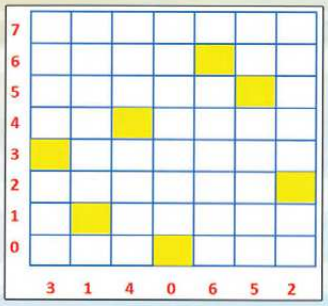
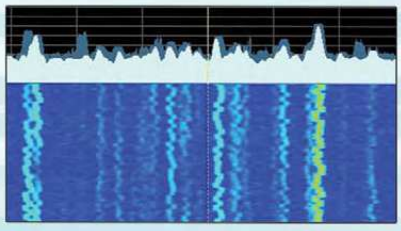
QST
DIGITAL EDITION

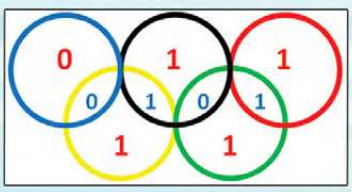
ARRL The National Association for Amateur Radio®
January 2024 www.arrl.org
DEVOTED ENTIRELY TO AMATEUR RADIO

A Look Inside

FT8







QST Reviews

Yaesu FTM-500DR C4FM/FM 144/430 MHz Transceiver

Portable Power Stations — Jackery Explorer 500, Bluetti EB55, EcoFlow RIVER 2 Max, and Bioenno Power BPP-M500

The radio... YAESU

Inherent Passion and Inspiration

Hybrid SDRs (Narrow Band SDR & Direct Sampling SDR)

2kHz RMDR 123dB+
2kHz BDR 150dB+
2kHz 3rd IMDR 110dB+

Ultra Low-Noise Local Oscillator System; 400MHz HRDDS (High Resolution Direct Digital Synthesizer)

2kHz Phase Noise −150dBc/Hz

VC-TUNE (Variable Capacitor Tune) signal peaking

Maximum Attenuation −70dB

3DSS (3-Dimensional Spectrum Stream) visual display view up to last 25 seconds of band conditions in real time

TX Signal Purity

TX Phase Noise −150dBc/Hz (TX 14MHz 2kHz separation)

* Microphone M-1: Optional

In Homage to the Founder of Yaesu – Sako Hasegawa JA1MP

FTDX101MP 200W
HF/50MHz TRANSCEIVER

- External Power Supply with 3.94" (100mm) Front Speaker, FPS-101 included
- VC-Tune unit × 2 (MAIN and SUB bands) included
- 300Hz Crystal roofing filter (MAIN band) included
- 600Hz Crystal roofing filter (MAIN and SUB bands) included
- 3kHz Crystal roofing filter (MAIN and SUB bands) included

The Ultimate
FTDX101D 100W
HF/50MHz TRANSCEIVER

- VC-Tune unit (MAIN band) included
- 600Hz Crystal roofing filter (MAIN and SUB bands) included
- 3kHz Crystal roofing filter (MAIN and SUB bands) included

YAESU
Radio for Professionals

YAESU USA
6125 Phyllis Drive, Cypress,
CA 90630 (714) 827-7600

For the latest Yaesu news, visit us on the Internet: **http://www.yaesu.com**

Carries the Yaesu genes for true RF performance

- **SDR circuit emphasizes Receiving Performance**
- **Powerful RF Front-End & Low Noise Oscillator Enable Phenomenal Multi-Signal Receiving Characteristics***
  - RMDR : 113dB+
  - BDR : 127dB+
  - 3rd IMDR : 102dB+
  - TX Phase Noise : −143dBc/Hz
- **Band-Pass-Filters dedicated for the amateur bands to eliminate out-of-band unwanted signals**
- **Built-in High-speed Automatic antenna tuner**
- **Effective QRM rejection by Dual-core DSP**

*Multi-signal receiving characteristic: 14MHz band/2kHz separation
*TX Phase Noise: 100W, CW mode

- **AESS** (Acoustic Enhanced Speaker System) with SP-40 speaker to create High-fidelity audio output
- **3DSS**, real-time 3-Dimentional Spectrum Stream presentation
- **High Resolution 4.3-inch TFT Color Touch Panel Display**
- **VMI** (VFO Mode Indicator) shows the current operating mode
- **"PRESET" Mode functions most suitable for FT8 operation**
- **Equipped with the External Display terminal**

FT-710 AESS

- Includes External Speaker SP-40

FT-710 Field

- Includes Carrying Belt
- To use the AESS function, External Speaker SP-40 (Optional) is required

- Display is not included. The image is shown with an optional third-party external display that may be connected using a DVI-D digital cable.

* Photo shows the FT-710 AESS

HF/50MHz 100W SDR TRANSCEIVER w/ SP-40

FT-710 Aess

Acoustic Enhanced Speaker System

HF/50MHz 100W SDR TRANSCEIVER

FT-710 Field

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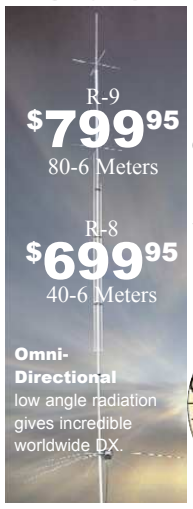
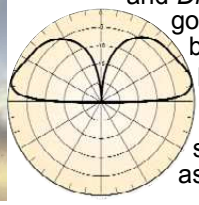
Cushcraft R9…80-6M Vertical…*No Radials…1500W*



Cushraft high performance R9 vertical gives you 9 bands *without radials*!

It's omni-directional low angle radiation delivers exciting and easy worldwide DX on all 9 bands: 75/80, 40, 30, 20, 17, 15, 12, 10 and 6 Meters with low SWR. QSY instantly -- no antenna tuner needed.

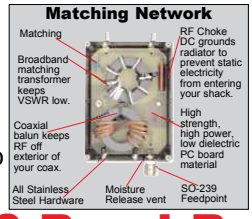
Use full *1500 Watts* SSB/CW and *Digital* when the going gets tough to break through pileups/poor band conditions.

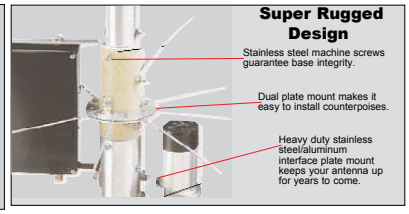


The R9 is super easy to assemble, installs just about anywhere, and its low profile blends inconspicuously into the background in urban and country settings alike.

Compact Footprint: Installs in an area about the size of a child's sandbox -- no ground radials to bury with all RF-energized surfaces safely out of reach.

Rugged Construction: Thick fiberglass insulators, all-stainless steel hardware and 6063 aircraft-aluminum tubing is double or triple walled at key stress points to handle anything Mother Nature can dish out.





31.5 feet tall, 25 lbs. Mounting mast 1.25 to 2 inches. Wind surface area is 4 square feet.

R8, $699.95. Like R9 antenna but less 75/80 Meters.

R-8TB, $119.95. Tilt-base lets you tilt your antenna up/down easily by yourself to work on.

R-8GK, $99.95. Three-point guy kit for high winds.

Cushcraft MA-6B 6-Band Beam

Small Footprint -- Big Signal

2-Elements on 20/17/15/12/10/6 Meters!!!

Cushcraft's latest MA-6B gives you *2-elements on 6 bands!* Solid *signal-boosting directivity* in bantam size/weight.

It mounts on your roof or mast using standard TV hardware. It's perfect for exploring exciting DX without the high cost and heavy lifting of installing a large tower and a full-sized array. 7' 3" boom has less than 9' of turning radius. Contest tough -- handles 1500 Watts.

The unique MA-6B is a *two-element Yagi* on 20/17/15/12/10/6 Meters. It delivers solid power-multiplying gain over a dipole on *all* bands. Automatic band switching and a super easy installation in a compact 26 pound package.

When working DX, what really matters are the interfering signals and noise *you don't hear.* That's where the MA-6B's impressive side rejection and front-to-back ratio really shines.

MA-5B, $759.95. Like MA-6B but 5 bands: 20/17/15/12/10 Meters. 12/17M is a single element trapped dipole.

Cushcraft A-3S 10/15/20 Meter Tribander Beams

Only the best tri-band antennas become DX classics, which is why the Cushcraft World-Ranger A4S, A3S, and A3WS go to the head of the class. For more than 30 years, these pace-setting performers have taken on the world's most demanding operating conditions and proven themselves every time. The key to success comes from attention to basics. For example, element length and spacing has been carefully refined over time, and high-power traps are still hand-made and individually tuned using labratory-grade instruments. All this attention to detail means low SWR, wide bandwidth, optimum directivity, and high efficiency -- important performance characteristics you rely on to maintain regular schedules, rack up impressive contest scores, and grow your collection of rare QSLs!

It goes without saying, the World-Ranger lineup is also famous for its rugged construction. In fact, the majority of these sold years ago are still in service! Conservative mechanical design, rugged over-sized components, stainless-steel hardware, and aircraft-grade 6063 make all the difference.

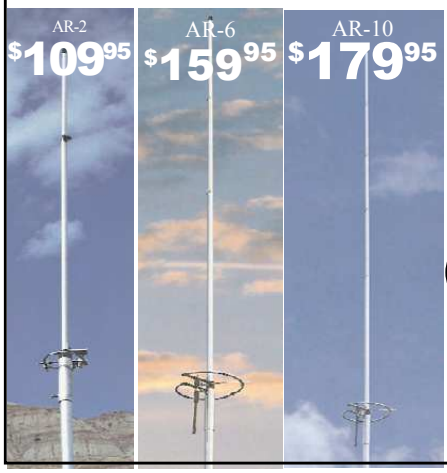
The 3-element A3S/A3WS and 4-element A4S are world-famous for powerhouse gain and super performance. **A-3WS**, **$649.95,** 12/17 M. **30/40 Meter** *add-on kits* available.

Cushcraft Dual Band Yagis

One Yagi for Dual-Band FM Radios

Dual-bander VHF rigs are the norm now, so why not compliment your FM station with a dual-band Yagi? Not only will you eliminate a costly feed line, you'll realize extra gain for digital modes like high-speed packet and D-Star! Cushcraft's A270-6S provides 3 elements per band and the A270-10S provides 5 for solid point-to-point performance. Both pre-tuned. Assembly is a snap using fully illustrated manual.

Cushcraft Famous *Ringo* Compact FM Verticals



W1BX's famous *Ringo* antenna has been around for a long time and remains unbeaten for solid reliability. The Ringo is broadbanded, lighting protected, extremely rugged, economical, electrically bullet-proof, low-angle, and more -- but mainly, it just plain works! To discover why hams and commercial two-way installers around the world still love this antenna, order yours now!

Call your dealer for your best price!

www.cushcraftamateur.com

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SWR
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	CN-501H	CN-501H2	CN-501V/N
Frequency	1.8~150MHz	1.8~150MHz	140~525MHz
Power Range: Forward	15/150/1.5KW	20/200/2KW	20W/200W
Power Rating	1.5KW (1.8~60MHz) 1KW (144MHz)	2KW (1.8~60MHz) 1KW (144MHz)	200W (140~525MHz)
Tolerance	±10% at Full Scale	±10% at Full Scale	±10% at Full Scale
SWR Measurement	1:1~1:∞	1:1~1:∞	1:1~1:∞
SWR Detection Sensitivity	4W MIN	4W MIN	4W MIN
Input/Output Impedance	50 ohms	50 ohms	50 ohms
Input/Output Connectors	SO-239	SO-239	SO-239 or N-Type

CN-501
Economy Series

Compact HF/VHF AVG reading SWR/Power Meter Cross needle technology displays:

***• FORWARD POWER • REFLECTED POWER • SWR** - Simultaneously!*

	CN-901HP	CN-901HP3	CN-901V/N	CN-901G
Frequency	1.8~200MHz	1.8~200MHz	140~525MHz	900~1300MHz
Power Range: Forward	20/200/2KW	30/300/3KW	20/200W	2/20W
Tolerance	±10% at Full Scale	±10% at Full Scale	±10% at Full Scale	±10% at Full Scale
SWR Measurement	1:1~1:∞	1:1~1:∞	1:1~1:∞	1:1~1:∞
SWR Detection Sensitivity	5W MIN	5W MIN	5W MIN	0.4W
Input/Output Impedance	50 ohms	50 ohms	50 ohms	50 ohms
Input/Output Connectors	SO-239	SO-239	SO-239 or N-Type	N-Type

CN-901
Professional Series

AVG & True PEP power meter .5 second PEP delay to dampen the needle movement with on/off switch:

***• FORWARD POWER • REFLECTED POWER • SWR** - Simultaneously!*

CS-201

Frequency Range (up to): 600MHz
Power Rating: 2.5 kW PEP1 kW CW
VSWR: Below 1.2:1
Insertion Loss: Less than 0.2 dB
Isolation: 60 dB 600 MHz
Connector: SO 239
Output Port: 2

CS-201GII

Frequency Range (up to): 2 GHz
Power Rating:
1.5 kW CW (up to 30 MHz)
250 W CW (up to 1 GHz)
150 W CW (up to 2 GHz)
VSWR: Below 1:1.3 at 1.3 GHz
Insertion Loss: Less than 1.2 dB at 1.2 GHz
Isolation: 50 dB 1 GHz
Connector: Gold Plated N-Type
Output Port: 2

NCG company

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QST

Contents

January 2024 ♦ Volume 108 ♦ Number 1

IMPORTANT: About Membership and Magazines
All members continue to have access to four digital magazines: *QST*, *On the Air*, *QEX*, and *NCJ*. Printed-and-mailed issues of *QST* and *On the Air* magazines will not be included with current and new memberships effective January 1, 2024. Print subscriptions are available and sold separately. A summary of 2024 dues rates and related changes are available at **www.arrl.org/2024-dues-rates**.

An icon next to an article means there's bonus content in the digital edition at **www.arrl.org/qst**.

Columns

Write for *QST*

www.arrl.org/qst-author-guide
email: **qst@arrl.org**

Departments

Digital and Mobile Editions

ARRL members can access the digital edition via a link at **www.arrl.org/qst**, download our iOS app from the iTunes Store, and download our Android app from the Google Play Store.

Our Cover
Many of us are familiar with the data waterfalls that clue us into the presence of stations when we're working digital modes, but what's behind those graphics? "FT8 Visualized" by Thomas W. Brooks, KE1R, dives into how FT8 data streams are created — read the article to learn how Costas arrays, delta time, and error correction all play a part in generating the information that then is visualized in the well-known waterfall. [Thomas W. Brooks, KE1R, images]

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ARRL Membership is available to individuals at $49 per year ($59 beginning 1/1/2024). A reduced rate is available for licensed radio amateurs under 26 years old, for $25 per year ($30 beginning 1/1/2024). Membership is available to the immediate family of a member living at the same address, and to anyone who is legally blind, for $10 per year ($12 beginning 1/1/2024). A complete list of dues rates is available at **www.arrl.org/join**. Foreign remittances should be by international postal or express money order or bank draft negotiable in the US and for an equivalent amount in US funds.

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SENSORS
Feel your surroundings with this atmospheric sensor

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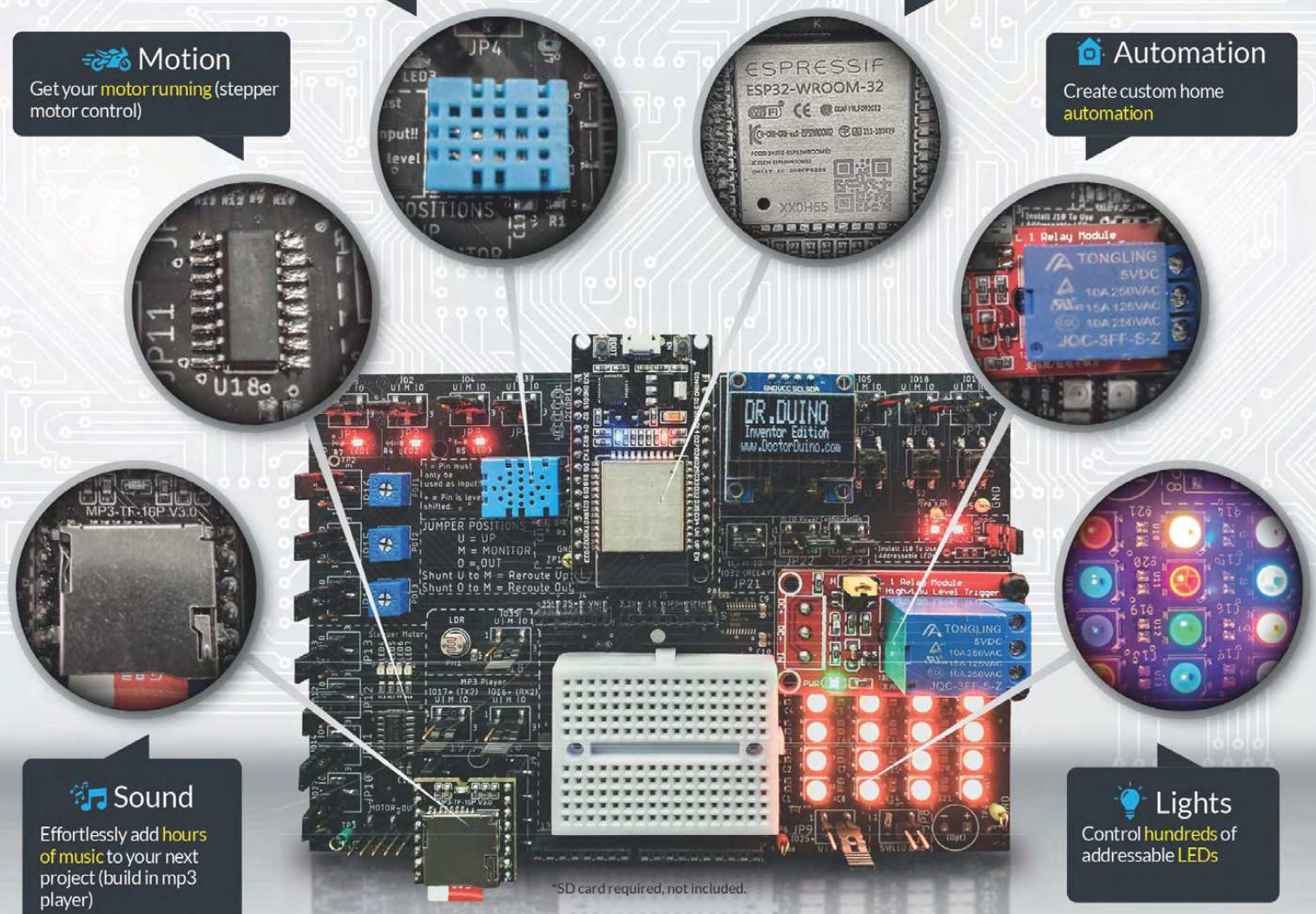
Motion
Get your motor running (stepper motor control)

Automation
Create custom home automation



*SD card required, not included.

Sound
Effortlessly add hours of music to your next project (build in mp3 player)

Lights
Control hundreds of addressable LEDs

QST

As Seen In QST Magazine
June 2023 Page 48 - Product Review Section

"Bottom Line - The Dr.Duino Inventor Edition is an ideal platform to design, create and test your next level ESP32-based Arduino projects" Effortlessly control thousands of LEDs, play hours of sound, spin motors, connect via WIFI & Bluetooth, flip relays and MORE!

Reviewed by-Glen Popiel, KW5GP

Use Exclusive Coupon Code: HOLIDAYS

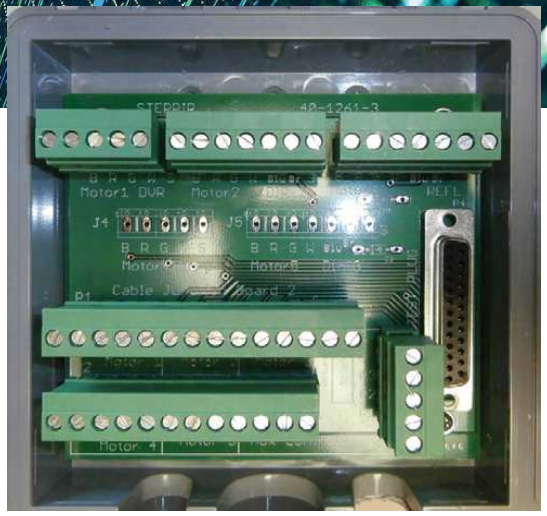
Scan me with your phone or visit:

www.DoctorDuino.com

Easy To Assemble, NO SOLDERING Required!

PREWIRING

FREE FROM THE FACTORY



The best performing antenna systems in the world, just got BETTER - Introducing control-cable prewiring for all new antenna purchases!

- Wiring is a thing of the past - greatly simplifies assembly of all SteppIR antenna products.
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DIAMOND ANTENNA

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When it comes to quality and performance, DIAMOND ANTENNA is the worldwide leader in VHF/UHF base and mobile antennas.

DIAMOND ANTENNAS help you get the most out of your on-air experience.

For all your base station and repeater needs, DIAMOND has an antenna that will work for you.

You've tried the rest, now own the best!

X700HNA Special Features:

- Heavy duty fiberglass radomes
- Four section assembly
- Overlapping outer shells for added strength
- Stainless steel mounting hardware & radials
- Strong waterproof joint couplings
- Type-N cable connection
- Wideband performance
- Highest gain Dual-band Base Antenna!

Here is a small sample of our wide variety of antennas

Model	Bands	Length Ft.	Max Pwr. Rating	Conn.
Dualband Base Station/Repeater Antennas				
X700HNA (4 section)	2m/70cm	24	200	N
X510HD (3 Section)	2m/70cm	17.2	330/250	UHF or N
X300A (2 Section)	2m/70cm	10	200	UHF or N
X200A (2 Section)	2m/70cm	8.3	200	UHF
X50A (1 Section)	2m/70cm	5.6	200	UHF or N
X30A (1 Section)	2m/70cm	4.5	150	UHF
Monoband Base Station/Repeater Antennas				
F23H (3 Section)	144-174 MHz (W/ Cut Chart)	15	350	UHF
F22A (2 Section)	2m	10.5	200	UHF
CP22E (Aluminum)	2m	8.9	200	UHF
F718A (Coax Element)	70cm	15	250	N
Dualband Mobile Antennas				
SG7900A	2m/70cm	62.2 in.	150	UHF or NMO
SG7500A	2m/70cm	40.6 in.	150	UHF or NMO
NR770H Series	2m/70cm	38.2 in.	200	UHF or NMO
MR77 Series	2m/70cm	20 in.	70	Mag Combo
AZ504FXH	2m/70cm	15.5 in.	50	UHF
AZ504SP	2m/70cm	15.5 in.	50	UHF
NR7900A	2m/70cm	57 in.	300/250	UHF
Monoband Mobile Antennas				
NR22L	2m	96.8 in.	100	UHF
M285	2m	52.4 in.	200	UHF or NMO

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David A. Minster, NA2AA, ARRL Chief Executive Officer, na2aa@arrl.org

Second Century

YEAR of the VOLUNTEERS

The Genealogy of Amateur Radio

What does that Norman Rockwellian image of amateur radio look like in your mind? Is it a picture, taken many years ago, in black and white, of you and a parent or grandparent at a desk with your first radio? Mine is a little like that.

My father introduced me to amateur radio, encouraging me to learn about radio by listening first, for stations in all 50 states, before I moved on to get my Novice license. The picture in my mind is of my dad and me, sitting on the floor with an open book, components neatly organized around a carefully drilled metal box, as we assembled a two-tube transmitter for 40 and 80 meters. I still have my dad and that transmitter in my life today, but that portrait-like moment is the defining image of the generations that form my life — my family tree — in amateur radio.

Ever since I was licensed there has been talk of the "graying" of amateur radio. The elders in my local Fair Lawn Amateur Radio Club, as well as my high school advisor, were all gray. But that was just a moment in time during the late 1970s. Today, amateur radio really is at a place where those who came into the hobby during a growth spurt in the 1950s have all but left us, and those of us in the second growth spurt of the 1970s are reaching, or are in, our retirement years. So what is the future of amateur radio? What will our family tree of generations of hams look like in 20 years?

Regrettably, as a community, we allowed the internet and smartphones to interpose themselves between us and our young people — our next generation. We are now well into the second generation of young people who did not grow up with amateur radio in their schools. The advisors have retired, and the stations have been dismantled for other uses. We've allowed the simple argument that "I can talk anywhere in the world on my phone" to be an acceptable excuse for why young people don't need to pursue an interest in amateur radio. It isn't.

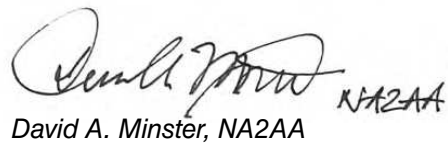
This is the moment where we must double, re-double, and double again our efforts to insert radio communications into the learning environment with young people. Amateur radio was STEM (science, technology, engineering, and math) before it became a buzzword. In tenth grade, I stayed after school for a week to learn logarithms while studying for my Advanced exam because I wanted to — I needed to — to understand the theory to pass my exam. Who does that today? Who has the inspiration to go beyond the curriculum and the largely programmed day young people live as they progress though their school years? ARRL must become a force in the STEM space to take what we know, what we can do, and who we know to create new capabilities, build new muscles, in this space.

We've been very successful in getting to know and work with the college community via our Collegiate Amateur Radio Program (CARP). Through monthly Zoom calls with college and university students and advisors across the country, we see and understand the attitudes of today's college community and create opportunities for amateur radio to find a place within their culture. You may have heard me speak of the technology-induced ADD most people, especially young people, suffer from today. There are hundreds of interruptions a day from their smartphone or smartwatch from one or more members of the various groups they belong to, with questions, comments, observations, updates, and the like. How do you neatly fit into, and take an important place within, a mind that is undergoing constant interruption and being connected 24 hours a day?

The answer is somewhere within how, for generations, families have stayed together and thrived. We must take this moment, this opportunity, to define how we can and will make amateur radio more relatable to the younger generations as the older generations continue to enjoy the connectedness our community offers. Globally.

As I have said many times, clubs are a critical part of this strategy. Invite the younger or youngest members of your club to be the ambassadors to new hams, irrespective of their age. Ensure that there are interesting activities such as kit night, or POTA, or satellites, or digital voice and data activities to capture that important mindshare of these new hams. We will be doing our part looking to move more training, better curriculum options, and hands-on exercises into classrooms across the country to regain that relationship we once had, creating life-defining moments with today's young hams.

Be radio active! Learn a new capability of amateur radio. Be a connector! Teach that new capability to others! And think about how you will fit into that genealogy — that family tree — of future hams to come.



David A. Minster, NA2AA
Chief Executive Officer

hy-gain HF Vertical Antennas

Work amazing DX with these extremely low radiation angle omnidirectional antennas. All self supporting, 1500 Watts PEP SSB, low SWR. Heavy duty, slotted, tapered, swaged, aircraft quality aluminum tubing. Stainless steel hardware. Two year limited warranty.

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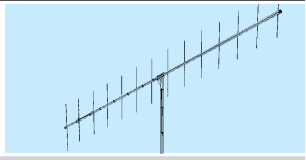

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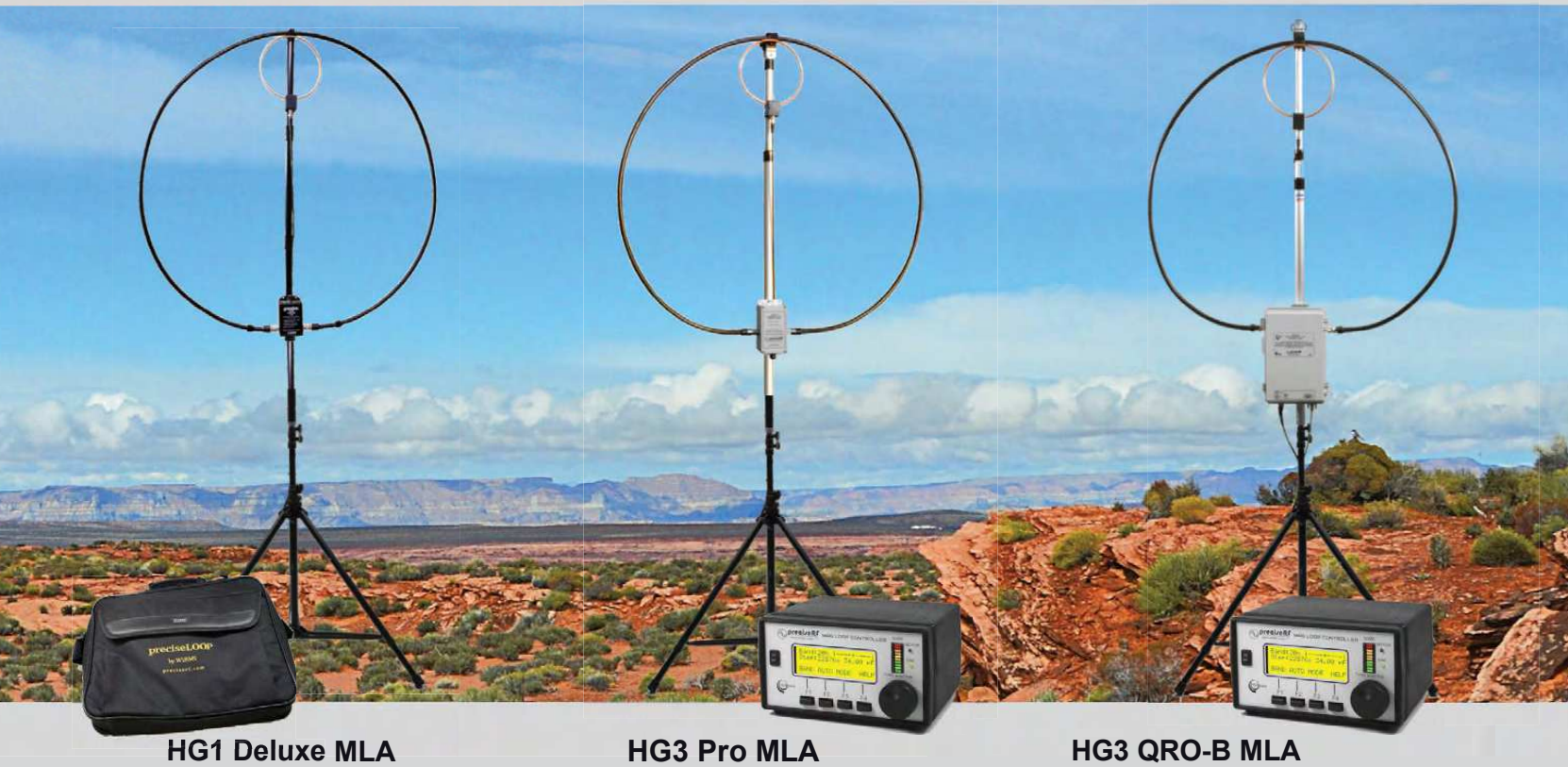

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Member Spotlight

In 2023, this column highlighted amateurs who have achieved recognition in areas outside of, or related to, amateur radio. Here's another to kick off 2024.

Sunita Williams, KD5PLB

Sunita "Suni" Williams, KD5PLB, has spent a total of 322 days in space, and she has the second-most cumulative spacewalk time by a female astronaut.

A Series of Career Influences

Upon graduating high school, Suni enrolled in the US Naval Academy and quickly discovered that she liked structure and teamwork. *Top Gun* had recently come out, inspiring her to become a helicopter pilot and later a test pilot instructor. She enjoyed working on an integrated team to make improvements to the aircraft. Suni appreciated that "sometimes helicopters break down and you have to get in there with the wrenches and do a little righty tighty, lefty loosey with the guys working on the engine and the rotor heads."

Suni's interest in becoming an astronaut was piqued when she toured Johnson Space Center in the early 1990s. There she met John Young, who talked about landing vertically on the moon. Years later, Suni is now getting ready to launch into space on another mission. She credits happenstance and her curiosity as leading to her eventual career as an astronaut and helping to build the International Space Station (ISS).

Amateur Radio in Space

The ISS boasts two amateur radio setups: one in the Russian Orbital Segment and another in the Columbus laboratory. With ARISS being an opportunity for astronauts to touch base with people on Earth, Suni would wear headphones and listen closely to counter the noise from the fans, pumps, treadmill, and other sources. When communicating with kids, she provided answers rapidly, because as she put it,

"the more kids you get, the more fun the whole conversation is." She relished those interactions. "Being able to talk to anyone in the world, and using parts of the world as relay stations, is pretty cool," she shared.

"The kids always want to know where you are and what you're doing on the ISS," she said. The challenge of fitting multiple questions from numerous students in a time span of only 10 minutes can seem daunting, so Suni and others are given the questions ahead of time to minimize delays caused by struggling to hear the communication and asking kids to repeat themselves. "It's a skill to talk fast to get to the point, and it's important to relay the kid's name and [to say] thank you."

About 10 years ago, a young family friend had learned about ham radio and told Suni's sister, "If we go out by the Nobska Lighthouse, I think we can talk to Suni." So before the sun came up, her family and the young boy drove to the lighthouse with ham gear in tow and made contact with Suni as she flew up the eastern seaboard. "It was really cool to have a spontaneous family conference. Of course, there wasn't any pre-scheduling. [The communication] was just exactly as we were flying over. And it was a clear night so they could see us also. Pretty powerful."

Suni makes an effort to make other special contacts, as well, saying, "If there's a connection, like through my family, let me try it. Why not? I'll turn the radio on. Give me the frequency. We'll do this."

Staying Fit and Running the Boston Marathon

Stressing the importance of physical fitness, especially as it relates to one's well-being, Suni said, "You need to be able to adapt to weird environments like microgravity and then come back [to Earth] also. Physical fitness is one of those things that helps you do that pretty well."

Becoming the first person to run the Boston Marathon (in 2007) in space took some convincing and much support on the part of Suni's colleagues. It needed to be feasible from a hardware perspective as well. "You don't want to break the only treadmill you have up there." Suni learned how to run on it correctly and ensure there wasn't too much wear and tear on it. Her crewmates set up the camera and cheered her on at the end. She acknowledged, "It took a little bit of a village to make it all happen."

Today, Suni still runs, and she's currently assigned to NASA's Boeing Crew Flight Test mission. It will be her third long-duration mission aboard the ISS.

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The 15 Divisions of ARRL are arranged into 71 administrative *Sections*, each headed by an elected *Section Manager* (SM). Your SM is the person to contact when you have news about your activities, or those of your radio club. If you need assistance with a local problem, your SM is your first point of contact. He or she can put you in touch with various ARRL volunteers who can help (such as Technical Specialists). Your SM is also the person to see if you'd like to become a Section volunteer. Whatever your license class, your SM has an appointment available. Visit your Section page at **www.arrl.org/sections**.

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Up Front

Family of Hams

Richard Karpinen, K6LJC, shared this photo of his family as they gathered for the holiday. From left to right: (front) Richard Karpinen, K6LJC; daughter Deborah Zaech, N6DAZ; son Scott Karpinen, K6ENG; daughter Pamela Sheridan, N6URS; (back) grandson Matthew Zaech, N6EGL; son-in-law Robert Zaech, N6RMZ; nephew Michael Kennedy, N6DMN; sister Georgia Mourikis, K7GAM, and son-in-law David Sheridan, N6BBL. [Richard Karpinen, K6LJC, photo]

Boat Anchor Night Light V2.0

While looking through old issues of *QST*, Terry White, VE5TLW, found a 2006 Up Front article describing a unique use for old vacuum tubes and junk box parts ("Boat anchor night light" by Phil Salas, AD5X) and wondered how he could make something similar. He had a collection of tubes, but no transformers, chassis, or tube sockets, but an Amazon search gave him an idea. He sorted through his collection and found some suitable tubes, and after checking the tube data, he chose a 6SN7GT and a 6EW76. He mounted the tubes on a piece of ¼-inch plywood. Hot glue provided strain relief for the power supply wire. Terry says, "My night light is a less elegant solution than Phil used; however, it works." [Terry White, VE5TLW, photo]

Ham and Eggs

While off-loading supplies from his truck after a grocery run, Kevin Scofield, KDØVHD, dropped the eggs (he lost three). Resting the remaining eggs on the rear bumper while picking up the mess, this image came to him — ham and eggs. [Kevin Scofield, KDØVHD, photo]

Moose Camouflage

Tom Farrington, KL7TF, has found a unique way to hide his antenna in the natural surroundings of his yard. The moose not only disguise the antenna, they help keep the neighbors far away! It may not work everywhere, but it's worth a try. [Tom Farrington, KL7TF, photo]

If you see something ham-related out in the world, take a photo of it and send it to "Up Front" at upfront@arrl.org.

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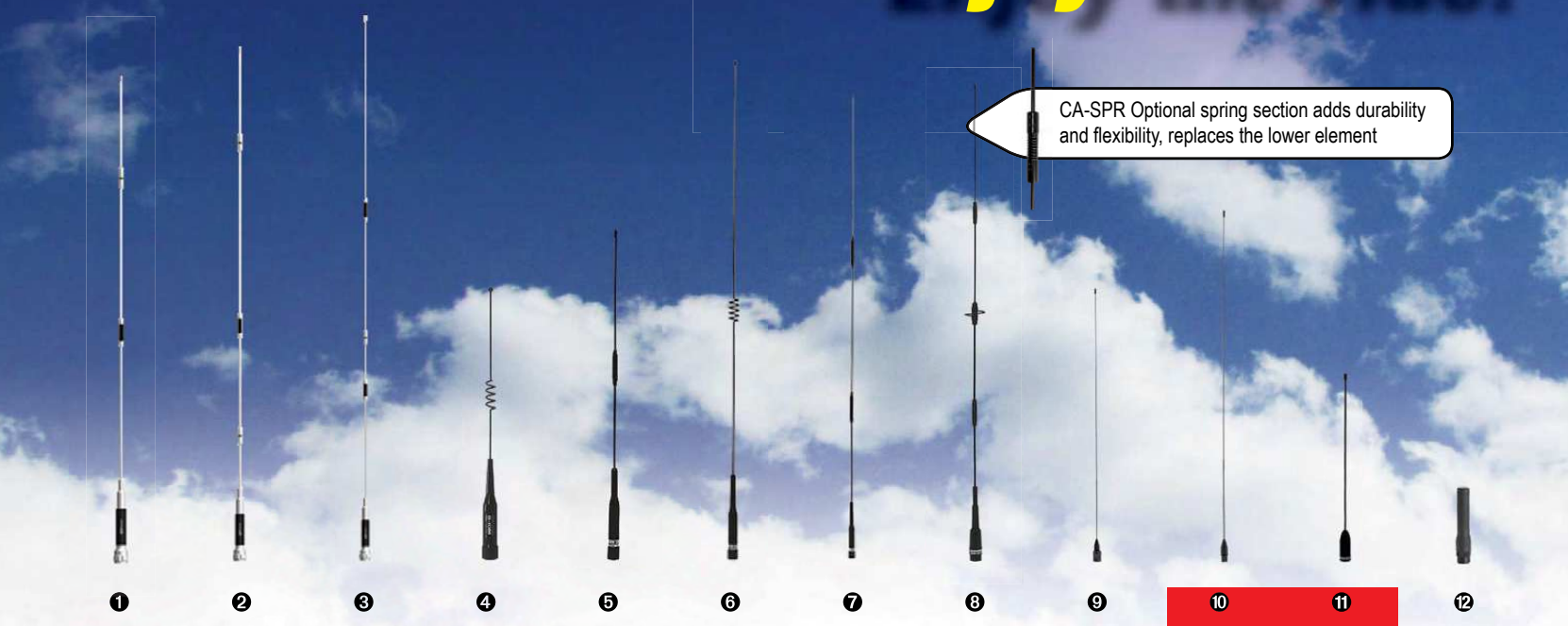

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Letters from Our Members

Home

"You can't go home again" generally means that things inevitably change, the old neighborhood is gone, and its nostalgia cannot be recaptured. It isn't different for amateur radio, as things change with the pace of technology.

As kids, we made friends in our neighborhood and school. Hams did this too, but their neighborhood was the bands. Friendships formed through daily contacts. When my family moved to a different state, I took my ham friends with me (as my mom would say). One of my friends cleverly described that period as "We all went to different high schools together." Similarly, we all went to different colleges together too, and we all worked different careers together.

Advancing technology has changed how — not why — we do amateur radio. The internet has made it easier to reconnect with old ham friends. Those who left radio even for decades can pick up where they left off, almost like no time has passed. Many of my most constant friends in life have been hams. We've led different lives, but together. In our amateur radio world, you can go home again. The old neighborhood is the bands, and they are always there.

Chris Codella, W2PA
Lagrangeville, New York
Life Member

Celebrating the ARRL Teachers Institute

I recently contributed to the ARRL Education and Technology Fund, and a short time later, I was pleasantly surprised with a letter of gratitude from one of the teachers who had attended the ARRL Teachers Institute on Wireless Technology. After attending the course, she was very enthusiastic about ham radio and couldn't wait to get on the air. This program is obviously positively affecting the teachers who attend and the students at their schools.

George Allison, K1IG
Westford, Massachusetts
Life Member

Another "Ham" Theory

Over the years, there have been many theories attempting to determine the origination of the term "ham." Recently, I came across another. In the book *The Victorian Internet: The Remarkable Story of the Telegraph and the Nineteenth Century's On-line Pioneers*, Tom Standage states, "The best operators often felt nothing but scorn toward the small-town, part-time operators they often encountered on-line, who were known as 'hams.'" This is a very interesting book about Samuel F. Morse, Thomas Edison, and more early pioneers.

Sumner Weisman, W1VIV
Framingham, Massachusetts

There's Always Something New to Learn

Many thanks to Al Rovner, K7AR, for his article "An Introduction to *WSJT*'s DXpedition Mode" in the October 2023 issue of *QST*.

As an active DXer, I almost skipped over it, thinking there wouldn't be anything new for me to learn, but Al's details from the perspective of a "Fox" were eye-opening. Recently, I worked a new DXCC entity (290) because I learned about the two additional 15-second grace periods after three failed attempts to complete a contact. In this instance, the Fox had stopped calling me, but my persistence paid off (where I would have otherwise given up and started calling again with my grid square).

WSJT has certainly changed the DXing game for compromise stations. Were it not for the weak signal modes, there would be a handful of DXCC entities that I wouldn't have contacted and confirmed.

John Mitton, KK7L
Saratoga Springs, Utah

Keynote Address Inspiration

My wife, Michele, KC1TIW, and I attended the Northeast HamXposition, ARRL New England Division Convention. I've been a regular attendee for more than 20 years. We sat in on ARRL President Rick Roderick's, K5UR, keynote address and took away his important message: "It's your job. It's your duty. It's your responsibility." These three points were so eloquently driven home in Rick's presentation. They reminded all attendees that this is what we need to do to keep amateur radio alive and well into the future.

When Larry Krainson, W1AST, said he needed help filling positions at the amateur radio booth at The Big E, we jumped at the opportunity. Larry and his team did a fantastic job organizing the booth and volunteers. We were fortunate to be able to help. We met other wonderful amateurs who were just as enthusiastic about sharing the hobby with the public. I left that day feeling like if I got at least one person to follow up, it was worth it. If you haven't volunteered for an event like this, I highly recommend it.

Ken Miller, WB1DX
Sturbridge, Massachusetts

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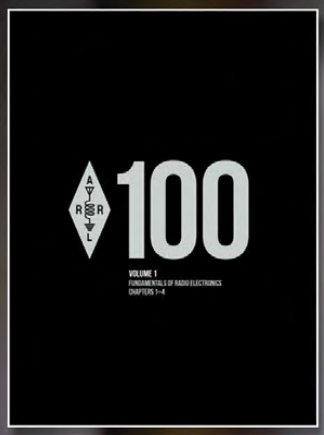

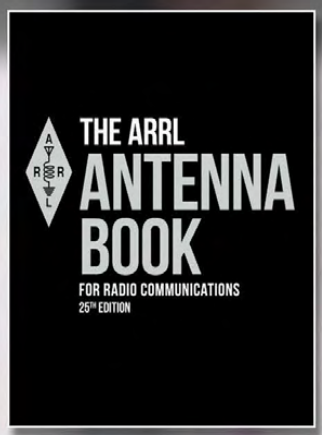

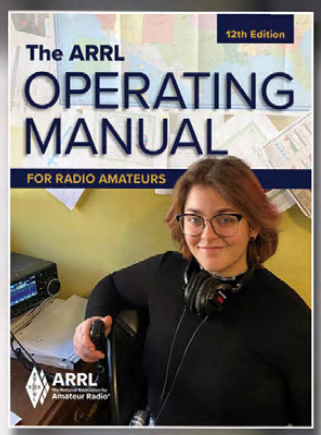

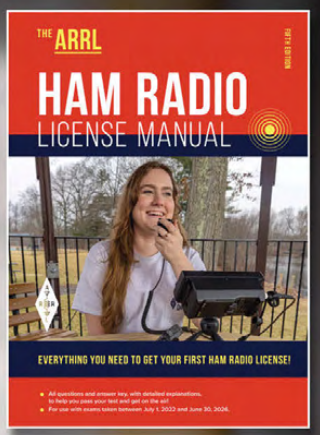

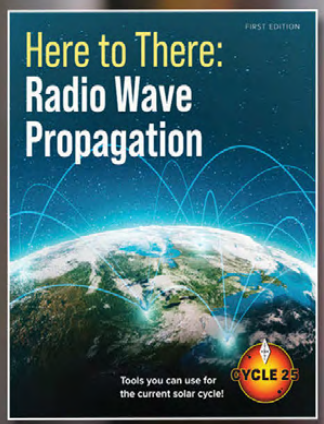

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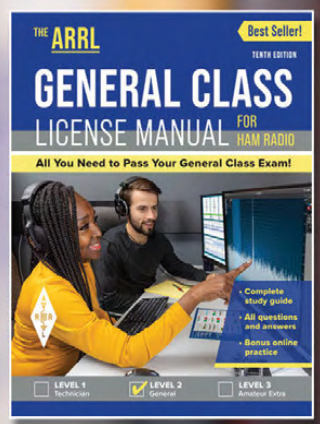

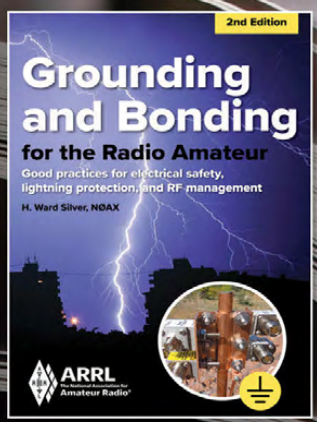

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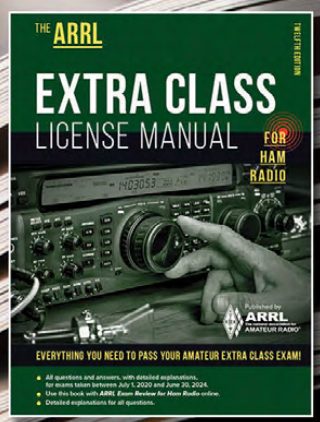


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W1AW Schedule

PAC	MTN	CENT	EAST	UTC	MON	TUE	WED	THU	FRI
6 AM	7 AM	8 AM	9 AM	1400		FAST CODE	SLOW CODE	FAST CODE	SLOW CODE
7 AM-12^{45} PM	8 AM-1^{45} PM	9 AM-2^{45} PM	10 AM-3^{45} PM	1500-2045	VISITING OPERATOR TIME				
1 PM	2 PM	3 PM	4 PM	2100	FAST CODE	SLOW CODE	FAST CODE	SLOW CODE	FAST CODE
2 PM	3 PM	4 PM	5 PM	2200	CODE BULLETIN				
3 PM	4 PM	5 PM	6 PM	2300	DIGITAL BULLETIN				
4 PM	5 PM	6 PM	7 PM	0000	SLOW CODE	FAST CODE	SLOW CODE	FAST CODE	SLOW CODE
5 PM	6 PM	7 PM	8 PM	0100	CODE BULLETIN				
6 PM	7 PM	8 PM	9 PM	0200	DIGITAL BULLETIN				
6^{45} PM	7^{45} PM	8^{45} PM	9^{45} PM	0245	VOICE BULLETIN				
7 PM	8 PM	9 PM	10 PM	0300	FAST CODE	SLOW CODE	FAST CODE	SLOW CODE	FAST CODE
8 PM	9 PM	10 PM	11 PM	0400	CODE BULLETIN				

W1AW's schedule is at the same local time throughout the year. From the second Sunday in March to the first Sunday in November, UTC = Eastern US time + 4 hours. For the rest of the year, UTC = Eastern US time + 5 hours.

♦ Morse code transmissions: Frequencies are 1.8025, 3.5815, 7.0475, 14.0475, 18.0975, 21.0675, 28.0675, 50.350, and 147.555 MHz.

Slow Code = practice sent at 5, 7½, 10, 13, and 15 WPM.

Fast Code = practice sent at 35, 30, 25, 20, 15, 13, and 10 WPM.

Code bulletins are sent at 18 WPM.

For more information, visit us at
www.arrl.org/w1aw

♦ W1AW Qualifying Runs are sent on the same frequencies as the Morse code transmissions. West Coast qualifying runs are transmitted by various West Coast stations on CW frequencies that are normally used by W1AW, in addition to 3590 kHz, at various times. Underline 1 minute of the highest speed you copied, certify that your copy was made without aid, and send it to ARRL for grading. Please include your name, call sign (if any), and complete mailing address. Fees: $10 for a certificate, $7.50 for endorsements.

♦ Digital transmissions: Frequencies are 3.5975, 7.095, 14.095, 18.1025, 21.095, 28.095, 50.350, and 147.555 MHz.

Bulletins are sent using 45.45-baud Baudot, PSK31 in BPSK mode, and MFSK16 on a daily revolving schedule.

Keplerian elements for many amateur satellites will be sent on the regular digital frequencies on Tuesdays and Fridays at 6:30 PM Eastern time using Baudot and PSK31.

♦ Voice transmissions: Frequencies are 1.855, 3.99, 7.29, 14.29, 18.16, 21.39, 28.59, 50.350, and 147.555 MHz. Voice transmissions on 7.290 MHz are in AM double sideband, full carrier.

♦ Notes: On Fridays, UTC, a DX bulletin replaces the regular bulletins. W1AW is open to visitors 10 AM to 3:45 PM Monday through Friday. FCC-licensed amateurs may operate the station during that time. Be sure to bring a reference copy of your current FCC amateur license. In a communication emergency, monitor W1AW for special bulletins as follows: voice on the hour, teleprinter at 15 minutes past the hour, and CW on the half hour.

W1AW code practice and CW/digital/phone bulletin transmission audio is also available real-time via the *EchoLink Conference Server* W1AWBDCT. The conference server runs concurrently with the regularly scheduled station transmissions. The W1AW Qualifying Run texts can also be copied via the EchoLink Conference Server.

During 2024, Headquarters and W1AW are closed on New Year's Day (January 1), Presidents Day (February 19), Memorial Day (May 27), Independence Day (July 4), Labor Day (September 2), Veterans Day (November 11), Thanksgiving and the following day (November 28 and 29), and Christmas Day (December 25).

The Legend Continues

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An Easy, Inexpensive Voice Keyer

This little box with "Record and Play" pushbuttons is convenient for contesting operations.

John S. Raydo, KØIZ

I frequently operate my Colorado station remotely using voice-operated transmit (VOX) with a laptop and PC headset. But for contests and special events, a voice keyer in a little box with a pushbutton to record a message would be better (see the lead image). The ISD1820 voice recorder module fits the bill. It's capable of recording and playing back one 10-second-long message.

