Get Into Node-RED | 30

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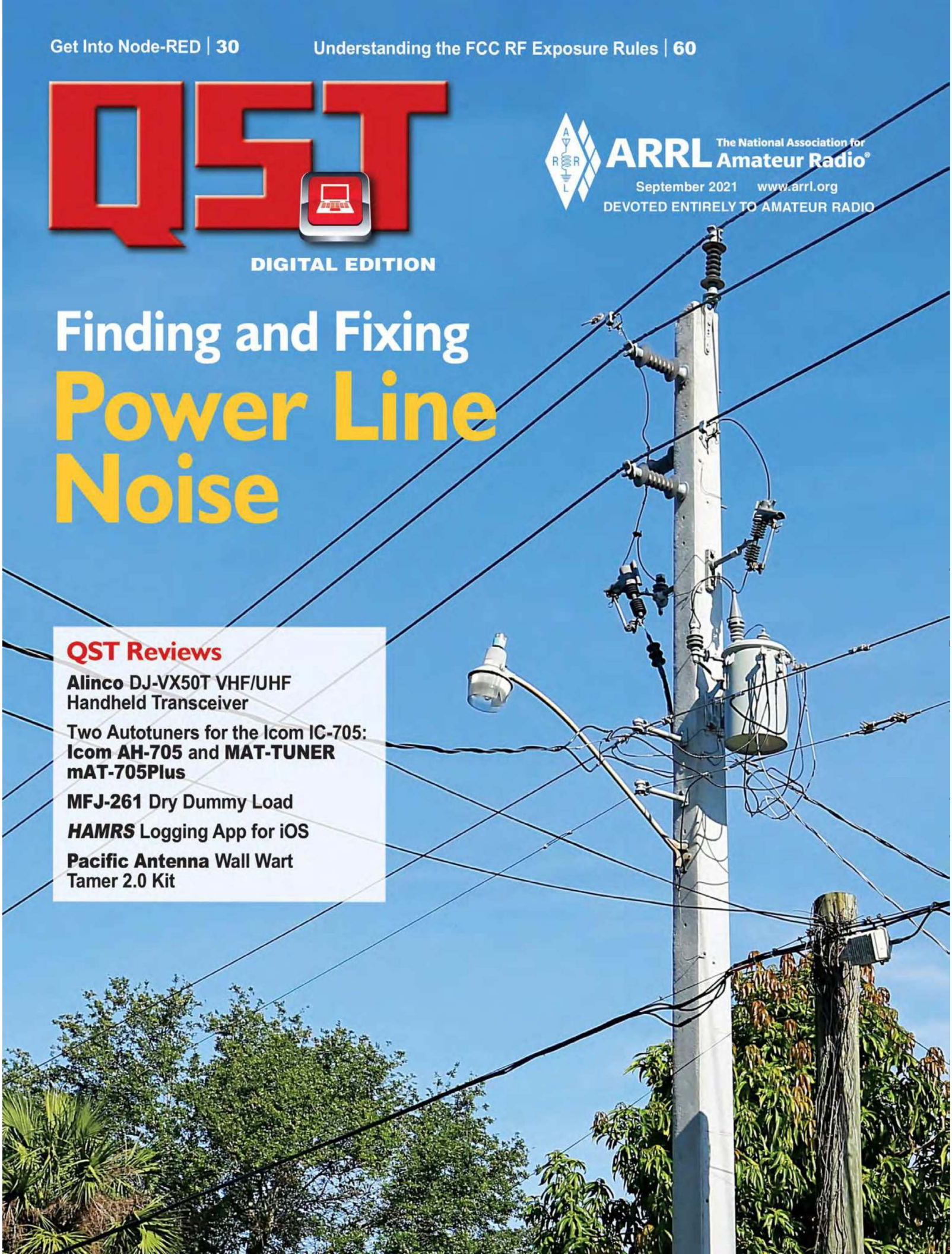
QST

DIGITAL EDITION

ARRL The National Association for Amateur Radio®
September 2021 www.arrl.org
DEVOTED ENTIRELY TO AMATEUR RADIO

Finding and Fixing Power Line Noise



QST Reviews

Alinco DJ-VX50T VHF/UHF Handheld Transceiver

Two Autotuners for the Icom IC-705: **Icom AH-705** and **MAT-TUNER mAT-705Plus**

MFJ-261 Dry Dummy Load

HAMRS Logging App for iOS

Pacific Antenna Wall Wart Tamer 2.0 Kit

The Best of the Best

A Superb All-around Wide-Coverage Transceiver

FT-991A 100W

HF/50/144/430MHz TRANSCEIVER

- Includes HF through UHF with one Radio
- Supports SSB/CW/AM/FM and C4FM digital
- IF Roofing Filters produce Excellent Shape Factor
- IF DSP enables Superb Interference Rejection
- Built in Real-Time Spectrum Scope Display
- 3.5-inch TFT Color Touch Panel Display
- 100 Watts (2 Meter & 70 Centimeter: 50 Watts) of Solid Performance

* External Speaker SP-10: Optional

The New Standard High Performance SDR Transceiver

FTDX10 100W

HF/50MHz TRANSCEIVER

- Hybrid SDR Receiver (Narrow Band SDR & Direct Sampling SDR)
- 9MHz Down Conversion Receiver Configuration
- IF Roofing Filters produce Excellent Shape Factor
- IF DSP enables Superb Interference Rejection
- 5-inch TFT Color Touch Panel with 3DSS*1 Visual Display
- Superior Operating Performance by means of the MPVD*3

* External Speaker SP-30: Optional

The World Leading HF Transceiver with Hybrid SDR

In Homage to the Founder of Yaesu – Sako Hasegawa JA1MP

FTDX101MP 200W

HF/50MHz TRANSCEIVER

The Ultimate

FTDX101D 100W

HF/50MHz TRANSCEIVER

- Dual Hybrid SDR Receivers (Narrow Band SDR & Direct Sampling SDR)
- 9MHz Down Conversion Receiver Configuration
- IF Roofing Filters produce Excellent Shape Factor
- VC-Tune (Variable Capacitor Tuning) Signal Peaking
- IF DSP enables Superb Interference Rejection
- 7-inch TFT Color Touch Panel with 3DSS*1 Visual Display
- Superior Operating Performance by means of ABI*2 & MPVD*3

* Microphone M-1: Optional

* Photo shows the FTDX101MP

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

YAESU The radio

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**

The Best of the Best

Narrow Band SDR Transceiver

FTDX10

Unrivaled RF Performance

Narrow Band SDR Technology is the Revolution

Inheriting the performance of the FTDX101, which is validated to exceed HF transceivers in laboratories around the world.

The most advanced digital narrow band SDR technology is combined with the RF Front-End engineering, such as the low noise-figure RF amplifier and the very sharp shape factor roofing filter designs that Yaesu has incorporated over the years, resulting in unsurpassed HF receiver performance.

Equipped with the latest MPVD feature, and 3DSS visual display to deliver superior Operability and Visibility.

A New Legend in HF Transceivers debuts

HF/50MHz TRANSCEIVER

FTDX10 100W

- The image is shown with an optional third party external display that may be connected using a DVI-D digital cable.
- Shown with Optional External Speaker SP-30.

YAESU
The radio

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**

New! Cushcraft R9 . . . *80-6 Meters*

80 Meters . . . No Radials . . . 1500W

Cushcraft's world famous R8 now has a big brother!

Big Brother R9 now includes 75/80 Meters for local ragchewing and worldwide low band DX *without radials*!

It's omni-directional low angle radiation gives you exciting and easy 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 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.

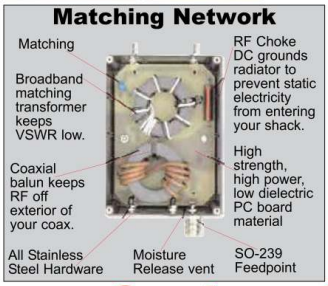
Rugged Construction: Thick fiberglass insulators, all-stainless steel hardware and 6063 aircraft-aluminum tubing is double or triple walled at key stress points to handle anything Mother Nature can dish out.

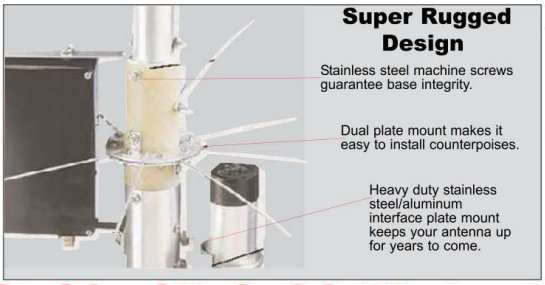
31.5 feet tall, 25 lbs. Mounting mast 1.25 to 2 inches. Wind surface area is 4 square feet.

R8, $619.95. Like R9 antenna but less 75/80 Meters.

R-8TB, $109.95. Tilt-base lets you tilt your antenna up/down easily by yourself to work on.

R-8GK, $89.95. Three-point guy kit for high winds.





MA-5B *5-Band* Beam

Small Footprint -- Big Signal

The MA-5B is one of Cushcraft's most popular HF antennas, delivering solid *signal-boosting directivity* in a bantam-weight package. Mounts on roof using standard TV hardware. Perfect for exploring exciting DX without the high cost and heavy lifting of installing a large tower and full-sized array. Its 7 foot 3-inch boom has less than 9 feet of turning radius. Contest tough -- handles 1500 Watts.

The unique MA-5B gives you 5-bands, automatic band switching and easy installation in a compact 26-pound package. On 10, 15 and 20 Meters the end elements become a two-element Yagi that delivers solid power-multiplying gain over a dipole on all three bands. On 12 and 17 Meters, the middle element is a highly efficient trap dipole. When working DX, what really matters are the interfering signals and noise you *don't hear*. That's where the MA-5B's impressive side rejection and front-to-back ratio really shines. *See* ***cushcraftamateur.com*** *for gain figures.*

Cushcraft 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 laboratory-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 that the World-Ranger lineup is also famous for its rugged construction. In fact, the majority of these antennas sold years ago are still in service today! 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, $569.95,** 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 these days, so why not compliment your FM base 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 three elements per band and the A270-10S provides five for solid point-to-point performance. They're both pre-tuned and assembly is a snap using the 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 broad-banded, 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!

***Free* Cushcraft Catalog**
and Nearest Dealer . . . 662-323-5803
Call your dealer for your best price!

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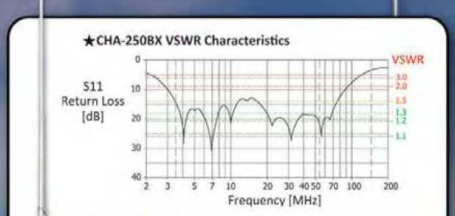


CHA-250B - *No Antenna Tuner Needed!*

CTC-50M *Window Gap Jumper*
No more drilling or open windows!

Base Antennas

❶ COMET CHA-250B BROADBAND 80M THROUGH 6M VERTICAL ANTENNA

A newly designed broadband vertical with NO GROUND RADIALS. EXTREMELY easy to assemble, requires no tuning or adjustments and VSWR is under 1.5:1 from 3.5-57MHz! • TX: 3.5MHz – 57MHz • RX: 2.0– 90MHz • VSWR is 1.5:1 or less, continuous • Max Power: 250W SSB/125W FM• Impedance: 50 Ohm • Length: 23' 5" • Weight: 7 lbs. 1 oz. • Conn: SO-239 • Mast Req'd: 1" – 2" dia. • Max wind speed: 67MPH

❷ COMET GP-3 DUAL-BAND 146/446MHZ BASE REPEATER ANTENNA

Wavelength: 146MHz 6/8 wave • 446MHz 5/8 wave x 3 • Max Pwr: 200W • Length: 5'11"• Weight: 2lbs. 9ozs. • Conn: Gold-plated SO-239 • Construction: Single-piece fiberglass

❸ COMET GP-6 DUAL-BAND 146/446MHZ BASE REPEATER ANTENNA

Wavelength: 146MHz 5/8 wave x 2 • 446MHz 5/8 wave x 5 • Max Pwr: 200W • Length: 10'2"• Weight: 3lbs. 8ozs. • Conn: Gold-plated SO-239 • Construction: Fiberglass, 2 Sections

❹ COMET GP-9 / GP-9N DUAL-BAND 146/446MHZ BASE REPEATER ANTENNA

BEST SELLER! • Wavelength: 146MHz 5/8 wave x 3 • 446MHz 5/8 wave x 8 • Max Pwr: 200W• Length: 16' 9"" • Weight: 5lbs. 11ozs. • Conn: GP-9 Gold-plated SO-239 • GP-9N Gold-plated N-type female • Construction: Fiberglass, 3 Sections

❺ COMET CX-333 TRI-BAND 146/220/446MHZ BASE REPEATER ANTENNA

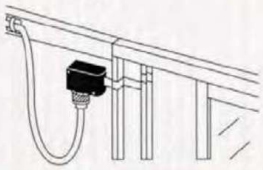
Wavelength: 146MHz 5/8 wave x 2 • 220MHz 5/8 wave x 3• 446MHz 5/8 wave x 5 • Max Pwr: 120W • Length: 10'2" • Weight: 3lbs. 1oz.• Conn: Gold-plated SO-239 • Construction: Fiberglass, 2 Sections

❻ COMET GP-15 TRI-BAND 52/146/446MHZ BASE REPEATER ANTENNA

Wavelength: 52MHz 5/8 wave • 146MHz 5/8 wave x 2 • 446MHz 5/8 wave x 4 • Max Pwr: 150W • Length: 7'11" • Weight: 3lbs. 1oz. • Conn: Gold-plated SO-239• 2MHz band-width after tuning (6M) • Construction: Single-piece fiberglass

❼ COMET CTC-50M WINDOW GAP JUMPER

Avoid drilling holes or leaving windows open/unlocked. Flat coax easily forms to window frame. Low loss SO-239 on each end, 15 inch length.
• Max Pwr: **HF** 100W PEP / **VHF** 60W FM / **UHF** 40W FM / **900-1300 MHz** 10W FM



CAA-500MarkII

1.8-500MHz Antenna analyzer

The CAA-500MarkII combines the simplicity and accuracy of an analog instrument, PLUS...a full color LCD graphic display • Resistive (R) and Reactive (X) components of impedance graphed and displayed numerically • SWR readings in both graphic and numerical results.

Operates on 8-16VDC external power, 6 AA Alkaline or NiMH rechargeable cells • Trickle charger built in (only when using NiMH batteries) • Typical battery life: 9 hours of continuous operation • Battery level indicator • Selectable auto power-off time limit preserves battery capacity • SO-239 connector for 1.8-300MHz range • N-female connector for 300-500MHz range

The perfect combination of analog and graphic information, designed in particular for antenna diagnostics and adjustments while on the roof, tower or in the field!

CAA-5SC

Protect your CAA-500MarkII from moisture, shock, dents and dings!

Shoulder strap included.

Call or visit your local dealer today!

www.natcommgroup.com | **800-962-2611**

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QST

Contents

September 2021 ♦ Volume 105 ♦ Number 9

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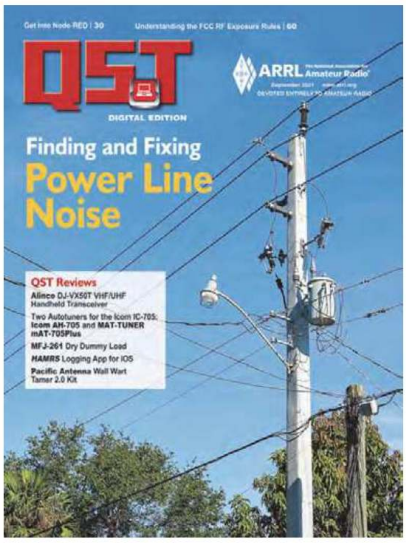
Write for *QST*

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



Our Cover
Interference can cause problems for any amateur radio operator. Richard Kiefer, KØKD, explains how he located and resolved power line interference in his article, "Eliminating Radio Frequency Interference from Power Lines," on page 34 of this issue. This issue also features guidelines to "Understanding the Changes to the FCC RF Exposure Rules" on page 60 to help you determine whether your station is affected.

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Membership without *QST* 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.

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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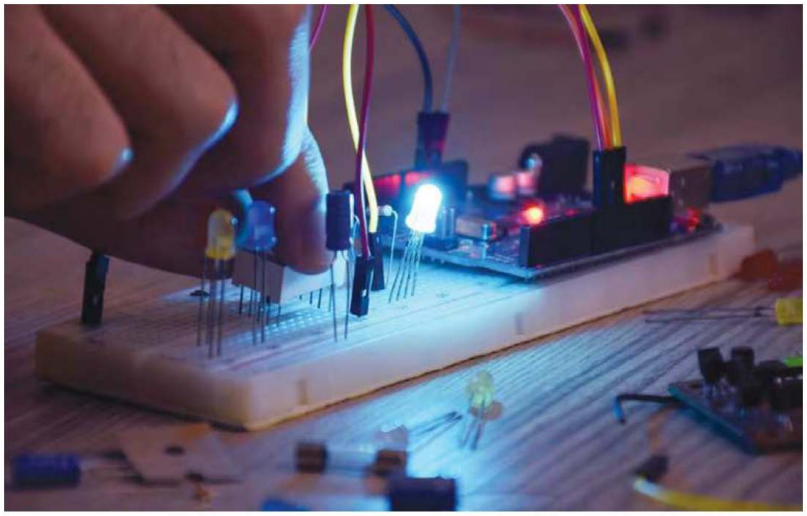
Advertorial

Learn Arduino FAST with this beginner course, NO EXPERIENCE NECESSARY!

By: Steve Buffa (5 Minute Read)



I've been a ham for over 20 years and have been building my own custom antennas from scratch, ranging from simple dipoles to Log-Periodic antennas. Lately I've become interested in controlling my rig electronically. Anything from building an automated antenna switch, to a CW keyer, and everything in between. There was just one problem: even though I'm proficient at basic skills like soldering, wiring, etc., I wasn't quite sure how to add electronic control to my projects. So, I started asking my friends at my local club.

Some said Arduino would be perfect for these projects, while others said I should use Raspberry Pi. However, I didn't know anything about either. I tried doing an internet search to help me learn the difference, but that left me more confused than ever.

Then I found out that my ham friend Aaron had the exact same problem — or, at least, he used to. He said he found an online course (**www.GetMyBootCamp.com**) that changed everything for him, and that he'd started making his own Arduino-based projects because of it.

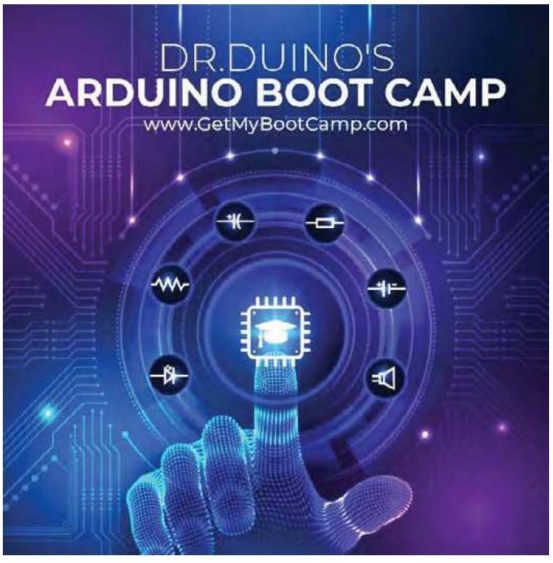
He proudly showed me some of them. They ranged from a simple RF power meter with green, yellow, and red LEDs that changed according to the signal strength, to an Arduino-controlled SDR. Aaron said the online course gave him the foundational skills he needed in order to tackle these projects, while also easily figuring out when to use Arduino over Raspberry Pi.

The secret lies in asking one simple question about your project: Does your project need to do tasks that a PC could do?

For example, does your project need a screen to display heavy graphics? If it does, then Raspberry Pi is the right path to take.

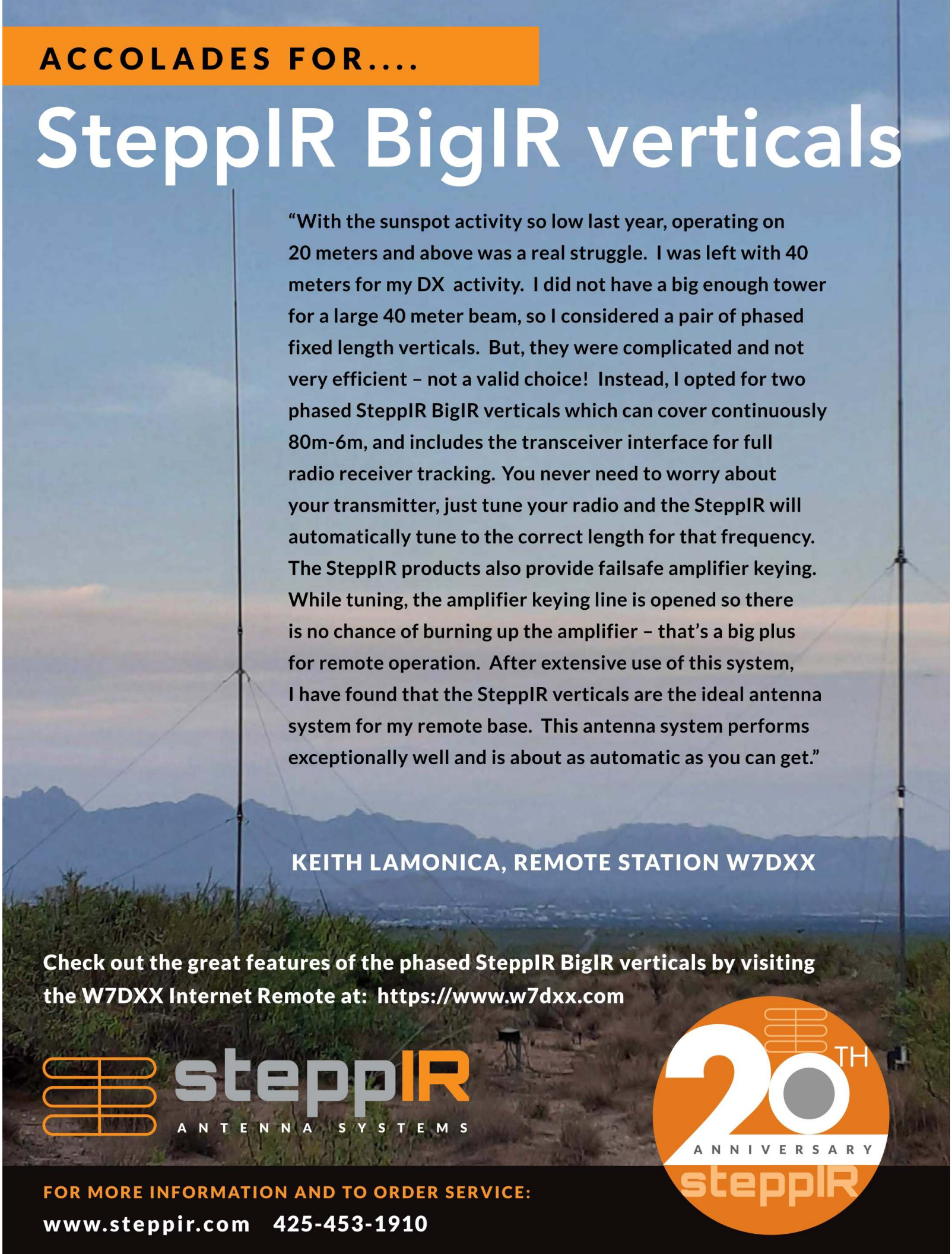
However, projects that monitor switches, or that turn motors or LEDs on and off are better suited for Arduino.

Armed with that knowledge, it was clear that the projects I wanted to do were perfectly suited for Arduino. There was just one question left in my mind: Coding. I didn't know anything about it! As it turns out, the course that Aaron found covers that, too. Much like basic training in the military, this boot camp (provided by a company called Dr.Duino) teaches you the basics for getting started with Arduino, which includes programming fundamentals.



It's eight chapters full of step-by-step, easy-to-follow examples, beginning with "what is Arduino," and ending in having you create and program your very own Morse Code Machine. That project helped solidify everything learned in the boot camp, and I completed it feeling I can finally start to tackle the electronic projects I've been wanting to build for years. So, if you're interested in getting started with Arduino, I highly recommend enrolling in the course at www.GetMyBootCamp.com.

PS- The first 200 people to enroll will receive a FREE Arduino Uno clone. HURRY, book your boot camp + receive a FREE Arduino Uno clone at **www.GetMyBootCamp.com**.



ACCOLADES FOR....

SteppIR BigIR verticals

"With the sunspot activity so low last year, operating on 20 meters and above was a real struggle. I was left with 40 meters for my DX activity. I did not have a big enough tower for a large 40 meter beam, so I considered a pair of phased fixed length verticals. But, they were complicated and not very efficient – not a valid choice! Instead, I opted for two phased SteppIR BigIR verticals which can cover continuously 80m-6m, and includes the transceiver interface for full radio receiver tracking. You never need to worry about your transmitter, just tune your radio and the SteppIR will automatically tune to the correct length for that frequency. The SteppIR products also provide failsafe amplifier keying. While tuning, the amplifier keying line is opened so there is no chance of burning up the amplifier – that's a big plus for remote operation. After extensive use of this system, I have found that the SteppIR verticals are the ideal antenna system for my remote base. This antenna system performs exceptionally well and is about as automatic as you can get."

KEITH LAMONICA, REMOTE STATION W7DXX

Check out the great features of the phased SteppIR BigIR verticals by visiting the W7DXX Internet Remote at: https://www.w7dxx.com

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DIAMOND ANTENNA

diamondantenna.net

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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.

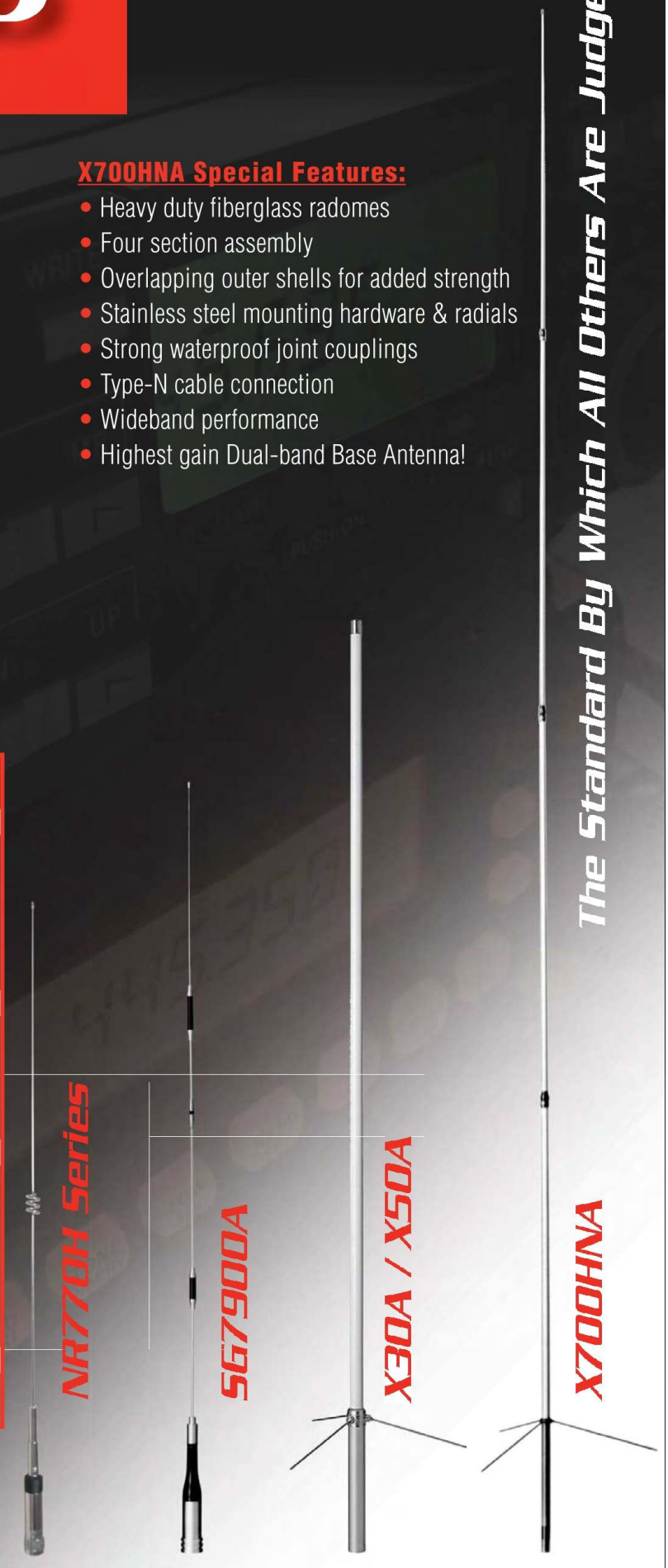
You've tried the rest, now own the best!

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



RF PARTS™ COMPANY

Diamond Antenna is a division of RF Parts Company

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

Second Century

ARRL Governance: Why is it Important?

When walking into ARRL Headquarters, you'll immediately notice a wall of pictures. It is our own Hall of Fame. These individuals are famous because, beginning with Hiram Percy Maxim himself to the current day, the wall features the pictures of every ARRL President! No one else, just the Presidents. That alone should be an indication of how important and significant the President's position is at ARRL. How does one become President? Selection by the ARRL Board!

Over the years, as an ARRL member, when a ballot would appear in the mail, to be honest, I never voted. It wasn't that I didn't want to play a part in determining who was going to be representing me. Rather, I believed that ARRL *always* had my back. Whether it was creating fantastic licensing books and tapes, as well as *The ARRL Handbook*; handling regulatory matters; administering programs like awards, contests, and Logbook of The World (LoTW), or causing me to want to read every issue of *QST* from cover to cover, I knew things were going just great and I was probably better off allowing things to progress as they always had.

What I have come to discover in just the past few years is how important it is to learn about who is running for office. Having the right people with the right skills in these Director-level positions is critically important. We enter this month knowing who is running for office in one-third of the Divisions. If you're in one of those five Divisions, your ballot will be arriving soon. I want to encourage you to open that ballot, spend some time getting to know who is running, and then vote for the people you feel will best meet the needs of moving ARRL forward into the future.

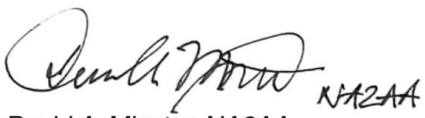
It is easy to write this process off as just another popularity contest. It is not, nor should it be. At Headquarters, we refer to the Board members as our "first among peers" — these are member-volunteers who must be committed to donating likely more than 1,000 hours per year in working for you. The job is daunting, and involves traveling to and participating in committee and Board meetings; working with groups; answering members; writing; staying online and engaged with Board business; working with legislators; visiting clubs, schools, and ARRL Field Day sites, and so on. These are very important positions within our governance!

And, of course, they also select and elect the ARRL President.

Nearly a year ago now, I received strong feedback from a few important members; these were members who play an important role in our community or who were large donors. The messaging was consistent and clear: they were not happy with where the governance of ARRL had strayed. They weren't asking me, they were telling me: I had to make it one of my top priorities. And I have. I believe that the relationship today at the Board, and between my office and the Board, has never been better. That has only been strengthened by the collaborative and effective in-person Board meeting we completed here in Newington in mid-July.

So, is the governance of our association important? You bet it is. And it is only improved when you participate! Use care and consideration when selecting who you vote for.

Above all, be radio active, be that connector bringing members together, and decide how you too might want to volunteer and play a larger role within ARRL.



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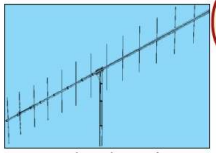
V42R, $219.95. *Dual band* covers 144/440 MHz bands. Two 5/8 Wave collinears.



VB-214FM, $149.95. *14-element* 2-Meter FM *beam* antenna provides exceptional front-to-back ratio and maximum obtainable gains.

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Frequency Range: 1.8 to 54 MHz
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Input Impedance: 50 ohms
Tuning Range: 10:1 SWR, 3:1 on 6M
Memories: 2000
Retune Time: Less than 1.0 second
Voltage: 13.8 VDC +/-15%
Current Draw: 500 mA tuning, 20 mA idle
Size: 6.3"x6.3"x1.5", 160x160x40mm
Weight: 1.5 pounds, 680 grams

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Leanna Figlewski, lfiglewski@arrl.org

Member Spotlight

Junie Cassone, N1DUC

An invitation to ARRL Field Day nearly 10 years ago opened up Junie's world to the joys of amateur radio and all that the hobby has to offer. However, it wasn't until after her time in the National Oceanic and Atmospheric Administration (NOAA) Commissioned Officer Corps that she earned her ham radio license. Her service career was cut short by an unfortunate injury, but she enjoys spending her free time operating ham radio with her ducks.

