An Early Peak to Cycle 25? p. 7

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CQ

COMMUNICATIONS & TECHNOLOGY

JUNE 2023

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- Results, 2022 CQ DX Marathon, p. 20
- YJ0A DXpedition to Vanuatu, p. 96
- Balun and Antenna Mini-Special, pgs. 38, 45 48, 78, 81

On the Cover: Bob Norin, W7YAQ, and Al Rovner, K7AR, operate from the beach in Vanuatu as YJ0A. Details on page 66 and in this month's DX column on page 96.

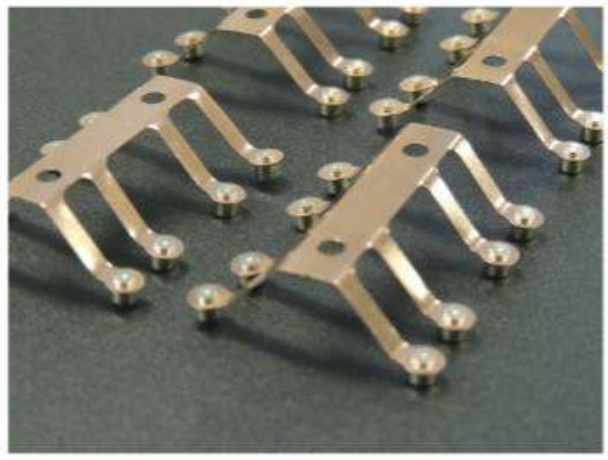
Raising the bar on performance and reliability!

EVERY STEPPIR SHIPS WITH THESE UPGRADES SINCE APRIL 2022

1

NEW BRUSH/CONTACT ASSEMBLY

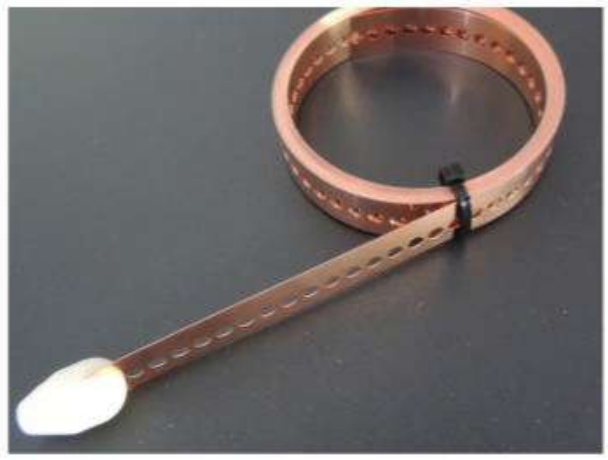
The new element housing unit (EHU) brush/contact assembly has greatly reduced friction buildup, with an average 36% friction reduction over the product life-cycle. The new assembly achieves this advantage without affecting product life expectations. The brush contact combination wears at a similar rate as our previous contacts. This new brush/contact not only has lower friction and the same longevity, it also greatly reduces RF noise during the tuning process due to the material properties of the contact.



2

NEW COPPER STRIP INDEXING

The engineering team at SteppIR has completely redesigned our copper strip indexing and crowning system – this has taken the better part of a year of extensive design and testing, along with a near total reconfiguration of the system. The resulting improvement in accuracy, pitch and repeatability is now producing the most consistent and reliable material we have ever had.



3

NEW 40/30 SWEEP ASSEMBLY

We always make it a point to listen closely to our customer base – we consider them to be an extension of our engineering department and are very thankful to have this resource. Thanks to a great initial idea we heard about from a few of our customers, we were able to leverage that knowledge into an all-new sweep system for our 40/30 loops. The new system will make the installation of antennas with loops, significantly easier and much more reliable. And, our new diverter system for the sweep return, will ensure that the copper conductor has a clear path through the sweep material at all times. This new design will eliminate the need for the sweep couplers.

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- DSP noise canceling versions EQ20-DSP, EQ20B-DSP with added Bluetooth on input

QST Dec 2019 review *"easy-to-use device that improves the audio clarity of amateur signals"*

In-Line Module

Great review in Jan '23 QST!

- 5W amplified DSP noise canceling In-Line module
- 8 filter levels 8 to 40dB - Use in-line with a loudspeaker
- Audio bypass feature - 3.5mm mono inputs and outputs
- Headphone socket - Audio input overload feature

Dual In-Line

Fully featured flexible dual channel DSP noise canceling unit

- 8 Filter levels 9 to 40dB
- 3.5mm mono or stereo inputs
- Line level input/output
- 7 watts mono speaker output
- Headphone socket
- Easy to use controls

Compact In-Line

- Portable DSP noise canceling unit
- Simple controls
- Use in-line with speakers or headphones
- Line/speaker level inputs
- Use with AA batteries or 12V DC supply

NEDSP1962-KBD 5W amplified DSP noise canceling speaker retrofit pcb module now available!

New

DESKTOP MKII

10W amplified DSP noise canceling speaker

- Simple controls
- 8 filter levels
- Separate line level and speaker level audio inputs
- 12V DC power
- Suitable for all radios incl' SDR, Elecraft and FlexRadio products

NES10-2MK4

- 5W DSP Noise Canceling Speaker - 8 filter levels
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- Three position switch for all functions
- Headphone socket

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announcements

JUNE

DEN HELDER, NETHERLANDS – Dutch Navy Radio Amateur Club (MARAC) will hold the Museum Ship Weekend on Saturday, June 3 on the Abraham Crijnssen, moored off the Navy Museum at Hoofdgracht 3, 1781 AA. Contact: Willem Van Essen, PA3CNI. Email: <pa3cni@hotmail.com>. Website: <http://www.marac-radio.nl/>.

HILTON, NEW YORK – The Rochester Amateur Radio Association will hold the Rochester Hamfest 2023 on Saturday, June 3 at the Hilton Exempt Club137 South Ave. Contact: Tim Guyot , KB1POP. Email: <timguyot@gmail.com>. Phone: (585) 210-8910. Website: <https://rochesterham.org>.

HUDSONVILLE, MICHIGAN – The Independent Repeater Association will hold the IRA Hudsonville Hamfest from 8:00 a.m. to noon., Saturday, June 3 at Hudsonville Fairgrounds 5235 Park Ave. Contact: Tom Bosscher, K8TB. Email: <hamfest@w8ira.org>. Phone: (616) 209-9296. Website: <http://www.w8ira.org >. Free VE testing.

MANASSAS PARK, VIRGINIA – The W4OVH Ole Virginia Hams will hold the W4OVH Ole Virginia Tailgate from 8:00 a.m. to 2:00 p.m. Saturday, June 3 at the Field Across from Signal Hill Park9300 Signal View Dr. Contact Don Meyerhoff, WA2SWX. Email: <wa2swxdm@gmail.com>. Phone: (703) 597-3211. Website: <https://w4ovh.net/tailgate/>. Talk-in: 146.970.

MANITOWOC, WISCONSIN – The USS Cobia Amateur Radio Club will be participating in the Museum Ships Afloat Week-end on Saturday June 3 and Sunday June 4 on the submarine USS Cobia SS-245, located in the docks next to 75 Maritime Dr. Contact: Anne Dirkman, KC9YL. Email: <kc9yl@arrl.net>. Website: <https://www.qrz.com/db/NB9QV>.

MARIETTA, GEORGIA – The Atlanta Radio Club W4DOC and the Kennehoochee ARC W4BTI will hold the Atlanta Hamfest - ARRL Georgia Section Convention on Saturday, June 3 at Jim R. Miller Park 2245 Callaway Rd. SW. Contact: John Talipsky, N3ACK. Email: < n3ack@atlantaradioclub.org>. Phone: (470) 272-8940. Website: <http://www.atlantahamfest.org>. Talk-in 146.820(-) PL 146.2. VE exams.

PLYMOUTH, MINNESOTA – The Northern Lights Radio Society will hold the Aurora '23 Conference from 9:00 a.m. to 5:30 p.m., Saturday June 3 at West Medicine Lake Community Club, 1705 Forestview Lane North. Contact: Paul Husby, W0UC. Email: <husby002@gmail.com>. Phone: (651) 642-1559. Website: < http://www.NLRS.club>. VE testing.

SPRINGFIELD, MISSOURI – The Southwest Missouri Amateur Radio Club will hold the SMARC Pre-Field Day Hamfest 8:00 a.m. to 12:30 p.m. on Saturday, June 3 at Salvation Army HQ - Springfield, MO 1707 W. Chestnut Expy. Contact: Jordan Justus, NØRK. Email: <info@smarc.org>. Phone: (417) 520-7324. Website: <https://tinyurl.com/3mbwnh78>. Talk-in 146.910 - offset PL: 162.2Hz. VE exams.

SPRING LAKE, NEW JERSEY – The Ocean Monmouth Amateur Radio Club will hold the Spring Hamfest – OMARC on Saturday, June 3 at the Spring Lake Heights Volunteer Fire Company Number One 700 Sixth Avenue. Contact: Joseph Kruszewski, KC2SVS. Email: <joekru1@hotmail.com>. Phone: (732) 618-5328. Website: <http://www.N2MO.ORG>. Talk-in 145.110 PL 127.3.

WAUSEON, OHIO – The Fulton County Amateur Radio Club will hold the FCARC Summer Hamfest from 8:00 a.m. to 1:00 p.m., Saturday, June 3 at the Roth Family Woodlot Park 105 Hill Ave. Contact: Bryan Patterson, KB8ELG. Email: <kb8elg@hotmail.com>. Phone: (419) 250-6694. Website: < https://k8bxq.org/hamfest>. Talk-in 147.195+ 103.5PL. VE exams.

CHELSEA, MICHIGAN – The Annual Chelsea Amateur Radio will hold the Annual Chelsea Amateur Radio Club Swap Meet Partnering w/Michigan Electronics Expo on Saturday June 4 at the Chelsea Community Fairgrounds20501 W. Old US Hwy 12. Contact: Michelle Dye, KD8GWX. Email: <wd8iel@gmail.com>. Phone: (734) 717-5660. Website: < http://wd8iel.com>.

PROSPECT, PENNSYLVANIA – The BreezeShooters ARC Inc will hold the BreezeShooters Hamfest Sunday June 4 at Big Butler Fair Grounds, 1127 New Castle Rd (Route 422). Contact: Marty Newinham, AG3I. Email: <ag3i@arrl.net>. Phone: (724) 875-5385. Website: < http://www.breezeshooters.org>. Talk-in 147.300(+)-pl 131.8.

SEASIDE, OREGON — The Oregon Tualatin Valley Amateur Radio Club and the Clark County Amateur Radio Club will hold the SEA-PAC, ARRL Northwestern Division Convention beginning 8:00 a.m., Friday, June 2 and ending Sunday, June 4 at 2:00 p.m. at the Seaside Civic and Convention Center, 415 1st Ave. Contact: Wayne Schuler, AI9Q. Website: <http://seapac.org>. Email: <info@seapac.org>. Phone: (503) 882-7388. Talk-in 145.49, -0.6 MHz, 118.8. VE exams.

GRANITE CITY, ILLINOIS — The Egyptian Radio Club, Inc will hold its Egyptian Fest 2023 from 7:00 a.m. to noon, Sunday, June 11 at the Schertz Civic Center, 1400 Schertz Pkwy. Contact: Aubrey Mason, WA6DMI. Website: <http://w9aiuorg>. Email: <kb9lbc@gmail.com>. Phone: (631) 829-9185. Talk-in 146.760 pl 141.3.

KNOXVILLE, TENNESSEE — The Radio Amateur Club of Knoxville will hold its Knoxville Hamfest and Electronics Convention – ARRL Tennessee State Convention from 8:30 a.m. to 3:30 p.m., Saturday, June 17 at the Kerbela Temple, 315 Mimosa Ave. Contact: Jim Norman, N4CFB. Website: <http://www.w4bbb.org>. Email: <jimn4cfb@gmail.com>. Phone: (865) 310-8310. Talk-in 147.300 T100.

NORTHPORT, ALABAMA — The Black Warrior Hamfest will hold its Black Warrior Hamfest from 8:30 a.m. to 2:00 p.m., Saturday, June 17 at the Tuscaloosa County High School, 12500 Wildcat Dr. Contact: Stan Lee, KF4DGS. Website: <http://blackwarriorhamfest.org>. Email: <kf4dgs1@gmail.com>. Phone: (205) 454-6721. Talk-in 145.350 191.5.

ORCUTT, CALIFORNIA — The Satellite Amateur Radio Club W6AB will hold its Santa Maria Hamfest from 9:00 a.m. to 3:00 p.m., Saturday, June 17 at the Newlove Picnic Grounds, Orcutt

(Continued on page 50)

ham radio news

New RF Exposure Rules Take Full Effect – Station Evaluations Required

The FCC's latest rules on RF exposure evaluations, which were announced two years ago, took full effect this May, meaning that all amateurs must now conduct evaluations of their current stations and do it again anytime there is a change that might affect RF exposure measurements. The ARRL has online tools available to help with making assessments. According to the *ARRL Letter*, its RF exposure landing page at <www.arrl.org/rf-exposure> offers a variety of resources, including an RF exposure calculator into which you can enter information about your station and your operating practices to see if you are in compliance. The *Letter* notes that these resources are available to all, regardless of ARRL membership.

FCC Looks for Input on 60 Meters

The FCC is asking the amateur community to weigh in on the future of the 60-meter band. In a proceeding more than seven years in the making, the Commission is proposing to adopt the contiguous 5351.5-5366.5 kHz segment approved by the International Telecommunication Union at the 2015 World Radiocommunication Conference (WRC-15), but is seeking comments on what to do about the four current 60-meter amateur channels that are not part of that segment, as well as the question of power limits. U.S. amateurs are currently permitted to use up to 100 watts effective radiated power (ERP) on the band while the international rules adopted at WRC-15 limit power to the equivalent of 9 watts ERP. For more detailed discussion of this matter, see this month's "Zero Bias" editorial on page 6. Proceeding numbers are ET Docket 23-120 and RM-11785. At press time, we did not have a comment deadline but it is expected to be late June or early July.

Tweaks Made to New General Class Question Pool

The Question Pool Committee of the National Conference of Volunteer Examiner Coordinators has made a few adjustments in the General Class (Element 3) question pool scheduled to be used on licensing exams beginning this July 1. According to the *ARRL Letter,* three questions were removed from the pool and minor changes have been made to several others. Details are available at <https://tinyurl.com/24p8brwc>.

Hams Heading to the Moon

Three of the four astronauts selected for next year's planned Artemis II mission to orbit the Moon are licensed hams. *Newsline* reports that mission commander Reid Wiseman, pilot Victor Glover and mission specialist Jeremy Hansen all hold amateur licenses (KF5LKT, KI5BKC, and KF5LKU, respectively). The only non-ham on the crew is mission specialist Christina Hammock Koch. There are no plans for any amateur radio activity during the mission, currently scheduled for November 2024.

2023 Dave Kalter Youth DX Adventure Trip Cancelled

The widely-reported backlog in processing U.S. passport applications has apparently caused the cancellation of this year's David Kalter Memorial Youth Adventure trip to Curacao. According to the Dayton Amateur Radio Association, which sponsors the program, "[T]here was not enough time to put a successful plan together and allow participants to obtain passports in a timely manner." The announcement suggested that alternate activities may be planned.

YOTA Camp Program to Expand Thanks to ARDC Grant

The Youth on the Air (YOTA) summer camp program is being funded through 2025 by a $125,000 grant from Amateur Radio Digital Communications, the foundation that has been providing funding for a wide variety of amateur radio programs and activities. The YOTA organization also reports that the grant will enable the 2024 and 2025 camp sessions to expand to 50 participants from the current 30. This year's YOTA summer camp is scheduled to be held in Ottawa, Ontario, from July 16-21.

ARDC Funds Spectrum Education Program

The National Radio Astronomy Observatory is using a grant from the Amateur Radio Digital Communications (ARDC) foundation to continue its "Exploring the Electromagnetic Spectrum (and Why Amateur Radio Matters)" program with a second group of 20 students between ages 18 and 20. According to ARDC, the online program will run for 40 weeks between September 2023 and May 2024 and "aims to educate emerging generations about the electromagnetic spectrum through an interactive, substantive experience with amateur radio." The program specifically aims to broaden the excitement of amateur radio among minority and LGBTQ students. Participants will receive a $4,000 stipend, meet weekly to learn about the role of the electromagnetic spectrum in a variety of science, technology, math and engineering fields, engage with scientists and engineers using state of the art technology, earn their Technician and General Class amateur radio licenses, and more. Additional information and program application may be found at <https://tinyurl.com/3bepb4bv>.

Vacuum Tubes Made in the USA

Newsline reports that vacuum tube manufacturing is making a comeback in the United States, and so is the Western Electric brand name. Charles Whitener purchased the rights to manufacture Western Electric vacuum tubes from AT&T 25 years ago and is now ramping up his plant in Rossville, Georgia to begin manufacturing a "reimagined" version of the iconic 12AX7 dual triode frequently found in guitar amplifiers, to be followed by others.

Vacuum tubes remain popular among hams, musicians and audiophiles as tube amplifiers produce a distinctive sound quality. For decades now, tubes have been manufactured primarily in Russia and China, but costs have been increasing along with U.S. sanctions on trade with Russia. A report in *Wired* magazine on Whitener's tube plant says that "if all goes to plan, the U.S. could once again dominate vacuum tube manufacturing."

"GridTracker" Wins Software Award

GridTracker, described by the *ARRL Letter* as "a tool that visualizes WSJT-X amateur radio traffic, like FT8 and contacts from log files, which makes it easier for radio amateurs to track their contacts and participate in contests," has been awarded the fourth annual Amateur Radio Software Award. According to the *Letter*, the award committee "was impressed by the breadth of features in GridTracker, its innovative graphic interface, and its ability to make amateur radio more fun." The ARSA awards recognize software projects that "enhance amateur radio and promote innovation, freedom and openness in amateur radio software development." More information about GridTracker is available at <https://gridtracker.org>.

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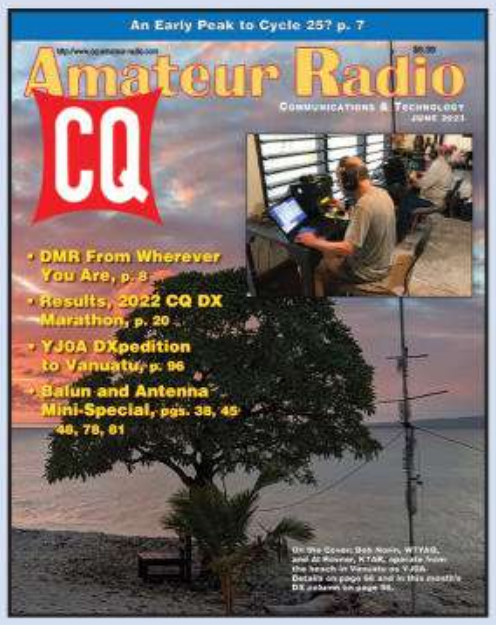
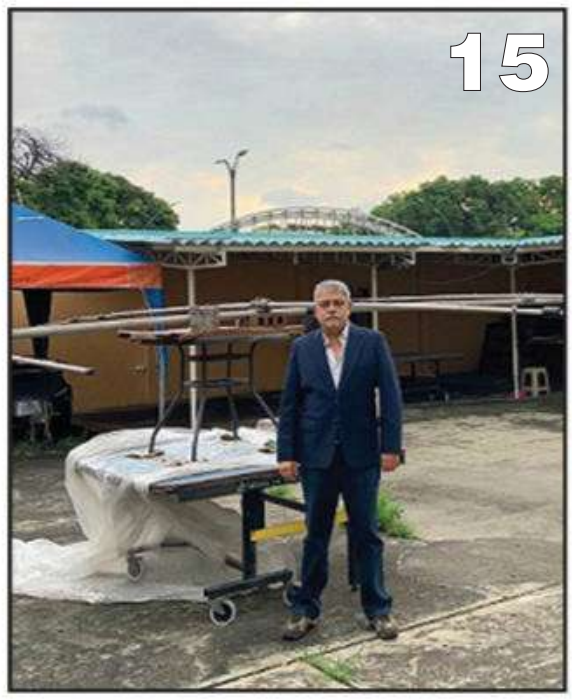
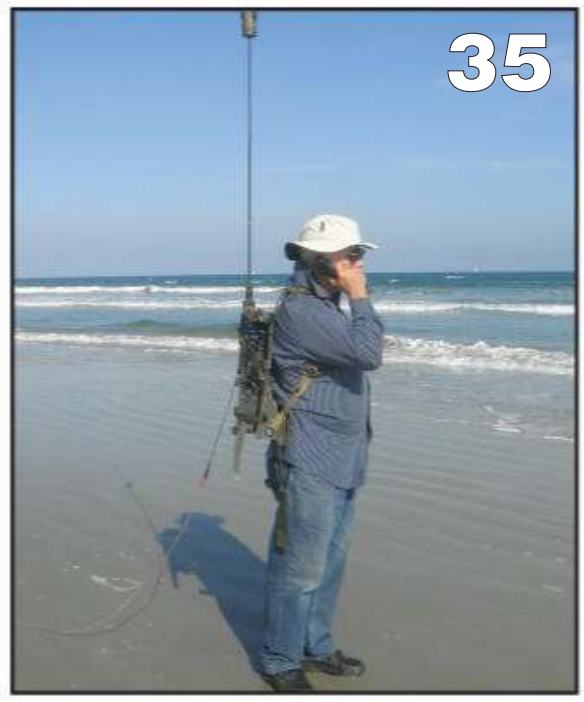
JUNE 2023 • VOLUME 79 NUMBER 6

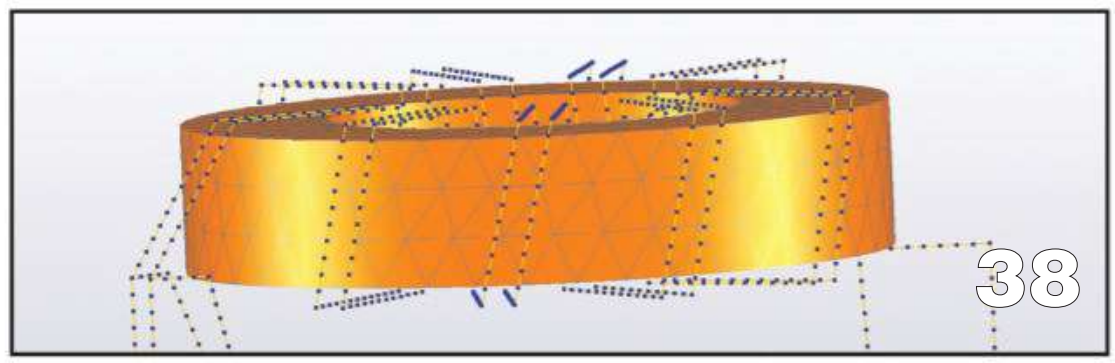


On the Cover:

A Butternut HF9V vertical was one of two antennas mounted on the beach in Vanuatu by Bob Norin, W7YAQ, and Al Rovner, K7AR, for their operation as YJ0A this past February. Bob and Al share their experience of "being the DX" and meeting the locals in our DX column on page 96. More about them on page 66. (Cover photos courtesy of K7AR and W7YAQ)







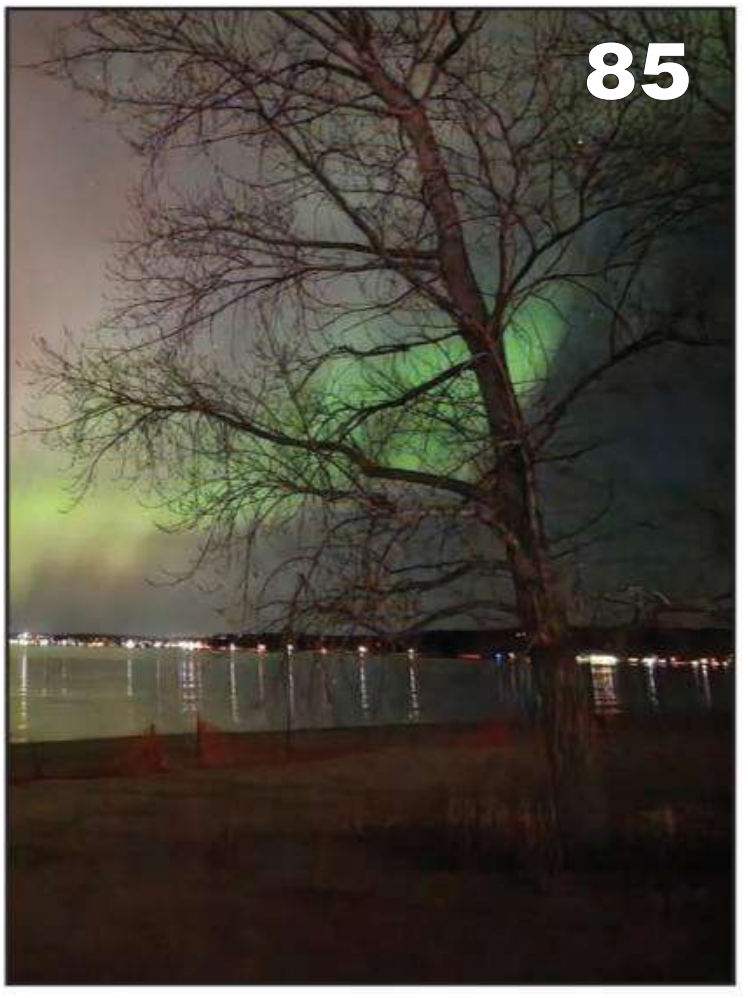
features

ANTENNA and BALUN MINI-SPECIAL: This month's issue takes a deep dive into baluns and antennas – building them, using them, and modifying existing hardware. June is the month for Field Day, and these two pieces of equipment can make or break a ham's experience! From the Guanella to the Bramham, there are many different types of baluns (and should they necessarily be called baluns? See page 45 for more on this!) and we talk more about them in this issue. We also take a look at different types of antennas. For example, on page 78 we explore the tri-vertical antenna used for 80, 40, and 20 meters. And on page 81, KB5NJD offers some thoughts on transmit antenna design for our medium and low frequency bands. The equipment used in ham radio is a fundamental part of the experience, especially considering how customized it often becomes. What do you like to use?

columns

departments

miscellaneous



zero bias: a cq editorial

BY RICH MOSESON,* W2VU

Random Thoughts

Sixty Meters, DXCC and More

I've got a few things floating around my brain this month, none of which can (or should) fill up a whole page, so we'll just make a quick visit to each of them, trying not to get lost while navigating the vast empty spaces in between …

Sixty Meters

The FCC is in somewhat of a quandary about the amateur allocation on the 60-meter (5-MHz) band. As you are probably aware, 60 meters is unique among ham bands in that it is channelized, with five distinct channels available on a secondary basis as long as we don't interfere with the primary (mostly federal government) users. For the record, there have been zero documented reports of interference since the band became available for hams 20 years ago. Hams in the U.S. are permitted to use up to 100 watts effective radiated power (ERP) on these frequencies, with a bandwidth limit of 2.8 kHz per channel. Since the band became available on a country-by-country basis over a long period of time, the specific frequencies and power levels available in different places have become something of a patchwork.

Back in 2015, the World Radiocommunication Conference (WRC-15) recognized this and proposed a harmonized frequency allocation and power level for hams worldwide, creating a 15-kHz-wide secondary amateur allocation at 5351.5-5366.5 kHz (no channels), with a power limit of 15 watts EIRP (effective or equivalent *isotropic* radiated power, or just over 9 watts ERP, according to the FCC).

[A quick detour on ERP vs. EIRP: Without getting too technical, the basic difference is that EIRP is the amount of power that would need to be radiated in all directions from an isotropic antenna (which exists only in theory) to have the same signal strength at a distant receiver as a signal transmitted from a real antenna with real gain. Since a half-wave dipole – the standard reference for ERP – has 2.15 dB of gain over an isotropic radiator, a signal measured in ERP would need less power in watts to reach a distant receiver than one measured in EIRP. The difference is magnified with a directional antenna such as a Yagi. Therefore, 15 watts EIRP is significantly less power than 15 watts ERP and gobs less power than 100 watts ERP.]

This all creates an interesting dilemma for U.S. hams and the FCC. Only one current 60-meter channel – Channel 3, 5358.5 kHz – is within the band established at WRC-15. Plus, as noted above, our current maximum power level of 100 watts ERP far exceeds the international standard of 15 watts EIRP.

In 2017, the ARRL petitioned the FCC to adopt the new band but to also retain the other four channels and the 100-watt power limit. For the past five years, the FCC has done what it does best in these situations … absolutely nothing! But as we edged closer to ten years with no action, the Commission finally decided it needed to do *something*. So it's punting … a notice of proposed rulemaking released in late April proposes adopting the "new" international band and seeks input from amateurs and others on whether to maintain the four "out-of-band" channels and what to do regarding permissible power levels.

The NPRM notes that Canada has already adopted a band plan essentially identical to the ARRL proposal, but also notes that the NTIA – National Telecommunications and Information Administration, which is the FCC's counterpart for federal agency frequency allocations – supports adopting the international allocation and very low power level while removing the other four channels from amateur use.

It is noteworthy that one of the FCC's arguments for eliminating the four "out-of-band" channels is that "amateur licensees also have access to other high frequency (HF) bands at 3 and 7 MHz, so we believe there should be sufficient spectrum options for amateur operations without deviating from the internationally harmonized spectrum." This makes absolutely no sense to anyone who recalls the original reasoning for establishing an amateur allocation at 5 MHz – to provide additional frequency options for emergency and disaster communications when propagation conditions made both 3 and 7 MHz unsuitable for communication needs. The band has served that purpose well, providing communication paths when neither 80 nor 40 meters is open. But more than peanut-whistle power may be needed to get through in those circumstances.

At press time, we did not have the comment deadline, but it will presumably be in late June or early July. We encourage amateurs – particularly those who are active on 60 meters – to weigh in with their opinions by filing formal comments with the FCC. The NPRM is part of ET Docket 23-120; the ARRL's petition for rule making is RM-11785.

DXCC Criteria

In his May editorial in that other magazine, ARRL CEO David Minster, NA2AA, discusses the difficulties faced by the 3YØJ DXpedition team in landing on and operating from Bouvet Island and wonders if it might be time to amend the DXCC rules to allow an operation from a vessel just offshore of an island to get credit for being there. While he notes that he does not have the authority to make such a change on his own, he feels that it is worth discussing further.

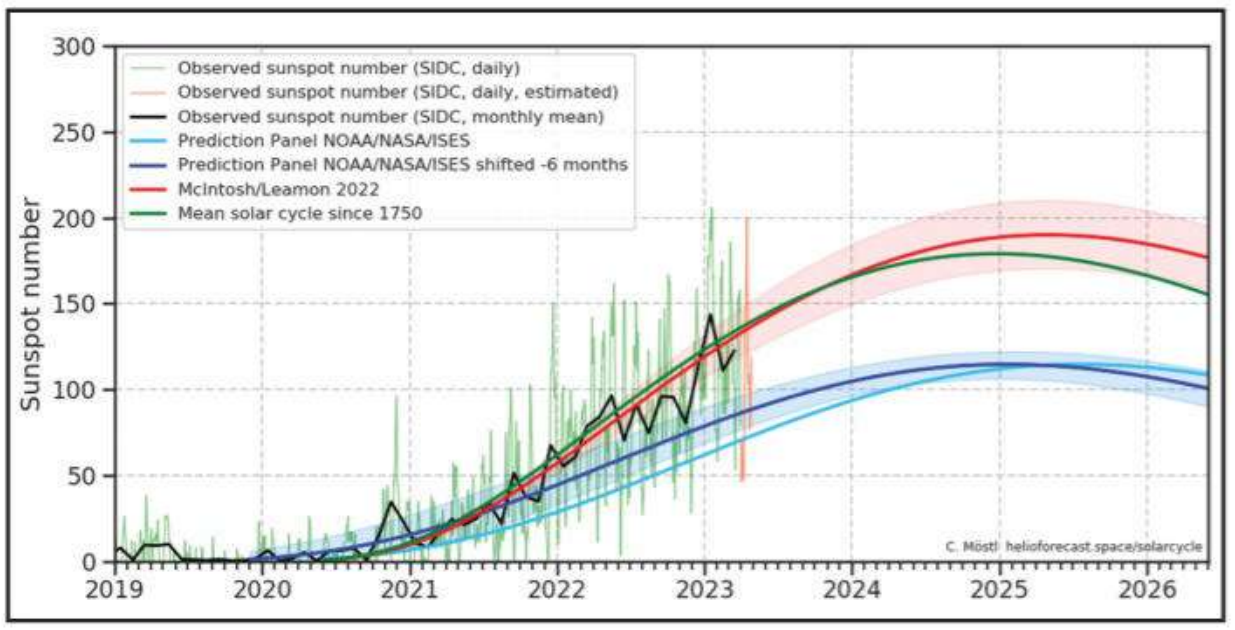
We agree, particularly in light of the development of remotely operated RIBs, or Radio in a Box setups currently being tested, and on which we've reported several times. These were developed in response to growing limitations on access to certain islands for environmental reasons and permit a self-contained station to be set up somewhere with a minimal footprint and then operated remotely from a nearby boat. NA2AA's proposal goes a step further, suggesting it should be OK to simply operate from the boat without setting foot on the island at all. We have even less direct influence over DXCC rules than David does, but we agree that the topic is worthy of discussion by the DXing community. Has the combination of access restrictions and advancing technology

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

(Continued on page 87)

news bytes:

An Early Peak to Cycle 25?



A detailed view of Cycle 25 in comparison with both the NOAA/ESA Consensus prediction and the McIntosh/Leamon prediction. (Source: Helio4cast/Austrian Space Weather Office <https://helioforecast.space/solarcycle>).

The same scientists who correctly predicted that Solar Cycle 25 would be a strong one (as opposed to the virtual repeat of Cycle 24 predicted by the "official" prognosticators) are now suggesting that the cycle may reach an early peak – later this year or the first half of next year – rather than the official prediction of a peak in 2025.[1]

In a paper published in the January 2023 issue of *Frontiers in Astronomy and Space Sciences*,[2] solar physicists Scott McIntosh, Robert Leamon, and Ricky Egeland also predict a peak sunspot number between 121 and 247 (with 95% confidence) or more likely between 167 and 201 (with 68% confidence), both ranges based on a center point of 184.[3]

Their full paper may be found online at <https://tinyurl.com/y333eyak>.

Notes:

1. The NOAA/ESA "Solar Cycle Consensus Prediction" calls for a peak sunspot number of 115 in July, 2025.
2. McIntosh, Leamon and Egeland, "Deciphering solar magnetic activity: The (solar) hale cycle terminator of 2021," *Frontiers in Astronomy and Space Sciences*, Jan 30, 2023, <https://tinyurl.com/y333eyak>
3. The sunspot numbers in all of these predictions (and actual measurements) are based on the new "version 2.0" method of counting sunspots. Based on data in the 4th edition of the *CQ Shortwave Propagation Handbook,* the "once in a lifetime" peak of 201 in 1958 would be 285 under the new system. The top end of the McIntosh team's predicted range would be very close to that, at 247.

Digital Mobile Radio, or DMR, is growing in popularity among hams. One benefit is its ability to use the internet to link repeaters or span long distances. K2ATY offers a step-by-step tutorial to setting up a DMR system to keep you in touch with your local friends while traveling … even from the middle of the ocean!

DMR on Land and Sea

BY ALFRED T. YERGER II,* K2ATY

One of the advantages of Digital Mobile Radio (DMR) is the ability to take our equipment on vacation and remain in contact with our friends back home. One way to do this is by using repeaters close to your current location with wide area talk groups or Brandmeister. Another method is to utilize a hotspot connected back to your home area via the internet.

In this article we are going to assume that you already have an operational hotspot. Our focus is going to be on establishing the internet connection for your hotspot. I use a ZUMspot (Photo A) that is available from Ham Radio Outlet and others.

If you are using a hotspot at home connected to your Wi-Fi, all you needed to do was enter into the hotspot's configuration the SSID and PSK (publicly shared key) for your Wi-Fi and the hotspot automatically connects to it when powered up. The same is true if you use your cellphone's Wi-Fi hotspot. Using your cellphone is great if you have cellular service available and an unlimited data plan. Otherwise, you will be looking at using a public Wi-Fi, which can present some challenges.

Most of these Wi-Fi systems, especially those on which you "pay to play," require a more complex login procedure requiring you to enter some additional credentials in addition to the password, such as your name, credit card, room number, etc. The hotspot is not programmed to provide this additional logon information.

Photo A: ZUMSpot DMR hotspot

The Travel Router

The answer to the problem is a little device called a Travel Router (Photo B). Obviously, we hams with our DMR hotspots are not the first to have this problem. The unit I

Photo B: TP-Link travel router

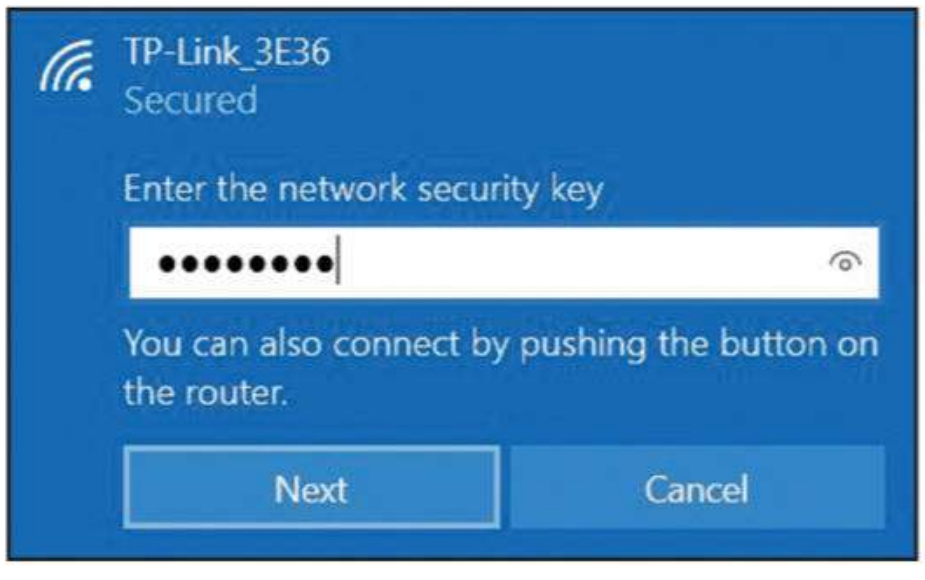


Figure 1: Connecting to the router's Wi-Fi

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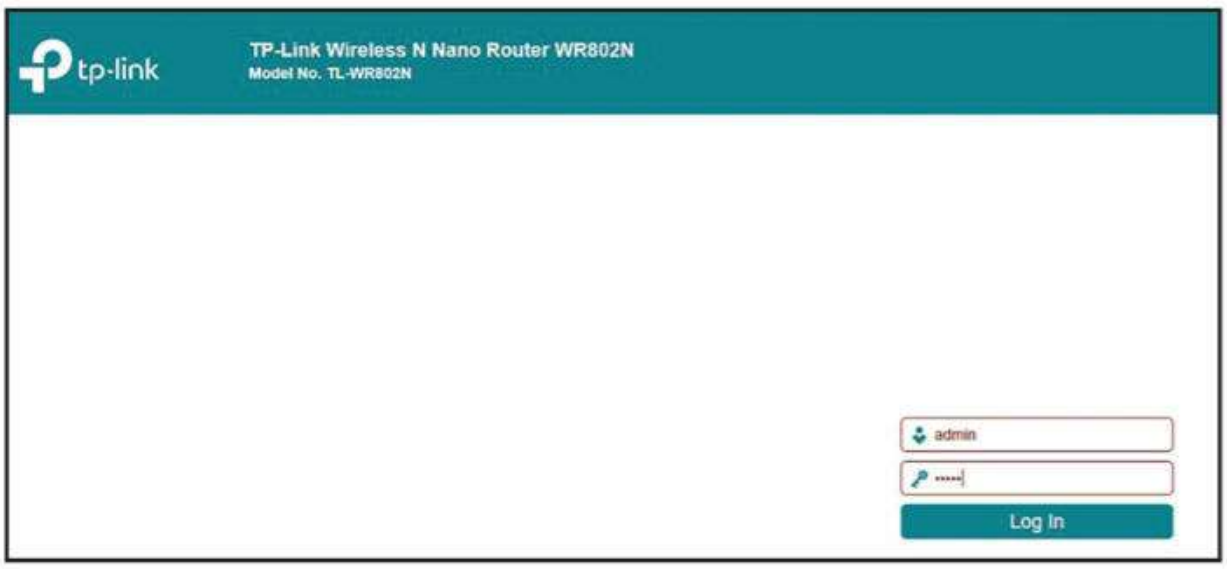


Figure 2: Router logon screen

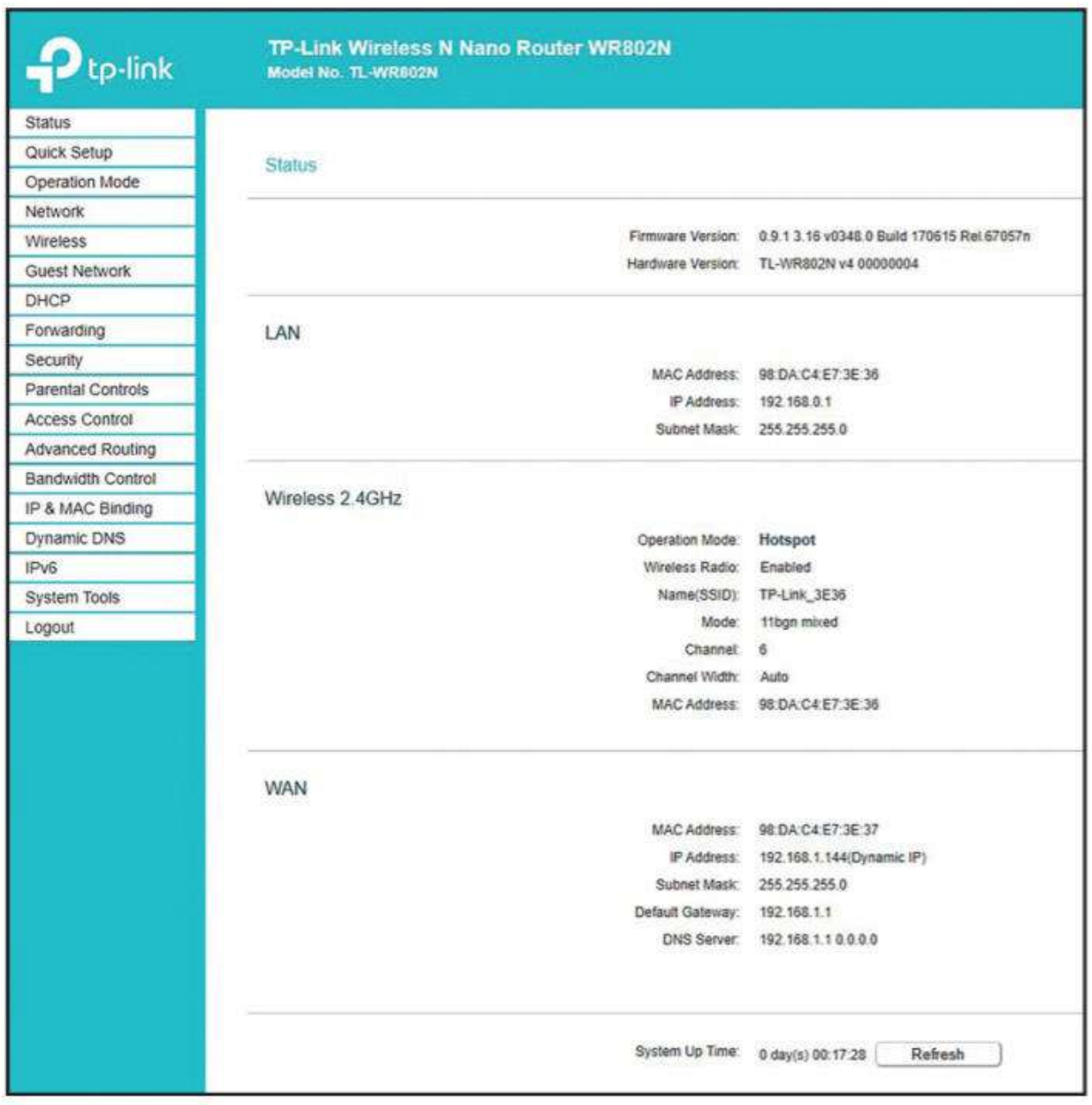


Figure 3: Router status screen

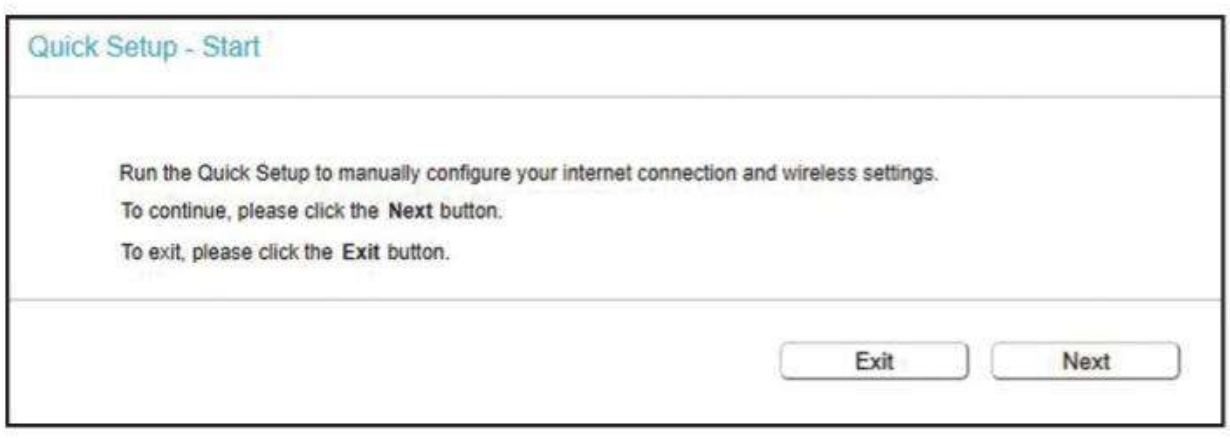


Figure 4: Quick setup start screen

A travel router is a device that is designed to allow you to setup your own wireless LAN and connect multiple devices to a hotel or other public network.

selected was a TP-Link 300 Mbps Wireless N Nano Router. The unit cost $29.95 with free 2-day delivery from Amazon (I have Prime). Can't beat that. The unit comes with cables and AC power supply. It can also be powered via a USB port.

A travel router is a device that is designed to allow you to setup your own wireless LAN and connect multiple devices to a hotel or other public network. It can interface to either a wired or wireless network. Once connected to the public network, additional devices such as your DMR hotspot can be connected to the travel router's Wi-Fi LAN and have internet access.

Connecting to the Travel Router

The travel router came with instructions on how to set it up, and as with many computer devices, it was not 100% clear what I needed to do. But by using the provided instructions along with a couple of YouTube videos, I was able to figure it out. I will try to save you some frustration by going over the process here.

First, connect the travel router to the power source, either the provided power supply or a powered USB port, and allow the router to boot up. In my case, the little green light on the router will blink until the configuration is complete and then turn steady green.

Second, turn on the Wi-Fi on your laptop and look for the router's default SSID. In my case it was "TP-Link_3E36". The SSID and password or PSK is provided by the manufacturer. Click on the SSID and then click on "Connect". Enter the password and click on "Next" (Figure 1). You will be connected to the router's Wi-Fi. As the laptop connects, you may get some security messages from Windows. Once you get up and running, you can change the SSID and password.

Configuring the Travel Router

In this section we are going to cover the basic configuration required to get the router working as a Wireless Access Point (WISP) on your home Wi-Fi network. Once you get to the hotel, cruise

ship or other public Wi-Fi, you will need to make some changes to the configuration. We will point those out along the way. The screen captures and examples in this article are based on the TP-Link unit, but others are probably similar.

Once you are connected to the router's Wi-Fi, you can launch your browser and go to the router's configuration page. For the TP-Link router this is <http://tplinkwifi.net>.

If your browser will not connect using the link above, you can also try entering the router's IP address. For the TP-Link, the default IP address is 192.168.0.1. Again, this will be provided by the manufacturer. If you still cannot access the configuration page, make sure you are connected to the router's Wi-Fi and not your home Wi-Fi. When all else fails, start over by using a paper clip to press the reset button on the router. This will reset the unit back to its original factory settings.

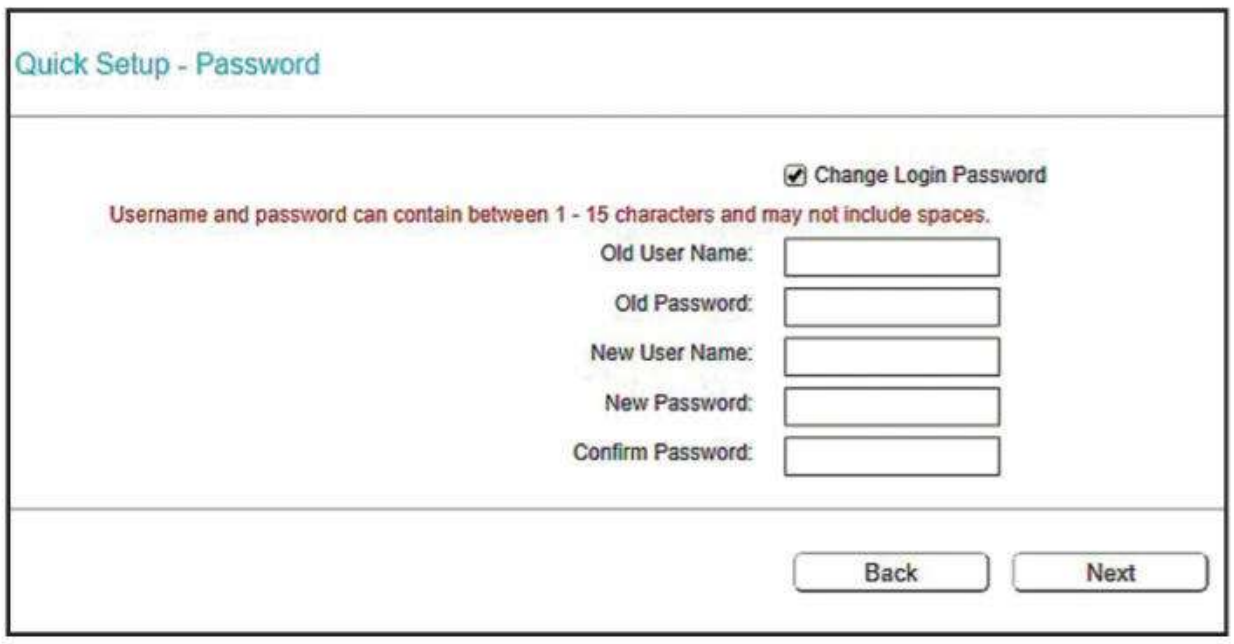


Figure 5: Password screen

Figure 6: Operation screen

The router's logon page will load (Figure 2). The default username and password are both "admin" in lower case. These parameters can be changed once you complete the basic configuration.

Enter the username and password and click on "Log In." You will be taken to the router's status page (Figure 3). On this page you can see all the current parameters. If this is your initial setup, there will not be any data in the WAN section as the WAN access has not been configured. To continue, you will need the SSID and password for your Wi-Fi network.

Down the left side of the screen are the various menu selections. For your initial configuration the best option is to select "Quick Setup." Once everything is set up and running, you can easily go back to this page and use the menus to make changes and customize your system.

To start, click on Quick Setup and the Quick Setup – Start screen (Figure 4) will appear. Then click on "Next."

A series of small screens will then walk you through the setup of the most important parameters. The first screen will be the password screen (Figure 5). This is the router's password, not the Wi-Fi password; we will get to that shortly.

Check the box to change the logon password. Leave the box unchecked and the username and password will

Figure 7: WAN connection type screen

remain “admin.” I would leave the username and password at the factory defaults until you become more familiar with the device. In either case, click “Next” to move to the Operation mode screen (Figure 6). Select “Hotspot Router” and click “Next.” The “WAN Connection Type” screen (Figure 7) will appear.

The most common selection would be “Dynamic IP” which is the same as DHCP. In the rare case where you know the IP you must use, then you would select “Static IP.” Click “Next” to move to the “AP Select” screen (Figure 8). At this point, you need to know the SSID and password for the Wi-Fi you are going to join, and you must be in range. You can’t do this in advance. This is one selection you will have to change when you get to another location. Right now, we are just going to get the system working on your home network.

Locate your SSID and click on “Connect.” If you don’t see it right away, wait a short time and click on “Refresh.” After you click on “Connect,” the Wireless Setup screen (Figure 9) will appear. The only thing you will need to enter on this screen is the Wireless Password for the Wi-Fi system you are connecting. Everything else has already been entered. At home, this will be your network’s password or PSK. Away from home, this will be the password provided by the Wi-Fi operator. If no password is required, leave the box blank.

After you have entered the password, click on “Next” and you will be returned to the logon screen. At this point your router is connected to the public Wi-Fi. Your laptop is already connected to the router and the router is now connected to the Wi-Fi. After you have connected to the Wi-Fi, there may be additional logon information required, such as your room

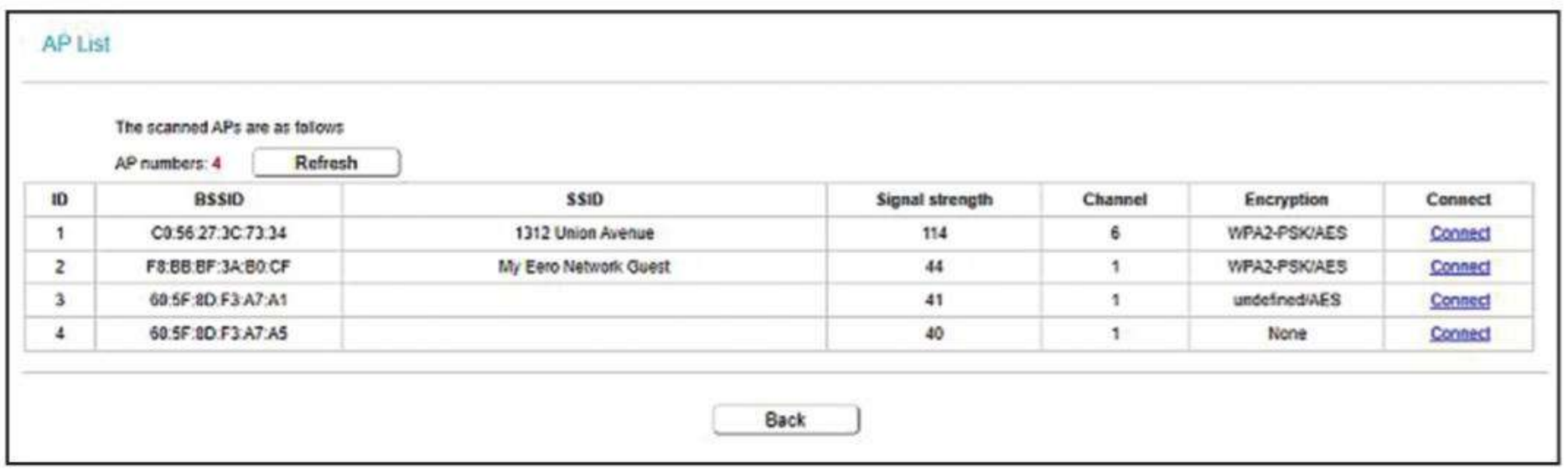


Figure 8: AP selection screen

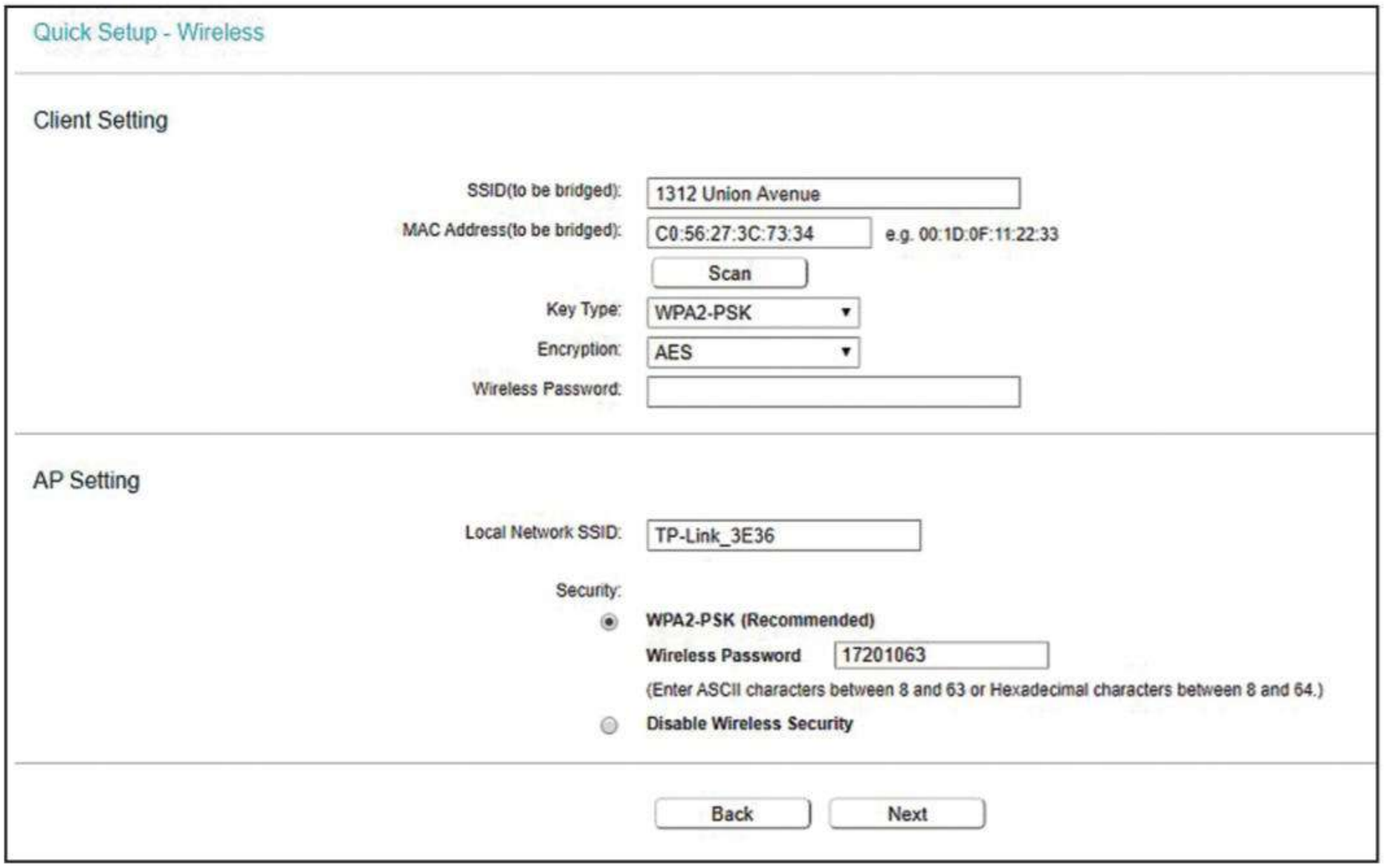


Figure 9: Wireless setup screen

Figure 10: Pi-Star home page.

Figure 11: Pi-Star log on page

number, etc. You should be able to use your laptop to provide the additional logon information.

Connecting the Hotspot to the Travel Router

For the hotspot to connect to the travel router, you will need to enter the SSID and password of the travel router into the list of available networks in the hotspot's wireless configuration. With the hotspot and your laptop logged onto the same network, probably your home Wi-Fi, access the hotspot using your browser. For my system I use <http://pi-star> (Figure 10). If that doesn't work, try using the hotspot's actual IP address. It will be on the bottom of the hotspot's screen whenever it is active.

Click on "Configuration" near the top right edge of the screen. This will take you to the configuration logon screen

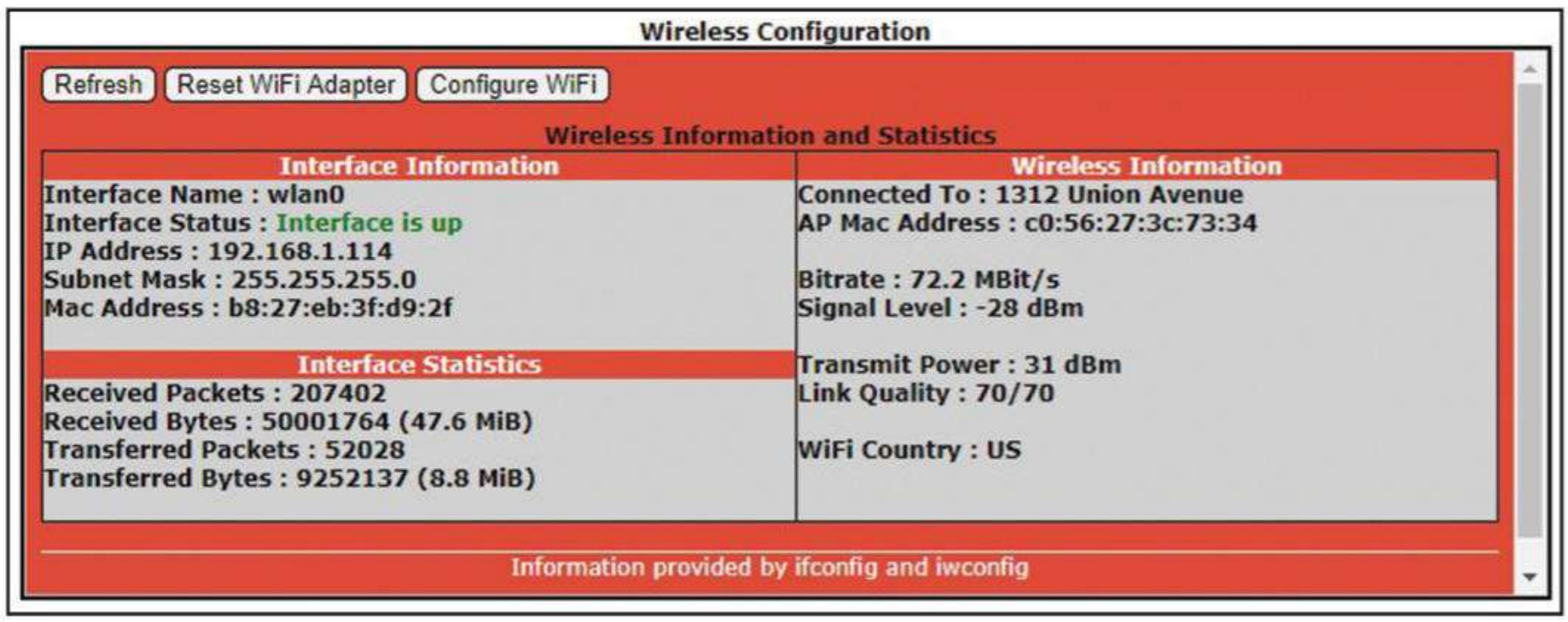


Figure 12: Pi-Star wireless configuration page

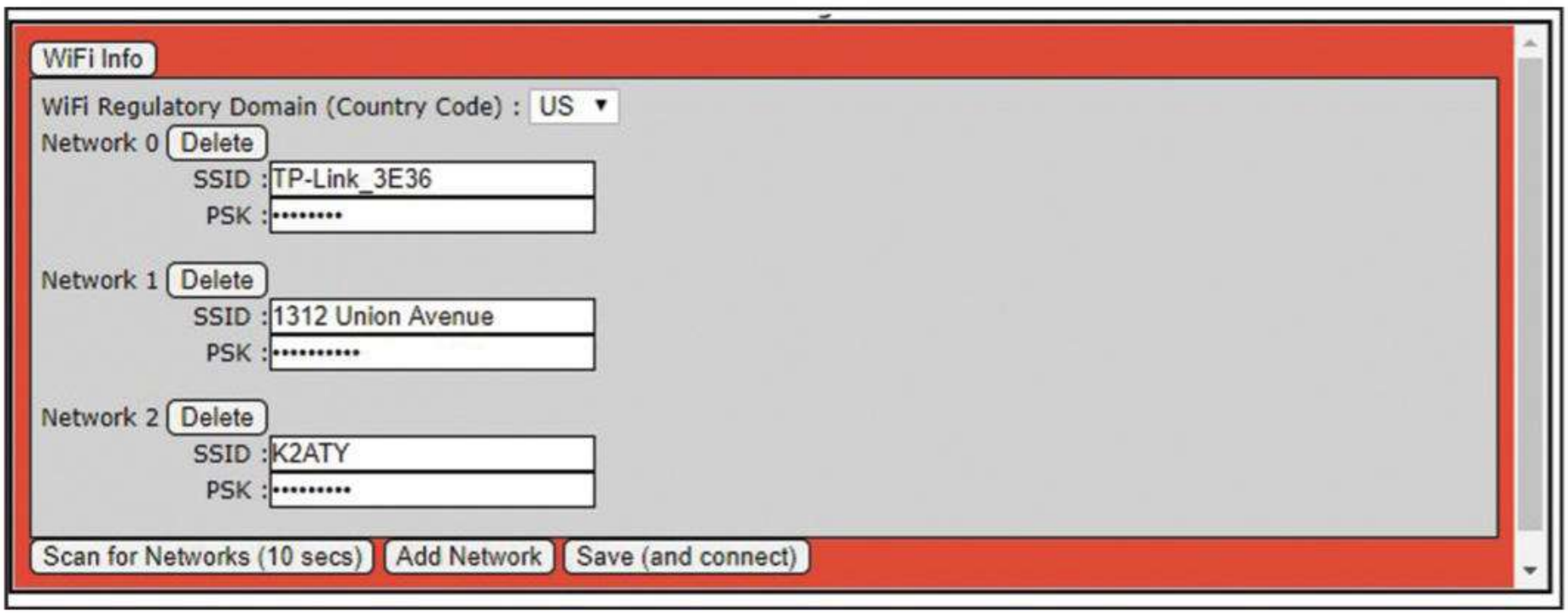


Figure 13: Pi-Star wireless networks page

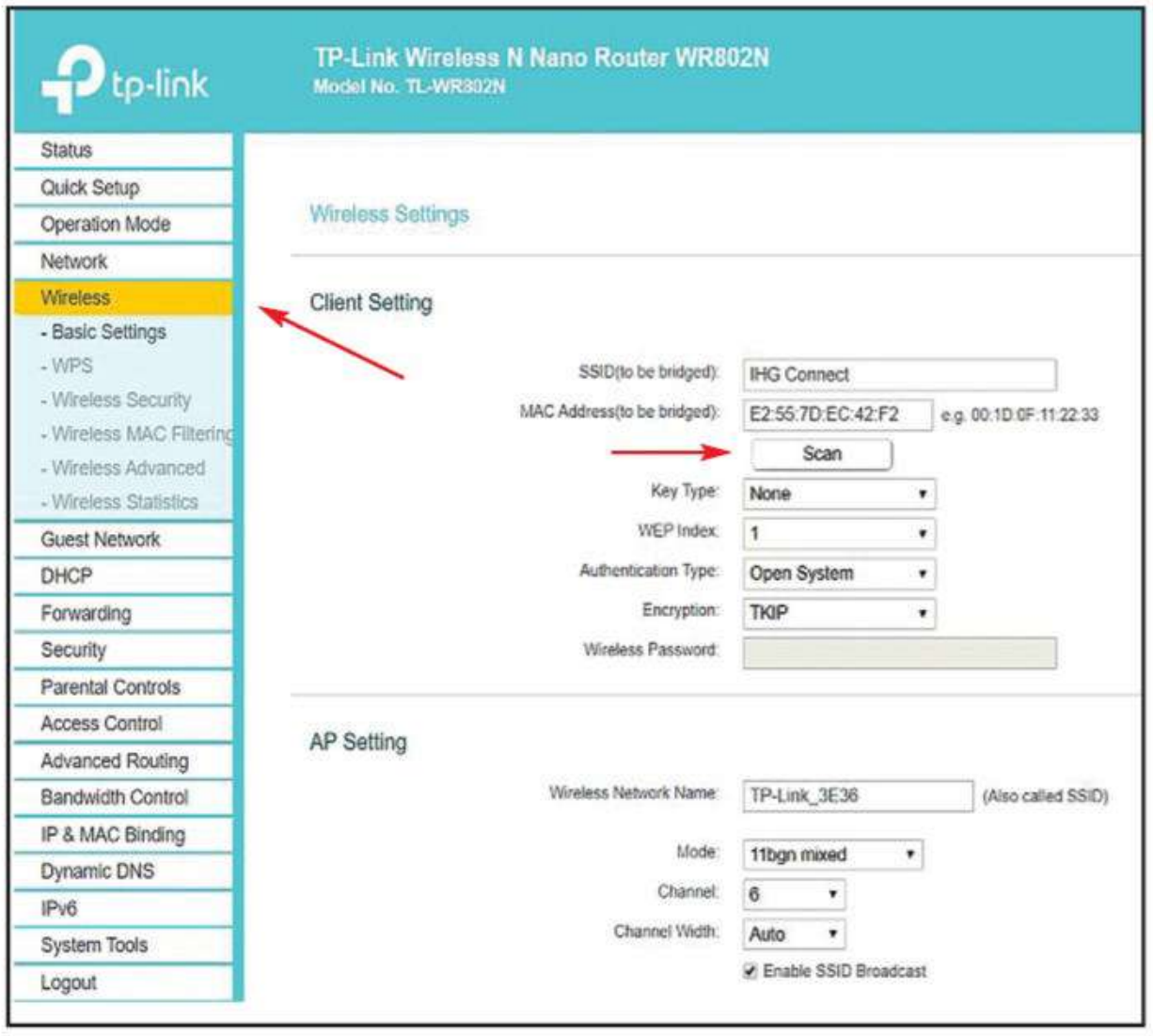


Figure 14: Router configuration screen. Select "Wireless" and "Scan" to have it find a network in a new location.

(Figure 11). The default logon for the pi-star software is:

Username "pi-star"

Password "raspberry"

Of course, if you have changed the username and password, you will need to use your values. Click on Sign In and you will be taken to the Configuration Screen (Figure 12). Click on "Configure Wi-Fi" to go to the "Wireless Networks" screen (Figure 13). Add the SSID and the PSK for the travel router. You may need to click on "Add Network" if there are no open slots and you don't want to overwrite one of your existing entries. In this example we have used the router's default SSID and password and entered it as Network 0. Please note, the hotspot will search for networks in the order shown on the Wireless Networks page. If none of the other networks are within range, it doesn't matter which network you define for the travel router. In this example, I put it in Network 0 so that while testing at home it would find the travel router first. Network 1 is my home Wi-Fi and Network 2 is for my cellphone's hotspot.

When you have finished entering the information, click on "Save (and connect)." The system should then go back to the home screen, but sometimes it

When you get to your location, the first thing you should do is plug in the travel router and let it start to boot up. You will need it to start its Wi-Fi before you can proceed.

doesn't. Either way, you can close the browser. Reboot the hotspot and it should join the travel router's network.

If everything is working OK, you should be on the air. I usually key up and test with the Parrot talk group. If I hear myself coming back, everything is working. When active, the hotspot should display an IP address on the travel router's network such as 192.168.0.101. This will confirm that the hotspot is connected to the travel router and not to your home network.

Setting up to Connect to a Public Wi-Fi

Now let's jump to some place with a public Wi-Fi that requires additional logon information like a hotel, resort, cruise ship, etc.

When you get to your location, the first thing you should do is plug in the travel router and let it start to boot up. You will need it to start its Wi-Fi before you can proceed.