Parts and Construction

I fit everything in a 100 × 60 × 25-millimeter plastic box, including the module, speaker, switches, and battery (see Figure 1). The module is attached using two #4-40 screws and nuts, plus two small nuts for spacers. I drilled 3/32-inch holes in a 1.25-inch round pattern for the included speaker and attached it with two dabs of hot glue.

The module includes switches to record and play, but these are inaccessible for practical use, so I added two momentary contact switches: a red double pole double throw (DPDT) for recording and a black single pole single throw (SPST) or single pole double throw (SPDT) for playback. I used switches similar to C&K 8221 (DPDT) and 8121 (SPDT).

Using a headset microphone to record the message helps make it sound nearly identical to live audio. I removed the on-board microphone element and added a Dupont two-pin header. A 3.5-millimeter stereo jack makes the connection to the headset electret microphone.

The DPDT record switch transfers the headset microphone from output to the module microphone input and starts the recording. The default sampling rate is 6.4 kHz. I added a small resistor to increase the rate to 8 kHz for better fidelity. This reduced the available

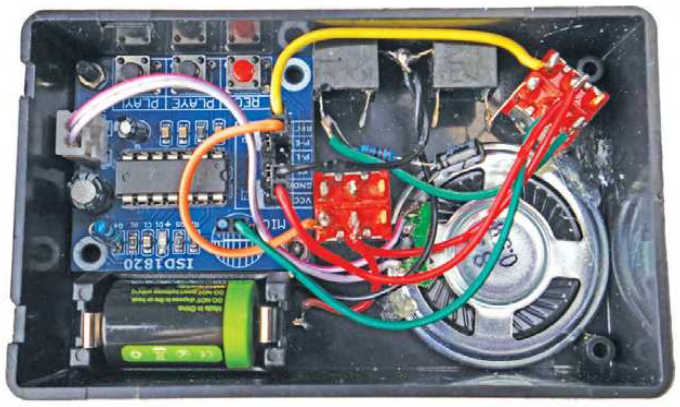


Figure 1 — An internal view of the voice keyer. The ISD1820 module is on the upper left, and the battery is on the lower left.

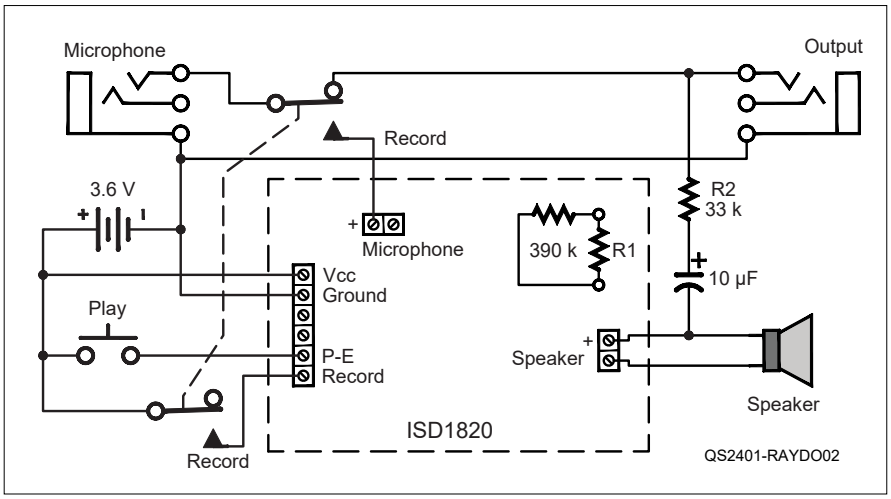


Figure 2 — Schematic of the voice keyer.

Figure 3 — Press and hold the red button on the top left corner of the keyer to record your 8- to 10-second message. Access the digital edition of *QST* (**www.arrl.org/qst**) to experience this voice keyer in action.

message length to 8 seconds, which is still adequate for my purpose. Add a 390 kΩ, ⅛ W resistor in parallel across R1, which is a 100 kΩ (marked 104) surface-mount resistor (see Figure 2).

The headset microphone audio and module audio are combined in the output using a 10 µF capacitor (the value isn't critical) and a series resistor. Select the R2 resistor value that makes the message volume equal to the headset microphone volume. I used 33 kΩ. A small trim pot would allow adjustment, if desired. A 3.5-millimeter stereo jack provides the combined output to the laptop.

I used Dupont-type plugs to connect the battery and switches. These plugs are available online or from defunct PCs. You could also solder the wires to the pins.

The module needs 2.7 to 5.5 V. The current drain during recordings is 10 mA, and the playback is 30 mA. Standby current is essentially zero (0.5 µA), so no power switch is needed. I selected an ER14250 3.6 V lithium battery for its small size (½ AA) and good capacity (1200 mAh). I attached the holder in the box with double-sided tape.

PC-type headsets use an electret microphone element, which is the same as the module. A dynamic-type microphone could be used instead, if a capacitor of around 10 µF is inserted between the microphone and the module connection to isolate the microphone from the module bias voltage.

Setup and Operation

Plug the headset microphone into the proper jack, and press the record button to start an 8- to 10-second message (see Figure 3). Release the button at the end of the message. The module has a lot of microphone gain. Even though it has automatic gain control, the audio will distort if you're speaking too loudly while recording. Press the play button to hear the recording on the internal speaker. Your message will be retained until you push the record button again.

I connected the keyer output (using a 3.5-millimeter stereo cable) and headset phones to a TRRS (four-pole) **Y** adapter to fit my laptop. My voice and the recorded message will trigger the VOX to transmit. This little device can record only one message. It's easy to use, inexpensive, and fun to build!

John S. Raydo, KØIZ, was first licensed in 1957 as KNØLMZ at age 13. He enjoys constructing equipment and has authored a number of articles in *QST*, *QEX*, and *Electric Radio*. His most recent projects include a 13-tube SSB transceiver and a grounded-grid 813 amplifier. Other interests include contesting and special event operations with WW1USA, the National WWI Museum and Memorial. John can be reached at **kcflyers@yahoo.com**.

For updates to this article, see the *QST* Feedback page at www.arrl.org/feedback.

FT8 Visualized

KE1R provides an overview of the structure and intricacies of FT8.

Thomas W. Brooks, KE1R

Data streams are nothing new, and neither is error correction. We stream data all the time with our cell phones, computers, and other devices. CW is a data stream, as are RTTY and PSK31. In this article, I will explore the general makeup of FT8 and explain the basics of error correction. A list of references that I consulted for this article is provided at **www.arrl.org/qst-in-depth**.

In 2001, Joe Taylor, K1JT, released *WSJT*; this changed the ease with which hams could interface transceivers with computers and experiment with weak-signal modes. Next came the release of *WSJT-X* in 2012, followed by FT8 in 2017. FT8, which limits messages to 13 characters, uses a 15-second cycle with a 50 Hz bandwidth. FT8 was initially created by Joe Taylor and Steve Franke, K9AN, for 6-meter E-skip propagation. In 2019, FT4 was added, with a 7.5-second cycle and a 90 Hz bandwidth.

I was curious about FT8 waterfall data streams and how they are structured (see Figures 1 and 2). Without delving too far into data communication theory and error correction techniques, I will offer some knowledge to help hams visualize such data streams and learn how they are generated and used.

You can look at a simple sudoku puzzle to understand error correction (see Figure 3). For those who are unfamiliar with sudoku puzzle rules, each of the four small 2 × 2 matrixes must contain 1, 2, 3, and 4. Additionally, each column and row of the larger 4 × 4 matrix must also contain 1, 2, 3, and 4. This structure is similar to how low-density parity check (LDPC) coding works. That is, it enables you to find and correct errors when you look at a completed matrix.

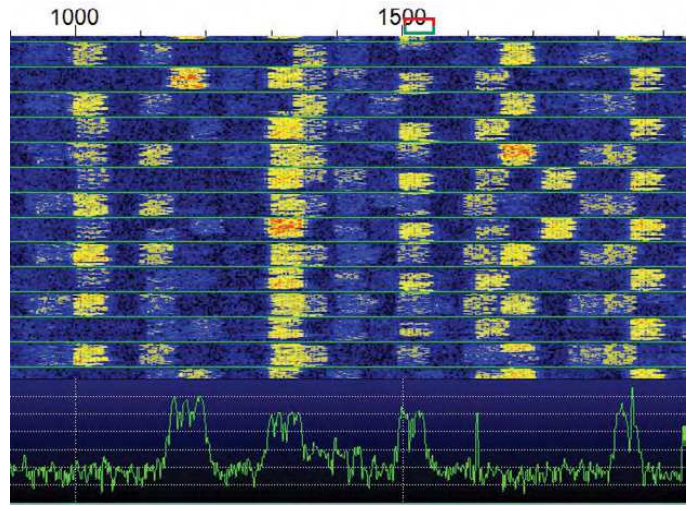


Figure 1 — The standard *WSJT* FT8 waterfall display.

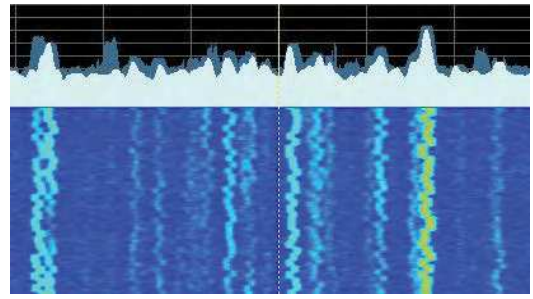


Figure 2 — An Icom IC-7610 waterfall display. This shows what the yellow blocks of data in Figure 1 look like when vertically spread.

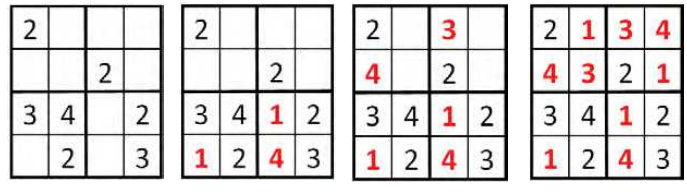


Figure 3 — A simple 4 × 4 sudoku puzzle.

Costas Arrays, DT, and CRC

Costas arrays were developed by electrical engineer John P. Costas in 1965 for use in sonar and radar systems. All FT8 transmissions contain an identical 7 × 7 Costas array at their beginning, middle, and end. Like sudoku, each digit (0 – 7) can be used only once. If you draw a line from each number square to all the other numbers, no two lines can have the same length at the same angle. In a 7 × 7 Costas array, there are 5,040 possible combinations (because 7 × 6 × 5 × 4 × 3 × 2 × 1 = 5,040), but only 200 of these combinations meet the Costas requirements. All FT8 transmissions use 3, 1, 4, 0, 6, 5, and 2, which is a valid Costas array (see Figure 4). Your computer looks for FT8 waveforms that start with the 3, 1, 4, 0, 6, 5, and 2 array. All other Costas arrays or data are rejected.

The base frequencies for the eight tones of FT8 are shown in Table 1; each tone creates three binary bits. Computers are binary devices that process 0s and 1s. Because $2^0 = 1$, $2^1 = 2$, and $2^2 = 4$, you can create a three-bit representation of the eight tones (see Table 2). Table 2 also shows Gray code, whereby each increasing number can change only one digit at a time.

Table 1 — Base Frequencies for the Eight Tones of FT8

Tone	Frequency (Hz)
0	6.25
1	12.50
2	18.75
3	25.00
4	31.25
5	37.50
6	43.75
7	50.00

Table 2 — Decimal, Binary, and Gray Code Equivalents to the Eight Tones of FT8

Decimal	Binary	Gray Code
0	000	000
1	001	001
2	010	011
3	011	010
4	100	110
5	101	111
6	110	101
7	111	100

In the *WSJT-X* data window, you will see a delta time (**DT**) column header. This shows the timing of each received FT8 message relative to your computer, and it should be correct within ±1 second if your computer is synchronized to an internet-accurate UTC time base. FT8 messages with excessive DT are difficult to decode (see Figure 5).

The basic cyclic redundancy check (CRC) concept was created by mathematician and computer scientist W. Wesley Peterson in 1961. It is a check code used in digital communication networks to detect data errors by dividing one polynomial by another, and then evaluating the remainder, or *check value*. This is done as part of the encoding process (transmission) and the decoding process at the receiver's end. It provides some degree of confidence that the received data is correct compared to what was transmitted, but it does not provide information about where any errors might be.

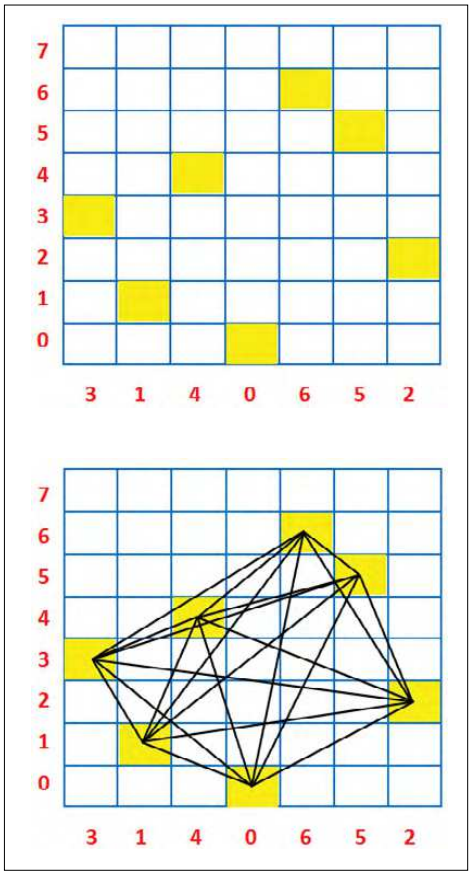


Figure 4 — The top Costas array shows FT8 values 3, 1, 4, 0, 6, 5, and 2. The bottom image shows that it is a valid Costas array.

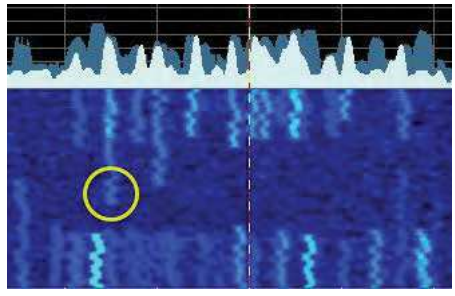


Figure 5 — FT8 messages with excessive delta time (DT). One such message is circled in yellow.

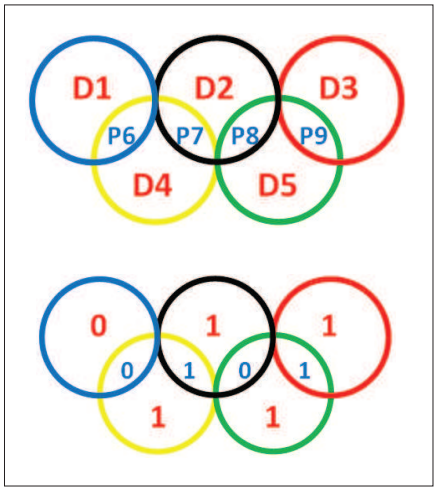


Figure 6 — An illustration of basic low-density parity check (LDPC) concepts.

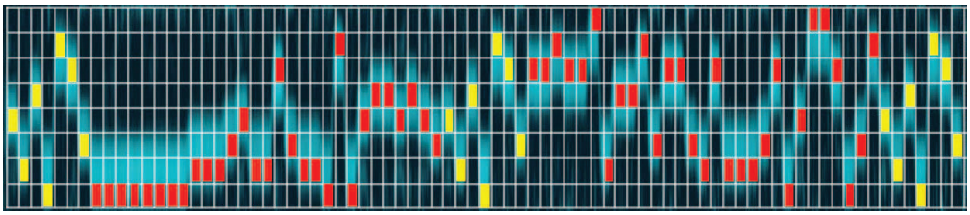


Figure 7 — A decoded bitstream, showing the 0 – 7 tones that can be translated into binary coding. For more about how this was accomplished, see **www.arrl.org/qst-in-depth**.

Consider this simplified example: 110111 ÷ 101 = 1011 remainder 0. Both the sender and receiver use the same CRC code, 101, with a remainder of 0 to indicate valid data. If the remainder is not 0, you will not be able to find the errors. For that, you will need low-density parity check (LDPC) error correction. Refer to Figure 6 for another simplified example. The five circles (D1, D2, D3, D4, and D5) represent data bits. The four intersections (P6, P7, P8, and P9) represent parity bits. The data and parity bits in each circle must sum to 0 — i.e., 0 + 0 = 0, 1 + 0 = 1, and 1 + 1 = 0 (no carryover).

This illustrates how data and parity bits can be used to show error location, and with some limits, what those errors likely are. Of course, LDPC is far more complex than Figure 6. Forms of LDPC are used in many digital communication protocols, including cellular 5G.

Final FT8 Format and More Resources

FT8 transmissions have 77 information bits, 14 CRC bits, and 83 parity bits, for a total of 174 bits. These are assembled in groups of three and converted to Gray code to get 58 symbols or transmitted tones. Add the three Costas arrays of seven symbols each (21 symbols in total) to determine that an FT8 message is 79 symbols, or the equivalent of 237 binary bits. Visit **www.arrl.org/qst-in-depth** for the process used to observe tone patterns (see Figure 7) in an FT8 signal.

Not enough can be said about the contributions to communications theory and impact to amateur radio that Joe Taylor; Steve Franke; Bill Somerville, G4WJS (SK), and Nick Palermo, IV3NWV, have provided, all under GNU Operating System free worldwide software licenses. Others continue to make helpful tools and resources for FT8. Gary Hinson, ZL2IFB, created the "FT8 Operating Guide" (see **https://www.g4ifb.com/FT8_Hinson_tips_for_HF_DXers.pdf**), and Steve Ford, WB8IMY, wrote *Get on the Air with HF Digital*. Laurie Cowcher, VK3AMA, wrote *JTAlert*, which supplements *WSJT*.

See *QST* in Depth for More!

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

- ✓ The author's references for this article
- ✓ The process used to observe tone patterns in an FT8 signal

All images provided by the author.

ARRL and Quarter Century Wireless Association Life Member Tom Brooks, KE1R, was first licensed in 1966. He has worked for the Federal Communications Commission (FCC) and the International Business Machines Corporation, and he currently volunteers at ARRL Headquarters. He holds Bachelor and Master of Science degrees in Electrical Engineering. In addition, he was a licensed professional engineer in California, New Mexico, and Vermont. Tom also holds FCC Radiotelephone and Radiotelegraph licenses with Ship Radar Endorsements. He can be reached at **ke1r@arrl.net**.

For updates to this article, see the *QST* Feedback page at www.arrl.org/feedback.

The Shorter Sterba

Making a high-performance 10-meter antenna fit into a smaller space.

Phil Hejtmanek, K9UC

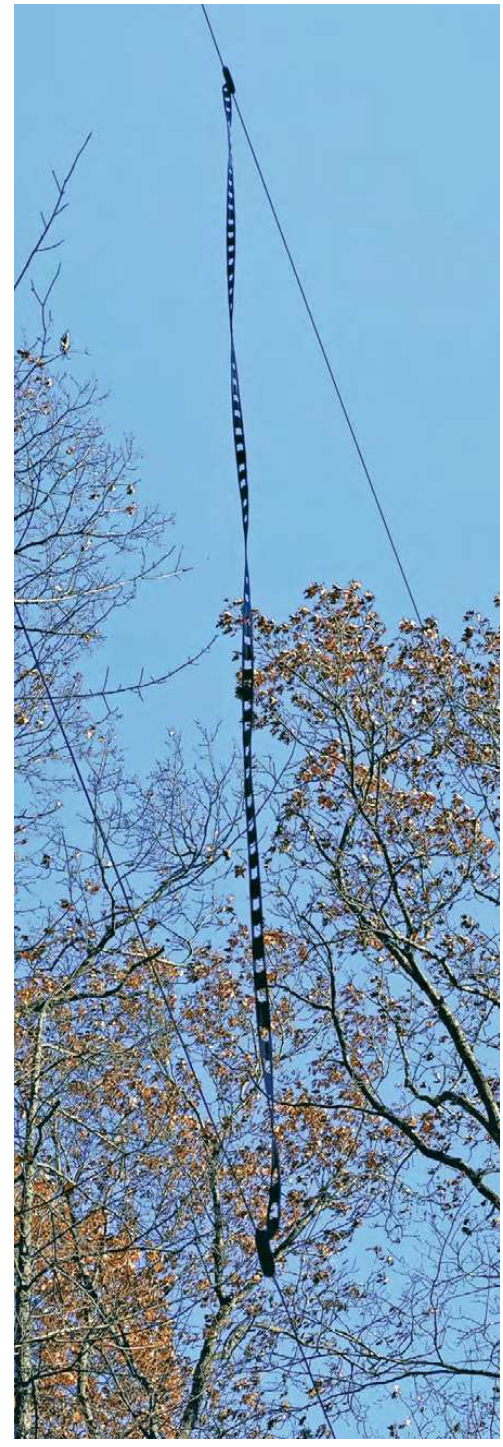
I've been a fan of the 10-meter band ever since 1994, when I upgraded to my Advanced license. That band was my first foray into HF phone operation as a Technician, and after participating in the ARRL 10-Meter Contest, I was hooked. The 10-meter band ebbs and flows with the sunspot cycle; when the spots are hot, so is the band, and when they're not so hot, you struggle. Solar Cycle 25 seems to be on its way up, so now might be a great time to give it a try, and join the fun of HF operating.

Over the years, I've tried a variety of antennas for operating on 10 meters, including verticals, single-band and multiband dipoles, single-band Yagis, and tribanders. But I had always wanted to try the legendary Sterba curtain (see the lead photo). This wire antenna is known for high gain and low takeoff angle, making it ideal for long-distance work, and it was used by the Bell System in the 1930s as part of the shortwave radio extension links used to relay telephone conversations across the Atlantic Ocean.

I was able to find the antenna design, as described by E.J. Sterba in the July 1931 issue of *Proceedings of the Institute of Radio Engineers*, as well as another description of the radio extension links in the October 1940 issue of the *Bell System Technical Journal*. Both articles illustrated the long line of gigantic towers used to support the antenna system. I also searched the *QST* archives and found "Curtains for You" by James Cain, K1TN, in the October 1991 issue. Cain's article describes his efforts with constructing the Sterba curtain, and shows the design that he developed. For documentation of the Sterba's history, see the *QST* in Depth web page (**www.arrl.org/qst-in-depth**).

How It Works

A Sterba curtain is a planar array of horizontally polarized half-wave dipoles, combined to be two high and three or more wide, physically creating what looks like a curtain. The top and bottom dipoles are separated vertically by a half wave and connected by high-impedance balanced feed lines that are twisted a half turn to reverse the phase, resulting in both dipoles being fed in phase. Additional pairs of dipoles can be added in the horizontal direction, and they receive power from the ends of the adjacent dipoles. Additional balanced and twisted transmission lines extend vertically from the ends of each dipole pair. These allow currents to flow to the next pair of dipoles in the proper phase. Additional pairs of dipoles may be attached to increase gain and narrow the azimuthal beamwidth of the antenna. K1TN's article offers a much more detailed technical explanation.



The antenna is difficult to see against the trees. The ladder line in this photograph seems to have several twists, but it has only one half twist.

Fitting It on My Lot

The first thing I noticed about the K1TN Sterba design was that it was fairly sizable; the eight-element design was more than 66 feet long and almost 17 feet high. In addition, the bottom dipole elements needed to be at least a half wavelength (another 17 feet or so at 28 MHz) above the ground, so an open space that was at least 75 feet long and 40 feet high was required. My location is a heavily wooded 3-acre lot on a lake in northern Wisconsin, and that sort of open area didn't exist until last summer, when the local power utility relocated our electric service underground, leaving me with an open space that might work.

I surveyed my newly open location and quickly realized that although there was a suitable tree at each end of the open space, there wasn't enough distance between the trees to accommodate the eight-element Sterba. I had only about 60 feet to work with, so the obvious solution was to rework the design using only six elements, resulting in an antenna that was approximately 50 feet long. I had to consider the potential change in the radiation pattern and direction that the main lobes would point.

The original design of the Sterba curtain was unidirectional and consisted of two curtains: an exciter curtain and a reflector curtain placed approximately a quarter wavelength away from each other in the opposite direction of the desired pattern. The K1TN design was a single-driven curtain, so the resulting pattern was bidirectional broadside. I surveyed the bearings of the proposed site at my location and determined that my antenna would stretch along a line from 130 to 310 degrees true, placing the main lobes at roughly 40 and 220 degrees. The 40-degree lobe would point at Europe, East Africa, and the Middle East, while the 220-degree lobe would point at the Southwest US, Mexico, and possibly New Zealand.

Feeding Options

The original antenna design used 450 Ω ladder line running to a tuner in a ham shack. The feed point was located some distance toward the center of the curtain, at one of the vertical phasing lines (see Figure 1). Because my shack was more than 100 feet away (and through the woods), I needed to feed the curtain from the near end of the array with 50 Ω coaxial cable. Thus, my new antenna had to be shorter and fed from a different point at a different impedance. Enter *EZNEC*.

My first step was building a model of the original Sterba curtain from the 1991 *QST* article, then modifying it to reflect my desired changes. Starting with an existing model that I found within an online tutorial, I was able to make a model for 28.4 MHz that physically matched the K1TN curtain and resulted in a predicted azimuth pattern similar to the one in his article. My next step was modifying the model to shorten the array and move the feed point to one corner of the array, as shown in Figure 2. I found that the proposed new feedpoint position was like the original Bell System curtains, with a continuous dc path of half-wavelength segments chained together. Apparently, Sterba had envisioned running dc current through the array for deicing.

Longer vs Shorter Sterba

The resulting azimuth plots for the original and the shorter Sterba at the design frequency revealed that the maximum gain for the original example was only about 2 dB greater than the shorter version, while the

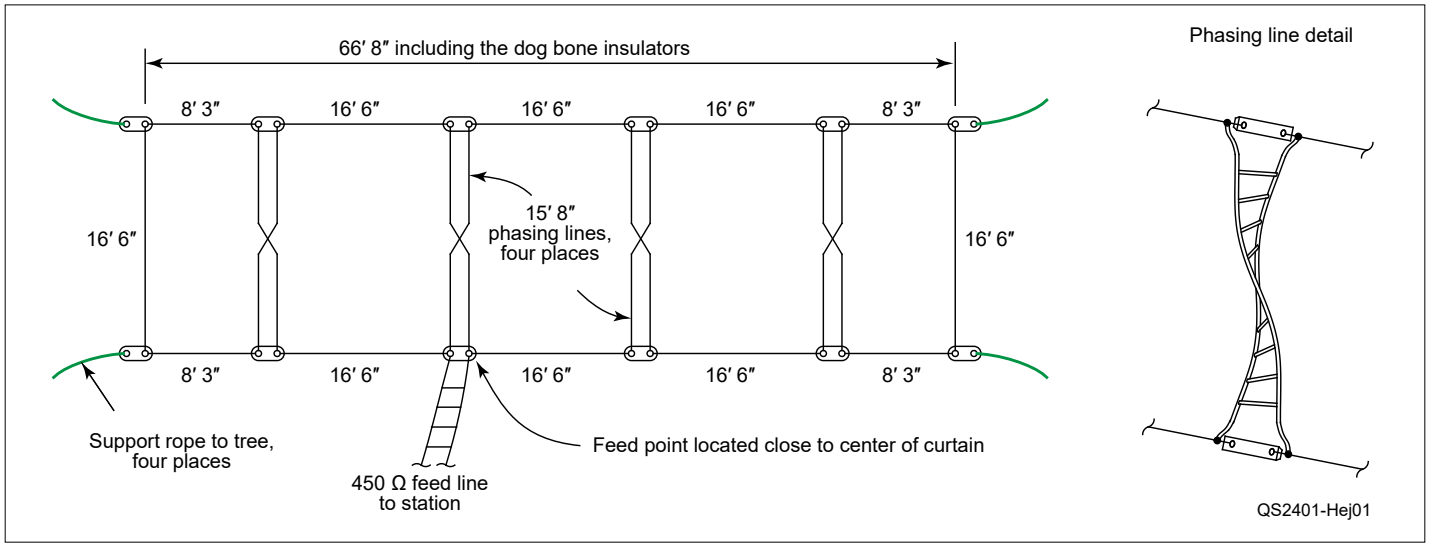


Figure 1 — Layout of the original K1TN Sterba curtain. See "Curtains for You" by K1TN in the October 1991 issue of *QST* for more details.

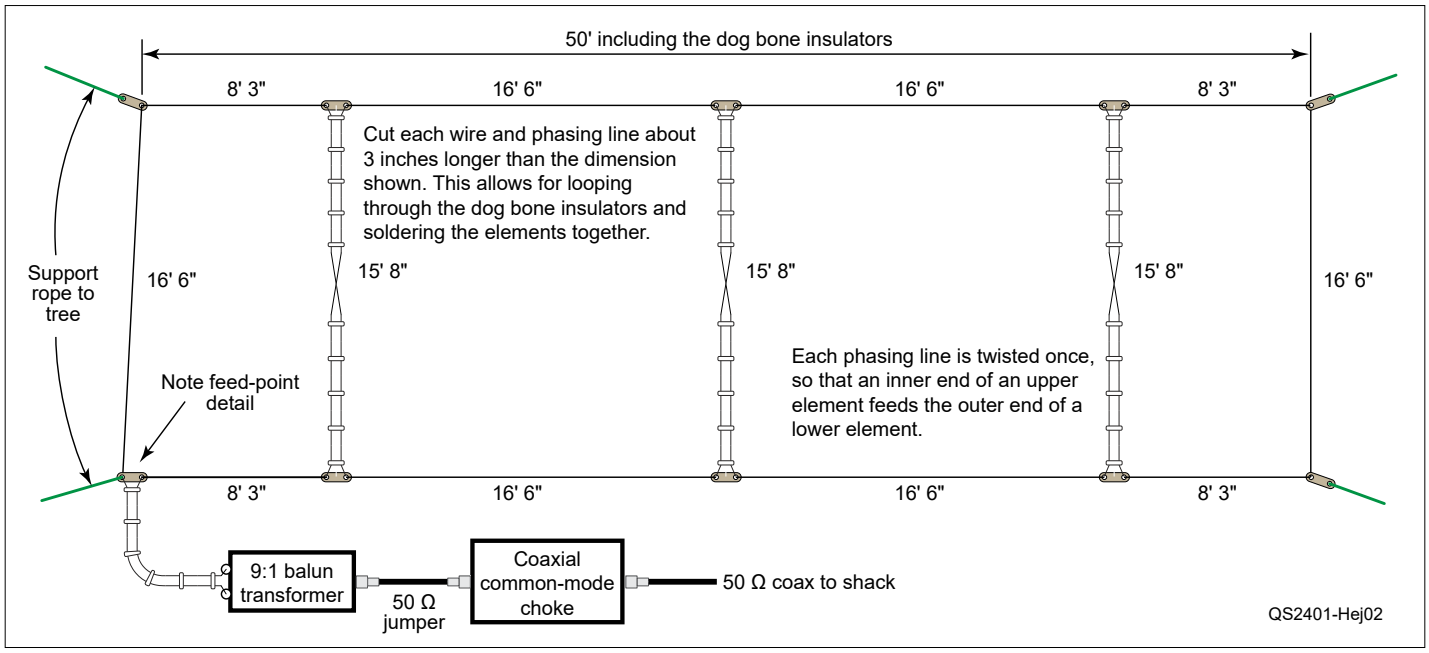


Figure 2 — Phil Hejtmanek's, K9UC, shorter Sterba curtain layout with dimensions.

Parts List

- 150 feet of #14 AWG stranded and insulated antenna wire
- 100 feet of 450 Ω window line for phasing lines and the lead in from the feed point to the 9:1 balun transformer
- 50 Ω coaxial cable long enough to reach your shack
- 10 plastic or ceramic dog bone insulators
- Polyester support rope, pulleys, and other hardware specific to the objects or trees used to support your antenna
- A 9:1 balun/transformer if you want to feed the array with 50 Ω coaxial cable

3 dB beamwidth was 25.5 degrees for the original and 33.7 degrees for the shorter one. Figure 3 compares the patterns of the original design and the shorter Sterba. I thought this was a great trade-off — a little less gain over a significantly wider area.

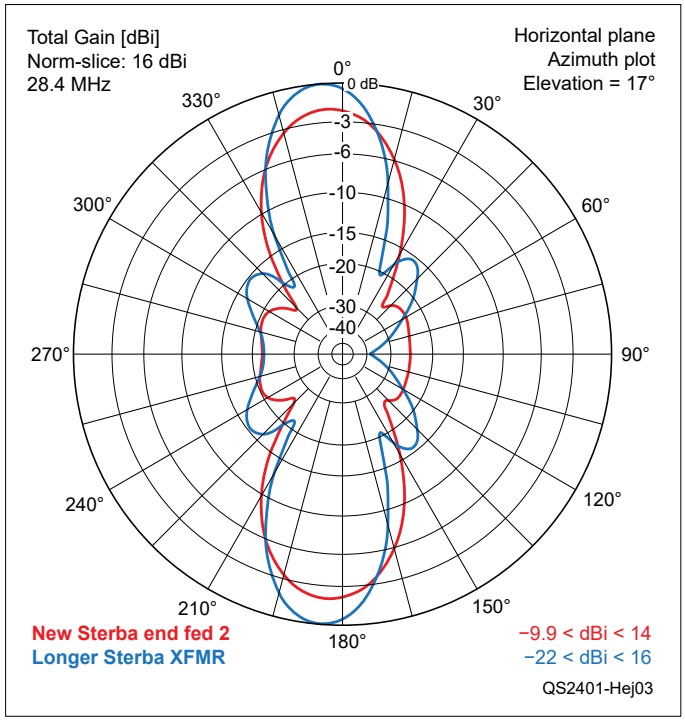


Figure 3 — *NEC* azimuth pattern for the original and shorter Sterba curtains at 28.4 MHz.

Building the Antenna

I needed four major items to make this curtain: suitable antenna wire, plastic or ceramic dog bone insulators, 450 Ω window line, and rope or cord to run from the ends of the array insulators to the supporting trees. I added pulleys for hoisting the antenna, and large screw eyes to attach the rope to the base of the tree (see the sidebar, "Parts List").

Next, I cut the wire into the required individual half-wave and quarter-wave segments. I made six half-wavelength segments and four quarter-wavelength segments of antenna wire, along with three half-wavelength segments of 450 Ω window line. I cut all of the lines about 5 to 6 inches longer than the length shown in Figure 2 to allow me to securely solder each end to itself after looping through the hole on the dog bone insulators. The phasing lines are slightly shorter to compensate for the velocity factor of the window line.

To build the array in place, I soldered together the top row and bottom row of dipole wires and dog bones ahead of time, then hung the top row of dipoles with the suspension ropes. I was then able to add the vertical wires, phasing lines, and the bottom row of dipoles, while gradually raising the curtain. Don't forget that the 450 Ω phasing lines need to have a half twist from top to bottom (see Figures 2 and 4). A hefty butane-fueled soldering iron was essential for in-place assembly. I finished by adding a length of ladder line to the feed point in the corner of the array and raising the curtain to its final height.

To feed the curtain with coaxial cable, I used a balun to match the unbalanced coax to the balanced antenna feed and to transform the 50 Ω impedance of the cable to the several-hundred-ohm impedance of the antenna itself. A 9:1 toroidal transformer worked nicely. I chose to wind my own, but devices of this type are readily available from a number of vendors, either as kits or in completed form. I added a coaxial/ferrite common-mode current choke to the system to minimize any possible RF feedback into my shack. These items were each housed in 4 × 4-inch waterproof plastic electrical boxes and mounted to a tree, as shown in Figure 5. The 450 Ω window line from the feed point to the transformer was about 20 feet long. This dimension is not critical; in fact, the window line and the transformer can go all the way to a balanced tuner at your transmitter, which will lower the losses. The lead photo shows the completed shorter Sterba in its final position. This type of wire antenna is pretty hard to see from a distance, so it might be a great solution for someone who wants a gain antenna for 10 meters in a neighborhood where towers and beam antennas are frowned upon.

On-Air Results

The best part of building antennas is actually putting them on the air and making contacts. But first, I wanted some comparative data between the curtain and my existing triband Yagi. To prevent any problems with subjective verbal signal reports, I used FT8 and kept track of the received signal strength data. The many Italian stations I heard on that first try were significantly stronger than other European stations farther off of the 40-degree bearing that my curtain favored. When I switched to the triband Yagi, I steered it to 40 degrees and looked for stations that I had heard before. These same signals were strong, but consistently 4 to 5 dB weaker than the levels received with the curtain. There are many variables that could affect this data, but I was encouraged that the curtain seemed to outperform the Yagi at the predicted bearing of its main lobe.

Figure 4 — Joining of wires to the ladder line.

Figure 5 — The balun, toroidal transformer, and coaxial/ferrite common-mode current choke were placed in two 4 × 4-inch waterproof plastic electrical boxes and mounted to a tree.

Next, I steered the Yagi to a bearing 90 degrees from the main lobe of the curtain, which happened to be 130 degrees — one that very much favors LU and PY at my location. Again, comparisons between antennas supported the directivity of the curtain. South American stations that were barely received using the shorter Sterba were easily decoded when the Yagi was used. This makes a strong case for having two Sterba arrays mounted at 90-degree angles to each other.

I had always planned to feed the shorter Sterba using an antenna tuner, mainly because my shack features a switching system that allows up to seven antennas and

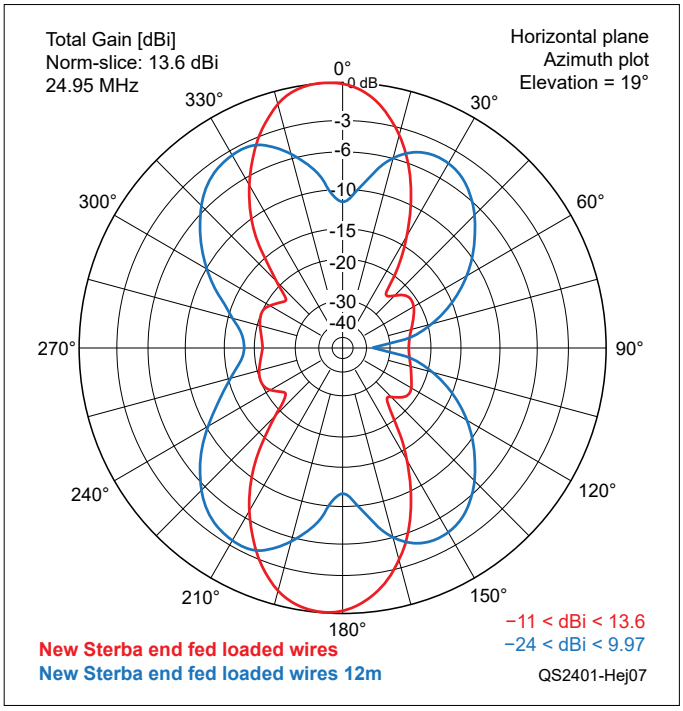


Figure 6 — *NEC* azimuth pattern for the shorter Sterba on 28.4 and 24.9 MHz.

a dummy load to be connected to each of the two antenna connectors on my transceiver. K1TN's 1991 article suggested that the curtain design would take power nicely on other bands, and my *EZNEC* model confirmed that the shorter Sterba would also, so I tried 12 meters. The azimuth plot at that frequency showed a much broader pair of lobes, broadside of the axis of the wires. Figure 6 is a plot of the shorter Sterba azimuth pattern for 12 and 10 meters.

I never had an antenna to operate on the 12-meter band before, so, in concert with some nice propagation, I found myself more than halfway to DXCC for that band in a matter of a few days. As predicted, the beamwidth on 24.9 MHz was broader than at 28 MHz, but the gain was still significantly better than a dipole in the general direction of the broadside lobes.

See *QST* in Depth for More!

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

- ✓ Documents about the history of the Sterba curtain antenna
- ✓ More on-air results
- ✓ Photos showing construction details
- ✓ Details on how to get the wires into the trees
- ✓ *EZNEC* files for the antenna
- ✓ SWR plot for the final antenna
- ✓ Details of the homebrew 9:1 balun
- ✓ Sources for materials

This antenna is a bit complicated to build and takes up more space than a simple dipole for 10 meters, but boy, does it perform — and it's stealthy. If you're a Technician, it could be just the thing to get you going on HF!

All photos by the author.

Phil Hejtmanek, K9UC, was first licensed in 1970 while in high school. He earned a BS from Southern Illinois University and an MBA from the University of Illinois. Phil is a retired broadcast TV director of engineering and a technical consultant. He's an active contester and enjoys experimenting with wire antennas. Phil can be reached at **p_hejtmanek@yahoo.com**.

For updates to this article, see the *QST* Feedback page at www.arrl.org/feedback.

Feedback

In the November 2023 issue, Figure 3 in "A Simple, Portable Satellite Tracker" by Ray Crafton, KN2K, contained two errors. Both instances of LM2569 should be LM2596. This has since been corrected in the digital edition.

Product Review

Yaesu FTM-500DR C4FM/FM 144/430 MHz Transceiver

Reviewed by Steve Ford, WB8IMY
wb8imy@arrl.net

The Yaesu FTM-500DR is what I call a "kitchen sink" transceiver, and that's intended as a compliment. It is just another way of saying that this radio includes everything except, as the old saying goes, the "kitchen sink."

The FTM-500DR operates either analog FM or C4FM digital on the 2-meter and 70-centimeter bands, but it also receives at all frequencies from 108 to 999.995 MHz (cellular frequencies blocked, of course; see Table 1). The transceiver offers RF output levels of 5, 25, and 50 W with a single SO-239 antenna port.

Like a number of Yaesu transceivers available today, the FTM-500DR is a System Fusion radio — that is, it can sense the modulation scheme of a received signal and adapt accordingly. When you have the Automatic Mode Select (**AMS**) function enabled, you may be called by someone on FM simplex, or through an analog FM repeater, and the FTM-500DR will configure itself for analog FM operation automatically. But if someone calls you using digital C4FM, the radio will instantly jump to C4FM mode without any input from you. While operating in digital mode, you can select between two modes: Voice Wide (**VW**) and Digital Narrow (**DN**). The **DN** mode carries 6.25 kHz of audio data and 6.25 kHz of other information, such as location data — all this simultaneously. If you go into the menu system, you can add the ability to operate in **VW**, which transmits a broader digital signal using the full 12.5 kHz for audio that permits higher fidelity. I found the **DN** mode to be sufficiently clear for my purposes, but the fidelity improvement when I tried **VW** mode was impressive.

The radio body has a slender profile, at about 5.5 × 1.7 × 5.2 inches. As you can see in the lead photo, the detachable control head is significantly larger, at 6.1 × 2.5 × 2.3 inches. The size disparity is understandable when you realize that the control head includes a 2.4-inch touchscreen that is used to display signals from two bands simultaneously, not to mention an optional band scope. The FTM-500DR also offers a sizable tuning knob, and other knobs and buttons that are sized and positioned for maximum ergonomic efficiency. The main and sub bands each have their own dedicated volume controls on the left-hand side of the head; you can adjust the squelch level with a single press on the desired volume knob.

The control head also includes its own speaker, which appears along the bottom of the unit. Another larger speaker is available on the body as well (we'll discuss the speakers in more detail later).

Of course, you have the option to relocate the body elsewhere in your vehicle, such as under the seats, but you'll need to purchase an optional extension cable to

Bottom Line

The FTM-500DR is a fully featured radio, but Yaesu's simplified approach makes it easy to operate even for beginners. The innovative Acoustic Enhanced Speaker System (AESS) is astonishing, especially for mobile use, and is something you really must hear for yourself.

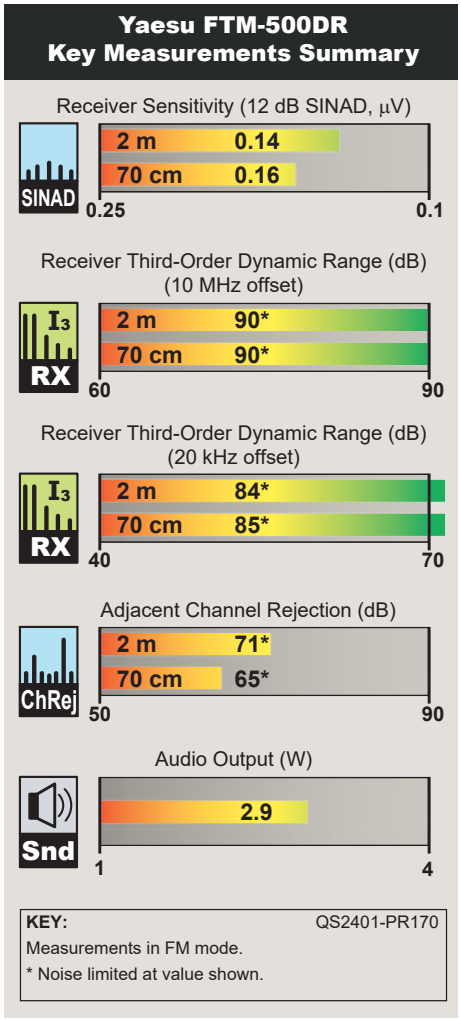


Table 1

Yaesu FTM-500DR, serial number 3E020243
Firmware: Main – 1.02, Sub – 1.02, DSP – 7.20

Manufacturer's Specifications	Measured in the ARRL Lab
Frequency coverage: receive, 108 – 137 MHz (air band), 137 – 174 MHz (144 MHz ham / VHF band), 174 – 400 MHz, 400 – 480 MHz (430 MHz ham / UHF band), 480 – 999.995 MHz (USA cellular blocked); transmit, 144 – 148, 430 – 450 MHz (FM).	As specified.
Modes: FM, digital voice, data.	As specified.
Power requirements: receive, 500 mA; transmit, 10 A on 144 and 430 MHz, 50 W at 13.8 V dc.	Receive, 462 mA (max volume, max lights, no signal, each receiver), 420 mA (max volume, min lights, no signal); transmit, 146 MHz, 9.1/5.8/2.8 A (high/med/low), 440 MHz, 9.9/6.8/3.3 A (high/med/low) at 13.8 V dc.
Receiver	**Receiver Dynamic Testing***
Sensitivity: FM (12 dB SINAD), 0.2 µV (137 – 150 MHz), 0.25 µV (150 – 174 MHz), 0.3 µV (174 – 222 MHz), 0.25 µV (222 – 300, 336 – 420 MHz), 0.2 µV (420 – 520 MHz), 0.4 µV (800 – 900 MHz), 0.8 µV (900 – 999.99 MHz); AM 10 dB S/N, 0.8 µV (108 – 137, 300 – 336 MHz).	FM (12 dB SINAD), 0.14 µV (144 MHz), 0.16 µV (440 MHz), 0.14 µV (WX), 0.48 µV (223 MHz), 0.44 µV (902 MHz); AM (10 dB S+N/N), 0.72 µV.
FM two-tone, third-order IMD dynamic range: Not specified.	20 kHz offset, 146 MHz, 84 dB†, 440 MHz, 85 dB†; 10 MHz offset, 146 MHz, 90 dB†, 440 MHz, 90 dB†.
FM two-tone, second-order IMD dynamic range: Not specified.	146 MHz, 95 dB, 440 MHz, 115 dB.
Adjacent-channel rejection: Not specified.	20 kHz offset, 146 MHz, 71 dB†, 440 MHz, 65 dB†.
Spurious response: Not specified.	If rejection, 146 MHz, 103 dB; 440 MHz, >136 dB; image rejection, 146 MHz, >137 dB, 440 MHz, 73 dB.
Squelch sensitivity: 0.16 µV (144/430 MHz).	At threshold, 146 MHz, 0.09 µV, 0.30 µV (max), 440 MHz, 0.15 µV, 0.36 µV (max).
S-meter sensitivity: Not specified.	S-9, 3.7 µV (144 MHz), 4.8 µV (440 MHz).
Audio output: 3 W at 10% THD into 8Ω.	2.9 W, 10% THD into 8Ω. THD at 1 V_{rms}, 1.6%.
Transmitter	**Transmitter Dynamic Testing**
Power output: 50, 20, 5 W (high, med, low). At 13.8 V dc nominal.	As specified.
Minimum operating voltage: Not specified.	At 12 V dc, 144 MHz, 47/24/5 W output.
Spurious signal and harmonic suppression: >60 dB.	≥60 dB, meets FCC requirements.
Transmit-receive turnaround time (PTT release to 50% of full audio output): Not specified.	Squelch off, S-9 signal, 146 MHz, 356 ms; 440 MHz, 360 ms. With AMS on. 146 MHz, 100 ms; 440 MHz, 102 ms. With AMS off.
Receive-transmit turnaround time ("tx delay"): Not specified.	146 MHz, 74 ms; 440 MHz, 75 ms.

Size (width, height, depth): 6.1 × 2.5 × 2.3 inches (control panel without knobs); 5.5 × 1.7 × 5.2 inches (radio unit).

Weight: 3.1 pounds (control panel + radio unit + control cable).

*"Main" and "Sub" receivers measured identically, unless noted.
†Measurement was noise limited at the value indicated.

do this, such as the 10-foot SCU-62 or the 20-foot CT-132. Note that a common Ethernet cable is not recommended, as it will impact the operation. The good news is that the large multifunction microphone can plug directly into the control head. Unlike some transceivers, you won't need to run a separate microphone cable to the body of the unit.

The FTM-500DR is a sharp-looking radio overall, and it is packed with so much functionality; the details can't be contained within a single operating manual (or within the confines of a single *QST* review). That's why the manual included with the radio highlights only the most used

features. If you want information about more advanced features, such as WIRES-X or the Automatic Packet Reporting System (APRS), you will need to download separate detailed manuals in PDF format from the Yaesu website.

The FTM-500DR Operating System

In a radio as complex as the FTM-500DR, anything that can be done to streamline operation for the user is worthwhile. Yaesu's solution is the Easy to Operate (E2O)-IV operating system. The short summary of E2O-IV is that it consolidates several potentially complicated functions, making the FTM-500DR much easier to learn and operate, even for a beginner.

Consider the **TOUCH & GO** and **SEARCH & GO** functions as examples. With the band scope running in the display, you can use **TOUCH & GO** to jump to a desired frequency with a single touch on a signal bar. With **SEARCH & GO**, a short press on the band scope will start simultaneous reception of that frequency and the main frequency. Another short press will return you to the scope screen.

E2O-IV also streamlines your ability to monitor up to five separate frequencies simultaneously. You "register" your favorites in the Primary Memory Group (**PMG**) with the touch of a button (see Figure 1). You can register up to five. When you press and briefly hold the **PMG** key, the radio begins scanning through the registered channels and displaying activity via vertical bars in the lower half of the display. If you notice that a frequency suddenly appears to be active, a single touch on the bar will take you to that frequency, which replaces the bars in the lower portion of the display.

Another E2O-IV enhancement is the Customized Function List (**CFL**). As with any feature-rich radio, there are some functions you'll use frequently, but others you'll rarely use at all. **CFL** allows you to create a quick-access list of only those functions you use most often. You can add up to eight functions to the list (such as **SCAN**, **APRS ON/OFF**, **TX PWR**, etc.) and then access the list with just a single press of the **FUNC** knob.

Figure 1 — The Yaesu FTM-500DR PMG feature.