Time at Sea

Prior to earning her license, Junie served in the NOAA Commissioned Officer Corps as a Junior Officer. In this position, she became familiar with shipboard activities and learned how to pilot the vessel for scientific operations — the captain entrusted her with the safety of the ship and assigned her to her own bridge watch. She also participated in surveys of marine life.

Eventually, Junie received the honor of being accepted into NOAA's aviation program. However, she was unable to achieve her goal of being a NOAA Aviator and Hurricane Hunter due to an injury sustained aboard ship, which resulted in a medical discharge. She operated maritime-band radios while at sea, but believes that the communication skills she's learned as a ham radio operator would have improved her experience with maritime radio operations.

Ducks on the Air

Junie adores all animals but has an affinity for ducks, as she currently cares for 11 of them. Even her call sign reflects her adoration: N1DUC translates to "number one duck."

"I had ducks growing up, and they always had an incredible bond and attachment to me," she shared. As an adult, Junie purchased ducklings of her own and decided to hatch two of their eggs, which created an unbreakable bond with those ducks, Marvel and Mochi. They've even become her ham radio companions. "My duck Mochi enjoys ham radio almost as much as I do," she said. When he makes an appearance on the air, she calls it a "QuackSO." Junie's contacts often request to speak with Mochi, and he enjoys saying hello.

Radio Operation

Junie earned her Technician-class license in 2019 and upgraded to her General-class license in 2020. She found the time to study while adhering to social distancing guidelines, allowing for "a new world of communications on HF."

Something that drew her to ham radio was how many different avenues there are for operators to engage in, as there's always something to do and learn within the hobby. Junie learned Morse code and enjoys her time on CW, but her "latest addiction" is operating Parks on the Air (POTA). "I enjoy the challenge of improving with each of my field activations, whether it's striving for the best SWR or making more contacts, perfecting my skills each time makes POTA gratifying," she said. As a Connecticut resident, she's activated 16 parks within the state, as well as parks in New York, New Hampshire, New Jersey, Delaware, Georgia, South Carolina, Virginia, and Tennessee. She hopes to eventually activate at least one park in every US state, as well as attempt to activate an island park.

Junie Cassone, N1DUC, operating POTA with her ducks, Mochi and Marvel.

Her portable station setup includes a Xiegu G90 transceiver with a maximum power of 20 W, which she also uses at her base station; a Buddipole™ antenna used for POTA, Summits on the Air (SOTA), and the Amateur Radio Lighthouse Society (ARLHS); a Diamond K702M magnet mount with 20- and 40-meter antennas, and an AnyTone AT-778UV dual-band transceiver mobile radio.

Getting Involved

Junie is an advocate for joining an amateur radio club, especially as a newly licensed ham, as active clubs can encourage personal growth within the hobby. When she first earned her license, she joined the Greater Bridgeport Amateur Radio Club (GBARC) in Bridgeport, Connecticut. She said, "I learned far more by being engaged in this group than if I enjoyed radio on my own. GBARC led me to POTA. The participants of POTA also have a wealth of knowledge to share. I've found being engaged in active groups makes the hobby more fulfilling."

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  Members in the US receive a choice of print magazine: *QST*, ARRL's membership journal (12 monthly issues), or *On the Air*, our new magazine for new and beginner-to-intermediate-level radio amateurs (6 bimonthly issues). All members can access the digital editions of *QST*, *On the Air*, *QEX*, and *NCJ* from a web browser and apps available for iOS, Android, and Kindle Fire devices. Members need a valid ARRL account to access ARRL's digital magazines, the Archives and Periodicals Search, and the Product Review Archive.
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ARRL The National Association for Amateur Radio® in the United States: supports the awareness and growth of Amateur Radio worldwide; advocates for meaningful access to radio spectrum; strives for every member to get involved, get active, and get on the air; encourages radio experimentation and, through its members, advances radio technology and education; and organizes and trains volunteers to serve their communities by providing public service and emergency communications *(ARRL's Vision Statement, adopted in January 2016).*

ARRL is an incorporated, noncommercial association without capital stock chartered under the laws of the State of Connecticut, and is an exempt organization under Section 501(c)(3) of the Internal Revenue Code of 1986. Its affairs are governed by a Board of Directors, whose voting members are elected every 3 years by the general membership. The officers are elected or appointed by the Directors.

ARRL is noncommercial, and no one with a pervasive and continuing conflict of interest is eligible for membership on its Board.

"Of, by, and for the radio amateur," ARRL numbers within its ranks the vast majority of active amateurs in the nation and has a proud history of achievement as the standard-bearer in amateur affairs.

A *bona fide* interest in Amateur Radio is the only essential qualification of membership; an amateur radio license is not a prerequisite, although full voting membership is granted only to licensed amateurs in the US.

Membership inquiries and general correspondence should be addressed to the administrative headquarters: ARRL, 225 Main St., Newington, Connecticut 06111-1400 USA.

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1.5-54 MHz including 6 Meters

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SWR Protection prevents amplifier damage if you switch to a wrong band, use the wrong antenna or have high SWR.

If forward or reflected output power exceeds a safe level then output power is automatically reduced to prevent amplifier damage by controlling ALC to exciter.

LED-illuminated Cross-Needle SWR/Wattmeter lets you read SWR, forward and reflected *peak* power simultaneously. You also get ALC, SWR, PA balance and current metering with LED backlight. An Operate/Standby switch lets you run "barefoot", but you can *instantly* switch to full power if needed.

Front-panel ALC control!

This *exclusive* Ameritron feature lets you adjust output power conveniently from the front panel.

Has bandswitch, ALC, SWR, PA and TX LED indicators.

Automatic Bandswitching!

Place your amplifier and power supply out-of-the-way and control your amplifier directly from your rig!

ALS-1306 automatic bandswitching reads band data from your transceiver and automatically changes bands as you change bands. An optional interface cable is required for your particular radio.

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Ameritron ALS-1306 amplifier has modular construction for *easy-servicing*, unlike other amplifiers that are so tightly packed they are un-serviceable.

ALS-1306 Power Supply

The ALS-1306 is powered by a 50 VDC switching power supply. Comes with a pre-wired cable to plug into the ALS-1306.

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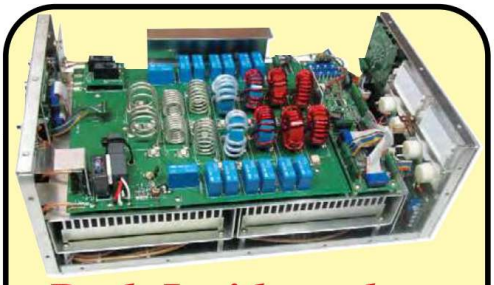

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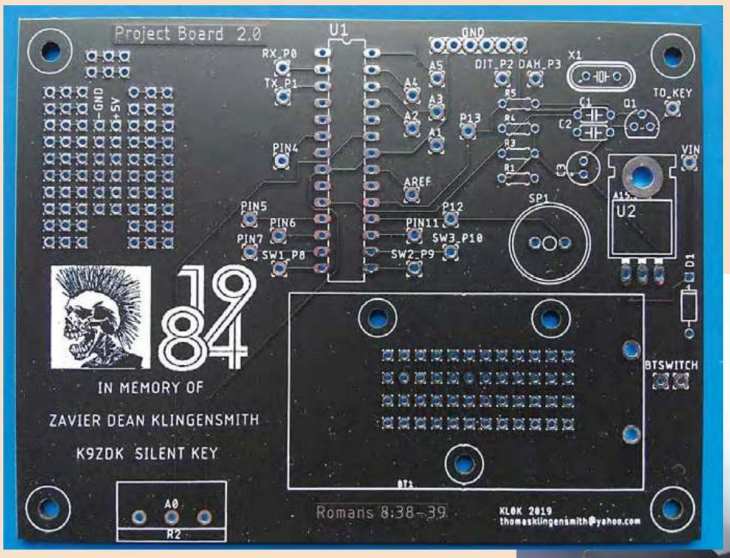
Up Front



◀The DIY kit for an iambic keyer, which Thomas developed and marked in Zavier's honor. [Nika Wolfe, KEØDQE, photo]

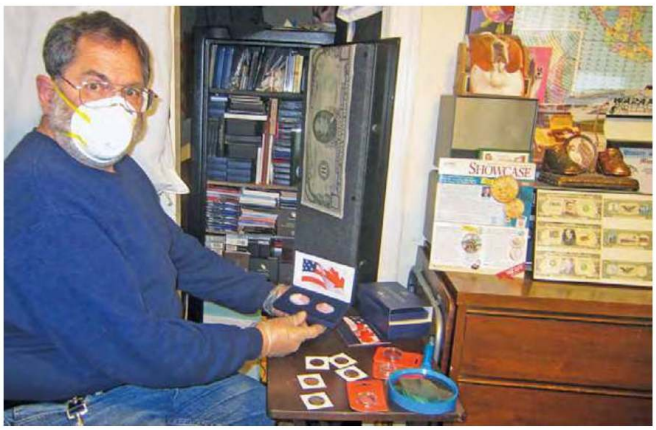
▼Zavier Klingensmith, K9ZDK (SK). [Thomas Klingensmith, KLØK, photo]

A Meaningful Project

Thomas Klingensmith, KLØK, lost is son Zavier, K9ZDK (SK), in June 2019. He was 22 years old. Thomas and Zavier shared ham radio as a common interest, and they would work on electronic projects, build antennas, and make contacts together. In Zavier's memory, Thomas created a DIY kit for an iambic keyer and is offering it free of charge to anyone who requests one. Details can be found on Thomas' QRZ page at **www.qrz.com/db/KL0K**.

Vintage Radios and Coins

Bob Lobenstein, WA2AXZ, has been a ham for over 50 years, and shared his love of radios and coin collecting from his father who was a World War II-era Navy radioman. Now a collector and amateur radio historian, Bob has amassed quite a large collection of vintage coins, which share the same space as his vintage 1960s-era Hallicrafters SX-122.



Building a 1930s-Era Radio

Former Louisiana State University faculty member Richard Rogers, K5RCR, built a 1930s-era radio from scratch in 2013. Using a 1947 *QST* technical article titled, "The Old Stand-By," Richard constructed the four-tube regenerative receiver and a homebrew two-tube, 10 W transmitter. In March 2021, Richard donated the receiver and transmitter to the Asheville Radio Museum.

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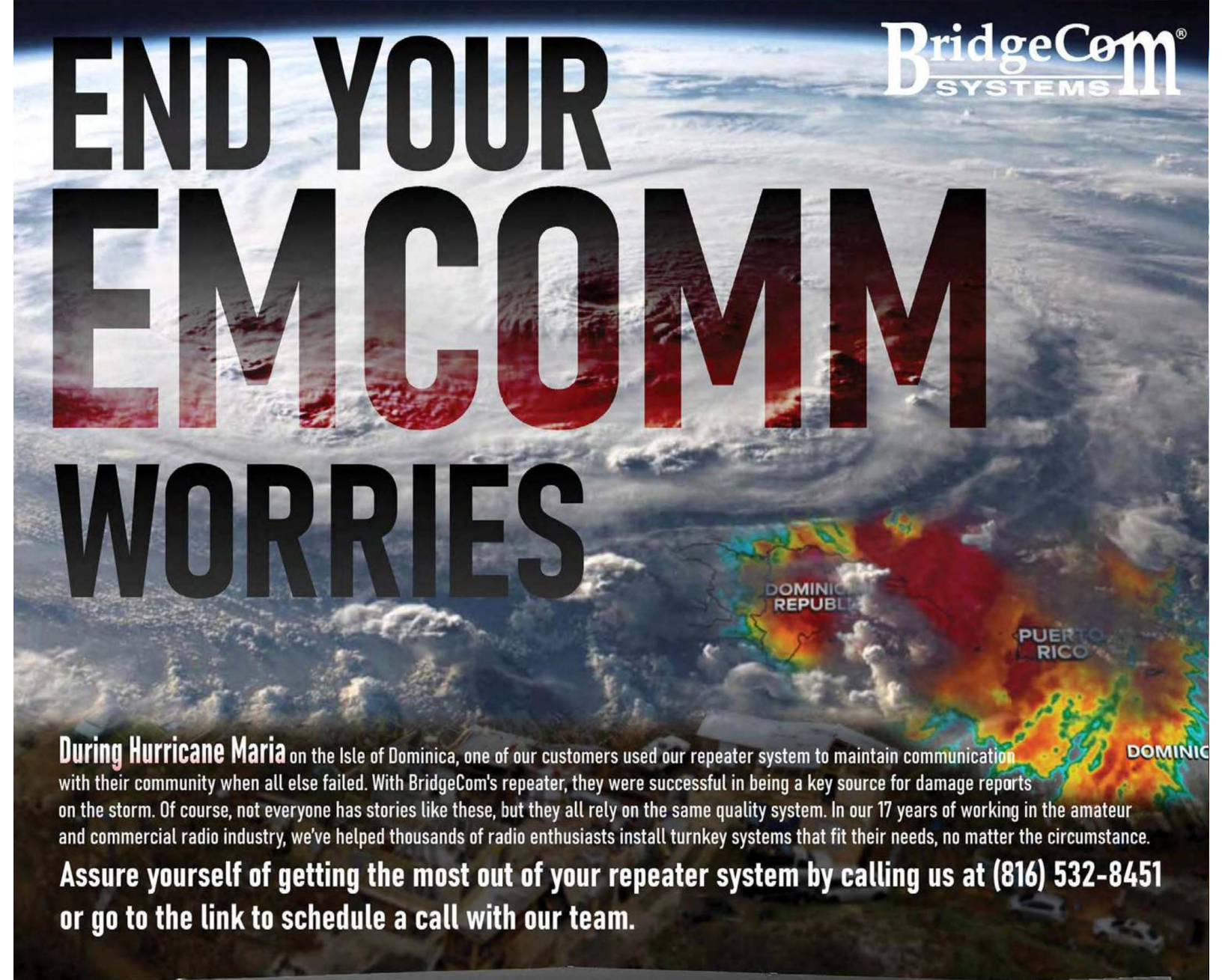

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Letters from Our Members

A Request for 10-Meter Operation

Each month, I check the "Special Event Stations" listings and am surprised by how few events offer 10-meter contacts. Of the 26 events in the June issue, only three listed 28 MHz as an operating frequency. The lack of 10-meter events denies a significant portion of amateurs (specifically Technicians) the opportunity to operate these stations.

Although 10-meter propagation has been poor in recent years, Solar Cycle 25 shows signs of improvement. FT8 is popular and can produce contacts during marginal propagation. I've made contacts as far as Brazil and Argentina from FN31 on 10 meters with FT8 to a 3 W Phaser. Additionally, 10-meter antennas are smaller and easier to set up.

Help the Technician-class licensees and give 10 meters a chance.

Geoff Gidman, KA1EPF
West Hartford, Connecticut

Longer Contacts for Meaningful Communication

The days of long communications via amateur radio are almost gone. Now, most contacts are made within a 15- or 30-second exchange of your call sign, grid square, and signal report.

Earning a ham radio license requires a lot of studying, hard work, and dedication. We should be making longer contacts to exchange ideas, cultures, technical information, and friendship — all of which are among the qualities of amateur radio that have been with us for over 100 years.

Let's communicate meaningfully again via amateur radio. We should embrace our ability to do so!

Rob McMillan, VE6XMB
Raymond, Alberta, Canada

Valuable Field Day Materials

I found the "2021 ARRL Field Day Guide" in the June issue to be incredibly helpful. It had checklists, safety reminders, a chili recipe, and more. I particularly liked that it could be easily removed from the magazine to take to Field Day with me. I hope to see it in *QST* every year!

Michael Farkas, N8GBU
Oregon, Ohio

Slowing Down for CW

I enjoyed reading "Slow Your Dits" by Lynn Kuluva, KØIMI, in the "Hints & Hacks" column of the July issue, regarding how to slow down dits on a bug key. I've been limited due to a recent surgery, but the author inspired me to do some experimenting of my own. I zip-tied a coiled clip lead to the end of the dit arm of my bug and it does a great job helping me operate low-speed CW.

A few years ago, I purchased an extra weight from eBay and added it to my bug keys. It helps slow me down to around 12 – 15 words per minute, but I've been needing something to help slow me down even more. I enjoy participating in slow-speed CW activities and helping friends who are starting out or getting back into CW.

Joe Falletta, W6UDO
Terrebonne, Oregon

Remembering a Rookie Project

While reading "A Look Back" in the June issue, I recognized the August 1971 issue cover: a truck camper with an attached tower and quad antenna. I remember reading that issue!

On the next page, I saw, "How to Make a Low-Cost Keying Mechanism" by A. K. Weis, WA5VQC, from the "Beginner and Novice" column, about converting your bug into a paddle for your keyer. At the time that issue was printed, I was a 14-year-old rookie ham hacksawing away on the base of an old Vibroplex Champion. "You will probably be a little proud of your finished product," the author wrote, and I was!

Mike Jacoby, N3MA
Lancaster, Pennsylvania
Life Member

Parachute Mobile

As a professional skydiving instructor, Carlos Felix Ortiz, KD9OLN, has reached a maximum speed of 120 MPH after jumping from a plane, prior to opening his parachute. I was amazed to find out he was parachute mobile when I answered his CQ on May 22, 2021, on 14.250 MHz. We exchanged 5-9 signal reports as he descended.

Ortiz had jumped out of a plane at 11,000 feet in Illinois, and contacted me in Virginia. He was able to manage the ham radio pileup, his parachute, and a video camera. Strapped to his waist was a 100 W transceiver, while his ladder-line J-pole antenna blew in the wind.

Having flown a light aircraft and captained my own sailboat maritime mobile off-shore, I was more than impressed by his radio-equipped leap into the sky. His QSL card arrived 2 weeks later. To watch a video of this jump and all the hams he contacted during it, visit **www.youtube.com/watch?v=9nOk6LZ-_wY**.

This was definitely one of my most memorable contacts!

Curtis Morris, K7KNM
Suffolk, Virginia

Send your letters to "Correspondence," ARRL, 225 Main St., Newington, CT 06111. You can also submit letters by fax at 860-594-0259, or via email to **letters@arrl.org**. We read every letter received, but we can only publish a few each month. We reserve the right to edit your letter for clarity, and to fit the available page space. Letters published in "Correspondence" may also appear in other ARRL media. The publishers of *QST* assume no responsibility for statements made by correspondents.

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Built in Helper	Yes, In the push of a button
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Output connector	N-type
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W1AW Schedule

PAC	MTN	CENT	EAST	UTC	MON	TUE	WED	THU	FRI
6 AM	7 AM	8 AM	9 AM	1300		FAST CODE	SLOW CODE	FAST CODE	SLOW CODE
7 AM-1 PM	8 AM-2 PM	9 AM-3 PM	10 AM-4 PM	1400-1600 1700-1945	VISITING OPERATOR TIME (12 PM-1 PM CLOSED FOR LUNCH)				
1 PM	2 PM	3 PM	4 PM	2000	FAST CODE	SLOW CODE	FAST CODE	SLOW CODE	FAST CODE
2 PM	3 PM	4 PM	5 PM	2100	CODE BULLETIN				
3 PM	4 PM	5 PM	6 PM	2200	DIGITAL BULLETIN				
4 PM	5 PM	6 PM	7 PM	2300	SLOW CODE	FAST CODE	SLOW CODE	FAST CODE	SLOW CODE
5 PM	6 PM	7 PM	8 PM	0000	CODE BULLETIN				
6 PM	7 PM	8 PM	9 PM	0100	DIGITAL BULLETIN				
6^{45} PM	7^{45} PM	8^{45} PM	9^{45} PM	0145	VOICE BULLETIN				
7 PM	8 PM	9 PM	10 PM	0200	FAST CODE	SLOW CODE	FAST CODE	SLOW CODE	FAST CODE
8 PM	9 PM	10 PM	11 PM	0300	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.

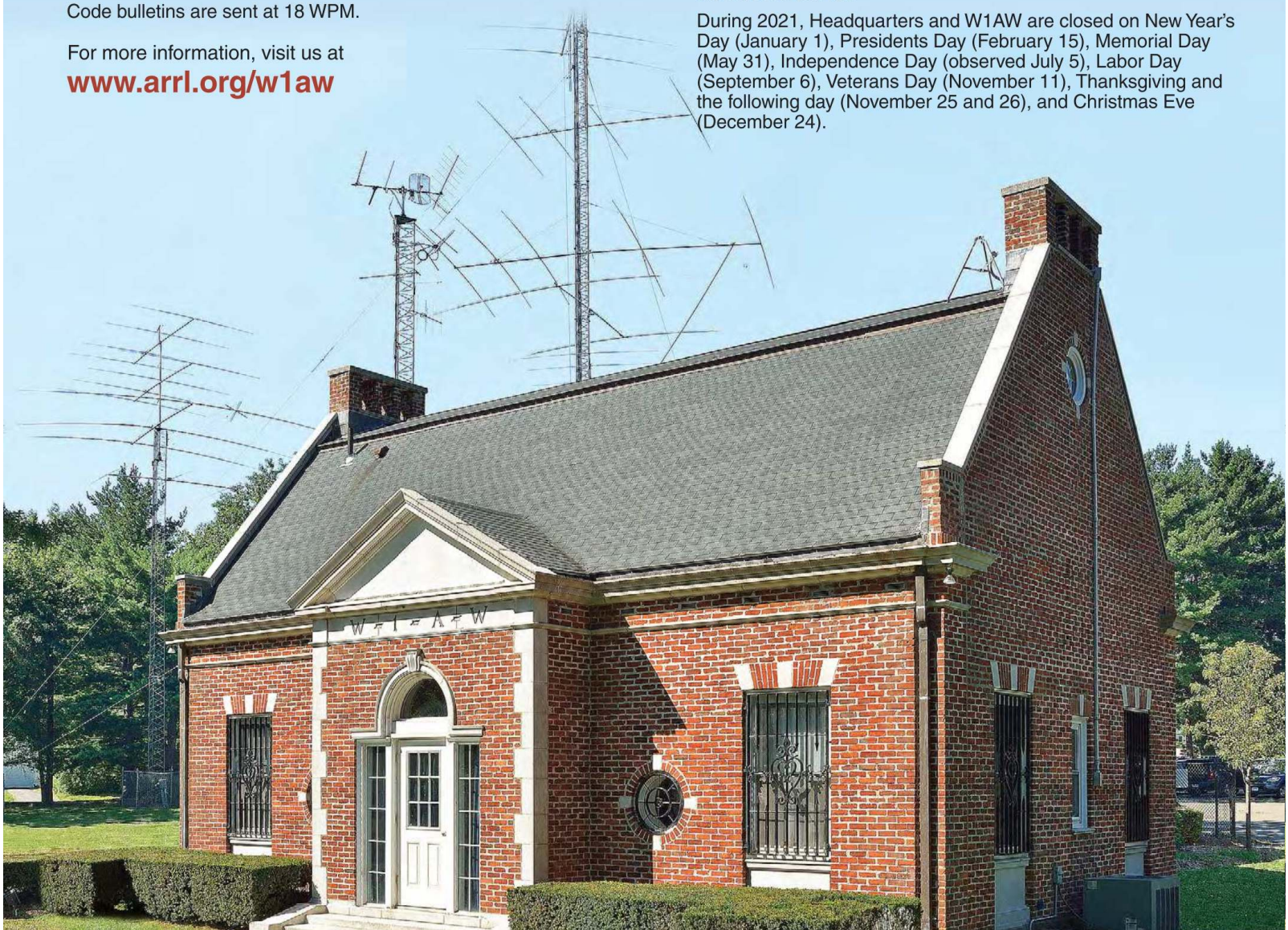
Keplerian elements for many amateur satellites will be sent on the regular digital frequencies on Tuesdays and Fridays at 6:30 PM Eastern time using Baudot and PSK31.

♦ 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 noon and 1 PM 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 2021, Headquarters and W1AW are closed on New Year's Day (January 1), Presidents Day (February 15), Memorial Day (May 31), Independence Day (observed July 5), Labor Day (September 6), Veterans Day (November 11), Thanksgiving and the following day (November 25 and 26), and Christmas Eve (December 24).



The Legend Continues

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Node-RED for Ham Radio

Use this graphical programming environment for device-to-device communications.

David De Coons, WO2X, and Michael Walker, VA3MW

Node-RED is a low-code graphical programming environment created by IBM to connect Internet of Things (IoT) devices and software. The need for machine-to-machine communications was part of the catalyst for developing Node-RED. To get started using Node-RED, you must install Node-RED on a Raspberry Pi, a Windows PC, or a computer running Debian Linux (see "Getting Started with Node-RED" at **www.arrl.org/qst-in-depth**, and the CTR2 blog at **https://lynovation.com**).

About 5 years ago, Andreas Junge, N6NU, wanted to create a graphical interface between his SteppIR antenna and his FlexRadio FLEX-6700. Using Node-RED, he built a *flow* — a predefined set of instructions to perform certain tasks. The flow interfaced these two devices using the FlexRadio TCP application programming interface (API). Node-RED can run a single flow or multiple flows. Andreas shared his flows with Mike Walker, VA3MW. Mike and Andreas expanded the use of Node-RED to include interfacing to the Elecraft wattmeter and KPA500 amplifier.

A few years ago, I started using Node-RED as a way to remotely control my station. I am not a programmer, but I do like to tinker, so I started writing flows in Node-RED for my Elecraft KPA1500 amplifier, rotator, and the Digital Loggers web power switch. This enabled me to remotely control my station, having full control of my amplifier, rotator, antenna switching, and other devices while simultaneously interacting with my FlexRadio FLEX-6700 radio. Other hams have used our flows as a starting point to integrate other model radios, amplifiers, rotators, wattmeters, antenna tuners, antenna switches, and programs like electronic logbooks (see sidebar, "Benefits of Using Node-RED").

"The need for machine-to-machine communications was part of the catalyst for developing Node-RED."

About Node-RED

Node-RED uses the Node JavaScript programming language. Flow creation is simplified by using a web browser-based editor. The flows are placed and wired together. When Node-RED is running, the input, output, and status nodes are visible in a dashboard viewable from any web browser, locally or remote. A Node-RED server can run on an inexpensive Raspberry Pi, a Windows PC, a Linux or Android environment, or on a cloud-based server. Because you would want the Node-RED server to be running continuously, the Raspberry Pi is a low-energy, low-cost solution. Node-RED will run on a Raspberry Pi 3B or newer Pi. I recommend a Pi model 4 for future expansion.

Benefits of Using Node-RED

Neal Pollack, N6YFM

- Node-RED can easily interface to and control a wide array of dissimilar hardware, often using simple and inexpensive hardware interfaces.
- It is very low cost.
- You communicate using any web browser. Handicap access can be added using Google *Alexa*.
- Modifications or additions can be made from any location using the web-based editor.
- The continuously expanding community shares their flows. For newcomers, the development time will be considerably easier and shorter. The community is eager to assist new members.

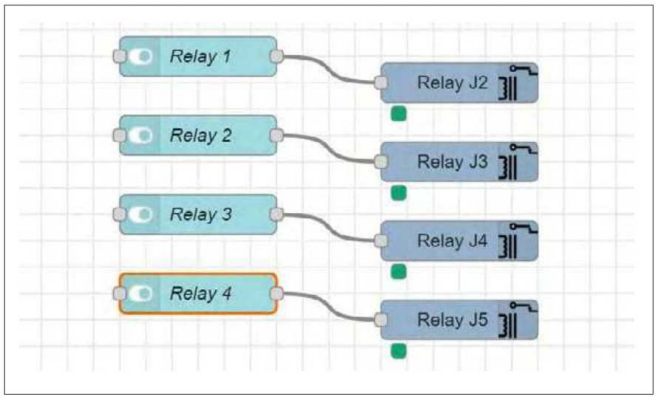


Figure 1 — A simple four-relay flow diagram.

Figure 2 — A simple four-relay dashboard.

How It Works

A *node* is the basic building block of a flow. A *flow* is a group or groups of connected nodes. Flows can be in individual tabs in the Node-RED editor, or more than one flow can be in a tab. In Node-RED, there are four main categories of nodes: input, output, processing, and the dashboard.

Input and output nodes are used to interface to each station component. These can be hardware or software programs, websites, or other sources of data. Examples of input/output nodes are serial, USB, TCP, UDP network connections, HTML, or CSV. There are also preexisting custom I/O nodes that are already available. Many manufacturers and software developers publish a programming reference guide or API. These programming guides contain information on the *syntax*, or format of data, as well as various commands and responses to allow communications with Node-RED and other third-party pro-

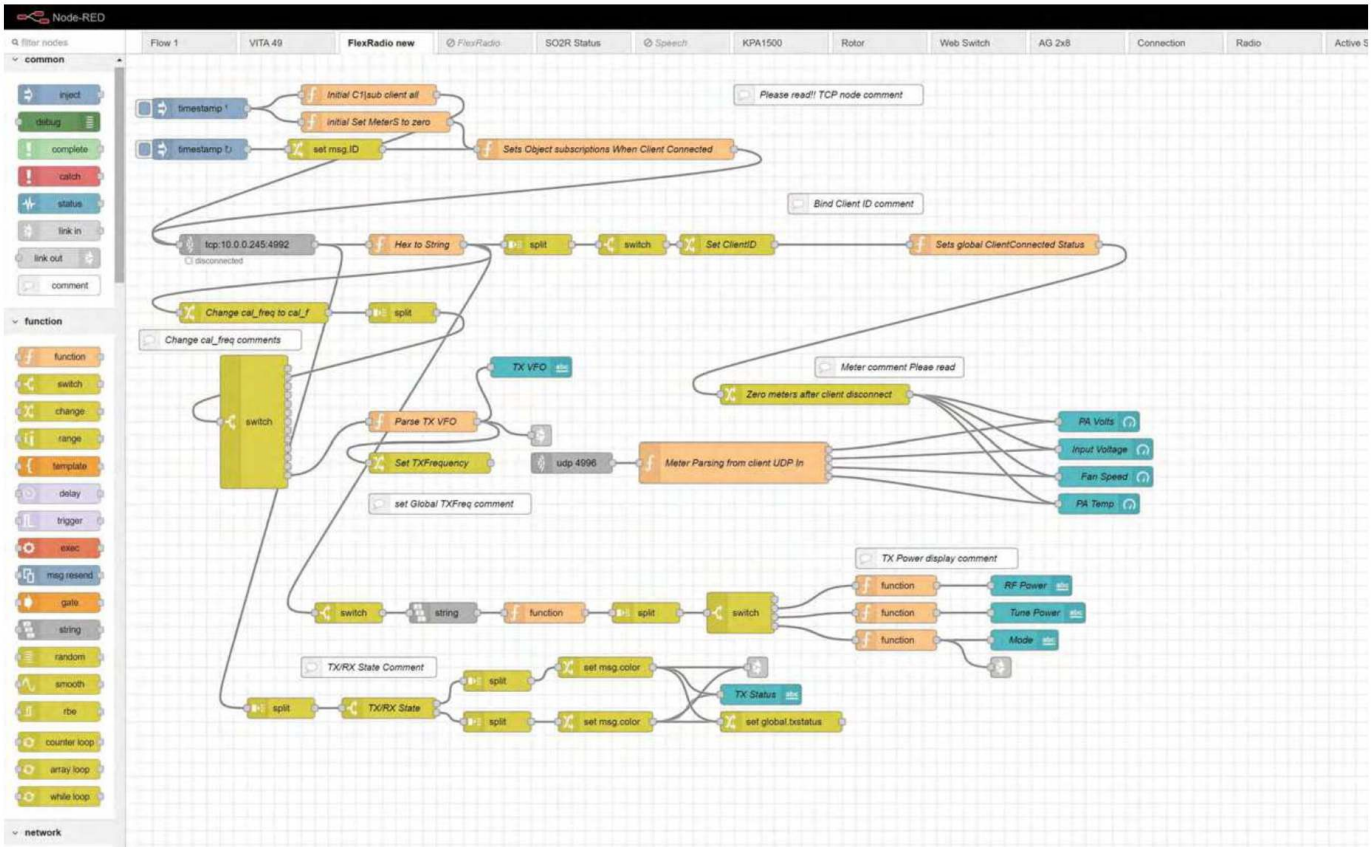


Figure 3 — The Node-RED editor in a web browser.