Next, boot up your laptop and turn on its Wi-Fi. Follow the instructions above in the section "Connecting to the Travel Router." Once you have connected to the travel router, you can search for and connect to the public Wi-Fi. You do not need to go through a complete configuration, but you do need to login to the travel router's home page. As before, for my TP-Link router the configuration page address is <http://tplinkwifi.net>.

The logon screen will appear. Enter the username and password and you will be taken to the configuration screen (Figure 14). Click on Wireless and then under "Client Setting" click on "Scan". This will cause the travel router to scan for all available wireless networks.

The access point list screen (Figure 15) will appear. Locate the network to which you wish to connect from the list. Hotels and such often have many access points. If there are multiple entries for your location, chose the one with the strongest signal. Click on "Connect" and you will be returned to the Router Status Screen.

Most public systems are open access at this point but if a password is required, you will have to get it from the local operator. Enter the password in the "Wireless Password" box in the "Client Setting" section on the Router Status Screen. Click on "Save" at the bottom of the screen and the travel router should be connected to the Public Wi-Fi.

You can then close your browser. You should be up and running. As I mentioned above, if you have access to the DMR "Parrot" talk group, you can send a test transmission and if you hear yourself come back after a few seconds, you are up and running. You should be able to make contacts on the talk groups you have programmed into the Hot Spot and your portable.

Operating Notes

When operating from hotels or other public access points within the continental United States, you shouldn't have any problems.

When operating in other countries, even though you are only talking two feet from your portable to the hot spot on very low power, you will still need a reciprocal license from that country.

Operating from a cruise ship can be a bit more complex. First, most cruise lines forbid you from bringing amateur radio equipment on board the ship (read the contract of carriage). This can sometimes be resolved by getting permission from the cruise line prior to boarding. Second, you will need a reciprocal license from the country in which the ship is registered. In the case of Princess, this is easy since all their ships are registered in Bermuda and Bermuda is very ham-friendly. Contact ARRL headquarters for the latest information. Third, you will need permission from the Master (captain) of the ship. Generally, if the cruise line says it's okay, the captain will go along. You can work this out through the Purser's desk or the Cruise Director.

Finally, when you are in port, you also need a reciprocal license from the country you are visiting. I avoid this problem by operating only at sea. You best indicator is, if the casino is open, you can operate.

I hope this helps you get on DMR when traveling.

(*For more information on types of internet hotspots and how to link them to your ham experience, see the Ham Radio Explorer's column, "Check Into Repeaters Around the World", elsewhere in this issue–ed).*

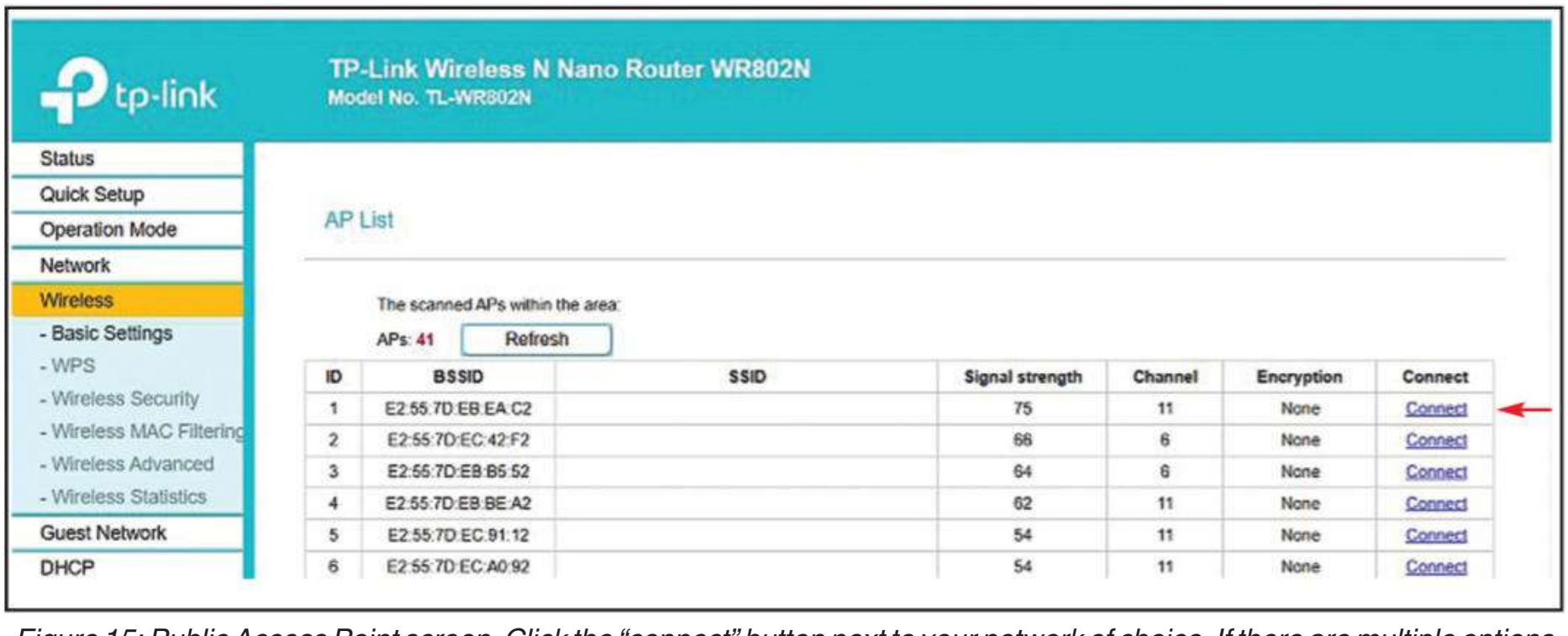


Figure 15: Public Access Point screen. Click the "connect" button next to your network of choice. If there are multiple options, choose the one with the strongest signal.

A proposed spectrum-use fee in Ecuador is treating hams the same as commerial broadcasters and is threatening to make the cost of amateur licenses out of reach for the majority of the country's hams. There are fears that neighboring countries may follow suit. Our contributing editor in South America digs in for details.

Will Ecuador Tax Amateur Radio Out of Existence?

BY MARTIN BUTERA,* PT2ZDX/LU9EFO

Ecuador's telecommunications regulator, ARCOTEL, recently proposed a fee of USD $450 for the "use and exploitation of the radio spectrum" on all licensees, including radio amateurs. In addition, the agency is planning to assess a USD $22.50 for the "Value of the Rights for Granting and Renewal of Enabling Titles," coming to a total of USD $472.50. While the fee covers a 10-year license term, it would need to be paid up front, something that is impossible for many of the approximately 700 licensed hams in Ecuador, as the country is currently in the midst of one of its toughest economic crises of recent years. There is also concern that other nearby countries may follow Ecuador's lead and impose similar fees.

To learn more about this topic, Contributing Editor At-Large Martin Butera, PT2ZDX/LU9EFO, interviewed Lorenzo Emilio Lertora Velarde, HC2BP, President of the Guayaquil Radio Club, which is Ecuador's member society of the International Amateur Radio Union. – W2VU

Since 1923, one hundred years ago, Ecuadorian radio amateurs have been serving their country, helping to communicate during natural disasters and providing community service, like hams around the world.

There have been many economic crises that the beautiful country of Ecuador has had to endure throughout history, from which it has always been able to recover with great effort and work by all of its people. Currently the economic scenario in Ecuador once again is not favorable at all.

Without a doubt, COVID-19 caused a great impact on Ecuador's economy. The country entered a state of "coma," that is to say, the entire country was paralyzed by a pandemic that nobody expected and from which it has not yet seemed to wake up.

To be fair, Ecuador is not the only country in crisis. Global supply chain issues and the economic impact of the invasion of Ukraine have made recovery even more difficult. In this context, Ecuador's government wants to impose a high "spectrum use" fee on radio amateurs as well as other licensees, running the risk that the hobby will disappear completely in that country.

To learn more about this situation, *CQ* interviewed colleague Lorenzo Emilio Lertora Velarde, HC2BP, President of the Guayaquil Radio Club (Photo A). The Guayaquil Radio Club, HC2GRC (Photos B and C), is the dean of the radio clubs of Ecuador and represents that country as an associate member in Region 2 of the IARU (International Amateur Radio Union).

CQ: *What is the name of the body that regulates the activity of radio amateurs in Ecuador?*
Lorenzo Emilio Lertora Velarde, HC2BP: The entity is the Ministry of Telecommunications and its Agency for Regulation and Control, ARCOTEL.

Photo A: Lorenzo Emilio Lertora Velarde, HC2BP, President of the Guayaquil Radio Club

** CQ Contributing Editor-At-Large*
E-mail: <martin_butera@yahoo.com.ar>

Photo B: The headquarters of the Guayaquil Radio Club, HC2GRC.

Photo C: HC2GRC is located in a densely-populated area of Guayaquil. Here, HC2BP is standing in an alleyway next to the club's building, where two of the station's towers are installed.

CQ: *Is there a specific law to regulate the activity of radio amateurs?*
HC2BP: There is no law. Everything is regulated by ministerial agreements and according to the Constitution, they must consult with radio amateurs before issuing the agreement.

CQ: *So what happened? Weren't the radio amateurs called for this new agreement?*
HC2BP: Unfortunately, no club or radio amateurs from Ecuador were invited and now we find ourselves with this surprise, that they want to charge us $472.50 for the use of the radio spectrum.

CQ: *In almost all parts of the world, amateur radio is considered a public service, but I get the feeling that for the Ecuadorian authorities, radio amateurs represent just another fee to collect and ways to generate money. What reflection can you make about this?*
HC2BP: In Ecuador. we operate in emergencies as volunteers in communications support. With this ministerial agreement, one thinks that (ARCOTEL) only wants to raise funds for the use of the radio spectrum but, in my opinion, they are unaware that we radio amateurs do not profit from the use of the bands, which are exclusive to radio amateurs, I want to think out of ignorance, as a first point. This is because today the use of cell phones and the internet is very common.

Being a radio amateur is not just practicing a hobby – you have to be curious and have the spirit to investigate how to communicate with the means we have, in circumstances or places where other systems for civil use fail to make contact. I think this is, from my point of view, something very valuable and productive for our entire society.

My opinion is that whoever drafted the ministerial agreement does not know what radio amateurs are, (that) we have the ability to communicate with the whole world, how supportive we all are, and how useful we can be for a country.

CQ: *Continuing with this, it is clear that radio amateurs do not exploit the radio service, but that they give and provide a service, what reflection can you make about this?*
HC2BP: Radio amateurs are the first aid group in an emergency to achieve and collaborate in communications. In many countries, there is currently a group formed and trained to operate in various types of disaster situations. In Ecuador, we were part of the Civil Defense for VHF/HF communications.

The Guayaquil Radio Club was the one that formed the Rescue Group of the Ecuadorian Air Force (SAR-GRC) with several of its members. We had training to rescue people from aviation accidents and we are trained to operate from the same place where an accident could occur. We are capable, for example, of transmitting with our own total communications base, to connect with the Air Command Center in Guayaquil. We have also acted in several earthquakes and several other emergency situations.

My reflection is that the Agency for the Regulation and Control of Telecommunications of Ecuador, today is acting with complete ignorance of who we radio amateurs are.

CQ: *How are amateurs organizing to oppose these fees? Are they preparing something collective among the other radio clubs? What is the next step?*
HC2BP: The club has already drafted a public claim note, which I would like you to add to this article (*see sidebar – ed.*). Also with a lawyer colleague, a *protection action* demand will be presented that is contemplated by the Constitution of Ecuador and will be signed by the presidents of several clubs in the country, this in addition to the letters that several clubs have already sent to ARCOTEL. Also radio amateurs who are not club members are personally invited to send a letter.

We, as the Guayaquil Radio Club and a member society of the IARU, represent Ecuador and we are going to defend all our radio amateurs in the country. We are committed to act, but only after carefully analyzing each step and action to follow, with the advice of several friends who also are lawyers.

CQ: *Have you already contacted or do you plan to request support from representatives at the ITU or CITEL?*
HC2BP: At the moment, we have not contacted members of the International Telecommunication Union or members of the Inter-American Telecommunication Commission. We are waiting for the result of the first judicial proceedings and the official letters presented. In the future, if these actions do not meet the established objective, of course we will contact these organizations, to raise our claims, until the last instance.

CQ: *For how many years has the Guayaquil Radio Club been a member of IARU Region 2? And have you already asked the IARU Region 2 for help?*
HC2BP: I contacted the current Vice President and Treasurer of IARU Region 2, Gustavo de Faria Franco, PT2ADM, who in turn has worked for 21 years in area F of IARU Region 2, which corresponds to Ecuador; and I asked him for a certification that he prepared. It is signed by the current IARU Region 2 President, Mr. George Gorsline,VE3YV, and the current Secretary, Mr. Rod Stafford, W6ROD.

That certification in Spanish, I would like you to be able to publish it together with this interview (*see sidebar – ed.*). The idea is to present this certification together with our claim.

Of course, the IARU does not have jurisdiction to act within Ecuador, but we understand that the support will be vital, to show more strength and unity. Today it is up to us to go through this difficult moment, but tomorrow it can be the turn of any league in any country That's why I think we should be united.

The Guayaquil Radio Club has been a member of the IARU since 1952 and maintains a very good relationship with the institution to date. The next General Assembly will take place in 2025 in Ecuador and, God willing, it will be organized by the Radio Club de Guayaquil.

CQ: *Ecuadorian radio amateurs have always been and will be an example for all of us, since they have always showed great solidarity, passion and courage, on all the occasions when they had to act in an emergency. I hope with all my heart, you can fix this problem as soon as possible.*
HC2BP: Thank you very much, Martin. I know of your concern, as well as that of many other radio amateurs from all over the world who have communicated with us, to give us their support.

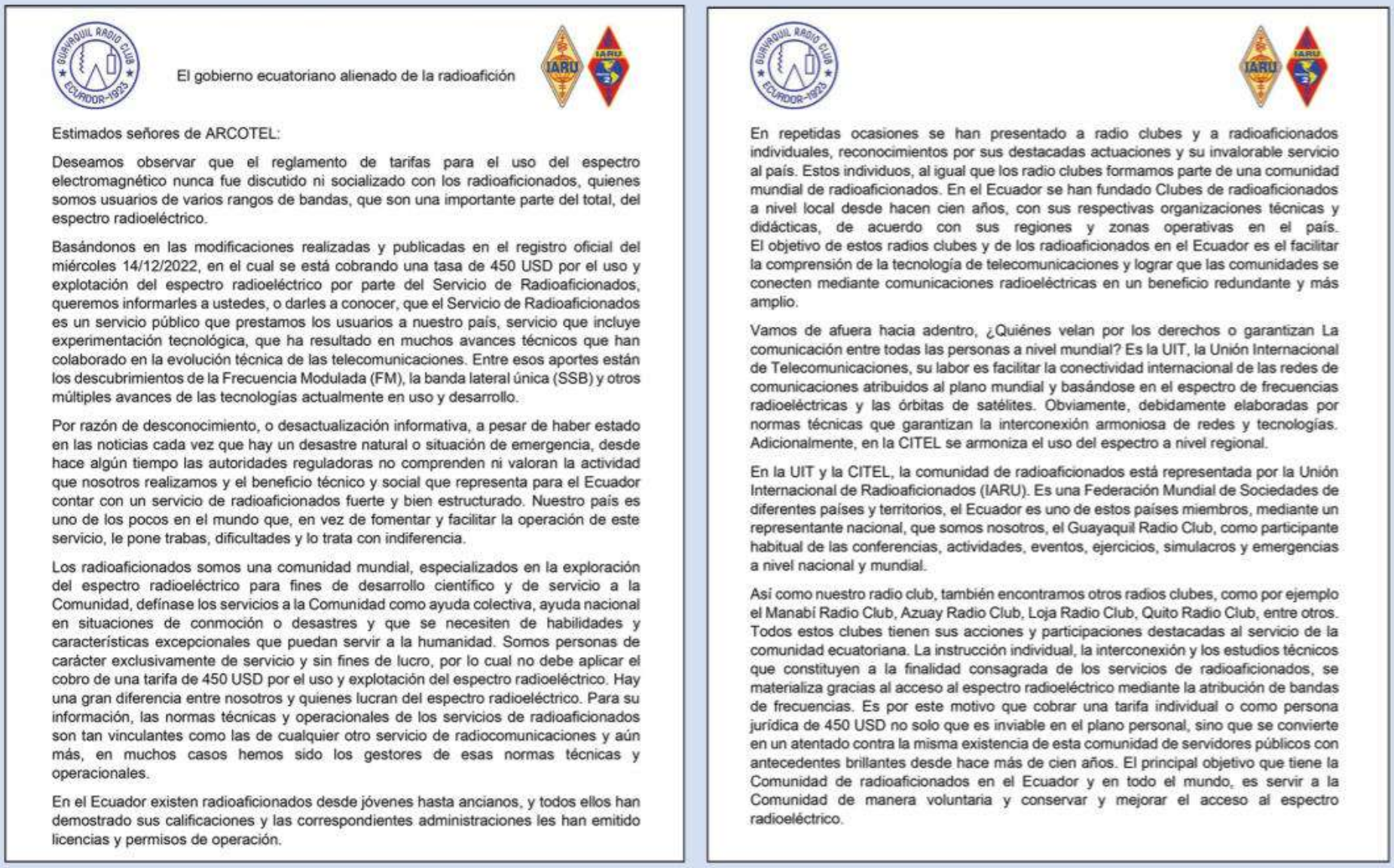
Unfortunately, for ARCOTEL, radio amateurs are just a group of users of the radio spectrum and they only want to

raise money with us. In any case, I have great hope and faith that within the organization there are executives who know our work in more detail and we hope that this situation can be resolved in the right direction.

Conclusion

To close this article, I would like to end with a short text written by prominent Ecuadorian journalist and fellow amateur Arturo Tello, HC2TE, which he himself entitles: "It's Called Ingratitude", in which he forcefully expresses the difficult and sad situation through which the radio amateurs of Ecuador are passing today.

> It's Called Ingratitude!!
> To be pleasant in life is to show that sacrifice has not been in vain. Pleasant are the children who recognize what their parents have done, pleasing is the society that has received the gifts of those who have selflessly served them, pleasing is the one who today enjoys the benefits achieved by their ancestors. In short, no one expects praise for what was done, but what is never expected to receive in return is punishment!
>
> A little over 100 years ago, Ecuador did not have a voice and data service like we have today. It was with great difficulty that (a) message (could be) transmitted at a distance and only to certain places. It was then that a group of very enthusiastic people began to experiment with something that was already a sensation in the United States: ignore borders and have their voices heard from a distance. Amateur radio was born.
>
> Just as recorded in history is how radio amateurs develop today. At that time, young people assembled their transmitters, made their antennas, built their towers, experimented and invented with one goal: that their voices go around the world and place Ecuador on the map. They did it with their own resources, knowing that in return they would only receive great personal satisfaction. Today is the same, nothing has changed in 100 years for radio amateurs, except that modern technology gave us the first blow of ingratitude.
>
> Few remember the disinterested work, risky but always opportune and efficient in facts, to name a few, such as: 1949, when an earthquake devastated the province of Tungurahua; 1976, fire south of Guayaquil in the Shell Gas warehouses; in 1981, a plane crash in which President Jaime Roldós died; 1982-83, during the violent El Niño phenomenon; 1985, before the effects of the deadly earthquake in Mexico. There, on multiple occasions and places, were radio amateurs.
>
> Even now, with all the technology available, the radio amateur has not ceased to be necessary. Every modern system needs electrical energy to function, but if it fails, the communication is impossible. Instead, the radio amateur arrives with his equipment, an antenna, a battery, a solar panel and in a few minutes he is the



El gobierno ecuatoriano alienado de la radioafición

Estimados señores de ARCOTEL:

Deseamos observar que el reglamento de tarifas para el uso del espectro electromagnético nunca fue discutido ni socializado con los radioaficionados, quienes somos usuarios de varios rangos de bandas, que son una importante parte del total, del espectro radioeléctrico.

Basándonos en las modificaciones realizadas y publicadas en el registro oficial del miércoles 14/12/2022, en el cual se está cobrando una tasa de 450 USD por el uso y explotación del espectro radioeléctrico por parte del Servicio de Radioaficionados, queremos informarles a ustedes, o darles a conocer, que el Servicio de Radioaficionados es un servicio público que prestamos los usuarios a nuestro país, servicio que incluye experimentación tecnológica, que ha resultado en muchos avances técnicos que han colaborado en la evolución técnica de las telecomunicaciones. Entre esos aportes están los descubrimientos de la Frecuencia Modulada (FM), la banda lateral única (SSB) y otros múltiples avances de las tecnologías actualmente en uso y desarrollo.

Por razón de desconocimiento, o desactualización informativa, a pesar de haber estado en las noticias cada vez que hay un desastre natural o situación de emergencia, desde hace algún tiempo las autoridades reguladoras no comprenden ni valoran la actividad que nosotros realizamos y el beneficio técnico y social que representa para el Ecuador contar con un servicio de radioaficionados fuerte y bien estructurado. Nuestro país es uno de los pocos en el mundo que, en vez de fomentar y facilitar la operación de este servicio, le pone trabas, dificultades y lo trata con indiferencia.

Los radioaficionados somos una comunidad mundial, especializados en la exploración del espectro radioeléctrico para fines de desarrollo científico y de servicio a la Comunidad, defínase los servicios a la Comunidad como ayuda colectiva, ayuda nacional en situaciones de conmoción o desastres y que se necesiten de habilidades y características excepcionales que puedan servir a la humanidad. Somos personas de carácter exclusivamente de servicio y sin fines de lucro, por lo cual no debe aplicar el cobro de una tarifa de 450 USD por el uso y explotación del espectro radioeléctrico. Hay una gran diferencia entre nosotros y quienes lucran del espectro radioeléctrico. Para su información, las normas técnicas y operacionales de los servicios de radioaficionados son tan vinculantes como las de cualquier otro servicio de radiocomunicaciones y aún más, en muchos casos hemos sido los gestores de esas normas técnicas y operacionales.

En el Ecuador existen radioaficionados desde jóvenes hasta ancianos, y todos ellos han demostrado sus calificaciones y las correspondientes administraciones les han emitido licencias y permisos de operación.

En repetidas ocasiones se han presentado a radio clubes y a radioaficionados individuales, reconocimientos por sus destacadas actuaciones y su invalorable servicio al país. Estos individuos, al igual que los radio clubes formamos parte de una comunidad mundial de radioaficionados. En el Ecuador se han fundado Clubes de radioaficionados a nivel local desde hacen cien años, con sus respectivas organizaciones técnicas y didácticas, de acuerdo con sus regiones y zonas operativas en el país. El objetivo de estos radios clubes y de los radioaficionados en el Ecuador es el facilitar la comprensión de la tecnología de telecomunicaciones y lograr que las comunidades se conecten mediante comunicaciones radioeléctricas en un beneficio redundante y más amplio.

Vamos de afuera hacia adentro, ¿Quiénes velan por los derechos o garantizan La comunicación entre todas las personas a nivel mundial? Es la UIT, la Unión Internacional de Telecomunicaciones, su labor es facilitar la conectividad internacional de las redes de comunicaciones atribuidos al plano mundial y basándose en el espectro de frecuencias radioeléctricas y las órbitas de satélites. Obviamente, debidamente elaboradas por normas técnicas que garantizan la interconexión armoniosa de redes y tecnologías. Adicionalmente, en la CITEL se armoniza el uso del espectro a nivel regional.

En la UIT y la CITEL, la comunidad de radioaficionados está representada por la Unión Internacional de Radioaficionados (IARU). Es una Federación Mundial de Sociedades de diferentes países y territorios, el Ecuador es uno de estos países miembros, mediante un representante nacional, que somos nosotros, el Guayaquil Radio Club, como participante habitual de las conferencias, actividades, eventos, ejercicios, simulacros y emergencias a nivel nacional y mundial.

Así como nuestro radio club, también encontramos otros radios clubes, como por ejemplo el Manabí Radio Club, Azuay Radio Club, Loja Radio Club, Quito Radio Club, entre otros. Todos estos clubes tienen sus acciones y participaciones destacadas al servicio de la comunidad ecuatoriana. La instrucción individual, la interconexión y los estudios técnicos que constituyen a la finalidad consagrada de los servicios de radioaficionados, se materializa gracias al acceso al espectro radioeléctrico mediante la atribución de bandas de frecuencias. Es por este motivo que cobrar una tarifa individual o como persona jurídica de 450 USD no solo que es inviable en el plano personal, sino que se convierte en un atentado contra la misma existencia de esta comunidad de servidores públicos con antecedentes brillantes desde hace más de cien años. El principal objetivo que tiene la Comunidad de radioaficionados en el Ecuador y en todo el mundo, es servir a la Comunidad de manera voluntaria y conservar y mejorar el acceso al espectro radioeléctrico.

At the request of Guayaquil Radio Club Presidenrt Lorenzo Emilio Lertora Velarde, HC2BP, we are sharing here the public claim note for ARCOTEL (Ecuadorian Telecommunications Regulation and Control Agency), prepared by the Guayaquil Radio Club, HC2GRC, as well as a letter from Region 2 of the International Radio Union (IARU), certifying that the Guayaquil club has been a member of, and Ecuador's representative to, the IARU since 1952. Both documents, of course, are in Spanish.

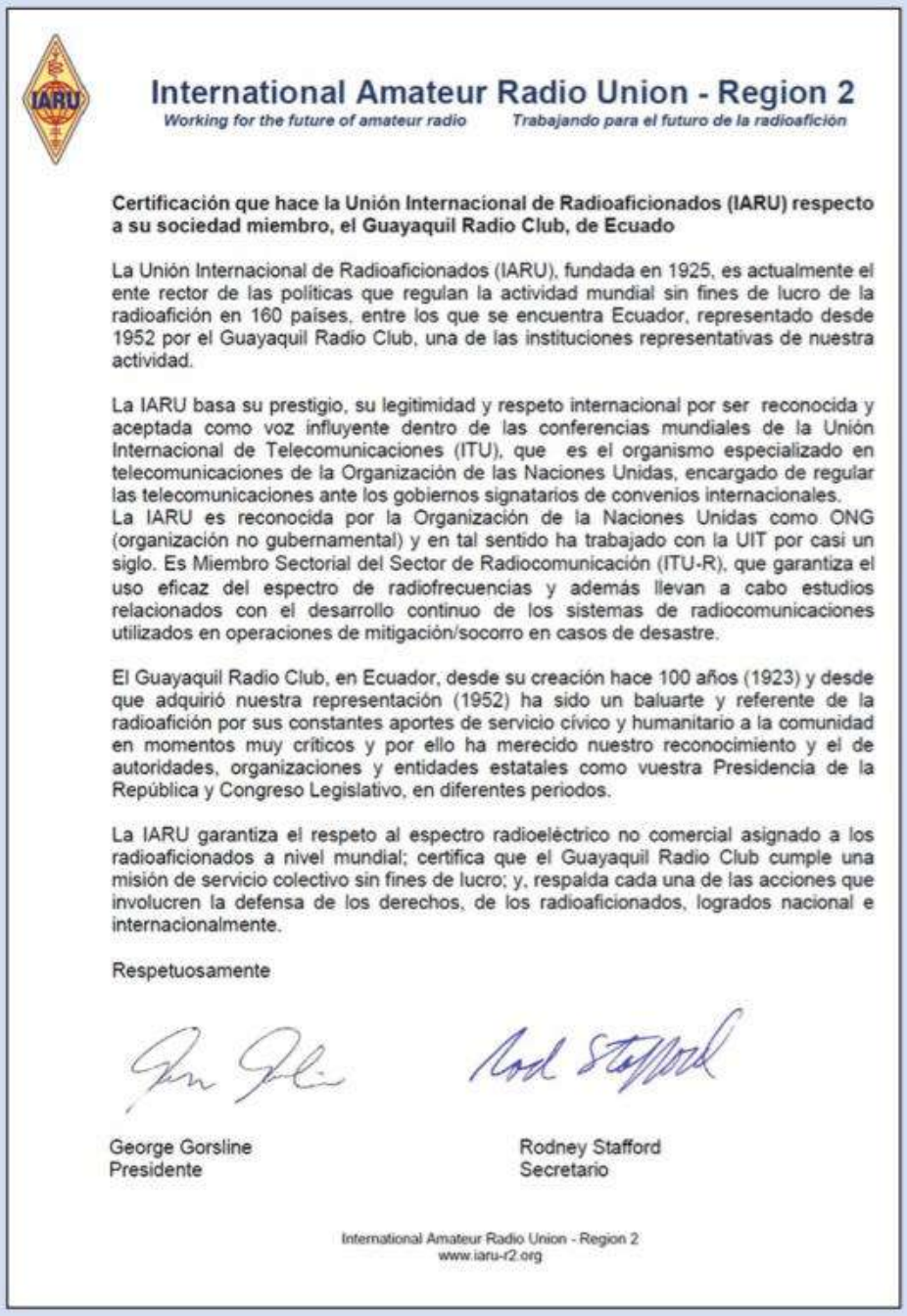
voice of salvation for many people, as happened in the 2016 Pedernales earthquake.

We are not paid to help, because it is our avocation. We don't need help, we do it because we love this activity. We do not want recognition or flattery, at no time do we raise our voice for anything other than defending our rights. We do not get involved in politics, radio amateurs are an example of universal brotherhood.

We are not a business, we do not bill, we do not provide public service to receive money in return, we do not sell anything, that is, we are synonymous with aid and humanitarianism. For this reason, we will not allow excessive ambitions or officials with total ignorance of what we do condemn us to disappear. All over the world they grant radio amateurs a license or registration, but only in Ecuador they invent a "Right for granting an enabling title" for $22.50 and a "Right to grant a qualifying title for the exploitation of the radioelectric spectrum" for $450.

Will any young (person) be interested in being a radio amateur knowing that he must pay $472.50? This is not an activity for the rich nor to use it and obtain economic benefits in return.

This is the ingratitude of which I speak. This is how the Agency for the Regulation and Control of Telecommunications (ARCOTEL) in Ecuador pays us back for our service. If the radio amateur is doomed to die, he will, he will die but with dignity and respect.



International Amateur Radio Union - Region 2

Working for the future of amateur radio — *Trabajando para el futuro de la radioafición*

Certificación que hace la Unión Internacional de Radioaficionados (IARU) respecto a su sociedad miembro, el Guayaquil Radio Club, de Ecuado

La Unión Internacional de Radioaficionados (IARU), fundada en 1925, es actualmente el ente rector de las políticas que regulan la actividad mundial sin fines de lucro de la radioafición en 160 países, entre los que se encuentra Ecuador, representado desde 1952 por el Guayaquil Radio Club, una de las instituciones representativas de nuestra actividad.

La IARU basa su prestigio, su legitimidad y respeto internacional por ser reconocida y aceptada como voz influyente dentro de las conferencias mundiales de la Unión Internacional de Telecomunicaciones (ITU), que es el organismo especializado en telecomunicaciones de la Organización de las Naciones Unidas, encargado de regular las telecomunicaciones ante los gobiernos signatarios de convenios internacionales.
La IARU es reconocida por la Organización de la Naciones Unidas como ONG (organización no gubernamental) y en tal sentido ha trabajado con la UIT por casi un siglo. Es Miembro Sectorial del Sector de Radiocomunicación (ITU-R), que garantiza el uso eficaz del espectro de radiofrecuencias y además llevan a cabo estudios relacionados con el desarrollo continuo de los sistemas de radiocomunicaciones utilizados en operaciones de mitigación/socorro en casos de desastre.

El Guayaquil Radio Club, en Ecuador, desde su creación hace 100 años (1923) y desde que adquirió nuestra representación (1952) ha sido un baluarte y referente de la radioafición por sus constantes aportes de servicio cívico y humanitario a la comunidad en momentos muy críticos y por ello ha merecido nuestro reconocimiento y el de autoridades, organizaciones y entidades estatales como vuestra Presidencia de la República y Congreso Legislativo, en diferentes periodos.

La IARU garantiza el respeto al espectro radioeléctrico no comercial asignado a los radioaficionados a nivel mundial; certifica que el Guayaquil Radio Club cumple una misión de servicio colectivo sin fines de lucro; y, respalda cada una de las acciones que involucren la defensa de los derechos, de los radioaficionados, logrados nacional e internacionalmente.

Respetuosamente

George Gorsline
Presidente

Rodney Stafford
Secretario

International Amateur Radio Union - Region 2
www.iaru-r2.org

Results of the 2022 CQ DX Marathon

BY MARK WOHLSCHLEGEL,* WC3W

First time in many years, I was without a beam, tower, and amplifier—so I tried concentrating on 30 meters. A whole new experience, and a lot of fun! I have all DX confirmed except for North Korea, and I can't do the weekend frenzies anymore; the Marathon has kept me active. I also note that for those of us "little" guys, FT8 is *the difference between having fun and not.* — **Stephen Oksala, NI3P**

Thoroughly enjoyed the challenge. — **MØVQ**

One more year (my 14th) I participate in this great challenge! — **Piero Giorgi, IK5FKF**

Thanks millions to the CQ DX Marathon organizers, sponsors, and everyone involved with this wonderful yearlong activity. — **Marvin Hlavac, VE3VEE**

Thank you CQ magazine, the annual DX Marathon was a blast! – **Bert Rollen, K4AR**

A year of amazing and unprecedented growth! With Cycle 25 coming in like a "lion," participation in the 2022 CQ DX Marathon grew at a double-digit rate. Specifically, we saw a 46.5% increase in participants from 2021, making the DX Marathon program the fastest growing DX program in amateur radio today!

The participation graph (Figure 1) shows the growth in 2022. Entrants worked 21,570 unique callsigns, the highest total in DX Marathon history. We also had a record number of logs submitted and the highest ever number of total QSOs as shown in Figures 2 and 3. Some of this growth may be attributed to Cycle 25 coming in strong, as well as the increasing popularity of the DX Marathon program. The popularity of digital modes is making it possible for those without large stations and linear amplifiers or those constrained by HOAs and limited antennas to play in the DX game. Digital participation accounted for 79% of all QSOs in 2022. This is an increase from less than 20% in 2015. The Mode graph (Figure 4) shows the change over the last few years.

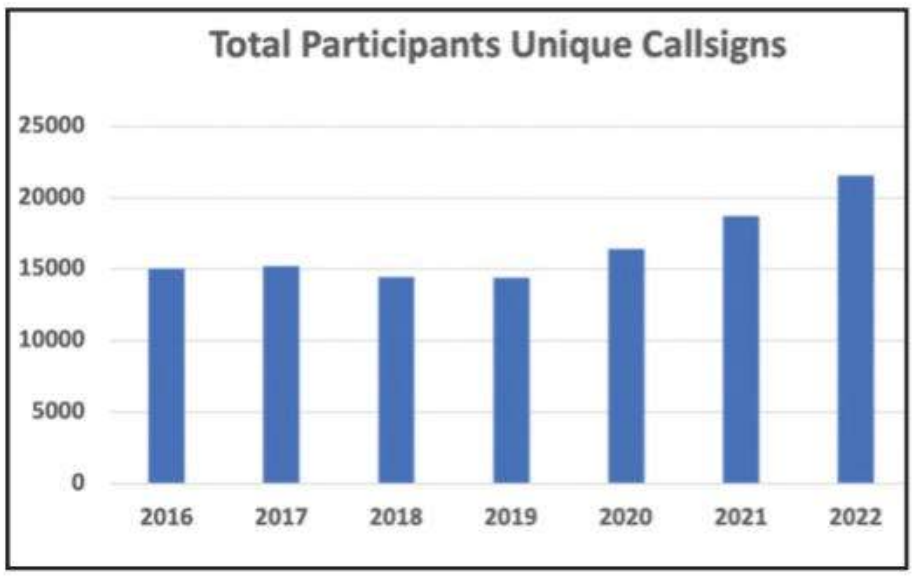


Figure 1. Total participation (unique call signs in submitted logs) in the CQ DX Marathon, 2016-2022.

During the scoring process, the DX Marathon staff carefully checks the accuracy of the submissions. Since the Marathon program does not require validating QSOs, we do recognize that the integrity of the program is dependent on accurate reporting of valid QSOs. As shown in Figure 5, for

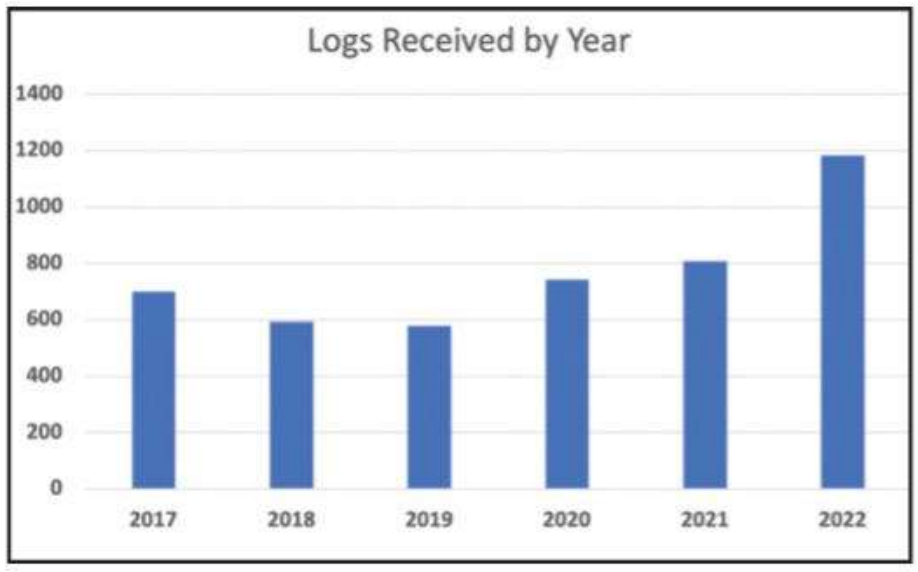


Figure 2. Number of logs submitted, 2016-2022. This year represented a 46% increase over 2021.

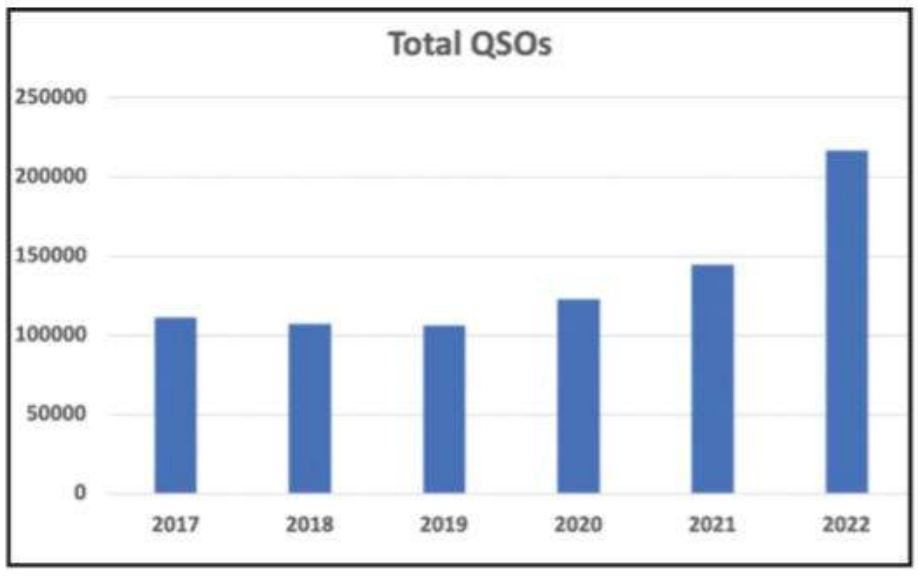


Figure 3. Total number of QSOs reported by Marathon participants, 2017-2022.

** Director, CQ DX Marathon*
E-mail: <wc3w@dxmarathon.com>

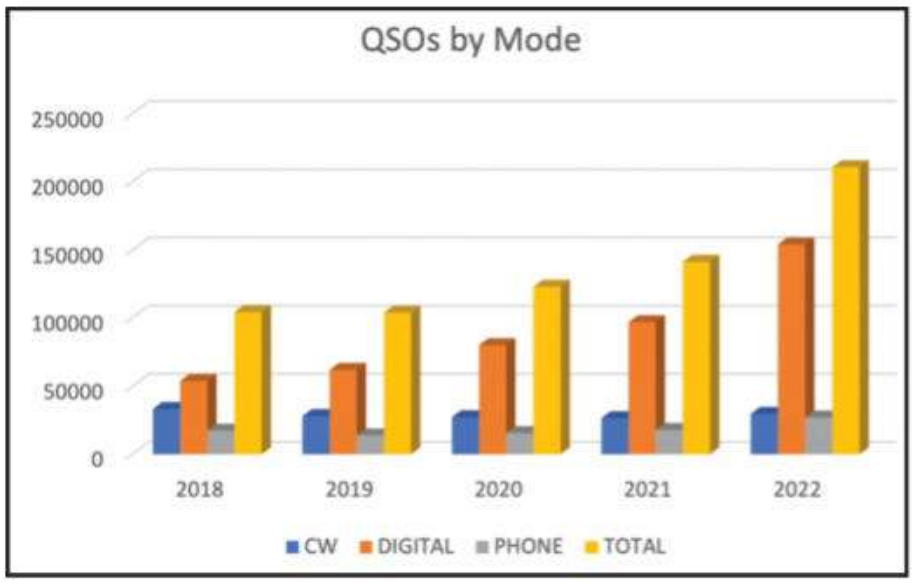


Figure 4. Mode breakdown of Marathon QSOs, 2018-2022. The percentage of digital QSOs keeps climbing.

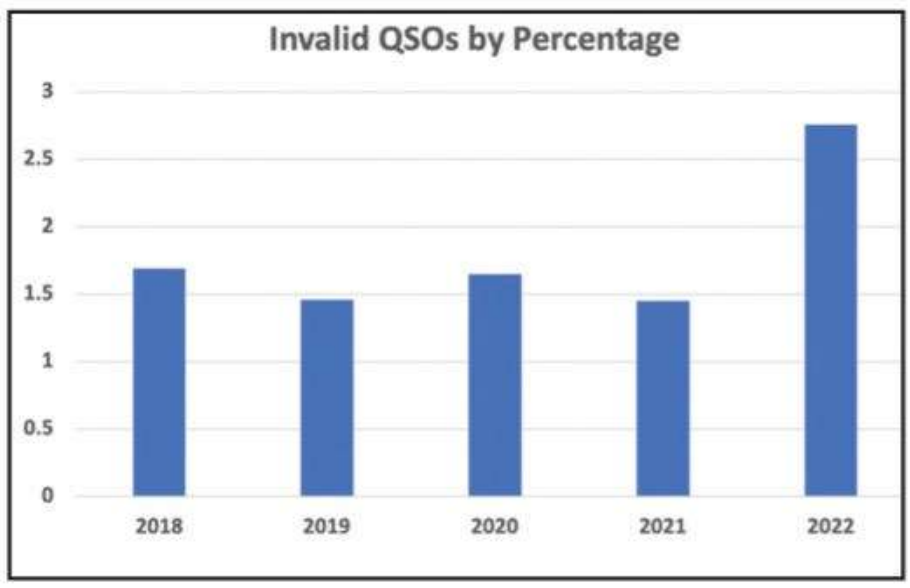


Figure 5. Tracking of invalid QSOs, 2018-2022.

2022 we had a much higher error rate than in years past, as expressed as a percentage of submittals. This was due to a number of items including a much more accurate scoring tool which includes a more comprehensive validating process that we are now using. Another reason was the larger than normal invalidation of QSOs claimed for Russia and Belarus. The CQ magazine policy was reflected on the Marathon website in the rules section, yet many participants reported QSOs during the invalidated period. This should not happen in the 2023 as the policy was updated in late 2022. We encourage all participants in 2023 to carefully check their logs and utilize the information that is posted on our new website at <www.dxmarathon.com>.

The highest scores in the DX Marathon program have historically been dependent on 1) propagation and 2) number of DXpedition activations. Both of these factors resulted this year in a top score in the Unlimited Class of 307. Surprisingly, the Limited Class turned in a top score of 303 which was quite formidable. Competition was fierce this year for the top spots in both Unlimited and Limited Class as six scores in the Unlimited and three scores in the Limited category exceeded 300 points.

Finally, we saw an unprecedented number of records broken this year. In 2021, our participants broke 28 all-time records which was a threefold increase over 2020. In 2022, 53 all-time records were broken! Three new band scores hit all-time highs, 2 meters, 6 meters, and 12 meters. Three digital continent mode records were broken, one continent Phone, and one continent CW score set new records. In addition, nine zone records were shattered while 29 new country records were broken. These will be posted on our website shortly so stand by for the details.

Some Interesting Metrics…

The average scores in the four categories of Unlimited, Limited, and Formula were slightly higher than in 2021: 187 for Unlimited, 168 for Limited, 159 for Formula 100, and 107 for Formula 5W. All combined, the average score was 178. The percentage of participants by class in 2022 was: Unlimited 65%, Limited 19.2%, Formula 100 13%, Formula 5W 2%.

As might be expected, with Cycle 25 advancing, the percentage of QSOs submitted for the 10, 12, and 15 meter bands increased from 44,306 in 2021 to 82,327 in 2022. The 10-meter band submissions were three times larger in 2022 while the 15-meter submissions were twice the number, while 20-meter QSO numbers were approximately the same.

Single-mode participant entries in 2022 represented 33% of the total, while all-mode entries were 67%. Single band entrants represented 5% of the total submissions. The 10-meter band represented the largest single band declared for single entry.

North America (including Canada) turned in 33.8% of the Continent entries. The second largest continent was South America at 27.9%. Oceania had 20.8%.

The breakdown of total QSOs submitted by mode yielded digital submittals at 73% of the total. CW submittals were 14%, while phone landed at 12.8%. Digital QSOs in 2022 increased by 5% while CW decreased by 4% over 2021. SSB was approximately the same percentage of the total QSOs. The total QSOs submitted by all participants set an all-time record of 216,505.

And the Winners Are…

The point spread at the top of the Unlimited Class ranged from 307 to 303 among the top six participants! John Carioti,

Photo A. The winner of the 2022 Unlimited Class was John Carioti, K2ZJ. John is a very active ham and regular participant in the DX Marathon program. John is shown here with his 2021 plaque for high score in North America. (All photos are of 2021 plaque winners)

K2ZJ (Photo A), who was runner-up last year in this class, squeaked out the top spot with 307 points, followed by a tie for second at 306 points by Antonio D'Arpino, IKØOZD, and Graham Alston, VK3GA. Ed Kuebert, K5EK, was at 305 for the number-3 spot, while a tie occurred for the number-4 spot with 303 points achieved by both Kent Olsen, N6WT, and Marvin Hlavac, VE3VEE. In the Limited Class, the competition was just as keen with Savas Pavlidis, SV2AEL, scoring 303. Pavlidis last year finished in second place, behind Jim Leahy, K2JL (Photo B). Ali Aktas, TA4RC, finished second this year with 302, and Mehmet Çevik, TA1CM, with 301 points, held down the third position. Congratulations to all of these excellent DX Marathon operators in the Unlimited and Limited classes.

In the Formula 100W Class, Karel Karmasin, OK2FD, bettered last year's score by 6 points finishing in the first position with a total this year of 297 points. Carlos Rincon, PY2CER, finished in second place with 269 points. Congratulations to Dan Walker, III, WG5G, in the QRP category for a first-place finish with 262 points. Anthony Luscre, K8ZT, finished in second place at 226 points. Working the Marathon with wire antennas is a real challenge but working DX with QRP power is quite an accomplishment.

All categories and scores are posted in this article but it is worth mentioning a couple of significant accomplishments. We are trying to encourage club submittals and would like to see a major increase in club participation in future years. In 2022, there was an increase of 23% in club submittals over 2021. For 2024, we have some plans to fuel the growth in club submittals. These proposed changes will be published in the November 2023 edition of *CQ*. In the interim, engage your clubs to submit in 2023 to get ready for some exciting competition in 2024. This year, we had an amazing performance from YB-Land. DXing Passion of Indonesia had an amazing record-setting total of 40,225 points! This set an all-time DX Club record by a very large margin. For the first year, we will be issuing a plaque to the top Club Score, compliments of the South Florida DX Association. The Rio DX Club, which won first place last year, held the number two position with 20,869, followed by the CDR Group of Brazil at 9998. Holding the number 4 and 5 positions were the Western Washington DX Club at 9026 and the Northern Illinois DX Association at 7573.

Single-Mode Winners

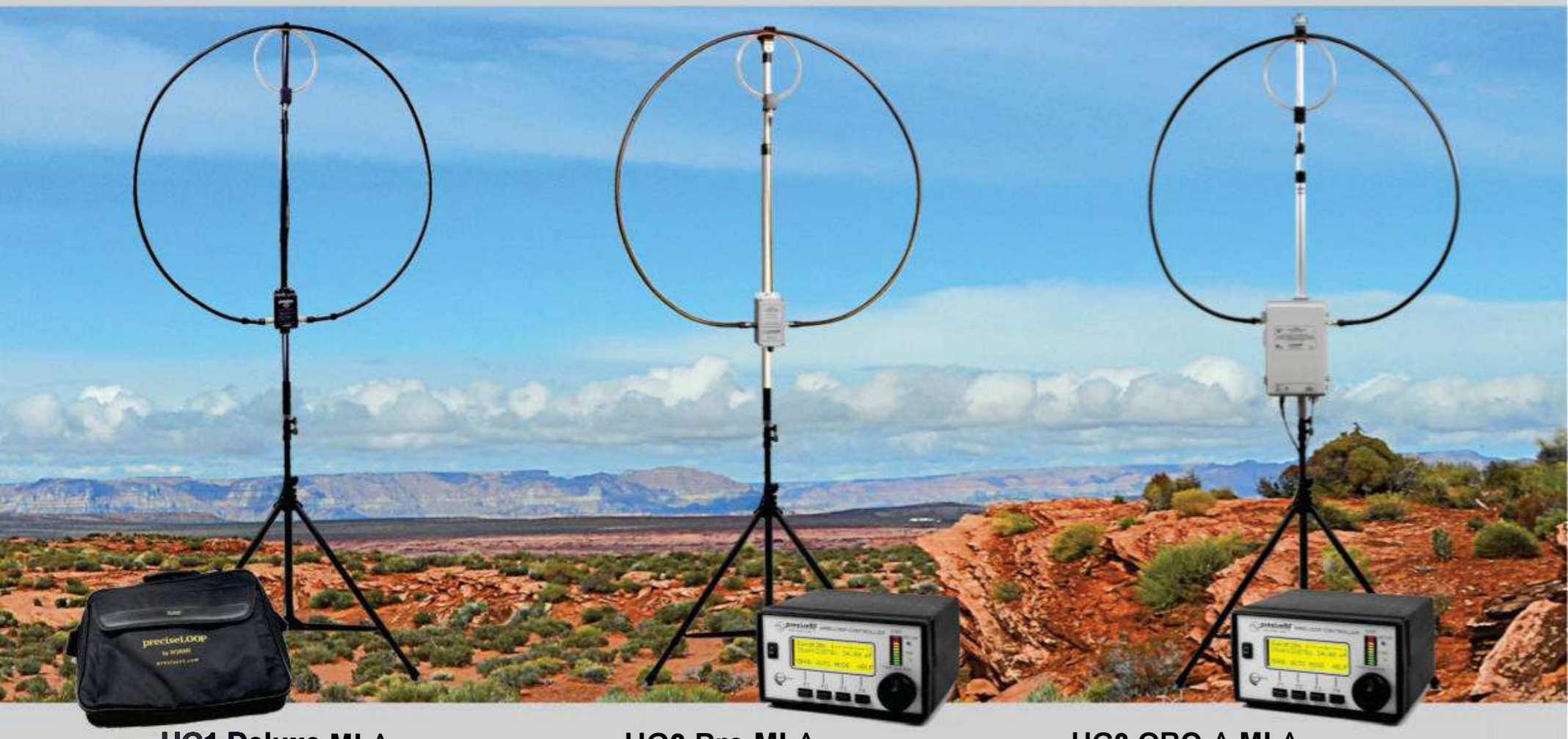
It is fitting to recognize the single-mode accomplishments for 2022. Lada Prajsner, OK2PAY (Photo C), the program's superstar CW performer with his 8th consecutive first-place

Photo C. One of the most consistent performers in the program, and an 8-time plaque winner, Lada Prajsner, OK2PAY, once again secured the CW world top score. Congratulations, Lada!

Photo B. The winner of the Limited Class in 2021 was Jim Leahy, K2JL. Jim is a veteran participant of the Marathon Program as well as a regular contester. Jim likes it simple with 100W and wire antennas and previously won the 2018 and 2019 Formula Class awards.

Photo D. Julio Peralta, W4HY, is the winner of the worldwide top phone category. Julio is definitely keeping phone alive in the Marathon program.

Upgrade Your Antenna, Get The Best Mag Loop Today!



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- 45W PEP
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- LMR600 Radiation Loop
- Integrated SWR Bridge

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Thanks to its quick and easy deployment, you'll be up and running in no time, ready to make the most of your SOTA experience. And with its QRP power handling capability of up to 15W PEP, you can trust that you'll be getting the most out of your radio while still keeping the weight of your gear to a minimum. Order your SOTA-1 MLA today and get ready to conquer the summits with your best SOTA performance yet!

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- High-Q Capacitor
- 3:1 Reduction Dial
- 15W PEP
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finish, won the worldwide CW mode competition with a score of 275. Julio Peralta, W4HY (Photo D), secured the first-place worldwide phone award with 274 points. Julio, thanks for keeping SSB alive! Fred Souto Maior, PY7ZZ, won worldwide first in digital with a score of 298. These gents will soon hold a beautiful DX Marathon plaque for their efforts.

Turning to North America, Bob Gill, K5BG (Photo E), after tying in 2021 for the NA CW top spot, won it outright this year with 250. Steve Larson, N3SL, secured top digital spot in NA with 287 points. Good going!

In addition to the overall and Mode plaques, each year we award plaques to the top score on each continent plus the highest score on each of the 6 through 160-meter bands. Top honors for Africa went once again to repeat winner Jose Vasconcelos, CT3MD (Photo F) with his top score of 291 which bettered his previous year's score of 279 by 12 points. Second place went to Barry Murrell, ZS2EZ, with a score of 258. Ever-present on the bands, Mikalai Makeichyk, D2UY, in Angola, secured third place with 235 points. In Asia, there was a tie for top score at 302 points between Halil Ayyildiz, TA2LG, and Ali Aktas, TA4RC. In the case of a tie, top honors go to the participant with the earliest date of the last QSO submittal. Ayyildiz had the earlier date of the last QSO submitted. Tac Yoshihori, JE1FQV, finished third in the Asia competition with a score of 297. In Europe, Antonio D'Arpino, IKØOZD, took the honor of first position with a score of 306. Savas Pavlidis, SV2AEL, from Greece finished second with 303 points. Mehmet Çevik, TA1CM, in European Turkey,

TOP SCORES

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

Unlimited Class
K2ZJ 307
IK0OZD 306
VK3GA 306
K5EK 305
N6WT 303
VE3VEE 303

Limited Class
SV2AEL 303
TA4RC 302
TA1CM 301
K2JL 297
PY2TC 295

Formula Class - 100w
OK2FD 297
PY2CER 269
HA7LJ 261
PY2DPM 261
K4AR 261

Formula Class - 5w
WG5G 262
K8ZT 226
DL6GBM 200
W8QZA 198
4Z4UO 166

CW
OK2PAY 275
PA3FQA 264
ZL3CW 263
K5BG 250
W4JS 238

Phone
W4HY 274
PA2LO 268
IZ5CML 254
PY4JW 249
N3CDA 242

Digital
PY7ZZ 298
HA1RB 296
YO5LD 295
R6YY 294
IK2RPE 293

Africa
CT3MD 291
ZS2EZ 258
D2UY 235
CT3HF 221
3C3CA 213

Asia
TA2LG 302
TA4RC 302
JE1FQV 297
JA0DAI 290
A71AE 283

Europe
IK0OZD 306
SV2AEL 303
TA1CM 301
CT1IUA 298
OK2FD 297

North America
K2ZJ 307
K5EK 305
N6WT 303
VE3VEE 303
K4ZO 302

Oceania
VK3GA 306
YB5QZ 297
VK3MH 285
YE9CDL 280
VK3IK 278

South America
PY7ZZ 298
PY2TC 295
PY4AZ 295
HK3W 292
PU2UAF 283

6 Meters
F5BZB* 189
PY2XB 152
IW2CAM 140

10 Meters
PU2UAF 283
EA1DR 278
PY2NF 264
CT1GFK 263
KB0EO 202

12 Meters
K2TQC 293
PY2CT 270
PU2MBO 251
PU2MST 237
PY5DD 157

15 Meters
PY4AZ 295
PY2CER 269
PU2RTO 221
K6RO 179
YC1LJT 122

17 Meters
PY2XU 278
PY2LCD 271
LY5M 211
PY5IP 194

20 Meters
VE3VEE 303
PY2TC 295
PP5DZ 167
PY2XJ 166
YI3WHR 132

30 Meters
LY5O 263
NI3P 185

40 Meters
W9KNI 271
PY5EG 266
9A2EU 250
OD5ZF 197
YD2CZV 173

60 Meters
HA5WA 194
W1NG 192
LY2FN 151

80 Meters
PP5JR 220
DL6DH 216
DL8OH 197
N3QE 121

160 Meters
LA3MHA* 137
K7ZV 117
IK0XBX 110
PY5XH 21

CW - Europe
OK2PAY 275
PA3FQA 264
LY5W 232
PA0INA 222
MM0TWX 191

CW - North America
K5BG 250
W4JS 238
K0AL 209
W2NK 205
W3GW 195

Continental Modes
Phone
VU2DED* 159
PA2LO* 268
W4HY 274
VK2BY* 237
PY4JW* 249

CW
TA4MA* 54
ZL3CW* 263
PY1VOY* 206

Digital
ZS2EZ* 258
4X4MF* 258
HA1RB* 296
N3SL* 287

rounded out position 3 with a formidable score of 301. In Oceania, Graham Alston, VK3GA, from down under, took the top spot at 306. Anton Iriawan, YB5QZ (Photo G), who generously did the translation for our new website into his native language, took the third position with a score of 297. Great job, Anton, and thank you for your special effort on the translation. The top North American score was our Unlimited Class winner, John Carioti, K2ZJ, with a total of 307. John will receive a beautiful plaque for top unlimited, but will just get an "attaboy" for top North American score as participants can qualify only for a single plaque according to the DX Marathon rules. Second place was Ed Kuebert, K5EK, with a strong 305 total, followed by Kent Olsen, N6WT, in third place at 303. Kent shared third position with steady performer Marvin Hlavac, VE3VEE (Photo H). Down south, Fred Souto Maior, PY7ZZ, took the top spot in South America with a score of 298, followed by Zaza Cabeço, PY2TC, at 295. Alex Alfenas, PY4AZ, was tied for second, also achieving a score of 295.

Band winners enjoyed great propagation this year. Six meters this year was won by Eric Trumeau, F5BZB, with a total of 189 points. This was an all-time high for six meters. Last year the 6-meter winner posted a score of 162. *Bon travail*, Eric, as this year we will issue a plaque for the 6-meter winner. Ten meters was won by Francisco Fagotte, PU2UAF, who will enjoy a beautiful plaque for his total score of 283. Last year, the 10-meter winner's total was 201! Veteran marathoner Bill Gibbons, K2TQC, had the top 12-meter score

YB1UUN* 275
PY7ZZ 298

Zone Winners

KL7TC* 267
VO2AC* 168
N6WT* 303
VE3VEE 303
K2ZJ 307
HI8RD* 285
HK3W* 292
OA4DX* 153
PY7ZZ 298
CE3BT* 234
LU2NI* 263
CT1IUA* 298
IK0OZD 306
R6YY 294
EX0DX* 104
SV2AEL 303
A71AE* 283
VU2IBI* 282
BV1EK* 179
JE1FQV* 297
E21EIC* 231
4F3BZ* 251
YB5QZ* 297
VK6DW* 265
VK3GA 306
WH6EY* 170
ZL3CW* 263
CT3MD 291
D2UY* 235
5H8HZ* 171
ZS2EZ 258
TF3JB* 247

Country Winners

3C3CA* 213
4X4MF 258
5H8HZ 171
7X - 7R68AR* 61
9A2EU* 250
9H/TA1HZ* 121
9M2SAF* 133
9V1PL* 78
A71AE 283
A92GE* 240
BV1EK 179
CE3BT 234
CO2QU* 251
CT1IUA 298
CT3MD 291
CX7BBR* 249
D2UY 235
DJ3AA* 286
DU - 4F3BZ 251
E21EIC 231
E76C* 281
EA1DR* 278
EI3CTB* 235
ER/UR7FM* 67
EX0DX 104
F6GCP* 294
FS - TO9W* 163
GU0SUP* 236
GW3SFC* 187
HA1RB 296
HB9FWB* 201
HI8RD 285
HK3W 292
HZ1SK* 201
IK0OZD 306
IT9RYJ* 272
JE1FQV 297
K2ZJ 307
KH8 - K8H* 152
KL7TC 267
KP4JFR* 261
LA3MHA 137
LU2NI 263
LY2MM* 266
M0NKR* 293
MI0BHX* 222
MM0HVU* 199
OA4DX 153
OD5ZZ* 254
OE1SGU* 272
OK2FD 297
ON6NL* 287
OZ - 5P1KZX* 277
PC3T* 290
PJ2/W9VA* 74
PJ7AA* 121
PU0FDN* 94
PY7ZZ 298
R6YY 294
S56A* 226
SM -8S9J* 245
SQ8N* 287
SV2AEL 303
SV5SKD* 192
SV9COL* 262
TA1CM* 301
TA2LG 302
TF3JB 247
V73MS* 161
VE3VEE 303
VK3GA 306
VU2IBI 282
WH6EY 170
YB5QZ 297
YI1WWA* 168
YO5LD* 295
YU6DX* 188
YV5OIE* 253
ZL3CW 263
ZS2EZ 258

USA Modes

Phone

W4HY 274

CW

K5BG 250

Digital

N3SL 287

US Call Areas

Unlimited

W1-W1JR* 288
W2-K2ZJ 307
W3-K3RA* 300
W4-K5EK* 305
W5-WA9PIE* 283
W6-N6WT 303
W7-W1YY* 295
W8-NU8Z* 283
W9-W9ILY* 301
W0-N3SL 287

Limited

W1-AK1P* 204
W2-K2JL* 297
W3-WA3WZR* 210
W4-AA8R* 262
W5-K5DC* 245
W6-WW6G* 203
W7-N7UVH* 215
W8-WT8E* 227
W9-W9RF* 280
W0-KY0O* 130

Formula 100W

W1-W1NG* 192
W2-KD2SPJ* 13
W3-NI3P* 185
W4-K4AR* 261
W5-AC7P* 197
W6-N6NFB* 145
W7-NY7H* 200
W8-K4YJ* 215
W9-W9KVR* 209
W0-AD1C* 230

Formula 5W

W1-KA1PPV* 13
W3-KZ3I* 157
W4-KR4EE* 36
W5-WG5G 262
W6-W8QZA* 198
W8-K8ZT* 226
W9-KW9E* 64

Canada Call Areas

VE2BR* 284
VE3VEE 303
VA7CRZ* 189
VE9VIC* 189
VO1HP* 200
VO2AC 168

Youth Score

PU5FJR 221
KJ7KOJ 199
PU5JDA 186
PU5BOB 176
PY2POA 156

Top Club Scores

YB-Land DXing Passion Is
Indonesia 40225
Rio DX Group
Brazil 20869
CDR Group
Brazil 9998
Western Washington DX Club
USA 9026
Northern Illinois DX Assoc.
USA 7523

of 293. Rumor has it that Bill will try another single band for 2023. The 15-meter winner, Alex Alfenas, PY4AZ, will secure a nice plaque for this band with a score of 295. Fellow Brazilian Val, PY4XU, is the winner of the 17-meter plaque with a 278. Veteran Marathoner and king of 20 meters, Marvin Hlavac, VE3VEE, secures the 20-meter win with a formidable score of 303. The 30-meter award goes to Bro Sriubas, LY5O, with a 263. It is wonderful to see that the founder of this program, Bob Locher, W9KNI, still enjoys participating. He won the 40-meter single band plaque with a score of 271. Thanks, Bob, for all you have done and wonderful to see you still enjoy participating in DX Marathon. George Szabadkay, HA5WA, from Hungary takes the 60-meter honor with a score of 194. Eighty-meter honors go to another Brazilian participant, Sergio Almeida, PP5JR, with a total of 220. Finally, 160 meters – for which a plaque sponsor has stepped up – was won by Morten Nordby, LA3MHA. Congratulations, Morten, for winning the first 160-meter plaque sponsored by the South Florida DX Association.

Youth Winner

This year we are awarding a plaque for the first time to the top

Photo E. Bob Gill, K5BG, took the top NA CW award this year. Bob is also a formidable force on 6 meters with his Killer Bee 6-element quad antenna.

Photo G. Anton Iriawan, YB5QZ, took home the Oceania prize plaque in 2021, but finished third in the category in 2022.

Photo F. Jose Vasconcelos, CT3MD, is an avid DX Marathon participant and won the top African award for the second straight year with a total score of 291, besting his 279 from 2021. His beautiful location of Porto Santo Island is gorgeous. He is frequently heard on all bands and all modes.

Photo H. Marvin Hlavac, VE3VEE, and is a veteran and frequent player in the Marathon program secured the single-band world 20-meter win.

youth performer in the program. This year that plaque will go to 14-year-old Eduardo Almeida, PU5FJR, of Brazil. He is under the tutelage of his father, PP5JR. His total score was 221.

Certificate Winners

In addition to the plaque winners, we are awarding many certificates of recognition. Please consult the detailed listings for the calls of the certificate winners. Certificates are awarded for the top continental score for each of the three modes, top score in each country, top score in each CQ zone, top score in each Canadian call district, top score in each USA call area for each of the four DX Marathon classes plus the top single mode score in the USA. Congratulations to all the 2022 certificate winners!

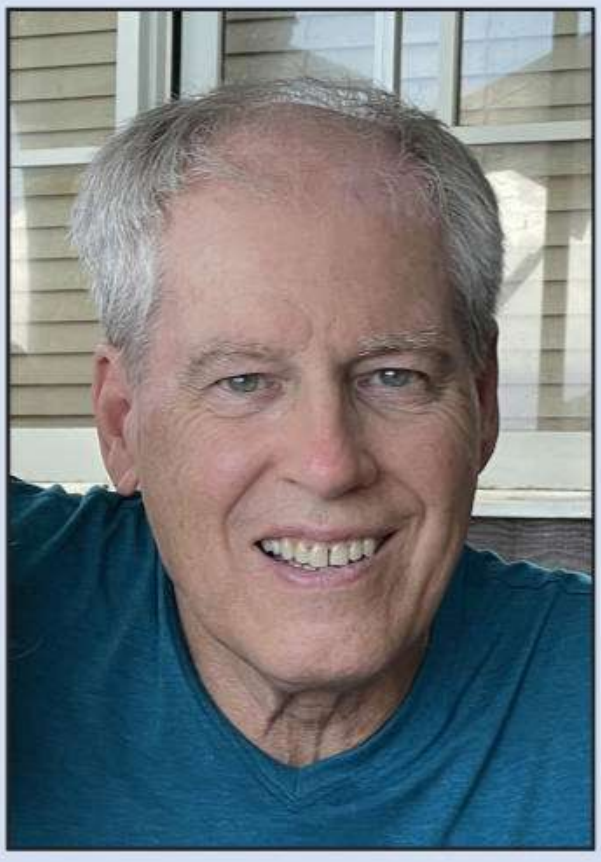
Some Operating Advice

During Hamcation® in Orlando this year, the DX Marathon launched a new website, <www.dxmarathon.com>. We encourage all participants to check it out. We also have a Group IO page that is available to exchange information and post questions. Please sign up as there are many great discussions that take place within the group.

Each year the DX Marathon website publishes a large amount of information to help participants minimize errors in their submissions. The Helpful Hints page can be accessed from the DX Marathon home page. In 2022, we pub-

A Big "Thank You" to John Sweeney, K9EL

Back in 2005, when Bob Locher, W9KNI, approached the leadership at *CQ* magazine with the idea of reconstituting the CQ DX Marathon program, he presented them with rules that are pretty much the same as those in place today. Bob recognized the huge amount of work involved in administering this program, and recruited a young John Sweeney, K9EL, who unselfishly picked it up. Seventeen years later, with much blood, sweat, and tears put into the program, not to mention the thousands of hours given back to "his hobby," John is "hanging up his cleats" and will continue to enjoy his hobby in retirement. So many of us over the years have taken from this wonderful hobby but few have given back unselfishly to it. John is clearly an exception. He has brought the program to the point where it is the fastest-growing DX program in the world and loved by so many of our fellow hams worldwide.



John Sweeney, K9EL (Photo courtesy K9EL)

An active DXer, John has worked all countries and needs only P5 on CW. He's also earned 5BWAZ (#703) and 160-Meter WAZ. Besides being active working DX, John enjoys *being* DX and has operated from VR2, HS, YB, 9V, 9K2, KH6, XE, 6Y5, VK, JA, EA6, F, G, DL, 4X, FS, VE, and others. He holds several foreign callsigns and is an active DXpeditioner, most recently frequenting FS, St. Martin.

When I first heard of John's retirement from the program, I called him up and asked him what was involved with its administration. Well, after that 30-minute phone discussion, I could not believe what one man could do in running this program, and I surely appreciated all he has done to bring it from starting from scratch to what it is today. I gave this much thought and came back to John and *CQ* with a plan. The plan was to basically redistribute what John had been doing single-handedly to a committee of 5 individuals plus myself. Today, we are off and running, but I still am amazed at how much John accomplished in those 17 years. We all owe John a debt of gratitude and I ask you to join me in congratulating John for a job well done. – WC3W

MODE & BAND SCORES

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

CW

OK2PAY 275
PA3FQA 264
ZL3CW 263
K5BG 250
W4JS 238
LY5W 232
PA0INA 222
K0AL 209
PY1VOY 206
W2NK 205
PY4XX 201
W3GW 195

PHONE

W4HY 274
PA2LO 268
IZ5CML 254
PY4JW 249
N3CDA 242
VK2BY 237
KD8NYP 222
MI0BHX 222
PU5YSV 220
KD8NYO 215
VA3IDD 201
PY6HD 198

DIGITAL

PY7ZZ 298
HA1RB 296
YO5LD 295
R6YY 294
IK2RPE 293
N3SL 287
IK5FKF 284
E76C 281
W9RF 280
IK0PEA 279
5P1KZX 277

2 METERS

YD5NPC 47

6 METERS

F5BZB* 189
PY2XB 152
IW2CAM 140

10 METERS

PU2UAF 283
EA1DR 278
PY2NF 264
CT1GFK 263
KB0EO 202
PY1AX 179
PY2WLM 169
NP3YL 147
PY2TMV 130
PX5M 124
PR2D 103
PY1OX 55
PU2SEX 46
KC1RWM 33

12 METERS

K2TQC 293
PY2CT 270
PU2MBO 251
PU2MST 237
PY5DD 157

15 METERS

PY4AZ 295
PY2CER 269
PU2RTO 221
K6RO 179
YC1LJT 122

17 METERS

PY2XU 278
PY2LCD 271
LY5M 211
PY5IP 194

20 METERS

VE3VEE 303
PY2TC 295
PP5DZ 167
PY2XJ 166
YI3WHR 132
KD2SPJ 13

30 METERS

LY5O 263
NI3P 185

40 METERS

W9KNI 271
PY5EG 266
9A2EU 250
OD5ZF 197
YD2CZV 173

60 METERS

HA5WA 194
W1NG 192
LY2FN 151

80 METERS

PP5JR 220
DL6DH 216
DL8OH 197
N3QE 121

160 METERS

LA3MHA* 137
K7ZV 117
IK0XBX 110
PY5XH 21

JH1AJT – A Winner in So Many Ways

BY JOHN SWEENEY, K9EL

Among the mementos of the late Zorro Miyazawa, JH1AJT, kept by his widow on her obutsudan (a Buddhist home altar) is Zorro's plaque from the 2021 CQ DX Marathon, in which he became the first worldwide winner from Asia. Zorro was a businessman, philanthropist, DXer, and DXpeditioner. He is a member of the CQ DX and Amateur Radio Halls of Fame, and became a Silent Key in 2022. (Photo via K9EL)

Managing CQ's DX Marathon from 2006 through 2022 was not only a challenge, but also very rewarding. The best rewards came from the winners of this annual DX challenge when they opened their plaques and posted their certificates on their walls.