E2O-IV makes it easy to group memories within the same frequency bands for easier scanning and recall. You can even choose to eliminate reception of a given band if it doesn't interest you. Not interested in listening to aeronautical traffic? Use the VFO Band Skip function to temporarily remove it from available bands. When you press the **BAND** button to toggle between bands, the aviation band (108 to 137 MHz) will no longer appear.

AESS

The Acoustic Enhanced Speaker System (**AESS**) is a feature unlike anything I've seen before in an amateur radio transceiver. While it can be described in words, **AESS** is something you really must hear for yourself.

Imagine that you have the FTM-500DR control head mounted beneath the dashboard of your vehicle while the transceiver body is resting beneath a back seat. As I mentioned previously, both units have speakers, and these speakers can be active simultaneously. But if your vehicle is like mine, you know it has its own peculiar acoustic environment. Some sounds you can hear well, but others not so much.

With **AESS**, you can adjust high- and low-frequency emphasis and total volume balance for each speaker independently. You can also adjust the phase balance between the two speakers, effectively introducing a slight delay in either the front or the rear. The effect in my SUV was astonishing. I found myself playing with the **AESS** for quite a while, just listening to the various effects. Your experience will vary depending on your vehicle, but I found **AESS** to be innovative and useful.

Memories and MicroSD

The FTM-500DR has more memories than most of us will ever use. The memory complement includes 1,104 channels with five "home" channels, 50 sets of memories for programmable memory scanning, and 999 "basic" memories.

Yaesu offers free software for managing memories (*ADMS*), but you will need to purchase the SCU-56 cable, which is included in the SCU-58 kit for about $40, in order to connect the radio to your computer. RT Systems (**www.rtsystems.com**) offers a software and cable package for $49.

The FTM-500DR can also accommodate a microSD memory card, and I found that it was possible to write the memory contents to the card, read the card into my computer, and then edit the information there. That's a multi-step process, however, and editing memories with a cable and software is much easier.

That said, I found it relatively straightforward to manipulate the memories via the transceiver's touchscreen. Yes, you have to go through a few steps, but I programmed the FTM-500DR this way initially, and it wasn't overly difficult.

Bluetooth

The wireless Bluetooth feature in the FTM-500DR is well designed. I have a Bluetooth microphone/headset that I use for online conferencing, and I was able to easily pair it with the transceiver. With the FTM-500DR's voice-operated switch (VOX) feature, all I had to do was speak and the radio began transmitting automatically. It pays to be careful if you use a wireless headset with the FTM-500DR in this fashion; you could transmit some utterances best kept to yourself!

Also, if you're considering using a headset as a wireless option while driving, check with your state motor vehicle department first. Some states prohibit headsets completely, while others allow them if they cover only one ear.

APRS

The APRS is a digital communication system for tracking moving objects (such as vehicles), but it also supports other data exchanges such as text messaging, weather information, and more (see Figure 2). In the FTM-500DR, Yaesu has included full-featured APRS functionality. There is a highly sensitive Global Positioning System (GPS) receiver on board that can determine your location within a few meters. The information can then be shared with the built-in terminal node controller (TNC) for transmission to the APRS network.

The APRS modem/TNC defaults to "off" out of the box, so you need to switch it on in the menu system. You will also need to input your APRS call sign and extension. Once you've completed these steps, and set the radio to 144.39 MHz, the FTM-500DR will begin displaying beacon data received from other stations.

I set up the transmit beacon function and drove around the area with the FTM-500DR blasting out my position at regular intervals. I even managed to get a couple of my beacon packets relayed by the digipeater aboard the International Space Station. Not bad for just 25 W to a magnetic mount antenna.

While the FTM-500DR can, of course, send and receive APRS text messages, entering a message for transmission is not easy. A convenient addition to a future transceiver would be the ability to interface a wireless keyboard.

At the rear of the FTM-500DR you'll find a data port to connect to a personal computer (see Figure 3). You can send APRS data to software on your PC, and you can even tap into the GPS data stream for use with another device.

It is also worth noting that the transceiver allows you to record your travel route to a microSD memory card for later viewing on an application such as Google Earth.

Group Monitor

Yaesu has included the Group Monitor feature in the FTM-500DR. While its use is limited to communicating with other Yaesu C4FM transceivers, it has the potential to be quite handy.

Figure 2 — The Yaesu FTM-500DR APRS screen.

Figure 3 — The Yaesu FTM-500DR rear panel.

Group Monitor essentially creates a kind of ad hoc network between compatible transceivers. Let's say you and several friends all own Yaesu C4FM transceivers with Group Monitor functionality. When the Group Monitor function is enabled (it is just a single button push on the top of the FTM-500DR control head), the radio begins pinging and listening for others who are in Group Monitor mode.

As responses are received, you can see a display of call signs, locations, and distances from your position. You can communicate with individuals in the group and even exchange text messages.

Unfortunately, I didn't have anyone nearby with a compatible transceiver, so I wasn't able to try Group Monitor myself. The Group Monitor feature is sufficiently complex to require its own manual, which is downloadable from the Yaesu website (**www.yaesu.com**).

WIRES-X

Perhaps the most interesting aspect of the FTM-500DR's digital functionality is its ability to interface with the WIRES-X network. The network is composed of nodes that act as portals to the network (see Figure 4). Most WIRES-X nodes are incorporated into System Fusion repeaters, but that doesn't mean that every Fusion repeater is hooked up to WIRES-X. In my immediate vicinity I found six Fusion repeaters, but only two supported WIRES-X. The easiest way to check is to go to the Yaesu WIRES-X Active Node ID List at **www.yaesu.com/jp/en/wires-x/id/active_node.php**. This list includes not only WIRES-X-capable repeaters, but simplex nodes as well.

Through WIRES-X you can enjoy conversations with amateurs all around the world, using the internet as a bridge to pass audio data and other information back and forth. Accessing the WIRES-X network is remarkably easy. I just selected a nearby WIRES-X repeater (I had programmed it into a memory slot) and then pressed the **DX** button on the top of the control head. The transceiver immediately attempted to establish a digital connection. It announced its success on the display, and I used the multifunction microphone to punch in the code for one of my favorite WIRES-X "rooms" (a room is like a reflector, or a group chat). Once I was connected, I soon heard a CQ from a station in the United Kingdom. At the same time, his call sign appeared in the display. I answered and we began carrying on a conversation while I zoomed along the interstate. It was a bit surreal to be doing this with a VHF/UHF transceiver.

Figure 4 — The Yaesu FTM-500DR connected to the WIRES-X network repeater node.

Please note that with the optional SCU-58 cable you can connect this radio directly to the WIRES-X network using a computer in portable digital node (PDN) mode. The PDN mode allows the FTM-500DR to act as a digital C4FM hotspot or a digital internet radio. If you opt for the optional HRI-200, all the necessary cables are provided. These features are covered in more detail in the Yaesu FTM-200DR review in the September 2023 issue of *QST*.

And That's Not All

The FTM-500DR is so feature rich, I tend to focus on the aspects that are new or novel. Of course, the FTM-500DR offers all the other features you've come to expect in a modern VHF/UHF transceiver. There are multiple frequency scanning modes, weather broadcast reception, a microphone with DTMF buttons and several multifunction programmable buttons, a powerful and quiet cooling fan, two speaker ports on the main body that can be dedicated to main or sub-band audio, and AM reception on the aeronautical band.

But there are also several other items that caught my attention. The first was a new dual CTCSS paging function. It combines two CTCSS tones as a reliable, yet unobtrusive, way of sending and receiving paging signals.

And thanks to its ability to accommodate a microSD card, the FTM-500DR allows you to record any received audio you wish. It will record your own transmissions as well. Install a card with sufficient capacity, and it will record for quite a while. I found the audio quality to be very good, and I can imagine using this feature during public service operations as a means of keeping a record of what transpired.

This may seem trivial, but I liked the fact that I could rotate the control head about 20 degrees to face upward. I haven't seen that feature on other radios lately,

and it can do wonders for display readability in a mobile environment. Yaesu also offers different mounting options for the remote head, like the SJMK-500 (Swing-Head Kit) and the MMB-103 (Dash Mount Bracket).

Finally, there is the "Super DX" function. This feature is a bit of a head scratcher because the manual has little to say about it, other than to note that pressing the **S-DX** button on the top of the control head improves sensitivity. That's it. It seemed to work at the frequencies I tried, but the effect was difficult to quantify in the field. I noticed a definite improvement with weak FM signals, roughly two S-units on 2 meters, for example.

Conclusion

If you are a fan of C4FM and System Fusion, it isn't hyperbole to say that the FTM-500DR is the ultimate transceiver in its class. It offers performance and features that are heads above any other FM/C4FM combo radio.

Manufacturer: Yaesu Musen Co., Ltd., Tokyo, Japan. Available from several US suppliers, **www.yaesu.com**. Price: $649.95.

Portable Power Stations — Jackery Explorer 500, Bluetti EB55, EcoFlow RIVER 2 Max, and Bioenno Power BPP-M500

Reviewed by Harold Kramer, WJ1B
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Introduction

I enjoy Parks on the Air (POTA) activations and other outdoor amateur radio activities that require portable dc power. I wanted some ac backup power at home to keep critical items running when the power goes out. I also believed that solar power should be a desirable option. I found a potential solution to these requirements with a battery-powered, portable power station that combines all these functions in one device.

A power station, sometimes called a "solar generator," is an integrated system consisting of a lithium-ion battery, a 110 V ac battery charger, a battery management system, a solar controller, a power display, and a 110 V ac inverter all in one case that has a variety of ac and dc inputs and outputs. In this review, we will be testing the devices themselves and not the solar panels.

They are advertised for use when camping and for providing backup power for cell phones, laptops, small appliances, and home medical devices. Some of them are more powerful and expensive, so we've concentrated the reviews on comparable portable units less than $500. They are safe, environmentally friendly, and quiet. The selected ones are easily carried and transported, and you don't need much technical knowledge to connect everything. However, their documentation is sparse, and schematics or diagrams are unavailable. They are not consumer serviceable.

To determine what these devices are capable of, the ARRL Lab and I tested four well-known brands: Jackery, Bluetti, EcoFlow, and Bioenno Power. Power stations are rated in watt hours (Wh) and are available from 250 to 3000 Wh. A watt hour is a unit of energy equal to 1 W expended for 1 hour of time. It is commonly used as a measure of the total amount of energy in a battery or other electrical device. For example, at 100% efficiency, a 500 Wh power station will provide 1 W for 500 hours, or 50 W for 10 hours. We selected 500 Wh power stations for their size, weight, charging options, and outputs (see Table 2). On average, they cost about one dollar per watt hour.

These power stations share many common characteristics. They all weigh 13 to 15 pounds. They are all squarish black and gray hard plastic boxes that are a few inches less than a foot wide and 7 or 8 inches both high and deep.

Table 2
Four Portable Power Stations

Brands and Models	Jackery Explorer 500	Bluetti EB55	EcoFlow RIVER 2 Max	Bioenno BPP-M500
Battery type	Lithium-ion	LiFePO4	LiFePO4	Lithium-ion
Battery pack capacity in watt hours	518 Wh	537 Wh	512 Wh	520 Wh
Recharge cycles with 80%+ capacity	500	2,500	3,000	2,000
Recharge time, 110 V ac	7.5 hours	Approx. 3 hours	1 hour	8 – 10 hours
Recharge time, accessory socket	7.5 hours	6.1 hours@100 W	Not specified	Not specified
Recharge time, solar panel	9.5 hours	1.8 – 2.3 hours	Not specified	Not specified
Light	Yes	Yes	No	No
Car accessory socket charging	Yes	Yes	Yes	Yes
USB charging	Yes	Yes	Yes	Yes
Solar input max	100 W	200 W	220 W	100 W
ac charger supplied	Yes	Yes	Internal	Yes
Number of 110 V ac outlets	1	4	4	2
110 V ac output	500 W	700 W	500 W	520 W
110 V ac output peak	1000 W	1400 W	1000 W	750 W
12 V dc accessory socket max	10 A	10 A	10 A	10 A
dc outlets, other	2	2	2	4
USB outputs	3	5	4	4
Controlled by app	No	No	Yes	Yes
Size in inches (height, width, depth)	9.2 × 11.8 × 7.6	7.8 × 10.9 × 7.9	10.2 × 10.6 × 7.7	6.9 × 12.0 × 7.9
Weight	13.3 lbs	16.5 lbs	13.4 lbs	14.3 lbs
Warranty	2+1 years	2 years	5 years	5 years
See *QST* in Depth (**www.arrl.org/qst-in-depth**) for the full ARRL Laboratory testing results for each unit.				

They all provide "pure sine wave" 110 V ac from their built-in inverters. They all have 110 V ac outlets that provide 500 to 700 W with a kW or more surge capability. All have a single car accessory socket that supplies 12 V dc at 10 A. Additional dc outputs can also be connected using 12 V barrel connectors. And they all have advanced battery management systems that protect the battery from overheating or otherwise shortening the battery's life.

On-the-Air Operations

The Car Accessory Socket Configuration

I configure my radios with Powerpole connectors, but only one of the power stations (Bioenno Power) has Powerpole outputs. For the others I had to use a car accessory socket male-connector-to-Powerpole adapter. I tried three different adapters until I found one that fit the accessory socket tightly. I gave the connectors a hard push to make them connect with the small positive contact inside the socket. As I learned the hard way, some of these adapters have internal fuses, and the 5 A fuse in one of the adapters blew as soon as I tried to transmit with the Icom IC-7300.

It is good practice not to exceed the 10 A limit of the connector or accessory socket, as overheating of the cable or other problems may occur. All of the power stations that I tested turned off by themselves when the current through the accessory socket exceeded 10 A or so.

After obtaining a solid connection with the accessory socket, I connected the power stations to my Icom IC-7300. To stay within the 10 A current limit of the accessory socket, I had to limit the IC-7300's RF output power to about 40 W. The power stations display only their output and input power in watts and the percentage of battery power remaining. So, I connected my in-line Powerwerx Power Analyzer that read volts, amps, and watts to make sure that the voltage and current going into the transceivers were within specifications.

The higher-wattage power stations would provide more operating time, but the 12 V dc output for the accessory socket was still limited to 10 A. At this power, an HF radio would run for about 8 hours on a 500 Wh power station depending on the individual transceiver, the mode, and the duty cycle of the transmission. This power output was fine for running a typical VHF/UHF mobile transceiver, a 100 W HF transceiver at reduced power, or a QRP rig.

The External 13.8 V Power Supply Configuration

Another way to connect a power station to a transceiver is to plug a 110-V-ac-to-13.8-V-dc power supply into a power station's ac outlet. This is the same way that you would connect a transceiver to a gas generator's 110 V ac outlet. This configuration works fine if you want to power your home station when the commercial power is out or if you prefer not to use commercial power.

The 110 V ac outputs on the power stations are rated 500 to 700 W, and that provides plenty of power to run a transceiver at 100 W. My Icom IC-7300 worked fine at 100 W RF output with this type of connection. While not very elegant, and with a slight loss of efficiency, this method is a good solution for backup power at a home station, particularly if the power station is also connected to a solar panel. The disadvantage of this method is that if the power station's battery runs down faster, an additional power supply is needed. I tried this configuration at home with my Samlex SEC-1235M power supply and in the ARRL Lab with a small MFJ switching power supply, and they both worked fine in this mode.

Jackery Explorer 500

I found the Jackery Explorer 500 to be an easy-to-use, compact power station that has a capacity of 518 Wh using a lithium-ion (NMC) battery. It is a handsome unit with its two-tone orange and black color scheme. Orange lines separate the functional areas, and the switches are labeled with white letters that are easy to see in low light.

It's the lightest and smallest of the group, weighing only 13.3 pounds and measuring 11.8 × 7.6 × 9.2 inches. With an integrated handle on the top of its case, it's easy to carry and transport, and it's very rugged.

Jackery specifies that the battery is good for 500 charging cycles to 80% capacity. It is protected for overvoltage and short circuits by a battery management system. The ac charging time is 7.5 hours with either the 110 V ac charger or the car accessory socket adapter.

The user manual is clearly written and nicely illustrated. There is little technical information, but there is a lot more information on the Jackery website (**www.jackery.com**). It was the only unit that came with a cloth zippered bag to store its car charging cable, and the external ac battery charger — a nice touch. Having an external ac charger makes the Jackery lighter in weight, and the charger can be replaced if necessary.

Bottom Line

The Jackery Explorer 500 is a solid option if you need a lightweight, compact, and easy-to-use power station. It is RF quiet using both the dc power and the 110 V ac outlet to a 13.8 V dc power supply.

Display

The front-panel LCD displays black symbols against a gray background, and it packs plenty of information. But it is smaller and not as bright of a display as the other reviewed power stations. The display indicates power level percentage, input and output power in watts, and warnings for low and high temperature, battery overcharging, overloading, and battery draining. There is also a bright flashlight on the side of the Explorer 500 that is controlled by a switch next to the light — a useful feature when the power is out.

Inputs

The Explorer 500's battery can be recharged with the supplied external 90 W ac charger. There is no indication of charging status on the ac adapter. It can also be recharged with a car accessory socket or a solar panel. It has a built-in maximum power point tracking charge controller that maximizes the efficiency of the solar panel. It pairs with the Jackery SolarSaga 100 W solar panel that is sold separately for $299. The SolarSaga can charge two small devices, like a cell phone or tablet, directly without the power station connected. The maximum solar panel input is limited to 200 W.

Output

The front panel has only one switchable, three-prong ac outlet that delivers 110 V ac at 500 W. That's fewer outlets than any of the other power stations. An ac multi-box would have to be added if more ac outlets are needed. There are two dc outputs at 12 V and 10 A, and there are three USB-A outputs labeled **5 V, 2.4 A**.

The car accessory socket that I used to power my radio provides about 13 V. I was disappointed that there was no rubber cover for the car accessory socket. There are also two dc barrel output connectors. All the dc output connectors are controlled with one switch.

I ran my Icom IC-7300 at 40 W for more than an hour on 20 meters FT8 using power from the accessory socket. After an hour, the battery still read 95% available, and it still supplied 13.2 V. It is RF quiet using the dc power or a 110-V-ac-to-13.8-V-dc power supply.

Summary

The Jackery Explorer 500 is a solid option if you need a lightweight, compact, and easy-to-use power station. Its only limitation is its one ac outlet and comparatively long battery-charging time. It has the best documentation and packaging, and its front panel is easy to use and understand. It is backed by an additional 2-year warranty and a 1-year extended warranty and lifetime technical support.

Manufacturer: Jackery Inc., 48531 Warm Springs Blvd., Ste. 408, Fremont, CA 94539, **www.jackery.com**. Price: $499.

Bluetti EB55 Portable Power Station

The Bluetti EB55, which is about the size of a small microwave oven, is a versatile power station with many advanced features. It is the heaviest of the reviewed units, at 16.5 pounds, and its LiFePO4 battery provides a 537 Wh capacity. It can produce 700 W ac power and up to 1400 W ac surge power.

It comes with a hefty external ac charger, a car charging cable, a solar charging cable, and a charging adapter cable. The printed user manual is a scant, folded piece of paper with only the most essential information. Bluetti's website (**www.bluettipower.com**) has more comprehensive information about its technical specifications and features.

It has a solid, steel gray case with light gray lines separating the switchable operating functions. The carrying handle on the top of the case folds down flush into the case when not in use. There is a powerful light with a 7-inch-long white diffuser and a switch on the rear of the case. On the first press of the switch, the light is on low illumination; on the second press, it is on high, and on the third press, the light blinks SOS in CW.

Bottom Line

The Bluetti EB55 with its 700 Wh is the most powerful unit of the four we've reviewed. Plus, in case of an emergency, the integrated light can blink SOS in CW. It's the only unit that has a 15 W wireless charging pad on top of the case.

Display

Its front-panel layout is clearly marked, and it has a bright and easy-to-understand blue and white LED display that indicates input and output in watts and a graphic representation of a battery that displays remaining battery power in percentage. The display also indicates when the unit is in eco-mode (more on that later), and there are alert icons for low voltage, temperature anomaly, overload, and short circuits.

Inputs

The EB55's battery is charged by the supplied external charger. The charger has an LED that is red when the EB55 is charging and green when the battery is full. The 90 W charger can recharge the battery in approximately 3 hours.

For even faster charging, the EB55 has a dual charging system that can use two ac adapters at the same

time or with the ac adapter and solar panel at the same time. With these two fast charging methods, the charging time is significantly reduced. Bluetti claims a full recharge of 1.8 hours with the dual ac chargers. They also note that "the battery's charge/discharge cycle life is 2500 times, so there is no need to worry about the battery's life span due to fast charging."

The EB55 can also be directly charged from a car accessory socket or solar charging. For solar charging, the EB55 can support up to a maximum of 200 W solar power input. The recommended Bluetti PV200 solar panel sells for $499 on Amazon.

Outputs

There are thirteen different outputs on the EB55 that can provide power simultaneously. These include four 120 V ac outlets that provide 700 W. A nice feature is that two of these outlets are two-prong outlets, and two of them are three-prong outlets. There is one USB-C port at 100 W maximum and four USB-A ports at 5 V at 3 A maximum. A feature that is unique to the EB55 is a wireless 15 W charging pad on top of the case. This is a handy feature for charging a smartphone without a cable.

In the dc output section of the front panel, there are two DC5521 barrel connectors that can supply 10 A at 12 V and one car accessory socket that also supplies 10 A at 12 V. There are protective rubber covers over the dc input connectors and the car accessory socket.

The EB55 has an eco-mode setting that improves energy efficiency. When enabled, the ac output automatically turns off the EB55 after an hour when the output is less than 10 W or when there is no load present.

I used the car accessory socket to supply power to my IC-7300 for about an hour on FT8 at 40 W RF output with no problems. However, when I used the Bluetti as a 110 V ac source to power my Samlex power supply, it produced RFI on some of the HF bands and 6 meters. This may be specifically related to my individual setup, as the ARRL Lab tested otherwise for this unit (see *QST* in Depth at **www.arrl.org/qst-in-depth** for the full testing results).

Summary

The EB55 is a good choice if you are looking for a power station with 700 Wh power, many charging options, and other helpful features. It can be used with a 200 W solar panel, and it has the most outputs of any of the power stations. It comes with a 24-month warranty.

Manufacturer: Bluetti Power, 6185 S. Valley View Blvd., Ste. D., Las Vegas, NV 89118, **www.bluettipower.com**. Price: $399.

EcoFlow RIVER 2 Max Portable Power Station

The EcoFlow RIVER 2 Max is a squarish two-tone gray power station that weighs 13.4 pounds. The front panel is dark gray, and although it is well labeled, I found the small, light gray labels hard to read in low light. Its substantial carrying handle is integrated with the top of the case on the rear of the cabinet. While this arrangement is different from the other power stations, I found it easy to carry and transport. However, sometimes it felt like it was going to land on its front panel when I put it down.

The box contains an ac charging cable, a car charging cable, a DC5521 connection cable, and a quick start guide that is well written and illustrated. However, there is limited technical information beyond basic connections and specifications. The EcoFlow website (**www.ecoflow.com**) has expanded technical and operating information. It is also the least expensive reviewed power station.

Bottom Line

The EcoFlow RIVER 2 Max claims that it can go through 3,000+ charge cycles during a period of 10 years before reducing to 80% battery power. This model is the fastest-charging unit of the four we've reviewed; it can fully charge its battery in only 70 minutes.

The RIVER 2 Max uses a 512 Wh LiFePO battery that EcoFlow claims can go through 3,000+ charge cycles for about 10 years before reducing to 80% battery power. It also has a 1000 V "X-Boost" mode if more power is needed. Like all of the power stations, it includes an advanced battery management system.

Display

The front panel has a bright and readable display with large numbers that show charging time, charge time percentage remaining, and input and output power in watts. The display also has warning icons for overload, battery charging temperature, and other critical functions. There are no voltage or amp labels on the front except for the one USB-C connection that is labeled **100 W**. The rear of the case has an ac outlet for charging and a dual pin socket for a solar panel.

Inputs

To charge the EcoFlow's battery, just plug in the supplied ac cord. It has the fastest charging system of any of the power stations that I tested, with the capability of fully charging its battery in only 70 minutes using what EcoFlow calls "X-Stream" fast-charging technology. Along with 110 V ac charging, the EcoFlow can be charged using a car accessory socket, USB-C charging, and solar charging with an EcoFlow 220 W solar panel. I noticed a big increase in RFI on the HF bands and 6 meters when it was being charged. I did not see or hear any RFI when it was not on ac charging.

Outputs

On the front panel, there are three USB-A outputs and one USB-C input or output. There are also two grounded ac outlets and two ac non-grounded outlets. There is a car accessory output with a rubber cover that provides 12 V at 10 A and two dc barrel connectors. Separate switches control each type of power.

Summary

I used the EcoFlow during a POTA activation at Sleeping Giant State Park (K-1717) in Connecticut for more than an hour using the car accessory socket with my Icom IC-7300 at 40 W SSB and FT8. After a little more than an hour's use, the EcoFlow's battery still showed 92% power, and the voltage was still above 13 V after about 20 SSB and 20 FT8 QSOs.

There are two unique features of the EcoFlow RIVER 2 Max. First, it can be controlled by a smart app. There is a QR code on the back of the unit that takes you to the website to download the app, which controls the EcoFlow via Wi-Fi or Bluetooth. According to EcoFlow, you can use their smartphone app to control and monitor charging levels, customize settings, and adjust charging speeds.

Second, the EcoFlow has an automatic switchover system that changes from commercial power to its internal power when commercial power is lost. EcoFlow claims a switchover speed of less than 30 ms. The EcoFlow comes with a 5-year warranty.

Manufacturer: EcoFlow Technology Inc., 1687 114th Ave. SE, Suite 101, Bellevue, WA 98004, **www.ecoflow.com**. Price: $469.

Bioenno Power 500 Wh Renewable Power Pack (BPP-M500)

The Bioenno BPP-M500 is a 520 Wh 750 W peak power station that uses a lithium-ion (NCA) battery. It's about the size of a conventional car battery and weighs 14.3 pounds. It has a black case with bright white letters and markings. The case has a heavy-duty top-mounted pull handle.

In the box there is a 90 W external ac charger. Bioenno states that the battery offers 2,000 charge cycles and takes about 8 to 10 hours for a full charge. Also included in the box are four round male dc barrel connec-

Bottom Line

Although Bioenno Power is well-known by hams, the company doesn't necessarily recommend the BPP-M500 for ham radio applications, but it can do the job. They also offer dc battery products, such as LiFePO batteries, that are more suitable for portable ham radio applications.

tors-to-Powerpole adapters, one dc jack connector to Powerpole, and one car accessory socket-to-Powerpole adapter. There is also a separate dc-to-dc converter included that raises the dc voltage to 13.8 V that Bioenno says can be used for "QRP radio applications."

Display

The display has a visual bar graph of battery output. There are no numerical ratings of power, voltage, or current on the front panel. When ac power is switched on, the letters **AC** appear in the display with a graphic of a sine wave. When dc is switched on, it displays the letters **DC** and a dc connector symbol. Unlike the other power stations, there is no indication of input or output in watts.

Inputs

There are two input connectors on the BPP-M500. A dc barrel connector is provided for the ac charging adapter, and a pair of Powerpole connectors connect to a solar panel. The solar panel output cannot exceed 6 A, and Bioenno sells a 100 W foldable solar panel, BSP-100-LITE, for $209.99.

Outputs

The Bioenno power pack has one 110 V ac outlet that can provide a maximum of 500 W. There are no protective covers over any of the connectors. There are four dc barrel jacks intended for "no more than 6 A" per jack. There are four USB outputs.

Summary

The Bioenno BPP-M500 appears to be more of a commercial or industrial power pack rather than a consumer model. I could not run more than 30 W RF output from the IC-7300 using either the car accessory socket or the supplied dc-to-dc converter. In all fairness, Bioenno does state in the user manual that "this unit is not intended for use with ham radio applications." They suggest that you keep the power below 30 W. It is worth mentioning that Bioenno Power is well-known by amateur radio operators for offering many other dc power products (such as the BLF-series LiFePO batteries) that are more suitable for portable ham radio applications. When I connected my Samlex power supply to the ac outlet on the BPP-M500, the IC-7300 worked fine at 100 W PEP with no discernible RFI.

Manufacturer: Bioenno Power, 3657 W. McFadden Ave., Santa Ana, CA 92704, **www.bioennopower.com**. Price: $499.

Conclusion

In summary, these power stations are lithium-ion battery-powered and are easy to use and connect ac and dc portable power supplies. They are not user serviceable, and their technical documentation does not provide much information.

They can be charged in a variety of ways, including solar power. While they are principally designed to power devices outdoors, these 500 Wh models can supply ac home backup power for low- to medium-power devices in the home or in the field, including amateur radio transceivers. For amateur radio usage, using the (car) accessory socket output, they can supply 12 to 13 V limited to 10 A or 120 W. This limits the RF output of most amateur radio transceivers to 30 to 40 W, which is perfectly acceptable for POTA, VHF/UHF mobile, or QRP transceivers.

Another method of powering an amateur radio transceiver with a power station is to use an external 110-V-ac-to-13.8-V power supply plugged into the power station's ac outlet. This will provide about 500 to 700 W at 110 V, which is enough power to run 100 W RF output.

Another approach to powering an amateur radio station with portable dc power is to buy a battery that is designed for communications applications, a battery charger, a metering device, connectors, and cases. I use a Bioenno 12 A lithium-ion battery in a Powerwerx battery box that provides all of these functions for my POTA activations. If you want to use solar power, you will need to purchase an external solar panel (solar panels are optional for power stations as well) and a solar power controller. This system involves choosing the individual devices and connecting them. An operator can customize this system to suit their needs. However, it would not be as easy to purchase, store, transport, or set up as a power station.

The selection of a particular power station for amateur radio use depends on price, operational ease, size, and weight. Electrically the selection depends on the number and type of inputs and outputs, power output in watts, battery capacity in watt hours, and how many devices you connect and run simultaneously. An operator can run a portable amateur radio station, particularly at 100 W or less RF power levels, for a long time, especially with solar power options.

See *QST* in Depth for More!

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

- ✓ Complete results of the waveform tests, no load and full load tests, and conducted emissions tests, which were performed by the ARRL Lab for all units
- ✓ Portable Power Stations Lab Notes

Dave Casler, KEØOG, askdave@arrl.org

Ask Dave

Get more information from the "*QST:* Ask Dave" YouTube playlist at **https://bit.ly/3z2MBMl**.

All About Antennas

Rearranging a Dipole for More Gain

Q Larry Hamre, AI9N, asks: Currently, one end of my 67-foot end-fed antenna is at 35 feet and the other end is at 13 feet. I run QRP (low power, usually 5 W or less) and am seeking better antenna performance on 5 W. If I raise the lower end of my antenna to 35 feet, would that improve my reception?

A The antenna configuration you have now is called a "sloper." It will work well and should give you good dipole-like performance on all the bands for which it is designed. A sloper is slightly directional toward the low end, as shown in Figure 1.

Although the textbook dipole radiation pattern for a level dipole shows most of the radiation off to the sides with sharp nulls off the ends, all practical dipoles have milder differences between the radiation off the sides and off the ends. Raising the far end of the antenna to 35 feet will affect the pattern somewhat. You will not have as much gain in the downslope, but you will have more even reception, with an emphasis on radiation off the sides.

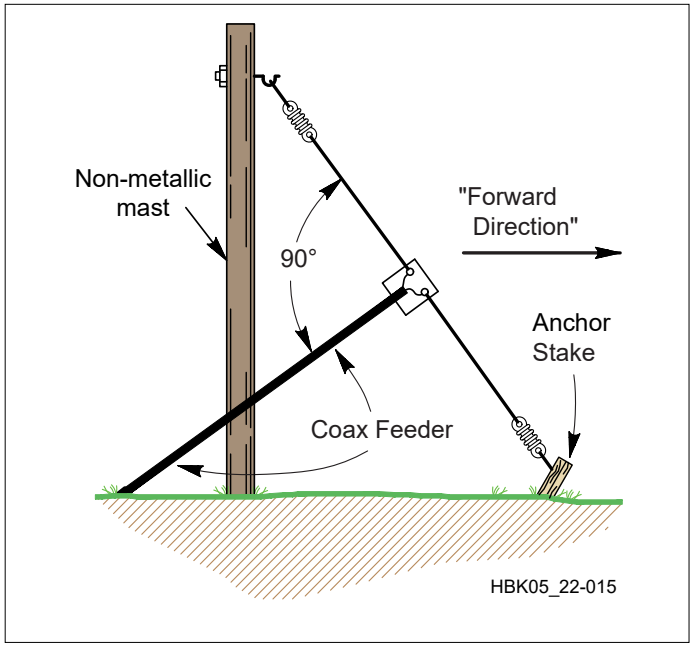


Figure 1 — When you have only one tall point on which to hang an HF antenna, you can put up an inverted **V** or a sloper. The inverted **V** has more uniform radiation in all directions, but the sloper has some directivity (shown by the arrow). Deciding which one to choose will depend on the location where you plan to erect your antenna.

A dipole is a dipole no matter how it is constructed or arranged. Thus, you will gain a decibel or two in new directions and lose the extra gain you had in the direction of the slope. If you can hear stations but they cannot hear you, consider more power. Another option is to operate CW. Using Morse code rather than single sideband will give your signal far more punch. QRP operation is an art. Persevere with it and you will take great satisfaction in working DX with so little power.

Flagpole Antenna Performance

Q Henry Brandt, W4HRB, asks: Do you have any experience with a 24-foot off-center-fed dipole flagpole compromise antenna and a way to evaluate which of the analyses might best match the physical performance? I live in an HOA community, and this type of antenna that does not require radials will meet the HOA rules. I'm always looking for antenna improvements.

A This is definitely a compromise antenna. A 24-foot dipole has a resonant frequency of 19.5 MHz. To make this antenna perform on 160 to 10 meters requires extensive loading, as well as an electrical layout that works on multiple bands. The compromise in this case will be bandwidth and lower gain. It will not cover all the various bands it's supposed to, and in a restricted community, this might be a compromise you have to make. I recommend a 100 W radio rather than QRP.

Given the complexity of the antenna inside the flagpole cover, the only way to model the entire antenna is for the manufacturer to release a model to use in *EZNEC* or a similar program. It would be easier to model one band at a time with appropriate loading. The first rule of antennas is that everything affects your antenna, so the environment around the flagpole will affect it too.

An older-designed flagpole antenna is simply a fixed-length vertical with radials. It is tuned across a lot of bands because a remote, high-powered tuner is located at its base and is controlled from the shack. Because the tuning can vary across any given band, the antenna will be resonant on any band you use it on from 160 to 10 meters or even 6 meters. Such antennas are usually mounted in the middle of a yard so radials can run in every direction. Regarding radial length, you will get a different answer from every ham you ask. I recommend spreading about

30 insulated radials, maybe 25 feet long, in every direction or where you have room. Use garden staples (which can be purchased at your local home improvement store) to secure the radials in place until the grass grows over them, and then you will be able to mow over them.

Thick Versus Thin Radials

Q David Vine, WA1EAW, asks: I have a 20-meter vertical antenna on a deck one floor above ground where stringing radials is inconvenient. Knowing the variables might help maximize counterpoise effectiveness, especially for limited-space verticals. Can I use a square piece of aluminum to serve as a suitable counterpoise? How do you calculate counterpoise system values?

A It sounds like you have a single-band quarter-wave vertical antenna. Given that the base of the antenna is about 10 feet off the ground, you need two tuned radials that are 16.5 feet long each. Ideally, they should be placed opposite each other, but it's not a significant compromise to run one along the house one way, and the other along the house at a 90-degree angle to the first radial, as shown in Figure 2. Make sure to use insulated wire.

Because the radials are at 90 degrees instead of 180, the pattern will be affected somewhat and peak slightly higher away from the radials. This effect may be so small it might be unnoticeable.

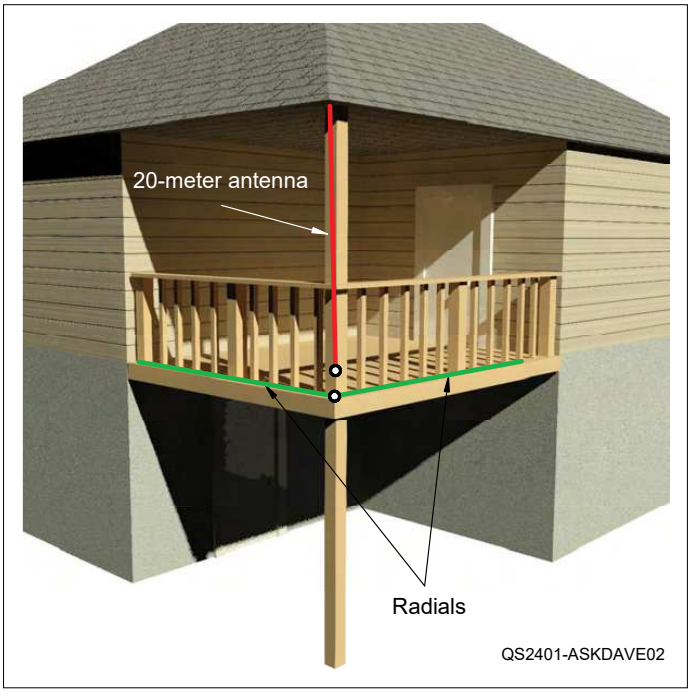


Figure 2 — Raised vertical antennas need at least two tuned radials (one quarter wavelength) for each band. If your raised antenna covers only one band, you can get by with two radials. As a compromise, these can be at 90 degrees to one another.

A ground-mounted quarter-wave vertical needs radials laid out on the ground around it. My ground-mounted multi-band vertical has about 30 untuned radials. If you elevate the vertical, it requires a minimum of two tuned quarter-wave elevated radials per band.

You can certainly try an aluminum square or even aluminum foil to serve as a suitable counterpoise, but I recommend real radials. A counterpoise is often defined as something for the antenna to work against, which is a vague definition, and hams have a variety of opinions as to what will work. Currents flow in radials in opposition to the flow in the antenna. Perhaps the best way to think of the radial system is as the other half of the vertical dipole.

The antenna with horizontal radials will have a feed-point impedance of about 30 Ω. This will result in a minimum standing wave ratio (SWR) of 1.5:1 or higher. This is not a problem because your rig's antenna tuner can tune that down to 1:1. Or you can bring the radials down a bit, so the ends are lower than the connection to the antenna. This will raise the impedance somewhat for a slightly better match. Note that an SWR of 1.5:1 is low enough to be fed by a transmitter without a tuner.

If you have trees behind your home, you can move the antenna there and stretch out as many radials as you want. Coax losses for RG-8X or LMR-240 are not large at HF.

Installing an Antenna on a Metal Roof

Q Zach Lamb, KQ4KYU, asks: Where on my roof should I install my antenna? I have a metal roof and my only options are about 5 feet away from the gable or 5 feet from the cable end. I have a Diamond X50A dual-band 2-meter/70-centimeter antenna with some LMR-400 coaxial cable. My house is about 20 feet tall, and the mast will be 20 feet plus the 5-foot antenna. I have a Yaesu FT-2980R.

A Either of the locations you are considering should work well. The choice of location will affect the antenna's pattern to a degree but should not stop you from being able to work any repeater you can hear.

Your choice of radio is a good one. Get on the air and have a two-way conversation to ensure everything is working. The LMR-400 cable is a good choice for 2 meters and will serve well when you get a radio that also works on 70 centimeters.

Send your questions to **askdave@arrl.org**. I answer some questions here, and some via videos on my YouTube channel (**www.youtube.com/davecasler**), or during my weekly livestream on Thursdays at 6:45 to 8:15 PM Mountain Time on my channel.

Hints & Hacks

A Traffic Cone for Winter Protection; A Homebrew Dummy Load for Power Supply Calibration

Winterizing Antennas with Traffic Cones

After living in Brooklyn, New York, for decades, I had gotten used to my 18 × 22-foot yard being useless for long wire antennas. As such, rooftop verticals were my go-to option.

I have since moved to Hubertus, Wisconsin, where I now have several acres of land to experiment with. My front yard was the perfect spot for a monoband 160-meter antenna, so I purchased a Cushcraft MA-160V and installed it on a pipe planted in the ground (see Figure 1). I cut the accompanying radial kit and placed it on top of the grass. I kept the radials there until I decided to trench the yard and install the wires underground. After retuning everything, I thought my work was done.

Snow is a given in Wisconsin. With the coaxial connections and radial plate barely 1 foot above the ground, I realized that heavy snowfall would bury those connections and potentially short them (see Figure 2). When I lived in Brooklyn, I simply wrapped the lower ends of my verticals with garbage bags until spring, but that technique was an eyesore.

After ruminating on how to protect the area in question, I had a moment of inspiration — a traffic cone! I went to a local home improvement store and paid $14 for a 28-inch cone. I then took down the upper portion of the antenna and positioned the cone over the lower connections (see Figure 3) before tightening the hose clamp on top to prevent seepage.

Figure 1 — The Cushcraft MA-160V antenna in my yard, before I buried the radials. [Robert W. Lobenstein, WA2AXZ/9, photo]

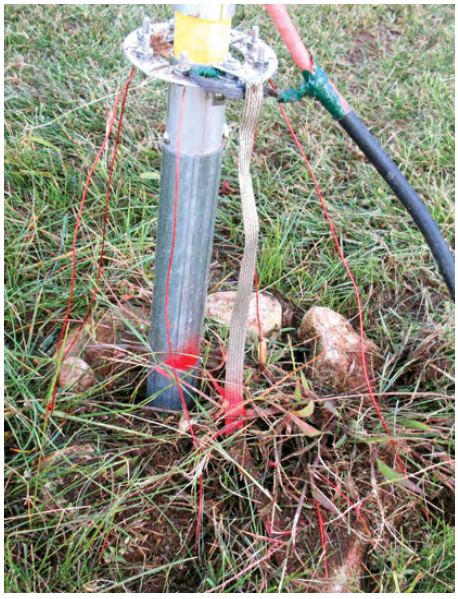


Figure 2 — The lower radial wire plate, along with the coaxial connections and ground rod cable. [Robert W. Lobenstein, WA2AXZ/9, photo]

Figure 3 — The traffic cone over the open connections on the lower part of the antenna. [Robert W. Lobenstein, WA2AXZ/9, photo]

Figure 4 — The traffic cone is now painted green and ready for winter. [Robert W. Lobenstein, WA2AXZ/9, photo]

So that I wouldn't have to endure the cone's gaudy orange color, my son-in-law, Michael Hanko, KD9FCB, suggested I paint it dark green to blend with the grass (see Figure 4). If you decide to use this type of protection, leaving the cone bright orange will not impede ham radio traffic, but it will at least deter vehicle traffic from your lawn. — *73, Robert W. Lobenstein, WA2AXZ/9,* **wa2axz@arrl.net**

Calibrating a 12 V Power Supply Ammeter

I own an Astron Corporation RS-50M linear power supply with a built-in voltmeter and an ammeter. I decided to calibrate the meters according to the instruction manual; the voltmeter posed no problems, but calibrating the ammeter required some extra thought.

The instructions said to calibrate the ammeter at full load. The RS-50M is rated at a 37 A continuous output at 13.8 V dc. This rating would require a dummy load with a resistance of 0.373 Ω and the capability of dissipating 511 W — at least for a short time. Various resistors in online catalogs convinced me that building such a dummy load would cost more than I wanted to spend, especially because I'd probably never have another use for it.

Another problem was measuring the actual current against some sort of reference standard. My digital multimeter does not handle more than 10 A, and I did not want to buy a new meter for this calibration. A small resistor capable of handling more current would have worked, but again, online catalog prices were not encouraging.

I found a solution by watching a YouTube video titled "100 AMP multimeter upgrade" by user Makin'Things (**www.youtube.com/watch?v=3FgKyRhIKSU&t=227s**). All I needed was the right length of a piece of wire. Fourteen-gauge copper wire has a resistance of 2.53 Ω per 1,000 feet, so a 0.01 Ω resistor can be made from 3.96 feet (1.2 meters) of common house wire. The same kind of house wire can be used to build a dummy load that can briefly handle enough power to calibrate the ammeter. Therefore, I needed at least 4 feet of 14-gauge wire.

I bought 50 feet of 14-gauge Romex® copper house wire from a home improvement store. I cut 40 centimeters (15¾ inches) from one end and temporarily wired the three conductors of both pieces in series. By connecting my digital multimeter to the short segment, I was able to directly read the current as 1/10 of the voltage in dc mV and adjust the ammeter's trimmer potentiometer to match (see Figure 5). When I finished, I had a lot of leftover wire for other household projects.

Figure 5 — I connected my digital multimeter to the short segment of dummy load wire and was able to read the current and calibrate the ammeter. [Steve Masticola, WX2S, photo]

The accuracy of this procedure is limited by how well the wire follows the standard resistance. And as the wire's temperature increases, its resistance will also increase. The dummy load became slightly warm within the short time that I applied current. So, keep the current on for as little as possible and allow the wire to cool if it heats too much. — *73, Steve Masticola, WX2S,* **wx2s@arrl.net**

"Hints and Hacks" items have not been tested by *QST* or ARRL unless otherwise stated. Although we can't guarantee that a given hint will work for your situation, we make every effort to screen out harmful information. Send technical questions directly to the hint's author.

QST invites you to share your hints with fellow hams. Send them to **hh@arrl.org**. Please include your name, call sign, complete mailing address, daytime telephone number, and email address on all correspondence. Whether you are praising or criticizing an item, please send the author(s) a copy of your comments.

Paul Wade, W1GHZ, w1ghz@arrl.org

Microwave Transverters

Perhaps you've heard about the fun challenge of microwaves, and maybe you've even used a borrowed rig to make some contacts. The most affordable next step is to get a transverter, which converts an existing transceiver, usually VHF or UHF, to a microwave band for transmitting and receiving. For instance, 144 to 148 MHz from a 2-meter transceiver translates to 1296 to 1300 MHz, with 144.1 MHz converting to the usual calling frequency of 1296.1 MHz.

Commercial transverters are available from multiple manufacturers, but you can homebrew your own from a kit, modules, or parts and a printed circuit (PC) board. Whichever you choose, you can start with a basic transverter and add capability later, if needed. Many hams like to build some of their equipment, and a homebrew transverter can be a good club project.

The Heart of the Transverter

A block diagram of a typical transverter is shown in Figure 1. The heart of a transverter is a frequency mixer and a local oscillator. To transmit, the mixer combines the signal frequency from the existing transceiver (called the "IF frequency") with the local oscillator (LO) frequency to produce the sum and difference of frequencies, one of which is the desired microwave frequency. The mixing operation takes place at milliwatt levels with some mixer loss, so the output power is less than 1 mW. For receiving, the mixer works in the other direction. The LO frequency is combined with microwave frequency (RF) to produce the sum and differences of frequencies. The difference at the IF frequency goes to the transverter, while the sum is a much higher frequency that the transceiver doesn't detect.

A good LO provides a clean, stable signal with low phase noise at a high enough power level to drive the mixer (typically +7 dBm or 5 mW). Traditionally, the LO source has been a crystal oscillator operating around 100 MHz followed by frequency multipliers to reach the desired frequency or the RF frequency minus the IF frequency for the transceiver. For example, 1296 – 144 = 1152 MHz or 10368 – 432 = 9936 MHz. Good crystals have become hard to find, so frequency synthesizers are more popular to generate LO signals directly, or sometimes followed by frequency multipliers for the higher bands.

The Importance of a Filter

After the mixer, a filter is needed to remove outputs or receive signals at undesired frequencies, some of which might be outside of the ham bands. This leaves the desired signals to be amplified to a higher transmit power or by a low-noise amplifier to increase receiver sensitivity. The filter must pass the desired RF frequency while blocking the LO frequency and the unwanted mixer products. At the lower microwave bands, a PC filter may be adequate. For the higher bands, a sharp filter is required, as the LO frequency is only 144 MHz away from the operating frequency. Many filters can do this, but pipe-cap filters made with common copper plumbing pipe caps are a simple and inexpensive solution for a homebrew. Using two caps separated by a monolithic microwave integrated

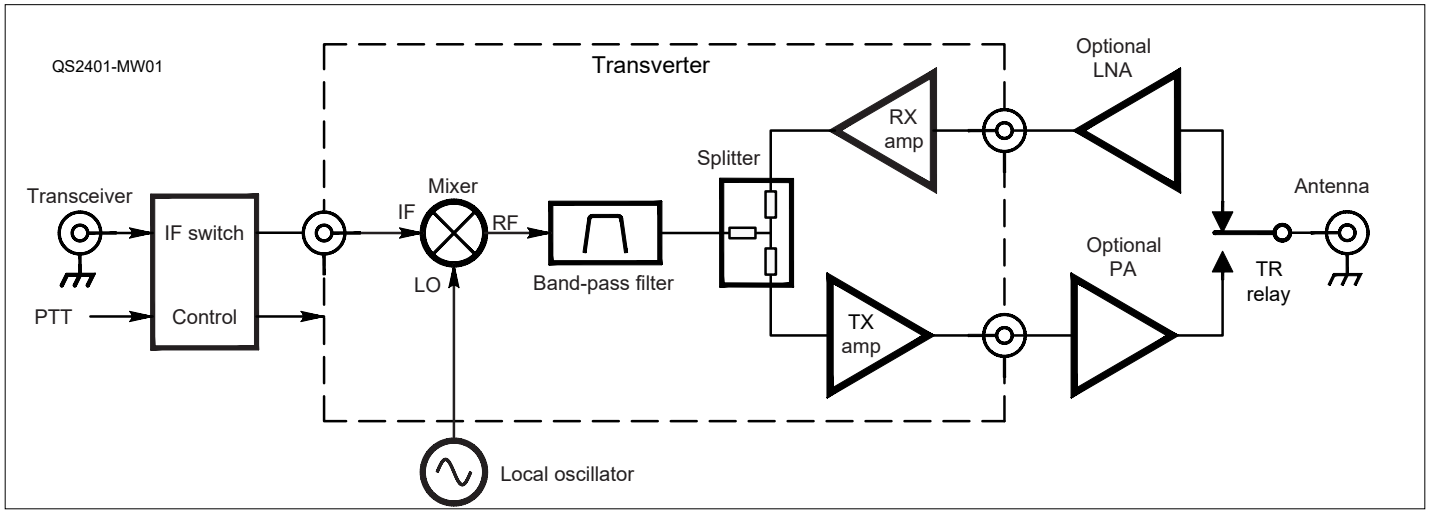


Figure 1 — A block diagram of a simple microwave transverter.

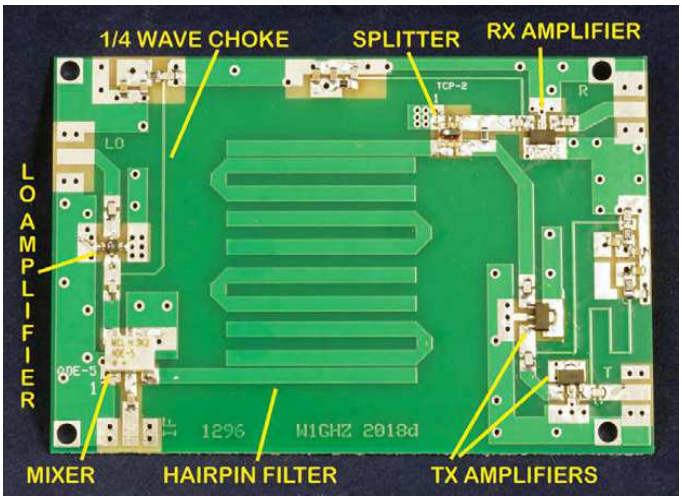


Figure 2 — A PC board transverter for 1296 MHz with a printed filter, so tuning is not required.