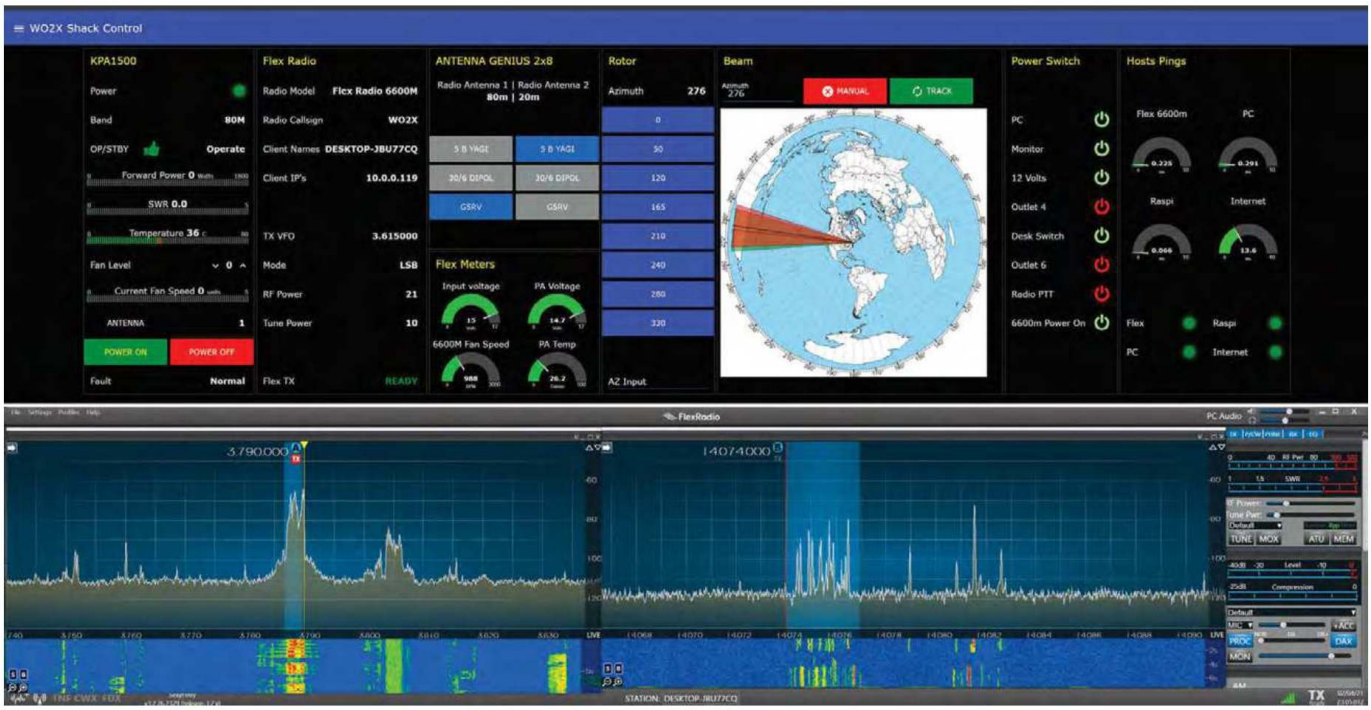


Figure 4 — The WO2X Node-RED dashboard with FlexSMART SDR.

grams and hardware. This information helps to choose the proper I/O nodes and build the flows to process the data.

Processing nodes are used to change or manipulate data. The data that is sent from one node to the next node is called a *message payload*. Nodes can be triggered by receiving data or by an external event, such as a timer or GPIO input. A *function node* is an example of a processing node and can be used to extract frequency in megahertz from an input node receiving Kenwood CAT command responses. Node-RED has become popular in ham radio because of its ability to take CAT information received from the radio, format the data, and forward it to an autotuner, amplifier, or other hardware and software. In addition to the nodes that are packaged with Node-RED, there are additional node libraries available for download. Figure 1 shows a simple four-relay flow, and Figure 2 shows the four-relay dashboard. The relay board plugs into the GPIO pins on the Raspberry Pi. The relay board is available from Amazon for under $10. A node for the KS0212 relay module is available for download from the Palette Manager.

Node-RED Editor/Dashboard

The Node-RED editor (see Figure 3) is accessed from any web browser that has access to the Node-RED server. The editor's initial layout has a blank workspace with available nodes along the left side.

"A flow is a predefined set of instructions to perform certain tasks."

The Palette Manager is used to load new nodes. The debug window helps to observe the message payload as you develop a flow.

The dashboard editor allows customizing the layout of dashboard nodes. The dashboard (see Figure 4) is the graphical interface to the various equipment and programs to which Node-RED connects. You can turn virtual knobs, push virtual buttons, and see data. Drag nodes into the workspace, and wire them together to form a flow. *Dashboard nodes* allow data to be displayed as text fields, gauges, meters, buttons, switches, and text input fields. The Node-RED dashboard is accessible from any web browser, so no special software is required, and it is user friendly with any operating system.

Node-RED and Ham Radio

Node-RED for ham radio has really gained interest, especially with remote operating becoming increasingly popular. Being able to run the complete station from a smartphone is now a reality. I can operate on HF from my iPhone while waiting in a supermarket parking lot. Club and contest stations are leveraging Node-RED to allow remote users to share a radio while still operating and monitoring station equipment

and other user activity. This is useful in remote multi-operator, two-transmitter operation and remote multi-operator, multi-transmitter operation to see the operating status of other operators in real time.

Getting Started

The Node-RED community is eager to assist all newcomers. See the Notes for pointers and resources that will help you get started. You will find existing flows to import to become familiar with Node-RED.

Notes

[1]Wiki to load the Raspberry Pi operating system and Node-RED; **https://groups.io/g/nodered-hamradio/wiki**.
[2]Node-RED for Ham Radio group sample flows; **https://groups.io/g/nodered-hamradio/files**.
[3]Additional sample flows; **https://flows.nodered.org/**.
[4]FlexRadio users can join; **https://community.flexradio.com/**.
[5]Node-RED basics YouTube video; **https://youtu.be/q0Ps5SfwAos**.
[6]Additional Node-RED info; **https://nodered.org/**.
[7]The relay HAT board; **https://www.amazon.com/KEYESTUDIO-4-Channel-Shield-Expansion-Raspberry/dp/B072XGF4Z3/ref=sr_1_3?dchild=1&keywords=KEYESTUDIO+5V+DCAC+4-Channel+Relay+Hat+Shield+Module+Expansion+Board+for+Raspberry+Pi+4%2FA%2B%2FB%2B%2FPi+2+Model+B%2FPi+3+Model+B&qid=1623945141&sr=8-3**.
[8]Simple four-relay flow using the Pi relay HAT board; **https://groups.io/g/nodered-hamradio/files/wo2x%20flows/KS0212%204%20relay%20flow.json**.

David De Coons, WO2X, was first licensed in 1983. He is the current President of North Jersey DX Association, which serves as the second call area incoming QSL bureau. He is also a member of the Frankford Radio Contest Club and enjoys participating in various HF contests. Dave's interests are HF DXing, contesting, repeater building, station integration and automation, and exploring SDR technology. He mentors other hams interested in station integration. Dave is retired after a career in the communications industry, having installed, maintained, and managed large two-way radio, 911, and mobile data systems. You can reach Dave at **wo2x@optonline.net**.

Michael Walker, VA3MW, was licensed in 1974. He operates mostly HF and VHF, all modes, looking for new countries and grid squares in all bands from 160 meters to VHF, including contesting at times. He also enjoys the technology and integration that goes with automating his remote HF station. Mike shares his knowledge in various social media forums, helping to mentor those that are new to the technologies. He has a career in the IT world of data protection and recovery. Mike currently represents FlexRadio Systems online and at various hamfests. You can reach Mike at **mike@portcredit.net**.

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

A Portable Two-Element 40-Meter Wire Beam

Designed for Field Day portability, this antenna can be hung between trees and has good forward gain and low SWR.

Bob Glorioso, W1IS, and Bob Rose, KC1DSQ

We wanted an effective Field Day antenna, so we designed this portable two-element 40-meter wire beam. The design goal was for a beam with 10-foot element spacing, so the spacers could easily be carried within a minivan. Because of this limitation, the front-to-back ratio is lower than with wider spacing, and the configuration is driver and director rather than the usual driver and reflector. A further small compromise enabled a 50 Ω impedance.

Working with EZNEC led to the design in Figure 1. At 40 feet elevation, the calculated gain is 8.4 dBi, and the front-to-back ratio is 8.5 dB at 7.2 MHz with a takeoff angle of about 40 degrees. At 7.05 MHz, the gain is 7.2 dBi and the front-to-back ratio is 5 dB. This is from ½ to 1 S-unit (3 – 6 dB) above the gain of a dipole at 40 feet, when the power gain across the band is multiplied two to four times.

You can optimize the antenna for the lower part of the band by increasing the director length to 64 feet, 4 inches and the driven element to 68 feet, 9 inches. Figures 2 and 3 show the SWR curves for the two different configurations.

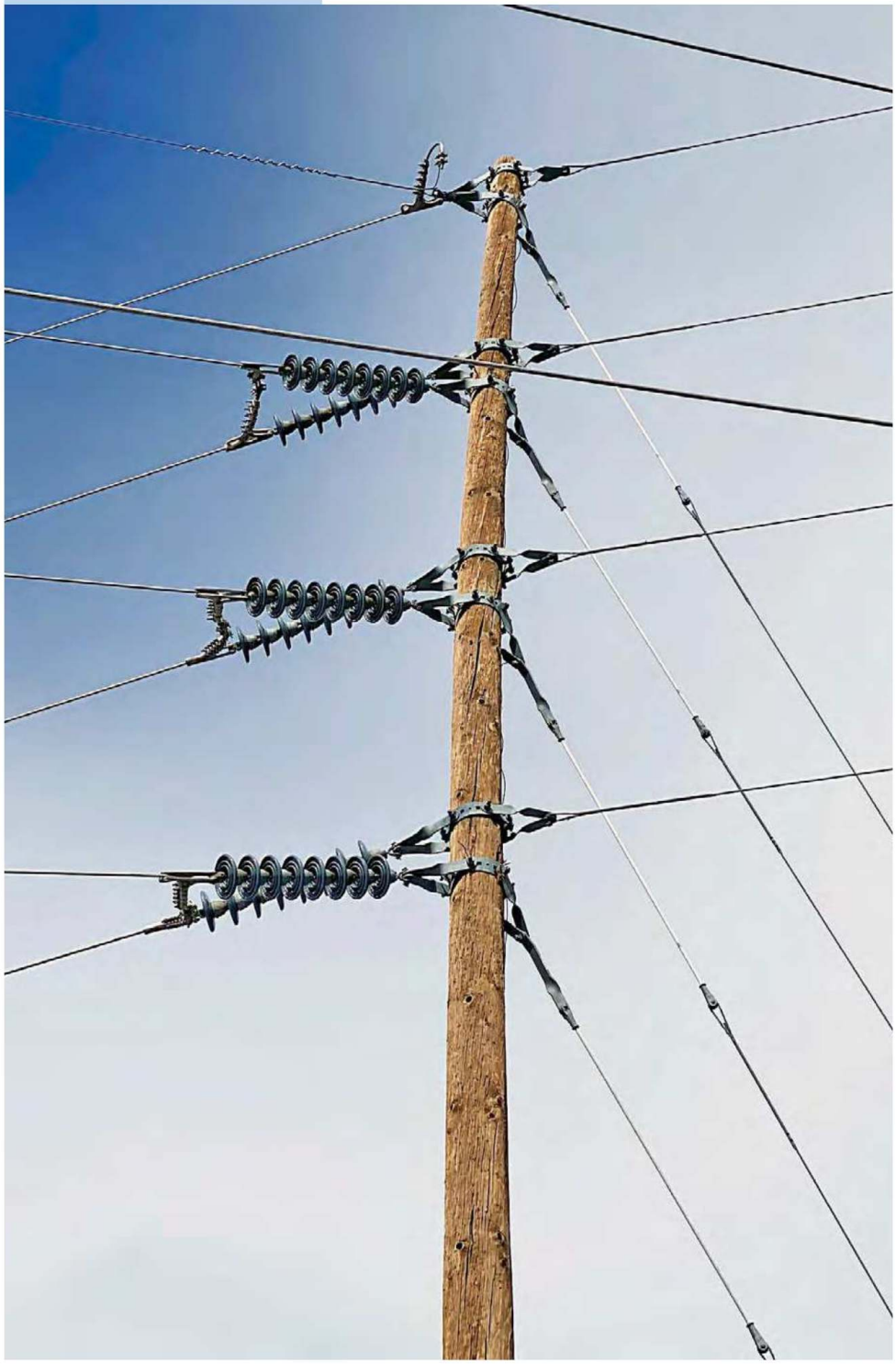
Construction and Tuning

The spreaders are wooden dowels with dimensions of 10 feet, 1.25 inches for the outside diameter, though lighter nonconductive materials may be used. The wire is either #14 THHN from your local hardware store or #14 FlexWeave™ from Davis RF. The balun, which provides about 10 dB of common-mode rejection, consists of five turns of RG-8X coax wound in a 5-inch-diameter coil and wrapped in tape. Other choke baluns may provide more isolation but could be heavier. Weight is an issue when hauling this antenna up with ropes slung over a tree limb.

The beam is being prepared to go in the van, so it can be used on a portable operation to be ready for ARRL Field Day

A case study on identifying, locating, and eliminating radio frequency interference (RFI) caused by 60 Hz power lines.

Eliminating Radio Frequency Interference from Power Lines



Richard Kiefer, KØDK

I had a 60 Hz power line noise, which severely limited my ability to hear weak signals on the 20-meter HF ham band. The troublesome noise was S-7 to S-9 in a 6 kHz AM bandwidth on 20 meters. Weak DX stations were diffcult to hear.

With the help of several hams and Xcel Energy (our electric utility company), I searched a large urban area at Boulder, Colorado, and found the noise source to be sparking ungrounded hardware on a 115 kV transmission line attached to a wooden pole (see the lead photo) 4.4 miles from my station, and at 600 feet above my antenna. It took 2 years of persistence, hard work, and cooperation of many individuals, but the RFI noise was eventually eliminated.

Identifying RFI's Audio Signature

Listen using the SSB or AM detector of your HF receiver. I prefer the AM detector and 6 kHz bandwidth of my Icom IC-7700 transceiver. Turn off all noise blanking and noise reduction as well as the AGC if possible.

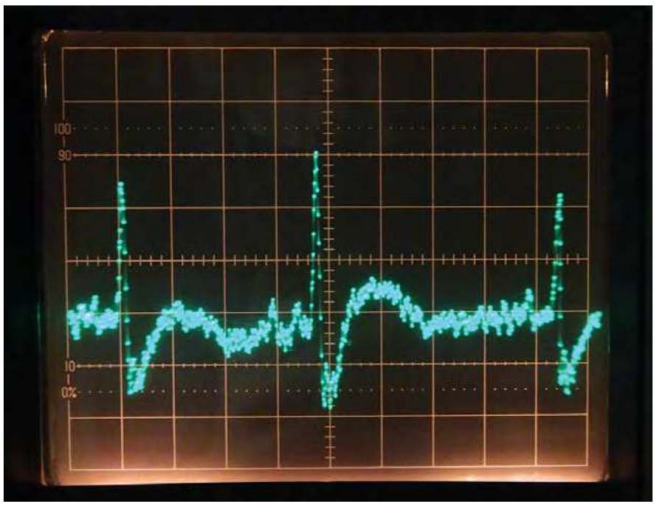


Figure 1 — The oscilloscope display of the power line noise signature at the audio output of IC-7700 receiver, 2 ms/div.

Figure 2 — The Icom IC-7700 receiver power line noise S-8 reading, and spectrum display, using the AM detector, with a 6 kHz bandwidth.

Forming a good mental impression of the noise makes it easier to identify in the field. In my case, the noise had the characteristic crackle of power line noise created by ungrounded or loose hardware on an electric power pole. Characteristically, the noise was intermittent, and often stopped with wet weather and lower temperatures. See **www.arrl.org/qst-in-depth** for additional details.

A positive identifier was the audio signature seen on an oscilloscope (see Figure 1) at the receiver audio output (see Figure 2) and on the Icom IC-7700 receiver spectrum display, using the AM detector, with 6 kHz bandwidth. See also Figure A on the *QST* in Depth web page.

With the scope synced to the power line frequency of 60 Hz, the noise exhibited pulses at a steady 120 Hz rate, indicating that the source of the RFI is the 60 Hz power system. The timing and duty cycle of RFI always provides a clue as to the source. The manual[1] for the Radar Engineers model 243 RFI Locator instrument describes how power line-induced arcing is created.

Determining the Distance

Use a directional antenna at the frequency of the interference to get a bearing on the location, then estimate the distance by its signal strength. Observations with my stacked Yagi antennas indicated that the noise source was far away.

With a directional antenna, you should be able to determine an accurate search vector to within a few degrees if you are careful.

Lacking a directional antenna, you must travel outward from your location in several directions in a vehicle equipped with a short whip antenna. It is best to try to correlate any intermittent characteristics of the noise. Once you get close to the RFI source, you can use a higher-frequency receiver (see Figure 3 and Figures B and C on the *QST* in Depth web page) and very directional antennas to pinpoint the noise.

You can also triangulate to the noise location by using a directional HF antenna from another ham's location. Make sure that you are both hearing the same noise source at the same time. We also eventually triangulated from a third location to pinpoint a peak in noise on a 115 kV transmission line, but that was not the problem. Be careful when listening to what you think is the same RFI source from different locations. See the sidebar, "Signature of the Noise."

Locating the Noise Source

Once you have determined a direction for the search, listen on the HF frequency of interference and travel out in the direction of the noise. When you are close, you can start to walk around with a higher-frequency receiver and directional antenna. We also used receivers at 318 MHz (see Figure B on the *QST* in Depth web page) and 150 MHz (see Figure 3) with

[1]Radar Engineers model 243 RFI Locator manual, battery-powered broadband receiver; **ked-wireless.com/RK_Documents/Radar_Engineers_243_RFI_Locator_Manual_03.18.19.pdf**.

Signature of the Noise

It is extremely important to correlate any intermittent characteristics of the noise. Your search may find many noisy poles, only one of which correlates with your RFI. Don't ask the power company to investigate the many noisy poles that do not correlate with your noise signature. This is time consuming and costly for the power companies, and it can be met with resistance. Narrow the search to the actual correlated noise source. — *Ed.*

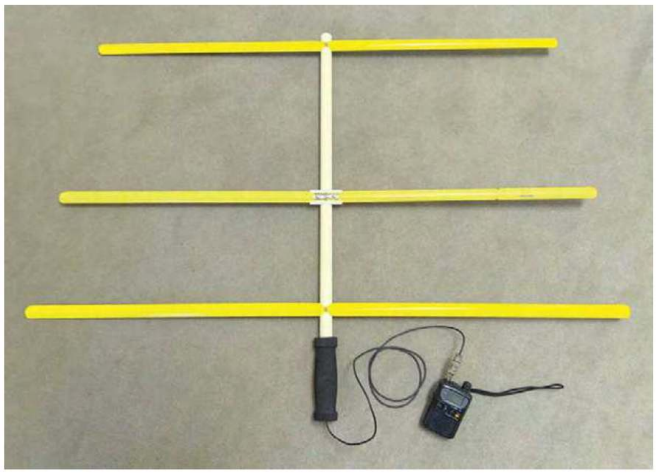


Figure 3 — The RFI receiver system for 150 MHz, using a tape measure-type antenna and an Icom IC-IQ7A receiver.

handheld Yagi antennas. We also verified with an ultrasonic acoustic dish receiver to spot specific insulators and hardware.

Check for coincidence by listening to both ends of the path simultaneously; listen to your home receiver over a cell phone. If both have the same audio characteristics, and are coincident in time, you have located the RFI.

In my case, the problem pole was screaming loudly at 150 and 300 MHz, and with the acoustic receiver, we could hear it from 600 feet away. The wood transmission pole (see the lead photo) had sparking hardware that was audible at 50 feet away.

It is very useful to have a signature for your own interference which can be used for comparison in the field. We used the Radar Engineers model 243 RFI Locator (see Figure A on the *QST* in Depth web page) with a reference signature recorded from my antenna. We found and bypassed many noise sources with similar signatures that were not an exact signature match.

Approaching Partners

The best way to resolve a power line caused RFI problem is to work jointly with your local power company to locate the noise source, and then convince them to fix it. If you try to find the problem yourself, then suggest where they might look, the power company can quickly verify your findings and will be more likely to fix the problem. In my case, it took 2 years, even with the full cooperation of the power company, to find and correct the problem.

It is important to note that a transmission line carries very high voltage — typically 115 to 345 kV — over long distances, and it terminates only in substations. A distribution line originates at a substation and usually carries less than 10 kV and supplies neighborhoods. Most ham RFI problems are caused by hardware on the poles of neighborhood distribution lines.

A Case Study

In early 2018, a strong power line noise appeared on the 20-meter band on a bearing of 240 degrees from my antenna. It was loud but intermittent. I probed around with my 318 MHz EMI finder (Figure B on the *QST* in Depth page) and located some noisy poles within a mile of my antenna. I called Jeremy Matzek, the Services and RFI Investigator for Xcel Energy, and he found some additional possibilities.

Fixing False Leads

After Xcel's line crews had quieted the hardware on several noisy poles (see the *QST* in Depth web page) to no effect, Jeremy and I were both a little frustrated. Clues came in by noticing that the noise was always about two S-units stronger on my upper Yagi antenna at 100 feet compared to the lower Yagi at 55 feet. This indicated that the noise source was farther away than we were searching.

I was also able to hear the same noise at the ham shack of Joe Woods, ADØI, who is located 1.5 miles to my west, but almost in line with my bearing to the RFI. I verified that Joe was hearing the same noise by listening to my receiver and his simultaneously over the phone. So, with his antenna pointed in the same direction as mine, it became apparent that the noise was farther away than 1.5 miles.

Because the noise was only S-3 on Joe's Icom IC-7300 with his three-element Yagi at 50 feet, the noise appeared to be much farther west than we thought.

Better Techniques

Knowing that the noise was farther away than the area in which we had been looking, we started to search the residential neighborhoods of north Boulder at over 2 miles from my antenna.

We started to use the Radar Engineers model 243 RFI Locator with a signature taken from my antenna. We eventually found a 115 kV transmission line on metal towers on the west side of Boulder at about 3.5 miles from my antenna, and it emitted noise with the same signature. The strength of the RFI peaked at two of the towers on the line, so we focused investigations there. At the towers we had strong noise at 14 MHz with the correct signature using the model 243, but very little noise at 300 MHz. We could also hear sparking in the ultrasonic dish when pointed at connecting hardware and insulators on the towers. We also triangulated to these towers from the ham location of Max Greenlee, KDØGF, where the noise was 20 dB over S-9. We thought that hearing the noise at 14 MHz, with the correct signature, and with triangulation, was justification to replace some hardware and insulators on the two metal towers. But that was just one of the false leads we fixed.

Finding and Fixing the RFI Source

We had good evidence that the problem was somewhere on the 115 kV transmission line because of the matching signature. We also observed that when it snowed or rained, the noise at my receiver and on the transmission line both went away. The line is about 4 miles long, about half in the city and half in the mountains, with a substation at each end. The noise source could be anywhere along the line or at either of the two substations. We also knew that the amplitude of the noise would rise and fall at regular intervals as you travel along the transmission line due to 14.2 MHz standing waves. Though, in this case, we could not drive the full length of the line because it goes over the top of Sanitas Mountain.

Figure 4 — A well-equipped lineman ready to climb the power pole with spikes.

Eventually, Jeremy found a wooden pole (see the lead photo) with very noisy hardware on the other side of Sanitas Mountain in Sunshine Canyon. From 600 feet away, on the canyon floor, we could hear the noise loudly with our acoustic dish, and at 150 and 300 MHz. With binoculars, we could see a ground

Lessons Learned

Consider the lessons we learned.

- Figure out if your noise is caused by the 60 Hz power line to determine if you need to get the power company involved. Be aware that if the power company determines their equipment is not the problem, you are on your own.
- Most power line RFI is created by loose or ungrounded hardware on wood poles.
- Insulators are usually not the problem, unless you can see damage with binoculars.
- In most cases, you will be able to hear the broad RF noise spectrum produced by hardware sparking at VHF or UHF frequencies. If you cannot hear the noise loudly at 300 MHz, you are probably at the wrong spot.
- The hardware of metal towers is usually not the problem. Even though we could hear noise at 14 MHz, and acoustic noise on the metal tower insulators in west Boulder, we could not hear much noise at 300 MHz.
- Use instrumentation in the field that can listen on the ham band of interference.
- Have instrumentation that can display a noise signature to make a positive identification.
- Use acoustic location to confirm and pinpoint the exact pole and hardware.
- Use the aiming sight on an ultrasonic dish to pinpoint specific metal brackets and insulators. The acoustic dish is much more directional than a five-element 318 MHz handheld Yagi.
- Getting time coincidence by listening simultaneously in the field and at home can be crucial in getting a positive identification on a noise source.
- Use triangulation on the band of interest from another ham's location to point a directional antenna at the same RFI source.
- Be prepared to spend a lot time finding the problem.
- Use the right equipment; guesswork leads to wasted time.
- The higher your antenna, the farther away the noise can be.
- The weather can be a factor; it can make the noise intermittent. Variable weather conditions can also be helpful in correlating your noise with noise in the field.
- First, try to find the problem yourself, to the limit of your ability. Then get the power company involved.

wire on the side of the pole that was broken in two places. We hiked to the pole through snowdrifts in January 2020. We could hear sparking noise by ear from 50 feet away. Loose, ungrounded hardware was sparking loudly. We could easily pinpoint all pieces of sparking hardware on the pole using the optical sight on the acoustic dish.

A short video (available at **ked-wireless.com/RK_Documents/noisy_transmission_pole_crackling-2.MOV**) shows the noisy power pole. You can clearly hear the sparking that was causing the RFI.

Xcel Energy Fixes the Hardware

A few weeks later, three Xcel Energy line crew members (see Figure 4) were air lifted by helicopter to the hillside location of the pole to fix the problem by splicing the ground wire, reconnecting the hardware, and tightening the bolts on all metal hardware. As soon as the transmission line was energized, the RFI had been fixed with no more noise on 20 meters.

Acknowledgments

I would like to acknowledge all who provided assistance, advice, and support over the 2-year process of identifying, locating, and eliminating my 20-meter RFI. Thanks to Jeremy Matzek, Services Investigator of Xcel Energy; Larry Benko, WØQE; Tom Thompson, WØIVJ; Paul Cianciolo, W1VLF; Ira Stoler, K2RD; Frank Haas, KB4T; RFI consultant Mike Martin, K3RFI; Joe Woods, ADØI; Max Greenlee, KDØGF, and Fred Horning of Radar Engineers Company.

Richard Kiefer, KØDK, is a retired electrical engineer who has been active in electronic product design since 1970. He holds both BSEE and MSEE degrees and has been a licensed ham since 1959. Richard's primary interest in amateur radio is HF operations, including working DX from a rural location near Boulder, Colorado.

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

Mark J. Wilson, K1RO, k1ro@arrl.org

Product Review

Alinco DJ-VX50T VHF/UHF Hand-held Transceiver

Reviewed by Steve Ford, WB8IMY
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The Alinco DJ-VX50T is a dual-band (2-meter and 70-centimeter) FM transceiver that is designed to be a serious contender in the lower-cost handheld market. It sets itself apart from the competition in several ways, beginning with its rugged construction. The radio is housed in a dense ABS plastic case with a textured surface to minimize slippage. With the 1,800 mAh Li-ion battery attached, the DJ-VX50T has a hefty, almost heavy feel.

As I examined the exterior, I noticed the external microphone and speaker ports were covered by a shield that you can only open by removing a screw. The robust shield is sealed with a gasket and present because the DJ-VX50T is water- and dustproof, carrying an Ingress Protection (IP) rating of 67. The first number designates protection against solid objects, such as dust and sand. This number can range from 0, meaning no protection, to 6, meaning 100% protection. The second number rates protection against liquids. It ranges from 0 to 8. So, the DJ-VX50T is 100% protected against solid objects, and it has been tested to work after being immersed under a meter of water, which earns the 7 — not completely waterproof, but close. I couldn't bring myself to dunk the radio in a bucket to verify the rating; I'll take Alinco's word for it.

The DJ-VX50T is supplied with the usual flexible rubber antenna and a stand-up battery charger. The charger is well designed and highly convenient. To charge the battery, just place it into the charging cradle. After a few hours — four at most — you're good to go. During the time I was using the DJ-VX50T, a full charge seemed adequate for about 24 hours of normal operating that included a lot of listening time. Of course, the battery life depends greatly on how much transmitting you are doing.

Bottom Line
The Alinco DJ-VX50T represents an excellent value for an entry-level dual-band analog FM handheld.

Exploring the DJ-VX50T

I think the first thing most amateurs do when they encounter a new handheld transceiver is turn it on. To do so, they go searching for the **POWER** button, which is often on the side or front of the radio. On the DJ-VX50T the power on/off function is part of the volume knob. You just give the knob a twist and the 1¼ × ½ inch amber display lights up (there are two other selectable color settings). While the display shown in Figure 1 isn't overly large, I found it easy to read under all lighting conditions.

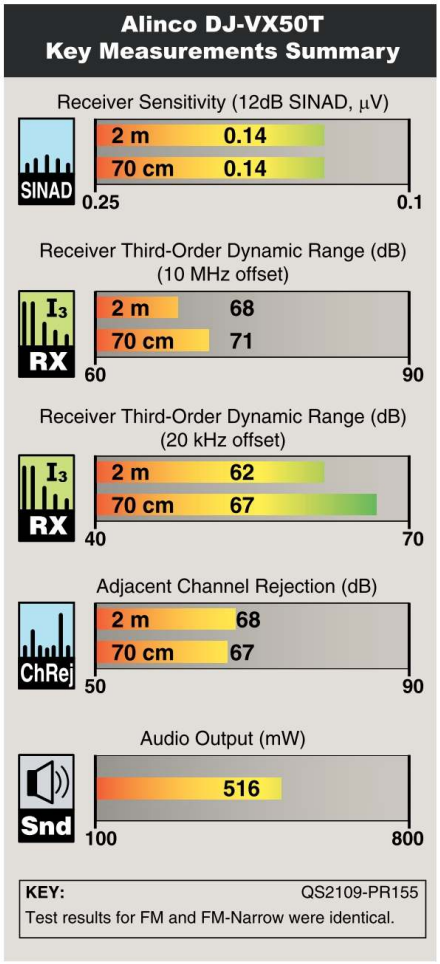

Table 1
Alinco, DJ-VX50T, serial number P001337

Manufacturer's Specifications	Measured in ARRL Lab
Frequency coverage: Receive, 136 – 174, 400 – 470 MHz (FM); 76 – 107.95 MHz (WFM); 118 – 135.995 MHz (AM). Transmit, 144 – 148 and 420 – 450 MHz.	Receive and transmit, as specified.
Modes: FM, FM-N (FM-Narrow). Receive only: WFM (FM broadcast band only), AM (air band only).	As specified.
Power requirements: 7.4 V dc ±20%. 7.4 V, 1,800 mAh Li-ion battery and rapid charger supplied.	At 8.2 V dc (full charge): Receive, 330 mA (no signal, max volume, lights on), 278 mA (lights off), 123 mA (standby, lights off); 22 mA (saver on); 0 mA (power off). Transmit (High/Med/Low), 146 MHz, 1.67/1.12/0.852 A 440 MHz, 1.68/1.18/0.843 A
Receiver	**Receiver Dynamic Testing***
FM sensitivity: For 12 dB SINAD, FM, 0.25 µV; FM-N, 0.5 µV.	For 12 dB SINAD: 146 and 440 MHz, 0.14 µV; 162 MHz, 0.13 µV; 100 MHz, 1.0 µV (WFM).
Two-tone, third-order IMD dynamic range: Not specified.	20 kHz offset: 146 MHz, 62 dB, 440 MHz, 67 dB. 10 MHz offset: 146 MHz, 68 dB; 440 MHz, 71 dB.
Two-tone, second-order IMD dynamic range: Not specified.	146 MHz, 84 dB; 440 MHz, 91 dB.
Adjacent-channel rejection: ≥60 dB.	20 kHz offset: 146 MHz, 68 dB; 440 MHz, 67 dB.
Squelch sensitivity: Not specified.	Squelch range, 146 MHz, 0.12 – 0.31 µV; 440 MHz, 0.12 – 0.25 µV.
S-meter sensitivity: Not specified.	For full-scale meter reading, 146 MHz, 0.38 µV; 440 MHz, 0.27 µV.
Audio output: 1 W at 10% THD.	516 mW into 8 Ω at 10% THD THD at 1 V_{RMS}, 1.8 %.
Transmitter	**Transmitter Dynamic Testing**
Power output: High/Med/Low, VHF, 5/2/1 W; UHF, 4/2/1 W.	At full charge, High/Med/Low: 146 MHz, 4.7/2.1/1.2 W 440 MHz, 4.4/2.5/1.2 W
Spurious signal and harmonic suppression: ≥60 dB.	146 MHz: >70 dB (High, Med); 67 dB (Low). 440 MHz: >70 dB. Meets FCC requirements.
Transmit-receive turnaround time (PTT release to 50% of full audio output): Not specified.	Squelch on, S-9 signal: 146 and 440 MHz, 266 ms.
Receive-transmit turnaround time (TX delay): Not specified.	146 MHz, 24 ms; 440 MHz, 34 ms.