From 2006 though 2020, we had 8 winners from North America, 5 from Europe and 2 from South America – not a single winner came from Asia, Africa, or Oceania. In 2020, Zorro Miyazawa, JH1AJT, whom I had met many years ago in Japan and maintained contact with over the years, decided he wanted to participate in the DX Marathon and wanted to become the first winner from Asia. He did well in 2020 but made enough mistakes to finish third worldwide – a fantastic result for his first year participating.

Zorro and I spent some time going over his 2020 results and he made some adjustments in his approach for his second attempt in 2021. After the logs were submitted, he told me he was quite ill but was anxious to hear the results of his efforts. Of course, I could not reveal the results early, but I never expected to hear a few days later that he had passed (*Zorro became a Silent Key on March 23, 2022*). I always felt bad that I never told him that he won the 2021 DX Marathon – the first-ever winner from Asia.

Through the wonderful efforts of Loren Pleet, AE6P, who was a good friend of Zorro, the 2021 Unlimited Class winners' plaque was prepared and shipped to Zorro's widow. She was able to display it as part of the many tributes to Zorro (see photo). It was a tremendous accomplishment by Zorro and many QSOs were made while he was in significant pain. Thank you, Zorro, for being such a wonderful person and we shall miss you. - John, K9EL

Spring is in the Air...

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by Ed Tobias, KR3E

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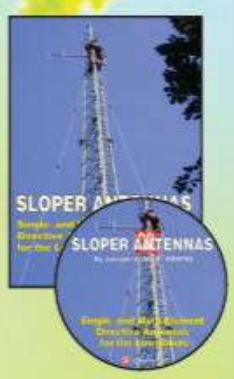

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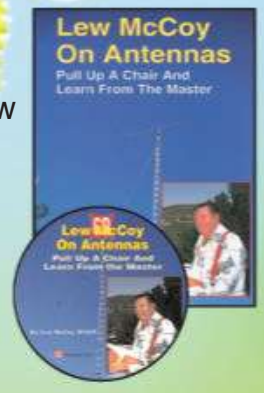

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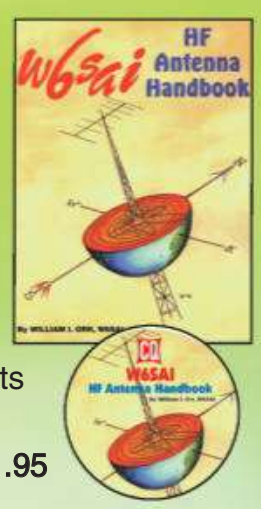

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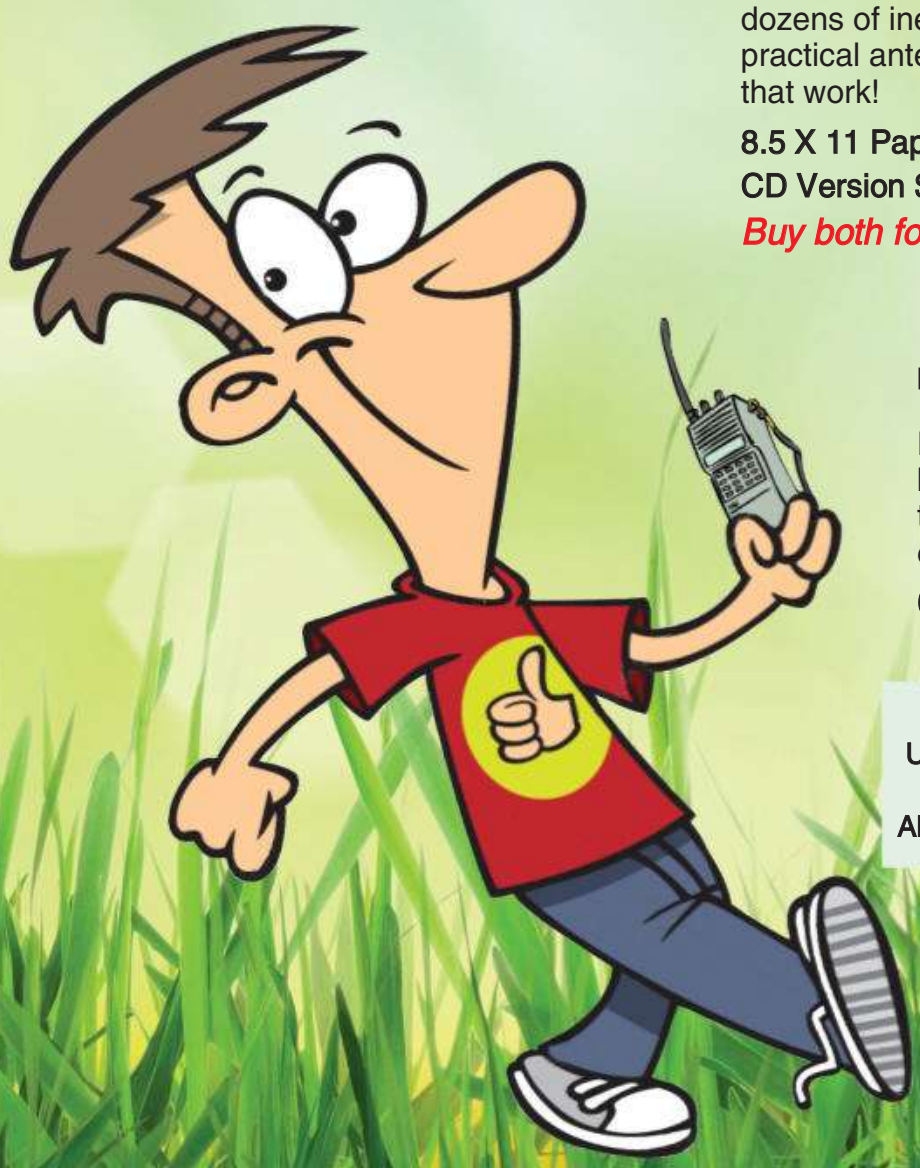

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lished over 1,000 callsign exceptions and notes to help every participant reduce the number of errors in their submissions. We also recommend that you regularly update your logging program callsign database if it has one. Unusual callsign prefixes seem to multiply every year, so updating your program's database is critical to properly determining the DX location and/or zone.

All participants work very hard at working country entities and zones. We encourage all to check their logs before submission, as each error discovered will result in a one-point deduction from your overall score. One of the highest error categories is *Wrong Zones*, which typically result in one-third of the errors. Confusion with USA zones is one of the biggest sources of zone errors. It is especially important to note that

CLUB SCORES

Club	Country	Score
YB-LAND DXING PASSION IS	Indonesia	40225
RIO DX GROUP	Brazil	20869
CDR GROUP	Brazil	9998
Western Washington DX Club	USA	9026
Northern Illinois DX Association	USA	7523
Southeastern DX Club	USA	6804
Araucaria DX Group	Brazil	6364
Willamette Valley DX Club	USA6	288
Carolina DX Association	USA	4205
CABREUVADX	Brazil	3092
Mother Lode DX/Contest Club	USA	2974
East Tennessee DX Association	USA	2641
ASSOCIACAO DOS RADIOAMADORES DO PARANA	Brazil	1957
UBRO	Brazil	1940
Italian Contest Club	Italy	1729
Hudson Valley Contesters and DX'ers	USA	1645
Chilean Pacific Dx Group	Chile	1631
Yankee Clipper Contest Club	USA	1618
VYTAUTAS MAGNUS UNIVERSITY RADIO CLUB	Lithuania	1593
Florida Contest Group	USA	1416
7A DX-CONTEST CLUB		1405
FALCONS DX GROUP		1255
Society of Midwest Contesters	USA	1213
CMDXGROUP	Brazil	1195
Salt City DX Association	USA	1145
Santiago de Cuba Contest Team	Cuba	1062
Bavarian Contest Club	Germany	955
Southern California DX Club	USA	908
VU CONTEST GROUP	India	904
NERG	Australia	903
Central Arixona DX Association	USA	759
Black River Radio Ops	USA	704
LU Contest Group	Argentina	699
SPDXT		620
Tennessee Contest Group	USA	567
Maritime Contest Club		557
North East Radio Group		536
Radio Club Venezolano	Venezuela	528
Clipperton DXC	France	527
Arabian Gulf DX Group		523
LSDXA	USA	495
ARI Brescia		494
Lake Washington Ham Club		482
CDXA	USA	463
Southwest Ohio DX Association	USA	440
Metro DX Club	USA	432
Potomac Valley Radio Club	USA	421
BALIDXCLUB	Indonesia	405
Just for Fun Contest Club	Germany	399
CE Contest Group	Chile	397
DFW Contest Group	USA	382
REP		382
Kansas City DX Club	USA	373
Southern California Contest Club	USA	368
101 DX CLUB		362
Spokane DX Assn	USA	356
Lighthouse ARA		346
Northern California Contest Club	USA	312
DUZRAD - Duzce Telsiz ve Radyo Amatorleri League		302
TEAMPAPA		302
GPDX	Portugal	298
GITRAd		292
Hotel India DX Club		285
Indio´s Team DX		278
SFDXA		276
CWOp's Worldwide		275
DX101 Contest Club	USA	275
NEWDXA		274
OMIK Amateur Radio Association		273
FT8DMC		272
Contest Club Ontario	Canada	266
STAR - Algarve STAR DX Team		263
Regionalis Radios Sportklub Puspokladan	Hungary	261
IARC		258
DX3H Ham Society of the Philippines	Philippines	251
GDXC	Cuba	251
EA CONTEST CLUB	Spain	250
Minas Dx Group		249
Danish DX Group		248
ARI		245
SSA		245
Woodbridge Wireless	USA	237
Kaunas University of Technology Radio Club		233
Mad River Radio Club	USA	232
Mile High DX Association	USA	230
CDXC		227
North Coast Contest Club	USA	226
TRUJILLO ALTO CONTEST CLUB	Puerto Rico	225
RDRC		223
CPDXG	Chile	222
Nixa Amateur Radio Club	USA	216
Gower/Gwyr CC		211
WACOM	USA	210
DARC P30	Germany	209
Iroquois County Amateur Radio Club		209
WNYDXA	USA	205
NCDXC	USA	203
Minnesota Wireless Association	USA	202
NADXC		201
TRAC		197
True Blue DXers Club		191
Contest Club Serbia		188
Dallas Amateur Radio Club	USA	185
MDXG Miramar DX Group		185
AG8GT		183
South East Contest Club		171
ADXA		162
Kentucky Contest Group		161
W WA DX CLUB	USA	158
Mississippi Valley DX/Contest Club		156
RHR Youth		156
South Jersey Radio Association	USA	155
Lighthouse ARA		154
CWSP		153
DARC		153
Waverley ARS		152
Contest Club	Belgium	151
Columbia ARC		141
Bristol (TN/VA) ARC		139
CECG CE Contest Group	Chile	138
Amateur Radio Club of Ohio State	USA	96
SILIWANGI DX HUNTER		91
G-QRP		87
Northeast Wisconsin DX Assn	USA	85
TARC		75
Giresun Radio Amateurs Club		67
YH2BB		57
Long Island CW Club	USA	42

USA callsign numbers are no longer required to match their QTH. A W6 could be in New York, or a KL7 could be in Florida. There are many special callsigns in Russia that do not follow the traditional callsign mapping, thus creating many errors in zones 16, 17, 18, and 19. Zone 2 also continues to be a problem. Very few VE2 stations are in Zone 2 – most are in Zone 5. The DX Marathon website does list the most active Zone 2 stations. The next highest error category was *Invalid Callsigns* – callsigns that were entered by participants but do not actually exist. There are many unique callsigns being used today so it is critical to review your DX Marathon submissions carefully. The number of bad spots on the DX Clusters also remains a big problem.

When logging a QSO from a DX spot, listen carefully to the DX station to make sure the callsign is logged correctly. Nearly 40% of all point subtractions are due to busted or incorrect callsigns. Some invalid callsigns may have been busted calls that were so bad that we could not determine the real callsign. Once again there were many mix-ups between "Ø" (Zero) and "O" (Oh). The computer is not forgiving, so check your log carefully! The database that is used for scoring the DX Marathon includes start and end dates for all major expeditions, so please make sure that dates and times are properly logged along with the callsign, country, and zone for each QSO. With more logs being posted online, it is easy to check if you are in the log before entering that QSO in the DX Marathon. We do publish a lot of helpful information on the DX Marathon website, but there is nothing we can do to make sure you are in the log. Unfortunately, subtractions due to pirates tripled from 2020.

As part of this article, you will find a complete listing of all scores plus a listing of the top scores in all available categories. The DX Marathon website will include additional information and details on the 2022 results plus photos of plaque winners as they become available. For any questions or comments about the DX Marathon, please contact the author.

Special Note from WC3W….

None of this wonderful program would be possible without you – our valuable participants. I am excited and believe we are in a position to double or triple our program participation in the next couple of years. I have been doing three to four Zoom meetings a week to clubs spreading the word. I would encourage all of you to speak up at your clubs and spread the word as well. We are the fastest-growing DX program in the world today and I believe we have not even begun to grow. With the advent of digital technology, and Cycle 25, many operators are now able to work DX regardless of station size or tower restrictions. Finally, we will be clarifying the classifications and rules for 2024. The success of our program depends on ensuring fairness and clarity in rules along with appropriate enforcement. Our program operates on the assumption of honest reporting and play, and we understand that to preserve our growth and encourage all, we must have rules and penalties for breaking of the rules. We do receive reports from our participants about potential violations of rules and we do vet these out when reported to ensure the continued integrity of our program. I am particularly concerned about the use of multi-locations/remote stations. Our rules are very clear on this issue, one TX/RX location per submission and it is my intent to clamp down on any participants who intentionally violate this rule.

Special Thanks…

The DX Marathon would not be possible without the incredible support and assistance from so many people. The team effort makes the DX Marathon possible. I want to first thank *CQ* magazine for developing the Marathon and providing continuing support. Many generous hams have given back to this hobby by supporting the Marathon program. Just a few include Alex Shovkoplyas, VE3NEA; Jim Reisert, AD1C; all the plaque sponsors; Dave Bernstein, AA6YQ, for his incorporation of the program within his DX Labs program; Mike Ricketts, W9MR; John Holmes, W9ILY, who has done all the certificates; Bob Locher, Jr, W9KNI, and Atilano Oms, PY5EG. Bernie McClenny, Jr, W3UR, has also been a tremendous supporter by including lots of DX Marathon info in his Daily DX newsletter. I also thank Laurie Cowcher, VK3AMA, for including DX Marathon support in his popular JT Alert software. Finally, I wish to thank my amazing operating group who have advanced us at least six months ahead of schedule for the turnover of the program administration to me from K9EL.

Thank you for your participation in 2022 and best of luck in 2023!

(Scores on page 32)

Results 2022 CQ DX Marathon

Unlimited Class

Callsign	Countries	Zones	Score
K2ZJ	267	40	307
IK0OZD	266	40	306
VK3GA	266	40	306
K5EK	265	40	305
N6WT	263	40	303
VE3VEE	263	40	303
K4ZO	262	40	302
TA2LG	262	40	302
W9ILY	261	40	301
K3RA	260	40	300
K9NU	258	40	298
N2BJ	259	39	298
CT1IUA	259	39	298
PY7ZZ	258	40	298
JE1FQV	259	38	297
YB5QZ	257	40	297
K1ZN	262	34	296
HA1RB	256	40	296
W1YY	255	40	295
YO5LD	255	40	295
W9MK	255	40	295
PY4AZ	256	39	295
R6YY	255	39	294
F6GCP	254	40	294
K2TQC	253	40	293
W6OAT	253	40	293
M0NKR	256	37	293
N6WS	251	40	291
KD5M	251	40	291
CT3MD	251	40	291
W7PC	250	40	290
JA0DAI	253	37	290
PC3T	250	40	290
W1JR	248	40	288
N3SL	248	39	287
W0RIC	247	40	287
WO7R	248	39	287
SQ8N	248	39	287
ON6NL	247	40	287
DJ3AA	249	37	286
SV1CNS	247	39	286
HI8RD	248	37	285
VK3MH	248	37	285
VE2BR	244	40	284
AA9A	244	40	284
IK5FKF	244	40	284
W9ZCL	243	40	283
NU8Z	243	40	283
PU2UAF	244	39	283
CT1ILT	246	37	283
A71AE	243	40	283
WA9PIE	245	38	283
K9KE	244	39	283
NS9I	243	39	282
N6JV	243	39	282
AA5JF	242	40	282
KJ7TEA	242	39	281
PY2GM	242	39	281
K4PI	242	39	281
N6RV	241	40	281
PY5DK	243	38	281
K9IR	240	40	280
YE9CDL	241	39	280
IK0PEA	240	39	279
F5RRS	240	39	279
EA1DR	241	37	278
PY2AE	239	39	278
VK3IK	241	37	278
PY2KP	237	40	277
5P1KZX	241	36	277
WC3W	238	38	276
JA1WWO	236	40	276
NK7I	238	38	276
OK2PAY	235	40	275
YB1UUN	237	38	275
W1SRD	238	37	275
PY2APK	236	39	275
W4HY	234	40	274
N7QT	234	40	274
KZ2I	235	39	274
W7YAQ	234	40	274
WA9GON	234	40	274
WQ6Q	233	40	273
W9JJB	233	40	273
IT9RYJ	234	38	272
AA5AM	232	40	272
OE1SGU	233	39	272
K7PI	232	39	271
W9KNI	231	40	271
PY2LCD	231	40	271
WD9DZV	232	38	270
YC9AAI	231	39	270
PY2CT	231	39	270
W6XK	230	40	270
KM8V	231	39	270
W6RS	233	36	269
W7WM	229	40	269
PA2LO	229	39	268
W4PNY	229	39	268
YE6YE	228	39	267
W9AP	228	39	267
W9MR	230	37	267
PY4OY	229	38	267
KL7TC	229	38	267
LY2MM	227	39	266
PY5EG	230	36	266
W1AJT	226	40	266
VK6DW	226	39	265
YB1AYO	226	39	265
EA5YI	226	39	265
PY2NF	224	40	264
K8YC	225	39	264
PA3FQA	225	39	264
WB6JJJ	224	40	264
AF7NX	224	39	263
CT1GFK	224	39	263
YB1TQL	225	38	263
ZL3CW	224	39	263
LY5O	223	40	263
SV9COL	225	37	262
N4TL	223	39	262
YB2HAF	224	37	261
N1NK	223	38	261
PY2COY	221	39	260
K9ARZ	224	36	260
ZS2EZ	218	40	258
4X4MF	219	39	258
WB9Z	221	36	257
WX6V	218	39	257
PY2GTA	216	40	256
KP4JRS	222	34	256
KI2D	217	39	256
YB3BBF	217	38	255
PS8CW	218	37	255
PT7WM	216	39	255
W4UCK	218	37	255
W4HG	217	38	255
DL1NKS	222	33	255
KA6BIM	215	39	254
AE4CW	215	39	254
IZ5CML	215	39	254
K8AC	215	39	254
YC4AOK	214	39	253
ON4LG	216	37	253
K9NB	213	40	253
W6DR	215	38	253
PY2BEK	212	40	252
K9RR	212	40	252
YB2MM	213	39	252
KU1CW	212	40	252
PY2VM	215	37	252
N4MIK	212	39	251
VK3MB	214	37	251
PU2MBO	211	40	251
WC4H	211	40	251
WX0Z	212	39	251
K5BG	210	40	250
9A2EU	211	39	250
PY4JW	211	38	249
ON6CC	216	33	249
W2FV	209	40	249
NQ7R	210	39	249
W7DO	209	39	248
VE3ZZ	208	40	248
YB9BUD	211	37	248
W7YED	209	39	248
W2AXR	209	39	248
PY2CX	216	32	248
OZ1IKY	211	37	248
W3GQ	209	39	248
YB0SAS	208	38	246
K4RUM	207	39	246
W8GJK	209	37	246
W1NK	207	39	246
PY2AB	211	35	246
PS8MT	208	37	245
PT7ZT	207	38	245
IK2XYI	206	39	245
W1SSN	208	37	245
8S9J	211	34	245
K7MH	204	40	244
W7AV	205	39	244
AA4R	205	39	244
WC7Q	204	40	244
PY2OKB	204	40	244
N1EN	203	40	243
YC5AKH	204	39	243
PY2GZ	203	40	243
K0XM	204	39	243
N1RR	203	40	243
VA2WA	206	37	243
N3CDA	205	37	242
WB2NVR	202	39	241
W9VA	201	40	241
PP5RG	200	40	240
CT2HUU	202	38	240
A92GE	202	38	240
A92AA	201	39	240
YB1BZV	200	39	239
ON7WM	206	33	239
AD7Z	202	37	239
YE3ESW	200	38	238
NK7Z	203	35	238
YD9HJD	203	35	238
YB1TDL	199	39	238
W4JS	198	40	238
PT9BM	199	38	237
VK2BY	205	32	237
YD9ABC	200	37	237
KX1X	197	40	237
WA3AFS	199	38	237
PU2MST	199	38	237
W8ZF	199	38	237
N4PQX	197	40	237
K0LB	199	38	237
PP2CS	198	38	236
K6MW	197	38	235
YB9KA	195	40	235
W9PDS	196	39	235
WT2P	195	40	235
D2UY	201	34	235
PU4CEP	196	38	234
K9JU	197	37	234
CE3BT	194	40	234
KE4UW	195	39	234
KZ1W	195	39	234
K6YK	197	37	234
PY7ZC	200	33	233
N2JJ	195	38	233
VE3CT	199	34	233
KB8O	195	38	233
WA7CPA	194	39	233
YC1RYX	193	39	232
YE7LTN	193	39	232
YB1LUE	200	32	232
LY5W	193	39	232
YB1IQE	192	39	231
YB1BA	193	38	231
E21EIC	192	39	231
K2SD	197	34	231
PY5ZHP	193	38	231
PY5QW	191	39	230
YE4LWU	191	39	230
YC9HIU	191	38	229
YC2KJC	190	39	229
PS8RV	190	39	229
PU2SWR	188	40	228
YD1FRU	189	39	228
PY2JG	189	39	228
YB2VYY	191	37	228
K7ACZ	188	40	228
IK0ALT	188	40	228
N0VT	187	40	227
EI2GLB	189	38	227
S56A	194	32	226
PY5CC	191	35	226
K9QJ	187	39	226
YB2TS	190	36	226
AJ8B	186	39	225
YE4FSB	188	37	225
EI7CC	186	39	225
KB2S	186	39	225
WP4WW	189	36	225
YB7BOB	185	39	224
W6DE	186	38	224
YC5NKF	185	39	224
YB2CAA	185	39	224
K7AR	184	40	224
PY4FD	185	39	224
VU2YYF	186	38	224
YB7WBC	185	38	223
KY7M	185	38	223
E74YM	183	39	222
KD8NYP	183	39	222
PA0INA	184	38	222
PP5ZP	184	38	222
CE3VRT	187	35	222
MI0BHX	185	37	222
PU1JSV	188	34	222
YC5NBY	186	35	221
K6SEA	186	35	221
YE0PO	182	39	221
CT3HF	185	36	221
W4UW	181	40	221
NV9L	184	36	220
YB9FAO	182	38	220
PP5JR	181	39	220
NC6R	183	37	220
YB3OK	181	38	219
K5ZD	181	38	219
YE5TA	181	38	219
PA1LX	185	34	219
W9II	179	40	219
PY5AMF	185	34	219
W2BJN	183	36	219
YD9RRB	179	39	218
YC1TCA	180	38	218
K6OK	180	38	218
VK3GK	179	39	218
N2SQW	180	37	217
YB7UTO	179	38	217
N7JP	179	38	217
W9SN	179	38	217
WA0JZK	178	38	216
YD7ICF	178	38	216
YB4LYD	178	38	216
DL6DH	179	37	216
DL8LAS	182	34	216
PY4LH	183	33	216
KD8NYO	179	36	215
YD2ULK	177	38	215
W7EED	179	36	215
YB7YGR	184	31	215
YC4SIZ	178	37	215
VK4CC	176	39	215
VU2TMP	176	37	213
PY2EU	178	35	213
3C3CA	178	35	213
WI7N	173	40	213
YB1HK	173	39	212
YC2CZF	175	37	212
YD0BJJ	180	32	212
N7EPD	174	38	212
KD7H	175	37	212
YB3BGM	175	37	212
CT7AIX	177	35	212
YD7MAW	175	36	211
LY5M	172	39	211
KN7K	173	38	211
G0BIX	175	36	211
WR7T	173	37	210
AF4T	171	39	210
K4MQM	172	38	210
PY2KS	190	19	209
YD9BIJ	174	35	209
K0AL	173	36	209
YC0UI	170	39	209
W7RM	170	39	209
YB1CQU	172	37	209
YC6IPX	170	39	209
YB9IPJ	172	37	209
YC1IFR	171	38	209
YB2SLF	171	38	209
K4ELI	169	39	208
YC2BST	174	33	207
YC8GPH	170	37	207
YB1INQ	175	32	207
K7ZA	169	38	207
NF7D	171	36	207
YB1VHC	171	36	207
DV1IIW	174	33	207
YC2CAB	168	38	206
PY2ACP	167	39	206
PY2IQ	168	38	206
PY1VOY	168	38	206
YB0KTT	169	37	206
YB2RT	168	37	205
YB7NUS	171	34	205
W0VQ	171	34	205
K1SND	167	37	204
YB1APD	168	36	204
PY7XC	168	36	204
YF3BVD	167	36	203
WE6Z	164	39	203
E2A	166	37	203
PY2YJ	169	34	203
LU6FOV	169	34	203
N4TOL	167	35	202
KB0EO	168	34	202
E25KAE	164	38	202
DM9EE	171	31	202
HB9FWB	169	32	201
PY4XX	168	33	201
WA4ZXV	163	38	201
YD9MBM	164	37	201
AB8M	164	37	201
TA3LHH	167	33	200
YD9AZN	168	32	200
W4DTA	165	35	200
YE1BON	167	33	200
IN3VZE	163	37	200
VO1HP	166	34	200
K9QVB	162	37	199
YC2XCD	163	36	199
N6MZ	161	38	199
KJ7KOJ	161	38	199
PY2UGO	165	34	199
YB1LKD	164	35	199
YB8RRN	160	39	199
N3QQ	161	38	199
K4MV	165	34	199
YD1CHM	161	37	198
TA3ST	161	37	198

PY6HD	167	31	198
PA7RA	162	35	197
DL8OH	160	37	197
PY2KNK	163	33	196
YE8TPA	158	38	196
PY2NL	160	36	196
CT7AKW	159	37	196
YB4KAR	158	37	195
YB6MIX	156	39	195
YB1MAE	160	35	195
YC1MRF	159	36	195
YB0MZI	157	38	195
YC5YDD	157	37	194
HA5WA	160	34	194
PY7RP	157	37	194
PY2PPZ	158	35	193
YB4HKR	158	35	193
W4PGM	157	36	193
N7DX	156	37	193
W4OX	154	38	192
PY2DSN	155	37	192
K5IB	154	38	192
WA7CPA/7	154	38	192
YB4AFL	157	35	192
WB9FLY	155	37	192
PY2VZ	162	30	192
KT7E	155	36	191
K2CIB	153	38	191
YB2SPP	161	30	191
MM0TWX	154	37	191
PY1CD	158	33	191
YB8CMT	153	37	190
PY1ZV	154	36	190
N4FN	155	35	190
YC8ABD	153	37	190
YC2DBW	156	34	190
YB4ECU	155	35	190
YB1TS	157	33	190
YF1ANL	154	36	190
F5BZB	157	32	189
VA7CRZ	153	36	189
YE2DOR	156	33	189
KF0IQ	151	38	189
KD4RH	152	37	189
LY7M	153	35	188
PY1GB	149	39	188
YC1CBC	153	35	188
YC2FIK	156	32	188
N4PL	153	35	188
PY2VH	155	32	187
WS7L	150	37	187
CE3DOH	147	39	186
YB1DMK	148	37	185
KG5EIU	150	35	185
PP4T	153	31	184
KT4O	148	36	184
KM2O	149	35	184
K2UF	148	35	183
IK7EOT	152	31	183
YC4AEW	149	34	183
YB0DOS	149	34	183
YC8CGZ	150	33	183
YC4GBF	149	34	183
YD2GYO	150	33	183
W7UDH	148	35	183
W7PEZ	147	36	183
N8XHF	148	35	183
PY2QT	149	33	182
NM2R	149	33	182
YG3CPY	145	36	181
PY4ARS	147	34	181
KK9H	148	33	181
PP2CC	145	35	180
K6RO	143	36	179
PY1AX	145	34	179
BV1EK	140	39	179
YC3CUG	143	35	178
YC2DUC	145	33	178
PY2WND	143	35	178
PT2ARR	147	31	178
PY5CV	161	17	178
YC7AHV	146	31	177
YD2UFR	141	35	176
YB1DIU	143	33	176
TF3T	150	26	176
PY4LI	143	33	176
PU2OYT	147	28	175
YE8DWC	138	36	174
CE4WT	138	35	173
W9YK	138	35	173
PY2BRA	140	33	173
K7WTG	135	38	173
K8AJS	142	31	173
PY2GIG	137	36	173
PY3DX	137	35	172
TC3X	141	31	172
YB7MP	141	31	172
AG7N	135	37	172
YC0NIU	135	36	171
PT1K	136	34	170
PY2OX	134	36	170
PY2UD	136	34	170
PY2AD	139	31	170
WH6EY	141	29	170
PY2TTN	136	34	170
YB1DCW	135	34	169
PY7GB	137	32	169
PY2WLM	136	33	169
PU2TWZ	141	28	169
VO2AC	134	34	168
YC2KDU	133	34	167
N9EP	130	37	167
YB1CUZ	132	34	166
PY1ID	135	31	166
N7RVD	131	35	166
PY2XJ	131	35	166
PU1AJN	137	28	165
YB2BNN	138	26	164
PY2MIG	129	35	164
PP5AX	133	31	164
YB7YDB	132	32	164
TO9W	127	36	163
TF3DC	134	29	163
PU1VMA	129	33	162
W6DCC	127	35	162
K7RF	126	36	162
YD2BHJ	128	33	161
N7US	126	35	161
WX7HS	125	36	161
YB6IVW	125	35	160
YC2LCZ	126	34	160
K1GU	126	34	160
PT2AW	128	32	160
W4ATL	129	31	160
W1RH	126	34	160
KV3T	125	34	159
PR8KW	126	33	159
VU2DED	127	32	159
YC0AIB	125	33	158
K0BL	128	30	158
PP5IP	131	27	158
PY5AKW	124	33	157
ZL1BBW	118	39	157
KO4VVQ	128	29	157
AD7L	123	34	157
NI0C	122	34	156
KB2S/7	127	29	156
W2CN	124	31	155
KM8L	124	31	155
WT8P	121	34	155
PY1KO	124	31	155
K1BDC	122	32	154
K7ZS	118	36	154
PU1KPS	126	28	154
K4NNK	123	31	154
N9LQ	119	35	154
PY2ZZ	120	33	153
PP1KV	118	35	153
NZ2Z	116	36	152
K8H	115	37	152
PY2XB	126	26	152
W3OA	122	30	152
W7VAS	113	39	152
VK3VT	116	36	152
K4FS	122	30	152
CE3PCG	122	29	151
CE2GT	122	29	151
LY2FN	122	29	151
PY6RT	121	30	151
PV2G	122	28	150
YD9BUV	115	34	149
CE7KF	123	26	149
KC7EFP	112	37	149
PY2RVM	118	31	149
PU2LOD	121	28	149
9A/W7AOF	118	30	148
PU2KNM	115	33	148
K7EG	112	36	148
KA2KON	120	27	147
XQ4CW	116	31	147
PY1IO	117	30	147
PY1FI	114	31	145
PU4MAM	115	30	145
GW4EVX	114	31	145
E2WRTC	111	32	143
YE1BHR	112	31	143
K7VIT	108	34	142
PY5EW	118	24	142
PY1NS	110	31	141
N7ESU	110	31	141
YD7ACD	107	33	140
IW2CAM	116	24	140
PY5FO	108	31	139
PY1BL	110	29	139
N4NT	109	30	139
LU1MAW	111	28	139
PY4HI	111	26	137
LA3MHA	106	31	137
PY8WW	110	26	136
PY3BEG	104	32	136
PR1T	110	26	136
YB9ELS	105	31	136
N7JB	104	31	135
PU1WZY	106	29	135
KK7GO	101	33	134
VU2RS	104	30	134
XQ7UP	105	29	134
9M2SAF	101	32	133
OD5UI	104	29	133
TA4AU	104	29	133
DR5X	106	27	133
PY2ANH	101	32	133
PY1KB	105	27	132
K9MM	99	32	131
PY2TMV	106	24	130
PY4BZ	106	24	130
PY1XA	101	29	130
AT75RS	101	29	130
WB5WAJ	102	28	130
PU1SKO	105	24	129
PY2OAL	99	29	128
PY8SL	99	29	128
PY2DMZ	97	31	128
YE3BER	107	20	127
PY1JR	102	25	127
YD0OXG	99	27	126
YG9CLB	93	32	125
ZW2T	97	28	125
PY2HJ	95	30	125
KX7DX	93	31	124
W3DQS	97	27	124
PU2YXB	93	31	124
PT2EM	100	23	123
PY1SAD	96	27	123
MM/W7YAQ	96	26	122
N3QE	97	24	121
YC8DUL	94	27	121
PP5PD	95	26	121
KR7D	88	33	121
YC3TSJ	89	31	120
PY3OO	91	29	120
KB7HDX	90	30	120
W2XL	92	27	119
PY2NNM	91	28	119
PY2CPS	90	28	118
K7ZV	84	33	117
PU2PKL	88	28	116
ZW5B	83	33	116
PS2REG	81	34	115
TA1API	90	24	114
N6VH	83	31	114
PY1DX	90	23	113
KI7Y	84	29	113
YB2CTE	86	27	113
PW8BR	81	29	110
IK0XBX	88	22	110
ZZ1M	87	21	108
PY1RI	86	22	108
TF3D	82	25	107
ZV8C	86	21	107
W1/PY1MX	85	22	107
PY2TTE	80	26	106
PY5IN	81	24	105
K6SZQ	75	30	105
CB6I	74	30	104
EX0DX	82	22	104
ZZ1S	75	28	103
NE7D	74	29	103
PY1RY	79	24	103
PR2D	75	28	103
K9DX	71	31	102
PT2SR	79	23	102
CE2SCZ	75	26	101
ZW2F	76	24	100
PY2AAK	75	25	100
PU5ALE	79	21	100
CB6CPC	72	27	99
PY1LO	78	21	99
KK7EXT	72	27	99
PY4ME	78	21	99
PP5DKM	71	26	97
K7PAX/7	70	27	97
KK4XA	78	19	97
KU4NY	71	24	95
N6GEO	67	27	94
PP2DX	73	21	94
K7WLG	71	23	94
PY5KA	70	24	94
CT7ANO	67	27	94
K6KR	67	26	93
YC1JGE	63	28	91
K7PAX	63	27	90
CE3MRD	68	22	90
YB8CS	64	26	90
LU1WCL	69	20	89
K7FU	60	26	86
9A5MP	72	13	85
PY4WWW	65	20	85
KQ7I	59	26	85
PY5GA	62	22	84
PT7BI	66	18	84
JO7KMB	64	20	84
PY1XW	62	22	84
ZV1T	63	19	82
PT7KC	62	20	82
CE6MRD	59	23	82
PT4T	59	22	81
PY1KIH	63	17	80
PY1DK	58	22	80
K9UQN	57	22	79
PY1AN	55	24	79
VU2KTW	64	15	79
9V1PL	62	16	78
TA4IGN	59	18	77
PY1PL	61	14	75
PJ2/W9VA	52	22	74
CX6VM	51	22	73
PU1LEO	51	21	72
PU2KJX	53	19	72
YE1BNI	43	27	70
ON4RAT/P	53	16	69
KA4UPI	48	21	69
OR7R	53	15	68
PU1VFO	50	18	68
W7YAQ/KH6	40	28	68
K6DW	44	24	68
PY2MQ	46	22	68
PY2RX	48	19	67
DL9EE	44	23	67
CE1UGE	45	22	67
PT7APM	45	22	67
VE3FU	50	16	66
ZW1M	46	17	63
W4TE	46	17	63
PY1MK	49	13	62
W7WLL	43	19	62
PT7KM	43	19	62
PY4CCL	46	15	61
ZV5O	41	20	61
YG9EEY	37	24	61
7R68AR	48	13	61
YB2BHX	34	23	57
KJ7SJG	38	18	56
PT4A	40	15	55
PY1OX	41	14	55
YG1BCP	34	20	54
PU7HLT	39	14	53
PY4RP	32	18	50
PY1BAB	33	14	47
PU2SEX	32	14	46
ZW1CML	33	12	45
7X4CZ	33	11	44
LU9CSM	29	15	44
OP45IH	36	6	42
KC1RWM	20	13	33
PU1KGE	19	13	32
WW8RR	18	14	32
YC1UK	18	11	29
PT2JAR	19	9	28
PY1IR	17	10	27
PY1FOX	19	8	27
PY2PZL	17	9	26
PY4DX	14	10	24
PY3TD	11	13	24
CE6TTL	14	9	23
PY5XH	14	7	21
CT2IUK	11	5	16
ZW1KDT	10	6	16
7X2JV	8	6	14
PY3ZZR	7	6	13
PU1JAH	6	6	12
CB7C	6	5	11
9A/TA7YLY	5	3	8
PY1KJA	3	3	6
PU2VLI	3	2	5
PY5ZD	3	2	5
PY1LOF	2	2	4
PY2GMI	2	2	4
PU1LLF	1	1	2
PY1MU	1	1	2
PU1YLL	1	1	2
PY2RKG	1	1	2
PY4BAL	1	1	2

Limited Class

Callsign	Countries	Zones	Score
SV2AEL	263	40	303
TA4RC	262	40	302
TA1CM	261	40	301
K2JL	258	39	297
PY2TC	255	40	295
IK2RPE	253	40	293
HK3W	254	38	292
VU2IBI	242	40	282
E76C	242	39	281
W9RF	240	40	280
K9GA	240	40	280
TA2L	242	37	279
PY2XU	241	37	278
YB1HR	232	38	270
LU2NI	225	38	263
AA8R	222	40	262
KP4JFR	224	37	261
TA6B	225	32	257

WU4B	218	38	256
VK3KTT	216	39	255
OD5ZZ	216	38	254
4F3BZ	211	40	251
CX7BBR	210	39	249
YB3EDD	209	38	247
K5DC	205	40	245
PP5XA	208	37	245
LY2KM	204	40	244
YB9LCM	205	37	242
YB9UA	202	39	241
YB1MIG	203	38	241
VU2PTT	201	38	239
YB3COY	199	39	238
N9AOL	201	36	237
GU0SUP	198	38	236
KK4TKJ	195	39	234
AF5CC	194	39	233
LW5HR	197	36	233
YD3DCZ	190	39	229
WT8E	191	36	227
YD3ASV	186	39	225
TA7I	186	38	224
PY4ZO	186	38	224
PY2VA	188	36	224
PU5BIA	184	38	222
WA3JAT	184	38	222
PU5FJR	183	38	221
PY1SX	185	36	221
CX2AQ	181	40	221
WB4RA	185	35	220
PU5YSV	182	38	220
PU2TNT	187	31	218
YE9PBZ	177	38	215
N7UVH	175	40	215
W4DEE	176	39	215
PU8YPL	178	37	215
K4VBM	176	38	214
YB0XTU	175	38	213
WA4HNL	178	33	211
YB8XOB	172	38	210
WA3WZR	174	36	210
YB1BUL	175	35	210
YB6DE	171	38	209
PU2STZ	175	33	208
YC2CKY	168	39	207
PU1VKG	175	32	207
K3GWK	170	36	206
W2NK	171	34	205
YC0MLE	166	38	204
AK1P	171	33	204
YC1JEL	171	33	204
WW6G	166	37	203
HZ1SK	164	37	201
MM0HVU	165	34	199
YE1AAH	161	37	198
WA9LEY	161	36	197
YG1BJM	162	35	197
YG2ABP	164	32	196
G6MXL	159	37	196
KG5RJ	157	38	195
PY4EP	157	37	194
KG5HTH	159	33	192
YG1BMZ	157	34	191
YC1CBY	156	34	190
YC1GDF	157	33	190
PP5TG	157	33	190
NG4DX	151	39	190
WA8ZNC	158	31	189
YD4AOP	153	35	188
YB5MB	150	37	187
YD2BIU	155	32	187
YF7UFT	154	33	187
GW3SFC	154	33	187
WA1S	149	38	187
YC3BMX	154	32	186
PU5JDA	146	39	185
LW5DR	146	39	185
YB4NY	148	36	184
PY2SGL	150	34	184
PU4MMZ	147	36	183
YB8SCP	145	37	182
IU2JWF	148	34	182
AE4WG	147	35	182
YB1NIN	143	34	177
PU2ORS	144	33	177
TA0A	139	38	177
IZ2BHQ	143	34	177
YB1IUQ	142	34	176
PU5BOB	141	35	176
KI1U	142	34	176
YC7VAD	141	34	175
IK2ULV	145	30	175
K7VAP	137	37	174
HB9DDZ	136	36	172
KE4QCM	139	32	171
YB7XYO	138	31	169
YI1WWA	141	27	168
PU2OGQ	133	35	168
CX7SS	134	33	167
YB7SKM	132	35	167
PP5DZ	133	34	167
YC6HSK	134	32	166
K9UB	131	35	166
YD1REA	130	33	163
TA2E	132	30	162
YC1BMI	128	33	161
V73MS	128	33	161
K4IE	130	31	161
PY2XZ	126	33	159
YB7RV	124	34	158
K7HV	126	32	158
PU2NBI	120	35	155
PY2ANY	124	31	155
K7HBN	120	34	154
VK5DG	121	33	154
OA4DX	122	31	153
IK2WXQ	122	31	153
DK1MI	125	28	153
W2NTV	123	30	153
ON9TT	122	29	151
YF7UET	116	35	151
CT7AQS	119	31	150
K4PWS	119	30	149
IQ2GM	115	33	148
KB7BTO	113	34	147
WZ8T	113	34	147
CO2VE	118	29	147
NP3YL	116	31	147
IU0RBE	112	34	146
TA5O	116	29	145
PU2MIW	118	27	145
N4FUR	118	27	145
YC1CAR	113	32	145
YG2BEB	111	32	143
PT8DX	113	30	143
YB0GIN	108	34	142
ON2AD	110	32	142
N4BQQ	114	27	141
YC7VOB	109	28	137
KR7X	108	29	137
PU5RSL	109	27	136
KH6RDO	102	34	136
YE4IJ	103	32	135
YC7UAH	104	31	135
YC1RHN	103	31	134
PY2TIM	101	32	133
N5ZY	103	30	133
YD7VNX	104	28	132
YB7UQU	104	28	132
YI3WHR	106	26	132
YB1EIG	103	28	131
TA4J	102	29	131
KY0O	103	27	130
YB3GER	99	29	128
ZY8AM	108	19	127
PY3YD	96	31	127
YE1AR	91	35	126
PX5M	97	27	124
YC1LJT	96	26	122
G4AYU	94	28	122
PY2EQ	94	28	122
YC0OSU	91	28	119
AE7U	89	28	117
CE6KL	88	29	117
PY5VE	88	26	114
ZW2A	87	27	114
PU2TES	87	27	114
W7TMT	85	27	112
M0VCP	90	21	111
CE1RT	85	25	110
NA6JD	81	29	110
PP5RB	80	27	107
TA8DX	85	20	105
K7WA	76	28	104
PU2YBW	81	22	103
PP5ZB	76	25	101
PP5BT	75	23	98
W7DGP	68	27	95
PU0FDN	74	20	94
YC7YYA	68	26	94
PY4NF	70	22	92
PY1CMT	75	16	91
PY1LU	67	21	88
PP5EI	63	24	87
K7LU	63	24	87
PV7M	63	21	84
PP5FE	63	21	84
YG2BBE	62	22	84
YF7RDM	55	25	80
PY2LRZ	60	18	78
5H3TSA	49	26	75
YC7UBK	50	20	70
N8YXR	41	18	59
PU5MFI	43	15	58
KI6BTY	36	20	56
TA3J	38	11	49
YD5NPC	33	14	47
PY3TAM	32	14	46
PU1NIO	28	14	42
TA3NTI	25	8	33
YC7HIJ	16	14	30
YC3CBH	17	12	29
PU1KVD	17	11	28
W4HZD	18	10	28
PU9PED	9	7	16
PY6FX	8	6	14
TA3BN	6	3	9
PY1EDB	3	2	5
PU5DEH	1	1	2

Formula Class - 100 Watt

Callsign	Countries	Zones	Score
OK2FD	257	40	297
PY2CER	231	38	269
HA7LJ	221	40	261
PY2DPM	225	36	261
K4AR	221	40	261
OK1TRJ	223	37	260
W4TV	218	39	257
YV5OIE	213	40	253
CO2QU	213	38	251
EA4HKF	214	36	250
LY2PAD	209	40	249
TF3JB	207	40	247
YD0BCG	206	38	244
YB8JEC	204	39	243
W4UWC	202	39	241
YD9UBT	203	37	240
PU2VLW	204	36	240
EI3CTB	196	39	235
YC0JOY	194	40	234
F4GYM	193	40	233
LY5GT	195	38	233
PU2MLO	194	37	231
AD1C	190	40	230
YD9UW	190	39	229
N9TF	190	37	227
CO8MCL	187	39	226
PP2RON	190	35	225
R1AV	183	40	223
NE5W	184	37	221
PU2RTO	186	35	221
YD8IKY	185	35	220
DL2RPN	177	40	217
SP8RO	179	38	217
YD0RFS	179	37	216
K4YJ	177	38	215
YC2VOC	174	39	213
DL5SFC	171	38	209
W9KVR	174	35	209
W7FKI	173	35	208
YV6BXN	171	35	206
4X1ST	170	35	205
YO4AAC	168	36	204
KM4VI	171	32	203
SO1RON	166	36	202
YC0SCZ	167	35	202
VA3IDD	168	33	201
IU2NUB	162	39	201
NY7H	164	36	200
VE3TG	166	34	200
SV2SKD	167	33	200
AC7P	163	34	197
OD5ZF	160	37	197
W3GW	160	35	195
PY5IP	158	36	194
CO2AJ	157	36	193
SV5SKD	161	31	192
W1NG	158	34	192
N9ATD	156	36	192
VE9VIC	150	39	189
YU6DX	151	37	188
PY6BK	156	32	188
KB4KBS	154	32	186
NI3P	149	36	185
WQ9F	149	35	184
K4UWC	150	34	184
DL7PJ	148	34	182
YD3CER	146	34	180
KW9U	143	36	179
YB8LDK	142	35	177
YC2FAJ	141	35	176
OE3OSB	140	36	176
YD2CZV	138	35	173
YB1KK	139	33	172
YC0RXA	159	13	172
5H8HZ	134	37	171
OK1BLU	134	36	170
IU0ITX	133	37	170
AJ4HW	139	30	169
JA1IRH	134	32	166
PY2MIA	134	31	165
W4SYB	131	33	164
TA7UHS	129	35	164
W4KVS	133	31	164
AB9YC	127	36	163
PY5WD	132	30	162
N5ER	130	32	162
N9LJX	126	34	160
KY0Q	126	34	160
PY5DD	121	36	157
PY2POA	120	36	156
K5TF	127	29	156
YC4RWH	122	34	156
KE9V	122	31	153
VK2EY	120	32	152
WV7S	120	31	151
N1RDN	117	31	148
CO8NMN	120	28	148
N6NFB	114	31	145
KN4TCF	108	33	141
YC8IKU	111	30	141
K5EM	108	33	141
WA3DB	110	30	140
CE1EW	104	34	138
PU5SIX	105	31	136
K8TWA	111	24	135
AF9W	103	32	135
AD7UZ	101	33	134
YC0SCL	99	31	130
YC7BNN	97	32	129
YG2BDN	100	28	128
K5TRP	98	29	127
PU5SVE	116	11	127
PU5NAO	99	24	123
TA1SOR	94	28	122
PJ7AA	88	33	121
9H/TA1HZ	91	30	121
N7JI	87	32	119
YD2KFP	87	30	117
PY5IQ	85	29	114
PG1R	88	24	112
AD5LU	84	26	110
PY2KME	82	26	108
AA8MA	83	25	108
YC4PKS	81	22	103
YD7AAC	75	27	102
YB3VK	74	27	101
YG2AMA	74	26	100
KE7AUB	70	27	97
AI3KS	76	21	97
AD8CM	78	18	96
N7RLV	69	22	91
PU4HUD	60	25	85
KA9JAC	63	22	85
PU2XMP	61	23	84
W4ANO	63	20	83
WC7L	55	27	82
YV5AJI	48	21	69
PU2WYP	50	18	68
TA7YLY	54	13	67
TA3CE	57	9	66
YD2CRJ	46	17	63
TA3P	55	8	63
KN4APC	38	21	59
N6JSO	37	22	59
ZZ2I	36	16	52
YC1JXU	33	19	52
PR2V	34	15	49
YD2IFA	29	14	43
N9KJU	26	16	42
YD0NXX	27	15	42
PY2MAM	28	12	40
W7JSM	18	12	30
TA3IEY	12	4	16
YG2AYH	7	7	14
KD2SPJ	7	6	13
KJ7PRS	5	4	9
PU1JDU	4	3	7

Formula Class - 5 Watt

Callsign	Countries	Zones	Score
WG5G	223	39	262
K8ZT	188	38	226
DL6GBM	162	38	200
W8QZA	160	38	198
4Z4UO	136	30	166
KZ3I	128	29	157
G1G	90	25	115
PU2GTA/QRP	95	20	115
PY2PLL	89	22	111
HK4KM	86	23	109
CT1END	73	18	91
M5AEF	68	19	87
PY2TDB	57	20	77
ER/UR7FM	56	11	67
KW9E	45	19	64
TA4MA	33	21	54
PU5IKE	34	13	47
KR4EE	23	13	36
KD5XB	19	16	35
TA2UMH	15	7	22
KA1PPV	8	5	13

Late, SWL & Check Logs

Callsign	Countries	Zones	Score
K9EL	284	40	304
YV6CA	184	38	222
LU5FF	121	24	145
NF7D	58	24	82

Portable hamming is easier than ever, and our favorite pedestrian-mobile author shares his adventures from a volcano to the seashore.

Have Radio, Will Travel

BY PAUL SIGNORELLI,* WØRW

(*WØRW shares details of two of his pedestrian mobile adventures, starting with a dormant volcano in New Mexico and then shifting to the seashore. – W2VU*

W5C, Capulin Volcano, New Mexico Operation

Capulin Volcano is not one of the Southwest's major tourist attractions, partly due to its isolated location in the far northeast corner of New Mexico, well away from other popular destinations. The land hereabouts is a transition zone between the high plains of north Texas and western New Mexico, and the foothills of the Rocky Mountains. The region contains mostly arid prairie, used for cattle rather than agriculture, and is crossed by numerous small ravines and washes, with occasional hilly outcrops. The hills and mesas become higher farther west, and the region between Clayton and Raton additionally has many scattered volcanic peaks – dormant volcanoes and cinder cones, all part of a great line of volcanism stretching from southeastern Colorado into Arizona.

Most of the peaks are quite small, rising just a few hundred feet above the plains, but one of the largest and best-preserved is the 1,000-foot-high Capulin Volcano (Photo A), located between the small towns of Folsom and Capulin (Figure 1), and proclaimed a national monument in 1916. Capulin means 'choke cherry' in Spanish, my favorite fruit. I picked the special call sign of 'W5C' for my visit there (Photo B), assigned for obvious reasons.

This HF backpack operation started at 1800z. It was a sunny day with temperatures around 55°F. There was still

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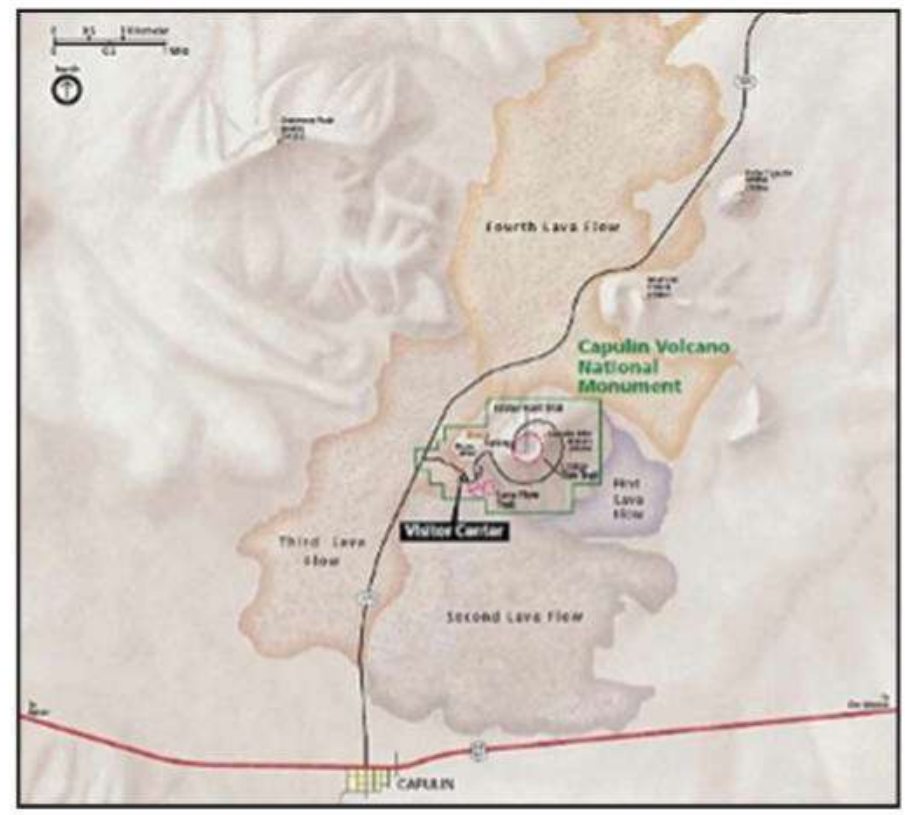

Figure 1: The volcano is located between the small towns of Capulin and Folsom, New Mexico. (National Park Service map)

Photo A: The Capulin Volcano in New Mexico. (National Park Service photo)

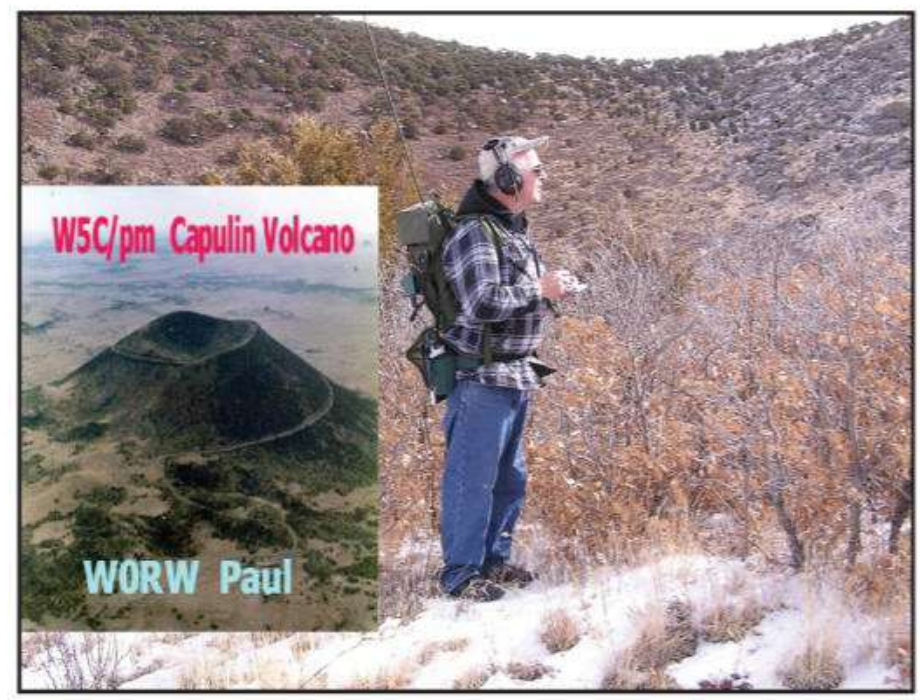

Photo B: The author used a special-event call of W5C for his operation from Capulin Volcano.

Photo C: Paul made several contacts from the volcano, but had to rely on his wife to change any settings on his backpack-mounted radio (and to take most of these photos!)

some snow on the road and on the trails. The Capulin Volcano has a perfectly formed cone and the rim rises 1,300 feet above the New Mexico plains to an elevation of 8,182 feet. The crater diameter is 1,450 feet. It consists chiefly of loose cinders, ash, and other rock debris. These materials were ejected during successive eruptions and fell back upon the vent, piling up to form the conical mountain.

The symmetry of Capulin Volcano was preserved because lava did not flow from the main crater but from secondary vents located at the western base of the cone. Evidence of the other episodes of volcanic activity can be seen in nearly 100 nearby volcanic peaks and lava-capped mesas.

I found no Arecibo-type gain or hot spots as I walked around the crater, except that the top rim at 8,182 feet was the best place for radio operations. This is not like walking around a baseball field. It takes time to circumnavigate the rim. It took 15 minutes to go from the north rim to the south rim, and almost an hour to walk around the rim loop trail which is one mile long and rises about 300 feet above the lower rim.

The bottom of the crater is a big -20 dB RF hole. No one down there had cell service but the ham gear still got out. My XYL (Sharon, NØOPM) made a few contacts on 146.52 FM and she did the frequency changing on my backpack radio. I can't reach any of the controls when it is on my back (Photo C), so she would push the buttons to change frequencies and retune the antenna. I depleted one NiCad and two Li ion bat-

Photo D: Getting out on the beach with salty sand beneath your feet results in immediate signal improvements, both on receive and transmit.

Photo E: Note the trailing drag wire (counterpoise) for the author's backpack-mounted vertical antenna.

teries after 6 hours of operation and had six spares on hand. The PRC319 was running 50 watts all the time and the 10-foot whip had a top hat on 30, 40, and 60 meters.

I worked several stations from the bottom of the crater on 20 meters CW, including Bob Reisenweber, W3BBO (running 1.5 watts to a vertical), K6DBG, N8EPE, WB3FOX, W6JRY, N7QU, VE7NH, VE3SIE (who made a recording of my signals), WA6RIK, K6BZZ, KØRHK, KJ5GT, KCØTOH, WK8S, WGØAT (175 mile ground wave QSO), N6JF, and WA2TDL.

Thanks to everyone who was listening for me. I could have never made this many contacts without you all being out there.

You can learn more about the Capulin Volcano National Monument at <https://tinyurl.com/4rzptjvz>.

Take It to the Beach…

Pedestrian-mobile operation on the beach has a lot of advantages, ocean breezes, beautiful views, no trees to snag your antenna and the 'saltwater amplifier.' You may have heard of the advantages of being *near* the beach, but until you walk right along the shore with your rig (Photo D), you won't really be able to experience the difference yourself.

If you hook up your little KX2 or KX3 (or similar portable HF rig) to a whip and walk out on the wet salty sand, you will notice the improvement in received signal strengths right away. It works the same way on transmit, too. You have to retune your antenna for the salty ground but as long as you stay on the salty wet sand you will notice the improvement. You need a drag wire of the appropriate length, of course (Photo E). There is no need to get into the water. In fact, you need to keep your radio away from any salt spray from the waves. My radio (military PRC319) is waterproof so I don't have to worry about any rogue waves.

On the east coast (Photo F), it is like opening a special DX window to work Europe. It seems better to me than working from any 14,000-foot peak in Colorado.

Some people will think you are just fishing, so they will ask 'What are you catching?' (Photo G). Actually, they ask the same question on top of mountains where there is no water in sight. The answer, of course, is that you're catching a wave … a radio wave!

Photo F: QSL from the beach in Florida. Operating from an east coast beach is like having your own DX window to Europe.

Photo G: Unless you're alone on the beach, you're likely to have some questions … such as "What are you catching?" The answer, of course, is "a wave."

Dave Ahlgren, K1BUK follows up his April 2022 article on using computer modeling to predict performance in 1:1 baluns with a look at applying the same techniques to 4:1 and 9:1 Guanella baluns, along with a guide to winding your own.

Experimenting with the Guanella Balun—A CAD Approach

BY DAVE AHLGREN,* K1BUK

In a previous article I wrote about the use of computer models to predict the performance of 1:1 current baluns.[1] This article describes the modeling, design, construction, and application of 4:1 and 9:1 Guanella baluns that provide high common model rejection and useful impedance transformations for amateur communication.

The Basic Guanella Balun

The Swiss inventor Gustav Guanella described these devices in a 1944 article.[2] Guanella's baluns consisted of two or more connected 1:1 current baluns. Wound with a short transmission line (TRL), the ideal 1:1 balun is lossless and it works equally well at all frequencies. In each 1:1 balun, RF signals propagate without loss or delay along the wound TRL. Figure 1 shows that the 4:1 Guanella balun consists of two 1:1 devices whose inputs are connected in parallel and outputs connected in series. This series connection is possible because the outputs are isolated from each other by the choking effect of the windings. A 9:1 Guanella balun consists of three 1:1 current baluns connected this way. Figure 1 also shows the currents and voltages in the 4:1 Guanella balun. When a voltage V is applied across the input terminals, half of the input current I flows into each 1:1 balun and out through the load Z_L. The load voltage is 2V. When a signal is applied to the input terminals by a source with an internal impedance of R (typically 50 ohms), the load power and the source power are equal when $Z_L = 4R$. With this load, the input impedance to the balun is equal to R, and the input SWR is 1:1.

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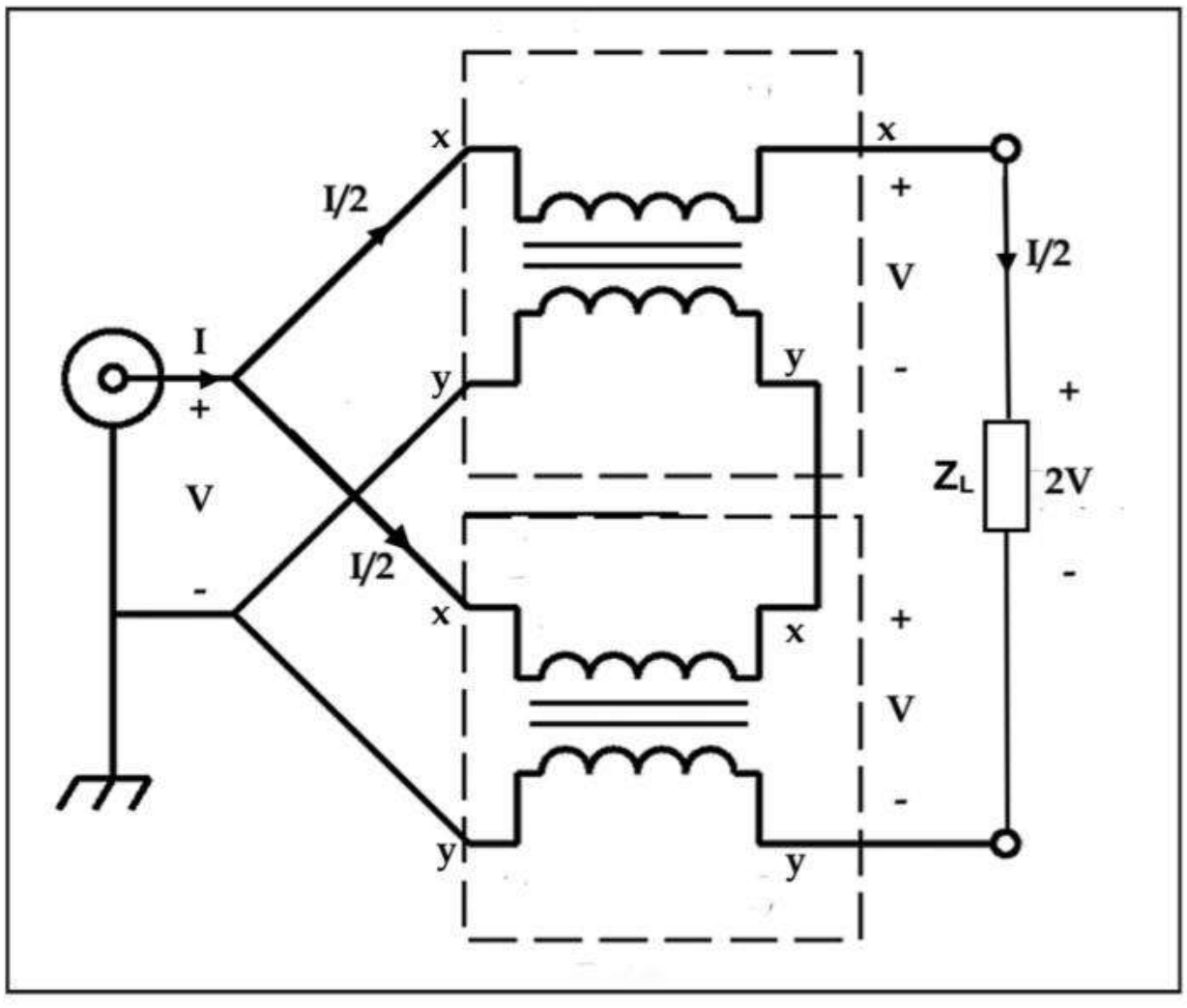

Figure 1. 4:1 Guanella balun schematic diagram

Computer Aided Design

My first step was to make 3D computer models of the 4:1 and 9:1 baluns with EMCoS Studio, a powerful CAD package for simulating electromagnetic systems using finite-element analysis.[3] The models and the physical baluns have the same geometry and are made from the same materials. The EMCoS program divides the model into a mesh—surfaces into triangular segments and wires into short rods—and sets up and solves equations that describe the interactions among currents and voltages in the mesh. The EMCoS models also predict far- and near-field radiation patterns, scattering parameters, power balance, and circuit impedances. The models account for the frequency-dependent variation of core material permeability, the skin effect, circuit imbalances, signal delay and heating losses, all factors that limit the performance of real baluns.

Experiment 1: Designing Guanella Baluns

I designed Guanella baluns that would work well with 50-ohm sources, the standard in amateur equipment. The parallel connection of TRLs at the input and the series connection at the output require a TRL with the characteristic

impedance Z_{OL} = 100 Ω. The 9:1 Guanella balun requires Z_{OL} = 150 Ω. The TRLs consist of parallel wires with diameter *d* and center-to-center separation *D*. The characteristic impedance is given by Formula 1; Figure 2 graphs Z_{OL} vs. *D* for AWG 12-18 wires.

As shown by the graph, a TRL with Z_{OL} = 100 Ω may be constructed using AWG #12 wire (d = 0.0808") with spacing D = 0.11". To get Z_{OL} = 150 Ω, we can use AWG #16 wire (d = 0.0508") and D = 0.096".