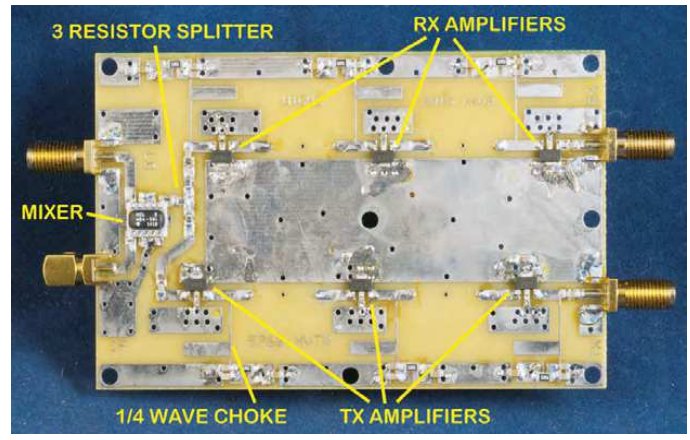


Figure 3 — A PC board transverter for 5760 MHz with separate pipe-cap filters and amplifiers for transmit and receive.

circuit (MMIC) amplifier provides good filter performance with low losses.

At very high microwave and millimeter-wave bands, where amplifiers are unavailable or unaffordable, the LO and mixer can be the whole transceiver operating at microwatt levels and rely on high antenna gain to make contacts over any distance. These bands are wide enough so that the undesired mixer products remain within the amateur allocation, so filtering is not essential.

For the 10 GHz band and below, amplifiers and mixers are readily available. Modules with RF connectors are available at moderate prices, while components are inexpensive. These are intended for surface-mount assembly on a PC board. I have designed PC boards for microwave transverters for bands up to 10 GHz (available at **www.w1ghz.org**). Other PC boards are available from multiple retailers. A few chip capacitors and resistors are needed to complete the assembly.

A typical transverter PC board for the lower microwave bands has only a single printed hairpin filter to save board real estate (see Figure 2), followed by a splitter to separate transmit and receive amplifiers (only one direction can be powered at a time, or the loop might become an oscillator). For the higher bands with a filter formed out of two pipe caps, the MMIC amplifier between them is not bidirectional, so it is easier to have separate transmit and receive filters with amplifiers (see Figure 3) than to elaborate switching. The amplifiers use printed ¼ λ lines as RF chokes for dc connections.

Available transverters do not include the antenna transmit/receive (TR) switch. This allows for the flexibility to add a transmit power amplifier or a receive low-noise amplifier to enhance performance. The enhancements are not essential, and many microwave contacts have been made with a basic transverter. The TR switch can be an inexpensive RF relay for wireless networks, a solid-state switch, or a specialized coaxial or waveguide switch for higher power levels.

Finally, some control circuitry is required to switch to and from receive and transmit and to control the voltages and the TR switch. The TR switch must operate before RF is applied. Otherwise, the switch or amplifier may be damaged. A sequencer circuit takes care of this.

Most transceivers used for microwave IF have several watts of transmit power, which must be reduced to less than 1 mW at the mixer. Zach Lau, W1VT (then KH6CP), described a solution in his article "A VHF/UHF/Microwave Transverter IF Switch" in the August 1988 issue of *QEX*. This switch has an attenuator in two sections. The first attenuates in both transmit and receive directions, and the second is switchable out of the transmit line on receive. The receiving line uses an MMIC amplifier to add slightly more gain than the loss of the first attenuator stage. I have used this technique in several sequencers to make them more user-friendly. Recent versions use Arduino software to make them as flexible and programmable as needed.

You can get started in microwaves with a transverter for a single band to make some contacts and then add enhancements and additional bands, as desired, to have more fun. Or you might decide that a new radio is in your future. The new Icom IC-905 transceiver is an alternative, as it includes most of the microwave bands. This rig is a quick way to get started, but a rather expensive commitment.

Technical Correspondence

Calibrating VFOs with WWV; A Feed-Line Spacer Construction Alternative

VFO Calibration Made Easier

Modern transceivers, especially the software-defined variety, have highly accurate frequency displays. However, many amateurs use older rigs in which variable frequency oscillator (VFO) display accuracy can differ. If you use an older rig, you may be able to obtain a service manual that details the calibration process, but you'll also need precise audio and RF frequency generators. I suggest an alternative to buying such expensive test gear.

My method is based on a free multi-mode sound card application known as *fldigi*. For both the audio and radio frequency standards, you can use signals from National Institute of Standards and Technology station WWV at 5, 10, 15, or 20 MHz.

Calibrate Your Sound Card

After installing and configuring *fldigi*, switch your radio to AM mode and tune to a WWV frequency of your choice. Listen for the beeping audio signals or voice announcements. You will hear the 1-second interval tones at an audio pitch of either 500 or 600 Hz (the pitch alternates each minute). Open *fldigi* and set the **OP MODE** in the menu to **FREQ ANALYSIS**.

Click on the ticking tones in your waterfall at either 500 or 600 Hz. Frequency analysis mode will measure the pitch at an accuracy of 0.01 Hz, which is far better than what you will need. It takes a few seconds for *fldigi* to settle on your sound card's reading (see Figure 1).

The sound card in your computer — or contained within an external sound device — will show a sound card correction of only a few parts per million. Adjust the sound card sample rate correction in *fldigi* until you see a 500 or 600 Hz reading on your *fldigi* frequency analysis display.

Calibrate Your Radio's VFO Dial Accuracy in USB Mode

Switch your radio to upper sideband (USB) mode, but do not touch the VFO dial. You should still hear the ticks from WWV at nearly the same audio pitch as when you were in AM mode — that is, at 500 or 600 Hz. If the radio's master oscillator VFO and the radio's beat frequency oscillator are well calibrated, the pitch you hear (the beeping tones) will be identical in both the AM and USB modes. However, there is often a slight change in pitch when switching from AM to single sideband (see Figure 2).

Let's say you hear and see the 600 Hz WWV tones at 610 Hz on the *fldigi* waterfall; this means that you have a

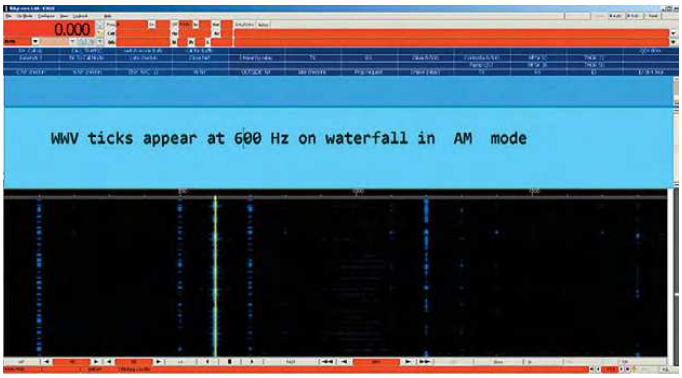


Figure 1 — Calibrating the sound card with a known 600 Hz audio tone from WWV.

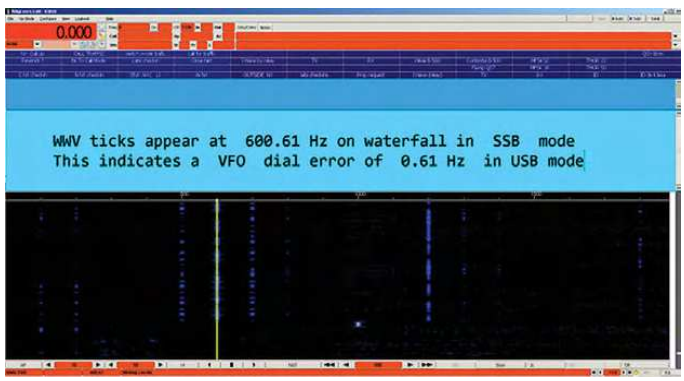


Figure 2 — Checking the variable frequency oscillator (VFO) dial while the radio is in upper sideband (USB) mode.

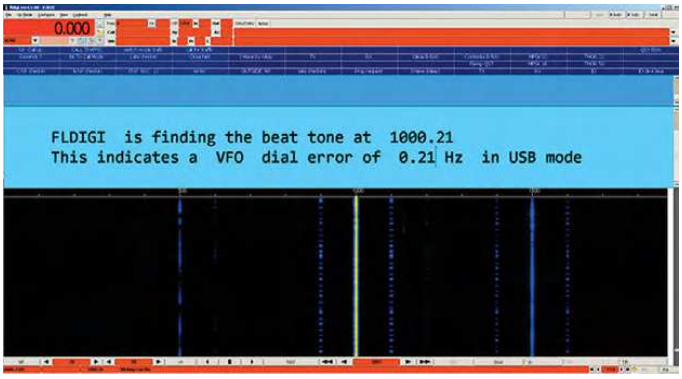


Figure 3 — In this example, the VFO is tuned to 9.999 MHz while the user is listening to WWV at 10.000 MHz in USB mode. The difference is less than 1.0 Hz, which is hardly worth correcting.

VFO dial error of +10 Hz. The next step is to adjust the VFO dial (this may be a mechanical adjustment in some radios) until the tone you see on the waterfall is back to 600 Hz. If your radio's VFO dial is correctly set, when you switch your radio from AM to USB, the 600 Hz tone should remain at the same pitch.

Another Method to Determine VFO Dial Accuracy

Keep your transceiver set to USB, but retune the VFO to 1 kHz *below* the WWV carrier frequency. For example, if you are listening to WWV on 10000 kHz, retune your VFO dial to 9999 kHz. In USB mode, you will see a constant audio tone of about 1000 Hz on your waterfall (the difference, or *beat* frequency). You may still hear the ticking sounds at 2000 Hz, but you can ignore those for now.

Use *fldigi* to determine that the constant tone's audio frequency is close to 1000 Hz by using frequency analysis mode. This will tell you how far your radio's VFO dial calibration is from the WWV carrier frequency. Note this number, which is the RF calibration check on your radio's VFO, only while in USB mode (see Figure 3).

For stations that cannot copy WWV, try Canada's National Research Council station, CHU, at 3.330 or 7.850 MHz. It transmits an AM signal as well, but the audio beeps are at 1000 Hz. The process to calibrate your radio's VFO dial reading will otherwise be the same as with WWV. — *Barry Feierman, K3EUI,* **k3euibarry@gmail.com**

A Different Approach to Feed-Line Spacers

In the June 2023 issue of *QST*, the article by Mark Volstad, AI4BJ, "Build a Portable 80- through 10-Meter Doublet," features an antenna that relies on a 600 Ω homebrew feed line that is constructed using 6-inch plastic spacers. The wires pass through the spacers and are held in place with epoxy.

While this technique allows easy assembly, there is a more durable alternative (see Figure 4). Rather than passing the wires through the spacers, notch the ends and drill holes close to those notches. Secure the feed-line wires in the notches with short wire ties that loop through the holes. This approach makes it easy to replace any damaged spacers. — *Dennis Murphy, KØGRM*

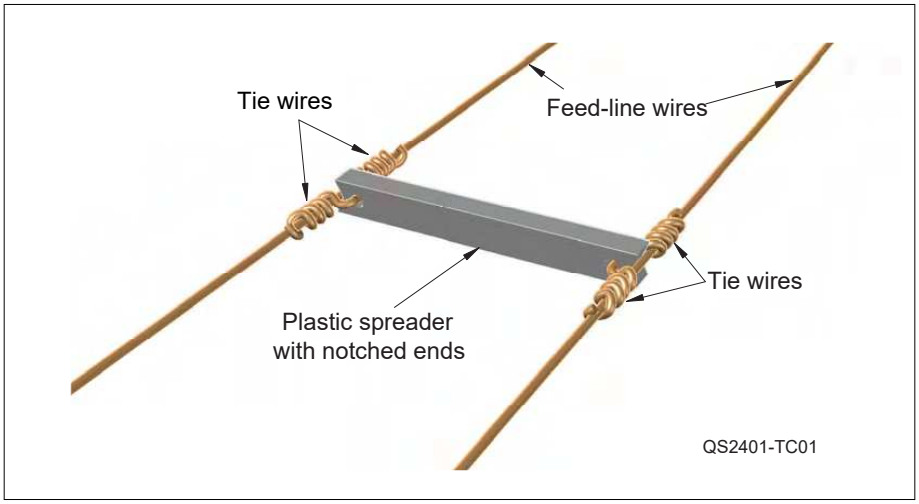


Figure 4 — An alternative approach to using plastic spacers for a 600 Ω feed line is to notch the ends of the spacers and drill holes near the notches. The feed-line wire is supported by the notches, while short wire ties are threaded through the holes and around the feed line to hold it in place.

Technical Correspondence items have not been tested by *QST* or ARRL unless otherwise stated. Although we can't guarantee that a given idea will work for your situation, we make every effort to screen out harmful information.

Materials for this column may be sent to **tc@arrl.org**. Please include your name, call sign, complete mailing address, daytime telephone number, and email address on all correspondence. Whether you are praising or criticizing a work, please send the author(s) a copy of your comments. The publishers of *QST* assume no responsibility for statements made herein by correspondents.

VHF Roving:
For Those Who Like to Wander

This slower-paced form of contesting makes you the center of attention — and it even gets you out of the house.

Andrea Slack, K2EZ

VHF contesting, which includes the VHF, UHF, and microwave bands, is the lesser-known cousin to HF contesting. The shorter propagation distances make for a very different contesting experience. Most of these contests have a rover entry category. A rover is a station that operates from more than one Maidenhead grid square. VHF contests use Maidenhead grid squares as multipliers, so in the hunt for contacts and multipliers, rovers are front and center due to their mobility.

One of the fun parts about roving is that every time a rover enters a new grid, they are fresh and can work any station again. This means you can always avoid getting stale by simply moving to a new grid.

Moving to a new grid is especially nice on VHF, as fixed stations have only so many other fixed stations they can reach. Deeper into the contest, the fixed stations have already worked most of the other fixed stations within reach. This is when they turn their attention to rovers because they can work a rover every time it moves.

Chris Knox, KI1P/R, set up on Mount Washington in New Hampshire.

Most VHF stations operate these contests using SSB, CW, and digital modes like FT8. The FM and digital voice radios that are much more common on VHF cannot detect these signals. As a result, many people are unaware that a VHF contest is taking place.

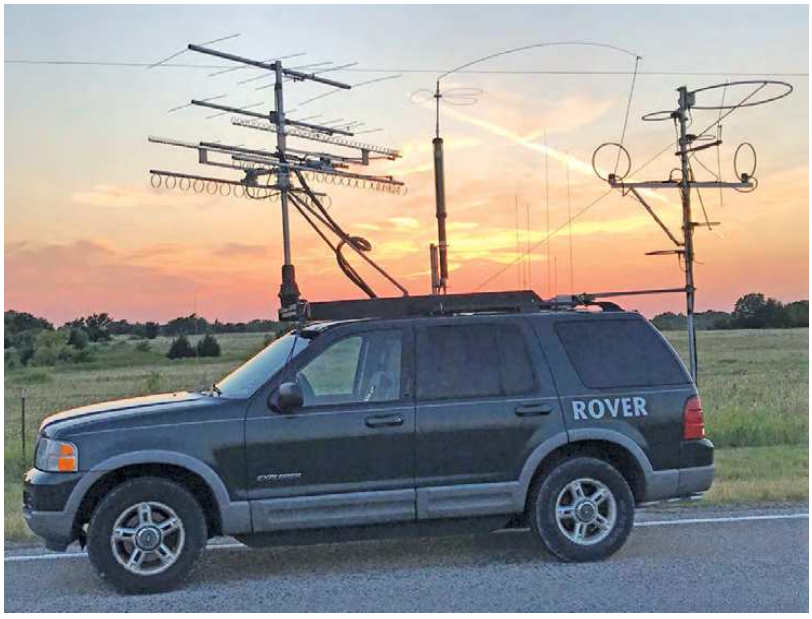
SSB, CW, and digital modes are favored in these contests because they can be copied at weaker levels, and allow contacts at significantly longer distances than those used to using FM might expect. By convention, horizontal polarization is used for these modes due to lower path losses and noise. FM simplex can be used, so don't forget a vertically polarized antenna if you go roving. There is even an FM-only category for fixed stations, but for rovers, having only FM will be a significant handicap.

Where to Start

To get into roving, a good place to start is with a multi-mode VHF-capable rig. There are several "shack in a box" rigs with HF/VHF/UHF that will cover three of the contest bands. There are also dedicated multi-mode VHF and UHF rigs. A simple roving setup may involve going to a few hilltops and deploying equipment from the back of a car. Or you can mount everything to the roof of your car and become a road warrior covering a dozen or more grids.

Plan some type of horizontal polarized antenna. A beam is great, but even horizontal omnidirectional loops can work well. For several years, I successfully ran only omnidirectional loops. I sacrificed distance and relied on fixed stations to do the heavy lifting, but I made up

for radio distance limitations with my mobility and driving greater distances. Beams can add complexity due to the need to rotate them, but you can rotate them by hand or fix-mount the beams to your car and turn the car.



Andrea's, K2EZ/R, eight-band rover from 50 MHz to 3.4 GHz after 7 years of improvements.

Ways to Operate

There are a few operating strategies that rovers may employ. Many involve the trade-off between operating from the best locations and using mobility to achieve geographic diversity. For example, if it takes an hour of driving on local roads and going way up a dirt road to a hilltop, it might be better to stop at a scenic overlook a few miles down the road that is not the best location, but will be good enough. Those 2 hours out and back versus the shorter distance to the scenic overlook can translate to 120 miles down the road, and with VHF, a 120-mile change in geographical location is significant. In that distance, you can activate a couple of grids and earn additional multipliers. It also means being able to copy new stations that were too far away to hear before. On the other hand, maybe you want to be a more relaxed rover and enjoy the views from the highest hilltops.

Other strategies involve picking locations near grid corners to allow operating from multiple grids without traveling far. Alternatively, you can sit on a grid line and hop back and forth across the line to work a station from two grids in quick succession. There is no limit to how much time you must stay in one grid. Rovers can also coordinate with other rovers to work combinations around a grid line or grid corner.

As for roving opportunities, ARRL hosts the three largest VHF contests every year. These take place in January, June, and September, and each one is a bit different. The January VHF Contest tends to be a grind where propagation is often challenging. The June VHF Contest is often characterized by 6-meter E skip and warm temperatures conducive to tropospheric enhancement, which helps higher frequencies. The September VHF Contest is in between these extremes.

The key to a successful rove is letting stations know you are out there. The best advice I can offer to new rovers is to reach out to other stations, especially rovers, in your area. Look at the VHF contest results and see who the rovers and the top fixed stations in your area are. Search for them on **www.qrz.com**, and if they have an email address listed, reach out to them. Operating practices vary by region, and these experienced stations will know what those practices are.

All photos by the author.

Andrea Slack, K2EZ, has been a ham radio operator since 1980 and works as an electrical engineer. Her latest passion — VHF, UHF, and microwave contesting and roving — began during a road trip in 2015 when she thought it would help to pass the time. Since then, Andrea has built a mobile contest station that covers 80 meters through 3 centimeters. She has won the limited and classic rover categories nationally. Andrea can be reached at **andrea_slack@yahoo.com**.

For updates to this article, see the *QST* Feedback page at www.arrl.org/feedback.

How to Become a POTA Hunter

With a focus on hunters, WJ1B describes the accessibility, rules, and perks of this popular ham radio program. A version of this article is featured in *The Parks on the Air® Book*, a new ARRL publication featuring expertise from 14 Parks on the Air (POTA) operators.

Harold Kramer, WJ1B

POTA is quickly becoming one of the best-known amateur operating programs. While not affiliated with ARRL, POTA is an outgrowth of ARRL's National Parks on the Air, which launched in 2016. POTA's success is partially due to how easy it is for any ham to participate. Within this program, there are two types of stations: *activators* and *hunters*. According to the POTA website (see **www.parksontheair.com**), "an activator is a licensed amateur radio operator in a park on POTA's designated list [who] contacts other licensed amateurs," and "a hunter is any other licensed amateur radio operator who contacts an activator at a park."

To participate from your station, the basic requirement is to work activators in the parks listed on the POTA website; a map of eligible parks is provided at **http://pota.app/#/map**. Each park is labeled with a unique reference code consisting of a letter and four or five digits. All US parks begin with the letter K. For example, Sleeping Giant State Park in Hamden, Connecticut, is designated K-1717.

There are no restrictions on bands, power levels, time of day, or modes when making POTA contacts. To be a POTA hunter, you simply need an operable station. While most POTA activity takes place on the HF bands, local VHF and UHF POTA stations often participate as well. Activators are mostly located in US parks, but parks in other countries continue to be added to the program.

POTA operators are urged to follow the DX Code of Conduct. While some activations create sizable pile-ups, operations are usually well controlled, as they tend to be less competitive than those in rare DX entities. An important distinction is that hunters do not need to submit any logs. Only activators submit logs to POTA.

Bands and Modes

Any amateur band can be used for POTA contacts, but most activators are on 20 meters because portable 20-meter antennas can easily be erected in a park or vehicle. The 20-meter band tends to have good propagation during the day, though 40 meters is also heavily used during the day or night. With better propagation as of late, there are more POTA stations on the HF bands and the 6-meter band. Most activators operate in the General-class portion of the amateur bands to attract more hunters.

An example of a Parks on the Air (POTA) Bronze Certificate. POTA hunters can earn various awards by contacting park activators.

POTA stations are permitted to use all modes, but most activations use single sideband (SSB) or CW. FT8 and FT4 usage continues to increase because these modes support low-power operating, which is helpful for activators who are running their stations on low power and compromised antennas.

Locating Activators

The best way for hunters to locate activators is by consulting the POTA website. To qualify for POTA awards and take full advantage of the program's features, hunters must be registered on the website.

Activators can help hunters by uploading information about their upcoming activations to the POTA website. While it looks similar to conventional DX spotting networks, the POTA spotting network lets hunters control the presentation of spotted stations. Activator searches can be filtered by band, mode, frequency, time, park, and other sorting terms.

Working Activators

Working a POTA activator is like working a DX or contest station, but in a less hectic operating environment. However, it still requires patience, good listening skills, and persistence. By using the POTA spotting network, you will know the activator's call sign and operating frequency in advance. Once you locate an activated park, the next step is to determine the activator's operating style. Calls are generally made on or close to the activator's frequency. There are no split operations in POTA, and FT8 and FT4 operations are usually conducted in their standard modes.

To initiate a POTA contact, say or send your call sign after the activator calls CQ, asks for your call sign, or ends their previous contact, depending on their individual operating technique. There is no need to send the activator's call sign. Don't assume that your signal is not getting through if the activator doesn't answer right away; they may be calling you back, but you may not hear them because activators use less RF power and less-efficient antennas. Signals may also fade as band conditions change. Don't hesitate to call a weak station, as they may be hearing you better than you're hearing them!

In some instances, you may need to call again because parks can be distracting environments for activators. Weather conditions change, curious park visitors ask questions, and park staff stop by to check in with the activator. Activators sometimes pause for a short time to change their batteries or make other adjustments, so keep listening and calling.

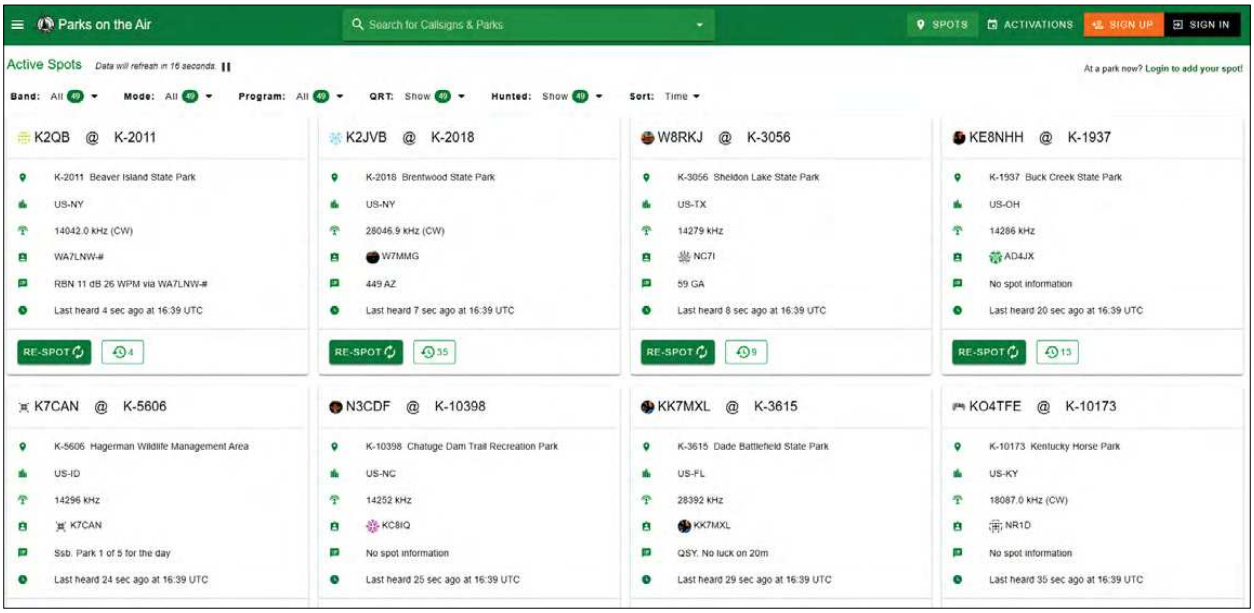
Once the activator acknowledges your call, your exchange should be an accurate signal report and your state or DX location. You can also thank the activator for putting the park on the air. Overall, ragchewing is not commonplace during POTA contacts, but if the activator is not busy, there may be some other information exchanged about the park or the activator's station. Hunters get credit for working a park only once on a given band on any given day. Keep track of your contacts to make sure you are not working a dupe.

If you are on SSB, use standard phonetics. Ensure that you copy the activator's call sign and not the call sign of another hunter. On CW, POTA contacts are sent at 13 – 22 WPM at most. It's best practice to match your CW speed to that of the activator, or to go slightly slower, as their park may be a difficult receiving environment. States are sent as their two-letter abbreviation — for example, "CT" on CW or "Charlie Tango" on SSB if you are operating from Connecticut.

Activators earn special awards for working another park, which is known as a *park-to-park* contact. You may hear stations calling "park to park" on the airwaves. These contacts can be difficult to complete, and it is discourteous to transmit when one park is trying to work another park. After completing a POTA contact, spot or re-spot the activator on the POTA website to show other hunters that the park is still being activated.

Logging

Hunters do not need to submit logs to confirm contacts; the activator alone is responsible for submitting logs directly to the POTA website. You can view your



A screenshot of the Active Spots web page on the POTA website (**https://pota.app/#/**). This is how hunters can locate activators.

contacts that have been submitted by activators at **https://pota.app/#/user/logbook**.

Though it is not required, each hunter should keep a personal log of his or her POTA contacts because questions can arise about specific contact information. Extra confirmation is sometimes needed for non-POTA operating awards like Worked all States, CQ WPX, or the County Hunter awards. For the same reasons, both hunters and activators typically submit their logs to their preferred online QSL services, such as Logbook of The World or QRZ.

Awards for Hunters

POTA offers a variety of awards for many types of on-air activity. The top hunters have worked and confirmed more than 8,000 parks and 25,000 contacts, but hunters can earn an award after confirming only 10 parks, or for confirming five unique DX stations. Hunters can qualify for these awards using any combination of modes or bands.

There are additional awards for hunters and activators who make park contacts at specific times. Early Shift and Late Shift awards are given to those who make early-morning or late-evening contacts. Because the sun rises and sets at different times depending on a station's location, the exact times during which you can earn these awards vary. Said times for each park are listed on the POTA website's Shifts Map (click the links in the Early Shift/Late Shift Awards section at **www.parksontheair.com/pota-awards/#advanced-awards**) and on the POTA park map (**http://pota.app/#/map**).

There is no need to apply for a POTA operating award. Once you are registered on the website, awards are automatically tracked and granted. If a hunter achieves an award, the website displays a professionally designed, personalized PDF certificate that they can download and print. The website has extensive award tracking information, so hunters can easily monitor their progress.

POTA also sponsors operating events throughout the year, such as New Year's Week and the annual Plaque Events. One of my favorites is Support Your Parks, which occurs during the third full weekend of each January, April, July, and October. Such events are designed to get more activators in the parks and encourage more hunters to work them.

There are many online materials about the POTA program for those who are interested in learning more.

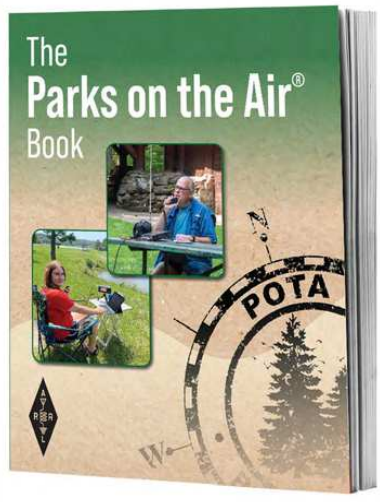
In the digital edition of *QST* (**www.arrl.org/qst**), the author, Harold Kramer, WJ1B, takes you inside the mind of a successful POTA hunter. Hear his tips and see them in action as he works a POTA activation from the ARRL Radio Laboratory, W1HQ.

Thanks to Dave Tipping, NZ1J; Shawn Warren, KC1NQE; Eric Olsson, KB1JL, and Bart Toftness, N1BRL, for sharing their knowledge about POTA with me as I wrote this article. A version of this piece is included in *The Parks on the Air® Book*, available at **www.arrl.org/shop**.

Harold Kramer, WJ1B, was first licensed in 1962 as KN1ZCK. He was the Publisher of *QST* and Chief Operating Officer of ARRL from 2005 until his retirement in 2016. He began his career in the emergent cable television business in 1973 and remained in that field until 2000, when he became Chief Technology Officer of Connecticut Public Broadcasting. He holds degrees from the University of Connecticut and the University of Hartford. Harold can be reached at **wj1b@arrl.net**.

For updates to this article, see the *QST* Feedback page at www.arrl.org/feedback.

For more information on how to become an effective POTA hunter, check out *The Parks on the Air® Book*, published by ARRL. It shares the experiences of various operators who activate park units, and it provides advice on how to work a POTA activator from the comfort of your home station.



The Parks on the Air® Book is available from the ARRL online store (**www.arrl.org/shop**) and ARRL dealers.

My CW Academy Journey

How a ham with dyslexia achieved his goals with the help of a series of CW courses.

Gerard van de Graaf, PA2G

In October 2019, I started taking an in-person CW course, but the weekly visits to the clubhouse for training stopped due to COVID-19. It was still possible to follow the training on the Rotterdam, Netherlands repeater on Monday evenings, and later with a software-defined radio. Still, I did not find such solutions adequate. Initially, I kept track of my practice, but it fell off compared to my time at the club. I am dyslexic, and in that CW course, I struggled to translate what I heard into readable characters in my head and even more so on paper. However, one of my rules is not to give up.

During the summer of 2020, I read an article about the CWops organization (**https://cwops.org**), and I found it fascinating. At the end of August 2020, I contacted Joe Fischer, AA8TA, who was the CWops Advisor and Manager at the time. Joe coordinated and scheduled the advisors in consultation with the courses. Within 24 hours, I was admitted to the CW Academy course that started a week later. The same day, I received a pleasant and interesting email from my CW Academy Advisor, Duncan Fisken, G3WZD, from which an amicable correspondence flowed. None of my questions went unanswered.

Starting Out

The CW Academy beginner course was held via Zoom. Course materials and other information were provided via email. A functioning computer, internet connection, and signal key were required to participate. We had to be willing to spend 60 minutes a day practicing via an online CWops Morse code trainer (**https://morsecode.world/international/trainer/trainer.html**). The training sessions didn't have to be in 1-hour blocks. They could be broken down into 30- or 10-minute blocks as long as we practiced daily.

The first lesson started at a fast pace. I was reassured that by the fifth session, the pace would no longer be a problem, which was true. The beginner course developed quickly, and by lesson 12 or 13, I was using the signal key. I looked forward to every class on Monday and Thursday nights and learned so much without even realizing it. Duncan was a very encouraging instructor.

Duncan suggested I participate in the weekly slow speed contest (SST) on Friday evenings, which were hosted by the K1USN Radio Club (**http://k1usn.com/sst.html**). During the SST, we made CW contacts with a speed of 12 to 20 WPM. It was a good first step toward strengthening my self-confidence with CW.

The beginner course lasted 2 months, which flew by. I passed and immediately registered for the fundamental course. I emailed another CW Academy Advisor at the time, Los Angeles Section Traffic Manager Kate Hutton, K6HTN, and Joe to ask if I could take the fundamental course with Duncan because he had read up on dyslexia and was a good motivator for me. Kate and Joe handled my request and allowed me to take the fundamental course with Duncan. In the meantime, I participated in the SST on Friday evenings, repeated the beginner classes at least 5 days a week, and used other Morse code learning tools — specifically Learn CW

Online (LCWO; **https://lcwo.net**) and Morse Code Ninja (**https://morsecode.ninja**) — to practice. LCWO allows you to practice, stay fluent, and improve your speed if you don't have a practice set at your disposal. Morse Code Ninja is another resource that allows you to practice numbers, call signs, and more. There are so many great resources on Morse Code Ninja that you will always find something different to practice or improve on.

The fundamental course began in January 2021. From the first day, the camaraderie within the class was great. We all got along very well and helped and supported each other. At the fourth lesson, another advisor, Theo Kindts, PA3HEN, was introduced to the course so Duncan could split the group in half and we could get more attention when carrying out our assignments. Everyone developed and improved because of the individual attention. In the end, we all passed and were encouraged to continue practicing.

During the intervening period between courses, I continued to increase my signaling speed and make sure the content was accurate, often using other CW training resources such as *RufzXP* (**www.rufzxp.net**) and QRQ (**http://fkurz.net/ham/qrq.html**). I worked very hard on this and received much-needed feedback from Theo and Duncan.

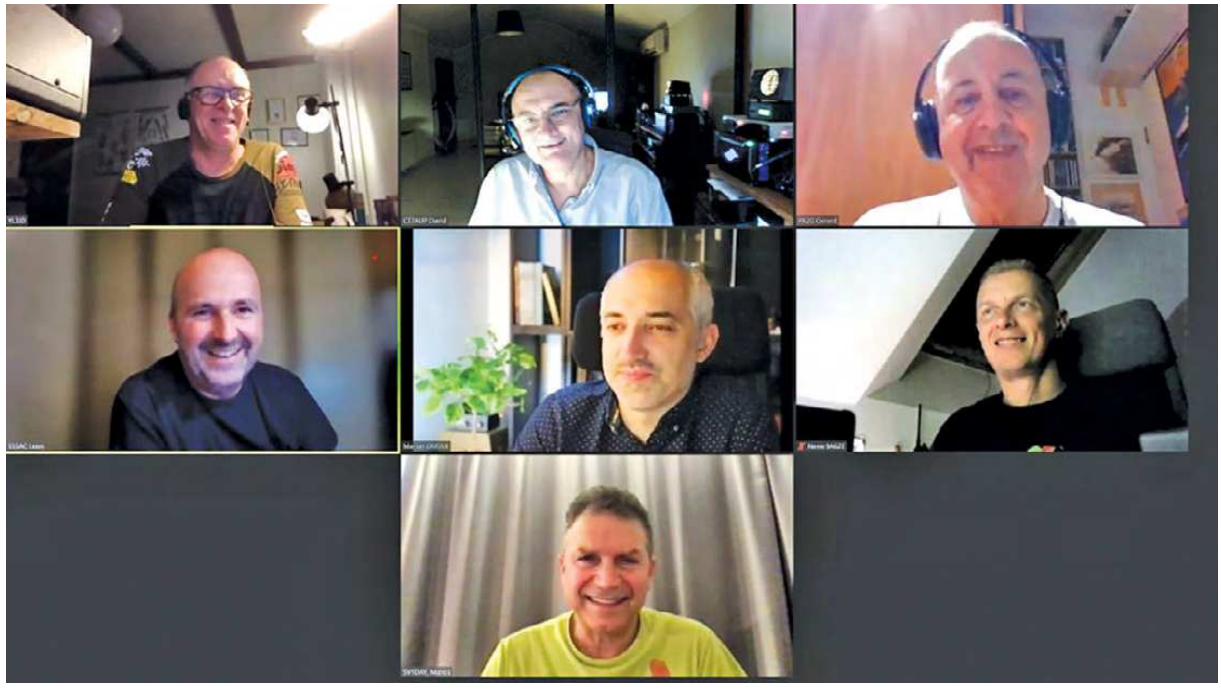
CW Academy: A Brief History

CWops began in December 2009, and in May 2011, Jay Temple, W5JQ; Rob Brownstein, K6RB, and Jack Ritter, WØUCE (SK), conceived the idea for CW Academy, which officially launched in August of that year. The first intermediate-level class included 47 students and 11 advisors. By the end of 2012, there were more than 200 students, and the following year, there were around 300. In April 2013, the beginner- and advanced-level courses were added. In May 2018, the fundamental-level course was added. CW Academy is free and supported by an all-volunteer organization.

As of November 2022, more than 10,000 students have registered for CW Academy, and of those, 85% have graduated. Currently, Bob Carter, WR7Q; Roland Smith, K7OJL, and Andrew Bunker, N7AST, manage and support CW Academy. — *Bob Carter, WR7Q*

Moving Up

In April 2021, the intermediate course began. This time, Hanz van de Pol, YL3JD, was the instructor. It soon became clear that Hanz was a passionate instructor who wanted to help everyone with CW and motivate them. Again, there was mutual respect and willingness to help each other within the group. We had a lot of fun learning from Hanz and other students about related radio hobby competitions and activities.



A CW Academy course via a video telecommunications conference. Pictured are (top, left to right) Hanz van de Pol, YL3JD; David Palma, CT7AUP; Gerad van de Graaf, PA2G; (middle, left to right) Leon Novak, S55AC; Marian Marencik, OM5MI; Neno Greblicki, 9A6ZE, and (bottom) Manos Chalaris, SV1DAY.

Although I initially had trouble with the head copy, Hanz was relentless about us repeating the exercises to form words and sentences and turning them into new sentences. Each student repeated this exercise with signals so that they would signal new sentences for the next student, who would then repeat the process. This was an effective learning method for the group. We continued to improve, created a readability signal strength tone report, and developed how to send our call signs and the time and date. It was a great experience.

Even after passing the intermediate course, we continued practicing with Hanz every week until the advanced course started. Most of us, including myself, went on summer vacation. However, we all managed to log in twice a week to practice. During the fundamental course, we started a WhatsApp group chat that we still used during the intermediate course to communicate daily. We were fully committed to practicing, with humor and fun mixed in, which is the key to success. A few group members became so skilled that they could become CW Academy instructors at some point.

We emailed Joe and Kate to see if we all could enroll in the advanced course together. Hanz led the course, and CW Academy was happy to honor our request. We were grateful for that. It's not often that I look forward to taking courses, but I was looking forward to the advanced course beginning at the end of August.

October 21, 2021, was our last lesson of the CW Academy advanced course, and the whole group of newfound friends completed this wonderful journey with flying colors. I never expected to achieve such a good pace with my dyslexia, sending 25 to 29 WPM. I must keep pushing myself out of my comfort zone. I still have a long way to go, but the CW fundamentals are there. I hope to meet more enthusiastic and driven CW amateurs from other countries.

Resources for Learning and Practicing Morse Code

Here are just a few of the online resources that can help you master Morse code.

www.morserino.info The Morserino is a full-featured device that you can build from a kit. Learn and practice Morse code on the built-in paddle, or connect an external paddle or straight key.

https://qsobot.online In conjunction with the Morserino, you can practice having real contacts with this website as the other end of the contact. It also has a number training game in which the site picks a number 1 – 100, and you have to guess it, based on clues of "higher" or "lower." You have to be very good with your keying, or the site will ask you to send again. Many find this a great way to work on their sending, without the pressure of talking with someone else.

https://morsecode.ninja Kurt Zoglmann, ADØWE, has made thousands of hours of practice sets at all speeds. You select the speed and the content, and the site redirects you to a YouTube video for the practice. Many CW enthusiasts will listen to the phrase, pause the video, send the phrase on their key, and then resume the video. This is a good way to practice sending and receiving at the same time.

https://hamradio.solutions/vband This is another great site. Multiple people who want to practice together can do it over the internet. Either use your computer keyboard as a straight key/paddle, or plug your key in with a USB adapter.

https://morse.mdp.im Mark Percival, KC4T, has made this interactive game and news headline website. It pulls news headlines and plays them at different speeds. He has also made some games to make practicing more enjoyable.

— Michael Fluegemann, KE8AQW

All photos courtesy of CW Academy.

Gerard van de Graaf, PA2G, is a rotating expert at Air Liquide and was a Marine Engineer. He has been a shortwave listener since 1990 and was first licensed in 1992. In addition to operating, Gerard enjoys spending his free time with his family and grandson, deep-sea diving, sailing, and touring by road bike. He can be reached at **bastiaan104@gmail.com**.

For updates to this article, see the *QST* Feedback page at www.arrl.org/feedback.

ARRL Hails FCC Action to Remove Symbol Rate Restrictions

On November 13, 2023, FCC commissioners unanimously voted to replace the baud rate limit on the amateur HF bands with a 2.8 kHz bandwidth limit; this decision will permit greater flexibility in data communications.

"The Federal Communications Commission [adopted new rules today] to incentivize innovation and experimentation in the amateur radio bands by removing outdated restrictions and providing licensees with the flexibility to use modern digital emissions," announced the FCC. "Specifically, we removed limitations on the symbol rate (also known as baud rate) — the rate at which the carrier waveform amplitude, frequency, and/or phase is varied to transmit information — applicable to data emissions in certain amateur bands," concluded the FCC Report and Order and Further Notice of Proposed Rulemaking (FNPRM), which can be read at **www.fcc.gov/document/fcc-amends-amateur-radio-rules-greater-flexibility**. "The amateur radio community can play a vital role in emergency response communications, but [it] is often unnecessarily hindered by the baud rate limitations in the rules," the report stated.

ARRL President Rick Roderick, K5UR, hailed the FCC's action to remove the symbol rate restrictions:

> This action will measurably facilitate the public service communications that amateurs step up to provide, especially at times of natural disasters and other emergencies, such as during the hurricane season. Digital technology continues to evolve, and removing the outmoded data restrictions restores the incentive for radio amateurs to continue to experiment and develop more spectrum-efficient protocols and methods, while the 2.8 kHz bandwidth limit will help protect the shared nature of our bands. [On behalf of all amateurs, we] thank Congresswoman [Debbie] Lesko (AZ-08) for her efforts to get these restrictions removed.

The FCC also proposed eliminating similar restrictions on other bands, where applicable. "We propose to remove the baud rate limitation in the [2200- and 630-meter bands]… and in the very-high frequency (VHF) bands and the ultra-high frequency (UHF) bands. Additionally, we seek comment on the appropriate bandwidth limitations for the 2200-meter band, the 630-meter band, and the VHF/UHF bands," they stated. ARRL has previously expressed support for eliminating the symbol rate limits in favor of bandwidth limits where they apply on the VHF and UHF bands, but it has also suggested that the bandwidth limits be reviewed in light of today's technology and tomorrow's possibilities. Similarly, when eliminating the baud limits on the 2200- and 630-meter bands, consideration should be given to what, if any, bandwidth limits are appropriate.

The new rules will become effective 30 days after being published in the *Federal Register*. The FCC will announce a period for public comment on the additional proposed changes after the FNPRM is published in the *Federal Register* as well. As of press time, no date has been set for publication.

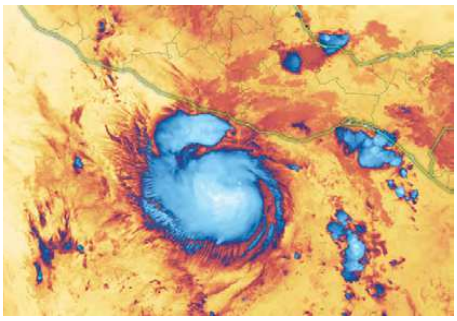
Amateur Radio Operators Provide Post-Hurricane Communications in Mexico

In the morning on October 25, 2023, 165 mile-per-hour winds from Hurricane Otis knocked out all communications and unleashed a nightmare scenario in Acapulco, Mexico. The area is home to roughly 800,000 people.

Hams had been providing communication services to and from the affected areas in and around Acapulco. Radio Club Querétaro member Ruben Navarrete Galvan, XE1EC, told ARRL that amateur radio operators were active with multiple operations, and they had been receiving citizen requests to obtain information on the whereabouts of their relatives.

"We keep an online database with these requests that we share with the different hams participating in the operation. Read-only access to this database is provided to the authorities who might need it, too. We also transmit this information to hams deployed in the Acapulco area via HF," Galvan said.

Additionally, hams in the Acapulco area were trying to locate civilians using their own resources. Some of these hams were operating their equipment on battery power, while



Before Hurricane Otis made landfall in Acapulco, Mexico, the Visible Infrared Imaging Radiometer Suite sensor on the NOAA-20 satellite captured this image of the hurricane at about 08:30 Universal Time on October 24, 2023. [NASA Earth Observatory photo]

others had access to generators. Accessing many areas in the region was a challenge due to the amount of debris blocking travel.

Amateur radio operators had also been receiving requests from Acapulco residents to call their relatives outside the affected area. Those requests were transmitted via HF to the Emergency Net Operator, and then the calls were made to the family members.

Galvan also reported that hams had been providing communication between state agencies and their field personnel deployed in the Acapulco area:

> At least three state agencies have hams on their teams. This is the case for the state of Durango, Morelos, and Santiago de Querétaro. We have been communicating their messages to their central coordination via HF relays. Requests for specific requirements have been escalated to the support teams. Air medical services have been directed to areas that were not being attended.

Hams also helped in other ways, including:

- Repairing a damaged repeater on Altzomoni at the Izta-Popo Zoquiapan National Park to support communication efforts in certain areas of Guerrero
- Deploying donations from a ham in Arizona, including a UHF repeater, solar panels, and 50 handhelds, to the affected area
- Getting the state agency's mobile stations back on the air and reinstalling the HF antennas that were damaged

International Amateur Radio Union Region 2 Emergency Communications Coordinator Carlos Alberto Santamaría González, CO2JC, said frequency protection was requested for the following bands and frequencies:

- 80-meter band: 3690 kHz
- 40-meter band: 7060 and 7095 kHz
- 20-meter band: 14.120 kHz

First 33-Centimeter Worked All States Certificate Awarded

On November 4, 2023, Al Ward's, W5LUA, 38-year quest to contact all 50 US states on the 33-centimeter band ended when he received the first-ever Worked All States (WAS) certificate for 902 – 928 MHz. Ward started collecting states on the band shortly after it opened to radio amateurs in 1985. He said:

> I am extremely grateful to Peter Van Horne, KA6U, for his Earth-Moon-Earth efforts. I was able to work Wisconsin for my last state [on] the 33-centimeter band on October 21. At the end of September, I [had] 32 states confirmed with cards and/or the Logbook of The World when Van Horne went on a 25-state expedition, providing my last 18 states.

In recent expeditions, Brian McCarthy, NX9O, and Jason Baack, N1AV, also provided several states for Ward.

Ward's station consists of a 5-meter dish powered by 400 W obtained from two 300 W Motorola amplifiers in parallel, as well as a dual-polarized patch feed.

Al Ward, W5LUA, holds his Worked All States (WAS) certificate in front of his 5-meter dish. [Al Ward, W5LUA, photo]

ARRL Radiosport and Regulatory Information Manager Bart Jahnke, W9JJ, was one of the first people to congratulate Ward on his accomplishment. He stated:

> It's my privilege to confirm the ARRL Awards Department has received your WAS application and Card Checker document, and we have issued the 33-centimeter (902 – 928 MHz) WAS number 1 to you in culmination of your 38-year quest to contact all 50 states on the 33-centimeter band.

Other stations close to earning their 33-centimeter WAS certificate include Wyatt Dirks, ACØRA; Roderick Blocksome, KØDAS, and Jason Baack.

The FCC initially allocated the band to Part 18 industrial, scientific, and medical (ISM) equipment. In that proceeding, the band was allocated to the Amateur Radio Service on a secondary basis, meaning amateurs could use the band if they accepted interference from primary users without also causing interference to said users.

ARRL Foundation Accepting Scholarship Applications

The ARRL Foundation is accepting applications for scholarships through January 10, 2024. The ARRL Foundation Scholarship Program supports eligible amateur radio operators pursuing higher education. It manages more than 100 scholarships — ranging from $500 to $25,000 — established by generous donors. Scholarships will be awarded for the academic year that will begin no earlier than June 2024 following the application deadline. The scholarships vary in eligibility requirements.

ARRL Director of Development Kevin Beal, K8EAL, said the scholarships pave the way for amateur radio being a hands-on pathway to science, technology, engineering, and mathematics careers:

> We are so thankful to donors who give to ARRL education programs because they are investing in the future of amateur radio. The ARRL Foundation Scholarship Program provides financial support at a critical time for students pursuing a college degree and keeps these young radio amateurs active in the hobby.

Additional information and a link to the application can be found at **www.arrl.org/scholarship-program**.

Section Manager Nomination Notice

To all ARRL members in Illinois, Indiana, Maine, Northern Florida, Oregon, Santa Clara Valley, Vermont, and Wisconsin. You are hereby solicited for nominating petitions pursuant to an election for Section Manager (SM). Incumbents are listed on page 16 of this issue.

To be valid, a petition must contain the signatures of five or more full ARRL members residing in the Sections concerned. It is advisable to have a few more than five signatures on each petition. A sample nomination form is available on the ARRL website at **www.arrl.org/section-terms-nomination-information**. Nominating petitions may be made by facsimile or electronic transmission of images, provided that upon request by the Field Services Manager, the original documents are received by the manager within 7 days of the request. It is acceptable to submit signatures that have been sent via email or mail under the following guidelines: The petition copies must be made from the original form supplied by ARRL or downloaded from the ARRL website. The form must be exactly the same on both sides (i.e., autobiographical information should appear exactly the same on all copies). All forms/copies must be submitted together.

Candidates may use any of the available electronic signature platforms such as DocuSign, Dropbox Sign, and Signed PDF. Candidates who use an electronic signature platform to be nominated, as described above, do not have to send original paper copies of the nominating documents. The packet that is sent to ARRL Headquarters must be complete. Multiple files or emails for a single petition will not be accepted.

We suggest the following format:

(Place and Date)

Field Services Manager, ARRL
225 Main St.
Newington, CT 06111

We, the undersigned full members of the _____ ARRL Section of the _____ Division, hereby nominate _____ as candidate for Section Manager of this Section for the next 2-year term of office.

(Signature _____ Call Sign _____ City _____ ZIP _____)

Any candidate for the office of Section Manager must be a resident of the Section, an amateur radio licensee of Technician class or higher, and a full member of ARRL for a continuous term of at least 2 years immediately preceding receipt of a nominating petition. Petitions must be received at Headquarters by 4:00 PM Eastern Time on March 8, 2024. If more than one member is nominated in a single Section, ballots will be mailed from Headquarters no later than April 1, 2024, to full members of record as of March 8, 2024, which is the closing date for nominations. Returns will be counted on May 21, 2024. Section Managers elected as a result of the above procedure will take office on July 1, 2024.