Size (height, width, depth): 4.7 × 2.4 × 1.5 inches (including protrusions); antenna length, 6.6 inches. Belt clip adds ½ inch to depth. Weight, 9.6 ounces with battery.

*There were no measured differences in sensitivity or adjacent-channel rejection between FM and FM-Narrow.

Below the push-to-talk button on the side of the radio, there are two smaller buttons. The top button accesses the squelch adjustment. You press and hold the button until the display switches to the squelch-adjust mode, after which you rotate the frequency/channel knob to set the desired level. The bottom **MONITOR** button opens the squelch whenever it is pressed. If you hold this button down for more than a couple of seconds, the squelch locks open continuously.

Tuning around the bands, I eavesdropped on several 2-meter and 70-centimeter repeaters. Despite the relatively small speaker, the audio was crisp and clear. The radio delivers more than half a watt of audio to the speaker, which I found to be more than adequate, even in a somewhat noisy mobile environment.

The DJ-VX50T is a dual-band radio, so you have the option of switching between the main and sub frequencies, but the way this is accomplished is not intuitive. For example, you won't find a button labeled **MAIN/SUB**. As the manual instructs, you must press the **UP** arrow button on the keypad to flip between them. The main frequency is displayed above the sub fre-

Figure 1 — The Alinco DJ-VX50T's simple display is easy to read under a variety of lighting conditions.

quency, and it is shown in a larger font for easy recognition.

Although the manual doesn't make this clear, I found the DJ-VX50T could receive on the main and sub frequencies simultaneously (but it can only transmit at the main frequency). You can listen to two frequencies within the same band or monitor two frequencies within separate bands.

If you get tired of listening to ham traffic, press the **FUNC** button, followed by the **1** button, and you're suddenly transported to the FM broadcast band. Reception is strictly monaural, though. More button presses will bring up AM reception in the aviation band, and even NOAA Weather Radio channels. These are features you don't always find in a transceiver in this price class.

Other than the lack of stereo, FM broadcast reception was excellent. With just the flexible antenna, I was able to enjoy not only the 50 kW behemoths, but also several low-power college stations in my area.

Aviation listening is always interesting, and I'm fortunate to have a substantial amount of air traffic in my area. Even so, monitoring aviation can be a challenge because of the constantly changing positions of the aircraft. While I was able to eavesdrop on high-altitude airplanes with the stock antenna, receive coverage was vastly improved when I connected the DJ-VX50T to an external antenna.

The DJ-VX50T sports several scanning modes, and I was pleasantly surprised to discover that they work even within the FM broadcast and aviation bands. You also have 200 memory channels to store whatever you stumble across, amateur or otherwise. Each memory channel can be labeled with alphanumeric characters.

On the subject of memories, like most modern transceivers, the DJ-VX50T memories can be programmed through external software. I couldn't test this feature with the DJ-VX50T, but I'm confident that it performs similarly to other software packages I've used. It is a matter of loading the transceiver's memory contents into your computer by attaching a USB cable to the rig and placing the radio in the clone mode. Once loading is complete, you can modify existing memories, add new ones, and make other changes. This is much easier than doing memory programming by hand through the keypad. The software and cable are available from RT Systems at **www.rtsystemsinc.com**.

On the Air

The DJ-VX50T is capable of 5 W output on 2 meters and 4 W on 70 centimeters. If you prefer to extend the battery life, you can select a lower output power setting.

With the flexible antenna and maximum output, I had little difficulty accessing all repeaters in my local area. Transmit audio reports were consistently good.

Taking the radio on the road, I replaced the flexible antenna with an SMA-to-BNC adapter and connected it to a dual-band magnetic mount antenna. Even at the lowest output power setting, the coverage was impressive.

The DJ-VX50T features voice-operated transmit/receive switching (VOX). I thought it might function only with an external speaker/microphone or headset, but I soon learned that the VOX works with the internal microphone as well. The feature toggles on or off with a push of the **FUNC** key, followed by the **3/VOX** key. I discovered right away that it pays to adjust the VOX delay setting in the transceiver menu. The default seemed to be 3 seconds, which can feel like an eternity when you're waiting for the radio to switch back to receive.

Speaking of voices, the DJ-VX50T is equipped with a voice annunciator that will call out the channel numbers when you are operating in the memory mode. This is convenient when you're in a low-light environment, or in those situations when you simply can't look at the display. The transceiver will also bark "Error!" if you're attempting to enter an incorrect frequency or trying to otherwise make the radio do something it prefers to avoid.

As I mentioned earlier, the battery is sizeable, and I was pleased with how long it lasted on a full charge, even with frequent transmissions. Interestingly, however, the DJ-VX50T includes a clever "battery save" feature. When enabled, the radio will essentially go to sleep and then periodically reawaken. When asleep, power drain is minimal, so your battery life is extended greatly. The sleep mode deactivates if you're operating the controls, scanning frequencies or memories, or if there is a signal present on the frequency you've selected. It's only when everything is quiet that the radio decides to take a snooze.

Conclusion

The Alinco DJ-VX50T is a capable dual-band FM transceiver that departs from what could be considered basic. Its durable design and wide range of features distinguish it from its competitors, yet it is priced to appeal to a wide audience, including new amateurs.

Manufacturer: Alinco, Osaka, Japan; **www.alinco.com**. Distributed in the US by REMTronix, Lathrop, California; **remtronix.com**, and available from a number of amateur radio dealers. Price: $100.

Two Autotuners for the Icom IC-705: The Icom AH-705 and the MAT-TUNER mAT-705Plus

Reviewed by Phil Salas AD5X
ad5x@arrl.net

While it is often convenient to have resonant, matched antennas at your home station, this is often not the case when operating portable. The IC-705 low-power portable transceiver (reviewed in the February 2021 issue of *QST*) doesn't have an internal antenna tuner, but there are several compact manual and automatic tuners that can be used with this radio.

In this review, we will look at two autotuners that are made specifically to interface with the IC-705 via its tuner interface, which has connections for Start, Ground, and Key. The Icom AH-705 and the MAT-TUNER mAT-705Plus both cover 160 through 6 meters and are controlled directly from the IC-705.

Table 2
Icom AH-705 Automatic Antenna Tuner

Manufacturer's Specifications

Frequency range: 1.8 – 54 MHz (>98.4-foot antenna),
3.5 – 54 MHz (>23-foot antenna).
Maximum input power: 10 W.
Tuning power required: 5 – 10 W.
Tuning time: Average 2 – 3 seconds, maximum 15 seconds.
Power supply requirement: Two AA cells or 13.8 V dc ±15%.
Current drain: Less than 300 mA (while tuning); less than 1 mA (standby).
Tuning accuracy: Less than 2:1 VSWR.
Number of tuned memories: 45.
Dimensions (height, width, depth): 1.6 × 4.1 × 7.5 inches.
Weight: 15.8 ounces without batteries.

AH-705 Resistive Load and Loss Testing

Untuned Load		Power Loss (%) and Tuned SWR by Band (meters)					
SWR	(Ω)	160	80	40	20	10	6
10:1	5.0	16% 1.3	16% 1.3	16% 1.2	<3% 1.3	<3% 1.3	<3% 1.3
8:1	6.25	12% 1.2	12% 1.2	12% 1.2	<3% 1.2	<3% 1.1	<3% 1.3
4:1	12.5	6% 1.1	6% 1.2	6% 1.2	6% 1.2	<3% 1.1	<3% 1.6
2:1	25	4% 1.1	<3% 1.3	<3% 1.3	<3% 1.1	<3% 1.1	<3% 1.6
1:1	50	<1% 1.0	<1% 1.0	<1% 1.0	1% 1.0	1% 1.0	<1% 1.0
2:1	100	<3% 1.2	<3% 1.2	<3% 1.2	<3% 1.1	<3% 1.0	<3% 1.3
4:1	200	8% 1.2	6% 1.3	5% 1.3	<3% 1.3	<3% 1.1	6% 1.5
8:1	400	8% 1.1	6% 1.3	5% 1.3	4% 1.2	<3% 1.1	NT —
10:1	500	11% 1.4	<3% 1.3	<3% 1.2	<3% 1.1	8% 1.3	NT —

NT = no tuning solution found

Figure 2 — One end of the Icom AH-705 has a BNC jack for RF from the transceiver, a jack for control signals from the transceiver, and an external dc power connector. The control and power jacks are protected by rubber covers when not in use.

Figure 3 — The other end of the AH-705 has an SO-239 jack for the antenna feed line and a binding post for ground.

Icom AH-705

The Icom AH-705 is housed in a weather-resistant case. It is powered by two internal AA batteries, or it can be powered from an external 13.8 V dc power supply. The AH-705 comes with a 6.6-foot BNC-to-BNC coaxial cable, a 6.6-foot control cable, a mounting bracket for attaching the tuner directly to an antenna or other structure, and a dc power plug. Table 2 lists the AH-705 specifications.

The AH-705 is fairly large, and the IC-705 could sit right on top of it. The input side of the AH-705 has a BNC connector, a 3.5-millimeter control cable connector, and a 2.1 × 5.5 millimeter coaxial connector for external dc power. The control and dc connectors are covered by water-resistant flaps. The output side of the AH-705 has an SO-239 connector and a ground lug with a wing nut (see Figures 2 and 3). The two AA batteries are easily accessible under a cover on the bottom side of the unit, and no special tools are required to change batteries. There are no indicators on the AH-705.

Basic Testing

Standard ARRL resistive load and loss testing was performed on the AH-705. The results are given in Table 2. Open/short testing was also performed. Ideally, a tuner should not be able to match an open or short circuit. However, many antenna tuners can tune into their own internal losses on some bands. As shown in Table 3, matches were found on some bands. See my article, "Antenna Tuner Loss Measurements," in the March/April 2021 issue of *QEX* for more information.

Using the AH-705

Most operators will probably use the internal AA batteries for powering the tuner. This minimizes required equipment in the field, as the AH-705 cannot be powered from the IC-705. While the AH-705 draws up to 300 mA during tuning, latching relays are used so that when tuning completes, the AH-705 draws very little current. As noted in the manual, when the AH-705 will not be used for a while, the control cable should be disconnected from the tuner to prevent

Table 3
AH-705 Open/Short Test Results

Band (Meters)	Open Circuit	Short Circuit
40	1.52:1	1.8:1
20	1.2:1	2.17:1
15	1.3:1	—
10	1.65:1	—

Table 4
AH-705 Tuned SWR with 43-Foot Vertical

Band	160	80	40	30	20	17	15	12	10	6
SWR	1.2:1	1.1:1	1:1	1:1	1:1	1:1	1:1	1:1	1:1	1:1

depleting the batteries. The AH-705 draws a small amount of battery current (about 0.33 mA) whenever the control cable is plugged in, even if the IC-705 is powered off.

To enable tuning, on the IC-705 display select **FUNCTION**, and then press and hold **TUNER**. Except for extreme SWR conditions, tuning occurs within about 2 seconds, unless that particular frequency has been tuned before. In that case, tuning is almost instantaneous as the information is already stored in the AH-705 memory.

My primary antenna is a 43-foot vertical, which connects to my ham station with 60 feet of FSJ4-50B ½-inch Heliax. With the IC-705 and the AH-705 located in the station, the AH-705 tuned the antenna on 160 through 6 meters, typically in less than 2 seconds. Frankly, I was surprised that it tuned the antenna on 160 meters, as the 43-foot vertical is less than half the recommended length (greater than 98.4 feet) for this band. Once I'd tuned each band, returning to that same frequency from another band resulted in an instant tuning solution from memory as soon as I touched my CW key or pressed the PTT switch on the IC-705. Table 4 lists the tuned SWR on the different bands.

Manufacturer: Icom America, 2380 116th Ave. NE, Bellevue, WA 98004; **www.icomamerica.com**. Price: $349.95.

MAT-TUNER mAT-705Plus

The mAT-705Plus is noticeably smaller than the AH-705. The mAT-705Plus is powered by internal lithium batteries, which are charged by a standard USB charger. The original mAT-705 used a 9 V battery, and replacement required disassembling the tuner and removing the PC board. The rechargeable batteries in the Plus model are a big improvement, and they can be recharged anywhere with USB power.

The tuner comes with a control cable and a USB-C charging cable. A 39-inch BNC-to-BNC interface cable for connecting the IC-705 to the mAT-705Plus is a $10 option.

Like the AH-705, the mAT-705 has no power switch. However, unlike the AH-705, the mAT-705 is turned on and off with the IC-705, so there is no need to disconnect the control cable to keep from drawing standby current when not in use.

The RF input and output ports are BNC connectors. Both of these connectors and the 3.5-millimeter control port are located on one side of the unit. The

Table 5
MAT-TUNER mAT-705Plus Automatic Antenna Tuner

Manufacturer's Specifications

Frequency range: 1.8 – 54 MHz.
Power handling: 30 W PEP, 10 W continuous.
Matching range: 5 to 1,500 Ω.
Tuning time: 5 seconds or less.
Power requirements: Internal rechargeable #10440 lithium batteries.
USB-C charging cable included (500 mA charging current).
Size (height, width, depth): 1.1 × 2.6 × 5.9 inches; weight 8 ounces.

mAT-705Plus Resistive Load and Loss Testing

Untuned Load		Power Loss (%) and Tuned SWR by Band (meters)					
SWR	(Ω)	160	80	40	20	10	6
10:1	5.0	27% 2.7	8% 1.4	<3% 1.1	<3% 1.4	<3% 1.3	<3% 1.7
8:1	6.25	17% 2.2	6% 1.3	3% 1.2	<3% 1.6	<3% 1.1	<3% 2.0
4:1	12.5	<3% 1.2	<3% 1.2	<3% 1.1	<3% 1.3	4% 1.5	4% 1.6
2:1	25	<3% 1.1	<3% 1.1	<3% 1.1	<3% 1.2	4% 1.3	16% 1.5
1:1	50	<1% 1.0	<1% 1.1	<1% 1.1	<1% 1.1	<1% 1.4	<1% 1.5
2:1	100	<3% 1.2	<3% 1.1	<3% 1.2	<3% 1.2	<3% 1.4	4% 1.5
4:1	200	5% 1.2	3% 1.1	<3% 1.0	<3% 1.1	<3% 1.2	4% 1.8
8:1	400	6% 1.2	6% 1.2	4% 1.0	3% 1.1	6% 1.6	6% 1.7
10:1	500	6% 1.5	6% 1.2	5% 1.3	3% 1.3	9% 1.5	36% 2.2

Figure 4 (left) — The MAT-TUNER mAT-705 front panel has indicator LEDs and a USB jack for charging the internal batteries.

Figure 5 (right) — The mAT-705 rear panel has the jack for transceiver control and BNC connectors for transceiver and antenna.

Table 6
mAT-705Plus Open/Short Test Results

Band (Meters)	Open Circuit	Short Circuit
20	—	2.1:1
15	—	2.2:1
10	2.34:1	—

Table 7
mAT-705Plus Tuned SWR with 43-Foot Vertical

Band	160	80	40	30	20	17	15	12	10	6
SWR	NT	1.1:1	1.1:1	1.1:1	1.1:1	1.1:1	1.5:1	1.2:1	1.5:1	1.7:1

NT = no tuning solution found

opposite side of the mAT-705 has the USB charging port, and **PWR/CHARGING** and **ONLINE/TUNING** LEDs (see Figures 4 and 5). Table 5 lists the mAT-705 specifications.

Basic Testing

Standard ARRL resistive load and loss testing and open/short testing was performed, and the results are shown in Table 5. While there were a few matches found in the open/short testing, no matches with less than a 2:1 SWR occurred, as shown in Table 6.

Using the mAT-705Plus

When you turn on the IC-705 with the mAT-705Plus connected via the control cable, the **PWR/CHARGE** LED on the tuner should light up solid green. If it flashes green, the tuner needs to be charged. While charging, the **PWR/CHARGE** indicator turns red. The tuning cycle is started by pressing **FUNCTION** on the IC-705 display, and then pressing and holding **TUNE**. The mAT-705Plus **ONLINE/TUNING** LED lights up red during the tuning cycle, and then turns green when tuning is complete. The mAT-705Plus uses latching relays, so minimal current is drawn after tuning is complete.

I ran tuning tests with my 43-foot vertical. The mAT-705Plus always seemed to take at least 5 seconds to tune the first time. After the initial tuning cycle, the tuner jumped to the prior tuning solution in a fraction of a second when I returned to a pre-tuned frequency. With 16,000 memory channels, you can expect quick re-tunes after initial tunes on many different frequencies, as long as you don't change antennas. As you can see in Table 7, the mAT-705Plus was unable to tune my 43-foot vertical on 160 meters but did find a solution on the other bands.

Manufacturer: Hengshui MAT-TUNER LLC, Hebei, China. Distributed in North America by Vibroplex, 1001 N. Broadway St., Knoxville, TN 37917; **www.vibroplex.com**. A 1-year parts and labor warranty is administered in the US and Canada by Vibroplex, and repair services are available. Price: $229.95. Optional BNC-to-BNC interface cable, $10.

Wrap Up

Autotuners provide simple and fast matching solutions when antennas aren't ideal. Both the Icom AH-705 and the MAT-TUNER mAT-705Plus simplify antenna tuning when used with the IC-705. There are some differences in matching ranges, tuning solutions, size, weight, and cost between these autotuners. As always, the end user needs to weigh the tradeoffs when making a purchase decision.

Bottom Line

Both the Icom AH-705 and the MAT-TUNER mAT-705Plus autotuners provide a seamless interface to the Icom IC-705 portable transceiver. They make antenna tuning with less-than-perfect antennas a simple operation.

MFJ-261 Dry Dummy Load

Reviewed by Jim Bogard, KY4L
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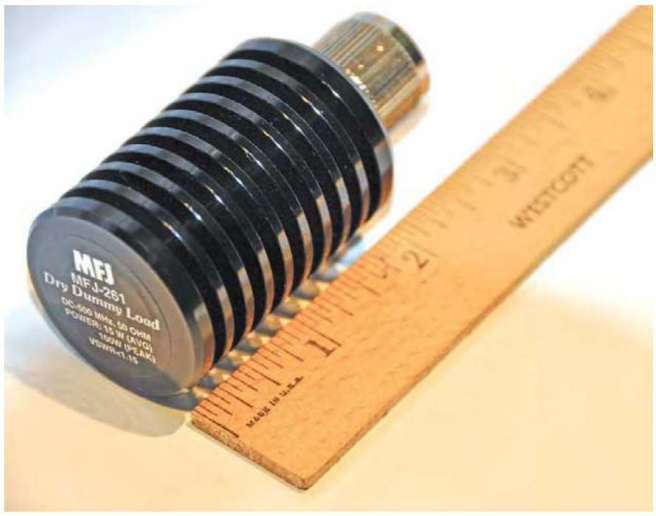
The MFJ-261 is a small, inexpensive 50 Ω dummy load with impressively flat SWR response over a very wide frequency range. The MFJ-261 is air cooled with a finned aluminum heatsink. Its power ratings are 100 W peak (30 seconds maximum, followed by 5 minutes off), and 15 W average (continuous duty). It connects directly to your transceiver with a PL-259 UHF connector, and so it requires no patch cable. MFJ specifies this device to present an SWR less than 1.15:1 from dc to 500 MHz, and with dimensions of 1⅝ inches round by 3 inches long, you can carry it in your pocket.

I measured the SWR curve of my MFJ-261 with a Rigol DSA815-TG spectrum analyzer, equipped with a VB1032 VSWR Bridge. While the MFJ-261 does not quite meet the manufacturer's specs, it still has low SWR up to 500 MHz. The SWR measures less than 1.15:1 in the 160-meter through 6-meter amateur bands, as shown in Figure 6. The SWR exceeds 1.15:1 in the 1.25-meter and 70-centimeter bands, but is still very usable at around 1.5:1 (see Figure 7).[1]



The MFJ-261 dummy load on which these measurements were made is actually the second I have owned. The connector became separated from the

Bottom Line

The MFJ-261 is an affordable dry dummy load for use up to the 70-centimeter band. It's rated for 100 W peak, but heed the 30-second limit at full power.

[1]The spectrum analyzer equipped with a tracking generator and SWR bridge actually provides a return loss measurement (RL, in decibels), which must be converted to SWR for the device under test. The formula is

$$VSWR = \frac{1+10^{-\frac{RL}{20}}}{1-10^{-\frac{RL}{20}}}$$

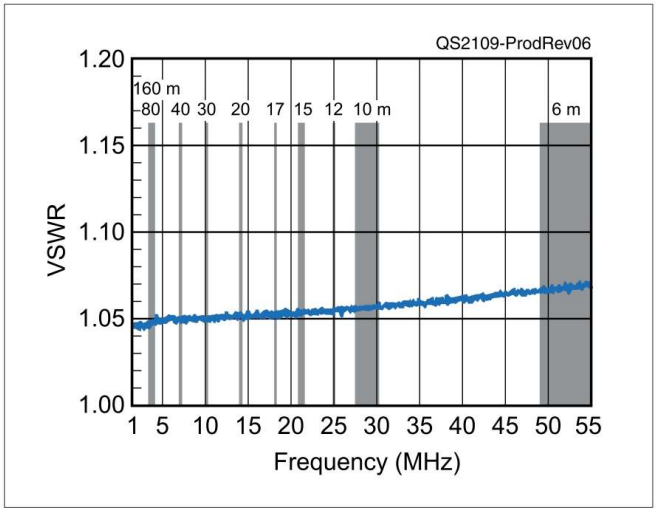


Figure 6 — The SWR trace for the MFJ-261 dummy load from 0 MHz to 55 MHz. Shaded areas show the amateur bands in this frequency range.

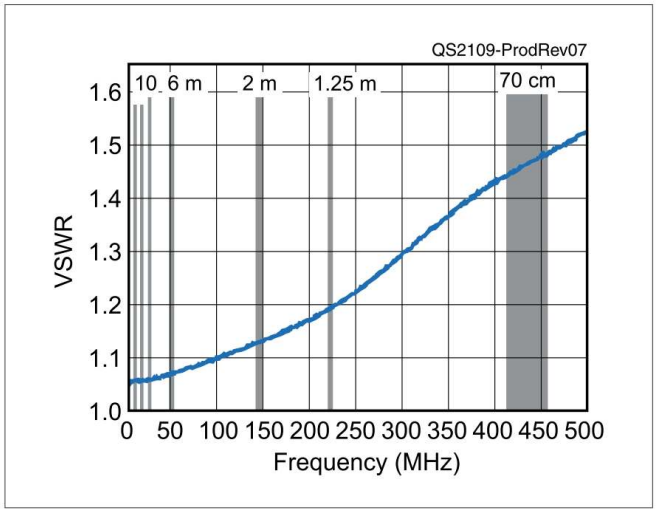


Figure 7 — The SWR trace for the MFJ-261 dummy load from 5 MHz to 500 MHz. Shaded areas show the amateur bands in this frequency range.

load in the first one. It still seems to work after being force fit back together, but the attachment of center pin to load is compromised, so I got the second unit. The later design appears more sturdily constructed, with the knurled connector nut affixed firmly to the body of the dummy load to prevent the connection from breaking. The nut no longer spins freely.

Although the MFJ-261 doesn't quite meet its specifications above 2 meters, I'd still recommend it as a very useful and affordable addition to any ham station with MF/HF through 70-centimeter capability.

Manufacturer: MFJ Enterprises, 300 Industrial Park Rd., Starkville, MS 39759; **www.mfjenterprises.com**. Price: $34.95.

HAMRS Logging App for iOS

Reviewed by Steve Ford, WB8IMY
wb8imy@arrl.net

Jarrett Green, KBØICT, created *HAMRS* with the idea that a mobile logging app should be able to support activities that require specific types of information. Not only that, it should also do so in a way that is straightforward and user friendly. *HAMRS* is available for a variety of platforms, including iOS, Android, Windows, macOS, Ubuntu, and Raspbian. This review focuses on the iOS app, but features and operation are similar with the other versions.

When you open *HAMRS* for the first time, you are asked to set up a profile (your name, call sign, and preferred language) as well as a new logbook. At the time this review was written, *HAMRS* provided logbook templates for Parks on the Air (POTA), ARRL Field Day, Winter Field Day, Summits On The Air (SOTA), or a generic log. Jarrett has been adding features regularly, and by the time you read this, there may be templates for other operating activities as well. As this review wrapped up, the latest version of *HAMRS* was 0.10.6.

POTA with *HAMRS*

I installed *HAMRS* onto my Apple iPad and chose the Parks on the Air (POTA) template. POTA is an ideal activity for mobile app logging, so I decided to give it a real-world test.

I loaded my transceiver, antenna, and iPad into the car and headed for a nearby state park. When I was set up at my destination and ready to take to the airwaves, I fired up *HAMRS*, chose FT8 from the mode menu, and started calling CQ using my FT8 software. The mode menu supports SSB, CW, AM, FM, RTTY, FT8, SSTV, C4FM, JS8, FT4, PSK31, digital voice, and D-STAR.

During a contact, it was simple to use the iPad keyboard to enter the call sign and signal report. (Note

Bottom Line

HAMRS is a logging application that's tailored for portable/mobile operation. Templates for several popular outdoor operating programs are available in addition to a generic logbook. New features and refinements have been added regularly.

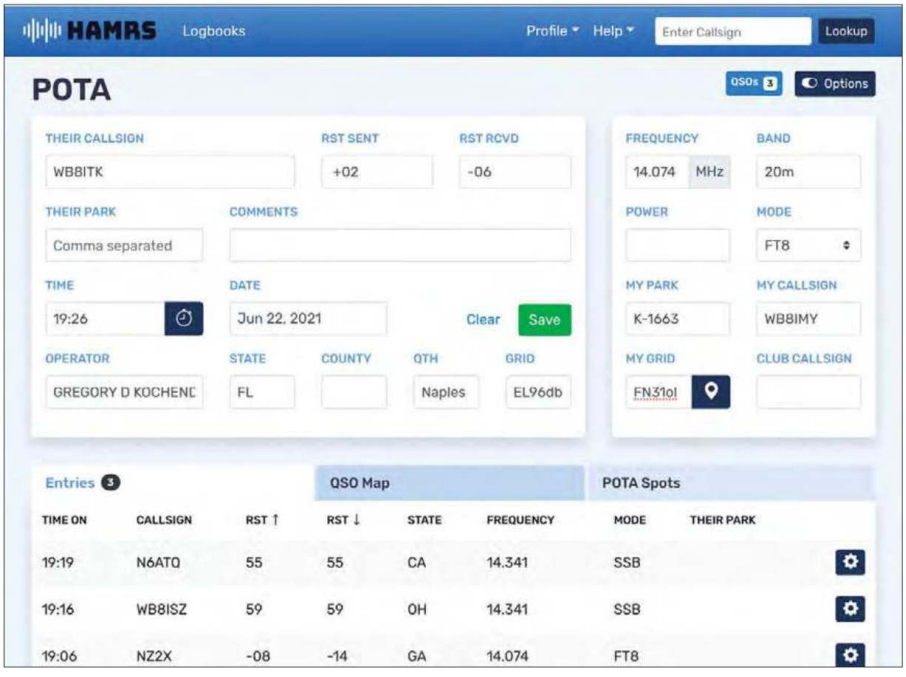


Figure 8 — Logging Parks on the Air (POTA) contacts with *HAMRS*. The Expanded Mode and QRZ Lookups options are enabled, so the other operator's name and location are filled in automatically and displayed in the lower section of the QSO entry window.

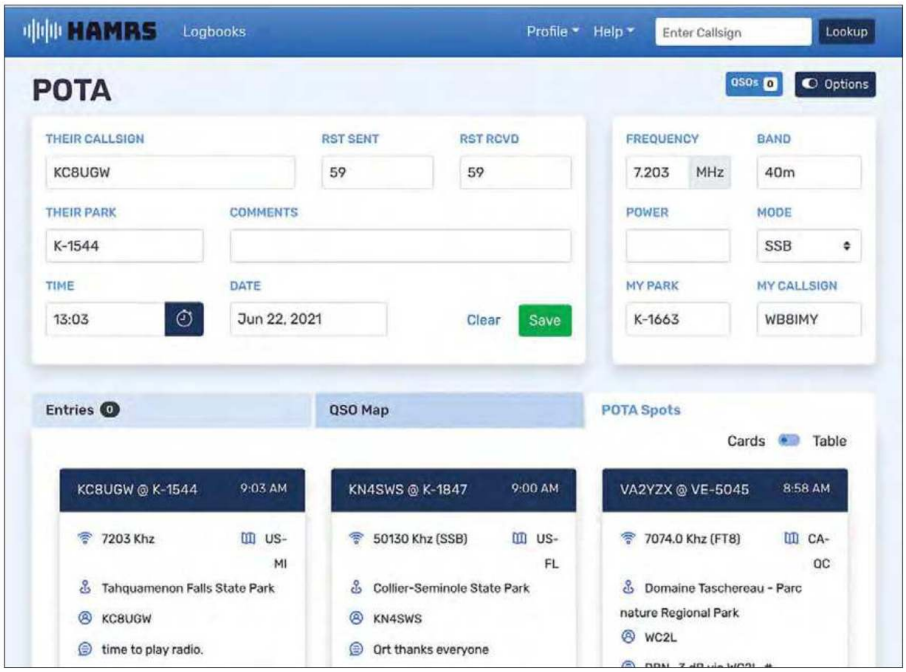


Figure 9 — If your device is connected to the internet, *HAMRS* will display POTA spots from the **pota.app** website. Clicking **COPY** on a spot transfers the call sign, frequency, park designator, and other information to the QSO entry window.

that the program accepts the SNR reports, for example +02, used for FT8 as well as RST.) *HAMRS* filled in the date and time automatically. In Figure 8, you'll also notice the right-hand window that contains my operating frequency, band, mode, and POTA park number. The information in this window remains fixed unless you change it.

If you happen to be using a device with access to the internet, with the **QRZ LOOKUPS** option enabled, *HAMRS* will automatically look up the name and location of the other operator after you enter their call sign. With **EXPANDED MODE** enabled, this information is displayed on the log entry screen, as shown in Figure 8. When you tap the **SAVE** button, the contact information is added to the log displayed in the lower portion of the screen, and the fields are cleared for your next contact.

A recent addition is the **POTA SPOTS** tab, which is used to display current spots from the **pota.app** website if your device is connected to the internet (see Figure 9). Click the **COPY** button on a spot, and the app will populate the fields with the spotted station's call sign, park, frequency, band, and mode.

After I finished my last contact, I tapped on **LOGBOOKS** in the upper left corner. *HAMRS* responded with a list of available logs and gave me the option of exporting the information to an ADIF (.adi) file. This is the format required for submission for POTA credit, and it's accepted by most other logging applications and ARRL's Logbook of The World (LoTW). I tapped the gear symbol, followed by **EXPORT ADI**. *HAMRS* allowed me to choose where I wanted the log file to be stored, or where I wanted to send it. I chose to send it to my home via email, and later I imported it into my primary station log.

Another recent addition is the **QSO MAP** tab (see Figure 10). This feature displays contacts for which *HAMRS* has logged location information (from the QRZ Lookups feature).

