process that is in place for other events in the CQ World Wide family of contests under the umbrella of the World Wide Radio Operators Foundation, Inc. <https://tinyurl.com/4p9dr6kd>. Net, net, I will do better in 2023.

What Else Will 2023 Bring?

The 2023 CQWW VHF Contest will be held on July 15th and 16th, the earliest dates that the third full weekend of July can fall. This weekend is also the closest to the summer solstice where the summer Sporadic-E season typically peaks and hopefully where participants can finally experience some enhanced propagation from Cycle 25?

Repeating the constant plea of past directors, if you operate, please send in a log. Any size log is greatly appreciated. If you need help, please ask. More logs make cross-checking the other logs more accurate.

Don't forget to check out the CQWW VHF Contest website <www.cqww-vhf.com>. Comments, suggestions, and corrections are always welcome. Quite a bit of the data was entered manually. If you find an error, please let us know.

Number/letter groups after call letters denote the following: Class (A = all band, 6 = 6 meters, 2 = 2 meters, Q = QRP, H = Hilltopper, R = rover. M = multi-operator), Final Score, Number of QSOs, Number of grid locators, State/Province (USA/Canada only), Grid Locator or Number of grids activated (rover only). Rover scores for USA are listed separately. Scores in bold indicate certificate winners. Score in italic are disqualified.

2022 VHF RESULTS
NORTH AMERICA
UNITED STATES

WZ1V	A	33,448	230	113	CT	FN31
N8RA	A	20,904	207	78	CT	FN31
N1JEZ	A	19,834	170	94	VT	FN44
K1KA	A	16,884	166	84	NH	FN42
NE1B	A	14,880	160	80	NH	FN42
AF1T	A	9,570	131	58	NH	FN43
N1SV	A	3,978	78	39	MA	FN42
N1JD	A	2,405	61	37	ME	FN44
N1PRW	A	1,856	58	29	MA	FN42
W1UED	A	1,725	44	23	CT	FN31
K1ZK	A	858	26	22	VT	FN34
K5ZD	A	850	50	17	MA	FN42
K1MD	A	836	35	22	RI	FN41
WA1LBK	A	702	29	18	MA	FN41
WB2VVQ	A	475	22	19	MA	FN32
N1SFE	A	420	26	14	CT	FN31
NE1F	A	352	22	16	NH	FN33
NF1O	A	312	24	13	NH	FN33
K2KA	A	310	22	10	MA	FN42
N2HX	6	20,448	217	96	MA	FN32
W1RM	6	6,272	113	56	CT	FN31
K1AR	6	5,175	116	45	NH	FN42
KB1W	6	2,074	61	34	MA	FN32
KE1R	6	1,988	74	28	CT	FN31
K1BZ	6	1,715	51	35	ME	FN54
K1TR	6	1,530	52	30	NH	FN42
K1EP	6	1,127	49	23	MA	FN42
W1MI	6	792	33	24	MA	FN32
K1KI	6	580	29	20	CT	FN32
AA1NK	6	532	40	14	MA	FN42
N1CEO	6	490	36	14	MA	FN42
W1AKI	6	490	38	14	NH	FN42
W1IG	6	364	26	14	CT	FN31
N1WRK	6	285	19	15	MA	FN41
K1ZZ	6	180	15	12	CT	FN31
K1SX	6	132	12	11	MA	FN41
WK1O	6	126	15	9	MA	FN42
AF1R	6	114	20	6	MA	FN42
W2CS	6	63	9	9	MA	FN41
N1ADX	6	49	7	7	MA	FN42
N1IBQ	6	25	5	5	CT	FN31
N1SOH	M	7,038	126	46	MA	FN42
				Ops: N1SOH W1FM		
N2JMH	A	35,090	217	121	NY	FN12
N2NT	A	33,363	231	99	NJ	FN20
					Op: N2NC	
WW2Y	A	27,560	214	106	NY	FN24
W9KXI	A	24,480	189	102	NY	FN12
KA2ENE	A	3,268	69	43	NY	FN13
K2RET	A	3,038	68	31	NJ	FM29
N2SLO	A	2,496	62	32	NY	FN30
W2SJ	A	2,352	63	28	NJ	FM29
K2OEQ	A	2,310	51	35	NY	FN13
WT2J	A	646	32	19	NY	FN30
WA3AFS	A	540	32	18	NY	FN32
W2RME	A	378	20	14	NY	FN22
					Op: W2BDN	
N2RC	A	352	21	16	NY	FN21
W2ZS	A	156	13	12	NY	FN23
N2NKX	A	126	12	9	NY	FN22
N3YY	6	14,596	171	89	NY	FN22
KZ2I	6	7,860	133	60	NJ	FM29
KA2MGE	6	6,370	100	65	NY	FN02
KD2JOE	6	4,437	89	51	NJ	FM29
W3SW	6	2,720	76	40	NY	FN22
W2FDJ	6	925	40	25	NJ	FM29
K2ZR	6	374	24	17	NY	FN03
N2OO	6	270	27	10	NJ	FM29
N2BEG	6	180	16	12	NY	FN12
N2JJ	6	108	14	9	NY	FN33
K2AMI	6	96	16	8	NJ	FN20
KX1W	6	90	12	9	NJ	FM29
K4RUM	6	77	12	7	NY	FN30
K1MUU	6	64	8	8	NY	FN32
KA2AEY	6	64	10	8	NY	FN13
N2SO	6	20	5	4	NY	FN31
K2MN	6	16	4	4	NJ	FM29
N2SFS	6	12	4	3	NY	FN21
K3TC	A	21,146	193	97	MD	FM19
K3ZO	A	10,184	142	67	MD	FM18
K3MD	A	7,296	104	64	PA	FN10
KR1ST	A	7,074	101	54	PA	FN21
NF3R	A	6,902	99	58	PA	FN20
N3MWQ	A	6,096	93	48	DE	FM29
K3SX	A	2,044	44	28	MD	FM19
KD3HN	A	1,344	48	28	PA	FM19
WB3IGR	A	576	25	18	PA	FN10
NG3W	A	72	6	6	PA	FN01
WA3AAN	A	66	11	6	PA	FN20
KB8TUY	A	24	8	3	PA	EN91
AA3S	A	4	2	2	MD	FM19
WA2FGK	6	27,522	287	99	PA	FN21
					Op: K2LNS	
K3ISH	6	10,001	137	73	PA	FN21
N1EK	6	5,668	112	52	MD	FM19
K3UA	6	3,588	80	46	PA	EN91
KB3ORR	6	825	34	25	PA	EN90
KB4BKV	6	405	28	15	MD	FM19
K3HX	6	270	19	15	PA	FN00
K3CU	6	204	17	12	PA	FN20
N3XL	6	144	16	9	MD	FM18
W3ZJ	6	90	10	9	DC	FM18
N3DUE	6	66	11	6	MD	FM19
K3KU	6	21	7	3	MD	FM19
N3QE	6	18	6	3	MD	FM19
KN1OLA	6	1	1	1	PA	FN00
W3XTT	2	12,426	110	57	PA	FN01
WA3EOQ	2	1,452	35	22	MD	FM09
K3HW	Q	272	18	16	PA	FN20
K3GD	H	551	21	19	PA	FN11
W3SO	M	62,181	324	141	PA	FN00
			Ops: W3XOX W3IDT W3SF W3BTX			
W3RFC	M	16,936	164	73	MD	FM19
			Ops: W3RFC KØOO WA3OFF K3OQ			
WA3EKL	M	15,614	162	74	MD	FM19
		Ops: WA3EKL KB3VQC WT3K W1TRT K3TBD N9SG N3DPB				
N3MK	A	49,368	304	132	VA	FM27
WA4GPM	A	40,415	278	137	FL	EM90
KK4MA	A	37,380	232	140	SC	EM93
K1HTV	A	37,128	266	119	VA	FM18
K3DNE	A	25,920	196	120	SC	EM94
N4HB	A	20,868	176	94	VA	FM17
K5VIP	A	19,074	186	102	VA	FM16
WB2SNN	A	16,055	166	95	FL	EL96
K5EK	A	14,014	156	91	NC	FM03
WB4OMG	A	13,973	137	89	FL	EL98
N4QV	A	11,644	142	82	FL	EL96
W1BQ	A	11,100	147	75	FL	EL98
K4WMS	A	9,588	122	68	VA	FM17
AB4SF	A	7,752	121	57	VA	FM17
W3IP	A	5,456	106	44	VA	FM19
N4LAZ	A	5,415	73	57	NC	EM95
KO4IJH	A	5,250	86	50	VA	FM18
NG4C	A	4,752	70	48	NC	FM16
K2PS	A	4,437	88	51	FL	EL98
K4MY	A	4,200	77	56	GA	EM74
K4EA	A	3,520	50	44	GA	EM74
K4BAI	A	3,486	84	42	GA	EM72
K4SO	A	3,034	57	41	VA	FM18
N2QT	A	2,867	63	47	VA	FM07
WA4LDU	A	2,501	52	41	SC	EM93
K4AKS	A	2,368	61	37	FL	EL88
K4FJW	A	2,100	45	35	VA	EM86
K4RW	A	2,091	51	41	SC	EM92
KM4QHI	A	1,947	51	33	GA	EM84
WA4DYD	A	1,870	53	34	GA	EM83
N3KN	A	1,776	48	37	VA	EM97
NN3W	A	1,749	55	33	VA	FM18
KQ4KX	A	1,600	47	32	FL	EL98
K7UWR	A	1,036	39	28	GA	EM92
K3NF	A	900	33	20	VA	FM18
W4IU	A	760	36	19	GA	EN74
N5SMQ	A	756	36	21	VA	FM08
KV4ZY	A	735	31	21	VA	FM08
K1DS	A	630	24	18	FL	FN20
KY4G	A	608	22	19	AL	EM64
N4SZF	A	551	31	19	NC	EM95
KI4LLA	A	494	23	19	VA	FM07
K4BSK	A	384	21	16	VA	FM07
WXØEMT	A	228	16	12	TN	EM85
AE4WG	A	168	15	12	FL	EL99
AC2N	A	143	13	11	FL	EL89
KM4KMU	A	135	13	9	VA	FM16
W3GQ	A	104	12	8	NC	EM95
WF4R	A	104	13	8	VA	FM16
K4FTO	A	78	8	6	VA	FM18
W4ATL	A	50	6	5	GA	EM73
K4BBH	A	42	8	6	GA	EM73
W4EE	A	35	9	5	FL	EL98
W4NZ	A	4	2	2	TN	EM75
K1TO	6	70,392	420	168	FL	EL87
N6AR	6	62,748	385	166	FL	EL98
KC4PX	6	25,584	212	123	FL	EL98
N8KH	6	17,978	187	101	FL	EL98
K4WI	6	17,094	224	77	AL	EM62
KM4HI	6	15,778	168	98	FL	EL89
WD4CNO	6	13,024	153	88	FL	EL87
KU8E	6	11,899	168	73	GA	EM72
WN2E	6	10,703	155	77	FL	EM60
WW3A	6	6,666	102	66	FL	EL99
N5BO	6	6,318	117	54	FL	EM60
N4SIX	6	6,111	98	63	NC	FM04
K2SG	6	5,490	92	61	FL	EL88
WB4EHG	6	5,073	94	57	FL	EL96
N4IDH	6	3,234	69	49	AL	EM71
KE4S	6	2,840	71	40	VA	FM19
KG4JPL	6	2,684	62	44	FL	EL88
KN4SM	6	2,337	57	41	VA	FM16
KN4PPD	6	2,014	55	38	FL	EL89
WC2F	6	2,014	53	38	FL	EM70
K4LDC	6	1,530	51	30	GA	EM74
K4YCR	6	1,512	56	28	VA	FM07
W4VIC	6	1,378	54	26	VA	FM16
WB4TDH	6	975	39	25	FL	EL87
K8LF	6	704	35	22	VA	FM17
W5MX	6	475	25	19	KY	EM77
KN4IWO	6	437	23	19	FL	EL79
W4UWC	6	375	27	15	KY	EM77
K4WW	6	320	20	16	KY	EM78
NV4C	6	315	22	15	GA	EM74
K4QE	6	270	18	15	NC	FM05
KS1G	6	216	21	12	VA	FM18
K8IJ	6	198	18	11	KY	EM78
NZ4N	6	198	18	11	NC	FM06
W9LN	6	169	14	13	AL	EM73
KM4SLW	6	168	14	12	GA	EM72
N4CF	6	168	15	12	VA	FM17
KK4LWR	6	165	15	11	FL	EL98
NJ4Q	6	156	14	12	VA	FM07
AI4WW	6	117	14	9	FL	EL96
N9TF	6	110	11	11	TN	EM66
WA4AH	6	110	12	10	FL	EL99
N4NQY	6	104	16	8	VA	FM17
KM4IAJ	6	100	10	10	VA	FM18
W4DTA	6	90	10	10	TN	EM55
K4XL	6	81	10	9	VA	FM07
K4ORD	6	42	7	6	VA	FM07
K4SBZ	6	42	7	6	FL	EM70
K5VG	6	30	8	5	VA	FM18
WA4JA	6	30	7	6	TN	EM65
KO4UJS	6	20	5	4	VA	FM17
KE4VNC	6	4	2	2	NC	FM05
N2YF	6	4	2	2	FL	EL87
AA4ZZ	2	14,098	133	53	NC	EM96
W4JFA	2	18	3	3	NC	EM95
K4CF	Q	1,060	39	20	NC	EM86
K3TW	Q	396	22	18	FL	EL88
W5NZ	Q	378	21	18	AL	EM62
W2QL	Q	112	11	7	VA	FM18
KC8KSK	Q	48	8	6	SC	FM03
N4SVC	M	99,182	438	202	FL	EM80
		Ops: WB2FKO K1UHF KE4PWE KD4AMP N2CEI				
W8ZN	M	92,070	424	165	VA	FM09
				Ops: W8ZN K1RA K1RZ		
WB4WXE	M	4,819	75	61	AL	EM74
				Ops: WB4WXE KB4ZFA		
N4JDB	M	2,769	77	39	AL	EM64
				Ops: N4JDB KS4B		
W5PR	A	50,370	324	146	TX	EL29
K5ND	A	17,856	170	96	TX	EM12
KA5D	A	15,120	149	90	TX	EM10
N5EKO	A	15,045	175	85	TX	EM20
W5KI	A	9,975	133	75	AR	EM36
AJ4F	A	9,600	132	75	TX	EL29
NN5T	A	6,254	128	53	TX	EM12
N5GIT	A	5,880	87	60	TX	EL09
AI5HG	A	5,358	94	57	MS	EM54
KG5ZMQ	A	5,074	85	59	LA	EM32
KB5VKP	A	4,399	75	53	TX	EM10
W5WGF	A	3,456	69	48	MS	EM54
N5DTT	A	2,666	62	43	TX	EL29
K5MNZ	A	1,575	46	35	TX	EM11
N5JS	A	1,350	44	30	TX	EM12
WA5LFD	A	1,200	43	24	TX	EM12
W5RAW	A	1,050	42	25	TX	DM95
WA8ZBT	A	578	34	17	TX	EM12
AE5P	A	558	25	18	TX	EM21
KI5UTQ	A	399	22	19	MS	EM54
K5GZR	A	60	10	6	TX	EL29
KCØLFQ	A	30	5	5	NM	DM65
W5WZ	A	16	5	4	LA	EM32
W5LO	6	34,846	264	133	TX	EM03
K5PI	6	31,354	261	122	TX	EM00
N5RZ	6	30,888	235	132	TX	EM00
N2IC	6	18,165	175	105	NM	DM52
N5TJ	6	16,170	167	98	TX	EM10
N5HHS	6	15,180	167	92	TX	EL29
K5TIA	6	12,672	138	96	TX	EL29
W5SUM	6	8,362	117	74	LA	EM32
KJ5RC	6	7,995	126	65	MS	EM42
AA5AU	6	5,208	95	56	LA	EL49
AE5FM	6	4,590	93	51	TX	EM13
K5CKS	6	4,240	83	53	AR	EM25
KC7QY	6	4,116	89	49	NM	DM64
WA2VYA	6	4,050	81	50	TX	EM10
WB5JJJ	6	3,869	78	53	AR	EM35
AF5CC	6	3,600	82	45	OK	EM04
WA5KBH	6	3,500	72	50	LA	EM30
KG5EIU	6	3,034	76	41	TX	EM13
WQ5L	6	2,709	64	43	MS	EM50
W2ODH	6	2,408	64	43	TX	EM13
NRØQ	6	2,312	70	34	OK	EM26
W5MO	6	2,142	52	42	TX	EL09
WS5N	6	2,124	61	36	NM	DM54
K7ZYV	6	1,890	55	35	MS	EM50
W1ZOT	6	1,750	53	35	TX	EM12
NM5WB	6	962	39	26	NM	DM65
WV5Y	6	759	36	23	TX	EL29
NØLD	6	624	29	24	OK	EM15
W5SRO	6	480	26	20	OK	EM15
K5AGE	6	437	23	19	TX	EM21
W5DDS	6	352	22	16	TX	EL09
KB5ZEA	6	308	24	14	MS	EM53
WØZW	6	300	20	15	NM	DM65
AA5AH	6	216	19	12	TX	EM12
WD5BJT	6	110	11	11	MS	EM50
KI6HQT	6	36	7	6	TX	EM10
AI5G	6	30	6	6	TX	EM13
K5QE	M	113,096	443	211	TX	EM31
		Ops: K5QE N5YA KI5MHB AF8Z KF5LKG K5SAB VE3WY				
KC5MVZ	M	3,400	65	50	TX	DM93
				Ops: KC5MVZ KE5BZO		
AG6X	A	42,180	299	114	CA	DM12
NA6MG	A	10,730	137	74	CA	DM04
KF6I	A	5,673	90	61	CA	DM13
AA2IL	A	5,151	92	51	CA	DM12
W6IT	A	2,106	49	39	CA	DM13
KA5WSS	A	1,012	43	23	CA	CM88
N6PGQ	A	240	19	10	CA	CM98
AG6JA	A	210	20	10	CA	CM87
K2GMY	A	140	15	7	CA	CM88
K6MAA	A	120	15	8	CA	DM04
KI6X	A	119	14	7	CA	DM13
KG6DNY	A	40	7	5	CA	DM13
N6QQ	6	17,195	187	95	CA	DM03
NU6S	6	10,944	145	76	CA	CM87
N5KO	6	9,842	135	74	CA	CM97
WM6Y	6	7,455	112	71	CA	DM13
AF6RT	6	6,720	115	60	CA	CM87
W6DR	6	5,814	107	57	CA	CM87
W6KAP	6	4,094	95	46	CA	CM98
W6BVB	6	3,780	87	45	CA	DM13
WA6GD	6	2,145	67	33	CA	DM04
NE6I	6	1,334	49	29	CA	DM12
K9TAD	6	1,326	52	26	CA	DM04
NU6V	6	759	34	23	CA	CM87
N6ORB	6	702	39	18	CA	CM87
W8GJK	6	660	32	22	CA	CM95
K6OAK	6	510	33	17	CA	CM97
KC6MIE	6	350	31	14	CA	DM13
N6IC	6	198	22	11	CA	DM04

2023-2024 calendars

We have two calendars to choose from this year.

The CQ Ham Radio Operator's Calendar with fifteen spectacular color images relating to amateur radio shacks and antennas from around the world; DXpeditions to exotic places and fellow hams!

The CQ Ham Shack Project Calendar which features fifteen spectacular color images of amateur building projects.

These 15-month calendars (January 2023 through March 2024) include dates of important Ham Radio events, major contests and other operating events, meteor showers, phases of the moon and other astronomical information plus important and popular holidays.

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http://store.cq-amateur-radio.com

N6VHF	6	168	21	8	CA	DM13
N6VOH	6	126	19	7	CA	DM13
AJ6HT	6	56	9	7	CA	CM87
W6DMW	6	40	8	5	CA	CM97
N4DLA	6	28	7	4	CA	CM87
W6SX	6	1	1	1	CA	DM07
N6AN	Q	16	5	4	CA	DM04
AA6XA	H	108	11	6	CA	CM87
WØXR	A	20,907	208	101	AZ	DM22
N7IR	A	15,300	177	85	AZ	DM43
N7EPD	A	9,776	156	52	WA	CN87
AA7A	A	8,040	118	67	AZ	DM43
W7FI	A	7,426	140	47	WA	CN87
W7MEM	A	6,728	98	58	ID	DN17
W7EW	A	6,171	109	51	OR	CN84
KD7UO	A	1,968	67	24	WA	CN87
KX7L	A	1,536	59	24	WA	CN87
W7OJT	A	1,428	40	28	AZ	DM24
K7IU	A	1,387	61	19	WA	CN97
N7QOZ	A	1,024	42	16	WA	CN87
N7NEV	A	988	38	26	AZ	DM43
N7XU	A	988	40	26	OR	CN94
						Op: K4XU
K7ULS	A	546	24	21	UT	DN41
KC7OOY	A	496	24	16	OR	CN82
WA7YAZ	A	396	23	18	UT	DN40
WO7V	A	294	21	14	OR	CN92
N7RK	A	264	21	11	AZ	DM33
N6ZE/7	A	210	22	7	WA	CN87
N7DB	A	162	19	6	OR	CN85
AF7GL	A	21	4	3	WA	CN96
WØRIC	6	16,471	182	91	AZ	DM33
KC7V	6	10,147	140	73	AZ	DM33
N7GP	6	9,432	131	72	AZ	DM42
NR7T	6	7,700	115	70	UT	DM38
K7PT	6	7,434	132	59	AZ	DM43
K7CW	6	6,950	142	50	WA	CN87
AL1VE	6	5,655	96	65	OR	DN02
KA6BIM	6	3,534	94	38	OR	CN73
K9DR	6	3,105	70	45	WY	DN62
KY7M	6	3,060	68	45	AZ	DM33
N7NW	6	1,701	64	27	WA	CN87
WR7AY	6	1,620	56	30	WY	DN74
K7HP	6	1,134	56	21	AZ	DM33
WA8ZNC	6	1,056	48	22	WA	CN85
NQ7R	6	805	35	23	AZ	DM42
W7TZ	6	770	37	22	OR	CN83
K7III	6	703	39	19	WA	CN87
K7BHM	6	700	35	20	AZ	DM43
W7OXB	6	384	34	12	WA	CN87
WA8ZID	6	338	26	13	AZ	DM33
K7JQ	6	325	26	13	AZ	DM43
K9PY	6	300	21	15	OR	CN94
W7GES	6	242	22	11	AZ	DM33
KE6GFI	6	140	14	10	AZ	DM34
KB9LHT	6	48	14	4	AZ	DM33
W6XI	6	48	8	6	AZ	DM42
KTØP	6	20	6	4	MT	DN28
N9NA	6	6	3	2	AZ	DM33
K7ND	2	550	26	11	WA	CN87
N7NMC	Q	100	12	10	OR	CN73
KE7UQL	Q	72	8	8	NV	DN00
K7ATN	H	39	7	3	WA	CN95
KB8U	A	13,272	126	84	MI	EN71
WA8MCD	A	7,920	119	60	MI	EN72
AA8MA	A	1,196	41	26	OH	EN80
KE8QEP	A	476	24	17	OH	EN91
N8QE	A	390	28	13	OH	EN91
K8BF	A	96	12	8	OH	EN91
WB8WUA	A	48	8	8	OH	EN91
K9NW	6	11,297	146	79	OH	EM79
W3HKK	6	1,600	52	32	OH	EN80
AA8SW	6	1,376	44	32	OH	EM79
AA4R	6	836	39	22	MI	EN64
K7DR	6	810	46	18	MI	EN82
WA8LRW	6	798	40	21	OH	EN91
N8WL	6	770	35	22	OH	EN80
N8PW	6	588	30	21	OH	EN90
KE8RJU	6	527	31	17	MI	EN62
W8KNO	6	240	21	15	OH	EN91
KB8ZR	6	234	21	13	OH	EM79
N5JED	6	180	19	10	OH	EN91
K8DP	6	150	15	10	MI	EN62
KD8VMM	6	70	11	7	OH	EN81
KT8X	6	56	8	7	MI	EN82
N4RA	6	28	7	4	WV	FM09
NS8O	6	15	5	5	OH	EM89
KD8ZEI	2	3,196	50	34	OH	EN81
W5UHQ	Q	1,215	47	27	OH	EN80
K8ZT	Q	192	19	8	OH	EN91
K2DRH	A	101,920	415	196	IL	EN41
K9KLD	A	47,995	276	145	IL	EM58
N4SV	A	17,085	171	85	IN	EN61
W9XT	A	13,608	142	81	WI	EN53
NØAKC	A	8,680	97	70	WI	EN44
KAØWAS	A	8,460	110	60	IN	EN61
KT8O	A	6,318	92	54	IN	EN71
N2BJ	A	4,370	68	46	IL	EN61
KØPG	A	3,318	79	42	IL	EN51
K9MU	A	2,542	46	31	WI	EN44
W9DZ	A	2,211	61	33	IN	EN61
K9DJT	A	1,824	45	32	WI	EN63
W9FF	A	1,008	25	21	IL	EN40
W9DP	A	646	35	19	IL	EN40
WB9HFK	A	224	15	14	IL	EN50
NJ9R	A	190	13	10	IL	EN62
K9QJ	A	140	11	10	IL	EN51
WØUC	A	130	10	10	WI	EN44
NA9RB	6	15,561	177	91	IL	EN40
WB9LWO	6	2,400	67	40	IL	EM49
W9VTD	6	1,620	54	30	IL	EN52
NY1V	6	1,218	45	29	IN	EM69
N9DJ	6	736	33	23	IL	EN52
K9OM	6	704	32	22	WI	EN65
K9CW	6	546	27	21	IL	EN50
K9EEH	6	304	21	16	IL	EN51
WU9D	6	228	19	12	IL	EN61
WA9LEY	6	135	15	9	IL	EN61
W9TA	6	72	10	8	WI	EN63
WO9B	6	35	7	5	WI	EN52
KO4HMB	6	30	6	5	IL	EN61
K9SUL	6	6	3	3	IL	EN50
W9EWZ	2	352	17	11	WI	EN52
KO9A	Q	29,820	229	105	IL	EN52
WB9AYW	Q	25	5	5	IL	EN51
K9PW	H	7,638	111	57	IL	EN51
ACØRA	A	144,904	492	236	IA	EN42
WQØP	A	20,592	160	99	KS	EM19
WØJW	A	19,594	191	101	IA	EN31
KØVG	A	4,664	74	53	MN	EN27
KØAWU	A	3,192	55	42	MN	EN37
WØZQ	A	2,856	58	34	MN	EN34
WØZA	A	1,683	53	33	NE	EN00
AAØAW	A	1,350	39	27	MN	EN36
KAØPQW	A	1,334	41	23	MN	EN33
KEØIZE	A	1,104	35	24	IA	EN41
WØRT	A	1,075	39	25	KS	EM27
W8LYJ	A	819	38	21	CO	DN70
KØSCO	A	589	26	19	MO	EM48
KGØTW	A	475	21	19	MO	EM49
KEØKKD	A	336	20	14	IA	EN31
KBØKQI	A	189	12	9	CO	DM79
W6GMT	A	56	7	7	MN	EN37
WAØLIF	A	48	8	4	MN	EN35
WØZF	A	27	5	3	MN	EN34
WDØBGZ	6	4,060	77	58	NE	EN00
NØPOH	6	2,698	71	38	CO	DM79
KA8MMI	6	2,562	64	42	KS	EM28
WØDTM	6	1,575	48	35	MO	EM48
KCØVDY	6	989	44	23	CO	DM59
KFØM	6	900	38	25	KS	EM17
WØGN	6	546	27	21	IA	EN42
KAØOUV	6	384	24	16	MO	EM38
KBØNES	6	270	19	15	MN	EN34
KØBJ	6	210	17	14	KS	DM99
KNØV	6	120	13	10	MN	EN34
KSØAA	6	56	9	7	KS	EM28
KØKEX	6	30	6	6	MO	EM29
WDØREW	6	25	6	5	MO	EM37
NØJK	6	16	4	4	KS	EM28
ADØH	6	4	2	2	IA	EN32
WE7L	2	988	26	19	CO	DM79
AAØMZ	2	612	19	17	KS	EM29
NØHJZ	2	576	24	12	MN	EN34
KØQEI	2	340	18	10	MN	EN35
NØAT	2	100	10	5	MN	EN34
WBØIXI	2	8	2	2	MO	EM29
WAØMN	Q	3,735	71	45	MN	EN33
						Op: NØUR
WØKI	Q	204	16	12	CO	DM79
NØSUW	Q	84	14	4	MN	EN34
KEØMHJ	H	551	21	19	MO	EN30

Rover

NV4B/R	R	52,752	269	168	MS	6
KG9OV/R	R	39,064	186	152	IL	7
AA5PR/R	R	21,090	188	111	NM	4
N6GP/R	R	16,470	162	90	CA	4
N2SLN/R	R	10,428	100	79	NY	4
W9YOY/R	R	7,018	98	58	IL	2
K9JK/R	R	6,360	81	60	IL	6
KØDAS/R	R	5,642	81	62	IA	6
AC1JR/R	R	4,462	86	46	MA	4
KD8RTT/R	R	3,496	67	46	KS	4
KF2MR/R	R	2,960	51	40	NY	2
N6UTC/R	R	2,448	57	34	CA	3
KØBAK/R	R	1,652	37	28	PA	2
AG6RS/R	R	1,612	49	31	CA	3
WD9EXD/R	R	1,518	41	33	MI	5
KA7RRA/R	R	1,479	54	17	WA	4
N9GH/R	R	1,104	29	24	IL	4
K6LMN/R	R	990	35	18	CA	2
KE4WMF/R	R	888	37	24	VA	5
WB2SIH/R	R	756	32	21	NY	2
W3DHJ/R	R	504	20	18	CO	4
KD6HOF/R	R	405	28	15	CA	3
ABØYM/R	R	234	16	13	CO	4
KD6EFQ/R	R	228	20	12	CA	2
KI5FIQ/R	R	144	12	12	TX	3
WØETT/R	R	90	11	9	WY	4
N6LB/R	R	88	9	8	WA	2

CANADA

VA3TIC	A	6,292	90	52	ON	FN14
VE3NRT	A	6,084	90	52	ON	FN03
VA2BN	A	5,890	96	62	QC	FN36
VA3IKE	A	5,842	76	46	ON	EN82
VE3RX	A	4,386	78	51	ON	EN96
VE7DAY	A	3,354	87	39	BC	CO70
VA3WB	A	3,010	57	43	ON	FN03
VE3KI	A	2,288	55	44	ON	FN25
VE3SST	A	2,277	50	33	ON	FN04
VA3UAP	A	2,112	47	32	ON	FN14
VE3ELL	A	1,568	38	28	ON	FN04
VE3PJ	A	1,300	54	25	ON	FN14
VE7AFZ	A	1,281	55	21	BC	CN89
VA3RQX	A	840	29	20	ON	FN03
VE3LFS	A	648	23	18	ON	FN04
VA6AN	A	442	24	13	AB	DO41
VE3AJB	A	425	25	17	ON	EN95
VE2OTA	A	325	17	13	QC	FN35
VE2NR	A	266	17	14	QC	FN35
						Op: VE2DDZ
VE2BAP	A	240	15	15	QC	FN46
VA7DXC	A	192	15	12	BC	CN89
VE6BMX	A	136	12	8	AB	DO33
VE5MX	A	120	12	12	SK	DN89
VA3PAF	A	49	7	7	ON	EN93
VE3AB	A	48	7	6	ON	EN86
VE2HAY	A	40	5	5	QC	FN35
VE3ETE	A	40	8	5	ON	EN86
VE3CYX	A	32	6	4	ON	EN85
VE3JFN	A	27	6	3	ON	EN95
VE3LDY	A	27	6	3	ON	EN95
VA3TSS	A	21	4	3	ON	EN96
VE3IQZ	A	20	4	4	ON	FN04
VE3AC	A	10	3	2	ON	EN96
VE3HZQ	A	4	2	1	ON	EN96
VE7AB	6	774	45	18	BC	CN88
VA7ST	6	589	31	19	BC	DO00
VA3WEB	6	480	25	20	ON	FN04
VO1HP	6	96	12	8	NL	GN37
VE3KP	6	90	10	9	ON	FN04
VE3TM	6	42	7	6	ON	FN25
VE3KG	6	30	6	6	ON	FN24
VA6MA	2	8	2	2	AB	DO33
VA2VT	Q	6,405	98	61	QC	FN45
VA7USD	Q	700	37	14	BC	CN88
VE7AJK	Q	104	14	8	BC	CN88
VE3JO	Q	49	7	7	ON	EN93
VE3EG	Q	9	3	3	ON	FN03
XM3A	H	3,710	82	35	ON	EN95
						Op: VE3ZF
VA3OGG/R	R	924	35	22	ON	3
VA7OTC/R	R	735	32	15	BC	2
VE3WVA/R	R	440	26	11	ON	3
VE2GT/R	R	99	12	9	QC	2
VE3LDE/R	R	60	7	6	ON	3

COSTA RICA

TI2ALF	6	40	8	5	EJ79

CUBA

CO3VR	6	4,902	88	57	EL93
CO2QU	6	4,743	96	51	EL83

DOMINICAN REPUBLIC

HI8RD	6	3,600	76	48	FK58
HI8LAM	6	110	11	11	FK58

GUATEMALA

TG9AJR	6	682	32	22	EK44

MEXICO

XE2JS	6	27,816	235	122	DL68
6D5C	6	18,768	185	102	DL80
					Op: XE1H
6F6F	6	9,648	146	67	EL60
					Op: XE1N
XE2OK	6	3,456	75	48	DL95
XE2TT	6	1,924	53	37	DL95
XE2YWH	6	1,392	49	29	DL92
XE1GPW	6	1,184	39	32	DL80
6EØJ	6	1,073	39	29	EL01
					Op: XE1EE
XE1AY	6	900	37	25	DK79
XE2YWB	Q	4,160	83	52	DL82
4A2MAX	M	7,020	109	65	DL64
					Ops: XE2DLC XE2JT XE2N
XE2NL	M	49	7	7	EL05
					Ops: XE2KSL XE2AHN XE2SK XE2N

AFRICA

CANARY ISLANDS

EA8DBM	A	94,612	399	218	IL18

ASIA

ASIATIC TURKEY

TA3AWB	A	8	4	1	KM38
TA4RC	6	192	16	12	KM59
TA3MTM	2	20	5	2	KM38
TA3UMO	2	2	1	1	KM38
TA3E	M	459	23	17	KM38
					Ops: TA3E TB3ALI

CHINA

BG7XWF	A	1,428	50	28	OL99
BG4HYK	A	476	30	17	PM00
BH6KWC	A	336	20	16	OM64
BD6JN	A	255	18	15	OM64
BD4SBN	6	4,947	101	51	PM01
BG2KAJ	6	1,302	64	21	PN23
BH4FSD	6	988	38	26	PM01
BG8DIV	6	425	26	17	OM20
BA5CW	6	336	23	16	PM00
BA4DL	6	273	21	13	PM01
BG4FQD	6	150	16	10	PM01
BD7LMB	6	120	13	10	OL63
BG8PM	6	80	11	8	OL36
BG2KZP	6	42	7	6	PN42
B7/BH4UMN		6	42	7	7 OL65
BH6KOK	6	35	7	5	OM64
BH4BFS	6	24	6	4	PM01
BG2KYH	6	4	2	2	PN23
BA7LAC	Q	204	17	12	OL63
BG7IKK	Q	140	14	10	OL63
BG5UZW	Q	12	4	3	OL96
BH3EMV	Q	9	3	3	OM89
BG5GDP	Q	9	3	3	PM00
BD7JIR	Q	4	2	2	OM89
BG5BAA/R	R	1,512	43	36	4

ISRAEL

4X2M	M	22,230	190	117	KM72
					Ops: 4Z1MS 4X1MM 4Z4AK 4Z5LY

JAPAN

JH9DRL	A	5,888	98	46	PM86
JQ1NGT	A	1,820	100	13	PM95
JL3MCM	6	1,944	54	36	PM74
JH4UTP	6	550	28	22	PM64
JE2BOM	6	320	21	16	PM84
7L4IOU	6	250	25	10	PM95
JE2UFF	6	221	17	13	PM94
7K4VPV	6	108	12	9	PM95
JO7KMB	6	56	8	8	QM09
JF2NLH	6	49	7	7	PM84
JP1LRT	6	48	8	8	PM95
JA6GCE	6	30	6	6	PM52
JK3HFN	6	25	5	5	PM75
JR3UIC	6	16	4	4	PM74
JO4JKL	6	16	4	4	PM65
JA6DWFM	6	6	3	2	PM52
JI1IKC	6	4	2	2	PM95
JF1RYU	2	3,120	120	13	PM96
JE2HXL/P	2	816	34	12	PM84
JH4PUS	2	44	11	2	PM64
JA1KPF	Q	228	14	12	QM06
JL3OXR	Q	60	6	5	QM06
8N2TY	Q	48	8	6	PM85
JA8CEA	Q	24	6	4	QN14
JH7UJU	Q	21	4	3	QM08
JF1TEU	Q	16	4	2	QM05
JR1NKN	Q	10	5	2	PM95
JK1VUZ	Q	4	2	2	PM95
JO6NZN	Q	1	1	1	PM52
JJ1WWL	H	3,520	115	20	PM96
JG3DHN/R	R	3,036	60	33	5

KAZAKHSTAN

UP4L	6	700	29	25	MO13
UN3G	6	100	10	10	MN83
UN7JX	6	81	9	9	NN19
UN9L	6	6	3	2	MO13
UN8G	6	4	2	2	MN83
UN2E	6	1	1	1	MO52

KYRGYSTAN

EX8MJ	6	154	14	11	MN72

KOREA

HL3AMO	A	4,032	98	42	PM36
HL2AHL	A	160	16	10	PM37
DS3EXT	A	154	13	11	PM36
HL2ZN	6	1,550	52	31	PM37
HL2ASZ	6	108	13	9	PM37
DS1TWO	2	140	35	2	PM37

SAUDI ARABIA

7Z1SJ	6	575	25	23	LL25

SRI LANKA

4S7JL	A	186	17	6	MJ96
4S6CPT	A	6	2	2	MJ96

TAIWAN

BU2EO	6	4	2	2	PL05

THAILAND

E27IHO	2	1,936	121	8	OK03
HS5NMF	2	66	11	3	OK04
E25JNR	Q	10	5	1	OK03
E25CHP	Q	8	4	1	OK03
E24QND	M	6,240	120	26	OK16
					Ops: E24QND E24QNC
E24ZPX	M	4,344	181	12	OK03
					Ops: E24ZPX E25GNL E25LOB E25MAP E25LRA E25HLF E25LBD E25PFE E25GQG HS6NNG
HSØEDP	M	3,586	164	11	OK04
					Ops: HSØEDP E22FFJ HSØQQB E22KKO E22EEO
HS1AN	M	2,896	181	8	OK03
					Ops: E22UYH E24PCN E25ETT E25CHO E25ANG
HS1AB	M	1,736	124	7	OK03
					Ops: E25FGL E22STE E2ØKDD E22HUF E24NLR E29MU E24UTB HS1BLE HS1GRL E21NJJ E21EEP E24RWE
E21AK	M	240	24	5	OK04
					Ops: E24SMC E2ØSJC HS3UBW E22DXH
E29AE	M	34	17	1	NJ99
					Ops: HS8MOM E25ARD E25GEP

WEST MALAYSIA

9W2W	A	36	6	4	OJ05
9W2VGR	A	33	7	3	OJ06
9W2EYR	Q	36	6	4	OJ05
9M2CDX	Q	2	1	1	OJ11
9M4CRX	M	60	8	5	OJ05
					Ops: 9W2XIO 9W2LDB 9W2EXL 9W2NNA 9W2ILR 9W2FXC

EUROPE

AUSTRIA

OE3MDB	2	1,326	39	17	JN88
OE3KAR/P	Q	270	15	9	JN86

BELGIUM

ON5JT	A	1,984	40	32	JO10

BOSNIA AND HERZEGOVINA

E74SL	A	7,260	102	60	JN94
E7ØAA	H	4,068	69	36	JN93
E74BYZ	M	4,576	91	52	JN84
					Ops: E73RB E73CV E76MD E76SU

BULGARIA

LZ2CH	Q	56	8	7	KN34
LZ3DP	6	9	3	3	KN32

CROATIA

9A2VX	6	609	29	21	JN75
9A1AR	2	3,240	60	27	JN75
					Op: 9A2AR
9A1I	M	3,510	71	26	JN85
					Ops: 9A9I 9A7IQG

CZECH REPUBLIC

OK4DJ	2	2,844	79	18	JN89
OK5SE	2	2,166	57	19	JN89
OK1RDO	M	31,230	197	90	JN69
					Ops: OK1DC OK1HRD OK1NMJ

DENMARK

OZ6OM	Q	12	4	3	JO55

ENGLAND

G4OED	A	3,815	63	35	IO91

M1VPN	6	132	12	11	IO80
GØDDZ	6	1	1	1	JO02
M5W	Q	2,420	58	44	IO80
					Op: MØHMJ
M7SPS	Q	629	37	17	IO92
G1E	M	2,482	52	34	JO00
					Ops: 2EØJAW GØKVF GØPOI GØTJH G1FBH G1TPA G6RZA G8KBI MØCFO M6HWM M7ABT

FRANCE

F4IVC	A	2,652	48	39	JN05
F5DE	A	220	12	10	JN05
TM7B	6	468	26	18	JN38
					Op: DL7BC
FØFEK	Q	224	14	8	JN19

GERMANY

DH6DAO	A	6,136	78	52	JO41
DK2OY	6	160	16	10	JO44
DL1EAL	6	63	9	7	JO31
DK7XX	6	20	5	4	JO53
DF4WO	6	9	3	3	JO30
DG3AL	6	4	2	2	JN37
DL1DBR	2	598	23	13	JO41
DK7PA	Q	240	12	10	JO41
DJ3EI	Q	28	7	4	JO62
DL2TM	Q	16	4	4	JO52
DH5MM	Q	1	1	1	JO52

GREECE

SX2I	6	24,592	216	116	KN10
					Op: SV2JAO
SV1NZX	6	12,282	139	89	KM17
SV2AEL	6	7,875	108	75	KN10
SV3AWG	6	63	9	7	KM08
SV3AUW	Q	4,104	76	54	KM17

HUNGARY

HG6Z	M	58,548	287	123	JN97
					Ops: HA6VV HG6IA HG6WF

IRELAND

EI6JK	6	255	17	15	IO53

ITALY

I1JTQ	A	13,176	128	72	JN34
IC8TEM	A	9,040	96	80	JN70
IK7LMX	A	7,076	94	61	JN80
IW1CHX	A	308	16	14	JN35
IZ5EME	6	10,556	119	91	JN52
IV3KKW	6	4,218	74	57	JN66
IK7IMO	6	1,380	47	30	JN90
IT9CKA	6	182	14	13	JM68
IN3TWX	6	99	11	9	JN56
IK3SWB	6	49	7	7	JN66
IT9BLB	6	30	6	6	JM68
IZ7UMS	2	4,672	74	32	JN81
IZ5HQB	Q	832	32	26	JN53
IR9K	M	82,256	369	194	JM67
					Ops: IT9DSZ IT9KXK IT9IVU IT9RJE IT9BXR IT9PPG IT9ATF IT9WDC IT9YMM
IQ1LA	M	286	16	11	JN44
					Ops: IU1LCU IZ1KGY

LATVIA

YL2QG	6	272	17	16	KO06
YL2LW	2	60	6	5	KO26
YL7X	M	12,231	118	81	KO07
					Ops: YL1ZF YL2LY

LITHUANIA

LY5W	6	1,610	46	35	KO15
LY1R	6	156	14	12	KO14

MONTENEGRO

4O6BLM	M	75,543	336	169	JN92
					Ops: 4O5JD 4O6ZD 4O3BUP 4O6LEE 4O4GIG

NETHERLANDS

PA8KM	A	6,688	88	44	JO32
PA5WT	6	240	16	15	JO22
PE1OBL	2	32	4	4	JO21

POLAND

SQ2EEQ	A	90	9	9	JO94
SP5UFK	6	28	7	4	KO02
SP2HHX	2	176	11	8	JO94
SQ1FYY	2	2	1	1	JO73
SP9SDF	Q	1,980	52	20	JN99

PORTUGAL

CT1END	Q	48	8	6	IM58

ROMANIA

YO5AVN	A	4,950	72	50	KN17
YO2NAA	6	3,450	76	46	KN05
YO9HP	6	288	18	16	KN35
YR2X	6	210	15	14	KN06
					Op: YO2LEA
YO3JW	6	99	11	9	KN35
YO5PUV/P	6	9	3	3	KN16
YO5LD	2	7,000	100	35	KN05
YO2LSP	2	4,758	61	39	KN05
YO2LLZ	2	4,536	81	28	KN05
YO2GL	2	1,054	32	17	KN05
YO9CWY	2	280	14	10	KN35
YO9CLG	2	64	8	4	KN35
YO8SSB	Q	225	16	15	KN27

SARDINIA

ISØBSR	6	28,495	209	139	JM49

SCOTLAND

GM5G	M	2,242	41	38	IO87
					Ops: 2MØSQL MMØHVW GM1TGY MMØGYX GM6PLQ

SERBIA

YU5R	6	306	18	17	KN04
					Op: YT2AAA
YT2TNT	6	4	2	2	KN04

SLOVAK REPUBLIC

OM7ANT	2	2,730	65	21	JN98

SLOVENIA

S56P	2	22,620	195	58	JN76

SPAIN

EA5IEA	6	621	27	23	IM97
EA1HRR	2	3,080	55	28	IN83
EC4AA	Q	6	3	3	IN80

SWEDEN

SF6F	A	7,497	87	63	JO67
SM5EPO	A	609	24	21	JP80
SM3PZG	6	208	16	13	JP93
SM7I	2	112	8	7	JO65

SWITZERLAND

HB9BAS	6	702	29	26	JN37

OCEANIA

INDONESIA

YE3DFB	A	60	11	3	OI62
YC3BHC	A	6	3	1	OI62
YB2ECG	A	4	2	2	OI52
YB2MDU	6	1,488	48	31	OI53
YC3FTY	2	56	14	2	OI62
YD3AVN	2	44	11	2	OI52
YF3CXB	2	44	11	2	OI52
YD3RAN	2	36	10	2	OI62
YC3GEV	2	32	8	2	OI62
YC3RJL	2	28	7	2	OI62
					Op: YD3RJL
YD3DBG	2	24	6	2	OI62
YB3BAR	2	6	3	1	OI62
YB3BX	2	6	3	1	OI62
YB3GET	2	6	3	1	OI62
					Op: YB3BAR
YE3DKB	2	6	3	1	OI62
					Op: YB3BAR
YF3DBR	2	6	3	1	OI62
					Op: YB3BAR
YD3BFV	Q	52	13	2	OI52
YF3GDE	Q	48	13	2	OI62
YC3PHR	Q	16	10	1	OI62
YG3CMS	Q	10	5	1	OI62
YC3AHD	H	48	13	2	OI62
7E3E	M	44	12	2	OI62
					Ops: YF3CYT YF3CYU YF3CYS YC3GFN YC3NHW
YD3AXD	R	28	8	2	1

SOUTH AMERICA

ARGENTINA

LU9DO	A	46	19	2	GF05
LU1BJW	A	22	7	2	GF05
LU2BN	A	12	4	2	GF05
LU2DX	6	11	11	1	GF05

BONAIRE

PJ4MM	6	182	14	14	FK52

BRAZIL

PY2AE	A	637	32	13	GG66
PV2Y	A	224	18	7	GG66
					Op: YV6CR
PY2WOT	A	182	17	7	GG76
PY2EU	A	100	12	5	GG76
PY3LX	A	88	12	4	GG40
PU2LFU	A	84	10	6	GG76
PY3TR	A	84	12	4	GF49
PU2USK	A	78	8	6	GG76
PU3DRM	A	63	11	3	GG40
PU4MMZ	A	60	6	6	GH80
PU2UAF	A	56	11	4	GG66
PU3YST	A	44	11	2	GG40
PU3DCC	A	24	6	2	GG40
PU1WRC	A	12	4	2	GG97
PY3DCC	6	4	3	2	GG49
PY2GTA	6	3	3	1	GG66
PU3MIP	2	170	17	5	GF49
PY2FSR	2	100	10	5	GG56
PU2OXB	2	64	8	4	GG56
PU3LMZ	2	48	12	2	GG40
PY3IE	2	48	12	2	GG40
PY3KT	2	48	12	2	GF49
PU3PIL	2	40	10	2	GF49
PU3SBL	2	36	9	2	GG40
PY5EK	2	32	4	4	GG43
PU3AFG	2	28	7	2	GG40
PY2EBD	2	24	6	3	GG67
PU3POE	2	24	6	2	GG40
PU1JSV	2	12	3	2	GG87
PY2QB	2	8	3	2	GG77
PU3RIN	2	8	2	2	GG30
PY3TL	2	8	2	2	GG30
PP5IP	2	2	1	1	GG53
PY2MIA	2	2	1	1	GG66
PY2CER	Q	72	9	4	GG67
PY2AD	Q	52	7	4	GG67
PU3MLN	Q	32	10	2	GG40
PY2TDB	H	16	4	2	GG66
PV2B	M	115	13	5	GG66
					Ops: PY2MIG PY2ANY PU2VJI

TRINIDAD & TOBAGO

9Y4D	A	690	27	23	FK90

CHECK LOGS

9A5ST, AE3T, E25OOO, EA3AYQ, EA3CX, EW1CD, K8YC, KC1RET, KG4QEN, PU2MLO, PY2DN, UN7ECA, XE1HG, YO5OHO.

Announcing:

The 2023 CQ World Wide WPX Contest

SSB: March 25-26 CW: May 27-28, 2023
Starts 0000 UTC Saturday; Ends 2359 UTC Sunday
Log Deadlines: SSB – 2359 UTC Mar 31, 2023 / CW – 2359 UTC Jun 2, 2023

Thrill in the chase of thousands of unique callsign prefixes from hundreds of DX entities in the world's largest everyone-works-everyone radio contests.

The CQ World Wide WPX contests are immensely popular operating activities that enjoy broad participation by amateurs around the globe. The events attract amateurs at all levels of proficiency from beginner to world champion and are rich hunting grounds for bagging callsign prefixes in pursuit of the coveted CQ WPX Awards Program endorsements. WPX features a diversity of categories for single operator and multi-operator stations, including the Youth Overlay for entrants 25 years of age or younger, so please come and join the fun!

Contest Basics

Each contest mode is a separate event running from 0000 UTC Saturday until 2359 UTC Sunday. SSB is the last full weekend of March and CW is the last full weekend of May.

Amateurs worldwide try to contact as many amateurs and prefixes as possible during the period of operation. Single-Operator stations may operate 36 of the 48 hours and off times must be a minimum of 60 minutes during which no QSO is logged. Multi-operator stations may operate the full 48 hours.

Contacts are valid on the 1.8-, 3.5-, 7-, 14-, 21-, and 28-MHz bands (no WARC bands). Exchange a RS(T) report plus a progressive contact serial number starting with 001 for the first contact. Note: Multi-Two, Multi-Unlimited, and Multi-Transmitter Distributed entrants use separate serial number sequences on each band.

Scoring

The final score is the result of the total QSO points multiplied by the number of different prefixes worked. A station may be worked once on each band for QSO point credit.

Contacts with your own country are worth one point on each band. Contacts between stations on different continents are worth three points on 28, 21, and 14 MHz and six points on 7, 3.5, and 1.8 MHz.

Contacts between stations on the same continent, but different countries, are worth one point on 28, 21, and 14 MHz and two points on 7, 3.5, and 1.8 MHz. Exception: For North American stations only — contacts between stations within the North American boundaries (both stations must be located in North America) are worth two points on 28, 21, and 14 MHz and four points on 7, 3.5, and 1.8 MHz.

The prefix multiplier is the number of valid prefixes worked. Each prefix is counted only once regardless of the band or number of times the same prefix is worked. Special event, commemorative, and other unique prefix stations are encouraged to participate. A station operating from a DXCC entity different from that indicated by its callsign is required to sign portable. Prefixes must be issued or permitted by the licensing authority of the country of operation. See the full rules for a description of what constitutes a prefix.

Entry Categories

The competition is divided into Single-Operator and Multi-Operator categories. Single-Operator categories also offer four Overlay categories which may be entered IN ADDITION TO the normal Single-Operator category. All entry categories may use QSO finding assistance except for the Classic Overlay.

Single Operator (all bands or any single band): Only one operator finds, makes, and logs all contacts.

- High power: Up to 1,500 watts
- Low power: 100 watts or less
- QRP: 5 watts or less

Single Operator Overlay Categories: Entrants in Single-Operator categories may also submit their log for one of the overlay categories shown below. Overlay entries are grouped into all band, high power or low power (includes QRP) in the results.

Tribander / Single Element Overlay – Allows the use of a multi-band, multi-element antenna with one feedline for the 14-, 21-, and 28-MHz bands, plus a single element antenna for each of the 3.5- and 7-MHz bands. One example is a 3-element tri-band antenna for 14, 21, and 28 MHz plus an inverted-V wire dipole for 3.5 MHz and another one for 7 MHz. Another example is a single-element, multi-band vertical antenna for all five bands or a fan dipole of single-element dipoles for each band using a single feedline.

Rookie Overlay – Open to operators who were first licensed as radio amateurs less than three (3) years before the date of the contest. You will be asked to indicate the year you were first licensed when submitting your log.

Youth Overlay – Open to all operators who are 25 years old or younger on the dates of the contest. You will be asked to indicate your birthday when submitting your log.

Classic Overlay – Allows only one radio, no receiving during transmitting, QSO finding assistance is NOT allowed and only the first 24 hours of operation count for the Classic Overlay score.

Multi-Operator Categories (All Band only): More than one person can contribute to the final score during the official contest period.