If only one valid petition is received from a Section, that nominee shall be declared elected without opposition for a 2-year term beginning July 1, 2024. If no petitions are received from a Section by the specified closing date, such Section will be resolicited in the July issue of *QST*. A Section Manager elected through the resolicitation will serve a term of 18 months. A Section Manager vacancy occurring between elections is filled through appointment by the Field Services Manager. — *Mike Walters, W8ZY, Field Services Manager*

SM NOMINATION RESOLICITATION:

Because no nomination petitions were received for the Kansas and New Mexico Section Manager elections by the nomination deadline of September 8, 2023, nominations are hereby resolicited. See above for details.

Steve Ford, WB8IMY, wb8imy@arrl.net

ORARI Supports Raimuna Nasional XII

In August 2023, the Indonesian Amateur Radio Organization (ORARI) carried out communications support activities at Raimuna Nasional XII, which was held at the Cibubur Camping and Tourism Grounds in Buperta, East Jakarta, Indonesia.

Raimuna Nasional is a Scout jamboree that attracts Scouts from all over Indonesia. The gathering takes place every 5 years with the aim of strengthening brotherhood and preserving culture through various Scouting activities.

Indonesian Amateur Radio Organization (ORARI) members (from left to right) Reyhan Hilmawansyah, YBØRWL; Fauzan Hakim, YDØBJB, and Muhamad Zainudin, YBØVYG, at Raimuna Nasional XII. [Reyhan Hilmawansyah, YBØRWL, photo]

ORARI volunteers established their central communication hub at the Jayakarta Media Center. ORARI support also included on-site repeaters and simplex links.

In addition to Indonesian participants, Raimuna Nasional was attended by Scout contingents from Malaysia, Timor-Leste, Brunei, Thailand, Japan, and India.

Our thanks to Reyhan Hilmawansyah, YBØRWL, for his contributions to this report.

Austrian Amateurs Join Emergency Exercises

Each year, Austria conducts regularly scheduled civil defense exercises throughout the country. Networks of sirens blare their warnings at designated times as part of the exercises. To help test the effectiveness of the sirens, Austrian amateurs relay signal reports concerning audio quality and volume at various locations.

In addition to sirens, the Austrian Broadcasting Corporation (ORF) transmits emergency alerts via FM broadcast stations. Even shortwave broadcasts play a crucial role, and in 2023, amateurs were asked to assist in these tests. Hams throughout Austria monitored transmissions from the ORF station in Moosbrunn on 6155 kHz on October 7, 2023. Signal reports were subsequently relayed via VHF and UHF links to OE1XKS/1, the central coordinating station in Vienna. Operators at OE1XKS uploaded the information to a website for analysis.

According to Vienna Emergency Communications Manager Martin Wytek, OE1MVA, the shortwave monitoring exercise was successful, and reports flooded in from many areas of the country.

Radio Club de Chile at the 42nd Meeting of the Permanent Consultative Committee II

Representatives of the Radio Club de Chile attended the 42nd meeting of the Permanent Consultative Committee II of the Inter-American Telecommunication Commission (CITEL), a dependent body of the Organization of American States. The meeting was held in Ottawa, Canada, on August 28 – September 1. CITEL is currently made up of 35 member-states and more than 100 institutions, organizations, and companies related to the telecommunications industry. Radio amateurs are represented in CITEL through the International Amateur Radio Union (IARU).

According to Radio Club de Chile Director José Tijoux, CE3BCO, their lobbying efforts for the Ottawa conference were focused on persuading the Chilean telecommunications regulator, Subsecretaría de Telecomunicaciones, to oppose changes to the 10 GHz amateur privileges. This effort was successful.

However, Tijoux reported that two Inter-American Proposals concerning space communication pose threats to amateur use of 440 MHz, 2.4 GHz, and 5 GHz. He stated that while the entire IARU Region 2 team attempted to negotiate this issue with NASA, they were unsuccessful. This proposal was scheduled for presentation during the International Telecommunication Union World Radiocommunication Conference 2023.

Rick Palm, K1CE, k1ce@arrl.net

Public Service

Hurricane Idalia: Lessons from a Disaster Area

As a longtime Florida resident, I've seen the projected tracks of hurricanes pointing to our state countless times. Some have been projected to hit our community, but have always seemed to track away without much more than some rain and minor winds; I became inured to the possibility of real personal danger. That perspective changed dramatically in September with Hurricane Idalia, which hit the Big Bend of Florida as a category 4 hurricane, then barreled over to rural Columbia County in northern Florida as a category 3 storm, packing winds of 110 – 130 mph.

Damage to Rick Palm's, K1CE, truck during Hurricane Idalia. Failure to evacuate meant that he never made it to his ARES assignment at one of the town's shelters and had to check in to the HWN via battery power to file a report on conditions. [Rick Palm, K1CE, photo]

I never made it to my Amateur Radio Emergency Service® (ARES®) assignment at a town shelter; instead, I hunkered down at home with my wife and five dogs. We watched as a huge tree snapped and crushed our two vehicles; we then realized we were directly in harm's way.

During a lull, and for the first time in more than 40 years of professional and amateur association with WX4NHC at the National Hurricane Center and the venerable Hurricane Watch Net (HWN), I found myself checking in to the net (on battery power) and filing a report on conditions. Thank you, net and station operators, for being there for us. I found that I had violated many standard, well-accepted recommendations due to stress.

Where I Went Wrong

First and foremost, we failed to evacuate to the town shelter, which is a scant mile or so away and is hardened against such storms. That decision put us in life-threatening danger, and I had possibly let my ARES team and the shelter residents down.

In the face of danger, psychological stressors and the primordial survival instinct cause a kind of tunnel vision — judgment and the ability to assess a situation more broadly and realistically are undermined. Denial is also a powerful defense mechanism that works against leaving home and hearth in any circumstance — no one believes it can actually happen to them. And, after years of recommending personal, family, and emergency communication plans, we had virtually none.

Upon checking into the HWN (14.325 MHz), the net control station asked for my report of conditions on the ground and my measured meteorological data, but I regrettably had no weather instruments to provide that data. I will be procuring and installing a set of instruments to provide what could be critical information in future incidents. (There are numerous home systems available from $100 and up that could be bolted to a roof or antenna mast or tower.)

On the positive side, my station is installed in a heavy steel 10 × 20-foot shipping container that has survived hurricane-force winds and airborne projectiles, such as trees, branches, and even lawn furniture (read "Shipping Containers for Sheltering Stations and Operators at Deployment Sites" in the September 2020 "Public

Service" column for more information on my shipping container station). I also had ample 12 to 13 V battery power and a generator fully gassed up and ready to go. Those assets enabled me to check into the HWN and provide a report for WX4NHC. I was also able to maintain communication with Columbia County ARES Emergency Coordinator (EC) Brad Swartz, N5CBP.

Columbia County ARES Response

Columbia County is a large, sparsely populated, rural county in north Florida, and it was in Idalia's path. My colleagues in the county's vital ARES group were busy. EC Swartz was the lead at the county Emergency Operations Center (EOC), where Florida Governor Ron DeSantis spoke with EOC staffers and held a press conference prior to the storm's arrival. The Columbia Amateur Radio Society is the main club in the area, and many of its members serve in the county ARES program.

In Columbia County, five shelters held a total of 87 residents. Five ARES members were dispatched to the shelters where they maintained communications with Swartz and other EOC amateur station operators. (There were always two operators on duty at the EOC to cover shift assignments and provide redundancy.) The EOC generator came on when the mains failed on site, providing the use of emergency power for the amateur station and critical EOC functions. Winlink email was set up and confirmed by sending and receiving email to and from the Alachua County EOC via radio, using only VHF peer-to-peer VARA FM. Both text and a photo were sent.

When cell phone service between the special needs shelter and the EOC became unreliable, ARES operators provided communication between shelter staff and the Florida Department of Health Services, assisting in several matters. At the request of Florida Division of Emergency Management Regional Coordinator Glen Hammers, ARES operators were able to establish communication with the neighboring Suwannee County's EOC. Also at his request, ARES operators were able to send a message to the neighboring Gilchrist County Emergency Manager. At the request of the American Red Cross, ARES operators attempted to contact the EOCs in Madison and Taylor (two of the hardest-hit counties). Contact was made with a radio amateur in Madison but not directly with the EOC.

Swartz summed up his team's response: "Information flow among our shelters and with the EOC was efficiently conducted, quickly and smoothly. We operated on VHF for local communication; the UHF SARnet (a statewide 70-centimeter repeater emergency communications network) was available for communication with the state EOC in Tallahassee, and two HF bands — 80 and 40 meters — were used for statewide communications."

Takeaways

Swartz indicated that the ARES group continues to gain experience and acceptance with the county staff. "We need to develop more understanding of our EOC organization and functions," he reported in an After-Action Report and Improvement Plan. "We also need to develop communication[s] and relationships with other county Emergency Coordinators." Recruitment of additional ARES operators is a major goal: "We continue to need to get more people involved to serve the county during emergencies," EC Swartz said. "Training is and always will be a continuing priority."

Field Organization Reports

October 2023

Public Service Honor Roll

This listing recognizes radio amateurs whose public service performance during the month indicated 70 or more points in six categories. Details on the program can be found at **www.arrl.org/public-service-honor-roll**.

665
AD8CM

635
KT5SR

579
WA7PTM

430
N9VC

415
WM5N
WA3EZN

289
KC8YVF

267
KB9PGY

260
KT2D

255
W9GRG
W7EES

254
KO4KUS

250
WO2H

242
WØPZD

241
W9RY

234
KE8BYC

231
KE8DON

230
KB9IME
N2LC

225
N5MKY

224
W7PAT

215
NW3X

212
KD2LPM
W1LEM

208
KC1OIP

205
AC8NP
N1PZP

195
N8SY

190
ND8W
KC8WH

182
KD2GXL

180
KV8Z
WA2BBS

170
WZØC
N1ILZ

165
KC9FXE
N4CNX

164
KC8T

161
KT5EM

160
K8AMH
W4DNA

157
K1XFC

156
KB8RCR
WM2C

155
K8MDA
KB8GUN

150
KD8ZCM
NI2W

147
K3JL

145
AG9G
KY2MMM

142
WB8YYS

140
ACØKQ
K9LGU
AI9F
WB9QPM
K7OED

135
WB9WKO
KE5YTA

133
KB3YRU

131
WV5Q

130
N2JBA
WK4WC
KW1U
N1UMJ

129
W5WMC

125
WA3QLW

121
W3YVQ
W8DJG

120
WA4VGZ
WC4FSU
NX9K
KDØHHN
KF5IVJ
W2AH
KY2D
WA1URS

117
KT4WX

115
W8IM

112
K5ANP

111
N2DW
WB8SIQ

110
AD4DO
KM4WHO
KA9MZJ

N2TSO
W8GSR
KF5OMH
KB2QO
K1UAF
W1FEA
W1INC
N1IQI
W1RVY

108
K5OB

107
K3EAM

105
K8RDN
KB8PGW
WX2DX

102
N3KRX

100
KZ8Q
WB4RJW
AA3SB
K3YAK
WB2VUF
W1KX
N1LAH
KC1KVY
KB1NMO

98
KC1HHO

97
KG5AOP

96
WW3S

95
KF7GC
KC3MAL

93
KA2HZP

92
W2OOD

91
KL7RF
KG5NNA

90
KB9GO
KC9UC
WA3QPX
K8ED

K8KRA
KB8HJJ
N8OD
KA1G
W4EDN
W4KX
N3GE

89
AA3N
K4DH

86
W4TTO
N3RPB
KBØDTI
K1HEJ

85
W7MIN
KO4OL
W4NHO
WB8R
WB3FTQ

82
KB1TCE

80
AE2EY

79
AJ7B

78
KFØBPN
WB8RGE
K2MTG
KB1NAL

76
NØET

74
KN4AAG
W3ZR
K1STM

72
KE8CYC
NT1N

71
KB4OLY
KB3MKX
ND3L
KAØDBK
K2PHD
W5XX

70
W7FSC
K4NWX

The following stations qualified for PSHR in September 2023, but were not acknowledged in this column yet. W9EEU 208, KA9QWC 120, K2VTT, K6HTN 110, KB2YAA, WA2U 100, AB9ZA 90, N6IET, KD2PQP 89, W9BGJ 80.

Section Traffic Manager Reports

The following Section Traffic Managers reported: AR, AZ, CO, CT, DE, EMA, EPA, GA, IL, KS, KY, LA, MDC, MI, MO, MS, ND, NE, NFL, NH, NLI, NNJ, NNY, NTX, OH, OR, RI, SD, SFL, SJV, SNJ, STX, TN, WCF, WI, WMA, WPA, WV, WWA, WY.

Section Emergency Coordinator Reports

The following Section Emergency Coordinators reported: AR, CT, EPA, EWA, GA, IN, KY, MDC, ME, MI, NFL, NLI, NNJ, NNY, NV, MO, RI, SCV, SNJ, STX, TN, VA, VI, WMA, WPA, WWA, WY.

Brass Pounders League

The BPL is open to all amateurs in the US, Canada, and US possessions who report to their SMs a total of 500 or more points or a sum of 100 or more origination and delivery points for any calendar month. Messages must be handled on amateur radio frequencies within 48 hours of receipt in standard ARRL radiogram format. Call signs of qualifiers and their monthly BPL total points follow.

NX9K 1,647, WB9WKO 1,563, KY2D 1,173, W2AH 842, KW1U 675, N5MKY 106 (originations plus deliveries).

Maria Somma, AB1FM, ab1fm@arrl.org

Exam Info

New Amateur Extra Question Pool Takes Effect July 1

On July 1, 2024, a new Element 4 Amateur Extra-class question pool will take effect for examinations. Volunteer Examiner Coordinators (VECs) and Volunteer Examiners (VEs) will have new test designs available that must be used at exam sessions, effective on that date.

The 2024 ARRL VEC Exam Fee Remains $15

Visit **www.arrl.org/arrl-vec-exam-fees** for more information.

The newly revised pool, released in December 2023 by the Question Pool Committee of the National Conference of Volunteer Examiner Coordinators (NCVEC), must be used starting July 1. There are 10 graphics required for this pool.

The updated question pool incorporates significant changes from the prior pool. The questions were checked for technical accuracy and relevance to current amateur radio practices, as well as for grammar, syntax, format, and clarity, in addition to redundancy within and between the pools. As a result, 83 new questions were created and 100 questions were eliminated, thereby reducing the number of questions from 622 to 605. Approximately 350 questions were modified. To view all three question pools, visit the NCVEC website at **www.ncvec.org**.

Previously supplied versions of ARRL VEC Amateur Extra-class exam booklets (the 2020 series) and computer-generated Amateur Extra-class exams from the 2020 question pool are valid until midnight on June 30, 2024.

The ARRL VEC will supply its officially appointed field-stocked VE teams with new Amateur Extra-class exam booklet designs in mid-June 2024. Field-stocked teams that no longer meet the field stock requirements or have not conducted a session in the past year, and non-field-stocked teams that have been keeping supplies without qualifying through the ARRL VEC, will not receive updated exams. Non-stocked VE teams should return their exam packages and supplies to the ARRL VEC after the session is completed. The officially stocked VE teams will receive their exam supplies in a large box, which is a 6- to 12-month supply, depending on the team's activity levels. To see if your team qualifies to be field stocked with a bulk quantity of our test materials, visit **www.arrl.org/field-stocked-ve-teams**.

ARRL Youth Licensing Grant Program

The ARRL Youth Licensing Grant Program, in effect since April 19, 2022, will cover the one-time $35 application fee for new license candidates younger than 18 years old who take tests administered under the ARRL VEC program.

The $35 FCC application fee will be reimbursed after the ARRL VEC receives the completed reimbursement form and the new license has been issued by the FCC. The reimbursement check will be mailed to the fee payer. Also, candidates younger than 18 years old pay a reduced exam session fee of $5 to the ARRL VEC VE team at the time of the exam. The $5 fee is for all candidates under the age of 18, regardless of the exam level taken. Proof of under-18 status is required at the session.

The ARRL Board of Directors approved the Youth Licensing Grant Program at its July 2021 meeting in Hartford, Connecticut, expanding on the scope of the original motion proposed by Director of the ARRL

Search for a Pending Application on the FCC Website

Exam applicants can look up and track the progress of their application on the FCC's Application Search web page (**https://wireless2.fcc.gov/UlsApp/ApplicationSearch/searchAppl.jsp**) using their FCC Registration Number. If the applicant has a pending application in the system, that means the VEC has submitted the application to the FCC. As soon as their application appears in the system, new license applicants can pay the $35 fee by logging in to the FCC COmission REgistration System at **https://apps.fcc.gov/cores/userLogin.do**.

ARRL VEC Program Available Services

Online Amateur Radio Exams

ARRL VE teams can go completely electronic by using a web-based exam system to administer online exams for in-person or remote video-supervised sessions.

Remote Video-Supervised Sessions

Remote sessions are conducted using an online video conferencing platform with on-screen tests.

Electronically File Exam Sessions to the VEC

Upload exam session documents or files for quicker service! New and upgraded licenses are transmitted to the FCC within 1 – 2 business days for weekend sessions, and they are usually transmitted on the same day for weekday sessions.

ARRL Member Licensing Support

Ongoing FCC licensing guidance and support for our ARRL members, including license renewal help, is an important part of our program services.

Please contact the ARRL VEC Department at **vec@arrl.org** for more information about our services.

Southeastern Division Mickey Baker, N4MB. The Board believes the recruitment and training of young amateur radio operators is a necessary and proper mission of ARRL, and that subsidization of the $35 fee will reduce the number of new amateurs who otherwise would be lost from these groups. Initially, the new program would serve up to 1,000 new license applicants under 18 years old. The program length is indefinite; it may be renewed or terminated by the Administration and Finance Committee or by the Board. Visit **www.arrl.org/youth-licensing-grant-program** for the program instructions and reimbursement form.

Resources for ARRL VEs

The Resources for VEs web page (**www.arrl.org/resources-for-ves**) on the ARRL website offers the information you will need to help conduct exam session business. Our support page offers easy access to online exams, remote video session instructions, session forms and information, VE Manual supplemental information, FCC rules, basic qualification question procedures, and more. There are also preparation resources for candidates, upcoming in-person and remote video exam session search tools, vanity call sign information, and more.

ARRL VEC VE E-Newsletter

The e-newsletter relays important news and updates relating to FCC rule or policy changes, exam session document or procedural changes, test booklets, the exam session documents upload web page, the online exam system, and other topics. Subscribe to the ARRL VEC VE e-newsletter at **https://reflector.arrl.org/mailman/listinfo/ve-list**.

Volunteer Monitor Program Report

The Volunteer Monitor (VM) Program is a joint initiative between ARRL and the FCC to enhance compliance in the Amateur Radio Service. This is the October 2023 activity report of the VM Program.

♦As a result of his operation on 14.265 MHz, an operator in Texas was sent an advisory notice cautioning him of the FCC power limits in the Amateur Radio Service.

♦An advisory notice was issued to a licensee in Texas cautioning him about broadcasting and failure to share the frequency on 10 meters. The operator was using an automatic device calling CQ with no interval between transmissions, resulting in complaints of monopolizing the frequency.

♦An advisory was issued to an operator in Georgia as a result of his playing music on 3.927 MHz.

♦Technician-class operators in Georgia and Missouri were issued advisories concerning FT8 operation on 15, 17, and 20 meters. Technicians have no operating privileges on 17 or 20 meters, and only CW privileges on 15 meters.

♦Amateur Extra-class operators in Kentucky and Virginia were issued advisory notices concerning long transmissions on 40 meters with no call sign identification.

♦An operator in Wisconsin was sent an advisory notice concerning deliberate interference to the Lakeshore Repeater Association's operation on 442 MHz. The operator was informed that the case was being referred to the FCC, and that the FCC would enforce the request by the repeater owner that he stay off the repeater.

♦The VM Program Administrator participated in one meeting with the FCC.

The totals for September monitoring were 2,133 hours on HF frequencies, and 2,703 hours on VHF frequencies and above, for a total of 4,836 hours. — *Thanks to Volunteer Monitor Program Administrator Riley Hollingsworth, K4ZDH*

Contest Corral

January 2024

Check for updates and a downloadable PDF version online at **www.arrl.org/contest-calendar**.
Refer to the contest websites for full rules, scoring information, operating periods or time limits, and log submission information.

Start - Finish Date	Time	Date	Time	Bands	Contest Name	Mode	Exchange	Sponsor's Website
1	0000	1	0100	3.5	AGB New Year Snowball Contest	CW Ph Dig	RST, serial, mbr (if any)	**www.qsl.net/eu1eu/agb_nysb.htm**
1	0000	1	0100	1.8-28	K1USN Slow Speed Test	CW	Max. 20 WPM; name, SPC	**www.k1usn.com/sst.html**
1	0800	1	1100	3.5,7	SARTG New Year RTTY Contest	Dig	RST, serial, happy new year (native language)	**www.sartg.com/contest/nyrules.htm**
1	0900	1	1200	3.5-14	AGCW Happy New Year Contest	CW	RST, serial, mbr (if any)	**www.agcw.de/contest/hnyc/hnyc-engl**
1	1400	1	1800	144,432	AGCW VHF/UHF Contest	CW	RST, serial, pwr class, 6-char grid	**www.agcw.de/contest/vhf-uhf**
2	0200	2	0400	3.5-28	ARS Spartan Sprint	CW	RST, SPC, pwr	**arsqrp.blogspot.com**
3	0200	3	0330	7	QRP Fox Hunt	CW	RST, SPC, name, pwr	**www.qrpfoxhunt.org**
3	1300	3	1400	1.8-28	CWops Test (CWT)	CW	Name, SPC or mbr	**cwops.org/cwops-tests**
3	1700	3	2100	144	VHF-UHF FT8 Activity Contest	FT8	4-char grid square	**www.ft8activity.eu/index.php/en**
3	2000	3	2100	3.5	UKEICC 8-Meter Contest	Ph	6-char grid square	**www.ukeicc.com/80m-rules.php**
4	0000	5	0300	7	Walk for the Bacon QRP Contest	CW	Max. 13 WPM; RST, SPC, name, mbr or pwr	**qrpcontest.com/pigwalk40**
4	1800	4	2200	28	NRAU 10-Meter Activity Contest	CW Ph Dig	RS(T), 6-char grid square	**nrau.net/nrau-contests-in-general**
4	2000	4	2200	1.8-28,50	SKCC Sprint Europe	CW	RST, SPC, name, mbr or "none"	**www.skccgroup.com**
5	0200	5	0330	3.5	QRP Fox Hunt	CW	RST, SPC, name, pwr	**www.qrpfoxhunt.org**
5	2000	5	2100	1.8-28	K1USN Slow Speed Test	CW	Max. 20 WPM; name, SPC	**www.k1usn.com/sst.html**
6	0000	6	2359	3.5-28	PODXS 070 Club PSKFest	Dig	RST, SPC	**www.podxs070.com**
6	0700	6	2100	3.5-14	Marconi Club ARI Loano QSO Party Day	CW	RST, serial, "MC" (if mbr)	**www.ariloano.it/marconiclub**
6	1200	7	1200	1.8-28	WW PMC Contest	CW Ph	RS(T), PMC abbrev or CQ zone	**www.s59dcd.si**
6	1300	6	1700	3.5,7	RSGB AFS Contest, CW	CW	RST, serial	**www.rsgbcc.org**
6	1800	6	2359	3.5-14,18, 21,24,28, 2-m rptrs	ARRL Kids Day	Ph	Name, age, QTH, favorite color	**www.arrl.org/kids-day**
6	1800	7	2359	3.5-28	ARRL RTTY Roundup	Dig	W/VE: RST, SP; non-W/VE: RST, serial	**www.arrl.org/rtty-roundup**
6	2000	7	0700	1.8	EUCW 160-Meter Contest	CW	RST, name, mbr or "NM"	**www.eucw.org/eu160.html**
8	0100	8	0300	1.8-28	4 States QRP Group Second Sunday Sprint	CW Ph	RS(T), SPC, mbr or pwr	**www.4sqrp.com/SSS/sss_rules.pdf**
10	1700	10	2100	432	VHF-UHF FT8 Activity Contest	FT8	4-char grid square	**www.ft8activity.eu**
13	0000	13	2359	3.5-28	YB DX Contest	Ph	RS, serial	**ybdxcontest.com**
13	1200	14	1200	3.5-28	UBA PSK63 Prefix Contest	Dig	ON: RSQ, UBA section or serial (starting with 001)	**www.uba.be**
13	1200	14	2359	1.8-28,50	SKCC Weekend Sprintathon	CW	RST, SPC, name, mbr or "none"	**www.skccgroup.com**
13	1800	14	0559	1.8-28	North American QSO Party, CW	CW	Name, SPC	**www.ncjweb.com/NAQP-Rules.pdf**
14	0630	14	0830	3.5,7	NRAU-Baltic Contest, SSB	Ph	RST, serial, 2-letter fylke/län/province/region	**www.nraubaltic.eu**
14	0900	14	1059	28	DARC 10-Meter Contest	CW Ph	RS(T), serial, DOK (if any)	**www.darc.de/der-club/referate/conteste**
14	0900	14	1100	3.5,7	NRAU-Baltic Contest, CW	CW	RST, serial, 2-letter fylke/län/province/region	**www.nraubaltic.eu**
17	1700	17	2100	1.2G	VHF-UHF FT8 Activity Contest	FT8	4-char grid square	**www.ft8activity.eu**
18	0000	19	0300	14	Walk for the Bacon QRP Contest	CW	Max. 13 WPM; RST, SPC, name, mbr or pwr	**qrpcontest.com/pigwalk20**
18	0130	18	0330	3.5-14	NAQCC CW Sprint	CW	RST, SPC, mbr or pwr	**naqcc.info**
20	1200	21	1159	1.8-28	Hungarian DX Contest	CW Ph	RS(T), serial, 2-letter county (if HA)	**ha-dx.com/en/contest-rules**
20	1200	21	1159	3.5-28	PRO Digi Contest	Dig	RST, serial, "ME" (if mbr)	**www.procontestclub.ro**
20	1800	21	0559	1.8-28	North American QSO Party, SSB	Ph	Name, SPC	**www.ncjweb.com/NAQP-Rules.pdf**
20	1800	21	0559	1.8-28	NA Collegiate Championship, SSB	Ph	Name, SPC if NA	**www.w9smc.com/nacc**
20	1900	22	0359	50 and up	ARRL January VHF Contest	CW Ph Dig	4-char grid square	**www.arrl.org/january-vhf**
20	2000	21	0559	1.8-7	Feld Hell Sprint	Dig	(See rules)	**sites.google.com/site/feldhellclub**
21	1300	21	1700	3.5,7	RSGB AFS Contest, Data	Dig	RST, serial	**www.rsgbcc.org**
21	2300	22	0100	1.8-28	Run for the Bacon QRP Contest	CW	RST, SPC, mbr or pwr	**qrpcontest.com/pigrun**
24	0000	24	0200	1.8-28,50	SKCC Sprint	CW	RST, SPC, name, mbr or "none"	**www.skccgroup.com**
26	2200	28	2200	1.8	CQ 160-Meter Contest, CW	CW	RST, SP or CQ zone	**www.cq160.com**
27	0600	28	1800	3.5-28	REF Contest, CW	CW	RST, French dept or serial	**concours.r-e-f.org/reglements**
27	1200	28	1200	3.5-28	BARTG RTTY Sprint	Dig	Serial (no signal report)	**bartg.org.uk**
27	1300	27	1700	3.5,7	RSGB AFS Contest, SSB	Ph	RS, serial	**www.rsgbcc.org**
27	1300	28	1300	3.5-28	UBA DX Contest, SSB	Ph	RST, serial, section (if ON)	**www.uba.be/en/hf/contest-rules**
27	1900	28	1900	No WARC	Winter Field Day	CW Ph Dig	Category, ARRL Section, MX or DX	**www.winterfieldday.com**
31	2000	31	2100	3.5	UKEICC 80-Meter Contest	CW	6-char grid square	**www.ukeicc.com**

There are a number of weekly contests not included in the table above. For more info, visit: **www.qrpfoxhunt.org**, **www.ncccsprint.com**, and **www.cwops.org**. All dates and times refer to UTC and may be different from calendar dates in North America. Contests are not conducted on the 60-, 30-, 17-, or 12-meter bands. Mbr = Membership number. Serial = Sequential number of the contact. SPC = State, Province, DXCC Entity. XE = Mexican state. Listings in blue indicate contests sponsored by ARRL or *NCJ*. The latest time to make a valid contest QSO is the minute listed in the "Finish Time" column. *Data for Contest Corral is maintained on the WA7BNM Contest Calendar at* **www.contestcalendar.com** *and is extracted for publication in* QST *2 months prior to the month of the contest. ARRL gratefully acknowledges the support of Bruce Horn, WA7BNM, in providing this service.*

Paul Bourque, N1SFE, n1sfe@arrl.org

2023 ARRL International Digital Contest Results

The 2023 ARRL International Digital Contest was held June 3 – 4, 2023.

Continental Winners

Africa

Single Operator, One Radio, Low Power	V51MA	2,686

Asia

Single Operator, One Radio, Low Power	JM1NKT	8,735
Single Operator, One Radio, Low Power, 8 Hours	JH7QXJ	3,486
Single Operator, One Radio, QRP	JA1KPF	1,281
Single Operator, One Radio, QRP, 8 Hours	JJ1SSY	561
Multioperator, Single Transmitter, Low Power	BY1RX	10,845

Europe

Single Operator, One Radio, Low Power	DR1X (DG6YID, op)	11,168
Single Operator, One Radio, Low Power, 8 Hours	ON6NL	4,534
Single Operator, One Radio, QRP	UT2IV	4,256
Single Operator, One Radio, QRP, 8 Hours	YL3FW	1,844
Single Operator, Two Radios, Low Power	YO9HP	13,110
Single Operator, Two Radios, Low Power, 8 Hours	UB7K	6,426
Multioperator, Single Transmitter, Low Power	DN5MT	5,440

North America

Single Operator, One Radio, Low Power	NP2X (K9VV, op)	7,159
Single Operator, One Radio, Low Power, 8 Hours	NP4TX	2,371
Single Operator, One Radio, QRP, 8 Hours	HI5YJM	397
Multioperator, Single Transmitter, Low Power	6Y5PW	4,941

Oceania

Single Operator, One Radio, Low Power	ZL3IO	20,552
Single Operator, One Radio, Low Power, 8 Hours	YC3DOC	3,461
Single Operator, One Radio, QRP	YC4SIZ	1,191
Single Operator, One Radio, QRP, 8 Hours	NH6O	1,470

South America

Single Operator, One Radio, Low Power	ZP5AA (W3MLJ, op)	11,146
Single Operator, One Radio, Low Power, 8 Hours	PY1ZV	4,702
Single Operator, One Radio, QRP	PY2CER	4,666
Single Operator, Two Radios, Low Power	PY2GTA	10,326

Top Ten — DX

Single Operator, One Radio, Low Power

ZL3IO	20,552
YE9BJM	13,880
VK2EHQ	11,543
DR1X (DG6YID, op)	11,168
ZP5AA (W3MLJ, op)	11,146
KH6AQ	10,752
CT2FEY	10,374
UA6CE	9,814
IT9VCE	9,433
JM1NKT	8,735

Single Operator, One Radio, Low Power, 8 Hours

PY1ZV	4,702
ON6NL	4,534
MR5W (MØHMJ, op)	4,340
PY1CG	4,152
JH7QXJ	3,486
YC3DOC	3,461
PU4MMZ	3,395
KH6WI	3,378
IK5AEQ	3,289
L77D (LU6DC, op)	3,232

Single Operator, One Radio, QRP

PY2CER	4,666
UT2IV	4,256
PY2MLO	3,294
SP8IDX	2,545
PY2PLL	1,979
PE2K	1,535
JA1KPF	1,281
YC4SIZ	1,191
EA4HWT	1,114
PY2TDB	528

Single Operator, One Radio, QRP, 8 Hours

YL3FW	1,844
NH6O	1,470
DM8MH	1,418
OK1GSB	1,013
YD6ROA	801
JJ1SSY	561
DH9DX/P	496
YC2BST	449
HI5YJM	397
YCØRFS	373

Single Operator, Two Radios, Low Power

YO9HP	13,110
PA4O	11,941
PY2GTA	10,326
PC4H	4,798

Single Operator, Two Radios, Low Power, 8 Hours

UB7K	6,426
EC3A	4,008
UT3N (UT3NK, op)	1,149

Multioperator, Single Transmitter, Low Power

BY1RX	10,845
DN5MT	5,440
6Y5PW	4,941
9A4AA	4,171
RW9Y	2,563
9A2EU	1,337
JL3ZHU	775
XE2NL	87

Jozsef Krasnyanszki, HA7JDU, participated in the 2023 ARRL International Digital Contest. He took second place in the Single Operator, One Radio, Low Power category from Hungary. [Jozsef Krasnyanszki, HA7JDU, photo]

Top Ten — W/VE

Single Operator, One Radio, Low Power

K9OM	12,422
N3QE	9,411
K6OK	9,349
WA2BOT	8,650
KA6BIM	8,360
NA5M	7,401
N6AR	7,212
K7HKR	6,813
WA8ZNC	6,092
AF6SA	6,011

Single Operator, One Radio, Low Power, 8 Hours

K6LL	6,633
W2LPL	3,652
K6XX	3,646
WA7BNM	2,801
NA4DA	2,668
KF7PBM	2,352
N7GCO	2,251
KC3PIB	2,229
WY3A	2,017
N9TF	1,999

Single Operator, One Radio, QRP

N9GQA	4,719
N4FUR	3,935
KG7CW	3,132
VE3CT	2,745
W7JET	2,104
N5ER	1,852
N3CKI	1,023
N3MWQ	886
WA2SEM	811
KE0VIM	737

Single Operator, One Radio, QRP, 8 Hours

WC4J	1,799
N2YCH	1,302
KA1ZE	886
N8URE	754
N1RDN	407
W4IL	378
W0KI	339
N9SSA	331
W4VG	241
K7WA	184

Single Operator, Two Radios, Low Power

K3MM	16,460
N8OO	16,221
NF3R	15,284
N8HRZ	12,910
AA3B	12,649
NA3M	7,347
K5ZD	6,728
N5YT	5,771
KW6S	5,622
WO2X	4,775

Single Operator, Two Radios, Low Power, 8 Hours

W1UE	4,879
WV4P	4,754
K9CT	4,454
KI6DY	4,296
K9WX	2,684
VE3MGY	1,786
NR4O	1,513
AB8MO	1,466
NS3T	382

Single Operator, Two Radios, QRP

KN6OKY	825

Single Operator, Two Radios, QRP, 8 Hours

WQ5L	2,337
NN7SS (K6UFO, op)	1,827

Multioperator, Single Transmitter, Low Power

W2ZQ	9,416
WT0DX	7,588
N1QD	4,310
AK4NF	1,401
KM5AT	1,374
VA7MM	1,371
N1SOH	406

The 2024 ARRL International Digital Contest will be held June 1 – 2, 2024.

Full Results Online

You can read the full results of the contest online at **https://contests.arrl.org**. You'll find detailed analysis and more play-by-play, along with the full line scores. Improve your results by studying your log-checking report, too.

Brandon Clark, KL7BSC, operated in this well-equipped vehicle, participating in the Single Operator, One Radio, Low Power, 8 Hours category. This photo was taken the first weekend in June during the event. Brandon wrote, "[I] had a great time operating portable for the event from Alaska. I even snagged a few European contacts over the north pole…and I even activated two Parks on the Air (POTA) units. Fun day!" [Brandon Clark, KL7BSC, photo]

Affiliated Club Competition

Club	Score	Entries
Medium		
Potomac Valley Radio Club	73,536	35
Frankford Radio Club	65,729	20
Northern California Contest Club	49,960	16
Yankee Clipper Contest Club	48,464	14
Florida Contest Group	22,428	9
Grand Mesa Contesters of Colorado	18,934	8
Society of Midwest Contesters	18,387	11
DFW Contest Group	14,690	4
Arizona Outlaws Contest Club	14,292	4
Southern California Contest Club	13,263	6
Idaho Mountain ARS	13,255	4
Spokane DX Assn.	12,965	7
Texas DX Soc.	10,756	5
Minnesota Wireless Assn.	10,537	7
Tennessee Contest Group	8,443	6
Kansas Nebraska Radio Club	5,617	6
Western Washington DX Club	5,505	3
Silver Comet ARS	4,557	5
Hudson Valley Contesters and DXers	1,899	3
Local		
Silver Springs Radio Club	4,684	3

Write for *QST*

The membership journal of ARRL is always open to manuscript submissions from ham radio operators.

QST looks for material that appeals to a broad cross-section of readers within the diverse amateur radio community. Feature articles published in *QST* fall into one of two broad categories: *technical* and *general interest*.

Technical articles outline a construction project or a technical concept. General interest articles are "everything else" that's not technical: recaps of DXpeditions, grid expeditions, or public service activities, or personal accounts of trying a new mode or style of operating — anything relating to operating or the ham radio avocation.

Whether your manuscript has a technical or general focus, a strong "how-to" component will make it stand out. Readers should come away from the article with specific ideas for recreating your experience.

General interest submissions should be in the range of 1,200 – 1,800 words, with 3 – 5 high-resolution images. Technical article submissions may be longer and include more images, as the subject matter requires (for example, if there are step-by-step instructions for a build project). Please submit images as separate attachments (rather than embedded in your manuscript), and include caption information for all images at the end of your manuscript. Send all manuscripts, with images, to **qst@arrl.org**.

For even more information on what *QST* is looking for, and further details on how to submit manuscripts, see our Author Guide at **www.arrl.org/qst-author-guide**.

The ARRL February School Club Roundup

This event begins on Monday, February 12 at 1300 UTC and runs through Friday, February 16 at 2359 UTC.

The 4-H Ham Radio Club, N4HKZ, of Fauquier County, Virginia, took first place in the October 2022 SCR in the Non-School Club — W/VE category. This was the club's first SCR. From front to back: Bri Wall, KO4NLR; Aurelia Martinez; Kieran Martinez, and Declan Martinez. SCR is a team effort for the club. Declan made contacts while Aurelia recorded logs. Kieran ran up to the whiteboard, and Bri coached and watched spotting networks for other schools/clubs. [Nic Wall, KY4OP, photo]

- Stations may operate for up to 24 hours during the entire contest and may operate for only 6 hours during any single 24-hour period. Any mode — SSB, CW, or digital — is allowed.
- There are five club participation categories: Elementary/Primary, Middle/Intermediate/Junior High School, Senior High School, College/University, and Non-School. There's also a category for individuals (individual participation is vital, as the schools need and want to contact as many stations as possible).
- School Club Roundup (SCR) is co-sponsored by ARRL and the Long Island Mobile Amateur Radio Club (LIMARC). Results will appear in *QST* and online at **https://contests.arrl.org**. The top three entries in each category will receive an award certificate.
- Share your team's photos and stories, and be sure to include a photo release (**www.arrl.org/photo-video-release-form**) for participants under 18 years of age. One of the best parts of SCR is showing off your team members and station! Upload your photos and stories when you submit your score at **https://contests.arrl.org/arrlscrscoresubmission.php**.

For complete rules, logging sheets, and other resources, visit www.arrl.org/school-club-roundup.

Strays

Searching for a Long-Lost Film

If anyone has access to the film *Fine Business* mentioned in "A Look Back" in the February 2023 issue of *QST*, please contact Garron Anderson, KI5PPB, at **garronanderson4321@gmail.com**. The film was produced by Ted Sparrow, VE3BQN, in 1973.

Sharing the Letter "P" Suffix

Telesforo "Tele" Figueroa, KP4P, has been collecting QSL cards for years like many other hams. However, his collection stands out because he concentrates on collecting only QSL cards that end in the letter P. Tele's collection has grown to somewhere between 150 and 200 cards, and he is always happy to receive more. You can check them out on his QRZ web page.

QST Congratulates...

The South Carolina Section Public Information Coordinator Gordon Mooneyhan, W4EGM, on the publication of his latest book, *Titanic: A Legal Perspective*. Gordon is also the author of *Public Relations for the Volunteer Public Information Officer* and has compiled three books on railroad dining car recipes. His latest book is available on Amazon in hardcover and paperback versions.

Volunteers On the Air Update

With the last weeks of VOTA braving winter-season winds, sleet, and snow (in some areas), despite the harsh weather, many ARRL member-volunteers continue to demonstrate that we can communicate despite challenges.

Now is a great time for that last push toward midnight on New Year's Eve, and to kick off Straight Key Night starting at 0000 UTC on January 1, 2024.

As you are reading this, remember there are still some terrific contests and operating events available to finish out the VOTA operating year. Check out "Contest Corral" in the December 2023 issue of *QST* for additional operating events.

To see which states are wrapping up or have concluded their portable operations, visit **https://contests.arrl.org/docs/2023-VOTA-State-Activations-Schedule.pdf**.

Listed below are initial QSO tallies from recent W1AW portable state activations, as of November 17:

Awaiting Logs:

- W1AW/5 New Mexico (March 22 – 28)
- W1AW/4 Alabama (June 7 – 13)
- W1AW/5 Oklahoma (August 16 – 22)
- W1AW/7 Arizona (August 30 – September 5)
- W1AW/5 New Mexico (October 4 – 10)
- W1AW/6 California (October 11 – 17)
- W1AW/4 Alabama (October 18 – 25)

Logs Received:

- W1AW/4 Kentucky (August 2 – 9) = 2,932 QSOs
- W1AW/Ø Colorado (September 13 – 19) = 7,889 QSOs
- W1AW/4 Tennessee (September 13 – 19) = 2,314 QSOs
- W1AW/1 New Hampshire (September 20 – 26) = 1,144 QSOs
- W1AW/1 Connecticut (September 27 – October 3) = 4,911 QSOs
- W1AW/3 Washington, DC (October 4 – 10) = 1,361 QSOs
- W1AW/Ø Missouri (October 11 – 17) = 4,907 QSOs
- W1AW/4 Virginia (October 25 – 31) = 1,724 QSOs
- W1AW/Ø Kansas (November 8 – 14) = 2,261 QSOs
- W1AW/3 Maryland (November 8 – 14) = 3,568 QSOs

VOTA Leaderboard Functionality Updates

- The leaderboard (**https://vota.arrl.org/leaderboard.php**) was updated to allow filtering by US or state only, and to list overall and state rank.
- The search-by-call-sign feature on the leaderboard now provides participant ranking overall within the country and state.
- Participant call signs have been hyperlinked to **www.qrz.com** for easy lookup.
- A **MY VOTA** page (**https://vota.arrl.org/my-info.php**) has been added to show overall and state rank information, W1AW portable states contacted, the W1AW portable states still needed to achieve all 50, the schedule of when they are on next, and QSO details (with cursor over points) for more information.
- VOTA certificates are here! We will collect all W1AW portable activation log uploads and all volunteer final uploads for 2023 QSOs on January 31. At that time, look for your final numbers on participation certificates and access your Worked All States certificate (if all 50 states were worked) at **https://vota.arrl.org/certificates.php**.

Follow what other VOTA participants are discussing on Facebook at **www.facebook.com/hashtag/volunteersontheair**.

To follow state activation dates, the leaderboard, and related activities of VOTA, visit **https://vota.arrl.org**.

Send your comments, suggestions, stories, and photos to **vota@arrl.org**.

A sample of the 2023 VOTA Worked All States certificate.

Certificate of Code Proficiency Recipients

This month, ARRL recognizes merit and progress in Morse code proficiency on the part of the following individuals, who have achieved proficiency at the following rates, in words per minute.

June 2023

Charles H. Brown, W3CHB	10
Russell L. Bast, Jr., AD2BO	15
Andrew J. Zimolzak, KI5PED	15
Michael J. Kerezsi, W3ASW	35
Brian D. Miller, K9RA	35
Ernesto M. Ong, AD5MD	35
Joseph W. Parskey, NJ1P	35

July 2023

John D. Kelley, K4WY	10
Brian Lutton, KC1NYZ	10
Eilert M. Menke, DL9BDM	10
Philip B. Mulford, AK4KM	10
Jerry C. Foster, Jr., KN4SYO	15
John D. Kelley, K4WY	15
Benjamin S. Williams, KO4BHX	15
John D. Kelley, K4WY	20
Scott T. McNutt, N3ADP	20
John D. Kelley, K4WY	25
John D. Kelley, K4WY	30
John D. Kelley, K4WY	35
Bert Beyt, W5ZR	40

August 2023

Charles W. Campbell, KØCWC	10
Mark C. Guenther, WB7TLK	10
Joseph L. Kelly, N9SV	10
Daniel H. Pressler, KF2HP	10
Wayne W. Wagner, WA3DHM	10
Joseph S. Gershon, NØHOV	20
Keith A. Marang, W4AFB	30
John D. Kelley, K4WY	40
Joseph W. Parskey, NJ1P	40

September 2023

Ralph E. Duncan, N7WWY	10
David G. Gower, W7JMG	10
Nathan T. Lyons, N8HWV	10
Ryan B. Massey, WB6EQK	10
Thomas F. Wentworth, W8LA	10
Christopher J. Brown, NY9X	15
Erich C. Fitschen, KQ4BBC	15
William G., Homsany, KG6COH	15
Nathan T. Lyons, N8HWV	15
Bruce Garrett, AC4CW	20
Joseph W. Chapman, NV1W	25
Dain Webster, K7SXN	25
Ron Kinney, KCØZPS	25
Michael J. Kerezsi, W3ASW	40

October 2023

Joseph P. Kononchik, KS1I	20

Congratulations to all of the recipients.

January 2024 W1AW Qualifying Runs

W1AW, the Hiram Percy Maxim Memorial Station at ARRL Headquarters in Newington, Connecticut, transmits Morse code Qualifying Runs to assist ham radio operators in increasing and perfecting their proficiency in Morse code. Amateur radio operators can earn a Certificate of Code Proficiency or endorsements by listening to W1AW Qualifying Runs.

January Qualifying Runs will be transmitted by W1AW in Newington, Connecticut, at the times shown on 1.802.5, 3.581.5, 7.047.5, 14.047.5, 18.097.5, 21.067.5, 28.067.5, 50.350, and 147.555 MHz. The West Coast Qualifying Runs will be transmitted by K9JM on Wednesday, January 24, at 9 PM PST (0500 UTC on January 25) on 3590 and 7047.5 kHz. Unless indicated otherwise, sending speeds are from 40 to 10 WPM.

Amateur radio operators who participate in Qualifying Runs may submit proof of 1 minute of the highest speed they have copied in the hope of qualifying for the Certificate of Code Proficiency, or an endorsement to their existing certificate. Legibly copy at least 1 minute of text by hand, and mail the sheet to: W1AW Qualifying Runs, 225 Main St., Newington, CT USA 06111. Include $10 (check or money order) if this is a submission for your initial Code Proficiency certificate; $7.50 if you are applying for an endorsement (available for speeds up to 40 WPM). Your test will be checked against the actual transmissions to determine if you have qualified.

Members of the North Fulton (Georgia) Amateur Radio League (**https://nfarl.org**) are offering to subsidize the total cost of a Code Proficiency certificate or endorsement submission for any individual age 21 years and younger, and who reside in either the US or Canada. Participants who wish to make use of this offer should indicate on their Qualifying Run submissions they are age 21 or younger, and certify as such via their signature. Eligible participants are not required to send any fee with their Code Proficiency submissions.

For more information about Qualifying Runs, please visit **www.arrl.org/qualifying-run-schedule**.

For information about how to qualify for the Certificate of Code Proficiency, please visit **www.arrl.org/code-proficiency-certificate**.

W1AW Qualifying Runs — January 2024
(All times are in Eastern Standard Time.)

Monday	Tuesday	Wednesday	Thursday	Friday
		1/3 7 PM – 0000Z **(1/4 – UTC)** 35 – 10 WPM	**1/4** 10 PM – 0300Z **(1/5 – UTC)** 10 – 40 WPM	**1/5** 9 AM – 1400Z 10 – 35 WPM
	1/9 4 PM – 2100Z 10 – 35 WPM	**1/10** 7 PM – 0000Z **(1/11 – UTC)** 10 – 40 WPM	**1/11** 9 AM – 1400Z 35 – 10 WPM	**1/12** 10 PM – 0300Z **(1/13 – UTC)** 10 – 35 WPM
	1/16 9 AM – 1400Z 10 – 35 WPM	**1/17** 10 PM – 0300Z **(1/18 – UTC)** 35 – 10 WPM	**1/18** 7 PM – 0000Z **(1/19 – UTC)** 10 – 35 WPM	**1/19** 4 PM – 2100Z 10 – 40 WPM
1/22 10 PM – 0300Z **(1/23 – UTC)** 10 – 40 WPM	**1/23** 9 AM – 1400Z 35 – 10 WPM		**1/25** 4 PM – 2100Z 35 – 10 WPM	

Mike Walters, W8ZY, mwalters@arrl.org

Club Station

Enhancing Club Meetings Using Hybrid Meeting Capabilities

During the COVID-19 pandemic, many amateur radio clubs stopped meeting in person and switched to having online monthly meetings, but most have since gone back to meeting only in person. In this month's column, Willamette Valley DX Club (WVDXC), W7AC, Board Member and Webmaster Al Rovner, K7AR, shares how the convenience of their post-pandemic hybrid meetings has benefitted the Portland, Oregon, club and attracted new members.

The Willamette Valley in Oregon is 150 miles long, and our club has members scattered all throughout the valley. So, after the COVID-19 state mandates for in-person gatherings were lifted, many WVDXC members asked that we continue with our online meeting format. Now, every meeting is hybrid, allowing members to choose to attend in person or via Zoom. This format allows members and speakers from all over to participate. In this article, I'll cover how WVDXC uses hybrid technology to achieve this.

Required Equipment

See the sidebar, "Required Equipment for Hybrid Meetings," for a list of necessary equipment.

You can use almost any laptop PC that can handle Zoom or another type of online meeting software. A good internet connection is required to prevent dropouts and stuttering video. WVDXC's laptop requires two USB ports and a video output (typically HDMI). We use a video projector and screen so the in-person audience can see the online activity and presentation (see Figure 1 for our setup).

Having two wireless microphones is ideal. This way one can be used by the meeting host and the other can be passed around the room as needed. The microphones that WVDXC have generally use UHF frequencies to communicate with the receiver.

The type of amplified speakers you need will vary, depending on the size of your club's meeting room. WVDXC meets in a restaurant and needs only a small pair of bookshelf-style speakers placed on a table. If you meet in a large room, you may need to mount speakers on tripods. Typically, these speakers have one- or two-line input jacks with RCA connectors.

An audio mixer is required so that the wireless microphone audio, and Zoom or online audio, may be fed to the amplified speakers. A complex mixer is not needed.

A USB-to-analog adapter plugs into the laptop's USB port and provides analog input/output using RCA connectors. You can find an adapter that sends wireless microphone audio from the meeting room to the Zoom audience, as well as sends the Zoom audio to the local meeting audience via the amplified speakers.