I made models of cross-wound Guanella baluns with 7, 9, and 11 turns on Type 31 and 43 ferrite cores. Simulations of the common mode rejection ratio (CMRR) over the HF range indicated that 9 turns are a good choice. I used Type 31 cores in the 4:1 Guanella balun and Type 43 in the 9:1 balun. Figure 3 shows the 4:1 model, and Photo A is a photograph of the physical device. Verification of models and the real baluns was carried out by examining the input SWR with non-inductive matched loads (200 Ω ± 0.5% with the 4:1, 450

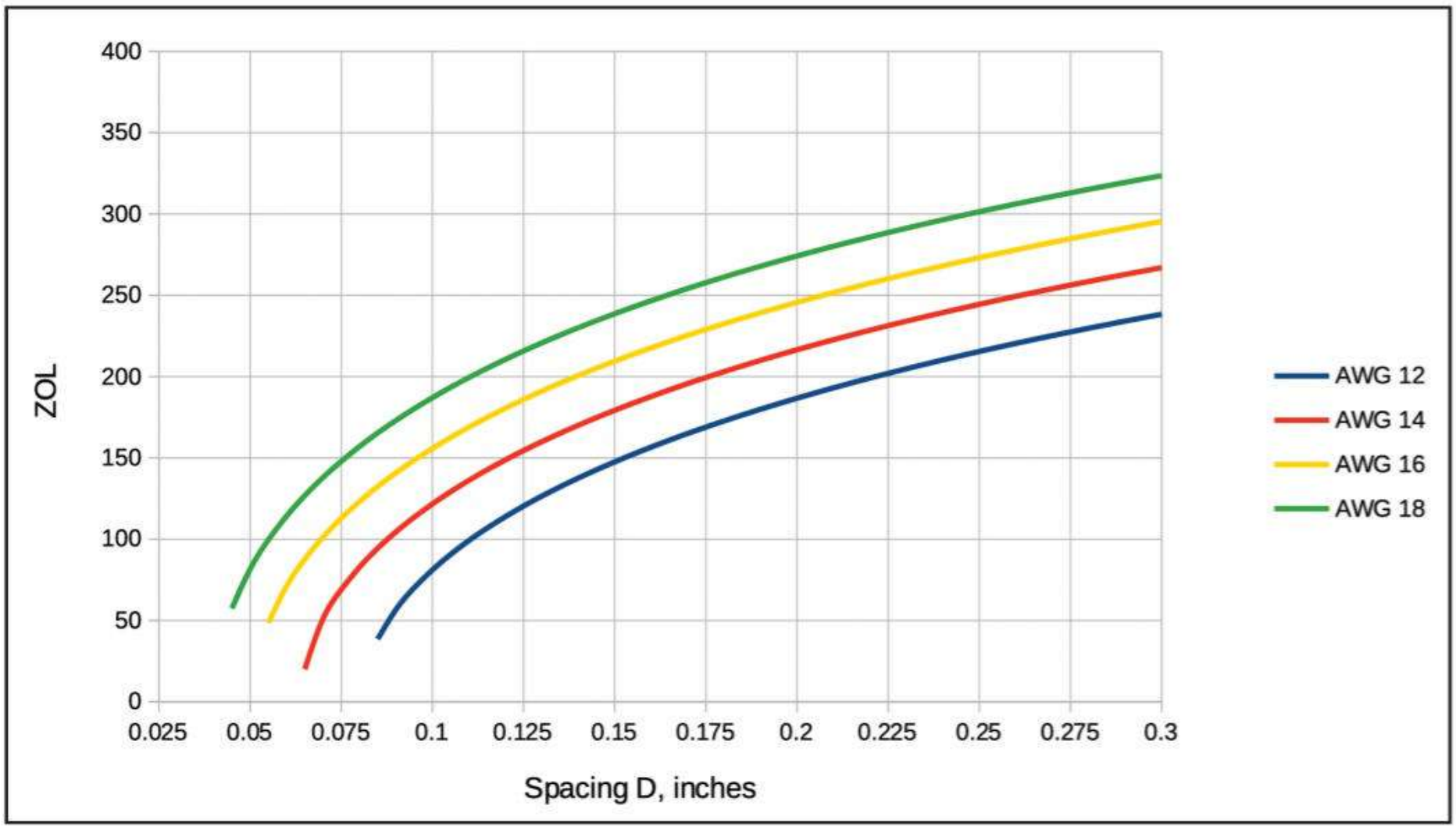

Figure 2: Graph of characteristic impedance vs. wire spacing for AWG 12, 14, 16, and 18 windings

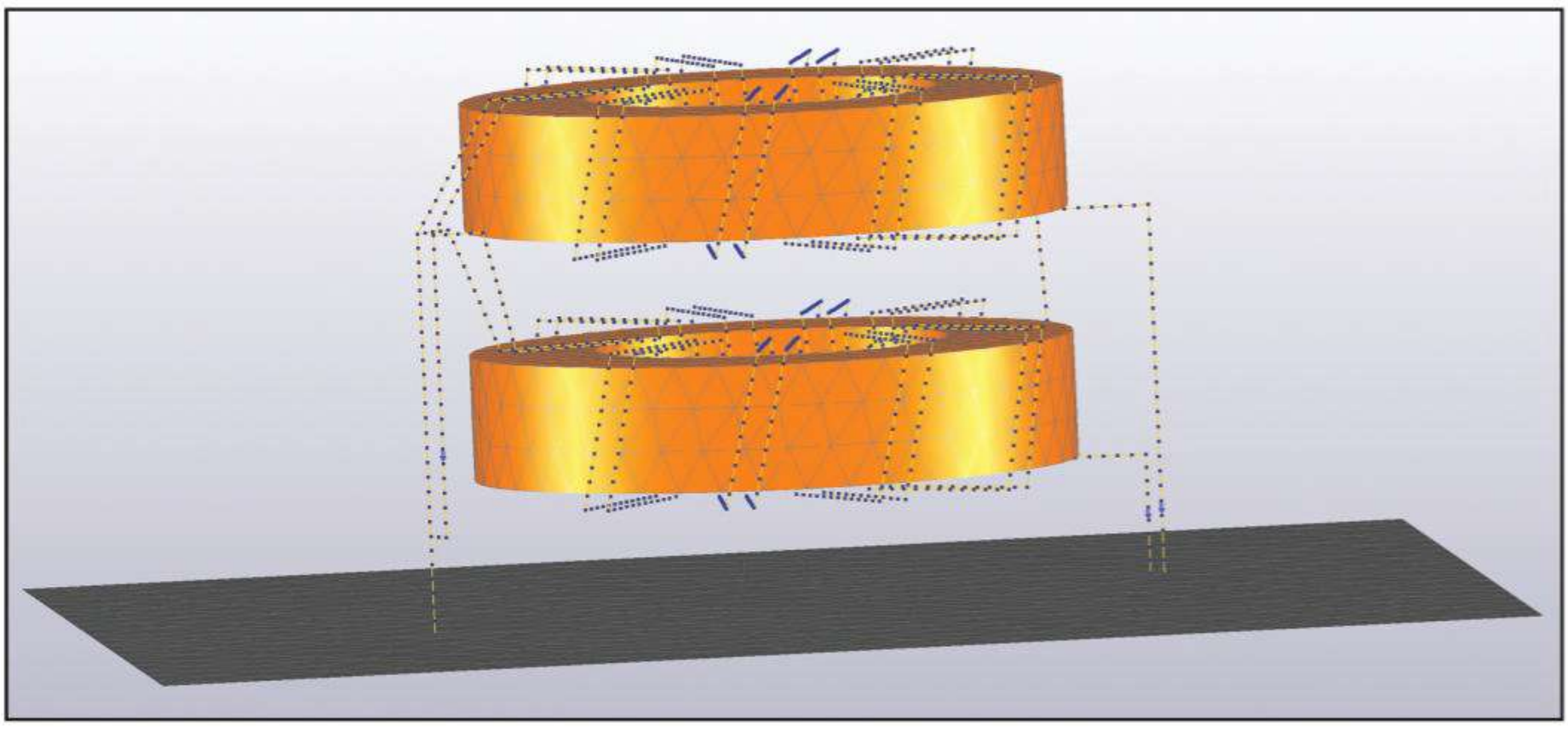

Figure 3: EMCoS Model of 4:1 Guanella balun. Depicts two 1:1 choke baluns, cross wound on FT-240 cores, over a copper ground plane.

$$Z_{OL} = 120 \ln\left(\frac{D}{d} + \sqrt{\left(\frac{D}{d}\right)^2 - 1}\right)$$

Formula 1. How to determine the characteristic impedance of a transmission line (TRL)

Ω ±0.1% with the 9:1). The SWR was measured over the HF range using my NanoVNA-F.[4] Figure 4 shows that the predicted and measured curves agree closely. The measured SWR is greatest at 30 MHz, where it was 1.16:1 with the 4:1 balun and 1.1:1 with the 9:1 balun.

During the modeling phase of this experiment, I used EMCoS Studio's visualization tools to examine current flow through the windings and load. An example is a snapshot taken from an animation of current flow in the 9:1 balun (Figure 5).

Experiment 2: Evaluating the CMRR

My April 2022 *CQ* article presented a method to predict and measure a balun's common mode rejection ratio based on scattering parameters. The CMRR, expressed in dB, measures the relative degree to which a balun passes transmitted signals (differential mode) and rejects common mode signals. The CMRR varies with frequency, and it depends on the core material's properties, the physical layout of windings and connections, and the number of turns. Using the models, I projected CMRR curves for the 4:1 and 9:1 baluns and confirmed them via measurements. The projections and the measurements were consistent (Figure 6), both predicting CMRRs exceeding 35 dB across the HF range.

Experiment 3: Finding Feasible Tuning Points

After I retired and got back into ham radio, I put up an 88-foot dipole fed with 45 feet of home-brewed ladder line. I made an L-network tuner to match this modest antenna and feedline to my transceiver (Figure 7). At its input, the tuner has a choke balun consisting of 10 turns of RG/142 50-ohm coax wound around a FT-240 toroid of Type 31 ferrite. The variable capacitor C and inductor L are junk box parts found on eBay. I didn't take great care to optimize the component layout. As a result, the total stray capacitance—in wires and switches plus the minimum setting of the variable capacitor—is 60 pF, as verified by a direct measurement. Because of this large capacitance, it wasn't possible to adjust the tuner for a perfect match on the 15-, 12-, and 10-meter bands. The question became, would the impedance transformation provided by the Guanella baluns allow me to use the tuner on those bands? My goal was to find all settings for L and C that would provide a match at the FT-8 frequencies. These tuning points would require C to be larger than 60 pF.

The experiment proceeded as follows:
–Using the NanoVNA-F, I measured the impedance presented by feedline at the input terminals to the tuner for the following:
1) direct connection of feedline to tuner
2) connection via the 4:1 balun, and
3) connection via the 9:1 balun.

For these connections, I found all low-pass L-networks that give a SWR of 1:1.[5] Table 1 lists the tuner settings in the first three columns.

Next, I used my tuner to verify each setting. A match was observed (SWR =1.0:1) at all listed settings except at 5.357 MHz, where the best measured SWR was 1.1:1. At that frequency, the required capacitance was C = 42 pF, about 20 pF less than the minimum tuner capacitance, so a perfect match was not possible.

Except for the 30-meter band, the antenna and feedline could be tuned from 80-17 meters without a Guanella balun. The 4:1 balun enabled a perfect match on the 80-, 40-, 30-, 20-, and 10-meter bands as did the 9:1 balun on 40, 20, 17,

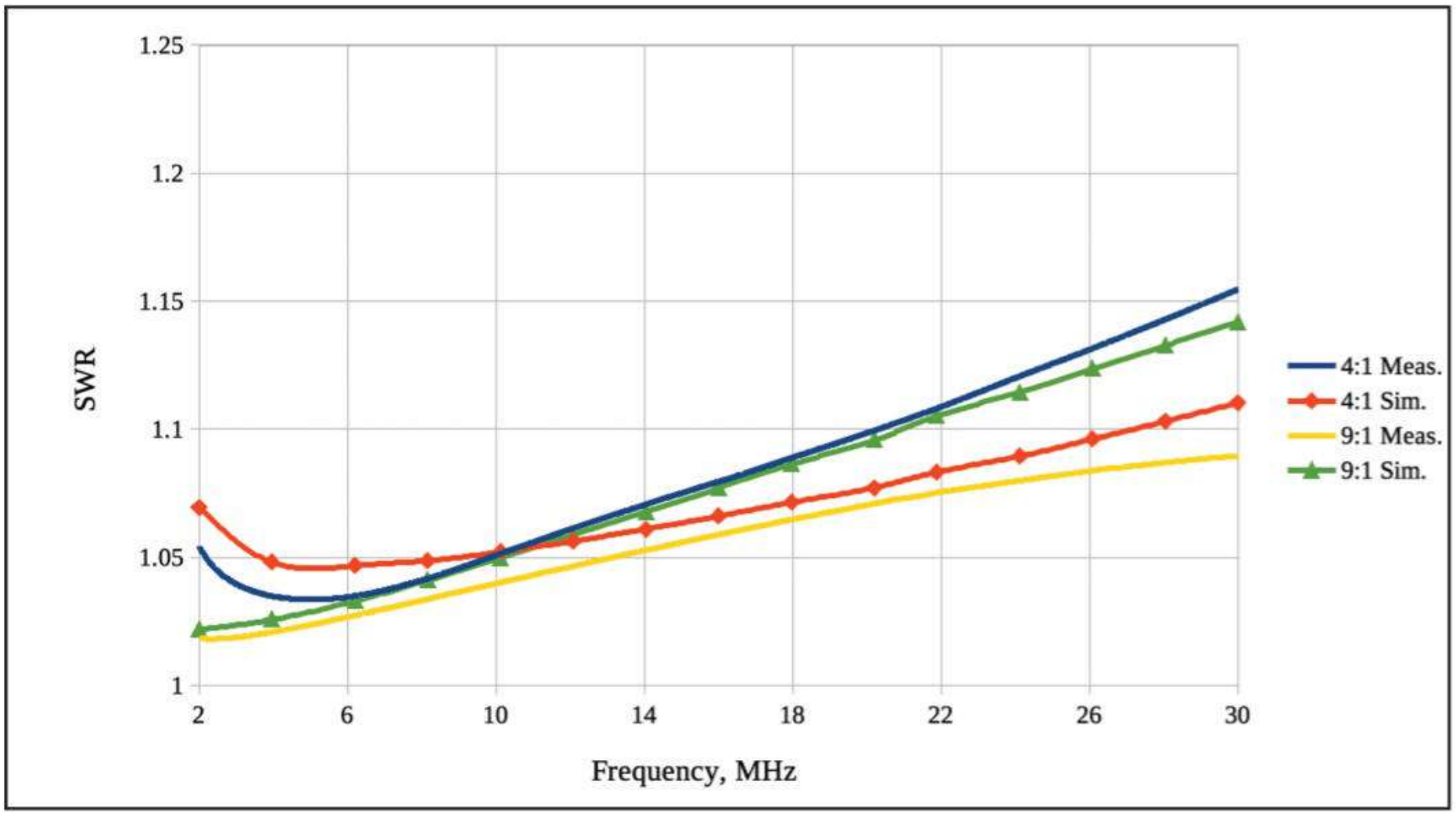

Figure 4: Projected vs. measured SWR curves for 4:1 and 9:1 baluns

Table 1

f, MHz	Network type: CL/LC	C, pF	L, µH	Modeled Heat Loss, dB	Max Transmit Power, Watts
3.573	LC	496	10.50	0.00	**
	LC	1171	6.70	0.20	420
5.357	LC*	42	13.60	0.00	**
7.074	LC	71	0.38	0.00	**
	LC	826	0.48	0.04	2240
	LC	954	1.54	0.09	1580
10.136	CL	249	2.45	0.29	330
14.074	LC	121	1.54	0.00	**
	LC	156	1.45	0.11	875
	LC	189	1.71	0.14	994
18.100	LC	93	0.45	0.00	**
	LC	116	0.58	0.07	1400
	LC	148	1.16	0.09	1550
21.074	LC	226	0.68	-0.20	670
24.915	LC	70	0.76	-0.16	845
28.074	LC	72	0.42	-0.09	992
	LC	77	0.96	-0.12	1140

Table 1: Summary of Feasible Matching Points. Connection type: Direct, 4:1, 9:1.
MTP = maximum transmitter power with 50% duty cycle and 5 watts total heating loss per core
*Best tuned SWR = 1.1. **MTP > 500 Watts, limited by loss in input balun and tuner

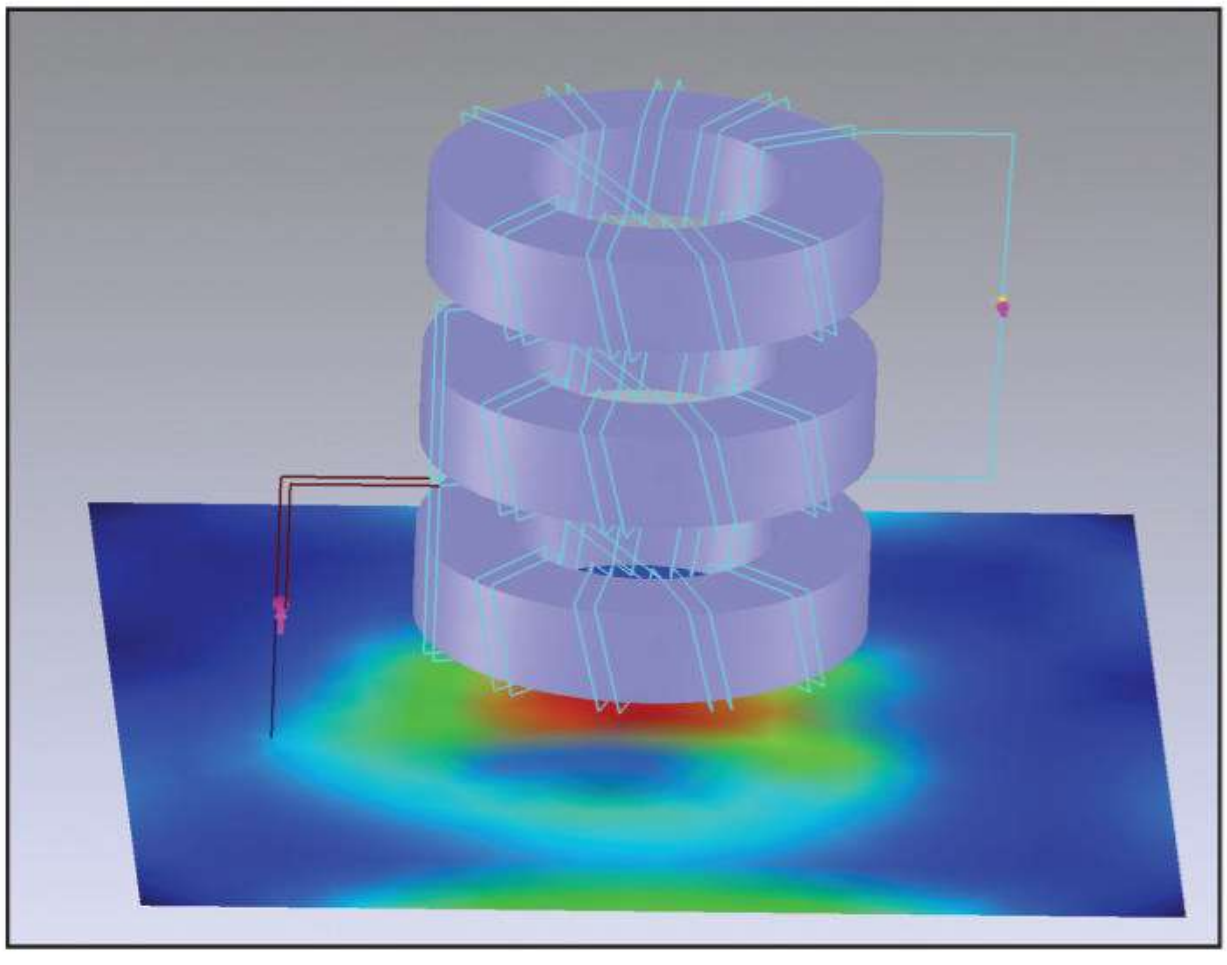

Figure 5: Simulated currents in 9:1 Guanella balun above copper ground plane. 7.074 MHz RF source is on the left (pink), load on the right (pink). Source current (I, dark red) splits into three equal parts (I/3,light blue) that flow through each 1:1 balun and the load. Color-coded surface currents in ground plane are induced by stray magnetic fields.

15, 12 and 10 meters. Table 1 shows that there is more than one useful tuner/balun combination on five bands.

Experiment 4: Modeling Power Loss

The goal of this experiment is to determine which tuning points lead to the smallest heating loss. I used EMCoS Studio's power balance analysis to predict the loss. This experiment was similar to Experiment 3 except that here I used balun and tuner models in place of the physical balun and tuner. From the power balance results, I calculated the maximum transmitter power (MTP) for 5 watts total heating (wire losses + ferrite losses) per toroid assuming a 50% transmit duty cycle, the upper bound for FT-8 transmission (Table 1).[6] The results indicate that at the tuning points, the greatest power loss was less than 0.3 dB, so small as to be unnoticeable during QSOs. The lowest MTP is on the 30-meter band (330 W), which is higher than the legal power limit on that band and higher than my operating power on the other bands. I concluded that I could use both Guanella baluns without worrying about overheating.

Experiment 5: Exploring the Impedance Transformation Ratio

In this experiment, I looked into the impedance transformation provided by my Guanella baluns when they are connected to the highly variable frequency-dependent load presented by my feedline. Would the baluns deliver the expected 4:1 and 9:1 transformation ratios? I used the NanoVNA-F to measure the following at 101 points across the 2-30 MHz range: 1) the impedance Z_{feed} presented by the feedline to the balanced side of the balun, and 2) the input impedance Z_{inb} of the balun with the feedline connected to the balun's balanced output. I calculated the ratio of these impedances Z_{feed}/Z_{inb} at each frequency. This ratio is a complex number consisting of the magnitude ratio (MR) and a phase difference. Based on data measured in Experiment 1, I also computed the MR when the baluns operate with matched loads (4:1 balun with a 200-ohm load and 9:1 balun with a 450-ohm load). Figure 8 summarizes the results and leads to these observations:

– With the matched loads, the Guanella baluns show the expected MRs across the HF range.

– The MR is larger than expected on frequencies at which the feedline presents

a capacitive load (X/R < 0) and smaller than expected with an inductive load (X/R >0). (At each frequency, X/R is the ratio of reactance to resistance of the impedance Z_{feed}.) With the 4:1 balun, the MR ranges from 1.2 to 10.5, and with the 9:1 balun, from 2.1 to 35.3. Even with this large variation of the MR, the baluns have extended the range of my tuner with low losses. Use it if it works!

Experiment 6: Make Guanella Baluns!

To make the 4:1 or the 9:1 balun you'll need tape, zip ties, and hardware:

– Glass cloth tape 1/2-inch wide, Amidon, <https://tinyurl.com/4ab38fdz>
– #95 Polyamide tape, Amidon, <https://tinyurl.com/4nsczubk>
– 6-inch zip ties
– Stainless steel screws (size 10-32), washers, and nuts to make terminals
– Wire lugs to fit 10-32 screws and AWG 12 wire

For the 4:1 balun, you'll also need the following materials.

– 10 ft. AWG #12 solid enameled wire. I used Thermalize AWG#12 HAPT, also available from Amidon at <https://tinyurl.com/2h6vcm7p>.
– 10 ft. Teflon® tubing, #12 gauge: <https://tinyurl.com/yn67yzvz>
– 36" glass cloth tape
– Enclosure, 4" x 4" x 2" PVC outlet box: <https://tinyurl.com/ywf4sez8>
– Two FT-240 Type 31 toroids: <https://tinyurl.com/2p8c6hts>
– SO-239 coax connector

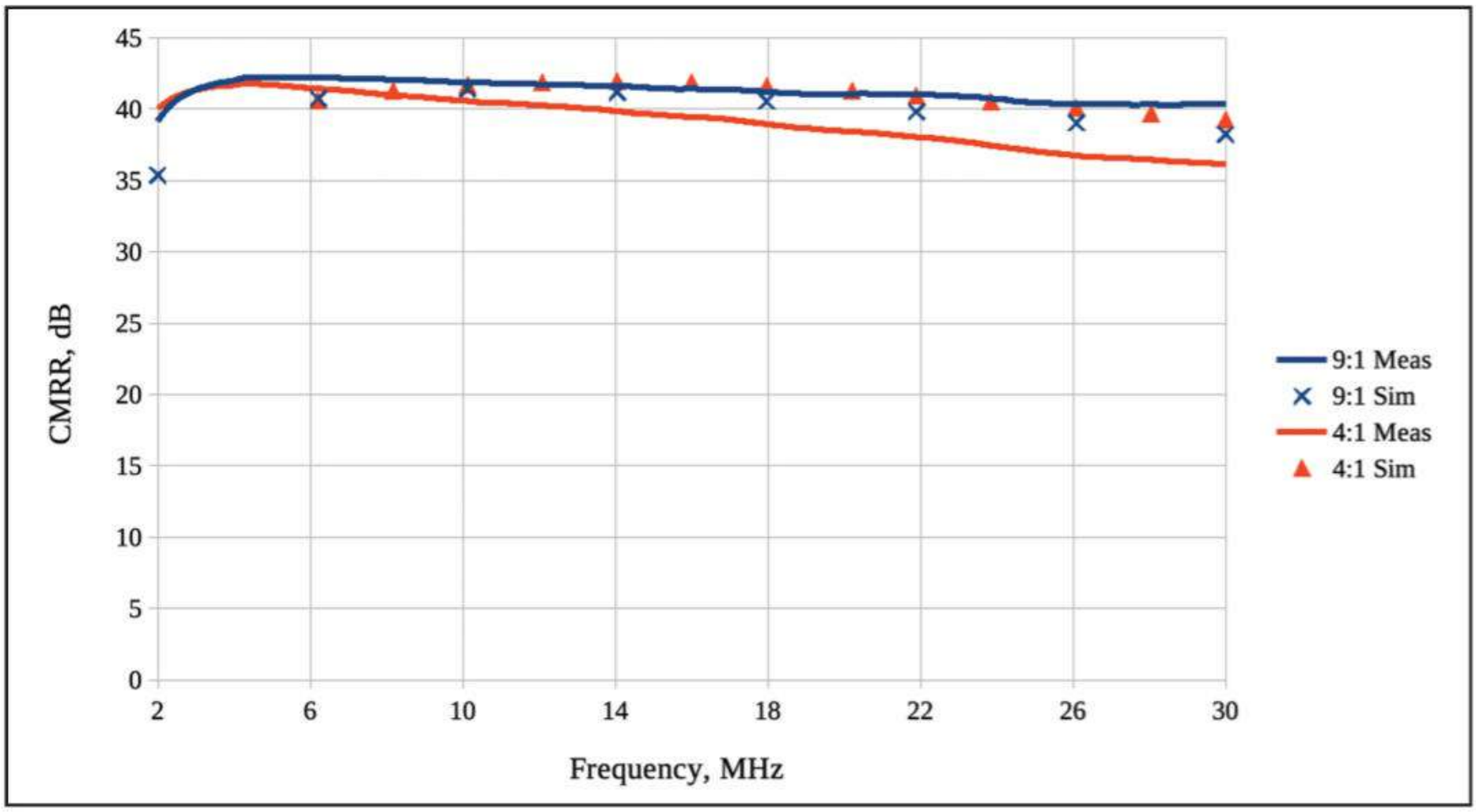

Figure 6: Simulated and measured CMRR curves for 4:1 and 9:1 baluns

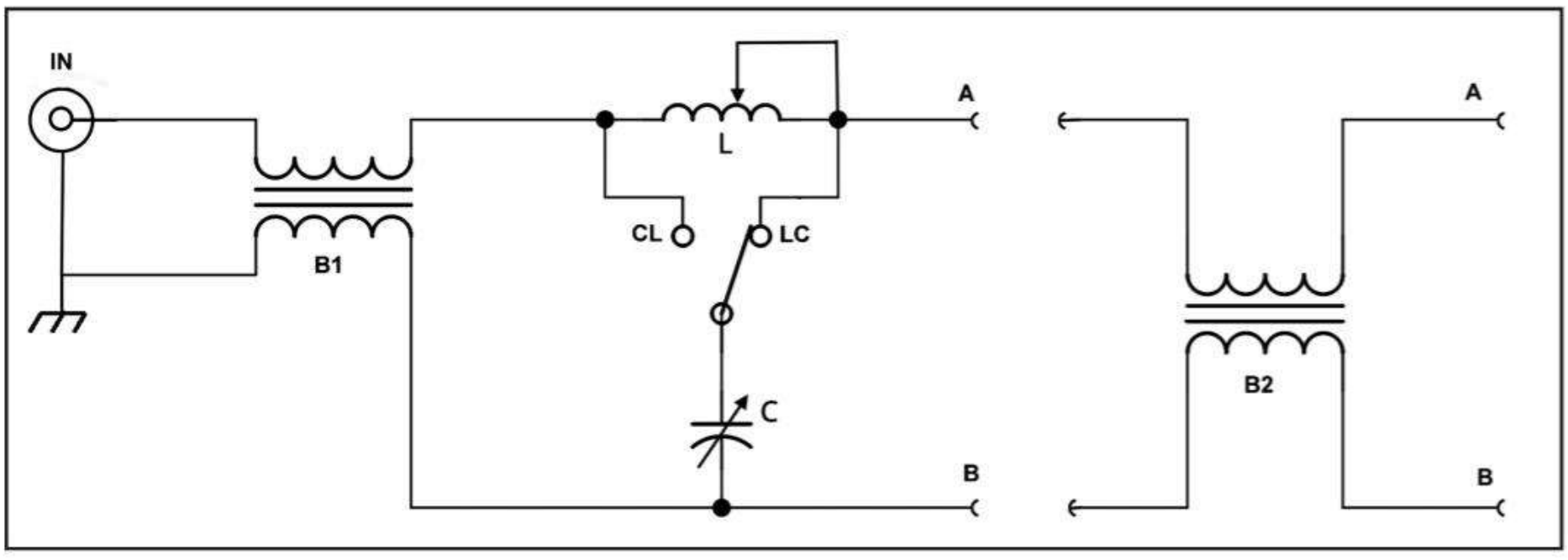

Figure 7: Balun B1 is input balun. Balun B2 is Guanella balun.

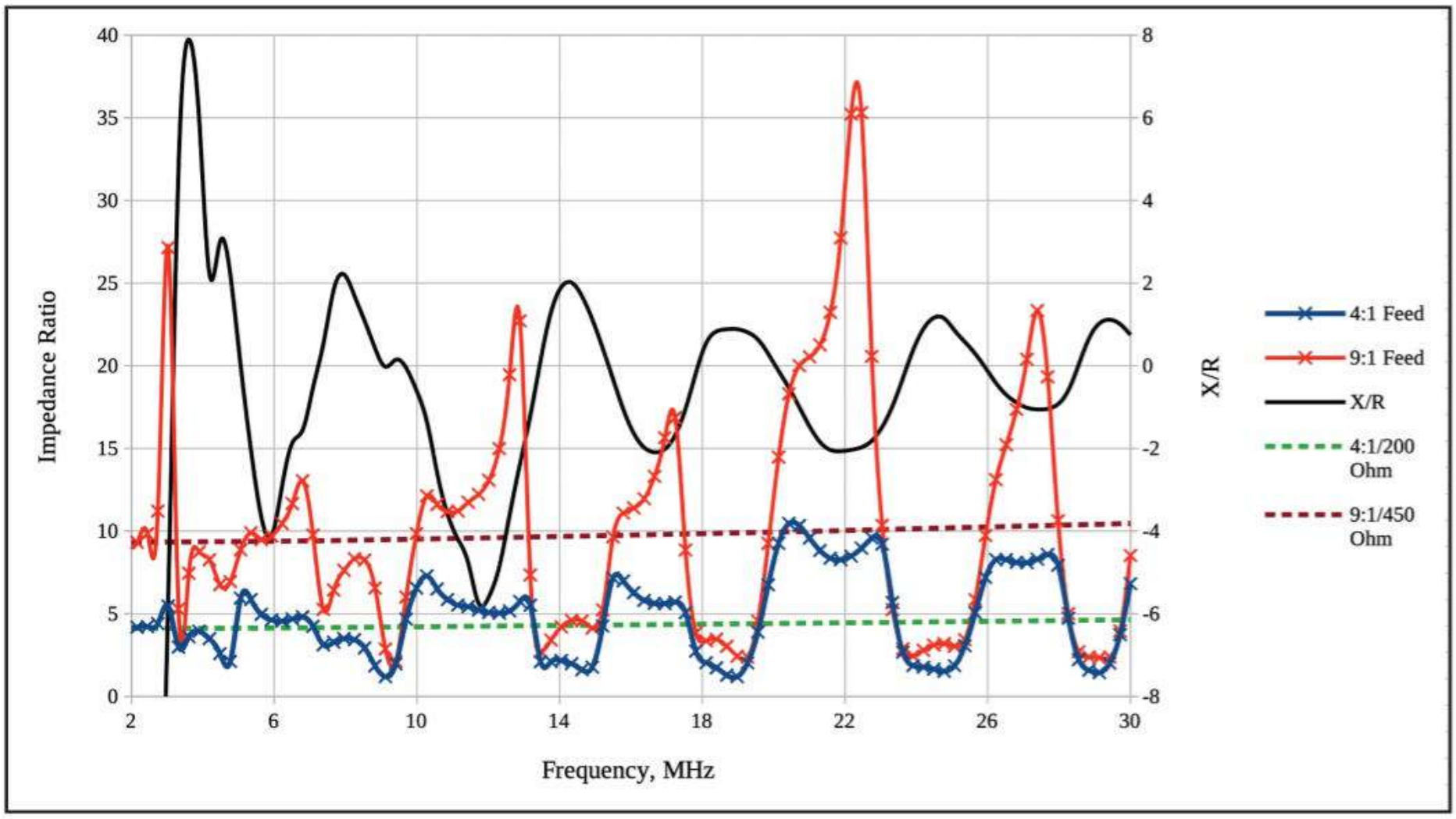

Figure 8: Magnitude transformation ratios with matched loads and feedline loads. X/R = ratio of reactance to resistance of feedline load at each frequency.

For the 9:1 balun, you'll need the following:
– 15 ft. AWG #16 enameled wire:
<https://tinyurl.com/2s4eddx5>
– 15 ft. Teflon® tubing, #14 gauge:
<https://tinyurl.com/ywmuhmjs>
– 48" glass cloth tape
– Enclosure, 4" x 4" x 4" PVC outlet box:
<https://tinyurl.com/39nrb4ms>
– Three FT-240 Type 43 toroids:
<https://tinyurl.com/2p8c6hts>
– SO-239 coax connector

To make the baluns, follow these steps:

Step 1: Before winding either balun, wrap each core with two layers of polyamide tape.

Step 2: (4:1 balun) Cut four 28-inch (71-centimeter) lengths AWG #12 wire and four 27-inch (69-centimeter) lengths of 12-gauge Teflon® tubing.

(9:1 balun): Cut six 28-inch (71-centimeter) lengths AWG #16 wire and six 27-inch (69-centimeter) lengths of 14-gauge Teflon® tubing.

After cutting the wires to length, pull them firmly and evenly over a thick dowel to straighten out kinks.

Step 3: Make the transmission lines.

– Insert each 28-inch wire into a length of tubing.

– Assemble two transmission lines by laying the wires on a flat surface and binding them together using 1-inch lengths of fiberglass tape spaced about 1-1/2 inches apart. (Note that you can trim or divide the tape to 1/4-inch width for this step.) Double up the taping on each end of the line.

– Make the required number of identical cross-wound 1:1 choke baluns as follows: Mark the midpoint of each transmission line. Insert the line through the toroid so that the midpoint is at the center of the toroid. Wind four turns on each side of center in the pattern shown in Photo A. Space the turns equally so that they fill about 5/6 of the toroid. Secure the ends of the windings with zip ties.

– Assemble the 4:1 Guanella balun. Using Figure 1 as a guide, identify the x-wire and the y-wire of each 1:1 choke balun. Plan to leave a separation of about 1/2 inch between the individual baluns, so trim the leads to an appropriate

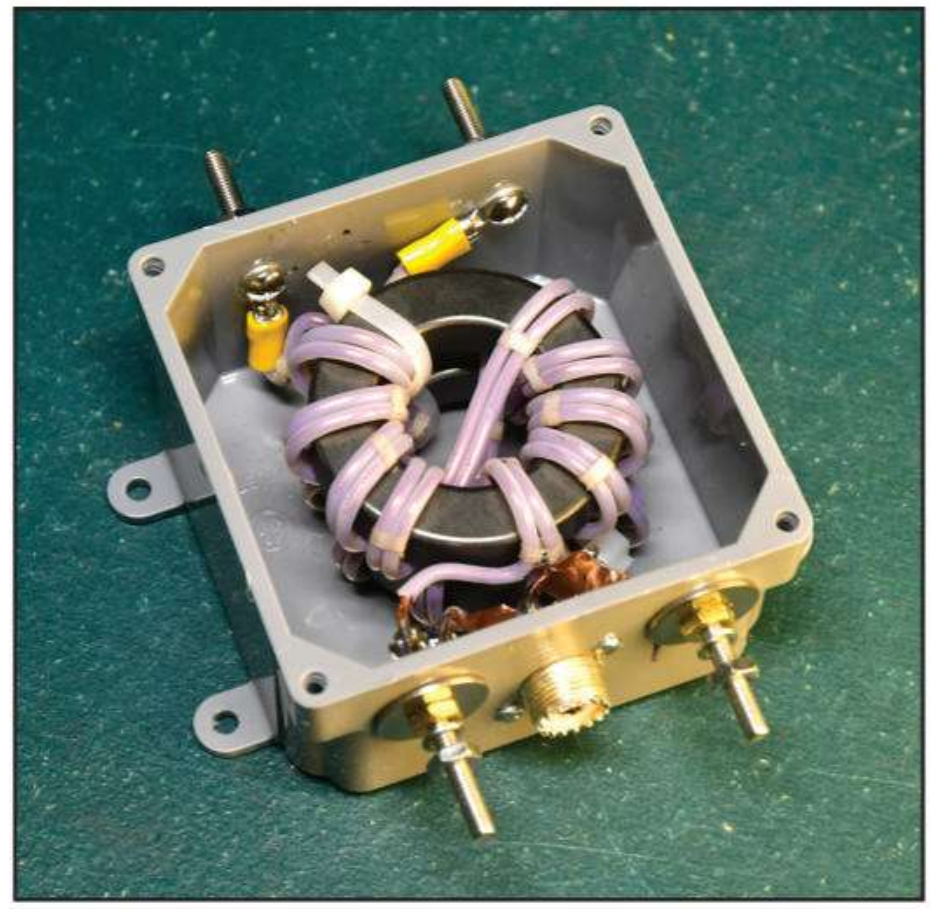

Photo A: Photograph of 4:1 Guanella balun, consisting of two FT-240 cores, Type 31 ferrite

length, remove 1/2-inch of enamel insulation from the wire ends, and tin them carefully. Solder the connections between the 1:1 baluns and solder a wire lug on each input and output lead. Prepare the enclosure by drilling holes for your connectors, attach the connectors, and mount the balun assembly in the PVC enclosure. Try to achieve wiring symmetry on the balanced side of the balun. I provided both a coaxial connector and screw terminals on the input side of the balun, allowing connection to either unbalanced or balanced sources.

To make the 9:1 balun, follow the procedure above with a few differences:
– Wind three 1:1 choke baluns instead of two.
– When making the three transmission lines, use AWG #16 wire and #14 Teflon® tubing. The tubing's wall is not thick enough to get the necessary center-to-center spacing for the 150-ohm TRL. I fixed this by winding 3-4 feet of 20-pound braided nylon fishing line over the Teflon® tubing on one of the TRL wires. Use a bit of masking tape to keep the fishing line in place temporarily and lay out the transmission line as described for the 4:1 balun. Stabilize the TRL by tying the wires together with 1-inch lengths of fiberglass tape spaced about 1-1/2 inches apart.

Discussion

This article has discussed the theory, design, construction, testing, and application of 4:1 and 9:1 Guanella baluns, and it discussed performance limitations including common-mode rejection ratio (CMRR), power loss, and variation in the impedance transformation ratio under frequency-dependent feedline loads. Computer models of the baluns were useful for predicting CMRR, visualizing current flow, and projecting power losses. The models evaluated the effects of various design choices, e.g., number of turns, core material, and characteristic impedance of the wound transmission line. Again, modeling proved its worth as a tool for designing baluns. The article presented several experiments focused on optimizing the use of my junk-box tuner, wire antenna, and feedline. Measurements of the feedline impedance and balun input impedance under load allowed me to predict feasible tuner settings of my simple, junk-box L-tuner. For each setting, heating loss in the balun's windings and core were estimated with the models.

The baluns perform very well on the air. Their high CMRR quiets common mode noise, and heating has not been observed on any band. With the newfound ability to use my 88-foot dipole on the 30-, 17-, 15-, and 12-meter bands, I completed Worked All States on each of those bands.

Acknowledgements

I thank EMCoS, Inc. for supporting this project. Thanks also to Michael Arasim of the Fair-Rite Corporation for providing guidelines on core power dissipation and to Bob Schwartz for helping with the calculations.

Notes

1. D. Ahlgren, "Predicting Balun Performance Using 3-D Models," *CQ* magazine, April 2022: 34-40.
2. G. Guanella, "New Method of Impedance Matching in Radio-Frequency Circuits," *Brown Boveri Review*, September 1944: 329–329
3. <www.emcos.com/?products=emcos-studio>
4. <https://deepelec.com/nanovna-f/>
5. Tool for matching network design: <https://tinyurl.com/3mwrfsxh>
6. Thermal runaway is a concern at about 1 Watt/cc of ferrite material (6.8-11.4 Watts for size 240 toroid)

Baluns and other impedance transformers are often among the least-understood elements of an antenna system. Michael Toia, K3MT, takes us for a test drive in a balun that isn't really a balun, but is an impedance transformer.

The Bramham 60° ~~Balun~~ Impedance Transformer

BY MICHAEL TOIA, * K3MT

There are baluns, and there are baluns. Peter Bramham's is a head slapper, prompting me to ask, why didn't I think of that?! It's simple, elegant, and uses readily available coax. So, who is Bramham, anyway?

In his words: [1]

"Back in 1959 I was a member of the international group working at CERN, the European Laboratory in Geneva, on a proton linear accelerator. … The high-power feeds to the accelerating cavities used 3-inch line made from brass or copper tubes, and phase-shifters and power-dividers were required in the lines. …

"At that time, there were various standard impedances for coaxial lines and cables. … So, I had to fit impedance transformers all over the place. … Hence my report CERN 59-37 [2] …

"The main interest in my transformer seems to have been in the USA, among radio-amateurs[3] ("hams"). A common problem was matching a 75-ohm feeder cable to a 50-ohm system. With my transformer you didn't have to look for a quarter-wavelength of 61-ohm cable."

The Bramham Balun

So, let's look into it a bit. Figure 1 is his little beauty. A 75-ohm load – perhaps a dipole antenna or a CATV signal – connects to the right end of 50-ohm RG-58 coax. That, in turn, connects to 75-ohm RG-6 coax. Each piece is a twelfth of a wavelength long – 30 electrical degrees, and *Bingo!* The left end comes out at 50 ohms!

It's reversible, too. Putting 50 ohms on the left converts to 75 ohms on the right.

It isn't really a *BALUN*. It doesn't convert a balanced load to unbalanced coax. It's an impedance transformer, but we've corrupted the word *balun* to include those as well. Figure 2 shows examples of the differences.

Let's see just how Bramham's transformer works, and how to design one. You could read his report, and wade through six pages of algebraic equations, but I'll do that math with *geometry*, a single sheet of paper, a section of a Smith chart, as shown in Figure 3.[4]

To keep the arithmetic simple, change 75 ohms of Figure 1 to 100 ohms, so the 50-ohm coax on the right operates at a 2:1 SWR. Since the device can be reversed, the 100-ohm coax does, too. The 2:1 SWR circle and rectangle drawn on the chart will make things simple.

A Bramham transformer converts an impedance in a ratio equal to the SWR. The diagonals of the rectangle intersect at chart center. Its size is adjusted so its two lower corners hit impedances in

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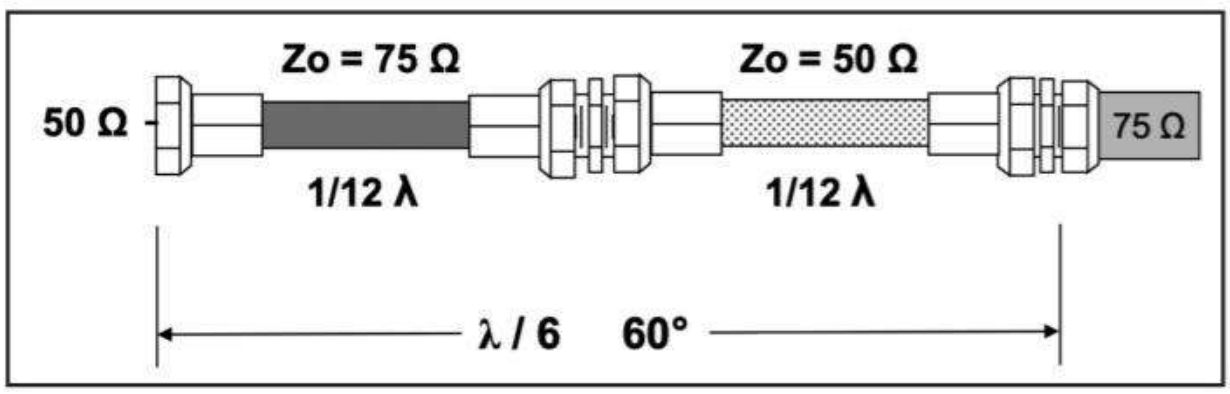


Figure 1. The Bramham twelfth-wave balun

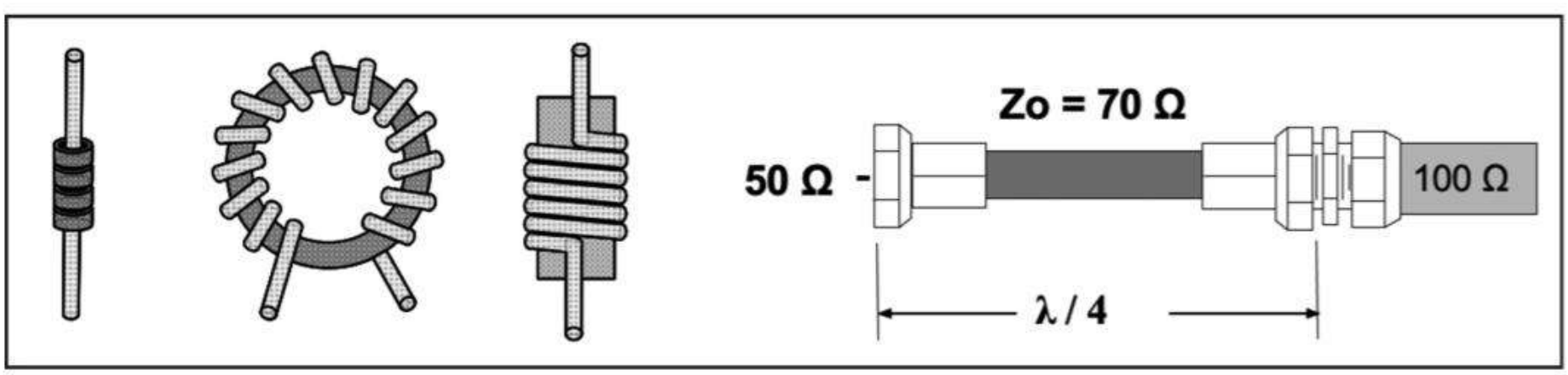


Figure 2. The difference between baluns (left) and an impedance transformer (right)

SPURIOUS SIGNALS By Jason Togyer W3MCK www.jaythurbershow.com

exact 2:1 ratios – here $z = 1.20 - j\,0.74$ on the right, and $z = 0.60 - j\,0.37$ on the left.

The rectangle's sides have a ratio of 1.47, and the diagonals make an angle of 56°. This takes 28° of 50-ohm coax[5] and converts the impedance to 70 –j 37 ohms as a load on the 100-ohm coax. An additional 28° of 100-ohm coax now brings the impedance to z = 0.5 –j 0.0, or 50 ohms. Magic!

We can design these for other uses. Figure 4 shows a 6:1 transformer. This is the ratio of 300 ohms to 75 ohms, and

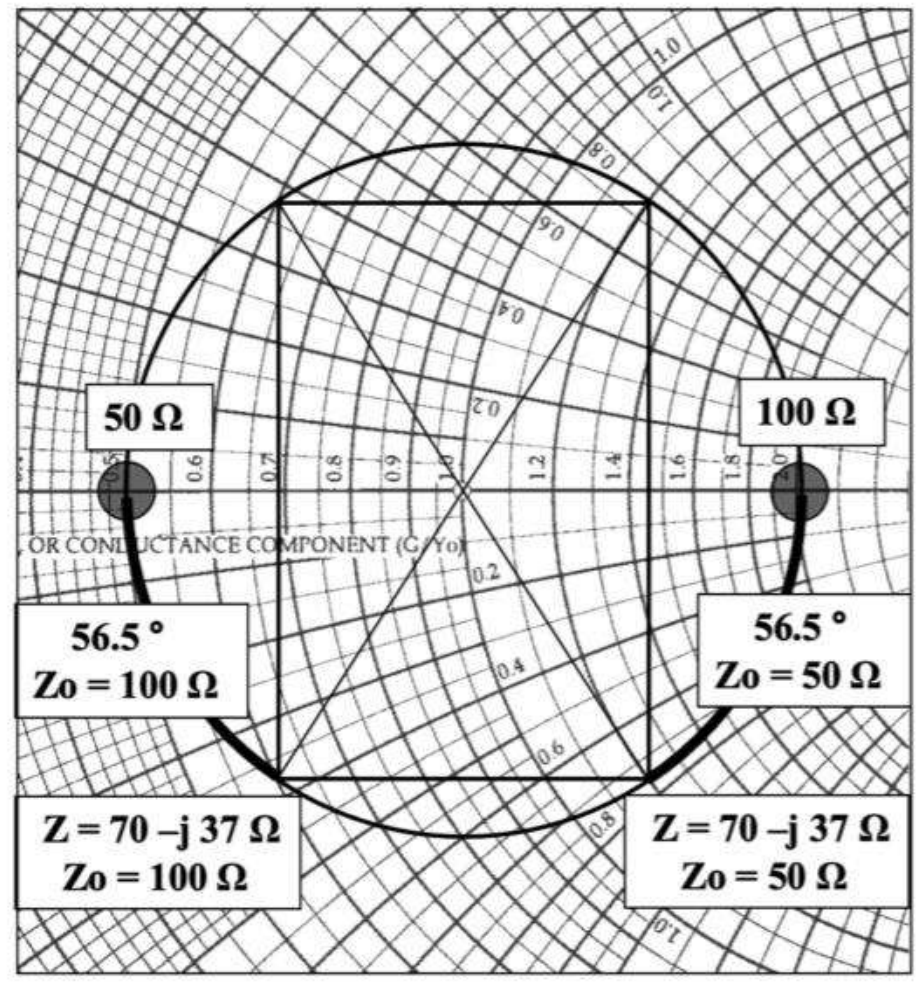


Figure 3. Smith chart of a 2:1 Bramham transformer

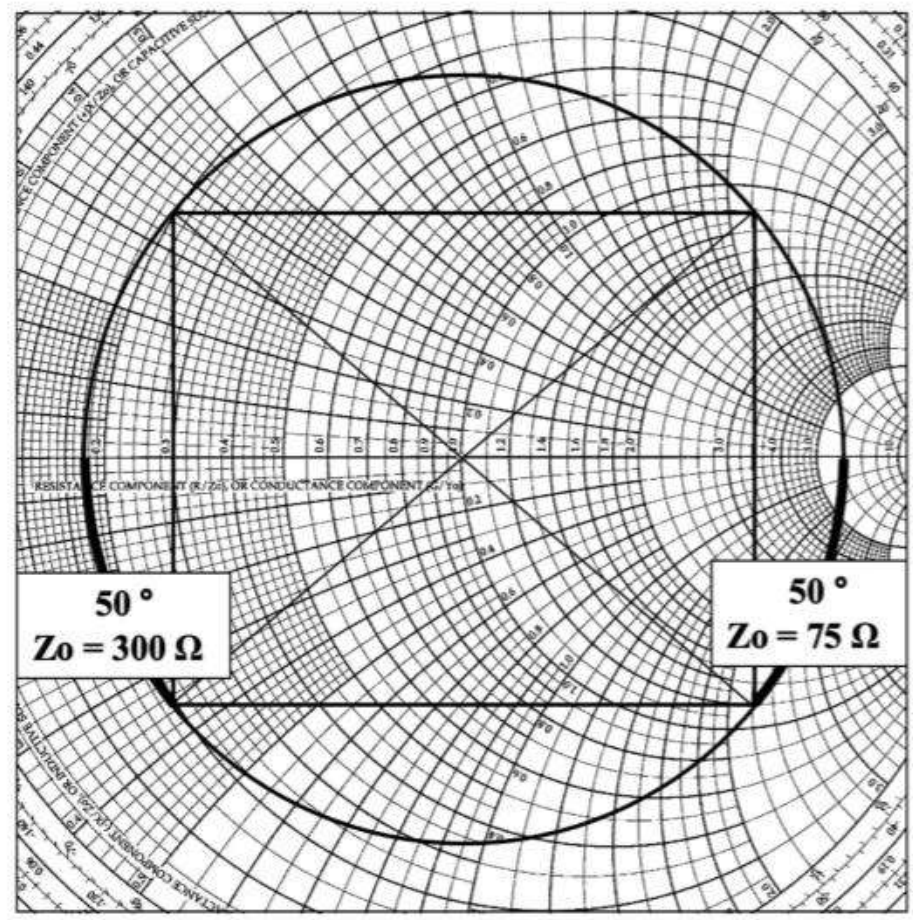


Figure 4. Smith chart of a Bramham transformer for converting 300 ohms (typical twinlead impedance) to 75 ohms and vice-versa

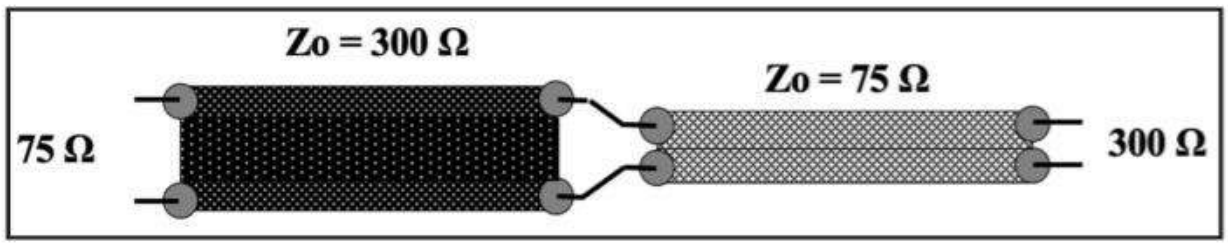
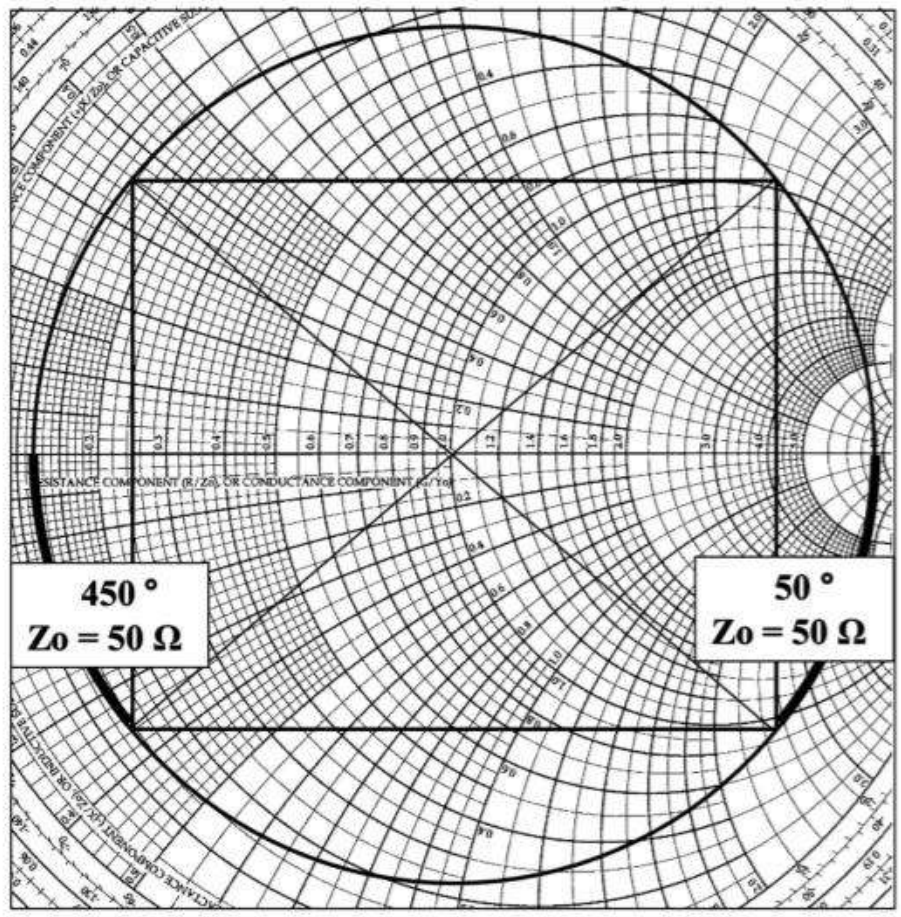


Figure 5. A 300-ohm to 75-ohm transformer

Figure 6. Smith chart of a 450-ohm (also common for twinlead) to 50-ohm transformer



the angle is 50 degrees. Why these values? It uses standard twin lead and converts a 75-ohm balanced dipole to 300 ohms, allowing normal lightweight twin lead as a feedline. Figure 5 is such a transformer.

Figure 6 shows conversion of 50 ohms to 450 ohms, allowing ladder line to be used in place of coax, if desired.

In Summary

I've shown the basics of Bramham's "twelfth-wave transformer." Most references say the two pieces of coax are 30 degrees long. Close, but at higher transformation ratios, the line lengths approach 25 degrees.

It's so easy to build these on demand with parallel-wire transmission lines, such as shown in Figure 5, by simply changing the spacing between the two wires at the right spot. The downside of these transformers is they are not broadband devices.

Now you have the simple design rules. Here's a synopsis:

1 – Get a Smith chart, ruler, pencil, and protractor. (*That's right; no computer needed! – ed.*)
2 – Decide on the desired impedance ratio and draw an SWR circle of this value on the chart.
3 – Draw a rectangle inside the circle and adjust its sides so the bottom corners touch the circle at the impedance ratio.
4 – Use the protractor to measure the angle of the rectangle's diameter and divide the angle by two.

This is the length of the two transmission lines, in electrical degrees – usually between 50°and 60°. Simplicity itself – as advertised!

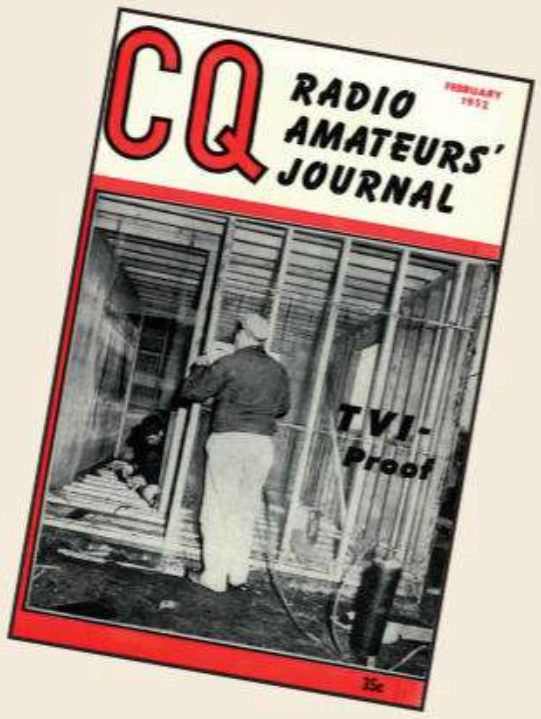
Notes:

1. <https://tinyurl.com/24yuvw6j>
2. P. Bramham, "A Convenient Transformer For Matching Coaxial Lines," CERN 59-37, November 1959
3. *QST*, June 1997, pp. 43-44
4. I assume basic familiarity with the Smith chart. There are hundreds of references to help you with this.
5. A 360° turn around the chart is a half wave, or 180° along the coax.

CQ CLASSIC

Basic Theory Still the Same...

Since we have two articles in this issue about baluns (Guanella and Bramham), and KL7AJ is writing about pi networks in his "Analog Adventures" column this month, we thought it would be appropriate to reprise *CQ*'s first-ever article about baluns from way back in the February 1952 issue. The basic theory hasn't changed in the past 70 years!



The Balun-

Theory and Design

J. ROY SMITH, W6WYA

If you like your theory in short, mild doses—try this one. The author presents a very readable account of the "balun" with a discussion of its uses and applications in the ham field —Editor.

In the reduction of TVI, it has been found that the *pi* coupler tank circuit and networks help to attenuate harmonics of the carrier frequency. The *pi* coupler can be built for balanced output using twice the usual number of components which doubles the cost and complicates tuning adjustments. It is much cheaper, equally effective and easier to use the regular unbalanced *pi* network and employ a device such as the "balun" to work into a balanced transmission line or antenna. The term "balun" is a contraction of the words balanced to unbalanced transformer.

Theory

Let us start our explanation of the "balun" witha typical problem. Referring to *Fig 1a*, we have a 300-ohm balanced[1] load (transmission line and antenna) which we want to connect to a generator (transmitter) whose internal impedance is 75 ohms (a *pi* network so adjusted). Since we said the load was a balanced load we can connect the electrical midpoint or center tap to ground without disturbing the circuit as illustrated in *Fig. 1b*. Now there are two 15O-ohm loads in series; one above ground and the other below ground. Stating it another way, each "hot" end of the load is of opposite polarity, or 180 degrees out of phase. Next, if we were to use some gadget to reverse the phase of one of the 15O-ohm loads we could place them both in parallel. Everyone knows that two 15O-ohm resistors in parallel equals 75 ohms. A 75-ohm. load connected to a generator whose internal impedance is 75 ohms will result in a perfect match. This needed gadget is the balun. It consists of a half wave length section of coaxial transmission line—that's all.

In studying transmission lines as impedance matching devices there are two important and accepted facts[2]:

(1) The input impedance of a half-wave length (electrical length) section of good transmission line is equal to the terminal impedance.

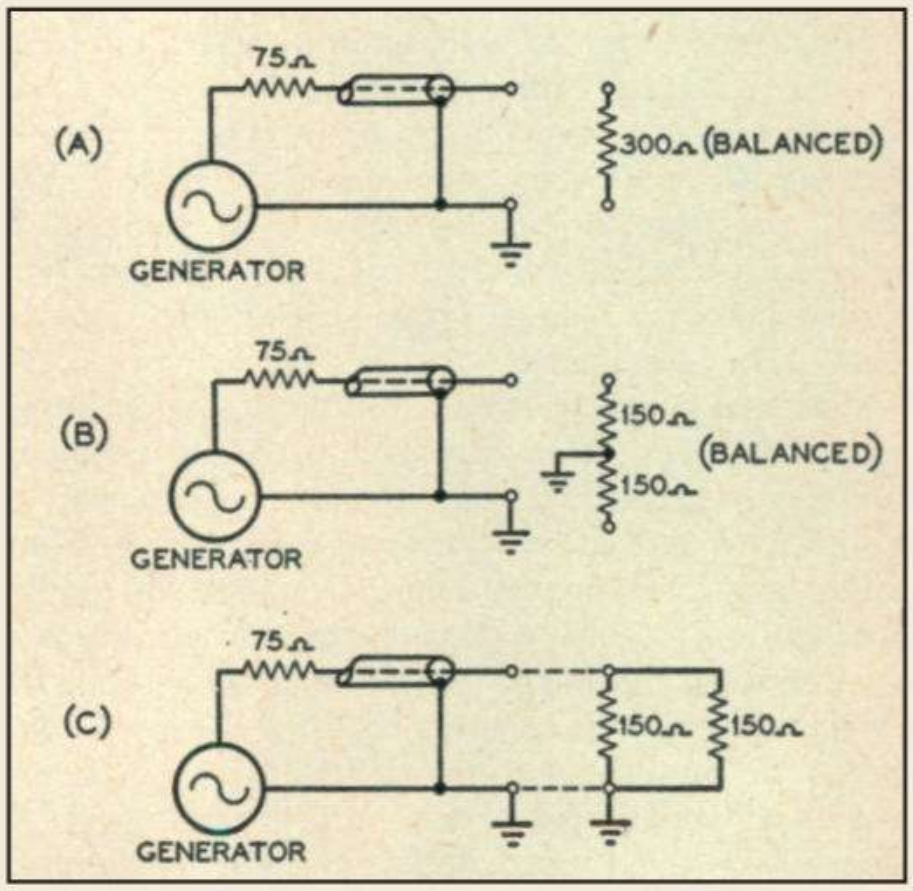


Fig. I. The basic problem is how to connect a 300-ohm balanced line to a 75-ohm unbalanced line.

[1] ARRL. "Radio Amateur's Handbook", 28th Edition 1951, p. 56
[2] King, Mimno and Wing, "Transmission Lines, Antennas and Wave Guides", McGraw-Hill Book Co., 1945, p. 44

(2) For such a half-wave section there is a 180 degree phase shift in the voltage and current without any change in magnitude.

Simplifying, this means that if we place a 150-ohm load at one end of a half-wave section of line and "look in" at the other end we will see 150-ohms load but it will be shifted in phase 180 degrees or completely reversed in polarity. Impedance consists of resistance and reactance. Considering a halfwave section of good line we can measure the resistance between the conductors and find it greater than a megohm. To measure the reactance along the line we could apply a source of signal through a slotted line measuring device to one end of the line leaving the other end open and measure the standing waves. Since no current is flowing across the open end, the standing waves measured is also the measure of reactance. However, to illustrate the change in polarity or phase of the reactance refer to the curve in *Fig. 2c*. If the high impedance of the open end is shunted with a 150-ohm resistor, the impedance along the line may be visualized by referring to the curve in *Fig. 2d*. Folding this halfwave section, doubling back in a "hair pin" fashion does not affect its phase reversing characteristics in any manner.

Going back to *Fig. 1b* apply this balun to one of the 150-ohm loads as shown in *Fig. 3a*. The balun reverses the phase of half of the load or 150 ohms and places it in parallel, in phase, with the other half of the load, resulting in an equivalent load of 75 ohms. Since the ends of the section's outer conductor are connected to ground points, they may also be connected together as presented in *Fig. 3b*.

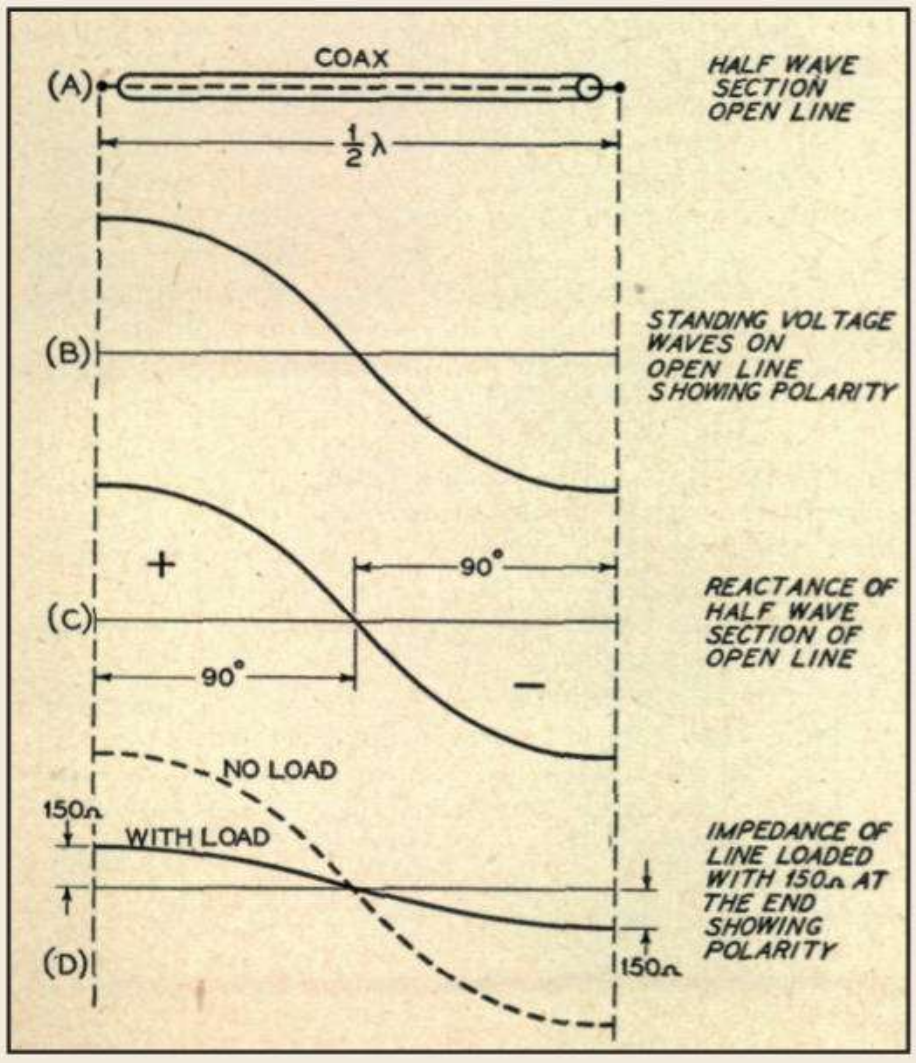


Fig. 2. Phase, voltage and reactance relationships along a half-wave coax line.

It should be pointed out that the balun, while being a balanced to unbalanced transformer, is also an impedance transformer with a 4:1 ratio. It can be used at other impedances such as 200:50 ohms or 600:150 ohms. The balun is a linear device and may be used to transmit energy in either direction. It works equally well with the balanced terminals connected to a balanced transmitter output in order to couple to a lower impedance unbalanced antenna, such as a quarter wave vertical whip.

The balun is just as effective as a balancing device at the third and other odd harmonics. This accounts for the use of the balun that the television industry has made in matching TV receivers to some antennas.

Designing a Balun

In designing a balun the length of the coax must be the electrical half-wave length which is less than a half-wave length in free space. It is determined by:

$$\text{half-wave length} = \frac{492 \times V_f}{f} \text{ (in feet)}$$

where f = frequency in megacycles
V_f = Velocity factor of the line used.

The velocity factor for various coaxial transmission lines are given in most handbooks[3]. Choosing 14.2 megacycles as an example, the length of RG 8/U cable is:

$$1/2\lambda = \frac{492 \times 0.66}{14.2} = 22.8 \text{ feet}$$

For 29.5 mc the length of coax is:

$$1/2\lambda = \frac{492 \times 0.66}{29.5} = 11 \text{ feet}$$

The half-wave length section of line is measured from connection *A* to connection *B* in *Fig. 3c*. The outer conductor should extend reasonably close to these connections *A* and *B*. Any of the popular coaxial lines may be used in a balun for any 4:1 ratio of impedances. Since many hams work with 300-ohm balanced lines (fixing the input impedance to the balun at 75 ohms), RG 59/U cable is generally preferred for feeding the unbalanced connections. However, RG 59/U cable is not likely to handle more than 680 watts at 30 mc without overheating. The low impedance unbalanced terminals may be connected to any length of coaxial cable whose characteristic impedance (Z_0) is equal to or reasonably close to the desired value, or it may be connected directly to the transmitter. In like manner the balanced connections may be connected to any length of balanced transmission line or directly to an antenna whose input is balanced and reasonably close to the proper impedance. In many instances connecting the balun directly to the antenna enables one to use a single coaxial cable to feed an antenna, keeping standing waves from appearing in the outer conductor, and, in turn, aiding in the reduction of TVI.

[3] ARRL, "Radio Amateur's Handbook", 28th Edition, 1951,p. 319

announcements (from page 2)

Hill. Contact: Robert Schrum, KN6RND. Website: < https://www.satellitearc.com/swapfest.html>. Email: <rschrum1532@verizon.net>. Phone: (805) 717-1699. Talk-in 145.14 (-) PL 131.8.

PISCATAWAY, NEW JERSEY — The Raritan Valley Radio Club will hold its **W2QW Raritan Valley Radio Club Hamfest** starting at 8:00 a.m., Saturday, June 17 at the Piscataway High School, 110 Behmer Road. Contact: Marv Bronstein, K2VHW. Website: <http://w2qw.org>. Email: <k2vhw@arrl.net>. Phone: (732) 887-0875. Talk-in 146.625-141.3 Hz CTCSS. VE testing.

PLYMOUTH, MINNESOTA — The Twin City FM Club will hold its **Spring Tailgate Hamfest** starting at 8:00 a.m., Saturday, June 17 at the West Medicine Lake Community Club, 1705 Forestview Lane N. Contact: Michael Miller, NØNY. Website: <http://TCFMC.org>. Email: <president@tcfmc.org>. Phone: (612) 728-4718. Talk-in 146.76 - PL 114.8 MHZ.

SCHERTZ, TEXAS — The San Antonio Radio Club will hold its **Radio Fiesta** from 7:00 a.m. to noon, Friday, June 16 and from 8:00 a.m. to 2:00 p.m. Saturday, June 17 at the Community Center, 2600 Washington Ave. Contact: Jason Cato, KB9LBC. Website: <https://w5sc.org/>. Email: <akengineering@live.com>. Phone: (210) 602-4291.

UPPERCO, MARYLAND — The Baltimore Amateur Radio Club will hold its **Father's Day Hamfest** from 8:00 a.m. to 2:00 p.m., Saturday, June 17 at the Monroe County Fairgrounds, 3775 S. Custer Rd. Contact: David Shadwell, AB3TE. Website: <http://W3FT.com>. Email: <W3FT67@yahoo.com>. Phone: (443) 379-1495. Talk-in 146.67 PL 107.2. VE testing. Card checking.

MONROE, MICHIGAN — The Monroe County Radio Communications Association will hold its **Monroe Hamfest** starting at 7:30 a.m. to 1:00 p.m., Sunday, June 18 at the Arcadia Fairgrounds, 16920 Carnival Ave. Contact: Fred VanDaele, K8EBI. Website: <http://mcrca.org/>. Email: <ka8ebi@yahoo.com>. Phone: (734) 755-4904. Talk-in 146.72/12 100 Hz.

FRIEDRICHSHAFEN, BADEN-WÜRTTEMBERG, GERMANY — The Ham Radio will hold its **International Amateur Radio Exhibition** starting at 9:00 a.m. to 6:00 p.m., Friday and Saturday, June 23 and 24, and 9:00 a.m. to 3:00 p.m., Sunday June 25 at the Neue Messe 1, 88046 Friedrichshafen. Contact: Lisa Schneider. Website: <https://www.hamradio-friedrichshafen.de>.Email: <presse@messe-fn.de>. Phone: +49 7541-708-307.

JULY

HARRISBURG, PENNSYLVANIA — The Murgas ARC will hold its **Firecracker Hamfest** starting at 8:00 a.m., Saturday July 1 at the Postal Employees Picnic Grounds, 1500 Roberts Valley Road. Contact: Terry Snyder, WB3BKN. Website: <http://www.W3uu.org>. Email: <wb3bkn1@gmail.com>. Phone: (717) 979-9515. Talk-in 147.075 (123).