Single-Transmitter: Only one transmitted signal is permitted at any time. The station may change bands up to 10 times per hour. This category has specific restrictions on band

changes so please read the full rules carefully.

- High power: Up to 1,500 watts
- Low power: 100 watts or less

Two-Transmitter: Two bands may be transmitted on simultaneously. Each station may change bands up to 8 times an hour.

Multi-Transmitter (Unlimited): One transmitted signal is allowed on each of the six contest bands.

Multi-Transmitter Distributed: A maximum of six transmitted signals, one per band at any one time, from stations in different locations. All equipment (transmitters, receivers, amplifiers, antennas, etc.) must be located in the same DXCC entity and CQ Zone, including remotely controlled equipment. Six bands may be activated simultaneously.

Checklog: Entry submitted to assist with the log checking. The entry will not have a score in the results and the log will not be made public.

Awards

Electronic certificates will be made available for download for everyone who submits an on-time entry. Plaques are awarded to recognize top performance in a number of categories. The current list of plaques and sponsors is at <www.cqwpx.com/plaques.htm>.

Club Competition

Many clubs around the world compete vigorously for the plaque awarded to the club making the highest total combined score in the SSB and CW weekends.

Submitting Your Log

Electronic logs should be in the Cabrillo format. Upload your log on the web at <www.cqwpx.com/logcheck>. Uploading logs via the web is the only approved method for submitting a log; paper logs are not accepted.

All entries must be emailed WITHIN FIVE (5) DAYS after the end of the contest: SSB logs no later than 2359 UTC 31 March 2023, CW logs no later than 2359 UTC 2 June 2023. Any log submission will replace any previous submissions. Resubmitting an entry after the deadline will result in it being considered as a late log.

Full Rules Online

Complete rules are available in several languages at <www.cqwpx.com/rules.htm> and in English only on *CQ* magazine's website <www.cq-amateur-radio.com>.

Looking Ahead

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

- A Variable Foxhunt Attenuator
- Fifty Years of Hamdom
- New Feature: QSL of the Month

Plus…

- Results: 2022 CQWW Foxhunting Weekend
- QRP: "V" is for Victory
- Organizing Your Scanner Frequencies

Do you have a hobby radio story to tell? A great project or exciting adventure? *CQ* covers the entire radio hobby. See our writers' guidelines on the CQ website at <http://bit.ly/2qBFOdU>.

Some hams like the features of the high-end commercial CODAN Envoy transceivers, but have trouble interfacing them with anything except CODAN's very expensive amplifier. N5SK takes a close look at the new CODAN High Power Amplifier Controller, which is designed to let the Envoy operate with the popular (and much less expensive) Ameritron ALS-1306 amplifier.

CQ Reviews:

The CODAN High Power Amplifier Controller (HPAC)

BY STEVEN KARTY,* N5SK

This article evaluates a new device that Australian-based CODAN recently introduced to interface its Envoy HF transceiver with an Ameritron ALS-1306 power amplifier, the CODAN High Power Amplifier Controller, or HPAC. Even though the Envoy is a commercial radio transceiver, most hams who bought Envoys assumed that connecting them to ham radio amplifiers would be easy. But trying to use the Envoy with anything other than a CODAN amplifier was a problem because there is no easy way to get a PTT output from the Envoy without an HPAC.

Photo A shows the HPAC, which measures 2 inches high by 5-11/16 inch wide and 3-3/4 inches deep. The mounting foot extends the width to 6-3/4 inches, and the TCVR (transceiver) connector protrudes from the front panel by 5/16 of an inch.

Although the Envoy is a fairly expensive commercial HF radio transceiver <https://tinyurl.com/2cmaxssw>, it has some unique features that are interesting to many hams. What makes us cringe is the thought of having to buy CODAN's companion 1,000-watt amplifier because it costs $43,000! Trying to use any other amplifier was a problem because there was no easy way to get a PTT (push-to-talk) output from the Envoy until CODAN developed its HPAC.

There are also several more incompatibilities between the Envoy and the $4,000 Ameritron ALS-1306 that the

Photo A. CODAN 08-07650-001 High Power Amplifier Controller (HPAC)

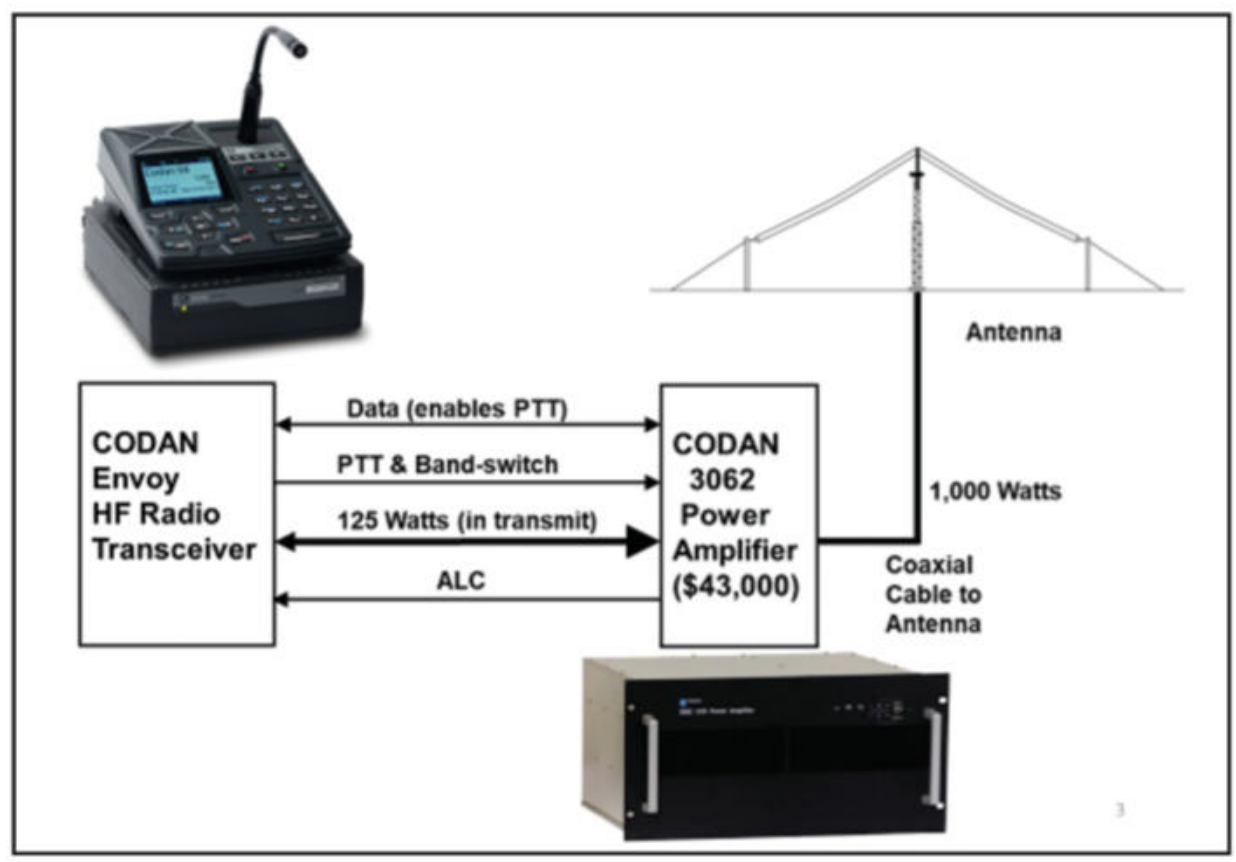

Figure 1. CODAN Envoy with CODAN 3062 amplifier. This combination, while excellent, is beyond the budgets of most amateurs.

*Email: <kartys@gmail.com>

$600 HPAC solves: These include automatic band-switching and Automatic Level Control (ALC). No HPAC is needed with CODAN's own $43,000 amplifier because it has all the HPAC functions built-in. Before the HPAC was introduced, I heard about some hams who developed a way to get a PTT output from the Envoy: They wrote their own custom firmware which also required cutting and rewiring some of the existing Envoy interface cables. Although their method provides a PTT output, they weren't able to fix the other interface problems.

Evaluation

Figure 1 shows the normal connections between a CODAN radio and a CODAN amplifier. HF radio amplifiers normally have a push-to-talk (PTT) input pin that needs to be connected to a radio's PTT output pin, so the radio can tell the amplifier when to transmit. Although the Envoy has a PTT output pin, it is not enabled by default. The Envoy has another pin for serial bi-directional data transfer that must be connected to the corresponding pin on a CODAN amplifier. The CODAN Envoy and the CODAN amplifier use their data pins to talk with each other so that, if they both agree, the Envoy enables its PTT output pin for use by the amplifier. The Envoy also has connections for providing band data to the amplifier and for receiving an ALC signal back from the amplifier.

Since ham radio amplifiers like the Ameritron don't have a serial bidirectional data pin, there is nothing to tell the Envoy to enable its PTT output pin, and there is no way for the Envoy to tell the Ameritron amplifier to go into transmit. Even if we could somehow get the Envoy's PTT output pin enabled, its output impedance of 1,000 ohms to ground is much too high to activate most amplifiers. The Ameritron amplifier must have its PTT input pin pulled down to less than 200 ohms to ground for transmitting. Although the Envoy provides an automatic band-switch selection output, its signal voltage levels are different from those needed by the Ameritron. Also, the Envoy switches bands at different frequencies from those needed by the Ameritron. The ALC voltage output from the Ameritron is also different from the ALC voltage input level needed by the Envoy. Because of all these differences in the data level voltages, formats, and impedances, the CODAN Envoy was completely incompatible with anything but a CODAN amplifier until CODAN developed the HPAC.

Figure 2 shows the normal operating configuration for connecting the Envoy to the Ameritron amplifier through an HPAC. The HPAC takes all of the signals from the Envoy and reduces them to a much simpler interface for the Ameritron amplifier. The HPAC enables the Envoy's PTT output and lowers its impedance, changes the Envoy's band-switch format to match the Ameritron's input, and changes the Ameritron's ALC level to match the Envoy. The PTT and band-switch lines shown in *Figures 1* and *2* are really eight different lines, seven of which are for the band-switch data. The HPAC accepts the band data output from the CODAN Envoy which is a ground on one of those 7 pins, depending on the operating frequency band selected: The HPAC translates those 7 pins into a single output pin going into the Ameritron amplifier that requires a different voltage input level for each band (ICOM format). This was the easiest interface problem for the HPAC to solve and it uses simple voltage dividers.

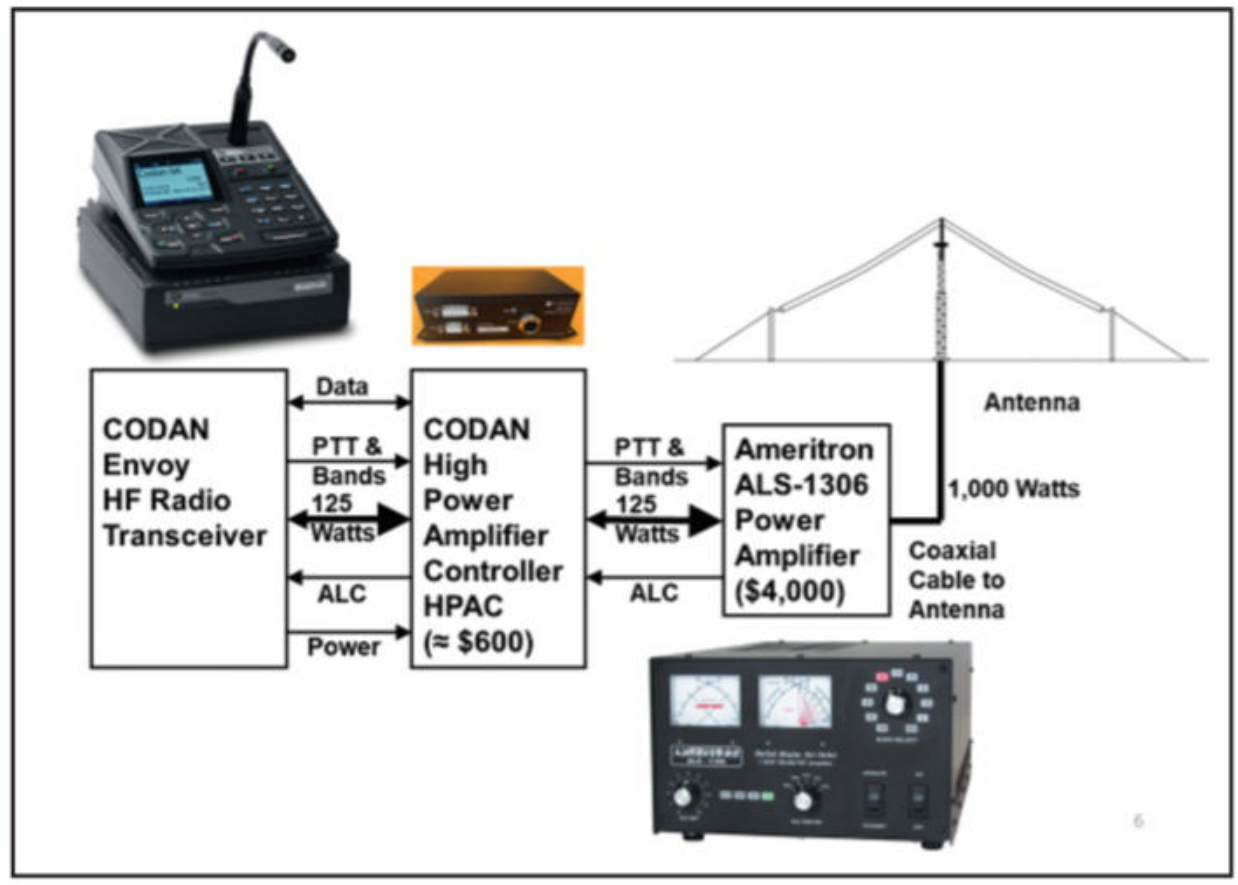

Figure 2. CODAN Envoy connected to Ameritron ALS-1306 amplifier through HPAC.

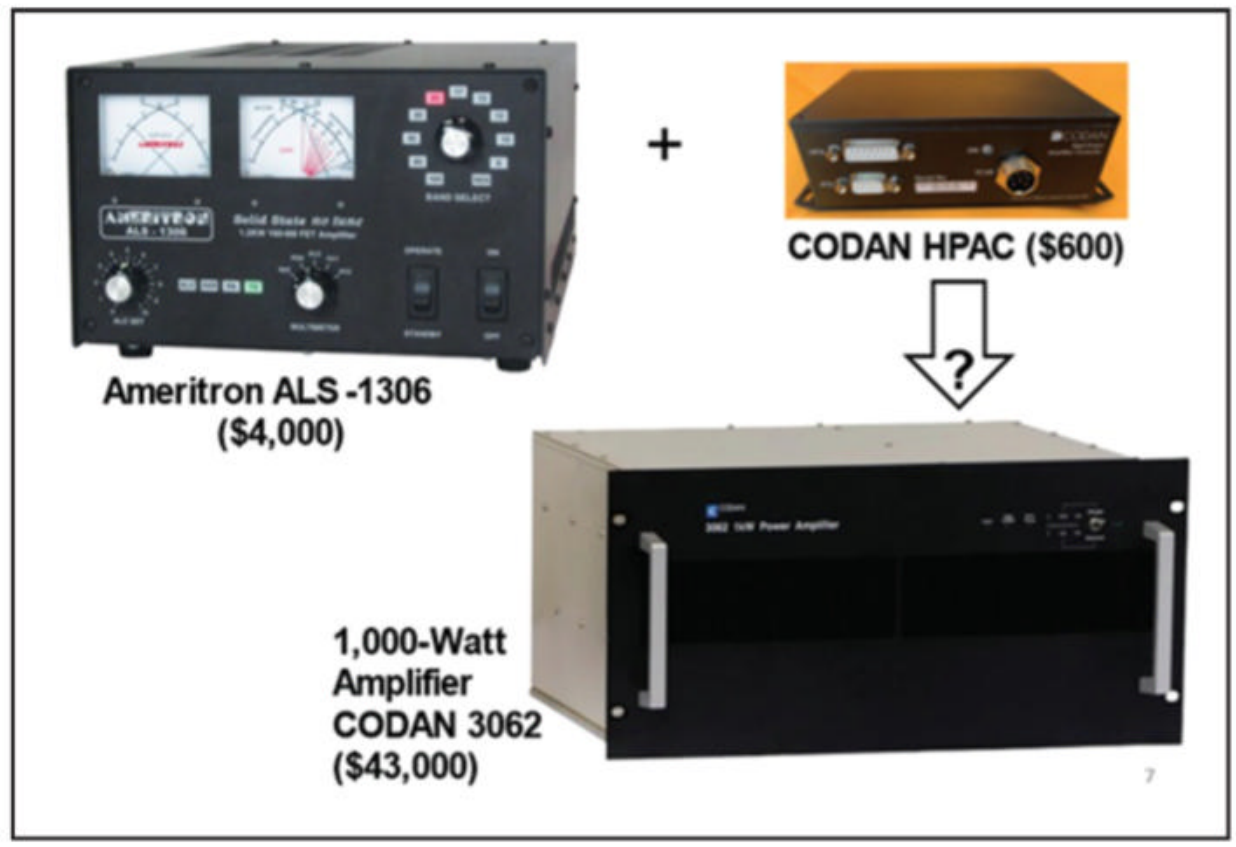

Figure 3. Ameritron ALS-1306 plus CODAN HPAC ≈ CODAN 3062? (No, not really.)

Photo B. The 08-05956-001 cable connects the transceiver to the HPAC.

Figure 3 asks the $43,000 question of whether the Ameritron ALS-1306 amplifier with the CODAN HPAC (for a total of $4,600) are the equivalent of the $43,000 CODAN 3062 amplifier: Although it's not an optimum configuration for commercial and government users who may need to access any portion of the entire HF radio band, it's a very workable combination for ham radio use.

Even with the HPAC, the Ameritron amplifier cannot operate over the entire HF radio band because it was not designed to operate outside ham radio frequencies. But its relatively low price makes it ideal for ham radio use. Also, the Ameritron is not suitable for completely unattended operation because it must be manually reset at its front panel if it experiences a problem. The Ameritron goes into standby mode when it senses a problem (such as high SWR) and it then has to be manually reset by an operator.

The CODAN amplifier is much more robust, and it will operate through problems that would cause the Ameritron to go into standby. Even if the CODAN amplifier faults, it has both automatic and remote reset capabilities. But it also costs ten times as much as the Ameritron / HPAC combo.

Equipment Description

HPAC Kit OPP-23652 Ameritron HPAC and accessories consists of the following items:

Part Number	Description
08-07650-001	HPAC (for ALS-1306 Amplifier)
08-05956-001	Cable, HPAC, 1m
08-07662-001	Cable, HPAC to Ameritron ALS-1306, 2m
15-04226-EN	Instruction Booklet, HPAC
08-01503-002	Cable, Coax assembly (RG58 UHF), 2m

The total cost of the first four items is approximately $600. Addition of the last item (the coaxial cable assembly) would increase the total by $142, so it is recommended that it be fabricated or separately purchased from a local source. (The MFJ-5806 6-foot long RG-58A/U patch cable with PL-259 connectors on both ends is available at Gigaparts <www.gigaparts.com> for $18.89 plus shipping.)

The 08-05956-001 cable in *Photo B* connects the CODAN Envoy transceiver to the HPAC. The male end of the cable connects to Envoy's antenna control connector and the female end of the cable connects to the TSVR (transceiver) connector on the HPAC. Although this cable appears to use the same type of connectors on both ends (except for one being male and the other female), the pin location for the second pin of the male connector is missing. The pin numbering also skips over the missing pin, so that the next pin is pin 2. This series connector does not seem to be readily available, and so this entire cable assembly should be purchased from CODAN along with the HPAC.

The 08-07662-001 HPA cable (*Photo C*) has a DA-15M connector on one end and two connectors (an RCA phono plug and a DE-9F connector) on the other end. The DA-15M connector plugs into the HPA connector on the HPAC. The end with two connectors plugs into the Ameritron amplifier's mating DE-9F Radio Interface connector and its RCA phono jack ALC connector. Although these are all readily available standard connectors, the plastic back shell of the DA-15M connector contains active circuitry. This active circuitry is a personality module for matching the Ameritron ALS-1306 amplifier. In the future, personality modules to suit different amplifiers may be made available if there is enough interest. This entire cable assembly must be purchased from CODAN along with the HPAC because of the active circuitry in back shell of the DA-15M connector.

The 08-01503-002 (*Photo D*) is a standard coaxial jumper cable with UHF connectors on both ends: This cable connects the Envoy's antenna connector to the amplifier's RF IN connector through a 2-meter length of RG58 coax. This cable can be fabricated or purchased locally for much less than its $142 price from CODAN. It is therefore recommended that everything else *except* this cable be purchased from CODAN, to keep the total price down to the $600 region.

Instruction Booklet

The instruction booklet does an excellent job of explaining the HPAC and how to use it to interface the CODAN Envoy with an Ameritron ALS-1306 power amplifier. Although the CODAN HPAC compensates for most of the Ameritron's idiosyncrasies, the instruction booklet contains the following note: "Each time the Envoy transmits on a different frequency, the amplifier PTT will be delayed by up to 700mS while the amplifier configures itself for the new frequency. Subsequent PTTs on the same frequency will not be delayed if the internal delay has already occurred however."

The initial version of the instruction booklet missed providing any explanation of what the different colors and flashing of the ON LED mean. The HPAC instruction booklet will be updated with the LED status details shown in *Table 1*. One additional observation is that the "red" LED color looks more

ON LED status	Meaning
Steady green	Device is functioning normally
Slow flashing green	Device is establishing communication with the radio
Steady yellow	Device is being reset
Slow flashing red	Device has been requested to perform a command that is not available
Steady red	Device has a non-recoverable configuration error

Table 1. What the HPAC "On" LED is telling you

Photo C. The 08-07662-001 HPA cable provides the communication between the HPAC and the Ameritron amplifier.

Photo D. The 08-01503-002 cable is a standard coaxial jumper. It's very expensive if you buy it from CODAN, but many other options are readily available.

orange than red. When the ON LED is glowing a steady green, it only indicates that the HPAC is connected correctly, and communications are available; it does not mean the correct Envoy settings have been selected for the Ameritron amplifier, nor that the power amplifier (PA) settings are correct.

The Envoy must have firmware version 3.10 or later to operate with the HPAC. Your CODAN distributor can remotely update your Envoy's firmware to a more recent version (currently 3.20) over the internet (if you have the CODAN 08-07215-001 Ethernet adapter plugged into the Envoy), after which the Envoy Desk Console firmware will automatically update itself.

Because the Ameritron ALS-1306 amplifier was built for amateur radio use, it is unable to operate over the entire HF spectrum from 1.6 to 30 MHz. The Ameritron amplifier also disables itself between 25 and 28 MHz, in accordance with FCC rules and regulations for ham radio power amplifiers, and it may not operate correctly beyond the ham radio bands' edges.

RF Pulse Issues

The CODAN Envoy normally transmits a short RF pulse at the start and end of each transmission. The Envoy Desk Console also beeps twice the first time it is PTTed after changing to a new frequency, coinciding with the initial RF pulse: The beeps are indicative of RF power being generated, which is required for a commercial external antenna tuner. The RF pulse at start of transmission is 50 watts, which occurs before the Envoy has PTTed the Ameritron amplifier (while the amplifier is in bypass). Ham radio automatic antenna tuners typically must be tuned at less than 20 watts, so it might be possible for CODAN to provide a future firmware upgrade to reduce the level of this pulse to between 10 and 15 watts when it is connected to the HPAC.

The end of transmission pulse from the Envoy is approximately 60 watts,

and it occurs while the amplifier is active so it causes the amplifier to produce full power. This ending pulse is slightly shorter than the starting pulse, but it contributes to the Ameritron amplifier sensing excessive reflected power on some frequencies and going into its standby (bypass) mode. CODAN provided instructions for turning off the ending RF pulse by going into the Envoy's Admin mode and selecting *Settings > Configuration > Handset PTT Beep*. The Ameritron amplifier operated much better after this simple change was made because it is overly sensitive to SWR above 2:1. The Ameritron amplifier faults and goes into its STANDBY (bypass) mode whenever it senses an SWR above 2:1 — after which it must be manually reset. Preventing this problem will probably require using an external automatic antenna tuner such as the MFJ-998 Intelli-Tuner.

It would be ideal to use the CODAN Envoy together with its companion CODAN power amplifier, but the high cost of the CODAN amplifier is discouraging when compared to other brands like the Ameritron ALS-1306 power amplifier. There is a huge price-performance trade-off from using the less expensive Ameritron amplifier: The CODAN amplifier is commercially rated versus the Ameritron amplifier's amateur status. Commercially rated amplifiers are built to much higher standards than amateur radio amplifiers, with better characteristics including improved reliability and longevity (especially when operated in continuous duty) with better harmonic suppression. The CODAN amplifier operates properly throughout the entire HF radio frequency band without any compromises, and it is able to accept fairly high SWRs and reflected power levels without faulting.

Additional Information

Step 3 on page 2 of the instruction booklet is confusing: It should say "To change to ALC Mode, the left arrow (<) on the Desk Console must be depressed and held down (as if reducing the power level) until 'ALC Mode' is displayed."

If the HPAC seems not to be functioning after connection, check to ensure that "PA" is displayed on the top notification bar of the Desk Console display. If not, press and hold button "6" until "PA" appears. If "PA" does not appear, check that the *Menu > User Data > Peripherals > Power Amplifier* is set to HPA Controller. If it was necessary to change this setting to HPA Controller, then press the checkmark key to save this change, power off and restart. Check that the RCA connector on the Ameritron end of the HPA cable is plugged into the Ameritron's "ALC" socket, which is the lowest RCA connector. If there is a slide switch on the Ameritron's back panel next to the Radio Interface connector, its slider should be at the Radio Interface connector end of its travel. Check that the Ameritron Band Select switch is set to REM.

Summary

The HPAC correctly controls PTT, enables proper automatic power amplifier band-switch filter selection, and level shifts the Automatic Level Control (ALC) signal from the Ameritron amplifier to the Envoy. Alternatively, the Envoy can be set to user-defined power so operators can run without ALC. The HPAC's ON LED is also helpful for verifying that most of the cables are connected to the Envoy and the amplifier, and that they are on and operating. The HPAC works perfectly with the Ameritron amplifier in its single-frequency mode and no problems were found with initial testing of ALE operation. Adding a $600 HPAC to a $4,000 Ameritron amplifier will not turn it into the equivalent of a $43,000 CODAN amplifier: The HPAC does everything that could possibly be expected of it to solve the interface compatibility problems between CODAN Envoy HF radio transceivers and Ameritron ALS-1306 amplifiers. Adding one $600 HPAC to an Ameritron amplifier makes it compatible with a CODAN Envoy HF radio transceiver.

Ordering Information

The HPACs can be ordered from Feather Tippetts <ftippetts@nviscom.com>, who works for John Rosica <john@nviscom.com> at NVIS Communications, LLC, 28850 Shannon Court, Tehachapi, CA 93561, (408) 782-8002 ext. 200. The HPACs cost slightly over $600 each, but only if the 08-01503-002 coax cable assembly is omitted when placing your order. Otherwise, the HPACs are $142 more.

The first part of this article showed you how to build a low-voltage power source using parts that may already be in your junk box. We conclude here with tips on using your new tool and keeping things safe.

Build Your Own Low-Voltage Transformer, Part 2

BY DAN SWENSON,* KBØVKS

Last month, we dealt with the construction of a low-voltage transformer (*Photo A*).[1] This tool can supply low voltage AC excitation to unknown iron-core power transformers to help identify and characterize them. The low-voltage approach is intended to reduce the likeliness and severity of electric shock. As mentioned last month, safety and liability are your own responsibilities. You are the responsible party, no one else. This concluding article will offer an old safety procedure to reduce risk, and a few examples of how to use this tool.

Continuity Testers

I advocate using continuity testers. These simple devices can rapidly discover shorts and open circuits, and you do not have to read any numbers. Simple continuity tests can also help reveal unsafe or defective transformers. Healthy transformers should exhibit a continuous primary and a continuous secondary; and should *not* show continuity from the primary to the laminations, from primary to secondary, or from secondary to the laminations, in most instances. There are some exceptions: The secondary of some high-voltage (HV) transformers are connected to the laminations. Many neon sign transformers and microwave oven transformers exhibit continuity from secondary to laminations.

Ohmmeters

An ohmmeter can also help identify unknown transformers. In general, manufacturers use smaller diameter wire on higher voltage windings and larger diameter wire on lower voltage windings. This means, in many cases, higher voltage windings have higher DC resistance, and lower voltage windings have lower DC resistance. While the above holds true in general, there are exceptions.

Shorted Turn

No serious discussion of inductors would be complete without mentioning the shorted turn. The shorted turn is a failure mode that occurs when one or more turns, on the primary or secondary, lose the insulation which would normally keep them separated. When turns short together, excessive current flows, even with no exterior load. Overheating, humming, and frequent blowing of the primary (line) fuse can occur. It is possible for a transformer that has a shorted turn to still pass continuity and ohmmeter tests. Rewinding or replacement is the cure. When installing a test secondary to determine volts-per-turn, be careful not to nick the insulation; a shorted turn could easily result. Use similar care when working on any permanent winding.

Turns Ratio

By convention, turns ratios are normally expressed with the higher number first, followed by a "1" as the lower number. A step-up plate transformer has a turns ratio expressed as: 1,200 volts / 120 volts = 10:1, not 1:10. A step-down filament transformer has a turns ratio expressed as: 120 volts / 12 volts = 10:1, not 1:10. Even though these two transformers

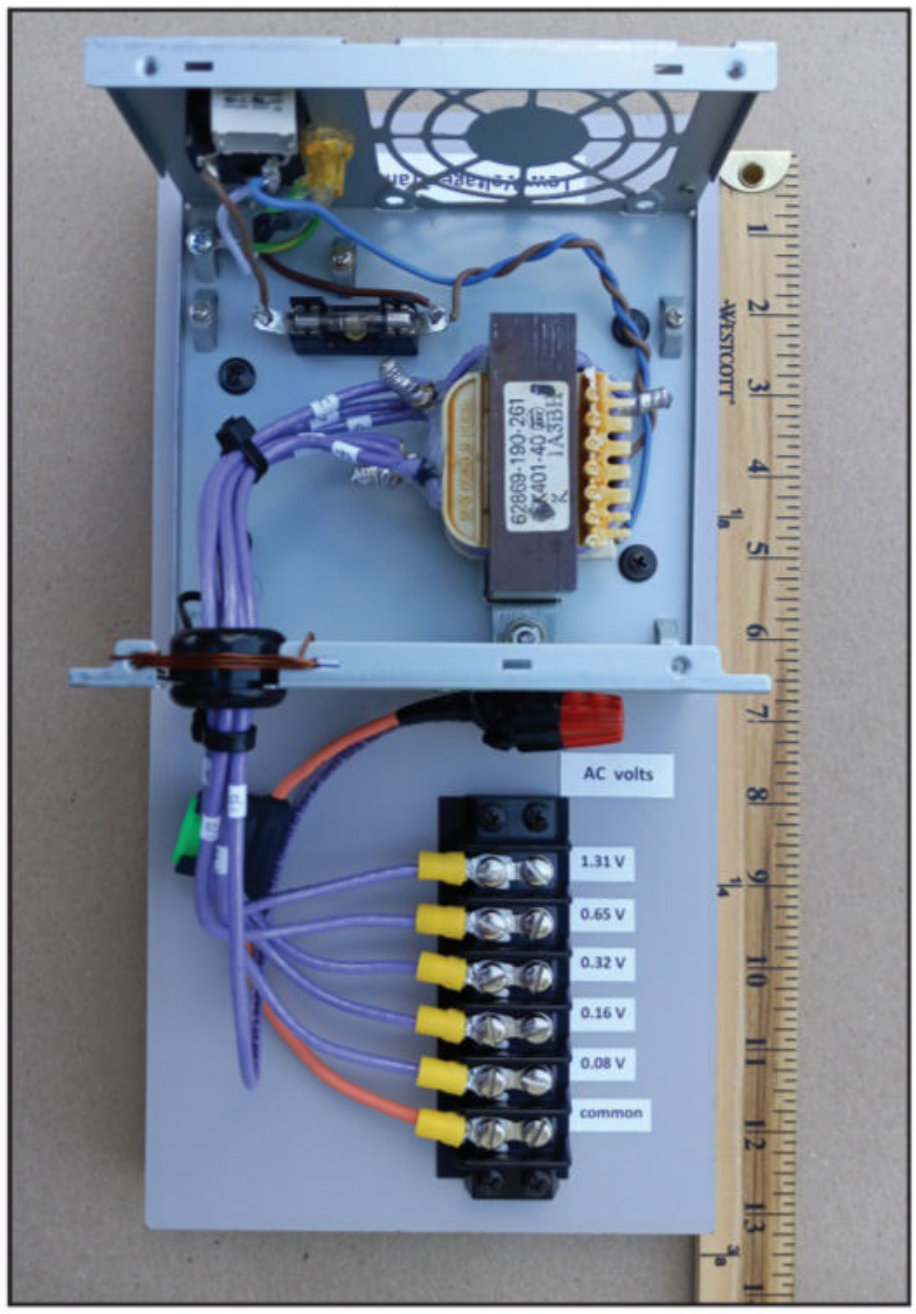

Photo A. The KBØVKS low-voltage transformer (construction details in part 1 of this article, Dec. 2022 CQ, p. 18). Use the various output taps as instructed here in part 2 to determine values and turns ratios of unknown-value transformers.

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are markedly different devices, they both have the same turns ratios, 10:1. In practical terms, voltage ratio = turns ratio. Turns ratio can easily be determined by using a low-voltage transformer. Practice the hands-off safety procedure reviewed below.

Volts-Per-Turn

Volts-per-turn should not be determined by using a low-voltage transformer. Attempting to determine volts-per-turn with a low-voltage transformer exciting the primary of an unknown transformer will produce a result in the lower millivolt range for one turn. This result can easily get lost in the electrical noise on your workbench. Also, do not excite just a few turns on an unknown transformer using a low-voltage transformer as a source. This attempt could force the unknown transformer into saturation, resulting in high currents, overheating, and inaccurate results. It is better to determine volts-per-turn with actual line voltage on the primary. Practice the hands-off safety procedure reviewed next.

An Old Safety Procedure

You can have the finest equipment and the best insulation, and still be in great danger because of poor testing procedures. For everyone, and especially for beginners, it is recommended that you take the time to learn this old procedure for your own safety, and for the safety of those around you:

1. Check that the low-voltage transformer is unplugged from the line.
2. Connect low-voltage tap of choice to one of the windings of the unknown transformer.
3. Select range and connect AC voltmeter to other winding of the unknown transformer.
4. Plug the low-voltage transformer into the line.
5. Hands off the equipment, read the AC voltmeter and record the number.
6. Unplug the low-voltage transformer from the line.

Note that fingers are not touching the voltmeter, the low-voltage transformer, or the unknown transformer during excitation. The whole idea is to reduce the danger associated with testing by not touching the meter or the transformer. To make this procedure easier, you may wish to make insulated adapters, to convert the voltmeter probes to insulated alligator clips.

A Few Practical Examples

Let's look at three examples, two step-up transformers and one step-down transformer. I used numbers in these examples which reflect my low-voltage transformer. Follow along with your low-voltage transformer in mind.

Transmitter Plate Transformer: The input and output wires are marked from the factory. Label shows primary is 234 volts and secondary is 2,600 volts. The likely turns ratio is: 2,600 volts / 234 volts = 11.1:1. Check with continuity tester shows normal results. Check with ohmmeter shows secondary has higher DC resistance than primary. The HV output is far in excess of the maximum capability of common AC voltmeters. Since turns ratio is not extreme, select medium excitation voltage. Choose 0.65-volts tap and follow safety procedure to excite primary. Meter reads 7.16 volts on secondary. Unplug from line. Determine turns ratio: 7.16 volts / 0.6 volts = 11:1. The hazard is less in comparison to attempting to measure 2,600 volts directly. Insulation fills both windows; it is not possible to determine volts-per-turn. Label transformer with turns ratio, 11:1.

Receiver Plate Transformer: Transformer has no label. Receiver schematic indicates transformer output is 170 volts with 117-volt line. The likely turns ratio is: 170 volts / 117 volts = 1.45:1. Wire color code not given. One pair dull gray, other pair faded green. Check with continuity tester shows normal. Check with ohmmeter reveals green pair has a bit higher DC resistance than gray pair. Speculate that gray pair is primary. Since turns ratio is low, select high excitation voltage. Choose 1.3-volts tap and follow safety procedure to excite gray pair. Meter reads 1.89 volts on green pair. Unplug from line. Because green pair has higher voltage than gray pair, speculation appears correct. Determine turns ratio: 1.89 volts / 1.3 volts = 1.45:1. To prove a point, change excitation to green pair per safety procedure. Meter reads 0.90 volts on gray pair. Unplug from line. Because green pair again has higher voltage than gray pair, speculation appears correct again. Determine turns ratio: 1.3 volts / 0.90 volts = 1.44:1, same as ratios above. This demonstrates that no matter the excitation winding, the resulting turns ratio is the same. You get the correct result either way.

Both windows of the E&I transformer have small empty spaces, enough room for two full turns of enameled wire, a test secondary. Place the wire gently, so as not to scuff the enamel, and connect the voltmeter. Follow safety procedure. Carefully apply line voltage to primary, gray pair. Meter reads 0.62 volts. Unplug from line. Remove test secondary. Normalize voltage to 117 volts if needed. Determine volts-per-turn: 0.62 volts / 2 turns = 0.31 volts-per-turn. This is very similar to what you did to determine volts-per-turn while constructing your low-voltage transformer. Determine turns on primary: 117 volts / 0.31 = 377 turns. Determine turns on secondary: 170 volts / 0.31 = 548 turns. Verify turns ratio: 548 turns / 377 turns = 1.45:1, same as ratios above. Label transformer with 0.31 volts-per-turn and 1.45:1 turns ratio. Label gray pair 117 volts primary; label green pair 170 volts.

Battery Charger Transformer: Suppose we have an old transformer salvaged from a 5-amp 12-volt battery charger; windings are visible, there is no label. From the solder terminals, it is not clear which is primary and which is secondary. Let's say we have an application that calls for 14-volts AC at 2 amps. Might this transformer be a good candidate? The transformer's capability to supply current seems adequate; proceed. Check with continuity tester identifies terminals for two windings. Check with ohmmeter reveals a high DC resistance winding and a low DC resistance winding. Speculate high resistance winding is primary. Estimate secondary voltage: 15 volts. Estimate turns ratio: 120 volts / 15 volts = 8:1. At this point, connecting the line to an unknown winding could be dangerous. If reverse connected, high voltage could be present: 120 volts x estimated turns ratio = 120 volts x 8 = 960 volts, and damage to transformer and meter could result. Since estimated turns ratio is not high, select high excitation voltage. Choose 1.3-volts tap and excite either winding per safety procedure. Meter reads 0.185 volts. Unplug from line. Appears primary has been excited; label excitation pair as primary. Because meter reading is a low value, change excitation to unlabeled winding to obtain a higher reading. Follow safety procedure. Meter reads 9.1 volts. Unplug from line. Appears secondary has been excited; label excited pair as secondary. Primary and secondary have been identified. Visual wire inspection reveals secondary is outer winding and primary is inner winding, proceed. Determine turns ratio: 9.1 volts / 1.3 volts = 7:1. Determine expected secondary voltage with 120-volt line: 120 volts / turns ratio = 120 volts / 7 = 17.14 volts.

Both windows have small empty spaces, enough room for three full turns of enameled wire, a test secondary. Place the

wire gently, so as not to scuff the enamel, and connect the voltmeter. Follow safety procedure. Carefully apply line voltage to primary. Meter reads 1.2 volts. Unplug from line. Remove test secondary. Normalize if needed. Determine volts-per-turn: 1.2 volts / 3 turns = 0.4 volts-per-turn. This is very similar to what you did to determine volts-per-turn while constructing your low-voltage transformer. Label transformer with 0.4 volts-per-turn; do not label for turns ratio at this time. Determine turns on primary: 120 volts / 0.4 = 300 turns. Change voltmeter to secondary. Apply line voltage to primary per safety procedure. Meter reads 17.14 volts at secondary. Unplug from line. Candidate has sufficient secondary voltage, proceed. Determine turns on secondary: 17.14 volts / 0.4 = 42.8 turns. Do not worry about the fraction of a turn. Estimate turns needed on secondary for 14-volt application: 14 volts / 0.4 = 35 turns. Estimate voltage decrease needed: 17.14 volts – 14 volts = 3.14 volts. Estimate turns to remove: 3.14 volts / 0.4 = 7.8 turns. Do not worry about the fraction of a turn. I suggest to start by removing only 4 turns, put a 2-amp load on the secondary, determine the secondary voltage sag under load, then remove only one turn at a time, until arriving at a voltage a bit above the target voltage, while under load. Remove 4 turns and begin testing under load. Tests reveal candidate has only 0.1-volt sag in secondary voltage under 2-amp load. Results are: 38 turns remaining x 0.4 volts-per-turn = 15.2 volts. Remove one more turn. Results are: 37 turns remaining x 0.4 = 14.8 volts. Normalize for 120-volt line if needed. Remove one more turn. Results are: 36 turns remaining x 0.4 = 14.4 volts. Again, normalize for 120-volt line if needed. Six turns have been removed; stop unwinding. Unplug from line. Secure secondary winding. Determine resulting turns ratio: 120 volts / 14.4 volts = 8.3:1. Verify turns ratio: 300 turns / 36 turns = 8.3:1. Add 8.3:1 turns ratio to transformer label. Candidate meets requirements of new application.

Summary

You have reviewed turns ratio and volts-per-turn, two important parameters of all transformers. You see the advantage of using a low-voltage transformer for determining turns ratio. Hazards are reduced. In practical terms, voltage ratio = turns ratio. You see how to determine volts-per-turn, still practicing the hands-off safety procedure. In industry, a close cousin to our low-voltage transformer would be a spot welder, low voltage and high current. As we near the end of this article, let's become a bit introspective. Determine the number of turns on the primary of your low-voltage transformer. My unit has: 120 volts / 0.1638 volts-per-turn = 732 turns. Focusing on just one turn on the secondary, determine the turns ratio: 732 turns / 1 turn = 732:1, which is huge. Focusing on the eight full turns on the secondary, determine the turns ratio: 732 turns / 8 turns = 91.5:1, still very high. Your ratios will be different, but they will also be quite large. I'd be curious to hear from you about the weight, cross-sectional core area, and volts-per-turn of your low-voltage transformer. Best wishes as you build projects with more safety.

Notes:

1. Swenson, "Build Your Own Low-Voltage Transformer, Part 1," *CQ* Dec 2022, p. 18

Photo A. My innocent looking flagpole. Pay no attention to that black ladder line, HOA.

Returning to the ham bands after a four-decade absence, N2EWS ("Every Woman's Sweetheart") shares his adventures in getting back on the air without attracting the attention of his homeowners' association. This is part one of three…

The Perverted V Antenna (Part 1)

Or … The Anticlimactic Adventures of Every Woman's Sweetheart

BY NICHOLAS PETRELEY,* N2EWS

Picture a TV show, set in the 1960s. It opens with a slinky femme fatale dispatching rogues with expert Kung Fu. She grabs their suspicious-looking package, tosses it into the passenger seat of a 350 GT Lamborghini, leaps in, and speeds away. She pulls up at a toll booth. An old man in a soiled hoodie, cigarette dangling from his lips, grumbles, "50 cents." She hands him a couple of quarters and steps on the gas. Cue the theme music as the voiceover announces, "The Adventures of Ralph J. Spumoni: Toll Collector."

My life is like that lately. I've been living one anticlimactic moment after another since recently passing the exam to get licensed again. My Advanced Class license expired some 30 years ago, so I had to start fresh to get back on the air. I abandoned my trusty Drake TR-4 and E.F. Johnson matchbox back when dinosaurs roamed the earth. I have limited resources, so I scour the web for affordable replacements. I know I'll need a power supply for typical 100-watt rigs. I pick up a used Astron RS-20A linear power supply. I figure 20 amps at 13.8 volts should leave plenty of room for 100-watts CW / SSB. I order a ground stake, wire, and an UNUN for an end-fed antenna, and an MFJ-4602 window pass-through. I have a nostalgic affinity for the TR-4, but there are better rigs now. I come across a used ICOM IC-7410 on eBay for about $500. I take a risk that it still works fine and snipe the 7410 for $500 and change. Finally, I grab a used MFJ-949D Deluxe Versa Tuner II for $60.

I set it all up the weekend after getting my callsign, KI5VDI. Yes, that's right. K-I-5-Venereal-Disease-Infection. I didn't think a callsign could be worse than the one I let expire,

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Photo B. The left leg of the dipole, bent at the fence corner and held by a 2.5-pound weight.

Photo C. Pipe clamps prevent each telescoping section from collapsing.

KBØFU, but there it is. I file for a vanity callsign so I can get something that resembles my old New Jersey call, WB2EWS, but shorter. N2EWS is available. I like it. North 2 East, West, South, or N-2 Every Woman's Sweetheart. (No, I didn't come up with that; that was suggested by a 6-meter contact while operating as WB2EWS at the Delaware Valley Radio Association club station, W2ZQ).

Searching for an HOA-Friendly Antenna

Now, we have a homeowners' association (HOA) that threatened to fine us

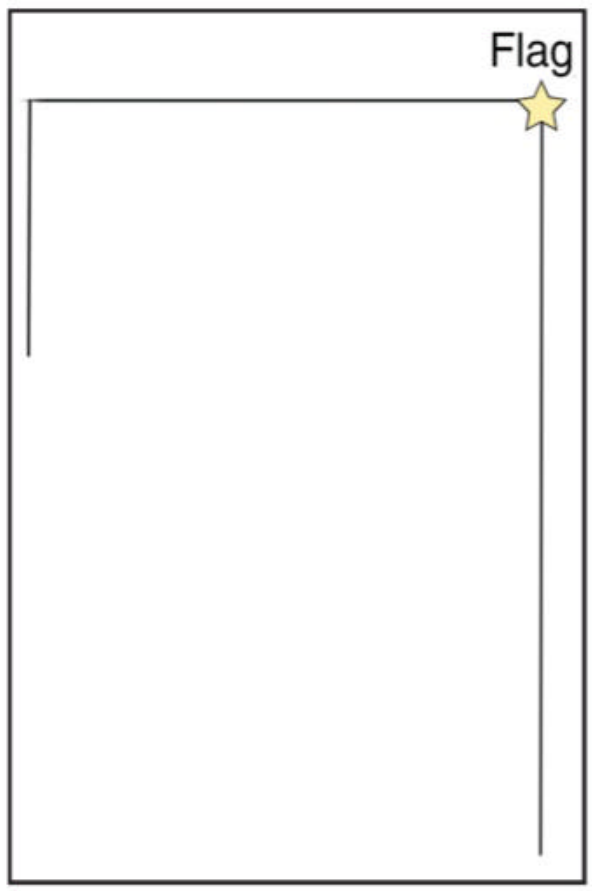

Figure 1. What the antenna must look like from above.

for leaving a squashed snake in our driveway for more than a day (how it got there is still a mystery). So, I must make sure the antenna is essentially invisible. Radiant barrier insulation makes the attic a virtual Faraday cage. The antenna must be outside.

I strung up a long wire just under the roof overhang of our ranch style house. It's only 10 feet off the ground and wrapped around the back of the house, but it is hidden.

I fire up the ICOM, which works very well, my hands greedily gripping the microphone, ready for QSOs and DX.

There are no answers to my CQ. Am I getting out at all? I'm only running half power, but it's still more than a QRP rig. I open the <http://na5b.com:8901> web-based SDR site, find an unused frequency and tune up on that frequency. Nothing. I'm not reaching the SDR receiver. I try web SDRs in other locations. Nothing.

Another cast of a CQ snags a fellow Texan, but he can barely hear me. I crank up the output to 100 watts. I push-to-talk, speak and the lights go out. I run to the garage and reset the circuit breaker. Second try — the lights go out again. Turns out the ICOM needs 23 amps. That's what I get for buying the power supply before I know what rig I'll be using. I order a new TekPower TP50SW 50-amp 13.8-volt power supply from Amazon.

Now, with full power, I try to check into the 40-meter OMISS net <www.omiss.

net>. They can't hear me. Clearly, I must do something about the antenna. Maybe end-fed so close to the ground is a wash. I order a multi-band off-center-fed-dipole with a 4:1 balun. I mistakenly order the one that's 90 feet on one side and 45 feet on the other. It's a beautiful design, but I don't have that kind of room. I compensate for the error by folding each side in half for a 45/22.5-foot OCFD, once again along the lip of the roof. Still, nobody can seem to hear me.

I pull down the off center and string up a 40-meter half-wave dipole under the roof overhang, which sadly still wraps around the back of the house for a few feet. Now, the OMISS 40-meter net can hear me, but just barely. Clearly, running any antenna 10 feet off the ground along the side of the house isn't going to work.

Run it Up the Flagpole…

I'm afraid to defy the HOA, but so powerful is my maniacal desire to get back on the air that the notion, "where there's a will, there's a way," burns white hot in my psyche. A magnetic loop, maybe? Perfect for the HOA, but I can't justify spending hundreds on a vacuum variable capacitor to handle the high voltage in the loop.

Elevation must be the key. Masts are totally out of the question. But … a flagpole! The HOA can't deny me an American flag, can it? I order a 25-foot telescoping flagpole. My antenna in vacation paradise Trenton, New Jersey, was a dipole 30 feet in the air alongside a brick duplex, fed with 300-ohm twin lead. It could still be there today; I don't know. Perhaps it's an historic landmark. Recalling my prior success getting multi-band performance out of twin lead and a tuner, I find a good price on one of the usable lengths of 450-ohm ladder line, 100 feet, from KF7P Metalwerks.

With the help of my better half, we erect what I affectionately dub the "perverted V," that is, a freakishly disfigured inverted-V hung just below old glory, about 20 feet high (*Photo A*). The pole is in the corner of the backyard, so the two legs of the dipole are at a 90° angle to one another. One side of the dipole is too long for the fence, so I bend it at the fence corner. The remainder of the length runs horizontally along the fence, parallel with the other dipole leg (*Photo B* and *Figure 1*). The paracords for both legs run through pulleys with a 2.5-pound weight. That way the pole can move in the wind and the wire will give as needed. A 5-pound weight works better but causes the pole to bend. Telescoping poles with twist locks tend to collapse on their own, so I fasten a pipe clamp at each section to prevent that from happening (*Photo C*).

The 100 feet of ladder line works almost perfectly to reach my window. The radiation pattern no doubt looks like a Jackson Pollock painting, but it must be better than what I tried before.

I gaze upon my mutant creation, and if I listen very carefully, I think I can hear the distant typing of a nastygram by the HOA. Nevertheless, I go inside, turn off the lights, and huddle over the microphone, hungrily scanning the bands to log a QSO. I stumble upon the NATA 40-meter net <www.natanet.info> and risk a check-in. Net control hears me! He's 20 over 9, and I'm a measly 5 by 7, but to me, it's victorious! Look out, this toll collector just got a promotion.

I know I'll have to entertain the question of what to do if, or more likely when, the HOA tells me to take down my perverted V. But until then, after 40 plus years of silence, I'm on the air again.

what's new

Icom IC-PW2 1-kW Linear Amp

Icom has introduced the IC-PW2, a new linear amplifier that features first-of-its-kind digital pre-distortion (DPD) and will let contesters operate in a Single-Operator Two Radios (SO2R) configuration with only one amplifier needed.

Icom's IC-PW2 will output 1,000 watts due to the new 65-volt LDMOS power transistors and a high-efficiency power supply. The IC-PW2 can achieve full 1-kilowatt power output when connected to a 220-volt AC power input. It can be operated at full-duty cycle as soon as the power is turned on.

The IC-PW2, when combined with the IC-7610 transceiver, can provide DPD by correcting signal distortion from the amplifier by applying inverse distortion to the output signal from the IC-7610 exciter in advance. However, you do not need an IC-7610 to get the full performance out of the IC-PW2.It will seamlessly work with all HF+6 Icom transceivers, as well as many non-Icom transceivers.

An 2 x 6 Automatic Antenna Selector enables up to six antennas to be independently switched when making a band change on either transceiver, so you can operate as if you have two linear amplifiers, which means you can operate SO2R and make calls on one radio, while monitoring another band on the other radio. In addition, an automatic antenna tuner and antenna quick select function can temporarily set to the preset antenna connector if you want to use a multi-band antenna or a dummy load.

Hams can bring their own band-pass filters, pre-amps, and attenuators by utilizing the two RX In/Out connectors located on the back of the unit. When two radios are used, one multi-band pass-band filter can be shared with these radios by switching the receiving radio. In addition, the band switching of multi-band band-pass filters can be controlled by the data output connector. The BAND 1 and BAND 2 data output connectors each can be set to either INPUT 1, INPUT 2, transmitter side, or receiver side and can be linked with band switching of various external devices.

Controlling the IC-PW2 is a controller unit with a 4.3-inch color touch screen that can be mounted to the IP-PW2 or used remotely via a remote-control cable. The touch screen uses a graphical user interface and can show connected antennas geographically for easy recognition.

Icom's IC-PW2 has not been approved by FCC for sale and no retail price has been set. For more information, visit <https://tinyurl.com/yuj23scy>.

Antennas are possibly hams' favorite topic of discussion, experimentation and misunderstanding. Countless books have been published to help us better understand these metallic marvels that make our communication possible. Yet, misconceptions persist. K3MT takes a closer look at a few of the most common.