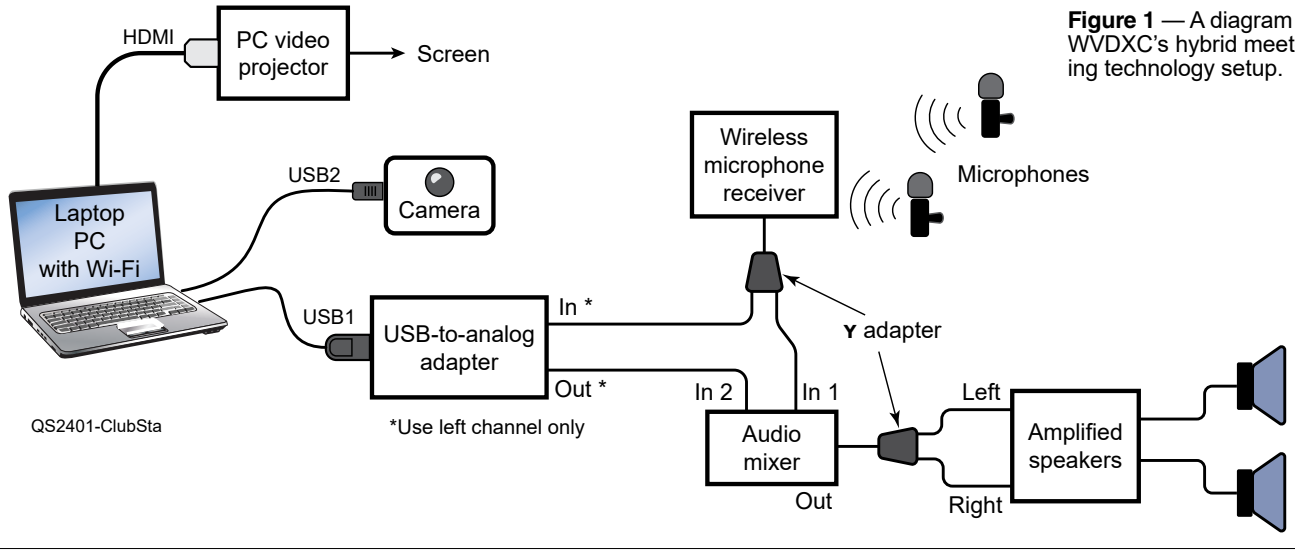


Figure 1 — A diagram of WVDXC's hybrid meeting technology setup.

Required Equipment for Hybrid Meetings

- ✓Laptop PC (with two or more USB ports and an HDMI output)
- ✓Wireless microphones (a set of two is ideal)
- ✓Amplified speakers
- ✓Small audio mixer
- ✓USB-to-analog audio adapter
- ✓Wide-angle camera and tripod
- ✓Various audio cables and adapters
- ✓PC video projector and screen

In general, a standard webcam is not sufficient to display a wide view of the meeting room to the Zoom audience. Instead, a wide-angle camera can capture most of the room. You'll need a tripod to mount the camera, and you'll likely need a USB extension cable, as the camera comes with a short cable. The camera plugs into the laptop's USB port.

A number of cables are needed to connect all this equipment. One cable connects the mixer output to the amplified speaker inputs and includes a **Y** adapter to connect mono audio to the left and right speaker inputs. Another cable connects the laptop's left channel analog output to input two on the audio mixer. You'll also need a USB extension cable for the camera, a **Y** adapter for the wireless microphone receiver, and a standard HDMI cable. One output connects to input one on the audio mixer. The second output connects to the laptop's left channel analog input. Your cabling needs will vary depending on the equipment being used.

In order for the local meeting audience to see the Zoom screen, the laptop must be connected to a PC video projector and screen. Generally, the PC and projector are connected via an HDMI cable. Don't forget an ac extension cord and power strip to connect all the components.

Using the Hybrid System

Assuming that you're using Zoom software for your hybrid meetings, you'll want to publicize your meeting link using your club's website or by sending an email to members. As the IT person for WVDXC, I arrive early to the meeting location to set up the equipment — it takes about 15 minutes to get everything connected. Make sure the wireless microphones have a fresh set of batteries and that the receiver is fully charged.

Using the laptop PC with an established internet connection, connect to the Zoom meeting using the published link. This works exactly the same as from your home location. While in Zoom, select **USB TO ANALOG ADAPTER** for the microphone input and speaker output. The adapter devices appear as **USB AUDIO CODEC**. Also, make your wide-angle camera (not the laptop's camera) the video input.

Use the input one level control on the audio mixer to adjust the wireless microphone audio as needed. As mentioned earlier, the microphone audio will be heard through the amplified speakers and by the Zoom audience. Use the input two level control on the audio mixer to control the Zoom audio level in the meeting room.

WVDXC has an hour-long online ragchew prior to the official start of club meetings. This allows members to socialize and talk about whatever the topic of the day is. Out of respect for our speakers and presenters, they're scheduled promptly at the start of the club meeting. Any other club business is held after the presentation has finished.

Once your meeting is over, the equipment and cabling should be repackaged in their original boxes and cases. All of the equipment shown in Figure 1 can easily fill up the rear of an SUV. Carefully track all of the equipment so it's ready for your next club meeting.

Attracting New Members

Publicizing your club's hybrid capability with other local clubs, and even not-so-local clubs, can allow potential new members to join your monthly meetings and see what activities take place. WVDXC has added many new members as a result of this convenient format!

Write for "Club Station"

QST's "Club Station" column is a designated space for clubs to share specific and practical ideas about what has contributed to their success, in the hope that the information will help other clubs grow and thrive. Visit **www.arrl.org/qst-club-station-guidelines-and-profile-form** for more information, including author guidelines and a Club Profile Form (this form is required in order for "Club Station" submissions to be considered complete).

ARRL Special Service Clubs

ARRL offers the Special Service Club (SSC) program for clubs that demonstrate that they're working to improve the amateur radio community by completing special projects, holding license classes, and working with local groups on events, among other activities. Visit **www.arrl.org/ssc-application** for more information about this program. Below is a list of new and renewing SSCs as of October 19, 2023.

Renewing SSCs

Northeastern Indiana ARA, W9OU	Auburn, IN
ARC of Columbia County, K4KNS	Evans, GA
Atlanta Radio Club, W4DOC	Atlanta, GA
Mid-Atlantic ARC, WB3JOE	Eagleville, PA
Holmesburg ARC, WM3PEN	Philadelphia, PA
Chehalis Valley ARS, K7PG	Chehalis, WA

Steve Goodgame, K5ATA, sgoodgame@arrl.org

Ham Media Playlist

K7AGE — A No-Nonsense Approach to Helping Hams

I often say that amateur radio operators were doing STEM before STEM was a thing. Hams have always enjoyed being at the forefront of wireless technology, seeking ways to innovate and improve. We hams have also always enjoyed talking to each other about amateur radio — our favorite modes, our antennas, and our shacks. This is what got Randy Hall, K7AGE, started on YouTube. Randy published his first video on August 21, 2006. (For reference, YouTube was created in 2005, so he was one of the first amateur radio YouTubers, or HamTubers, out there.)

Establishing K7AGE in the Early Days of YouTube

"K7AGE, hamshack tour" (**https://tinyurl.com/k7age-shack**) was the first video that Randy posted. To put in perspective just how long ago that was, to post the video, Randy had to connect his camcorder via FireWire to his desktop computer. The result was, by modern standards, grainy with poor audio. For 2006, this was cutting-edge, and Randy was living on that edge. That video has garnered more than 64,000 views to date.

As time went on, Randy experimented with different types of videos, while simply doing what he was interested in, and recording videos of himself operating his station. Randy even took part in a YouTubers on the Air event 16 years ago (**https://tinyurl.com/k7age-ytota**)!

Grainy footage of Randy's, K7AGE, first-ever YouTube video in 2006.

Randy's YouTube channel slowly and steadily grew, until the day he posted a video titled "How to receive PSK-31, Introduction" (**https://tinyurl.com/k7age-psk31**). This video served as the catalyst that propelled the channel to where it is today. He posted it in 2007, when PSK-31 was gaining in popularity as an amateur radio digital mode. In this how-to video, Randy introduces viewers to PSK-31 and gives a bit of history about it. He then steps users through the process of downloading and configuring the needed software. One of my favorite things about this video is what I found in the comments. Viewers who were not licensed amateur radio operators were commenting and taking an interest in amateur radio, as were hams who were interested in trying out this "new" digital mode. Randy was using YouTube to reach newcomers 16 years ago.

As a new ham, Randy was fortunate to have his father as his mentor when he was first licensed in 1968. Later, when he was in college and getting into FM RTTY operations, he found yet another mentor, Bob, WA2MQX (SK). After posting his first how-to video about PSK-31, Randy became a sort of mentor to the masses. He saw the popularity of, and need for, that kind of video, so he sought to fill the gap that many hams were experiencing.

Installing a Tower, Activating POTA, and More

Randy has learned that his viewers enjoy the feeling of looking over his shoulder when he is teaching. Whether he is building a kit or an antenna, receiving SSTV images from the International Space Station, or activating parks for Parks on the Air (POTA), his viewers love the feeling of being along for the ride. As such, Randy's channel has grown to more than 43,000 subscribers.

Many hams dream of having a tower. The process of installing a tower can be daunting, though. Randy created a 10-part series called "K7AGE Tower & Antenna Project" (**https://tinyurl.com/k7age-tower**). This se-

As part of Randy's, K7AGE, tower installation series, he demonstrates how to mount the rotor to the tower.

ries steps viewers through the entire process Randy went through to get his new tower installed. From preplanning all the way to installing antennas, Randy shares the experience with his viewers so they will feel more comfortable planning their first, or next, tower installation.

This series goes into just enough detail to help viewers understand the requirements of the job, but it isn't so detailed that viewers get lost. For example, when Randy explains the process of mounting the rotor assembly to the tower, he points out the basics of mounting the plate, the thrust bearing, and the mast, without expecting viewers to watch every little step of the process.

Additionally, Randy thoroughly enjoys operating in the POTA program. Traveling with his Micro Minnie camp trailer in tow, Randy enjoys stopping at parks and activating them. In "K7AGE's first POTA Activation" (**https://tinyurl.com/k7age-pota**), Randy attempts his first activation at Humboldt Lagoons State Park (K-1162). Randy's first-ever POTA contact is with Gary, KEØYZB, with whom Randy has a quick QSO. He explains to Gary that he is his first POTA contact. Randy's enjoyment during the activation is evident. He doesn't rush his contacts, but rather takes the time to enjoy each one.

Taking Time for Hams

In addition to helping hams on YouTube, Randy regularly presents at various hamfests. He has presented on various topics at Pacificon, SEA-PAC, and Quartzfest, and his presentations are always well received.

Having met Randy in person, I found him to be not only a wealth of good information, but a true delight to talk to. He takes the time, both in person and on video, to walk people through the material he is helping them with, at a pace and level of detail necessary to not only accomplish the task, but to help viewers feel comfortable doing so.

Randy's YouTube channel can be found at **www.youtube.com/@K7AGE**. There you'll find his no-nonsense way of helping viewers learn about and enjoy amateur radio.

Randy, K7AGE, set up with his camper and vertical antenna, ready to attempt his first POTA activation.

Bernie McClenny, W3UR, w3ur@arrl.org

How's DX?

FO/C — Clipperton Island

Clipperton Island is an uninhabited French atoll located more than 1,200 kilometers (about 745 miles) southwest of Acapulco, Mexico. Clipperton Rock, situated on the southeast side of the atoll, is its highest point at about 29 meters (roughly 95 feet) above sea level. It is named after historic English privateer John Clipperton.

A map of Clipperton Island (FO/C). It currently ranks number 37 on Club Log's DXCC Most Wanted List.

DXCC History

Clipperton Island was originally included in the ARRL DXCC list published in February 1947, and it wasn't until April 1954 that the first FO/C DXpedition, FO8AJ, was completed. Sponsored by Hallicrafters, the operation was conducted by former ARRL President Bob Denniston, WØNWX; Leo Olney, WØNUC; Gene O'Leary, WØVDQ; Vern Hedman, and Tom Partridge. It took the team two tries to make it to Clipperton — during their first attempt aboard the *Sea Rider*, their sextant broke, leaving them with no way of continuing the voyage. On the second attempt aboard the *Barca de Oro II*, they faced "oil- and water-line leaks, thunderstorms, torn sails, [a] leaky hull, a dead battery in the ship's 32 V system, and generator-starting trouble" (see Bob Denniston's "DXpedition to Clipperton...The Story of FO8AJ" in the July 1954 issue of *QST*), but successfully landed on April 23. The team logged about 1,100 contacts.

Four years later, members of the San Diego DX Club teamed up with International Geophysical Year scientists to conduct the FO8AT DXpedition. On August 1,1958, both parties departed San Diego, California, via the *Spencer F. Baird* and arrived on Clipperton 6 days later. A storm delayed operations for 1 day, so the FO8AT team was active on CW, AM, and single sideband (SSB) on August 8 – 23.

In November 1960, famed DXpeditioner Danny Weil, VP2VB, and his wife, Naomi, departed Quito, Ecuador, aboard the *YASME III*. The pair stopped at the Galápagos Islands (HC8) before sailing to Clipperton for the FO8AN DXpedition. After setting up his Hallicrafters HT-32 and SX-101, he made several hundred contacts in about 4 hours. The next morning, "…Danny discovered that his anchor winch [had] rusted up and was inoperative," according to *YASME: The Danny Weil and Colvin Radio Expeditions* by James D. Cain, K1TN. He was eventually able to return to the atoll and work about 700 more stations before ending the operation.

Almost 2 decades later, Clipperton Island was climbing higher on the most-wanted lists. A team of hams from France, Switzerland, and the US headed there for the FOØXA DXpedition in March 1978, which led to the founding of the Clipperton DX Club. The call signs of those team members were as follows: F5II, F6AOI, F6AQO, F6ARC, F6BBJ, F6BFH, F9IE, F9JS, HB9AHL, HB9AEE, HE9SWL, WA4WME, W6HVN, N6IC, W6QKI, W6SO, and WA9INK. They made more than 29,000 contacts.

In April 1985, another international DX team operated from Clipperton as FOØXX. Their individual call signs were DJ9ZB, F6GXB, F9LX, FO8GW, JG3LZG, K3NA, KK6X, N6GJ, N7NG, TI2CF, W6OAT, W8TN, WA7NIN, and XE1ZZA. There, they used five stations on all bands from 1.8 to 50 MHz to make almost 31,000 contacts. N7NG and W6OAT went back to Clipperton a year later, along with W6RGG, W6SZN, and AI6V. Using the same call sign as the previous year, they were active for 4½ days and made about 16,000 contacts.

Another FOØXA Clipperton DXpedition was conducted only 4 months later by French operators with the call signs FO8LP, F6HSW, and F6GXB. This team made 3,653 contacts in 45 hours.

The next Clipperton Island operation, FOØCI, occurred in March 1992. It was originally scheduled for early 1991 but was delayed due to the Persian Gulf War. The team of nine had seven radios and made 46,000 contacts. Their call signs were NØAFW, WA2FIJ, N7QQ, N7CQQ, GØLMX, ON6TT, N9NS (SK), PA3DUU, and WA6FGV.

FOØAAA was active from Clipperton in March 2000. This team consisted of JK7TKE, HB9AHL, N6TQS, VE5RA, EA3NY, N9NS, NØTT, N7CQQ, K4UEE, ON4WW, N9TK, and 9V1YC. With their five stations, they made more than 75,000 contacts.

In March 2005, Vincent Ortega, F5MJV, operated on the atoll for only a few hours as FOØ/F8UFT.

During late February and early March 2008, the 9-day TX5C DXpedition yielded 71,794 contacts. Individuals on this team held the following call signs: N6OX, N7CQQ, K4SV, N2WB, N6HC, W8AEF, WA1S, K6SGH, K3VN, F2JD, F5AHO, F5PAC, VA7DX, F6BFH, F5JY, F8FDN, FM5CD, F6FVY, K8LEE (SK), and K4ZLE.

In March 2013, yet another international team activated Clipperton as TX5K. This group included USØVA, KE3D, W7GJ, NP4IW, F1NGP, DD2CW, DJ2HD, KF4ZZ, OZ1IKY, KK6EK, XE1L, US5WDX, I5JHW, N6XG, DL5LYM, WA6O, DJ9RR, DL3DXX, DL1MGB, DJ5IW, DJ7EO, WJ2O, and SP5XVY. In 8 days, they made 113,603 contacts — 24,414 of them were unique call signs.

Finally, the most recent operation from Clipperton was by Alain Duchauchoy, F6BFH, who went there for a scientific expedition in April 2015. He was on the air in his spare time as TX5P, and he made about 3,600 contacts.

Upcoming TX5S DXpedition to Clipperton

In March 2022, members of the Perseverance DX Group (PDXG) announced their plans to conduct a Clipperton Island DXpedition as TX5S on January 18 – February 2, 2024. Clipperton currently ranks number 37 worldwide on Club Log's DXCC Most Wanted List. PDXG is the same group that carried out the TX5N DXpedition from the Austral Islands in 2022 (see the November 2022 "How's DX?" column) and the 2020 VP8PJ DXpedition from the South Orkney Islands.

In a joint statement, the PDXG informed me, "Now [that it is] designated a protected environmental reserve, visits to Clipperton require a lengthy and detailed application process." But thankfully, they have "previous experience [in] sensitive and [United Nations Educational, Scientific and Cultural Organization] World Heritage locations," so the French government issued the team's landing permit.

The TX5S Team

The TX5S team will include DXpedition leader Jacky Calvo, ZL3CW/F2CW; co-organizer Dave Lloyd, K3EL; co-organizer Steve Dyer, W1SRD; co-organizer and treasurer Gene Spinelli, K5GS; medical officer Arliss Thompson, W7XU; Heye Harms, DJ9RR; Walt Wilson, N6XG; Rob Fanfant, N7QT; Chris Tate, N6WM; Glenn Petri, KE4KY; Ricardo Rodrigues, PY2PT; Andreas Junge, N6NU; Dave Jorgensen, WD5COV; Nodir Tursun-Zade, EY8MM; Paul Ewing, N6PSE, and Allan Batievsky, EA3HSO.

The following pilot stations will maintain communications between the TX5S team and various DX communities around the world: chief pilot Curt Foote, WX4W, will handle North America; Joe Aoki, JJ3PRT, will handle Japan; Alex Teimurazov, 4L5A, will specifically handle Russian-speaking hams; Luke Steele, VK3HJ, will be in charge of Oceania; Andre Pretorius, V51B, will handle Africa; Claudio Gimenez, PY2KP, will handle South America, and Björn Dettmaring, ON9CFG, will handle Europe.

Band Plan

TX5S will be strictly operating split on CW, SSB, RTTY, and FT8 on 1.8 – 50 MHz. Remember to refrain from transmitting on their transmit frequency. You can listen for them on the following frequencies for each mode:

CW: 1826.5, 3523, 7010, 10105, 14023, 18069, 21023, 24891, and 28023 KHz

SSB: 3790, 7090, 14195, 18130, 21285, 24955, and 28485 KHz

RTTY: 7045, 10142, 14080, 18105, 21080, 24910, and 28080 KHz

FT8: 1836, 3567, 5357, 7056, 10131, 14092, 18095, 21091, 24911, 28091, and 50313 KHz

For further reference, TX5S has a helpful "How to Work Us" web page at **www.clip.pdxg.net/how-to-work-us**.

Change of Plans

In the November 2023 "How's DX?" column, I mentioned that the Intrepid DX Group would be going to Temotu Province as H4ØWA from October 26 to November 9. Since that announcement, the team changed their dates due to shipping and flight issues. The DXpedition is now scheduled to take place on February 22 – March 7. More details can be found at **www.intrepid-dx.com/temotu2023**.

Wrap-Up

That's all for this month. Don't forget to send your DX news, photos, and club newsletters to **bernie@dailydx.com**. Until next month, see you in the pileups! — *Bernie, W3UR*

Jon Jones, NØJK, n0jk@arrl.org

October HF DXpeditions Bring Rare DX to 6 Meters

Throughout October, several DXpeditions in rare entities were active on 6 meters. The W8S team on Swains Island made 6-meter Earth-Moon-Earth (EME) contacts with KJ9I and Terry, K4RX (EM85), who was the second ham to work W8S, followed by NØTB. Terry applauded the Swains Island team's "Herculean" effort to operate 6-meter EME. W8S also made some terrestrial 6-meter contacts, first with Bob, K6QXY, on FT8, and then with FK8CP and VK4HJ. It is unclear whether KJ9I or Bob was the first to work W8S on 6 meters. Additionally, TO8FH in Mayotte was on 6 meters, and Dave, N4QS (EM56), logged the station on FT8 on October 19. He noted that TO8FH was running 50 W to a 6-meter Yagi, which was suspended in a tree at only 2.5 meters off the ground! Greg, N9PGG (FM05), and Jeff, W7JW (EN82), worked TO8FH on the same band the next day. T2C in Tuvalu later made 6-meter contacts with stations in California and Hawaii.

The PSK Reporter flags for Warwick Latham, E51WL, on 6 meters, seen in the evening of October 22, 2023. [**www.pskreporter.info/pskmap**]

The W6JKV and K5AND 6-Meter BBQ

Jimmy Treybig, W6JKV, and Dick Hanson, K5AND, hosted their 27th annual 6-meter BBQ in Austin, Texas, on September 29 – 30. I and the other attendees enjoyed great food and camaraderie at the event, and it was rewarding to meet DX operators like Dale Green, CE2SV; Peter Taylor, G8BCG; Paul Haavin, LB2TG; Héctor García, XE2K, and others in person. There was an outstanding presentation lineup on the second day. I opened with a short talk on "The World Above 50 MHz" column and radio activity on the Galápagos Islands. Mike Crownover, AB5EB, reviewed the challenges faced by the 3YØJ team on their 2023 Bouvet Island DXpedition. And later, Joe Taylor, K1JT, gave a presentation on *WSJT*, during which he referred to *WSJT-X* as "the finest arcade game in radio land." An interesting takeaway from Joe's presentation is that the frequencies used for various *WSJT-X* modes, such as 50.313 MHz for FT8, can be changed as the amateur radio community sees fit. There was further discussion about moving the 6-meter Q65 and FT8 frequencies. Carl Luetzelschwab, K9LA, also provided an outstanding analysis of Solar Cycle 25 and various 6-meter propagation topics. Lance Collister, W7GJ, detailed his 2023 3B9GJ 6-meter EME DXpedition. Al Ward, W5LUA, discussed EME on the microwave bands, and Hector, XE2K, concluded with a practical discussion about coaxial connectors and how to weatherproof them. You can view all the presentations from the event at **www.w6jkvk5andbbq.com/tech-talks**.

Rare South Pacific and Indian Ocean Openings

October 20 – 23 had memorable 6-meter activity. There were widespread openings to the South Pacific and the Indian Ocean from North America, along with considerable stateside sporadic E. Starting on October 20, many stations along the eastern seaboard, including Rich Zwirko, K1HTV, and Ken, KE2N, worked 3B9FR. Clark, W8TN (EM98), spotted 7Q7EMH. Rich also noted E_s to transequatorial propagation (TEP) toward South America that afternoon. That evening, stations in the South Pacific were being detected by those in the northeast. Rich identified ZL1RS, ZL3RC, and VK4WTN, and then he received PSK flags from VK4WTN, VK4MA, and VK4HJ. W8TN worked VK4HJ for a new country. Larry, NØLL, was operating portable in EM18, and Tom, N4HN

(EM95), worked Larry along with stations in Argentina and Brazil. Andy, W3SW, worked LW2DO (FF94) with a three-element Yagi elevated 20 feet.

Glenn, K3SWZ (FN10), reported logging VK4WTN, FK8HA, and 3B9FR for new countries on October 21. N4HN also worked FK8HA. Ron Todd, K3FR (FM18), detected an E_s-to-TEP link toward LW2DO (FF94) with his indoor antenna. Tom, W3TA (FN20), worked eight Argentinian stations on CW and single sideband (SSB). K7ULS in Utah noted stations in South America, too. Bob, W9EWZ (EN52), worked six New Zealand stations, with ZL3AAU peaking at +28 dB. W8TN worked FK8HA, and later, K1HTV worked VP8LP, many others in South America, and VP8NO. By that evening, K1HTV copied FK8HA and FK8CP with a solar flux index of only 123. I, NØJK, was in Arizona at the time. From my hotel room in Scottsdale, I copied NØLL (EM09), NØKQY (DM98) — who was calling FK8CP — and NØOT (DM88) on E_s at 1950 UTC. Mike, N1XK (EN32), worked ZL1RS at 1842 UTC while running only 70 W; before that contact, NØLL received FK8CP and ZL1RS while operating mobile with a Hamstick antenna. Gary, NØKQY (DM98), worked four New Zealand stations, with ZL1RS at +31 dB. I suspect this occurred due to the same E_s cloud with which I copied NØKQY, NØLL, and others.

In the evening on October 22, I (DM43) worked W5JAY (EM26) via FT8 E_s with 7 W and an indoor dipole at 0136 UTC. W8TN logged E51WL, as did NØLL. N4II (EM70) received YE1BON via short-path propagation at 0145 UTC. At 2353 UTC, Rick, W5EME (EM32), worked E51WL on SSB. W5JAY logged 3D2AG at around 0025 UTC.

On October 23, Glenn, WØGJ (EN43), noted 3B8CW, 3B8FA, and 3B9FR on the air for 90 minutes. Clive's, 3B8CW, signal was strong at +0 dB. He uses a four-element Moxon and 300 W. Jim Wilson, K5ND (EM12), logged E51WL on FT4. Contacts can be made faster on FT4, so the pileups for rare DX entities on that mode can be less intense. Glen, WAØFMY (EN11), worked ZL1RS at 1900Z on the same day. Sporadic E played a major role in these activities, though this type of propagation is rare in October. However, E_s can link to TEP, and there was an unexpected coronal mass ejection impact on October 20. The Kp index changed to 5, which elevated the F-layer maximum usable frequency, extended the TEP zones, and perhaps enhanced the E_s. So, a fortuitous combination of rare out-of-season sporadic E and geomagnetic storming helped create magic on 6 meters.

On the Bands

50 MHz. On October 7, there was a late-evening E_s-to-TEP opening. I noted sporadic E from Kansas to Arizona and Northern Mexico. Later, an E_s link from my, NØJK (EM28), location to Dale, CE2SV, resulted in a contact at 0136Z. I also copied CE3SOC and XQ3MCC, and NØLL worked stations in South America. The next morning, Martin, PJ4MM (FK52), worked 4W/JH2EUV (PI21) with a +12 dB signal report, and he worked JA6GNL via long path at around 1445Z. There were almost daily morning long-path openings from the Caribbean and Central America to Malaysia and other countries in East Asia throughout mid-October. On October 10, Juan, TG9AJR (EK44), reported that he made "easy" long-path contacts to China, Hong Kong, Malaysia, and more. The next day, the long-path opening extended to Florida. Ken Reecy, AC4TO (EM70), worked JH5FXP at 1326Z for his first-ever long-path contact on 6 meters. He later logged JM1SZY, JN1JFC, and JE6AZU at 1344Z. On October 17, 9Z4Y (FK90) copied 4S7AB.

Bob, N4XU (EM73), had a great opening to South America on October 27, logging stations in Uruguay, Argentina, and VP8LP in the Falkland Islands. The next day, Dave, N4QS (EM56), worked 3B9FR at 1503 UTC. He said that Robert, 3B9FR, was using a new quad antenna. Steve, NN4T, worked 3B9FR at 1450 UTC on October 29 using a remote station in FN65. 3D2AG (RH91) worked UN8GEQ (MN83) and EX8MLE (MN72), and AAØMZ (EM29) spotted HC1MD/2. NØLL later worked VP8LP. Stations along the Gulf Coast, including W5EME (EM32), worked ZL7DX at around 2150 UTC. I, NØJK, copied PP5AMP.

144 MHz. Ron Klimas, WZ1V (FN31), noted strong tropospheric propagation into Florida on October 25, and his best DX was WB4OMG (EL98) on FT8 at a distance of 1,698 kilometers. He worked K2IL (EL97) and W4AS (EL95) on October 26.

432 MHz. On October 5, Ron, K3FR, worked K1WHS (FN43) from 739 kilometers away on FT8 during the 70-centimeter sprint. Ron used his indoor Yagi for this contact. He said that during the contest, there was tropospheric propagation from Nova Scotia, Canada, to Georgia. Dave, K1WHS, noted AA4ZZ (EM96) was 59+ dB on 222 and 432 MHz.

Here and There

The Quadrantid meteor shower will be active on January 3 – 4 this year. The predicted peak will be at 1253 UTC on January 4 with more than 100 meteors per hour, during which the radiant will be visible from North America. The best path at the peak is northeast to southwest — this shower is best for 6 and 2 meters.

Convention and Hamfest Calendar

A = AUCTION
D = DEALERS / VENDORS
F = FLEA MARKET
H = HANDICAP ACCESS
Q = FIELD CHECKING OF QSL CARDS
R = REFRESHMENTS
S = SEMINARS / PRESENTATIONS
T = TAILGATING
V = VE SESSIONS

Abbreviations

Spr = Sponsor
Tl = Talk-in frequency
Adm = Admission

Arizona (Glendale) — Jan. 13 H Q R S T V
7 AM – noon. *Spr:* Thunderbird ARC, Amateur Radio Council of Arizona. Haven Church, 5902 W. Cactus Rd. *Tl:* 146.040 (162.2 Hz), 446.15 (100.0 Hz). *Adm:* $5. **www.tbirdfest.org**

QUARTZFEST CONVENTION

January 21 – 27, Quartzsite, Arizona

F H S T V
All day, every day. *Spr:* Quartzfest Committee. Road Runner short-term BLM camping area, US-95 and La Paz Valley Rd. N. *Tl:* 146.55 (simplex). *Adm:* Free. **www.quartzfest.org**

Colorado (Loveland) — Jan. 20 D H R S V
8 AM – 1 PM. *Spr:* Northern Colorado ARC. The Ranch Events Complex, 5280 Arena Cir. *Tl:* 448.025 (100 Hz). *Adm:* $7. **www.ncarc.net**

Florida (Fort Myers) — Jan. 19 – 20 D H Q R S T V
Fri. 12 PM – 5 PM, Sat. 8 AM – 4 PM. *Spr:* Fort Myers ARC. Florida SouthWestern State College Building U, 8099 College Pkwy. *Tl:* 145.170 (136.5 Hz). *Adm:* $10. **www.swflhamfest.info**

Florida (Orlando) — Jan. 13 F H T
6 AM – noon. *Spr:* South Conway Road Baptist Church, 6099 S. Conway Rd. ZIP code 32812. *Adm:* Free. **k4kdi.square.site**

ARRL FLORIDA STATE CONVENTION

February 9 – 11, Orlando, Florida

D F H Q R S T V
Fri. and Sat. 9 AM – 5 PM, Sun. 9 AM – 1 PM. *Spr:* Orlando ARC. Central Florida Fair, 4603 W. Colonial Dr. *Tl:* 146.73 (103.5 Hz). *Adm:* $20 Advance, $25 door. **www.hamcation.com**

WINTER FIELD DAY & TAILGATING

January 27, Scout Key, Florida

T
10 AM – 6 PM. *Spr:* Conch Auxiliary Radio Emergency Services. GSA Camp Wesumkee, 34200 Overseas Hwy. *Tl:* Monroe County repeaters. *Adm:* Free. **www.keyscares.net**

ARRL MIDWEST DIVISION CONVENTION

January 27, Collinsville, Illinois

D F H Q R S V
8 AM – 1 PM. *Spr:* St. Louis and Suburban Radio Club. Gateway Convention Center, 1 Gateway Dr. *Tl:* 146.85 (141.3 Hz). *Adm:* $12 Advance, $14 door. **winterfest.slsrc.org**

Illinois (St. Charles) — Jan. 14 F H R S V
8 AM – 1 PM. *Spr:* Wheaton Community Radio Amateurs. Kane Co. Fairgrounds, 525 S. Randall Rd. *Tl:* 145.31 (107.2 Hz). *Adm:* $8 Advance, $10 door. **www.w9ccu.org**

Indiana (Danville) — Feb. 10 D F H
9 AM – 1:30 PM. *Spr:* Hendricks Co. ARS. Hendricks Co. 4-H Fairgrounds and Conference Center, 1900 E. Main St. *Tl:* 147.015 (88.5 Hz). *Adm:* $7. **www.n9hc.org**

Louisiana (Ponchatoula) — Jan. 20 D F H Q R S V
8 AM – 4 PM. *Spr:* Southeast Louisiana ARC. Ponchatoula Community Center, 300 N. 5th St. *Tl:* 147.000 (107.2 Hz). *Adm:* $5. **www.selarc.org**

ARRL MISSISSIPPI STATE CONVENTION

February 2 – 3, Jackson, Mississippi

D F H Q R S T V
Fri. 4 PM – 7 PM, Sat. 8 AM – 3:30 PM. *Spr:* Jackson ARC. Mississippi Trade Mart, 1200 Mississippi St. *Tl:* 146.76 (77 Hz). *Adm:* $10. **www.msham.org**

New Mexico (Albuquerque) — Jan. 27 F H R T
Sunrise – 11 AM. *Spr:* 146.580 Simplex Group. Stoneface Tavern parking lot, 8201 San Pedro Dr. NE. *Tl:* 145.330 (100 Hz), 444.000 (100 Hz). *Adm:* Free. Email: **k5tee@arrl.net**

New York (Almond) — Feb. 3 D F H R
7 AM – noon. *Spr:* Keuka Lake ARA. Almond Community Building, 1 Marvin Ln. *Tl:* 147.045 (110.9 Hz). *Adm:* Free. **www.klara.us**

New York (Marathon) — Jan. 13 F H R V
7 AM – noon. *Spr:* Skyline ARC. Marathon Civic Center, 11 Brink St. *Tl:* 147.180 (71.9 Hz). *Adm:* $6. **www.skylinehamradioclub.org**

Ohio (Shade) — Jan. 14 D F H R V
8 AM. *Spr:* Sunday Creek Amateur Radio Federation. Shade Community Center, 2380 Old Rte. 33. *Adm:* $6. Email: **jeramy_duncan30@yahoo.com**

Pennsylvania (Harrisburg) — Jan. 13 D F H Q R
7 AM – 11 AM. *Spr:* Harrisburg Radio Amateurs Club. Vietnam Veterans Association Building, 8000 Derry St. *Tl:* 147.075 (123 Hz). *Adm:* $5. **www.w3uu.org**

ARRL PUERTO RICO STATE CONVENTION

January 12 – 14, Hatillo, Puerto Rico

D F H Q R S V
9 AM – 4:30 PM. *Spr:* Caribbean Amateur Radio Group, ARRL Puerto Rico State Convention, Inc. Coliseo Francisco "Pancho" Deida, F5MM + H3H, C. Tulipán. *Tl:* 147.37 (77 Hz), 448.300 (100 Hz), 146.52. *Adm:* Free. **www.arrlpr.com**

ARRL NORTH TEXAS SECTION CONVENTION

January 19 – 20, Forest Hill, Texas

D F H R S T V
Fri. 3 PM – 7 PM, Sat. 7 AM – 3 PM. *Spr:* Cowtown ARC. Forest Hill Civic and Convention Center, 6901 Wichita St. *Tl:* 146.940 (110.9 Hz). *Adm:* $8 Advance, $10 door. **www.cowtownhamfest.com**

To All Event Sponsors

Before making a final decision on a date for your event, you are encouraged to check the Hamfest and Convention Database (**www.arrl.org/hamfests-and-conventions-calendar**) for events that may already be scheduled in your area on that date. You are also encouraged to register your event with HQ as far in advance as your planning permits. See **www.arrl.org/hamfest-convention-application** for an online registration form. Dates may be recorded up to 2 years in advance.

Events that are sanctioned by ARRL receive special benefits, including an announcement in these listings and online. Sanctioned conventions are also listed in *The ARRL Letter.* In addition, events receive donated ARRL prize certificates and handouts. Once the form has been submitted, your ARRL Director will decide whether to approve the date and provide ARRL sanction.

Special Event Stations

Working special event stations is an enjoyable way to help commemorate history. Many provide a special QSL card or certificate!

Dec. 16 – Dec. 23, 1400Z – 0600Z, KC5OUR, Belen, NM. Valencia County Amateur Radio Association. **Christmas in Bethlehem, New Mexico**. 7.183 14.283 21.283 28.383. QSL. VCARA, P.O. Box 268, Peralta, NM 87042. **kc5our@arrl.net**

Jan. 2 – Jan. 31, 0000Z – 2359Z, K3Y/0 – 9, KH6, KL7, KP4, and DX member stations in six WAC areas, Worldwide. SKCC — Straight Key Century Club. **18th Annual Straight Key Month**. 3.550 7.055 14.050 21.050. Certificate & QSL. SKCC c/o Ted Rachwal, K8AQM, 6237 Twin Lakes Dr., Smiths Creek, MI 48074. *QSL card confirms one QSO per area, up to 19 for all-area sweep. See website for operating schedule, map, stats, etc*. **www.skccgroup.com/k3y**

Jan. 6, 1600Z – 2200Z, W9RH, Milwaukee, WI. Milwaukee Radio Amateurs' Club. **107th Anniversary**. 7.250 14.250 21.350 145.390. E-certificate. Email **specialevent@w9rh.org**. Also celebrating 105 years of ARRL affiliation. *We'll be on HF, our VHF repeater, or WIRES-X (#43588).* **www.w9rh.org/special-event-station**

Jan. 6 – Jan. 7, 1300Z – 2200Z daily, K2S, Bushnell, FL. Hog County Amateur Radio Association (K4HOG**). Second Seminole Indian War Reenactment**. 14.045 14.250 21.325 28.450. Certificate. Gene King, KI4LEH, 4655 NW 68th Blvd., Lake Panasoffkee, FL 33538. **k4hogfl@gmail.com** or **www.k4hog.org**

Jan. 13 – Jan. 14, 1400Z – 2200Z, K5S, Beaumont, TX. Beaumont Amateur Radio Club. **123rd Anniversary of the Lucas Gusher**. 3.870 7.250 14.074 14.250. Certificate and e-certificate. Beaumont Amateur Radio Club, 4839 Hwy. 326N, Kountze, TX 77625. **k5s.lucasgusher@gmail.com** or **www.w5rin.com**

Jan. 20, 1600Z – 2200Z, W8VP, Cambridge, OH. Cambridge Amateur Radio Association. **110th Anniversary**. 14.240. Certificate and e-certificate. Jim Shaw, 46006 King St., Caldwell, OH 43724. **ab8pjlshaw@yahoo.com** or **www.w8vp.org**

Jan. 22 – Jan. 25, 0000Z – 2359Z, W7Q, Quartzsite, AZ. Northern Arizona DX Association. **Distance Challenge at Quartzfest**. All bands, all modes. *See website for information. This is an operating event happening during Quartzfest*. **www.nadxa.com**

Jan. 27 – Jan. 28, 1900Z – 1859Z, W5BCS, Bryan, TX. Bryan Amateur Radio Club. **Winter Field Day with BARC**. 7.250 14.270. QSL. Bryan Amateur Radio Club, P.O. Box 4442, Bryan, TX 77805. **www.w5bcs.radio**

Jan. 27 – Jan. 29, 1700Z – 0100Z, AG6AU, Coloma, CA. El Dorado County Amateur Radio Club. **Discovery of Gold in California**. 7.248 14.248 21.348 28.348. QSL. El Dorado County ARC, P.O. Box 451, Placerville, CA 95667. **www.edcarc.net**

Certificates and QSL cards: To obtain a certificate from any of the special event stations offering them, send your QSO information along with a 9 × 12-inch self-addressed, stamped envelope (3 units of postage) to the address listed in the announcement. To receive a special event QSL card (when offered), be sure to include a self-addressed, stamped business envelope along with your QSL card and QSO information.

Special Events Announcements: For items to be listed in this column, use the ARRL Special Events Listing Form at **www.arrl.org/special-events-application**, or email information to **events@arrl.org**.

Submissions must be received by ARRL HQ no later than the 1st of the second month preceding the publication date; a special event listing for **April** *QST* would have to be received by **February 1.** In addition to being listed in *QST*, your event will be listed on the ARRL Web Special Event page. **Note**: All received events are acknowledged. If you do not receive an acknowledgment within a few days, please contact us. ARRL reserves the right to exclude events of a commercial or political nature.

You can view all received Special Events at **www.arrl.org/special-event-stations**.

Strays

Book Translated to Share Knowledge

The Gesellschaft der Freunde der Geschichte des Funkwesens (GFGF) of Germany has had their book *A Short History of Radio Communication Receivers in Functional Diagrams 1929 – 1983: GFGF Series on Radio History Volume 10* translated to English. The book provides insight into the technical development of radio message receivers for commercial radio services, and the Amateur Radio Service from electron tube technology to the first phase of semiconductor technology. There is a fact sheet available in English at **www.miller-e-books.de/presseinfos/A_short_history_of_Communication_Receivers-Miller_E-Books_PM.pdf**. The book is available in a Kindle version from Amazon.

Christina Lessard, clessard@arrl.org

At the Foundation

New ARRL Foundation Scholarships

The ARRL Foundation Board of Directors is pleased to announce three new scholarships established to assist amateur radio operators with college or university costs.

The Hy and Mimi Ginsberg Memorial Scholarship

David Ginsberg, N3BKV, established an annual $4,000 scholarship in memory of his parents, who supported his passion for amateur radio. The scholarship is available to students attending any college or university and in any academic discipline. Students performing at a high academic level who demonstrate financial need will be given preference.

The CARA Merit Scholarship

The Columbia Amateur Radio Association (CARA) of Howard County, Maryland, will sponsor a $3,000 scholarship. Applicants must demonstrate they are active in amateur radio, and preference will be given to Maryland residents.

The Michael, K8MJH, and Mary, KC8OIP, Holt Scholarship

Endowed through the generosity of Michael (SK) and Mary Holt, this annual scholarship will provide two students with $2,500 each, renewable for up to 3 years, provided the applicant maintains a GPA of 3.0 or higher. Applicants pursuing a degree in engineering and those with a General-class amateur radio license or higher will be given preference.

The 2024 scholarship open application period began on October 30, 2023, and will remain open until January 10, 2024. We encourage licensed, active amateur radio high school seniors or students attending college next year to apply. Awards will be announced in the spring of 2024.

Full eligibility requirements for all scholarships can be found at **www.arrl.org/scholarship-descriptions**. To learn more about the ARRL Foundation Scholarship Program, visit **www.arrl.org/scholarship-program**.

Congratulations

October 2023
QST Cover Plaque Award Winner

Al Rovner, K7AR

In his article, "An Introduction to *WSJT*'s DXpedition Mode," Al reviews DXpedition mode's two major features, Fox and Hound, and shares his experiences operating as a Fox.

QST Cover Plaque Awards are given to the author or authors of the most popular article in each issue. *You* choose the winners by casting your vote online at

www.arrl.org/cover-plaque-poll

Log in now and choose your favorite article in this issue!

An Introduction to WSJT's DXpedition Mode

Learn how Fox and Hound mode allows DXpeditions to fill their logs and make contacts on multiple bands.

Al Rovner, K7AR

I first heard of FT8 in 2017, right before leaving for a DXpedition to Samoa as 5W0RA. I didn't know much about it, other than that it was a new audio-based mode for amateur radio. I installed it on my laptop and read over the documentation on the flight.

I set up my station with the audio gear connected already, as I planned on using RTTY, and it was easy to get the *WSJT* software running. I initially found FT8 to be slow and tedious. It's typical for DX stations to have a backup of more than 15 – 20 stations calling them. With FT8, each station is contacted serially, so they might have to wait a long time before making a contact.

Fortunately, the creators of *WSJT* realized this, and added a new feature in 2018, called FT8 DXpedition mode. (What we call "Fox and Hound mode" is more accurately called "DXpedition mode.") This mode allows an expedition to contact stations in parallel, while managing multiple contacts during one 15-second cycle.

In this article, I'll review the two major features of DXpedition mode, called Fox and Hound, and share my experiences operating as a Fox.

DXpedition Mode Basic Concepts

In the DX world, a DX station can be considered the Fox, while home stations are considered to be the Hounds chasing after the Fox (DX station).

On standard FT8 frequencies, such as 14074 kHz, the entire audio bandwidth is available for anyone to use. But in DXpedition mode, audio frequencies below 1000 Hz are reserved for Foxes, and those above 1000 Hz are for Hounds. Due to inaccuracies in exact frequency placement, it's recommended that Hounds stay at 1025 Hz or above; otherwise the Fox may not be able to decode their signal.

As of this writing, release candidate versions of *WSJT-X* won't display Hounds calling below 1000 Hz, so Foxes won't see calls below that frequency.

Hound Mode Setup

To make the change from operating as a regular FT8 user to operating as a Hound, you must modify these values in *WSJT*'s **SETTINGS MENU**:

- Access the **RADIO** tab to enable split operation, by selecting **RIG** or **FAKE IT**.
- Choosing the **GENERAL** tab and selecting **MONITOR** will revert back to your last used frequency.
- On the **ADVANCED** tab, check the **SPECIAL OPERATING ACTIVITY** box, then select **HOUND**, and click **OK**.
- Verify that a red marker stating "Hound" is shown in the lower center part of the main window.

Hound Mode Calling Procedure

1 Check DX spotting networks to find the Fox's operating frequency, or consult the Fox's website for specific information.

2 Add the Fox's operating frequency to *WSJT*'s frequency list using the **SETTINGS – FREQUENCIES** table.

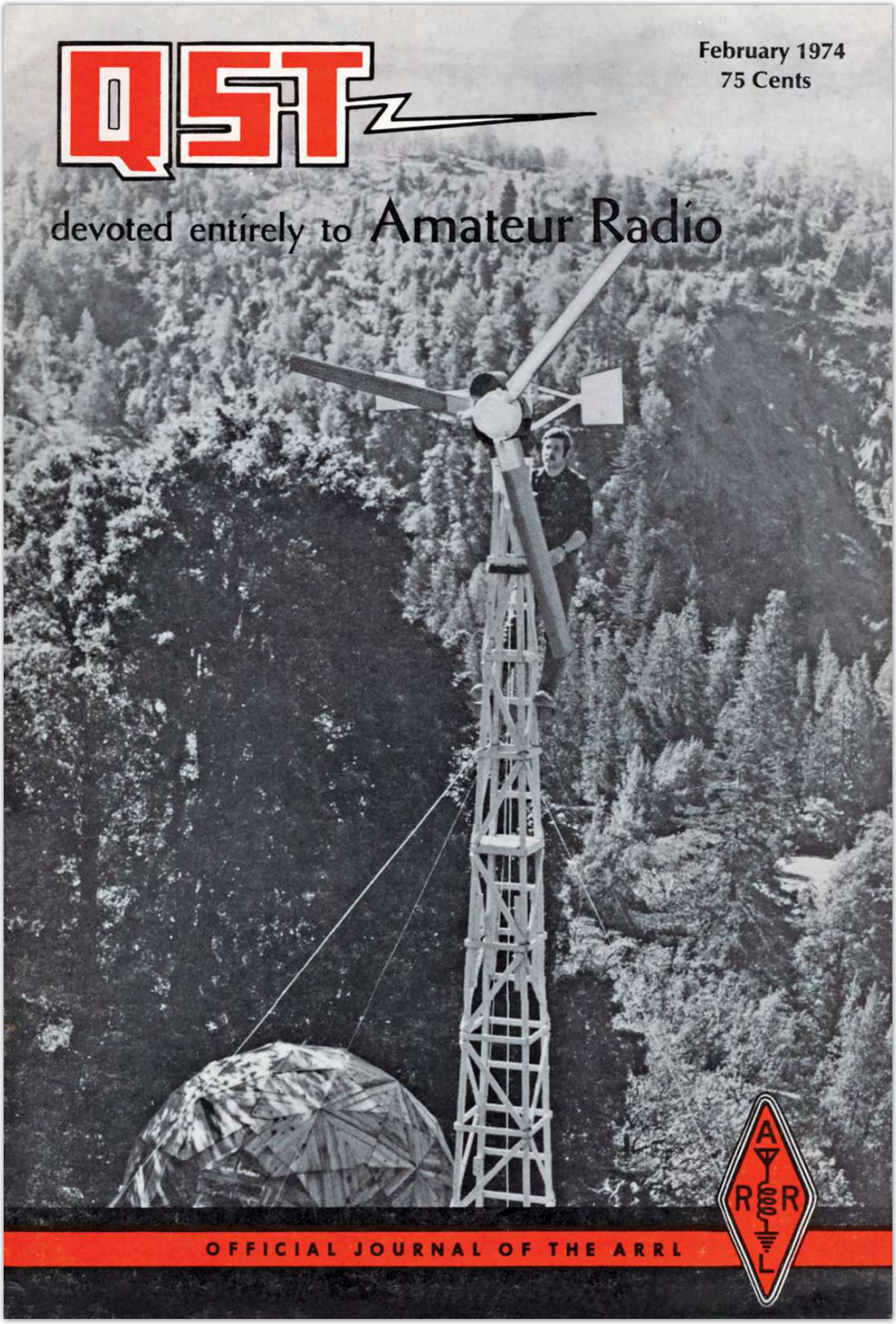
3 Select the frequency just added by the Fox, using *WSJT*'s frequency dropdown list.

4 Verify that you can hear the Fox. If you can't, then there's no reason to call.

5 Set your Tx frequency to be above 1000 Hz.

6 Select **ENABLE Tx** to call the Fox.

A Look Back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ARRL

"It Seems to Us..."

ARRL GOVERNMENT

AT ITS BIRTH in 1914, the American Radio Relay League was managed by a "relay committee" of the old Radio Club of Hartford, with Hiram Percy Maxim and Clarence D. Tuska generally in charge of activities. The League quickly outgrew this temporary structure and in early 1915 was incorporated under the laws of Connecticut. For the first decade, ARRL had a board of directors considerably different from our present setup – it was self-perpetuating. A number of prominent, capable amateurs were picked to serve as "directors," and when one died or resigned, the remaining group chose a successor on the spot. Oh, there were "elections" by membership balloting, but always of a hand-picked slate. So only two of the 17 directors were from west of the Mississippi (California, Texas) and they as well as even some of the few midwesterners found it inconvenient to attend regular board meetings in New York City. Most matters were decided and implemented by Maxim, and later by Kenneth Warner and the Hq. crew generally. Thus an "eastern clique" dominated ARRL affairs – in all dedication and sincerity, please understand, as well as with considerable success, but still with normal human prejudices and tendencies stemming from provincial backgrounds.

It was Secretary Warner himself who, on return from an extensive 1923 field trip, primarily to the west coast, recognized a missing element. He found many members in some areas of the country feeling completely isolated from the course of ARRL affairs. Current directors were certainly highly capable and dedicated, he told the board bluntly, but they were not geographically distributed to give any kind of equality in territorial representation. "KBW" was requested to prepare suitable amendments to the constitution; he went one better and rewrote it from top to bottom. With some revisions, his draft was accepted, and the directors voted themselves out of office to prepare for a new board nominated and elected by the membership. Hq. directors – Warner, Schnell, Service, Hebert and Kruse – resigned.

Warner outlined the principles in a February, 1924, editorial:

With the resumption of amateur activities after the war the League operated under a constitution which provided for the government of its affairs by a Board of seventeen directors, elected at large by the entire membership. While we were a small and rapidly growing organization this probably was the best possible form of government for us. It was lacking, however, in that it did not take into account the idea of *representation*, and there were many large areas of the country which had no particular representation on the Board – every director was a director-at-large, and merely one-seventeenth of the whole governing power. The time has now come when we are a big enough organization to adopt the idea of divisional representation, and the new constitution provides that there shall be one director from each division in the United States, charged with the duty of keeeping himself informed on the needs of the membership in his division, that he may act as their representative in guiding A.R.R.L. policies. The new Board will consist of these Directors, a Canadian General Manager representing all of A.R.R.L. north of the boundary, and a President and a Vice-President which will be elected by the new Board at its first meeting; the salaried officers of the League will not be directors.