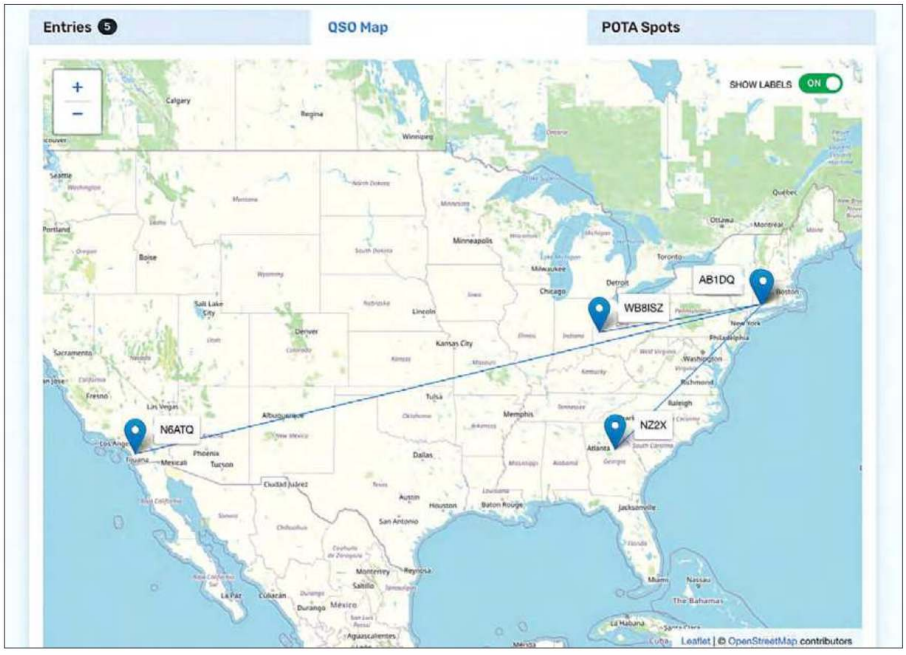


Figure 10 — Logged contacts can be displayed using the **QSO MAP** feature.

Quick and Simple

When activity is intense, it is a blessing to have logging software that doesn't require much attention. You want to log the contact with as few keystrokes as possible, save it,

and then go on to the next contact. That's exactly how *HAMRS* is designed to operate. It achieves this with a layout that is visually clean, not cluttered with a bunch of distracting fields and virtual buttons.

HAMRS has been enthusiastically received in the ham community, and it will be interesting to watch the evolution of this app in the months to come. An interactive section of the *HAMRS* website is available for support, bug reports, and feature requests.

Manufacturer: Lost Cabins, LLC; **www.hamrs.app**. Mobile app versions available in the Apple App Store and Google Play, $4.99.

Pacific Antenna Wall Wart Tamer 2.0 Kit

Reviewed by Paul Danzer, N1II
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If you're like me, you have a collection of "wall warts" in a box somewhere, waiting for them to be needed. Figure 11 shows just a few from a box under my workbench. Many are added, but few are removed. It's not always easy to find one with the right voltage or current ratings for a new project, especially if you need well-filtered and regulated dc.

Pacific Antenna recognized this problem and designed the Wall Wart Tamer. This small kit is neatly built on a 2.3 × 4.3 inch PC board. It accepts input voltages from 5 to 25 V, either ac or dc. It is not polarized for dc — you can connect either wire from the wall wart to either of the input terminals.

The Wall Wart Tamer board includes a rectifier, filter capacitors, and a regulator to provide clean, stable dc output. Output is adjustable from approximately 1.25 V minimum to about 3 V below the input voltage (for example, 12 V output maximum for a 15 V wall wart). Output current can be as high as 1.5 A, assuming the wall wart can supply that much current. This PC board can also be connected to any sort of other power source, such as a surplus computer power supply.

Bottom Line

The Pacific Antenna Wall Wart Tamer kit transforms a surplus wall cube into a well-filtered, well-regulated, adjustable, low-current power supply.

Construction

The eight-page construction manual is a PDF downloaded from the Pacific Antenna website. A schematic is not supplied, but the manual says a bridge rectifier, capacitive filter, and LM317 adjustable regulator are used.

The parts list includes the component designation, value, and a photo of the part. Step-by-step instructions include a brief description and picture for each part installed on the board. When a part must be installed in a certain way (polarized capacitors, for example), the instructions for that step make it clear which way the part needs to be positioned. I found it helpful to keep the PDF with the instructions open on my computer, because some of the illustrations are very small when printed on 8½ × 11 inch paper.

Three large 2,200 µF capacitors may be supplied with axial or radial leads, and the board is designed to accept either style. The 0.1 µF capacitors may be

Figure 11 — You may already have a collection of abandoned wall warts. Put them to use with this kit.

marked with the code 104. Construction time is on the order of one or two short evenings, and this would be a good experience for first-time kit builders.

Final Steps

There is no formal check-out procedure. Make a visual inspection for short circuits or bad solder joints. Then connect the input power leads from the wall wart and look for the two LEDs to light. Attach a voltmeter, set the output voltage with a tiny screwdriver for the miniature potentiometer, and you are finished. I used my digital voltmeter to check the output voltage regulation under varying inputs and loads. Only the right-hand decimal place moved slightly (for example, it jittered between 9.36 and 9.37 V).

Another characteristic that's important to me is what happens when the load decreases suddenly, and whether the output voltage jumps up and then recovers. I could not find any evidence of that behavior. As an additional test, I set the voltage in the evening, turned everything off, and then turned it back on in the morning. The output voltage stayed the same (drastic changes in room temperature might affect that stability).

The only difficulty I ran into was with several of my wall warts, not the Wall Wart Tamer board. When I tried to draw current near the limit shown on the wall wart label, the wall wart output voltage collapsed. For example, a wall wart marked as 10 V went to 2 V when I tried to draw current near its maximum rating with the PC board output set to 6 V. The poor quality wall warts went off to recycling, and I was able to reduce the size of my collection a bit.

If you need an adjustable power supply quickly, the Wall Wart Tamer offers a flexible solution. Just add this little circuit to one of the wall warts from your collection, and you're ready to go.

Manufacturer: Pacific Antenna, P.O. Box 10301, Fayetteville, AR 72703; **www.qrpkits.com**.
Price: $20 plus shipping.

Dave Casler, KEØOG, askdave@arrl.org

Ask Dave

QST's new question-and-answer column is here. Submit your questions to askdave@arrl.org.

What an Amplifier Can Fix

Consider an Amplifier

Q Chase Palmer, KJ7OXM, asks: While operating from a field setup in preparation for ARRL Field Day, I was trying to make some contacts. Lots of DX stations were calling CQ, but my 100 W setup could not beat out any of the stations running 1,500 W. I know that an antenna with good directional gain is going to do a lot, but my question is whether an amplifier is necessary for being able to work those DX stations.

A Many times, I've simply not been able to break the pileup on a DX station, even though I'm using all the tricks of the trade, such as timing my signal to be either first or last, following the DX station's instructions as to how many kilohertz above or below their station to call, using properly set compression, and so on. At some point, you just have to move on to work another station. The reason you don't get through is because so many other stations are calling, and it becomes impossible for the DX station to pick out call signs.

Even so, there are a couple of general rules that may help. First, as you improve your station, be sure to improve your antenna. If you can't hear other stations very well, odds are they can't hear you very well. Second, if you consistently hear other stations that cannot hear you, it might be time to consider an amplifier. Usually, amplifiers are far more expensive than simple antenna improvements, such as raising the antenna's height, trying a vertical loop, and so on. The ARRL bookstore is full of antenna-related books.

I have an Ameritron ALS-500M 500 W amplifier and power supply, but I don't normally call CQ with it. Stations that can hear me weakly are so far in the noise that I can't hear them. However, I do use it from time to time to answer CQs. It can make a major difference even though the improvement in my signal is only a little more than one S-unit.

An amplifier is certainly not a requirement to enjoy amateur radio. Many hams have earned their DX Century Club (DXCC) award (which means they have confirmed contacts with at least 100 DXCC "entities"), with 100 W or less. It's challenging, but many people find the enjoyment in seeking out all-time new ones.

Converting from Average Power to Peak Power

Q Ken Faria, NTØY, asks: Can you give me a clear formula for converting average power to peak envelope power (PEP)?

A I can't, because there isn't a constant relationship. Peak envelope power is the instantaneous peak power that is often the maximum that a transmitter can create. It's the power of a dit or dah, or the peak power of a digital waveform. In the case of single sideband, it's the power at a voice peak. In the case of AM, it's four times the carrier power of a voice peak if the transmitter is set up properly for 100% modulation.

For an unmodified voice waveform, the average power from an SSB transmitter is on the order of 20% of the peak (see Figure 1). However, with good compression techniques,

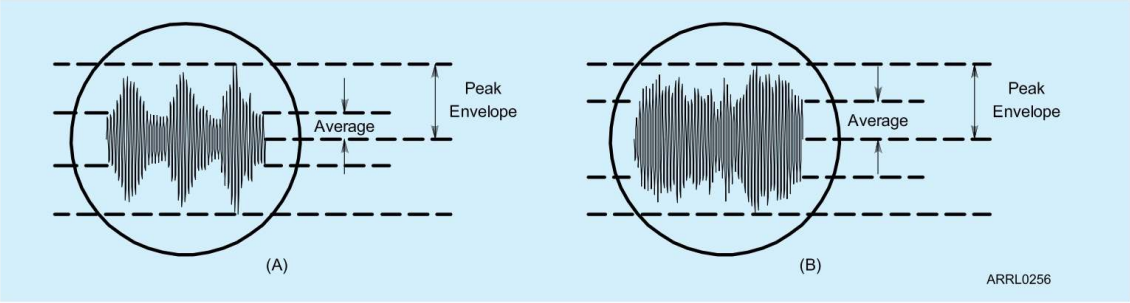


Figure 1 — Two modulation envelope patterns that show the difference between average and peak power levels. In each case, the RF amplitude is plotted as a function of time. In B, the average power level has been increased compared to the peak value.

found in all recent SSB transceivers, the average output power is on the order of 40% of the peak, nearly doubling the average power. This makes your signal seem twice as loud as a non-compressed signal. To set up compression properly, follow your rig's instruction manual carefully, because too much compression can distort your signal to the point of unintelligibility.

Note that good compression makes your signal twice as strong from a listening point of view. That's 3 dB or a half S-unit. While not a huge amount, it can make the difference between making a contact or not.

Winter Contacts versus Summer Contacts

Q Fred Reisfeld, KC2HH, asks: I have an old Cushcraft antenna, and during February, March, and April, I was able to make a large number of contacts. These contacts were both in the US and Europe. During May and June, I made fewer contacts — in June very few. My house is surrounded by very large oak trees, which are fully leafed in mid-June. What I read is that trees should not affect HF signals. This does not seem accurate. The band I use most is 20 meters.

A There are several factors at work here. Remember that the first rule of antennas is that everything affects everything. It is indeed possible that thick canopies of oak leaves can attenuate signals somewhat.

However, I think something simpler is going on, and that is seasonal propagation change. In the North American winter, much of the signal path is in darkness, using the ionospheric F layer. In the spring and summer, much of the signal path is in daylight, using the F1, F2, and sporadically, the E layer. Further, wherever the sun is up, the D layer is active. This, however, won't have much effect on 20 meters.

In the summer, explore higher frequencies during the daytime, such as 17 meters and 15 meters. Even 10 and 6 meters can offer some activity. During this part of the solar cycle, propagation is still not good. In another year or two, that will change, and you will find more activity on the higher bands.

VHF Interference Problems

Q Neil Poff, KI5LDD, asks: I've been fighting an RFI problem on 147.255 for about 3 months. I've been through the usual interference-fighting techniques, including turning electricity on and off and contacting the power and cable companies, both of which have been cooperative. But the interference persists.

A Neil, you don't say whether the RFI is just on one frequency or across the band. I suspect, from what you described, it's just on that frequency. I've had that problem myself, and when trying to listen to a specific frequency, all I get is garbage all the time. 147.225 MHz is a repeater output frequency, so perhaps that's why you want to listen on that frequency. You point out you've tried all the usual methods, including a different radio.

This leads me to think the problem is highly unique to your situation and is due to intermodulation. If you can receive on other frequencies, and if you drive some distance from your home (a mile or so), and the problem goes away, it's almost always intermodulation. Going back to modulation theory, you combine two frequencies to create a third. For example, you may have a radio that listens on 7 to 7.3 MHz. Your radio might have a signal generator at 2 to 2.3 MHz. These two signals go into a mixer, and you get 5 to 5.3 MHz and 9 to 9.3 MHz. Your intermediate frequency receiver is at 9.15 MHz. A signal coming in at 7.15 MHz gets heterodyned (the process of mixing two frequencies to create a third) to 9.15 MHz, which is detected and sent to your loudspeaker.

Note this can happen using any non-linear device as a mixer. A diode, a tube, or even two pieces of metal with a poor connection between them. This latter possibility could be what's causing your problem. A constant signal, such as a carrier from the cable TV, mixes with a broadcast station because of a loose bolt on someone's roof. It creates sporadic problems, and only on one frequency. The problem is that it's extremely hard to track down. I was once in a club whose repeater input frequency had this intermodulation problem. It took many hours and many attempts to track down what turned out to be a loose bolt on the tower assembly.

You can tell if you have an intermodulation problem because it's usually on only specific frequencies. If that's the case, it's possible direction-finding can help. Good luck, because it may end up being impossible to track down.

Send your questions to **askdave@arrl.org**, or fill out the form at **www.ke0og.net/ask-dave**. 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

Noise from an Unlikely Source, Sorting Cables, a Helpful Wooden Stand, and More

Wireless Speaker Interference

For about a year, I was plagued by a series of signal spikes every 33 kHz or so, including one right in the middle of a portion of 75 meters, from 3.877 to 3.883 MHz. The signals also appeared above and below the band. The spikes would generally peak at about an S7 or so, and were only about 1 kHz wide, but were just wide enough and loud enough to create an annoying buzz on weaker AM signals, as well as SSB signals.

The spikes were particularly apparent when using my 80/160-meter shunt-fed tower, which is located about 90 feet from our house and has an extensive radial field. After an exhaustive hunt around the house with a portable AM radio, I found a variety of noise sources from switching power supplies, computers, and more, but none proved to be generating interference beyond a few feet from the respective device. I was convinced that the noise was not coming from our house or property, but decided to turn off each circuit breaker in a last-ditch effort to see if I could find the culprit.

After going through our entire breaker panel and subpanel, I turned off one of our exterior ground fault circuit interrupter (GFCI) breakers and found that the spike was suddenly gone. That outdoor line extended about 75 feet or so through our backyard and fed several low-voltage transformers and electronic timers, but the line also picked up one outlet located on our back porch that powered a high-end wireless speaker. I never suspected the speaker, but it ended up being the culprit. Its Wi-Fi transceiver must have induced oscillator noise into the long outside ac line and various low-voltage cables running around the yard. I'm sure the proximity of an extensive radial field to those lines didn't help. Figure 1 shows the RF spike at about S7 just below the passband of an AM signal on 3.885 MHz. Figure 2 shows the result with the speaker disconnected.

Plugging the device into one of the interior house circuits, in combination with wrapping several turns of the line cord around a snap-on ferrite suppressor, has all but eliminated the noise. The speaker was made by Definitive Technology, Model W7.

The lesson learned here is that you should check your outdoor GFCI underground wiring for devices that might be coupling RF from wireless sources. That wiring serves as a nice antenna system to transfer the noise to your antenna farm. And you might also want to check your wireless speakers as sources of interference.
— *73, Tom Daniels, N3CXP,* **tkdaniels@ptd.net**

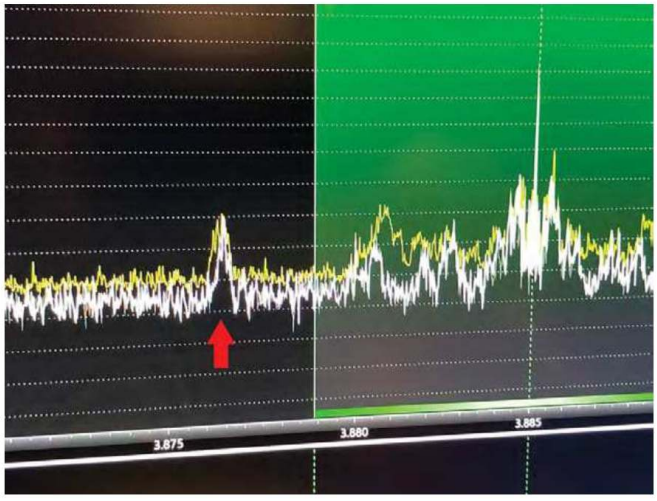


Figure 1 – Here you can see one of the offending signals (marked with a red arrow) just below an AM signal.

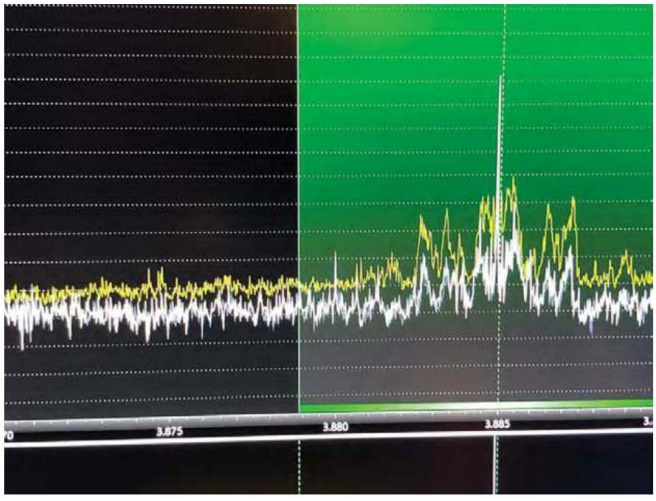


Figure 2 – When the wireless speaker is disconnected, the signal vanishes.

Cable Organization

Like many radio amateurs, I have a lot of wire and cable laying around, just waiting to be used in a project. However, this stuff can take up a lot of space, and a coil of coax can become a tangled mess if you're not careful. To keep things organized, I made a simple rack for spools of wire using ½-inch electrical conduit and metal curtain rod brackets from the hardware store. Each pair of brackets was under $3, and a 10-foot piece of conduit was about $10. For the coax and other large cables, I discovered that my local dollar store sold metal garden hose hangers for about $3 each, including mounting hardware. I mounted four of these on the wall and was able to get all my cable off the floor (see Figure 3). I spent about $30, which cleaned up the shack considerably and made accessing these materials for projects much less painful.
— *73, Chris Parker, VA7PK,* **parkercac@gmail.com**

Figure 3 — A small investment in hardware was all it took to create a clean space for cable storage. [Chris Parker, VA7PK, photo]

An Easy Handheld Stand

Handheld transceivers tend to be unstable when standing upright. There are several commercial stands available, but they generally cost about $20. I built a suitable stand out of a 4-inch-long piece of 1 × 3 inch scrap wood (see Figure 4).

The vertical section is a piece of ⅛-inch-thick hardboard (Masonite), cut to the width of the base block and about 5 inches long. Using a table saw, I made a kerf cut halfway through the base block at an angle of 15 to 20 degrees, about a third of the way from one end of the block. The kerf provides a snug fit for the Masonite, but a dab of glue may be necessary. A notch can be cut in the top of the Masonite to accept the radio's belt clip. Finishing is optional. — *73, Stephen Peterson, KI7L,* **scpki7l@gmail.com**

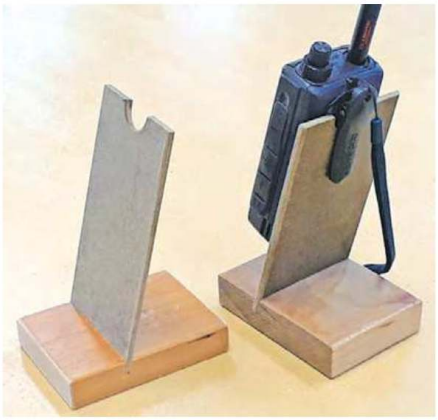


Figure 4 — An attractive handheld transceiver stand crafted from a 4-inch-long piece of 1 × 3 inch scrap wood. [Stephen Peterson, KI7L, photo]

A Different Approach to QSL Counting

I've found an easy way to count stacks of QSL cards, which involves a precision measurement tool known as a micrometer. Micrometers have been around for ages and you can find modern versions with digital displays for less than $40 from sources like Amazon (see Figure 5). They're great to have around when you need to precisely measure the thickness of an object.

In this instance, use the micrometer to measure the thickness of a single QSL card in the stack. Write down the result. Then, using a millimeter ruler, stack the cards together side by side and measure the thickness of the entire stack. Divide this measurement by the thickness of the single card and you will discover the approximate number of cards in the stack.
— *73, Theo Turk, WB8ADA,* **HammyTee@hotmail.com**

Figure 5 — A low-cost digital micrometer. [Theo Turk, WB8ADA, photo]

"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 "Attn: Hints and Hacks" at ARRL Headquarters, 225 Main St., Newington, CT 06111, or via email 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.

Steve Ford, WB8IMY, wb8imy@arrl.net

Eclectic Technology

Band-Hopping with WSPR

The Weak Signal Propagation Reporter, better known as WSPR, is one of the digital modes available in the *WSJT-X* software suite. Over the years, it has become the gold standard for antenna testing and propagation research. It will become an even more valuable tool as we experience the changes anticipated during Cycle 25.

On any given day, you'll find hams transmitting low-power WSPR signals from various points throughout the world. Thanks to the extraordinary ability of *WSJT-X* to decode these very weak signals, and to report the results to online data aggregation sites such as WSPRnet (**www.wsprnet.org**), it is possible to observe propagation conditions in near-real time.

Of course, propagation conditions change according to frequency and time of day, among other factors. That's why some WSPR users change bands throughout the day.

If your transceiver is connected to your station computer for CAT (computer aided transceiver) control, *WSJT-X* can automatically change bands for you in steps that coordinate with other stations. The result is more useful propagation data for everyone to enjoy. This will become critical as we approach the peak of Cycle 25.

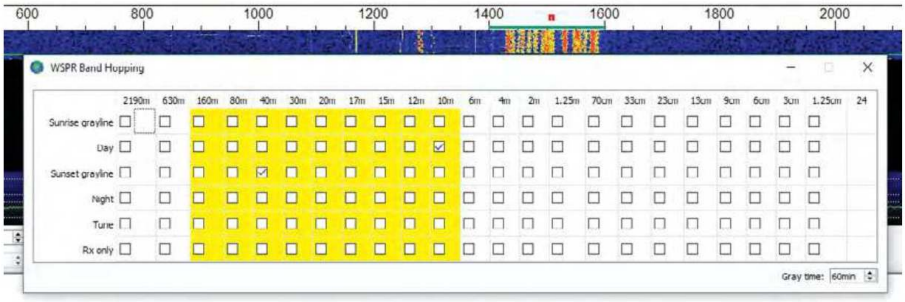


Figure 1 — The WSPR band-hopping matrix in *WSJT-X*.

Figure 2 — VK6PK decoded WB8IMY's WSPR transmission on 20 meters while both stations were in their respective sunrise/sunset grayline zones.

Minute by Minute, and More

Switch *WSJT-X* to WSPR mode and you'll see a checkbox labeled **BAND HOPPING**. Check this box and then click on the **SCHEDULE** button.

You'll be presented with a matrix of checkboxes (see Figure 1) that allows you to select your bands of interest. You can choose to make transmissions during the day, night, at sunrise or sunset grayline periods, or you can choose to only receive during any of these periods.

WSJT-X will automatically switch your radio to each band you've selected about three times each hour. Everyone who has enabled band hopping will switch to the same band (assuming they selected it in the matrix) at the same time. If you are transmitting, the WSPR algorithm guarantees at least one transmission on each chosen band every 2 hours. The result is many stations transmitting (or listening) to specific bands at specific times, and this makes it much easier to see trends at your own station and in the online data.

One thing that's particularly clever about the band-hopping feature is its ability to calculate sunrise or sunset times for your location and change bands accordingly. In Figure 2, you can see a WSPRnet map indicating that Peter Hackett, VK6PK, near Perth, Australia, picked up my 5 W transmission from Connecticut on 20 meters as the sunset/sunrise graylines swept over our respective locations. I had selected 20 meters among several bands in the band-hopping matrix and had also chosen "sunset grayline." When the program hopped my radio to 20 meters as twilight fell over New England, it sent a transmission that Peter was able to decode not long after his sunrise.

The SKYWARN Storm Spotter Program

Ham participation is essential to keep local communities safe with this severe-weather volunteer program.

Rob Macedo, KD1CY

One of the most powerful ways amateur radio contributes to community service, public service, and emergency communications is through participation in the National Weather Service (NWS) SKYWARN® Storm Spotter Program. SKYWARN is a volunteer weather-spotting program, in which severe-weather reporting based on the NWS reporting criteria protects the lives and properties of local communities.

ARRL, by way of the Amateur Radio Emergency Service® (ARES®) program, has a Memorandum of Understanding with the NWS on the role amateur radio plays in weather spotting and the SKYWARN program. Program training sessions are offered by local NWS forecast offices around the country. Despite the COVID-19 pandemic, sessions have been held virtually, with some NWS forecast offices providing a certificate or spotter ID number upon completion of the training. Other NWS offices require passing an online quiz in addition to completing the virtual training.

The Importance of Amateur Radio Storm Spotters

Amateur radio operators can provide the NWS with ground-truth reporting that can't be obtained through other methods. Some radio operators involved in public safety can provide quality reporting due to their unique positions with those entities. Amateur radio SKYWARN nets can receive reports from various areas, including: operators involved in public safety, operators spotting activity from their home locations, or operators traveling in their vehicles. Additionally, radio amateurs can help monitor social media outlets for factual reports and refute inaccurate ones. They can even report using social media if they can't get to their radio equipment.

An example of amateur radio operators playing a critical role in severe weather reporting is when an EF0 (Enhanced Fujita Scale) tornado struck the communities of Sandisfield and Tolland, Massachusetts. Damage reports were received in near real-time and amateur radio SKYWARN Storm Spotters Larry Spencer, N1LWS, and Adam Sullivan, WX4FUN, were able capture the storm damage using a drone. This facilitated an NWS survey of the area, which was made easier by other amateur radio reports confirming an EF0 tornado in that location.

Adjusting to the Pandemic

The COVID-19 pandemic has changed the way radio amateurs have had to operate during severe weather events. NWS forecast offices have been running with minimal staff on site, while much of their personnel has been operating remotely. Volunteer ARES operators, who would typically operate amateur radio stations at the NWS forecast offices, weren't able to do so because of the pandemic. Many of the volunteers who would take reports at the NWS offices have had to utilize their home stations or other similar station setups to relay information via programs such as the NWSChat program (only open to ARES SKYWARN leaders and net controls) and NWS online reporting forms and emails.

During the 2020 SKYWARN Recognition Day, Rob Macedo, KD1CY, operated from his home station to gather reports from a major winter storm in southern New England. He accepted contacts representing the NWS Boston/Norton forecast office.

In 1999, the NWS and ARRL developed SKYWARN Recognition Day (SRD), held annually on the first Saturday in December from 0000 – 2400 UTC. This day recognizes the hard work and efforts of SKYWARN Storm Spotters and radio amateurs around the country. Due to the COVID-19 pandemic, the 2020 event was transformed to allow for contacts between NWS offices, as well as between the offices and spotters. Additionally, it allowed for contacts among all amateur radio SKYWARN Storm Spotters with each other, as well as with any other NWS offices on the air. The online SRD certificate system was also adjusted to allow amateur radio spotters to select their own certificate type for making any number of contacts during the event.

An SRD Facebook group was created for the event. It allowed non-amateur radio SKYWARN Storm Spotters to participate and to learn more about meteorological topics and how hams report to local NWS forecast offices.

The 2021 SKYWARN Recognition Day will be held on Saturday, December 4. More information about the event will be available as it gets closer.

Hurricane Season Storm Spotting

SKYWARN plays a critical role during Atlantic hurricane season, with local and regional SKYWARN programs providing reports to their local NWS forecast offices. The 2020 hurricane season was record-breaking, with the most named systems. WX4NHC, the National Hurricane Center amateur radio station (**www.wx4nhc.org**), as well as amateur radio nets like the Hurricane Watch Net (HWN) and the Voice over Internet Protocol (VoIP) Hurricane Net, were active during hurricane season across the Atlantic and the Caribbean and interacted with many amateur radio SKYWARN spotters. These nets facilitated reporting to the National Hurricane Center (NHC) in Miami, Florida, as well as local NWS forecast offices in the affected areas.

Amid the 2020 Atlantic hurricane season, an online weather station at the Lake Charles, Louisiana, Emergency Operations Center (EOC) recorded a wind gust of 137 MPH during Hurricane Laura. The city's Automated Surface Observing System (ASOS) recorded a wind gust of 133 MPH before both instruments malfunctioned and the Doppler radar was severely damaged. The VoIP Hurricane Net relayed reports of the wind gust to WX4NHC and the local NWS forecast office, hours before a Lake Charles NWS meteorologist sent the report in from the EOC. This is a great example of the value of having amateur radio operators as storm spotters, as they were able to relay meteorological and surface data to local NWS forecast offices by sending reports in a timely fashion. The HWN also relayed critical reports during many of the 2020 hurricanes from their HF net to the NHC, which were utilized in NHC advisories.

During an EF0 tornado in Tolland, Massachusetts, Adam Sullivan, WX4FUN, captured an aerial view of some of the tree damage via drone.

Becoming a Trained Storm Spotter

The partnership between ARRL and the NWS is one of the strongest and simplest examples of amateur radio's value to partner agencies. We encourage amateur radio operators interested in public service to become trained SKYWARN Storm Spotters to interact with amateur radio SKYWARN nets and support the amateur radio hurricane nets. For more information on SKYWARN and how to become a trained storm spotter, visit **www.weather.gov/SKYWARN**.

All photos by the author.

Rob Macedo, KD1CY, earned his electrical engineering degree from UMass Dartmouth and has worked at Dell Technologies for over 25 years. He is a senior principle hardware engineer and former Director of System Integration in the Drive Storage Media Engineering (DSME) Department. He has always had an interest in technology, meteorology, emergency management, and emergency and public service event communications. Rob has been the ARES SKYWARN Coordinator for NWS Boston/Norton for 25 years, and is the Eastern Massachusetts ARES Section Emergency Coordinator. When he's not at work or doing amateur radio public service, emergency communications, and weather spotting volunteer work, Rob enjoys movies, shows, time with family and friends, and sporting events. He can be reached at **kd1cy.rob@gmail.com**.

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

This annual event brings together the amateur radio community and professional scientists.

A Synopsis of the 2021 HamSCI Virtual Workshop

Phil Erickson, W1PJE

This year's HamSCI Workshop was held on March 19 and 20, 2021, via Zoom. The event was managed by Dr. Nathaniel A. Frissell, W2NAF, of The University of Scranton, as well as many other team members, and included guest speakers, poster presentations, and demonstrations.

The Theme

The event theme was "midlatitude ionospheric science." Ionospheric scientists conduct studies on variations in the charged part of Earth's upper atmosphere, which includes the same electrons that refract HF radio signals used by amateur radio operators worldwide. The midlatitude portion of the ionosphere is roughly located between 30° and 60° magnetic latitude, where the vast majority of radio amateurs operate, and covers the entire continental US. The midlatitude ionosphere has historically been considered less "active" than the high-latitude auroral regions, or the low-latitude equatorial zone, and has received less scientific attention. However, the bulk of humanity lives at these latitudes, and major vulnerabilities to space weather disturbances are found there. These are increasingly vital to understand in today's communication-dependent society. Some of these disturbances, such as fading and multipath propagation, will be well-known effects to radio amateurs operating HF communications links.

Speakers and Presentations

A review of midlatitude ionospheric physics was given by Dr. J. Michael Ruohoniemi of Virginia Polytechnic Institute and State University (Virginia Tech), which involved some unresolved scientific questions on the midlatitude ionosphere's behavior. He discussed how the amateur radio community can contribute to advancing scientific understanding and technical capabilities. Dr. Ruohoniemi runs several National Science Foundation-sponsored radars within the Super Dual Auroral Radar Network (SuperDARN), an international scientific initiative. This initiative studies the ionosphere at midlatitudes and polar regions using more than 30 low-power HF radars.

Joe Dzekevich, K1YOW, presented "Amateur Radio Observations and the Science of Midlatitude Sporadic E." He looked at the effects of terrestrial tropospheric weather on propagation, showing how disturbances in the troposphere and gradients in the jet stream can create atmospheric gravity waves in the lower atmosphere. These can aid in the formation of sporadic-E propagation, such as we experienced during 2021 Field Day. (Read "Upper-Level Lows and 6-Meter Sporadic E," by Joe Dzekevich, K1YOW, in the December 2017 issue of *QST* for more information.)