PLAINS, PENNSYLVANIA — The Harrisburg Radio Amateurs Club will hold its **Murgas Hamfest and Computerfest** starting at 8:00 a.m., Sunday July 2 at the Polish American Veteran's Club, 2 South Oak Street. Contact: Herb Krumich, K2LNS. Website: <http://murgasarc.org>. Email: <wa2fgk@yahoo.com>. Phone: (570) 829-2695. Talk-in 146.61 PL 82.5. VE Exams.

ERIE, PENNSYLVANIA — The Wattsburg Wireless Association will hold its **NW PA Hamfest** starting at 7:00 a.m. on Saturday, July 8 at the Greene Township Municipal Building, 9333 Tate Road Room 114. Contact: Larry Kemmler II, KC3JBR. Website: <http://www.wattsburg-wireless.us/>. Email: < lkemmler@yahoo.com>. Phone: (814) 881-2689. Talk-in 147.315 CTCSS 186.2. VE exams.

MANSFIELD, OHIO — The Intercity Amateur Radio Club will hold its **Mansfield Trunkfest 2023** on Saturday, July 8 at the Richland Co. Fairgrounds, 740 N. Home Road. Contact: Danny Bailey, W8DLB. Website: <http://iarc.club>. Email: <w8dlb60@gmail.com>. Phone: (567) 899-3881. Talk-in 146.940 PL. 71.9.

MILTON, FLORIDA — The Milton Amateur Radio Club will hold its **2023 Milton Hamfest** starting at 3:00 p.m. to 8:00 p.m., on Friday July 7 and 8:00 a.m. to 1:00 p.m. on Saturday July 8 at the Santa Rosa County Auditorium, 4530 Spikes Way. Contact: Charles Tow, KN4VGY. Website: <http://miltonarc.org>. Email: <kn4vgy@gmail.com>. Phone: (850) 554-2109. Talk-in 146.700 CTCSS 100. VE Exams.

SALISBURY, NORTH CAROLINA — The Rowan County Amateur Radio Society will hold its **Firecracker Hamfest** time TBA on Saturday July 8 at the Salisbury Civic Center, 315 S. Martin Luther King Ave. Contact: Ralph Mowery, KU4PT. Website: <https://rowanars.org/>. Email: <ku4pt@arrl.org>. Phone: (704) 279-4737.

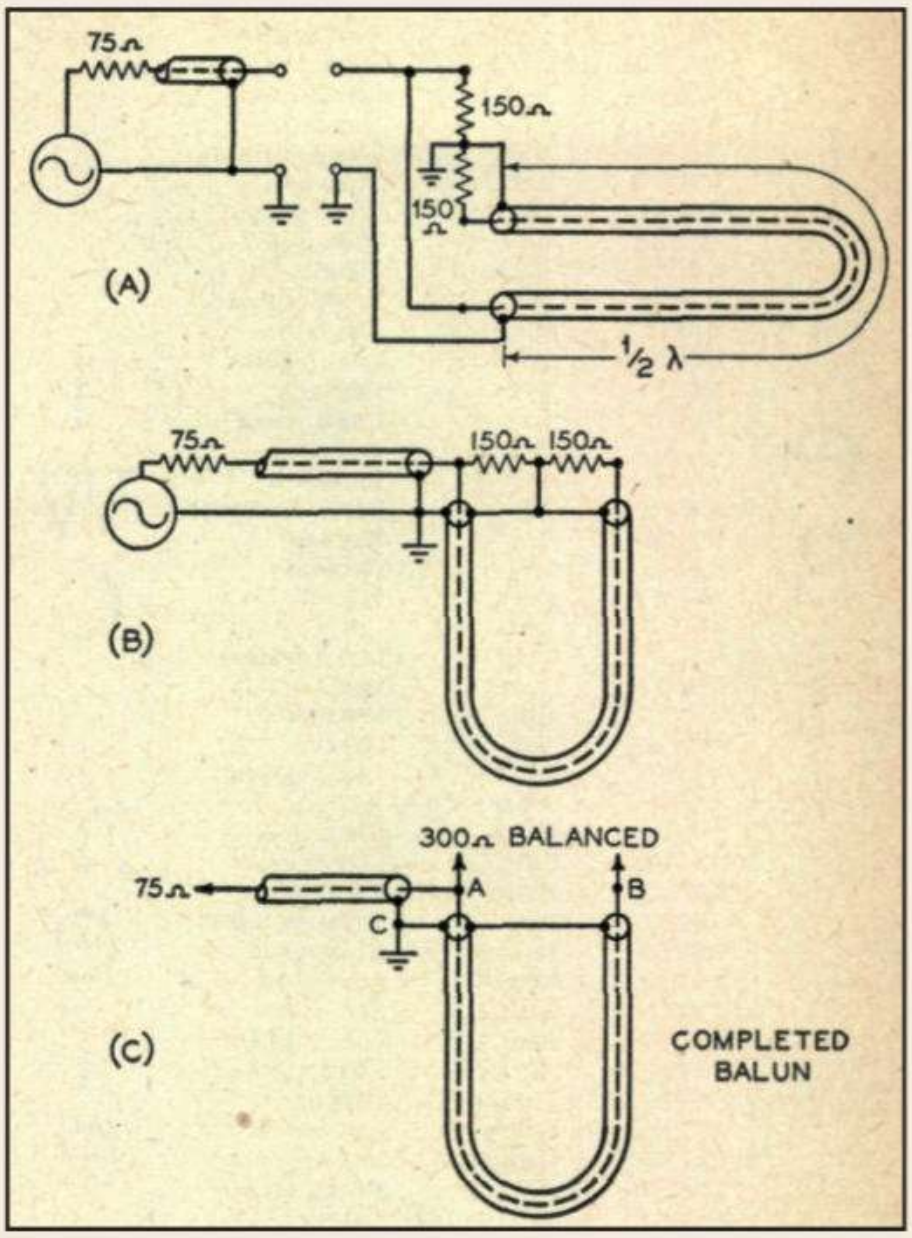


Fig. 3. Physical derivation of the "balun."

It is suggested that the balun be strung out, doubled back upon itself as shown in the sketch and then have as few additional folds as possible It is not recommended that it be coiled up to be placed in a small box.

Conclusions

In conclusion, the advantages of the balun arc as follows:

(1) It matches a balanced transmission system to an unbalanced one.

(2) It is also a 4:1 impedance transforming device.

(3) It works well over a wide band of frequencies.

(4) It can be used to aid in the reduction of TVI by coupling to balanced or unbalanced TVI reducing filters, by enabling the use of an unbalanced *pi* network or tank circuit with a balanced antenna system and by reducing unbalanced currents and standing waves on transmission lines.

(5) It is easily and cheaply built.

It does have two disadvantages, however:

(1) It is not a multiple band device for more than a single amateur band as it requires a separate design for each band.

(2) It gets to be quite long in dimensions for the low frequency bands such as 3.5 megacycles.

No attempt is made here to explain the "BAZOOKA", which is closely akin to the balun. The bazooka is considerably more difficult for most hams to construct.

Carbon microphones, like you might find in an old phone or a "boat anchor" ham rig, remain popular among amateurs today, not only for use with vintage radios, but also with modern gear. W3MEO offers an interface circuit for using a carbon mic with a rig designed for an electret element.

Carbon Renaissance

BY SCOTT MCCANN,* W3MEO

Photo A: Solder connections to a T1 carbon mic element from an old telephone.

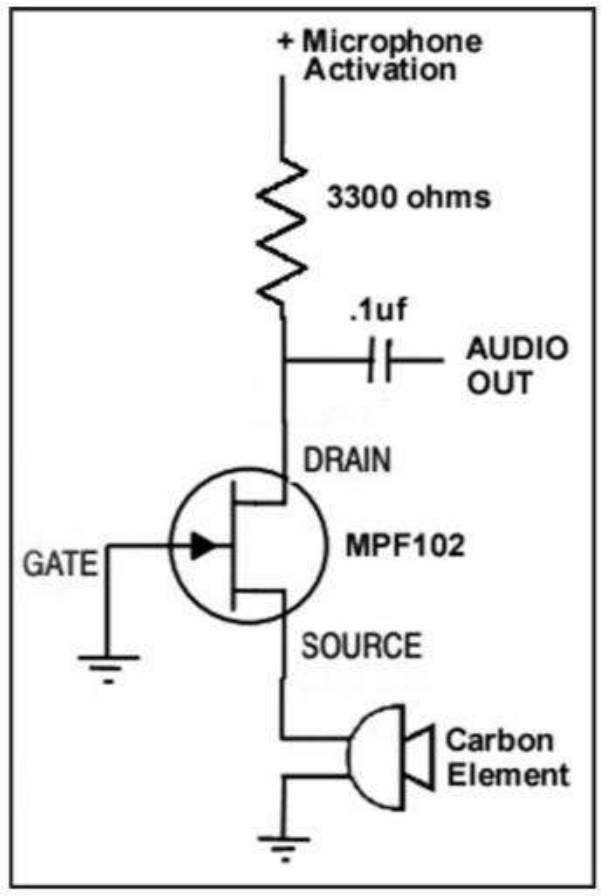


Figure 1: Schematic of an interface circuit to allow the use of carbon mics with modern rigs designed for electret elements.

The first practical voice transmitter, the carbon microphone, was invented about 1876. Carbon microphones were used in telephones, early broadcast studios, and all types of communications radios until the end of the 20th century. If you want to add a vintage "element" to your ham shack, even with a modern transceiver, carbon mics are easy to find and easy to interface to current gear.

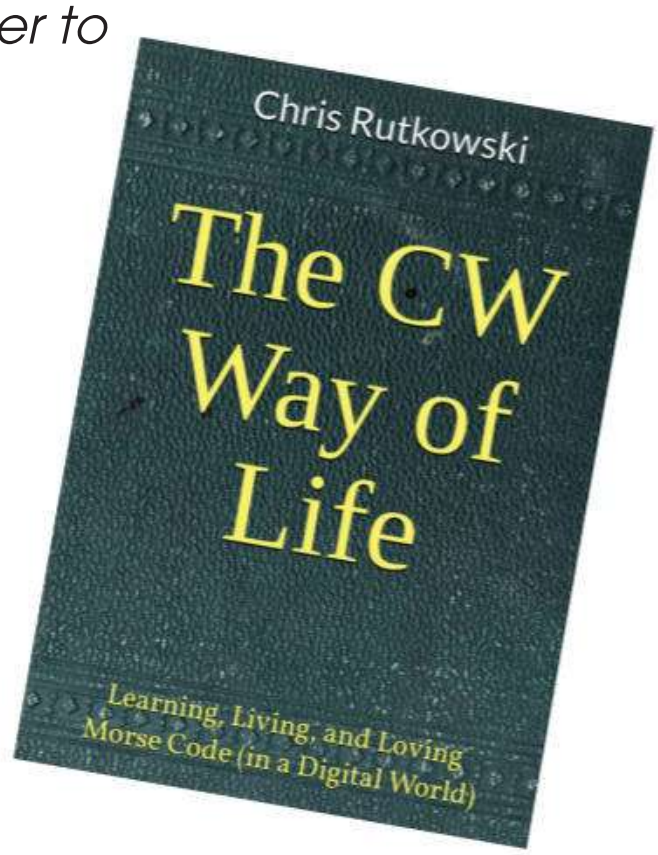
Auction sites list all types of carbon microphones, including commercial communication types. Inexpensive carbon microphone elements ideal for experimental use are also available from internet dealers in parts for older telephones.

Photo A shows the back of a T1 carbon microphone element, from a standard desk telephone, with connection leads soldered on and a drop of glue for strain relief. Soldered leads are fine for tests and homebrew microphone construction, but be very cautious if you decide to solder your leads, as T1 elements do not like a lot of heat. Use a hot iron and make a very small "dab" of solder followed by a damp rag so the heat won't damage the element. Figure 1 is a schematic of a circuit for interfacing the carbon element to an electret microphone input common to modern rigs. My transceiver provides 8 VDC activation voltage which operated the microphone circuit very nicely. A 9-volt battery works for activation if your rig does not provide microphone activation output. If you use this circuit with a dynamic mic input, you may have to attenuate the mic output or reduce the transmitter mic gain in your audio settings.

Several tests on nets and individual QSOs gave this T1 carbon microphone fully satisfactory reports. The factory parts department quoted me about $80 for a replacement microphone for my transceiver. This microphone can be built for 10% of that and you will be using 150-year-old technology, patented long before the development of radio, a 19th century invention that still does a superb job in the 21st.

*160 Shields Lane
Queenstown MD 21658
E-mail: <achess@juno.com>

Morse code, says NW6V in his new book, is more than a mode of communicating – it's a way of life! And who better to review it than a professional telegrapher?



CQ Book Review:

"The CW Way of Life – Learning, Living and Loving Morse Code (in a Digital World)"

BY CHRIS RUTKOWSKI, NW6V

REVIEWED BY D. J. J. RING, JR.,* N1EA

Walking, skipping, and running with Morse. Why "dot dot dot" when you can "diddle-it"? That's all part of this new and fascinating book, "The CW Way of Life," by Chris Rutkowski, NW6V.[1]

Morse is a pattern of rhythms – and the rhythm is the DIT TRAIN! It's the basis of the fused harmonics that help you say, tap, and copy Morse; knowing this unlocks many of the secrets that have long frustrated Morse learners and users alike.

It's the DIT TRAIN! Dah-Dah! See it, say it, tap it! If you fall off, just climb back on!

Use all of the ways we communicate; they reinforce each other: learn to tap out Morse, even by tapping on a table, because outflow and inflow are intertwined, reinforcing each other. Sending code is thus as fundamental to learning code as speaking is to learning any language. Do it even if you don't know what it means, mimic the Morse.

From the back cover:

More than just another Morse "how-to." CWOL takes you on a deep dive into the history, theory, and practice of Morse.

It reveals:
— How your brain tums sensations into thoughts
— Morse's true rhythmic nature – harmonics – not ratios!
— How to ride the "dit train" to fluid keying
— The lost technologies of code talking and speed keying
— The true cause and prevention of "glass arm"
— How to attain Morse fluency before you know the code!

Read CWOL like a tourist guide to Morseland – there are plenty of sights to see. When you're ready, roll up your sleeves, do the drills, and set yourself on the path to Morse mastery!

CWOL's curriculum combines known practices with modern training principles, creating a learning system like no other. The most important component is you! No computer needed.

A tone is a perceptible thing which happens when dot and dash pulses fuse into a perceptible whole. These "tones" – whether beeps, buzzes, eye blinks – are why Morse works. The on/off switching carries the data, not the thing being switched. At high speed, Morse works by fusing. It's the way we perceive Morse, with dots – or *dits* – above a certain speed at which we can no longer count individual dots; they bond into a pattern, and amazingly enough, we learn how to discern that pattern and not the individual dots (and later dashes). There is a transition from pulses, or low buzzes, into tones as speeds progress from very slow speeds to 13, 20, 25, 35 WPM and beyond where dots, dashes, and spaces all fuse.

Music You Can Feel

The change in our perception of Morse is what creates the *plateaus* Morse students experience when, after continuous progress in sending and receiving, suddenly there is no progress and they're stuck. This book has a cure for this.

Plateaus are caused by moving from the world of individual, countable clicks and pops – under 13 WPM – to the realm of low frequency, *feelable tones* (20 WPM), to a point at which those tones fuse into music (25+ WPM). Morse is music you can feel.

The man who took Samuel F. B. Morse's original American Morse was Germany's Friedrich Clemens Gerke, writer, lover of language, and a working musician. He changed the dot-to-dash ratio from Morse's 2:1, making it longer – 3:1– and giving his new International Morse code a musical sound that interfaces so well with our abilities to send and receive Morse.

Most interesting to me is the comparison to sending Morse with a straight key to types of ambulation: Walking, jogging, skipping, running, and flying and the physical implications for sending Morse at each of those speeds, the top speed – "flying" – world champion class straight key sending speed at over 35 WPM at which dots, dashes, and spacings all automatically fuse into a separate reality (both in sending and receiving) with which your body and mind interact (see Figure 1).

The book gives details on the "Modified American Technique" (MAT) of using a straight key which minimizes

Figure 1: NW6V's chart comparing different levels of Morse code proficiency with different walking/ running speeds. (From the book)

Brass-Pounding Level	SK Speed	Brain Integration	Gait
World Record	35+ WPM	Dit and Dah sets both fully fused = Full "QRQ" (very high speed)	Flying
1st Class (Pro)	25 WPM	Dit "sets" fuse with Dahs	Running
Amateur Extra	20 WPM	Dit "sets" harmonically timed	Skipping
General	13 WPM	Top of dit counting range. Start "harmonically timed" actions	Jogging
Novice	5 WPM	Countable - voluntary muscle actions	Walking

and even prevents flexion, the cause of the dreaded *glass arm* or *telegrapher's paralysis.* Long-time *CQ* author Robert W. Shrader, W6BNB (SK), and a fellow Radio Officer used this interesting method of sending on a straight key:

"A desirable way of using a straight key is to place the tip of the first finger on the key knob at a position of about 12 o'clock, with the thumb lightly touching the underside of the knob at about seven o 'clock. Flip the three other fingers downward about halfway to the desktop. This should close the key and open it again as the fingers swing back upward. Note that the wrist will push upward as the fingers go down. This is a correct way to make a dot. If the wrist goes down when the key goes down it is the arm that is doing the keying. Fingers are so much less tiring to use! (I once sent messages with a straight key for five hours with no stopping, from the Yangtze River to San Francisco, after my ship was bombed – but that's another story.) Flip the fingers downward twice rapidly for two dots. Three times for three dots, etc. Practice making some eight dot groups. All dots should come out with equal timing. Note the wrist – Make sure it goes up when the fingers go down. To make dashes, flip the fingers downward farther and hold the knob down for at least three times as long as with dots. Practice making dashes in groups of eight or more. Note the wrist action with dashes – it should move farther upward than when making dots."[2]

I've tried both methods: I've been using a variation of the MAT for many years and I find it to be very relaxing and excellent for sending Morse. However, I have NOT learned to progress to what the author calls "running." I found that increasing my speed on the straight key above 23 WPM to be impossible; I'd hit a plateau. I've heard the "old salt's tale" that "every WPM above 20 (the required speed for the 2nd class radiotelegraph licenses needed for seagoing radio officers) takes twice the effort as the previous increase of 1 WPM." By the time I raised my speed from 23 to 25 WPM, it probably would take me a year. For me, it was easier just to just switch to a Vibroplex at 23 WPM, the minimum speed those keys were designed to send.

After the professional radiotelegraphy schools closed, straight key (25+ WPM) fast Morse was kept alive by professional Morse coastal radio stations, like UK's Portishead Radio, GKA, that required their radio officers to prove annually they could send and receive at 27 WPM by hand for 5 minutes error-free. Very few USA operators could do this on a straight key; we were mostly Vibroplex users. There is a historic recording online from 1967 of the USA liner *SS United States*/KCEJ on Vibroplex and UK *RMS Queen Mary*/GBTT on long lever Marconi straight key as an example.[3] Note the modulated CW tone of GBTT.

How do we learn Morse? JUST DO IT.

Stop complaining, just do it. You will master it. If you keep trying, your brain will integrate your practice automatically. It just takes time and commitment. This book reveals all the secrets of success.

I'm interested in trying the book's promising recommendations which no one is teaching anymore. They worked for the author; he was 2016 first prize straight key sending medalist (mixed alphanumeric groups at 26 WPM) at Friendship Radio Sport Games in Portland, Oregon.

A Great Resource

The writing is top-notch. This is a fabulous book which has information that I never knew that the author brings out clearly. If you have any interest in learning and/or using CW, this is one book you will definitely want to buy!

The author advocates common sense: Practice, practice, practice; watch your timings, especially your spacings. Keep letters and words far enough apart to be distinct, but close enough to bond into words. This is a crucial skill for Morse – the person who is copying must make sense of what you send.

How do we learn Morse? JUST DO IT.

Stop complaining, just do it. You will master it. If you keep trying, your brain will integrate your practice automatically. It just takes time and commitment. This book reveals all the secrets of success.

I recommended it unconditionally to all who love Morse or want to learn it.

Notes:

1. MorseBusters Publishing, <http://morsebusters.com>, ISBN 9498377407164, available at Amazon.

2. Shrader, Bob (Robert L.) "73 Amateur Radio Today", March 1999, pp 31-36. retrieved from <https://tinyurl.com/mr3pkdk5>.

3. Hear a radio officer from the fastest ship of all time, SS UNITED STATES/KJEH, sending a message from her Master, John S. Tucker, to Treasure Jones, Master, RMS Queen Mary/GBTT and hear the excellent fists of USA (Vibroplex) and UK (straight key) radio officers. <https://tinyurl.com/asrek55n>.

An often-overlooked aspect of restoring vintage gear (especially of the solid-state variety) is the importance of assuring solid connections between heat-generating components and their respective heat sinks. K8BYP has a guide to guaranteeing good heat transfer in restoring older solid-state equipment.

Heatsink Restoration for Old Electronics

BY DAVID CAMPBELL,* K8BYP

Heat is molecular motion, transferred by contact between objects. It is always from the hotter to colder body. Heat is measured in units of Watt per meter Kelvin (WM/K). All materials have thermal properties. Different materials have different levels of thermal conductivity or resistance. Metals tend to be good thermal conductors, plastics poor conductors. Generally, those which conduct electricity also conduct heat.

That Sinking Feeling

A heat *source* supplies heat energy, a heat *sink* receives and transfers it. Heat sinking in electronics transfers heat from a transistor or IC, usually to air, either still or moving. A transistor or IC (device) may have a thermal spreader, a metal surface that is placed in contact with a heat sink. These are usually made of copper and/or aluminum, both of which have very high thermal conductivity. Unless the device has a spreader soldered to a heat sink like in an RF power amplifier, heat is transferred by mechanical contact between the two. This contact tends to resist heat transfer because of poor mechanical contact and oxidation.

If the surfaces are perfectly flat and not oxidized, the transfer is perfect. This is never the case. The surfaces are usually rough and not flat. Aluminum tends to oxidize badly and oxides resist heat transfer. To compensate for poor mechanical contact between spreader and heat sink, a thermal compound is placed between the two, often called heat sink grease (thermal compound). Thermal compounds have better transfer than air, but much less than aluminum or copper.

Heat transfer compounds range in thermal conductivity from about 0.5 to 85 WM/K. Common silicon compound has a very poor conductivity at about 0.5 WM/K. Modern metal-filled compounds may range up to 85 WM/K but are much more expensive. Aluminum and copper are about 200 WM/K.

Restoring Heat Sinks in Vintage Gear

In restoring old heat sink applications, it is critical to address the fact that repeated heating and cooling, and force between the device and heat sink from screws or other fasteners, cause severe distortion of the surfaces, tending to reduce their metal-to-metal contact. With heat and time, the compound dries out, further reducing heat transfer (Photo A). This leads to overheating of the device.

In the Kenwood TS430 I restored, there are several ICs and transistors on heat sinks and these heat sink contacts were restored to prevent device damage. All the original compound was dried out, and three screws on the RF power amplifier (PA) transistors were loose, which will eventually destroy the PA transistors.

It is necessary to machine or manually scrape or sand both the device and heat sink surfaces to restore flatness and proper metal-to-metal contact and remove oxides. The dull edge of a large razor blade works well when drawn across the surface at an angle. These items can also be surface ground by rubbing them over fine grit sandpaper on a very flat surface such as plate glass or polished granite. For large surfaces, a machinist's parallel strip makes a good scraper (Photo B).

Photo A. Transistor as removed from old heat sink. Note the pitting and uneven surfaces.

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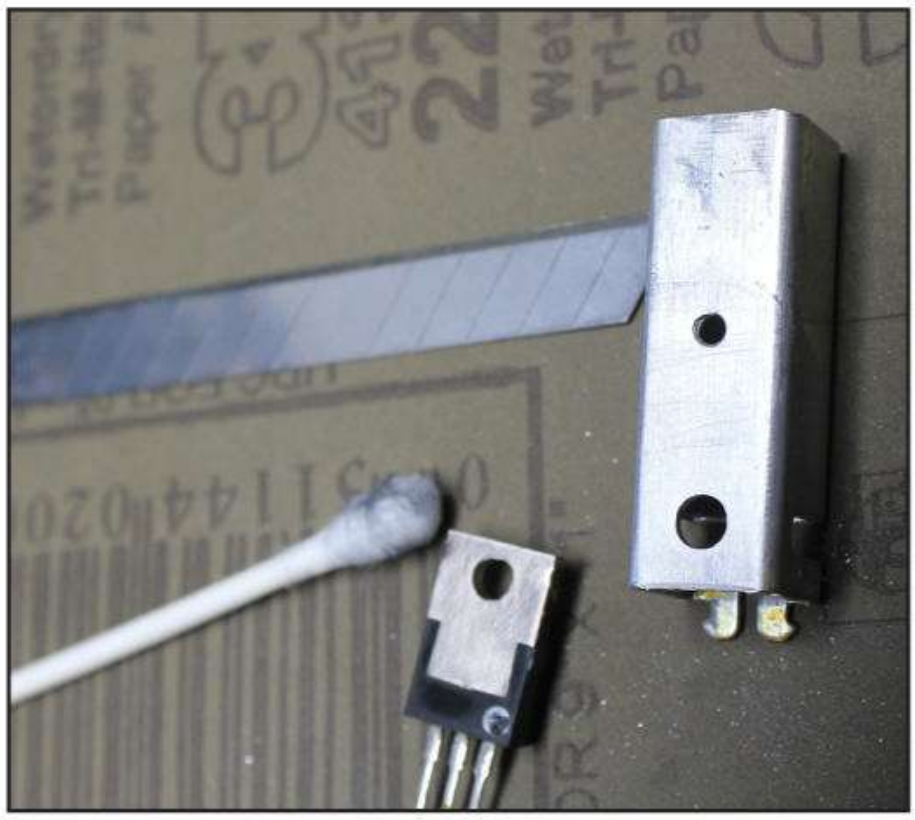

Photo B. Cleanup tools … a machinist's parallel strip for scraping, fine sandpaper and a Q-Tip®.

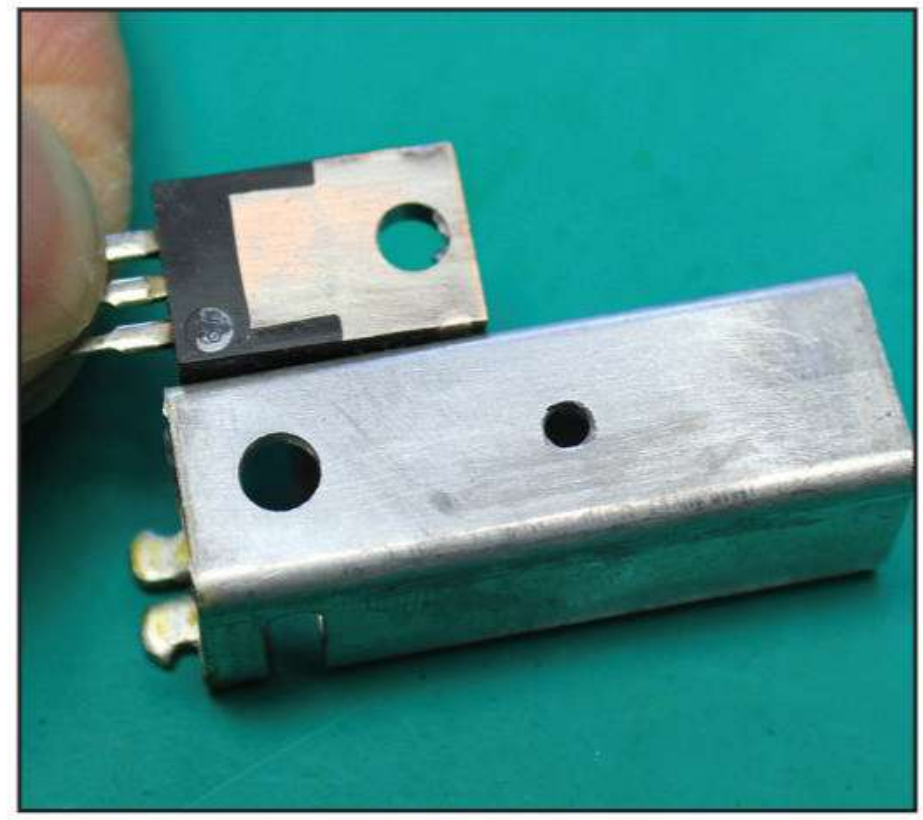

Photo C. Newly-restored transistor and heat sink after scraping both surfaces and sanding to 320 grit.

Surface out-of-flatness can be indicated by rubbing white heat sink compound on them, then scraping off the excess. The compound will still be visible in the low areas.

The surfaces should be sanded or otherwise smoothed to an equivalent of 320 grit sandpaper or finer, the smoother and flatter the better (Photo C). One manufacturer of high-power flange resistors required a surface flatness of 0.001 inch (one one-thousandth). After working, thoroughly clean the surfaces with isopropyl alcohol or solvent and cotton swabs.

It is critical to not apply so much compound that it prevents metal-to-metal contact, as that contact is the main path for heat transfer. The compound replaces air, which is a very good insulator, that would be trapped between the surfaces with compound having a higher thermal conductivity, but it is still much less conductive than metal-to-metal contact. Rub a very small amount of compound on both surfaces, press the device to the heat sink and move it slightly. Remove the device and inspect the compound, scrape off the excess, and install the device.

Devices are usually fastened to heat sinks with screws, which are likely to loosen over time, and, as a result of screw torque, pull the spreader and heat sink surface out of flatness. Screw threads in the heat sink are likely to be pulled through and that damage must be eliminated. Screws should never be torqued enough to deform the materials. Device manufacturers' data sheets should specify a maximum fastener torque. If not, use just enough torque to keep the two surfaces in contact. Do not rely on old screw threads to hold the screw in place, use low strength Loctite® to prevent loosening. I recommend using Loctite® and only finger-tightening the fasteners.

For sink contacts that transfer large amounts of heat and go through thermal cycling, the device should be evenly pressed against the heat sink with fasteners and springs as seen in heat spreaders used in computer microprocessor applications. The spreader on a PC microprocessor may have a thermal spreader which is polished like a mirror to ensure the best metal to metal contact.

It is also good to replace the three-terminal-regulator IC devices in these old rigs, especially the five-volt '7805' devices. If they fail from overheating and the internal pass transistor shorts, this will destroy the computer devices in the rig.

If you can't make an island DXpedition yourself, the next best thing is to hear about a few directly from participants. And that's a big part of the fun of attending a DX convention, such as the annual International DX Convention in Visalia, California.

Coming Ashore for an Island Dinner

A Visit to the 28th Annual IOTA Dinner at Visalia

BY RON WILCOX,* KF7ZN

Islands On the Air (IOTA) held its annual Friday night dinner at the International DX Convention in Visalia, California on April 21st. This was the 28th year without a break, including both in-person and virtual, that this dinner has taken place. The food was great and there was plenty of it. The presentations were both fun and of great interest. This was all brought about by Will Costello, WC6DX, who put a lot of hard work into putting everything together and deserves credit for the success of the evening.

After dinner, we enjoyed a presentation by Adrian Ciuperca, KO8SCA, on Kiska Island (Photo A – *also see his story in the March CQ DX column – ed.*). The originally scheduled presenter was unable to be there at the last minute and Adrian stepped in. It was an excellent presentation covering some of the history of the island and its role in World War II. Adrian also told us of challenges and the experience of activating it.

Our next speaker was Dan Sullivan, W4DKS (Photo B), who spoke on CYØS, Sable Island. Dan did a great job of explaining the preparation and the time involved in getting permission to stay on the island and activate it, giving many ATNOs (all-time new ones - this author was one of those). We learned some of the history of the island, including the many ships that have been wrecked off its shores over the centuries, and the story of the horses that live there.

It was wonderful to see old friends and meet new ones (Photo C). A big thanks and our appreciation to Will. We are all looking forward to the next one.

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Photo A. Adrian Ciuperca, KO8SCA (in blue shirt), shared the story of his expedition to Kiska Island in Alaska's Aleutian chain with attendees at the IOTA dinner at the International DX Convention in Visalia, California. (Photos by Ron Wilcox, KF7ZN)

Islands On The Air

About IOTA

IOTA, or Islands on the Air, is the granddaddy of today's many "OTA" programs. Established in 1964 by the Radio Society of Great Britain (RSGB), the program encourages amateur radio operation from the world's many islands through a series of award certificates both for activators and chasers, those hams who try to make contact with as many different islands as possible. In 2016, having outgrown RSGB's ability to administer it, the IOTA program was spun off as an independent entity. More details about the program, its history and its many awards are available at <https://www.iota-world.org>.

Photo B. Dan Sullivan, W4DKS, presenting on Sable Island.

About Visalia

The International DX Convention is sponsored jointly by the Northern California DX Club (NCDXC) and the Central Arizona DX Association. This year marked the 74th annual convention. The first one was held in Fresno, California in 1957, and it has been held in Visalia since 1978, drawing DXers and DXpeditioners from around the world. Visalia was chosen because it is centrally-located roughly halfway between the Los Angeles and San Francisco metropolitan areas. Approximately 450 hams attended this year's event.

Photo C. New and old friends gathered at the IOTA dinner.

One easy way to check out worldwide propagation conditions on THE HF bands is to tune in to the International Beacon Project's beacon frequency on each band and determine which of the beacons scattered around the world you can hear. JF1RWZ has a webpage that will help you identify which station is transmitting when, even if you can't copy the stations' Morse code identifiers.

Introducing "IBP Beacon NOW"

BY JUNICHI OKAMURA,* JF1RWZ

Cycle 25 is rising quickly, and I am looking forward to future DX communication. Recently, digital communication such as FT8 has become popular, and DX communication is now possible with simple equipment, but communication that allows you to enjoy conversations on CW and SSB is also attractive.

Analog communication gives you the pleasure of communication by hearing the sound from speaker accompanied by fading with one's own ears. The International Beacon Project (IBP) is a convenient tool that allows you to know which area of the world is open for analog communication. The IBP is sponsored by the Northern California DX Foundation (NCDXF) and the International Amateur Radio Union (IARU). The first beacon started transmitting from Northern California in 1979. This was so well received that IARU proposed a worldwide network of beacons operating 24 hours a day. The current 18-beacon system started operation in 1995. Stations use a specialized beacon controller (Photo A) and transmit one by one in a set order and format on a coordinated time schedule.

As shown in Figure 1, each beacon transmits a call sign in Morse code for 3 seconds followed by four 1-second-long dashes for a total of 7 seconds. The first dash is sent at 100 watts; the second at 10 watts, followed by 1 watt and 100 milliwatts. After three seconds of silence, the next beacon in the sequence begins to transmit (and the previous station moves to the next higher band). Since 18 stations share one frequency on each band, it takes 180 seconds, or 3 minutes, to complete a full cycle. If you have a clock calibrated to an accurate time source, you can calculate where the signal you just heard came from based on the time schedule, even if you didn't copy the CW call sign.

IBP Beacon NOW

I made a website called IBP Beacon NOW so that people who are not good at Morse code can use it without having to do this troublesome calculation. The URL is <https://www.radioboy.net/ibn/>.

IBP Beacon NOW displays the call sign of each beacon station on the map, and displays the beacon point currently active in red. The frequency of the beacon, for example, 14.100 MHz for 20 meters, is shown on the upper right, the call sign of the currently-transmitting beacon being is

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This article was originally published in CQ hamradio (Japanese CQ) and is republished with permission.

Figure 1: Sequence of IBP beacon transmission.

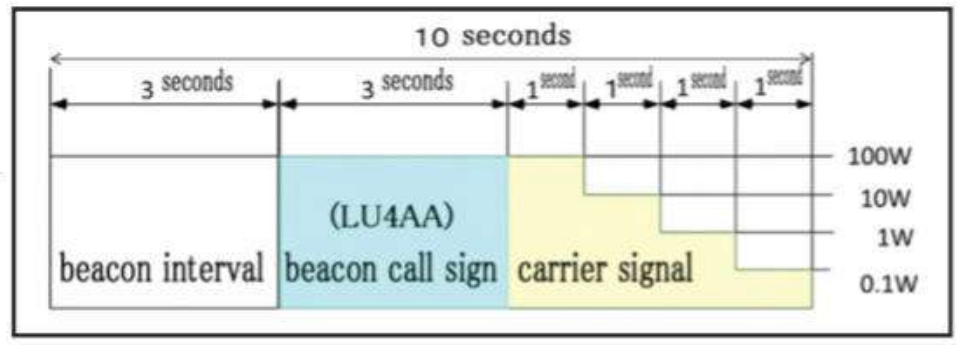


Figure 2: IBP NOW band selection screen.

displayed on the upper left, and the time is displayed on the lower right.

How to Use IBP Beacon NOW

IBP Beacon NOW can be used with browsers on PCs and smartphones. First, be sure to accurately set the time on your PC. If the difference from the standard time is within 1 second, that's fine. Next, select frequency and map from the IBP Beacon NOW menu (Figure 2). Two types of maps are available, an equidistant azimuth map (Figure 3) – shown with a circle ○ on the menu page – and a Mercator map (Figure 4), shown on the menu page with a square □. After selecting the band from the menu, set your rig to CW and tune the frequency accurately.

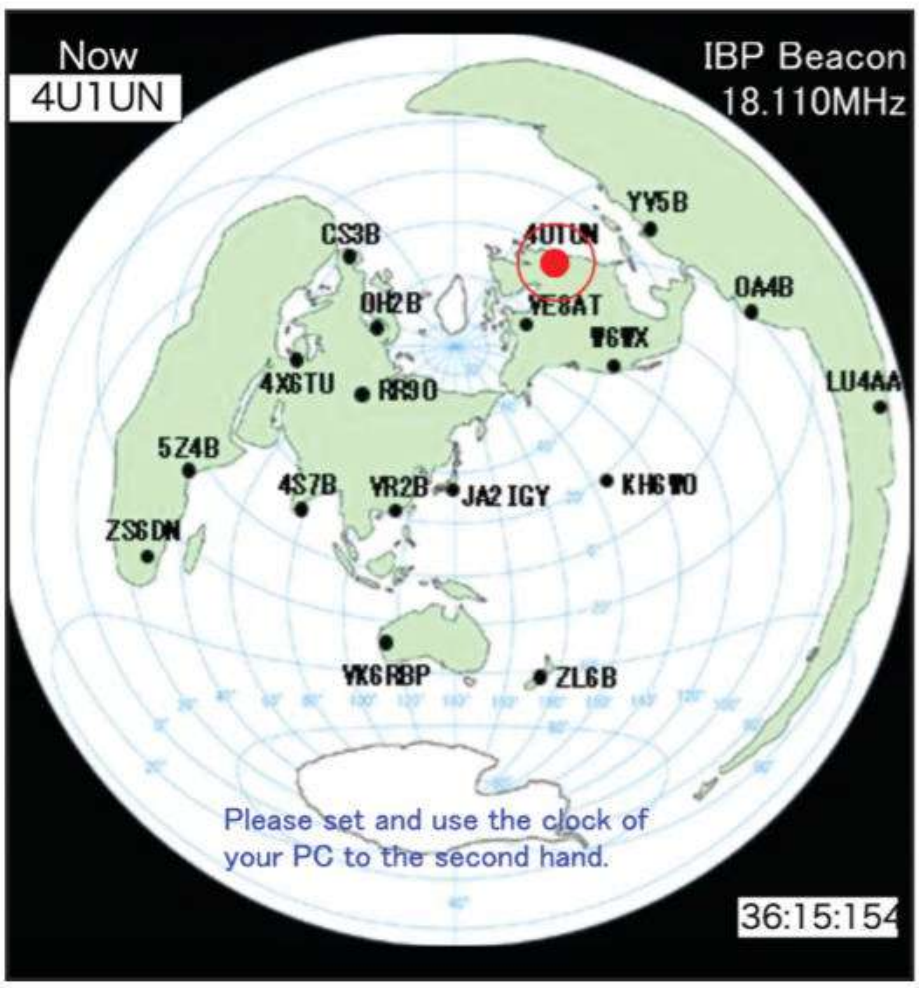


Figure 3: IBP Beacon NOW equidistant azimuth map.

Morse code that arrives from a distant country is romantic and fun to listen to. For those who are not good at Morse, the map will let you know the source of the signal.

IBP Beacon Operation Information

Operation information of the IBP beacons can be found at <https://www.ncdxf.org/beacon/>.

When you open the URL, you will see a small number next to the call sign of the beacon station. The meaning of the numbers is as follows

1: The beacon is off the air temporarily. We expect it will be back soon.
2: (Relates to relocation of beacon station VE8AT [Photo B])
3: (Not currently in use)
4: Off due to hardware failure. The operators are working on the problem. Please be patient.
5: The beacon will be off from time to time due to frequent power cuts and heavy thunderstorms.
6: The beacon hasn't been heard for a while. We are contacting the operator.

Photo A: International Beacon Project stations use a specialized beacon controller to assure that they transmit on the proper time sequence. (Photos from NCDXF/IARU IBP website)

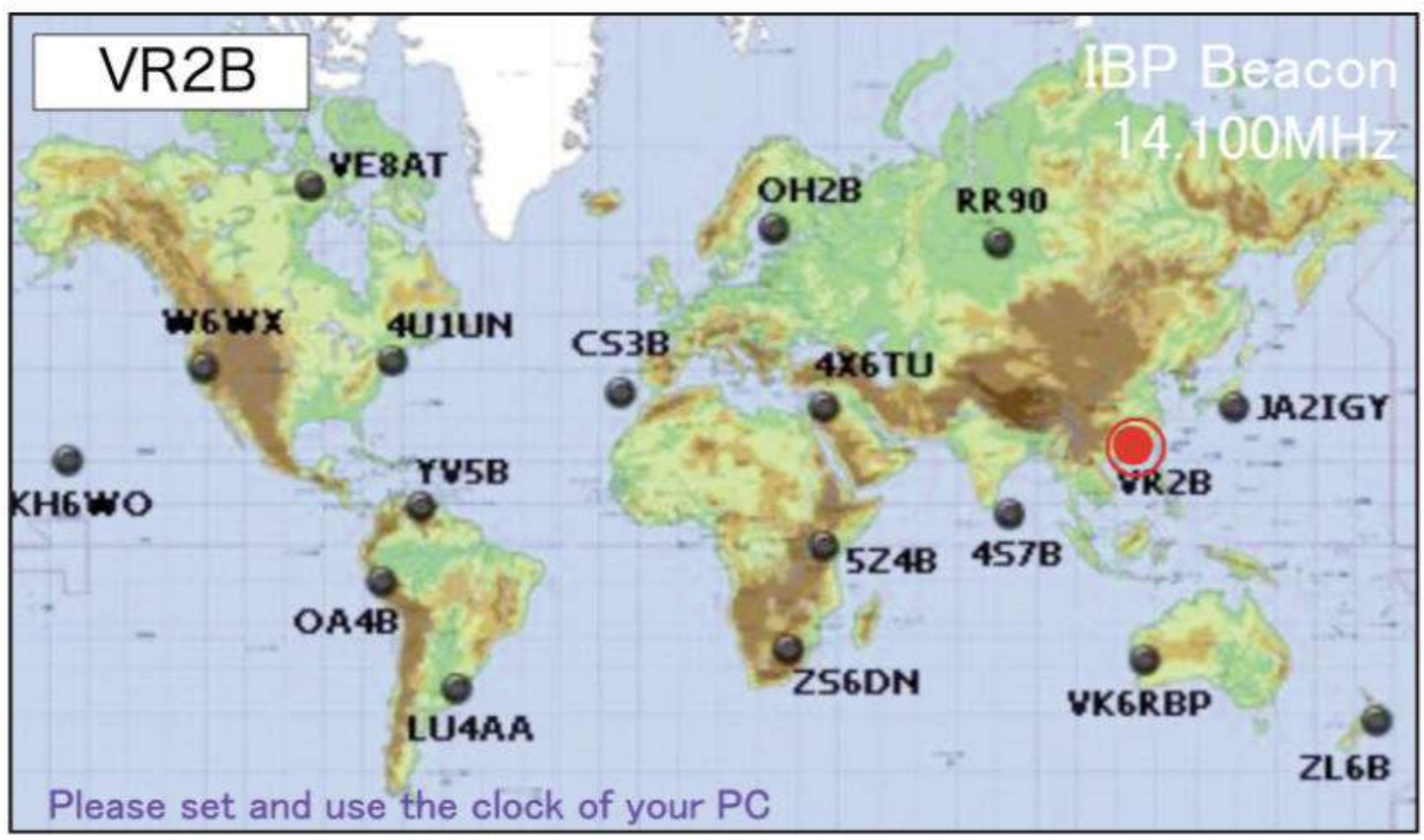


Figure 4: IBP Beacon NOW Mercator map.

Photo B: VE8AT IBP beacon controller and transmitter.

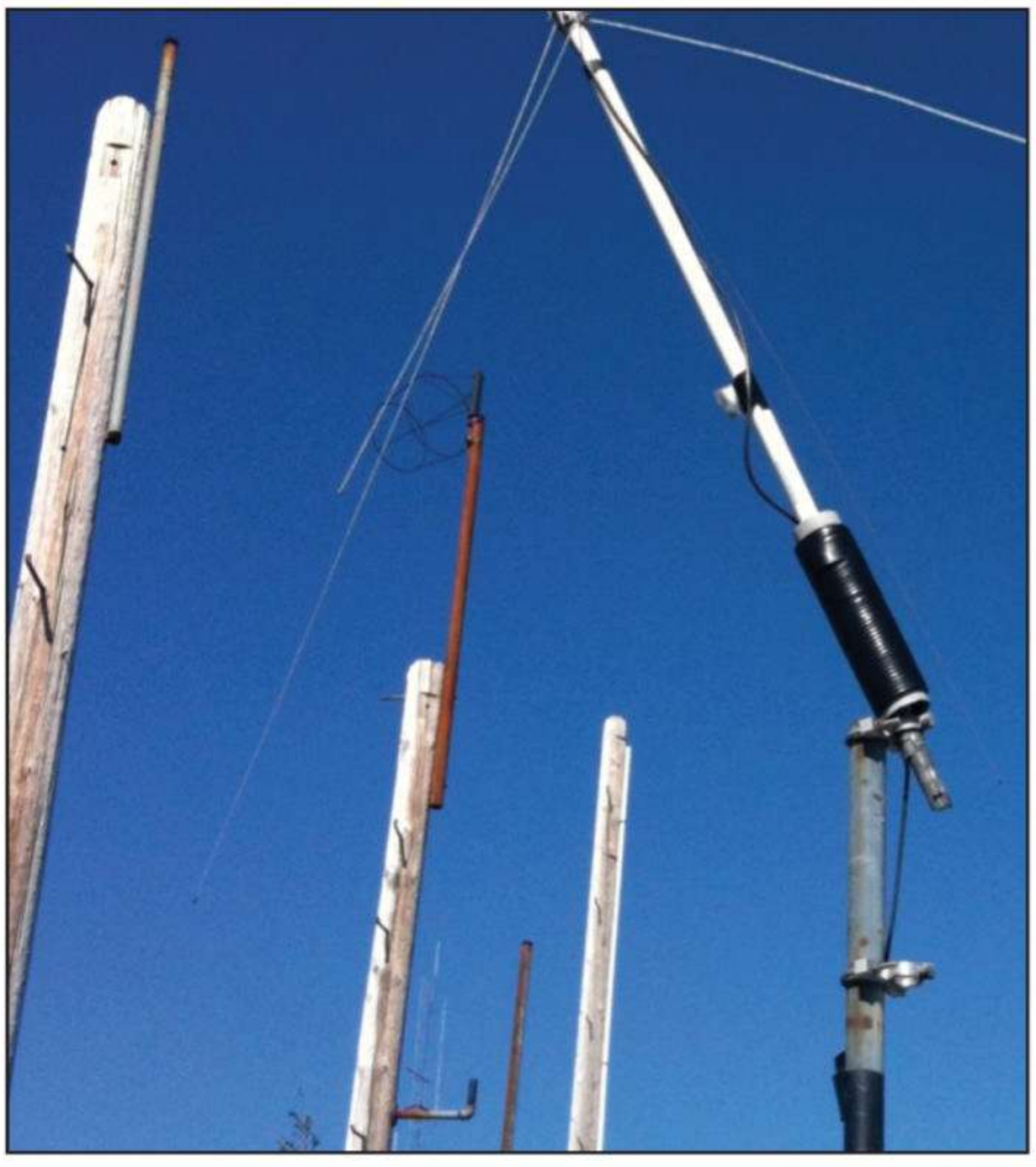


Photo C: W6WX beacon antenna damaged by wind. The beacon stations sometimes operate in very harsh weather conditions.

IBP Frequencies

The International Beacon Project's 18 transmitters share a single frequency on each HF band between 20 and 10 meters. Here's where to listen (courtesy of NCDXF/IARU IBP):
20 meters: 14.100 MHz
17 meters: 18.110 MHz
15 meters: 21.150 MHz
12 meters: 24.930 MHz
10 meters: 28.200 MHz

The IBP beacons sometimes operate under harsh conditions. Stations have been struck by lightning, storms have knocked over antennas (Photo C), components have failed, and rigs have even been stolen! IBP tries hard to keep all of its stations on the air.

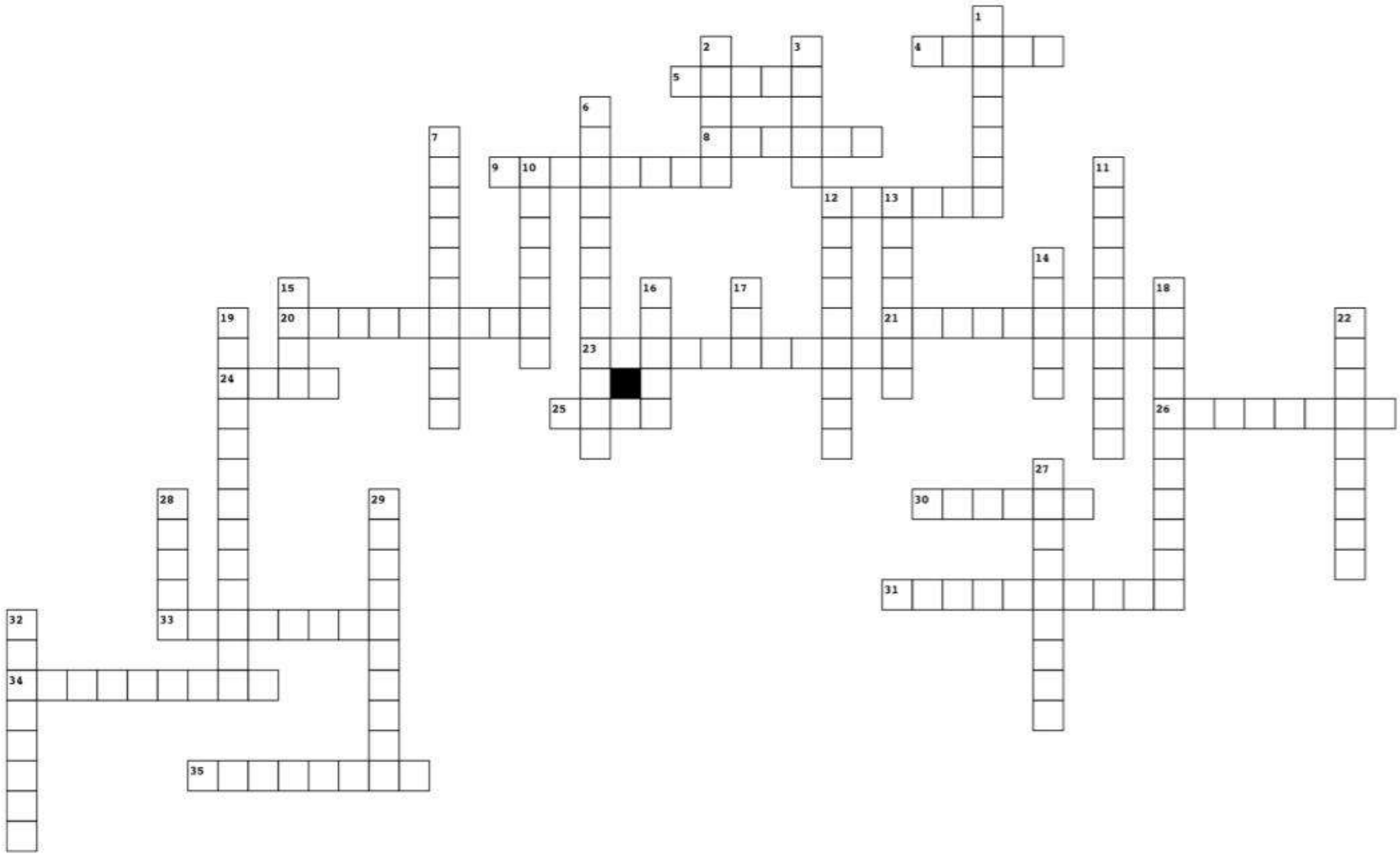
IBP-RBN Challenge!

The International Beacon Program and the Reverse Beacon Network are currently challenging amateurs to monitor as many of the 18 IBP beacon stations as possible in a single day. Can you hear all the beacons from your location? Can you hear them all in one day? Details on the IBP-RBN Challenge, along with listings of successful stations, can be found at <https://www.ncdxf.org/beacon/RBN.html>.

Let's enjoy DX communication using IBP Beacon NOW. We recommend bookmarking your browser, <https://www.radioboy.net/ibn/>.

73, JF1RWZ

CQ Crossword Puzzle



ACROSS

4. An individual who acts as an advisor or mentor to a newly licensed amateur
5. Any of the several methods used by amateurs to transmit speech
8. A device used to connect or disconnect electrical contacts
9. Non-digital
12. A circuit that will allow some signals to pass through it but will greatly reduce the strength of others
20. A material that maintains atight grip on its electrons, so that an electric current cannot pass through it (within voltage limits)
21. A solid-state device made of three layers of semiconductor material
23. The region in Earth's atmosphere just above the Earth's surface and below the ionosphere
24. A type of feed line with one conductor inside the othe.
25. The material used in the center of an inductor coil, where the magnetic field is concentrated
26. A type of interference to stations on nearby frequencie.
30. A small piece of wire used to connect two parts of a circuit
31. A packet-radio station used to retransmit signals that are specifically addressed to be retransmitted by that station
33. Dark spots on the surface of the sun
34. The condition in which two packet-radio stations are sending information to each other
35. A device that allows a dual-band radio to use a single dual-band antenna

DOWN

1. A test instrument that measures current
2. Inventor of the telegraph
3. An alternating-current frequency of one cycle per second
6. The electrical-field characteristic of a radio wave
7. A measure of the ability of a coil to store energy in a magnetic field
10. A term used to describe several packet stations linked together to transmit data over long distances
11. The ability to oppose an electric current
12. The number of complete cycles of an alternating current that occur per second
13. A stage of an FM receiver that makes the receiver less sensitive to amplitude variations and pulse noise
14. A slight shift in transmitter frequency each time you key the transmitter
15. The metric prefix for 10^9, or times 1,000,000,000.
16. Another name for voice communications
17. Best known Morse code message
18. A device that produces radio-frequency signals.
19. You need more than 999 to get this award
22. The sum or difference frequencies generated when an RF carrier is mixed with an audio signal
27. An element behind the driven element in a Yagi and some other directional antennas.
28. They don't count during a contest, but also don't count against you
29. A region of electrically charged gases high in the atmosphere.
32. A device that converts radio waves into signals we can hear or see.

(Answers on page 91)

math's notes

BY IRWIN MATH,* WA2NDM

Replace Those Batteries?

While purchasing batteries for my HT and some battery powered test equipment I have often wished that I could just plug them into the AC line and forget about the batteries, especially for non-portable devices. This month I will show you an interesting way that I used to solved the problem.

The main item that sparked all of this was a new telephone I bought for my shack. This was a beautiful land-line – a Panasonic model which had all of the features I wanted. The only problem with this phone was that it took three AA batteries in order for some of the features to operate properly. According to the manual, you needed to replace these at least once per year or you would lose the internal logs, etc. Furthermore, you had to do this within a couple of minutes as the phone could only hold a charged capacitor that short period, and if it took too longer all stored information would be lost.

I first opened the phone and carefully looked at the battery compartment. Sure enough the three batteries were connected by a series of small strips of metal and springs. There were no "center taps" so all I needed was 4.5 volts. *Why not just use a cell phone charger or even an old "wall-wart",* I thought? I had a box full of both kinds that I had accumulated over the years. I started to measure what I had on hand. Some were indeed at 5 volts (+/- a half volt). Most so called "cell phone 5-volt chargers" however actually produced 10 to 12 volts (no load) and only dropped to 5 volts with a load which seemed to vary from model to model. Other plain "wall-warts" produced anywhere from 6 to 12 volts when tested under load. I could not take a chance with this and possible destroy the phone. Obviously, something had to be done.

If I were to use a common 5-volt cell phone charger I would have to drop the voltage. A simple 1N4002 diode in

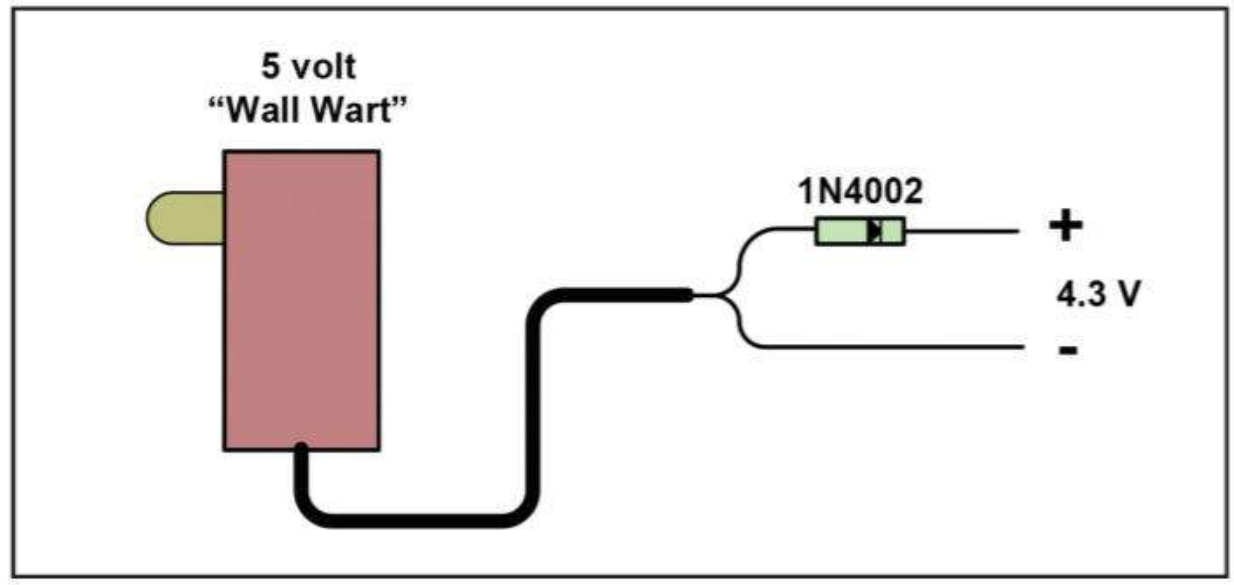


Figure 1. Wall wart battery replacement

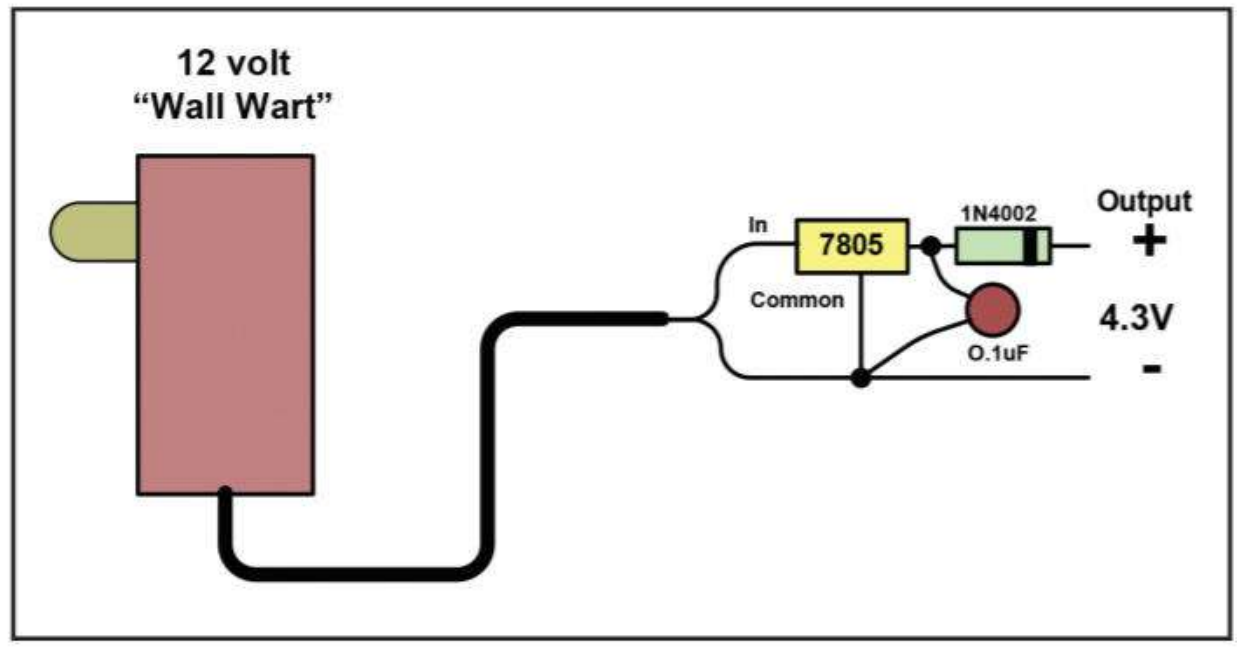


Figure 2. Wall wart battery replacement

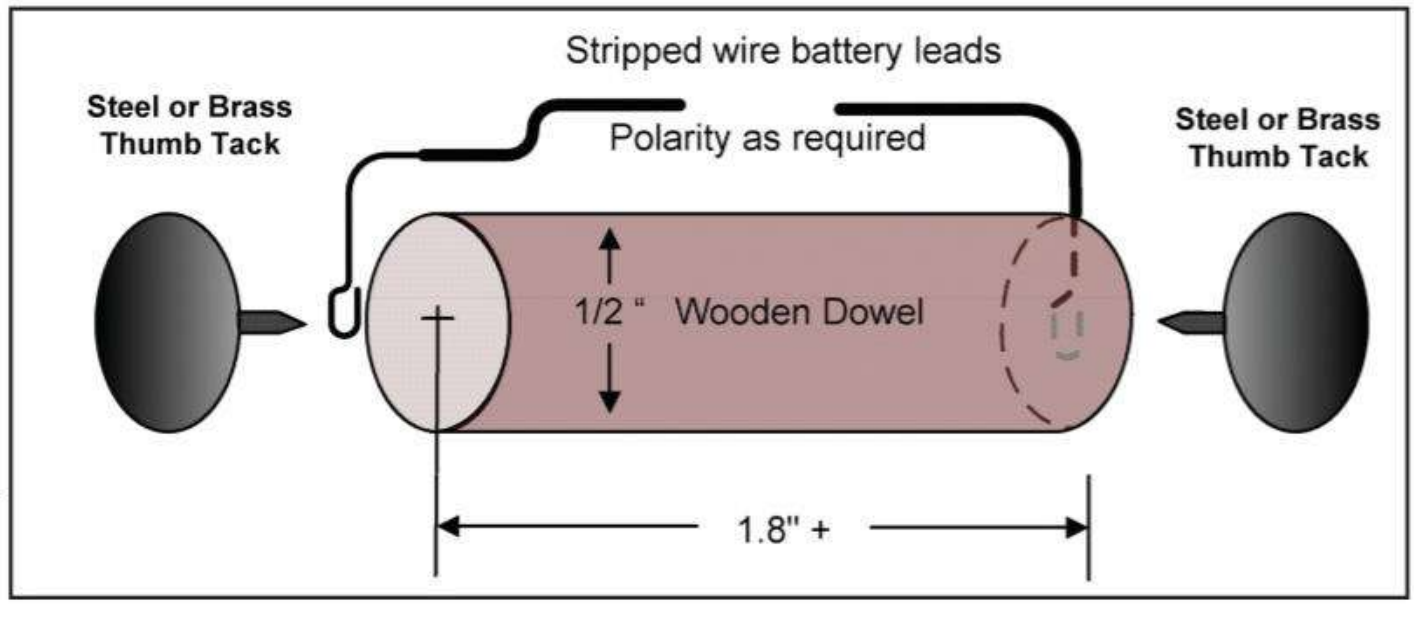


Figure 3. Details of wooden battery replacement

*c/o CQ magazine

I hope this gives you an idea of how to use your favorite battery-operated amateur radio...

series with the output from a regulated true 5-volt charger would certainly do it. Using this approach (Figure 1) would give me 5 – 0.7 or 4.3 volts, just in the range of what a set of three new batteries would produce. If my charger or wall-wart had a higher output voltage however then I could use a common regulator chip in the 7800 series (Figure 2). Three batteries would require a 7805 and a diode. Four batteries for a device that required 6 volts could use a 7806. Other voltages such as 8-volt, 9-volt, and even 12-volt requirements could be obtained from other 7800 units. No matter which one you chose to use be sure that the input voltage to the regulator from your "wall-wart" is at least 2-3 volts higher than the output you desire with the load connected. Note that the 0.1uF ceramic capacitor shown in the schematic is optional but may be needed depending on the nature of the device you are powering. Also note that the diode cathode is pointing to the output. Then just solder it and the capacitor across the output pins of the regulator as shown. Always remember the overall result should be the desired output voltage across the estimated load, so check it before you actually use it. This takes care of the first part of the problem. Now comes the task of how to connect the power supply to the phone or other device.

The solution is shown in Figure 3. I simply bought a small length of common ½ inch diameter wooden dowel from the local home improvement store and cut a few 1.8-inch (approximately) lengths. These dimensions came to roughly the size of an AA cell. I then pressed a couple of conductive metal thumb tacks into each end of the dowel with a length of wired underneath and I had my "wooden" battery replacement. In my case the spring in the battery holder of the telephone was just enough to hold the assembly properly. You may have to trim the length of the dowel to fit in your specific application but this is not a difficult task. You can then connect one such assembly to the "wall-wart" in the correct direction for proper polarity and you are done. Now you can either use actual batteries or the AC line.

I hope this gives you an idea of how to use your favorite battery-operated amateur radio as well as non-amateur devices from the AC line.

73, Irwin
WA2NDM

emergency communications

BY JOHN FERGUSON,* K3PFW

Whatcha Gonna Do When The Lights Go Out? – Part 2

Well, what *are* you going to do? Do you have a plan? Have you practiced the plan? Maybe we need to look at this question of "what are ya gonna do when the lights go out," as an issue that might need some looking into. It is not a question of "if," it's a question of "when," and you need a plan.

Photo A: "The Rack" in the amateur radio station at the Sussex County (DE) Emergency Operations Center (EOC). The three power supplies, associated charge controllers and batteries power the three operating positions. Redundancy allows for a quick switch and substitution if a failure occurs. Likewise, the antenna patch panel provides the flexibility to connect any radio to any antenna.

For emergency power sources, you have a range of possibilities. There is, of course, the old standby, batteries. Then there's the possibility of a generator. With advances in technology, solar is an attractive alternative source. Even better if you combine some of these sources into a complimentary system. This article is not meant as a definitive plan but more as a discussion on what is a very broad and varied field.

Chemical reactions creating an electric charge have been around since the days of Alessandro de Volta and his letter to the Royal Society in 1800. They may not be new but they have certainly been improved! Still somewhat the gold standard for standby power sources, where weight isn't an issue, is lead-acid technology. Maybe not something you want for your dual-band HT, however. Of course, there's the expanding family of the lithium-based technology. Really attractive with its high current density to weight ratio, but can be a bit pricey. And, the most prevalent by far, the so called "dry cell" (alkaline) family that evolved from its humble carbon-zinc beginnings. What your needs are will have a great impact on the decision of what you will use. This is again the place where there is not a "one size/mode fits all" solution.

Generators are the workhorses that you need for the larger and longer duration periods of standby power, be they gasoline, diesel, or propane. The previous idea that they were big, ugly, messy, and noisy is not true of the smaller inverter type portable generators. How much power you need will determine the size and fuel that you choose.

Relatively new on the standby scene is solar power. Development here has made the idea of portable solar power attractive, and when combined with a rechargeable battery, a really great combination system. This combo is adaptable to a fixed location backup.

I would caution you to not consider price as your first concern. Safety is, and should always be, your number one selection and design criterion for your

Photo B: The charge controllers allow the power supplies to operate the positions, with an instantaneous switch to battery in case of a power loss. They are out in plain sight so issues are spotted quickly.

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standby power. All of these alternative sources of power have safety issues, some inherently more than others. And, it is electricity; it can be deadly!

What are you going to need to power? For how long? On what kind of duty cycle? Are you thinking just your radios? It will get dark, every day. Will you need lights? What about all the other things you need to stay at home? Having one of the new lithium iron phosphate batteries to take to the local park for a Parks on the Air (POTA) trip is one thing. Operating for days after a hurricane or blizzard is a whole 'nother issue.

Batteries

Batteries have been the standby power choice in communications for many years. I remember when Dad used to take me through where he worked – in the telephone central offices, where "wet cells" were often used. Thomas Edison developed, patented, and produced a nickel-iron battery in the early 1900s that he claimed was superior to the lead plates and acid batteries of the day. What was old is new again, as we see iron popping up in the mix of the lithium family of batteries. The Edison battery was rechargeable (approx. 1.7 volts/cell) and had a long life. They are still manufactured today. Today, the best bang for your buck for emergency standby power at your home station, is a deep cycle lead-acid battery. They come in two varieties: the Sealed Lead Acid (SLA) and the Absorbed Glass Mat (AGM). The biggest advantage is they are non-spillable, and don't require maintenance in terms of adding water. The "car battery" is not what you want. It is designed to develop a high current surge for starting, then quietly stabilize the car's electrical system at about 13.5 volts. They do not like to be discharged and recharged. In fact, battery manufacturers will tell you to not take the voltage of a lead-acid battery down too far (< 10.5 volts), or it will shorten the battery's life. I would recommend no lower than 11.5 volts before recharging.

The lithium family of batteries is being developed into a very competitive, high energy density product. With, however, a somewhat checkered safety record for the straight lithium-ion type, historically. The newer technologies are more stable and safer product. If you need portability, you need lithium, and a large piggy bank. One of the latest on the market, the **lithium iron phosphate** (LiFePO4) type, is exceptionally good.

The ampere/hour rating for batteries, for most of the products in the field, is based on a "twenty-hour rate". This is

the number of amps that can be withdrawn at a constant rate for 20 hours @ 80° F before voltage drops to 1.75 volts per cell (discharged). Therefore, your 100-amp/hr battery should be able to do 5 amps for 20 hours before being discharged. Age and initial charge condition will affect this figure.

Generators

For continuous power over time, you definitely want to consider a generator. Your fuel choices for motor driven types are primarily gasoline, diesel, or propane. Each fuel has its own advantages and disadvantages. All are highly flammable and explosive. Safety is a primary concern in both use and storage. Sizes run from portable hand0-carried to humongous in fixed installations. There may be local zoning rules on how much of what kind of fuel you can store in a residential situation. Motor-driven generators are rated in kilowatts at rated voltage and/or full load amperes. Don't plan on running a generator right at full load when you design your backup, particularly if you are doing residential backup. Your max should be no more than 75% of full load, and I would recommend 50% if you are planning on starting heat pumps, water, pumps, refrigeration, and other motor loads.

For a fixed installation, if you've got the space, assets, zoning clearance, a natural power source, wind, solar or water – charging a bank of batteries is about the best possible system you can develop. If you want to be "off the grid" this is the way to go.