And so it was that 50 years ago this month, *QST* carried a call for nominations of candidates under the new democratic scheme. There were then, incidentally, only twelve U.S. divisions, plus Canada. A new Hudson Division came into being almost immediately, carving New York "metropolitan" area out of Atlantic territory; in 1936 a Southwestern Division was split off from the Pacific; and a decade later Great Lakes came into being, the eastern half of the huge Central Division.

Fifty years ago, as now, selection of directors/representatives rested entirely in the hands of the membership. Warner's admonition still rings true:

A.R.R.L. members everywhere should give deep consideration to the choice of their new directors and choose men not merely for their ability to represent the division but for their executive ability, vision and wisdom – men who in all things will act for the greatest good of our organization.

9

Computerized Search for Receiver Birdies

BY T.A. GADWA,* W2JO

THE IDENTIFICATION of those spurious signals present in most amateur-band superheterodyne receivers can be aided by means of a computer. The phenomenal speed and accuracy of a computer for doing complicated repetitive numerical computations makes its use logical for finding those frequencies.

Some high-quality receivers employ two local oscillators, one at a fixed and the other at a variable frequency (see Fig. 1). These oscillators are used to produce a third higher frequency, the sum of the two, which is mixed or heterodyned with the received signal to produce still another lower frequency that is the difference or intermediate frequency (i-f). It is this frequency which is amplified and detected.

Also present are many undesirable weaker harmonics which are simple integer or whole multiples of the oscillator fundamentals, along with their mixing products. Most mixers or detectors are nonlinear devices. Their outputs contain all the input frequencies, harmonics, the desired and undesired difference and sum frequencies. The rejection of all frequencies except the desired one will depend upon the selectivity of the various tuned circuits. "Birdie" is the name given to the bird-like sound of the tweet, chirp, or beep as two oscillators beat against each other when tuning across the band. These birdies should not be present or should be weak and few in number, and located so as not to be objectionable. For multiband operation this may be impossible.

The number of combinations of frequencies become exceedingly large and difficult to identify. A graphical method is described in *CQ*[1,2] that uses a family of curves and a table of formulas to identify each frequency. Readings from the curves are approximate, and the table and hand calculations are tedious and subject to error. By computer, the tabulated results are accurate, rapid, and easily obtained.

* 160 Pennsylvania Ave., Yonkers, NY 10707.

[1] Lee, "Mixer Spurious Frequency Analysis," *CQ*, September, 1965.

[2] Lee, "Further Notes on Mixer Spurious Frequency Analysis, *CQ*, February, 1968.

The Mathematical Equations

There are four mathematical equations involved. The equations listed below apply to the mixing scheme shown in Fig. 1. For other mixing schemes, a rearrangement of the terms for Eq. 1 and Eq. 3 may be necessary, and some of the algebraic signs might require a change.[3]

$$FZ = FS + FX - FL \quad (1)$$

$$FV = \frac{\pm FX + FZ\,(N)}{M} \quad (2)$$

$$FT = FS + FV - FL \quad (3)$$

$$NM = N + M \quad (4)$$

where all frequencies, F, are in the same units, MHz, kHz or Hz.

FV = frequency of variable oscillator (also see FL and FU)
FZ = frequency of fixed oscillator
FL = lower limit of FV
FU = upper limit of FV
FS = lower limit of band
FT = frequency of birdie
FX = intermediate frequency
N = integer harmonic of FZ
M = integer harmonic of FV
NM = N + M, order of harmonics

[3] [EDITOR'S NOTE: For other mixing arrangements it may be helpful to draw the receiver in block form as in Fig. 1. Eq. 1 is derived from information in the block following the second mixer in that figure. Eq. 3 expresses the relationship between the frequency of the VFO and that indicated on the receiver tuning dial. As another example, a popular mixing system is the double-conversion process used in many of Heath's receivers, using an 8.395-8.895 MHz first i-f and a 3.395-MHz second i-f. For this mixing system, Eq. 1 becomes FZ = FS + FX + FU, and Eq. 3 becomes FT = FS — FV + FU. Eqs. 2 and 4 remain the same as given in the text.]

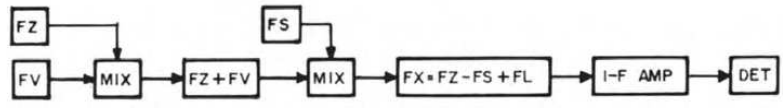


Fig. 1 — Block diagram of a receiver using the mixing arrangement discussed in the text. As far as the signal is concerned, this is a single-conversion receiver. The first mixer provides for pre-mixing of the variable and fixed frequency oscillators to derive the HFO-injection frequency.

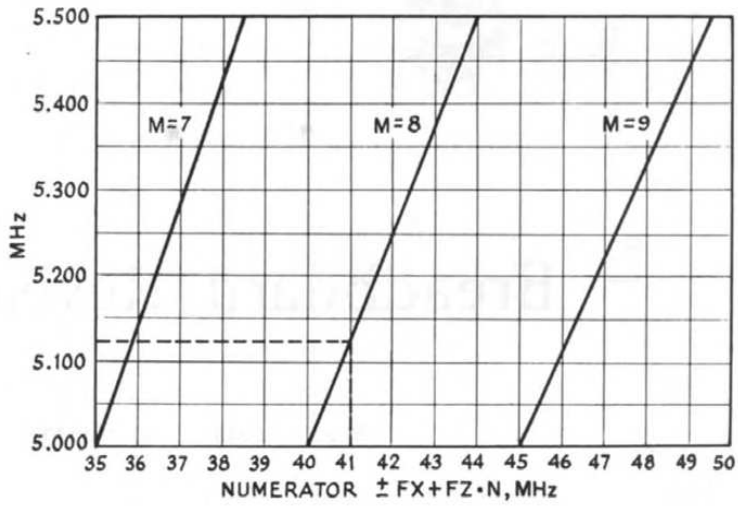


Fig. 2 — An approximate graphical solution shows the relationships expressed by the equations given in the text.

The ±FX means that FV or harmonics are either above or below FZ or its harmonics. When the difference of any two frequencies is equal to the i-f, a birdie will be present. Only variable oscillator frequencies, FV, that are within the range between FL and FU are noted. FT is the apparent frequency of the birdie as indicated by the band scale and is always present and fixed for each band.

When the order of harmonics is more than 10, such cases may usually be assumed negligible, which shortens the problem. For five bands of eight ranges, 880 possible different cases must be evaluated. A computer program has been written in Fortran (FORmula TRANslation) language and tested on a time-sharing system from a terminal that employs a special teletypewriter connected by ordinary telephone line to a remote computer of General Electric and Rapidata. Less than 5 seconds are required by the computer to make all computations and less than 10 minutes to run the program and print the answers at the terminal at a speed of 10 characters per second (100 words per minute). About 1000 characters of instruction on perforated tape are required. The estimated computer cost is less than $2, exclusive of program development.

A test case for a popular receiver described in *QST* is used.[4] A copy of the sample output is listed in Table I. For this case FX = 9.0 MHz, FL = 5.0 MHz, FU = 5.5 MHz, FS = 3.5, 7, 14, 21, 28, 28.5, 29, and 29.5 MHz. There are a total of 11 birdies in all ranges with at least one at the edge or in each band. To verify the results for FS = 28 MHz, N = 1, and M = 8, proceed as follows.

From Eq. 1, FZ = 28 + 9 – 5 = 32 MHz

From Eq. 2, FV = [+9 + 32(1)]/8 = 41/8 = 5.125 MHz

From Eq. 3, FT = 28 + 5.125 – 5 = 28 + 0.125 = 28.125 MHz

[4] Curtis, "The W5OMX Communications Receiver," *QST*, January, 1968.

An approximate graphical solution is shown in Fig. 2. The vertical scale covers the range of FV from FL to FU while the horizontal scale is the numerator of Eq. 1. If the vertical projection intersects a sloping line of harmonic M, FV is read on the vertical scale. Shown is a numerator value of 41 intersecting M = 8 at 5.125 MHz.

By this method a computer can be of aid to the radio amateur toward a better understanding of the perplexing problem of birdies. QST

Table I
Computer Output

FX		FS	FZ	FL
N	M	NM	FV	FT
9.000		3.500	7.500	5.000
1	3	4	5.500	4.000
3	6	9	5.250	3.750
4	4	8	5.250	3.750
9.000		7.000	11.000	5.000
1	4	5	5.000	7.000
2	6	8	5.167	7.167
9.000		14.000	18.000	5.000
1	5	6	5.400	14.400
2	5	7	5.400	14.400
9.000		21.000	25.000	5.000
1	3	4	5.333	21.333
2	8	10	5.125	21.125
9.000		28.000	32.000	5.000
1	8	9	5.125	28.125
9.000		28.500	32.500	5.000
1	8	9	5.187	28.687
9.000		29.000	33.000	5.000
1	8	9	5.250	29.250
9.000		29.500	33.500	5.000
1	8	9	5.312	29.812

END

One of the uses for Oscar 6 envisioned from the outset was as a classroom teaching aid in the areas related to space science: physics, mathematics, astronomy, and communications. ARRL and Amsat are cooperating with NASA in promoting this use. In particular, live demonstrations of satellite communication by amateurs for students are the kinds of activities which can be of great assistance in securing approvals for the launch of future satellites.

At this writing, Amsat has scheduled Oscar 6 operating periods on Tuesday and Friday mornings (subject to change) for the primary purpose of making the satellite available for school use. Additional operation of the satellite for special demonstrations which cannot be made on these days can be scheduled through ARRL headquarters. Of course, in the event the satellite is turned on especially for such a demonstration, amateurs not participating are requested to refrain from using the satellite.

Local amateurs have an excellent opportunity to acquaint students and educators with the space-age aspects of our hobby through the Oscar educational program. Anyone planning such a demonstration can contact ARRL headquarters for the booklets "Space Science Involvement" and "Member's Guide to Amateur Satellites," which will provide some additional background.

Here are some tips for Oscar classroom demonstrations:

1) An Oscar demonstration is usually of greatest interest at the junior or senior high school level. Your school's science teacher or science department chairman might be your best first contact.

2) Many schools have amateur radio clubs and may have some of the equipment needed for your Oscar demonstration. If not, it may be possible to bring along your own gear for the demonstration.

3) A *transmitting and receiving* demonstration is always the most effective. If possible, make a schedule in advance with another Oscar user for a contact. Next best is just a receiver set up in the classroom. In this type of demonstration, still set up a schedule to have another amateur make a transmission to the class. Have him mention the school's name via Oscar to increase interest.

4) Ssb rather than cw makes the most easily understood demonstration. If you'll only be able to transmit from the class on cw though, a cross-mode contact with a phone station can be effective.

5) Be careful to keep ssb tuned in clearly. Often we can understand a mis-tuned signal which is unintelligible to non amateurs.

6) Don't make assumptions about what the students already know about satellites or amateur radio. Give clear and complete explanations and always define whatever technical terms you find necessary to use. Excessive use of ham lingo, RST signal reports, phonetics, etc., tend to confuse a non-amateur audience.

7) Before you demonstrate Oscar communications, explain everything the students should expect to hear and understand. Use a map or globe to illustrate the orbit.

8) Arrange in advance for assistance from a student or other radio amateur for setting up equipment.

9) If possible, check out your system on an orbit prior to your demonstration. Local noise may be a reception problem you'll have to solve in advance.

OSCAR NEWS

JA1NEZ boasts an effective antenna farm for Oscar work. In the foreground are turnstiles for 2 and 10 meters, which are most effective when the satellite is well above the horizon. The array on the tower comes into play at low elevation angles. Note the two driven elements on the 4-element ten-meter beam, an interesting adaptation of the "ZL Special" design.

Recent Satellite DX Achievement Award Winners

VK7LZ VK5HI JA1EMX
DL9GU HG5KEB DC8BB

Certificates have been issued to 173 stations in 29 countries and 5 continents.

10) Please let ARRL headquarters know how your Oscar demonstration went!

WAS Totals Wanted

With an increasing number of stations nearing the goal of Worked All States via Oscar 6, a monthly listing of WAS totals will be of interest to many. This listing will replace the "Oscar 6 Two-Ways" box which has been a part of this column since last March. We hope to be able to report the awarding of the special Amsat Satellite-WAS trophy to many more amateurs in the coming months. – *K1ZND*

US Amateur Radio Bands

Operator license classes: **E** = Amateur Extra **A** = Advanced **G** = General **T** = Technician **N** = Novice
CW operation is permitted throughout all amateur bands. Except as noted, all frequencies are in megahertz (MHz).

= RTTY, data, phone, image = USB phone, RTTY, data and CW = RTTY and data = phone and image
= SSB phone = CW only

LF – Low Frequency band

2200 Meters (135 kHz) E,A,G

1 W EIRP maximum

135.7 kHz — 137.8 kHz

MF – Medium Frequency bands

630 Meters (472 kHz) E,A,G

5 W EIRP max, except in Alaska within 496 miles of Russia where the limit is **1 W EIRP**

472 kHz — 479 kHz

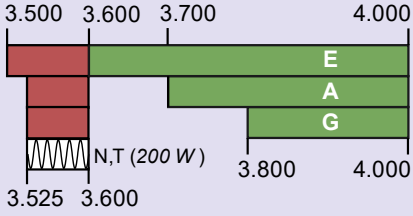
160 Meters (1.8 MHz) E,A,G

1.800 — 1.900 — 2.000 MHz

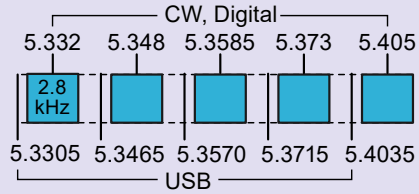
Amateurs wishing to operate on **2200 or 630 meters** must first register with the Utilities Technology Council online at **https://utc.org/plc-database-amateur-notification-process/.** You need only register once for each band.

HF – High Frequency bands

80 Meters (3.5 MHz) E,A,G,T,N

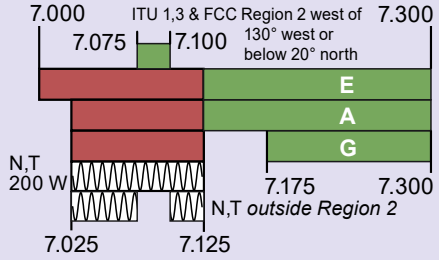


60 Meters (5.3 MHz) E, A, G (100 W)

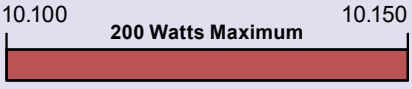


General, Advanced, and Extra licensees may operate on a secondary basis with a maximum ERP of 100 W (relative to a half-wave dipole antenna).

40 Meters (7 MHz) E,A,G,T,N

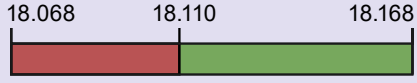


30 Meters (10.1 MHz) E,A,G

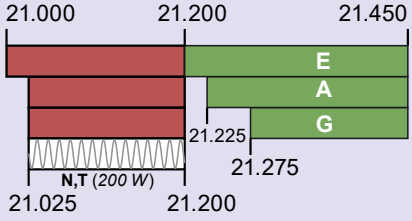


20 Meters (14 MHz) E,A,G

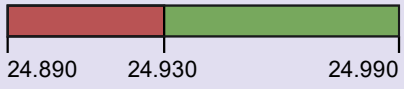
17 Meters (18 MHz) E,A,G



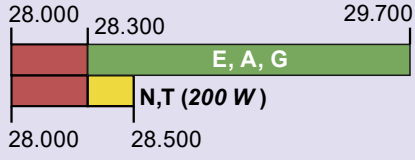
15 Meters (21 MHz) E,A,G,T,N



12 Meters (24 MHz) E,A,G



10 Meters (28 MHz) E,A,G,T,N

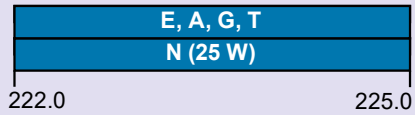


VHF – Very High Frequency bands

6 Meters (50 MHz) E,A,G,T

2 Meters (144 MHz) E,A,G,T

1.25 Meters (222 MHz) E,A,G,T,N

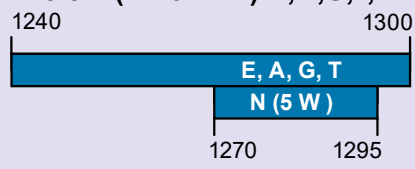


UHF – Ultra High Frequency bands

70 cm (420 MHz) E,A,G,T

33 cm (902 MHz) E,A,G,T

23 cm (1240 MHz) E,A,G,T,N



SHF&EHF – Super and Extremely High Frequency bands

All licensees except Novices are authorized all modes on the following frequencies:

2300-2310 MHz	3300-3450 MHz	10.0-10.5 GHz	47.0-47.2 GHz	122.25-123.0 GHz	241-250 GHz
2390-2450 MHz	5650-5925 MHz	24.0-24.25 GHz	76.0-81.0 GHz	134-141 GHz	All above 275 GHz

See www.arrl.org/band-plan for detailed band plans.

OTAbands **rev. 11/16/2023**

Celebrating Our Legacy

A Community of Voices

My husband, Ed Heyboer, KF8EV, was legally blind. He was looking for a hobby and found an article about amateur radio. It spiked his interest, and eventually, he became a ham.

Ed took his radio with him everywhere. It came on our errands around town and all our traveling adventures. On our 6-week trip to Alaska, one of the first things he did at Denali National Park and Preserve was throw an antenna up in a tree. The voices went everywhere with us. On March 28, 2018, the voices stopped when Ed became a Silent Key.

I was never really interested in amateur radio, but after 3 years of silence in my house, I pulled out one of Ed's handheld radios. I turned it on, and there were the voices again. It was like Ed was back, filling the room with the voices of the ham community once again.

I asked a friend who was a ham to give me some instructions on how to use the handheld and how I could listen to more nets. He told me to get my license to get on the air. Despite being intimidated by all the technology that goes along with it, for 2 weeks, I studied 400 questions and answers. Once I took my test, they told me I aced it. What a joy it was to hear all those voices welcoming me into the amateur radio community.

Ed loved this hobby and the community. Even though I know nothing about coaxial cable, watts and voltage, or antennas, I am so happy to be a part of the community of voices.

Mary Heyboer, N8GMJ
Zeeland, Michigan

A Lifetime of Radio Thanks to My Mentor

I was listening to the shortwave band on my parents' radio when I heard two ham radio operators. There were no hams in my small town of 3,000 people, but my father talked to the local radio repair person who used to be a ham, and he became my mentor. He taught me how to solder, helped me build a crystal radio, and helped me build an oscillator to learn Morse code.

In 1950, a General license was required to be a ham radio operator, and, at the age of 13, I could not meet the 13 WPM of Morse code. In 1951, the FCC offered the new entry-level Novice license. My father had located a ham about 30 miles away who gave me the test, and I passed and received the call sign WN7SCY.

Bob Weed, W7SCY, in 1953. [Bob Weed, W7SCY, photo]

My mentor helped me build a 12 W transmitter, and I was on the air with a used Hallicrafters S-40B receiver. In February 1952, I took the General exam, and I received my new call sign, W7SCY. I inspired several others to become hams, including my dad, grandfather, brother, wife, son, and son's wife, and I inspired my mentor to get his license once again.

Ham radio led me to a 35-year career in broadcast radio, and I am still on the air after 70 years. The magic of ham radio is still with me, and I am still involved with several clubs.

Bob Weed, W7SCY
Bend, Oregon

Radio Friendships

About 50 years ago, I received my first ham radio license. I was always interested in electronics; however, it was not until my late twenties that I was introduced to ham radio.

My first call sign, WBØGDE, expanded my world. One contact I made with Duane, WBØDSC, stood out. We shared many of the same interests. We both had an interest in aviation, mostly radio-controlled models. Duane's main reason for becoming a ham was to use the ham frequencies specifically allocated for radio control.

A couple of years later, I got my private pilot's license. Unbeknownst to me, Duane had received his pilot's license about 15 years earlier but had not pursued it beyond that. My license rekindled his interest, and he resolved to refresh his proficiency. Our families traveled all over the Midwest, often using ham radio to stay in touch. Our local repeater was set up with a phone patch.

Over the years, our lives diverged. I moved east, but we have always kept in touch. However, we both got caught up in our working lives, our interest in ham radio waned, and we failed to renew our licenses.

Years passed, and I eventually retired. Then, I studied and retook the exam and joined a local club. While I have a serious interest in the hobby, it is the friendships that I appreciate the most. My retired life would not be the same without them. Duane is a Silent Key now. He always credited ham radio for bringing us together.

John W. Grubmuller, K1XF
Bedford, New Hampshire

Send reminiscences of your early days in radio to **celebrate@arrl.org**. Submissions selected for publication will be edited for space and clarity. Material published in "Celebrating Our Legacy" may also appear in other ARRL media. The publishers of *QST* assume no responsibility for statements made in this column.

Scott Freeberg, WA9WFA, wa9wfa@arrl.net

Classic Radio

ARRL's Lightning Calculators of the 1930s

In the early 1930s, most hams built their own transmitters and receivers and often needed to perform complex mathematical calculations to determine resonant frequency, resistance, inductance, capacitance, and Ohm's law, among others. They needed to sit down with a sharp pencil and a piece of paper (or a slide rule if they knew how to use one) and grind out the calculation using multiplication or division, dealing with negative and positive exponentials, and consulting square root tables.

In 1932, W. P. Koeche designed a series of cardboard calculators for ham radio, called lightning calculators, that allowed hams to solve difficult mathematical equations in seconds. The 1936 *The Radio Amateur's Handbook* said, "…the League, under license of the designer…has made available several calculators to obviate the tedious and sometimes difficult mathematical work involved in the design and construction of radio equipment. The various lightning calculators are ingenious devices for rapid, certain, and simple solution[s] of the various mathematical problems which arise in all kinds of radio and allied work."

Calculator Varieties

ARRL lightning calculators cost between 50 cents and $1 in 1936 ($11 to $22 today), and they consisted of an 8½×11-inch piece of thin stiff cardboard with fixed scales colorfully printed on the board, one or more movable flat scales that rotated around the center of the fixed scales, and a clear plastic slider or hairline. To perform a calculation, the user would turn or rotate the movable scales and hairline to input data and read out calculated results.

Figure 1 — An example of the Type A lightning calculator in use. This image shows it solving for a resonant frequency from 20 µµF and 100 µH.

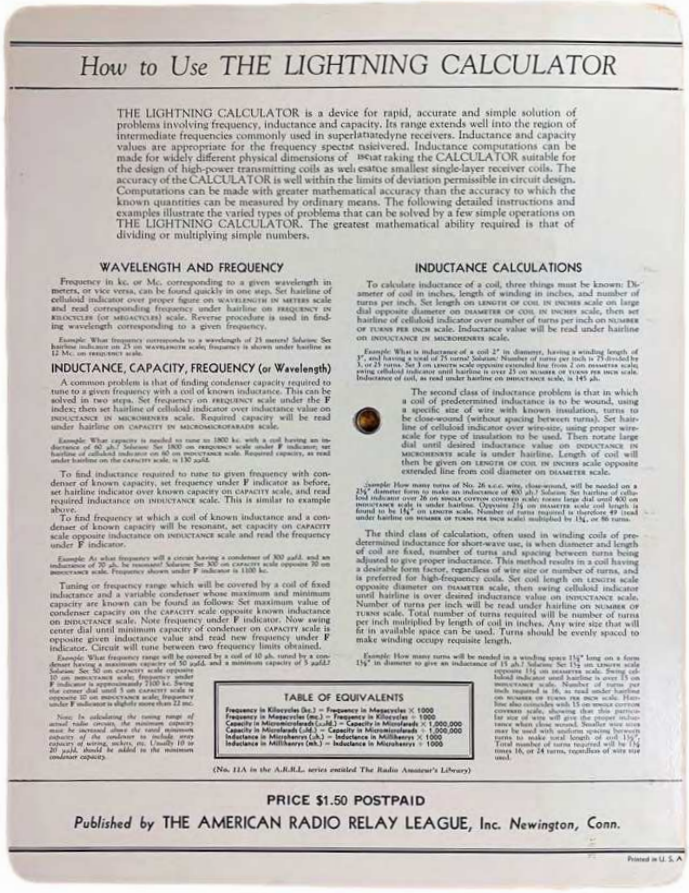


Figure 2 — All of the lightning calculators had instructions printed on the back. This is the back of the Type A calculator.

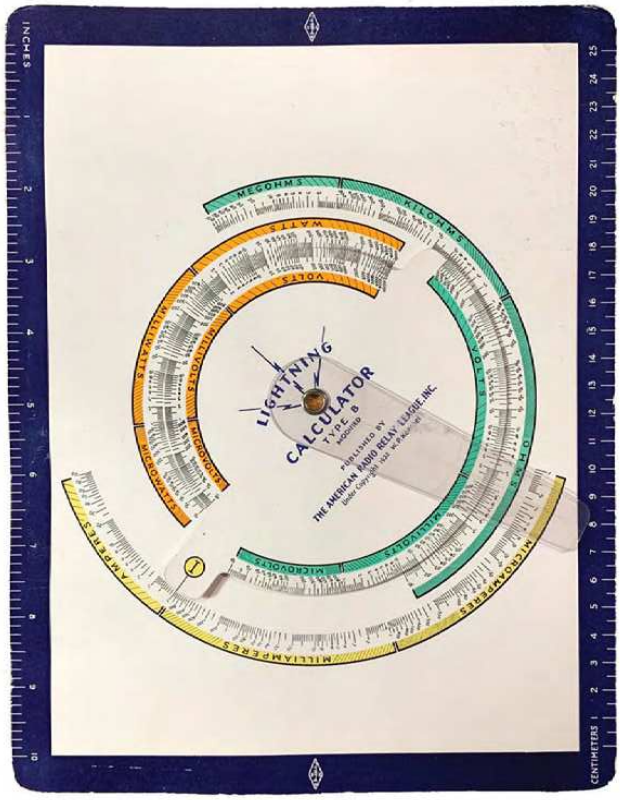


Figure 3 — An example of the Type B lightning calculator solving Ohm's law with 1 A, 1 V, and 1 Ω.

There were six lightning calculators in the series, identified as Types A, B, C, D, E, and F. Each type calculated different mathematical equations, so a 1932 ham likely owned more than one type. (I would've owned a Type A and Type B for sure!)

Type A determined the resonance of a resonant circuit, frequency, required capacitance, inductance, number of turns of wire needed on a coil, and more. The calculator solved some scary-looking equations, such as

$$f = \frac{1}{2\pi\sqrt{LC}} \qquad L(\mu H) = \frac{\text{a(squared)} \times \text{n(squared)}}{9\text{a} + 10\text{b}}$$

To solve the equation for the frequency of a resonant circuit, the known capacitance (*C*) and inductance (*L*) values were input in the lightning calculator using its two movable scales. The smaller dial had capacitance values from 3 to 1000 µµF printed on it, and the larger dial had inductance values from 1 to 1500 µH printed on it.

Figure 1 shows the Type A calculator set up to solve for the resonant frequency of a 20 µµF capacitor and a 100 µH inductor. The plastic hairline slider is set directly over the red 20 µµF capacitor mark on the inner scale, and the capacitor scale and plastic hairline are turned until they line up with 100 µH on the inductance scale. In the upper right corner, the green F points to the frequency on the scale directly below it. It reads approximately 3550 kHz. The modern calculator calculates those values to be 3560 kHz.

In 1932 electronics, those two values were close enough to be considered equal. It's amazing — a piece of cardboard can make a 5-second calculation. It took me longer to punch the numbers into my modern electronic calculator! An advertisement in the 1936 *Handbook* claimed the Type A would yield "…accuracy well within the tolerances of practical construction," and this is true. Figure 2 shows the instructions on the back of the Type A calculator.

Type B calculated Ohm's law, solving for voltage, current, and resistance (see Figure 3 for an example). The advertisement for this lightning calculator claimed that "all answers will be accurate within the tolerances of commercial equipment."

Type C was a wire data calculator, used for determining the type and size of wire that were needed for a task based on wire-based material, diameter, insulation, current-carrying capacity, resistance per 1,000 feet, tensile strength, and more.

Type D was a decibel calculator, used to determine gain or loss in decibels via the input and output factors of voltage, current, power, or signal input to receiver output.

Type E was used to calculate parallel resistance and series capacity. There was no need to calculate series resistance or parallel capacitance because they simply add together.

Type F calculated the resistance of a resistor or circuit based on a known supply voltage and a measured voltage drop across the resistor or circuit. Today, the typical digital voltmeter includes an ohmmeter, but this wasn't always the case in the early 30s, when a ham was lucky to have even a voltmeter.

Modern-Day Use

I recently built a 1929-era three-tube 80-meter regenerative receiver and used the Type A lightning calculator. First, I calculated the necessary coil inductance that results in 3500 kHz with a 100 µµF variable capacitor. Then, I calculated the number of turns of wire that needed to be wound on the inductive coil form. I used those values, and it worked — the receiver was on frequency!

Lightning calculators from 1932 worked well back then, and they still work well today because radio mathematics haven't changed; just the methods of calculating have vastly improved. Many of these calculations are on the FCC amateur radio test, so they are still relevant today. It's amazing that this piece of cardboard with printed colorful scales and spinning wheels and dials can solve complex radio equations and still get the job done nearly 100 years later. When they aren't in use, lightning calculators can be hung on the wall because they're cool to look at!

All photos by the author.

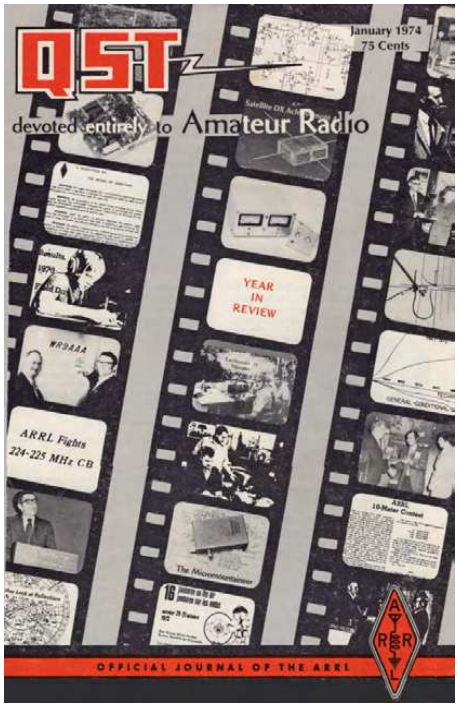
100, 50, and 25 Years Ago

January 1924

- The cover drawing by Clyde Darr, 8ZZ, and S. Scott, 9CCW, takes a prophetic look at what DXing will be like in the future — 1930 — with QSLs on the wall from all over the world.
- The "Editorials: Achievement" chronicles the many records that have been accomplished over the past year, and brings us back to a July 1914 announcement stating the League's original objective — "to establish wireless communications between far distant points…"
- The story of the amateurs involved in the first two-way amateur contact across the ocean is told in "Transatlantic Amateur Communication Accomplished!" by K.B. Warner, 1BHW.
- All anti-regeneration devices are built up from a few simple ideas. Lewis M. Hull, Ph.D., explains just how the final circuits work in "Anti-Regenerative Amplification."
- An amateur sending set and an antenna system that works easily and efficiently anywhere in the amateur wave bands are presented in "1XAM's Transmitter" by John L. Reinartz, 1QP-1XAM.
- "The Crew at 1045 Main Street" is highlighted in "Who's Who in Amateur Wireless" by K.B. Warner, 1BHW.

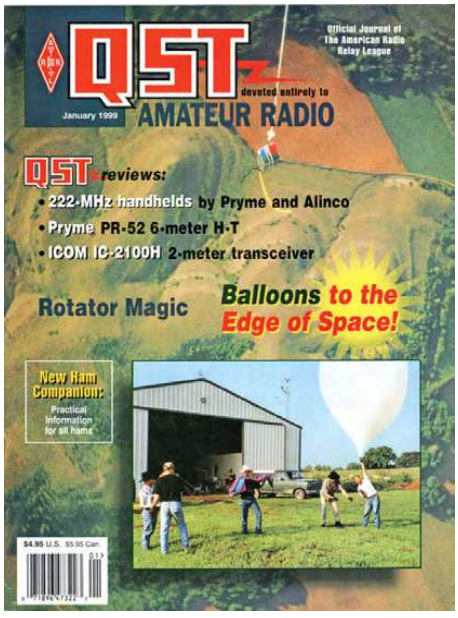
January 1974

- Picture clips of amateur activities during 1973 are shown on the cover.
- "It Seems to Us…A Not-Too-Fond '73' to 1973" discusses regulations — actual, proposed, upheld, interpreted, and hinted at — that framed the central theme of amateur history in 1973.
- The grid-dip oscillator has long been a standard piece of test equipment. Twenty ways to use your dipper are described in "Beginner and Novice: The Art of Dipping" by Benjamin Clark, WB4OBZ.
- A way to install your mobile gear out of the way in the trunk, and still have control from the dashboard, appears in "Gimmicks and Gadgets: Remote Control for a Mobile Transceiver" by George Tamer, W4BAD.
- Just how inexpensively can a frequency counter be made by an average constructor? Ralph V. Anderson, KØNL, answers in "The Thirty Dollar Counter."
- Part 3 of a primer on the phenomenon we call electricity appears in "'Current' Theories of Electricity" by Margaret Koerner, WBØBEM. (A fun test follows.)
- It's been said that the day of the written message has passed. "Amateur Radio Public Service: The Importance of Records" by Bill Mann, WA1FCM, explains why this isn't always true.



January 1999

- Our cover shows the members of the Kansas Near Space Project preparing to launch their balloon, and a photo from the camera riding with the payload capsule after the launch. The accompanying story "Ham Radio Ballooning to Near Space" by Lloyd Verhage, KD4STH, also appears in this issue.
- The FCC's proposal to reduce the number of classes of amateur license from six to four, and ARRL's response are discussed in "It Seems to Us…Restructuring: The Next Step" by David Sumner, K1ZZ.
- If you're stuck without the proper regulator IC for your project, this work-around may be just what you need, explains Sam Ulbing, N4UAU, in "Getting More Voltage Out of a Regulator IC."
- Larry "Tree" Tyree, N6TR, gives all the particulars of an opportunity to make an immense difference in the life of a child in "Kid's Day!"
- Robert B. Whitaker, KI5PG, shows how to adapt a UPS to supply 120 V ac and 12 V dc for a wide variety of applications in "Technical Correspondence: UPS — 'Universal' Power Supply."



Silent Keys

It is with deep regret that we record the passing of these radio amateurs:

vW1CNY **Rinaldi**, Robert J., Simsbury, CT
vWA1FRG **Conover**, John W., Clinton, CT
vW1GP **Porter**, Gilbert, Fair Point, NY
vW1PJR **Raneri**, Phillip J., Nantucket, MA
KD1PO **Ruhl**, Harold J., Jr., Durham, CT
KC2AWW **Johnson**, Charles W., Westbury, NY
N2AYM **Fougere**, Daniel R., Lakewood, NJ
WA2HTD **Doyle**, William E., Crown Point, NY
vK2JMY **Zulkowski**, Theodore J., Poughkeepsie, NY
v♦K2JV **Cohen**, Barry G., Berkeley Heights, NJ
K2JWW **Whitbeck**, James W., Sr., Ballston Spa, NY
vW2LU **Fuller**, Eugene B., Webster, NY
K2PJC **Cottone**, Paul J., Bullville, NY
vK2QCG **Hammond**, Paul G., Cicero, NY
KC2QGL **Fitzpatrick**, Vincent, Westwood, NJ
vAL2R **Baker**, Lara H., Anchorage, AK
vN2SWX **Moore**, William, Red Hook, NY
vWA2TML **Colabrese**, Charles A., Blackwood, NJ
KB3BYT **Roomberg**, Robert A., Jim Thorpe, PA
•W3CSX **Vance**, Jason J., Westminster, MD
WB3EAO **Doughty**, Barbara J., Phoenixville, PA
N3EQW **Whisler**, Dot F., Wilmington, DE
N3KOM **Castellani**, Patrick E., Camp Hill, PA
vWF3M **Bosler**, William L., Whitehall, PA
vKB3PO **Rogers**, John F., Dillsburg, PA
v♦K3TKZ **Jars**, Edward J., Feasterville-Trevose, PA
vK3UBW **Schneck**, John, Center Valley, PA
vK3UMV **Drager**, William L., Hagerstown, MD
v♦♦W3UQH **Redline**, Duane C., Fleetwood, PA
AJ3V **Dovenspike**, Keith M., Hawthorn, PA
W3VGF **Hillman**, James D., Confluence, PA
KC3W **Swan**, Robert D., La Vale, MD
vWA3YTE **Lasher**, Charles A., Dallas, PA
KM4AID **Wirtz**, David E., Saint George, SC
♦•N4APZ **MacDonald**, Deborah O., Waynesboro, GA
v♦♦KB4AZR **Hamilton**, Hollice J., North Miami, FL
W4BCU **Lilly**, Robert S., Blountville, TN
W4CKP **White**, Deryl E., Jr., Midlothian, VA
W4CZJ **Culbreth**, Michael L., Boonville, NC
K4DHY **Ratcliffe**, James M., Saltville, VA
vKQ4DLN **Jarvis**, Raymond M., Gastonia, NC
vW4HTR **Riggins**, Harold T., Alpine, AL
N4IFN **Holland**, Henry L., Rocky Mount, VA
W4KHB **Blanton**, Kenneth, Jr., Shelby, NC
KD4KMB **Miller**, Lester M., San Luis Obispo, CA
vKC4MCL **Anderson**, Howard T., Valparaiso, FL
KB4MYH **Swink**, Donald T., Rutherfordton, NC
N4NPH **Humphrey**, Duncan R., Holly Ridge, NC
KI4RO **Smith**, John P., Harts, WV
K4SVX **Dunn**, Ken, Milton, FL
vN4VE **Atkins**, Michael D., Winston-Salem, NC
vN4VPO **Hall**, Michael B., Goodview, VA
•WK4W **McKinnon**, James E., Rural Retreat, VA
•AL4W **Wardman**, R. James, Leander, TX
vK4WMS **Smith**, William M., Saint Stephens Church, VA
KR4WP **Carter**, Rod A., Paris, TN
vW4YRY **Pope**, Jerry A., Raleigh, NC
vW5AGK **King**, George L., Alleyton, TX
vN5AIE **Cardwell**, David M., Royal, AR
W5CGW **Wallace**, Cynthia G., San Antonio, TX
♦WB5FBS **Priez**, Robert G., Hammond, LA
W5HTR **Zimring**, Fred E., Richardson, TX
•W5IFN **Black**, Harold L., Norman, OK
N5LTX **Ostergard**, Edward T., Corpus Christi, TX
♦WA5OCV **Murphy**, Walter H., Port Neches, TX
AE5RJ **Junge**, Reiner, El Paso, TX
WA5ROP **McSpadden**, Jack O., Cave City, AR
•KG5UG **Granger**, Clara B., Edmond, OK
K5ZLZ **Johnson**, Bob T., Forest, MS
N6BOW **Fowler**, Douglas H., Redding, CA
vWA6HJZ **Glose**, Michael R., Petaluma, CA
KK6JSP **Sawyer**, Wendell D., Corona Del Mar, CA
K6LTS **Montgomery**, Donald R., Turner, OR
N6OUA **Ericson**, Marjorie G., Brentwood, TN
♦W6SL **Baer**, John D., Arroyo Grande, CA
WA6SOP **Fruhling**, George A., Cedar City, UT
WB6TTS **High**, Robert H., Lancaster, CA
vK6UE **Clasby**, Francis X., Jr., Alameda, CA
WA6WFC **Mork**, Gary P., Whittier, CA
KG7A **Bolsega**, Ronny W., Mesa, AZ
vAA7CX **Hanson**, Kenneth W., Port Ludlow, WA
K7DPT **Woodford**, Leonard G., Covington, WA
N7FMW **Scott**, Ruth B., Proctor, MT
vWA7GGV **Messex**, Clark L., Laurel, WA
KE7GKI **Krueger**, Jeff P., Wickenburg, AZ
vN7PEI **Rhodes**, David E., River Heights, UT
•W7RMJ **Johnson**, Robert M., Tualatin, OR
NX7S **Jones**, Bernard L., Great Falls, MT
KD7TRN **Baldwin**, Thomas P., Smithfield, UT
K7ZP **Hall**, Frank E., Jr., Oak Harbor, WA
K8CCE **Vasold**, Duane A., Freeland, MI
W8EII **Keadle**, John T., Hernando, FL
AB8GB **McCutcheon**, Phillip M., Columbus, OH
vK8OVO **Buehrer**, Donald D., Tontogany, OH
♦K8RS **Stimson**, Roger C., Okemos, MI
KB8RYA **Forshaw**, Don E., Mansfield, OH
N8TQ **Martin**, William C., Mansfield, OH
vKD8TYI **Markiecki**, Armando E., Columbus, OH
WB8WKN **Suits**, Bryan H., Houghton, MI
W9DBB **Homer**, John F., Lubbock, TX
W9FUL **Pawlowski**, John F., Libertyville, IL
KC9FWL **Sallee**, Michael R., Bloomington, IL
v•KB9GRM **McKee**, Michael L., Martinsville, IN
N9HWO **Fleming**, Philip B., II, Canton, IL
v♦WB9ICU **Forss**, Don N., Omro, WI
•N9LO **Olson**, Lee A., Marshfield, MN
vWB9MQA **Cass**, Leonard G., Fountaintown, IN
vW9NUT **Schindel**, Jerome H., Muncie, IN
vK9QID **Brandeau**, Donald G., Village of Lakewood, IL
vWA9RDI **Stiller**, Theodore, Milwaukee, WI
♦N9SH **Harlan**, Sharon, Rockford, IL
♦N9SW **Sochor**, Gene W., Wayne, IL
W9TEY **Pflueger**, Phillip G., Marietta, GA
vN9TMO **Hobbs**, George W., Shelbyville, IN
♦W9TRC **Anderson**, John P., Springfield, IL
K9VCZ **McNamara**, Peter, Racine, WI
•KC9ZBV **Hehn**, Thomas G., Bolingbrook, IL
vW9ZN **Crane**, William F., Chicago, IL
KØBAX **Hill**, Robert W., Clinton, IA
♦KØHWE **Hammond**, Albert S., Atkins, IA
vKNØM **Sugrue**, Steve C., Sioux Falls, SD
vKBØMO **Thompson**, James L., Dexter, MO
vABØOI **Hooper**, Galen R., Roosevelt, UT
v•KCØOXB **Thomas**, Scott K., Sr., Broomfield, CO
vWIØW **O'Dell**, G. Lyndon, Des Moines, IA
♦KØXH **Clayton**, Michael R., Mapleton, IA
NXØY **Sherwood**, Jesse, Stilwell, KS
KBØYTO **Mayo**, Robert N., Kearney, NE
vWCØZ **Mattingly**, Clark H., Lincoln, NE
•KFØZG **Yohnke**, David G., Wall Lake, IA
WØZMU **Stubbe**, Roger G., George, IA
♦VE3FA **Haines**, Ronald, Ottawa, ON, Canada
VE7CQ **Blake**, William D., Maple Ridge, BC, Canada

♦ Life Member, ARRL
♦ Maxim Society
♦ Current Diamond Club
v Veteran
• Former call sign

For information on how to list a Silent Key in *QST*, please visit **www.arrl.org/silent-key-submission-guidelines**.

Note: Silent Key reports must confirm the death by one of the following means: a copy of a newspaper obituary notice, a copy of the death certificate, or a letter from the family lawyer or the executor. Please be sure to include the amateur's name, address, and call sign. Allow several months for the listing to appear in this column.

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IC-7100 | *All Mode Transceiver*

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IC-2730A | *VHF/UHF Dual Band Transceiver*

• VHF/VHF, UHF/UHF simultaneous receive • 50 watts of output on VHF and UHF • Optional VS-3 Bluetooth® headset • Easy-to-See large white backlight LCD • Controller attachment to the main Unit

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• 65W of Power for Long Range Communications • 4.5 Watts Loud & Clear Audio • Modern White Display & Simple Operation • Weather Channel Receive & Alert Function

ID-50A | *VHF/UHF D-STAR Portable*

• High Visible LCD with Backlight Function • Find Nearby Repeaters with the Built-In GPS • Easy D-STAR Settings for Beginners • Voice Recorder Function • Share Pictures in DV Mode

IC-V86 | *VHF 7W HT*

• 7W OutputPower Plus New Antenna Provides 1.5 Times More Coverage • More Audio, 1500 mW Audio Output • IP54 & MIL-STD 810G–Rugged Design Against Dust & Water • 19 Hours of Long Lasting Battery Life • 200 Memory Channels, 1 Call Channel & 6 Scan Edges

IC-T10 | *Rugged 144/430 MHz Dual Band*

• Disaster Ready - Excellent Fit for Your Emergency Bag • Loud Audio - New Speaker Design • Long Bettery Life - Up to 11 Hours • FM Broadcast & Weather Channels

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FTDX10 | *HF/50MHz 100 W SDR Transceiver*

• Narrow Band and Direct Sampling SDR • Down Conversion, 9MHz IF Roofing Filters Produce Excellent Shape Factor • 5" Full-Color Touch Panel w/3D Spectrum Stream • High Speed Auto Antenna Tuner • Microphone Amplifier w/3-Stage Parametric Equalizer • Remote Operation w/optional LAN Unit (SCU-LAN10)

FT-991A | *HF/VHF/UHF All ModeTransceiver*

Real-time Spectrum Scope with Automatic Scope Control • Multi-color waterfall display • State of the art 32-bit Digital Signal Processing System • 3kHz Roofing Filter for enhanced performance • 3.5 Inch Full Color TFT USB Capable • Internal Automatic Antenna Tuner • High Accuracy TCXO

FTDX101D | *HF + 6M Transceiver*

• Narrow Band SDR & Direct Sampling SDR • Crystal Roofing Filters Phenomenal Multi-Signal Receiving Characteristics • Unparalleled - 70dB Maximum Attenuation VC-Tune • 15 Separate (HAM 10 + GEN 5) Powerful Band Pass Filters • New Generation Scope Displays 3-Dimensional Spectrum Stream

FT-710 Aess | *HF/50MHz 100W SDR Transceiver*

• Unmatched SDR Receiving Performance • Band Pass Filters Dedicated for the Amateur Bands • High Res 4.3-inch TFT Color Touch Display • AESS: Acoustic Enhanced Speaker System with SP-40 For High-Fidelity Audio • Built-in High Speed Auto Antenna Tuner

FT-891 | *HF+50 MHz All Mode Mobile Transceiver*

Stable 100 Watt Output • 32-Bit IF DSP • Large Dot Matrix LCD Display with Quick Spectrum Scope • USB Port Allows Connection to a PC with a Single Cable • CAT Control, PTT/RTTY Control

FTM-300DR | *C4FM/FM 144/430MHz Dual Band*

• 50W Output Power • Real Dual Band Operation • Full Color TFT Display • Band Scope • Built-in Bluetooth • WiRES-X Portable Digital Node/Fixed Node with HRI-200

FT-2980R | *Heavy-Duty 80W 2M FM Transceiver*

• 80 watts of RF power • Large 6 digit backlit LCD display for excellent visibility • 200 memory channels for serious users

FTM-200DR | *C4FM/FM 144/430MHz Dual Band*

• 1200/9600bps APRS® Data Communications • 2" High-Res Full-Color TFT Display • High-Speed Band Scope • Advanced C4FM Digital Mode • Voice Recording Function for TX/RX

FTM-500DR | *C4FM/FM 144/430MHz Dual Band Xcvr*

• Front Firing Acoustically Enhanced Speaker System • True Dual Band Operation, C4FM/C4FM Digital D-D Dual Receive • 2.4" High-Resolution Full-Color Touch Panel Display • Built-in High Precision GPS Receiver • Wireless Operation Capability with Optional Bluetooth® Headset

FT-70DR *C4FM/FM 144/430MHz Xcvr*

• System Fusion Compatible • Large Front Speaker delivers 700 mW of Loud Audio Output • Automatic Mode Select detects C4FM or Fm Analog and Switches Accordingly • Huge 1,105 Channel Memory Capacity • External DC Jack for DC Supply and Battery Charging

FT-5DR *C4FM/FM 144/430 MHz Dual Band*

• High-Res Full-Color Touch Screen TFT LCD Display • Easy Hands-Free Operation w/Built-In Bluetooth© Unit • Built-In High Precision GPS Antenna • 1200/9600bps APRS Data Communications • Supports Simultaneous C4FM Digital • Micro SD Card Slot

FT-65R | *144/430 MHz Transceiver*

Compact Commercial Grade Rugged Design • Large Front Speaker Delivers 1W of Powerful Clear Audio • 5 Watts of Reliable RF Power Within a compact Body • 3.5-Hour Rapid Charger Included • Large White LED Flashlight, Alarm and Quick Home Channel Access

FTM-6000R | *50W VHF/UHF Mobile Transceiver*

• All New User Operating Interface-E2O-III (Easy to Operate-III) • Robust Speaker Delivers 3W of Clear, Crisp Receive Audio • Detachable Front Panel Can Be Mounted in Multiple Positions • Supports Optional Bluetooth® Wireless Operation Using the SSM-BT10 or a Commercially Available Bluetooth® Headset

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80-10 Meters with single EFHW antenna, no tuner needed!

MFJ-1982MP, $99.95

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- **End-Fed Half-Waves** (EFHW) resonate on halfwave fundamental frequency and even harmonics. 80-10 Meters -- no traps, stubs, resonators. Broad-band matching transformer gives you low SWR! No tuner usually needed.
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MFJ-1984MP, $89.95. *300 Watts* Restricted space, 40-10M. 66 feet.
MFJ-1982HP, $129.95. *800 Watts*, high power, 80-10 Meters. 132 feet.
MFJ-1984HP, $109.95. *800 Watts*, high power, 40-10 Meters. 66 feet.
MFJ-1982LP, $89.95. *30 Watts* QRP, 80-10 Meters. 132 feet.
MFJ-1984LP, $79.95. *30 Watts* QRP, 40-10 Meters. 66 feet.

G5RV Antenna

MFJ-1778, $89.95. 80-10 Meters G5RV is 102 foot wide copper wire, 32.5 feet ladder line center to SO-239.

Premium stainless steel telescopic whips

-- Build collapsible dipoles, mobiles, portable and base antennas. Great for traveling. Rigidly collared at the base, stronger than plated brass, resists rust/corrosion. 16.9/12/10/8/4.5' models available.

MFJ-1979, $69.95. *Most popular!* 16.9' ext., 27" collapsed. 10 sect. 20-6M.

MFJ-1936T, $49.95. Ground rod, 3/8-24 mount, 17' whip, counterpoise.

Continuously tuneable Portable 60-6M Antenna

MFJ-1898, $149.95. Get 60/40/30/20/17/15/12/10/6-Meters in one portable *continuously tuneable* antenna!!! Great for POTA, SOTA, DXPeditions or just in your backyard. Collapses to 1.25x11.5 inches in two sections. Fully extended it's a whopping 103 inches! Easy to tune. Tuning section base unscrews to reveal a nifty tuning chart (like a ruler). Handles 125 Watts PEP SSB. Quick and painless band changing.