Antenna Misconceptions

BY MICHAEL TOIA,* K3MT

"It ain't what we don't know that gets us in trouble: It's what we do know for sure that just ain't so." [1]

Words that ring so true to understanding radio antennas. I've had the "knows" listed below most of my early adult life, and in a continuous quest, a thirst, for more knowledge on the subject, have found misconceptions that I share here. Am I the final arbiter thereof? Hardly. As a challenge, convince me that I'm wrong …

1) SWR: A lecture about antennas began with an ice breaker, a simple question: "What's the most important thing about a radio antenna?" A bit of fishing among the raised hands got, within three attempts: "SWR".

Really?

Much of the audience agreed. A Heathkit "Cantenna"[2] dummy load rose from beneath the lectern, with the statement, "Lecture over. Thank you all for coming." (*Figure 1*)

But a chorus of "Hey! It don't radiate!" saved the day. Apparently the "antenna SWR"[3] isn't that important: It's darned nearly the *least* important parameter. Does the Cantenna or the dipole have the lower SWR, and which would you want for a QSO? So just what *is* the all-important, number one, parameter?

It's the current on the antenna. Do everything you can to get the highest current for a given power. Radio theory centers around the electric (*E*) and the magnetic (*H*) fields. These quickly reduce to the scalar potential, *ϕ*, and the magnetic(?) vector potential, *A*. I question the term *magnetic* because it is so only when no charges oscillate to and fro, and that is not antenna theory.

ϕ disappears at great distances. *A* weakens inversely with distance (1/r), is proportional to the oscillating current on the antenna, and is parallel to the direction of current — a dipole's wire. And … the distant *E* field becomes just the rate at which *A* vibrates.[4] Soo … the greater the current, the greater the *E* field at a receiving antenna. The antenna's function is to raise a racket at a distance. Ergo, damn the SWR. *The current does the talking.*[5]

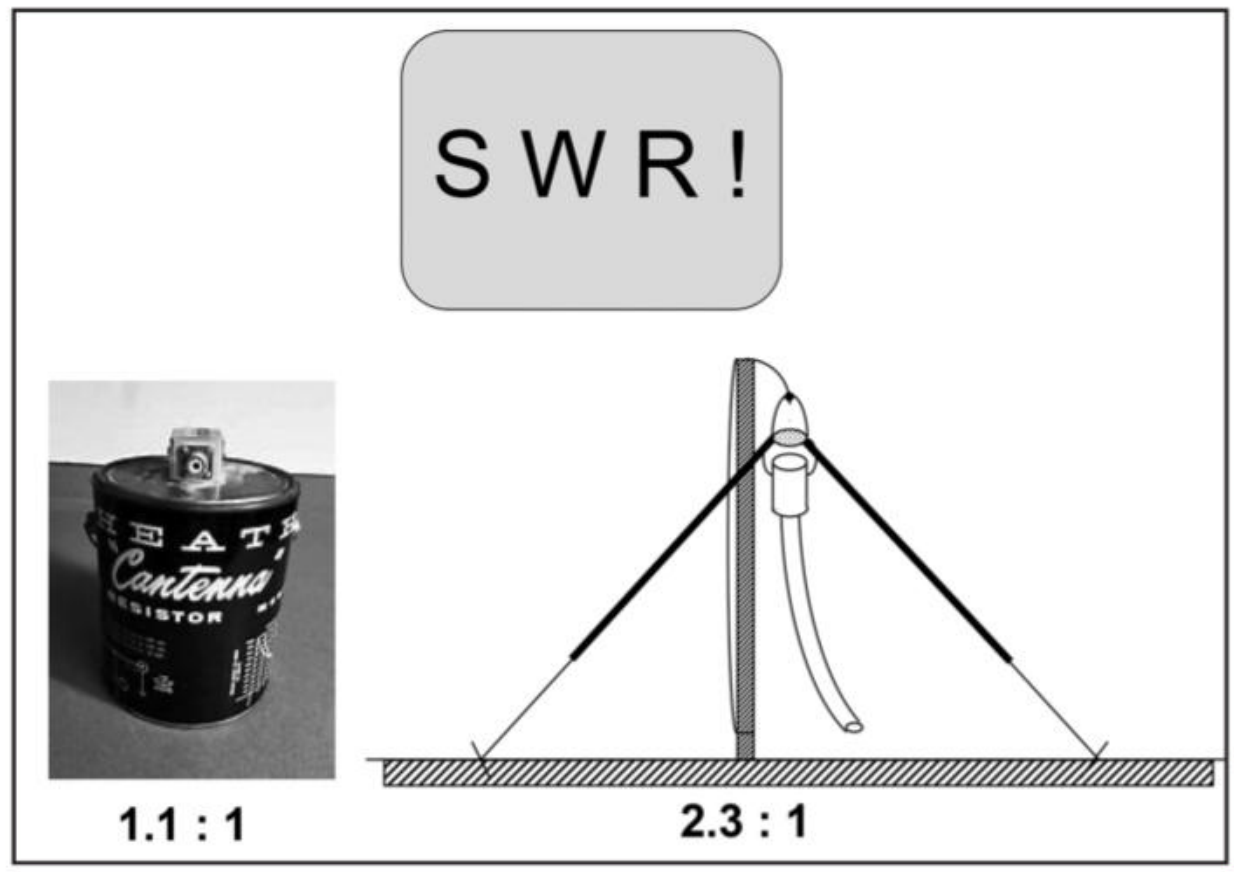

Figure 1. The "Cantenna" dummy load has a better SWR than the antenna. But which one will get you more QSOs?

2) Antenna SWR: What do you mean by "the antenna's SWR"? Standing Wave Ratio applies to transmission lines, not to antennas. On a piece of 50-ohm coax,[6] fed 50 watts, terminated in a 50-ohm resistor, the voltage at all points inside the coax is the same — 50 volts — and the current is constant at 1 amp. But terminate it in 100 ohms, and the voltage will vary from 70.7 volts to half that, 35.4 volts, at quarter-wave intervals (*Figure 2*).

Concurrently, the current varies from 0.7 amps to twice that, 1.4 amps, in opposition to the voltage. There's a stationary, or standing, wave of voltage on the coax, called a "2:1 Voltage Standing Wave Ratio", or VSWR. But there's also a 2:1 current standing wave. That's why it's not really "VSWR", but "SWR."

When someone asks about an antenna's SWR, they actually mean, "what is the SWR on coax feeding the antenna?" It depends on the coax Z_0 and antenna impedance. Feed a 300-ohm antenna with 75-ohm coax, get a 4:1 SWR. Feed it with 300-ohm twinlead, get a 1:1 SWR.

3) Voltage along a dipole: Too many antenna references show a sketch of current and voltage on a half-wave dipole, as in the lower diagram in *Figure*

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Web: <www.jokalympress.com>

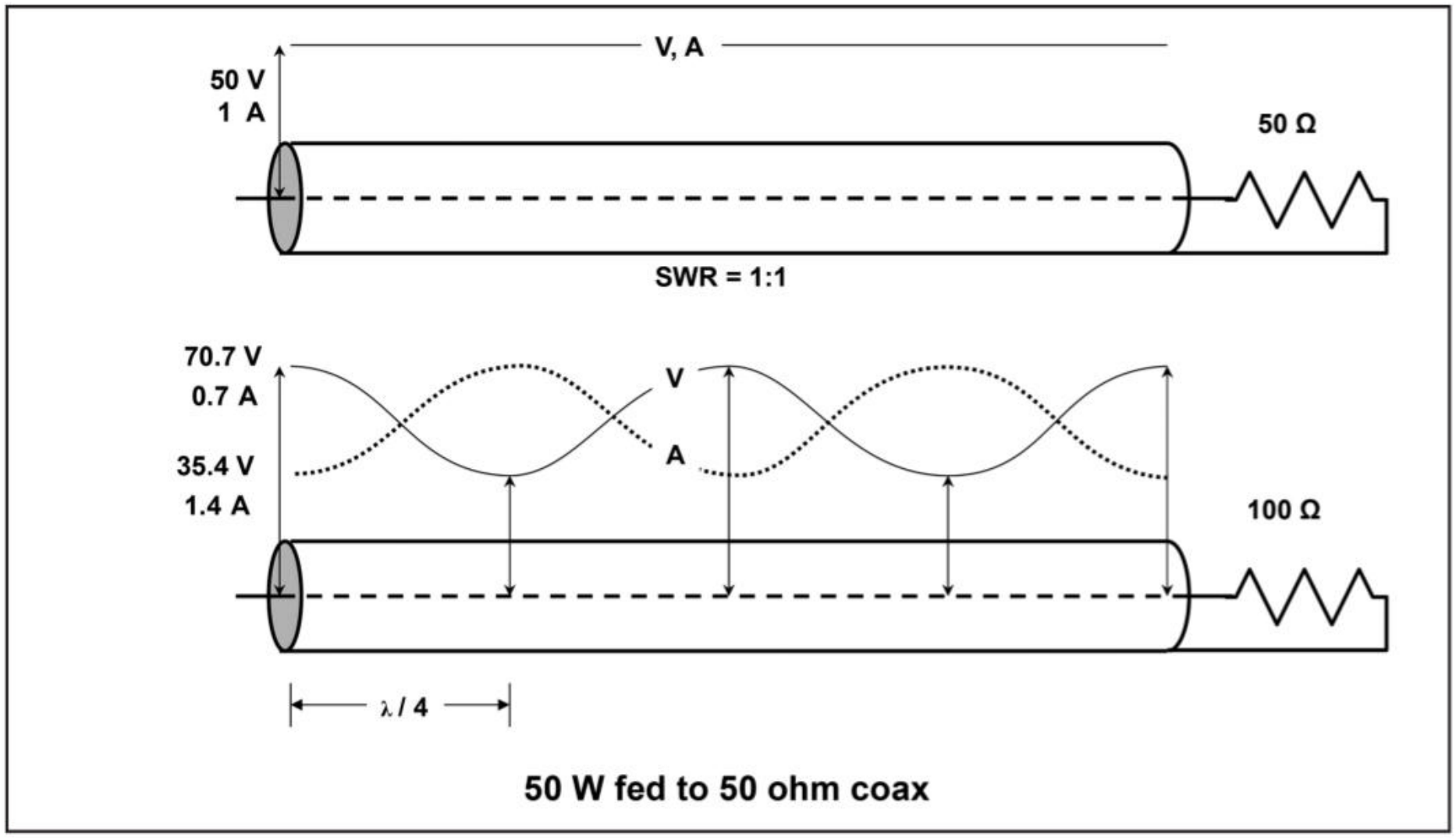

Figure 2. SWR applies to feedlines, not antennas. In a perfect match between transmitter and antenna (top), voltage and current values are consistent all along the line. If the match is less than perfect, both voltage and current will vary along the line.

2. The current is shown as half a sine wave, and the voltage the same, displaced a quarter cycle, positive at one end, zero at the center, and negative at the other end. *This not so*! At the center, the dipole is split in two, where the transmitter's transmission line places a voltage step.

But wait! There's more!

A 75-ohm line feeding a 75-ohm dipole causes a ±75-volt step at 300 watts.[7] The voltage rises almost linearly along the antenna. Data from Chemandy[8] and modeling by NEC4[9] are plotted against the textbook references, scaled to match halfway along the dipole (*Figure 3*). The important part is the voltage step of 150 volts across the antenna midpoint gap.

The three match fairly closely elsewhere, until approaching the ends. Chemandy exceeds the text value, but the NEC voltage is highest, possibly because Chemandy's voltage probe slightly suppressed the very sensitive electric field near the end.

4) Coax will radiate if SWR is not 1:1: FALSE! Let's build two small sheds side by side, made entirely of highly conducting metal (*Figure 4*). Connect them with a metal pipe, and thread a wire through the pipe on a string of dielectric beads. Size the pipe and wire to make 50-ohm coax.

In one shed, connect a transmitter to the coax. In the other, connect a dummy load. With a load of 50 ohms, the first shed sees a SWR of 1:1. The coax does not radiate.

Then change the load to 500 ohms. The SWR changes to 10:1. But still, the current on the center wire is exactly equal to, but opposite, of that in the pipe. The two sheds and pipe are one solid, perfect shield. The line does not radiate, despite the high SWR.

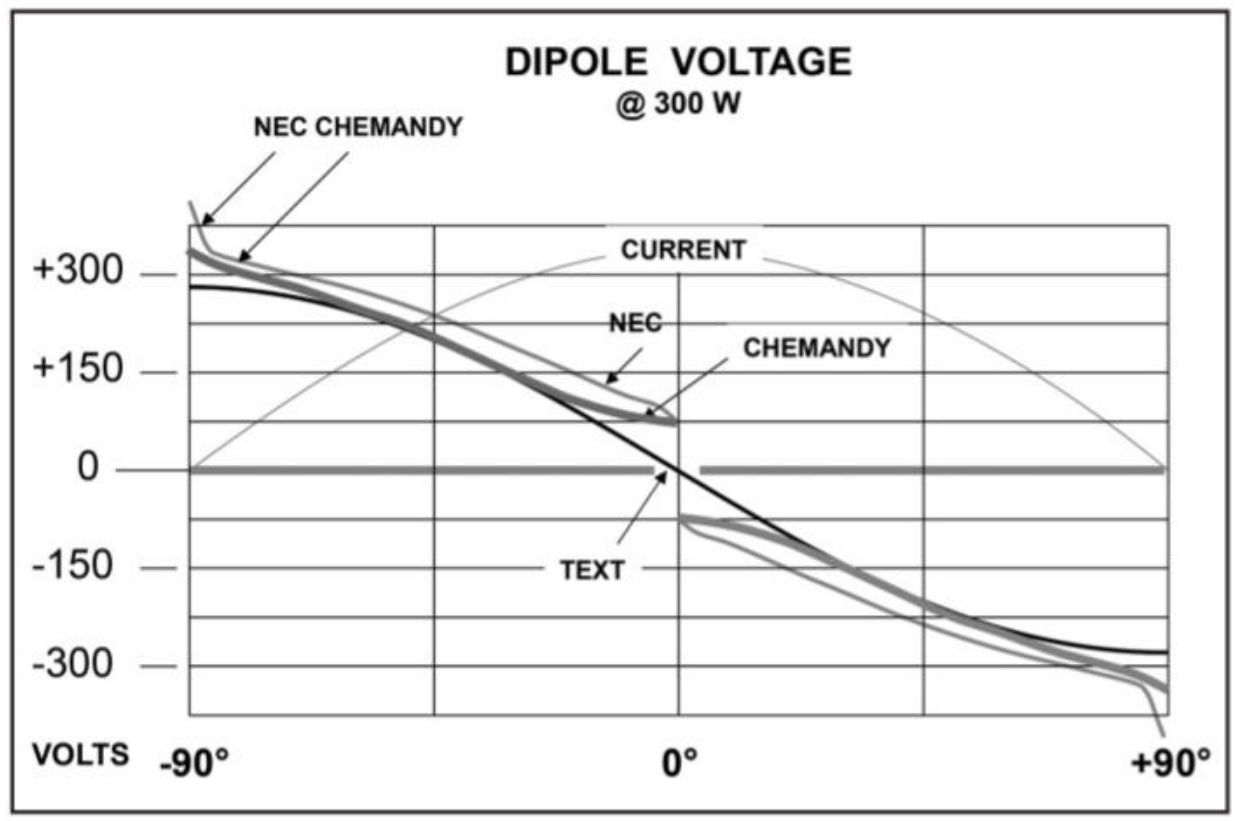

Figure 3. Voltage along a dipole fed with 300 watts, based on three different sources (see text). Note the 150-volt gap at the center shown by two of the three sources.

5) The coax SWR depends on its Z_o and the antenna impedance: Of course — but those can differ when transmitting and when receiving. In the latter case, the signal generator is the antenna, and the load, the receiver (*Figure 5*). So, the SWR transmitting and receiving can, and almost always does, differ.

6) An antenna tuner in the shack, or one built-in to the transceiver, can tune the antenna: Not really. It does nothing to the coax SWR when transmitting. It simply takes a bad match at the transmit end and converts it to a 50-ohm load for the transmitter. A true "antenna tuner" is located at the antenna (lower half of *Figure 5*). There are several outdoor, remote antenna tuners that do such a job.

And finally, one of my favorites, that delves into the physics of radiation:

7) A cubical quad antenna is circularly polarized! Really? Left, or right? The answer is — both! An antenna converts oscillating charges to photons. But photons have "spin" — they are circularly polarized.

This struck me while working with an optical antenna using the radiation of Cesium, the "D2 line" at ~850 nanometers. It splits in a magnetic field (called Zeeman splitting). The photon stream separates into two very nearby frequencies, and both are circularly polarized, one left, one right. Most antennas create photons in pairs, of opposite spin and polarity.

So, I offer these brain teasers, and invite critical thinking on the matter.

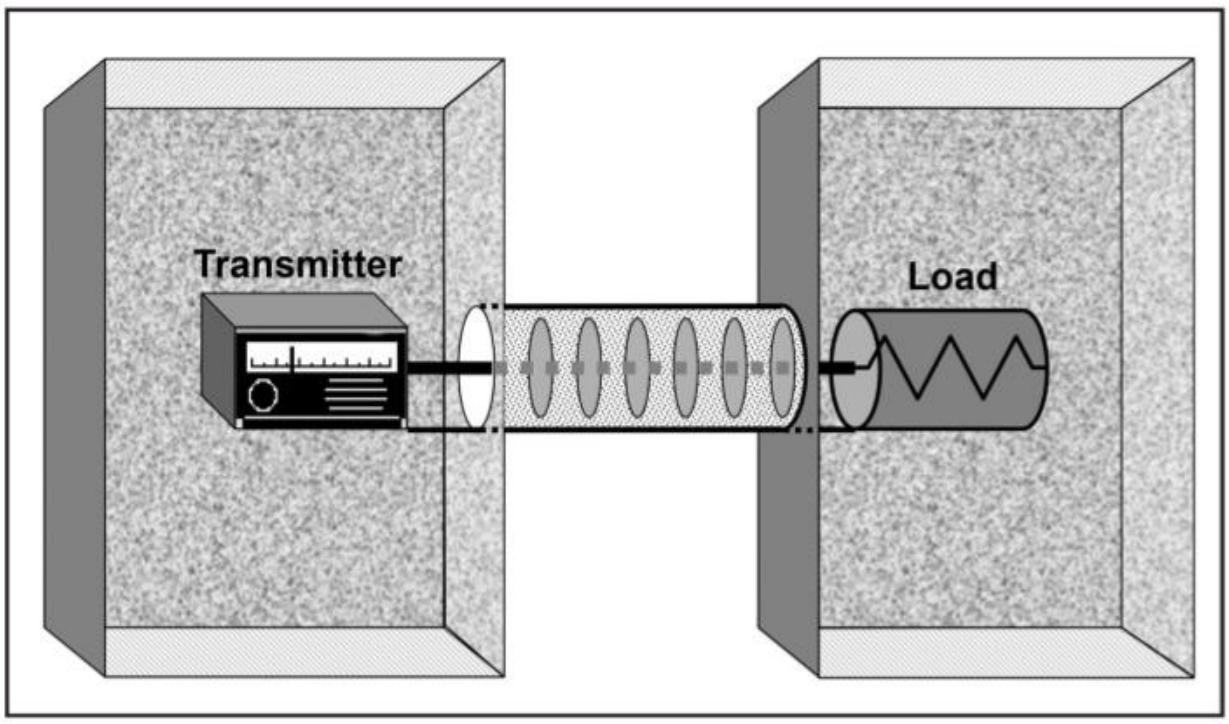

Figure 4. These hypothetical metal sheds connected by a 50-ohm feedline demonstrate that coax will not radiate if the SWR is higher than 1:1.

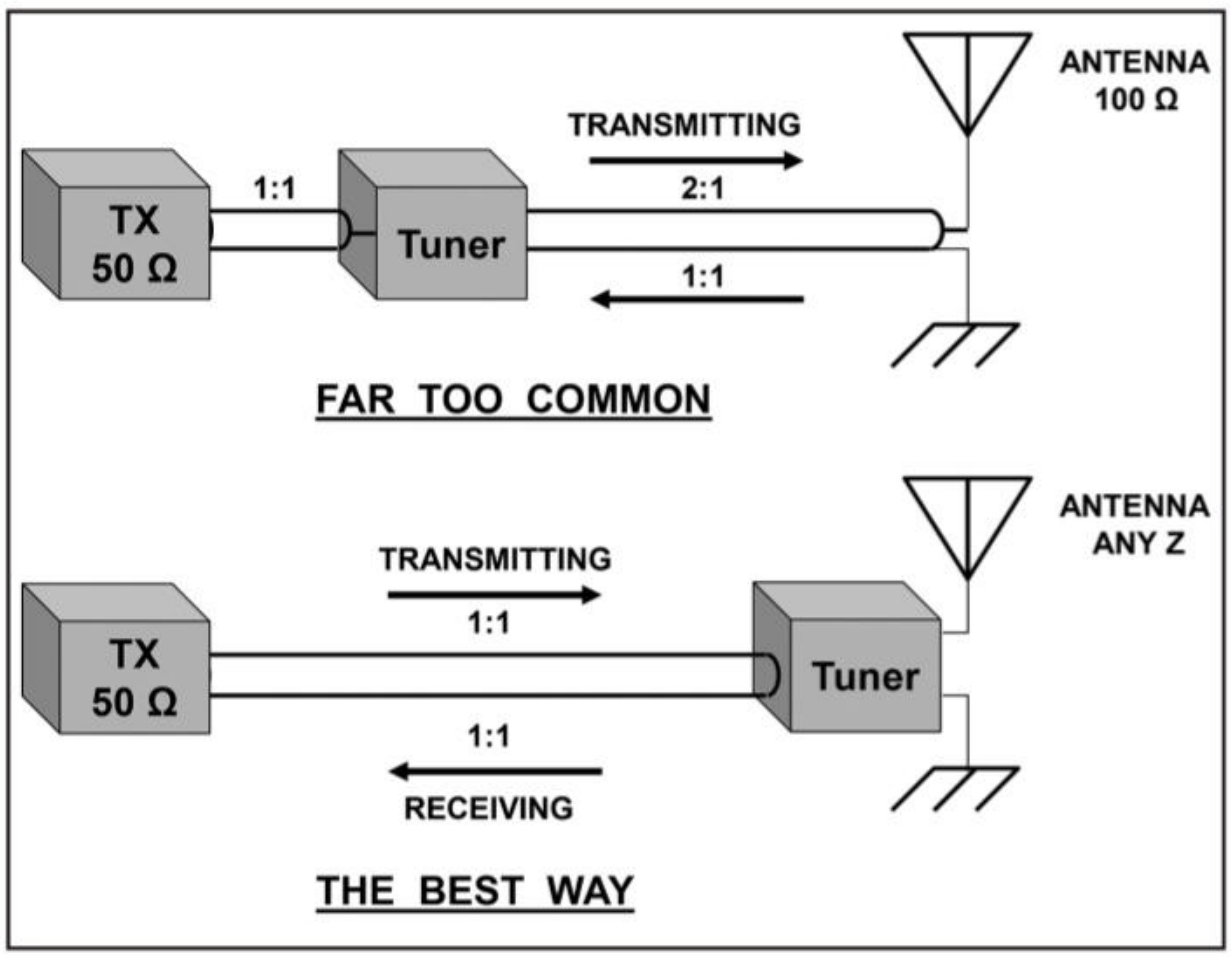

Figure 5. SWR on receive may be different from SWR on transmit, as the antenna now becomes the signal generator and the receiver the load. Having a tuner at the antenna rather than the radio balances the system in both directions.

Notes:

1. Attribution (variously) — Mark Twain — Will Rogers — Others
2. A 50-ohm power resistor in an oil-filled gallon paint can, sold by Heathkit of yore.
3. Itself a misconception. Keep reading …
4. Mathematically, proportional to d*A*/dt
5. Quote from radio engineers of decades past.
6. An inclusive term herein, meaning a transmission line of any sort.
7. 150 volts across 75 ohms: $P = E^2 / R = (2 \times 75)^2 / 75$ W = (4 x 75) x (75 / 75) W
8. Chemandy Electronics, "*Antenna Voltage, Phase, Power and Impedance Distribution*", <www.Chemandy.com>, October 2012.
9. In-house work at K3MT.

The Sherwood Tables of Receiver Tests have long been valued by contesters as tools for selecting new radios. K4FMH has created several tools on his website to help non-contesters make use of these valuable independent rig rankings as well. Here is his introduction to each of them.

New Tools for Using the Sherwood Tables for Transceiver Selection

BY FRANK M. HOWELL, PH.D.,* K4FMH

Receive performance has been one of the top criteria for transceiver selection by hams for decades. As the well-worn phrase goes, "if you can't hear 'em, you can't work 'em." Rob Sherwood has been conducting bench tests on the receive performance of rigs for several decades, accepts no advertising, and does not, with rare exception, accept transceivers or receivers directly from manufacturers for testing. He is adamant about independence in his assessments. In addition, his tests are "worst case" assessments by design. In general, his resulting Sherwood Tables of Receiver Tests are considered the gold standard by many hams, particularly contesters.

Sherwood publishes his tables on his Sherwood Engineering website,[1] sorted by values resulting from the *narrow dynamic range* (NDR) test. He strongly believes that this is the single best criterion for the CW contest operator. He has long been an active contester. His disagreement with the ARRL Lab review of a Drake R4C receiver led him to construct his own set of bench tests which he believed to be a more valid set. The rest, of course, is history from which the amateur radio world has benefited greatly.

Beyond the NDR

But for hams who are not CW contest operators, this single criterion of using the NDR rank-order as a decision rule may not yield an optimal conclusion. As he has stated numerous times, this is perhaps the most common source of frustration for viewers of Rob's tremendous resource. The difference between rigs *ranked* in sequence may not be numerically that different or, consequently, substantively differentiated. This produces much debate and potential confusion about the bench test results, as evidenced by reading blogs, forums, and just listening in on the ham bands.

It is usually easier to visualize many statistical results like these that are often published solely in tables. Adding the price point for the viewer to evaluate performance against their budget for a new rig is key, too. Because of continual but sometimes dramatic improvements in rig technology, the year of market release is another consideration. Finally, knowing how other users of a rig feel about it, whether or not one agrees with any single evaluation, certainly weighs in on rig purchase decisions.

But how should a ham operator in the market for a new rig approach this stressful process? As a ham who is also a statistician, my suggestion is a first step of organizing the relevant information. That can be confusing, but I hope that some work I've published on my FoxMikeHotel.com website can help. Thus far, I've published seven interactive tools to assist viewers in better utilizing the Sherwood Tables. I've included price at market entry expressed in 2021 U.S. dollars, the cumulative eHam average rating, and the year the rig manufacturer entered it into the marketplace.

New Tools for Using the Sherwood Tables

Following the template I created in my two-part *National Contest Journal* series (Vols 49, 1-2, 3-4, 2021), I've created several interactive tools that have at their base Rob's table of bench tests. Working with Rob, I've used the circa March

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Sortable Sherwood Table	<https://tinyurl.com/3dw7mszy>
Excel version of Sherwood Tables	<https://tinyurl.com/4va6ucc2>
Better understand Rob's ranking	<https://tinyurl.com/27md6fz6>
Relationship between the SPI and Narrow Dynamic Range	<https://tinyurl.com/33yafjpn>
3D Data Cube of SPI, Price and eHam Rating	<https://tinyurl.com/p6p9tju5>
Rig Performance-for-Price by Year of MArket Introduction	<https://tinyurl.com/3s9r4f25>
A Golden Quadrant Analysis of Price, Rx Performance and Satisfaction	<https://tinyurl.com/bdkc9upa>
The Golden Quads List: Price Unlimited & Performance-for-Price	<https://tinyurl.com/2397axdu>

Figure 1. Table of interactive tools for interrogating the Sherwood Tables with price, year and eHam rating. Source: <https://tinyurl.com/yc3n48yn>

5, 2022 version of his table. I've added the market-entry price converted to 2021 U.S. dollars as well as the year the rig was released to the market. The circa cumulative average rating on eHam.net of each rig (as of the same date) is also included. *Figure 1* is a table that I will refer to in describing the set of interactive tools available at foxmikehotel.com.

Sortable Sherwood. The major question that I've received in giving a number of club talks on my *NCJ* articles is "why can't I sort the table like I want?" Rob sorts it to give him the ranking that he feels is most important for his focus in operating: CW contesting. But some hams seem to at least look at the results using other criteria in the table. I built a "sortable" Sherwood Table as the first tool. All nine of Rob's tests are included as well as the composite index I created (see *NCJ* articles or my website for details), called the *Sherwood Performance Index* (or SPI). Each column can be sorted for the viewer's preferences. For viewers who like to "roll their own" analyses, I've included Rob's table in an Excel® spreadsheet that is downloadable to a local PC. The viewer can sort rigs, for instance, by Rob's own ranking or by the composite index of tests (SPI) for easy comparisons. This tool addresses the question of how to fully explore rig comparison on Rob's nine individual tests as well as the composite index combining them all.

Don't Get Out-Ranked! One of the issues confusing hams who study the Sherwood Tables is the ranking. There's nothing wrong with Rob's ranking of radios. He is explicitly clear about it and why he sorts it that way. But one issue for viewers is that they intuitively feel that a radio ranked even one place higher is substantively "better" than another, no matter how close the two rigs are on measured narrow dynamic range. This is particularly the case for amateurs who are

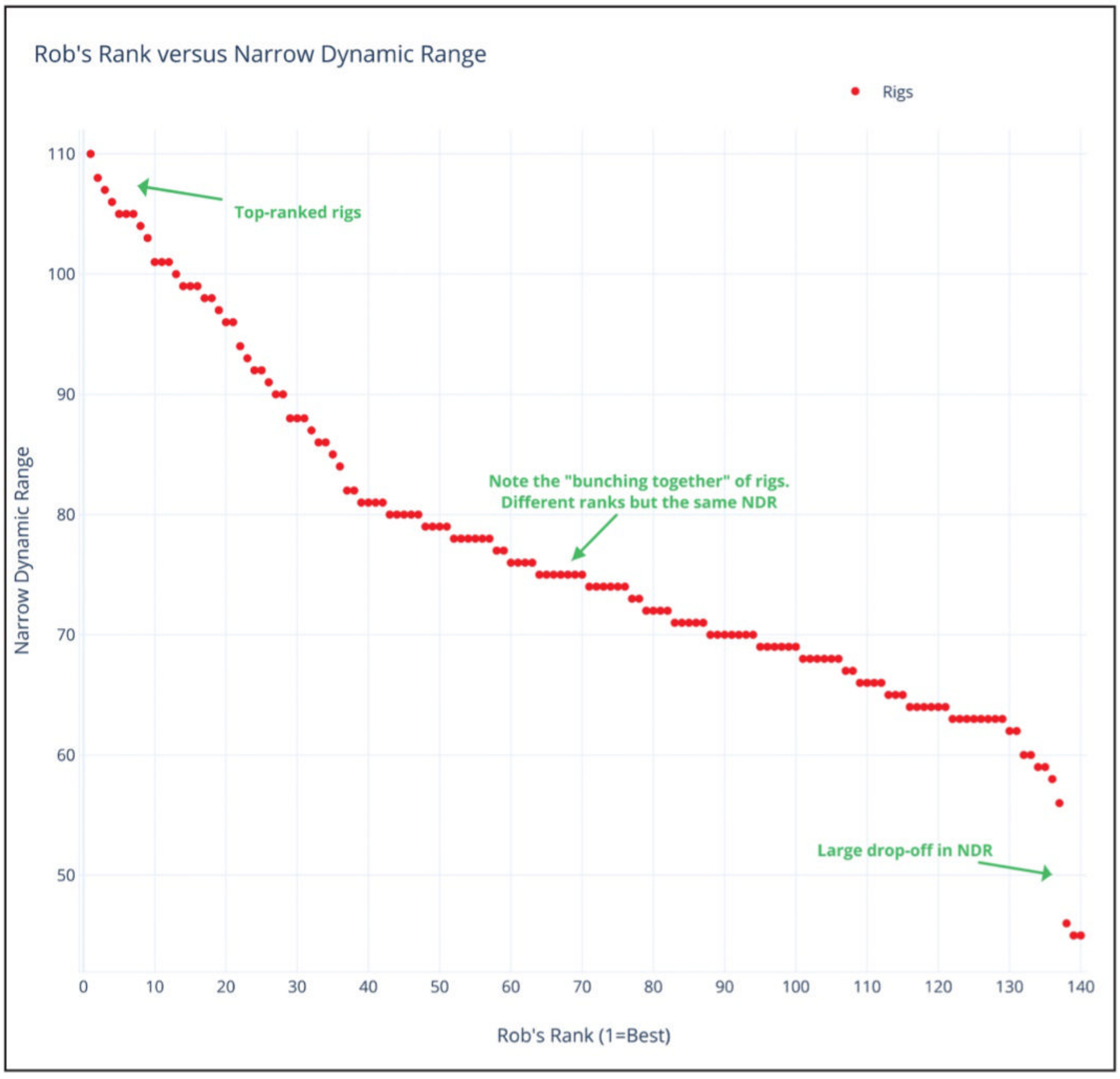


Figure 2. Sherwood Tables ranking versus narrow dynamic range. Source: <https://tinyurl.com/27md6fz6>

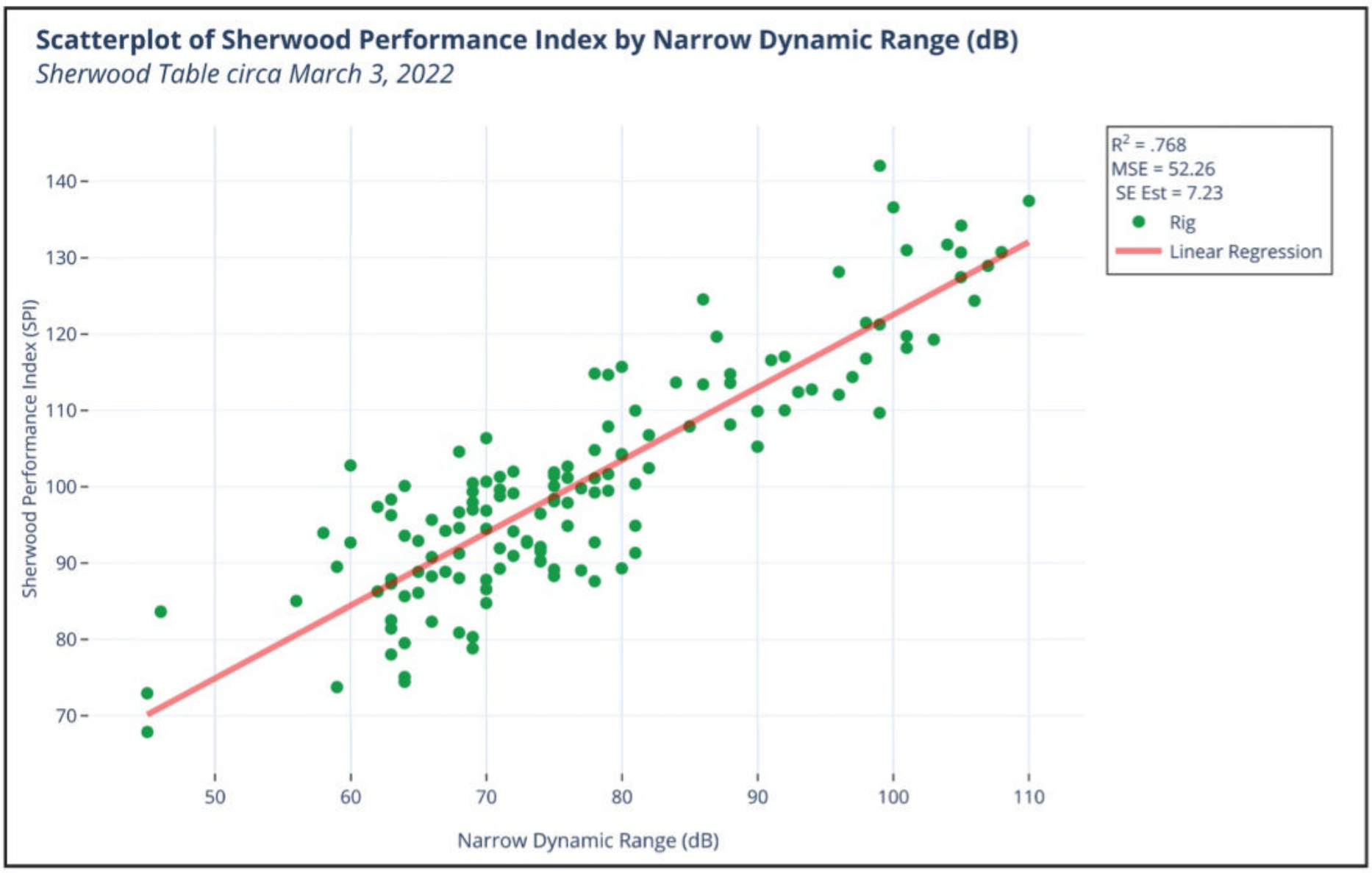


Figure 3. Relationship between Sherwood Performance Index and Narrow Dynamic Range. Source: <https://tinyurl.com/33yafjpn>

not themselves experienced in bench-testing, for they are clinging mainly to what they see: A ranking of radios by a metric with which they are not very familiar.

Imagine a high school sports team returning home from a tournament, chanting "*We're number ten! We're number ten!*" I can't really imagine that, either. But what if the metric distinguishing those teams was very, very small? Number 10 might be substantively as good as Number 1. *And that's the problem with using only the rank* of a radio without consideration of the narrow dynamic range that determines that rank, even if it's just the difference in the third decimal. Of course, Rob provides both the rank and the metric, but it's an issue with segments of the audience for his popular resource.

I've created an interactive scatter plot of the narrow dynamic range on the vertical axis and the rank of the radio on the horizontal axis, as shown in *Figure 2*. There is a ribbon of controls at the top right of this (and the other) tools for user-control of several aspects of the data visualization. Each data point is interactive; hovering near it will pop up the rig name. Drawing a rectangle around some data points will zoom in to just those rigs. The key thing that I've annotated in *Figure 2* is how rigs "cluster" around a certain narrow dynamic range value (close enough to not visually distinguish) yet are sequentially ranked. Resembling short rows of beads, these rigs appear to be different in rank in a table but clearly not very different when visualized. This tool helps the viewer readily make those distinctions but on an easier-to-digest basis.

Narrow Dynamic Range and SPI. My creating a composite index of all nine of the Sherwood tests appeared in my *NCJ* articles. There is a technical and substantive explanation of the methods there, as well as on my website in the longer manuscript. The SPI is a broader measurement of receive performance but is strongly related to the narrow dynamic range measurement favored by NCØB. It includes the narrow dynamic range, of course, but the scatter plot reveals which radios score better on the SPI than would be predicted by the NDR. Each data point can be identified with a mouse click.

What viewers can find is how the same NDR measurements can have vary disparate SPI scores. There are examples on the webpage, but note just this one not annotated in *Figure 3*: The Icom 7800 has a narrow dynamic range of about 80 with an SPI of 117, while the Yaesu 901-DM with the same narrow dynamic range has an SPI of less than 90. If we think of rigs with similar NDR scores as "comps" in a house purchase evaluation to determine sales market value, those radios above the linear regression line are more *fully featured* radios with more complete packages that appear to perform better on Rob's complete bench test suite than the comparable radio below the line. Of course, here we simply do not have all of the features identified or measured for this set of rigs but the systematic pattern is more than suggestive that the SPI captures a broader and more encompassing measure of the radio's receive performance with implications for the full radio itself. This tool helps the viewer better understand both the metric Rob uses for his ranking as well as the full set of his bench tests.

3D Sherwood. Examining the three variables of composite Sherwood bench tests, price and eHam ratings in a table, even a sortable one, can be challenging. The relationships among these three variables (discussed in my *NCJ* articles) is not as strong as common sense might suggest, making the juggling of columns of data almost a mind trick of sorts. One way to do this is through a 3D data cube, as illustrated

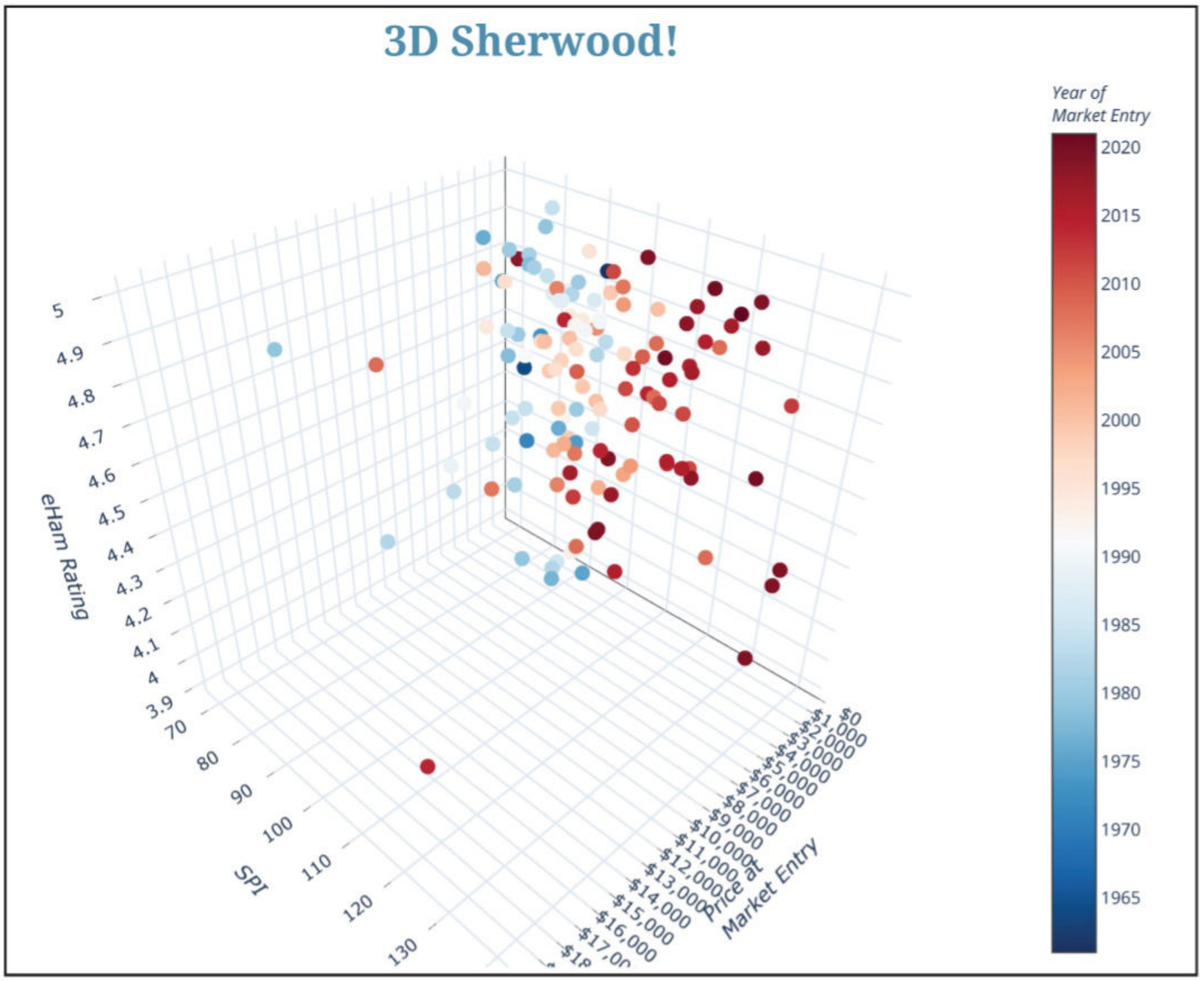


Figure 4. Sherwood Performance Index, price and eHam rating in rotatable 3-D data cube. Source: <https://tinyurl.com/p6p9tju5>

in *Figure 4*. This cube can be fully rotated by the viewer using a mouse. There is a "turntable" mode which is more stable for the new user, but the orbital mode is not unlike what a jet fighter pilot might experience. Sections (or slices) of the cube can be customized by the user to focus on certain price, performance, or satisfaction ranges. All can be returned to the outset using an icon on the control ribbon.

While not illustrated here, there is a companion graph in 2-D with the third dimension illustrated through colorized points. The user who does not prefer the 3-D rendering can obtain a similar set of results for their research. This companion 2-D graph has a slider tool at the bottom to make the slice selections on price in the 2-D graph. This pair of tools can help with setting budget limits in rig selection as well as better "seeing" the finer distinctions among radios in Rob's table.

Performance-for-Price. One of the pervasive aspects of a rig that hams comment on is their perception of what performance you get "for the money." I created a *Performance-for-Price Ratio* (PPR) for the SPI and price in 2021 dollars. A value of 1.0 occurs when both the SPI and price are at their respective average (median) values. Values over 1.0 reflect a higher "bang for the buck" while those less than 1.0 are the opposite.

An interactive scatter plot (*Figure 5*) was created with the PPR display with the year of market entry by each rig. Each point can be clicked to identify the rig. The slider tool at the bottom can select subsets of years to evaluate, for instance, only rigs entering the market since 2010. The regression line illustrates the clear improvement in what hams get in better receive performance over the past half-century. But this line also gives a benchmark against how each rig does on the PPR relative to what the secular trend, or long-term variation, would expect. Notice that within the same period, there are very large differences in rigs on the PPR, such as the Elecraft KX3 and the Hilberling PT-8000A, that can be seen on the tool itself. For a given period of time, the viewer can make judgments about how financially efficient the purchase of a given rig might be as compared to others released during that era. One modest surprise to the reader might be that the highly popular Icom IC-7300 does not have the highest PPR for that period of rigs in Rob's table. This tool can greatly aid the viewer in evaluating the relative value in measured receive performance.

Golden Quadrant Analysis and Lists. To assist viewers in identifying a subset of radios that are higher in performance and that get higher ratings by others on eHam, all with a price

point in mind, I've used a technique highly popular in business analytics. The *Magic Quadrant* used by Gartner helps clients see several factors at once, resulting in a thinning of options directed toward maximizing choices in a rational way. This visualization tool is essentially a scatter plot with reference lines on each axis to reflect desired cut-points on each variable. Put another way, it's a 2x2 grid with the upper-right cell being the "golden" set of choices. Thus, I call my version the *Golden Quadrant.*

I created two of them, one for the SPI and eHam ratings with the unlimited market-entry price and the other substituting the performance-to-price ratio for the SPI but designating the absolute price quartile for each rig. Based upon these two Golden Quadrant analyses, I constructed lists of the radios in each analysis with the values used to create those quadrants supplemented by the year of entry into the market. I'll only use one of the quadrants here to illustrate.

In *Figure 6*, the golden rectangle represents the area above the median values for eHam rating and the composite SPI. The price quartiles are reflected in the lighter-to-darker brown points in the graph as illustrated in the legend of each graph. Each data point can be hovered, producing a popup label with the rig's name. All of the ribbon tools at the top right of each graph allow for zooming in or out, selecting subsets of rigs, and so forth. A screenshot can be taken for downloading to a local computer. The range slider can assist by shaping the region of performance desired by the viewer, which I expect to be used to examine highest performing rigs. But this can be combined with the selection or zoom tools to define a subset of rigs at a region of eHam rating, composite performance, and know the price quartiles, too.

The Golden Quads lists are simply an easier means for the viewer to see all of the rigs making the specific quads. They are in price unlimited and a performance-for-price categories. I've noted on the website to not get caught up in the ranking of rigs within these Golden Quad lists, for reasons illustrated in *Figure 2*. The same principles apply. These rigs may be a good point for viewers to begin their research while taking the time and effort to write down the features and ergonomics they are seeking. Note, too, that not all rigs are bench tested by Rob Sherwood, especially QRP rigs. There are other sources for individual reviews of QRP rigs, especially QRPer.com, where Thomas Witherspoon, K4SWL, seems to get most of them released to the market in the past decade.

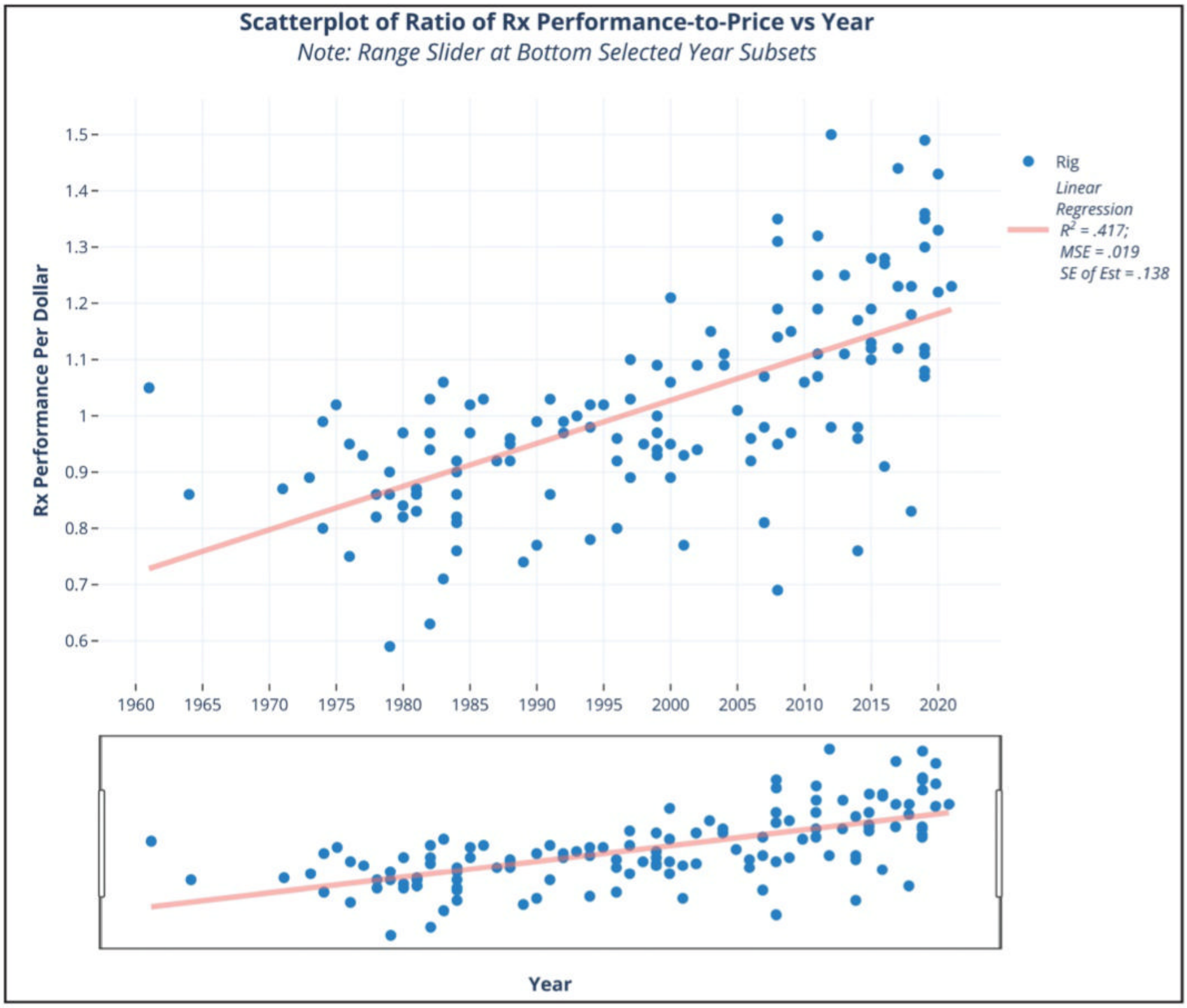


Figure 5. Performance-for-Price by year with slider tool. Source: <https://tinyurl.com/3s9r4f25>

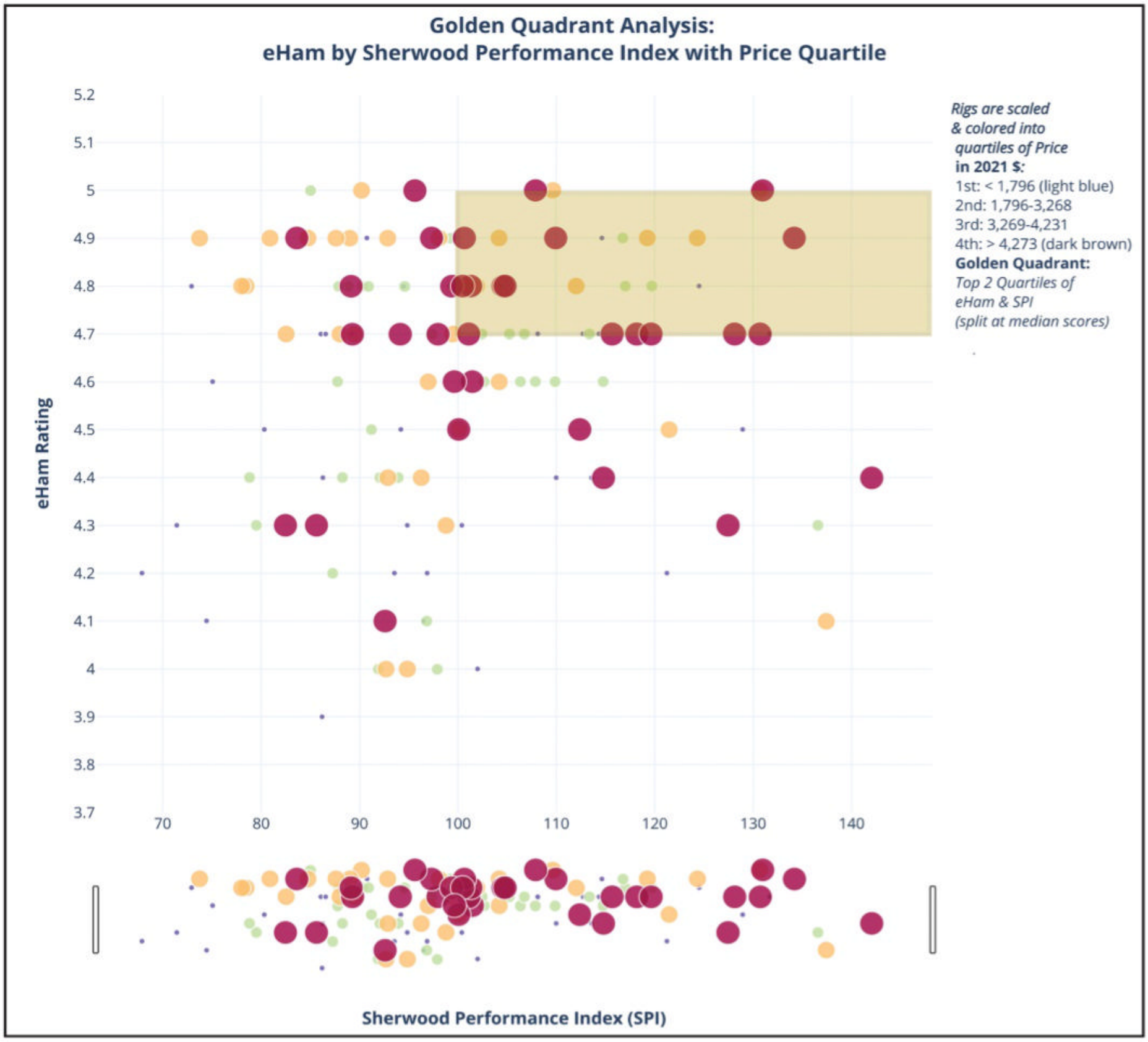


Figure 6. Golden Quadrant Analysis of eHam rating and Sherwood Performance Index with price. Source: <https://tinyurl.com/bdkc9upa>

This pair of tools helps the viewer quickly hone in on a set of highly-rated, high bench-performing, radios coded by price and performance-for-price. It can be a starting point or a near-ending point, depending on how the viewer approaches transceiver evaluation after desired features and ergonomics are identified.