Sizing

So, how much of what do I need? First you need to figure out what you are going to power, then for how long. Electrical energy is measured in watt/hours. How many watts are you going to use in how many hours? That gets a little confusing when batteries are rated in ampere/hours. Well, there is Ohm's Law and the power formula that will help you with the relationship. Power (watts) is equal to the voltage (volts) times the current (amperes). But there is also the "duty cycle" question. Your radio uses more current transmitting than receiving. How long will you be doing each? Let's say you talk for two minutes (6 amperes on transmit) and listen for eight minutes (2 amperes on receive), and you do this for an hour. We will consider the voltage to the radio as 14 volts.

Considering the above, that's a total of 2 minutes multiplied by six times in the hour for a total of 12 minutes (.2 hr.) at 6 amperes for transmit. On receive it would be 8 minutes multiplied by 6 times in the hour for a total of 48 minutes (.8 hr.) at 2 amperes. So, looking at a one-hour total, that would be 2 amperes multiplied by .8 hr. for the receive total of 1.6

On the Cover

There's only one thing better for a DXer than making contact with a fellow ham on a remote South Seas island: *Being that ham!* Al Rovner, K7AR, of Vancouver, Washington, and Bob Norin, W7YAQ, of Sisters, Oregon, have been and continue to be *those hams*, traveling to and operating from various exotic locales around the world, often expeditioning together.

Bob has been on more than two dozen DXpeditions in the past 25 years – mostly to different locations in Oceania – and Al shares his love of DXing beyond the HF bands. In addition to his travels, Bob maintains the DX Northwest DX Cluster at <http://www.k7ar.net/> and offers tips to first-time DXpeditioners on his YouTube channel with a program called "Planning Your First DXpedition" at <https://tinyurl.com/cvs6b4dv>.

Unlike the crew that we featured last month that battled the elements to operate from a tent on the rocky shores of Bouvet island, Bob and Al prefer to visit places populated by other people, not just penguins, and where they can set up a station in a seaside resort, as they did this past February during their YJ0A operation from Vanuatu. For them, they wrote in this month's DX column (page 96), getting to meet local people and learn about different cultures is at least as important as getting their ham stations on the air. (Cover photos courtesy of K7AR and W7VAQ)

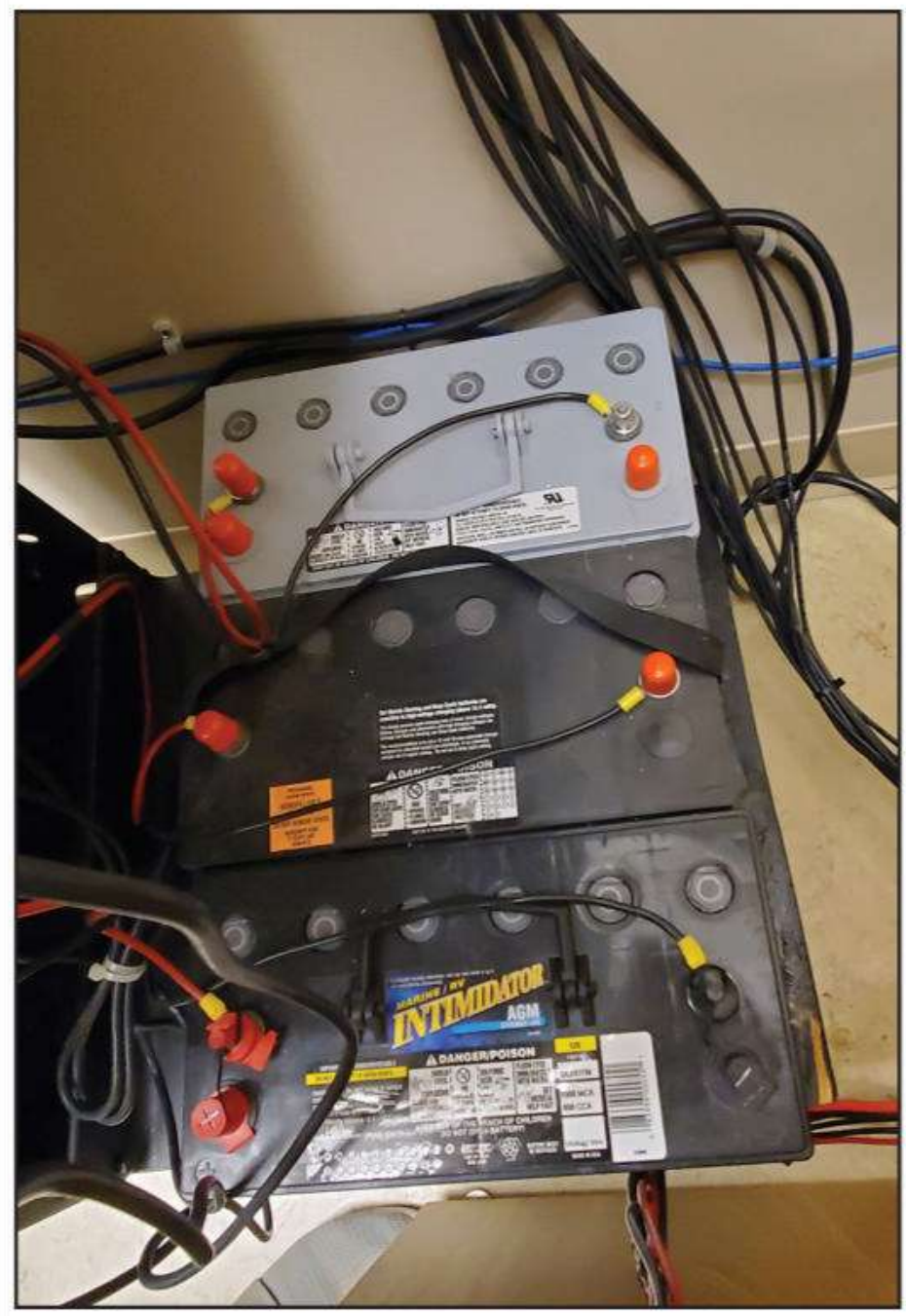

Photo C: The battery bank for the operating positions. Positive terminals have insulating protectors on them. They sit on the rack base behind the front panel.

Photo D: Three 100-amp/hour Group 27 AGM batteries for the "go kits" in battery boxes. All your standby batteries for your home station should be in boxes like these for safety.

ampere/hours. For transmit it would be 8 amperes multiplied by .2 hours for a total transmit load of 1.6 ampere hours. Adding the transmit and receive totals together gives 3.2 ampere/hours for the one hour of activity. Keeping this up for 12 hours a day for two days, your battery now needs a rating of the original 3.2 ampere/hours multiplied by 24 (12+12) for a total of 76.8 ampere hours. Despite the rule of thumb that says you should have twice what you calculated, for the above discussion, a 100-Ampere/hour battery would be adequate. The issue is that as soon as you start using power, the battery voltage will begin to drop, eventually reaching a point where the radio won't work or the battery will be damaged.

Now let's look at watt/hours, where the actual energy being used is measured. On transmit, that would be the 8 amperes multiplied by the 14 volts for a total of 112 watts, multiplied by the amount of time, .2 hr., is 22.4 watt/hours, or approximately .022 kilowatt hours. For receive, that would be 2 amperes multiplied by the 14 volts for a total of 28 watts, multiplied by the time of .8 hours for a total of .022 kilowatt/hours. Add the transmit and receive for a total of .044 kilowatt/hours.

The figures just discussed are for a single radio, not a heavy-duty cycle. You can almost figure under disaster operating conditions, transmit and receive will be about 50/50, and if you are in a mass care shelter or operations center, that will be around the clock operating. Since generators are usually powering these types of operations, you are more likely to run out of operators before the generators run out of fuel!

You must plan for your family and their needs – they come first! So, if circumstances allow you to work from home in a disaster, and you have enough power available to maintain a reasonably comfortable style, that's great. Now you are taking into account all the electrical loads that you believe you are going to use. The advantage here is most appliances and things in the home have a nameplate rating in watts, so you don't have to calculate that. They will add up fast, and you may have to decide what you really don't need to power up. Cooking and air conditioning are two energy drains that you may be able to work around. Heating will be required in winter weather situations, because you do want to avoid damage from frozen pipes.

Initially for my home and station, a 2.5-kilowatt gasoline-fueled portable generator covered all my emergency operating needs for lights, water pump, and heat, with a microwave for cooking. However, it didn't cover hot water. Fuel consumption was moderate and the generator wasn't under strain. However, it was somewhat of a Spartan lifestyle at times. With additions, up-grades, and renovations over time, the generator now will get me by, somewhat, except for extreme cold weather.

This is my first anniversary column, number twelve, I've been at this a year. I hope, you, the readers, have learned a few things along the way. I do like hearing from you. Next month will probably be something on antennas, since it's summer, the weather is nice, and you can get outside and do something.

kit building

BY JOE EISENBERG,* K0NEB

Finishing up Saguaro and Ozarkcon

As I mentioned last month, the build process for the DZKit Saguaro SR-74 receiver kit takes about 12 hours. Upon finishing the kit, there were a few firmware upgrades that improved the AGC performance and the sound quality. I have found this kit to be a great way to simplify using what is one of the most popular SDR receivers, the SDRPlay. Using a Raspberry Pi 4 as the user interface makes this a nice way to enjoy SDR.

During assembly, I had to deal with many multiple pin-type connectors. I have found a method to speed that process up which I will discuss more thoroughly in the future. The main point is to simply solder them and not worry about solder bridges. Then go over it with the soldering iron tip with the board tilted to draw away the excess solder onto the tip, resulting in the removal of excess solder, as well as the unwanted solder bridges. I can't emphasize enough the need to carefully solder each component and carefully check for problems such as poor connections and solder bridges (Photo A).

The final assembly includes thoroughly testing the power supply as well as extensive internal wiring to interconnect the main board, the power supply, the SDRPlay, and the Raspberry Pi as well as the display and the controls. External wiring is also needed to make a connection to the Pi from the SDRPlay. Follow the directions explicitly to be sure of correctly placing each interconnection (Photos B and C).

Upgrading the firmware is dependent on having a keyboard and mouse to make the process easier. This doesn't have to be a big expense as most USB PC keyboard/mouse combos work fine with the Raspberry Pi, including those that have a wireless USB dongle. DZKit also makes a set available should you need one. The firmware upgrade process is spelled out in the document that accompanies the firmware update. For those not familiar with using the LINUX-based operating system of the Raspberry Pi, it uses a graphical user interface (GUI) that is similar to Microsoft Windows®. Updating the firmware involves downloading the files on a PC, transferring them to a USB thumb drive and plugging that drive into the Raspberry Pi USB ports available on the back of the radio. Using the Windows-like interface, it is a simple process to replace the affected files. Rebooting the receiver using the suggested process immediately applies the upgrades.

There is also a procedure to change the SDR interface from the default Saguaro software to CUBIC SDR software that also comes pre-installed. Using that software allows you to use the full capabilities of the SDRPlay, including frequency coverage up to 2 GHz. Keep in mind that using a keyboard and mouse are necessary to use CUBIC. The CUBIC software allows more flexibility but requires more effort

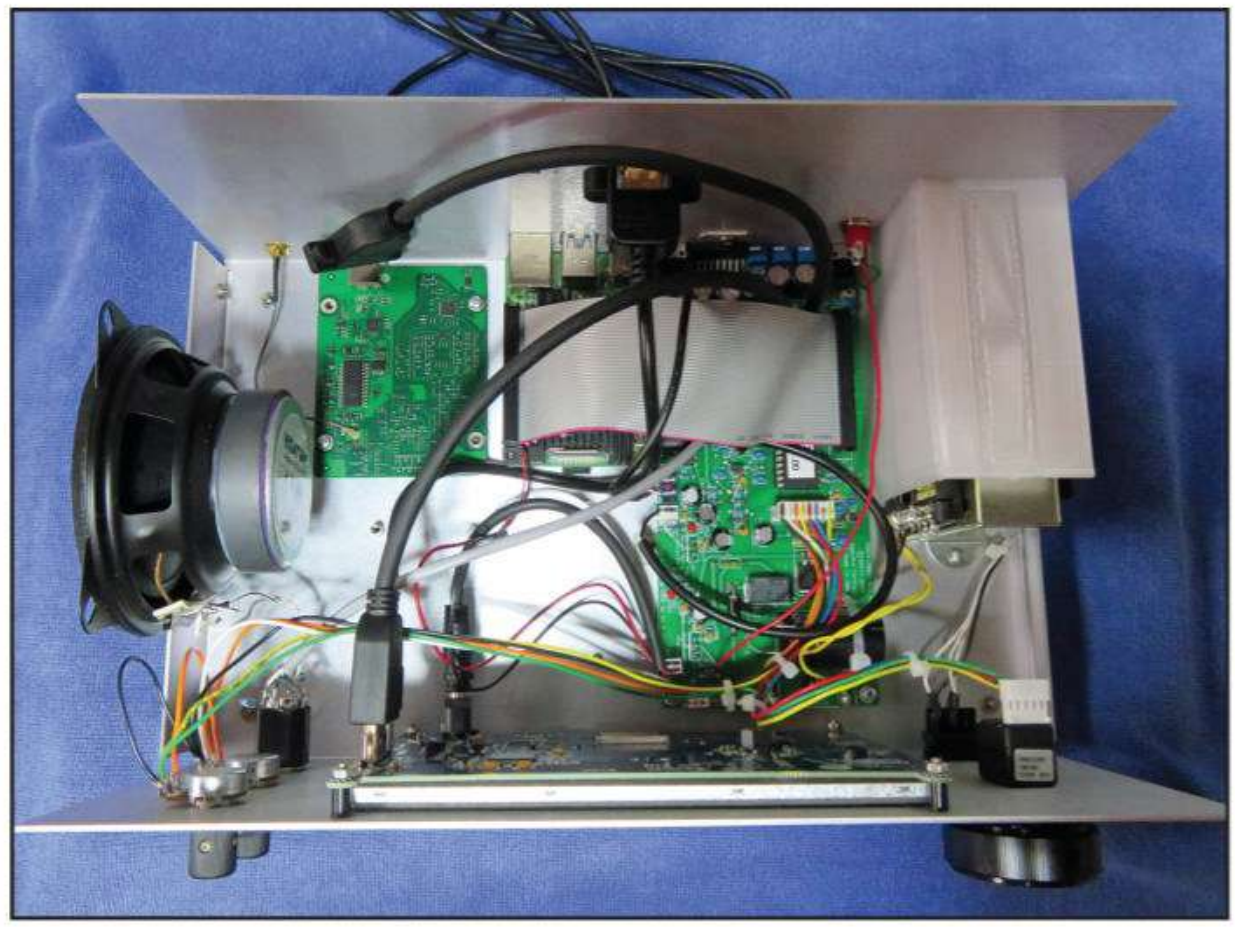

Photo A. The internal wiring of the DZKit Saguaro SR-74 is finished and ready for the external connections.

Photo B. The rear panel of the Saguaro has the connections to the Raspberry Pi as well as audio output and a paddle input for the built-in code practice keyer.

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Photo C. The case is finally closed and the receiver is working and tuned to WRMI 5.050 MHz.

Photo D. Frequencies as high as the FM broadcast band are received. This is tuned to KTGL, a local FM station. For higher frequencies up to 2 GHz, CUBIC SDR software is included on the Pi software SD card but must be accessed using a keyboard and mouse.

to operate than the Saguaro software. Either program still takes advantage of the powerful audio of the SR-74. The main board has a large IC that is commonly used in car stereo design, making it able to supply plenty of audio power to the speaker (Photo D).

I found using the attenuator and RF Gain settings were necessary to handle cases of overload caused by using my outdoor antennas with the number of strong local AM and FM signals in my area. I also found that touching the screen to select the band segments or the function buttons can sometimes be a bit tricky for my fingers, so using a pen that has a rubber touch screen stylus on it works not only on your cell phone but on the Saguaro's screen as well.

An unexpected extra feature included in this kit radio is a built-in code practice oscillator. There is a jack on the back of the receiver to accommodate a paddle and three trim pots accessible nearby. Those three pots control speed, pitch, and volume. So, while you are listening to your favorite shortwave signals, you can also practice your CW with the built in code practice keyer! For the most current pricing on the kit and its options and availability, visit DZKit at <www.dzkit.com>.

Ozarkcon

The annual Ozarkcon QRP convention was recently held in Branson, Missouri, and a great time was had. Kit designer David Cripe, NMØS, spoke about progress on the T41 kit development as well as the future of new Four State QRP Group kits in the pipeline. Look for more great and innovative kits in the future.

Photo E. My first-time field test of my QDX QRP digital modes transceiver in northwestern Arkansas. I used the QDX along with an Elecraft T1 tuner and a Pacific Antennas 20/40-meter dipole kit.

Photo F. The crew that brought me along for the day-long SOTA adventure included, on left, front to rear: Curtis E Hays, II, KC5CW; Timothy McDonough, N9PUZ; Gary Auchard ,WØMNA; Martha Auchard, WØERI. On right, front to rear: Bryan Nehl, KØEMT; John Watkins, NØEVH; Al Sutton, Sr., N4EII, and Frank Thies, KDØMQO.

We did a group kit building experience using the SMT Dummy Load kit. The builders were treated to instructions on how to work with surface mount components using either their soldering irons or solder paste and a heat tool to assemble the kits. The kit build had a 100% success rate and now the builders have a great tool to use when working with QRP kits and radios.

I also had a chance to once again operate SOTA (Summits on the Air) and POTA (Parks on the Air) using some kit radios while in Branson. My SOTA and POTA operations included using a QDX QRP digital modes transceiver. It was amazing how many responses I got once I was spotted as operating SOTA and POTA. We activated two peaks in northwestern Arkansas as well as a park on Table Rock Lake. I give a big thank you to Gary Auchard, WØMNA, and Martha Auchard, WØERI, for taking me along on their SOTA adventures and to Ozarkcon for making the POTA learning experience possible. The weather for the most part cooperated and made it a great experience. Using an antenna tuner not only made sure a proper match was provided to the radio, it also acted as a bandpass filter to help reduce any problems from the other operators who came along and were operating nearby on other bands and modes (Photos E and F).

I look forward to being at the Oklahoma Ham Holiday as well as the Cedar Rapids, Iowa, Hamfest and of course the Huntsville Hamfest coming up. Be sure to say hi! Don't forget that Field Day is a great time to try out your kit radios and accessories.

Until next time,
73 de KØNEB

Looking Ahead in CQ

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

- The DK6ED Double Loop V3
- A Foxhunt in India
- Another Radio for High(er) Speed Packet

Plus…

- Results: 2022 CQ WW RTTY WPX Contest
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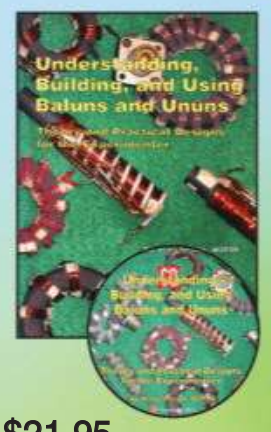

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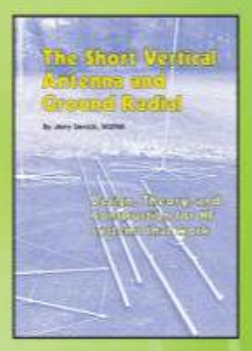

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learning curve

BY RON OCHU, KOØZ

Amateur Radio in June

Although this is the June edition of *CQ*, this article was written in April. April showers bring May flowers, but in the Midwest, it can also bring very strong showers in the form of thunderstorms. Warm spring temperatures combined with an advancing cold front can cause quite a few storms. Such was just the case in my neck of the woods. Strong winds brought down a 6-inch tree limb which took out my Butternut HF2V vertical antenna (Photo A). I've had this 32 foot, 80-, 40- and 30-meter antenna for at least 20 years. I remember buying it at the Dayton Hamvention and transporting it back to Missouri via my Plymouth Voyager van. I've made numerous QSOs both near and far with this antenna! I've used it in both Missouri and in Illinois. I hope I will be able to salvage it. This setback especially stings because I just spent a few days adding more ground radials to lower its overall angle of radiation and to increase its efficiency. On the brighter side, a perceived setback is an opportunity to make improvements. Thank goodness for aluminum tube manufacturers.

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

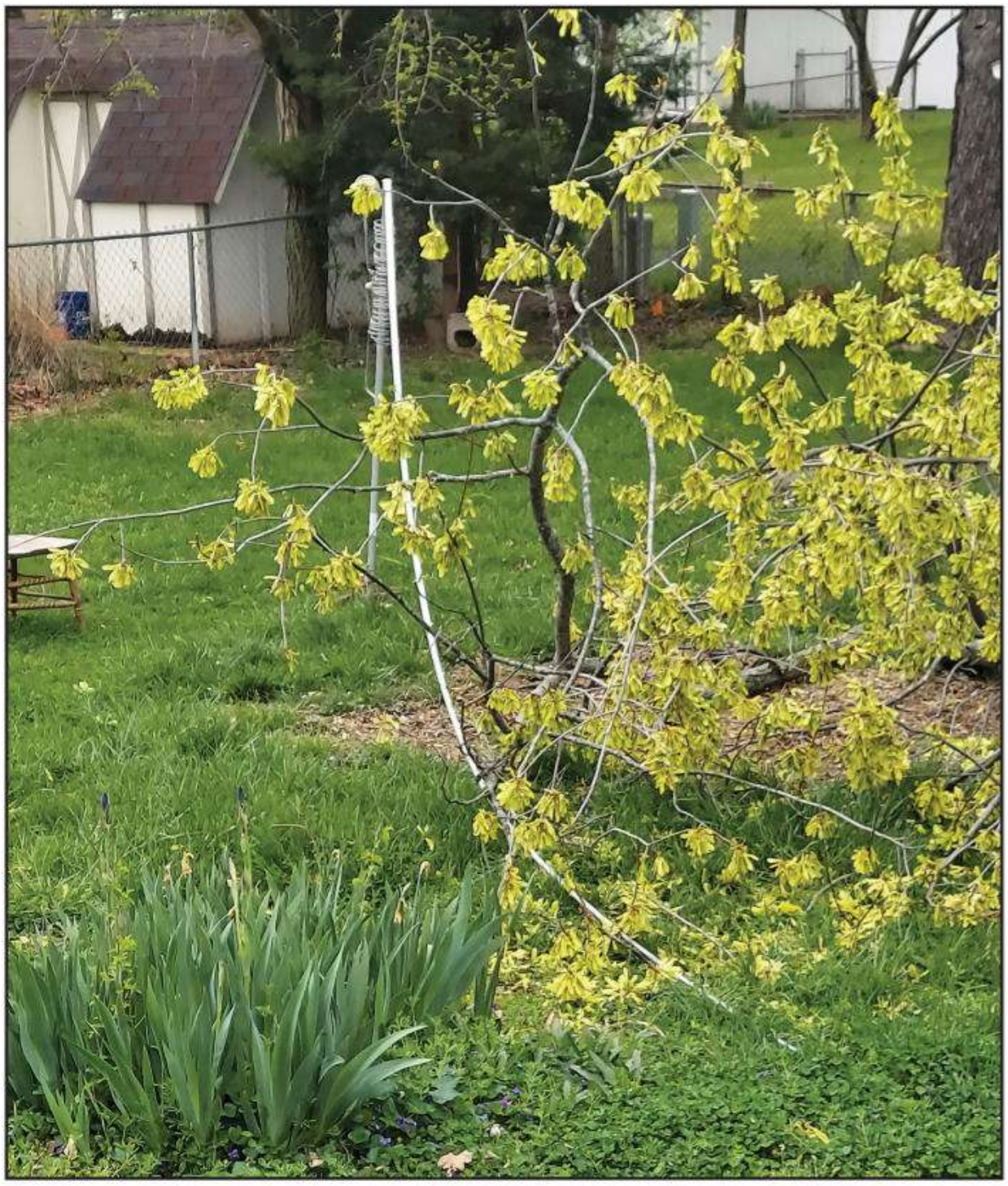


Photo A: An April thunderstorm's high winds broke a tree branch that took out my Butternut HF2V vertical antenna. Thankfully, nobody was hurt, and my antenna was the only wind damage "casualty" to my QTH. (All photos by author.)

June and Skywarn®

I have every intention of putting my antenna back into service before this article is published in June. June is a prime month for severe thunderstorms and the beginning of hurricane season in the northern hemisphere. The potential for damaging winds increases with the warmer months of spring and summer. Are you familiar with your local Skywarn® net (Photo B)? I checked into my local Skywarn® net in St. Charles County, MO via the 145.49 repeater to give net control an update on the high winds at my QTH (location) and my consequent wind damage to my antenna. NWS (National Weather Service) meteorologists are very interested in getting real-time, ground truth reports regarding wind damage, flooding, hail, wall clouds, funnel clouds, and tornadoes. In other parts of the country, NWS meteorologists also get hurricane/typhoon, earthquake and fire reports from radio amateurs.

Every spring I urge *CQ* readers to be active with their local Skwarn® program. If your area doesn't have one, then why not think about forming one? All it takes is getting a few like-minded hams, like yourself, with an interest in severe weather and community preparedness to become storm spotters. Form a VHF

Photo B: National Weather Service's Skywarn© logo. Do you participate in Skywarn®?

Photo C: A typical summer hamfest scene. This photo is from the West Central Illinois Hamfest held in early August.

net and give weather reports back to net control. Net control can pass the traffic on to the NWS. Once you've established a reliable, working, local weather net, contact your local NWS weather forecast office and introduce yourselves. Let them know about your net and they will provide you with a means to contact office meteorologists in real time. You will be providing an important community service and you'll be showcasing amateur radio!

June Hamfests

Besides severe weather, June is a great time for outdoor hamfests (Photos C and D). For the uninitiated, hamfests are ham radio flea markets sponsored by area clubs. A hamfest is a great place for a meet and greet, as well as a great place to find good deals on ham radio equipment. Hamfest sponsors use any proceeds as needed revenue for club projects such as repeater maintenance, club stations, etc. Supporting hamfests is a great way to support ham radio. Ham radio clubs are the backbone of amateur radio. Currently there appears to be an uptick in COVID-19 cases among people gathering indoors. Many hamfests are outdoors, but a little common sense and caution is urged. Hopefully, viral impacts will be on the downswing soon.

June is Field Day!

Towards the end of June is a time-honored event called Field Day. Field Day (FD) is sponsored by the ARRL (The National Association for Amateur Radio). Field Day is a twenty-four-hour emergency preparedness simulation designed to challenge ham radio clubs and individuals to operate in the field with other radio amateurs (Photo E). Over the years it has become a premiere operating event and club activity. To some, FD is a contest of sorts for club bragging rights; it's

Photo D: Bargains to be found at a hamfest.

Photo E: Macoupin County, Illinois, K9MCE members erecting a Field Day antenna in the Girard town square park. This setting gave the club visibility to the public and showcased ham radio to the public.

also a club social event. Most of all, Field Day is a time to make friends and to make new, fond memories. It is a chance for Technician class licensees to experience HF communications. It also offers club members the opportunity to view experienced ops make CW and SSB contacts with ease while generating runs. A run occurs when stations call you one after the other. No sooner have you finished the contact than another station is calling. Runs generate a lot of Qs in a short time period. They are intense, they are fun, and they make time fly for the operator! Logging contacts is a very important Field Day aspect (Photo F). Software logging programs make the task a lot easier and more accurate. A good logging partner is worth their weight in gold! The overall goal is to make as many contacts with North American clubs as possible within the allotted time.

WHY NOT MAKE JUNE RADIOACTIVE?

I've suggested a few ham radio activities for June. In addition to Skywarn©, hamfests, and Field Day, there should be ample VHF/UHF activity. Static levels on HF increase in the northern hemisphere due to more lightning strikes, making DX on the nighttime bands harder to hear, but 6-meter sporadic E openings, 2-meter ducting and bouncing VHF signals off of meteor burns makes for additional summer excitement. Don't forget about Parks on the Air (POTA) and Summits on the Air (SOTA) operations. The park and summit activators are happy to put more contacts into their logbooks. Have fun operating this June – I hope to hear you on the air. As always, thank you for reading *CQ*.

73, Ron KOØZ

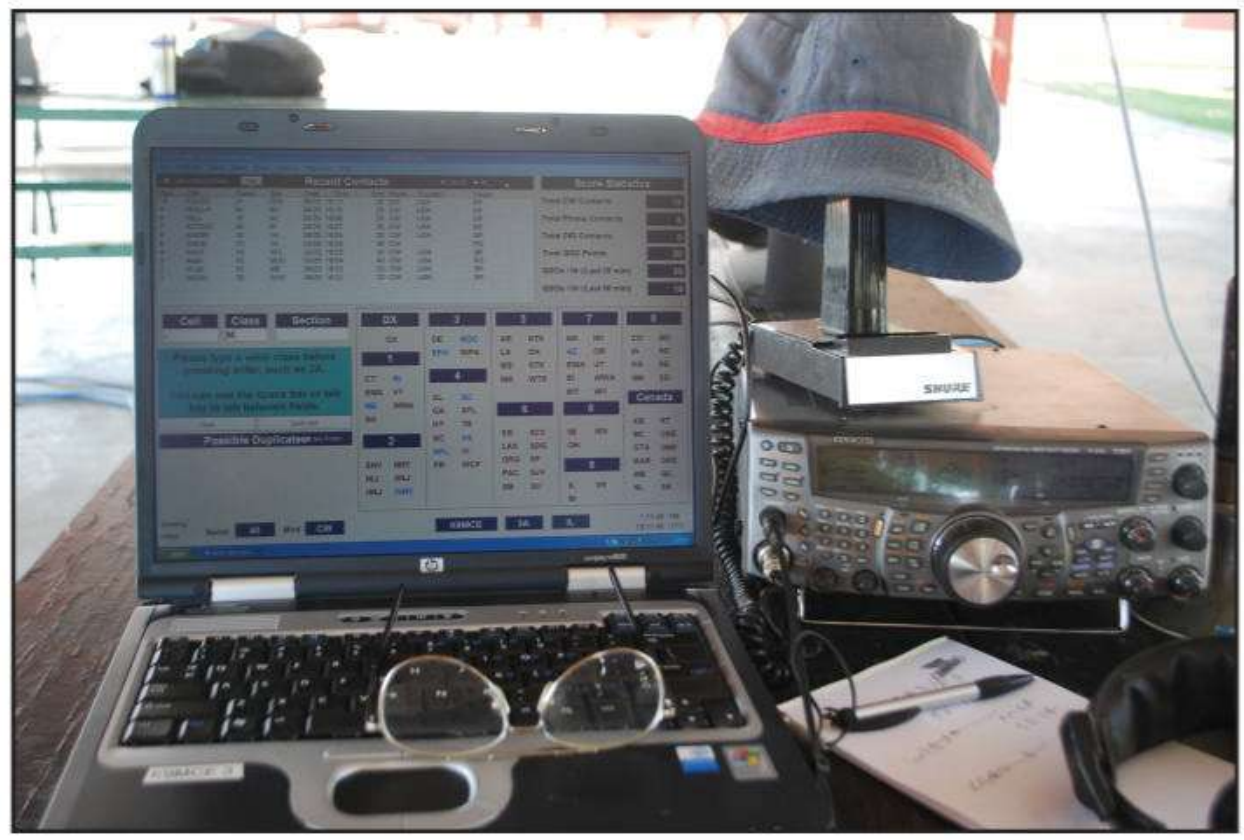


Photo F: FD logging program. A good logging program networked with other FD operating stations is a tremendous work saver. It also allows club members new to Field Day a chance to actively participate. Today's logging programs are intuitive and easy to operate. Pictured is N3FJP's FD logging program on the laptop screen.

analog adventures

BY ERIC P. NICHOLS,* KL7AJ

Tanks a Lot

One of the oldest circuits in all of hamdom is the *tank* circuit, which in its various incarnations has presented a profound mystery to many hams. In this Adventure, we hope to take some of the mystery out of tank circuits in general, and the commonly perplexing *Pi-network* in particular. As is often the case, we'll also learn some interesting physics in the process. We will also determine whether or not you actually BELIEVE Kirchhoff's current law (KCL).

As some of you may recall, a while back, I presented this paradox of sorts in the form of a simple question, based on the schematic in Figure 1:

Is the circuit in Figure 1 a series or parallel circuit?

Your answer is wrong.

The reason it's wrong is because there isn't enough information to define the circuit. To answer the question, we need to know where we're applying the voltage.

Figure 2 is a little more meaningful. We've attached a signal source to the two components, L1 and C1, which we can NOW define as being in parallel. For now, we'll leave the actual component values unknown.

As we've said a few times before, it's important to explore IDEAL components before looking at real world components. We should never be daunted by *infinity* (even though some computer programs *are*, which is something we'll explore later). Infinity is a perfectly good number, as is zero.

Assuming we have no resistance in either component L1 or C1, there will be infinite current circulating in the LC loop at the resonant frequency. (Actually, the current isn't circulating in one direction, but rather, sloshing back and forth between L and C).

Now, as we discussed in our earlier Analog Adventure, "Vitamin K," we have this concept of the *node*, as seen in Figure 3.

Let's look at Node 1, the junction between the tops of C1, L1, and the voltage source V1. (Node 0 at the "bottom" of the circuit will be a perfect duplicate of Node 1. We can just ground that if we'd like).

Now, KCL tells us that the sums of the currents in any node have to add up to 0. The node has three *ports,* and we have three corresponding currents, I1, I2, and I3. At resonance, at any instant in time, the current leaving the top of L1 into the node (I1), and the current *leaving* the node into the top of C1 (I2) are equal and opposite. This leaves NO current available for I3 without violating KCL. What this means is that, at resonance, we have infinite CIRCULATING current and zero source current.

Now, in reality, with less-than-perfect components, the circulating current will not be infinite, but very, very, high. And at resonance, the current drawn from V1 will be minimum. In the most practical and familiar application of this, such as in a vacuum tube linear amplifier, I3 will be the plate current. When tuned to resonance, the plate current will "dip" at the same time the circulating current is maximum.

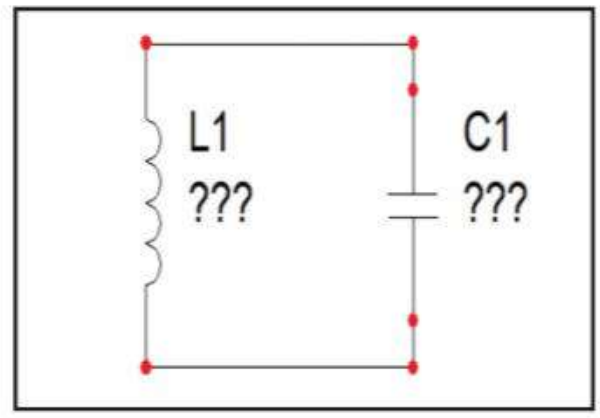
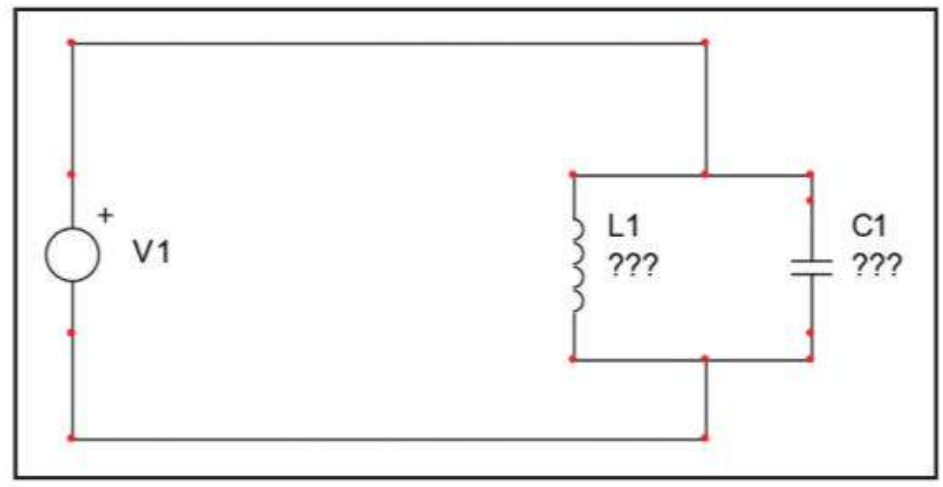


Figure 1.

Figure 2.



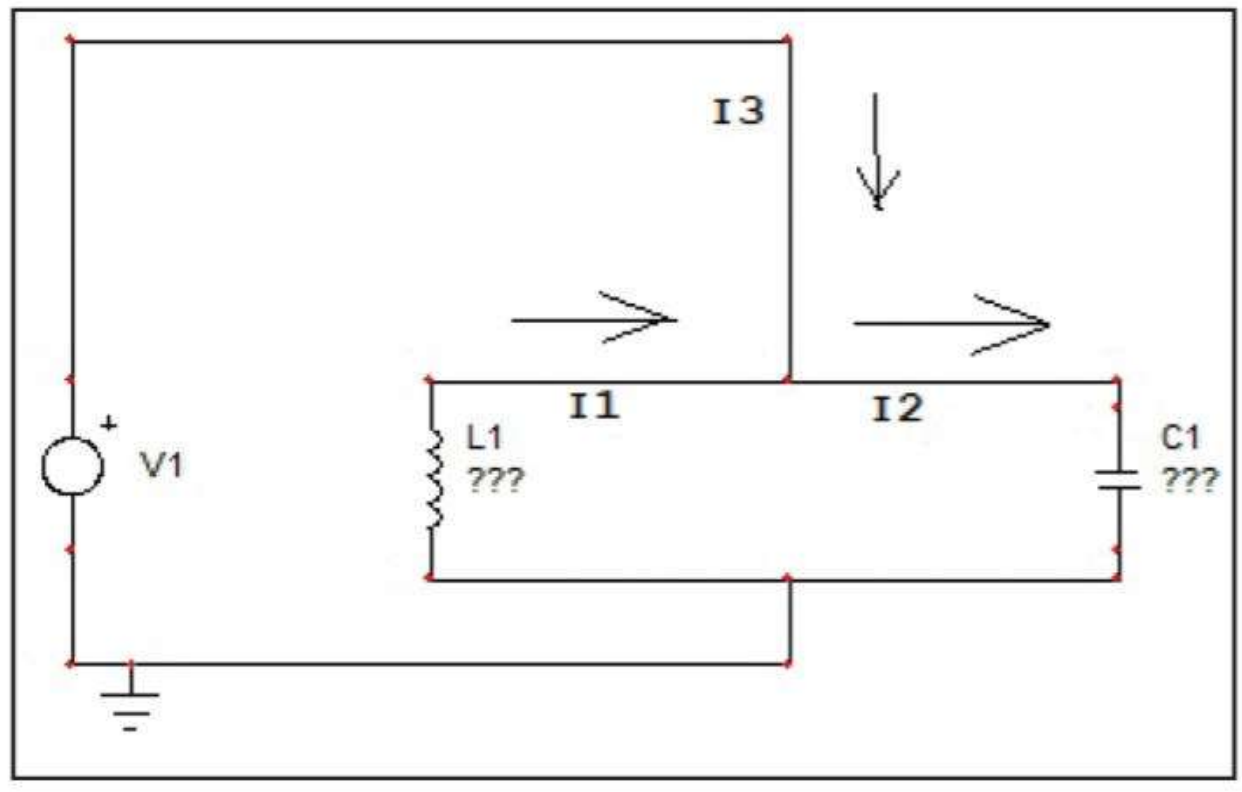


Figure 3.

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Another fact that should be evident is that, whenever I1 is NOT exactly equal to I2, there must be some current present at I3. This is where we approach the concept of *loading*, or extracting useful power from the tank circuit, presumably into an antenna or dummy load.

In the ancient days, energy was typically extracted from a transmitter tank circuit by means of a coupling link. This was a small inductance placed in proximity to the main tank inductor, as shown in Figure 4.

This arrangement was used very successfully for decades, when most hams were using open wire feedlines (typically 600 ohms or so). With the advent of unbalanced coax cable, the modern-day Pi-network largely supplanted the link coupled arrangement. (But not entirely – all 360 push-pull transmitters at the immense HAARP facility use link-coupled output stages!)

Traditionally, the loading of the link coupled network was adjusted by physically changing the proximity (or sometimes the orientation) of L2 to L1. This presented some mechanical (as well as safety) issues, which drove the development of the nearly universal Pi-network. The Pi-network, shown in Figure 5, very elegantly solves a number of problems, while still retaining all the fundamental characteristics of a simple tank circuit.

In essence, the only change made is to replace L2 with C2. As far as the circulating current is concerned, C2 and C1 are in series. C1 and C2 are both *variable*, but C2 is usually an order of magnitude greater than C1. The total

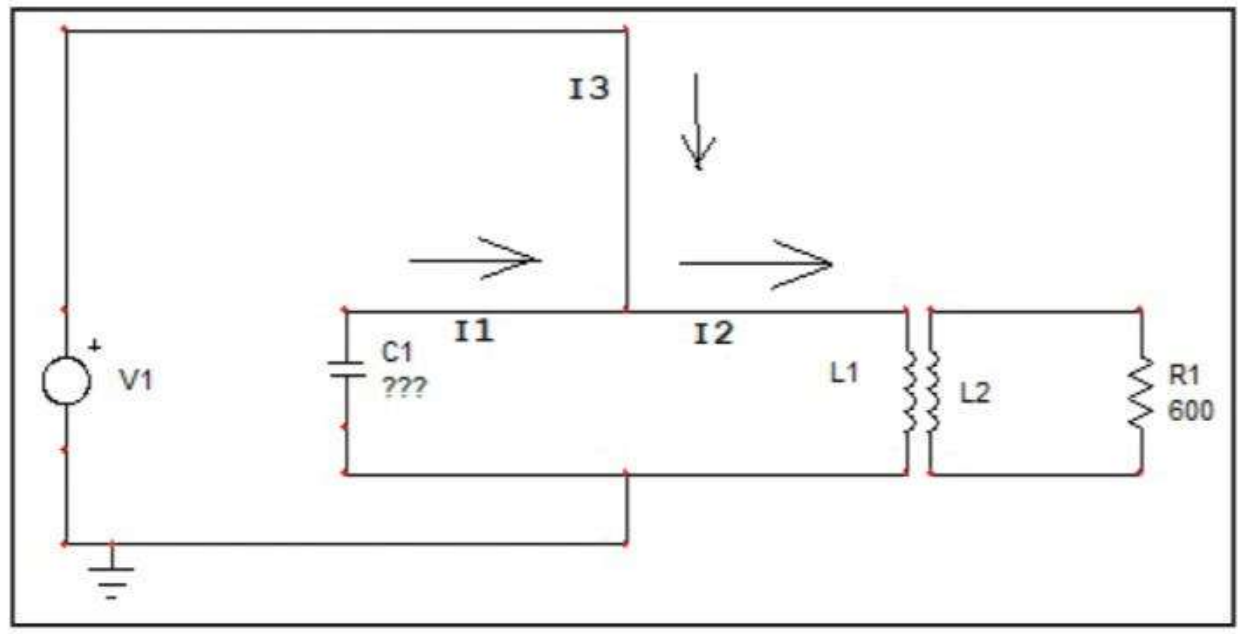

Figure 4.

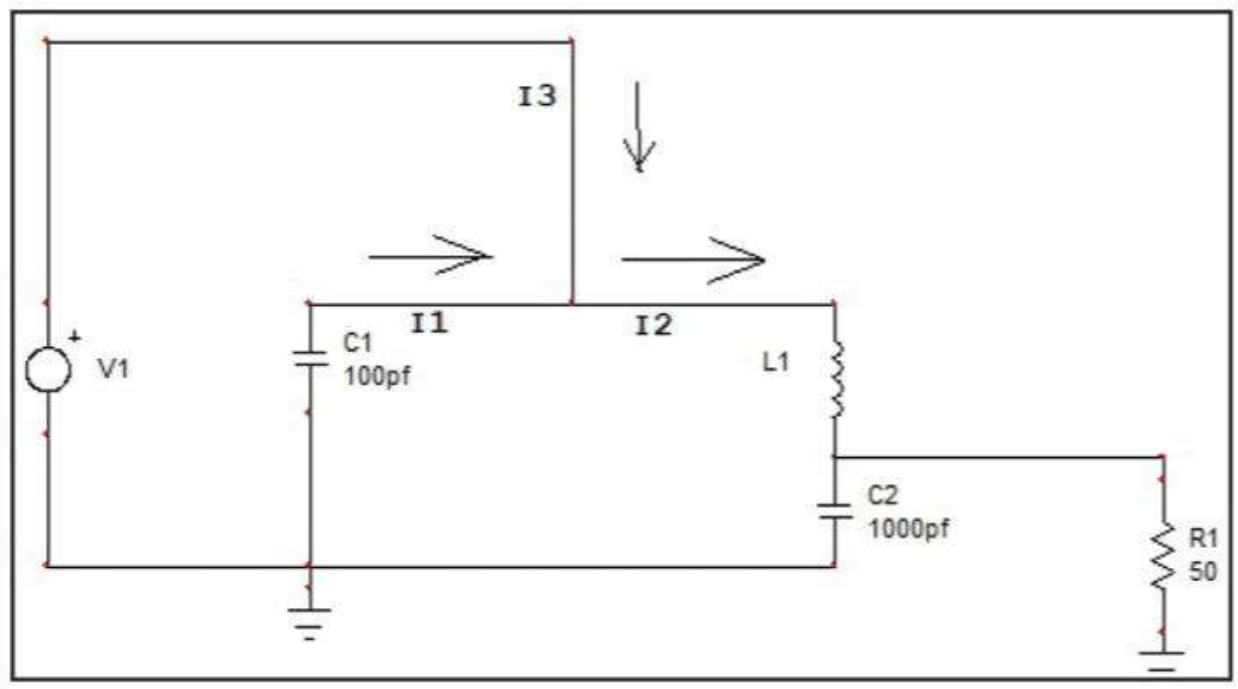

Figure 5.

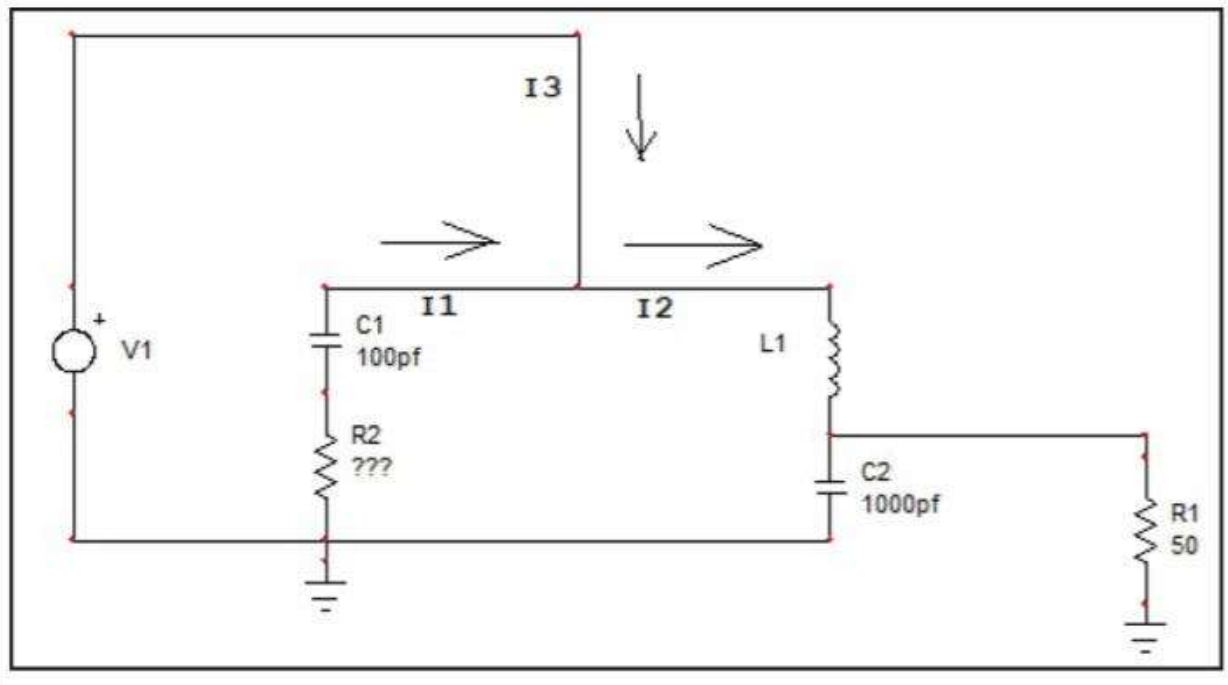

Figure 6.

what's new

RadioPod

The RadioPod, created by Paul Cybulski, KD9WTB, is a portable mount for your radio. The design is currently configured to hold many of the more common two-way radios in place on your vehicle and elsewhere (details on specific radio types at <https://coldspringcustoms.com/pages/radiopod>). Cybulski plans on expanding the line to fit even more radio types in the future. The RadioPod is CNC milled from 3/4-inch high grade industrial textured HDPE, and is available in a variety of colors. They are custom fit with different bolt options and are currently being made to order.

The RadioPod attached to a car dash. (Photo by Paul Cybulski, KD9WTB)

circuit capacitance can be no greater than the smallest value of capacitance, so C1 *primarily* determines the resonant frequency of the circuit. C2 also changes the resonant frequency, but not so profoundly. The main function of C2 is to serve as part of a *voltage divider* between itself and L1. When C2 is large, there is a smaller voltage drop across it, which also means a smaller voltage drop across R1, the load resistance, and hence lower output power. As C1 is decreased, there is a greater voltage drop across it and R1, resulting in greater loading and output power. (C1 must also be tweaked whenever C2 is changed in order to maintain circuit resonance).

Now, here is where KCL comes into play, as well. If power is extracted from the circuit by R1, this means that less voltage appears at the top of L1. I1 and I2 are no longer equal and opposite, so the remaining current MUST be made up for by I3 (remember, KCL is never violated), which means as you increase the antenna loading, the plate current must increase as well.

As well as greatly simplifying things mechanically (a variable capacitor is much easier to build than a "swinging link"), the Pi-network also serves as an effective low-pass filter, providing better harmonic suppression than the link-coupled network.

The Remaining Mystery Solved

One of the most perplexing ideas for many hams is the difference between loaded and unloaded Q, and sometimes the very definition of Q itself. In Figure 6, we've added one more component, R2, which will bring great clarity to this idea.

You may have heard that for a SERIES resonant circuit, Q is defined as X/R, while for a parallel circuit, the Q is defined as R/X. Well – sort of. This simplistic statement fails to identify which R we're talking about!

R2 is the internal "circulating" resistance, which is determined primarily by the "wire" resistance of L1, and to a smaller extent imperfections in C1 and C2.

The composite circuit losses can be consolidated into R2 (which can actually be inserted anywhere in the loop; we've chosen its particular location merely as a convenience). You can't do much about R2; it's fairly intrinsic to the "make-ability" of the components themselves. Hopefully, the value of R2 is very small compared to the reactances of the other components. It is this R that determines the UNLOADED Q of the circuit, and indeed is accurately expressed by X/R. However, in a useful parallel tank circuit, it is R1 which determines the LOADED Q of the circuit. Presumably, the "useful loss" in R1 FAR exceeds the combined losses of R2. It is *this* R that makes the R/X value of Q for a parallel circuit meaningful. When R1 is high, the selectivity of the circuit is high. When R1 is low, the selectivity of the circuit is low – the opposite effect that R2 has.

For the best *efficiency*, we want the value of R1 higher than R2 – or, more succinctly, the efficiency of the circuit is the ratio of R1 to R2. Pretty simple, actually!

Hopefully, we've helped make a little sense of this incredibly useful circuit. Next time, we'll actually do some modeling of real-world tank circuits and see how they compare with reality.

73, Eric

BY KENT BRITAIN*, WA5VJB

The Tri-Vertical

A Three-Band Vertical Beam for 80, 40 and 20 Meters

BY MICHAEL TOIA,# K3MT, GUEST EDITOR

WA5VJB was up to his ears in work for his day job this month, so we asked frequent contributor Michael Toia, K3MT, to step in as Guest Editor for this issue. He shares a design for a 3-element triband vertical beam. – W2VU

In the late 1970s, a three-element, 80-40-20-meter vertical beam graced my property. It worked wonderful DX until I changed QTH and tore it down. Now, at age 85, I recapture from memory its essential details that may guide one to rebuilding it, as my ability to do so by field work has long since faded.

Figure 1 is an isometric 3-D sketch of the antenna, three verticals with a radial field used for NEC code modeling. The verticals are each 10 meters high, separated horizontally by 12 meters. Their radials are described in Figure 2,[1] and are 10 meters long when open-ended, shorter elsewhere.

Driving verticals 1 and 2 out of phase generates a classic figure-8 pattern, with a null broadside, as shown in Figure 3.[2] On a plane between the two, their E fields cancel, so no electrons move on any metal object placed there. I placed vertical 3 there, to form an equilateral triangle in plain view; it is decoupled from the other two.

Verticals over real earth are more lossy than over perfect earth. Figure 4 is such a comparison, showing calculated azimuth and elevation patterns for perfect earth (dotted line)

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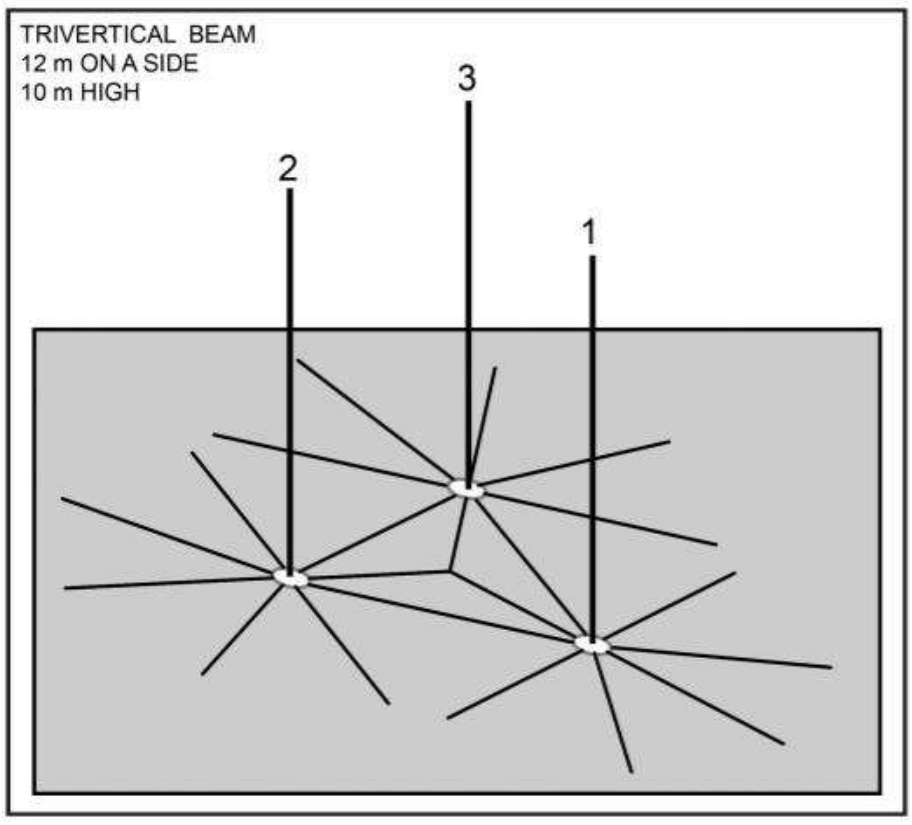

Figure 1: Isometric view, trivertical HF beam.

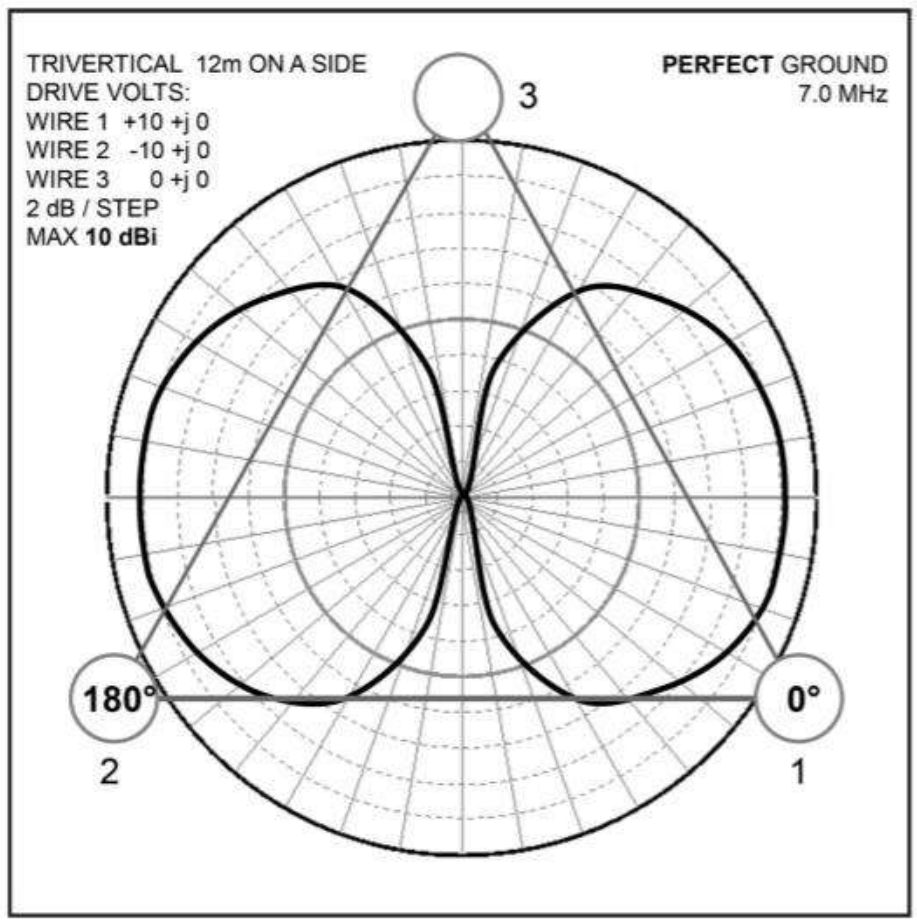

Figure 2: Plan view, showing radial field.

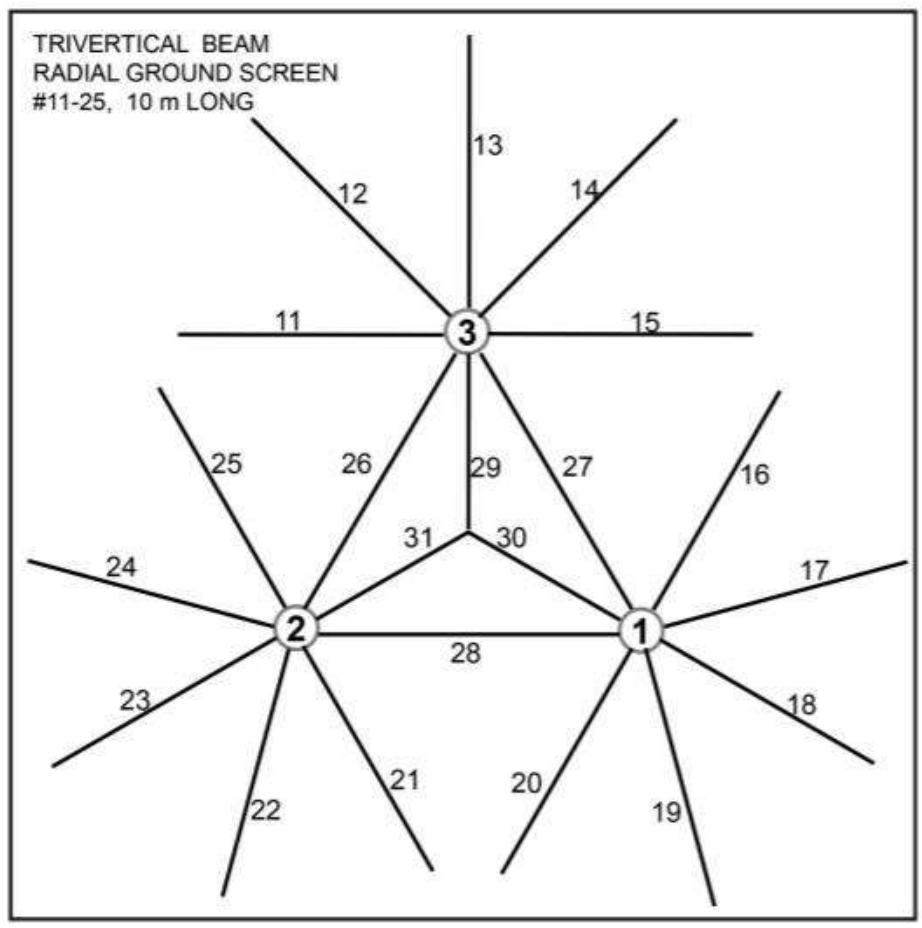

Figure 3: Figure-8 pattern, two verticals antiphased.

and real earth, Sommerfeld approximation[3] (solid line). The relative gains at 20 degrees elevation are 3.5 and -2 dBi, respectively, calculated at 7 MHz.

Driving vertical 3's current 90 degrees out of phase with the first two produces a standard cardioid pattern. Figure 5 shows the azimuth (AZ) pattern for 80 meters over real earth with Sommerfeld approximation, along with its elevation pattern in the main beam at an elevation angle of 20 degrees. The gain is now +1 dBi, 3 dB better than a single vertical.

NOTE: By exchanging verticals 1 and 2, the pattern can be flipped in azimuth, permitting its maximum to appear at either 0° or 180°. Likewise, by exchanging connections

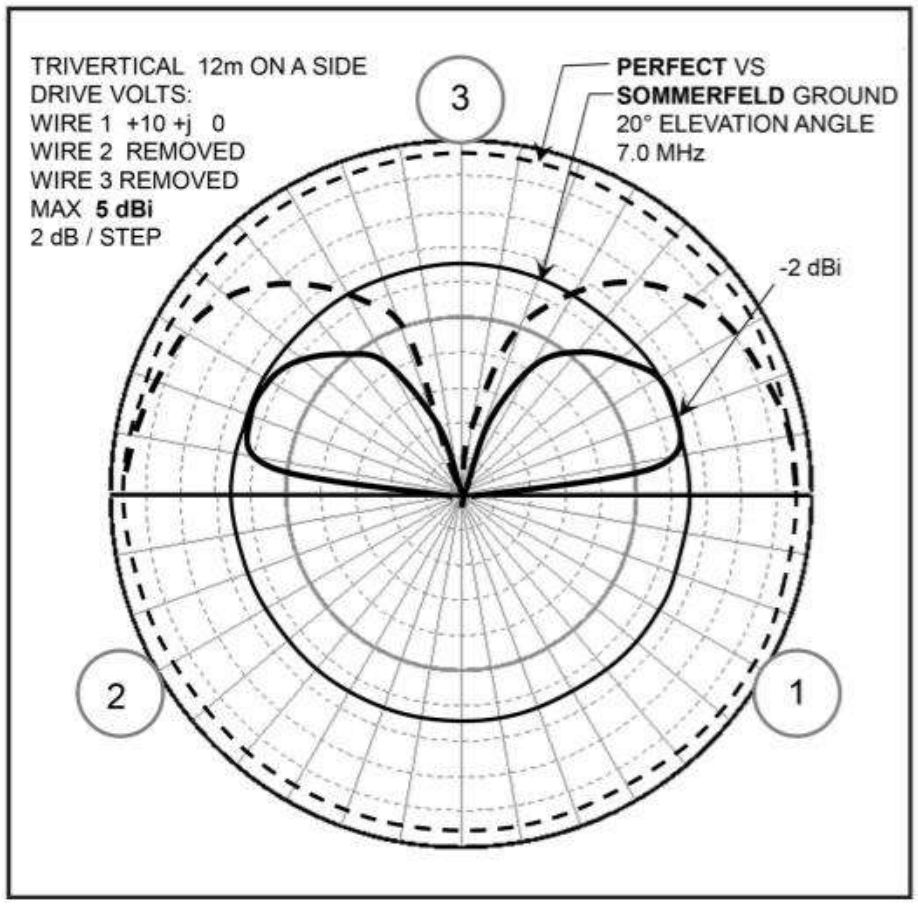

Figure 4: Az/El pattern, single vertical.

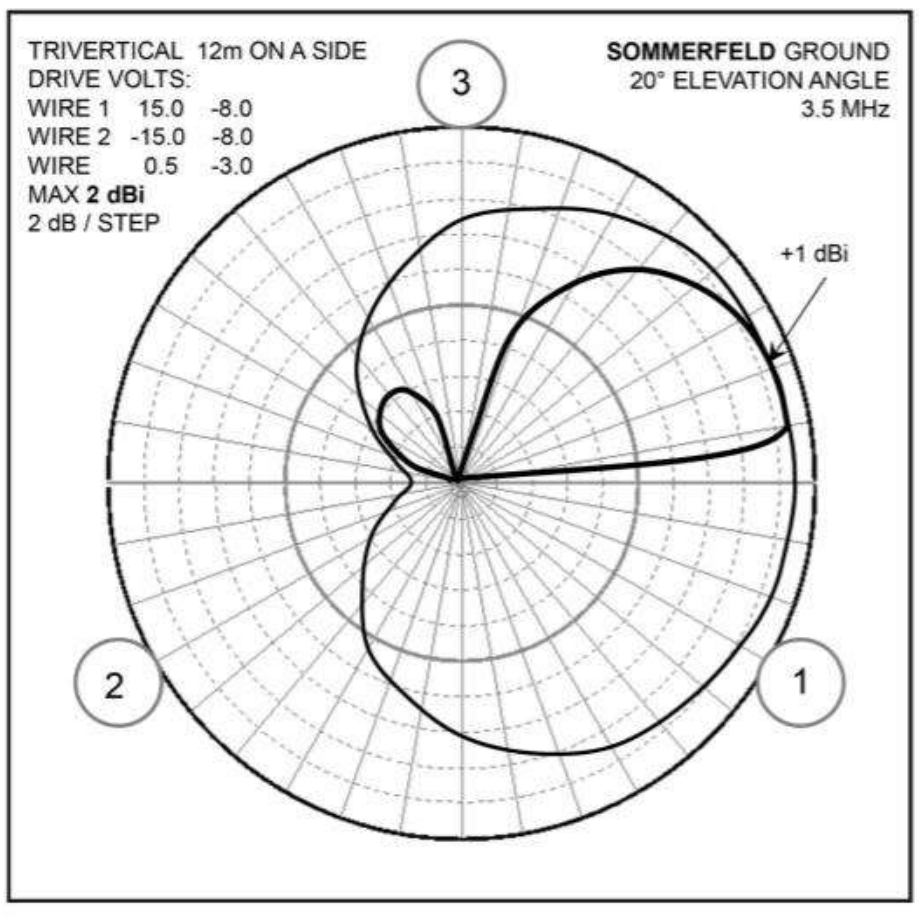

Figure 5: Calculated Az/El pattern, 80 meters.

between verticals 1 and 3, the pattern rotates 60° counterclockwise, and by instead exchanging verticals 2 and 3, it rotates 60° clockwise. In this manner, it can be switched about the horizon in sixty degree steps. The gain 30 degrees off the main lobe is 0 dBi, 1 dB down. A simple set of DPDT relays did the trick for my 1970s design.

Radial Details

The radials follow the teachings of Jerry Sevick, W2FMI (SK),[4] their lengths equal to the height of the vertical. More are better, but Sevick reported a "knee" in the improvement curve at about sixteen. Although in practice I had placed that number under each vertical, my NEC modeling used the field shown herein.

Figure 6 is a calculated pattern for 40 meters, and Figure 7 for 20 meters. The gain over a single vertical at 80 and 40 becomes 3 dB, and at 20, 4.5 dB. I add that no attempt was made in my analysis to maximize gain, nor to optimize patterns. All work done was by guesswork and the beginnings of an exhaustive search procedure.

You may think that a 20-degree elevation angle is not optimum. However, a paper by Professor J. Wait[5] highlighted the wave tilt phenomenon, in which RF tangent to the Earth moves more slowly in the dirt than in the air, and forms a wavefront tilted so as to arrive at about a 20-degree elevation angle, rather optimum for verticals.

After my original array had been torn down, we were granted the 60- and 30-meter bands. This antenna can likely be put to good use there as well. However, it is NOT optimum for NVIS (near-vertical incidence skywave); it's a DX antenna.

Real-World Results

On-the-air experience was gratifying. I routinely worked into Europe on 80 meters a few hours after midnight local time, 0500-0800 Z. And on one occasion, working EI (Ireland), the chap asked if I would listen for several others "riding shotgun." I did so, and worked Guernsey, Isle of Man, Jersey, Scotland, and Wales as well … six countries in ten minutes.

Notes:

1. Numbers refer to wire numbers used in NEC code modeling.
2. Upper Left Corner notation: NEC-4 input data, voltages driven into bottom of each vertical: Vertical 1 10 + j 0 volts Vertical 2 -10 + j0 volts (out of phase) Vertical 3 0 +j 0 volt (no drive).
3. A feature of NEC4 software.
4. See Sevick, *The Short Vertical and Ground Radial*, CQ Communications, 2003; available from CQ Bookstore
5. "Wave Tilt of Radio Waves Propagating Over a Layered Ground," *Wait and Neblusi*, Geophysics, Vol, 61, No. 6, Nov-Dec 1996, pp 1647-1652

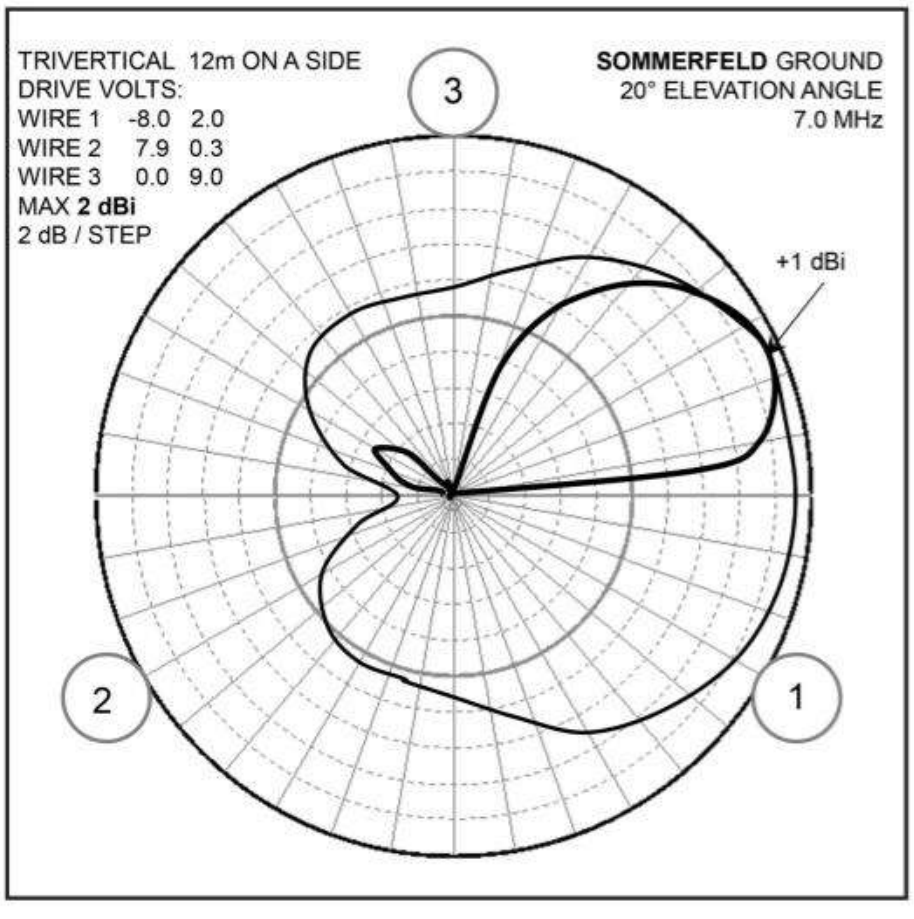

Figure 6: Calculated Az/El pattern, 40 meters.