What Is HamSCI?

Following the long tradition of amateur radio's support of scientific research, HamSCI (Ham Radio Science Citizen Investigation) promotes projects such as the Solar Eclipse QSO Party and development of the Personal Space Weather Station. The HamSCI community fosters collaboration between professional researchers and hams. It doesn't own or manage projects, but assists in developing standards and agreements with the following objectives:

- ✔ Advance scientific research and understanding through amateur radio activities
- ✔ Encourage the development of new technologies to support this research
- ✔ Provide educational opportunities for the amateur community and the general public

In June of this year, hams worldwide helped assess the effects of a solar eclipse in the Arctic by making frequency measurements during the event (**https://hamsci.org/june-2021-eclipse-festival-frequency-measurement**)

If you're interested in radio-related science and assisting research in ways unique to amateur radio, read about the HamSCI Google Group at **https://hamsci.org/get-involved**.

The workshop's keynote address on the history of radio was given by Dr. Elizabeth Bruton of the Science Museum in London, England. She discussed the history, science, technology, and licensing of radio amateur communities from the early 1900s to the present. Dr. Bruton also explored how individuals and communities contributed to "citizen science" long before the term entered popular usage in the 1990s.

Twenty-nine poster sessions covered a variety of amateur radio-related topics. A full list of these sessions can be found at **https://hamsci.org/hamsci-2021-program**. Kristina Collins, KD8OXT, described frequency measurements made by amateurs during a solar eclipse in December 2020. Other posters covered The Great Collegiate Shortwave Listening Contest by discussing *WSPRnet* (Weak Signal Propagation Reporter) to characterize sporadic-E propagation, open-source HF propagation prediction tools, geocaching in the ionosphere, and enhancing NASA's Radio JOVE project, as well as a history of antenna technology at Arecibo Observatory, presented by Jim Breakall, WA3FET.

Virtual oral presentations were given by researchers from the NASA Goddard Space Flight Center, MIT Haystack Observatory, University of Oslo, University of Bath, Case Western Reserve University, Dartmouth College, The University of Alabama, Clemson University, New Jersey Institute of Technology, The University of Scranton, and others.

All of the presentations, including video recordings of the speakers, are available at **http://hamsci.org/hamsci-2021-program**. Publications from the 2018, 2019, and 2020 workshops are available at **https://hamsci.org/meetings**.

HamSCI Personal Space Weather Station

The HamSCI workshop also served as a team meeting for the HamSCI Personal Space Weather Station project (**www.hamsci.org/psws**). This project seeks to harness the power of a carefully designed amateur radio network of software-defined radio (SDR) receivers and other instruments to better understand and measure the upper levels of Earth's atmosphere.

This project is a joint venture between HamSCI and other entities, including Case Western Reserve University, The University of Alabama, and the Texas Academic Performance Reports (TAPR) collective, a non-profit organization of operators who are interested in advancing the state of the art of radio. TAPR (**https://tapr.org**) is leading hardware and software design, implementation, and testing.

For the scientific community, the project intends to produce precise measurements that are time-tagged by UTC-synchronized clocks to measure propagation, signal variations, frequency broadening, and related subjects. HamSCI will process and study this information, which will also be used in scientific publications and existing worldwide professional scientific networks of instruments, providing much more information on the ionosphere than can be determined from any individual measurement system.

For the amateur radio community, plans include developing monitors of radio propagation in a long-term and real-time sense that can help operators determine the best bands and modes for regional and DX communications from their own location.

Making a Difference with Radio

Ham radio benefits from the improved understanding of phenomena like sporadic-E propagation, aurora, and how space weather affects the geomagnetic field's stability. Science benefits in return, as thousands of hams collect useful data used in geophysics research programs at universities and other institutions.

As part of amateur radio's "Basis and purpose" in FCC Part §97.1, HamSCI is a great way for amateur radio operators to "advance the radio art" by creating innovative systems and conducting experiments. In the process, we learn more about the physical world and radio propagation, which we use on the air every day.

Phil Erickson, W1PJE, is an Amateur Extra-class licensee; an Associate Director at MIT Haystack Observatory; a member of ARRL, Tuscan Amateur Packet Radio (TAPR), and the Radio Society of Great Britain (RSGB), and is Vice President of the Nashoba Valley Amateur Radio Club in Pepperell, Massachusetts. He leads the Atmospheric and Geospace Sciences Group at MIT Haystack Observatory for studies of the ionosphere, neutral atmosphere, and other aspects of near-Earth space. Phil is also on the science steering board for the HamSCI amateur-professional scientific collective. He enjoys all aspects of radio propagation and communication. Phil can be reached at **w1pje@arrl.net**.

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

Understanding the Changes to the FCC RF Exposure Rules

Learn whether these changes affect your station, and how you can easily evaluate it to comply with FCC regulations.

Ed Hare, W1RFI

On May 3, 2021, the new FCC rules regarding exposure to RF energy went into effect. Stations operating under the exemptions included in the old rules must comply with the rules changes by May 3, 2023. This article provides a historical background on the amateur rules for RF exposure, as well as information about the exposure limits, other requirements for amateur stations, and changes to how many amateurs can continue to be exempt from the requirement to evaluate their stations.

Recent Changes to the Rules

When the FCC first introduced regulations about human exposure to RF energy in 1996, amateur radio was included. The first RF exposure rules set limits for human exposure to radio transmitters. Although these limits applied to amateur radio, amateurs were not required to evaluate their stations.

In 2020, the FCC finalized significant changes to the rules. Under the new rules, amateur stations are still required to comply with the exposure limits, but more amateur stations are required to conduct a "routine station evaluation" to determine that their station complies with the limits for human exposure. In the old rules, there were numerous exemptions from this requirement based on frequency of operation, power level, and the type of operating being done. Mobile and handheld portable transmitters that used push-to-talk (PTT) were exempt from the need to evaluate, as were most repeater stations. These service-specific exemptions were replaced in the new rules with simple formula-based methods of determining whether a particular station needs to be evaluated.

Determining If Your Station Needs an Evaluation

If you performed an evaluation of your station under the old rules, you don't need to to do so again, unless you make a change that could increase the amount of RF energy present near your station, such as increasing transmitter power, changing your antenna type, or using a new band or operating mode. If you don't make these kinds of changes, you may continue to operate.

If your station was exempt from evaluation under the old rules, you'll need to either assess your station or use the exemption formula to determine whether or not it needs to be evaluated under the new rules. Those with stations in this category have until May 3, 2023, to complete the evaluation.

Table 1 shows the formulas you can use to determine whether you're exempt from needing to do an evaluation. This table cannot be used for exposure distances < $\lambda/2\pi$ or for distances closer than 20 centimeters.

Table 1 — Single RF Sources Subject to Routine Environmental Evaluation under MPE-Based Exemptions, $R \geq \lambda/2\pi$

Transmitter Frequency	Threshold Effective Radiated Power (ERP)
0.3 – 1.34	1,920 R^2
1.34 – 30	3,450 R^2/f^2
30 – 300	3.83 R^2
300 – 1500	0.0128 R^2f
1500 – 100000	19.2 R^2

Note: Transmitter frequency is in MHz, threshold ERP is in watts, R is in meters, and frequency (f) is in MHz.

Using Table 1 for the frequency (f in MHz) and separation distance (R in meters) at which the RF source operates, single RF sources are exempt if the ERP (in watts) is no more than the calculated value prescribed for that frequency. For the exemption in Table 1 to apply, the separation distance in meters (R) must be at least $\lambda/2\pi$, where λ is the free-space operating wavelength. If the ERP of a single RF source is not easily obtained, then the available maximum (source-based) time-averaged power may be used in lieu of ERP if the device antenna(s) or radiating structure(s) do not exceed the electrical length of $\lambda/4$. If the ERP of the single RF source and transmitting antenna(s), including coherent array, exceeds the ERP threshold, then the RF source is not exempt, and the applicant must prepare an evaluation.

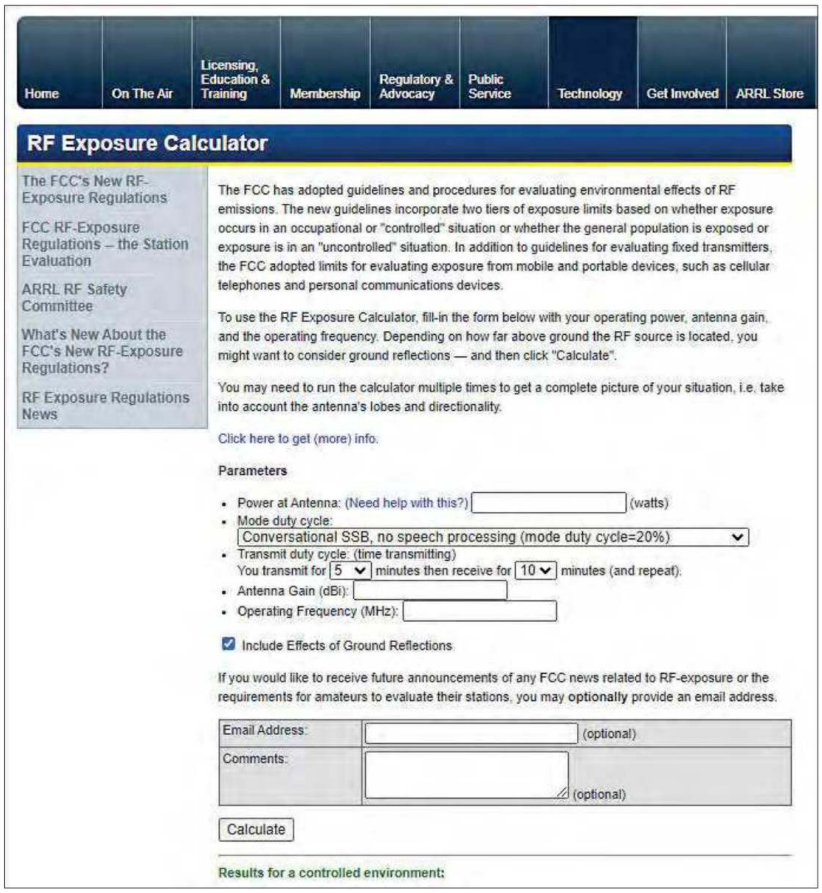


Figure 1 — This simple RF calculator can do most evaluations in 1 minute or less. To use this calculator, visit **www.arrl.org/rf-exposure-calculator**.

Regarding the RF exposure rules, the FCC has clarified that effective radiated power (ERP) is the gain of an antenna compared to the gain of a half-wave dipole at the same location. For example, if you're operating 28.5 MHz and the closest place where people might be exposed (including you and your family) is 12 meters diagonally to any part of your antenna, then the maximum ERP you can use by this formula is 611.5 W. If you're running 100 W to a dipole, then your station is exempt from evaluation on this band. If you run 500 W to a Yagi antenna with a gain of 5.35 dBd (if the gain of the antenna is specified in dBi, convert this to dBd by subtracting 2.15 dB), your ERP would be 1713.8 W, so you would not be exempt on this band for that power and antenna configuration. If this was a new installation, in order to put that station into operation you would need to do an evaluation, reduce power, locate your antenna farther away from people, or control access to areas that were this close to the antenna.

If you run 100 W on 3.5 MHz to any antenna, you need to do an evaluation in all cases if the exposure occurs at a distance of 13.6 meters or less, because this would be within the near-field distance defined by $\lambda/2\pi$.

If you have to do an evaluation, there's no need to panic. In most cases, you can do a simple calculation using an online RF calculator.

To perform an evaluation, you're going to compare the power density and field strength of your antenna to the limits in the FCC rules. Table 2 shows the limits for the amount of RF exposure that can occur from the operation of any transmitter in any radio service.

The FCC has determined that amateur radio operators and the members of their households can be evaluated to the higher (Controlled) exposure limits if the amateur has provided them with RF safety instruction and training. (The FCC was not specific as to what this training shall be.)

Exposure must meet all three limits — power density, electric field, and magnetic field strength. The limits are for exposure averaging over 30 minutes for Uncontrolled and 6 minutes for Controlled. To obtain this average exposure, evaluators should determine the average power of the transmitter being evaluated, using mode duty factors and the on/off duty cycle of the transmitter over the averaging period.

Using RF Calculators

The easiest way to do an evaluation is to use ARRL's RF exposure calculator at **www.arrl.org/rf-exposure-calculator** (see Figure 1). The calculator will take your average power, the frequency you're using, your antenna gain, and your operating mode to calculate the minimum compliance distance from any part of your antenna. At this distance, the power density, E-field, and H-field all meet the FCC's limits.

You can calculate your average power by inputting the mode with the highest duty factor you intend to use and telling the calculator about your on/off operating times. You should use the "worst case" that you might ever be using when people may be exposed by the signals from your antenna. For example, if you might transmit a carrier for 10 minutes to adjust your station at full power, you should select 100% as your mode duty factor. Even if you usually transmit for only 1 – 2 minutes then listen, but you might occasionally transmit for 20 minutes in a single transmission, you should enter that worst-case scenario into the calculator.

Table 2 — Limits for Maximum Permissible Exposure (MPE)				
Frequency Range (MHz)	**Electric Field Strength (V/m)**	**Magnetic Field Strength (A/m)**	**Power Density (mW/cm^2)**	**Averaging Time (minutes)**
(A) Limits for Occupational/Controlled Exposure				
0.3 – 3.0	614	1.63	*(100)	≤ 6
3.0 – 30	1842/f	4.89/f	*(900/f^2)	< 6
30 – 300	61.4	0.163	1.0	< 6
300 – 1500			f/300	< 6
1500 – 100000			5	< 6
(B) Limits for General Population/Uncontrolled Exposure				
0.3 – 1.34	614	1.63	*(100)	< 30
1.34 – 30	824/f	2.19/f	*(180/f^2)	< 30
30 – 300	27.5	0.073	0.2	< 30
300 – 1500			f/1500	< 30
1500 – 100000			1.0	< 30
f = frequency in MHz and * = plane-wave equivalent power density				

If the distance where people may be exposed is greater than the distance the calculator estimates, your evaluation is complete.

Once you do this evaluation on each band and mode you might use, you have done what the rules require. On HF, the upper bands have lower limits, so if you're using a tribander antenna on 29.7 MHz and you pass, you'll also pass on the lower bands using that same antenna. Likewise, if you pass at a 100% duty factor, you'll also pass if you use a mode with the same duty factor and power level, while using the same antenna.

Other Means of Evaluation

While the calculator is the easiest way, it's a conservative calculation, so it often overestimates the signal from your antenna. If you don't "pass," you can use other, more accurate ways to calculate the signals from your station.

For example, you can use antenna modeling to predict the field strength from your station. How this is done involves a lengthy explanation, but you can enter the dimensions of your antenna and use the near-field calculator built into most antenna-modeling programs. Although it's beyond the capabilities of most amateurs, the FCC would also permit you to make measurements of field strength. To do this accurately requires a calibrated antenna and measuring instrument. The small handheld electromagnetic field (EMF) meters that are available generally don't give good results.

Mitigation

If you don't pass, the FCC gives you a lot of flexibility in the ways you can mitigate and control exposure. You can use a different frequency and operating mode. You can also control where your antenna points. For example, if you model your antenna and find that you may exceed the limits in a neighbor's home (if you point the antenna in that direction), you could choose not to point your antenna at your neighbor's home while someone may be inside. You can also lower power under circumstances where human exposure may occur, closer than the distances you calculated. (You will have to repeat the calculation with your lower power level when you do this, to ensure that it meets the limits.)

Completing Your Evaluation

The good news is that there's no paperwork. When you complete your evaluation, you've fulfilled the rules requirement. Unless specifically requested by an agent of the FCC, you aren't required to submit any paperwork to them. However, it's a good idea for you to keep a copy of your evaluations in your station records.

More Information

In addition to this article, there's a lot of good information available at **http://arrl.org/rf-exposure**. Additionally, my book, *RF Exposure and You*, is available at **www.arrl.org/files/file/Technology/RFsafety Committee/RF+Exposure+and+You.pdf**.

If, after utilizing these resources, you still have questions about how to apply the information to your particular station configuration, you can email the ARRL Lab at **tis@arrl.org**. Include your name, call sign, and as much information about your station as you can and one of the ARRL Lab engineers will help you.

Table data provided by **www.fcc.gov**.

Ed Hare, W1RFI, is the ARRL Laboratory Manager. He can be reached at **ehare@arrl.org**.

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

Completing the DXCC Challenge

The DXCC Challenge is a great way to get involved with DXing and earn awards like the DeSoto Cup and medals — and right now is the perfect time to start, thanks to the rise of Cycle 25.

Bart Jahnke, W9JJ
ARRL Radiosport & Regulatory Information Manager

In January 2000, the ARRL DXCC program added new operating award opportunities for DXers of all levels. Among others, the ARRL DXCC Challenge Award and the DeSoto Cup and medals debuted that year.

The DXCC Challenge Award Plaque

The DXCC Challenge is based on accumulated contact credits made on all eligible bands within the DXCC program, using only current DXCC entities. The DXCC Challenge Award plaque is given to hams who have contacted and confirmed at least 1,000 DXCC band-entities on any amateur bands from 160 through 6 meters (excluding 60 meters). Plaques are endorsed using medallions that denote increments of 500 entities and are totaled to give the challenge standing. Deleted entities don't count for this award. All contacts must be made after November 15, 1945. Confirmations on bands with less than 100 entities are acceptable for credit.

The DeSoto Cup

For top competitors, the prestigious DeSoto Cup is presented annually to the DXCC Challenge leader as of December 31. Only one cup is awarded to any single individual. A medal is presented to a repeat winner in subsequent years. Medals are also awarded annually to the second- and third-place winners.

DeSoto Cup winners have included John Eshleman, W4DR; Fausto Minardi, I4EAT (SK), and Fernando Fernandez Martin, EA8AK. They are also multiple-year DeSoto Cup and challenge medal winners.

Other challenge medal winners have included Austin Regal, N4WW; Randy Schaaf, W9ZR, and Rick Roderick, K5UR. Multiple-year challenge medal winners include Kenneth Bolin, W1NG; Leif Ottosen, OZ1LO; Ryszard Tymkiewicz, SP5EWY, and Istvan Kölcsey, HAØDU.

The DeSoto Cup is named after Clinton B. DeSoto, W1CBD, whose article, "How to Count Countries Worked: A New DX Scoring System," in the October 1935 issue of *QST*, shaped the DXCC awards program.

Participant Qualifications

All Logbook of The World (LoTW) participants are eligible to compete in the DXCC Challenge. LoTW automatically includes a Challenge Award category tally when you view your DXCC Award Account Status.

Every DX contact obtained through LoTW is considered for, and potentially contributes to, the DXCC Challenge. The more band/mode DX contacts confirmed, the more your DXCC Challenge Award total can grow.

Conclusion

As groups venture out for DXpeditions again and the rarer 6-meter VHF countries become active, there's no better time to begin or expand your efforts toward the ARRL DXCC Challenge Award. Visit **www.arrl.org/dxcc-challenge** for the full challenge details, and don't forget to check your LoTW DXCC Standings to see how your challenge points are accumulating.

Taking Advantage of Solar Cycle 25

With Solar Cycle 25 increasing propagation on 6, 10, 12, and 15 meters, there's no better time to get on the air and fill your country, band, and mode totals for the DXCC Challenge. By operating CW or digital modes (such as *WSJT-X*), you may be able to reach that rare country or band/mode you need. *QEX* Editor and *QST* Contributor Dr. Kai Siwiak, KE4PT, said, "The use of *WSJT-X* modes allows hams to get deeper into a less reflective ionosphere, which could be applied to this award."

Bart Jahnke, W9JJ, is the ARRL Radiosport & Regulatory Information Manager for ARRL. He can be reached at **bjahnke@arrl.org**.

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

2021 Simulated Emergency Test

Assess your emergency preparedness on October 2 – 3, 2021.

Steve Ewald, WV1X

ARRL's annual Simulated Emergency Test (SET) is a nationwide exercise that focuses on the amateur radio community's commitment to being prepared and practicing how to respond before, during, and after a communications emergency.

This is a great time to check readiness for yourself, as well as your home station and portable radio equipment, antennas, and accessories in a simulated emergency-like deployment. The ARRL SET is an invitation to get involved, practice your skills, and test your response plan.

Partner Agencies and Organizations

ARRL Field Organization, Amateur Radio Emergency Service® (ARES®), National Traffic System (NTS), and Radio Amateur Civil Emergency Service (RACES) leaders and participants are among the many radio amateurs active in public service and emergency communications. They're developing simulated emergency scenarios in consultation with a number of agencies and organizations for whom radio amateurs are known to provide service during disasters and emergencies.

ARRL has formal relationships with several national organizations, including the American Red Cross, the National Weather Service (NWS), the Federal Emergency Management Agency (FEMA), and the Salvation Army (among several others). Visit **www.arrl.org/served-agencies-and-partners** for more information.

National Preparedness Month is recognized each September to promote family and community disaster planning, now and throughout the year. This is a nationwide effort to encourage everyone to take steps to prepare for emergencies in their homes, workplaces, schools, and communities. The US Department of Homeland Security works with a variety of organizations to highlight the importance of emergency preparedness and promote individual involvement through events and activities across the nation. We encourage you to consider this year's ARRL SET and all preparations for it as a demonstration of amateur radio's commitment to being prepared and ready. More information on National Preparedness Month can be found at **www.ready.gov**.

SET to Go!

ARRL Field Organization leaders have the option of conducting their local or Section-wide SET on another weekend besides October 2 and 3, 2021. SETs should be conducted no later than the end of the fall season or the calendar year.

To find out how to be involved in this year's SET, contact your local ARRL Emergency Coordinator or Net Manager. Contact your local club or other area clubs to find out who the Emergency Coordinator is and where the nearest ARES or NTS nets meet. In addition, refer to the ARRL Section web pages at **www.arrl.org/groups/sections**.

During the 2020 ARRL SET, a search and rescue team gathered prior to a simulated exercise to find two lost hikers in Shawnee State Park in western Pennsylvania. ARES members of the Bedford County Amateur Radio Society (BCARS) provided supplementary communications for 75 volunteers from 16 federal, state, and local agencies. [Lloyd Bankson Roach, K3QNT, photo]

Guidelines and specific SET reporting forms for the ARRL Section and Field Organization leaders are posted at **www.arrl.org/public-service-field-services-forms**. Download the forms, fill them out as appropriate, and return them to **sewald@arrl.org** at ARRL Headquarters (copying your Section Manager, Section Emergency Coordinator, and Section Traffic Manager).

Rick Lindquist, WW1ME, ww1me@arrl.org

Happenings

FCC Reaffirms Nearly $3 Million Fine for Marketing Unauthorized Drone Transmitters

In a *Memorandum Opinion and Order* (*MO&O*) released on June 17, the FCC denied a *Petition for Reconsideration* filed by HobbyKing of a $2,861,128 fine for marketing noncompliant RF equipment and for failing to respond to FCC orders in its investigation of the company's practices. In the same step, the FCC enforced its equipment marketing rules. The fine resulted from an FCC investigation initiated by ARRL's January 2017 complaint that the HobbyKing equipment was "blatantly illegal at multiple levels."

A representative of the ARRL Board's Electromagnetic Compatibility (EMC) Committee called the *Forfeiture Order* "the final chapter of a story that started with a report to the ARRL Board by the committee in 2017 as a result of the discovery that aerial drone TV transmitting equipment was being imported and marketed without proper FCC authorization under FCC Part 15 rules." The complaint credited the committee with calling attention to the issue and prompting ARRL's action.

As spelled out in ARRL's 2017 complaint, the ARRL Lab had documented that the operating frequencies of these drone TV transmitters near the 1.3 GHz amateur band were DIP-switch selectable for frequencies internationally assigned for use by Aeronautical Navigation, GPS, GLONASS L1, ATC Mode S, as well as to both the interrogation and reply frequencies used for Air Traffic Control Air Route Surveillance "transponder" radar systems.

ARRL's complaint noted that, given the channel configuration, these units would not have a legitimate amateur radio use, and that the marketing was directed at drone enthusiasts and not to licensed radio amateurs. "ARRL Laboratory tests did prove that only one of the seven available channels was within the 1.3 GHz amateur band," the EMC representative said. "This is another example of ARRL not only affirmatively acting to protect our members' interests, but also acting to protect the safety and security of vital services and the general public."

HobbyKing had denied that it was marketing its drone transmitters to US customers, but as the ARRL January 2017 complaint pointed out, ARRL Lab Manager Ed Hare, W1RFI, was able to purchase two drone transmitters from HobbyKing for testing in the ARRL Lab. "The FCC noted that amateur radio equipment used to telecommand model craft are limited to 1 W (1,000 mW), but three transmitters included in the FCC investigation operated at significantly higher power levels of 1,500 mW and 2,000 mW," ARRL said.

HobbyKing had told the FCC that it had no notice of the Commission's authorization requirements; that the Fifth Amendment relieved HobbyKing of its duty to respond; that the forfeiture amount was inappropriate because its parent company, Indubitably, Inc., lacked the ability to pay to the Forfeiture Order, and that the FCC was time-barred from taking action against ABC Fulfillment Services LLC because it was not part of HobbyKing's business.

"Upon review of HobbyKing's *Petition for Reconsideration* and the entire record, we find no basis for reconsideration because the petition fails to present new information warranting reconsideration," the FCC said in the *MO&O*.

HobbyKing is the trade name of two US-based companies that include ABC Fulfillment Services LLC and Indubitably, Inc.

40th Annual ARRL-TAPR Digital Communications Conference Set

The 40th annual ARRL-TAPR Digital Communications Conference (DCC) will be held online September 17 – 18. Registered DCC attendees participating via Zoom will be able to interact with presenters and other attendees via a chat room and have the option to "raise a virtual hand" to ask questions. You may register to attend, but non-registered participants can view the livestream on YouTube at no cost as well as chat and ask questions via the moderator monitoring the channel.

Registration, accessible via **tapr.org/shop**, is free for TAPR members and $30 for non-members. (Members receive a 100% discount at checkout.) Non-members who would like to join TAPR and receive the free DCC pass can add TAPR membership and DCC registration to their shopping carts. After checkout, they will receive the free DCC pass when their membership is processed.

Speakers are invited to deliver presentations on topics of interest without submitting papers for the *Conference Proceedings*.

In addition to scheduled formal presentations, ad hoc "lightning talks" on various topics of interest will be announced throughout the conference, and registered attendees will be able to participate in any lightning talk that interests them. Hardware and software demonstrations will be conducted during the DCC by means of Zoom's breakout room feature. — *Thanks to Stan Horzepa, WA1LOU*

ARRL Announces Partnership with Maglite

ARRL and Mag Instrument, Inc., the US manufacturer of the Maglite® flashlight, have announced a partnership based on common interests in equipping people to be prepared for emergencies and to serve their communities in extreme situations such as natural disasters. ARRL members expand the reservoir of trained operators and technicians in radio communications and radio technology, and provide public service through the ARRL Amateur Radio Emergency Service® (ARES®). Maglite is the leading maker of US-manufactured high-quality flashlights that have a reputation for toughness and durability.

"Amateur radio operators help people in times of difficulty, often by supporting emergency communications when critical infrastructure is damaged, and by aiding first responders' need to keep connected," said Anthony Maglica, Founder, Owner, and CEO of MAG Instrument, Inc. "We manufacture a product that has been used in public safety for over 40 years, and we are very supportive of the incredible dedication of radio amateurs, so culturally this is a great alliance for both brands."

"ARRL is delighted that Maglite recognizes the service and skill of ARRL members. This partnership will help us introduce amateur radio to more people," said ARRL CEO David Minster, NA2AA.

New Section Managers Appointed in Orange and Eastern Washington

Bob Turner, W6RHK, of Perris, California, has been appointed to start his new term of office as ARRL Orange Section Manager (SM) early. Earlier this year, then-incumbent SM Carl Gardenias, WU6D, also of Perris, announced that he was stepping down after serving since 2003. His term expired at the end of March, but he agreed to continue serving until a successor was chosen.

Turner was the only nominee responding to a re-solicitation for SM nominations in the Orange Section this past spring. As the only candidate, he was declared elected. Because his 2-year term of office would not officially begin until October 1, and Gardenias had said he wished to step down as Section Manager at the end of June, ARRL Field Services Manager Mike Walters, W8ZY, appointed Turner to start his term as Orange Section Manager on July 1. Walters made his decision after consulting with ARRL Southwestern Division Director Dick Norton, N6AA, and Gardenias. Turner has been the Section Emergency Coordinator for the past 10 years.

A similar situation transpired in the Eastern Washington Section, after SM Jack Tiley, AD7FO, stepped down early from his term that was set to conclude on September 30. Tiley, of Spokane Valley, had served for 2½ years.

Jo Whitney, KA7LJQ, was the only nominee when the June 4 nomination deadline arrived, and she was declared elected. Whitney was initially scheduled to start her term of office on October 1, but because Tiley is stepping down before the end of his term, Walters — after consulting with the ARRL Northwestern Division Director — appointed Whitney to start her term of office on July 1.

Whitney, of Yakima, has been an ARRL Emergency Coordinator since 2003, and she served as a District Emergency Coordinator in 2018 and 2019.

First X-Class Major Solar Flare of Solar Cycle 25 Blacks Out HF on July 3

X-class solar flares have the ability to cause temporary radio blackouts. [NASA image]

For a brief time on July 3, a lot of radio amateurs wondered, "Where did the bands go?" as the first X-class solar flare in 4 years briefly blacked out HF propagation.

"I was on 20-meter FT8, and my waterfall display went from solid red signals to solid nothing in the blink of an eye," Scott Craig, WA4TTK, told "K7RA Solar Update" Editor Tad Cook, K7RA. "It lasted about 10 minutes." Craig was not alone.

"Many American radio amateurs reported sudden HF propagation blackouts on Saturday morning, July 3, when solar active region 2838 produced an X1.5 major solar flare that reached maximum intensity at 1429 UTC, the first X-class solar flare of Solar Cycle 25 and the first since 2017," said Frank Donovan, W3LPL. "HF propagation blackouts are caused when X-ray and extreme ultraviolet radiation from X-class solar flares strongly ionizes the absorbing D region in the Earth's sun-facing dense lower ionosphere," he explained. NOAA's Space Weather Prediction Center (SWPC) categorized the July 3 incident as a R3-level or "strong" radio blackout (on a scale of R1 – R5), which can cause a "wide-area blackout of HF radio communication [and] loss of radio contact for about an hour on [the] sunlit side of Earth."

Donovan said that X-class major solar flares are necessary consequences of steadily increasing Solar Cycle 25 activity. "95% of all X-class solar flares occur when the solar flux index is 90 or greater. The remaining 5% can occur any time during the solar cycle," he pointed out.

X-class major flares are measured on an open-ended scale. The strongest one ever recorded was an X28 flare in 2003, hundreds of times more powerful than the July 3 X1.5 solar flare. X10-class and stronger solar flares typically have effects that last for most of a day and affect the entire sunlit side of the Earth. Fortunately, X10-class solar flares occur only about once every 20 years or more.

The coronal mass ejection (CME) associated with the July 3 X1.5 solar flare was likely to have little to no effect on HF propagation going forward, because the active region was very close to the western edge of the visible solar disk when the CME erupted. Region 2838 rotated off the visible disk on July 4. — *Thanks to Frank Donovan, W3LPL*

3YØJ Bouvet Island DXpedition Team Hasn't Given Up

As of mid-July, the 3YØJ DXpedition team was still hoping to have a go at Bouvet Island in 2023. The Intrepid-DX Group had planned to travel to Bouvet via the RV *Braveheart*, owned by Nigel Jolly, K6NRJ. When the vessel went on the market, however, the contract with 3YØJ was canceled.

"The *Braveheart* is still for sale with no new buyer," DXpedition co-leader Paul Ewing, N6PSE, said. "We are in touch with Nigel Jolly and he hopes to be able to continue to manage the ship and book charters for a new owner."

In any case, Ewing said, the DXpedition will continue trying to find suitable transportation to Bouvet Island. "We have a strong desire to go to Bouvet; however, we have been unable to find an alternative ship that is suitable/affordable and willing to go to Bouvet. We have fully refunded all donations," he said.

The Intrepid-DX Group announced in mid-June that it was canceling its long-anticipated DXpedition to Bouvet.

A dependency of Norway, Bouvet is a sub-Antarctic island in the South Atlantic. It is the second-most-wanted DXCC entity, behind North Korea.