Conclusion

It has been clear from my reading of forums, participating in club talks, attending hamfests (before Covid-19), and listening to ragchews on the air that buying a new transceiver is challenging, at best. Much of the data that hams already take into account, to some degree, are available from various sources. None are more relevant than the Sherwood Tables of receive performance. My compiling a unique dataset of the Sherwood Table tests (and composite index), price at market-entry, eHam satisfaction rating, and year of the rig's release, set off a flurry of club talks and queries about how to use these data. Some these are on my website from their YouTube sources as published by the host clubs. Bear in mind that the average eHam ratings may change somewhat over time as more reviews are added for a given rig. These data do not reflect discounted new or used prices for rigs.

But there is a need to have tools to allow viewers to interrogate the data more directly by themselves with a minimum of fuss. That was the genesis of my building out these seven online tools as a service to other hams. My intent is to update these tools as Rob Sherwood updates his test tables. I will add more tools or analyses on these and other data in the future. I'll announce them on my blog <k4fmh.com> which is syndicated via AmateurRadio.com. I hope these tools help readers make better rig choices and spend their funds in ways that both improve their stations and their satisfaction with the hobby.

Notes:

1. <http://sherweng.com/table.html>

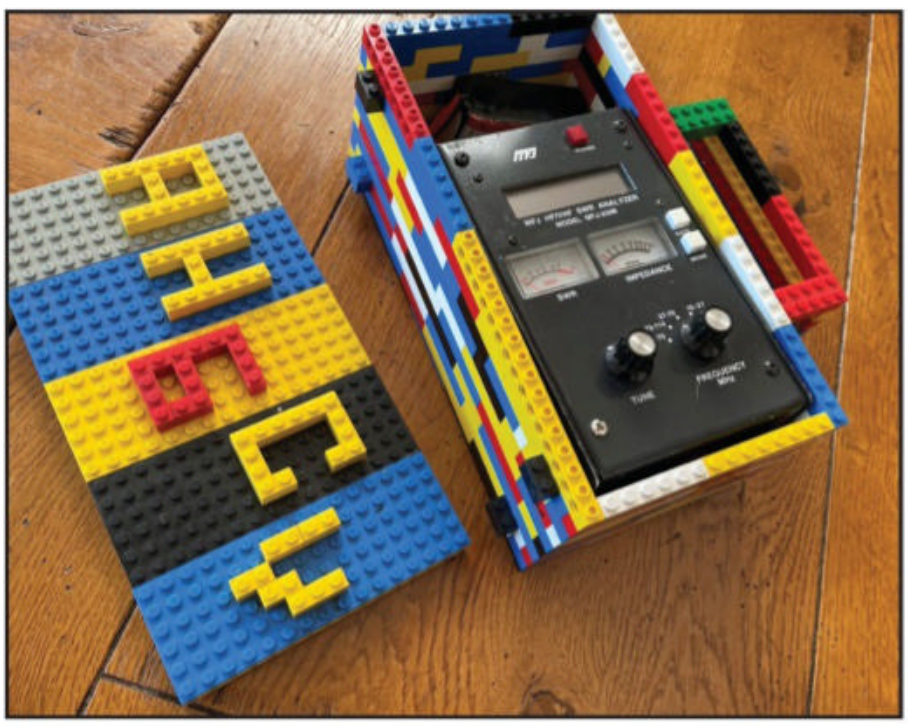
Whoever came up with the conservation mantra of "Reduce, Reuse, Recycle" left out a fourth "R" — "Repurpose" — something hams have been doing since the dawn of radio. Here's a colorful example from AH6CY, who describes his projects using repurposed LEGO® bricks as "an old-timer's 3-D printer."

Playing With LEGO® Bricks for Ham Radio

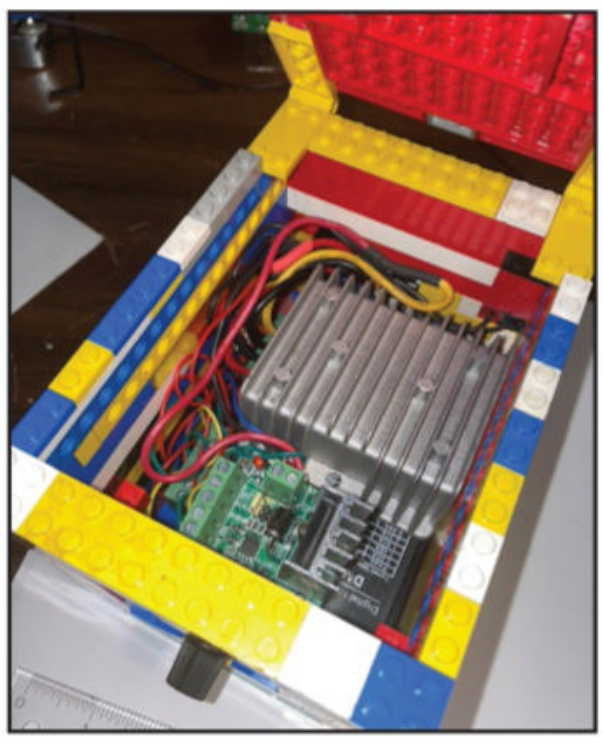
PHOTO ESSAY BY HIROKI KATO,* AH6CY

If you are an old grandfather like me, chances are that you are stuck with hundreds of LEGO® pieces left by your offspring who has / have moved on to other playthings. I find that LEGOs are great building blocks for custom ham radio equipment enclosures and for constructing accessories. I'd call them an old-timer's 3-D printer.

Here are some examples of my creations:

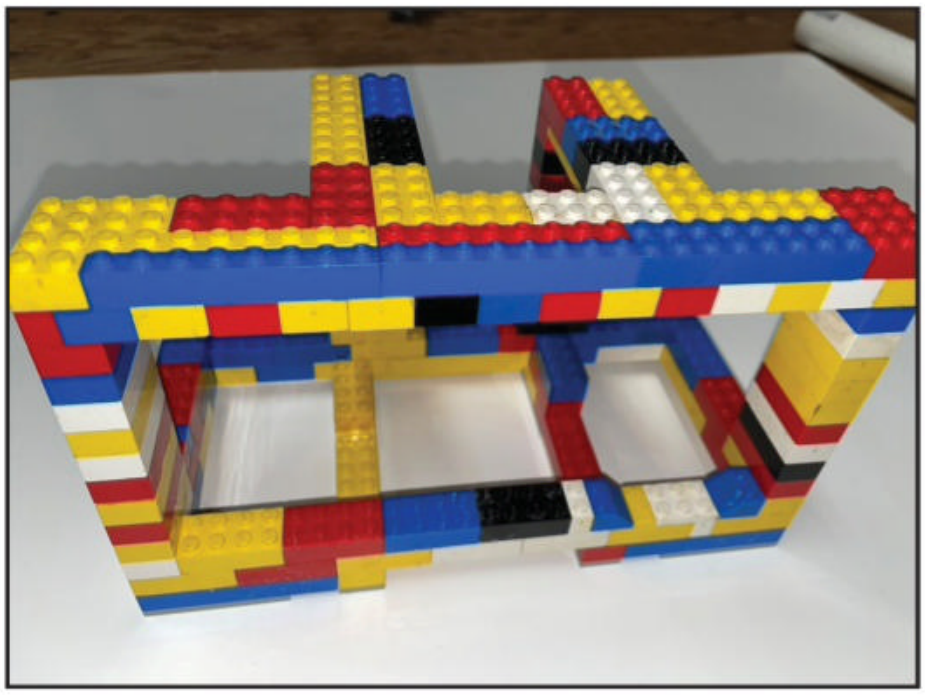


A utility box. This box was made specifically to house my MFJ-259 antenna analyzer and a small external battery. With the lid on, you can carry it like a lunchbox!

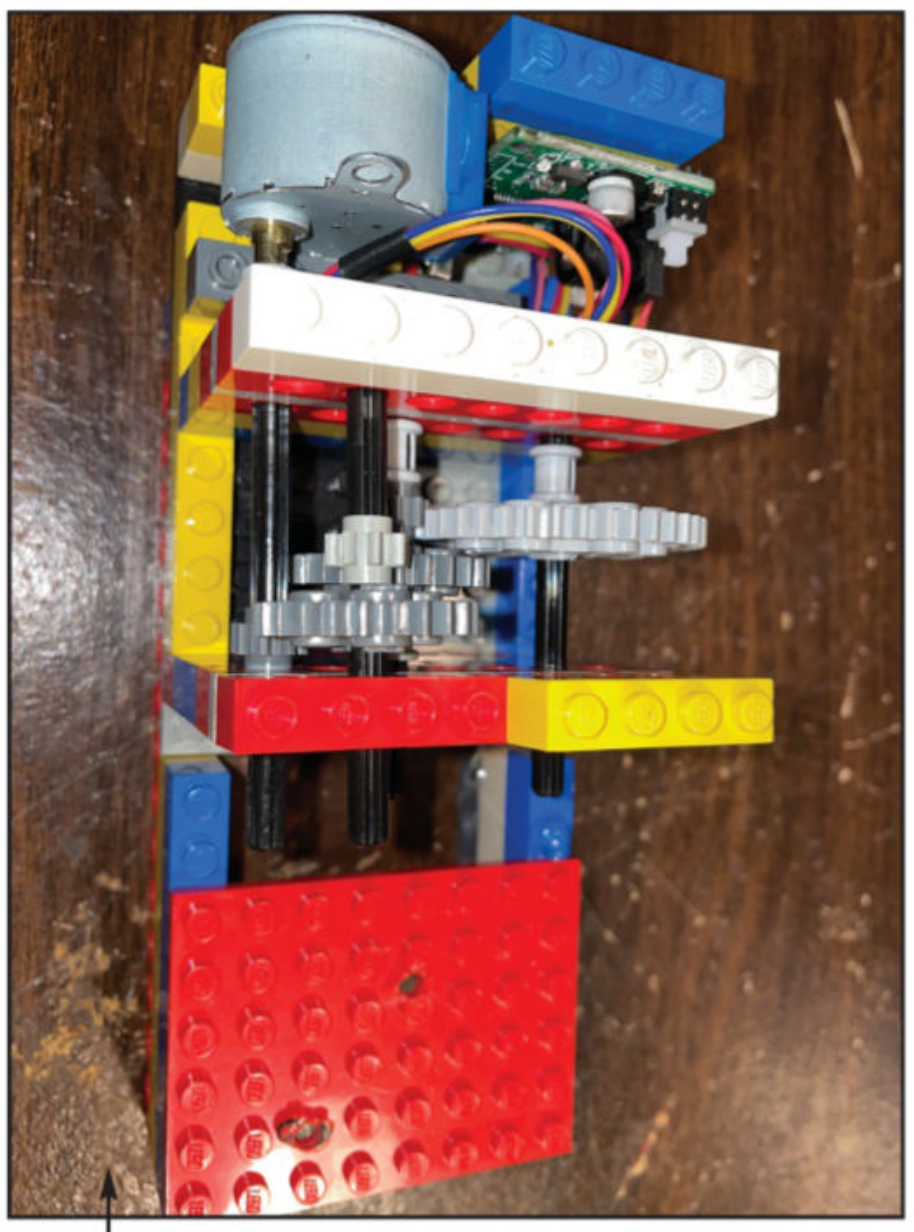


An enclosure for a homebrew remote stepper motor control for a homebrew QRO magnetic loop antenna with a vacuum variable capacitor. It has hinges to easily open and close the top.

* Email: <hiroki@pacbell.net>

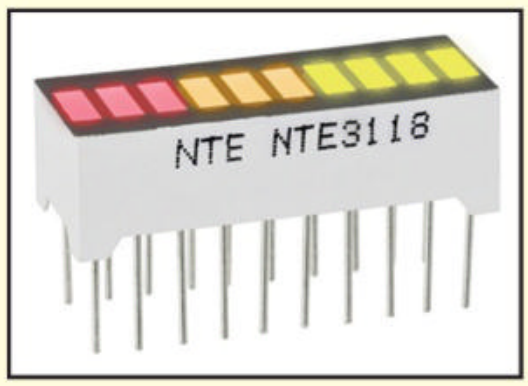


A protective frame for the IC-705 portable transceiver.



A wireless remote tuner for the AlexLoop magnetic antenna. The AlexLoop[1] is my favorite multi-band portable antenna. One weakness, however, is that tuning is very sharp and requires a delicate touch. By remotely tuning it with a reduction gear, it is much easier to tune and avoids slight detuning by the proximity of the body.

what's new



NTE 3118 LED Bar Graph

NTE Parts Direct has announced that its new LED Bargraph display is now available for shipping, making it ideal for any ham radio project that might need a colored LED indicator. Generally, these displays can be used as a battery level indicator in audio equipment, industrial control panels, and hundreds of other applications.

The 10-segment LED bar graph can be connected to an electronic circuit or microcontroller with an easy-to-connect anode and cathode pin for each LED segment. This device contains three red segments, three orange segments, and four yellow-green segments on a single, end stackable black-face package with white fields. The LEDs offer high intensity brightness and require low power to operate and are RoHS compliant.

The Bragraph Display is available now and has a suggested retail price of $1.87 each with pricing varying with each quantity ordered. For more information visit <https://tinyurl.com/mry6h68v>.

Max Ratings:

Absolute Maximum Ratings: (T_A = +25° C unless otherwise specified)

Power Dissipation (Per Segment): 65 mW

Peak Forward Current (Per Segment, 1/10 Duty Cycle, 0.1ms Pulse Width): 100mA

Average Forward Current (Per Segment): 30mA

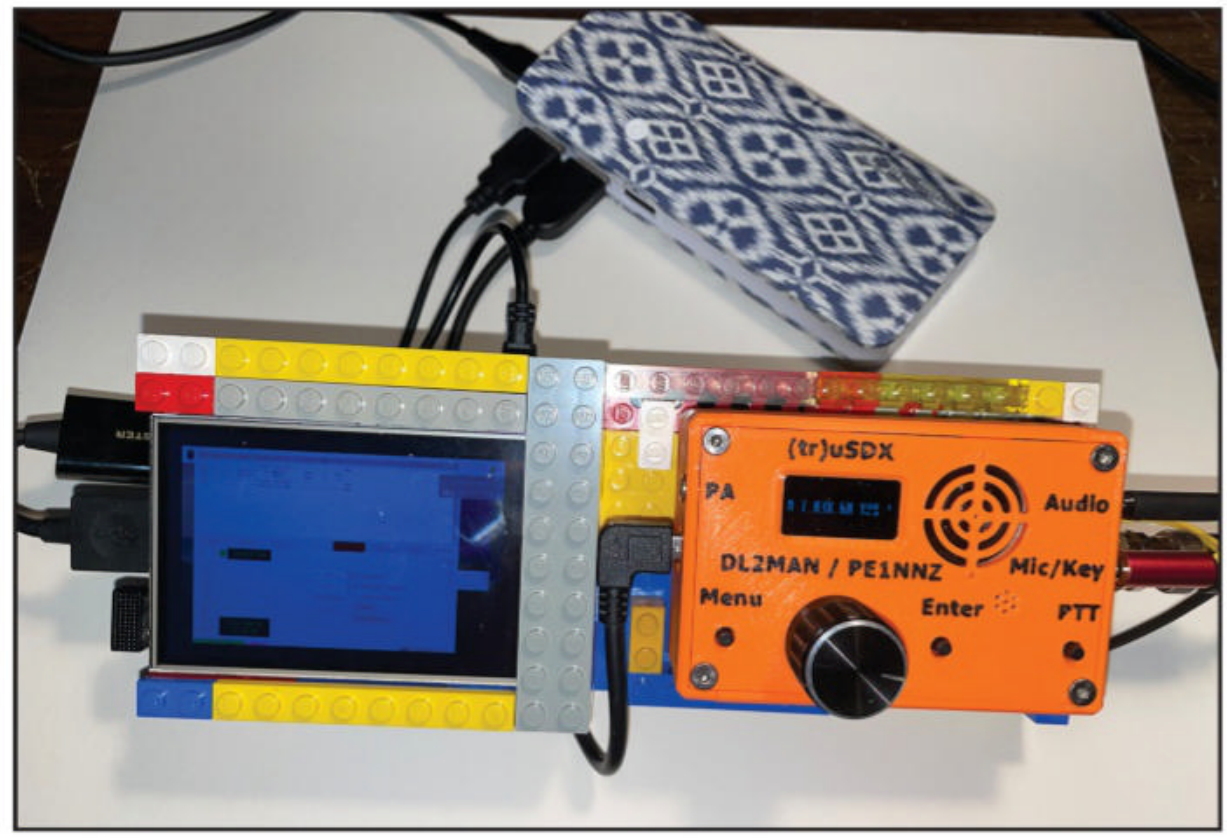
Derate Linear from +25° C (Per Segment): 0.33mA / C

Reverse Voltage (Per Segment): 5 volts

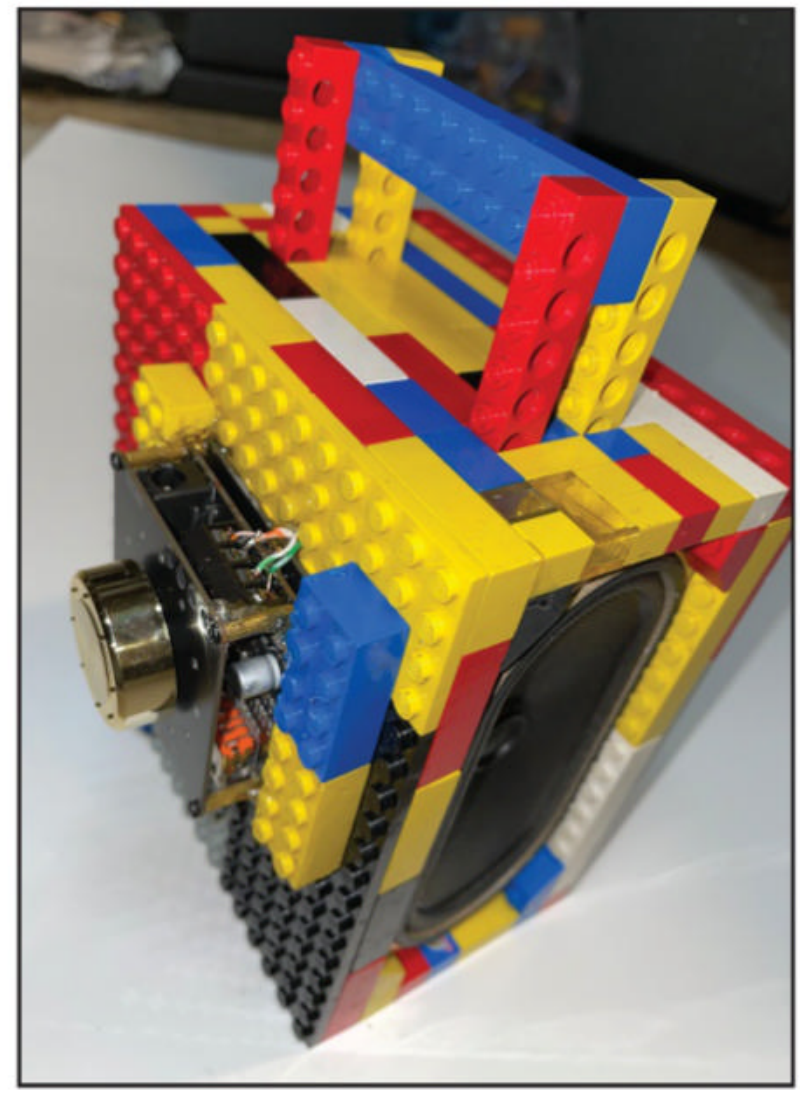
Operating Temperature Range: -40 to +105° C

Storage Temperature Range: -40 to +105° C

Lead Temperature (During Soldering, 1.6 mm from Body, 3 sec max): +260° C



A platform for the (tr)uSDX transceiver and a Raspberry Pi computer. This is possibly the smallest self-contained multi-band, all-mode, battery-operated setup.[2] A rechargeable battery is placed under the case.



A Bluetooth two-speaker box. It can be placed vertically or horizontally. The electronics for this box are from ICStation.[3]

With LEGO®, you, too, can let your imagination run wild like a young kid and build something useful and uniquely your own for our hobby.

Notes:

1. The AlexLoop magnetic loop antenna was reviewed in *QST*, August 2020 pp.48-50. The infrared wireless remote-controlled stepper motor kit, used here, is available on eBay from several vendors in China. For example: <https://tinyurl.com/22kr3yhu>.
2. For info on the (tr)uSDX transceiver, see <https://dl2man.de>
3. <https://tinyurl.com/yvdfnu2m>

NanoVNA Software and Video … Update to September's "Protect Your NanoVNA"

BY JIM KOCSIS,* WA9PYH

When clearing off the top of my workbench I found some notes on my NanoVNA that will be very useful to owners and users of the NanoVNA, which I wrote about in the September 2022 issue of CQ ("Protect Your NanoVNA," p. 33). The notes (below) tell how to connect a NanoVNA to a PC to do much more than just touch the screen with a stylus … which is very cumbersome. The NanoVNA Saver software provides a LOT of information and eliminates all the strokes / screen touches to get information. Best of all, it's FREE! – WA9PYH

Here's how to use NanoVNA Saver software on a Windows PC (Windows 10 is what I use):

The software is available at <www.nanovna.com>. At the bottom of this page is a link for downloading the software. Or if it's not there, you can go directly to <https://tinyurl.com/2p9es3b8>.

** 53180 Flicker Lane*
South Bend, IN 46637
Email: <wa9pyh@arrl.net>

There is also an excellent YouTube video, by "The Smokin Ape," that shows all the steps for using the software. It's at <https://tinyurl.com/bdd64tyn>. Please give him a "like" — it's a really good video and it's intended for hams.

Setup Tips

My PC had trouble finding the unit. Here's how to ensure the software "finds" yours:

1. Set nano VNA power OFF.
2. Connect it to a USB port.
3. Turn on the power at the unit's switch.
4. Start the program. On my Windows 10 PC, the software shows up on the tray at the bottom of the screen.
5. Click on the NanoSaver icon.
6. A DOS window will pop up then a full Windows screen will appear.
7. Scroll down to where you see "COM X (H)" in port window.
8. Click on "connect to device."
9. Follow the instructions in the YouTube video.

Many of us like to supplement our ham gear with one or more scanners, whether to listen for activity on multiple repeaters while monitoring a "main" one, or keeping an ear on local public safety agencies. WB9YBM offers some tips on pulling in the greatest number of signals to your scanner.

Scanner Range Improvements

BY KLAUS SPIES,* WB9YBM

Regardless of whether you're operating fixed, mobile, or portable, and regardless of which aspect of radio communication you're involved with — ham, commercial, C.B., or scanning — the radio enthusiast will usually be driven to obtain better range.

While there are several constants that apply to all radio services (like the antenna adage "Height is Might"), there are also suggestions for improvements specific to a given service. In this article we'll be taking a look at VHF / UHF scanners. Certain ideas will apply specifically to base, mobile, or portable station operation while other suggestions can be used across the board. Let's take a look at a few:

1. Antenna height: As a minimum, antennas need to get above the "ground clutter" — objects that are either RF-opaque (wood, like trees and shrubs; people; other non-conductive objects) or block RF (metal objects like vehicles, metal girders in commercial buildings, and aluminum siding on homes). This will also get antennas farther away from RF noise like electric motors (from things like washing machines, refrigerators, and HVAC — worn motors may have internal sparking that cause electrical hash), ignition noise from spark plugs in vehicles, and so on. A good antenna height will also let a radio look farther over the horizon. Just be aware of coax line losses: depending upon the quality and length you're using and frequencies listened to, you *might* need a more expensive type. Most coax is also considered disposable since — over time — weather, air pollution, and the suns' ultraviolet rays will cause it to degrade.

2. Antenna type: The basic antenna that came with your scanner is just that: basic. It's a balance between allowing the listener to start using his/her radio right away without the manufacturer cutting into his/her profits by providing anything spectacular. These antennas — usually of the "rubber duck" variety — are okay for close-range work (or strong signals a bit farther out), and have the benefit of being short enough to not poke someone in the armpit when the radio's clipped to your belt. If you're monitoring the hotels' housekeeping staff or other nearby businesses from poolside, a basic antenna will do just fine. Fortunately, most (if not all) radios come with a standard BNC antenna connector which means we can easily exchange antennas. The first — and most basic — exchange is shown in *Photo A*: The standard rubber duck (the short, black antenna) in the center and a telescopic antenna (this one from RadioShack … remember RadioShack?) on the right, both shown next to the scanner for size comparison. A chart is provided with the telescopic antenna showing which segments to extend or retract for various frequency bands. Yes, a tuned antenna is always better than one that's not tuned although it's not as critical for receivers as it is for transmitters since we don't have to worry as much about SWR. What's more important in receive is to increase surface area: The more surface area there is, the more signal can get captured. Base station antennas are available as well as mobile options; a mag-mount antenna is shown in *Photo B*. Be aware that many (if not all) states do not allow scanner listening while driving — sometimes scanners aren't even allowed in the passenger compartment of vehicles — and these laws can vary from state to state, and in some cases even city to city. So check your local laws before doing any mobile scanning. (*Some jurisdictions have exemptions for licensed amateurs, but not all police officers will be aware of that. – ed*)

Photo A. An easy way to increase the range of a handheld scanner is to replace the "rubber duck" antenna (center) with an extendable whip (right). (Photos by the author)

** Email: <wb9ybm1@yahoo.com>*

3. Pre-amplifiers: The Amateur Radio Service has been aware of these little gems for a long time, but they don't get much mention in the scanner community. The challenge is making a high-quality broadband pre-amp: The basic rule-of-thumb has always been that the best quality amplifiers need to be relatively narrow-banded. In the world of scanning this means we either have to put up with a less-than-ideal unit, or find some way to parallel (or swap) multiple amplifiers. One cure for this problem is shown in *Photo C*: A pre-amp intended for analog television receivers (model shown manufactured by RadioShack). Analog television channels had a 4-MHz bandwidth, and VHF and UHF television channels are spread over quite a wide range of frequency allocations, so amplifiers such as the one shown had to cover quite a bit of territory. These pre-amps can be used with either antennas mounted outside, or — with a bit of caution — a handheld receiver. In the case of handheld use, I made sure to use coax with a good quality shield between the amp and my scanner (the antenna I've mounted directly to the "ANT" port of the amp), and moved the amp away from the scanner. Fortunately, the pre-amp I have is in a shielded (metal) enclosure so I don't have to worry about it picking up (or emitting) any extraneous signals that might cause RF feedback.

Probably the most beneficial help in increased coverage in scanner listening does not come from our efforts, but from those who are doing the transmitting.

4. Location: When operating away from home with its well-placed base station antenna on a high mast, getting good reception can be a challenge. Time to get creative. And no, I'm definitely not recommending anyone climb on the roof of the hotel they're staying in! How do we improve the range of a rubber duck antenna mounted on the receiver? Sometimes all it takes to improve a signal is to move a few feet (usually in multiples of the wavelength of the frequency we're listening to), to get away from something between the radio and the source that's causing a signal shadow. Things that cause a signal shadow can be anything from a metal vehicle passing between my radio and the station I'm trying to listen to, to something that might be a bit more unexpected. For example, one thing many people might not realize is that many commercial buildings — everything from a strip mall to an office building — have steel beams and girders, (yes, even those that look like they're

Photo B. A magnetic mount ("mag-mount") antenna placed on top of a car or other metal surface can greatly expand your monitoring range.

Photo C. A VHF/UHF TV/FM preamplifier provides broadbanded amplification over the VHF and UHF portions of the spectrum where most scanner listening takes place. With the advent of digital TV and the market dominance of cable and satellite TV systems, look for these at bargain prices at hamfests and even yard sales.

brick-and-mortar buildings), metal HVAC duct work, and etc. Even though these metal structures are not as tight as a metal box housing electronic equipment, there's still enough metal in these buildings to cause issues with radio signals.

5. Create options: When operating on vacation, the hotel / motel staff would probably take a dim view of guests climbing on the roof or stringing coax cables and remote antennas that others will trip over or become an eyesore. Time to get creative! Depending on where I'm vacationing, it's easy to put up a lawn chair next to my car while enjoying seeing the sights as they pass me by (or supervising the kids in the outdoor pool). The car provides a great ground-plane for a mobile mag-mount antenna, which also has a larger signal capture area than my portable antennas. Depending on where you're traveling to, be aware of your surroundings and be prepared to *safely* use them. One such example I remember from my travels to California: We were visiting Twin Peaks, and I found a foot path leading up to one of the two peaks. Taking my ham radio portable with me, I was able to transmit 80 miles using nothing more than 2.5 watts and a 5/8-wave antenna. This was not a fluke; I got pretty impressive range when operating 2.5 watts into a rubber duck antenna while in my dad's airplane at 4,500 feet. The point is, if a safe opportunity presents itself to improve reception, try it!

Probably the most beneficial help in increased coverage in scanner listening does not come from our efforts, but from those who are doing the transmitting. For commercial users of radio equipment, the focus is on getting reliable coverage over a specified range — they're not going to waste time or lose business because of inadequate coverage. Because of this way of thinking, most of the hard work in getting good coverage is already done for us by the people doing the transmitting. Of course, for scanner enthusiasts who *do* enjoy more of a challenge, there's always FRS,[1] MURS,[2] simplex GMRS,[3] and amateur radio to listen to.

Notes:

1. Family Radio Service; unlicensed; operates in the 450-MHz range.

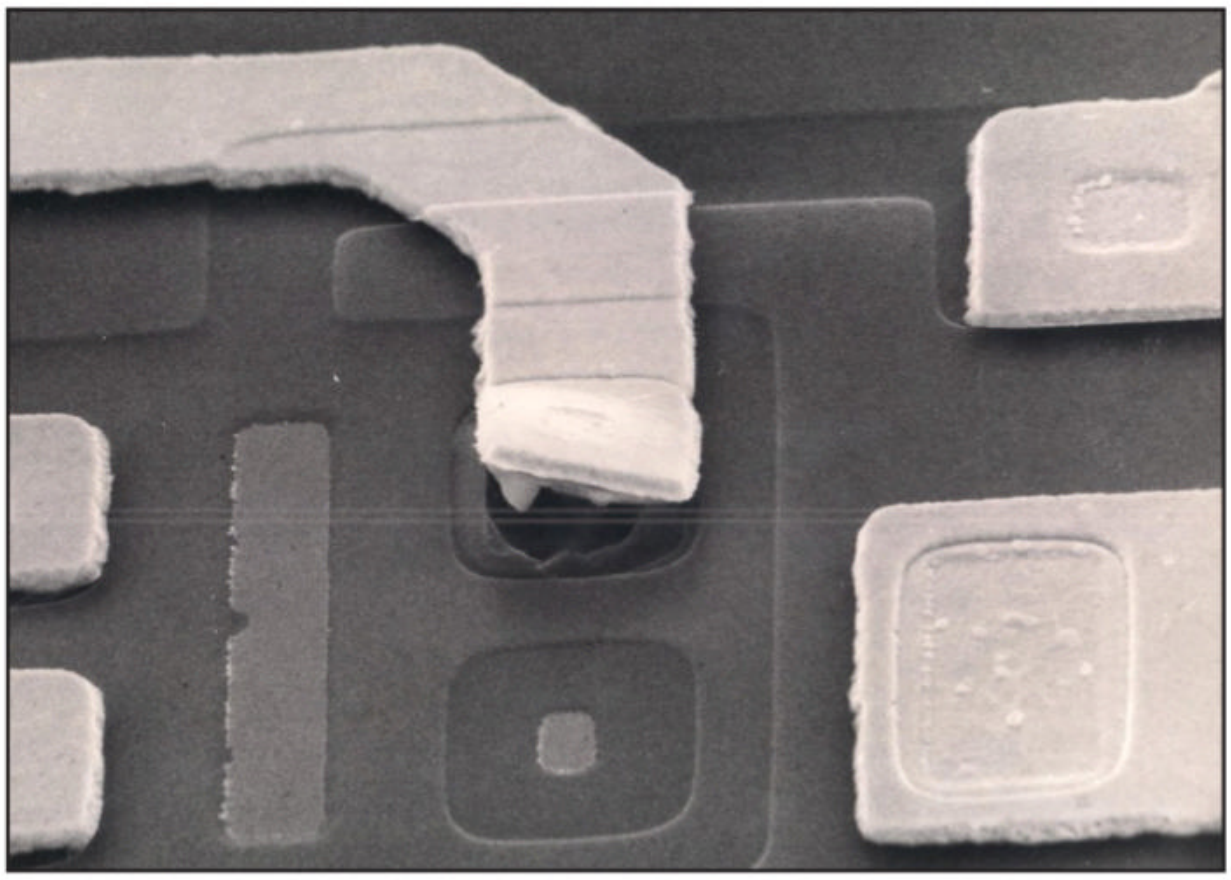
2. Multi-Use Radio Service; unlicensed, operates in the 155-MHz range.

3. General Mobile Radio Service; licensed, operates in the 450-MHz range with some channels shared with FRS.

Did you ever wonder what actually went wrong when an integrated circuit chip fails? Our intrepid investigator has access to some of the tools needed to find out…

Sherlock Investigates: Microcircuit Failure Analysis

BY "SHERLOCK"*



This photo of a failed IC, taken by a scanning electron microscope and magnified 1,000 times, shows the impact of an external electrical overstress, such as an electrostatic discharge, on the circuitry inside the chip. (Photo courtesy of Sherlock)

Microcircuit failure analysis is rarely ever done by users these days because it is such a costly endeavor, requiring highly specialized and massively expensive equipment. Today's microcircuits (or chips) are so small and dense that accessing the inner parts must be left to the most advanced laboratories.

One of the most singular analyses ever found in my records was the "Cecil the Seasick Sea Serpent" failure found in collaboration with the Martin Marietta Failure Analysis Lab. It shows the emitter metallization of a transistor on the die that was blown apart (see photo). The scanning electron microscope photograph was taken at a magnification of 1,000 times.

Failure analysis rarely shows such detail that leads directly to the cause as easily as this one. The metallization that lifted (which looks like Cecil from the old "Beany and Cecil" TV show) was caused by some electrical overstress from an external source. The damage was on pin 14 of the device so the cause could traced back to the source. It was probably caused by some large electrostatic discharge or by some test equipment glitch.

It's amazing what you can learn when you have the right equipment!

– Sherlock

** c/o CQ magazine*

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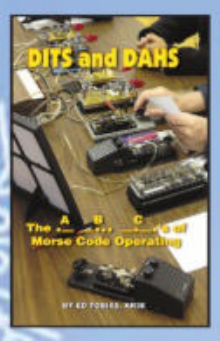

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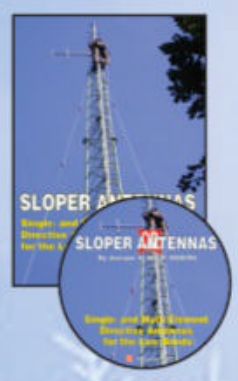
Sloper Antennas

by Juergen A. Weigl, OE5CWL



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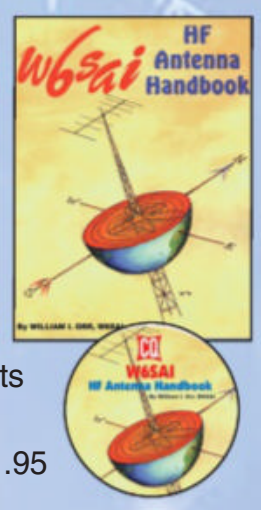

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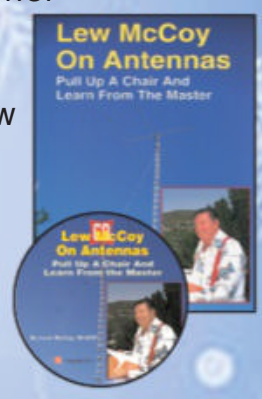
by Lew McCoy, W1ICP



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math's notes

BY IRWIN MATH,* WA2NDM

Low Resistance Ohmmeter

First, I want to wish all of my long-term, short-term, and new readers of this column a very happy and healthy new year.

The response to our "simple test equipment" columns last year was overwhelming, and since so many asked for "more of the same" type of projects, we thought that a good way of beginning a new year was to present another one. This time it is a simple inexpensive ohmmeter circuit that will enable you to check resistances below 1 ohm with reasonable accuracy. Before going further, I just want to mention to the "nit pickers" who read this that I am aware of the four terminal method of measuring very low resistances but this design is not really intended to compete with ultra-precision measurements but rather to be used to give you a general idea of contact closer resistances, poor solder joints, and any other place where very low resistances need to be measured with reasonably accuracy.

The first step is to realize that, when measuring very low resistances, even the resistance of the actual test leads will add to the measurements. For example, *Table 1* shows some common resistances of the typical types of copper wire you may encounter.

You will note that using a standard DVM will not tell you very much. It is obvious that we need to come up with a different approach. Before showing you my solution, the method we chose is to pass a small current through the wire (or contact) to be measured and then to amplify the voltage drop produced across it to some higher value. Then, using Ohm's Law, one could determine the actual resistance. In the first case, for example, if we were to pass a 10-mA current through the 0.0065-ohm resistance of 1 foot of #18 wire, we would come up with 65 microvolts (0.1 x 0.0065). This is quite small, so we obviously must amplify it and *Figure 1* shows our circuit, which is composed of a common op-amp, current-to-voltage converter.

For simplicity, we have chosen to use the 0 to 1-volt range of a DVM to represent 0 to 1 ohm. To accomplish this,

*c/o CQ magazine

Table 1

Wire Gauge	Resistance	Resistance per foot
#18	6.51 ohms / 1,000 feet	0.0065 ohms
#16	4.09 ohms / 1,000 feet	0.0041 ohms
#14	2.58 ohms / 1,000 feet	0.0026 ohms
#12	1.62 ohms / 1,000 feet	0.0016 ohms

Table 1. Typical resistance values of several common sizes of copper wire. These values must be taken into account when measuring very low resistances.

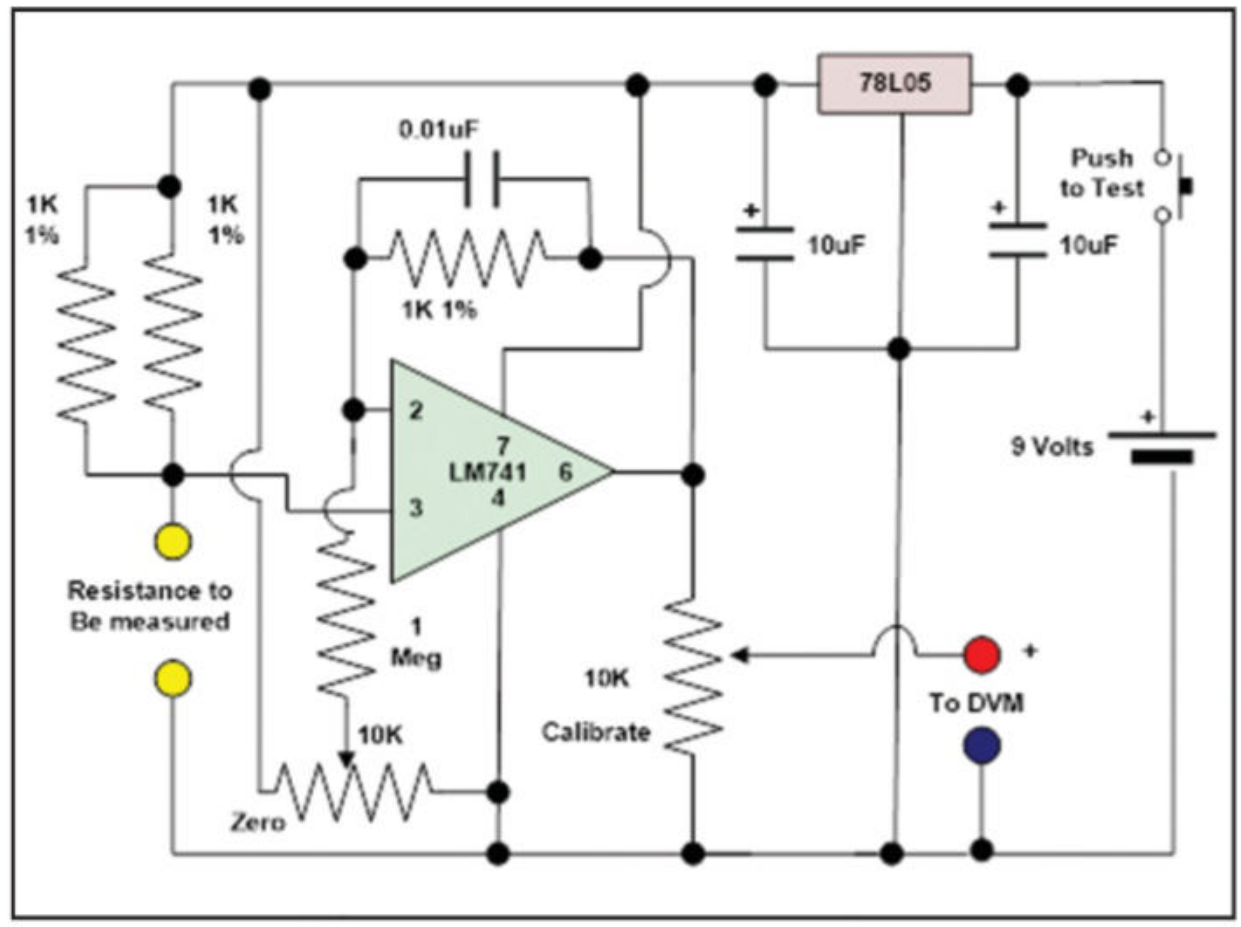

Figure 1. Low resistance ohmmeter schematic

we used a current of 10 mA as our reference. Therefore, 1 ohm in series with 500 ohms will produce 100 µA of current passing through the 1-ohm portion of the combination. This current will then produce a voltage of 1 millivolt. The op-amp will then amplify this voltage by 1,000 times to 1 volt, which is how the scale of the DVM was chosen. With a 3-digit meter, you will be able to measure down to 0.001 ohms. Now for some other details.

Since the current flowing through a 500-ohm resistor from a voltage of 5 volts will be 10 milliamps, we made up this resistor by using two 1,000-ohm 1% devices in parallel. This will obviously come close to 10 mA but will not be exact due to the tolerances of the resistors and the accuracy of the 5-volt regulator. However, we will compensate for this with a calibration control. Next, we have chosen a common LM741 op-amp, although most other similar devices will work. By the way, the capacitor across the 1K-gain resistor is used to eliminate any residual noise or jitter that may be present due to the high gain. Finally, the output of the op-amp is applied across a 10K potentiometer which is used as a calibration control. Another 10K pot is provided as a zero adjust control. You will also note that I used a push button switch for power since a 9-volt battery will not provide much current for long periods of time and I was concerned about long battery life.

To try to properly calibrate the unit,

you would obviously need a precision 0.1-ohm resistor, which is difficult but not necessarily impossible to find. In this case, since the circuit is quite linear, you could use a precision 1.0-ohm 1% resistor which you can easily get; temporarily replace the 1K op-amp feedback resistor with a 100-ohm 1% resistor, which is also commonly available, and then calibrate the circuit for a full-scale value of 1.0 ohm. After doing so, by replacing the 100-ohm 1% resistor with the 1K 1% resistor, you will be close. If you find that the full-scale reading is too low to allow the calibrate potentiometer to properly calibrate the unit, simply replace (or parallel) one of the 1K current dropping resistors with a standard 5% resistor to raise the 10-mA current slightly so that the output voltage rises somewhat higher than you require. Then you can readjust the setting of the calibration potentiometer for the proper value. In any event, if you are careful, you could probably get overall accuracies of 5% or even better.

When using the circuit remember that it is measuring fractions of an ohm. As a result, the binding posts used for the unknown resistance must be of the lowest resistance possible. If you are using test leads as probes then their overall resistances must also be much lower than what you are measuring. As in the case of "old style" ohmmeters, before measuring resistance first short the tips of the probe leads you are using together, set the zero adjust potentiometer to 0, and touch the tips of the probes between the area you wish to measure. Then make your measurement.

If you do build this circuit, remember that by changing either the test current or the gain resistor, you can come up with whatever range you require.

– Good Luck! Irwin, WA2NDM

behind the bylines...

… a little bit about some of the authors whose articles appear in this issue.

Marija Kostic, YU3AWA ("Rare DX From the Heart of Italy," p. 8), is a prominent young amateur in Europe. A biomedical engineering student at the Faculty of Technical Sciences in Novi Sad, Serbia, she was introduced to amateur radio and amateur radio direction finding in 2013 and earned her license in 2015. Marija is very active in international ARDF competitions, YOTA (Youngsters On The Air) activities, DXing, and outdoor operating.

Steven Karty, N5SK ("CQ Reviews: CODAN High Power Amplifier Controller," p. 36), is a senior engineer with the U.S. Department of Homeland Security and former manager of the agency's SHARES (SHAred RESources) HF Radio Program. He has been writing for amateur radio magazines, including *CQ*, for the past 25 years.

Nicholas Petreley, N2EWS ("The Perverted V Antenna, Part 1," p. 44), says he is certainly not every woman's sweetheart (phonetics for his call), but he is thankful to be his lovely wife's sweetheart. He was an award-winning columnist for the computer journal *InfoWorld* in a former life; a teacher, consultant, and programmer in an even former former life, and is currently a technical consulting engineer for Cisco Systems, Inc. You can reach him at <nicholas@petreley.com>.

Michael Toia, K3MT ("Antenna Misconceptions," p. 47), has been a ham since 1952 and has had a lengthy career as a communications and antenna engineer for various U.S. government agencies as well as Northrup Grumman. Now semi-retired, he continues to work as a teacher and mentor to young engineers in his field. He also publishes a variety of antenna-related books and DVDs, and notes on his QRZ.com page that he was born on the same day that Marconi died!

Frank M. Howell, Ph.D., K4FMH ("New Tools for Using the Sherwood Tables for Transceiver Selection," p. 50), lives in Ridgeland, Mississippi. He is a member of the ICQ Podcast team and blogs at <k4fmh.com> and <foxmikehotel.com>. Frank is also an ARRL Assistant Director for the Delta Division. He enjoys building and testing equipment on his workbench and portable operations with his small team of area hams. He is Professor Emeritus at Mississippi State University and an adjunct professor at Emory University in Atlanta, Georgia.

Hiroki Kato, AH6CY ("Playing With LEGO® Bricks for Ham Radio," p. 56), is a frequent contributor to *CQ*, as well as many other radio publications. One of his passions is restoring World War II military and spy radios and has written a book, *The Paraset Radio*, which was published in 2020 by the Radio Society of Great Britain. Kato has also written about Parasets for *CQ*. He lives in Portola Valley, California, on the outskirts of Silicon Valley.

the listening post

BY GERRY DEXTER

Hurricane Ian Whacks WRMI

WTWW Goes Silent
Shortwave broadcaster WTWW in Lebanon, Tennessee, went silent on its longtime frequency of 5085 kHz in early November, now "broadcasting" only on the internet. Much of the musical and ham radio-related programming has moved to WRMI on 9455 kHz.See this month's News Bytes column for details and last-minute updates.

~ Hurricane Ian gave WRMI a huge gut punch, pounding the station's 23-tower antenna field with estimated 100 mile per hour (MPH) winds, creating extensive damage to much of the area, likely including WMRI's 14 high-frequency (HF) transmitters. We at *CQ* send our best wishes to WRMI's General Manager Jeff White and his staff for a quick recovery and best wishes for success in their appeals for financial help from the shortwave (SW) community.

~ Heartiest congratulations to all at the BBC on their 100th anniversary. You can find special program details on their website <www.bbc.co.uk/100>.

~ SW conditions out of Asia have been particularly good lately, especially from Myanmar, the various Chinese outlets and the Philippine stations, so keep an ear tuned!

Listener Logs

Your shortwave broadcast station logs are always welcome. But 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. 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 via Anchor Point on 9580 in English at 1440 with man talking about the Biblical Joshua. (Sellers, BC) On 11830 in Mandarin at 1553. (Brossell, WI)

ALGERIA—Radio Algerienne on 7200 via Bechar at 0419 with Middle Eastern music and a man talking in Arabic, time pips, and a station ID at 0500 then apparent news, suddenly cut off at 0502. (Barton, AZ) Heard at 0449. (Taylor, WI)

ASCENCION—BBC-North Atlantic relay on 11810 via English Bay at 2100 with world news. (Brossell, WI)

AUSTRALIA—Reach Beyond on 9720 via Kununurra with a promo followed by the "Focus on the Family" program at 1344. (Sellers, BC) On 12010 at 1146 in Nepalese. (Brossell, WI)

AUSTRIA—Radio Austria Intl. on 6155 via Moosbrunn at 0507 with male and female announcers reading the news in German and several English clips. (D'Angelo, PA) Heard at 0522 in German. (Taylor, WI)

BOTSWANA— Voice of America (VOA) Relay via Mopeng Hill on 12075 at 2119 with English-to-French lessons. (Brossell, WI) On 13830 in French at 0540. (Barton, AZ)

BRAZIL—(*All in Portuguese –GLD*)

Radio Brazil Central via Goiania on 4985 at 0034 with man hosting discussion program, station ID at 0100, Brazilian pop music, needed to use lower sideband (LSB) to separate from a UTE, harmonic on 11815 was good. (D'Angelo, PA)

Voz Missionaria via Florinapolis on 9665 at 2250 with a sermon. (Brossell, WI)

Radio Aparecida via Aparecida on 11855 with talks at 2244. (Brossell, WI)

Radio Inconfidencia via Belo Horizonte with a woman talking and bridge into Brazilian music at 2311, later with a DJ-style discussion. (Taylor, WI)

CANADA—CFVP via Calgary on 6030 with a stand-up radio comic at 1515, station ID at 1615. (Sellers, BC)

Bible Voice on 11790 via Nauen in Oromo at 1605. (Brossell, WI) On 11590 via Uzbekistan in Kazakh at 1328 and woman ending program, fill music to off at 1330 per schedule. (Taylor, WI)

CHINA—China Radio Intl. on 15125 via the Mali relay with Arabic-to-Mandarin lessons. (Brossell, WI) On 5990 via Cuba in Spanish at 0015 other sites were dark due to Ian; on 11820 via Xinyang at 0005 in Cantonese; on 15245 via Kashi with man and woman hosting a talk program at 1545. (Barton, AZ)

COLOMBIA—Fuerza de Paz via Arauca on tentatively 4940 at 0452 in Spanish with religious talk on through the top of the hour with some sort of a station ID, possibly from Colombia or Venezuela. (D'Angelo, PA)

CUBA—Radio Havana Cuba on 5040 via Bauta with several men in a discussion in Spanish, but nothing noted since Ian. (D'Angelo, PA)

**c/o CQ magazine*

Here's what's left of the WRMI antennas after Hurricane Ian had its way.