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MFJ-16XXT, $22.95-$29.95. Monoband portable hamsticks make POTA fun & easy! Small, lightweight, efficient, and easy-to-use. Dual center and distributed loading lets you radiate efficiently -- get more power out for working DX and ragchewing. Ruggedly constructed. Heavy duty 4'-3/8" diameter fiberglass rod, .125" diameter PH-17-7 stainless steel whip, chrome plated brass fittings give years of dependability. Adjust whip for lowest SWR. Allen wrench, tuning/matching instructions. 250W. PEP. 7' fully extended, collapses to 4' for easy storage. 6/10/12/15/20/30/40/60/75M. 3/8 x 24 mount.

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MFJ-1918EX, $129.95. Tripod, 9.5' telescoping fiberglass mast. 3.8' collapsed. 6½ lbs.

Tripods Only

MFJ-1921, $219.95, *Giant tripod* base spreads to 8'! Supports massive antennas. Adjustable non-skid legs. 14 lbs.

MFJ-1905, $44.95. *Optional* foot anchors,

MFJ-1919, $129.95, Base spreads 4.8'. Supports 100 lbs. 7.8 ft, 9.75 lbs.

MFJ-1918, $84.95, Base spreads 2.75'. Support 66 lbs. 6.75 lbs.

Telescopic Fiberglass Masts

Pull out sections and lock to extend your antenna way to the sky. Lightweight, Light-Duty or Super-Strong Thick-Wall models, 25-43'. Each collapses for easy-to-carry size for true portablilty.

MFJ-1910, $119.95. 33', light duty, has top tie ring for wires.

MFJ-1915, $159.95. 25 feet, for heavier duty use.

MFJ-1917, $209.95. 43 feet, heavier duty use, has top tie ring for wires.

MFJ RFI Isolator

MFJ-915, $49.95. Prevents unwanted RFI from traveling on your coax shield into your expensive transceiver and other electronic equipment. Prevents painful RF "bites" and erratic operation. 1.5 kW. 1.8-30 MHz.

MFJ 4:1 Balun

MFJ-918, $49.95. True 1:1 current balun/center insulator. High-permeability ferrite beads on RG-303 *Teflon*® coax. 2" dia.x6" long. 14 gauge 7-strand copper wire. 1.5 kW 1.8-30 MHz.

MFJ POTA Antenna Tuners

MFJ-939, $199.95. Automatic Tuner, 200W Digital/SSB/CW. 20,000 memories, super fast automatic tuning. Includes interface cable, 2-year warranty. Compact 6½Wx2⅞Hx8⅜D".

MFJ-945E, $189.95. 160-6M Manual antenna tuner. Lighted Cross-Needle SWR/Wattmeter, Lamp/ Bypass switches. 300 Watts. Compact 8Wx2Hx6D inches.

MFJ 30 Amp Power Supply

MFJ-4230MVP, $159.95.

Ham radio's *best seller* is just 5Wx2½Hx6D inches, and just 3 pounds. Perfect for home, POTA or for power for your "*Go-Box*". 25A continuous, 30A surge at 13.8 VDC. Adjusts 4-16 VDC. 120/240 VAC at 47-63 Hz -- worldwide! V/A Meter switch. 75% efficiency, low ripple/noise, <100 mV. Over-voltage/current protections.

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World's best selling analyzer covers 280 KHz to 230 MHz, has LCD that reads SWR and impedance or SWR bargraph, SWR and Impedance analog meters, signal generator, frequency counter.

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An inexpensive wide-band SDR dongle receiver lets you see entire bands on frequency/waterfall computer displays!

MFJ-1708B-SDR
$139.95

If you want to know where the activity is, who's generating splatter, what's in the DX window, how wide your audio is or what frequencies are clear, it's all right there! While receiving on your transceiver, MFJ-1708B-SDR switches your SDR to your antenna showing the entire band. On transmit your SDR is switched out and grounded to protect your SDR. PTT and a fail-safe RF sense switches MFJ-1708B-SDR. For HF/VHF/UHF. Monitor multiple bands with multiple SDRs and a multi-coupler.

MFJ-1708B-SDRS, $139.95. SMA connector for your SDR.

New B series improvements . . .

The original MFJ-1708 series used one relay and wires to connect the SO-239s. The *new B-series* uses *four* relays and connectors on a *single* pc board. This gives you > 50 dB isolation at 300 MHz and > 68 dB at 50 MHz. SWR < 1.16:1 at 50 MHz and < 1.75:1 at 450 MHz at the transmit port. Mute output is a selectable short or open to ground. Use "boat anchors" or modern receivers or key a linear amplifier. Receiver input protection prevents overload from nearby high power signals and from receive to transmit. A hybrid splitter on SDR models reduces loading effect and gives > 15 dB isolation between the SDR REC and XCVR ports to reduce interference. The original MFJ-1708 series is still available.

MFJ Low Noise VLF/HF Receiving Loop

Pull weak signals out of static crashes, atmospheric, man-made and power line noise!

Hear signals 50 KHz to 30 MHz cleaner, quieter than ever before! Power line noise disappears. Rotate its figure 8 pattern and its extremely deep null to completely eliminate an interfering signal or greatly peak a desired one. Fully protected state-of-the-art Gali MMICs in push-pull gives you a preamp with extremely high dynamic range, low IMD and 25 dB of low noise gain. Excellent performance on strong and weak signals without overload. 36-inch dia. loop. 1-in. OD 6061 aluminum.

MFJ-1886
$329.95

MFJ-1886TR
$369.95
with built-in Transmit/ Receive switch

MFJ *wideband* SDR *Discone* Antenna

Receives 25-1300 MHz

MFJ ultra wide-band *Discone* Antenna receives 25-1300 MHz. Perfect for all band SDR reception. Covers 10, 6, 2 Meters, 220 and 440 MHz and 33/23 CM ham bands and everything in between. It is excellent for monitoring multiple bands simultaneously using multiple SDRs and a multi-coupler. Also test any transmitter 50-1300 MHz using a single discone and single coax. Handles 200W. Includes 50 feet coax, stainless steel elements and mounting hardware.

MFJ-1866, $79.95. Like MFJ-1868 but transmits 144-1290 MHz. Coax and mounting hardware not included.

MFJ-1868
$99.95

Tuned Indoor SDR Active Antenna

Make your SDR receiver come alive with HF signals, .3-40 MHz, while rejecting interference with MFJ-1020C *tuneable* indoor active antenna! Gain control, telescoping whip.

MFJ-1020C
$129.95

Untuned Indoor SDR Active Antenna

MFJ-1022, $89.95. Hear weak, noisy VLF to UHF signals. Noise-less feedback gives excellent low noise reception. Handles strong signals.

Active OutdoorAntenna

MFJ-1024
$219.95

World Radio TV Handbook says "MFJ-1024 is a *first rate, easy-to-operate active antenna, quiet, excellent dynamic range, good gain, very low noise factor, broad frequency coverage, excellent choice . . .*"

Outdoor mounted 54-inch whip/preamp gives maximum signal and minimum noise. Covers .05-30 MHz.

Indoor unit: 20 dB attenuator, gain control, 2 receiver and 2 antenna switches.

HF SDR Preselector

Tuneable MFJ-1040C lets you copy **w**eak, noisy SDR signals from 1.8 to 54 MHz. Greatly tunes out and reject out-of-band interference. Up to 20 dB gain. Has gain control. Cascode FET/bipolar transistor gives low noise, high gain without overloading. Switches for 2 antennas and 2 receivers. SO-239s. Has 20 dB attenuator. Automatically bypasses when transmitting or use PTT. 6½Wx2½Hx4D inches.

MFJ-1040C
$149.95

MFJ LW/MW/SW SDR Preselector/Tuner

Highly rated series-tuned MFJ boosts your desired signals while greatly rejecting interference and preventing serious overload.

Greatly improves reception 0.15 to 30 MHz. Incredibly effective below 2 MHz.

Super easy to operate, select band and tune!

Bypass tuner and ground receiver switch positions.

Compact 2x3x4 inches. SO-239 connectors.

MFJ-956
$109.95

MFJ RF Sense Transmit/Receive Switch

MFJ-1708B
$139.95.

Switches your antenna from receiver to transmitter using a relay. Shorts your receiver to ground during transmit. Use RF sensing with adjustable delay or PTT line. Has selectable open/short mute.

Auto switch XCVR between 2 antennas

MFJ-1707B
$139.95.

Automatically switches separate transmit and receive antennas on transceivers with only one antenna port. *Example:* Efficient 75M dipole for XMIT and low noise MFJ loop for receive -- *no static crashes!*

MFJ Enterprises, Inc. 300 Industrial Pk Rd, Starkville, MS 39759
Phone: (662) 323-5869 • **Tech Help:** (662) 323-0549 • **FAX:** (662) 323-6551 8-4:30 CST, Mon.-Fri.

MFJ Reach for the Sky Mister!

Get that antenna up where it belongs, high in the sky with MFJ's heavy-duty Telescopic Masts and accessories. We have all you need for temporary, portable or permanent antenna installations.

18' Telescopic Mast/Tripod

MFJ-1919EX, $199.95.

Put your antennas up high anywhere with this super-strong* 18 foot telescoping fiberglass mast and MFJ-1919 heavy duty steel tripod. *QuickClamps™ lower mast to 5 feet. Mast has thick 1/8 in. wall, .75" top, 1.5" bottom dia. 15 lbs. Steel tripod has braced triangle base, non-skid feet, mast lock.

9.5' Telescopic Mast/Tripod

MFJ-1918EX, $129.95.

MFJ-1918 *tripod with 9.5 ft. telescoping fiberglass mast*. 3.8 feet collapsed. 6.5 lbs.

Tripods Only

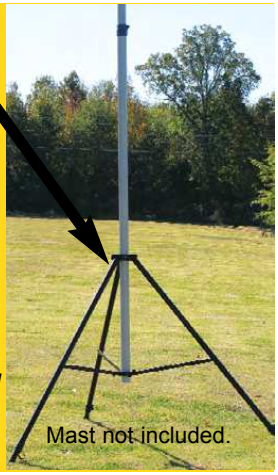
MFJ-1921, $219.95.

Giant tripod base spreads to 8'! Supports massive masts/ antennas. Adjustable length non-skid legs accommodates uneven ground surfaces. Optional foot anchors. 14 lbs.

MFJ-1919, $129.95.

Large tripod spreads to 4.8 ft. Support 100 lbs. 7.8', 9.75 lbs.

MFJ-1918, $84.95, *Small tripod* base spreads to 2.75 ft. Support 66 lbs. 6.75 lbs.



Light Duty Lightweight Fiberglass Masts

Portable, telescoping high-strength fiberglass masts extend way up into the sky! Just pull out sections and lock.

Choose Lightweight-Light-Duty or Super-Strong Thick-Wall models -- 10 to 50 feet long. Each collapses to an easy-to-carry size for true portablilty.

For quick put-up and take-down, light-duty models have Twist & Lock sections and heavy-duty thick wall models use military style *QuickClamps*™ or stainless steel hose clamps.

Use them for traveling, camping, at hotels, hamfests, field day, DX-peditions. Put up full size full performance inverted Vee, dipole or vertical antenna in minutes at heights that will snag you real DX.

Use multiple telescoping masts to make loops, quads, rotatable dipoles even beams.

Light Duty Lightweight Fiberglass Masts

So lightweight you can take them anywhere!

MFJ's most popular MFJ-1910 is 33 feet long, 3.3 lbs.

MFJ-1910, $119.95. 33 ft., light duty w/top tie ring.
MFJ-1911, $129.95. 20 ft., light duty w/top tie ring.
MFJ-1913, $129.95. 28 ft., lightweight w/top tie ring.
MFJ-1915, $159.95. 25 ft., for heavier duty use.
MFJ-1916, $199.95. 34 ft., for heavier duty use.
MFJ-1917, $209.95. 43 ft., heavier duty w/top tie ring.

Super-strong .125" Thick-Wall Fiberglass Masts

Use for temporary or permanent wire antennas, small beams or verticals. **Best seller** is 48 ft. long, just 24 lbs.

Heavy Duty Models: All have QuickClamps™

MFJ-1908HD, $319.95 is 48' ext., 7.75-ft. collapsed, has 2½" OD bottom, 1" OD top, seven 7.75-ft. sections, 24 lbs.
MFJ-1906HD, $269.95 is 38' extended, 6 feet collapsed, has 2½" OD bottom, 1" OD top, seven 6-foot sections, 24 lbs.
MFJ-1904HD, $199.95 is 25' extended, 4 feet collapsed, has 2½" OD bottom, 1" OD top, seven 4-foot sections, 14 lbs.
MFJ-1904H, $179.95. 22' ext., 5' collapsed, 9 lbs. 2½" OD.
MFJ-1902H, $159.95, 10' ext., 38" collapsed, 5 lbs. 2½" OD

Standard Models: H models have QuickClamps™

MFJ-1906, $179.95/MFJ-1906H, $239.95, 33 feet, ext., 6 ft. collapsed, six 6-ft. sections, 13 lbs. 2" bottom, 3/4" top OD.
MFJ-1908, $239.95/MFJ-1908H, $289.95, 41' ext., 7.75-ft. collapsed, six 7.75-ft. sect., 16 lbs. 2" bottom, 3/4" top OD.

Mast Accessories

MFJ-1900, $99.95. Mount clamps mast to mounting pipe.
MFJ-13, $84.95. 5 Military Quick*Clamps*™. Fit 3/4" to 2" OD.
MFJ-13HD, $84.95. Extra set clamps, 1- 2½" masts.

Mast Guy Ring Sets

Fits masts 3/4" to 1¼" dia. OD. **MFJ-2830X, $13.95,** *fiber-glass*; **MFJ-2840X, $19.95,** *aluminum*.

Left: *Stainless Steel Hose Clamps* recommended for permanent installations. Fiberglass is slotted.
Right: UV protected Military grade *Quick-Clamps*.Guy 2 levels when fully extended.

80-6 Meter Telescopic Antenna

3.8 foot fiberglass mast telescopes to a 31' self-supporting *high performance* 80-6 Meter antenna in minutes! 1/4 wave performance on 40M, 1/2 wave on 20M. High-Q air wound loading coil. Use antenna tuner for 30/20/15/12/10/6. 600 Watts SSB/CW. Temporary, portable or permanent ant-enna for home, RV, field day, DXpedition. Includes four 12 foot radials. Current balun reduces feedline radiation and pattern distortion. **MFJ-2982, $179.95.** 80-6M. **MFJ-2980, $139.95.** 40-6M.

MFJ "*HamStick*" *Isolated* Dipole

MFJ-347, $29.95. Build your own 80-6 Meter *mini*-dipole using two HF mobile whips! MFJ-347 *isolates* dipole elements. Lets you use a balun to give a *true balanced dipole.* Prevents pattern distortion, noise pickup and RFI radiation from RF on coax shield. Solid aluminum. Use masts up to 1¼" OD.

3/8-24 Hamstick Mount. MFJ-342T, $19.95. Mount 3/8-24 HF/VHF hamsticks vertically or horizontally on masts to 1 inch. Built-in SO239.

MFJ Balcony Mount

Mount *multiple* HF/VHF hamsticks, verticals, dipoles vertically or horizontally on your balcony. High-strength aircraft aluminum extends out 14 inches. Two U-bolts mount to 1½ inches diameter railing/fence post.

Tripod Anchors

MFJ-1905, $44.95. Securely anchor your tripods to the ground with these 3 *stainless steel* foot braces and your stakes. For high winds, unlevel ground. Fits legs to 1½ inchesOD.

Portable Mast Supports

MFJ-1912, $129.95. Just drive your car or truck tire over the stainless steel base of the mount. You're ready for virtually any antenna. Fits up to 2.25" masts.

MFJ-1914, $139.95. Stainless steel antenna mast mount includes four heavy duty galvanized ground stakes to hold your antenna up safely in the field. Use up to 2.25" masts.

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MFJ ANTENNAS

MFJ Wire Antennas

G5RV -- *Most popular antenna in the world!*

Operate 80-10 or 40-10M with tuner. 14 gauge, 7-strand copper antenna wire. 1.5kW. 32.5' ladder line matching section with SO-239 for coax.
MFJ-1778, $89.95. 80-10M. 102 feet long.
MFJ-1778M, $79.95. 40-10M. 52 feet long.

End Fed Half Waves

Operate 80-10 or 40-10M with one support/no tuner.
80-10 Meters, 132 feet:
MFJ-1982HP, $129.95. 800 Watts.
MFJ-1982MP, $99.95. 300 Watts.
MFJ-1982LP, $89.95. 30 Watts.
40-10 Meters, 66 feet:
MFJ-1984HP, $109.95. 800 Watts.
MFJ-1984MP, $89.95. 300 Watts.
MFJ-1984LP, $79.95. 30 Watts.

Off Center Fed Dipoles

Lightweight, virtually invisible. Gives you directivity and gain (*see MFJ website*).
MFJ-2012, $109.95, 40/20/10/6 Meters, 1500 Watts. 67 ft.
MFJ-2010, $89.95. 40/20/10/6 Meters, 300 Watts. 67 ft.
MFJ-2014, $139.95. 75/40 Meters, 1500 Watts. 122 ft.
MFJ-2016, $169.95. 160/75/40 Meters, 1500 Watts. 240 ft.
MFJ-2013, $109.95. 60/30 Meters, 300 Watts. 86 ft.

Dual Band 80/40 or 40/20 Dipoles, 1.5 kW

MFJ-17758, $129.95. 80/40 Meters, 95 feet long, ultra-efficient end-loading on 80 Meters. No tuner needed. Super-strong center insulator, built-in SO239, hanghole.
MFJ-17754, $89.95. 40/20M, 42 ft.

MFJ All Band Doublet

MFJ-1777, $129.95.102 foot, 160-6 Meters with tuner/balun. *Extremely low feedline loss*. Super strong fiberglass center insulator provides stress relief for included 100 feet ladder line. *Ceramic* end insulators. 1500 Watts SSB/CW/Digital.

MFJ 1.5 kW Dipoles

7-strand, 14-ga. copper wire.*Ceramic* insulators. Center insulator with SO-239
MFJ-1779C, $59.95. 20-6M, 35 feet.
MFJ-1779B, $79.95. 80-40M,135 feet.
MFJ-1779A, $99.95. 160M, 265 feet.

20M Extended Double Zepp

MFJ-1742, $124.95. See web for gain. 90 ft. long, 100 ft. ladder line. 7-strand, 14-ga. wire. 80-10M with tuner/balun. 1500 Watts SSB/CW/Digital.

80M End-Fed Zepp

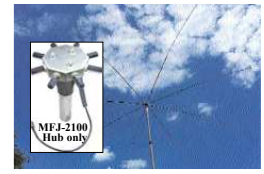
MFJ-1748, $124.95. 125 feet long, 100 foot ladder line included. 7-strand, 14-ga. wire. Use tuner/balun. 1500 Watts SSB/CW/Digital.

MFJ Vertical Mounted Antennas

MFJ 6-Band Cobweb Antenna

MFJ-1836H, $319.95. Six-bands: 20/17/15/12/10/6 Meters, 1.5 kW. *Perfect for restricted space*. Nearly invisible. 9x9x1/2 feet, 8 lbs. Outstand-ing performance! Horizontally polarized gives less noise, more gain over verticals. Omni-directional. No radials needed! Works great at low heights. Low SWR.
MFJ-1836, $299.95. Like MFJ-1836H, but 300 Watts.

MFJ *4-Band* Dipole Octopus Antenna



***Octopus** antenna hub turns hamsticks into four balanced* HF/VHF/UHF *dipoles!* Rotate for maximum signal, minimum QRM/noise. Mount low for local NVIS, high for DX. Perfect for portable, limited space, HOAs, camping, ARES. Balun. No tuner needed.
MFJ-2104, $299.95. Includes 8 hamsticks for 75/40/20/15 M.
MFJ-2100, $129.95. Hub only. Use eight hamsticks.

MFJ Multi-Band Verticals, no radials needed!

Low angle radiation lets you easily work far-away, rare DX!
Efficient end loading gives maximum radiated power.
1500 Watts SSB/CW/Digital. Low SWR. Omni-directional. No radials or antenna tuner needed.
Low profiles blend into any surroundings. Mount them anywhere ground level, roof tops, apartments, houses, small lots.
Efficient high-Q coils. High power air-wound choke balun.
Built-to-last. Solid fiberglass rod, aircraft aluminum tubing.
5 models: Choose your bands 80-2 Meters
MFJ-1796, $369.95. 6 bands: 40/20/15/10/6/2M, 12 feet.
MFJ-1797, $399.95. 7 bands:40/30/20/17/15/12/10M. 23 ft.
MFJ-1797LP, $369.95. Like MFJ-1797, but only 9 feet tall. Narrower bandwidth on 40 Meters.
MFJ-1799, $599.95.10 bands: 80/40/30/20/17/15/12/10/6/2M. 20 ft.
MFJ-1799X, $549.95. Like MFJ-1799, but less 80M.

MFJ 43-foot Vertical, 160-6 Meter

MFJ-2990,$469.95. High performance 43 foot vertical operates 160-6 Meters, 1500 Watts SSB/CW/Digital. 2 square feet wind load. Self-supporting, no guy wires needed. 6063 aircraft aluminum tubing, bottom section 2" OD, .120" wall thickness. 20 lbs. Requires antenna tuner, ground/counterpoise.

BigStick ™ Vertical

MFJ-2286, $149.95. 7-55 MHz, *full 1/4 wave* 20-6M, 40M coil. 17 ft. extended, 28" collapsed. 2 lbs. 1 KW. Mount, radial kit included.

BigEAR ™ Dipole

MFJ-2289, $249.95. 7-55 MHz. *Full-size* 20-6 Meter dipole, 40M air loading coil. Two 17 ft. telescopic whips, 28" collapsed.

MFJ-915, $49.95 RFI Isolator

Prevents unwanted RF from traveling on your coax shield into your expensive transceiver. Prevents painful RF "bites" and erratic operation. 1.5 kW. 1.8-30 MHz.

MFJ-918, $49.95 4:1 Balun

True 1:1 current balun/center insulator. High-permeability ferrite beads on RG-303 *Teflon*(R) coax. 2" dia.x6" long. 14 gauge 7-strand copper wire. 1.5 kW 1.8-30 MHz.

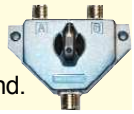
MFJ-913, $49.95, 300W MFJ-919, $84.95, 1.5 kW

True 4:1 current baluns/antenna center insulators transform 200 ohms to 50 ohms, 1.8-30 MHz. Transmission line transformer, low permeability ferrite cores, SO-239, stainless steel hardware with direct 14 gauge stranded copper wire to antenna.

Lightning surge protectors

MFJ-270, $27.95. 400W.
MFJ-272, $37.95. 1500W.
Gas discharge tube shunts 5000 amps peak.< 0.1 dB loss. 1 GHz. SO-239s.

2-Position Antenna Switch



MFJ-1702C, $69.95. 2-position antenna switch, lightning surge protection, center ground.

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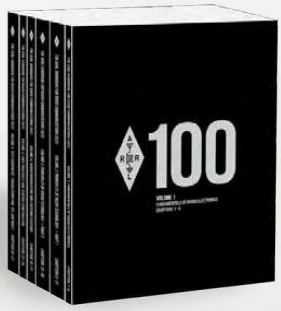
Mix and Match Your Favorite Formats!

Handbook 100

The ARRL Handbook includes new and updated topics, content, and projects. It is written by radio amateurs who share their experience, learning, and discovery from across the state-of-the-art and emerging technologies. Each chapter in *The Handbook* is authored and edited by experts in the subject. There are hands-on projects for all skill levels — from simple accessories and small power supplies to amplifiers and high-gain antennas.



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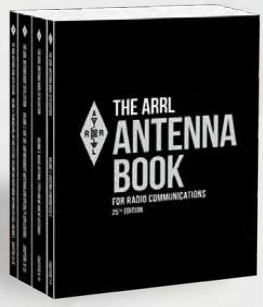
Antenna Book 25

The ARRL Antenna Book includes everything you need to construct your own antenna system, and provides useful advice on selecting, designing, building, testing, and installing antenna systems for every band. From simple dipoles and verticals for portable operation and inverted Ls for 80 and 160 meters, to slot antennas for VHF and dishes for observing the star-forming regions of space, *The Antenna Book* has it all for the active radio amateur.



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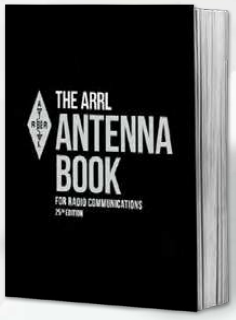

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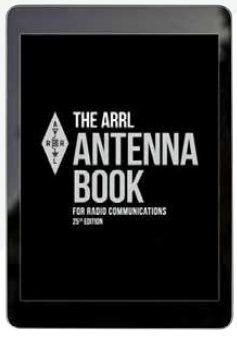

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$299.95
300W

MFJ-1836H
$319.95
1.5 kW

Restricted space spoiling your operating fun? MFJ Cobweb puts your call back on the map!

This six-band (20, 17, 15, 12, 10, 6 Meters) full half-wave *Cobweb Antenna* is perfect for restricted space or portable operation. Sky-gray fiberglass spreaders and *nearly invisible* wire elements (flat 9x9x1/2 feet square. 8 pounds), blend in with your surroundings while standing tough against nasty weather.

Outstanding performance! Horizontally polarized for less local noise pickup plus solid gain over verticals will allow you to work DX easily -- even on QRP. Omni-directional. No radials needed! Works great at low heights. Low SWR is due to MFJ's exclusive *Spider-Match*™ broadband network. Use lightweight TV hardware to mount on your chimney, balcony, mast.

Low in cost, but big on performance. MFJ *Cobweb Antenna* turns your space problem into a stack of QSL cards from far away places.

MFJ-1836HK34, $159.95. Add-on kit adds 40/30 Meters to MFJ-1836/1836H cobwebs.

MFJ-1838
$489.95

40-6 Meter Cobweb Super Heavy-Duty, 1.5 kW

New! Super heavy-duty 40-6 Meter Cobweb Antenna. Built to survive harsh northern winters, heavy snow, ice and strong winds -- has super-strong large diameter fiberglass and heavy-duty 14 gauge stranded hard copper wire. 8-bands: 40, 30, 20, 17, 15, 12, 10, 6 Meters, 1500 Watts. 12 feet, 23 lbs.

MFJ 20/17/15/12/10/6 Meter Hexbeam

MFJ-1846
$599.95
10/12/15/17/20M, 1.5 kW

MFJ-1848
$799.95
10/12/15/17/20/30/40M, 1.5 kW

***New* MFJ HexBeams** deliver solid gain and directivity on 20/17/15/12/10/6 Meters with two elements on each band.

MFJ uses an updated G3TXQ element configuration for excellent gain, improved bandwidth, superior front-to-back ratio and low SWR!

MFJ takes the HexBeam's unique balanced-tension framework to a new level with rugged mounting hardware, exceptionally durable spreaders and sliding antenna wire guides -- designed to ensure years of reliable service.

MFJ-1846, $599.95. 6 Bands: 20/17/15/12/10/6M, 2-elements per band, full 1500W. 25 lbs. 11 ft. turning radius.

MFJ-1848, $799.95. 8 Bands: 20/17/15/12/10/6M, 2-elements per band; 40/30M, single elements, full 1500W. 28 lbs. 14 ft. turning radius.

Reach for the Sky!

MFJ-1906H, $239.95. Strong durable telescoping fiberglass pole gets your antenna up in the air fast! *QuickClamps*™, 33 feet extended, 6 feet collapsed. Six 6 foot sections, 13 lbs. 2" bottom OD, 3/4" top OD.

MFJ-1919EX, $199.95. Strong 18 foot telescoping fiberglass mast and heavy duty steel tripod.

MFJ-1918EX, $129.95. Tripod with 9.5 foot telescoping fiberglass mast.

MFJ Isolator and 1:1 Balun

MFJ-915, $49.95 Stop *RF* traveling down coax line, painful RF "bites" and erratic operation. 1.5 kW 1.8-60 MHz. 2Wx5H". SO-239s.

MFJ-918, $49.95 True 1:1 Current balun & center insulator forces equal antenna currents in dipole elements.

MFJ Dry Dummy Load

MFJ-260C, $69.95 Air-cooled, 300 Watt dry dummy load with a non-inductive resistor in a perforated metal housing.

SO-239 connector. Full load 30 seconds. Silk-screened derating curve to 5 minutes. SWR below 1.1:1 to 30 MHz, 1.5:1 from 30 to 650 MHz.

MFJ 2-Pos. Antenna Switch

MFJ-1702C, $69.95 2-Position antenna switch has center ground, auto grounding of unused positions, handles 2.5 kW PEP and works to over 500 MHz. Lightning surge protection. Quality SO-239 connectors, heavy duty diecast.

MFJ-1704, $129.95. Like MFJ-1702C but has 4 positions.

MFJ G5RV Antenna

MFJ-1778, $89.95 G5RV antenna covers 160-10 Meters with antenna tuner. 102 ft. long. Inverted vee or sloper. Use on 160 Meters as Marconi. 1500 Watts. Super-strong fiberglass center feedpoint insulators. Glazed ceramic end insulators. Hand soldered. Add coax, some rope and *you're on the air!*

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high-performance durable ANTENNAS

PENTA10

Momobeam Penta10 five band yagi antenna is the ideal partner for those who want an antenna easy to be assembled, with excellent performance and compact dimensions.

Bands: 10/12/15/17/20
Elements: Aluminum 6060T6
Hardware: Stainless Steel
Boom: Square Boom Design
Includes: Tools and Spare Parts

RV

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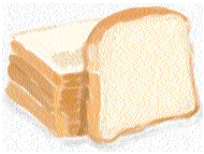


"Best thing since sliced bread!"

More hams use MFJ analyzers than all others in the world!

MFJ-269D . . . 280 KHz - 230 MHz plus 415-470 MHz, 12-bit A/D

New and improved. Now covers 280 KHz to 230 MHz and 415 to 470 MHz and 2200 Meter band!

Instantly gives you a complete picture of your antenna.

Read SWR, return loss, reflect-ion coefficient, match efficiency at any frequency simultaneously.

Read Complex Impedance (100 KHz to 230 MHz) as series equivalent resistance and reactance (Rs+jXs) or as magnitude (Z) and phase (degrees). Also reads parallel equivalent resistance and reactance (Rp+jXp).

Determine velocity factor, coax loss in dB, length of coax and *distance to short or open in feet (it's like a built-in TDR).*

Coax Calculator™ calculates coax line length in feet given degrees and vice versa for any frequency, velocity factor.

New! MFJ-269D **$449.95**

Measure SWR and loss of coax with *any* characteristic impedance (280 KHz to 230 MHz) from 10 to over 600 Ohms.

Measures inductance in uH and capacitance in pF at RF frequencies, 100 KHz to 230 MHz.

High contrast LCD gives precision readings and two side-by-side analog meters make antenna adjustments smooth and easy.

12-bit A/D converter gives much better accuracy and resolution than common 8-bits -- *MFJ-269D exclusive!*

Built-in frequency counter, battery saver, low battery warning, Ni-Mh/NiCd charge circuit. 4Wx2Dx6¾", 2 lbs. Use ten aA batteries or 110 VAC with MFJ-1312D, $19.95.

MFJ-269DPRO™ SWR Analyzer

MFJ-269DPro, $519.95. Like MFJ-269D, but UHF range covers ***430 to 520 MHz***. For commercial work.

MFJ-259D . . . World's Most Popular Antenna Analyzer!

New!

MFJ-259D **$349.95** ***New and improved, now covers 280 KHz-230 MHz!***

World famous MFJ-259D gives you a complete picture of your antenna's SWR and Complex Impedance.

MFJ-259D is a complete ham radio test station including frequency counter, RF signal generator, *SWR Analyzer™*, RF Resistance/Reactance Analyzer, Coax Analyzer, Capacitance/Inductance Meter and more!

Read Complex Impedance as series resistance and reactance (R+jX) or as magnitude (Z) and phase (degrees).

Determine velocity factor, coax cable loss in dB, length of coax and distance to short/open.

Read SWR, return loss and reflection coefficient at any frequency simultaneously.

Read inductance (uH) and capacitance (pF) at RF frequencies.

Large easy-to-read two line LCD screen and side-by-side meters clearly display your information.

Built-in frequency counter, Ni-MH/Ni-CD charger circuit, battery saver, low battery warning, smooth reduction drive tuning.

Super easy-to-use! Just set the bandswitch and tune the dial -- just like your transceiver. SWR, Complex impedance displayed instantly!

Fully portable, take it anywhere -- remote sites, up towers, on DX-peditions. Use 10 AA or Ni-Cad or Ni-MH batteries (not included) or 110 VAC with MFJ-1312D, $19.95. Rugged metal cabinet, 4x2x6¾". **MFJ-249D, $329.95.**

MFJ-249D does everything MFJ-259D does with digital display only.

1500 Watt *Legal Limit*

for Ameritron AL-1500/1200/82 amps

MFJ-998 **$769.95**

Roam the entire HF spectrum 1.8- 30 MHz *hands-free* with full *1500 Watt* legal limit on SSB/CW/Digital and near-perfect SWR! Ultra-fast automatic antenna tuning, back-lighted LCD and Cross-Needle SWR/Wattmeter. Highly efficient L-network, 12-1600 Ohms impedance matching, 20,000 *VirtualAntenna™* memories, audio SWR, multiple antenna connections. Made in USA!

MFJ-225 1.5-180 MHz *continu-ous* Two-Port Graphic Analyzer

MFJ-225 **$399.95**

Out in the field, the MFJ-225 is a compact completely *self-contained handheld graphing analyzer*. On the bench it becomes a full-fledged two-port (S21) desktop machine when teamed up with your PC. Using powerful IG-miniVNA freeware, you'll run de-tailed data analysis and print out stunning color-graphic plots to document your work! Built-in back-lighted *3-inch LCD graphic* display. Make fine adjustments using full-screen easy-to-view SWR bar-graph, capture vivid swept displays for SWR, impedance, re-turn loss, phase angle, more. DDS generator.

SWR Analyzer Accessories

A. MFJ-29D/MFJ-39D, $39.95. Carrying Pouch for MFJ-259D/269D.

B. MFJ-92AA10, $59.95. 10-Pk 2500 mAh Ni-MH Supercells.

C. MFJ-66C, $59.95. Dip coils, set of two covers 1.8-230 MHz.

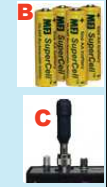
D. MFJ-731, $134.95. Tunable Analyzer Filter, 1.8-30 MHz, for strong RF fields.

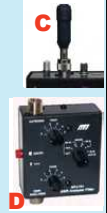
E. MFJ-917, $39.95. 1:1 Current balun for SWR Analyzers to test balanced line antennas, other loads.

F. MFJ-7737, $8.95. PL-259 to BNC Female.

G. MFJ-7727, $9.95. PL-259 to SMA Female.

H. MFJ-5510C, $19.95. 12VDC cigarette lighter adapter.





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Born in the U.S.A.!

Buy American! MFJ automatic tuners are built on American soil by American workers right here in Starkville, Mississippi USA.

MFJ *IntelliTuner*™ Automatic Tuners

The MFJ-993B *IntelliTuner*™ lets you tune any antenna *automatically -- ultra fast*.

It's a comprehensive automatic *antenna tuning center* complete with SWR/Wattmeter, antenna switch for two antennas, wire connection and 4:1 current balun for balanced lines.

MFJ's exclusive *IntelliTuner*™, *Adaptive Search*™ and *Instant Recall*™ algorithms give you *ultra fast* automatic tuning with over 20,000 *VirtualAntenna*™ Memories.

MFJ-993B **$329.95** ***Full Digital Power!***

You get a highly efficient L-network, 6-1600 ohm matching at 300 Watts SSB/CW and digital or *extra-wide* 6-3200 Ohm matching at 150 Watts SSB/CW and digital, 1.8-30 MHz coverage, Cross-Needle *and* digital meters, audio SWR meter, *backlit* LCD, remote control port, radio interface, heavy-duty 16 amp/1000V relays. MFJ-993B automatically tunes for minimum SWR and remembers your frequency and tuner settings. The next time you operate on that frequency and antenna, these tuner settings are instantly restored and *you're ready to operate in milliseconds!* 10Wx2¾Hx9D inches. Use 12-15 VDC/1 amp or 110 VAC with **MFJ-1316, $29.95**. Radio interface cables, remote control available. See ***www.mfjenterprises.com***

made in USA

600 Watt MFJ Automatic Antenna Tuner

MFJ-994B, $419.95. Like MFJ-993B but handles 600 Watts SSB/CW/Digital, matches 12-800 Ohms. 10,000 memories. Doesn't have LCD, antenna switch, balun, audio SWR meter. 10Wx2¾Hx9D inches.

More hams use MFJ tuners than all other tuners in the world!

World's most advanced Automatic Antenna Tuners feature world renowned MFJ AdaptiveSearch™ and AutomaticRecall™ algorithms -- world's fastest ultra-wide range tuning. Nine World Class models! Choose your features: Digital/Analog/Audio SWR-Wattmeter, Antenna Switch, Balun, Radio Interface, Digital frequency readout, Remoteable, Coax/Balanced Lines/Wire Tuning, Field Upgradeable . . .

1500 Watt *Legal Limit*

for Ameritron AL-1500/1200/82 amps

Roam the entire HF spectrum 1.8- 30 MHz *hands-free* with full *1500 Watt* legal limit on SSB/CW/Digital and near-perfect SWR! Lighted LCD/Cross-Needle Meter.

MFJ-998 **$769.95** ***Full Digital Power!***

300 Watt ...Extra Wide Range

SWR/Wattmeter, 10000 VA Memories

Extra *wide matching range at less cost.* MFJ's *exclusive* dual power level: 300 Watts for 6-1600 Ohms; 150Watts for 6-3200 Ohms. Cross-Needle SWR/Wattmeter.

MFJ-991B **$309.95** ***Full Digital Power!***

200 Watt ...Compact

Digital Meter, Ant Switch, Wide Range

World's fastest compact auto tuner uses MFJ *Adaptive Search*™ and *InstantRecall*™ algorithms. 132,072 tuning solutions instantly match virtually any antenna with near perfect SWR. Bright LCD Display.

MFJ-929 **$279.95** ***Full Digital Power!***

200 Watt *MightyMite*™

Matches IC-706, FT-857D, TS-50S

Full Digital Power!

MFJ-939KIY **$199.95**

200W SSB/CW and Digital. Low-profile automatic tuner is great for those tiny new rigs. Just tune and talk! Includes interface cable, 2-year warranty. 6½Wx2⅞Hx3⅜D".

MFJ *Remote* AutoTuners

Get greatly reduced losses and high efficiencies with long coax runs and high SWR antennas. ***Full Digital Power!***

MFJ-926B, $299.95. 200W.
MFJ-993BRT, $399.95. 300W.
MFJ-994BRT, $499.95. 600W.
MFJ-998BRT, $949.95. 1.5 kW.

G5RV Antennas

Cover 160-10 Meters with antenna tuner. 102 ft. long. Use as inverted vee or sloper, 160 Meters as Marconi. 1500 Watts. Super-strong fiberglass center/feedpoint insulators. *Glazed ceramic* end insulators.

MFJ-1778 **$89.95**

MFJ-1778M, $79.95. 52'. 40-10M.

No Matter What™ Warranty

Protected by MFJ's famous one year *No Matter What*™ limited warranty. We will repair or replace (at our option) for a full year.

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MFJ Antenna Tuners

New, Improved MFJ-989D 1500 Watt Legal Limit Antenna Tuner

World's most popular 1500W Legal Limit Tuner just got better -- *much better* -- gives you more for your money!

New, Improved MFJ-989D legal limit antenna tuner gives you beter efficiency, lower losses and a new true peak reading meter. It easily handles full 1500 Watts SSB/CW, 1.8 to 30 MHz, including MARS/WARC bands.

New, dual 500 pF air variable capacitors give you twice the capacitance for more efficient operation on 160/80 Meters.

New, improved *AirCore*™ Roller Inductor gives you lower losses, higher Q and handles more power more efficiently.

New, *TrueActive*™ peak reading Cross-Needle SWR/Wattmeter lets you read true peak power on all modes.

MFJ-989D, $539.95

New, high voltage current balun lets you tune balanced lines at high power with no worries.

New, crank knob lets you reset your roller inductor quickly, smoothly and accurately.

New, larger 2-inch diameter capacitor knobs with easy-to-see dials make tuning much easier.

New, cabinet maintains components' high-Q. Generous air vents keep components cool.

$12^{7}/_{8}$Wx6Hx$11^{5}/_{8}$D inches.

Includes six position ceramic antenna switch, 50 Ohm dummy load, indestructible multi-color Lexan front panel with detailed logging scales and legends.

The MFJ-989D uses the superb time-tested T-Network. It has the widest matching range and is the easiest to use of all matching networks. Now with MFJ's new 500 pF air variable capacitors and new low loss roller inductor, it easily handles higher power much more efficiently.

***No Matter What*™ Warranty**

Every MFJ tuner is protected by MFJ's famous one year *No Matter What*™ limited warranty. We will repair or replace your MFJ tuner (at our option) for a full year.

MFJ-986 Two Knob *Differential-T*™

MFJ-986, $479.95

Two knob tuning (differential capacitor and *AirCore*™ roller inductor) makes tuning foolproof and easier than ever. Gives minimum SWR at only one setting. Handles 3 kW PEP SSB amplifier input power (1.5 kW output). Gear-driven turns counter, lighted peak/average Cross-Needle SWR/Wattmeter, antenna switch, balun, 1.8 to 30 MHz. 15Wx$4^{1}/_{2}$Hx$10^{3}/_{4}$D".

MFJ-962E compact kW Tuner

MFJ-962E, $399.95

A few more dollars steps you up to a kW tuner for an amp later. Handles 1.5 kW PEP/SSB amplifier input power (800W output). Ideal for Ameritron's AL-811H. *AirCore*™ roller inductor, gear-driven turns counter, peak/avg lighted Cross-needle SWR/Wattmeter, antenna switch, balun, Lexan front, 1.8 to 30 MHz. $10^{7}/_{8}$Wx$14^{1}/_{2}$Hx$10^{3}/_{4}$D".

MFJ-969 300W Roller Inductor Tuner

MFJ-969, $319.95

Superb, *AirCore*™ roller inductor. Covers 6 Meters through 160 Meters! 300 Watts PEP SSB. Active true peak reading lighted Cross-Needle SWR/WAttmeter, *QRM-Free PreTune*™ antenna switch, dummy load, 4:1 balun, Lexan front. $10^{1}/_{2}$Wx$3^{1}/_{2}$Hx$9^{1}/_{2}$D".

MFJ-949E deluxe 300 Watt Tuner

MFJ-949E, $279.95

More hams use MFJ-949s than any other antenna tuner in the world! Handles 300 Watts, full 1.8-30 MHz coverage, custom inductor switch, 1000V tuning capacitors, full size peak/average lighted Cross-Needle SWR/Wattmeter, 8 position antenna switch, dummy load, *QRM-Free PreTune*™, scratch proof Lexan front panel. $10^{5}/_{8}$Wx$3^{1}/_{2}$Hx7D". **MFJ-948, $259.95.** Econ-omy version of MFJ-949E, less dummy load.

MFJ-941E Super Value Tuner

MFJ-941E, $239.95

Most for your money! 300 Watts PEP, 1.8-30 MHz, lighted Cross-Needle SWR/Wattmeter, 8-position antenna switch, 4:1 balun, 1000 Volt capacitors, Lexan front panel. $10^{1}/_{2}$Wx$2^{1}/_{2}$Hx7D". **MFJ-941EK, $209.95.** Tuner Kit -- *Build your own!*

MFJ-945E HF/6M mobile Tuner

MFJ-945E, $189.95

Extends your mobile antenna bandwidth so you don't have to stop, go outside and adjust your antenna. Tiny 8Wx2Hx6D". Lighted Cross-Needle SWR/Wattmeter, Lamp and Bypass switches. Covers 1.8-30 MHz and 6-Meters. 300 Watts PEP. **MFJ-20, $14.95**, mobile mount.

MFJ-971 portable/QRP Tuner

MFJ-971, $179.95

Tunes coax, balanced lines, random wire, 1.8-30 MHz. Cross-Needle Meter, SWR, 30/300 or 6 Watt QRP ranges. Matches popular MFJ rigs. Tiny $6^{1}/_{2}$Wx$2^{1}/_{2}$Hx6D".

MFJ-901B smallest Versa Tuner

MFJ-901B, $149.95

MFJ's smallest (5Wx2Hx6D") and most affordable wide range 200 Watt PEP Versa Tuner. Covers 1.8 to 30 MHz. Great for matching solid state rigs to linear amps.

MFJ-902B Tiny Travel Tuner

MFJ-902B, $149.95

Tiny $4^{1}/_{2}$Wx$2^{1}/_{4}$Hx3D", full 150 Watts, 80-6 Meters, has tuner bypass switch for coax/random wire. **MFJ-904H, $199.95.** Same but adds Cross-needle SWR/Wattmeter and 4:1 balun for balanced lines. $7^{1}/_{4}$Wx$2^{3}/_{4}$Hx$2^{3}/_{4}$D".

MFJ-16010 random wire Tuner

MFJ-16010, $109.95

Operate all bands anywhere with MFJ's reversible L-network. Turns random wire into powerful transmitting antennas. 1.8-30 MHz. 200 Watts PEP. Tiny 4Wx2Hx3D".

MFJ-9201 *QRPocket*™ Tuner

MFJ-9201, $79.95

80-10 Meters, 25 Watts. 12 position inductor, tune/bypass switch, wide-range T-network. BNCs. 4Wx$2^{5}/_{8}$Hx$1^{1}/_{2}$D".

MFJ-921/924 VHF/UHF Tuners

MFJ-921/924, $149.95

MFJ-921 covers 2 Meters/220 MHz. **MFJ-924** covers 440 MHz. SWR/Wattmeter. 8Wx$2^{1}/_{2}$Hx3D".

MFJ-931 Artificial RF Ground

MFJ-931, $159.95

Eliminates RF hot spots, RF feedback, TVI/RFI, weak signals caused by poor RF grounding. Creates artificial RF ground or electrically places far away RF ground directly at rig. **MFJ-934, $299.95.** Artificial ground/300 Watt Tuner/Cross-Needle SWR/Wattmeter.

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MFJ *Low-Noise Receiving Loops*

Work DX and ragchew even through horrendous noise!

Pull weak signals out of static crashes, atmospheric, man-made and power line noise!

Clearly hear signals 50 KHz to 30 MHz you never knew existed. Power line noise and static just disappears.

MFJ-1886 drastically reduces noise and interference by receiving the magnetic field and rejecting the electric field. Rotate MFJ-1886 receiving loop to totally eliminate interfering signals or greatly peak desired signal.

Excellent antenna and preamplifier balance gives deep null.

State-of-the-art push-pull Gali MMICs preamp gives you high dynamic range, low IMD and 25 dB of low noise gain.

Gives excellent strong and weak signal performance without overload.

Fully protected preamplifier -- magnetically coupled voltages up to 40V and capacitively coupled voltages up to 20V will not damage preamplifier.

Output is protected from transmission line surges induced by distant lightning.

Use anywhere, inside or outside. RF signal and power goes through your 50 Ohm coax.

Ruggedly built to withstand extreme weather. 1-inch OD diameter 6061 aluminum tubing. 36-inch diameter. 2½lbs. SO-239. Use masts up to 1¾ inches.

MFJ-1886, $329.95. Includes receive loop and MFJ-4116 bias-tee to power MFJ-1886 through coax.

MFJ-1886TR, $369.95. Includes MFJ-1886 and MFJ-4113TR Bias-Tee/Transmit/Receive switch. MFJ-4113TR powers MFJ-1886 through coax and switches between transmitting antenna and receiving loop. For radios with only one antenna connector.

MFJ-4116, $44.95. Bias-Tee provides RF signal and power through coax transmission line. Send up to 1A DC up to 50 Volts.

MFJ-4113TR, $119.95. Bias-Tee with built-in Transmit/Receive switch. Switches between transmitting and receiving antenna. For radios with only one antenna connector. Provides RF signal and power through coax.

Multi-coupler/Bias-Tee

New! **MFJ-1888MC, $249.95.** Connect four receivers to one antenna. Receivers are fully isolated. Each receiver port has 1-12 dB adjustable gain. IP3 is +15 dB. 2dB noise figure. Built-in Bias-Tee powers receiving loop through coax. SO-239s. Use 12 VDC or 110 VAC with MFJ-1312D, $19.95. RF tight, 7¼Wx1¾Hx5D inches.

Super High Dynamic Range High Gain Receiving Loop

New! **MFJ-1888, $499.95.** 32 dB gain from 50 KHz to 30 MHz. 20 dB gain at 80 MHz. IP3 is + 30 dB, 1 dB compression point is 23 dB, noise figure is 1.7 dB. Built-in BCB input filters to reduce overloading. Includes MFJ-1888MC remote multi-coupler. Can be used with MFJ-4113TR Bias-Tee/T/R switch and/or MFJ-4116 bias tee. 36-inch diameter. 2½ lbs. SO-239. Use masts up to 1¾ inches.

Antenna Rotator

Perfect for MFJ-1886/1786/1788 loop, VHF/UHF, small HF beams, TV, FM antennas.

AR-500
$199.95

Weather-proof one piece cast aluminum housing with precision all metal gears, steel thrust bearings and automatic braking. Includes rotator, controller, remote control, clamps, hardware. Memories for 12 directions! Digitally displays position. 110/220 VAC.

Wipe out RFI

Wipe out RFI, noise, interference from any direction at any frequency with a 60 dB notch before it gets into your receiver!

MFJ-1026
$259.95

Eliminate power line noise, fluorescent lamps, light dimmers, computers, TVs, lightning, motors, industrial processes.

Null out QRM on rare DX and work him! Null out local ham or AM station to prevent receiver overload. Works on SSB, AM, CW, FM, digital BCB to lower VHF. Plugs between antenna and transceiver. 12VDC, 110VAC with MFJ-1312D, $19.95.

MFJ *Super High-Q™ Transmitting Loop* Antennas

MFJ 36-inch diameter transmitting loop antenna lets you operate 10-30 MHz continuously including WARC bands!

Ideal for limited space, HOA.

Work DX with low angle radiation and local close-in contacts with high angle radiation when mounted vertically. 150 watts.

Super easy-to-use! MFJ remote control auto tunes to your desired band. Fast/slow tune buttons, Cross-Needle SWR/Watt-meter lets you quickly tune to your exact frequency. No control cable needed.

***World's** most efficient small loop antenna has all welded construction, welded butterfly capacitor with no rotating contacts, large 1.050 inch diameter aluminum radiator for highest efficiency.*

Every capacitor plate is welded for extremely low loss and polished to prevent high voltage arcing. Nylon bearing, anti-backlash mechanism, limit switches, continuous no-step DC motor gives smooth precision tuning. Heavy-duty ABS plastic housing has ultraviolet inhibitor.

Cover 40-15 Meters. MFJ-1788, $719.95. Like MFJ-1786 but covers 40-15 Meters continuous. Includes remote control.

Portable Loop

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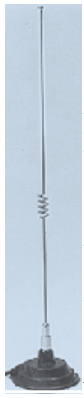

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