Rick Palm, K1CE, k1ce@arrl.org

Public Service

A Simple Modular Rack System, Field Day at the EOC, and EmComm at the ARRL National Convention

I recently built a modular rack system out of scraps of wood from previous projects. This system allows radios and peripheral accessories to interchange between being "fixed" or being portable/mobile installations, which can be swapped quickly and easily.

An Inexpensive Modular Rack

If you'd like to build this rack system, first you'll need to construct a rectangular box to fit on top of the spare tire well in the trunk of your car (see Figure 1). The length and width of the box will vary depending on your car — mine is 37 × 29 inches and fits snugly inside the hatchback of my 2016 Honda Fit.

Once you've figured out your measurements, bolt together two-by-fours using heavy hardware and attach them to a ¾-inch-thick plywood bottom. Secure your box to the vehicle's interior framing with zip ties. The box's interior dimensions can be adjusted by placing four-by-four spacers inside of it. Do not bolt these to the base, as they can be positioned as needed, depending on the number of radio and/or peripheral modules you use.

The crux of the system is the modules. I have two radios: one for VHF FM and another for multimode HF/VHF/UHF. Each mounting bracket is screwed onto opposing ends of individual four-by-fours. The radios are then mounted on the brackets. In my case, this made two four-by-four modules. The number of modules will vary based on how many radios you have.

For dc power management, I mounted a West Mountain Radio N8XJK Super Booster onto a third module to use with my 12 V sealed lead acid (SLA) batteries. (When the voltage from the battery drops, the booster brings it up to a level that allows for optimal transmission.) Lastly, I mounted my West Mountain Radio Epic PWRgate, which is programmed to charge my lithium iron phosphate (LFP) battery from a solar panel or power supply, onto a fourth four-by-four to place with the others inside the box. They can easily be taken out of the box for the sake of portability, but the gear is secure while inside the box (see Figure 2).

The radios and mounted peripherals can be turned to face the front or the rear of the vehicle, depending on where the operator wants to sit. The remainder of the space in the box can be filled by the extra spacers to provide stability, or it can be used for securely fastened batteries. I secured my two SLA batteries and one LFP battery inside the extra space.

Once the portable/mobile deployment is completed, the modules can be taken out of the box and placed on your home operating desk, floor, or workbench (see Figure 3). Additionally, they can be moved back inside your vehicle quickly and easily.

This module mount system is sturdy and inexpensive to construct. It would make a good personal, radio club, or Amateur Radio Emergency Service® (ARES) group project.

Figure 1 — My empty box frame with spacers secured for the modular rack system. The frame sits on top of the spare tire well in my vehicle.

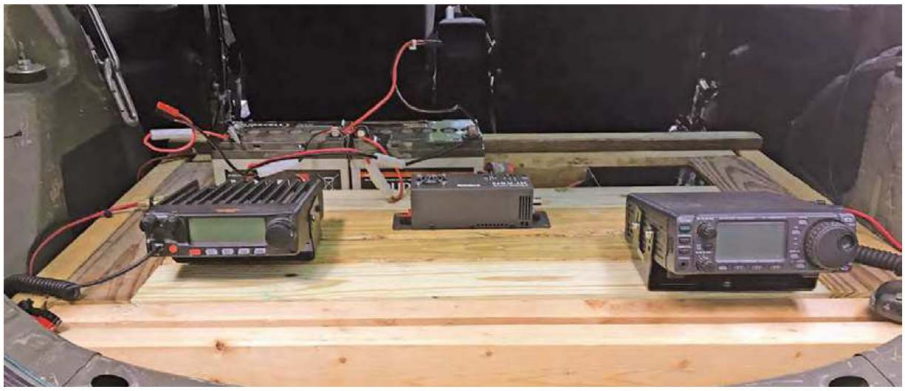


Figure 2 — My frame with radio/peripheral modules in place, and batteries in the space at the rear of the box (coax and cables have been removed for this photo).

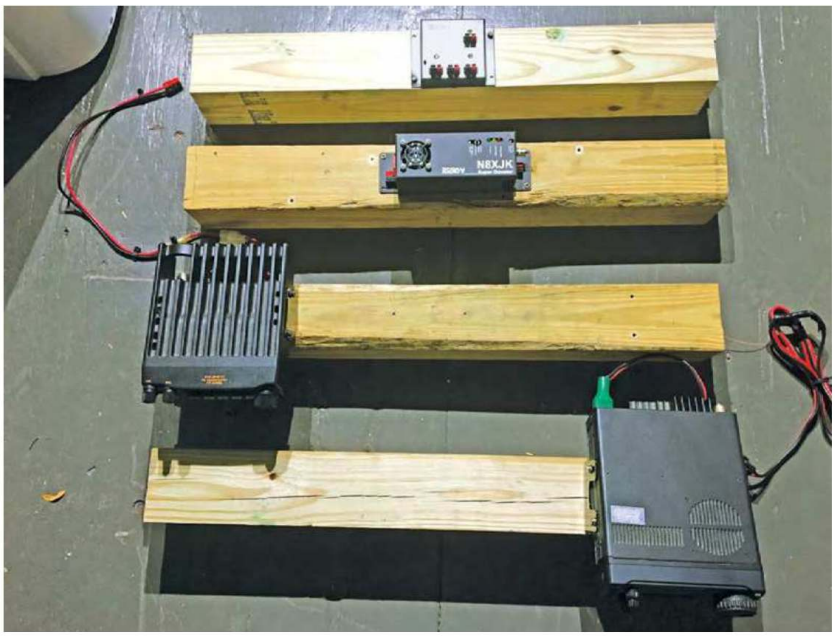


Figure 3 — My modules arranged on the floor of my home shack.

Field Day at the Local EOC

This year, I had the opportunity to operate Field Day in Class F: operation from an Emergency Operation Center — EOC. The North Florida Amateur Radio Club (NFARC) and Alachua County EOC Radio Club were invited to operate from the Alachua County EOC in Gainesville, Florida, under the call sign NF4AC.

I learned about operating in an EOC and, more specifically, I learned more about operating FT8 when the bandwidth was crowded with other stations. I also mentored a few other rookie FT8 operators.

It's been indicated that this was the best Field Day performance the Alachua County EOC has ever had. It was incredibly organized and included a microwave mesh network for coordinating logging and operating among the team's radio operators.

ARRL National Convention EmComm Training Track

It's not too early to plan on attending the 2022 ARRL National Convention, set to take place at Orlando HamCation® (**www.hamcation.com**) on February 11 – 13, 2022. A day-long workshop on emergency communications is scheduled as one of the training tracks that'll be offered as part of the convention program, preceding HamCation on February 10. The training presentations will feature current protocols, techniques, and responsibilities for the modern volunteer radio operator serving partner public safety entities. The presenters are all subject-matter experts.

Topics to be covered include the ARRL National and Florida Emergency Communicator Task Books, an overview of amateur radio responses to disasters, basic voice-traffic handling with hands-on voice traffic net/message transfer practice, using the ICS-213 form, Winlink's ARDOP (Amateur Radio Digital Open) and VARA protocols, the Radio Mail Server (RMS) demonstration, and more. Registration for the training tracks will open in September at **www.arrl.org/expo**.

All photos by the author.

Field Organization Reports

June 2021

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**.

580
KK7GXG
510
KB2RTZ
495
WA3EZN
480
N9VC
447
W7PAT
444
KE8BYC
440
W8MAL
438
WA7PTM
350
W7EES
326
KD2LPM
K2TV
320
KD2NMG
319
AD8CM
310
KB3YRU
280
ND8W
274
K8AMH
270
WØPZD
265
W9GRG
261
N3KRX
260
ACØKQ
255
N5MKY
239
W9RY
235
N8SY
N2WGF
KD2LPM
230
KT2D
KD2JKV
225
K9LGU
224
KC8YVF
220
KM8V

218
WA2CCN
K2KNB
215
N3XMB
213
KE8KOC
205
W4CMH
200
KW9EMG
WO2H
KD8UUB
190
W2PH
187
KD2GXL
180
AI9F
170
WM5N
166
W2ARP
164
KB5PGY
WM2C
KD8ZCM
160
W2PAX
W8DJG
155
WB9WKO
N4CNX
154
K9ILJ
150
W3CJD
KK3F
148
W8IM
145
KC9FXE
W4DNA
141
KV8Z
140
K4IWW
W3GWM
WB9QPM
KØRCJ
KG5NNA
136
ALØY
135
KY2MMM
N2DW
W3YVQ
KB8PGW

130
WK4WC
WA4VGZ
N2JBA
KW1U
N1LL
129
W4INX
WD8USA
125
AG9G
N2LC
AC8NP
KB8RCR
123
WB2ZEX
KD2GRS
WB2ZEX
120
WC4FSU
KDØHHN
KY2D
W4NWT
K3JL
AD3J
KA2QWC
KA9MZJ
KF5OMH
NA7G
119
WA2BSS
118
KT4WX
117
K7OED
116
KØWAV
115
N2TSO
N1TF
113
WV5Q
112
K8MDA
110
WA1URS
K6HTN
KC8WH
WB8YYS
N3SW
KB2QO
AF4NC
N1IQI
W1RVY
KA5AZK
KE5YTA
WA3QLW
K8BKM
WB8TQZ
WF2Y
WS4P

109
K2MZ
108
KD2IWN
107
KU1U
K1HEJ
106
KO4OL
105
KE4DRF
KB3IN
K1XFC
KØFBS
102
KD8KBX
KC8T
101
K3FAZ
100
WB4RJW
KZ8Q
W1KX
KN9P
NX9K
WØLAW
AC8RV
WB8SIQ
W2AH
N1LAH
K2EAG
KB2YAA
W2ZXN
W9EEU
KB1NMO
AA3SB
98
N4ZM
KB1TCE
95
AA3N
KA2GQQ
94
NI2W
93
N7IE
92
AB3WG
90
N6IET
KB9GO
W4KX
KT5SR
KA9IKK
KL7RF
K8KRA
N8MRS
K2MJF
KA2HZP
K3MIY
KC1KVY

WA1LPM
KC1MSN
KD2PQP
AB9ZA
AA7BM
KI7TIG
K8ED
WB8TQZ
89
KC1HHO
88
WB6YJJ
W4TTO
W3NTS
86
W3ZR
N3ARB
K6JT
K8RDN
85
K4FHR
WB6NCT
K5OB
KA2JFU
84
W7PHX
83
WX2DX
KFØBPN
82
KBØDTI
81
WB8R
80
KR4ST
KM4WHO
KN4AAG
W4EDN
KA1G
W8GSR
KB3MXK
AE2EY
KC1OIP
W2BGJ
KF7GC
KJ7TIG
KJ7BHO
79
K3YAK
76
K2MTG
WA2U
75
NV1N
74
N3JET
73
KB8HJJ
70
K7ASA
W5XX

The following stations qualified for PSHR in May, but were not reported in this column yet: AI9F 265, W9RY 238, KF5OMH 170, WB9QPM 140, K8AMH 130, KA9MJZ, NA7G, N7IE 120, KA5AZK, KG5NNA 110, WDØBFO, KI5GRH 90, KAØDBK 83, K6JT 81, KF5IVJ 80.

Section Traffic Manager Reports

The following Section Traffic Managers reported: AK, AZ, CO, CT, DE, EMA, ENY, EPA, IL, IN, KS, KY, LA, LAX, MDC, ME, MI, MN, MO, MT, NC, NFL, NLI, NM, NNJ, NTX, OH, OR, SC, SD, SFL, SJV, SNJ, STX, TN, UT, WCF, WI, WMA, WNY, WPA, WV, WY.

Section Emergency Coordinator Reports

The following Section Emergency Coordinators reported: AR, ENY, EPA, GA, ID, KY, LA, MDC, ME, MI, MN, MO, MS, NLI, NM, NNJ, NNY, NV, OH, OK, OR, PAC, SCV, SFL, SJV, SNJ, STX, TN, UT, VI, WCF, WPA, WTX, WV, WY.

Brass Pounders League

TThe 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.

KK3F 1,619, NX9K 1,518, K6HTN 1,294, N9CK 934, WB9WKO 827.

Bruce Draper, AA5B, aa5b.corral@gmail.com

Contest Corral — September 2021

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.

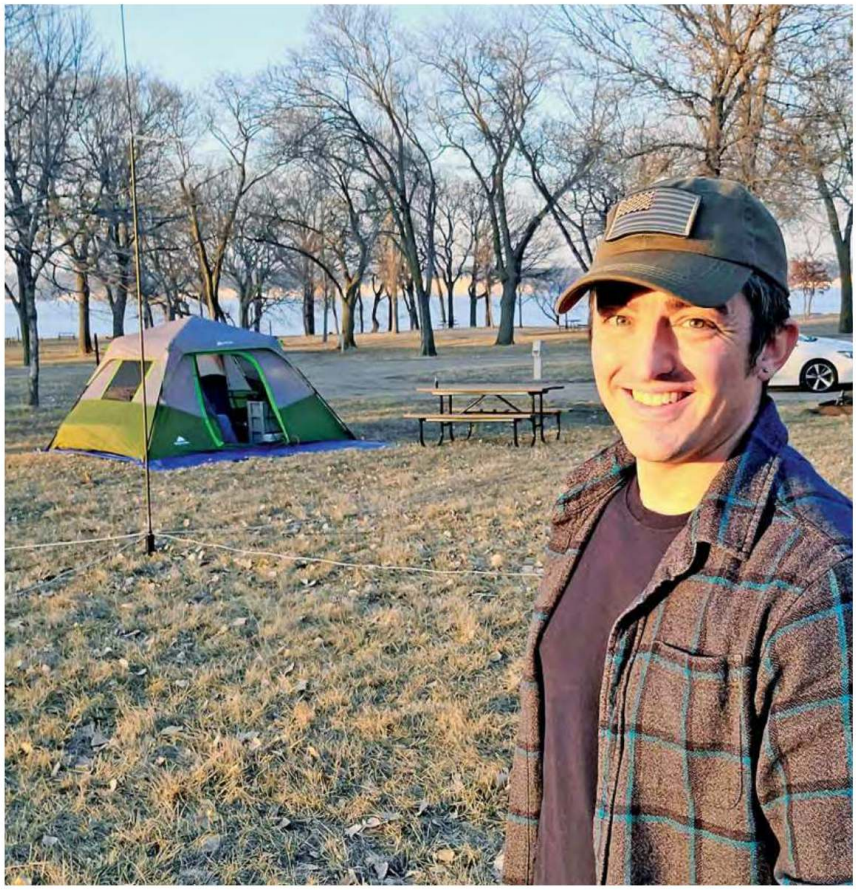
Start - Finish Date-Time		Date-Time		Bands	Contest Name	Mode	Exchange	Sponsor's Website
1	1700	1	2000	144	VHF-UHF FT8 Activity Contest	Dig	4-char grid square	ft8activity.eu/index.php/en
1	2000	1	2100	3.5	UKEICC 80-Meter Contest	Ph	6-char grid square	ukeicc.com/80m-rules.php
1	2300	3	2300	3.5-28	G3ZQS Memorial Straight Key Contest	CW	RST, SPC, name, mbr or power	fistsna.org/operating.html
2	1700	2	2100	28	NRAU 10-Meter Activity Contest	CW Ph Dig	RS(T), 6-char grid square	nrrlcontest.no
2	1900	2	2100	1.8-50	SKCC Sprint Europe	CW	RST, SPC, name, mbr or "none"	www.skccgroup.com
4	0000	4	0359	1.8-28	CWOps CW Open	CW	Serial, name	cwops.org
4	0000	4	2359	3.5-28	Russian RTTY WW Contest	Dig	RST, 2-letter RU oblast or CQ zone	qrz.ru/contest/detail/93
4	0000	5	2359	3.5-28	All Asian DX Contest, Phone	Ph	RS, 2-digit age	www.jarl.org/English
4	0600	4	0800	7, 14	Wake-Up! QRP Sprint	CW	RST, serial, suffix of previous QSO	qrp.ru/contest/wakeup
4	1200	4	1559	1.8-28	CWOps CW Open	CW	Serial, name	cwops.org
4	1300	4	1330	144	Two-Meter Classic Sprint	CW Ph	Serial, 4-char gird square	fwrc.info
4	1300	4	1600	7	AGCW Straight Key Party	CW	RST, serial, class, name, age	alt.agcw.de/index.php/en
4	1300	5	0400	All	Colorado QSO Party	CW Ph Dig	Name, CO county or SPC	ppraa.org/coqp
4	1300	5	1259	1.8-28	IARU Region 1 Field Day, SSB	Ph	RST, serial	darc.de/der-club/referate/conteste
4	1300	5	1300	3.5-28	RSGB SSB Field Day	Ph	RS, serial	www.rsgbcc.org/hf
4	1400	5	1400	145	IARU Region 1 145 MHz Contest	CW Ph Dig	RS(T), serial, 6-char grid	www.iaru-r1.org
4	2000	4	2359	1.8-28	CWOps CW Open	CW	Serial, name	cwops.org
4	2000	5	2000	3.5	PODXS 070 Club Jay Hudak Memorial	Dig	RST, SPC	www.podxs070.com
5	1000	5	1400	144	WAB 144 MHz QRO Phone	Ph	RS, serial, WAB square or country	wab.intermip.net
5	1800	6	0300	All	Tennessee QSO Party	CW Ph Dig	RS(T), TN county or SPC	tnqp.org/rules
6	1900	6	2030	3.5	RSGB 80-Meter Autumn Series, SSB	Ph	RS, serial	www.rsgbcc.org/hf
6	2300	7	0300	1.8-50	MI QRP Labor Day CW Sprint	CW	RST, SPC, mbr or power	www.miqrp.net/contest
7	0100	7	0300	3.5-28	ARS Spartan Sprint	CW	RST, SPC, power	arsqrp.blogspot.com
8	1700	8	2000	432	VHF-UHF FT8 Activity Contest	Dig	4-char grid square	ft8activity.eu/index.php/en
11	0000	11	2359	1.8-VHF	FOC QSO Party	CW	RST, name, mbr (if any)	g4foc.org/qsoparty
11	0000	12	2359	3.5-28	WAE DX Contest, SSB	Ph	RS, serial	darc.de/der-club/referate/conteste
11	0800	12	0600	1.8-28	SARL Field Day Contest	CW Ph Dig	RS(T), # of rigs, cateogry, province	www.sarl.org.za
11	0900	12	1400	7	YB7-DX Contest	Ph	RS, serial	yb7dxc.com/rule
11	1200	12	2359	1.8-50	SKCC Weekend Sprintathon	CW	RST, SPC, name, mbr or "none"	www.skccgroup.com
11	1400	11	2200	3.5-28	Ohio State Parks on the Air	Ph	OH park abbreviation or SPC	ospota.org
11	1500	12	0300	3.5-28	Alabama QSO Party	CW Ph	RS(T), AL county or SPC	www.alabamaqsoparty.org
11	1500	12	0959	3.5-28	Russian Cup Digital Contest	Dig	Serial, 4-char grid square	qrz.ru/contest/detail/86.html
11	1800	13	0300	50 and up	ARRL September VHF Contest	CW Ph Dig	4-char grid square	www.arrl.org/september-vhf
12	0000	12	0400	3.5-14	North American Sprint, CW	CW	Other's call, your call, serial, name, SPC	ncjweb.com
13	0000	13	0200	1.8-28	4 States QRP Second Sunday Sprint	CW Ph	RS(T), SPC, mbr or power	www.4sqrp.com
15	1900	15	2030	3.5	RSGB 80-Meter Autumn Series, CW	CW	RST, serial	www.rsgbcc.org/hf
16	0030	16	0230	3.5-14	NAQCC CW Sprint	CW	RST, SPC, mbr or power	naqcc.info
16	1800	16	1959	3.5	BCC QSO Party	CW Ph Dig	RS(T), T-shirt size	bavarian-contest-club.de/contest
17	2100	17	2359	3.5	AGB NEMIGA Contest	CW Ph Dig	RST, serial, mbr (if any)	www.ev5agb.com
18	0000	19	2359	All	Collegiate QSO Party	CW Ph Dig	School name, RS(T), op class	collegiateqsoparty.com
18	0500	19	1100	50-1296	SARL VHF/UHF Digital Contest	Dig	RST, 6-char grid locator	www.sarl.org.za
18	0600	19	2359	10 GHz to light	ARRL 10 GHz and Up Contest	CW Ph Dig	6-char grid	www.arrl.org/10-ghz-up
18	1200	19	1200	3.5-28	Scandinavian Activity Contest, CW	CW	RST, serial	www.sactest.net
18	1400	19	0200	All	Iowa QSO Party	CW Ph Dig	RS(T), IA county or SPC	www.w0yl.com/IAQP
18	1400	19	2000	All	Texas QSO Party	CW Ph Dig	RS(T), TX county or SPC	www.txqp.net
18	1500	18	2100	1.8-28	QRP Afield	CW Ph Dig	RS(T), SPC, power or mbr	newenglandqrp.org
18	1600	18	2300	3.5-144	Wisconsin Parks on the Air	CW Ph	WI park abbreviation or SPC	wipota.com
18	1600	19	0359	3.5-28	New Jersey QSO Party	CW Ph Dig	RS(T), NJ county or SPC	k2td-bcrc.org/njqp/
18	1600	19	2200	All	New Hampshire QSO Party	CW DigPh	RS(T), NH county or SPC	www.w1wqm.org/nhqso
18	1600	19	2359	1.8-144	Washington State Salmon Run	CW Ph Dig	RS(T), WA county or SPC	salmonrun.wwdxc.org
18	1800	18	1959	1.8-50	Feld Hell Sprint	Dig	RST, mbr, SPC, grid	sites.google.com/site/feldhellclub
19	0000	19	0400	3.5-14	North American Sprint, RTTY	Dig	Other's call, your call, serial, name, SPC	ncjweb.com
19	1700	19	2059	3.5-28	BARTG Sprint PSK63 Contest	Dig	Serial	bartg.org.uk/wp
19	2300	20	0100	1.8-28	Run for the Bacon QRP Contest	CW	RST, SPC, mbr or power	qrpcontest.com/pigrun
20	1900	20	2300	144	144 MHz Fall Sprint	CW Ph Dig	4-char grid square	svhfs.org
22	0000	22	0200	1.8-50	SKCC Sprint	CW	RST, SPC, name, mbr or "none"	www.skccgroup.com
23	1900	23	2030	3.5	RSGB 80-Meter Autumn Series, Data	Dig	RST, serial	www.rsgbcc.org/hf
25	0000	26	2359	3.5-28	CQ Worldwide DX Contest, RTTY	Dig	RST, CQ zone (+ state/prov for US/VE)	www.cqwwrtty.com
25	1200	26	1200	1.8-28	Maine QSO Party	CW Ph	RS(T), ME county or SPC	ws1sm.com/MEQP.html
25	1400	25	1800	144, 432	AGCW VHF/UHF Contest	CW	RST, serial, power, 6-char gird	agcw.de/contest/vhf-uhf
25	1400	25	2200	3.5-28	Masonic Lodges on the Air	Ph	Lodge name/number/jurisdiction	cqmorelight.com/rules
27	1900	27	2030	3.5-14	RSGB FT4 Contest Series	Dig	4-char grid square	www.rsgbcc.org/hf
28	1900	28	2300	222	222 MHz Fall Sprint	CW Ph Dig	4-char grid square	svhfs.org
29	2000	29	2100	3.5	UKEICC 80-Meter Contest	CW	6-char grid square	ukeicc.com/80m-rules.php

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 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.*

Chris Tate, N6WM, n6wm@largeradio.org

2021 ARRL International DX Phone Contest Results

This year's ARRL DX Phone Contest was held March 6 – 7, 2021.



The 2021 ARRL International DX Contest was Chris Whalen's, KEØQGJ, first time operating in a contest. He operated a low-power portable station at a local park near Omaha, Nebraska. [Chris Whalen, KEØQGJ, photo]

Full Results Online

You can read the full results of the contest online at **http://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.

Affiliated Club Competition

Club	Score	Entries
Unlimited		
Frankford Radio Club	157,523,307	257
Yankee Clipper Contest Club	106,928,559	207
Potomac Valley Radio Club	97,965,663	232
Contest Club Ontario	29,306,424	73
Florida Contest Group	23,578,464	72
Southern California Contest Club	21,520,677	61
Arizona Outlaws Contest Club	20,859,123	52
Society of Midwest Contesters	19,731,921	122
Tennessee Contest Group	13,983,621	52
Northern California Contest Club	12,743,277	80
Minnesota Wireless Assn.	12,458,031	119
Medium		
North Coast Contesters	12,835,713	28
Hudson Valley Contesters and DXers	7,576,206	35
Mad River Radio Club	7,195,443	25
Kentucky Contest Group	6,351,633	27
Carolina DX Assn.	6,100,677	26
Willamette Valley DX Club	5,455,647	30
Order of Boiled Owls of New York	5,272,374	10
Western Washington DX Club	4,682,619	38
South East Contest Club	4,378,947	24
Texas DX Society	3,870,234	16
Alabama Contest Group	3,548,058	12
Northeast Maryland Amateur Radio Contest Society	3,042,966	23
Central Texas DX and Contest Club	2,989,581	22
Niagara Frontier Radiosport	2,955,909	22
Big Sky Contesters	2,863,476	10
DFW Contest Group	2,821,077	32
Maui ARC	2,817,600	5
Maritime Contest Club	2,814,453	6
Swamp Fox Contest Group	2,441,079	23
Bay Area DXers	2,269,581	11
Arkansas DX Assn.	1,986,717	13
Georgia Contest Group	1,897,488	7
Grand Mesa Contesters of Colorado	1,815,090	27
Mother Lode DX/Contest Club	1,751,265	20
Northeast Wisconsin DX Assn.	1,750,893	8
Kansas City Contest Club	1,570,995	15
Orca DX and Contest Club	1,481,913	25
North Texas Contest Club	1,189,581	5
North Carolina DX and Contest Club	754,281	3
Rochester (NY) DX Assn.	616,119	14
599 DX Assn.	592,221	7
Spokane DX Assn.	546,048	12
Portage County Amateur Radio Service	505,224	7
Skyview Radio Society	495,417	3
Great Places Contest Club	405,240	3
Pacific Northwest VHF Society	352,692	3
Mississippi Valley DX/Contest Club	330,672	8
Saskatchewan Contest Club	329,844	8
Not Quite Workable Contest Club	320,031	3
Louisiana Contest Club	301,416	6
Providence Radio Assn.	273,402	5
South Jersey Radio Assn.	217,140	4
New Providence ARC	197,811	5
Driftless Zone Contesters	171,816	3
Fourlanders Contest Team	124,836	3
Granite State ARA	98,034	3
Alberta Clippers	73,149	3
Silver Comet ARS	60,504	4
Sierra Nevada ARS	48,204	3
Long Island Mobile ARC	35,685	5
Oklahoma City Autopatch Assn.	20,901	3
Edmonds Woodway ARC	684	4
Local		
CTRI Contest Group	6,319,527	7
Central Virginia Contest Club	2,310,288	8
The Villages ARC	1,585,797	8
Metro DX Club	548,364	7
Bristol (TN) ARC	448,290	4
Bolingbrook ARS	351,717	7
Meriden ARC	182,070	5
Vienna Wireless Society	156,885	3
Redwood Empire DX Assn.	153,783	3
Bellbrook ARC	117,654	3
West Park Radiops	74,379	6
Lake Area Amateur Radio Klub	59,253	3
Hilltop Transmitting Assn.	44,964	3
St. Louis ARC	40,182	3
OH-KY-IN ARS	19,143	4
TX Emergency Amateur Communicators	9,519	3
Hazel Park ARC	9,201	4

Top Ten — US and Canada

Single Operator, High Power

VY2ZM	2,565,009
XL3A (VE3AT, op)	1,883,007
N1UR	1,829,520
VE3DZ	1,341,153
K4AB	1,182,255
K3ZO	1,101,915
AA1ON	836,703
K2XA	806,664
NA8V	770,904
K8GL	576,090

Single Operator, Low Power

KU2M	543,600
N4TZ	338,022
N8II	230,598
AC0W	181,200
K5FUV	166,848
N8GLS	159,510
N1DD	148,992
W6DVS	145,545
AC4G	144,978
AK6A	140,049

Single Operator, QRP

W1MR	34,452
W6QU (W8QZA, op)	23,622
ND0C	23,316
N4WLL	15,660
N3CI	7,257
WB4GHZ	3,960
KZ3I	3,276
N8XA	1,224
KE0WPA	1,104
KG4WOJ	1,083

Single Operator Unlimited, High Power

VE3EJ	2,276,136
K1KI (KM1P, op)	2,046,966
K5ZD	2,041,200
AA3B	1,890,945
AA1K	1,817,712
K3WW	1,802,112
N3RS	1,714,560
N3RD	1,683,144
N2NT	1,480,920
N2SR	1,281,336

Single Operator Unlimited, Low Power

N4XL	373,317
N8CWU	340,938
K9OM	306,000
WE9R	303,600
VE3PJ	294,150
N2SQW	270,414
NM1C	265,527
W3KB	255,420
VA2CZ	253,935
NY6DX	148,836

Single Operator Unlimited, QRP

K8ZT	5,439
N9SM	3,348
K2GMY	2,040
VE6EX	1,725
WA4JQS	1,440
W3EK	231
K6CTA	12

Single Operator, 160 Meters

K5UR	3,306
N4XD	2,574
VE3PN	2,160
W2VO	2,160
W8WTS	216
K7SS	126
WB4WXE	126
N6RK	48
WC4Y	18

Single Operator, 80 Meters

W1HI	17,748
VA3SK	5,088
NY1E	1,860
VE9ML	1,620
WB4DNL	1,020
K4ESE	672
AF8C	363
NG0C	144
K4HPS	75
WZ6ZZ	36

Single Operator, 40 Meters

K3UA	291,000
WV4P	41,400
NR4L	25,254
N4IJ	13,350
K9CJ	8,694
KK4AND	8,280
WA3FAE	7,137
WA8RCN	5,940
AA8BV	5,202
K3HW	4,464

Single Operator, 20 Meters

K3LR (N2NC, op)	621,528
KV0Q	293,280
K9BGL	218,430
W2AW (N2GM, op)	120,786
W1AVK	86,625
WX5S	79,872
N7TU	58,500
W8WA	56,160
K0BBB	55,650
N0OK	53,040

Single Operator, 15 Meters

K1MM	48,321
N6WM	47,730
K0EJ	18,081
N4OX	16,482
N7RQ	14,319
W2FU	11,865
W7ZR	10,080
W8HAP	8,874
N2BEG	5,928
NC0B	5,175

Single Operator, 10 Meters

W5PR	5,355
K4WI	2,016
KN6EVH	12

Multioperator, Single Transmitter, High Power

WW4LL	1,707,918
K1IR	1,628,700
N1MM	1,206,804
K3JO	1,182,330
K3ND	1,106,640
KA1ZD	1,019,640
W8PR	871,560
AD3C	608,076
N7DX	561,510
K9YY	470,307

Multioperator, Single Transmitter, Low Power

K1XM	528,984
N8YXR	154,836
NA5NN	89,856
W1JSR	28,032
WA8Q	3,948
KC8PKY	3,813
W8CUL	1,500
AF0S	27

Multioperator, Two Transmitter

W3LPL	3,821,625
ND7K	2,185,620
K1RX	1,936,752
K2AX	1,686,180
K2NJ	1,050,990
W2MKM	796,824
NX6T	678,720
K2DM	627,165
K3CCR	603,705
WA3EKL	560,070

Multioperator, Multitransmitter

K1TTT	2,562,840
NE3F	827,658
N1SOH	223,665
VY2IDX	21,780
K5LRW	17,112

Top Ten — DX

Single Operator, High Power

ZF5T	4,660,425
FM5BH	4,334,766
KP2M (KT3Y, op)	1,985,160
EB5A	1,567,824
CE7VPQ	862,050
OA4SS	848,484
EA5DFV	840,960
IK0ETA	768,552
CE6CGX	712,965
KL7RA (KL7SB, op)	606,936

Single Operator, Low Power

WP3R	4,119,165
NP4DX (N2TTA, op)	2,782,593
HI3T	2,668,464
HH2AA (K0BBC, op)	1,680,948
KH6CJJ	1,253,616
PJ7AA	1,176,057
TG9ANF	684,945
PY2EX	627,510
8P1W	561,330
PZ5RA	359,499

Single Operator, QRP

F5BEG	17,982
LW3DG	12,831
JH1OGC	11,232
PY2BN	10,200
JH7UJU	9,120
JH1APZ	3,078
JQ1NGT	2,961
JR1NKN	897
OK1DMP	792
IW2NRI	627

Single Operator Unlimited, High Power

ZW5B (LU9ESD, op)	4,005,810
KH7M (NA2U, op)	3,111,900
ED8W (EA1BP, op)	2,724,288
FS4WBS	1,207,908
OM2VL	1,177,512
ZM4T (ZL3IO, op)	988,524
PY2MP	638,580
SN7D (SQ7D, op)	580,488
PY5QW	532,377
LO7H	517,752

Single Operator Unlimited, Low Power

TM6M (F4DXW, op)	722,796
PT7ZT	499,464
9Z4Y	490,455
XE2B	339,150
PY8WW	330,444
NP2KW	292,890
YY5RAB	252,945
PY2ZR	187,557
PY5FO	172,800
LW4EF	172,584

Single Operator Unlimited, QRP

EA3O	12,384
CT1BXT	8,712
IZ2FLX	8,448
F8AOF	5,934
JK1TCV	4,221
YU1LM	561
YE8RAF	90
YC2VOC	45
PE2K	27
GW0EGH	18

Single Operator, 160 Meters

I5JVA	26,862
HA0NAR	10,248
SN7Q (SP7GIQ, op)	2,832
RM4F	966
JA0QNJ	60

Single Operator, 80 Meters

XE2X	230,898
NP2J (K8RF, op)	213,993
KP4KE	188,859
GM3PPG (G4BYB, op)	101,904
9A8M	76,506
EA7JZ	72,369
I4AVG	59,400
F6AGM (FM5CD, op)	59,220
S54ZZ	56,760
S53M (S57UN, op)	53,703

Single Operator, 40 Meters

CR6T	396,303
TI1T (TI2CC, op)	325,728
D4Z (IK2NCJ, op)	306,387
S51YI	224,070
YU1EXY (YU1FW, op)	181,278
EA8ZS	166,485
OM3KAP (OM4AZF, op)	134,826
HA3NU	129,900
YU7U	108,888
PI4COM (PD9DX, op)	97,524

Single Operator, 20 Meters

9A9A	393,825
IR4K (IZ4JUK, op)	358,602
S55OO	348,159
IO5O (IK5RLP, op)	324,264
S50K	308,865
OK7K (OK1BN, op)	279,129
DM0A	251,163
PY2NY	246,384
OM4MM	245,322
II2S (IU2IBU, op)	230,724

Single Operator, 15 Meters

PT5J (PP5JR, op)	530,115
ZP5DBC	435,774
PR4T (PY4BZ, op)	410,940
KP4AA	388,962
PX2A (PY2LED, op)	382,104
LU5FC	353,115
PJ4DX	275,865
XQ1KZ	213,528
HC1JQ	164,256
PP5JN	161,082

Single Operator, 10 Meters

LU8DPM (LU5WW, op)	69,987
LU1DK	45,372
PU5FJR	39,429
XQ3PC	28,836
LU9FHF	19,584
PY2TMV	15,921
PY4AZ	12,267
PY2CX	10,854
YV4ABR	5,874
ZX2V (PY2XV, op)	4,752

Multioperator, Single Transmitter, High Power

J68HZ	6,597,360
ZF1A	5,982,912
HP3SS	2,363,844
TI1K	2,230,524
IR6T	1,913,760
4A7S	1,843,140
CQ8M	1,431,888
OK5Z	1,216,194
LZ5R	1,169,430
LZ9W	1,116,720

Multioperator, Single Transmitter, Low Power

FY5KE	2,449,755
V31MA	1,922,544
ZW8T	1,890,720
LV4V	358,620
PY2KGB	32,637
3Z1K	30,645
F6KRK	21,888
PY2ERA	8,874
JK2VOC	7,098
DX4EVM	2,295

Multioperator, Two Transmitter

HI3LT	3,722,103
ED7R	2,233,680
II9P	1,984,044
F8KGM	1,178,253
JR8VSE	379,554

Multioperator, Multitransmitter

PJ2T	6,687,756
3G2K	2,607,579
LN8W	283,200
EA2BI	176,880
CS5LX	4,200

Sponsored Plaque Winners

Thanks to the generous support of numerous clubs and individuals, we are pleased to list the winners of the sponsored International DX Phone Contest plaques below. For more information on plaque sponsorship or to order a duplicate plaque, contact the ARRL Contest Program at 860-594-0232 or **contests@arrl.org**. Plaques cost $80, which includes all shipping charges.