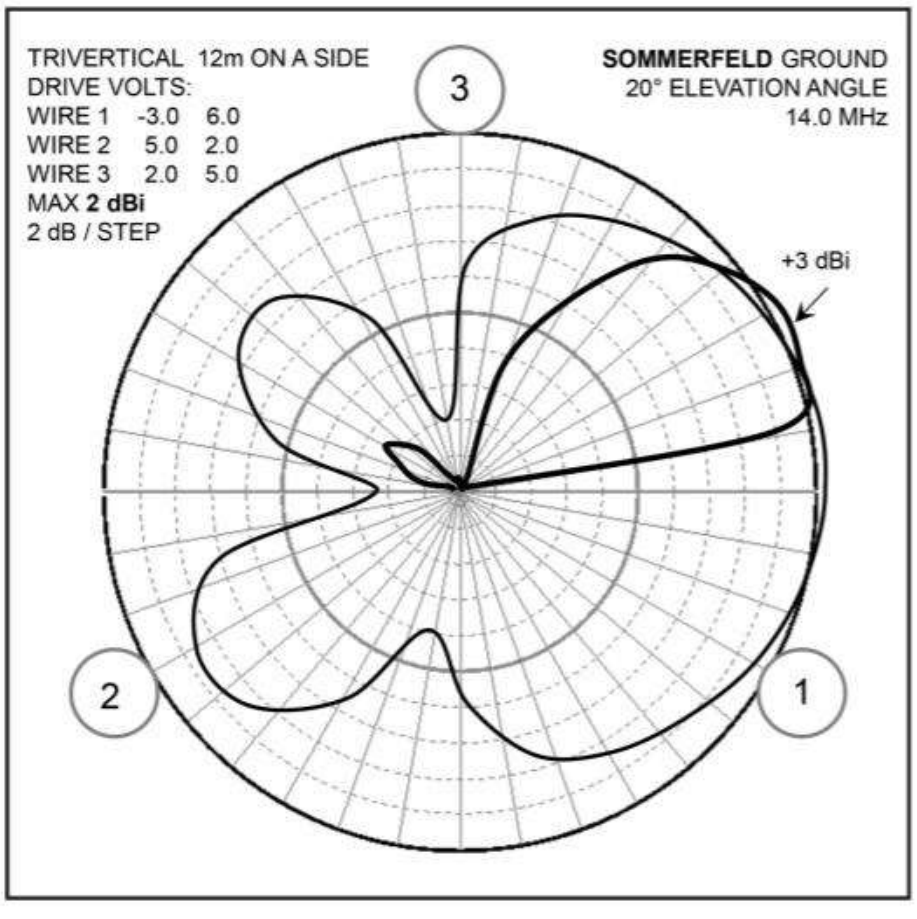

Figure 7: Calculated Az/El pattern, 20 meters.

mf/lf operating: Life Below the AM Broadcast Band

BY JOHN LANGRIDGE, * KB5NJD

Some Thoughts on 630- and 2200-Meter Transmit Antenna Design

Plus a trifecta of antenna problems for KB5NJD, W3TS and GØMRF

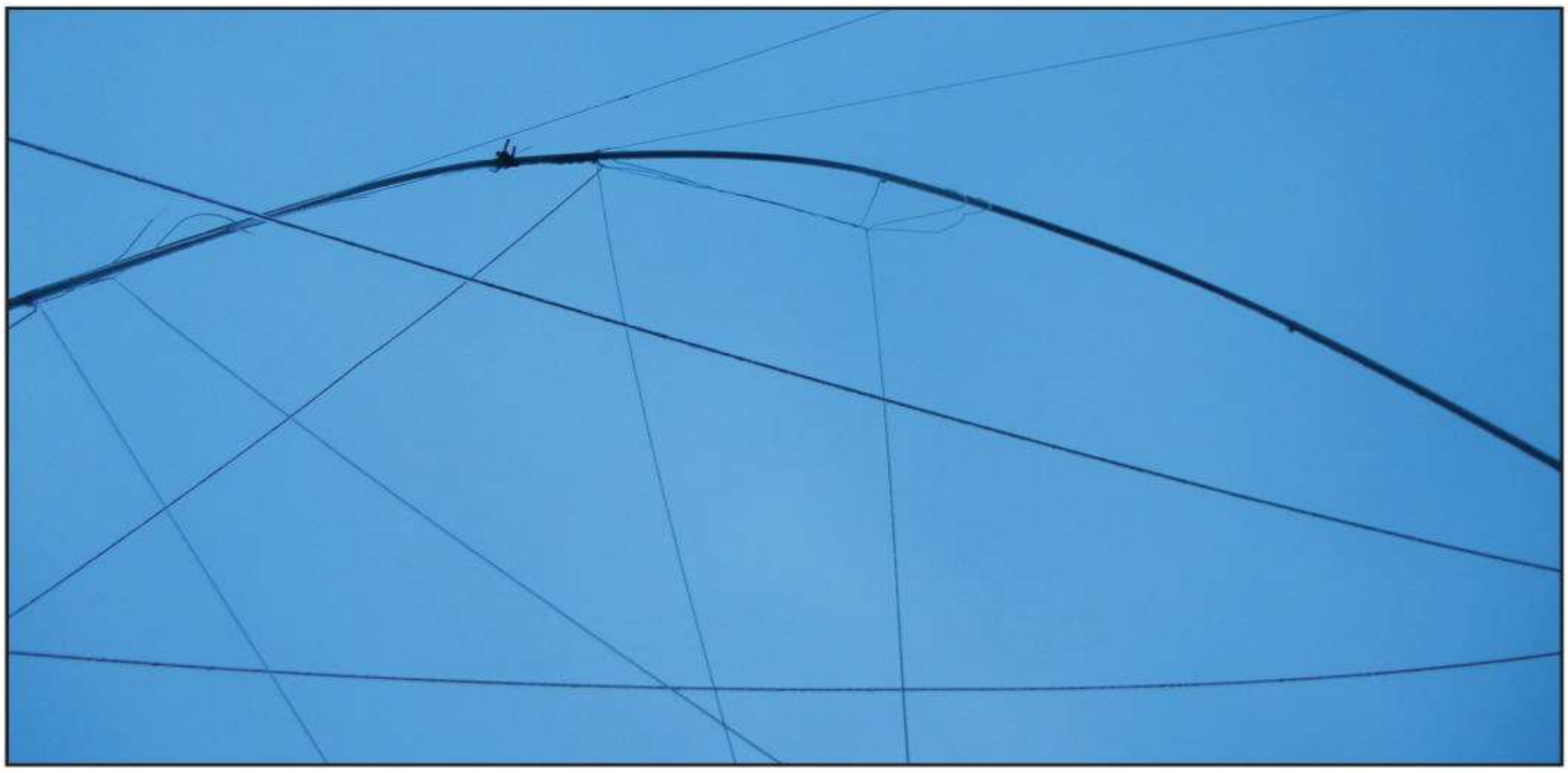

Photo A: Following an ice storm here in North Texas in February, my 80-foot-tall vertical finally had enough abuse after eleven years in the air. Living on a small lot, the guying footprint was a bit small for a vertical of this height but all was well until the weight of one inch radial ice got the structure out of alignment. This antenna has been through a lot of bad weather but this storm was the one that had the honor of taking it down. Fortunately it has since been replaced and I am back on the air waiting for the next storm.

A lot has transpired since my last column, and this month's discussion topic is fresh in my mind following the destruction of my 80-foot-tall asymmetric Marconi-T vertical in early February (due to an ice storm that hit North Texas). As they say, if it doesn't fall down, it wasn't big enough, and that was clearly the case after being in the air for about eleven years and seeing a number of challenging weather events. Fortunately, there were enough pieces still in good shape to cobble a vertical antenna back together and get back on the air within a couple of days of warming up. The new antenna is considerably shorter than the original and has one less top loading wire, making it now an inverted L. Whether I increase the height further and add additional top loading wires will be a decision for later this year. The good news is that it is basically the same radiated signal that I had prior to the storm due to my ability to increase power output from the amplifier to the antenna to make up for the reduced radiation resistance of the shorter antenna (Photo A).

In reality, you can load up just about anything and make it radiate some of the time. I sometimes get discouraged when I hear someone comment that they don't have space for an antenna capable of working on 630 or 2200 meters, yet they have an inverted L in their yard for 80 or 160 meters. I think what they really mean is that they are unwilling to take the time to figure out how to load the antenna on a lower frequency.

For all intents and purposes, the antennas that we will use on 630 or 2200 meters will always be capacitively reactive and their vertical height will always be short with respect to a quarter wavelength as federal law dictates a maximum vertical height of 60 meters. There are many ways to load an antenna to resonance; from loading a coil somewhere in series to the use of long top loading wires attached to the top of the vertical element radiating outward. With no *practical* exceptions to speak of, we typically use some type of inductor to function as an inductive reactance that is balanced to cancel the inherent capacitive reactance that is present in electrically short antennas. Often, these inductors are used in concert with top loading wires to offer some degree of so called "lossless" loading. In fact, it would almost be a shame to see any 630 or 2200 meter antenna that did not have some degree of capacitive top loading, but I can also appreciate that space can sometimes be a constraint that is overlooked by those without the same constraint.

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I have a number of opinions about how to accomplish loading a vertical antenna to resonance, some of which may not be in agreement with the classical approach that has been used by amateurs for about 100 years now. First of all, I don't get too concerned about the use of large loading coils. Coils built on five gallon buckets are common, often implemented as a variometer for on-demand adjustment of inductance. Reactive antenna tuning tends to vary with temperature, moisture, and environmental factors that most amateurs operating high frequencies (HF) rarely have to consider. Having the ability to adjust the coil from ground level by way of a tap and/or variometer movement can be quite valuable and necessitate that base loading be implemented. As I've said before, what we do down below the AM broadcast band is often very different from what is acceptable at HF. We would almost never tell someone to base load their HF vertical, yet it is very common on 630 and 2200 meters.

Photo B: This is a variometer that is commonly used to resonate 630- and 2200-meter antennas. It is two coils in series, a fixed outer coil and another that is rotatable inside of the bucket. RF is applied to one of the taps, selected experimentally using an antenna analyzer to find where reactance goes to zero, thus resolving the resonant point. The top of the coil feeds into the shaft of the nested coil and then returns through the same shaft with the returning wire going to the antenna.

Photo C: Here is an image of the nested coil of a variometer. In this position the coil provides minimum inductance. The number of turns on the nested coil also determines the rate of change of inductance. Input and output for the nested coil are accomplished via the shaft that is used to adjust its orientation. (Courtesy WA3ETD)

Since I mentioned the variometer and that its use is very common on both 630 and 2200 meters, let's briefly discuss what it is. The variometer is basically a movable coil mounted inside of a larger fixed coil. The outer coil is connected in series with a smaller nested coil. The nested coil is rotatable, allowing for fine tuning of the inductance and is typically used to resonate a short vertical antenna. Often, these coils are built using plastic five gallon buckets like those found at home improvement stores. Nested coils are wound on some type of plastic form, often PVC, and a hollow shaft centers the coil inside the bucket and allows the nested coil to be adjusted on demand (Photos B and C). I will go into more detail on the construction and tuning in subsequent articles.

Some operators in the pursuit of more efficient systems have chosen to use elevated and fixed inductors in series with their vertical element, resulting in an inductively reactive antenna that is then brought to resonance with a series vacuum variable capacitor at the base. That approach is fine, but I can tell you that I currently don't know of any active operators using elevated coils because of the mechanics of making them work over the long haul. Even a well-varnished coil will break down as dirty snow or rain adheres contaminants to an otherwise insulated surface. Unless you want lots of aggravation in the long term or you enjoy the engineering aspects of station building over actually operating, stick with a base coil. You can always go back later and work on trying to make your system more efficient.

Something else I don't care for when talking specifically about 630 meters: litz wire. You will regularly run across all sorts of people talking about winding coils with litz wire. If that's you, more power to you, but did you purchase wire that is suitable for the frequency of interest? Skin depths of RF on the wires, number of strands, and other factors impact the performance of litz wire so it could be that you really just overpaid for something not much better than THHN (thermoplastic, high-heat resistant nylon coated) wire often found at electrical supply stores and home improvement centers. Most of us are using THHN house wire or something equivalent. There are reasons that solid #10 and #12 are better, but stranded wire is just easier to work with while winding turns side-by-side on your form, whether that be a bucket or something else. Amateurs will sometimes state that the litz wire helps by reducing the resistance of the antenna and thus helps with receiving. The reality is that a majority of operators seem to be primarily using separate receive antennas, making the wire selection less of a concern.

So why do I think it's all right to not consider many of the inefficiencies that a lot of amateurs tend to obsess over? Since we are regulated by radiated power rules, and power is both cheap and easy to generate at these frequencies, it just makes more sense for the amateur who is interested in actually operating to simply use more power to the antenna to achieve maximum effective isotropic radiating power (EIRP) for the band of interest. That's easy, for the most part, on 630 meters but can be a bit more challenging on 2200 meters and I certainly concede that fact. It's not impossible, however. On 630 meters we are allowed to use up to 500 watts of power to the antenna to achieve 5 watts EIRP. In practice, most of us use between 50-150 watts to accomplish the task. On 2200 meters, 1500 watts of power to the anten-

na is permissible to achieve 1 watt EIRP. Many of the operators on that band can achieve maximum EIRP with 300-500 watts applied to the antenna, in practice.

Determining compliance with radiated power rules is often done by measuring antenna current with a thermocouple RF ammeter. By estimating radiation resistance of the antenna structure in question through a standard calculation that takes into account the physical parameters of the antenna including both height and capacitive top loading wire length for a given frequency, it is possible to get a rough estimate of the EIRP. Calculation of EIRP in watts is done by squaring the measured antenna current and multiplying by the estimated radiation resistance. Multiplying by a directivity factor of three completes the calculation. In practice, if you are within 3-6 dB of the maximum EIRP, you are doing really well, which is just a reality for the average backyard antenna. Most of us do not live on antenna ranges and the implementation is almost always far from perfect. I think most of us exercise due diligence in making sure that we are in compliance and do our best to justify, on paper, how much power we are applying to our antennas.

Ground loses can be high on these bands and often amateurs implement insufficient radial systems. In recent years, I've encountered amateurs who have completed DXCC on 160 meters with only two or three ground-mounted radials. It's a noble accomplishment but may lead to serious disappointment on 630 and 2200 meters. Experience says that even very short antennas can perform well, particularly on 630 meters, when quality radial systems are implemented. That does not mean that you must install a broadcast-quality radial system but ensuring that your

Photos D, E, and F: When things get out of control at the antenna on 2200 meters, they can REALLY get out of control. These images from David Bowman, GØMRF, show just how much energy is present when something goes wrong. Be careful when using ropes that may absorb water when supporting antennas as they can and often will become conductive, resulting in a runaway situation. David did not indicate what finally stopped the runaway event but I'm going to guess that it was a power supply circuit breaker. Most of the silicon carbide FETs in use today in homebrew amplifiers typically don't care if something begins to arc and will continue to generate power until something in the source fails.

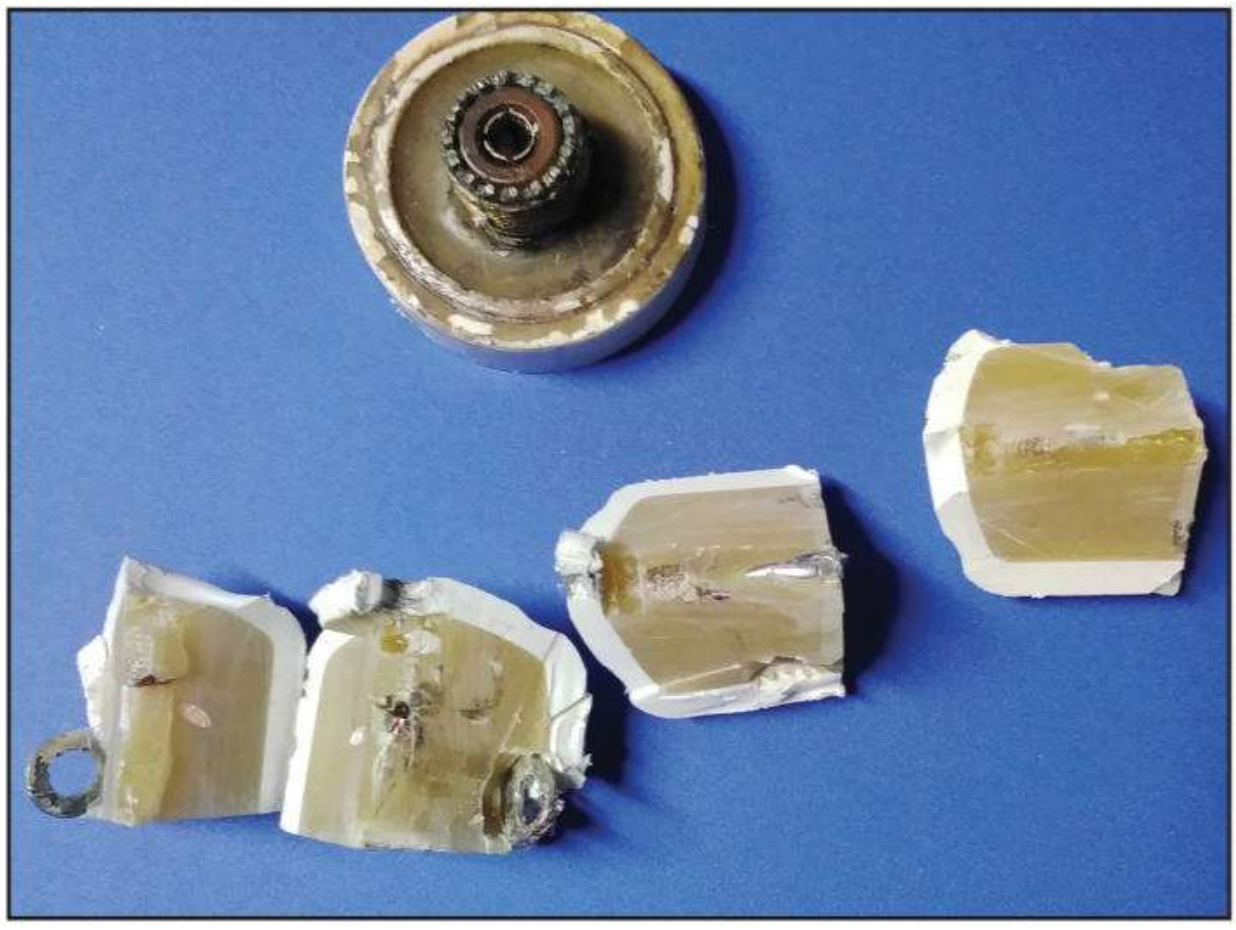

Photo G: This is the 37-year-old W3TS insulator that arced within the epoxy potting. Mike noted that the eye bolt support on top only had about 1/8 inch separation from the SO-239 center wire. Just a bit of cracking in the potting could certainly result in a path for an arc to develop.

unmatched system resistance is below 50 ohms is a very desirable thing. In practice, many operators report system resistances from 10 ohms up to about 25 ohms, as measured on an antenna analyzer at resonance. That makes antenna matching fairly easy to accomplish using shunt inductors or traditional transformers. A recent discussion on the RSGB low frequency Groups.io reflector indicated that on 2200 meters, a couple of ground rods implemented at the ends of a number of radials that are installed under top loading wires *may* be more desirable than a dense radial field. I will let readers research that further and decide for themselves.

John Devoldere, ON4UN (SK), included a section in his book, "Lowband DXing," in which he discussed optimum radial implementation depending the amount of wire available. I think it is a must-read for anyone preparing to install a low band antenna system. As a generalization, more shorter radials are typically better. Radials longer than the vertical height of the antenna are not as impactful unless there are many radials (perhaps hundreds?) equally spaced around the antenna. When capacitive top loading wires are implemented, a number of longer radials under the top loading wire and extending beyond, perhaps 10 to 25% longer, can be useful. My radial system was built about 20 years ago when I was very active on 160 meters. The antenna was 70 feet tall at the time with a combination of base loading and top loading and the radial system included 150- and 100-foot-long radials. The implementation was more or less homogeneous with respect to the layout although radials were slightly shorter to the south. I am fortunate to be in a situation where I can have radials that spill off of my property onto surrounding land.

When I implemented the 160-meter antenna for 630 and 2200 meters, increasing the height to 80 feet and adding top loading wires that were 100 and 200 feet long in an asymmetric Marconi-T configuration, approximately twelve additional radials were added under the 200-foot top loading wire and they were slightly longer at the far end . The tree that this long top loading wire terminated in is also not located on my property. With my recent decrease in antenna height due to the ice storm, I have really long radials with respect to the antenna height but my system resistance is about 13.4 ohms as I write this article in late winter and I suspect that the value will change as we move into spring and summer environmental conditions. A resistance of 13.4 ohms is easy to match to the coax using a small air-wound shunt inductor.

All of this is food for thought as you prepare to build your 630- and 2200-meter station. In our next installment we will discuss the finer details of constructing and tuning a bucket variometer. There is a lot of information on the internet about how to do this and I have described it in detail in my writings in recent years so if you want to get started now, a little research will pay dividends!

2200-Meter Antenna Fire at G0MRF/p

Since we are on the subject of antennas and loading coils, it is appropriate to present a cautionary tale from David Bowman, GØMRF, of Whitton, West London, England. David has been a regular contributor to this column and for several years has been operating a seasonal remotely controlled station with a large vertical antenna system in a rural area several hours from his home. He has operated the system remotely on both 630 and 2200 meters but this year his activity was primarily on 2200 meters. That is, until disaster struck. A fire started when the antenna arced to and burned through a wet support rope. The live antenna then fell onto a barbed wire fence, resulting in a short circuit that David reports caused an even higher voltage than normal to be developed at the top of the loading coil. A large plastic trash can was inverted over the coil assembly for weather protection and was located about three inches from the top of the coil. It seems to have encountered the worst of it. Let's all be careful out there! (Photos D, E, and F)

More Trouble at W3TS

In my previous two columns, I detailed some of the encounters between Murphy and Mike Michael, W3TS, of Halifax, Pennsylvania, that required considerable effort to correct. Perhaps the third time is a charm as Mike reports another arcing event, this time at the top dipole feedpoint insulator that supports his 40- and 80-meter dipoles that also accomplishes top loading for 160 and 630 meters. The insulator was 37 years old so none of this probably should be unexpected. Carbon tracks developed in the epoxy potting material so it is possible that a moisture incursion and cracking with time resulted in this latest problem. Once all of these problems are resolved, Mike may have a brand new antenna. (Photo G)

That's all for this month. If you have questions or comments, please direct them to me at <kb5njd@gmail.com>.

qrp: low-power communications

BY R. SCOTT ROUGHT,* KA8SMA

Contesting Strategies for the QRP Operator

One of my favorite aspects of amateur radio is contesting. There are four contests I look forward to operating each year: the CQ World Wide DX Contest, CQ World Wide WPX (Prefix) Contest, the American Radio Relay League (ARRL) International DX Contest, and the ARRL November Sweepstakes. I usually make a good effort by operating 20 or more hours in the SSB leg of each contest and only an hour or two (if any time at all) in the CW portion of each contest. Although I enjoy CW, I am intimidated by the high speeds [30 or more words per minute (wpm)] at which many operators send code during contests. For this reason, I lean toward the phone contests where I trade high-speed CW for fast-speaking hams with foreign accents, which has its own type of frustration.

After working the ARRL International DX and CQ WPX contests in March, I felt the need to go back and review my August 2016 column, "The Do's and Don'ts of QRP Contesting." I did this to refresh myself on some of the cardinal rules of QRP contesting and to help me better prepare for the upcoming CQ World Wide DX and ARRL November Sweepstakes contests. With the solar cycle changing for the better and more hams potentially giving contesting at QRP power levels a try, I am providing a recap of some of the more important Do's and Don'ts of QRP contesting and adding some I have learned since.

During the spring contests I heard more QRP stations on the air than I have in past contests. How did I know these stations were operating QRP since neither contest requires power output to be identified? The answer is simple, they were adding "/QRP" to their callsigns. I admit that when I first started to actively contest QRP-style, I added /QRP to my callsign with the idea it would get me noticed in a pileup; however, this can be confusing for the operator on the other end and takes more time. During a contest, the exchange needs to be short and concise. I have already received grief from

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Photo A: The northern lights as seen from Grand Traverse Bay in Traverse City, Michigan on Thursday, March 23, 2023. (Photo by Helen Rought)

fellow contesters that my call sign (my original 2x3 Novice callsign) is too long and I should consider exchanging it for a shorter one. I have heard on more than one occasion that real contesters have three or four letter callsigns – ouch! Adding "/QRP" makes your call longer, regardless of whether your callsign is a 1x2, a 2x2, etc. Also, some contesters may not work you because they do not know how to enter your call in their log (do I add /QRP to the callsign or not?) or may not work you solely because it is a lot to write in the log. Do not be left out of a log, *drop "/QRP" from your call*.

A pet peeve for many contesters is beginning your exchange with "please copy." Some readers may recall my story in a previous column about the operator in 6-land who denied me his contact in ARRL's November Sweepstakes because I started my exchange with "please copy." After I had provided my report the operator responded with "I don't work hams who say please copy," then said QRZ and moved to the next station giving him the serial number (contact number) he had given me. Later in the contest, I contacted this ham again to secure the contact, but as he was replying he stopped short of completing my full call (he was as far as saying "KA8S") and then called QRZ. It was as though I did not exist and was put on a "Do Not Contact" list. Since contest exchanges should be short with no added verbiage, I try hard to rid my vocabulary of this phrase and provide only the information that is necessary for the exchange and nothing additional. As a QRP operator I need every contact I can make, especially if it is a needed section for a clean sweep (which I did not achieve) in ARRL's November Sweepstakes. I hear "please copy" numerous times during contests. Don't let this unnecessary phrase deprive you of a contact.

Search-and-pounce is the QRP operator's friend in contests, and learning how to do this well can have huge payoffs. This should be done methodically by beginning at one end of the band and slowly scrolling across the dial in search of stations calling "CQ test." After reaching the end of the band, go back to the beginning and scroll across a second time in search of more contacts. As you move across the dial, work all the stations you can hear, but do not get caught up in calling a station more than three or four times. If the station calling CQ does not reply to you on your first few calls, do not fret, simply write down the station's call sign and frequency and return later to try again. This is often hard to do, especially if the station is a needed multiplier or rare DX, but your time will be better spent working other stations and snagging multipliers that are easier to work. Do the same for pileups. If you cannot break the pileup in a few calls, then try again later. Remember that when working a pileup, timing and frequency are everything, whether operating CW or SSB. Ask yourself whether the calling station works "tail enders" or only stations that wait until after he calls QRZ or gives his callsign. Also, adjust your transmit frequency as necessary. I have found that some operators "running" a frequency (staying on one frequency and calling CQ) may be listening slightly off frequency. Try and learn the operator's habits before spending time trying to work this station.

If you hear a weak station calling "CQ test," reply with no hesitation; do not think about whether the station may hear you. I have been surprised on numerous occasions when I have called a faint station that is nearly buried in my noise level and received an immediate reply. Be prepared to copy his information as you do not want to be in the position of asking for a repeat when his signal is weak.

A QRP station running a frequency can and does happen; however, do not try this at the beginning of the contest as your pipsqueak signal will be overshadowed by the number of QRO stations calling CQ. I have found that after the contest's midpoint, the bands are less crowded, providing clear frequencies for a QRP station to sit on and call CQ. A running technique I heard during a recent contest was a station announcing he was QRP as part of his CQ. The station simply called "CQ WPX from QRP station X." I am not sure how the contest community may view this, but I like it. Operators searching for contacts may feel the need to help the little pistol and toss out their callsign as they tune across the band. Although some may consider this ham is trying to score contacts by playing the sympathy card (indeed, he may be), a contact is a contact. A lot of hams rely on tall towers, stacked Yagis and amplifiers to make contacts during contests; QRP operators rely on timing, sheer will, and sometimes a little ingenuity.

Photo B: The PreppComm MMX Multi-Band Morse Code Transceiver. Stay tuned for an upcoming review.

Probably the number one consideration in QRP contesting is knowing when conditions will be favorable for each band. Ten and 15 meters are a QRP contester's dream when they are open. With Cycle 25 heating up, one can spend hours on either of these bands working one DX station after another during a contest. However, do not be too dependent on one band. A high number of contacts is important, but do not forget you also need multipliers. Working multiple stations in Austria on 10 meters is good for your score; however, working a station in Austria on 10, 15, and 20 meters is better given the contest awards a multiplier each time you contact Austria on each different band.

Staying abreast of propagation forecasts is also useful for the QRP operator, but do not become reliant on them. Several days before the CQ WPX SSB contest, I started looking at solar forecasts on <www.spaceweather.com>. Everything was on target for a good contest with favorable solar indices, then on Thursday night at 10:00 p.m. (less than 24 hours before the beginning of the contest), my wife told me a friend had just posted a photo on social media of the northern lights taken from her backyard. I immediately went outdoors, looked north, and saw a whitish haze above the horizon. My wife (right behind me) said let's go to the lake (Lake Michigan) for a better view. A few minutes later we were parked along the lake where I watched the glistening greens and reds danc-

ing against the back scape of Lake Michigan (Photo A). At that point, I knew this would be a difficult contest, especially for the low power operator.

When we arrived home at about 11:00 p.m., I checked <www.spaceweather.com> and there was news about a "surprise geomagnetic storm" that had just occurred. When I checked the website the next morning, the geomagnetic storm had been upgraded to a severe storm and was identified as the strongest storm seen in nearly six years. It was also reported that "forecasters did not see this one coming." The cause of the storm was not known, but it was believed to be the ripple effect of a coronal mass ejection (CME) that had occurred earlier and missed Earth (not forecasted to be a concern).

It is important to note there are also times when the solar indices may indicate poor band conditions, but the bands are open. Bottom line, do not fully rely on solar predictions. I look at solar forecasters the same way I do weather forecasters, it is the only job where you can be wrong 50% of the time and still stay employed!

As I reread my column from 2016, I noted one "Don't" at which I have completely failed … "Don't get discouraged if you have a slow QSO rate." For me, this applies to my QSO rate in CW contests. As mentioned at the front end of the column, I sway from CW contests because I have difficulty copying high-speed CW (my comfort speed is around 15 wpm) and, after an hour or two of not making as many contacts as I would like, I give up. To help me overcome this issue and increase my CW speed, I downloaded MorseRunner, a free Morse code simulator available online at <https://tinyurl.com/4s3krxdn> that provides all the fun and challenges (QRM, QRN, loud pileups, etc.) of a contest. This appears to be a great tool, but I need to spend more practice time with the simulator for it to make a significant difference in my CW skills.

As it turns out, I am reviewing the PreppComm MMX Multi-Band Morse Code Transceiver (Photo B) that will be featured in an upcoming edition of *CQ*. This unit can be used as either a QRP transceiver or can be attached to another transceiver and used as a CW decoder/encoder. PreppComm claims the MMX will decode fast CW operators and help you learn to do it, too, by cognitive association. This could be another answer to my high-speed CW debacle. Stay tuned as I get warm and fuzzy with this unit.

Until August, 73

behind the bylines...

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

Alfred Yerger II, K2ATY ("DMR on Land and Sea," p. 8) has been a professional in the land mobile communications industry for nearly 50 years, currently working on interference mitigation and antenna site issues for Bird Technologies Group. He operates an Echolink node and is very active in local clubs near his home in Newburgh, New York. His most recent focus, as is evident from his article in this issue, is the marriage of the Internet and amateur radio. "If done properly," he says, "the Internet will enhance amateur radio, not diminish it."

Michael Toia, K3MT ("The Bramham 60° ~~Balun~~ Impedance Transformer," p. 45 and Guest Antennas Editor, p. 78), is a frequent contributor to *CQ*. He was first licensed at age 14 as WN3TQM in 1952, worked his way up to Extra Class and received K3MT when vanity calls first became available in 1976.

As a physicist, he tells us, "I've worked EM theory – antennas and *electromagical* effects – at Ft. Monmouth Signal Labs, Army, Air Force, FCC, VOA, GSA, industry, academia, and assorted indescribable programs … Retired in 2016, I now write and publish technical references, DVDs and books (see <www.jokalympress.com>). Google K3MT to get a glimpse of my work. KG4ABD is my XYL, and YL KF4LGR is our first harmonic."

David J.J. Ring, Jr., N1EA (CQ Book Review: "The CW Way of Life," p. 52) is a rarity in today's world, a professional telegrapher who worked as a Merchant Marine Radio Officer from 1980-93. In 1980, he and a colleague received and relayed CW distress calls from the S.S. Prinsendam, which had caught fire in the Gulf of Alaska. The ship's satellite communications failed during the emergency and Morse code on 500 kHz was the only means the crew had to communicate. Everyone aboard was rescued. In 1986, Ring and his colleague were honored by the Veteran Wireless Operators Association with the Marconi Gold Medal for their work in coordinating the rescue.

Junichi "Jun" Okamura, JF1RWZ ("Introducing 'IBP Beacon Now'," p. 58) has been a ham since 1966 and loves collecting awards. He lives in the suburbs of Tokyo and has built the webpage he writes about in this issue to help DXers gauge propagation on the upper HF bands via the international beacon system, regardless of their Morse code proficiency. A version of this article appeared previously in *cq hamradio* (Japanese CQ) and is republished here with permission.

zero bias *(from page 6)*

made it time to consider a change in DXCC criteria? Perhaps operating from an entity's territorial waters should count, especially if operating from land is difficult or impossible. We'll be happy to share opinions in our pages, but of course any decision to make a change ultimately lies with the ARRL board of directors.

Little Jabs from Murphy

The other day, I realized that my shack computer was actually discouraging me from getting on the air. It was built by dinosaurs, is very cranky and slow to boot up … if it boots up … and then even slower to shut down when I'm done. Thinking about all that waiting time often makes me think it might be better to do something else. So I dug out an old paper logbook, made a few copies of a blank page and turned on the radio. I was greeted by … nothing! The bands appeared to be totally dead, except for one guy on 20-meter CW working a state QSO party – and I couldn't even hear him, just the people working him! I tried a few CQs on a couple of bands but had no takers, and was actually relieved when it was time to shut down. Thank goodness for contest weekends, when band activity is guaranteed and your chances of making some contacts – even non-contest contacts – greatly improve.

Summer is almost here. Take your gear out in the field if you can and make some noise on the bands. The people listening for your CQs will thank you!

73, Rich W2VU

ham radio explorer

BY ANTHONY A. LUSCRE*, K8ZT

Check Into Repeaters Around the World

No Extra or Special Radio Needed

When you saw the headline, you might have thought of DMR, D-Star, or Fusion radios and their ability to contact repeaters worldwide using the internet as a backbone. For any of these, you typically need to buy a new radio with digital FM capabilities or a hotspot supporting your chosen protocol(s) (*see article on DMR hotspots elsewhere in this issue – ed.)*. The good news is this month's column will not require you to purchase any new radio equipment. Instead, we will explore two methods that will allow you to access many repeaters (analog and digital) via your home computer, smartphone or tablet.

What is the Catch?

There are a couple of limitations. First, for analog repeaters, the repeater owner has to add a "gateway" to allow you to access the repeater via an internet protocol. Fortunately, this is a relatively easy and inexpensive process which I will outline later in the article. There are a few different "gateways" we could use, but for the purpose of this article, we will use Echolink, found at <www.echolink.org>. The second catch is that you must register as an Echolink user and provide proof of your amateur radio license; therefore, it may take a few days to a few weeks. For digital-FM repeaters (DMR, D-Star, and Fusion), we will use a pair of applications that can be used on your computer – DudeStar <https://tinyurl.com/kh3k432w> – or smartphone – DroidStar <https://tinyurl.com/9jchfx7p>.

Echolink

From the Echolink website: "EchoLink® software allows licensed Amateur Radio stations to communicate with one another over the internet, using streaming-audio technology. The program allows worldwide connections to be made between stations or from computer to station, greatly enhancing Amateur Radio's communications capabilities. There are more than 350,000 validated users worldwide — in 159 of

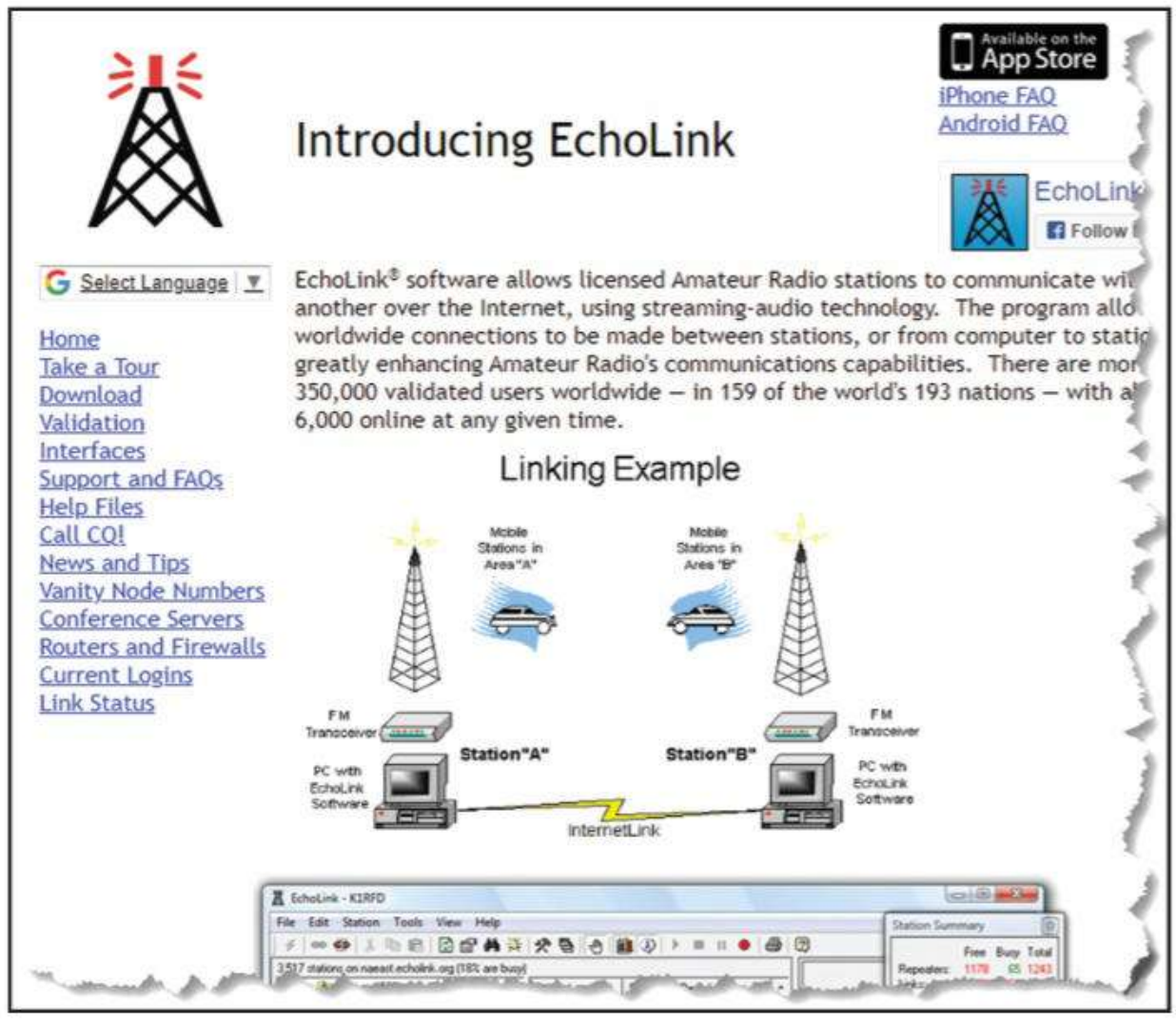


Figure 1: Screenshot of the Echolink website.

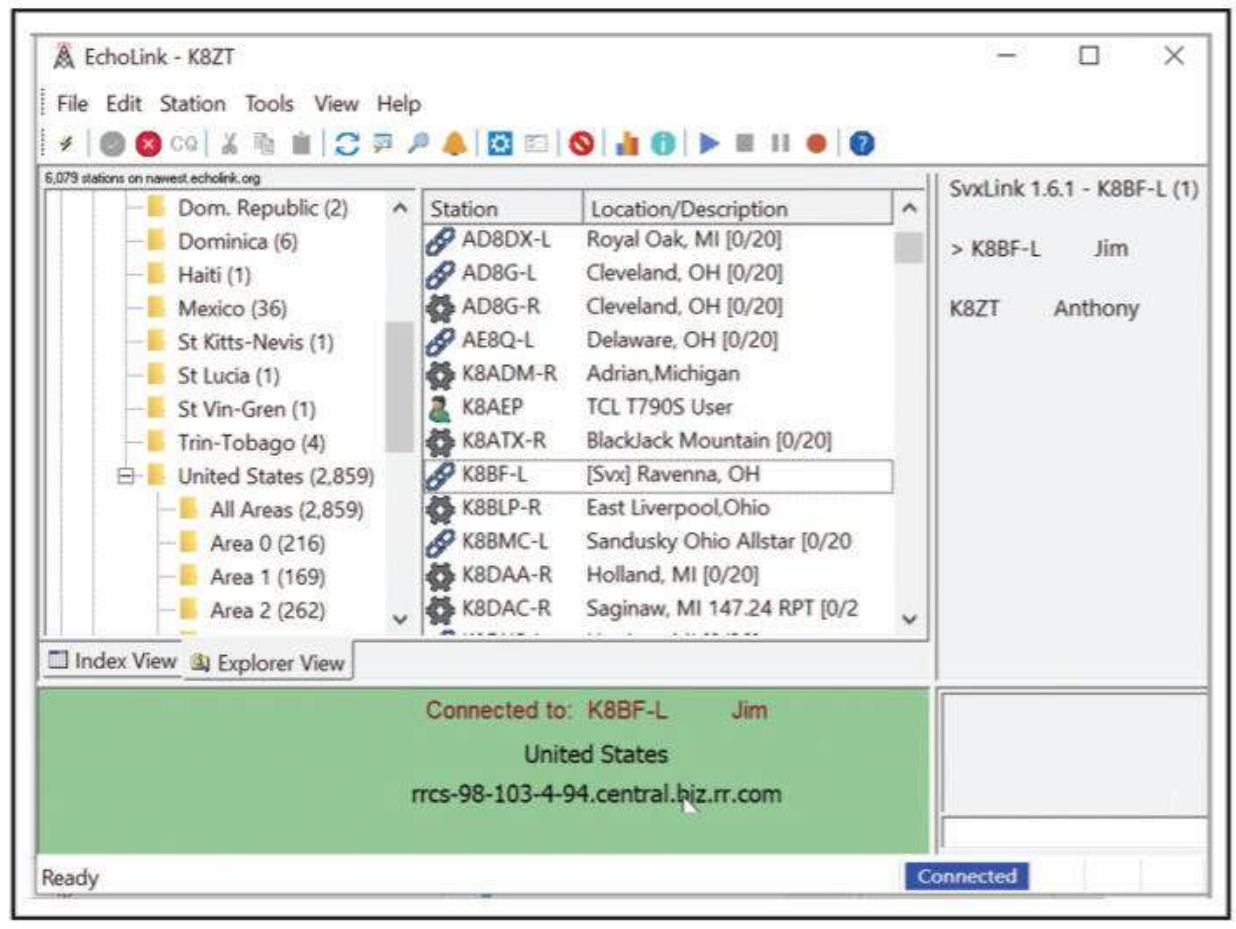


Figure 2: Screenshot of Echolink software showing connection to K8BF repeater in Ravenna, Ohio.

**Email: <k8zt@arrl.net>, website <www.k8zt.com>*

the world's 193 nations — with about 6,000 online at any given time."

We will explore Echolink's end-user (computer user mode) portion and leave the repeater set up (Sysop mode) for local repeater owners.

Installing Echolink

Basic instructions:

a. Download free software <https://tinyurl.com/yshbav7s> and install it to your PC. For a smartphone, install EchoLink App from Google Play Store or Apple App Store.

b. Configure software.

c. Choose Computer User mode (NOT Sysop mode).

d. Next, you'll be asked to enter some information about your station.

- Callsign: Set the callsign precisely as you wish to be registered with EchoLink. If you have already registered, use the same callsign you used previously.
- Password: If you have used EchoLink previously, type your original password here. Otherwise, select a password you can easily remember, which will be assigned to you as you register. Be sure to make a note of it in case you need to reinstall the software.
- First Name: When you establish contact, this name will appear on the other station's screen. Enter the name by which you wish to be called.
- Location: Enter the location of your station or a description of its function. This location will appear in the list of available users. Example: "Akron, OH"
- Email Address: Please enter your e-mail address. This address is used only for initial registration and will not be published or displayed anywhere. After registration, please use the EchoLink Web site to inform us of any change in your e-mail address.
- Region: You will be asked to indicate in which general region of the world you are located.
- Firewall Test

e. Configure your computer microphone and speakers.

- From the top menu bar, choose Tools, then Setup
- Choose Audio tab

f. Callsign Validation: If you have never used EchoLink before, the callsign you entered will need to be validated by the system before you will be able to access it. To gain access, you must provide proof of license to the EchoLink system; for details, go the Validation page on the EchoLink website, located at <https://tinyurl.com/mpn9cznr>. Until the callsign has been validated, the Station List area of the screen will be blank or may display a message indicating that your callsign is not yet validated. Once validation is complete, you will see the list of stations appear in the Station List area, and you can proceed to use EchoLink.

Making Your First Echolink Contact

After your Call Validation has been completed, click on Locations, then choose a region with which you would like to make contact. Drill down through listings to find a desired

repeater. Alternatively, if you know the call sign of a specific repeater, you can skip ahead by going to the top menu and choosing “Station” then “Connect To.” After double-clicking on your chosen repeater, you will receive an audible indication and display notifying you that you are connected. Some repeaters will also give you an audio signal, including their callsign. You will use the computer’s keyboard’s space bar to toggle transmit on and off. You can continue to remain connected and listen to the local repeater. When you are done, you can click the small red “X” on the top menu to disconnect from the repeater.

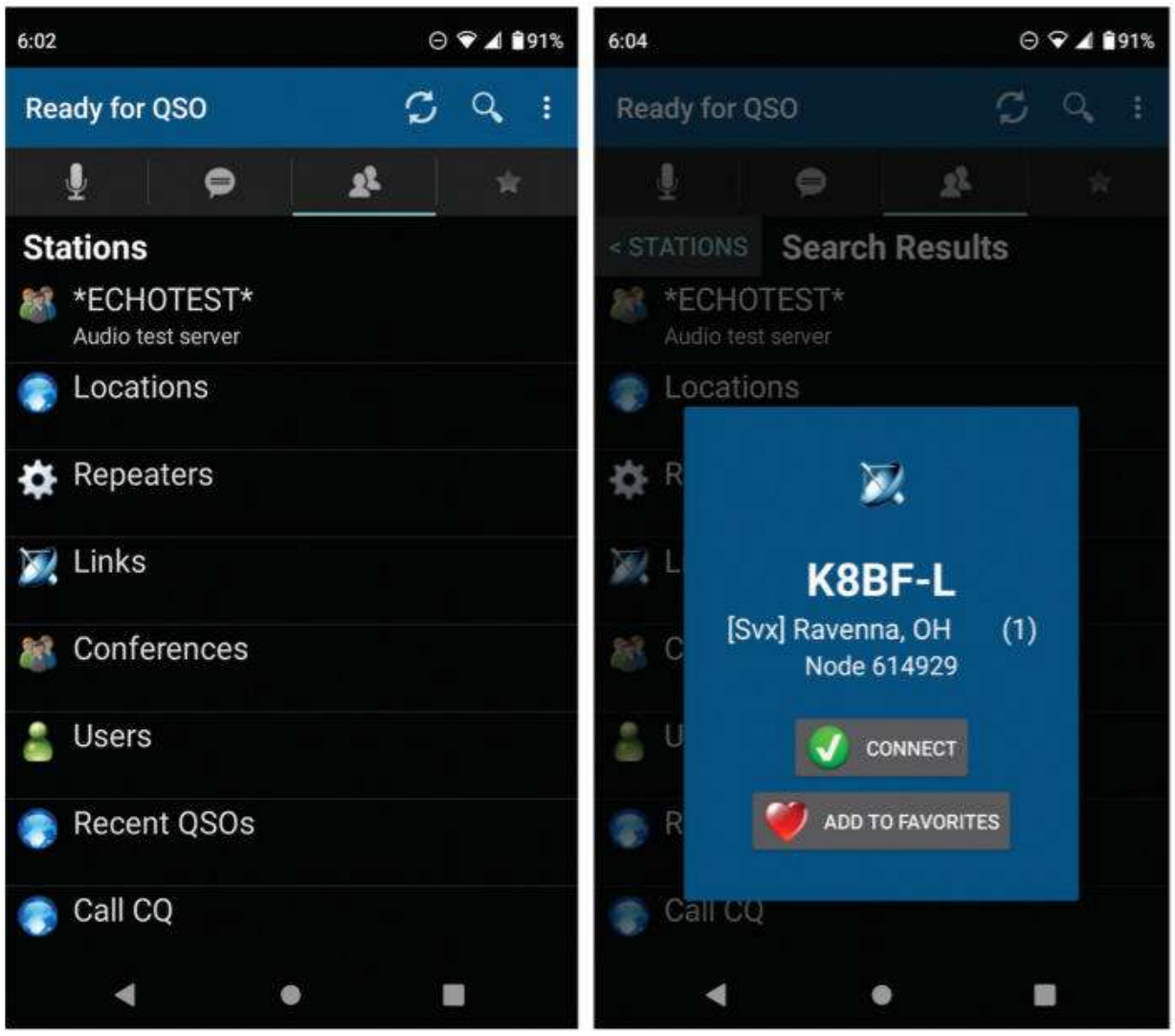


Figure 3: Screen capture of Echolink App for Android.

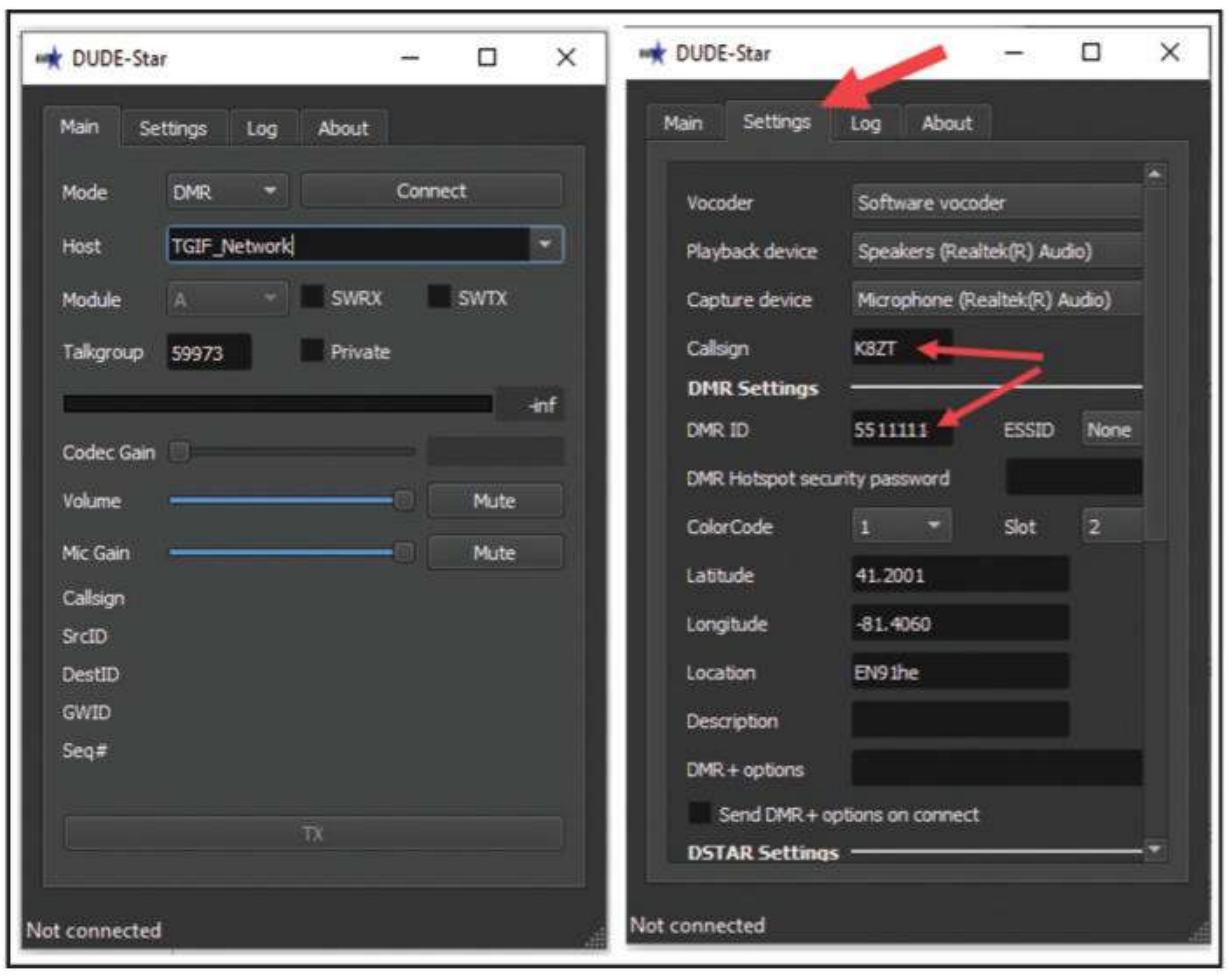


Figure 4: Screen capture of DudeStar for Windows.

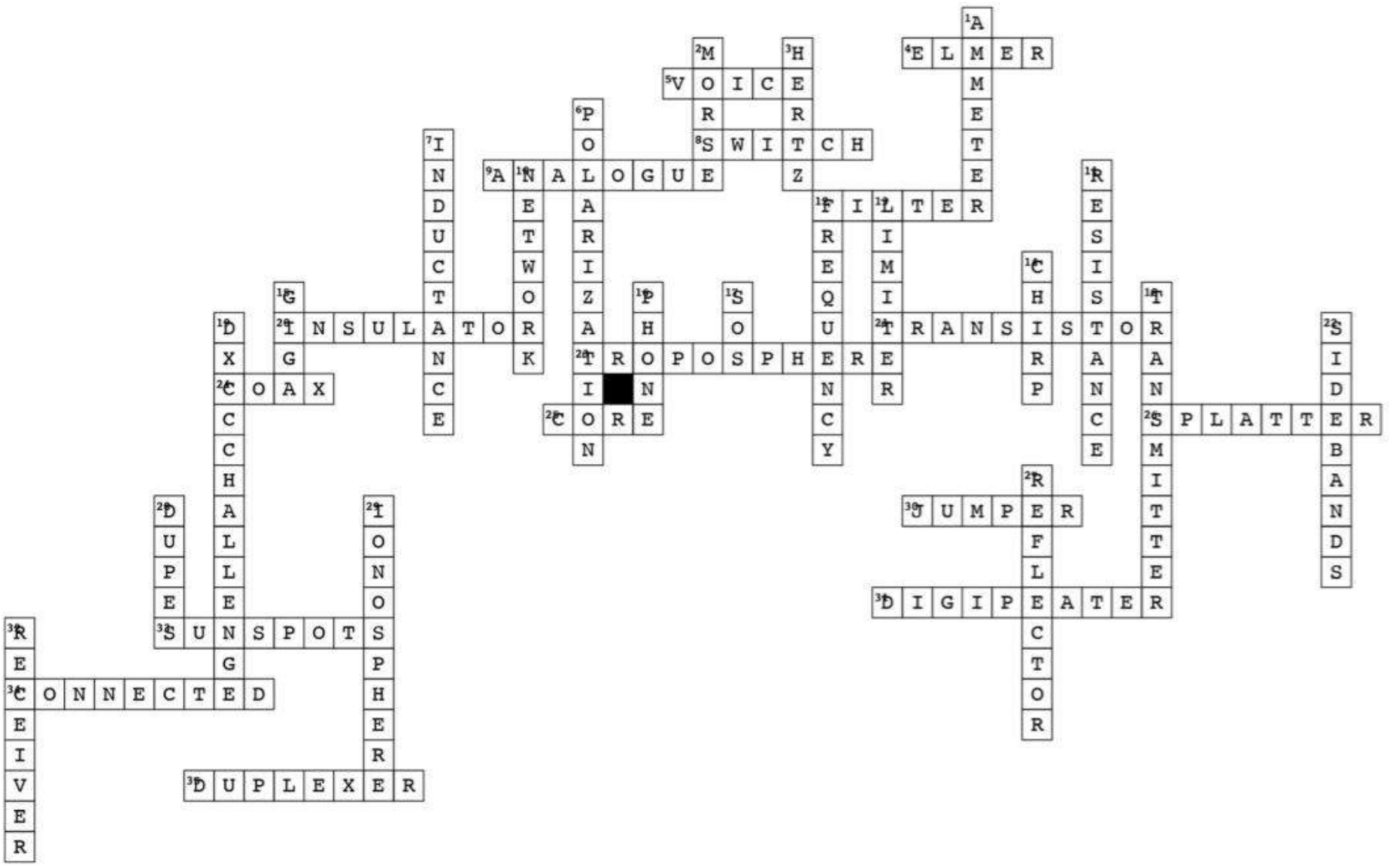
DroidStar and DudeStar

These two programs from Doug McLain, AD8DP, allow you to access DMR, DStar, Yaesu Fusion, M17, P25, and NXDN digital repeater modes without a radio or hotspot. It uses the internet to make connections. DudeStar is a Windows-based computer program, and DroidStar is an Android app. Please note these programs are still in development, so your mileage may vary. You can download the DudeStar software at <https://tinyurl.com/5t3ckpam>. To use this software, you will need a DMR ID. If you don’t already have an ID, you can get one on <www.radioid.net>. Even though a DMR ID is not necessary to transmit on the D-Star or Yaesu networks, DUDE-Star uses it to ensure that you have a valid call sign and are allowed to transmit on the ham radio bands. Verifying your license is usually quick, but it might take up to a couple of days to validate your account.

After downloading your software, you will need to configure it. First, enter your callsign and DMR ID on the “Settings” tab. The DMR password is required for Yaesu Fusion and D-Star. For Yaesu Fusion, this is all you need to set up. There are additional required settings for D-Star and M17. On the “Main” tab, you will need to select the “Mode” you want to use. You must also know “Host” information, “Talkgroup,” etc. The rest of the process is beyond this article’s scope and requires some basic knowledge of specific digital repeater modes. So as the column name suggests, it will require additional exploring on your part.

That’s it for this month. If you are interested in some of my recent ham radio presentations to radio clubs via Zoom, visit <tiny.cc/k8zt-p>. Remember, I am always looking for information on your new activities, ideas for future columns, and feedback from this column, so please email me at k8zt@arrl.net.

Answers to CQ Crossword Puzzle *(located on page 61)*



vhf plus

BY TRENT FLEMING,* N4DTF

ON4KT Chat Comments – a Tool for VHFers

By the time you read this, Sporadic-E season will be in full swing across the northern hemisphere. This year, and for at least the next three or four years, 6 meters will also benefit from the peak of the current sunspot cycle, and F^2 propagation will also be possible. When Sporadic-E combines with other modes, including TEP and F^2, amazing things can and will happen. My message remains simple – be on the air as much as you can. Phone, CW, digital, meteor scatter … pay attention and you will be able to add to your totals for new grids, new countries, and new 6-meter friends. Please keep me posted on your activities! This month, a potpourri of tips to help you improve your station and operating practices.

Check out the ON4KST Facebook page, the VHF Slack group, or another resource of your choosing and see if you don't improve your chances of on-air activity.

If you are new to VHF and above, you may not be aware of the widespread use of <www.ON4KT.com> and the various chat rooms offered there. The higher the frequency, the harder it is to make and complete contacts. A resource like ON4KT that provides a common space for hams to announce that they are calling or listening on a certain frequency is invaluable, whether trying to generate activity or perhaps test a new piece of equipment. ON4KT has resources for the various VHF and up bands, allowing communication between stations that are trying to orient antennas and bounce signals off the moon, a passing plane, or even a distant thunderstorm – all in an effort to complete a contact. You know that I'm a proponent of calling CQ "around the compass points" to generate activity, but sometimes that is just not enough. An online clearinghouse can bring hams together in a way that greatly improves your chances to complete a contact. There's also a VHF Slack channel that provides similar capabilities, although you do need a basic knowledge of Slack to participate. I've noticed that several of the other online resources, like Facebook pages, have started chat groups, and that is fine – but that also provides the potential for operators to be fragmented into smaller groups, which reduces the chances for successful contacts. Check out the ON4KST Facebook page, the VHF Slack group, or another resource of your choosing and see if you don't improve your chances of on-air activity.

Don't Scrimp on the Coax!

Recently, on the "VHF/UHF Weak Signal Amateur Radio" Facebook page, David Buckwalter, K3SK, (FMØ7) offered the following observations on his feed line experiences:

"Before I moved, I had hardline on almost everything. I even had 7/8 Heliax on my HF beam! That all changed when I moved and switched to crank-up tilt-over towers. I put LMR4ØØ on just about everything except 40, 80 & 160 meters where I use RG-213. I thought LMR4ØØ would be sufficient on my VHF/UHF weak signal antennas. It turns out it wasn't as good as I had hoped. I was doing ok, but not as good as I thought I should have been doing. At the end of December I ventured into EME. It's been a struggle, but I've worked contacts on 144, 222 & 432 MHz. It was also frustrating getting messages that I had been heard but I was not hearing other stations. That all changed today. I splurged on some really good feedline that works on crank-up, tilt-over towers that I got installed this week. I put it on all four of my VHF/UHF arrays (2 m, 1.25 m, 70 cm, 23 cm). It wasn't cheap and we are now eating every third day, but man, what a difference on EME. In the past, on a good day I might have worked one or two 2-meter contacts. Today so far, and there's lots of visible moon left, I've worked nine EME contacts in eight different countries.

I am a believer!"

Checking connectors and cables periodically is an important part of station maintenance and will pay dividends many times over.

Folks, even good operators make mistakes, and David's transparency serves as a good lesson here. We all have resource constraints, and I do not recommend forgoing regular meals in order to buy better coax, but I do recommend using the best coax you can for a given frequency. As frequencies rise, so do losses, so plan accordingly, and pay attention not only to what you are installing, but how it is "weathering." Checking connectors and cables periodically is an important part of station maintenance and will pay dividends many times over.

On the lighter side, in the "tell me you are a ham without telling me you are a ham category" I offer the pronunciation of "coax" as a good example. Even when I know the writer intends to "coax" me into their beliefs, I read and hear "coax." Can't help myself!!!

On the Air

Aurora

Amateur radio offers many interesting opportunities, across the whole spectrum of our frequencies, and via various modes of propagation. When elevated solar activity produces flares and other events that impact Earth, the impact on your activities can be varied. A strong solar storm can almost completely black out propagation at HF frequencies (3-30 MHz) but simultaneously provide exciting opportunities at VHF (especially 6 meters, 2 meters, and 1.25 meters) for propagation via the Aurora. When there are auroral events, stations in the northern hemisphere will point near north, hoping to work other stations also pointing north via auroral reflection. Directional antennas are best here, but as always, try it with whatever you have. There's no firm direction to point, other than "near north" until you hit an angle that matches that of another station. Distances of up to 600 miles are possible, depending on launch angles and the density of the aurora. Watch for a

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

rising K index. K numbers above 4 are generally good indicators of the potential for aurora, and of course if you are far enough north to actually *see* the Northern Lights, you have a visual indication that auroral propagation may be possible! Late March brought some opportunities for VHF and above communications via Aurora.

On March 24, David Olean, K1WHS, in FN43 wrote across several email groups:

"Hello VHF ops,

I was watching the solar indices in hopes that we might get a dump of solar particles down on the poles to spark off a real bonafide aurora. After dinner, I trudged up the hill and turned on the generator to get stuff running. I started calling CQ on 222.100 and also monitored the ON4KST page (*see discussion above – ed.*). There was some concerted activity on 6 and 2 meters. I was a tad disappointed that more folks didn't make the move to the higher band as conditions warranted. Still, there was activity on the 222 MHz band. My first AU contact was good old VA3ELE running just 25 watts! Peter had a great signal via aurora. Next station worked was VE3DS who was really pounding in. I found that my "sweet spot" seemed to be between 295 and about 305 degrees. As time went along, I found that 295 degrees was the best heading. I heard N4PZ near Chicago with a great 55A signal several times, but Steve did not answer my calls. Both VE3DS in Toronto, and Steve, N4PZ, peaked at about the same heading. That N4PZ contact would have been a great QSO and I suspect RX problems were the fly in the ointment. I also heard and worked WX3K in PA. Stephanie lives near the Delaware Water Gap in FN2Ø. She announced that this was her first 222 MHz aurora QSO! Congratulations are in order for that. WX3K had a good 55A signal as well. Totals for me were three 222 MHz AU QSOs and four stations heard."

Just another example of the importance of paying attention to conditions and knowing the potential impacts on propagation. Thanks to David for sharing this info. Good resources include <spaceweather.com> and any of the various VHF propagation maps that you like to use.

Tropo

Spring and fall are often prime times for tropospheric propagation. Many amateurs watch the "Hepburn Maps" that attempt to predict tropo paths by looking at APRS and other predictable signals. Here is a location where you can easily find these predictions: <https://tinyurl.com/bdfhuvcx>. Recently, our friend David Thier, WA3GWK, commented on Gulf Coast tropo activity via the "VHF/UHF Weak Signal Amateur Radio" Facebook page (Photo A). Changing seasons and the associated weather patterns were favorable this week for such activity. On a recent morning, David reported these contacts from his station in EM6Ø – Great tropo conditions across the north Gulf Coast this morning on 2 meters. Hoping that some good conditions reappear this evening and expect a repeat performance tomorrow (*April 20 – ed.*). More activity is needed! Here are the grids I was able to work on SSB from my location on the gulf cost of Alabama in EM6Ø, most with strong to very strong signals: EM46, EM45, EM43, EM4Ø, EM32, EM3Ø, EL29, and EL18.

That's it for this month – enjoy the enhanced conditions and keep me posted on your activities!

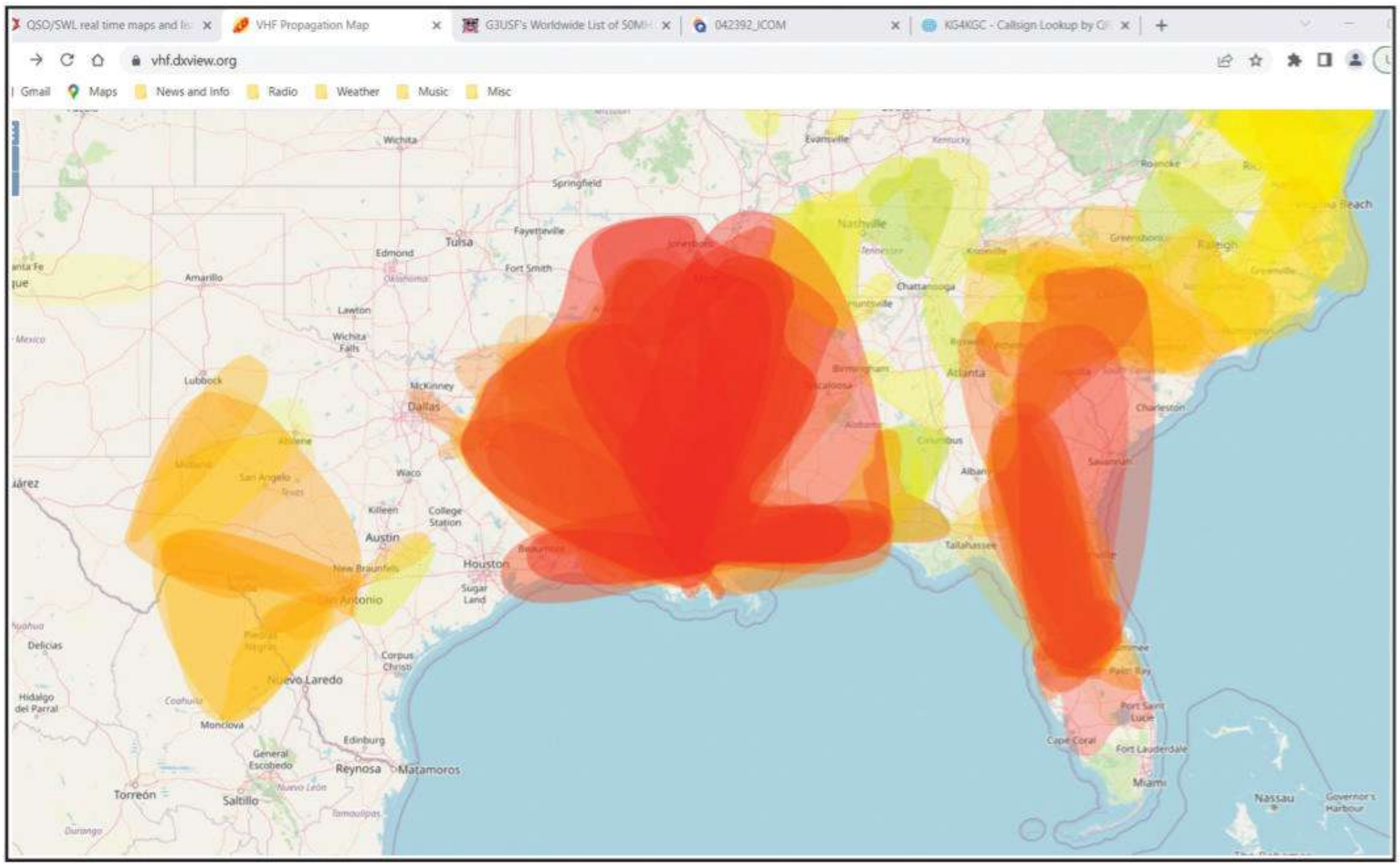


Photo A: Tropo map around the Gulf of Mexico on April 20, 2023.

awards

BY STEVE MOLO,* KI4KWR

Introducing the FT4DMC

A

B

Photo A: FT4 Digital Mode Club President Jo Engelbrecht, OE6VIE (all photos courtesy FT4DMC).

Photo B: FT4DMC Vice President Hannes Gruensteidl, OE1SGU.

As digital modes become more and more popular, it was inevitable that awards would be introduced focusing on achievements made using one or more of those modes. This was the case with FT8, as two amateurs in Belgium – Jo Engelbrecht, OE6VIE (Photo A), and Hannes Gruensteidl, OE1SGU (Photo B) – launched the FT8 Digital Mode Club and its series of awards in 2017, followed now by a new club with a new award series, the FT4 Digital Mode Club or FT4DMC. Here is their announcement:

> Almost six years after the FT8 Digital Mode Club was founded in 2017, our members were increasingly asking why there were no diplomas for the FT4 operating mode. The implementation in the already existing diplomas turned out to be too complex (change the templates for over 200 different diplomas). The club name FT8DMC would then no longer have fitted. The solution lay in founding a new club.
>
> So on March 17th, 2023 the FT4DMC was launched. The aim of the club is to promote radio operations in FT4 and, with a moderate number of available diplomas, to create incentives to use this mode of operation more and generally to increase activity on the amateur radio bands (use them or lose them). There are currently 17 different diplomas, with more to come. Membership in the FT4DMC is free and open to all interested parties.
>
> FT4 is becoming more and more popular and many DXpeditions now also use this type of transmission and distribute additional band points. FT4, like FT8, was developed by Dr. Joe Taylor, K1JT. Contacts in this mode count like all other digital broadcast types for the Digital (RTTY) DXCC award of the ARRL. The original idea was to only use FT4 for contests. In the meantime, however, regular operations are being carried out. With about 2.5 times the speed of FT8, FT4 is of course very efficient.
>
> As with the FT8DMC, the level of interest is terrific. After just under three weeks, the FT4DMC already has over 1300 members and the first diplomas have been awarded. As with the FT8DMC, the application for and issuing of the diplomas takes place via the UAAC program developed by Heinz, DK5UR, which is used by a total of 9 clubs.
>
> It should be mentioned that the FT8DMC now has 21,600 members from 148 DXCC entities. The number of diplomas issued is over 1.5 million.
>
> Of course, every new member receives a nice membership certificate (Photo C). We would be happy to welcome you as a new member!