ENGLAND—BBC on 11810 via Woofferton at 2100 with news magazine program; on 15300 via an unknown transmitter at 1930 with man and woman speaking in French. (Barton, AZ)

ESWATINI—Trans World Radio via Manzini on 9585 at 1453 with chimes, station ID under KNLS splatter, English station ID, CRI came on frequency at 1500. (Sellers, BC) On 15105 noted in Arabic at 1544. (Brossell, WI)

FRANCE—Radio France Intl. via Issoudun on 11700 with news at 0600; on 15300 at 1930 with man and woman speaking in French. (Barton, AZ)

GERMANY—DW Pinneberg on 5905 in German at 0616 with a woman talking likely a religious broadcast, harmonic on 6180 was very poor. (Taylor, WI)

GUAM—Adventist World Radio on 12040 opening at 2200 in Basa Sunda with flutes and drums. (Barton, AZ) On 12120 in Hakka at 1155. (Brossell, WI)

INDIA—All India Radio on 11560 via Bengaluru with news in Russian at 1702; on 15030 in Swahili at 1230. (Brossell, WI)

TWR India on 13690 via Armenia in English at 1433 with a woman telling a Bible story and preaching. (Sellers, BC)

JAPAN—Radio Japan on 9560 via France with what seemed like a current events program in Japanese at 1600; on 9615 at 0730 upbeat banter between two women; on 11815 news in English at 1400. (Barton, AZ) On 15130 via France at 2046-2058 with a man and woman speaking Japanese, closing announcements at 2054. (D'Angelo, PA) On 15130 in Japanese at 2009. (Brossell, WI)

Radio Nikkei 1 on 11615 via Nagara at 0800 with woman giving a station ID, brief talk in Japanese, pop-style vocal. (Taylor, WI)

MADAGASCAR—Adventist World Radio on 15605 via Talata in Lushai with hymn, announcements off for a few seconds, then into Malayalam with a station ID and music bridge. (Sellers, BC)

MALAYSIA—Sarawak FM on 9835 via Kujang at 1240 in Malay and some Arabic with a series of upper register chants, brief Qu'ran recitations, man talking over dramatic music, apparent news after a station ID at 1300. (Taylor, WI)

MYANMAR—Myanmar Radio on 5915 via Naypyidaw in Burmese at 1252 with woman hosting a show and featuring distinctive Burmese music. (Taylor, WI)

NORTH KOREA—KCBS on 11815 in Korean with martial music at 1214. (Brossell, WI)

OPPOSITION—Radio Ndrason Intl. (via Ascension to Chad) on 5960 at 0504 in Kanuai with a woman talking with indigenous music, second woman speaking for several minutes, followed by a man giving a long talk. (Taylor, WI)

Radio Republica (via France to Cuba) opening with marching band then a man giving station ID, news in Spanish. (D'Angelo, PA)

Echo of Reunification (North Korea to South) on 5905 with man singing in Korean at 1330. (Barton, AZ)

Radio Free North Korea (via Uzbekistan to NK) on 11510 at 1323 with man and woman talking alternately 1 to 2 minutes each. (Taylor, WI)

Radio Dabanga (via Madagascar to Sudan) on 11650 at 0430 with Sudanese music, woman spoke for several minutes. (Taylor, WI)

Radio Tamazuj (via Vatican to Sudan) on 15400 at 1753 in Sudanese Arabic. (Brossell, WI)

Denge Welat (via Bulgaria to Turkey) on 7285 in Kurdish at 0500 with a male announcer and dramatic sounding Kurdish music. (Taylor, WI)

PHILIPPINES—Radio Pilipinas on 15190 at 1753 in Tagalog. (Brossell, WI) At 1845 with a mix of Tagalog and English, station ID on the hour. (Barton, AZ)

PIRATES—WJAN on 6935 upper sideband (u) with '70s progressive rock. Radio Gaga on 6925u at 0135, sounded like Frank Zappa, off at 0150. Mushroom Head Radio on 4124u at 2230 with rock just over the noise level. WLIS on 7000 at 0025 repeating the same IS. WREC on 5050 with hard rock at 2305. (Hassig, IL)

WPIG on 6950u at 0026 with pig and pork songs, frequent station IDs, and acknowledged WDOG's relay. Black Star Radio on 6920 at 0047 with David Bowie songs, voice-over station ID, and one in CW. (Taylor, WI)

PREVIOUSLY REPORTED—WWWW, Thunder Chicken, Radio Free Whatever,

Radio Austria International's QSL shows a very attractive lake.

Antenna feed lines at Vatican Radio's Santa Maria Galeria site.

The SWBC DXs' White Hair club in a summer meet a few years ago.

Wolverine Radio, Mix Radio Intl., Sycko Radio, WDOG, Wolverine Radio, Ballsmacker Radio, Damn Skippy, Outhouse Radio.

ROMANIA—Radio Romania Intl. on 11790 via Galbeni at 0630 with long talk by woman in Arabic, domestic music, dialogue between a man and woman. (Barton, AZ)

SAO TOME—on 11900 at 2027 in French. (Brossell, WI) On 13630 via Pinheria relay with a man giving a long talk in Kinyarwanda at 1600. (Barton, AZ)

SAUDI ARABIA—Al-Azm Radio on 11745 via Jeddah at 2302 with a man singing in Arabic. (D'Angelo, PA)

SINGAPORE—BBC-Far East Relay on 12025 via Kranji with world news at 1505. (Sellers, BC) Heard at 1530. (Barton, AZ) Heard at 1557 on the stock market. (Brossell, WI)

SOUTH KOREA—KBS World Radio on 15575 via Kimjae on negative effects of Russia's invasion of Ukraine. (Brossell, WI)

SRI LANKA—Sri Lanka Broadcasting Corp. on 11905 at 0040 with Southeast Asian vocal, off suddenly at 0059. (Barton, AZ) Heard at 0044 in Bangla to 0058. (D'Angelo, PA)

TAIWAN—Radio Taiwan Intl. on 9405 via Danshui with news at 1601. (Sellers, BC)

THAILAND—Voice of Thailand on 15590 via Udon Thani from 0000-0059 with three-time pips opening, man reading the news, several station IDs, and announcements, good for first 30 minutes, but poor during second half hour. (D'Angelo, PA)

TURKEY—Voice of Turkey on 9830 via Emirlrer at 2124 with Turkish vocals, man with English station ID opening English service with time pips, announcements, news, some UTE QRM. (D'Angelo. PA) On 15450 at 1236 on Europe's stability. (Brossell, WI)

UNITED STATES—Voice of America on 11900 via Vatican at 2148-2159 with an interview in Bambara. (D'Angelo, PA) On 15120 via Greenville in Bambara at 2130. (D'Angelo, PA) On 15195 via the Thailand relay at 1230 in Kurdish. (Brossell, WI)

RFE / Radio Liberty on 15255 via Thailand at 1407 with woman speaking in Turkman and a man with sound bites; on 15310 via Woofferton at 1414 with a man talking at length, interesting long- / short-path echo. (Taylor, WI)

Radio Free Asia on 11520 via the Northern Marianas relay in Mandarin at 1615; on 13580 via Tajikistan in Tibetan at 1234. (Brossell, WI)

Radio Farda on 15690 via Biblis at 1518 in Farsi. (Brossell, WI)

Adventist World Radio on 9445 via Afghanistan with vocal ID and into Tamil, poor, with "windstorm" noise; on 15515 via Tajikistan with preacher speaking in English; on 15670 via Nauen with man and woman saying greetings at 1531 and then into Christian songs (Sellers, BC) On 11985 via the Madagascar Relay at 2047 in Yoruba. (Brossell, WI) On 15490 via Germany at 1645 with domestic music from Africa, woman speaking in Tigrinya, off suddenly at 1700. (Barton, AZ)

Overcomer Ministry on 9400 via Bulgaria at 1504. (Sellers, BC)

VANUATU—Radio Vanuatu on 11835 third harmonic at 0838 with '50s rock, woman speaking in Bislama / English. (Taylor, WI)

VATICAN—Vatican Radio on 7320 via Philippines on just after 1430 with woman giving Latin station ID, followed by man and woman speaking in Hindi with church service; On 1620 via S.M. Galeria at 1615 switching from French to English station IDs. (Sellers, BC)

VIETNAM—VOV on 9840 via Sontay at 1311 with news headlines; harmonic on 12020 both very poor; on 11885 at 1650 with man reading the news in English. (Sellers, BC) On 12020 at 1150 on Russia's Ukraine invasion. (Brossell, WI)

Quien Sabe (Who Knows?)

~ Unidentified station on 13720 kHz at 1345 UTC in possible Russian with a woman interviewing another woman, musical bridge, then a woman interviewing another woman, man talking at 1157, contemporary dance at 1158 UTC, off just before 1300 UTC, carrier dropped at 1340 UTC. HFCC shows Radio Russia via Irkutsk at 1300-1400, nothing on EiBi or Aoki, WINB 1100-1400 but was definitely not in English, says Mark Taylor.

Just Sayin'

Let's do another reminder: Biblis, Nauen, Lamperthiem are all relay sites and are all from Germany.

As Time Goes By

La Pearl del Acre, Cobija, Bolivia, on 4600 kHz at 0140 UTC on August 18, 1989 in Spanish with its domestic service.

Thank You

Thank you goes out to the good guys who submitted reports this month: William Hassig, Mt. Pleasant, IL; Rick Barton, El Mirage, AZ; Mark Taylor, Madison, WI; Rich D'Angelo, Wyomissing PA; and Bob Brossell, Pewaukee, WI.

And until next time — keep on keepin' on and be sure to Celebrate Shortwave!

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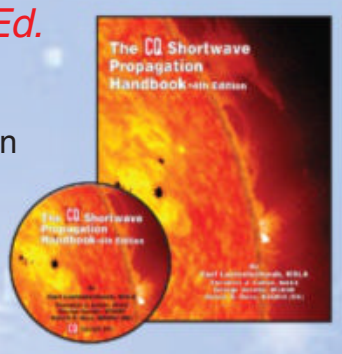

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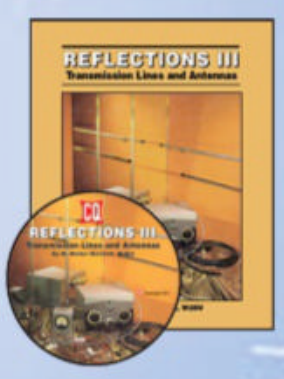

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emergency communications

BY JOHN FERGUSON,* K3PFW

The Five "P"s

In the last two columns we've talked about planning, and we've talked a bit about technology. What we now need to look at is bringing them together to create and develop an effective plan for your auxiliary communication support group. "Winging it" or the popular "knee jerk reaction" is not a substitute for planning. As I've probably said before, the Five Ps; "Prior Planning Prevents Poor Performance," should be the hallmark of your group.

Before we get to the planning part, let me restate something from a previous column. It bears repeating. The first of the five reasons, as described in Part 97, that we have the amateur radio privileges we enjoy is that we are supposedly an "in being" emergency communication service. Let me also add that next year brings another World Radiocommunication Conference, where they decide on who gets what slices of the very limited resource called the radio frequency spectrum. The hams have gained some and lost more over time since regulation first started in the early 1900s. Then we have those pesky HOA issues, where resident hams say they need antennas to provide emergency communication when disasters strike. That's a great idea, but do these same hams participate in public service events, exercises or activities like Field Day, so they might be ready? The phrase, "use it or lose it" is very applicable to the situation of amateur privileges and getting reasonable accommodation with HOA requirements. There are several exemplary communities under HOA management that have reasonable accommodation for amateurs, so it is possible.

When "The Big One" Hits

"The Big One" hits, you and your group are now going to have to prove that you are an asset, and you deserve the privileges the hams have. Who are you going to talk to, on what band, what mode, and what volume of message traffic can you expect? What agency, government, or non-governmental organization (NGO) are you going to be supporting? Will you be using mobiles, HTs, home stations, or portable setups? If you're smart, plan for all of the foregoing, and anything else that gets thrown in the basket! Y'all got a plan?

Where you are in terms of geography will have a lot of impact on what bands you will find most useful. Yes, the 2-meter and 70-centimeter bands are the workhorse bands for public service and disaster communications, but if you're in East Podunk, and the state capital is in West Oshkosh, 200 miles away, that HT just ain't gonna cut it. Chances are your 50-watt FM mobile rig won't, either. Plan for having an HF component in your plan, and do think digital as well as good old analog voice.

What modes you will incorporate is a bigger question today than in the past. Start with the most common voice mode in your area for your VHF/UHF voice communication. What digital modes are being used in your area? Digital is great from moving a lot of message traffic efficiently. The more "tools" you have in your tool box, the better you will be able to fix things when they're broken. New modes are being developed all the time. One of the newer ones, VARA, is quite exciting.

Five Ps; "Prior Planning Prevents Poor Performance," should be the hallmark of your group.

The whole idea of auxiliary communication support is that you are providing additional communication capacity for an agency involved in the response and recovery operations where you are. The agency representatives, who you need to talk with, and plan with, well before the "Big One," will have a lot of input to your planning. This cooperation is usually spelled out in a Memorandum of Understanding (MOU) and describes the relationship and responsibilities of the parties. It's a step in the process that you don't want to bypass.

If you are in the Midwest, the wide open plains are great for repeaters, as are some of the more mountainous areas. But mountains also bring "shadows" which may create some intermittent coverage. For auxiliary communication support, repeaters are great, as long as they are as reliable as they can possibly be. You will have a big hole in your plan if the only repeater that you wrote into your plan fails during the Big One; and repeaters *will* fail, so have a backup in the plan.

Radio spectrum resources, hardware, and equipment are only part of the equation. You need operators, and those operators need training. Getting operators is not hard if you actively recruit members for your group. Getting them to get the training you would like them to have may be a little more difficult. People all have their own personal reasons for volunteering for something, and there is plenty of competition for the volunteers who are available. A group that is active, associated with an agency, and regularly practicing the craft of communication in public service events, will definitely attract members.

So, let's say you are the Central City Amateur Radio Club (CCARC) in Central City, of course. It is the county seat for Liberty County. The state capital for the State of Columbia, where you are, is Capital City in Pine County, about two counties to the west of you. Now before you say, "there ain't no such place," there is. You'll find it and a number of other interesting locations when you take advanced Department of Homeland Security Emergency Management courses. The only downside to living in the State of Columbia is that it is regularly having some kind of disaster somewhere. How else would the students have something to work on?

The CCARC has met with the Emergency Management Director of the Liberty County Emergency Management Agency (LCEMA) and his staff. An agreement has been reached where the CCARC will provide auxiliary communications for the emergency evacuation shelters that may need to be opened in the county from time to time, providing information from the shelters to the LCEMA, and directions and information from the LCEMA to the shelters. The officers of the CCARC will be responsible for developing and presenting a draft MOU to the LCEMA director and staff for their input and approval.

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So, at a scheduled meeting the officers of the CCARC, sit down and consider all the items that should be included in the MOU that you will present for consideration to the LCEMA.

- Each agency in the agreement must be described.
- The purpose of the MOU should be stated, clearly but simply.
- The roles of the agencies involved need to be explained in general terms.
- Identify by title and function (names may change) Points of Contact (POC) and management positions of authority.
- Provide a clear path for resolving questions that may arise.
- Indicate an anniversary date for review and renewal.
- Authorized parties from both agencies must sign the MOU, including their title or position.

An MOU is just what it says, an agreement of understanding that the parties agree to work together for a common purpose.

Along with the MOU should be a draft of the Communication Plan that your group intends to follow when called into action. The more complete and detailed the better, although you won't get there on the first try.

Where is your base of operations going to be? Hopefully the LCEMA Emergency Operations Center (EOC). If not, let's say it's the CCARC clubhouse, how are you going to relay between the EOC and there? Can you place an operator(s) at the EOC? Don't count on the internet or telephones, and definitely not cell phones.

For your VHF/UHF operation are you going simplex, or local repeaters? Simplex is great if you have the range and coverage necessary. Repeaters are a definite plus, as long as you can reasonably count on them functioning under disaster conditions. Will the licensee of the repeater allow you to use it? Does repeater site have emergency back-up power, preferably a generator? Is there enough fuel for a sustained operation over a period of days? Is it a solid, well installed system? High winds and ice can wreak havoc on towers and antennas, and if you don't have icing, you probably can experience a hurricane. They, too, like to push towers over. Do you have a secondary repeater that can provide coverage? Linked repeaters can cover a wide area, statewide even, but are the links dependable? Again, internet-dependent modes are not a good choice for emergency and disaster systems. Despite protestations to the contrary, the internet and cell phones *will* fail in a disaster.

How are you going to provide equipment for the shelters? Will each operator bring their own "go kit" or can the club treasury buy what's needed? Having standard "go kits" ready to go is great if you can arrange that. You may not be able to do it initially, but down the road, maybe a grant will help. Usually, evacuation shelters are pre-identified by emergency management. Definitely do consider pre-installing antennas at designated shelter locations, it will be a big plus. Better coverage with lower power is a blessing if you happen to be working off of batteries. Getting antennas installed at a shelter location requires a great deal of planning and coordination with the administration at that location. Liability for the install is also a consideration.

Training, Training, Training

Operators need training. The comments I hear, "I've been a ham for the last 23 years, I don't need no training," and "What good is it to train for something we probably won't see?" are

some examples of excuses that really don't hold up. Training is necessary for operators to work comfortably in the Incident Command System (ICS) environment. It's not difficult to learn, and makes a lot of sense when you are in the middle of a mess and have a standard way of dealing with the management of it, that the others you may be working with, for the first time, understand. Free courses are available online through FEMA that cover the ICS and other response and recovery topics. Like it or not, even though you may say you are "just radio operators," you are part of the complex response and recovery operation in a disaster. The more you understand about what's going on around you, the better off you will be. The National Weather Service offers free Skywarn training. All your operators should have it. Severe weather is everywhere and getting more so.

While we're on the subject of training, and what training your operators need, the American Radio Relay League (ARRL) supports the Amateur Radio Emergency Service® (ARES®). Here is a great program through which your members can get nationally recognized, documented, training. You might really want to consider urging your members become members of the ARRL and ARES, and your club to become affiliated with the ARRL. It is the national advocate for amateur radio.

Training in message traffic handling is essential. That's what we're all about. Relaying messages from sender to receiver. Whether it's the standard radiogram or the memo style ICS 213, being comfortable with its application and fluent in its transmission is critical when lives might be at stake. Disasters bring health-and-welfare traffic. This is probably one of the greatest ways we can serve the hobby by promptly forwarding these messages, letting people know that ham radio is still alive and well, and performing a public service, at the same time letting them know that their family members or friends are safe. Do include the provision for generating and forwarding this type of message in your plan.

How are you going to handle the regular traffic of the disaster? Each local situation and, for that matter, each disaster is unique. What worked last time may not be the best this time. Flexibility and redundant channels are necessary. If one fails, use another, and fail they will. Plan for it and it is not a problem. May I, as a dinosaur from the analog age, suggest that you seriously consider digital / data modes where they might be appropriate? Yes, you will need analog voice and HTs for tactical type communications. Public service events are typical applications, and again a good and fun way to get training. Back to the idea it might be your club station that is the hub for your communication effort, then seriously consider a digital-type link to the EOC. Accurate voice traffic in the middle of organized chaos is slow, and questionable in accuracy when compared to digital for the same application.

In closing, something to keep in mind as you put your plan together: There is a "thing" called the Communication Theory. There are at least five different explanations of "what is communication." However, in its simplest form, it is getting a thought from the mind of the sender to the mind of the receiver. Simple, yes, in practical applications not quite so. The thought in the mind of the sender, for all practical purposes has to be spoken or typed. Then that data will be encoded and sent through a transmitter, through feedline and antenna, radiated through the ether to induce a voltage in the receiving antenna down the coax to a receiver, decoded, and presented to the receiving mind in some form. Lots of opportunity here for errors and interference, which will result in ineffective communication. Along the way there is plenty of chance for all sorts of interference, noise, QRM, etc., to garble the information. Try for methods and locations that will minimize the interference. Think about it.

kit building

BY JOE EISENBERG,* K0NEB

Looking Into the Crystal Ball

The Discovery Crystal Radio

My project doing beta building of the big T41 SDT kit is still under way, but I am waiting on some parts. So, I thought this would be a good time to look at a new take on an old favorite. I think most hams my age started their kit building years ago with a simple crystal set. Crystal sets date back over 100 years to the earliest days of radio.

The principle that defines a crystal radio is its ability to receive AM signals using only the RF energy present in the air, without amplification or the need for a power supply. When we measure signal strength present at the antenna input to a receiver, it is often measured in millivolts or microvolts. After all, the energy from the AM transmitter is dispersed over a wide area to reach as many listeners as possible. In the days before receiver amplification was possible, it was required that the transmitting station put out as much power as possible and the receiving station have as big an antenna as possible in order to maximize the chances of receiving the signal, using only the power of the signal itself. In the case of spark transmissions, they were heard as a raspy buzzing sound. The earliest AM transmissions were audible, but not always as loud as the spark signals unless you were either close to the AM transmitter or using a large receiving antenna to capture as much signal as possible.

The detectors used many years ago were often things like a galena crystal being contacted by a tiny wire, often called a "cat's whisker" due to its appearance. This arrangement looks somewhat like the insides of a modern diode. Like a diode, these detectors were able to detect the modulation present in a radio wave and yet were rather poor rectifiers of AC.

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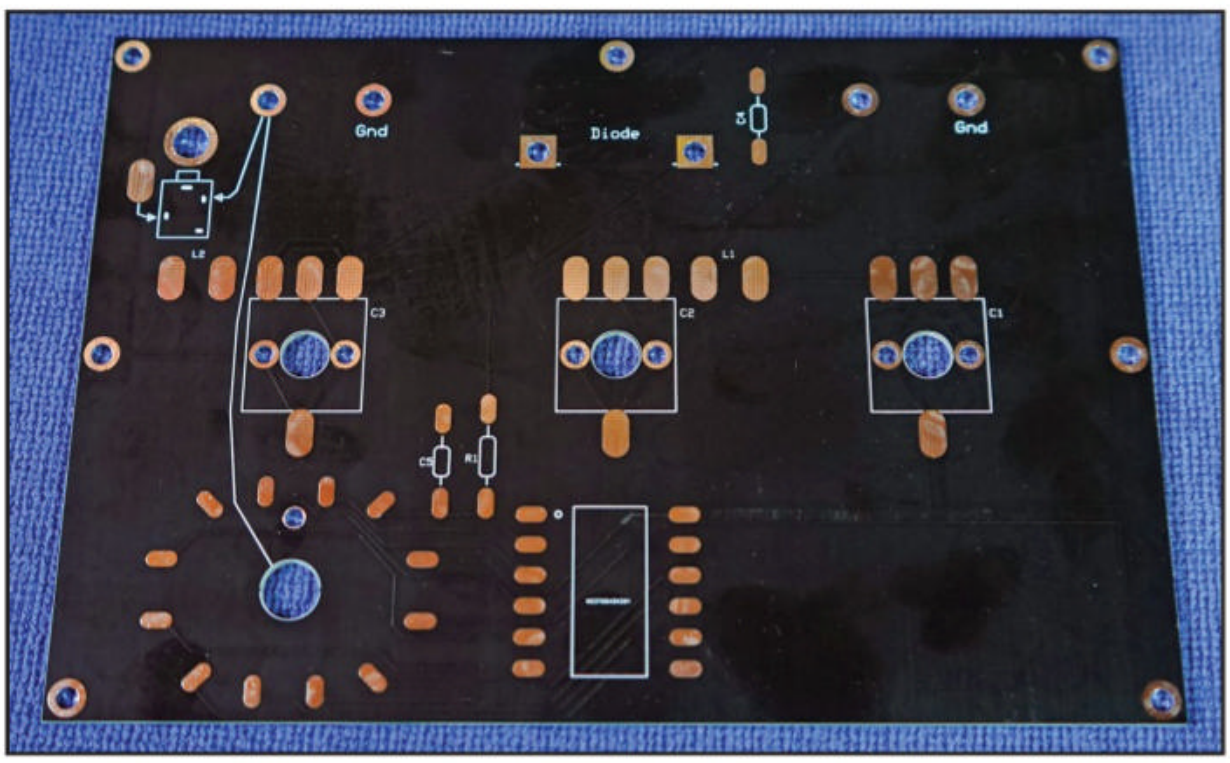
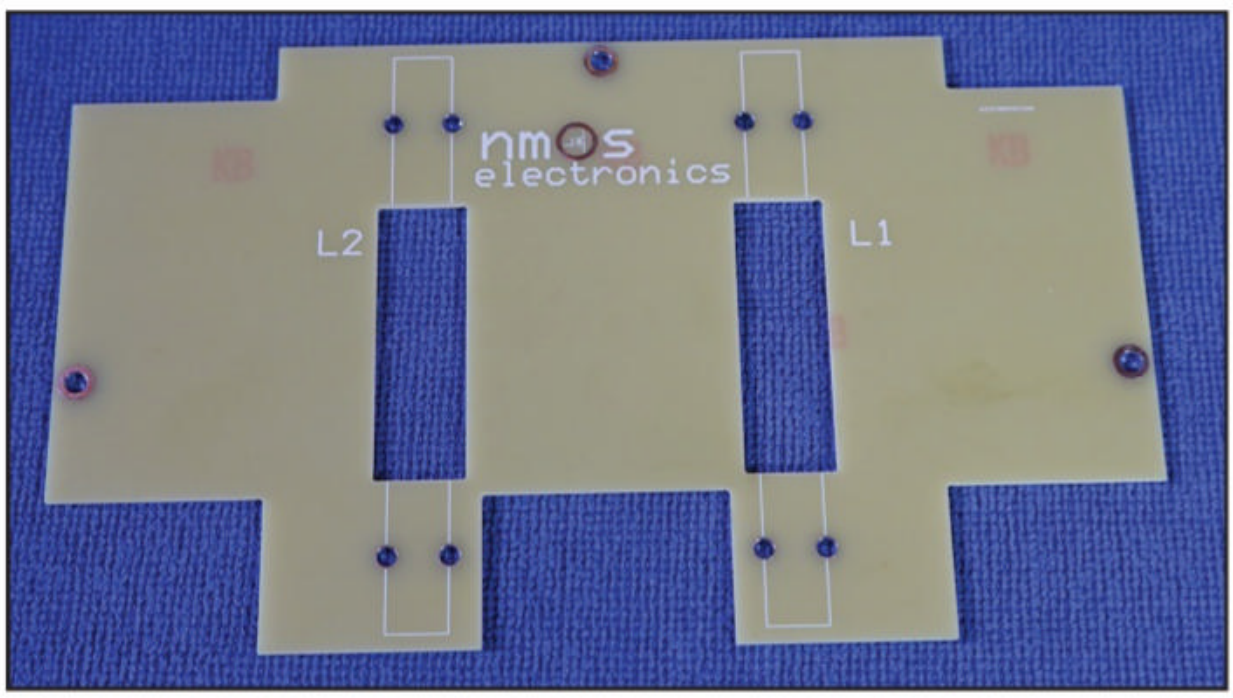
Hamfest Hotline #5855

The parts for the Discovery crystal set kit all sorted and ready for assembly.

The front panel side of the main PC board before assembly.



The back side of the main board showing parts placement pads for "Pittsburg" style component mounting.



The lower PC board which holds the ferrite loop stick inductors.

Another early detector was called a coherer, and was made up of a glass tube with metal filings between two contacts. Once vacuum tube technology took over, it was simpler to use a tube to act as a much more efficient detector.

The magic of the crystal set is its ability to operate with no power source at all. Over the years, many different techniques have been used to make a crystal set more sensitive and selective and able to make more audio available from the detected RF energy at the earpiece or headset. Heathkit came out with its take on the classic crystal set when it sold the CR-1 crystal set kit in the 1950s and '60s. This set utilized several techniques to improve the sensitivity and selectivity of a crystal set and made for a better listening experience. Because in many areas AM stations are not spaced far apart on the band, improvements in selectivity were needed to separate the signals from the jumble of RF energy present.

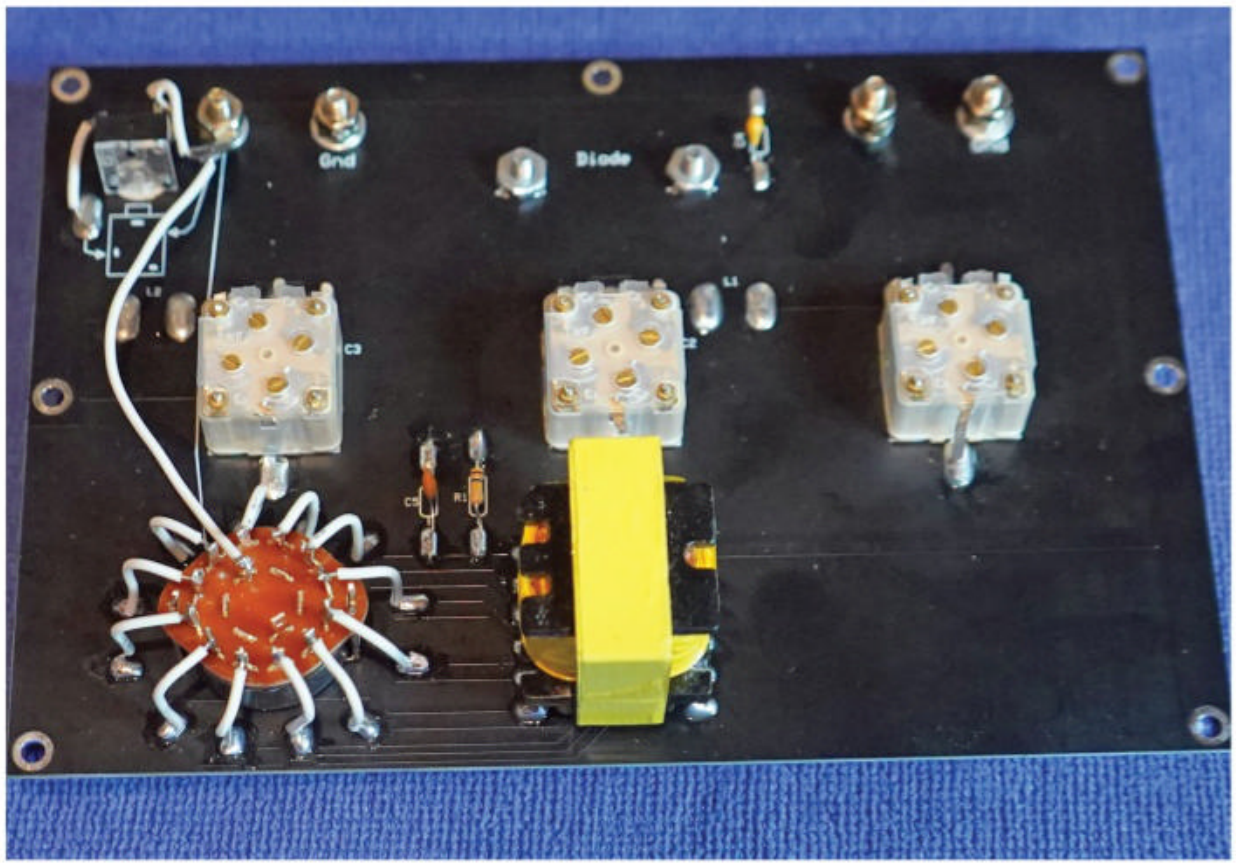
Fast-Forward to 2023

Bringing the crystal set into the 21st century, David Cripe, NMØS, has updated his Discovery crystal radio kit, using some of the same ideas from the original Heathkit CR-1 while adding in a feature not often found on crystal sets. Most crystal sets rely on the use of high-impedance headphones or earpieces. This is because they do not need as much voltage to produce audio. Nowadays, the majority of earpieces like earbuds and modern headphones have a much lower impedance and normally cannot be used with a crystal set. The Discovery has a large audio impedance transformer with multiple taps that allows for optimizing the output impedance to best match the type of headset in use, including more modern low impedance ones. However, the kit is still supplied with a high-impedance earpiece.

Construction

The construction of the Discovery begins with preparing the case, which is not supplied with the kit, but is available from Hobby Lobby. This is a wooden case with a latch and carrying handle, making for a very nice appearance. There are four wooden blocks that are supplied with the kit to be glued into the four corners of the case to make up the internal supports to the two PC boards that comprise the receiver.

The main board holds the transformer and all the other components and connectors except for the two ferrite loop



The main board assembled and ready to be joined with the lower board.

The finished Discovery crystal set in the Hobby Lobby wooden case.

sticks that are mounted on a lower board to space them away from the main board. Instead of simple magnet wire on the loop sticks, this kit utilizes Litz wire, which is really a bundle of very thin magnet wires in a bundle. This is used to maximize the "skin" area of the wire, making for a much higher amount of RF energy being passed on to the detector and audio output. If you look in most small AM radios, you will see this special type of wire wrapped around the ferrite bar. Litz wire makes this type of inductor a lot more efficient at lower frequencies.

An improvement over the previous version of this kit is the placement of the detector diode on the front panel, allowing the builder to experiment with different types of detectors, including coherers, cat's whiskers, different types of diodes, and even using blued razor blades and pencil lead to form a detector as was done in World War II foxhole receivers.

The components on the main board are attached using the "Pittsburg" design of soldering to pads just like kits such as the Four States QRP Group Murania as well as the Ozark Patrol. This method makes it very easy to remove or replace parts if needed without desoldering tools. Just heating the pads with your soldering iron and lifting the wire is all that is needed.

Listening In…

I used my 160-meter antenna to test it out and was pleasantly surprised to be able to not only hear my three local AM radio stations on 1240, 1400, and 1480 kHz, but I could tune the receiver to eliminate the other signals, allowing me to hear just one station at a time. With three local signals this close together on the band, it is a great accomplishment to be able to separate them out, especially the two at 1400 and 1480 kHz. I was also able to hear KFAB 1110 from Omaha at a distance of 50 miles with its 50-kilowatt powerhouse.

The Discovery crystal set kit is available from NMØS Electronics online at <https://tinyurl.com/rz49689z>[1]. I'll try some different detectors and antennas and headsets and report my findings soon. Be sure to say hi when you see me at upcoming hamfests such as the St. Louis Winterfest as well and the Orlando Hamcation!

– Until next time, 73 and Happy New Year de KØNEB

Note:

1. At press time, the kit was selling for $65 plus shipping. However, the previous version was featured on the NMØS website.

learning curve

BY RON OCHU, KOØZ

Sunspots and DX

This month let's continue our foray into space weather and its impact on HF propagation. Over the past two months, we've scratched the surface of HF (high frequency) DX (long distance) propagation by examining great circle pathways, auroral circles, radiation, geomagnetic storms, sudden ionospheric disturbances (SIDs), coronal mass ejections (CMEs), and radio blackouts. These events result from "space weather." Our Sun is the origin of "space weather." Space weather impacts our Earth's magnetic field and our ionosphere. Earth's ionosphere and its magnetic field are closely related. Impacting one will influence the other, which in turn impacts — yep, you guessed it — our HF propagation.

Solar Indices

This month we'll focus our attention on SSN (smoothed sunspot numbers), SFI (solar flux index), and A and K solar indices to finish our three-part delve into space weather. I've found taking a quick peek at SSN, "A," and "K" indices gives me a fast, "shorthand," nearly0-real-time glimpse into solar and HF propagation conditions I can expect for the day. However, for me to get to the point of understanding the potential HF implications of these solar indices, I first needed to become acquainted with their overreaching impacts.

Over the past two months, this column's space weather topics can be thought of as a "reverse engineering" tutorial to HF propagation. We've examined some major space weather impacts upon propagation such as CMEs, geomagnetic storms, and blackouts upon our ionosphere.

With this understanding, we are now better prepared to appreciate and interpret solar indices. For example, if I see a solar A index of 300 and a K index of 8, I'm not going to expect much in the way of HF DXing. Why? These numbers tell me there is a major geomagnetic storm underway. Instead of DX signals filling my receiver to greet my ears, static, (QRN) and deep fading (QSB) will be the norm temporarily. My "radio" time may be better spent on building a radio project.

On the other hand, I could also look at the auroral oval forecast models and listen to 6 and 2 meters for a possibly great auroral propagation opening. When the aurora is especially energized, it is possible to bounce 6- and 2-meter signals off the aurora's energized particles. Nothing beats an unexpected auroral VHF (very high frequency) opening to get the adrenaline pumping.

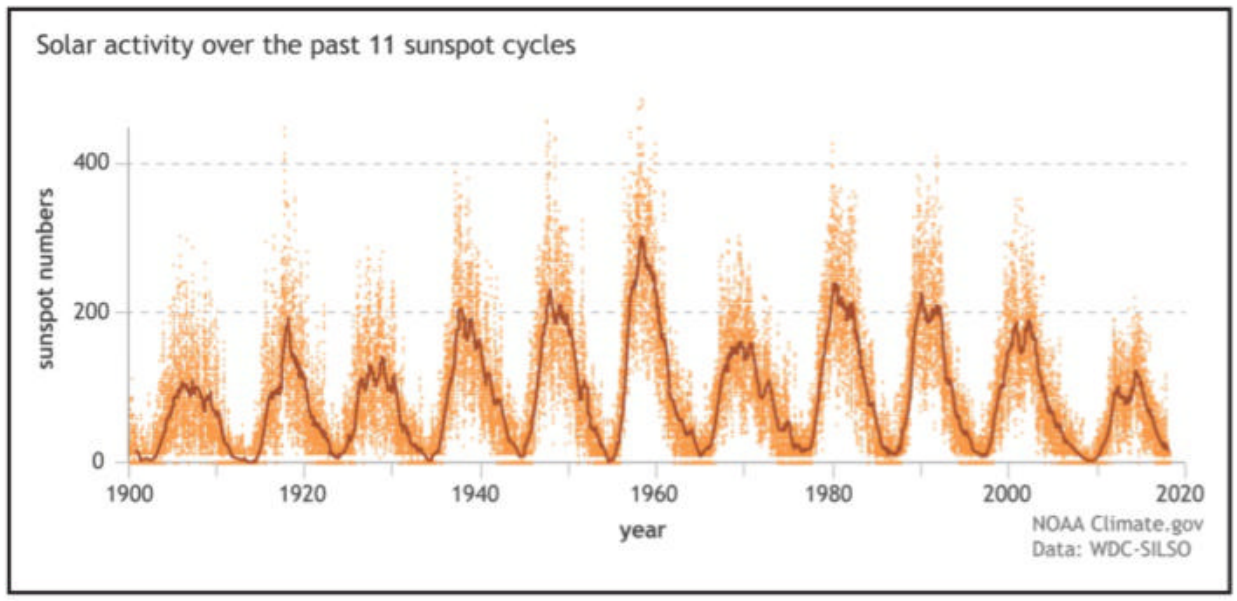


Photo A. This chart graphs the 11-year sunspot cycles from the years 1900 to 2020. Note the 1920 and 1960 cycles had one major peak, while more recent solar cycles around 2000 and 2020 have bimodal peaks (two peaks). Bimodal peaks result from the Sun's northern and southern hemispheres peaking at different times. We are in Solar Cycle 25. Will it be a single or a bimodal peak? Time will tell. (Photo by KOØZ)

SSN

First on our solar indices "hit parade" is SSN. According to spaceweather.com <https://tinyurl.com/3jdrabem>, "Scientists track solar cycles by counting sunspots (*Photo A*) — cool planet-sized areas on the Sun where intense magnetic loops poke through the star's visible surface." That's right, you read it correctly, planet-sized sunspots. The size of our Sun is mind-bending. It's hard to wrap our minds around astronomical sizes, speeds, and distances isn't it (*Photo B*)? Some sunspots are so large, several Earths could fit in a single spot.

Spaceweather.com continues, "counting sunspots is not as straightforward as it sounds. Suppose you looked at the Sun through a pair of (properly filtered) low-power binoculars — you might be able to see two or three large spots. An observer peering through a high-powered telescope might see 10 or 20. A powerful space-based observatory could see even more — say, 50 to 100. Which is the correct sunspot number?"

The answer to that question is that the NOAA (National Oceanic and Atmospheric Administration) Space Environment Center uses a formula that considers these variables to come up with the daily Boulder index. So, how does that statistic help radio amateurs? In general, the higher the sunspot number, the more energetic is the sun and its influence on space weather. By the way, the highest recorded sunspot number is 285 in March 1958 during solar cycle 19 (*Photo A*). One of the all-time best solar cycles for HF propagation and DXing, I've been told. Cycle 25 (our current solar cycle) hasn't reached that milestone yet, but hope does spring eternal.

SFI

Solar flux index (SFI) or solar radio flux is a good indicator of ole Sol's impact on our ionosphere. According to NOAA:

The solar radio flux at 10.7 cm (2800 MHz) is an excellent indicator of solar

**Email: <ko0z@cq-amateur-radio.com>*

activity. Often called the F10.7 index, it is one of the longest running records of solar activity. The F10.7 radio emissions originates high in the chromosphere and low in the corona of the solar atmosphere. The F10.7 correlates well with the sunspot number as well as a number of Ultraviolet (UV) and visible solar irradiance records. The F10.7 has been measured consistently in Canada since 1947, first at Ottawa, Ontario; and then at the Penticton Radio Observatory in British Columbia. Unlike many solar indices, the F10.7 radio flux can easily be measured reliably on a day-to-day basis from the Earth's surface, in all types of weather. Reported in "solar flux units", (s.f.u.), the F10.7 can vary from below 50 s.f.u., to above 300 s.f.u., over the course of a solar cycle.

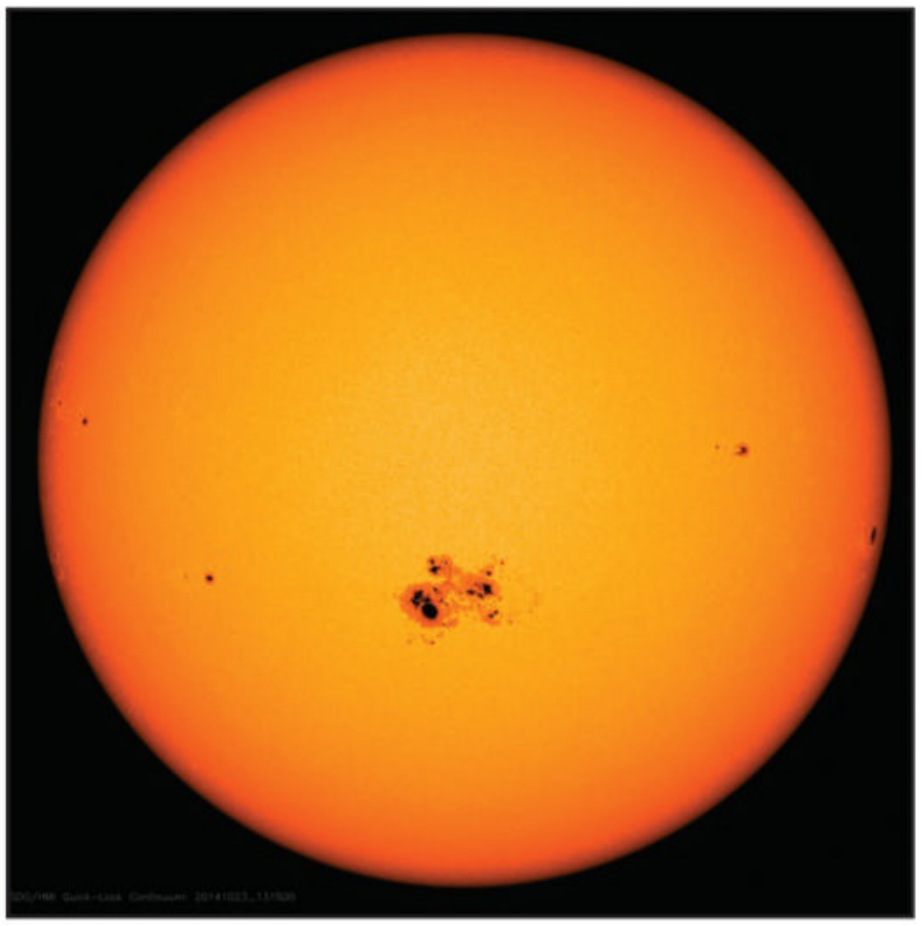


Photo B. Sunspots are cooler regions on our Sun's surface. They are a good indicator of solar activity which will ultimately affect HF propagation. (Courtesy of NOAA)

There is a correlation between sunspots and solar flux. As sunspots increase in number so does the solar flux index. When there is a *sustained* increase in the SFI, then Earth's ionosphere becomes more charged with ions, resulting in a denser layer of ions. Dense layers of ions better propagate higher HF bands (20 through 6 meters). By sustained, it is meant solar flux values extended over a week or longer. A single day of higher values will not create *long-term* DX propagation. Trinity County Amateur Radio Club in California has a nice website <https://tinyurl.com/459u9jhx> dedicated to understanding HF propagation. The club uses these sunspot numbers as a general guide to predict upper band HF propagation (10-20 meters).

SN
- <50 = Propagation conditions potentially very bad
- 50-75 = Propagation conditions attenuated
- 75-100 = Propagation conditions might be good
- 100-150 = Propagation conditions should be idea
- >150 = Propagation conditions possibly exceptional

In addition, the club also offers a solar flux chart to predict upper band HF propagation as well.

SFI
- <70 = Propagation poor
- 80-90 = Propagation somewhat low

Photo C. Screenshot of one of my favorite space weather websites <dxqsl.net/propagation> which provides an important aid with my personal HF propagation predictions for the day. (Photo by KOØZ)

• 90-100 = Propagation average
• 100-150 = Propagation good
• >150 = Propagation ideal

Note the HF high-band propagation correlation between SN and SFI. From personal DXing experience, I heartily agree with their published numbers and propagation correlations. Let these numbers serve as a guide. Of course, there is no substitute for actually turning on the radio and listening to HF band conditions yourself. However, if the bands appear to be lifeless, then checking out the actual SN and SFI values can offer insight as to the why the bands appear to be dead. SN and SFI are not the only indices indicating HF propagation.

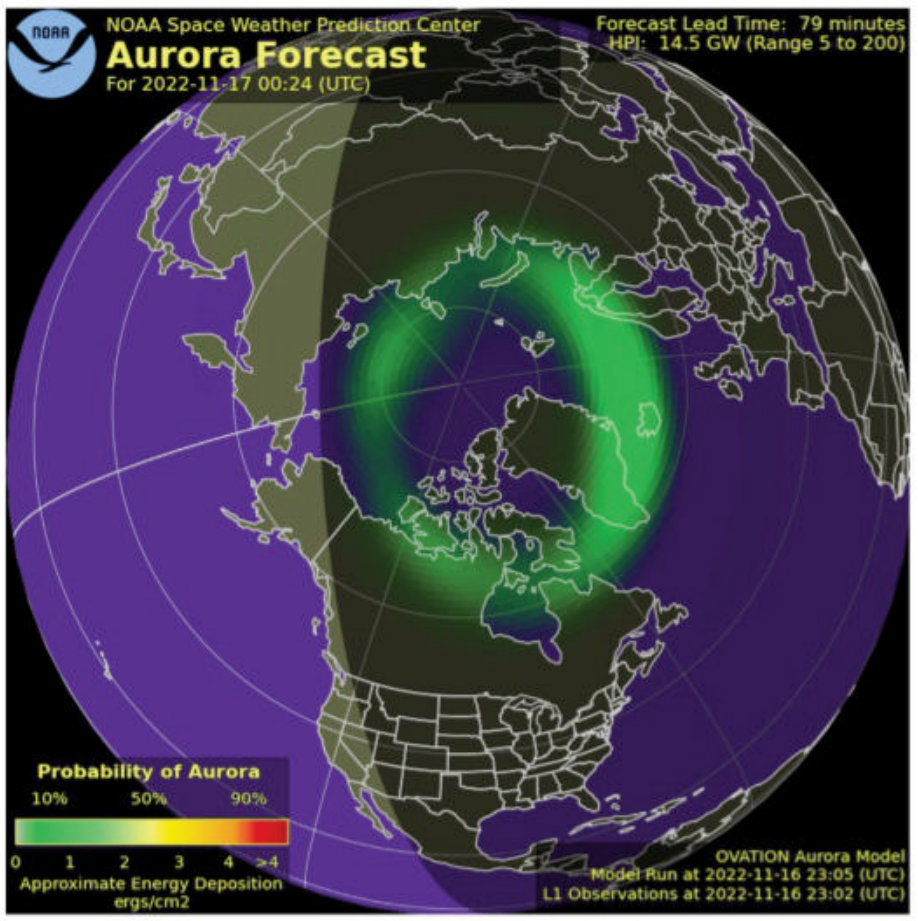


Photo D. The North American auroral oval isn't too active on November 15, 2022. This means HF signals from Europe to North America are far less likely to be absorbed in the ionosphere. Likewise for signals going from North America to Asia and vice versa. (Courtesy of NOAA)

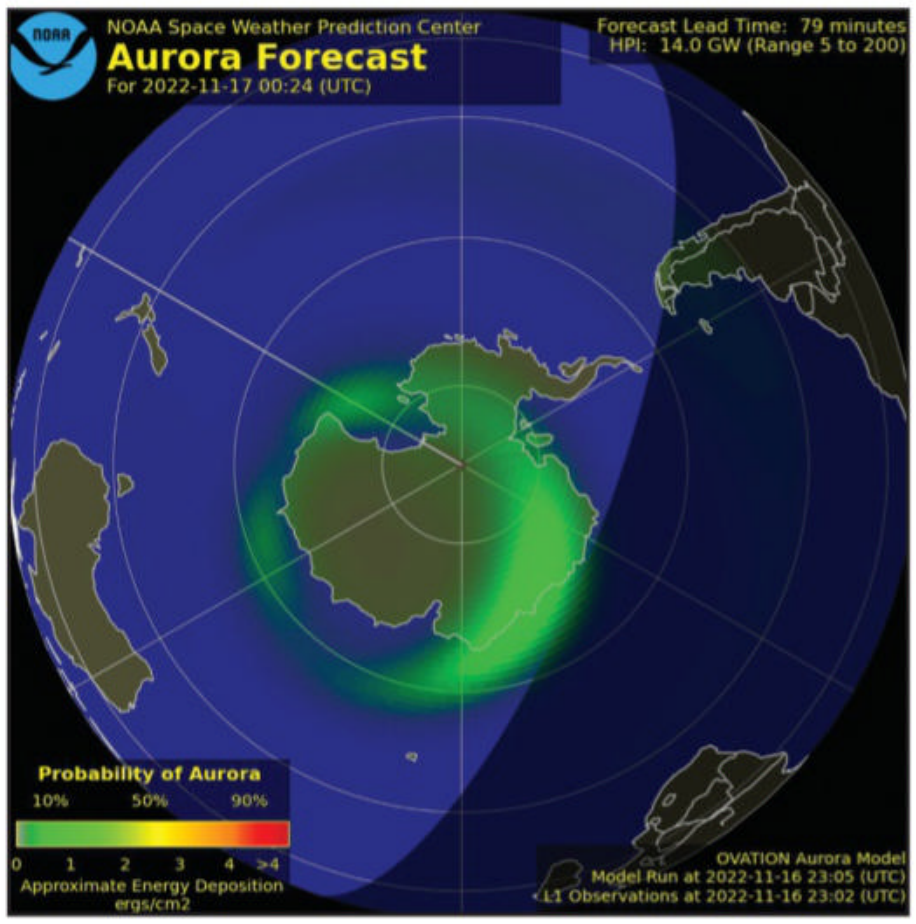


Photo E. Southern auroral oval isn't very active on November 16th. Any HF signal paths crossing over the South Pole are less likely to be absorbed and attenuated. (NOAA image)

A Index

Along with SFI, the A index is a typically seen HF propagation value. SpaceWeatherLive.com offers this A index definition:

The A_p-index provides a daily average level for geomagnetic activity. Because of the non-linear relationship of the K-scale to magnetometer fluctuations, it is not meaningful to take the average of a set of K-indices. Instead, every 3-hour K-value will be converted back into a linear scale called the A-index. The average from 8 daily A-values gives us the A_p-index of a certain day. The A_p-index is thus a geomagnetic activity index where days with high levels of geomagnetic activity have a higher daily A_p-value.

The subscript "P" indicates planetary. In other words, the A index is averaged over a 24-hour period. From a ham radio perspective, the A index tells us how active our Earth's magnetic field *has been over the last day* and it can give us insight into what upcoming propagation may be awaiting us on the HF bands. In the definition, please note, the term K-index is used. This brings us to our next topic.

K Index

The K index also measures our Earth's magnetic field. SpaceWeatherLive.com defines the K index:

The K_p-index is the global geomagnetic activity index that is based on 3-hour measurements from ground-based magnetometers around the world. Each station is calibrated according to its latitude and reports a certain K-index depending on the geomagnetic activity measured at the location of the magnetometer. The K-index itself is a 3-hour-long quasi-logarithmic local index of the geomagnetic activity at the given location and time compared to a calm day curve. A magnetometer measures the maximum deviation of the horizontal component of the magnetic field at its location and reports this. The global K_p-index is then determined with an algorithm that puts the reported K-values of every station together. The K_p-index ranges from 0 to 9 where a value of 0 means that there is very little geomagnetic activity and a value of 9 means extreme geomagnetic storming.

The takeaway here is the K index is a more *immediate reflection* of Earth's geomagnetic status. If the A index is high and the K index is falling, then the geomagnetic storm is beginning to subside. If both the K and the A index are high, one might be better looking for VHF propagation as opposed to HF in the hopes of auroral activity.

One Stop HF Prop Shop

As I've written before, one of my favorite websites for HF propagation is DX.QSL.net, <https://dx.qsl.net/propagation> (*Photo C*). There is a plethora of valuable space weather information all in one website. For example, on November 16, 2022, the SFI = 133, the A index is 3, and the K index is 1. For the moment, Earth's geomagnetic field is quiet and propagation on the upper HF bands should be good. As it

Photo F. Screenshot of my go-to website for a more detailed accounting of space weather events <spaceweather.com>. (Photo by KOØZ)

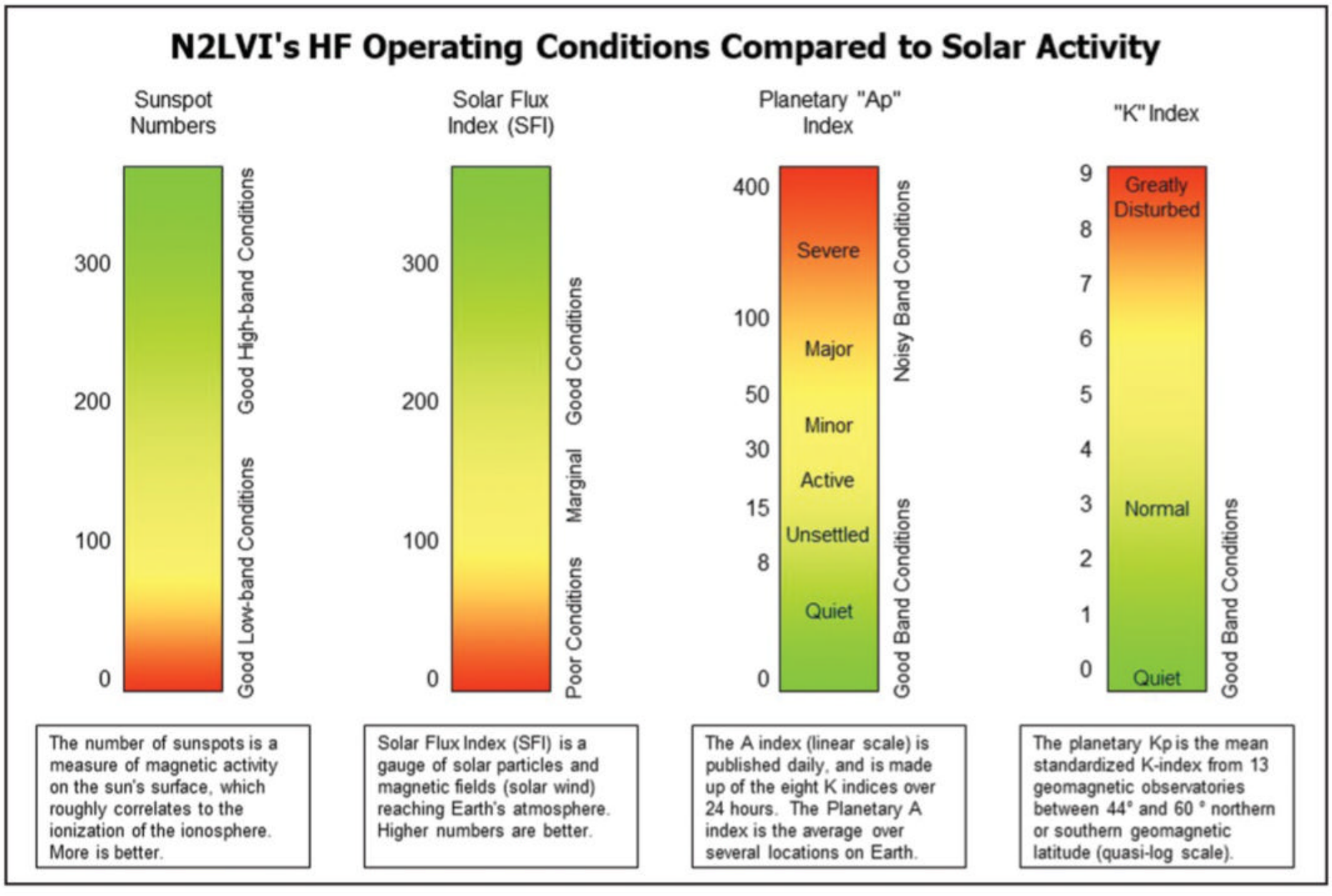


Figure 1. Peter Greene, N2LVI, created a solar chart that is easy to understand and very helpful in understanding space weather's ionospheric impacts. (Image courtesy of Peter Greene, N2LVI)

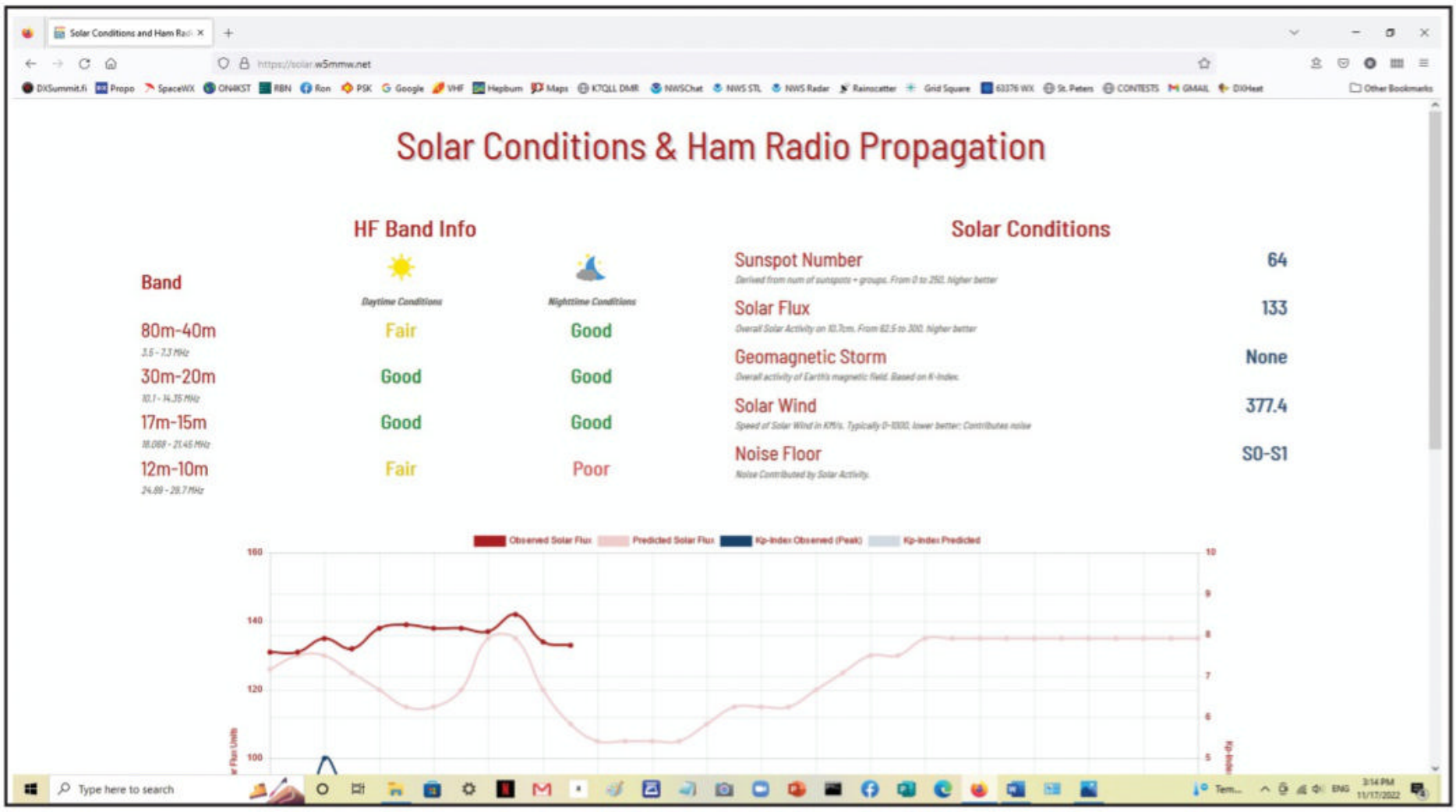


Photo G. This screenshot of Matthew Manjos, W5MMW's, website is another good source for daily solar activity and HF propagation predictions. (Photo by KOØZ)

The subscript "p" means planetary and designates a global magnetic activity index. The following 13 observatories, which lie between 46 and 63 degrees north and south geomagnetic latitude, now contribute to the planetary indices: Lerwick (UK), Eskdalemuir (UK), Hartland (UK), Ottawa (Canada), Fredericksburg (USA), Meannook (Canada), Sitka (USA), Eyrewell (New Zealand), Canberra (Australia), Lovo (Sweden), Brorfelde (Denmark), Wingst (Germany), and Niemegk (Germany).

THREE-HOUR-RANGE INDEX K

K indices isolate solar particle effects on the earth's magnetic field; over a 3-hour period, they classify into disturbance levels the range of variation of the more unsettled horizontal field component. Each activity level relates almost logarithmically to its corresponding disturbance amplitude. Three-hour indices discriminate conservatively between true magnetic field perturbations and the quiet-day variations produced by ionospheric currents. K indices range in 28 steps from 0 (quiet) to 9 (greatly disturbed) with fractional parts expressed in thirds of a unit. A K-value equal to 27, for example, means 2 and 2/3 or 3-; a K-value equal to 30 means 3 and 0/3 or 3 exactly; and a K-value equal to 33 means 3 and 1/3 or 3+. The arithmetic mean of the K values scaled at the 13 observatories listed above gives Kp.

EQUIVALENT AMPLITUDE

The a-index ranges from 0 to 400 and represents a K-value converted to a linear scale in gammas (nanoTeslas, nT) – a scale that measures equivalent disturbance amplitude of a station at which K=9 has a lower limit of 400 gammas.

K	0	1	2	3	4	5	6	7	8	9
a	0	3	7	15	27	48	80	140	240	400

http://www.dxlc.com/solar/	Solar Terrestrial Activity Report
http://www.eham.net/DX/propagation	Links to many useful websites, with relevance ratings
http://www.ngdc.noaa.gov/stp/GLOSSARY/glossary.html	Glossary
http://www.sec.noaa.gov/ftpdir/indices/DGD.txt	Recent K and A values
http://www.arrl.org/tis/info/k9la-prop.html	ARRL tutorial on solar effects on propagation

Table 1. Peter Greene, N2LVI, includes an excellent description to accompany his solar chart. (Image courtesy of Peter Greene, N2LVI)

turns out, HF propagation was good from Missouri on that day. In the same area as the indices box, there is a forecast section. On November 16, 2022, the forecast calls for no space weather storms. Scrolling down the page a little bit, I note the solar wind's velocity is 310.2 kilometers per second (km/s) and the proton density is 2.2. Another reassuring set of data points to indicate I can expect "quiet" DX propagation conditions. Scrolling down a bit farther, looking at the Ovation Aurora models on the website, *Photos D* and *E* for November 16th, the auroral ovals don't look too energized. Good news for HF propagation paths over the poles. However, the probability of VHF auroral propagation is not looking very well.

Another website I like to visit for more detailed space weather information is Spaceweather.com <www.spaceweather.com> (*Photo F*). This website is useful because it offers timely information on solar flares, CMEs, high-velocity solar winds capable of geomagnetic storms, and auroras and upcoming meteor showers. Ah yes, meteor showers. We will save that topic for a future column. There is another very useful website for interpreting daily, solar, activity and HF propagation maintained by Matthew Manjos, W5MMW, <https://solar.w5mmw.net> (*Photo G*). And of course, our own Propagation Editor, NW7US, maintains an excellent solar weather website at <http://SunSpotWatch.com>.

N2LVI

In the meantime, I'd like to express my sincere thanks to Peter Greene, N2LVI, for giving us permission to reprint his excellent solar index chart and table. It does an excellent job of tying together solar indices in a very presentable visualization that is easy to interpret and to understand (*Figure 1* and *Table 1*). I highly suggest making a copy of it and prominently displaying it in your shack (radio room).

If I've done my job correctly...you now have a deeper understanding and an appreciation of space weather's influence on HF propagation.

I've Done My Job!

If I've done my job correctly over the past few installments, you now have a deeper understanding and an appreciation of space weather's influence on HF propagation. Dead bands just don't become "dead." Now there's an explanation as to why the band appears to be "dead."

However, I must caution you not to be fooled into a false sense of complacency. If the seemingly dead band remains dead for an extended period of time, and the websites I've provided indicate good propagation; may I suggest you look for another cause for the "dead band" such as a waterlogged coax connector, a broken antenna, a short resulting in high SWR (standing wave ratio) or some other culprit that requires leaving the warm comfort of the shack and venturing out into winter's chill. I speak from personal experience, hi, hi.

Happy New Year!

Chances are your shack and antennas will be fine and any apparent "HF dead bands" will only be temporary and space weather related. Shortly, your logbook will be again quickly filling up with numerous DX QSOs (contacts). May I wish you and your family a very joyous 2023! Thank you for reading *CQ*.

– 73, KOØZ

the ham notebook

TEXT AND PHOTOS BY WAYNE YOSHIDA*, KH6WZ

A is for Arc, G is for Ground

AFCI and GFCI Protection Devices on the AC Mains

KH6WZ was unable to do a column this month, but recommended that we reprise his January 2015 column on an important topic that bears repeating at least once every 8 years! – W2VU

[Author's note: I am not a licensed electrician. All information presented here is based on studying various resources, including websites, visits to hardware stores, and conversations with electricians. Be careful when examining, testing or replacing AC mains circuitry and components to prevent electrical shock. Before attempting any work, make sure you understand any codes and laws pertaining to your building. If you do not understand what you are doing, hire a licensed professional to perform the work for you.]

There is considerable concern, confusion and frustration about Arc Fault Circuit Interrupters (AFCIs) used in the AC mains of new buildings and renovation projects. Adding to the confusion are Internet chat rooms that are sprinkled with inaccurate information (as well as correct information, but sometimes it's hard to know which is which). At least one discussion thread on AFCIs included information about how *Ground Fault Circuit Interrupters* (GFCIs) work, which are completely different.

Rather than going into the reasons why you should not install these items, let's focus on how to live with them in harmony, especially since they are intended to improve electrical fire prevention and are mandatory in many instances.

All hams should know what arcs are. Some arcs are considered normal, like the sparking that happens inside an electric motor. Lightning might be called an arc, and is never a good thing in relation to electronics. In radio applications, arcs are just as bad and can happen when a transmitter is not happy with its load, or antenna. Remember what happened when someone forgot to change the antenna when operating the 40-meter station on Field Day? Something in the antenna tuner box arced over because the 20-meter antenna was connected to it. Fortunately, the transceiver had built-in protection circuitry, so the rig was not damaged.

The AFCI vs. GFCI

First, let's clarify what the AFCI is and what it does, and how it differs from the GFCI.

The Arc Fault Circuit Interrupter — AFCI — is an AC mains safety component used in certain places in new North American homes and commercial buildings (see Photo A). An arc fault happens when current flows through an unintended path. The arc can create enough heat to start a fire. These arcs may be difficult to find, since they are frequently intermittent.

The Ground Fault Circuit Interrupter — GFCI — is something completely different. The function of the GFCI is to protect people from electrocution if an electrical device becomes energized due to a ground fault. Remember the 1964 James Bond movie, "Goldfinger," where Bond throws a portable heater into the bathtub with a bad guy in it? He closes the scene with the statement, "Shocking."

A GFCI would have shut off the electricity at the outlet when the heater went into the water. The water causes a ground fault: The entire appliance, including the housing and metal heat reflector, becomes energized, and a GFCI would trip, cutting the power to the heater.

A Personal Encounter

When my house was being renovated, one of the finish carpenters said I had an electrical problem in the living room. When he tried to use his chop saw, the breaker would trip, so he had to run a long extension cord from another room to power the saw. The carpenters knew nothing about electrical systems, so they were not able to fix the problem.

When they finished the living room work, I tried to locate the problem. It seemed that no matter what I did, I could not make the breaker trip and the outlet seemed fine. However, I did notice the lamps plugged into different outlets along the same line sometimes flickered, even though the bulbs were firmly in their sockets. I checked the voltage at each outlet, and it was fine, 120 VAC. I probably should have checked the circuit with an oscilloscope to see what was going on, but I did not.

I hired an electrician to check the outlet. I watched as he removed each outlet cover and examined each wire, terminal and outlet very closely, using a flashlight. Then he used his multimeter and checked all connections again.

After several minutes, he said, "Found it. Take a look."

He pointed to a series of very tiny holes in the white and the black insulated wires inside the Romex® cable. The holes

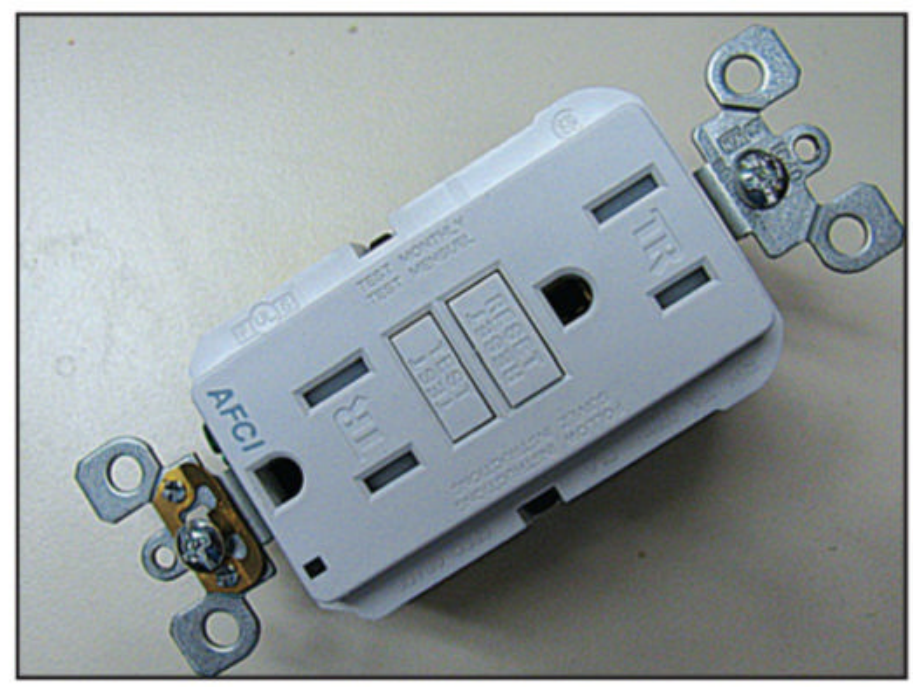


Photo A. An AFCI branch circuit receptacle looks like a GFCI, but it functions quite differently.

email: <kh6wz@cq-amateur-radio.com>
Linkedin: www.linkedin.com/in/wayneTyoshida

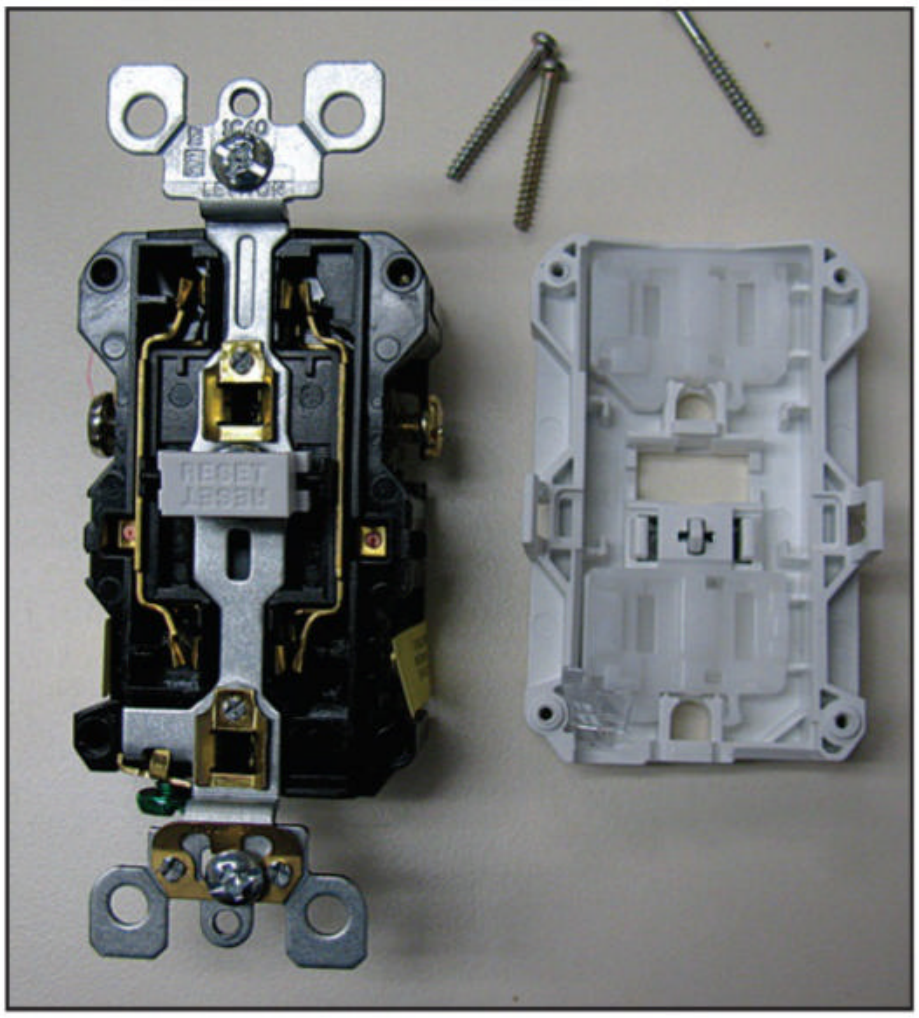


Photo B. Removing the back cover on the AFCI does not show us anything very interesting.

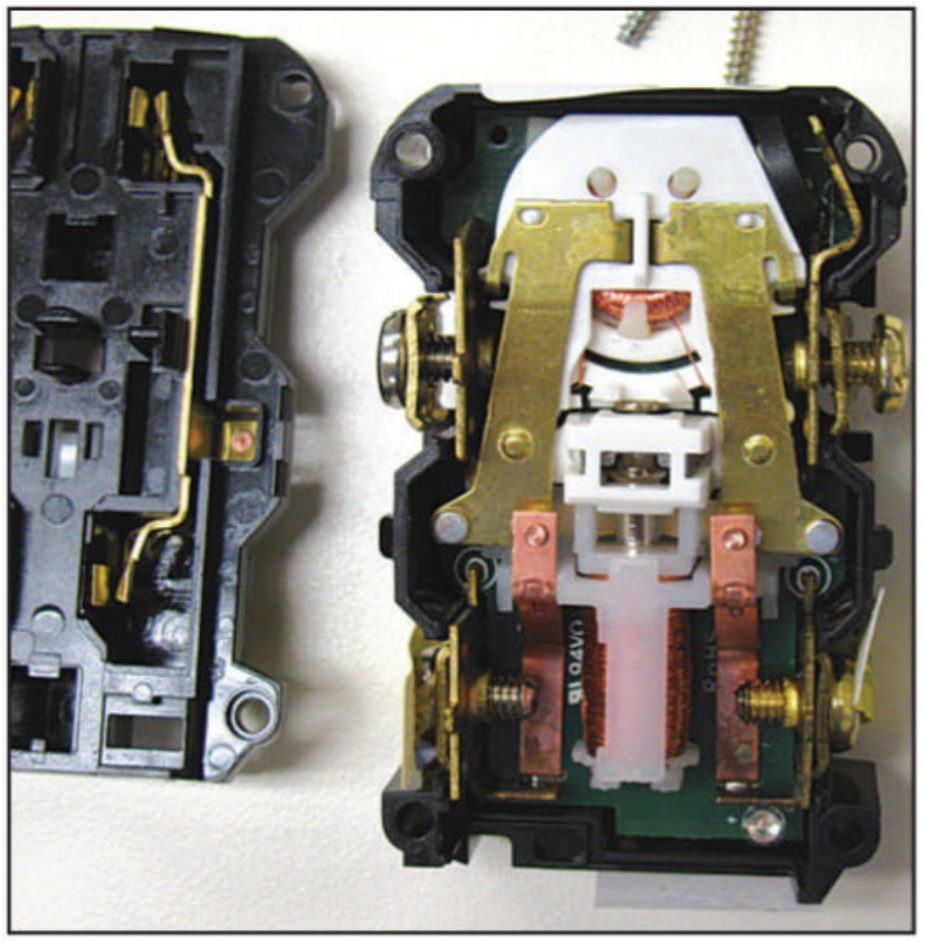


Photo C. Now we are seeing something interesting. There's a solenoid coil and plunger and some other stuff.

had to touch each other in just the right places in order to short circuit and trip the 15-amp circuit breaker.

He said I was very lucky there hadn't been an electrical fire in the house, since the wires were probably in this condition when the house was built.

He insulated the wires along the line and the flickering light problem went away. Although I did not know what an arc fault was at the time, I certainly did experience one.

Do They Work or Not?

Bob Huddleston, an electrical safety engineer, reports that AFCIs do not really work. I exchanged a quick e-mail with Bob, and he confirms the AFCIs he tested, including some of the newest generation units, still do not trip when an arc fault occurs. Read his online article "AFCI — Why I Have a Problem With It," at <http://bit.ly/1o9eCHd>.

Caveat Emptor – Buyer Beware

Here is an example of something useless to stay away from: An *AFCI tester*, sold by various stores and online auction sites. I was about to buy one of these until I read the description of the item. It says "AF120 Receptacle/AFCI Breaker Tripper" in its bold headline. Then, the very last bullet point says, "Does not simulate an actual arc." How strange is that? This thing is being sold to test AFCIs and yet does not test for the "A" part. See <http://www.etcon.com/af120.htm>

What's On Sale

While doing research on this topic, I visited a local hardware store to see what information is available. I brought a picture of the circuit breakers from my electrical box with me. The associate in the electrical department (a licensed electrician with over 30 years' experience) said they did not carry that style breaker in an AFCI version, but that he had seen them "somewhere." He suggested there may be an alternative to an AFCI circuit breaker — there are receptacles that are equipped with an AFCI function. He did not have any in stock, but they are available online. I have more information about these devices later.

The electrical man said the revised-current and upcoming rules for the AFCIs are confusing, and many customers who buy AFCI circuit breakers install them — and then return them "all the time" because they do not work. He mentioned the phrase "nuisance tripping," a term I ran into often when doing my AFCI research.

How Do These Things Work?

The answer to this question took a lot of research, which did not return much information. Explanations are over-simplified at best ("remove the suspected bad AFCI and install a new one in its place to see if it stops nuisance tripping"), and many articles repeat the same text without providing credit to the original source. Here is an example, taken from the National Electrical Manufacturers Association (NEMA) website <http://bit.ly/1xTMWNK>:

"Unlike a standard circuit breaker detecting overloads and short circuits, an AFCI utilizes advanced electronic technology to 'sense' the different arcing conditions. While there are different technologies employed to measure arcs by the various AFCI manufacturers, the end result is the same, detecting parallel arcs (line to line, line to neutral, and line to ground) and/or series arcs (arcing in series with one of the conductors).

"How does arc fault detection work? In essence, the detection is accomplished by the use of advanced electronic technology to monitor the circuit for the presence of 'normal' and 'dangerous' arcing conditions. Some equipment in the home, such as a motor driven vacuum cleaner or furnace motor, naturally creates arcs. This is considered to be a normal arcing condition. Another normal arcing condition that can some-

times be seen is when a light switch is turned off and the opening of the contacts creates an arc.

"A dangerous arc, as mentioned earlier, occurs for many reasons including damage of the electrical conductor insulation. When arcing occurs, the AFCI analyzes the characteristics of the event and determines if it is a hazardous event. AFCI manufacturers test for the hundreds of possible operating conditions and then program their devices to monitor constantly for the normal and dangerous arcing conditions."

I decided this was not enough information, and, being the curious type, I ordered two AFCI receptacles from an online store. It took about a week for them to arrive at my front door. I dis-

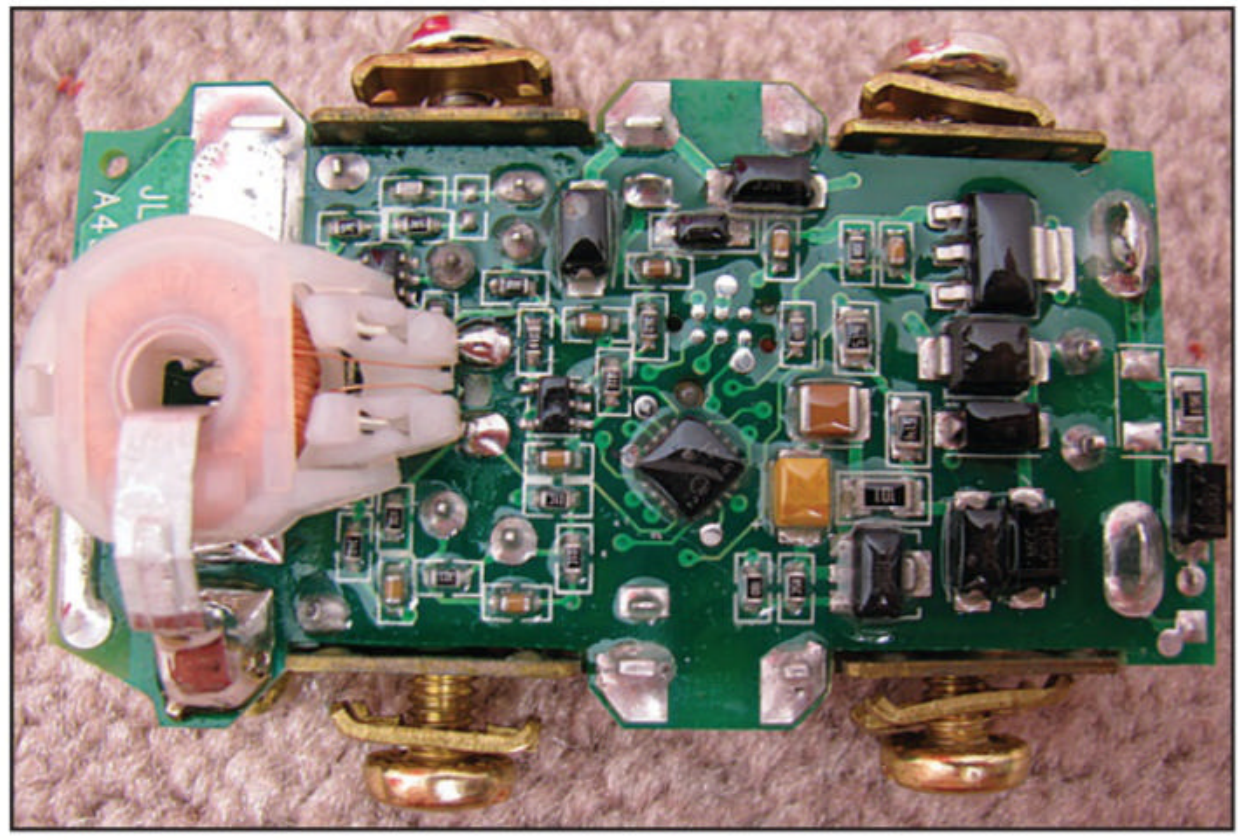


Photo D. The most interesting item inside is the PCB, with a tiny 16-pin IC near the center. Some switching FETs and other surface-mount components are also in there. It is definitely more complex than a GFCI or ordinary circuit breaker.

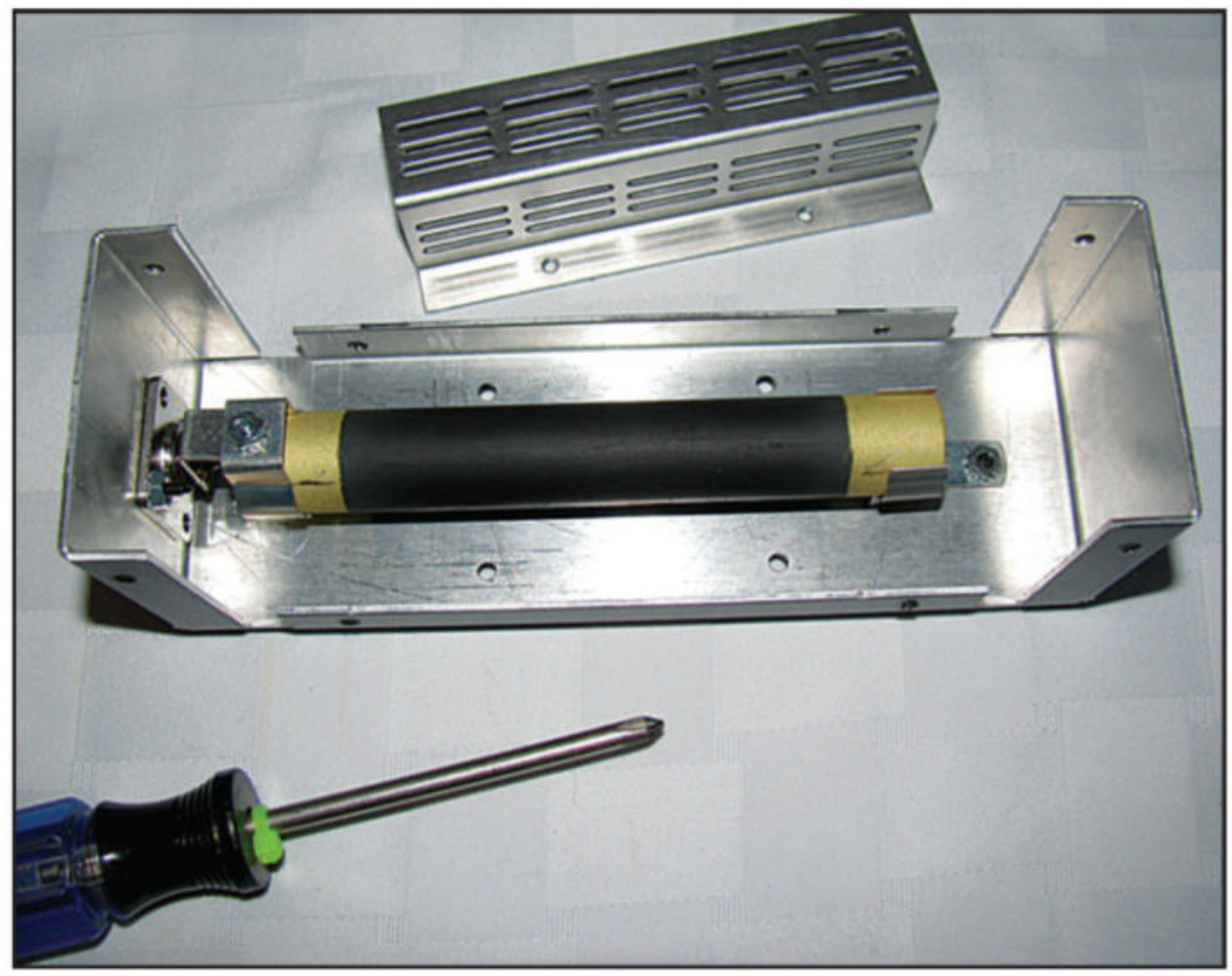


Photo D. A dry dummy load without its shield allows some RF to get into the AFCI.

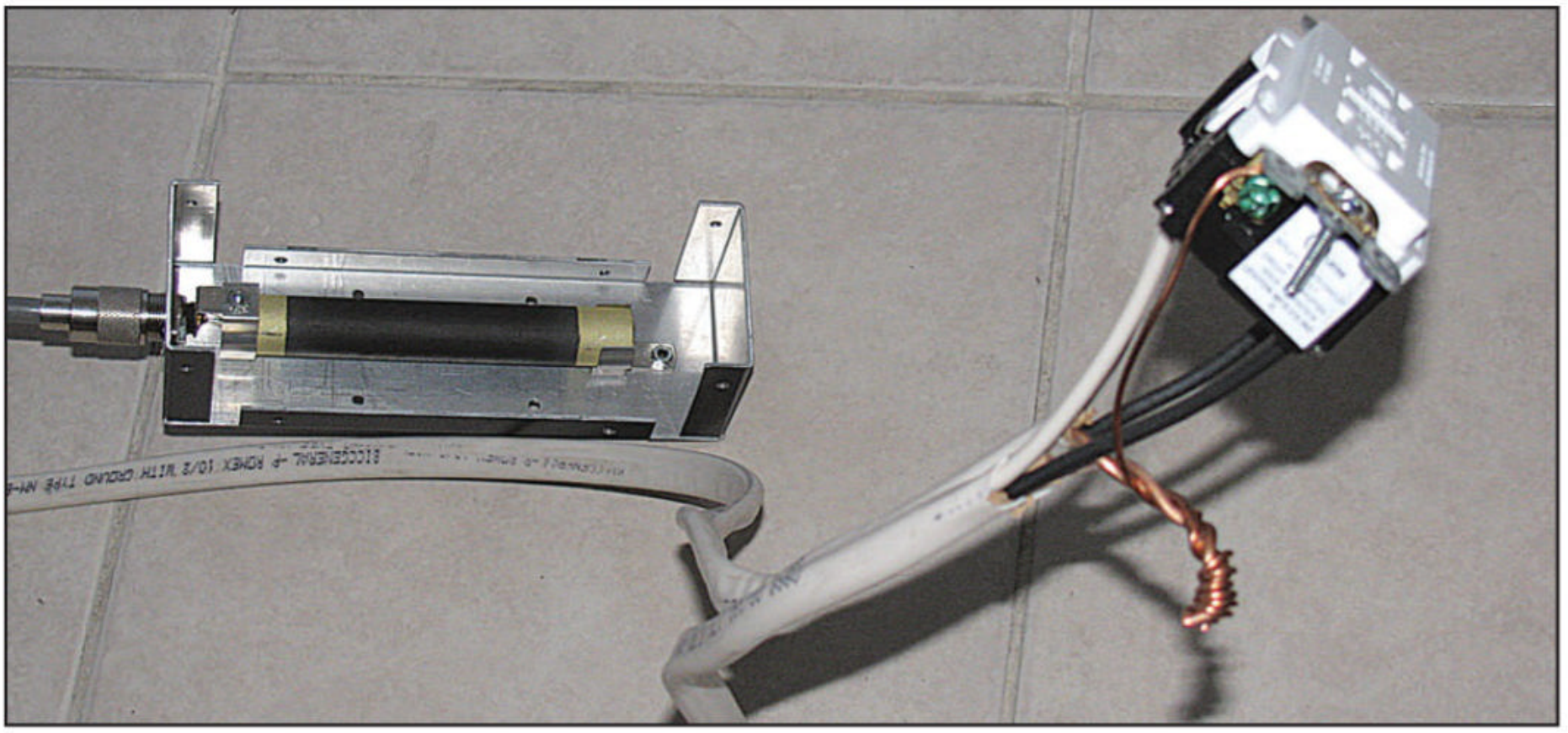


Photo F. The radiating dummy load placed 20 inches away from the AFCI receptacle.

sected one AFCI device to see the circuitry inside. A number zero Phillips screwdriver and a few minutes allow us to peek inside one of these AFCI receptacles (see Photos A through D).

As you can see, the circuitry is quite complex. The 16-pin Plastic Leaded Chip Carrier (PLCC) device is the "brains" of the unit. A solenoid coil and spring-loaded plunger are used to trigger and trip off the connection to the AC mains terminals. I have not attempted any detailed reverse-engineering on this unit, but it certainly is much more than a thermal sensor and switch device, like an ordinary circuit breaker.

After destroying one AFCI, I decided it was time to do some experimenting to see if I could "nuisance trip" the gizmo using my HF transceiver.

Some Experiments

I decided to try an AFCI experiment to see what some RF energy would do to these devices. I had some Romex®, a plastic receptacle box, a three-wire plug, and a 15-amp receptacle on hand, and followed the installation instructions that came with the AFCI receptacle.

I used 10-foot lengths of Romex® between the AC input, the AFCI outlet and the "load" outlet. I did not attach the wires to any sort of support structure; the wires were laid around my dining room. It looked messy, but it should very roughly resemble a circuit in a residence, but without the drywall.

For my first test, I thought plugging in something with an electric motor might trip the AFCI, since the contacts would spark. A large fan I use to cool down my garage has a 1.4-amp motor in it. It ran just fine. Ditto when I plugged in my very noisy shop vacuum. So "normal arcing" may be acceptable, the AFCI did not trip and all seemed normal. (But remember Bob Huddleston's experiments concerning AFCIs not tripping when they are supposed to.)

In my second experiment, I set up my all-band, all-mode 100-watt transceiver in the dining room and connected the rig to a dry dummy load with an 8-foot length of RG-8X. I put the dummy load 20-inches away from the "load" outlet. The big fan was left plugged in for use as a load for the circuit.

I set the mode switch to CW, and transmitted "CQ CQ CQ de KH6WZ KH6WZ KH6WZ" at about 10 WPM with 10 watts. Nothing happened on any band. I did the same thing on SSB, calling CQ into the microphone and transmitting into the dummy load. Same results on all bands: Nothing bad happened, the AFCI never tripped, and the fan continued to run.

I increased the power to 50 W, called CQ on both CW and phone, and had the same results. I increased the power and repeated the test. One hundred watts on 160 meters. Nothing. Switched to 80 meters. Nothing. On 40, the same thing happened: Nothing. As I continued through the rest of the bands, nothing happened.

And then I had a thought: The dummy load is shielded. What would happen if I removed the metal cover and tried the experiment again? See Photos E and F.

I repeated the experiment. Nothing on 160 meters. Nothing on 80 meters. Just as this started to get boring, the AFCI

Photo G. I re-built the test setup and mounted the components on a scrap piece of wood. Now I can take this rig and test other stations and conditions to see how an AFCI would behave at different locations.

References

As always, the Internet is a great information source, but be sure to use your judgment while reading, since sometimes information may be inaccurate. Use a rule journalists practice: Verify your references and their information.

National Electric Manufacturers Association, Low Voltage Distribution Section, "What is an AFCI?"

This site includes a form for "AFCI Unwanted Tripping Report" — so if you experience a problem, report it so problems can be documented and may lead to a solution

<http://www.afcisafety.org/qa.html>

The Circuit Detective
AFCI Circuit Breaker Troubleshooting
<http://www.thecircuitdetective.com/afci_circuit_breakers.htm>

"AFCI - Why I Have a Problem With It," by Bob Huddleston
<http://bit.ly/1o9eCHd>

"ARRL Helps Manufacturer to Resolve Arc Fault Circuit Interrupter RFI Problems,"
<http://bit.ly/1taXx0K>

"GE Industrial - Arc Fault Circuit Interrupter (AFCI)"
<http://bit.ly/1xlJ9Jp>

"Troubleshooting Guide White Paper Arc Fault Circuit Interrupters (AFCIs)"
<http://sie.ag/1BKNSIA>

P3 International Killer Watt Meter
<http://bit.ly/14HxslG>

tripped just before the end of the CQ cycle on 30 meters (10 MHz). I had to do this several times just to make sure. And yes, each and every time I transmitted on 10 MHz, with 100 watts, the AFCI would trip. (Remember, maximum power on 30 meters is 200 watts, so there is still plenty of potential for more serious RFI problems on this band.)

I decided to clean up my dining room, and made a nicer-looking test unit, shown in Photo G. I mounted the AFCI receptacle and an outlet into one box and added an AC meter called the "Killer Watt" in the load outlet. The Killer Watt is a fancy digital meter for reading line voltage, frequency, and current. It also measures power factor. Now I can take this "system" out to other ham shacks to see what happens under real station conditions, and at higher power levels.

In the Ham Shack

As mentioned earlier, we need to understand how these things work in order to live with them in harmony. It seems some people continue to experience nuisance tripping and others do not. And, since every installation is different, it is nearly impossible to recommend a single cure for everyone.

If you have AFCI receptacles or circuit breaker devices in your home, please report any problems to the National Electric Manufacturers Association (NEMA) website, so "our" problems can be documented and hopefully will result in improvements or exceptions for amateur radio equipment. Use the form for "AFCI Unwanted Tripping Report" at <http://www.afcisafety.org/qa.html>.

In the meantime, keep the antenna VSWR low and make sure your station equipment is properly grounded, in both the electrical sense and the RF sense, to minimize any effects of RF interference in your shack. It may be a wise idea to specify the use of wires inside metal conduit rather than Romex® cable for your house wiring, if possible. Metal conduit should provide shielding to help minimize the effects of RF getting into the electrical system. But always check your local building codes and discuss this with your electrician. Differences in cost must also be a practical factor to consider when re-wiring your home with AFCI protection components.

I hope everyone who encounters any problems with Arc Fault Circuit Interrupters will report what they are experiencing to the NMEA so something can be done about it.

73,
Wayne KH6WZ

magic in the sky

BY JEFF REINHARDT,* AA6JR

The Greatest Club in the USA?

If radio technology is the basis of our many common interests, I'll posit that amateur radio clubs form the skeleton that holds our operational body together. Think about it. Chances are, you are, have been, or know someone who is a member of a club that supports our hobby. Beside the standard concept of a "club", that is, one that has meetings at some location with a roster of members, there are also common interest gatherings that may take the form of nets, award chasing groups, specific interest groups like AMSAT, DX, Skywarn, ARES, RACES, and more.

As one who's had the privilege of attending many club meetings across the U.S., I've encountered many fine organizations that support our efforts and more importantly, those who comprise their membership. Admittedly, I've not been to every meeting of every club, but I dare say, a pretty good smattering. They are indeed the "grass roots" of our hobby.

Why? There are many reasons, but principal among them is what I believe to be the best characteristic of "hamdom" that is, "hams helping hams." Sharing knowledge; passing along our history while staying abreast of new technologies and operating modes through monthly speakers; conducting education for each license class; building and maintaining projects from simple antennas to repeater systems; holding exam sessions; coordinating an annual Field Day operation including a group site, a traditional Saturday evening "feed" and assembling a report; having several social events apart from regular club meetings, like T-hunts, picnics and occasional special operating events; and by rotating leadership positions among its members.

You might ask, "what kind of a club can do all those things?" I'll submit one name — The Conejo Valley Amateur Radio Club (CVARC, club call AA6CV) based in Thousand Oaks, California. And yes, I've been a proud dues-paying member for many years. More on that in a moment.

Now there are many fine clubs that do things on a major scale. I doubt that anyone would argue that a prime example is the Dayton Amateur Radio Association (DARA), which takes on the monumental task of conducting the nation's (world's?) largest hamfest each year. Overcoming myriad obstacles, DARA puts on a quality event every time. It's in a class by itself. That's not to diminish the efforts of groups that conduct events in Orlando, Huntsville, and elsewhere; we not only enjoy those events, I suggest we need them.

On a more local level, the Western Reserve Amateur Radio Club in Ohio (W8WRC) does a super job for its members; kudos go to the Radio Amateurs of Western New York,

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e-mail: <aa6jr@cq-amateur-radio.com>

Eric, WB6PYK, hoping his pickup will also "pick up" some HF signals. (All photos by AA6JR)

Norm, AB6ET, and Kat, K6VQN, working CW contacts.

(RAWNY W2PE) for its 100 years of service; the Santa Barbara ARC (W6TZ) and the San Fernando Valley ARC (W6SD) are longtime supporters of the hobby and the list of good active clubs and their respective accomplishments could probably fill this magazine.

However, if you're looking for ideas on starting a club, or reinvigorating an existing one, check the websites of those above, or do a larger Google search on amateur radio clubs. The cross-pollination of ideas including entertaining or instructional programs, social events, on-air operations like special events, family group activities, and leadership development might just prove worthwhile.

One Saturday in November

But let's get back to our "grass roots." Among the many emails I receive from CVARC, several days prior to the event, I was notified the club was conducting a "micro field day" at a remote park location, just for fun.

Craig, KD6NFD, makes Parks On The Air contacts from the Santa Monica Mountains National Recreation Area (Park K-0648).

Steven, W6SMR, field tests his new antenna with a classic radio and a great smile.

Despite chilly (for Southern California) temperatures and strong Santa Ana winds, some 30 operators showed up, set up high frequency (HF) rigs and, in true "field" conditions, relied on makeshift antennas, self-contained power, and operated throughout the day. While there was no specific agenda, there were operations using voice, data, and CW. Each operator was happy to share the specifics of their rigs, antennas, and band conditions. Craig, KD6NFD, used the event to operate a Parks On The AIR (POTA) station on 20 meters using the AA6CV call from the Santa Monica Mountains National Recreation Area. If you would like to learn more about POTA, check out <www.parksontheair.com>. Contacts were made with eight different states.

See the photos for a sample of the rigs and operators who chose to take their radios into the field on the Saturday before Thanksgiving. If there's a common theme that shines through, it's simply hams having fun with radio on an autumn day — no pressure, no special agendas.

What doesn't appear is the experience gained, antenna systems tested, knowledge shared, and new friendships formed directly from that gathering. And events such as these may also explain another CVARC success story — the club finished first overall in total points for the 2022 Field Day event conducted by the ARRL. Like the old baseball *aficionados* say, "you could look it up."

There's Always More

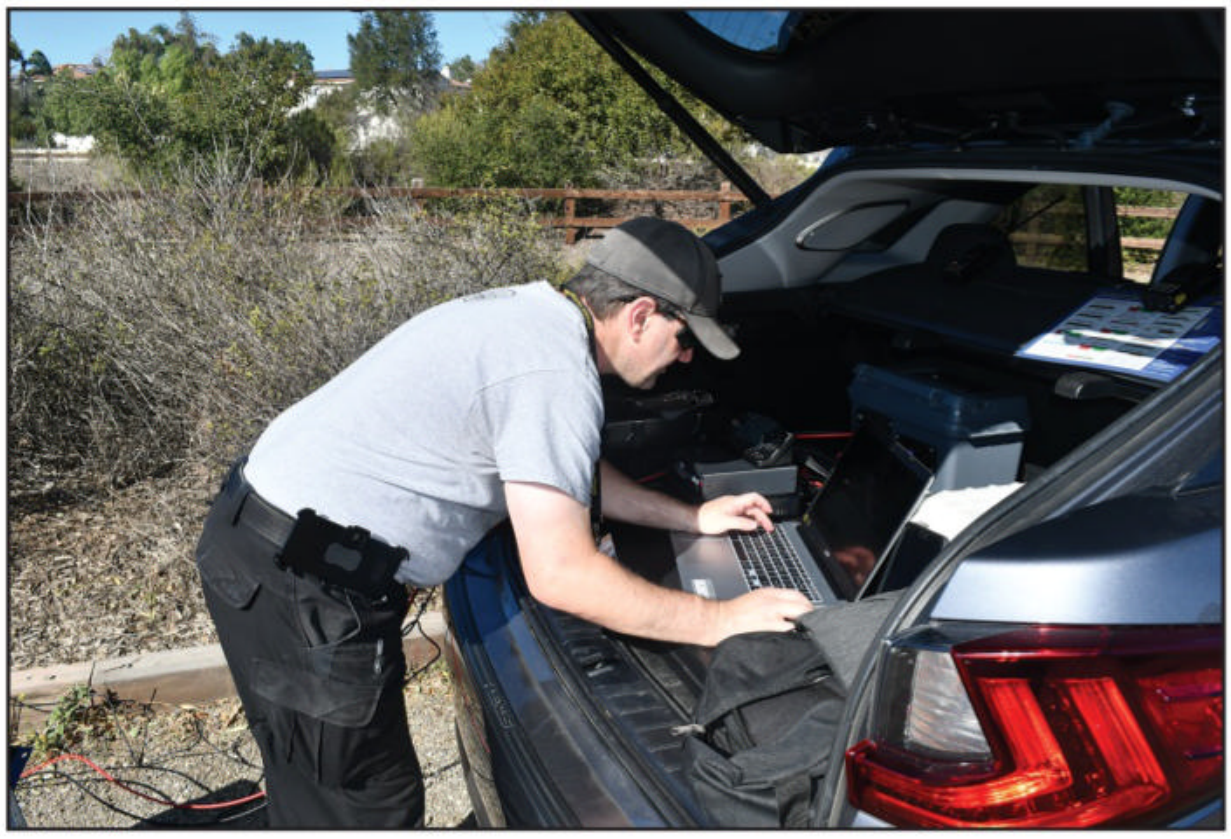
While I would like to think of (or designate) CVARC as the "Greatest Club in The Land," it would not be right or fair to do so — and Editor Rich might comment that such a designation is beyond the powers vested in me. Nevertheless, it's nice to be of that opinion, but here's where *The Magic* kicks in — you have that same power. In other words, there's no reason you can't designate your club with the same status, provided its ongoing activities warrant that claim.

The ARRL is also ramping up its emphasis on the importance clubs have in the continuation and growth of our hobby, with renewed focus on recognizing club efforts and support for those organizations through a variety of means.

It only takes a spark to create a dynamic group. On the other hand, I was sad to learn of a club disbanded simply because no one wanted to take on the leadership roles and the old leaders were burned out. All it would have taken to save the group was for a few good folks to step forward and not worry about failing, because there are many examples and support resources available to acclimate new leaders.

All it takes is a bit of energy and imagination — and isn't that what propelled most of us into the hobby in the first place?

The shared vision for 2023 is one of thriving, healthy clubs across the U.S. and in fact, in every country. Their continuing existence will assure the ongoing and future presence of *The Magic In The Sky.*



Ryan, KI6BTY, seems immersed in his digital contact efforts.

COVID? What COVID?

A side note — when COVID-19 first broke out, the ensuing lockdown put the entire country on "pause." CVARC countered that isolation by scheduling a VHF repeater net that met three times each day, morning, afternoon, and evening, providing support and companionship for everyone who wanted to participate or just listen. From idle chit-chat to where to find essentials (like TP), tech talk and even occasional recipe sharing, the nets gave everyone a risk-free social outlet that COVID couldn't touch. Was it a success? Some two years later, the daily gatherings still occur, hosted by a rotating cadre of net control operators.

A well-designed "go kit" makes field operations easy!

digital connection

BY DON ROTOLO,* N2IRZ

Tis The Season: Internet Archive and Other Bits

New Year's Housekeeping

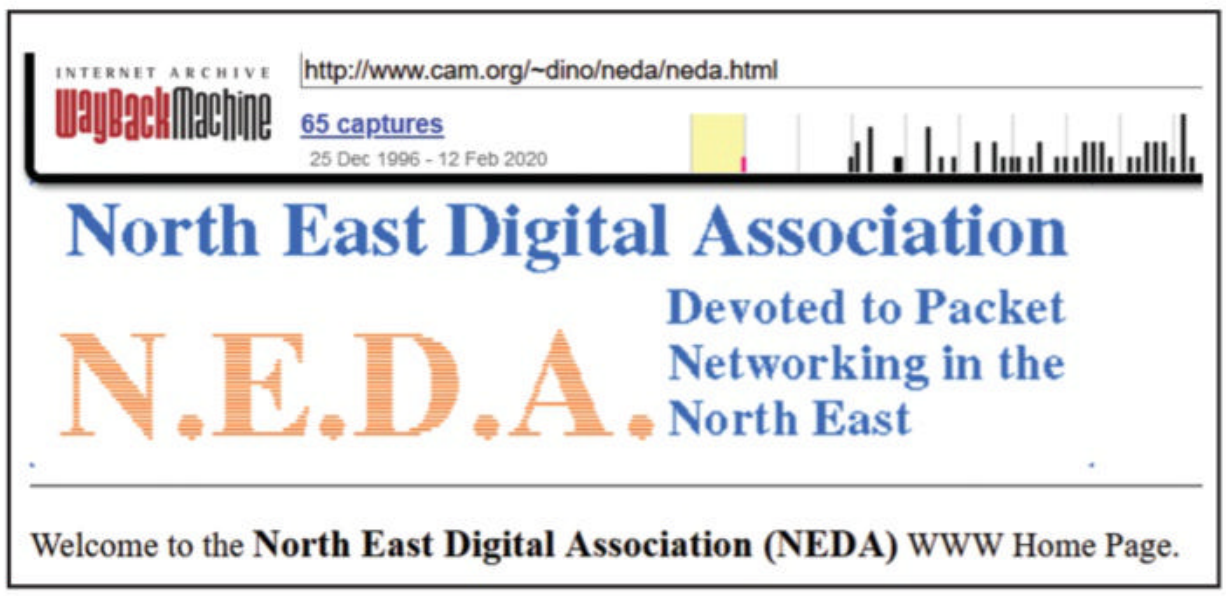
All the very best wishes to you and yours for a happy, healthy, and prosperous new year. As one of my new year's resolutions, I need to clean up and mention a couple of topics that have been on the back burner for some time. There's not much else going on at the moment, so this month will be a little shorter than usual.