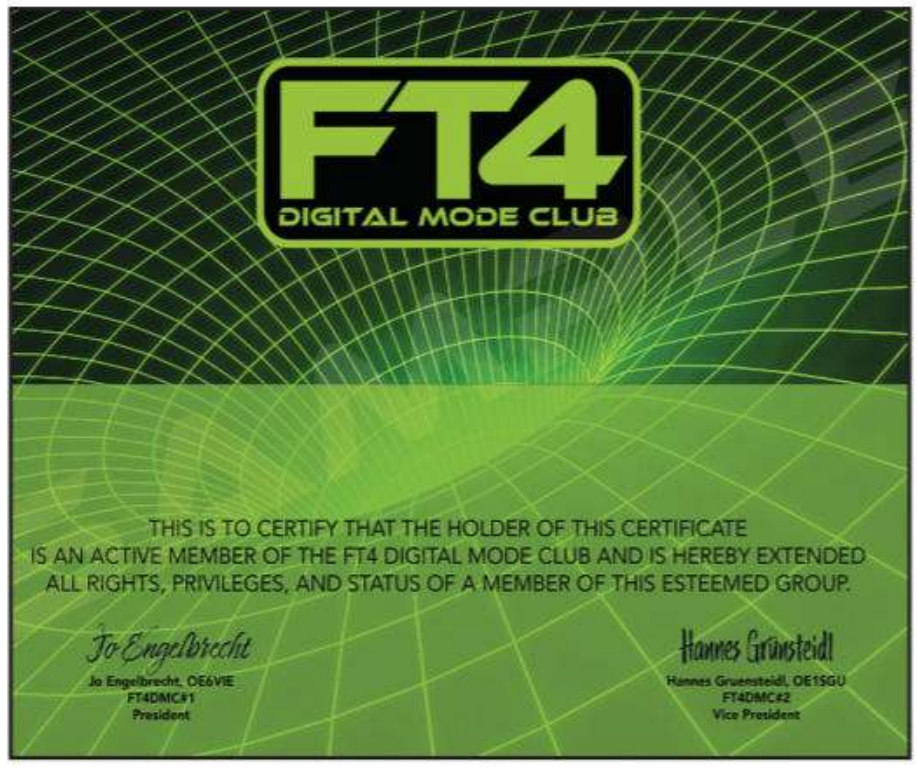


Photo C: FT4DMC membership certificate.

*Email: <KI4KWR@cq-amateur-radio.com>

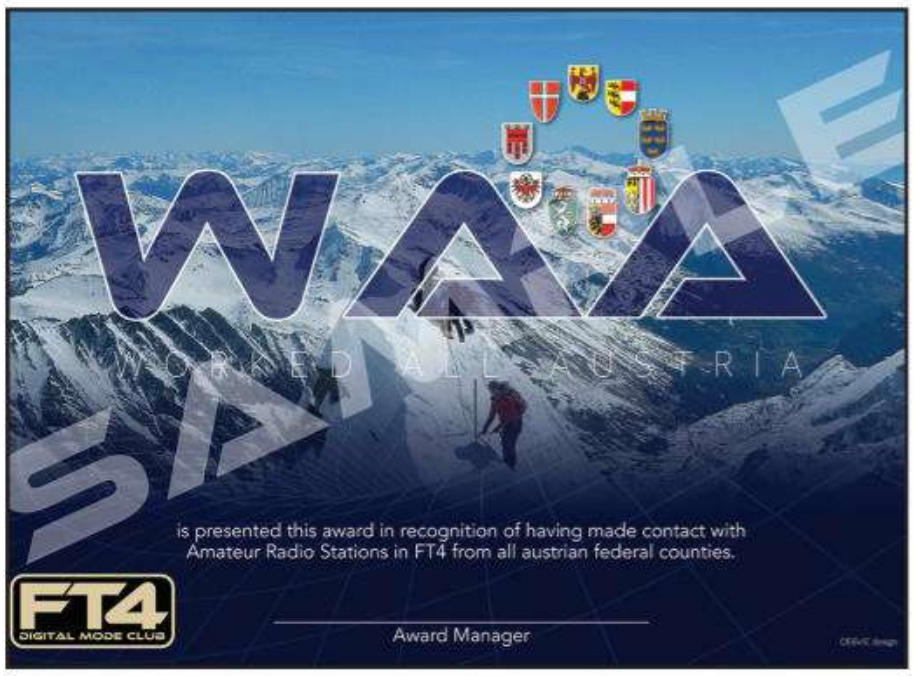


Photo D: FT4DMC WAA award for working all Austrian call areas via FT4.

Photo E: FT4DMC's WAS award for making FT8 contacts with amateurs in all 50 U.S. states.

How does one become a member of the FT4DMC or the FT8DMC and where can I find additional information?

FT4DMC: <https://ft4dmc.com/>
FT8DMC: <https://ft8dmc.eu/>

73 and have fun operating FT4!
Jo, OE6VIE, and Hannes, OE1SGU

FT4DMC awards include certificates (called diplomas in Europe) for working all Austrian call areas (Photo D), working all U.S. states (Photo E), 100 or more DX entities, certain numbers of entities on different continents, 100 DX entities via the QO-100 geostationary amateur satellite, and more, all using the FT4 mode exclusively. Complete information is available on the FT4DMC website above.

Until next month, 73.

BY BOB SCHENCK,* N2OO

YJ0A DXpedition to Vanuatu – A South Pacific Adventure

BY AL ROVNER, K7AR, AND BOB NORIN, W7YAQ

Hello, fellow DXers! I hope you are enjoying the great HF propagation! I'm also looking forward to the upcoming summer 6-meter activity! I have been recovering from shoulder surgery. I am grateful for my friends who have helped provide us all with a variety of articles for your reading pleasure. Working long periods on the computer keyboard is pretty difficult for me right now. But hopefully I'll be back to normal soon. Meanwhile, I'll see ya in the pileups.

This month, I am turning over the keyboard to an old friend to tell us about the YJ0A Vanuatu DXpedition. I hope you enjoy Al, K7AR's, article about his South Pacific adventure! – 73, Bob, N2OO

For the last three years, our DXpedition activity has been shut down due to the pandemic. Since travel restrictions are being lifted, we have traveled twice in the last three months. The bottleneck has been lifted! In November, 2022, we had a successful expedition to American Samoa as K8H, and in February, 2023 we activated YJØA in Vanuatu. The goal of this expedition was to participate in the CQ WPX RTTY and ARRL DX CW contests, as well as operating DXpedition-style during our two-week visit.

Vanuatu is an island nation in the South Pacific Ocean, consisting of 13 principal and other smaller islands. The archipelago is located about 500 miles west of Fiji (3D2). We operated from the main island of Efate. Figure 1 shows the location of Vanuatu on a Pacific map.

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email: <k7ar@comcast.net>

Customary Customs Complications

As usual for international travel, immigration forms were distributed on the flight to Port Vila. Going through immigration when landing was easy and simple. Where are you staying? How long will you be there? And so on. Going through customs was not easy and simple. The customs officials asked if they could scan our luggage. Yes, of course. Then there were many questions about our equipment. What is it for? Do you have import permission? Did you pay taxes on the gear? We attempted to explain the equipment was our personal gear (not for business purposes), we were there as tourists for a vacation, and all gear would return home when we left. We discussed what amateur radio was and that we

Figure 1. Pacific and Vanuatu maps

were setting up temporary stations. We presented a copy of our YJØA license, granted by their government's telecom authority.

This discussion continued for at least a half hour, then customs decided to confiscate and lock up all our radio gear. We were permitted to leave the airport with our clothing and personal luggage. It was suggested we return in the morning to speak with the supervisor.

After meeting the supervisor the next day, and still more discussion, all the radio gear cleared customs and we finally were on our way. Many hams around the world offered their support to help us. This is a great example of ham spirit. Thanks especially to Norman Shackley, GØOSX, former Director of Customs in Vanuatu, for his help in this matter.

Photo A. Bob Norin, W7YAQ (left), and Al Rovner, K7AR (right), operating as YJ0A from Vanuatu (all photos courtesy of the authors).

Setup and Operating

After that somewhat hectic arrival, we settled into our QTH, a comfortable bungalow at South Pacific Memories, a boutique resort on Pango Point southeast of Port Vila. There we set up two identical stations, each consisting of an Elecraft K3 transceiver, KAT500 antenna tuner, and KPA500 amplifier. This equipment has been on several DXpeditions and served us well. Photo A shows the two stations on the air.

We had four antennas available for use: Two HF verticals – a DX Commander Classic and Butternut HF9V – both located on the beach; an inverted-L for 160-meter transmit, and a pennant loop receive antenna for the low bands. The two HF verticals are shown in Photo B. This is also our QSL card.

Contest Operating

We participated as a single-op (W7YAQ) in the CQ WPX RTTY Contest. Bob logged 500 RTTY QSOs in 44 countries, while Al plied the WARC bands for general DX contacts.

Photo B. HF verticals on the beach: DX Commander on the left and HF9V on the right.

Photo C. Traditional Lap Lap meal. In this photo, fresh coconut cream is being added to the dish just before serving. See text for additional details.

Photo D. Al watching the preparation of kava, a favorite South Pacific drink.

Photo E. Bob enjoying a freshly made kava drink.

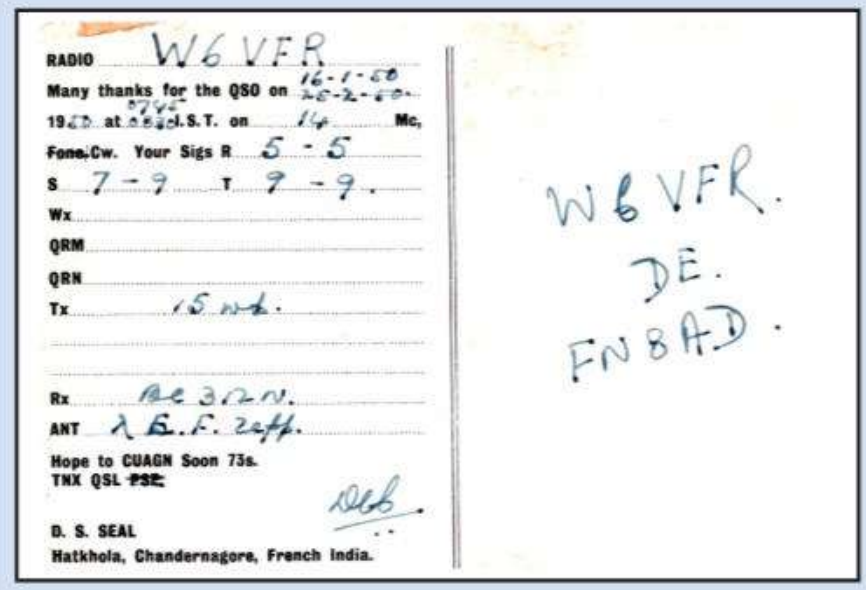
We also did a full 48-hour multi-op effort in the ARRL DX CW Contest, taking turns operating in 3- or 4-hour shifts. While 160 and 80 meters were lagging and not very productive, the other bands were jumping. Ten meters was especially active with over 600 QSOs. Our final ARRL score was 1,223,250 points and 1750 QSOs.

Experiencing Vanuatuan Culture and Tradition

Part of the DXpedition experience is not only to operate radio, but to meet local people and engage in their culture. It was a pleasure to be invited to a dinner at a neighbor's location and have Lap Lap. This is the national dish of Vanuatu, made by grating taro root into a paste. The paste is wrapped in a cabbage-like leaves, with chicken added, then covered in banana leaves and cooked in an underground stone oven. After cooking, fresh coconut cream is added in the center. Photo C shows the coconut cream being added to the center of the Lap Lap just before eating.

We also experienced the making (and consumption) of the drink *kava*, common on many Pacific islands. Kava is made

QSL of the Month: FN8AD, French India



D.S. Seal, FN8AD, a French Consul General for India, also VU2AX and AC4AX (Tibet), was one of two known operations from the ARRL DXCC deleted entity of French India. The other was FN1C from the 1930s. French India was a colony comprising five geographically separated enclaves on the Indian subcontinent. Mr. Seal operated from Chandernagore, which is a city in the Hooghly district in the Indian state of West Bengal. Only contacts with French India from October 31, 1954 and earlier count for this DXCC entity. – 73, Tom, K8CX

(Images courtesy K8CX Ham Gallery <www.hamgallery.com>)

The WAZ Program

SINGLE BAND WAZ

6 Meter

207 .....JH9DRL, 26 Zones
208 .....UT5EL, 25 Zones
209 .....TG9AJR, 26 Zones
210 .....NX7U, 26 Zones
211 .....JO7KMB, 26 Zones
212 .....HI8RD, 25 Zones
213 .....XE2X, 28 Zones
214 .....IZ4DPV, 31 Zones

10M Digital

7 .....IW3GJF
8 .....K3FRK

12M CW

116 .....EY8MM

12M Digital

12 .....N1NK
13 .....JA4FCV
14 .....K9NR
15 .....W1OPD
16 .....HI8RD

12M SSB

62 .....KE9L

15M CW

386 .....DL3HAH

15M Digital

21 .....IW3GJF
22 .....WI7P

15M SSB

691 .....YB0DJ

17M CW

142 .....LU4FPZ
143 .....N6PF
144 .....EY8MM

17M Digital

40 .....WI7P
41 .....OE6ATD
42 .....W1OPD

17M SSB

71 .....KE9L

20M CW

693 .....WØAD
694 .....K4ST

20M Digital

75 .....KX4HV
76 .....OE6ATD
77 .....JA8KFR
78 .....IZ4IRO
79 .....AE5FM
80 .....N9AVC

20M SSB

1276 .....NK8N
1277 .....KE9L

30M CW

174 .....EY8MM

ALL BAND WAZ

CW

1250 .....DU3LA
1251 .....KQ6K
1252 .....JA3RAR
1253 .....AJ9C
1254 .....W8FIB
1255 .....N6DHZ
1256 .....W1VT
1257 .....ES2MC
1258 .....HB9CPS
1259 .....W4QN
1260 .....7M4CLF

Digital

472 .....W3REP
473 .....AC8TO
474 .....JA3RAR
475 .....W2JAN
476 .....N9DR
477 .....KX4HV
478 .....JA8KFR
479 .....JK1BCK
480 .....JS1LQI
481 .....ES2MC
482 .....ZL3CW
483 .....JJ1HMR
484 .....K8ARY
485 .....N2TC
486 .....AE5FM

SSB

5557 .....JA3RAR
5558 .....NS3L
5559 .....W6OZI
5560 .....ES2MC
5561 .....K1YWW
5562 .....IZ4DPV
5563 .....IV3UT
5564 .....KØRJW
5565 .....YBØDJ

RTTY

321 .....W4QN

SATELLITE

81 .....N8MR, 25 Zones
82 .....KS1G, 25 Zones
83 .....JN2QCV, 25 Zones

MIXED

10464 .....DU3LA
10465 .....HB9AWS
10466 .....JN1BMX
10467 .....AC8TO
10468 .....JA3RAR
10469 .....W2JAN
10470 .....N9DR
10471 .....9A5VS
10472 .....EA5GDY
10473 .....JA1OHP
10474 .....W5AJ
10475 .....OE6ATD
10476 .....AJ9C
10477 .....MØKCM
10478 .....JA9KFR
10479 .....JK1BCK
10480 .....JS1LQI
10481 .....JG3LWP
10482 .....WN3DX
10483 .....K7RAN
10484 .....JH8SST
10485 .....AB9YC
10486 .....JA4ENY
10487 .....VA2EBI
10488 .....W6OZI
10489 .....N8TCP
10490 .....ES2MC
10491 .....KC7EFP
10492 .....EA4HKV
10493 .....HB9CPS
10494 .....JF1CKO
10495 .....VA2BBW
10496 .....7M4CLF
10497 .....N2TC
10498 .....N9HR
10499 .....VE1YY
10500 .....WA2VJL
10501 .....KØARM
10502 .....NI8Z
10503 .....AA4U
10504 .....AE5FM
10505 .....BG6GQE
10506 .....F4JEH
10507 .....DG8FBV
10508 .....JM1MTE
10509 .....K6VHF
10510 .....LU8EKC

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 all *CQ* awards is $6.00 for subscribers (please include your most recent *CQ* mailing label or a copy) and $12.00 for nonsubscribers. Please make all checks payable to Jose Castillo, N4BAA. 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>.

Photo F. Rod Newell, YJ8RN, in his shack.

by grinding the kava root, combining with a little water, then filtering the mixture and drinking in a coconut shell as a cup. Our demonstration showed how coral pieces were originally used to grind the root, and today a homemade cheese grater device is used for grinding. Kava bars are very common in the local area. Photo E shows Al observing the Kava being filtered and made ready for drinking, and in Photo F, Bob is enjoying a drink from the coconut shell.

Visiting Local Hams

A real treat while on an expedition is the opportunity to meet and visit with local

Rank	Country	# QSOs
1	JA	4105
2	K	3810
3	I	1212
4	UA	1139
5	DL	829
6	SP	590
7	OH	386
8	UR	345
9	UA9	341
10	F	327

Table 1. Top-ten list of countries contacted (excluding ARRL DX Contest)

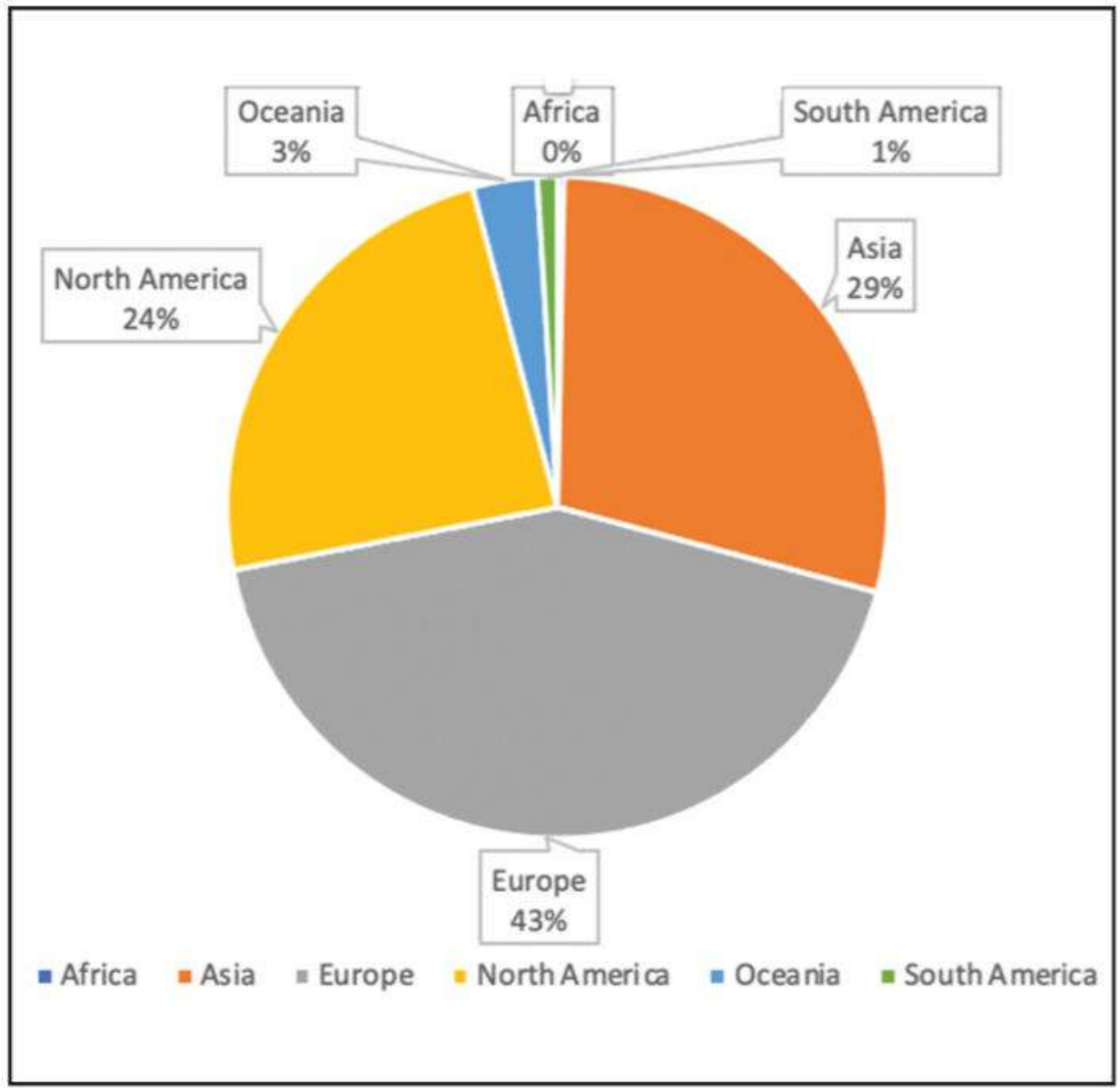


Figure 2. YJØA QSOs by continent. Our paths to Europe produced nearly as many QSOs as to other continents combined.

CQ DX Awards Program

New Award-SSB

N9TOD 2668

Endorsement-SSB

N9TOD 150

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.

hams. We met Rod Newell, YJ8RN, and had the opportunity to have lunch at his house, prepared by his wife Ruth. Rod gave us a tour of his shack (Photo F) and the many projects he works on. Rod travels to many of the Vanuatuan islands to service Red Cross and aviation communication radios, maintain towers and antennas, and keep the infrastructure running. On the ham bands, he is very active on FT8.

A Number of Firsts

We experienced several "first-time" events on this expedition. Al discovered that while the DX Commander antenna had a 4:1 SWR on the 60-meter band, the antenna tuner could handle it, and bring the SWR to 1:1. Not an ideal setup, but it worked. So we got on 60 meters for the first time, and worked 28 countries including western Europe. Our sunset (around 0700Z) proved to be a good time to look for the U.S. East Coast on 60 meters, and several contacts were made.

While our 160-meter inverted-L has been used on many expeditions, we used a pennant loop receive antenna here for the first time. We found the pennant was quieter than the L and didn't pick up electrical noise. Nonetheless, 160 turned out to offer only regional propagation, with few openings outside the Asia/Pacific area.

While heading over to breakfast, we decided to monitor the 50.313 FT8 frequency while we were eating and see if we could hear anything. Surprise, yes we can! Several JAs and ZLs were copied, so we CQ'ed for a while on 6 meters. We worked several JA and BY

5 Band WAZ

As of April 15, 2023
2491 stations have attained at least the 150 Zone level, and **1140** stations have attained the 200 Zone level.

As of April 15, 2023
The top contenders for 5 Band WAZ (Zones needed on 80 or other if indicated):
CHANGES shown in **BOLD**

Callsign	Zones	Zones Needed
AJ9C	199	23
AK8A	199	17
DF2GH	199	31
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
IT9GSF	199	1
IZ3ZNR	199	1
JA1CMD	199	2
JA5IU	199	2
JA7XBG	199	2
JH7CFX	199	2
JI4POR	199	2
JK1BSM	199	2
JK1EXO	199	2
K1LI	199	24
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
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
SP9JZU	199	19 on 10M
USØSY	199	1 on 15M
VE2EBK	199	26
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
ZL3CW	199	34
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
G4OWT	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
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
JN1BMX	2475	03/18/2023	200
WI7P	2476	03/18/2023	170
AC8TO	2477	03/18/2023	157
JH7IMX	2478	03/27/2023	191
W5AJ	2479	03/27/2023	200
KE9L	2480	03/27/2023	199
AJ9C	2481	03/27/2023	199
MØKCM	2482	03/28/2023	150
W1VT	2483	03/28/2023	194
WF4U	2484	03/28/2023	200
DL3HAH	2485	03/29/2023	173
ES2MC	2486	03/31/2023	200
W1OPD	2487	04/02/2023	190
K4ST	2488	04/05/2023	183
DL5KW	2489	04/05/2023	150
N9AVC	2490	04/09/2023	152
AE5FM	2491	04/14/2023	150

Updates to the 5BWAZ list of stations:

Callsign	5BWAZ #	Date	# Zones
VA2ZO	2464	2/25/2023	200
W3LL	1489	3/25/2006	200
W4PNY	2364	4/25/2022	174
K3EA	2194	2/22/2020	191
K9NR	2449	1/29/2023	183
OE6ATD	2294	3/9/2021	176
N6PEQ	1932	4/17/2016	183
N8SNM	1652	8/26/2009	192
W8CZN	2432	12/17/2022	195
KE9L	2480	3/27/2023	200
K3MSB	1610	8/16/2008	197
ZL3CW	2072	9/1/2018	199
KDØQ	2163	11/2/2019	197
IZ4DPV	2210	5/5/2020	163
K3FRK	2326	10/5/2021	189
AA8SW	2371	5/11/2022	169

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

5BWAZ #	Callsign	Date	All 200 #
2464	VA2ZO	2/25/2023	1134
1489	W3LL	3/16/2023	1135
2475	JN1BMX	3/18/2023	1136
2479	W5AJ	3/27/2023	1137
2484	WF4U	3/28/2023	1138
2480	KE9L	3/27/2023	1139
2486	ES2MC	3/31/2023	1140

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).**

stations, just using the HF antennas on the beach. We didn't have a Yagi antenna for six. Bob also worked an XE station. On future trips, we will certainly monitor 6 meters more frequently and be more active here.

Cycle 25 is Here!

While 160 was somewhat disappointing, and 80 meters was full of woodpeckers and radars, the upper bands were amazing ... 10, 12, and 15 meters were open late into the night, and possibly 24 hours. The upper bands helped us to make many contacts with areas of the world that can be difficult to contact from the Pacific, such as western Europe and the U.S. east coast. Even with simple vertical antennas on the beach, the bands were wide open to many areas of the world. Some statistics of our trip are shown in Figure 2 and Table 1.

Statistics and Summary

For another first, the number of European QSOs exceeded the number of North Amereican and Asian QSOs. Very interesting, see the distribution of QSOs in Figure 2. This excludes the ARRL DX Contest. Table 1 is a top-10 list of the number of countries worked (excluding the ARRL DX Contest). Note that 7 of the top 10 are in Europe.

In Conclusion

This was another successful Pacific expedition for us. Thanks to Anne and Petter from South Pacific Memories for all their hospitality. They now know much more about amateur radio and our hobby. We are looking at future trips for this fall, so stay tuned. All of our QSOs are uploaded to Clublog and available to order QSL cards. Thanks for 20,000 QSOs and vy 73.

CQ DX Honor Roll

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

CW

DL3DXX.....339
HB9DDZ.....339
K4IQJ.....339
K9MM.....339
N4MM.....339
WB4UBD.....339
WS9V.....339
EA2IA.....339
F3TH.....339
K2FL..... 339
K2TQC.....339
K3JGJ.....339
K3UA.....339
K4CN.....339
K4JLD.....339
K4MQG.....339
K5RT.....339
K7LAY.....339
K7VV.....339
K8LJG.....339
N4AH.....339
N4CH.....339
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contesting

BY TIM SHOPPA,* N3QE

Build an Automatic "Mult" Bell

Working a rare country in a big DX contest – or a rare state/province in a domestic contest - is often worth the extra effort because it'll add to your multiplier count and substantially boost your final contest score. This month, let's build an automatic mult bell that will ring every time you rack up a new multiplier, triggered by the network packets that modern contest loggers send after you log each QSO. Manually-operated "mult bells" are a long tradition at multi-operator stations to let each position brag to everyone else in the shack about the new country they just racked up – the automatic bell here carries the tradition into the networking age.

Like many advances in station automation in the past decades, the station's ethernet network provides the backbone for accessory communication, and we'll use it to ring our mult bell. Many loggers (both contesting and DX-oriented) can send UDP packets on various topics for driving accessory hardware. In particular, the N1MM+ logger supports seven different kinds of UDP broadcasts that can be turned on and off. I've found that two particular packets – <RadioInfo> and <ContactInfo> – are especially useful for driving gadgets around the ham shack.

How far do your logger's UDP messages go? The most common configuration is to broadcast UDP messages only onto your local network. If you have set up VPN for a geographically distributed station (as has been allowed for the past couple years in many ARRL and CQ contests), your VPN may have a configuration option to let the logger's UDP packets go to the other sites.

Antenna-switching relays can use the <RadioInfo> UDP packets from N1MM+ to drive smart antenna relay devices. The N1MM+ logger includes not just your rig's frequency in this packet, but can also include alternate antenna selections for each band. An example device using this packet is the FreqEZ antenna relay driver by Larry Gauthier, K8UT. You can read more about the FreqEZ's Raspberry-Pi based architecture at <https://freqez.com>.

email: <n3qe@cq-amateur-radio.com>

For our mult bell project, we'll use the <ContactInfo> packet, which is issued every time a QSO is logged. In addition to the basic information you'd expect in any contest log entry – the time, date, callsign, and exchange – this packet also tells us whether a contact is a new multiplier. The data dictionary of what's in this packet can be found under "External UDP Messages" in the N1MM+ documentation, available on the web at <https://bit.ly/3VcLB4G>. A quick keyword search for "mult" in the documentation turns up three tagged fields in each <ContactInfo> packet: <ismultiplier1>, <ismultiplier2>, and <ismultiplier3>. Experienced N1MM+ users will remember seeing that their log pane has more than one multiplier column as well – these map directly to the three multiplier tag types. Let's explore why some contests have more complex multipliers than others.

ARRL Sweepstakes was the first contest to have the multiplier figure into its total score. Sweepstakes has a **single**

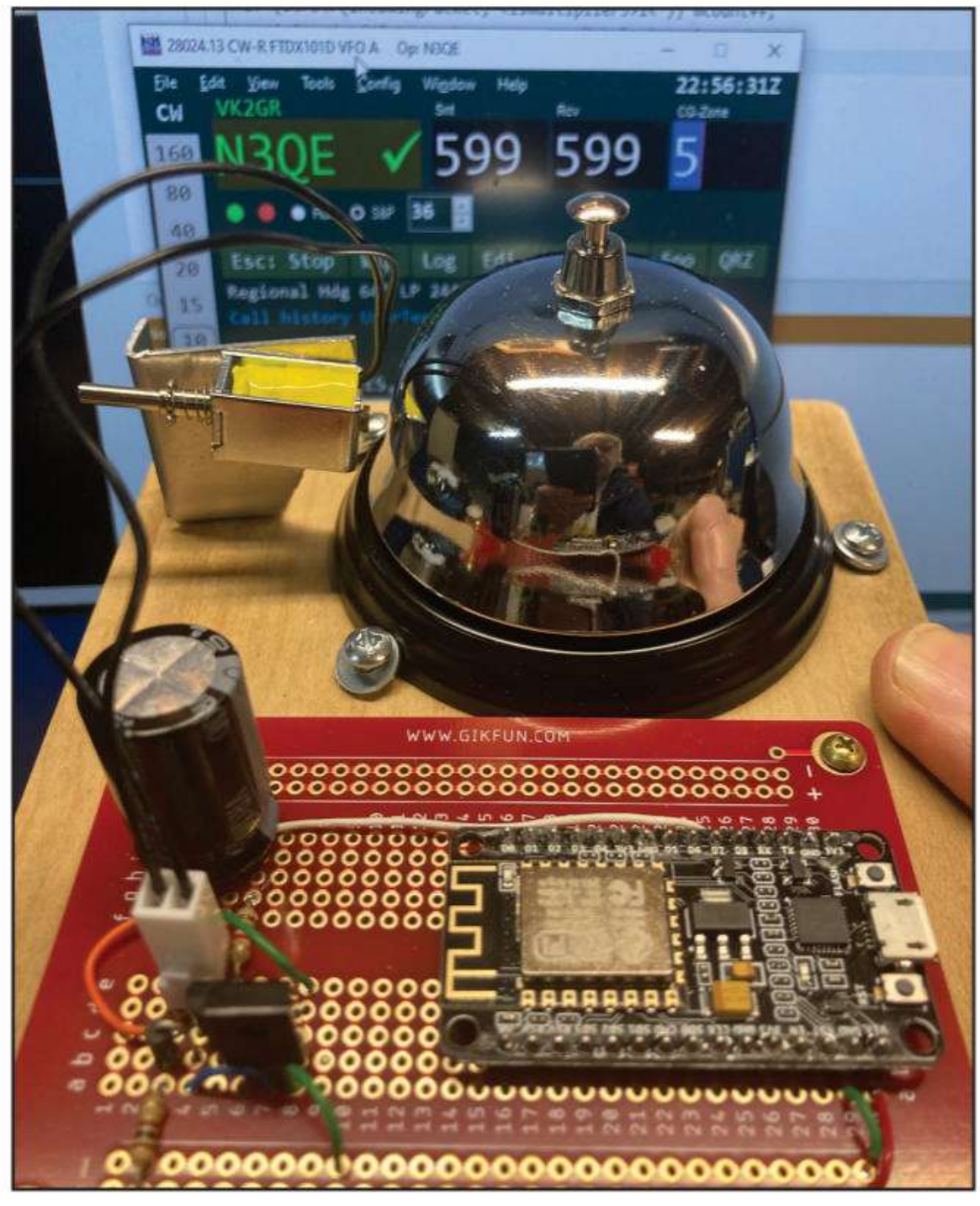

Photo A. The logger-controlled mult bell is built on a wooden breadboard. The prototyping board has the NodeMCU ESP8266 carrier on the right, and on the left is the charge reservoir electrolytic capacitor and a Darlington driver. The metal call bell is held in place by three screws and washers around its perimeter. The solenoid that rings the bell is on a simple angle bracket bent out of sheet aluminum. The solenoid is attached through its prethreaded holes via M2 machine screws.

multiplier, the ARRL/RAC section. In its <ContactInfo> UDP packet, N1MM+ flags new section multipliers with a value of 1 in the <ismultiplier1> field. Sweepstakes to this day still only counts multipliers once per contest, and not once per band, so multipliers top out at the number of ARRL sections (for this falls Sweepstakes, it will be 85).

Other contests count multipliers separately for each band. For example, the upcoming ARRL June VHF and CQ VHF contests use grid squares as multipliers, and working a grid square on each band counts as a multiplier. This encourages "moves" between bands of multipliers – working a station on the 6-meter band first, then asking for a move to the 2-meter band, etc. The excitement of moving a grid square mult through multiple VHF and UHF bands is essential to any competitive ARRL June VHF entry.

Some contests have two kinds of multipliers, but no QSO can ever count towards two different multipliers. The IARU HF Contest coming up in July is a great example. The most common multiplier you'll find in this contest is the ITU zone number (*different from CQ zone numbers – ed.*), a number running from 1 through 85, exchanged by the non-headquarter entrants in this contest. N1MM's internal scorekeeping, and the externally visible UDP broadcast packets, count new ITU zones through the <ismultiplier1> field. There's a second kind of multiplier, given out by IARU headquarters stations, that exchange a multi-letter abbreviation representing their nation's amateur radio organization. The ARRL HQ station, W1AW, gives the exchange "ARRL" on the air, counting as a HQ credit but not for an ITU zone credit. N1MM counts HQ mults in the <ismultiplier2> field of the UDP packets it broadcasts.

The most popular contests of all, the CQ WW CW and SSB contests held each fall, have **two kinds of multipliers and each QSO can provide credit for two multipliers**. In CQ WW, there is credit for both the country multiplier and the CQ zone multiplier, and for the most part, whenever you work a new CQ zone, you'll often be working a **double mult** because it will also be a new country. The N1MM+ logger counts countries under the <ismultiplier1> tag and counts CQ zones under <ismultiplier2> tag. In fact, in my multiplier bell implementation, I made sure that double mults rang out as ding-ding, a double bell ring. In the CQ WW contests, multipliers count per band, so both mults and double mults are especially plentiful early as each DX band opens to a new part of the world.

A handful of contests have **three multipliers**: CQ WW RTTY is an example, which uses not just zones and country multipliers, but adds a state/province multiplier for W/VE stations. This leads to the concept of the **triple mult** the first time you work the US and Canada on each band. CQ WW RTTY is one of the few contests for which the <ismultiplier3> information will show the third multiplier type. As sunspot numbers rise, the ready availability of double and triple mults on each band is a compelling incentive to be sure to work not

Calendar of Events

All year	CQ DX Marathon	bit.ly/3FyPiui
May 27-28	CQ WW WPX CW Contest	http://www.cqwpx.com/
June 2-4	PODXS 070 Club Three Day Weekend Contest	http://bit.ly/2Srdp8A
June 3	UKSMG Summer Es Contest Rules	https://uksmg.org/summer-contest-rules.php
June 3-4	10-10 Open Season PSK Contest	http://bit.ly/1FrFeBc
June 3-4	ARRL Int'l Digital Contest	https://contests.arrl.org/dig/
June 3-4	IARC Region 1 Field Day	http://bit.ly/3cC0HKf
June 3-4	KANHAM Contest	https://bit.ly/3MG6jVR
June 3-4	Kentucky QSO Party	http://www.kyqsoparty.org/
June 3-4	RSGB CW Field Day	bit.ly/3TxCrxl
June 3-4	Tisza Cup CW Contest	https://www.tiszacup.eu/index.php/en/contest-rules
June 5	RSGB 80m Club Championship, Data	bit.ly/3TxCrxl
June 7	VHF-UHF FT8 Activity Contest	http://www.ft8activity.eu/index.php/en/
June 10	Asia-Pacific SSB Sprint	http://jsfc.org/apsprint/
June 10-11	Portugal Day Contest	https://portugaldaycontest.rep.pt/rules.php
June 10-11	REF DDFM 6M Contest	http://concours.r-e-f.org/index.php
June 10-11	GACW WWSA CW DX Contest	bit.ly/425Ee23
June 10-11	VK Shires Contest	http://www.wia.org.au/members/contests/wavks/
June 10-12	ARRL June VHF QSO Party	http://www.arrl.org/june-vhf
June 11	Cookie Crumble QRP Contest	https://w3atb.com/cookie-crumble/
June 14	RSGB 80m Club Championship, CW	bit.ly/3TxCrxl
June 14	VHF-UHF FT8 Activity Contest	http://www.ft8activity.eu/index.php/en/
June 17	GCW VHF-UHF Contest	https://www.agcw.de/contest/vhf-uhf/
June 17	ARRL Kids Day Contest	http://www.arrl.org/kids-day
June 17	FIRAC VHF Contest	http://www.firac.de/html/contest.html
June 17-18	All Asian CW DX Contest	https://bit.ly/3HVjkra
June 17-18	IARU Region 1 50 MHz Contest	https://bit.ly/3r1kqvT
June 17-18	SMIRK Contest	http://www.smirk.org/contest.html
June 17-18	Stew Perry Topband Challenge	https://www.kkn.net/stew/stew_rules.html
June 17-18	West Virginia QSO Party	http://bit.ly/3l3K6Z7
June 18	WAB 50 MHz Phone	http://bit.ly/31yE4kT
June 21	VHF-UHF FT8 Activity Contest	http://www.ft8activity.eu/index.php/en/
June 22	RSGB 80m Club Championship, SSB	bit.ly/3TxCrxl

just the high band DX in daylight, but also to switch to the low bands in the evening for multipliers.

Photo A shows the logger-controlled mult bell that I built. On the right-hand side of the prototype board, you see an ESP8266 microcontroller that has built-in Wi-Fi capability. While the ESP8266 is a modern surface mount chip, it's easy to breadboard circuits by using the NodeMCU DIP-pinout board that carries the SMT components. If you've done other Arduino-based projects around the shack, you'll already have the Arduino IDE; if not, it can be downloaded at <https://www.arduino.cc/>. The NodeMCU carrier board includes a microUSB port that is used to program the ESP8266; you'll find information about configuring your Arduino development environment for this combination at <https://bit.ly/3LzcI6S>. I've made the source code for my multiplier-bell ringer on my website, <http://n3qe.org/Mult_bell_raw.ino>.

The schematic (Figure 1) shows a design using only three pins on the NodeMCU ESP8266 carrier. The circuit is powered from any USB charger via the microUSB port. The GND and VIN pins on the carrier are used to extract a nominal 4.5 volts to power the bell-ringer circuitry, and the D7 general-purpose IO pin of the ESP8266 is used to drive a pair of Darlington-connected transistors that provide the high current necessary to ring the bell.

Solenoid L1 is a nominal 4.5-volt intermittent-service linear actuator with about 3/16-inch of throw. It has a DC resistance of just 4 ohms, so if we directly drove it from our 5-volt supply, it would draw a current over 1 amp. Because it is only driven occasionally, C1 – a 2200- µF electrolytic capacitor – is used to supply the peak solenoid driving current. C1 is topped up by a 100-ohm resistor (R1). Diode D1 is used to absorb voltage spikes from the solenoid coil.

Experimenting with drive parameters for the solenoid, I found that a 20-millisecond pulse would result in full throw of the actuator. Another important time constant is set by R1 and C1; the product of these (220 milliseconds) is the timescale it takes for C1 to recharge after each bell ring. Both the on- and off-time constants are encoded into the source code.

Before compiling and uploading the source code, you'll have to edit it to insert your own Wi-Fi network's SSID and password in quotes into the constants at the top. After programming, you should switch to the "Serial Monitor" tab in the Arduino software; you'll be able to verify from the diagnostic messages it prints on startup that it can log into your Wi-Fi system and the IP address it is assigned.

The framework of the code is general and lends itself to other ESP8266 UDP-sniffing gadgets around the shack. In the loop() subroutine, you'll see three distinct sections broken out. First, the incoming UDP packet is read from Wi-Fi. Then the packet is processed – in this case looking to see how many of the <ismultiplier1>, <ismultiplier2>, and <ismultiplier3> fields are equal to 1. We develop the actionable info

June 24	UFT QRP Contest	https://www.uft.net/concours-qrp-uft/
June 24-25	ARRL Field Day	http://www.arrl.org/field-day
June 24-25	His Maj. King of Spain SSB Contest	http://bit.ly/1cKAR5V
June 26	RSGB FT4 Contest Series	bit.ly/3TxCrxl
July 1	RAC Canada Day Contest	https://www.rac.ca/contesting-results/
July 1	Venezuelan Ind. Day Contest	https://bit.ly/3NDZghb
July 1-2	Original QRP Contest	http://www.qrpcc.de/contestrules/index.html
July 1-2	Marconi Memorial HF Contest	http://www.arifano.it/contest_marconi.html
July 1-2	DL-DX RTTY Contest	http://www.drcg.de/
July 1-2	NZART Memorial Contest	https://bit.ly/3wYqvx1
July 3	RSGB 80m Club Championship, CW	bit.ly/3TxCrxl
July 5	VHF-UHF FT8 Activity Contest	http://www.ft8activity.eu/index.php/en/
July 8-9	10-10 Int. Weak Signal QSO Party	http://bit.ly/1FrFeBc
July 8-9	IARU HF Championship	http://www.arrl.org/iaru-hf-world-championship
July 8-9	World Radiosport Team Championship (WRTC)	https://www.wrtc2022.it/
July 8-9	PODXS 070 Club 40 Meter Firecracker Sprint	http://bit.ly/2FUmeOL
July 8-9	Veron SLP Contest	http://bit.ly/2L9eT1L
July 9	QRP ARCI Summer Homebrew Sprint	http://www.qrparci.org/contests
July 12	RSGB 80m Club Championship, SSB	bit.ly/3TxCrxl
July 12	VHF-UHF FT8 Activity Contest	http://www.ft8activity.eu/index.php/en/
July 15-16	***CQ* WW VHF Contest**	**http://www.cqww-vhf.com/**
July 15-16	IARU Region 1 70 MHz Contest	https://bit.ly/3r1kqvT
July 15-16	North American RTTY QSO Party	http://ncjweb.com/NAQP-Rules.pdf
July 16	CQC Great Colorado Gold Rush	http://www.coloradoqrpclub.org/contests/gold.htm
July 16	RSGB International Low Power Contest	bit.ly/3TxCrxl
July 17	RSGB FT4 Contest Series	bit.ly/3TxCrxl
July 19	VHF-UHF FT8 Activity Contest	http://www.ft8activity.eu/index.php/en/
July 22-30	Maidenhead Mayhem Sprint	https://w9et.com/rules.html
July 22	YOTA Contest	https://www.ham-yota.com/contest/
July 27	RSGB 80m Club Championship, Data	bit.ly/3TxCrxl
July 29	WAB 144 MHz Low Power Phone	http://bit.ly/31yE4kT
July 29-30	RSGB IOTA Contest	bit.ly/3TxCrxl
July 30	ARS Flight of the Bumblebees	http://arsqrp.blogspot.com/
Sept. 23-24	***CQ* WW RTTY DX Contest**	**http://www.cqwwrtty.com**

– whether the logged QSO is a multiplier, and if so, how many times the bell should be rung – into the variable mcount. The final part of the code processes mcount by toggling the GPIO pin with the appropriate 20-millisecond pulses and pauses between bell rings for double- and triple-mults.

So how often would this mult bell ring at a large multi-operator contest station? In the 2022 CQ WW CW contest, multi-multi superstation K3LR was staffed and active on all six HF bands at the starting gun. During the first hour, 221 multipliers were worked, for an average of 4 bell-dings per minute. The next major bump in multiplier count happened Saturday morning in the 12Z hour, as all three high bands were open to Europe and 103 multipliers were racked up, nearly two dings a minute. By the time Sunday morning came around, multipliers were much less common. Only 10 multipliers were worked in the 13Z hour, and in the last hour, only 2 multipliers were worked.

Among assisted single-operator entries in the 2022 CQ WW CW contest, K5ZD worked 81 multipliers in the first hour. N4YDU operated unassisted as NR3X, and only had 56 multipliers in the first hour. Indeed, we would expect competitive assisted entries to have improved access to multipliers.

For on-air events that don't have multipliers but do track points – I'm thinking specifically of Field Day - you can repurpose the mult bell to become a "points bell." Replace the search for the multiplier flags with code that instead processes the <points> field. If your club is putting an effort in on both CW and SSB, you might consider ringing the bell once for SSB QSOs (2 points) and twice for CW QSOs (4 points). This would be a great way for the cooks, helpers, and visitors at your Field Day event to audibly key in to your club's on-air progress in racking up QSOs, without having to wander over and peer over your shoulder at your logging computer's screen.

June and July Contest Highlights

The second running of the **ARRL International Digital Contest** uses the FT4 and FT8 modes. It starts 1800Z Saturday June 3 and runs through 2400Z June 4. In this contest, the point value is determined by the distance between grid squares; this leads to a heavy emphasis on working DX stations especially on the high bands, rather than working locals. Find complete rules at <https://tinyurl.com/mrxk36dt>.

The **ARRL June VHF Contest** will be packed with 6-meter activity as sunspot numbers rise. Remember that in prime conditions, you'll rack up many more QSOs in the same amount of time on phone or CW, as compared to the slower FT8 mode. If you're equipped for 2-meter and up VHF operation, you'll find that phone and CW modes are also the best way to "move" contacts to other bands for additional mults and points. Contest activity starts at 1800Z July 10 and runs through 0300Z July 12. Find full rules at <http://www.arrl.org/june-vhf>.

Last month, I discussed some of the recent tweaks in **ARRL Field Day** rules, the most substantial being that class D (home stations using commercial power) entrants continue to be able to work other class D entrants for points. The rules also lift several limits that had applied to the Get-On-The-Air station, providing encouragement for clubs to let hams without stations of their own (perhaps they are HOA-limited) get their feet wet with some contest-type operation. Find a complete information packet at <http://www.arrl.org/field-day>.

At press time, rules and site selection were being finalized for the **World Radiosport Team Championship (WRTC)** event in Italy, as a "contest within a contest" concurrent with the **IARU HF contest.** I will be on one of 70 two-ham teams competing in the WRTC; over 4,000 entrants and several dozen HQ stations will be on from around the world in IARU HF. Look for announcements about the special WRTC callsigns at<https://www.wrtc2022.it/> and find the rules for the IARU HF Contest at<https://tinyurl.com/jk44bx3u>.

The **CQ WW VHF Contest** is held from 1800Z July 15 through 2100Z July 16. Activity is on the 6-meter and 2-meter bands only; again, be sure to switch to CW or SSB modes for rates higher than can be supported by FT8 mode during good propagation. Rules in last month's *CQ* or at <https://cqww-vhf.com/>.

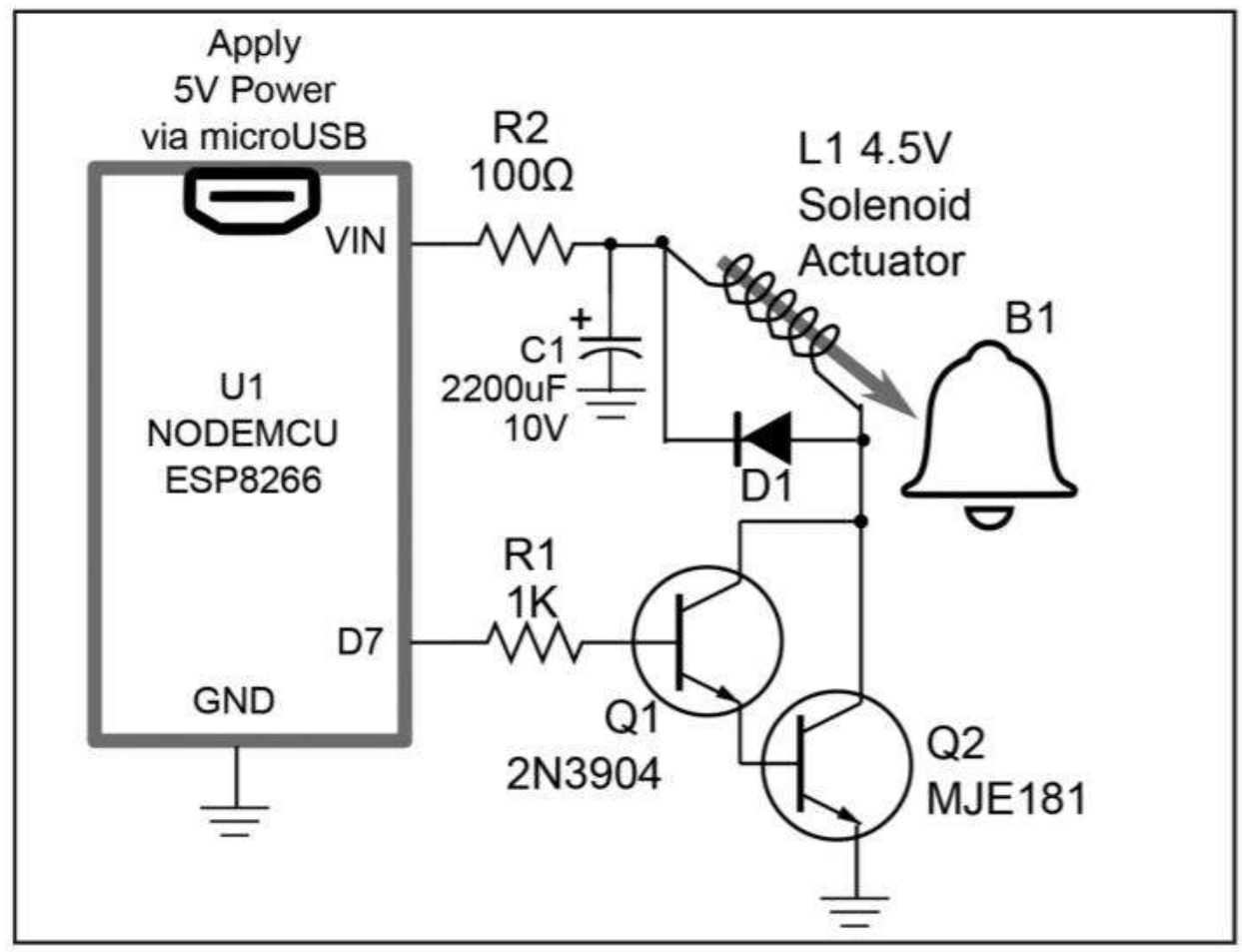

Figure 1. Schematic for the automatic mult bell.

PARTS LIST

B1 – Amazon Basics metal call bell
L1 – 4.5V Mini Push Pull Solenoid found from any of several sellers on Amazon. Nominal 4 ohm coil resistance.
Q1 – 2N3904 or other general purpose small signal NPN transistor
Q2 – MJE181, TIP31, or other TO-216/TO-220 3-Amp power transistor
R1 – 100 ohm, 1/4 Watt
R2 – 1K ohm, 1/4 Watt
C1 – 2200 µF electrolytic, rated for 10V or greater
D1 – 1N4001

propagation

BY TOMAS HOOD,* NW7US

ARRL Field Day and All About Ångströms

Quick Look at Current Cycle 25 Conditions:
(Data rounded to nearest whole number)

Sunspots:
Observed Monthly, March 2023: **123**
12-month smoothed, September 2022: **96**

10.7-cm Flux:
Observed Monthly, March 2023: **158**
12-month smoothed, September 2022: **134**

8One Year Ago:
(Data rounded to nearest whole number)

Sunspots:
Observed Monthly, March 2022:: **69**
12-month smoothed, September 2021: **41**

10.7-cm Flux:
Observed Monthly, March 2022:: **118**
12-month smoothed, September 2021: **89**

The annual ARRL Field Day, amateur radio's open house, is always the fourth full weekend in June. This year, that means Field Day is June 24 and 25. Operations begin at 1800 UTC Saturday and end at 2059 UTC Sunday. Refer to the official ARRL Field Day Packet for full rules and details. The packet can be downloaded by browsing to <https://g.nw7us.us/42dfTXo> for the 2023 Field Day Packet PDF download.

The introduction to Field Day, found on the Field Day webpage at ARRL <http://www.arrl.org/field-day>, states:

> ***"Field Day is ham radio's open house.*** *Every June, more than 40,000 hams throughout North America set up temporary transmitting stations in public places to demonstrate ham radio's science, skill and service to our communities and our nation. It combines public service, emergency preparedness, community outreach, and technical skills all in a single event. Field Day has been an annual event since 1933, and remains the most popular event in ham radio."*

The official Field Day 2023 introduction states that the goal of this year's field day is officially an *operating event*, not a contest. The idea of Field Day, according to the ARRL, is "the demonstration of the communications ability of the amateur radio community in simulated emergency situations. Groups across the continent use Field Day as a literal *show and tell* exhibition."

One of the best available methods to predict HF propagation conditions in advance is the 27-day recurrence tendencies of geomagnetic, solar, and ionospheric conditions. It is not an absolute method, but it does give a very good indication of what is expected. This column was written in early May, about two 27-day solar rotation cycles away from the start of the Field Day weekend. Based on a study of the patterns expected during the next two rotational periods of the Sun, it looks as if conditions for Field Day, June 24 and 25, will be excellent with low geomagnetic activity, and higher daily 10.7-cm radio flux levels than in the past several years.

Predictions for one 27-day rotational period are far more accurate than for two or three periods. Be sure to carefully check conditions on May 27 and 28, since this would be one rotational period before the Field Day weekend. There is better than a 90% chance that conditions observed on those days will recur during the event weekend.

Remember, short-skip propagation (often by sporadic-E, or E_S, mode) is a big part of Field Day on-air activity, especially on the higher HF bands and even on low VHF bands. No matter how the ionospheric F-layer is faring at various points in the sunspot cycle, E_S propagation keeps Field Day full of potential.

If you wish to maximize your on-air efforts, you'll want to check out the Last-Minute Forecast. Use these charts, as well as a good forecasting and analysis propagation tool, like the online VOACAP website <https://www.voacap.com>, to help you prepare operating guides for your Field Day operations. For the very latest update on conditions, look online at my up-to-the-day Last Minute Forecast chart, available on

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LAST-MINUTE FORECAST

Day-to-Day Conditions Expected for May 2023

	Expected Signal Quality			
Propagation Index	**(4)**	**(3)**	**(2)**	**(1)**
Above Normal: 1-3,5-11,14-16,19,24-25, 27-30	A	A	B	C
High Normal: 4,12-13,20,26	A	B	C	C-D
Low Normal: 22-23	B	C-B	C-D	D-E
Below Normal: 21	C	C-D	D-E	E
Disturbed: 17-18	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 **4** will be excellent on June 1 through June 16, but poor to fair on June 17 and 18, 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.

my Space Weather and Radio Propagation Center <https://SunspotWatch.com> website.

The Ångström and the Sun

The Sun is always emitting electromagnetic radiation as well as spewing out vast amounts of plasma. The Sun's electromagnetic radiation occurs at many wavelengths, a number of which ionize particular regions of the Earth's atmosphere (the group of regions known as the ionosphere). Hard x-rays (1-10 Ångströms in wavelength) ionize the D-region, which is the lowest (or closest to the Earth) portion of the ionosphere. Soft x-rays (10-100 Ångströms in wavelength) ionize the E-region (where sporadic-E and auroral-E propagation occur), while ultraviolet light (100-1000 Ångströms) ionizes the F-regions (these regions are most useful for world-wide propagation of shortwave frequencies).

An Ångström (Å) is the unit of measurement used by astronomers to measure wavelength (typically of electromagnetic radiation and light). The length of an electromagnetic wave (a wavelength) is the distance between its peaks. We use this wavelength to define the energy of the radiation. An Ångström is equal to one hundred-millionth of a centimeter. Using such units makes it easier for us to refer to measurements of light radiation, because it allows us to avoid using lots of zeroes.

Visible light covers the range from 4,000 to 8,000 Ångströms. By comparison, a page from this magazine is approximately 1,000,000 Ångströms thick.

The Solar Dynamics Observatory (SDO) is the most advanced spacecraft ever designed to study the Sun. SDO provides images at various wavelengths with clarity ten times better than high-definition television. The images often included with this column are captured by the special instruments aboard SDO, grouped in two arrays, the HMI and AIA instruments.

The Helioseismic and Magnetic Imager (HMI) maps solar magnetic fields and looks beneath the Sun's opaque surface. The experiment deciphers the physics of the Sun's activity, taking pictures in several very narrow bands of visible light. Scientists are able to make ultrasound images of the Sun and study active regions in a way like watching sand shift in a desert dune.

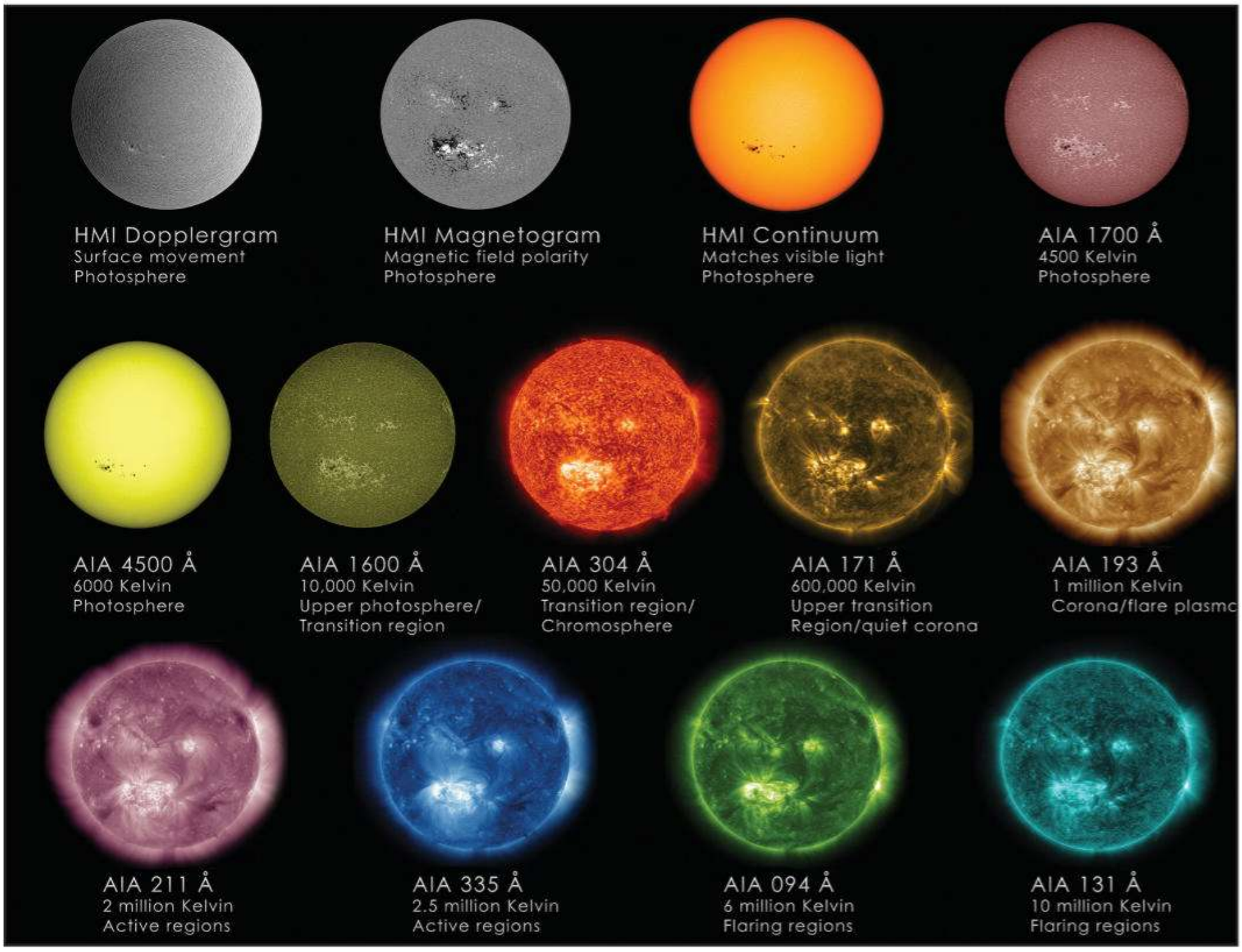

Figure 1: Each of the wavelengths observed by NASA's Solar Dynamics Observatory (SDO) was chosen to emphasize a specific aspect of the Sun's surface or atmosphere. This composite shows imagery both from the Advanced Imaging Assembly (AIA), which helps scientists observe how solar material moves around the Sun's atmosphere, and the Helioseismic and Magnetic Imager (HMI), which focuses on the movement and magnetic properties of the Sun's surface.

The colors (many of them false colors, as we cannot see these wavelengths with the naked eye) used in SDO images are: AIA 171 (gold); AIA 193 (bronze); AIA 304 (red); AIA 211 (purple); AIA 131 (teal); AIA 335 (blue); AIA 94 (green); AIA 1600 (yellow/green); and AIA 1700 (pink). (Credit: NASA/SDO/Goddard Space Flight Center)

The Atmospheric Imaging Assembly (AIA) is a group of four telescopes designed to photograph the sun's surface and atmosphere. The instrument covers 10 different wavelength bands, or colors, selected to reveal key aspects of solar activity. These types of images show details never seen before by scientists. From the Sun's surface on out, the wavelengths SDO observes, measured in Ångströms, are:

4500: At a temperature of about 6,000 degrees Kelvin, shows the Sun's surface or *photosphere*. This is close to the white light images, such as the HMI Intensity-grams that are sometimes featured in this column.

1700: 4500 Kelvin; shows the surface of the Sun, as well as a layer of the Sun's atmosphere called the *chromosphere*, which lies just above the photosphere and is where the temperature begins rising as altitude above the photosphere increases.

1600: 10,000 Kelvin; shows a mixture between the upper photosphere and what's called the *transition region*, a region between the chromosphere and the uppermost layer of the Sun's atmosphere called the *corona*. The transition region is where the Sun's temperature rapidly rises.

304: 50,000 Kelvin; this light is emitted from the chromosphere and transition region.

171: 600,000 Kelvin; this wavelength shows the Sun's atmosphere, or corona, when it's quiet. It also shows giant magnetic arcs known as coronal loops. Images from this wavelength are often included with this column, as we are interested in the magnetic structures at play on the Sun.

193: 1 million Kelvin; shows a slightly hotter region of the corona as well as the much hotter material of a solar flare. This wavelength also reveals coronal holes, when present.

211: 2 million Kelvin; this wavelength shows hotter, magnetically active regions in the Sun's corona.

335: 2.5 million Kelvin; this wavelength also shows hotter, magnetically active regions in the corona.

94: 6 million Kelvin; this highlights regions of the corona during a solar flare.

131: 10 million Kelvin; the hottest material in a flare.

At each wavelength, unique processes and features of the Sun's activity are revealed. To help scientists categorize and observe specific events and the details occurring, they artificially color the images of each particular wavelength. They have standardized the col-

ors so that anyone can know which wavelength is being viewed just by the color used (see Figure 1).

When electromagnetic radiation from the Sun strips an electron off a neutral constituent in our atmosphere, the resulting electron can spiral along a magnetic field line. Thus, the condition of the ionosphere depends on the state of Earth's magnetic field. This is important because Earth's magnetic field plays a big part in the propagation of radio signals around our planet. Generally, an A index at or below 15, or a K index at or below 3, is best for propagation.

During the peak of solar activity, the steady occurrence of x-ray flares, erupting back-to-back, can over-energize the ionosphere and cause radio blackouts on the entire shortwave radio spectrum for many hours. Of course, that's the most intense possibility during the peak of a solar cycle. Most of the time during this solar maximum, the radio spectrum is useful for world-wide communications, because of the high level of energy delivered to the ionosphere.

We'll continue diving into the science of the ionosphere and space weather, as well as using computer software tools that aid in understanding, analyzing, and predicting radio signal propagation. Stay tuned each month!

June Shortwave Propagation

It is during this month that we see a change from the yearly spring equinoctial propagation patterns to the summertime propagation conditions on the high frequency (HF) spectrum. The ionospheric absorption levels are expected to be at seasonally high levels (primarily by the D-region), resulting in generally weaker signals during the hours of daylight when compared to reception during the winter and spring months.

Ten-meter propagation to DX locations far to the east and west are possible. With solar activity quite high, we are witnessing strong F-region openings both on paths between north and south points and on paths between points east and west. We also expect sporadic-E (E_S) short skip propagation to be prevalent on the 10-meter band.

The 17- and 15-meter bands will be significantly more reliable than 10 meters, holding great promise. Look for excellent conditions around sunrise and sunset, though openings remain over sunlit paths.

Twenty meters is fair during the hours of darkness, and excellent during daylight hours now that sunspot activity is high. Like we see on 15 meters, the best openings on 20 will be the hours around sunrise and sunset.

The 30- and 40-meter bands should offer good DX conditions during the early morning, late evening, and during the night despite higher static. Look for Europe and Africa as early as sunset. After midnight, start looking south and west for Pacific, South America, and Asia. Short skip propagation should be possible out to about 750 miles during the daytime.

Expect some openings on 80, similar to how 40 meters will be acting. Fairly frequent short-skip openings up to 1,000 miles are possible during darkness but expect very few daytime openings with all the static and absorption due to summer weather storms and summertime ionospheric chemistry.

Recurring coronal holes will cause occasional periods of geomagnetic storminess during June, degrading higher latitude signal paths more than middle and low latitude paths. Geomagnetic storms will play rough on HF propagation. In addition, noise from electrical storms increases considerably during June and the summer months. These higher static levels will make DXing on 40, 80, and 160 more of a challenge.

With the Sun increasing in activity, we expect an increase in the number of x-ray flares as we get closer and closer to the peak of Solar Cycle 25 (expected sometime between 2024 and 2026). These flares not only cause instant radio blackouts on the sunlit side of the Earth, facing those flares, but they may be associated with *coronal mass ejection* (CME) events. The arrival of a CME may cause the same kind of propagation degradation as we see from the solar wind effects from recurring coronal holes.

Again, with sporadic-E propagation peaking during June, expect an increase in the number of short-skip openings on HF, and often on 6- and 2-meters, with paths open between 50 and 2,300 miles.

VHF Conditions

Expect low-VHF (six-meter) propagation to be *red-hot*! There might even be openings on the two-meter band. All month, you can expect to see 20 to 24 days with some E_S activity. Usually these openings are single-hop events with paths up to 1,000 miles, but June's E_S openings are often double-hop. Europe can generally be worked from the East Coast throughout June.

During the daylight hours, monitor six meters for transcontinental openings, as well as between Hawaii and the western states, and the Caribbean and Central and South America. The best time to look for these is during the afternoon hours, especially when conditions are High Normal or better.

Check out <https://tinyurl.com/2a9yd7e7> for a complete calendar of meteor showers in 2023.

If you use Twitter, you can follow @hfradiospacewx for hourly updates that include the K index numbers. You can also check the numbers at <https://SunSpotWatch.com>, where this columnist provides a wealth of current space weather details as well as links. Please report your observations of any notable propagation conditions, by writing this columnist via Twitter, or via the Space Weather and Radio Propagation Facebook page at <https://fb.me/spacewx.hfradio>.

Current Solar Cycle Progress

The Royal Observatory of Belgium reports that the monthly mean observed sunspot number for March 2023 is 122.6, up from 110.9 for February. The twelve-month running smoothed sunspot number centered on September 2022 is 96.4. A smoothed sunspot count of 97, give or take about 9 points, is expected for June 2023.

The Dominion Radio Astrophysical Observatory at Penticton, BC, Canada, reports a 10.7-cm observed monthly mean solar flux of 157.53 for March 2023. The twelve-month smoothed 10.7-cm flux centered on September 2022 is 138.1. The predicted smoothed 10.7-cm solar flux for June 2023 is 132, give or take 7 points.

Geomagnetic activity level this month is expected to range from quiet to stormy, resulting in occasional degraded propagation this month. Remember that you can get an up-to-the-day ***Last-Minute Forecast*** at <https://SunSpotWatch.com>.

I welcome your thoughts, questions, and experiences regarding this fascinating science of propagation. You may e-mail 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

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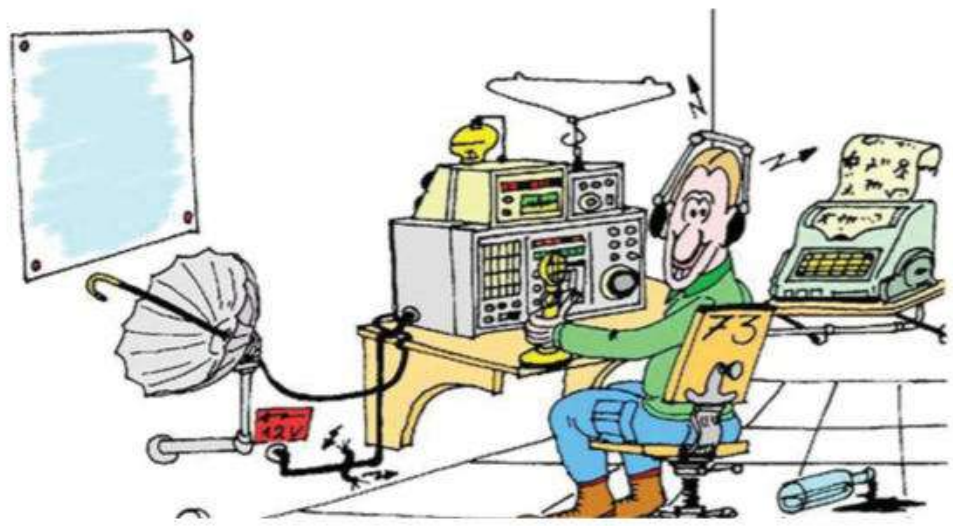

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