Last November, I wrote about the ARRL/TAPR Digital Communications Conference (DCC), and one of the topics there was the Internet Archive <https://archive.org>, the 501(c)(3) nonprofit organization behind the Wayback Machine. The IA is an online library of sorts, providing free access to anyone who wants it. Their collection includes a lot of everything, and their official mission is to provide "Universal Access to All Knowledge." And that statement isn't just fluff: They have 625 billion web pages, 38 million books and texts, plus millions and millions of audio recordings, videos, images, and software programs.

One might think that with all that stuff (over 99 petabytes!), they'd be kinda full and satisfied, but no: They want more. Lots more. At the DCC, they made a specific appeal to the amateur radio community. They are actively seeking old and new publications, club newsletters, operating instructions and schematics, service books, and anything else ham related. (*Be sure you have the rights to anything you contribute. – ed.*)

For my part, I'm in the process of scanning in all the North East Digital Association (NEDA) and Radio Amateur Telecommunications Society (RATS) publications I can find. These two organizations, in which I was an officer for some time, represent quite a lot of knowledge about packet radio networking starting in the early 1980s.

So, if you have anything that might be considered part of All Human Knowledge, create a free account, and upload it. It doesn't have to be today, but really give it some serious thought, since it's entirely possible that you have the only surviving copy of something getting dusty on a shelf there. They also accept physical donations, but can neither return them after digitizing nor specify when digitization might happen. Of course, they do ask that you check if they already have a copy of something before sending it in — just like in contesting, de-duping is important.



The North East Digital Association (NEDA) homepage as it looked on Christmas Day in 1996, courtesy of the Internet Archive's Wayback Machine. Although they store lots of old web pages, the Internet Archive is also interested in amateur radio related publications, like the club newsletters up in your attic. You can preserve them for posterity and get them out of the house at the same time!

Out With The Old...

And in with the new. Yes, it's a new year — been there, done that — but what about you? Is there something new you want to explore this year? Maybe get an inexpensive computer-radio interface and try something digital? Maybe a new contest mode? Or — get this — a digital mode contest!

If you have long lusted after DXCC, try the FT8 digital mode. There is a lot of activity on the bands, and the robustness of this popular digital mode makes it far easier to work new countries with even a modest setup. Or WAZ, WAC, WAS, and the other awards: Maybe this will be your year? You won't know until you give it a try. Consider making this one of your new year's resolutions.

FRC

Over the years I've written about FIRST Robotics. While the organization sponsors robotics competitions for students from pre-K through 12th grade, my own involvement is with the First Robotics Competition (FRC), which is for high-school students. The nearly 4,000 teams worldwide, with almost 100,000 students participating, have only a few weeks to design and build a ~120-pound robot to compete in a new game every year, which is announced in early January. Which, you might notice, is right now.

As a ham, you probably have quite a lot of relevant knowledge that can help a team. Who knows, maybe some of those students might be interested in getting their radio license?

Wherever you are, there is very likely a team nearby that could use your expertise and help. An important part of FIRST (For Inspiration and Recognition of Science and Technology) is its reliance on adult mentors to help guide students and transfer knowledge. Some teams have several excellent mentors, but many teams could definitely use a few more.

As a ham, you probably have quite a lot of relevant knowledge that can help a team. Who knows, maybe some of

**c/o CQ magazine*
Email : <N2IRZ@cq-amateur-radio.com>

One my latest projects, a portable antenna support for Field Day. The crane is optional.

Members of FRC (FIRST Robotics Competition) Team 823, Team OSCAR, work on some last-minute adjustments to their robot. Share your life experience by helping mentor a high-school robotics team. Sharing your knowledge is a valuable service to society and is very rewarding.

Dale Heatherington WA4DSY, SK

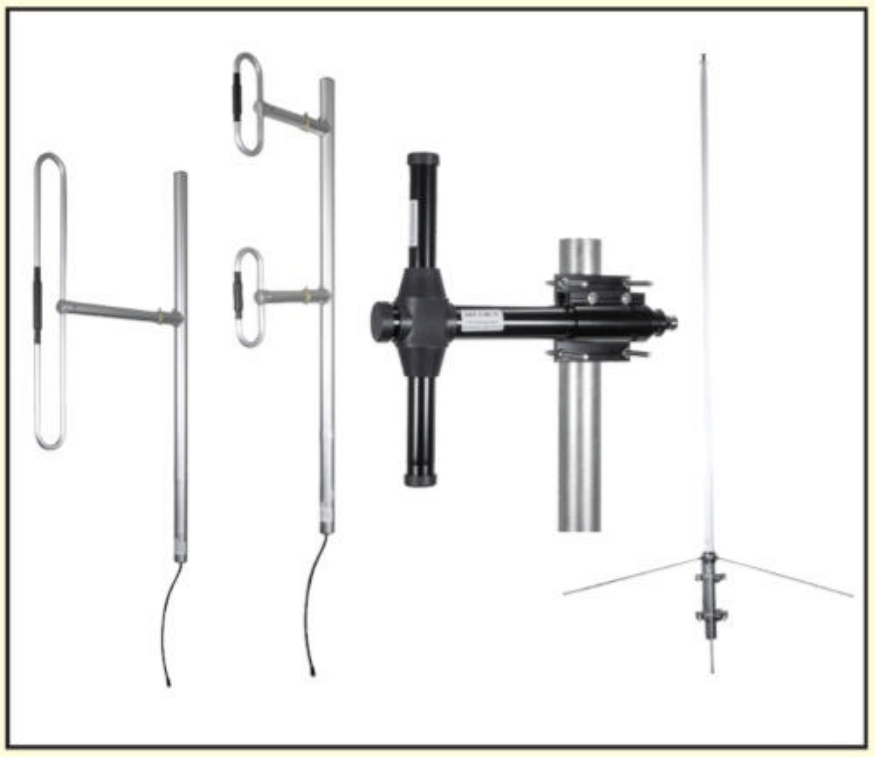
It is with great sadness that we report the passing of Dale Alan Heatherington, WA4DSY, on June 5, 2021. As a young engineer, Dale worked with Dennis Hayes to essentially invent the dial-up modem. In an interview with N2IRZ (*CQ*, March 2016), Dale noted that the problem they solved was of how to end the connection: "*When you're sending a file, you don't know what's in the file. You can't designate a particular character as a hang-up character...*" The answer to this problem became the basis of the Hayes Command Set, a widely used set of dozens of commands still used to control virtually all telephone modems.

His professional career aside, Dale also became well-known in the digital amateur radio world from his WA4DSY 56-kilobaud GRAPES radio modem. Able to transfer data at blinding speeds, it was by far the fastest amateur radio modem of its day. Unfortunately, its cost and complexity meant that it was never widely adopted. Dale was also a fierce competitor in game robots.

Digital communications pioneer Dale Heatherington, WA4DSY, co-inventor of the dial-up modem, became a Silent Key last June. (Photos courtesy of WA4DSY)

One of Dale's major contributions to amateur radio digital technology was his 56-kilobaud GRAPES radio modem, the fastest amateur radio modem of its day.

what's new



KP Performance Antennas Launches VHF/UHF Dipole, Collinear and Yagi Antennas

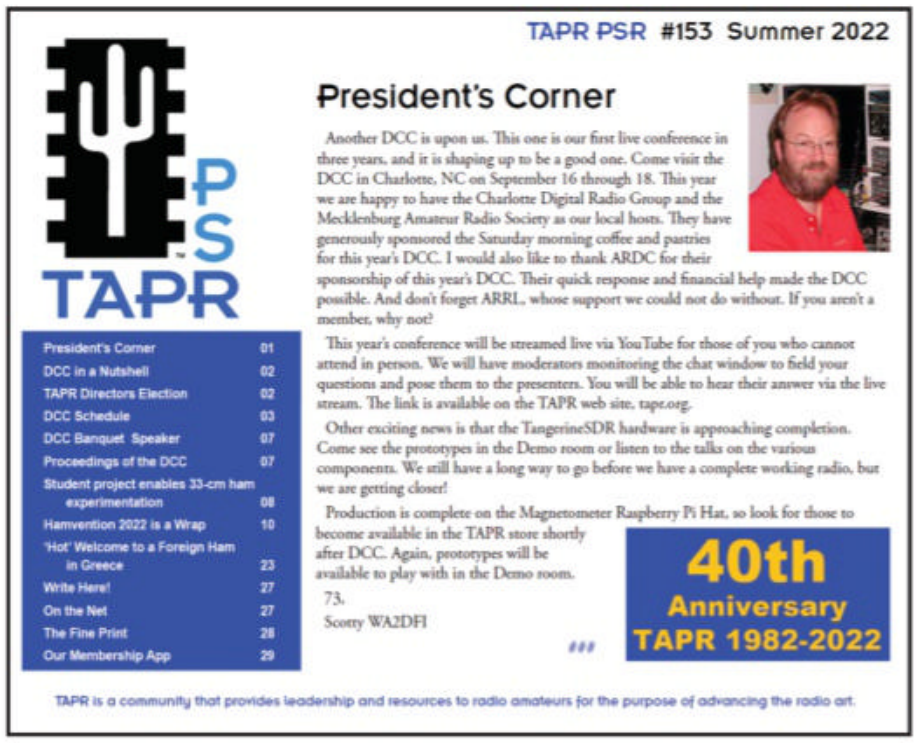
KP Performance Antennas, an Infinite Electronics brand, and a manufacturer of wireless network antennas, just introduced a new series of VHF/UHF dipole, collinear and Yagi antennas for land mobile radio (LMR), public safety, military communications, trunking, and amateur radio applications.

KP's new series of VHF/UHF exposed dipole arrays, omnidirectional collinear and Yagi antennas cover frequencies of 135 MHz to 512 MHz and feature high-power handling of over 200 watts.

The rugged outdoor designs of these VHF/UHF antennas ensure high performance in all environmental conditions. The individual folded and straight dipole antennas allow for minimal storage and efficient transportation. KP also offers pre-configured dipole arrays with internalized cabling, making for quick and simple deployments.

The VHF/UHF antennas feature multiple gain options with fixed and adjustable dipole configurations. All components are DC grounded for lightning protection and are offered in optional prefabricated arrays with fixed quarter-wave or half-wave spacing from the mast.

KP Performance Antennas' new VHF/UHF dipole, collinear and Yagi antennas are in-stock and available with pricing varying by model. For more information, call (855) 276-5772 or visit <www.kpperformance.com>.



TAPR PSR #153 Summer 2022

TAPR PS

President's Corner

Another DCC is upon us. This one is our first live conference in three years, and it is shaping up to be a good one. Come visit the DCC in Charlotte, NC on September 16 through 18. This year we are happy to have the Charlotte Digital Radio Group and the Mecklenburg Amateur Radio Society as our local hosts. They have generously sponsored the Saturday morning coffee and pastries for this year's DCC. I would also like to thank ARDC for their sponsorship of this year's DCC. Their quick response and financial help made the DCC possible. And don't forget ARRL, whose support we could not do without. If you aren't a member, why not?

This year's conference will be streamed live via YouTube for those of you who cannot attend in person. We will have moderators monitoring the chat window to field your questions and pose them to the presenters. You will be able to hear their answer via the live stream. The link is available on the TAPR web site, tapr.org.

Other exciting news is that the TangerineSDR hardware is approaching completion. Come see the prototypes in the Demo room or listen to the talks on the various components. We still have a long way to go before we have a complete working radio, but we are getting closer!

Production is complete on the Magnetometer Raspberry Pi Hat, so look for those to become available in the TAPR store shortly after DCC. Again, prototypes will be available to play with in the Demo room.

73.
Scotty WA2DFI

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40th Anniversary TAPR 1982-2022

TAPR is a community that provides leadership and resources to radio amateurs for the purpose of advancing the radio art.

Write something for the TAPR Packet Status Register! Visit <tapr.org> to find out how. Surely there is something you can share?

those students might be interested in getting their radio license? But at the very least, everyone has something good to teach to a high-school student. It's not a year-round commitment, just a few weeks, and the reward is the immense satisfaction of seeing all those little light bulbs above their heads switch on and burn brightly.

I've been an FRC mentor since 2005, and I believe in the impact this program has. I've seen kids who (literally) had never held a screwdriver grow and get a degree in mechanical engineering. These are the kids who are going to invent a machine to save my life someday. And, if you are expecting the typical high school student, be advised that these kids are different — very intelligent, highly motivated, eager to learn, and immensely grateful.

So, consider this your personal invitation to find a local FRC team and ask if they could use some help. Visit the FIRST website <www.firstinspires.org>, click on *Find FIRST Near You* and connect with a team. Trust me, you'll be glad you did.

Unselfishness

Speaking of sharing your life experiences, it doesn't have to be my passion of FRC. Instead, what is your passion? Think you might be able to get one — just one — kid under 18 to get their radio license this year? Or teach someone to fish, or use a drill press, name that bird, nurture those tomatoes, or ... well, you get the idea. You have a lifetime of unique experiences, knowledge, and skills that would benefit society if you could pass at least some of it on to the next bunch.

Indeed, I am of the mind that not trying to do this is a bit selfish. While I do agree that most people don't really want advice, if you ask and they agree, clearly they do. Our society depends on ever-increasing productivity, and that never happens by the boss telling you how to do something. Instead, we each learn — in little bits (usually) — how to make ourselves just a bit more efficient and work faster or easier or whatever.

So whether it's FRC, ham radio, or whatever floats your boat, make another resolution this year to give something you have away — and get to keep it too.

And that's my wish for you this year, in addition to health, happiness, and prosperity in the new year.– *73, Don, N2IRZ*

vhf plus

BY TRENT FLEMING,* N4DTF

Beacons Help You Make More Contacts

One of the frequent complaints you will hear about any band is, "the band(s) is dead." When you see the activity increase as it does in contests, you sometimes wonder, "is a dead band really dead?" For VHF and above, I think there are two major ways we can do more to activate a potentially dead band. First, don't just turn on the rig and tune around listening ... stop and call CQ periodically to improve everyone's chances of catching a band opening.

Then listen ... before giving up. Many of us are monitoring calling frequencies like 50.125 or 222.1 MHz while doing other things, and it may take a minute for us to finish an email, put down the soldering iron, or otherwise redirect our efforts to answering your call. On some bands, you will find that you need to call on more than one frequency. For example, on 2-meter sideband, you will find signals on 144.190, 144.210, and 144.250 MHz in addition to the calling frequency of 144.200 MHz. Note that many of the SWOT (Side Winders On Two) nets are held on 144.250 MHz. Of course, in different regions of the country you will find different "favorite frequencies" so scanning the bands is always a good idea.

Another key tool for understanding propagation and identifying openings for VHF+ operators are beacons. These automated transmitters basically substitute for someone calling CQ around the clock, from a known location. Knowing where these transmitters are located can help you identify the most likely areas where you can make contact. See sidebar for information about accessing a list of beacons. If you are near the radio, and hearing a beacon, by all means switch to the phone or CW segments and make a call. Don't hesitate to self-spot, or make a post on any of the social media platforms where VHF+ enthusiasts hang out. There are several good weak-signal pages on FaceBook, as well as an active Slack channel, and a number of spotting or collaboration sites, ranging from DXmaps.com to the ON4KST.com website that hosts chats for all bands and activity modes. You may have other favorites, and I would love to hear about them. Let's make some noise and get these bands more active.

But, you say, don't most beacons transmit their callsign via CW? What if I can't do code? Relax. If you are hearing a repeating stream of code on the frequency, it is very likely it is the beacon in question. If you take a little time to listen to the transmission, and compare it to a guide for Morse Code, you will begin to figure out something simple like a continuous CQ or callsign being transmitted. Heck, you might decide you want to learn CW — the original digital mode.

Speaking of digital modes, can FT8 be a valuable resource? I think so. By allowing you to see activity in real time, along with signal reports, FT8 and related modes can help you understand propagation opportunities and make contacts. But don't think in terms of just digital contacts. When digital signal reports begin to approach or move above 0 dB consider moving to CW or phone on that band to see if there is also activity. Nothing wrong with the digital modes, but an occasional CW or phone conversation will help you meet new hams, learn about their equipment and operating practices, and generally expand your enjoyment of the hobby.

Finally, I will offer two more important benefits that beacons offer. Because much of the equipment at SHF frequencies is to some extent homebrewed or modified, beacons allow you to check frequency accuracy in a simple way. That's a plus if you are trying to get some gear on the air and don't have a local ham to help out on a particular band. In the spirit of "use it or lose it," I need to point out that we recently lost a partial allocation at 9 centimeters (cm) and there is commercial interest in part of the 3-cm band. Beacons help us to show interest in the frequencies allocated to us, and especially when the use of a beacon results in QSO activity, which clearly demonstrates activity on the bands.

Correction

Alert reader Michael, K6PQM, noticed an error in my October column regarding building a 6-meter antenna. All of the dimensions are correct, but the line "total length of 12 feet" had the number transposed and should have read 21 feet. I apologize for any confusion or inconvenience, but I was told there would not be math involved in writing this column.

On the Air

Dave, W4JVN, is new to 6 meters, but not to amateur radio. Dave reports that after 62+ years of ham radio, he experienced his first TEP from FM17. On 10/16/22 at 2255 UTC via FT8, he worked: CX9AU, LW2EDM, LU5FF, LU4FPZ, CE3SOC, and CX6UM. That's a good list. "Quite a thrill," says Dave. Welcome to 6 meters, Dave, and congratulations on those contacts!

Mark Your Calendar

I'm pleased to report that the "Microwave Update 2023," which includes the Northeast VHF/UHF Conference will be held in person next year. The dates are April 14 & 15th, 2023 at the Hilton Garden Inn at the Bradley Airport in Windsor, Connecticut. Watch for more information at <microwaveupdate.com>.

That's it for this month ... I hope you are recovering from the holidays and looking ahead to a new year full of activity on new and old bands! Please continue to send along your experiences and your ideas.

How to Find Beacons

Finding beacons by frequency and location is often a challenge. Ron Klimas, WZ1V, maintains the most comprehensive list of beacons for VHF / UHF / SHF that I am aware of. You can visit Ron's site here: <https://tinyurl.com/2n64dtrz>. A recent discussion on the Midwest Microwave group (Midwest-Microwave on groups.io) discussed the importance of helping Ron keep this list current, by notifying him of any changes you encounter when listening for beacons. It is also most helpful if beacon owners self-report to Ron about changes, additions, or deletions. A big thanks to Ron for volunteering his time and energy to maintain this list!

Band	Beacon Frequencies (MHz)
6 meters	50.060-50.080
2 meters	144.275-144.300
1.25 meters	222.05-222.06
70 cm	432.30-432.40
33 cm	903.000-903.100
23 cm	1296.200-1296.400
13 cm	2304.300-2304.400
5 cm	5760.3-5760.4
3 cm	10368.300-10368.400

Table 1. VHF and Beacon Allocations

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

awards

BY STEVE MOLO,* KI4KWR

Municipalities of Spain Diploma

NOTE: Thank you to Bill, KØDEQ, for notifying me of this award available from Spain.

In the search for old and even new awards available to amateur radio operators and shortwave listeners (SWLs), I was tipped off by Bill, KØDEQ, to this fine award called the Municipalities of Spain Diploma, which is administered by the Union de Radioaficianados Espanoles (URE). No, you are not graduating from high school again, but it is common in Europe to call award certificates diplomas. To obtain the Municipalities of Spain Diploma requires hams or SWLs to contact or hear a minimum of 300 municipalities in Spain. To find a listing of all the municipalities of Spain, you can find a listing at the online census of the National Institute of Statistics <www.ine.es/en/index.htm>. The award is available for contacts made by phone, CW, and digital modes.

The award period began January 1st, 1999, for any band authorized for hams. However, repeater QSOs are not valid, which seems like a fair rule to have. One odd statement is the following: "The accreditation of a municipality will be carried out regardless of the band and the way in which it has been worked, and it will be enough that the QSL clearly shows the reference and/or name of the municipality, or any reference that geographically identifies the municipality from which the contact has been made for its acceptance in the diploma." This gives me the impression that the contact just needs to meet the list of areas covered.

The award has three different levels consisting of DME Single Band, DME Plus, and DME Master, each of which is explained below.

DME Single Band is awarded for achieving the 300 municipalities minimum on the same band. Bands covered are 160-10 meters, but, remember this category must have contacts made on just one band and no mixed bands.

DME Plus needs the operator to contact 1,000 municipalities on phone, CW, or digital modes and the operator can use mixed mode to make those contacts.

Lastly, the DME Master Diploma requires 2,000 municipalities but has quite the challenge: For this award you need 2,000 from each mode consisting of phone, CW, and digital modes totaling 6,000 contacts. I can see this one will be a challenge for many … challenge accepted. NOTE: For this category, contacts count starting September 1st, 2018, so I'm not exactly sure how the January 1st, 1999 beginning is affected.

Contacts made via portable or mobile operation appear to have a system of rules to follow and if I listed them, it would likely cause confusion, so I suggest you read the full rules available online <https://tinyurl.com/yj386p6d> and take a moment to digest it.

Similar to the ARRL DXCC award, if a municipality is removed from the official list, the DME and all the accredited contacts are removed. So please be vigilant and check your status often at the website <https://tinyurl.com/yj386p6d> to ensure none of your contacts have been removed.

The single-band version of the Municipalities of Spain award appears to be the most-commonly chased version at the moment. (Image via URE website)

To apply for the DME, you need to register at the website <https://tinyurl.com/2ep3m6rw> to get the process started. Not fully understood when I wrote this column, is the need to provide physical QSL cards to the award committee to prove that you made the contacts for the initial award. After reading the rules, it appears that you must provide physical QSL cards for the initial award, and nothing indicates the ability of using a third-party QSL confirmation platform. However, it does appear you can use Logbook of the World and eQSL to apply for endorsements. If your application is accepted, a high-quality PDF will be emailed to you. Paper copies are available for 5€ or $5.23 U.S.

After some research done on this end, the best source of answers for any questions you may have, you can email the award committee at <diplomas@ure.es> or by regular mail to: URE, Vocalía de Diplomas, Av. Monte Igueldo 102, 28053 Madrid, SPAIN or P.O. Box 55055 – 28053, Madrid, SPAIN.

I get the impression after reading the rules that accuracy is strictly enforced by the awards committee, which is an aspect of the award structure that I admire, as it keeps everything fair and the opportunity to obtain the certificate pure. So, applicants should be very careful entering callsigns in your log or they will be invalid and there is no tolerance for a lost log or no evidence of activity. In addition, any attempt at fraud — such as forging or altering QSL cars — will result in immediate disqualification of the applicant.

With 8,131 DME references currently in their database, this award program has unlimited potential for many opportunities to add wallpaper to your shack. As of November 15th, 2022 nobody is listed for DME Master or DME Plus; and there are less than 10 for Top DME. However, the monoband category is full presently, which seems to be the most-commonly chased award. Here is the next award to chase in 2023 and I wish everyone luck who may take on the challenge.

*Email: <KI4KWR@cq-amateur-radio.com>

our readers say...

October Anniversary Articles

Editor, *CQ*:

What an awesome article about MFJ! ("MFJ at 50" and "CQ Classic," October *CQ*) Martin is one of the most humble super geniuses I've ever met (though very briefly in Dayton when he won an award — can't remember which). It was great that you named all of the folks in the pictures and I really got the feeling they were a big ol' family. I really think they need to make a movie about him. His comments in Dayton made me realize … wow, yeah, he didn't look like the other kids growing up but dang … he made the American dream become a reality! I still can't believe he drives a car with 100,000 miles on it. Wait. Strike that. Yes I can.

Thank you for the mag. The article. Can't wait to see y'all back in Dayton.

– 73 de Tom Foy, N4HAI

Editor, *CQ*:

The October issue has some great articles. I enjoy reading *CQ*. *CQ* has more interesting articles, with much better writing.

Great articles on MFJ, and I hope that it results in some MFJ ads in *CQ*. *QST* sometimes reads like an MFJ catalog. I stopped by the MFJ booth at Xenia last spring, and I suggested that they place ads in *CQ*.

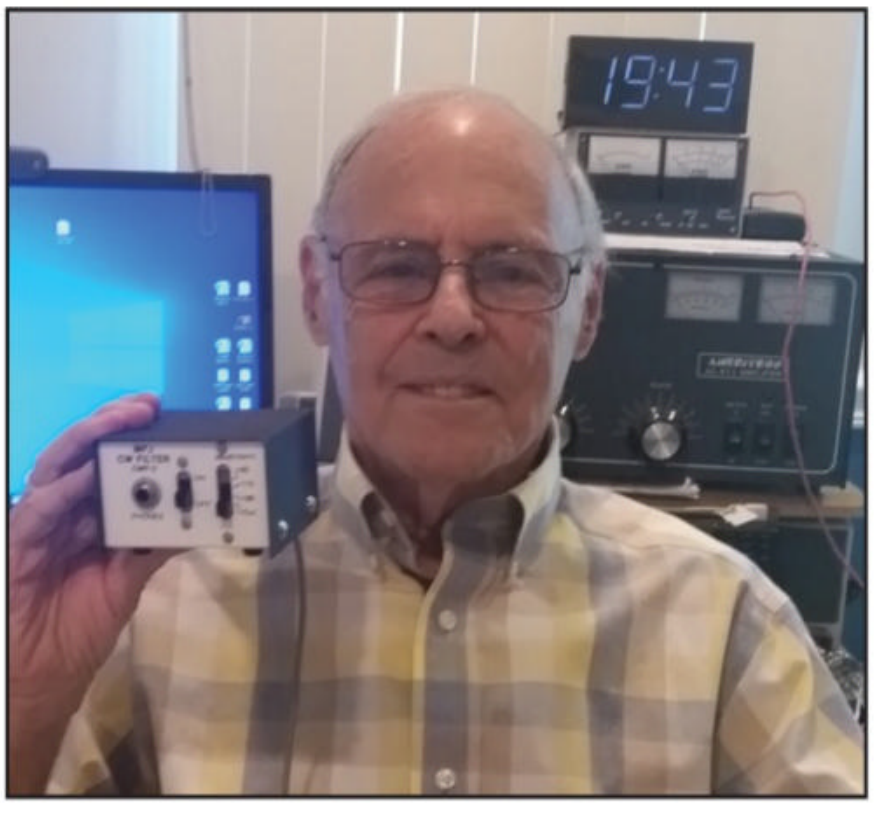
Excellent article on the Sputnik and the Cleveland high schoolers. I wonder whatever happened to the boys. Must be in their 80s by now. Did they end up becoming engineers, space scientists, etc.? Who knows? A few of the calls show up in QRZ.com, but with very few "views" indicating that they are not very active, if at all.

Keep up the great work.

– 73, Fred Matos, W3ICM

W2VU replies:

Hi Fred. Glad you enjoyed the articles. Some of the St. Joseph's club members have shared stories of their subsequent lives and careers on the club's commemorative webpage, <http://sjhrc.org>, under "Member Stories."



Dennis Lazar, W4DNN, with his original MFJ CW filter

Editor, *CQ*:

That was a great retro article describing Martin Jue and the origins of MFJ Enterprises. Talk about missed opportunities. In 1971, a year before Martin came out with his little CW filter box, while working with NASA on the Apollo moon lander, I designed and wrote an article in *73* magazine about a CW filter. It employed newly available toroids. Had I fabricated it and advertised it, perhaps the big name in ham equipment might have been DJL Enterprises, hi hi.

– Dennis J. Lazar, W4DNN

P.S. I still have my MFJ CW filter (see photo). Not quite as good as the one I designed but a bit smaller.

Cars and Ham Radio

The following letter was directed to Mobiling Editor Jeff Reihardt, AA6JR:

Hi Jeff, I thoroughly enjoyed your column comparing cars and ham radio. I'm a car nut of sorts too — I like drag racing: Speed, smoke, and noise! But I digress … the part about computers making contacts may not be far off. I distinctly remember Wayne Green (remember him?) saying in addition to what you said that "our computers will make contacts without us being there and *will tell us how much fun we had*." That's probably not too far off.

I'm 50/50 on self-driving cars. They're a bit scary but so are people driving down the interstate talking on their cell phone. Or reading a book like you mentioned!

I am a tinkerer and like to take things apart to see how they work and are put together and maybe even use some of the parts for a project. I also homebrew a LOT! See my QRZ page. I spend a lot of time (too much?) building, testing, etc., then moving on, leaving little time for operating a bit of CW, SSB, and FM … almost no FT8.

Keep up the good work on your columns in *CQ*!

– 73, Jim Kocsis, WA9PYH

AA6JR replies:

Jim, thanks for the nice note. I had the pleasure of chatting with Wayne many times; wrote a few pieces for *73* before I got on board with *CQ*. Wayne never lacked for opinions but they were always thought provoking.

I'm currently in the midst of a cross country motor trip and having a lot of fun along with great autumn scenery and getting together with old friends. So far I've made it from SoCal to Connecticut, may head down the east coast corridor next. Listening for traffic on the 2-meter call channel but so far, no contacts.

Thanks for reading *CQ* and for sharing your thoughts.

Editor, *CQ*:

I've been a ham for about 20 years or so (I think) and I consider myself pretty new at it. I enjoyed the article on "Fusion Cooking" (Math's Notes, November *CQ*). Not the least bit offensive in my view. I suppose I'm a fusion-fusion ham … haven't ever built a transmitter or receiver, but I have built and operated my own antennas. And you're absolutely correct, there is something to be said for the thrill of communication with something you actually built.

Thanks for the article and the perspective!

– 73 de KC2KVZ
Charlie Friderici

BY BOB SCHENCK,* N2OO

J28MD Djibouti – DXpedition to the Horn of Africa

BY ADRIAN CIUPERCA,# KO8SCA

*I hope everybody is getting ready for the upcoming 3YØJ DXpedition to Bouvet! This is gonna be fun! We wish the team a safe and successful DXpedition to one of the most remote islands in the world! This month, we turn over the keyboard to my friend Adrian, KO8SCA (*Photo A*), who will take us along for a look inside the recent J28MD DXpedition to Djibouti. I hope that you enjoy it!*

– 73 and see ya' in the pileups! Bob, N2OO

As I write these lines in early November, the 2022 Mediterraneo DX Club DXpedition to Djibouti with the callsign J28MD is coming to an end. The team effort and the good propagation produced a good number of QSOs (over 90k) and so everyone in the team is in good spirits and preparing for the long way home. Before getting into the details of the DXpedition, let me tell you a little bit about the location.

Djibouti

Djibouti is a country in Africa about the size of the state of New Jersey and has a predominantly Muslim population. Formerly known as French Somaliland, the country took its name as Djibouti when it gained independence from France in 1977.

The country is located in the Horn of Africa and is bordered by Somalia, Ethiopia, Eritrea, and the Red Sea. The Port of

Photo A. Adrian, KO8SCA, entertaining a local visitor. (All photos courtesy of J28MD team)

Photo B. The J28MD team

* Email: <n2oo@comcast.net>
# Email: <ciup@yahoo.com>

Photo C. J28MD team meeting at the Busto Arsizio Radio Club in Milan, Italy.

5 Band WAZ

As of November 15, 2022
2423 stations have attained at least the 150 Zone level, and 1107 stations have attained the 200 Zone level.

As of November 15, 2022
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
IZ3ZNR	199	1
JA1CMD	199	2
JA5IU	199	2
JA7XBG	199	2
JH7CFX	199	2
JI4POR	199	2
JK1AJX	199	2 on 10M
JK1BSM	199	2
JK1EXO	199	2
K1LI	199	24
K1OA	199	28
K3LR	199	23
K4HB	199	26
K5TR	199	22
K7UR	199	34
KZ4V	199	26
N3UN	199	18
N4NX	199	26
N4WW	199	26
N4XR	199	27
N6PF	199	23 on 10M
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
Callsign	Zones	Zones Needed
SP9JZU	199	19 on 10M
USØSY	199	1 on 15M
VK3HJ	199	34
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
AB4IQ	198	23, 26
DL6JZ	198	1, 31
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
JH1BNC	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
K3WA	198	23,26
K3XA	198	23,34
K4JLD	198	18, 24
K9MM	198	22, 26
KI1G	198	24, 23 on 10M
KZ2I	198	24, 26
LA3MHA	198	31 &32 on 10M
N4GG	198	18, 24
NXØI	198	18, 23
ON4CAS	198	1,19
OZ4VW	198	1, 2
RL3FA	198	2 on 80 & 10M
UA4LY	198	6 & 2 on 10M
UN5J	198	2, 7
US7MM	198	2, 6
Callsign	Zones	Zones Needed
W2IRT	198	28, 28
W5CWQ	198	17, 18
W7AH	198	22, 34
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
VA3VF	2413	10/04/2022	157
IT9DAA	2414	10/09/2022	181
JA3ENN	2415	10/10/2022	199
8P6NW	2416	10/15/2022	154
YB2DX	2417	10/15/2022	189
VA3VET	2418	10/21/2022	165
IU3FBL	2419	10/24/2022	157
WT2P	2420	10/25/2022	162
KI2D	2421	10/31/2022	151
KF2DT	2422	11/02/2022	154
JH4DYP	2423	11/12/2022	191

Updates to the 5BWAZ list of stations:

Callsign	5BWAZ #	Date	# Zones
HI3T	2318	8/19/2021	190
IK5ZUK	1908	6/8/2015	196
K3LR	2051	6/22/2018	199
HI3T	2318	8/19/2021	191
RC2A	2217	5/20/2020	190
UT4EK	1520	10/17/2006	197
EA5B	2305	4/30/2021	174

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

5BWAZ #	Callsign	Date	All 200 #
No Update			

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, Jose Castillo, N4BAA, 6773 South State Road 103, Straughn, IN 47387. 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 Jose Castillo. Applicants sending QSL cards to a *CQ* checkpoint or the Award Manager must include return postage. N4BAA may also be reached via email: <n4baa@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).

Djibouti is a maritime port strategically positioned near the world's busiest shipping lanes.

Our Location

The team leaders found an excellent operating location in Arta province, about an hour's drive from Djibouti's capital, a site located on the top of a hill, 700 meters (~2,000 feet) above sea level. The location is a hotel but also a training center for young people hoping to learn the skills for working in the hospitability industry.

The hotel manager was very flexible with our requests and that ensured our operating success. We received approval to install our numerous antennas on top of the buildings, on the hotel grounds, next to the buildings, on the fence, even with the risk of inconveniencing the other guests of the hotel.

The hotel manager was also instrumental in dealing with the local military administration as he was worried that our radio operation might interfere with the military activity in the compounds nearby.

I should mention here that the Arta location was not our initial location choice. Our initial chosen location was near the city of Obok but that location turned out to be too close to the "hot" border with Eritrea and too close to the current conflict areas. So the Djibouti Security Agency "suggested" that we avoid that area and search for a safer location closer to the capital city.

Photo D. Martino, IU8LMC, exercising his culinary skills.

Logistics

Organizing a 15-person DXpedition with the required radios, antennas, amplifiers, computers, and all other related equipment in a faraway location is a challenge itself, but organizing it in an unstable area of the globe such as the Horn of Africa, adds significantly to the challenge. To ensure team safety, the Italian team leaders have worked closely with the Italian Consulate in Djibouti, which in turn established a direct communication channel with the Djibouti Security Agency, providing the team leaders with the details needed to secure a safe location.

Of course, not everything worked out as planned. It never does. The Djibouti Airport Customs Office is just one such an example. It is frequently a challenge for DXpeditions to convince the customs officers that all the radio equipment being carried into the country will have no commercial usage but it is just hobby related. Djibouti customs was no exception. But the vast experience in organizing many prior DXpeditions came in handy for the team leaders, and after long negotiations, they were able to lower the customs fees significantly and that allowed us to start the DXpedition without wasting precious time.

Radio Equipment

Five Kenwood TS-590 radios (a small, light, performance radio with an RX

The WPX Program

CW

4068 .....K5YX
4069 .....NC4S

SSB

4445 .....VE3GJP
4446 .....K5YX
4447 .....ZL2ABK
4448 .....K4NWX
4449 .....W5MPB

Mixed

4502 .....9K2TV
4503 .....K3ZGA
4504 .....NZ2Z
4505 .....WD6Y
4506 .....W1MVY
4507 .....KY4KP
4508 .....NØBBD
4509 .....ZL2ABK
4510 .....MMØNBW
4511 .....N4QWB
4512 .....KA4RUR QRP
4513 .....KC1IZC
4514 .....JL3OXR
4515 .....W9JLF
4516 .....EA8DIB
4517 .....K1EHT

Digital

1840 .....9K2TV
1841 .....NZ2Z
1842 .....KQ4ADO
1844 .....W1MVY
1845 .....NØBBD
1846 .....ZL2ABK
1847 .....MMØNBW
1848 .....JH3CON
1849 .....K1BJC
1850 .....JR7CDI
1851 .....KC1IZC
1852 .....W9JLF
1853 .....KE9HS
1854 .....BH4DKR

CW: 350: ZL2ABK, KA4RUR. 650: JF2OHQ. 750: KG5RJ. 1700: W2YR.

SSB: 350: VE3GJP, YBØFLY. 400: ZL2ABK. 450: CE2EP. 750: IU8LMC. 1750: W2YR.

Mixed: 450: K7ZPJ, W1MVY, KA4RUR, KC1IZC, CE2EP. 500: WD6Y, MMØNBW, K1EHT. 600: ZL2ABK, W9NB. 650: 9K2TV. 700: NZ2Z, K5YX, KK6YYF. 750: VE3MSC. 850: K4NWX, KD2RUY. 900: N2YU. 950: N2TC. 1050: N6DSC, NC4S. 1150: IU8LMC. 1250: JF2OHQ. 1500: KA5WSS. 1950: EA5B. 2000: EA8DIB. 2100: EA3EQT. 2500: KG5RJ. 2800: TF5B.

Digital: 350; JH3CON. 400: W1MVY, K1EHT. 450: K7ZPJ, KC1IZC. 550: NZ2Z, N7JB. 600: 9K2TV, W9NB. 650: IU8LMC, K4NWX. 700: KK6YYF. 750: N2YU, VE3MSC. 850: KD2RUY. 900: EA3EQT, N2TC. 1050: KG5RJ, N6DSC. 1100: KA5WSS. 1500: EA5B. 2700: TF5B.

160 Meters: NZ2Z, NC4S
80 Meters: IU8LMC, W9NB, W9JLF, VE3MSC, K1EHT
60 Meters: KA5WSS
40 Meters: KG5RJ, VE3GJP, W9JLF, VE3MSC, EA8DIB, K1EHT
30 Meters: N7JB. VE3MSC, EA8DIB
20 Meters: KG5RJ, ZL2ABK, MMØNBW, VE3MSC
17 Meters: KK6YYF
15 Meters: KM4VI, N2TC
10 Meters: EA5B, KM4VI

Asia: 9K2TV, KG5RJ, N7JB, WD6Y, N2TC, W1MVY, ZL2ABK, IU8LMC, JH3CON, JR7CDI, JL3OXR, EA8DIB, BH4DKR
Europe: 9K2TV, KG5RJ, MMØNBW, K4NWX, NC4S, KC1IZC, CE2EP, VE3MSC, EA8DIB. K1EHT, KE9HS
Oceania: KG5RJ, ZL2ABK, JH3CON, YBØFLY, EA8DIB
North America: KG5RJ, NZ2Z, K3ZGA, N7JB, KQ4ADO, VE3GJP, WD6Y, W1MVY, KY4KP, NØBBD, K5YX, ZL2ABK, N4QWB, K1BJC, K4NWX, NC4S, KA4RUR, W5MPB, KC1IZC, W9JLF, EA8DIB, K1EHT
South America: KG5RJ, N2TC, EA8DIB

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.

input) and four ACOM 1011 amplifiers (light, portable, 600 watts out) were used for the following four operating positions:

1. CW only
2. DIGITAL: RTTY & FT8
3. MIX: CW & SSB
4. SSB only

For EME operation, an FT-857 radio was used, with a 1-kilowatt amplifier (Phoenix 1000 50 / 70 / 144 MHz) There was also a sixth TS-590 radio, dedicated to the 6-meter FT8 operation position. All QSO logging laptops run Windows 10 with WinTest logging software.

One interesting aspect is the fact that our DXpedition provided almost real-time logging online via the internet, using HRDlog <www.hrdlog.net>, allowing hams to see their QSOs posted a few minutes after working our DXpedition.

Unfortunately, the internet connection at our hotel was not reliable and so, sometimes, the live update feature would stop working temporarily, causing hams to doubt their QSO was in the log and thus making dupe QSOs.

After two days, the team leaders were able to discuss this issue with the hotel management and we were granted per-

Photo E. Team members IZ3GNG, IZ2GNQ, IU8LMC, YO8WW, and team leader IZ8CCW raising a wire beam antenna.

The WAZ Program

SINGLE BAND WAZ

6 Meter

201 .....HI3T, (25 Zones)

15 Meter CW

382 .....SP9JZU

15 Meter Digital

14 .....K3EA

17 Meter CW

137 .....AA6AA

17 Meter Digital

29 .....JG4BLW

20 Meter Digital

58 .....IUØAWH

ALL BAND WAZ

CW

1213 .....KF2DT

Digital

397 .....USØYA
398 .....DM6MA
399 .....JA5AEA
400 .....YV5KAJ
401 .....WT2P
402 .....W3GP
403 .....KB2BK
404 .....JH4DYP

Mixed

10329 .....DM6MA
10330 .....IK3ASM
10331 .....IU3FBL
10332 .....IKØKXP
10333 .....WT2P
10334 .....KI2D
10335 .....JM8FEI
10336 .....N1RM
10337 .....NE9U
10338 .....KF2DT
10339 .....DL6NAV
10340 .....KB2BK
10341 .....DK1KW
10342 .....ON8AH
10343 .....PA5BM
10344 .....VK4KX

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, Jose Castillo, N4BAA, 6773 South State Road 103, Straughn, IN 47387. 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 Jose Castillo. Applicants sending QSL cards to a *CQ* checkpoint or the Award Manager must include return postage. N4BAA may also be reached via email: <n4baa@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).

The CQ DX Field Award Program

Digital Endorsement

NK0S 150
WA5VGI 156
W1CU 206

CW Endorsement

W1CU 254

SSB Endorsement

W1CU 249

Mixed Endorsement

W9RPM 184
WA5VGI 216
K1NU 204
W1CU 254

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, Keith Gilbertson, KØKG, 21688 Sandy Beach Lane, Rochert, MN 56578-9604 USA. Please make all checks payable to the award manager.

CQ DX Awards Program

CW Endorsement

W4UM 201
W2OR 316
N4RF 318
K9VKY 331

SSB Endorsement

KM2P 340

RTTY Endorsement

K4FQJ 304

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.

CQ DX Field Award Honor Roll

The CQ DX Field Award Honor Roll recognizes those DXers who have submitted proof of confirmation with 175 or more grid fields. Honor Roll lisiting is automatic upon approval of an application for 175 or more grid fields. To remain on the CQ DX Field Award Honor Roll, annual updates are required. Updates must be accompanied by an SASE if confirmation is desired. The fee for endorsement stickers is $1.00 each plus SASE. Please make all checks payable to the Award Manager, Keith Gilbertson. Mail all updates to Keith Gilbertson, KØKG, 21688 Sandy Beach Lane, Rochert, MN 56578-9604.

Mixed

K2TQC.....288	HA1RW.....239	WI8A.....219	KF8UN.....205	ON4CAS.....194	K2SHZ.....182
W1CU.....269	VE3XN.....239	HA1AG.....218	OM2VL.....205	HB9DDZ.....193	KJ6P.....180
VE7IG.....254	I6T.....230	WA5VGI.....216	K1NU.....204	N4NX.....192	W6XK.....180
HAØDU.....253	K8OOK.....229	JN3SAC.....214	K1NV.....204	HA1ZH.....190	W5ODD.....177
OM3JW.....253	N8PR.....229	HA9PP.....213	VE7SMP.....204	BA4DW.....188	NØFW.....176
W6OAT.....252	HA5AGS.....228	IV3GOW.....211	RW4NH.....203	K2AU.....187	WA9PIE.....176
HA5WA.....250	9A5CY.....227	W4UM.....210	HB9AAA.....200	K8YTO.....186	HB9BOS.....175
IK1GPG.....245	K9YC.....227	N4MM.....208	N5KE.....200	WO7R.....185	NKØS.....175
OK1ADM.....245	VE3ZZ.....226	OK1AOV.....208	W3LL.....199	N3RC.....184	
K8SIX.....240	KØDEQ.....221	F6HMJ.....206	NIØC.....196	W9RPM.....184	

SSB

W1CU.....249	VE7SMP.....201	W4UM.....198	N4MM.....189	W3LL.....187	DL3DXX.....175
W4ABW.....202	KØDEQ.....198	JN3SAC.....191	WA5VGI.....189	NØFW.....176	

CW

W1CU.....254	KØDEQ.....214	DL2DXA.....209	WA5VGI.....197	N4MM.....186	N7WO.....175
HA5WA.....234	JN3SAC.....211	W4UM.....201	NIØC.....196	OK2PO.....184	
DL6KVA.....233	DL3DXX.....210	OK1AOV.....198	HB9DZZ.....189	N4NX.....177	

Digital

W1CU.....206	HA5WA.....177	JN3SAC.....175	KØDEQ.....175

mission to patch directly into the main facility internet router, significantly improving the reliability of our connection.

The Team

The J28MD team was made up of 15 ham operators from Italy, France, Germany, Romania, and the USA (*Photo B*).[1] The team members met at the start of the DXpedition on October 27, 2022 at the Busto Arsizio radio club outside Milan, Italy (*Photo C*). The hosts at the radio club did an incredible job so that all of us felt welcome. Italian pasta prepared at the club and wine were, of course, the staples of the served lunch. The clubhouse was the stage for gathering of all the equipment and team members before the journey to Djibouti. This has been a tradition for all the Mediterraneo DX Club past DXpeditions.

On every DXpedition, each team member brings skills which enhance the overall success of the DXpedition. These include technical skills acquired from participating in previous DXpeditions or as part of the daily-life job: Antenna designers, IT consultants, engineers, etc. But on Saturday evening, other skills were revealed when Martino, IU8LMC, exercised his culinary skills in the hotel's kitchen (*Photo D*) to prepare an excellent Italian evening for the team with pasta, gnocchi, and pizza.

Antennas

The main ingredient of any DXpedition is the antennas and so J28MD had a wide array of antennas raised in the air or laid on the ground (*Photo E*) to allow

Photo F. Baboon visiting the J28MD antenna field.

Photo G. A camel walking by our Spiderbeam wire beam antennas and the 80-meter vertical.

multiple modes of operation simultaneously in the same band (in-band operation). They were:

• Four Spiderbeam wire beams for 10 / 15 / 20 / 40 meters as well as the WARC bands (30, 17, and 12 meters), which generated the bulk of the QSOs and took advantage of the incredible openings that we witnessed on the 12- and 10-meter bands.

• 80-meter vertical with 16 ground radials built on a fiberglass Spiderpole

• 160-meter Spiderbeam wire vertical on an 18-meter fiberglass pole with a capacitive hat

• BOG (Beverage On the Ground) receive antennas for NA / EU / AS that were shared by multiple stations and used for 160-, 80-, and 40-meter operating

• 40- and 60-meter verticals

The WPX Honor Roll

The WPX Honor Roll is based on the current confirmed prefixes which are submitted by separate application in strict conformance with the CQ Master Prefix list. Scores are based on the current prefix total, regardless of an operator's all-time count. Honor Roll must be updated annually by addition to, or confirmation of, present total. If no up-date, files will be made inactive. Visit <https://tinyurl.com/mrxuvwvv> for current listings.

MIXED

9676.....9A2AA	4763.....KW9A	3109.....NXØI	2465.....N6PM	1870.....N5KAE	1480.....K4JKB	1217.....AB1QB	1032.....DG5LAC	757.....WB3D
8663.....9A2NA	4757.....I2MQP	3099.....N6FX	2420.....WA6KHK	1828.....K7LV	1462.....AC7JM	1204.....VA2IG	1023.....N4WQH	750.....AB1Q
8188.....K2VV	4703.....IK2ILH	3077.....K1PL	2400.....N7ZO	1824.....WF7T	1462.....DL4CW	1201.....K9BO	1016.....W9QL	736.....JA3MAT
8188.....W1CU	4668.....JH8BOE	3028.....IK2DZN	2391.....WO7R	1821.....PY5FB	1447.....K3XA	1167.....WA9PIE	1012.....NØVVV	711.....AG1T
7059.....EA2IA	4574.....JN3SAC	2992.....W2YR	2391.....IZØFUW	1746.....K6UXO	1437.....KC1UX	1153.....N3CAL	1010.....VE3RZ	695.....W8WDW
6955.....KF2O	4461.....K1BV	2987.....AG4W	2356.....NE6I	1741.....N6PEQ	1422.....I2VGW	1148.....SP8HKT	1007.....AA4QE	682.....AI8P
6040.....KØDEQ	4423.....N1RR	2968.....AB1OC	2225.....JH1APK	1711.....NS3L	1408.....NH6T	1141.....4F3BZ	1006.....NØRQV	678.....WE8L
5859.....ON4CAS	4417.....WD9DZV	2963.....N3RC	2203.....KI1U	1707.....K4WY	1398.....ES4RLH	1137.....YO5BRZ	1000.....WB6IZG	674.....N5JED
5826.....ON4APU	4342.....WB2YQH	2697.....AK7O	2176.....V51YJ	1684.....W1FNB	1361.....VA3VF	1136.....KO9V	999.....N3DF	661.....AL4Y
5715.....S53EO	4298.....VE3XN	2651.....HK3W	2159.....VA7CRZ	1672.....WU9D	1333.....AF4T	1116.....YU7FW	995.....PU2GTA	633.....TI5LUA
5597.....N4NO	4241.....N6QQ	2642.....AA8R	2133.....KØKG	1667.....AD3Y	1322.....AA4FU	1112.....N6MM	966.....W6WF	621.....K4HDW
5511.....N8BJQ	4215.....W3LL	2616.....9A2GA	2113.....W2FKF	1643.....SV1DPI	1301.....KB9OWD	1107.....PY2MC	953.....JP1KHY	616.....AC6BW
5482.....VE1YX	4201.....YO9HP	2591.....IK2RPE	2077.....JH1QKG	1639.....N7QU	1301.....K1DX	1100.....WA3GOS	919.....ON7MIC	605.....IW2FLB
5453.....YU1AB	3818.....K9UQN	2589.....DG7RO	2056.....NKØS	1616.....TA1L	1301.....KM5VI	1109.....KE8FMJ	908.....N2YU	
5409.....N6JV	3793.....AB1J	2583.....PA2TMS	2046.....YO8CRU	1590.....JF1LMB	1299.....JA6JYM	1088.....NJ4Z	889.....WU1U	
5387.....W9OP	3538.....9A4W	2583.....AE5B	2016.....N2WK	1570.....PY5VC	1295.....NIØC	1084.....KG4JSZ	866.....K2KJ	
5215.....I5RFD	3459.....W9IL	2550.....K6ND	1995.....JR3UIC	1568.....N3AIU	1280.....WF1H	1069.....IZ4MJP	857.....R1AV	
5172.....W9OO	3130.....SV1EDY	2457.....K5UR	1972.....K3CWF	1524.....NH6T/W4	1260.....UR6LEY	1058.....N6DBF	835.....K6RAH	
5018.....WA5VGI	3109.....W6XK	2538.....K4HB	1955.....NIØC	1484.....FG4NO	1219.....K6HRT	1036.....DL5KW	758.....N4JJS	

SSB

7045.....OZ5EV	3174.....I3ZSX	2515.....W9IL	2094.....I8LEL	1587.....N3XX	1150.....VE6BMX	1004.....WA5UA	758.....IV3GOW	637.....K5WAF
6334.....9A2NA	3172.....YO9HP	2483.....AG4W	2093.....W2WC	1550.....IK2RPE	1146.....SQ7B	978.....EA7HY	724.....WF1H	630.....W6US
6145.....K2VV	3141.....DL8AAV	2451.....EA3GHZ	2084.....K5UR	1442.....DG7RO	1136.....K3CWF	957.....W9QL	724.....W3TZ	624.....K6KZM
5404.....VE1YX	3139.....N8BJQ	2443.....JN3SAC	2076.....K2XF	1393.....N5KAE	1112.....NH6T	934.....PY5VC	717.....KØDAN	606.....KJ4BIX
5149.....KF2O	3108.....I4CSP	2335.....KG1E	2048.....W4QNW	1389.....NKØS	1098.....K4CN	931.....YB1AR	717.....N3JON	604.....GØBPK
4916.....EA2IA	3104.....WA5VGI	2327.....K1PL	1955.....EA3NP	1386.....HK3W	1096.....JA7HYS	929.....NS3L	714.....YB2TJV	
4410.....I2MQP	3067.....N6QQ	2326.....CX6BZ	1935.....SV1EOS	1386.....IK4HPU	1093.....N6MM	919.....KA5EYH	713.....JH1APK	
4165.....KØDEQ	2990.....KF7RU	2209.....IK2QPR	1884.....WA6KHK	1371.....VE6BF	1089.....IZ8FFA	893.....W9RPM	710.....WA9PIE	
3723.....I8KCI	2984.....KI7AO	2201.....NQ3A	1879.....K3IXD	1338.....NE6I	1089.....IT9ABN	889.....N3AIU	700.....N4FNB	
3681.....N4NO	2946.....PT7ZT	2200.....N6FX	1848.....AB5C	1334.....EA3EQT	1042.....IZØBNR	875.....K7SAM	700.....JA1PLL	
3585.....SV3AQR	2903.....IN3QCI	2198.....AB1OC	1825.....KQ8D	1264.....N6PEQ	1032.....DG5LAC	854.....K6HRT	694.....KG4HUF	
3535.....KW9A	2857.....4X6DK	2155.....K9UQN	1812.....K6ND	1262.....K7LV	1031.....K4CN	833.....DK8MCT	690.....W6PN	
3456.....W9OO	2650.....IK2DZN	2131.....N3RC	1699.....W2YR	1258.....N1KC	1031.....IK8OZP	808.....UR6LEY	684.....KO9V	
3416.....W3LL	2595.....EA1JG	2129.....AE5B	1646.....VE7SMP	1222.....YF1AR	1022.....NW3H	802.....N6OU	675.....F1MQJ	
3348.....CT1AHU	2582.....PA2TMS	2113.....W2FKF	1641.....AE9DX	1187.....IZ1JLG	1012.....KU4BP	801.....K3XA	655.....VA3VF	
3274.....YU7BCD	2576.....AA1VX	2112.....WD9DZV	1622.....K5CX	1183.....KI1U	1006.....NJ4Z	766.....I2VGW	647.....YB8NT	
3184.....N1RR	2568.....SM6DHU	2109.....NXØI	1611.....W2ME	1151.....W6XK	1004.....K4HB	763.....K4JKB	640.....UA9YF	

CW

7543.....WA2HZR	4164.....WA5VGI	3031.....EA7AAW	2357.....W9HR	1708.....NIØC	1421.....KN1CBR	992.....F5PBL	807.....N5KAE	620.....AF5DM
7200.....K2VV	4076.....I7PXV	2948.....IK3GER	2291.....N3XX	1691.....KI1U	1389.....IT9ELD	968.....K3CWF	783.....YB1AR	615.....JH6JMM
6024.....9A2NA	3974.....JN3SAC	2943.....N6QQ	2212.....AC5K	1672.....W2YR	1342.....VE6BMX	962.....K7LV	752.....K6HRT	608.....W9RPM
5392.....EA2IA	3804.....W9OO	2915.....KA7T	2203.....NXØI	1633.....W6XK	1235.....JH1APK	944.....AB1OC	743.....JA5NSR	600.....NY4G
5311.....N6JV	3773.....KW9A	2811.....OZ5UR	2022.....AF5CC	1620.....DG7RO	1220.....AA4FU	908.....NH6T	738.....NH6T/W4	600.....IK2SGV
5261.....KF2O	3647.....N1RR	2679.....W9IL	1998.....K5UR	1595.....PY5FB	1210.....DL4CW	897.....HK3W	732.....SQ7B	
5160.....N4NO	3504.....YU7BCD	2548.....EA2CIN	1973.....N3RC	1555.....K1PL	1196.....N3AIU	891.....DK8MCT	727.....JF1LMB	
4992.....W8IQ	3462.....K9UQN	2531.....I2MQP	1905.....WA6KHK	1508.....W6XK	1098.....LU5OM	890.....NS3L	722.....WA9PIE	
4916.....IZ3ETU	3279.....IØNNY	2497.....W3LL	1832.....N4YB	1483.....VE1YX	1088.....AE5B	889.....N3AIU	720.....K4CN	
4886.....I3FIY	3220.....WD9DZV	2490.....N6FX	1762.....K6ND	1480.....WO3Z	1062.....K3XA	864.....YO5BRZ	652.....IK2DZN	
4874.....KØDEQ	3214.....SM6DHU	2477.....VE6BF	1744.....NE6I	1458.....AG4W	1036.....DL5KW	848.....PY5VC	636.....NKØS	
4769.....N8BJQ	3041.....YO9HP	2424.....W2WC	1727.....K6UXO	1443.....WA2VQV	997.....N6PEQ	821.....HB9DAX	629.....IV3GOW	

DIGITAL

3187.....KØDEQ	2251.....EA2IA	1759.....N7ZO	1378.....K3CWF	1108.....KE8FMJ	1002.....NØRQV	866.....SQ7B	750.....ON7MIC	636.....W9RPM
3137.....KF2O	2242.....HK3W	1727.....W2YR	1353.....K1PL	1093.....KI1U	992.....N3DF	862.....JP1KHY	750.....NH6T/W4	611.....KO9V
2996.....W3LL	2345.....WA5VGI	1704.....IK2DZN	1345.....KC1UX	1091.....VA3VF	992.....K9UQN	855.....R1AV	681.....PY5VC	600.....ADØFL
2978.....N8BJQ	2308.....N6PM	1638.....N1RR	1333.....W1FNB	1089.....AC7JM	983.....PU2GTA	812.....UR6LEY	680.....K2KJ	
2929.....WD9DZV	2217.....YO9HP	1643.....N3RC	1308.....NKØS	1060.....AF4T	966.....NS3L	811.....WF1H	672.....K9AAN	
2628.....W6XK	1836.....AG4W	1501W2/JR1AQN	1227.....ES4RLH	1054.....KW9A	947.....I2VGW	810.....N3CAL	670.....IV3GOW	
2558.....NT2A	1818.....W1EQ	1500.....JH1APK	1189.....JF1LMB	1051.....KH6SAT	917.....K7LV	800.....WA3GOS	668.....KA5EYH	
2518.....K2YYY	1811.....NXØI	1461.....WU9D	1149.....W9IL	1047.....RW4WZ	881.....NE6I	783.....YB1AR	654.....JA3MAT	
2345.....WA5VGI	1790.....JN3SAC	1426.....AB1OC	1112.....AB1QB	1009.....GUØSUP	870.....WB6IZG	758.....N4JJS	640.....WA9ONY	

REMOTE OPERATION

CW	MIXED	SSB	DIGITAL
7277.....K9QVB	4026.....N1RR	2953.....N1RR	671.....N1RR
3292.....N1RR			

Photo H. EME antenna, 80-meter vertical, and wire beam antennas in the sunset.

- 80-meter dipole raised between three street light poles
- 6-meter Hexbeam
- 2-meter beam with 16 elements, designed by IØJXX

Although the hotel is fenced-in, some wildlife would always find its way in. The large monkeys (sacred baboons; *Photo F*) seemed to particularly enjoy chewing the 160-meter antenna radial wires. There were also some camels on the premises (*Photo G*) that the staff attempted to ride and sometimes we had to make some minor antenna repairs as a result.

Earth-Moon-Earth (EME)

Moonbounce is the technical pinnacle of ham radio and consists of sending amateur radio signals to the moon. A tiny fraction of those signals is reflected back to Earth and received by another ham located somewhere else on our

Photo I. Gilles, F6IRA, and Dario, IZ4UEZ, adjusting one of the vertical antennas.

Photo J. Fabio, IK4QJF, and Steve, AG4W, operating digital modes and SSB.

planet. This was the first ever 2-meter EME operation from Djibouti and resulted in 131 QSOs.

Emil, DL8JJ, was in charge of the EME operation and he was challenged by the local RF noise, a frequent occurrence everywhere in our modern society, and thus he needed to change the location of the 16-element portable EME antenna (*Photo H*) a few times during our stay here.

Operating

After the antenna installation at the beginning of the DXpedition in which everyone participated (*Photo I*), each operator had two daily operating shifts of three hours each (*Photo J*) and a day off that the operators could use to relax or make excursions nearby.

The focus of the DXpedition was the "human modes," i.e., CW and SSB, and that clearly shows in the log statistics. The CW contacts are taking a whopping 35% of the total log with 25% on SSB while the rest are RTTY, FT8, and JT65 QSOs. J28MD was also active on RTTY, giving a chance to those die-hard RTTY operators to add J2 to their logs.

For more details, statistics, and additional pictures from our DXpedition please visit the DXpedition homepage at <https://mdxc.org/j28md> and the J28MD Facebook page.

– 73, Adrian Ciuperca, KO8SCA
Arta, Djibouti

Note:

1. The J28MD team members are: Antonio Cannataro, IZ8CCW, team leader; Dario Grossi, IZ4UEZ, organizational support & low bands; Marco Zanchi, IZ2GNQ, technical manager; Marco Piras, IZ3GNG; Gabi Paisa, YO8WW; Emil Bergmann, DL8JJ; Peter Schmeiduch, DL6LZM; Fabio Azzali, IK4QJF; Max George, NG7M; Adrian Ciuperca, KO8SCA; Gerhard Richter, DJ5IW; Uwe Koenneker, DL8OBF; Martino Merola, IU8LMC; Steve Werner, AG4W; and Gilles Desansac, F6IRA.

announcements *(from page 2)*

BISMARCK, NORTH DAKOTA — The Central Dakota Amateur Radio Club will hold the CDARC 2023 Hamfest from 7:30 a.m. to 12:30 p.m. Saturday, February 25 at the Bismarck State College Career Academy, 1221 College Drive. Contact: Lorne Campbell <lorne@bis.midco.net>. Website: <http://cdarcnd.com>. Talk-in 146.85-. VE exams.

COLCHESTER, VERMONT — The Radio Amateurs of Northern Vermont will hold Ham-Con 2023 from 8 a.m. to 1 p.m., Saturday, February 25 at the Hampton Inn, 42 Lower Mountain Road. Phone: (802) 879-6589. Email: <w1sj@arrl.net>. Website: <ham-con.org>. Talk-in 145.15-. VE exams, card checking.

ORANGE, TEXAS — The Orange Amateur Radio Cub, Jefferson County Amateur Radio Club, and Beaumont Amateur Radio Club will hold the Orange Hamfest 2023 and 2023 ARRL Texas State Convention from 7:30 a.m. to 2 p.m., Saturday, February 25 at the Orange County Convention & Expo Center, 11475 FM 1442. Contact: Rocky Wilson, (409) 988-8906. Email: <n5mtx55@gmail.com>. Website: <www.qsl.net/w5nd>. VE exams

PERRY, IOWA — The Hiawatha Amateur Radio Club will hold its Winter RF Fest from 8 a.m. to noon, Saturday, February 25 at the Perry National Guard Armory, 2930 Willis Avenue. Contact Bob Ray, KDØBR, (515) 334-7231. Email: <hamfest@harciowa.org>. Website: <www.qsl.net/kd0neb>. VE exams.

MARCH

ROSENBERG, TEXAS — The Brazos Valley Amateur Radio Club will hold the Greater Houston Hamfest and 2023 ARRL Texas State Convention on Friday, March 3 and Saturday, March 4 at the Fort Bend County Fairgrounds, 4310 Texas 36. Phone: (713) 826-6917 or (713) 569-8799. Website: <www.houstonhamfest.org>. Talk-in 146.94 (PL 167.9). VE exams.

TRUSSVILLE, ALABAMA — The Birmingham Amateur Radio Club will hold the BirmingHAMfest 2023 and 2023 ARRL Alabama Section Convention from 4-7 p.m., Friday, March 3 and from 8:30 a.m. to 4 p.m., Saturday, March 4 at the Trussville Civic Center, 5381 Trussville-Clay Road. Contact: Rosalind Fazel, KD4ZGO, (205) 853-3220. Email: <rfazel.rf9@gmail.com>. Website: <www.birminghamfest.org>. Talk-in 146.88 (PL 88.5). VE exams.

CAVE CITY, KENTUCKY — The Mammoth Cave Amateur Radio Club will hold the 47th Annual Cave City Hamfest beginning 7:30 a.m., Saturday March 4 at the Cave City Convention Center, 502 Mammoth Cave Street. Contact: Larry Brumett, KN4IV, (270) 651-2363 or (270) 308-1417 (cell). Email: <lbrumett@glasgow-ky.com>. Website: <http://ky4x.org>. Talk-in 146.35+. VE exams.

CONCORD, NORTH CAROLINA — The Mecklenburg Amateur Radio Society will hold the Charlotte Hamfest from 3-7 p.m., Friday, March 10 and from 8:30 a.m. to 4 p.m., Saturday, March 11 at the Cabarrus Arena & Events Center-Gold Hall, 4551 Old Airport Road. Phone: (704) 948-7373. Website: <www.charlotte-hamfest.org>. Talk-in 146.655 or 146.940 (PL 118.8).

PUYALLUP, WASHINGTON — The Mike & Key Amateur Radio Club will hold the 41st Annual Mike and Key Electronics Show & Swap Meet from 9 a.m. to 3 p.m., Saturday March 11 at the Pavilion Exhibition Hall, Washington State Fairgrounds, 110 9th Avenue SW. Phone: (253) 631-3756. Email: <n7wa@arrl.net>. Website: <www.mikeandkey.org>. Talk-in 146.82- (PL 103.5). VE exams.

RAYNE, LOUISIANA — The Acadiana DX Association will hold its Hamfest & Swapmeet from 8 a.m. to 2 p.m., Saturday, March 11 at the Rayne Civic Center, 210 Frog Festival Drive. Contact: James Romero, K5CNU, (337) 319-6414. Email: <k5cnu@att.net>. Website: <http://kn5grk.com>. Talk-in 145.410 (PL 123). VE exams.

TULLAHOMA, TENNESSEE — The Middle Tennessee Amateur Radio Society will hold the MTARS Tullahoma Hamfest from 8 a.m. to 2 p.m., Saturday, March 11 at the First United Methodist Church, 208 West Lauderdale Street. Contact: Larry Cagle, K4WLO, (251) 680-3250. Email-: <k4wlo@arrl.net>. Website: <www.mtars-ham.org>. Talk-in 146.700- (PL 114.8) or 443.950+ (PL 107.2). VE exams.

FORT WALTON BEACH, FLORIDA — The Playground Amateur Radio Club will hold its 53rd Annual Hamfest from 4-7 p.m., Friday, March 17 and from 8 a.m. to 2 p.m., Saturday, March 18 at the Northwest Florida Fairgrounds, 1958 Lewis Turner Boulevard. Phone: (850) 359-9186. Email: <hamfest@w4zbb.org>. Website: <www.w4bzz.org>.

BUFFALO, MINNESOTA — The Maple Grove Radio Club will hold its 39th Annual Midwinter Madness Hobby Electronics Show from 8 a.m. to noon, Saturday, March 18 at the Buffalo Civic Center, 1306 County Road 134. Phone: (763) 537-1722. Website: <http://k0ltc.org>. Talk-in 147.000+ (PL 114.8). VE exams, ARRL card checking.

LOOMIS, CALIFORNIA — The Sierra Foothills Amateur Radio Club will hold the 7th Annual Loomis Hamfest from 7 a.m. to noon, Saturday, March 18 at the Historic Loomis Train Depot, 5775 Horseshoe Bar Road. Website: <www.w6ek.org>.

STUART, FLORIDA — The Martin County Amateur Radio Association will hold the 48th Annual Stuart Hamfest from 8 a.m. to 2 p.m., Saturday, March 18 at the Martin County Fairgrounds, 2616 SE Dixie Highway (A1A). Website: <www.mcaraweb.com>. Talk-in 145.150- (PL 107.2).

TROY, MICHIGAN — The Utica Shelby Emergency Communications Association will hold the USECA 2023 Swap and Shop from 8 a.m. to 2 p.m., Saturday, March 26 at the Balkan America Community Center, 1451 E. Big Beaver Road. Website: <http://usecaarc.org>. VE exams.

contesting

BY TIM SHOPPA,* N3QE

Voice Keyers to Give Your Vocal Cords a Break

The SSB edition of the North American QSO Party — starting on Saturday, January 21 in 2023 — will be packed with action from hams with a wide range of contesting experience. Experienced contesters flock to the NAQPs to practice advanced SO2R (Single-Operator 2 Radio) techniques. Recently licensed hams looking to quickly earn credit toward awards such as Worked All States (WAS) turn up in big numbers. Operators with some experience and modest stations will be able to hold a run frequency and call CQ with success, as the 100-watt limit for all entrants help flatten the playing field. This month, let's look at the messages and recording technologies that will lessen stress on your vocal cords and optimize your fun in any SSB contest.

Figure 1 shows five different methods of voice keying in a contest. All feature a memory component denoted by M that can record and play back short audio messages. With the "+" sign, I also identify the mixing or selection component that combines two audio sources.

Figure 1a shows a traditional voice memory keyer, such as the MFJ-434B, between the microphone and radio. The basic user interface is a set of buttons on the front of the voice keyer to allow initiation of playback and recording of contest messages; when the memory function is not being invoked, the unit passes audio through from the microphone to the rig. This style of keyer is largely independent of computer logging; many computer logging users added their own parallel port interface to allow keyboard commands to the logging software to send pulses via a parallel port with simulated button pushes on the keyer.

Figures 1b through *1d* show various ways of getting computer .WAV files to mix with microphone audio and into the radio. The mixer element in *Figure 1b* may be as simple as a resistor network that sums audio from the microphone with that from the computer, or as complex as a small USB-soundcard mixer console that accepts analog microphone-level input. I've used the Behringer XENYX 302USB with success for simple mixing and level adjustment; there are more advanced models from several manufacturers that allow full parametric equalization of your microphone audio.

Figure 1c shows a variation in which the audio file is stored and played back from the computer, often called WAV keying after the audio file. Two audio inputs are used in the radio: One for the microphone and a separate input for audio from the computer. The audio from the computer may be fed into the radio via line-level analog cabling, or the computer may interface to a USB sound card, a feature of most recent HF rigs. One detail that will vary from rig to rig is how the radio selects its audio source; some will accept input from two sources simultaneously, but more commonly the PTT switch and/or CAT commands from the computer may be necessary to switch the transmit audio source between microphone and computer.

Figure 1d is yet another variation on computer-based WAV keying; here the microphone does not attach directly to the radio, but is a sound card input to the computer. The computer — either in the sound card or in a virtual audio mixer — mixes the microphone audio with contest message WAV playback, which is then delivered for transmission by the radio. The user interface for mixing and level adjustment resides in the computer's on-screen mixer panel, which is appealing to those who don't want to tweak physical radio or mixer audio level knobs. At the same time, even microphone audio becomes utterly dependent on the computer and its

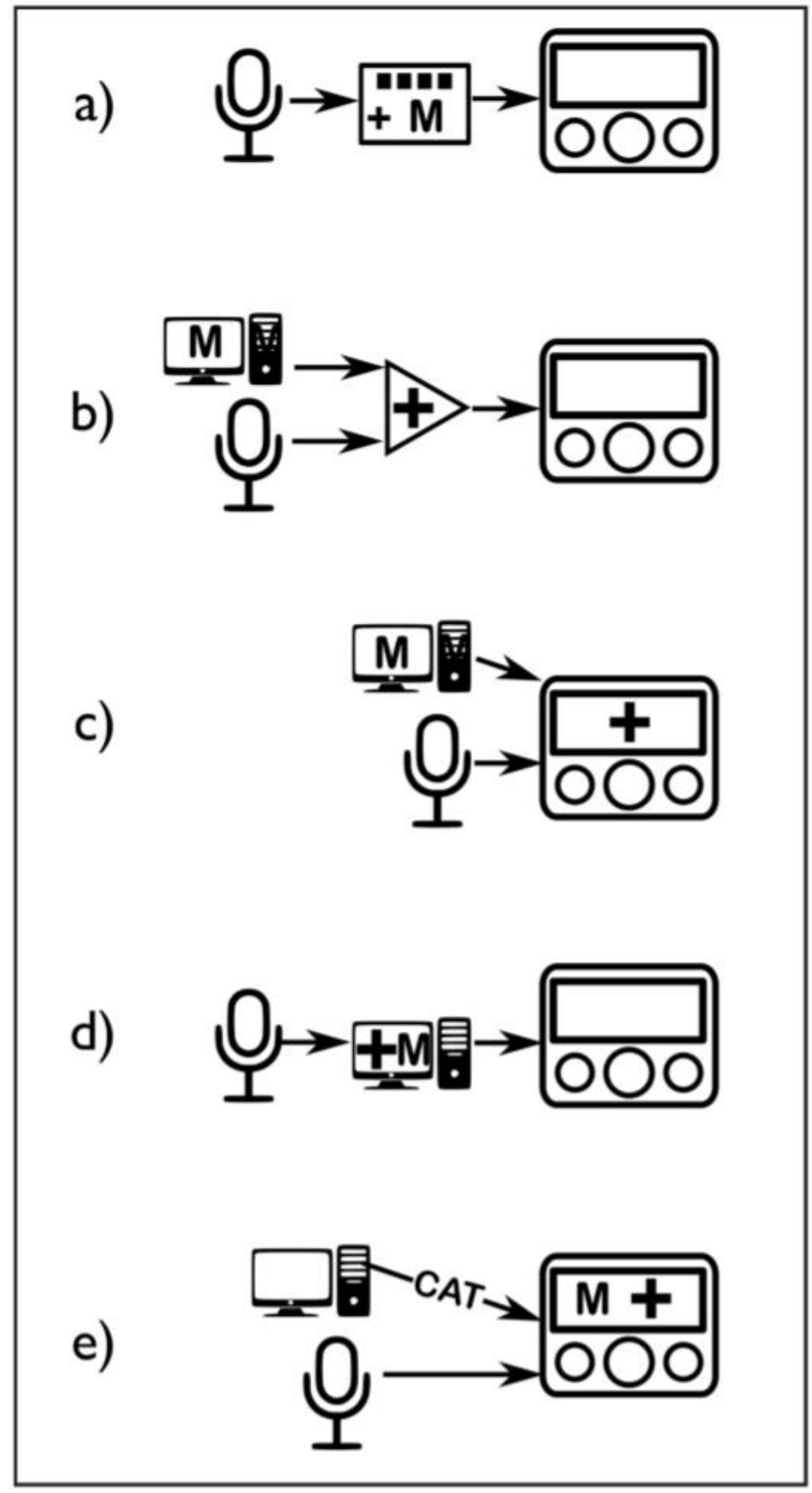


Figure 1. Five common configurations for contest voice keying. The memory element is marked with M; the mixer or selector element is marked with a plus sign (+). See text for details.

email: <n3qe@cq-amateur-radio.com>

audio drivers functioning, and any computer glitch will take you off the air until its resolved.

Finally, *Figure 1e* shows a configuration that you may prefer if your radio has an internal digital voice keyer. Just a few years ago internal DVKs were options, but they are increasingly common in recent HF rigs. Both the memory and selection functions reside in the radio; playback of messages may be triggered either from the front panel or touch screen of the radio, or preferably through CAT commands initiated from the computer's logging software.

No matter which signal flow delivers audio messages to the computer or the logging software, contest software authors have agreed on the function key mappings for the four most common recorded audio messages. If you are using computer-based WAV messages, you may be able to define a dozen or more possible messages; if you are using a radio or external DVK, you may be limited to four or five stored messages.

Standard Function Key Messages

The F1 key traditionally is used for the long CQ message. In the recently completed ARRL November SSB Sweepstakes, my long CQ of "CQ Sweepstakes, November Three Queen Echo, Norway Three Queen Ecuador," clocked in at 5 seconds. It's common to include your callsign twice in the long CQ, which you'll send repeatedly when action is slow in the contest, trying to attract callers. A second shorter CQ might be simply voiced as needed when QSO rates are high, or recorded as a separate message in a fifth memory slot.

The exchange message is conventionally played by hitting the F2 key. In many contests with simple, non-variable exchanges (e.g. "59 15" in CQWW DX, or "Tim Maryland" in the North American QSO Party), a search and pounce station simply sends this message after copying the running station's exchange. If the exchange involves a serial number as well as fixed elements that do not change from QSO to QSO, the exchange message can be triggered to play the fixed element. When running, the operator will use the mic to give the S&P station's call, then hit F2 to play the exchange message.

The thanks message — commonly invoked by the F3 button of the logger — is used by a running operator at the conclusion of a QSO. If rates are slow, I'll include my call in the thanks to help inform any listeners who I am, i.e., "Thanks! November Three Queen Echo." If I know I have a pileup of callers waiting, I'll use an abbreviated "Thanks!" Many operators who do a lot of running will have both the short and long thanks as macros; others may program just one or the other.

As a rules reminder, running stations should identify at least every three QSOs, no matter how thick of a pileup is waiting for them. This is codified, for example, in CQWW DX rule XII. A. 6 under "Unsportsmanlike Conduct." While my thanks message usually includes full phonetics, a more productive station with higher rates might include a non-phonetic rapid-fire voicing of their callsign in this message, and still be fully compliant with both the spirit and letter of the requirement to identify.

The callsign message is used by search-and-pounce stations to respond to a CQ. It will often be just your callsign in standard phonetics, given a single time. If you're asked for a repeat, be aware that simply repeating the exact same pronunciation in the recording is rarely going to be successful; you might resort to an alternate emphasis in pronouncing standard phonetics, or a less-standard set of alternate phonetics. The F4 key is what is most commonly used to invoke this message; if you're going to be almost entirely search-and-pounce, you may want to store alternative pronunciations to be activated by the F3 key (which may never be used if you aren't running.)

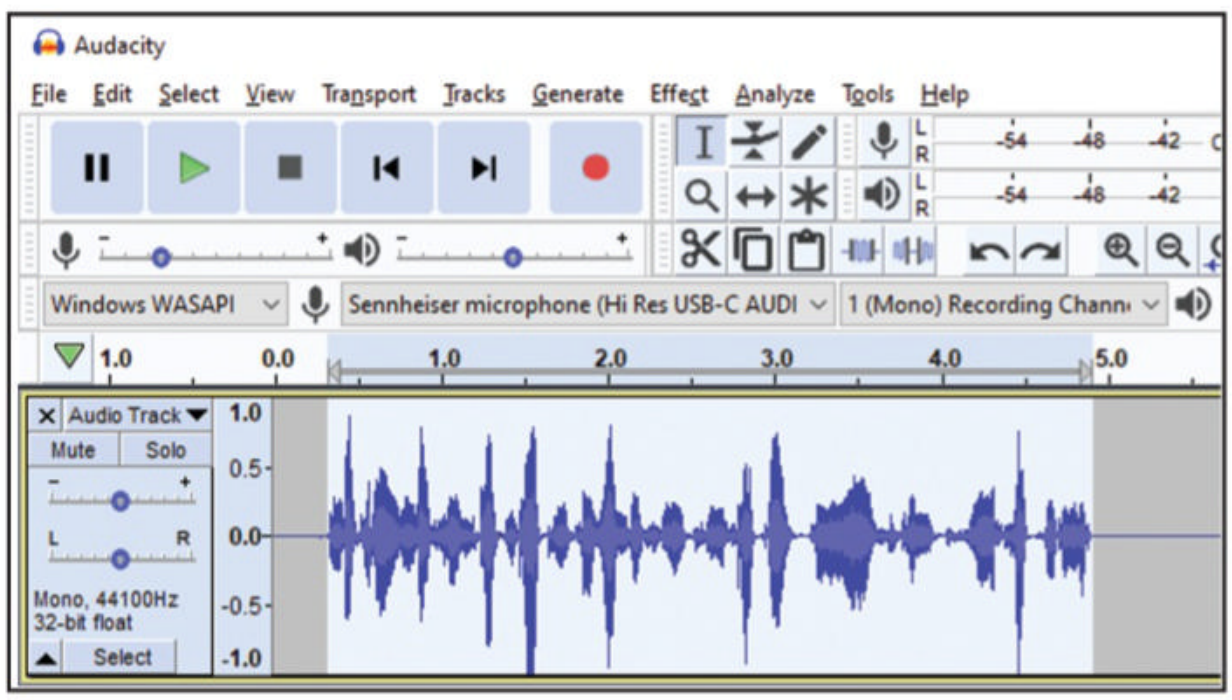


Figure 2. Audacity is commonly used by contesters to create and optimize .WAV files for outgoing messages. In this example, the mouse has been used to select the beginning and end of the exported WAV, optimally trimming off silent areas before and after a CQ message.

Recording Techniques

Recording your message without dead air before or after it is essential to efficient contesting. A fraction of a second of dead air before your message lengthens your CQ without making any noise to attract callers, and heightens the possibility that you'll "double" with a caller due to poor timing. Similarly, letting your transmitter hang for a half second or a second after your CQ, will result in chopping off the first letter of responding callsigns, requiring an entire repeat cycle.

When recording with an outboard voice keyer or your rig's built-in digital voice keyer, you'll find that a complicated sequence of button or touchscreen pushes and (depending on model) a tap of the foot pedal are probably necessary to start the recording. It will likely require pressing a different button or touchscreen area on the rig to stop recording. I've been using voice keyers with this style of user interface for decades but still struggle with the exact timing of voice keying using rig or recorder buttons; to a large extent, the touchscreen style common today is even more difficult due to the lack of tactile feedback.

Recent advances in logger macros result in some permutations of logging software and hardware that allow efficient recording of DVK messages straight from the logger's keyboard. I recently wrote up instructions and a set of macros for triggering and ending recording for modern Yaesu rigs with built-in DVKs on the N1MM+ mailing list; you can find it online at <https://bit.ly/3V1MxIa>. Bob Wilson, N6TV, has a kit of macros for WinTest users that enable easy in-rig DVK recording from the keyboard; find it at <https://bit.ly/3OrgKOF>.

If you are keying via WAV files and your computer's sound card, many common logging programs offer a bare-bones recording WAV function that is accessed from within the logger. If you're using N1MM+, "on-the-fly" recording is quickly accessed via Ctrl+Shift+Fkey to start and end the recording.

If setting up for a contest in advance, you'll have some extra time to set up and optimize your WAV messages using a full-featured audio editor such as Audacity. When recording with Audacity, I don't fret over the exact timing during the recording; I hit the record button, speak the message when I'm ready, and then stop the recording. I then go in with the mouse and trim off leading and tailing silence. Audacity also has a built-in function called "truncate silence" that streamlines this even more, and can even remove unnecessary pauses internal to your message. I will often then apply a low-pass filter below 2700 Hz and a high-pass filter above 300 Hz to remove unnecessary energy outside the SSB passband, normalize and apply some audio compression, and save the resulting WAV file. *Figure 2* shows the easy graphical selection that's possible in Audacity on one of my long CQ messages.

The N1MM+ logger supports an advanced feature called Voicing in which you record all the individual numbers and letters in advance of a contest as individual WAV files, and the logger plays them back concatenated to create a callsigns and/or serial numbers using your own voice. The normal expected voice inflections at the beginning and end of a transmission are largely missing, however, so while the resulting transmission is using your own voice, it still sounds a little oddly timed and awkward. If you take the extra step of recording .WAV files with common callsigns and complete multi-digit serial numbers, the result can be much more natural sounding. The N1MM+ online documentation has good advice on Voicing feature; find it at <https://bit.ly/3TYfOCn>.

More advanced voice synthesizer technology has been completely integrated into the HamRacer logging software by Petr Maly, OK1FIG. The synthesizer is not based on your own voice, but rather is fully synthesized, sounding somewhat robotic but with useful inflections at the beginning and end of each transmission. Check out the video demonstrations at the HamRacer website, <https://bit.ly/3Ez6C1A>, and read Jamie Dupree, NS3T's, review of it in the December 2018 CQ.

Calendar of Events

All year	CQ DX Marathon	http://bit.ly/vEKMWD
Dec. 31-Jan. 1	Bogor Old and New Contest	https://contest.orari-bogor.org/#!/rules
Jan. 1	AGB New Year Snowball Contest	https://tinyurl.com/2bhzx96n
Jan. 1	AGCW Happy New Year Contest	www.agcw.de/contest/hnyc/hnyc-engl
Jan. 1	AGCW VHF/UHF Contest	www.agcw.de/contest/vhf-uhf
Jan. 1	ARRL Straight Key Night	www.arrl.org/straight-key-night
Jan. 1	QRP ARCI New Year's Day Sprint	http://qrpcontest.com/
Jan. 1	SARTG New Year RTTY Contest	www.sartg.com
Jan. 4	UKEICC 80 Meter Contest SSB	https://ukeicc.com/80m-rules.php
Jan. 4	VHF-UHF FT8 Activity	www.ft8activity.eu/index.php/en
Jan. 7	ARRL Kids Day	www.arrl.org/kids-day
Jan. 7	PODSX PSKFest	http://bit.ly/2Qv3wkA
Jan. 7-8	Original QRP Contest	www.qrpcc.de/contestrules/index.html
Jan. 7-8	WW PMC Contest	http://bit.ly/2y2QWCc
Jan. 7-8	ARRL RTTY Roundup	www.arrl.org/rtty-roundup
Jan. 7-8	EUCW 160m Contest	www.eucw.org/eu160.html
Jan. 8	DARC 10-Meter Contest	http://bit.ly/2pCiRo1
Jan. 8	Veron SWL New Year Contest	http://bit.ly/2L9eT1L
Jan. 11	VHF-UHF FT8 Activity	www.ft8activity.eu/index.php/en
Jan. 14	YB DX Contest SSB	https://ybdxcontest.com
Jan. 14-15	Feld Hell "Low Down" Sprint	https://bit.ly/3eKxi2f
Jan. 14-15	North American CW QSO Party	http://ncjweb.com/naqp
Jan. 14-15	UBA PSK63 Prefix Contest	http://bit.ly/2Oi8fsa
Jan. 15	NRAU – Baltic SSB Contest	www.nrau.net/nrau-contests
Jan. 15	NRAU – Baltic CW Contest	www.nrau.net/nrau-contests
Jan. 18	VHF-UHF FT8 Activity	www.ft8activity.eu/index.php/en
Jan. 21-22	Hungarian DX Contest	www.ha-dx.com/en/contest-rules
Jan. 21-22	North American SSB QSO Party	http://ncjweb.com/naqp
Jan. 21-22	PRO Digi Contest	https://tinyurl.com/3ptzsmxz
Jan. 21-23	ARRL January VHF Contest	www.arrl.org/january-vhf
Jan. 25	UKEICC 80 Meter Contest CW	https://ukeicc.com/80m-rules.php
Jan. 25-26	AWA Linc Cundall Memorial Contest	https://bit.ly/3iDUm34
Jan. 27-29	CQWW 160M CW Contest	http://cq160.com/rules.htm
Jan. 28-29	AWA Linc Cundall Memorial Contest	https://bit.ly/3iDUm34
Jan. 28-29	BARTG RTTY Sprint	http://bartg.org.uk/wp/contests
Jan. 28-29	REF CW Contest	https://tinyurl.com/p4bbva92
Jan. 28-29	UBA SSB Contest	http://bit.ly/W0gZiE
Jan. 28-29	Veron SLP Contest	http://bit.ly/2L9eT1L
Jan. 28-29	Winter Field Day	www.winterfieldday.com

When it comes to on-the-air voice synthesis, NS3T is an expert. Jamie has entered more than 20 SSB contests since losing his voice in 2016, using advanced synthesis technology based on his own recordings from decades past. I've worked Jamie more than 40 times in recent years in on-the-air contests and his synthesized voice always sounds perfectly natural; he can invoke several common phrases and pleasantries from his keyboard and logger instantaneously. The CBC's "As It Happens" program interviewed Jamie, discussing the state of the art in voice synthesis as used in Jamie's over-the-air professional reporting. The interview is online at <https://bit.ly/3tTuXKI>. This hints at technologies that may become available to everyday hams in the coming years for SSB contesting.

January and February Contest Highlights

I'll be on for all three modes of the winter North American QSO Parties. In addition to the SSB session already discussed on January 22nd, there's also the NAQP CW on January 15th and the NAQP RTTY on February 25th. The Assisted category was new for 2022 and continues into 2023; 35% of entrants choose the assisted category. Multipliers count per band in this contest, and with rising sunspot numbers it's worth checking 10 meters for activity, not just at the start of the contest but all the way up to your local sunset. Find full rules at <https://ncjweb.com/naqp>.

If you've gained experience in both running and search-and-pounce in the CW NAQP, you're ready to try the short 4-hour NA Sprint CW that is held the evening of Saturday, February 5th. There's no simple running in this one, as the sprint format requires that you relinquish the run frequency and spin the dial after you complete a run QSO. Rules for the 4-hour event are at <https://tinyurl.com/mt2hsc2c>. To warm up for the 4-hour sprint, try entering several Thursday evening NCCC Sprints this winter; these half hour sessions follow a similar format. More on the NCCC Sprints, including detailed operating hints, can be found at <www.ncccsprint.com>.

The CQ World Wide 160-Meter Contest is also split up with a weekend per mode. The intense 160-meter activity worldwide starts at 2200Z on Friday (late afternoon in North America, evening in Europe) and continues for 48 hours. CW runs from January 26th through 28th, and SSB is February 20th through 22nd. Details are at <https://cq160.com>.

Feb. 1	UKEICC 80m Contests SSB	https://ukeicc.com/80m-rules.php
Feb. 1	VHF-UHF FT8 Activity	www.ft8activity.eu/index.php/en
Feb. 4	AGCW Straight Key Party	www.agcw.de/contest/htp/htp-en
Feb. 4	FYBO Winter QRP Sprint	https://qrper.com/tag/fybo
Feb. 4	Minnesota QSO Party	www.w0aa.org/mn-qso-party
Feb. 4-5	10-10 Int'l Winter Contest	http://bit.ly/1FrFeBc
Feb. 4-5	British Columbia QSO Party	www.orcadxcc.org/bcqp_rules.html
Feb. 4-5	European Union DX Contest	https://eudxcc.altervista.org/eu-dx-contest
Feb. 4-5	Mexico RTTY International Contest	www.rtty.fmre.mx/index.html
Feb. 4-5	North American CW Sprint	http://ncjweb.com/north-american-sprint
Feb. 4-5	Vermont QSO Party	www.ranv.org/ranv.html
Feb. 6	RSGB 80m Club Championship, SSB	bit.ly/3TxCrxl
Feb. 8	VHF-UHF FT8 Activity	www.ft8activity.eu/index.php/en
Feb.11	FISTS Winter Saturday Sprint	www.fistsna.org/operating.html
Feb. 11	Asia-Pacific Spring Sprint (CW)	http://jsfc.org/apsprint
Feb. 11	RSGB 1st 1.8 MHZ Contest CW	bit.ly/3TxCrxl
Feb. 11-12	CQWW RTTY WPX Contest	www.cqwpxrtty.com
Feb. 11-12	Dutch PACC Contest	http://pacc.veron.nl
Feb. 11-12	KCJ Topband Contest	www.kcj-cw.com/e_index.htm
Feb. 11-12	OMISS QSO Party	www.omiss.net/Facelift/qsoparty.php
Feb. 11-12	SARL Field Day Contest	http://bit.ly/H0IqQf
Feb. 11-13	YL OM Contest	https://ylrl.org/wp/yl-om-contest
Feb. 12	CQC Winter QSO Party	http://bit.ly/2Qayte1
Feb. 13-17	ARRL School Club Roundup	www.arrl.org/school-club-roundup
Feb. 14	PODXS 070 Club Valentine Sprint	http://bit.ly/2Rp8LTk
Feb. 15	AGCW Semi-Automatic Key Evening	www.agcw.de/contest/sta
Feb. 15	RSGB 80m Club Championship, DATA	bit.ly/3TxCrxl
Feb. 15	VHF-UHF FT8 Activity	www.ft8activity.eu/index.php/en
Feb. 18-19	ARRL CW DX Contest	www.arrl.org/arrl-dx
Feb. 19	FISTS Winter Sunday Sprint	www.fistsna.org/operating.html
Feb. 22	UKEICC 80m Contests CW	https://ukeicc.com/80m-rules.php
Feb. 23	RSGB 80m Club Championship, CW	bit.ly/3TxCrxl
Feb. 24-26	CQWW 160M SSB Contest	www.cq160.com/rules.htm
Feb. 25-26	Hiroshima Worked All Squares	www.hs-contest.org
Feb. 25-26	North American RTTY QSO Party	http://ncjweb.com/naqp
Feb. 25-26	REF SSB Contest	https://tinyurl.com/p4bbva92
Feb. 25-26	South Carolina QSO Party	http://scqso.com
Feb. 25-26	UBA CW DX Contest	http://bit.ly/W0gZiE
Feb. 26	High Speed Club CW Contest	www.highspeedclub.org
Feb. 26-27	North Carolina QSO Party	http://ncqsoparty.org/rules
Feb. 27	RSGB FT4 Contest Series	bit.ly/3TxCrxl

propagation

BY TOMAS HOOD,* NW7US

What to Expect on the Bands in 2023

Quick Look at Current Cycle 25 Conditions:
(Data rounded to nearest whole number)

Sunspots:
Observed Monthly, October 2022: 96
12-month smoothed, April 2022: 73

10.7-cm Flux:
Observed Monthly, October 2022: 131
12-month smoothed, April 2022: 116

One Year Ago:
(Data rounded to nearest whole number)

Sunspots:
Observed Monthly, October 2021: 37
12-month smoothed, April 2021: 24

10.7-cm Flux:
Observed Monthly, October 2021: 90
12-month smoothed, April 2021: 80

Here is an overview of expected propagation conditions on each amateur band between 6 and 160 meters for 2023, as we see continued improvement from the rising solar cycle:

Six Meters: This band may see occasional DX-distance F-layer propagation, on days with high 10.7-cm Radio Flux numbers (greater than 100 — remember that the predicted monthly number is the expected smoothed number, and that daily numbers can range above and below the smoothed). Be observant and you might catch one of the short openings. However, it is not expected that this will be often active for DX, compared to the years of the solar cycle maximum. The summer season will bring the usual troposcatter (aka tropospheric scatter — see <https://tinyurl.com/267vxfaz>) and Sporadic-E (E_s — see <https://tinyurl.com/5bmeep59>) activity. Aurora will still play a major role during spring and fall.

Ten and 12 Meters: These bands will be fair to good, especially during times of E_s activity. Expect most DX openings to be primarily on north-south paths during hours of sunlight along the entire path. This year, solar activity may support propagation on higher bands, as the sunspot activity increases.

Fifteen Meters: This band will be good, occasionally seeing worldwide openings during the daylight hours. With the recent uptick in solar activity, this band may wake up often, so be ready for DX.

Seventeen Meters: This band should behave much like 15, but you will find it open more often, with it remaining open for DX an hour or two longer than 15 meters.

Twenty Meters: Expect good conditions during the daylight hours, with worldwide DX openings possible throughout the year along the daylight / nighttime edge (the gray line terminator). DX conditions on this band tend to peak for a few hours after local sunrise and again during the sunset period. During the summer, expect this band to remain open for DX several hours after local sunset, occasionally later into the night. In the winter months of 2023, some nighttime DX openings are expected.

Thirty Meters: This band will provide great DX openings, especially a few hours before sunset until a few hours after sunrise. In 2023, 30 meters will be an exciting band for those looking for low-power digital signals. Winter brings longer nights, providing the right mix for exceptional worldwide DX. If you don't yet have a dedicated 30-meter antenna, consider adding this to your station, and get on this band (remember to follow the special rules for this band).

Forty, 60, 80, and 160 Meters: These are nighttime DX bands, though 40 meters can provide DX during some daytime hours (mornings, evenings). Great worldwide 40-meter DX continues from about two hours before sunset to approximately two hours after sunrise during all seasons. Expect coast-to-coast openings on the 60-meter band, around dusk and dawn, possibly into the noon hours. DX openings on 80 and 160 meters should peak during the early spring, late fall,

LAST-MINUTE FORECAST

Day-to-Day Conditions Expected for January 2023

	Expected Signal Quality			
Propagation Index	(4)	(3)	(2)	(1)
Above Normal: 3-18, 26-27, 30-31	A	A	B	C
High Normal: 2, 20-21, 25, 29	A	B	C	C-D
Low Normal: 1, 19, 28	B	C-B	C-D	D-E
Below Normal: 22-24	C	C-D	D-E	E
Disturbed: n/a	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 3 will be fair to good on January 1st, good on January 2nd, then excellent from January 3rd through January 18th, 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 <https://SunSpotWatch.com> provided by NW7US.

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and winter months. Expect somewhat stronger signals than those of the last few years.

Stay tuned for updates and other space weather and radio propagation information.

January Shortwave Propagation

It should be a toss-up between 15, 17, and 20 meters for great long-distance DX propagation openings during the daylight hours. These bands should open to most areas of the world, often with strong signals. Fifteen meters may have a slight edge before noon, with 17 meters taking the lead after noon and becoming the optimum DX band during the late afternoon hours. Short-skip openings between distances of about 1,200 and 2,300 miles should be excellent during the daylight hours. Fair to moderate short-skip openings are expected on 15 and 17 meters from shortly after sunrise through the early evening hours for distances between 1,000 and 2,300 miles.

Twenty meters will offer all of that, but longer, and slightly earlier, and then again starting in the early evening and continuing into the early night. We expected 20 meters to be a solid band with excellent around-the-clock openings for both DX and short skip. DX conditions should peak during a window of an hour or so right after sunrise and again during the late afternoon and early evening hours. Short-skip openings between approximately 1,300 and 2,300 miles should be possible from just after sunrise to as late as midnight. Shorter distance openings should also be possible from mid-morning to mid-afternoon.

The optimum band for DX conditions during the hours of darkness should be 40 meters, though 30 meters is a fair competitor when digital modes or CW is preferred. Expect openings to most areas of the world from shortly before sundown, through the hours of darkness, and until shortly after sunrise. Signal levels may be exceptionally strong at times. During daylight hours, short-skip conditions should be optimal for openings between approximately 100 and 600 miles. Skip will lengthen during the late afternoon, and by nightfall, short-skip conditions should be optimal for openings between 800 and 2,300 miles.

Expect 60 meters to play a significant role in nightly DX across the U.S. With exceptionally low noise levels this month, the weaker signals of 60 meters will be easier to copy.

Because atmospheric noise levels will be at seasonally minimum levels in the Northern Hemisphere during January, the 80- and 160-meter bands should be hot. Expect some good openings to many parts of the world on 80 meters during the hours of darkness and the sunrise period. Short-skip openings between distances of 50 and 250 miles should be optimal on 80 meters during the daylight hours. During the later afternoon and early evening hours short-skip openings should increase to between 250 and 1,500 miles and by nightfall openings up to and beyond 2,300 miles should be possible.

Expect some DX openings on the 160-meter band during the hours of darkness. Openings toward Europe and the east should peak at about midnight. Openings toward the South Pacific and in a generally southerly direction may be possible just before daybreak, as well as openings into Asia and North Pacific. Short-skip openings up to 1,300 miles should be possible during the hours of darkness, and frequently the skip will extend out as far as 2,300 miles. During the daylight hours intense ionospheric absorption will severely limit openings, although some may be possible at times up to 150 miles or so.

VHF Conditions

E_S can occur during January, so be on the lookout. Aurora is likely to occur so expect occasional Auroral-E propaga-

tion. The Quantrantids meteor shower is the major meteor shower for January, and it can appear any time during the first week of January, peaking on January 4th. This can sometimes be quite intense, so it may be a good idea to set up some 2- and 6-meter schedules. Morning meteor openings may be the best bet during this month.

For a detailed list of meteor showers, check out <https://tinyurl.com/rnfkd2d8> for a complete calendar of meteor showers in 2023.

Current Solar Cycle Progress

The Royal Observatory of Belgium reports that the monthly mean observed sunspot number for October 2022 was 96.3. The 12-month running smoothed sunspot number centered on April 2022 is 73.1. A smoothed sunspot count of 75, give or take about 9 points, is expected for January 2023.

The Dominion Radio Astrophysical Observatory at Penticton, BC, Canada, reports a 10.7-cm observed monthly mean solar flux of 132.84 for October 2022. The 12-month smoothed 10.7-cm flux centered on April 2022 is 130.63. The predicted smoothed 10.7-cm solar flux for January 2023 is 111, give or take 7 points.

Geomagnetic activity level this month is expected to range from quiet to stormy, resulting in occasional degraded propagation. Remember that you can get an up-to-the-day *Last-Minute Forecast* at <https://SunSpotWatch.com> on the main page.

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>. Also, please check out the new alternative social networking ham radio group at <https://amateurhamradio.locals.com> and please share this with your amateur radio friends and clubs.

– 73, Tomas, NW7US

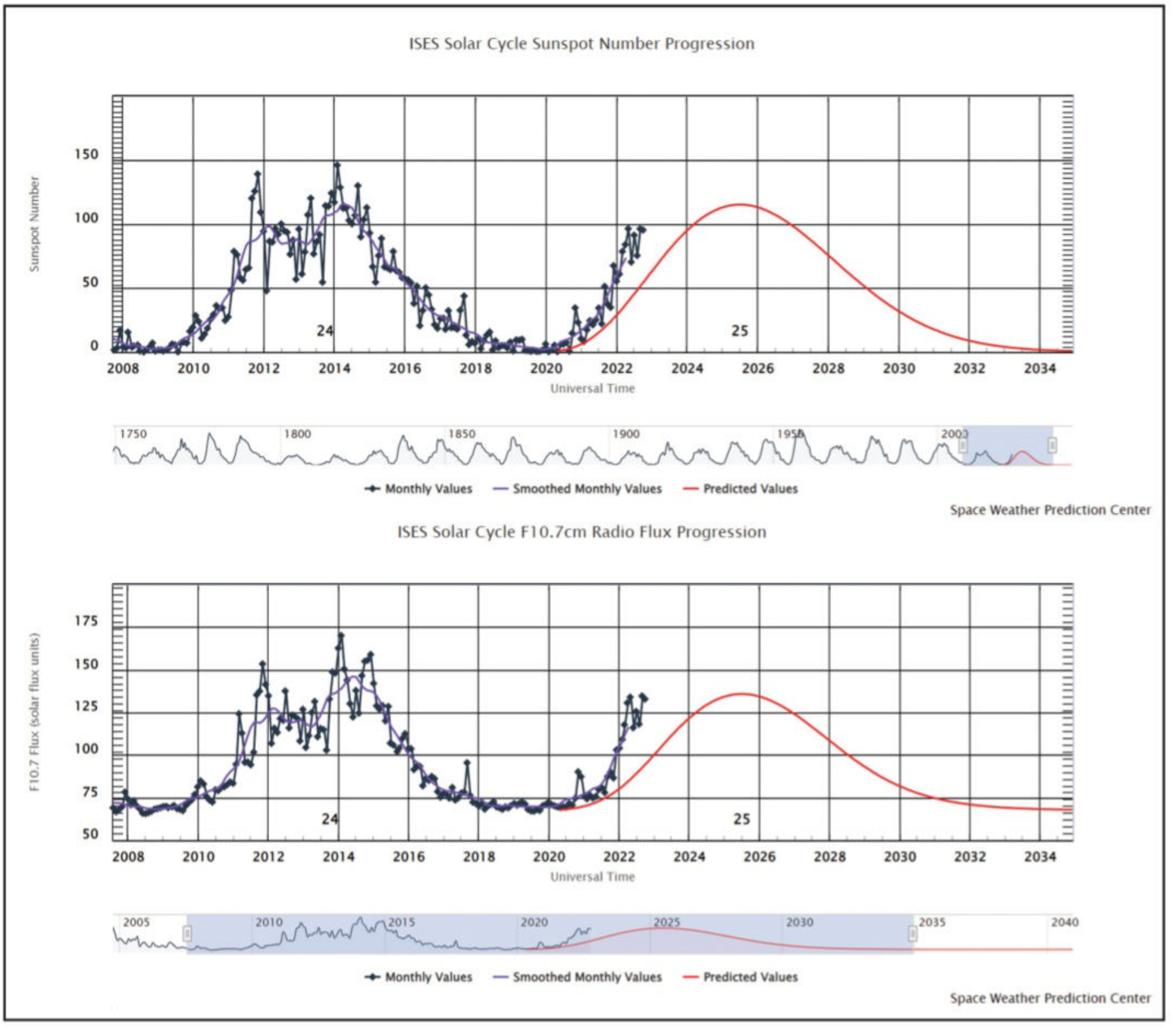

Figure 1. These plots reveal the current level of solar cycle activity that we are seeing so far in Sunspot Cycle 25. As of now we are ahead of the curve. Will we see any higher activity levels? (Courtesy of NOAA / SWPC)

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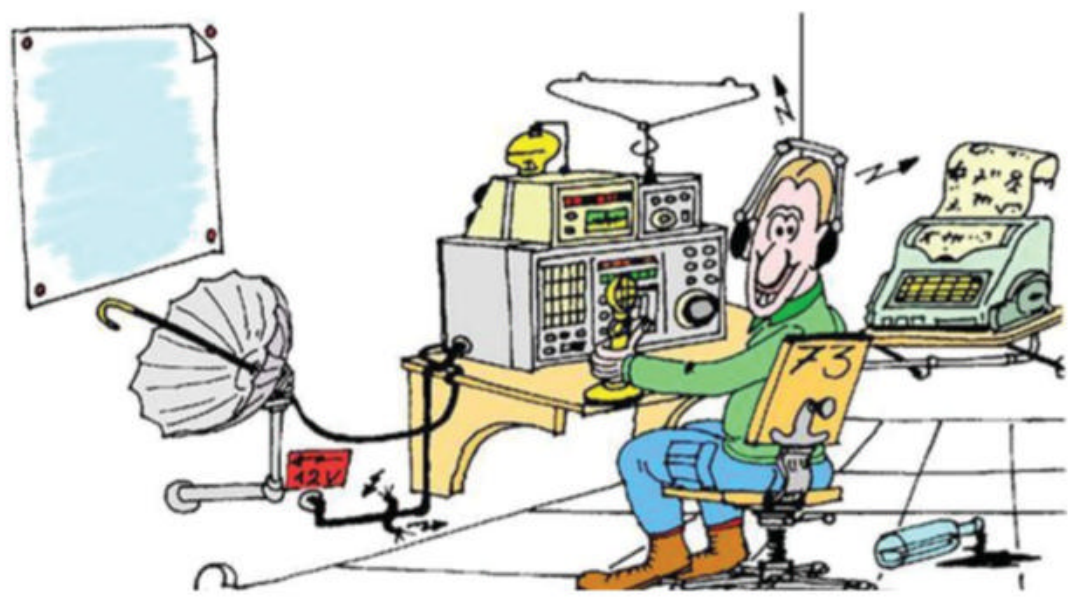

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