Winner	Plaque Category	Plaque Sponsor
CW Winners		
N2NT	W/VE Single Operator High Power	Frankford Radio Club
N4TZ	W/VE Single Operator Low Power	The CW Operators' Club
K5ZD (AK1W, op)	W/VE Single Operator Unlimited, High Power	Harold Ritchey, W3WPG, Memorial
K9OM	W/VE Single Operator Unlimited, Low Power	Chick Allen, NW3Y
K3JO	W/VE Multioperator Single Transmitter High Power	The CW Operators' Club
W3LPL	W/VE Multioperator Two Transmitter	The CW Operators' Club
N4WW	W/VE Multioperator Unlimited Transmitter	Drew Vonada-Smith, K3PA
W1UE	W/VE 3.5 MHz	The CW Operators' Club
K3UA	W/VE 7 MHz	Drew Vonada-Smith, K3PA
K3LR (N2NC, op)	W/VE 14 MHz	The CW Operators' Club
N5AW	W/VE 21 MHz	Carl Luetzelschwab, K9LA
ZF1A (N6MJ,op)	World Single Operator High Power	North Jersey DX Assn.
NP3X (N2TTA, op)	World Single Operator Low Power	The CW Operators' Club
HZ1TT	World Single Operator QRP	The CW Operators' Club
P44W (W2GD, op)	World Single Operator Unlimited, High Power	The CW Operators' Club
HI0LT (KC1XX,op)	World Single Operator Unlimited, Low Power	The CW Operators' Club
9A7A	World Multioperator Two Transmitters	Frankford Radio Club, K2TD, Memorial
KP4AA	World Multioperator Single Transmitter, High Power	John Patterson, WC0W/V31TP
ZF5T	World Multioperator, Single Transmitter, Low Power	John Patterson, WC0W/V31TP
NP2J (K8RF, op)	World 1.8 MHz	Jim George, N3BB
XE2X	World 3.5 MHz	W1FJ — In memory of W1BIH, N4XR, and W1AX
D4Z (IK2NCJ, op)	World 7 MHz	The CW Operators' Club
PJ4A	World 14 MHz	Caribbean Contesting Consortium, PJ2T
CE3CT	World 28 MHz	Jeff Stuparits, W4DD
ZF1A (N6MJ, op)	North America Single Operator High Power	Potomac Valley Radio Club
NP3X (N2TTA)	North America Single Operator Low Power	Fred Hoffert, NA2U
HI3T	North America Single Operator QRP	The CW Operators' Club
KP4AA	North America Multioperator Single Transmitter	The CW Operators' Club
AA3B	Atlantic Division Single Operator	Chick Allen, NW3Y
W9RE	Central Division Single Operator High Power	Northern Illinois DX Assn.
N4TZ	Central Division Single Operator Low Power	Society of Midwest Contesters
K9CT	Central Division Single Operator Unlimited, High Power	Society of Midwest Contesters
N9CO	Central Division Single Operator Unlimited, Low Power	Society of Midwest Contesters
N4SS (W5MX)	Great Lakes Division Single Operator	North Coast Contesters
N2BA	Hudson Division Single Operator Unlimited, Low Power	Hudson Valley Contesters and DXers — In memory of K2ONP
KA6BIM	Northwestern Division Single Operator Unlimited	Randall Stegemeyer, W7HR
N9RV	Seventh Call Area Single Operator High Power	Willamette Valley DX Club
EA8RM	Africa Single Operator	The CW Operators' Club
JN2AMD	Asia Single Operator High Power	The CW Operators' Club
JH4UYB	Asia Multioperator Single Transmitter High Power	Yankee Clipper Contest Club
NP3X (N2TTA, op)	Caribbean Single Operator Low Power	Frankford Radio Club, 9Y4VU, Memorial
M7DX (M0UNN, op)	Europe Single Operator QRP	The CW Operators' Club
CR6K (CT1ILT, op)	Europe Single Operator High Power	Jim George, N3BB
S52NR	Europe Single Operator Low Power	Jeff Hartley, N8II
EA7X	Europe Single Operator Unlimited, High Power	The CW Operators' Club
EA5RS	Europe Multioperator Single Transmitter	The CW Operators' Club
9A7A	Europe Multioperator Two Transmitter	The CW Operators' Club
II9P	Europe Multioperator Unlimited	Charles Wooten, NF4A
JH1EAQ	Japan Single Operator Low Power	The CW Operators Club
KH7M (NA2U, op)	Oceania Single Operator	The CW Operators' Club
P44W (W2GD, op)	South America Single Operator	The CW Operators' Club
CW/Phone Combination Winner		
N1UR	W/VE Single Operator High Power Combined Score	Chick Allen, NW3Y
Phone Winners		
VY2ZM	W/VE Single Operator High Power	Frankford Radio Club
VE3EJ	W/VE Single Operator Unlimited, High Power	Pete Carter, K3VW, Memorial
K5UR	W/VE 1.8 MHz	Butch Greve, W9EWC, Memorial
K3UA	W/VE 7 MHz	Charles Wooten, NF4A
K1MM	W/VE 21 MHz	Northern Illinois DX Assn.
ZF5T	World Single Operator High Power	North Jersey DX Assn.
WP3R	World Single Operator Low Power	Arizona Outlaws Contest Club
F5BEG	World Single Operator QRP	Bill Parker, W8QZA
ZW5B (LU9ESD, op)	World Single Operator Unlimited, High Power	Charles Dietz, W5PR
LU8DPM (LU5WW, op)	World 28 MHz	Jeff Stuparits, W4DD
N1UR	USA Single Operator High Power	Ed Sawyer, N1UR
KD9MS	Central Division Single Operator High Power	Society of Midwest Contesters
N4TZ	Central Division Single Operator Low Power	Society of Midwest Contesters
W9PA	Central Division Single Operator Unlimited, High Power	Society of Midwest Contesters
WE9R	Central Division Single Operator Unlimited, Low Power	Society of Midwest Contesters
NA8V	Great Lakes Division Single Operator	North Coast Contesters
WB4TDH	Southeastern Division Single Operator Low Power	Charles Wooten, NF4A
N1LN	Fourth Call Area Single Operator Unlimited, High Power	Charles Wooten, NF4A
N9RV	Seventh Call Area Single Operator High Power	Willamette Valley DX Club
JH4UYB	Asia Multioperator Single Transmitter, High Power	Yankee Clipper Contest Club
LN8W	Europe Multioperator Unlimited	Charles Wooten, NF4A
WH6FAM	Oceania Single Operator High Power	Albert Crespo, F5VHJ — In memory of Carl Cook, AI6V
KH6QJ	Oceania 3.5 MHz	Burton M. Parmeter, KG7MD, Memorial Award

Division Winners

Single Operator, High Power

Atlantic	K3ZO	1,101,915
Central	KD9MS	157,785
Dakota	KØTT	357,120
Delta	WQ5L	67,122
Great Lakes	NA8V	770,904
Hudson	K2XA	806,664
Midwest	NIØG	160,176
New England	N1UR	1,829,520
Northwestern	N9RV	562,464
Pacific	AA6AA	189,756
Roanoke	K4CGY	242,055
Rocky Mountain	W5RJJ	102,660
Southeastern	K4AB	1,182,255
Southwestern	N6AA	230,643
West Gulf	N5AW	318,060
Canada	VY2ZM	2,565,009

Single Operator, Low Power

Atlantic	K3SU	120,663
Central	N4TZ	338,022
Dakota	ACØW	181,200
Delta	K5FUV	166,848
Great Lakes	N8GLS	159,510
Hudson	KU2M	543,600
Midwest	KØDD	67,362
New England	N1DD	148,992
Northwestern	AK6A	140,049
Pacific	W6US	43,680
Roanoke	N8II	230,598
Rocky Mountain	N7MZW	7,080
Southeastern	WB4TDH	107,880
Southwestern	WN6K	75,240
West Gulf	KD2KW	47,790
Canada	VE5SF	71,712

Single Operator, QRP

Atlantic	KZ3I	3,276
Dakota	NDØC	23,316
Delta	WB4GHZ	3,960
Great Lakes	N8XA	1,224
New England	W1MR	34,452
Northwestern	N7JI	288
Roanoke	KG4WOJ	1,083
Southeastern	N4WLL	15,660
Southwestern	W6QU (W8QZA, op)	23,622
West Gulf	N3CI	7,257

Single Operator Unlimited, High Power

Atlantic	AA3B	1,890,945
Central	W9PA	407,745
Dakota	KØMD	302,058
Delta	KD5JRY	315,648
Great Lakes	W5MX	682,068
Hudson	N2NT	1,480,920
Midwest	N9GB	505,176
New England	K1KI (KM1P, op)	2,046,966
Northwestern	KA6BIM	684,420
Pacific	W6YX (N7MH, op)	894,852
Roanoke	N1LN	1,161,558
Rocky Mountain	WØPSY	75,048
Southeastern	WX4G	536,907
Southwestern	W6YI	796,110
West Gulf	W5LO	310,206
Canada	VE3EJ	2,276,136

Single Operator Unlimited, Low Power

Atlantic	W3KB	255,420
Central	WE9R	303,600
Dakota	KØEA	66,033
Delta	AC5O	57,873
Great Lakes	N8CWU	340,938
Hudson	N2SQW	270,414
Midwest	AAØAI	99,468
New England	NM1C	265,527
Northwestern	WZ8T	80,910
Pacific	NJ6G	111,375
Roanoke	N4XL	373,317
Rocky Mountain	AD1C	44,631
Southeastern	K9OM	306,000
Southwestern	N7IR	104,130
West Gulf	KI5MM	95,625
Canada	VE3PJ	294,150

Single Operator Unlimited, QRP

Atlantic	W3EK	231
Great Lakes	K8ZT	5,439
Pacific	K2GMY	2,040
Southeastern	N9SM	3,348
Canada	VE6EX	1,725

Single Operator, 160 Meters

Atlantic	W2VO	2,160
Delta	K5UR	3,306
Great Lakes	W8WTS	216
Northwestern	K7SS	126
Pacific	N6RK	48
Roanoke	N4XD	2,574
Southeastern	WB4WXE	126
Canada	VE3PN	2,160

Single Operator, 80 Meters

Dakota	NGØC	144
Great Lakes	AF8C	363
New England	W1HI	17,748
Pacific	WZ6ZZ	36
Roanoke	WB4DNL	1,020
Canada	VA3SK	5,088

Single Operator, 40 Meters

Atlantic	K3UA	291,000
Central	K9CJ	8,694
Delta	WV4P	41,400
Great Lakes	WA8RCN	5,940
Hudson	N1MID	126
New England	AA1QD	2,760
Pacific	W6RKC	3,450
Roanoke	N4IJ	13,350
Southeastern	KK4AND	8,280
Southwestern	N7RK	2,430

Single Operator, 20 Meters

Atlantic	K3LR (N2NC, op)	621,528
Central	K9BGL	218,430
Dakota	KØBBB	55,650
Delta	KB8VND	7,254
Great Lakes	W8WA	56,160
Hudson	W2AW (N2GM, op)	120,786
Midwest	KBØKFH	2,730
New England	W1AVK	86,625
Northwestern	AA7UN	2,898
Pacific	WX5S	79,872
Roanoke	N4MM	26,364
Rocky Mountain	KVØQ	293,280
Southeastern	NE8P	38,367
Southwestern	N7TU	58,500
West Gulf	WA5GEO	192
Canada	VE7FE	46,011

Single Operator, 15 Meters

Atlantic	W2FU	11,865
Central	WB9HFK	2,520
Delta	KØEJ	18,081
Great Lakes	N8QE	1,632
Hudson	WB2AMU	210
Midwest	KØARM	75
New England	W8HAP	8,874
Northwestern	WA8ZNC	60
Pacific	N6WM	47,730
Rocky Mountain	NCØB	5,175
Southeastern	K1MM	48,321
Southwestern	N7RQ	14,319
West Gulf	WE6EZ	5,070
Canada	VE2NCG	210

Single Operator, 10 Meters

Pacific	KN6EVH	12
Southeastern	K4WI	2,016
West Gulf	W5PR	5,355

Multioperator, Single Transmitter, High Power

Atlantic	K3ND	1,106,640
Central	K9YY	470,307
Delta	W5GAD	4,050
Great Lakes	W8PR	871,560
Hudson	WA2JQK	165,042
Midwest	WØMB	106,200
New England	WW4LL	1,707,918
Northwestern	N7DX	561,510
Pacific	W7EB	86,328
Roanoke	W4TG	158,544
Southeastern	AD4ES	257,499
West Gulf	KG5VK	121,380
Canada	VE3UZ	170,040

Multioperator, Single Transmitter, Low Power

Central	KC8PKY	3,813
Delta	NA5NN	89,856
Great Lakes	N8YXR	154,836
New England	K1XM	528,984
Roanoke	W8CUL	1,500
Rocky Mountain	AFØS	27

Multioperator, Two Transmitter

Atlantic	W3LPL	3,821,625
Great Lakes	WC8VOA	115,884
Hudson	K2NJ	1,050,990
New England	K1RX	1,936,752
Northwestern	KT7E	483,840
Southeastern	K2DM	627,165
Southwestern	ND7K	2,185,620
Canada	VA7GI	6,960

Multioperator, Multitransmitter

Atlantic	NE3F	827,658
New England	K1TTT	2,562,840
Rocky Mountain	K5LRW	17,112
Canada	VY2IDX	21,780

The next ARRL International DX Phone Contest will be held March 5 – 6, 2022.

Certificate of Code Proficiency

Recipients

Sponsored by
VIBROPLEX
www.vibroplex.com

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.

April 2021

William T. Cronenwett, W5TPJ	10
Dane E. Groszek, KD2SSS	10
Christopher J. Porter, AA7KL	10
Donald L. Steinbach, AE6PM	10
Bill H. Stephens, NUØY	10
Joel F. Wagner, III, ND5V	10
Richard J. Berezanich, WB3HUS	15
Victor Denisov, N6DVS	15
Edward H. Linch, III, N4LS	15
Richard B. Peglowski, KE4SAV	15
Warren T. Seeley, W4FLL	15
John H. Summers, Jr., WØDY	15
Richard B. Dervan, N1RBD	20
Robert T. Marston, AA6XE	20
Arvid W. Weflen, KL7YC	25
James Carson, WT8P	30
Christopher G. Pearson, G5VZ	30
Edward J. Picha, N9EP	35

May 2021

Angelica T. Brewer, KN4SGS	10
James W. Carter, K7IOL	10
Federico Grau, KC3MWD	10
Roger L. Burkhart, N3GE	15
Daniel Lasorso, KD8OFT	15
Bill H. Stephens, NUØY	15
Joel F. Wagner, III, ND5V	15
Roger L. Burkhart, N3GE	20
Bill H. Stephens, NUØY	20
William N. Massie, AA8KY	20
Dennis J. Niles, WV7S	20
Paul D. Manoli, KB1NCD	35

June 2021

David O. Ausley, WB4NCT	10
Russell Calabrese, KR2NZ	10
Harold D. Craft, Jr., AA2JQ	10
Jere F. McAlister, N5DFW	10
Glenn E. Schnell, KC3LBI	10
Lawrence Schall, KB2MN	15

July 2021

Roy L. Schmiesing, KT6B	10

Congratulations to all the recipients.

September 2021 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.

September Qualifying Runs will be transmitted by W1AW in Newington, Connecticut at the times shown at 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 are tentatively scheduled to be transmitted by K6KPH on Saturday, September 25 at 2 PM PDT (2100 UTC) on 3581.5, 7047.5, 14047.5, and 18097.5 kHz. Unless indicated otherwise, sending speeds are from 10 to 35 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 Code Proficiency Schedule — September 2021
(All times are in Eastern Daylight Time)

Monday	Tuesday	Wednesday	Thursday	Friday
Labor Day	**9/7** 7 PM – 2300Z 35 – 10 WPM		**9/9** 10 PM – 0200Z **(9/10 – UTC)** 10 – 40 WPM	**9/10** 9 AM – 1300Z 10 – 35 WPM
	9/14 4 PM – 2000Z 10 – 35 WPM	**9/15** 7 PM – 2300Z 10 – 40 WPM	**9/16** 9 AM – 1300Z 35 – 10 WPM	**9/17** 10 PM – 0200Z **(9/18 – UTC)** 10 – 35 WPM
	9/21 9 AM – 1300Z 10 – 35 WPM	**9/22** 10 PM – 0200Z **(9/23 – UTC)** 35 – 10 WPM	**9/23** 7 PM – 2300Z 10 – 35 WPM	**9/24** 4 PM – 2000Z 10 – 40 WPM
9/27 10 PM – 0200Z **(9/28 – UTC)** 10 – 40 WPM		**9/29** 9 AM – 1300Z 35 – 10 WPM	**9/30** 4 PM – 2000Z 35 – 10 WPM	

Bernie McClenny, W3UR, w3ur@arrl.org

How's DX?

The Battle Creek Special Antenna

In this month's column, guest authors George Guerin, K8GG, and George Taft, W8UVZ, explain the history of the first "Battle Creek Special" antenna, and how it's being used today.

The "Battle Creek Special" antenna originated in Battle Creek, Michigan, but was better known for its use during the 1990 Norwegian DXpedition, 3Y5X, to Bouvet Island. With a possible Bouvet DXpedition around the corner, let's look at the 30-year history of the Battle Creek Special.

Design and Evolution

In the 1980s, Charlie Dewey, WØCD (SK), was very active on 160 meters, and he helped support a travelling vertical antenna, which was designed and built by Barry Boothe, W9UCW. It was about 42 feet tall, with a loading coil and whip above for 160 meters. It worked on 20, 40, 80, and 160 meters, using matching networks and ground radials.

Charlie decided the antenna should be stronger, using 6061-T6 aluminum tubing and taller for more signal strength on 80 and 160 meters. He wanted it to be assembled on the ground and tilted up by as few as two people — without risk of a permanent bend in the mast.

The conceptual design was a 48.5-foot-tall mast, with a trap at 33 feet for 40 meters, a top loading coil for 160 meters, with a whip above, and a loading wire below the loading coil to resonate the mast on 80 meters. The ground system had 16 radials, each at 135 feet long. This worked very well on 40 and 80 meters, but when power was fed to the antenna on 160 meters, the top loading coil quickly softened, due to inductive heating.

This loading coil was then replaced with an 80-meter trap and a top loading wire for 160 meters, which would take high power in an inverted-**L** configuration (see Figure 1). Charlie also made a 2:1 unun for 160 meters, as the feed point impedance on 160 meters is nominally 25 Ω. This evolution was dubbed "The Battle Creek Special." This design covers all of 40 meters and 3500 – 3570 KHz on 80 meters and 40 KHz in the DX window on 160 meters.

A Reliable DX Antenna

The Battle Creek Special group — which included Charlie, WØCD (SK); George, W8UVZ; and George, K8GG — offered the antenna to the DXpedition team going to Bouvet Island. The group fine-tuned the construction, printed a manual, and built a shipping box (see Figure 2) that would hold the mast sections, guy ropes, and ground radials.

Since then, Charlie constructed three more Battle Creek Specials, all with shipping containers, including a heavy-duty model for 100+ MPH winds, specifically for VKØIR, Heard Island, and other DXpeditions in the Southern Hemishpere, where prevailing gale-force winds blow persistently. One antenna was donated to the NCDXF and sent to South Africa, where it is managed by local DXers for African DXpeditions. The others are maintained in Battle Creek, Michigan, by George, W8UVZ; Larry,

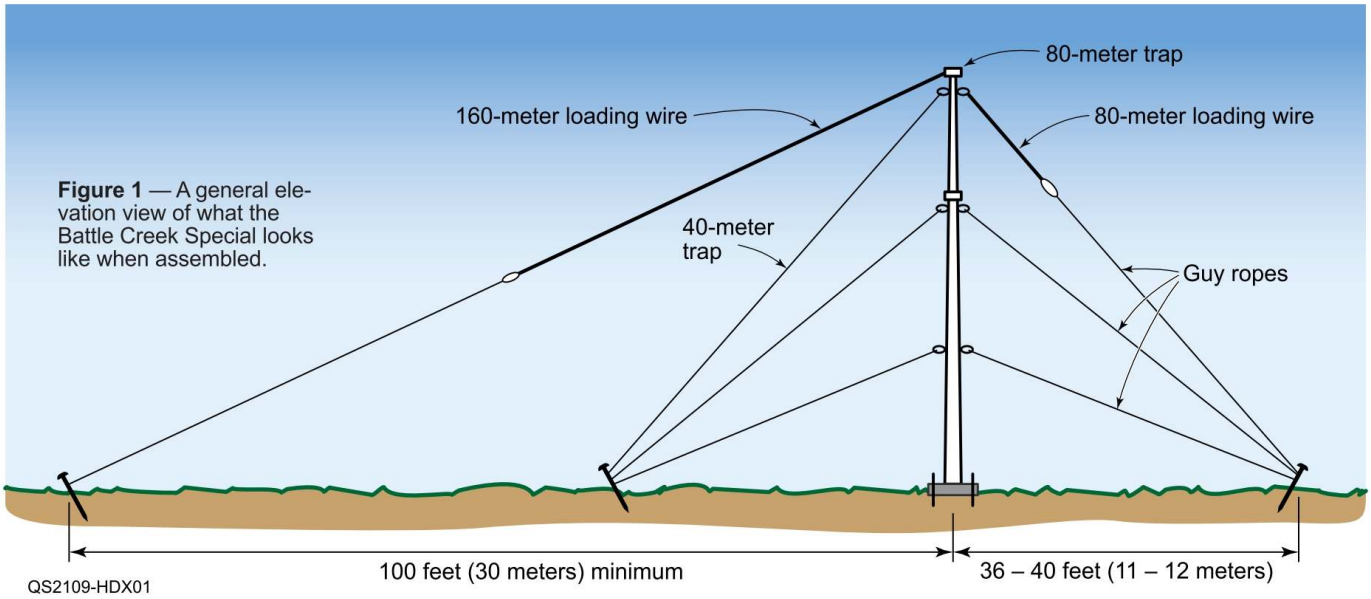


Figure 1 — A general elevation view of what the Battle Creek Special looks like when assembled.

Figure 2 — One of the shipping crates used for the Battle Creek Special.

Figure 3 — An L-C trap made with #10 enameled copper wire on CPVC pipe forms and capacitors made from RG-213 coaxial cable located inside the antenna sections.

Figure 4 — Instead of using coaxial cable, the capacitor is made by sleeving two sections of aluminum tubing with layers of PTFE heat-shrink tubing as the dielectric.

W8VVG, and George, K8GG. The antennas are shipped around the world to various locations, so DXpeditions have a reliable antenna for the low bands.

Lessons Learned

1 32 radials, each at 70 feet long result in a lower ground loss and better signal strength. The shorter radials are also easier to deploy and take up less area.

2 The original traps were made from RG-58 coaxial cable. They were replaced with L-C traps made with #10 enameled copper wire on CPVC pipe forms and capacitors made from RG-213 coaxial cable located inside the antenna sections (see Figure 3).

3 For the 80-meter trap, Gary Nichols, KD9SV, made us a trap by sleeving two sections of aluminum tubing with layers of polytetrafluoroethylene (PTFE) heat-shrink tubing as the dielectric (see Figure 4). An additional benefit is the reduced weight of the trap, making erection and take-down easier, reducing the chance of damage if the trap hits the ground.

4 Traps should be constructed to resonate at the bottom of the desired frequency coverage. For example, our traps dip between 6970 and 7030 KHz and between 3470 and 3525 KHz on 40 and 80 meters, respectively. Higher resonant frequencies will result in high SWR at the bottom band edges.

5 The best guy rope we've found is black military-grade double-braided polyester. These are available direct and through amateur radio stores at **www.syntheticextilesinc.com**.

None of this would have ever happened without the concepts and perseverance of Charles E. Dewey, Jr., WØCD (SK). Since the initial DXpedition to Bouvet, Battle Creek Special Antennas have been to over 50 DXCC entities around the world. We even made a wire version to be hung in a tree. This version was sent to Africa with Paul Wyse, W4PFM, operating as 5X4F and 5Z4FO. Many thanks to the DXers that provided generous financial support for shipping and maintenance.

Retiring the BC Special

The Battle Creek Special antennas are portable antennas meant to be taken on DXpeditions. They are not designed for use in permanent home stations, where shunt-fed towers, full-size, or top-loaded verticals and taller inverted-**L** antennas are the norm.

Over the years, DXpeditions have gotten larger, with phased arrays for 40 and 80 meters and fiberglass masts to support taller inverted-**L** antennas on 160 meters. Accordingly, the Battle Creek Special group is retiring and phasing out their efforts. We are looking to gift these antennas to active DXpeditioners. Contact W8UVZ or K8GG if seriously interested.

All photos by George Guerin, K8GG.

Wrap-Up

That's it for this month, with thanks to George Guerin, K8GG, and George Taft, W8UVZ. 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

High Solar Cycle 25 Activity May Enhance Sporadic E

Solar Cycle 25 activity picked up dramatically in early July 2021. An A-, C-, M-, then X-class solar flare occurred on July 3. The solar flare scale is logarithmic, so an M1 flare is 10 times stronger than a C1, and an X1 is 10 times stronger than a M1. In a report titled, "First X-Flare in 4 Years," **Spaceweather.com** said, "A new sunspot emerged during the early hours of July 3, and promptly exploded, producing the first X-class solar flare since September 2017."

Strong 2-meter sporadic E appeared on June 27, and it was followed by an intense sporadic-E opening from North America to Europe and the East on July 2 and 3. This had DXers wondering if the high solar activity spurred the sporadic E.

The causes of mid- and high-latitude summer sporadic-E openings are not well understood. *Wind shear* — or the difference in wind speed or direction — in the sporadic-E layer is felt to be one of the main causes. Other researchers wonder about a connection to severe thunderstorms. But the intense and widespread sporadic E during the last weekend of June and first days of July imply a global phenomenon. It could also be caused by changes in the Earth's magnetic field from solar flare X-ray radiation ionizing the top of the ionosphere.

The sporadic-E season will be winding down in September. But high solar activity and coronal mass ejection (CME) impacts may cause more 50 MHz and higher VHF band DX during fall 2021. The Autumnal Equinox is a prime time for *aurora*, which occurs during geomagnetic storms and can reflect signals from 50 MHz up to the microwave bands (see Figure 1). During an aurora, the F2 maximum usable frequency (MUF) can sometimes go over 50 MHz. This is usually on north-south paths, such as North America to the Caribbean and South America. **Spaceweather.com** and **Solarham.com** are good sources of information.

When to Send "RR73"

Using "RR73" has become a popular way to conclude an FT8 or MSK144 contact. By using "RR73," stations can save one to two sequences. This can be significant if a DX station is trying to work as many people as possible. However, receiving an "RR73" from a rare station may not guarantee the contact is in the log.

Some stations want a "73" from you to verify reception. Additionally, signal fading and interference can complicate things. My version of *WSJT-X* sends only one "73" after receiving an "RR73." Lance, W7GJ; Jim, AAØMZ, and others suggest sending "RRR" rather than "RR73," particularly if conditions are not good. This requests a "73" response from the other station, and ensures the contact is in the log.

On the Bands

50 MHz. June was an interesting month. There were strong openings at the beginning and end of the month, but dry patches in the middle. One highlight was on June 1, when Rich, K1HTV (FM18), logged JR1LZK and JA8ISU. EI7GL and NN4X noted that KG6DX (QK23), in Guam, worked into central Europe on June 1, making contacts with DK1MAX (JN58) and S57RR (JN65) at 0615Z over 12,000-kilometer paths. On June 3, K7ULS (DN41) worked F1GTU, and Dan, NP2J, worked 44 European stations on CW. XE2X (EL06) worked 9K2ØD (LL49) at 1335Z on 50.323 MHz.

On June 7, Mike, KMØT (EN13), found SV3DXC, TK5MH, and Z37CXY. Roger, VE1SKY, logged 9K2NO. On June 11, Ron, KF3R (FM18), worked EA6SX (JM19) and K1RI (FN41) in Rhode Island. Nelson, KD2CYU (FN20), found six new countries on June 11, including 7X3WPL (who runs 40 W and a dipole), EA9ACD, and ES6RQ.

On June 13, VK4HJ (QG63) worked EA8DBM (IL18) at 0625Z at 16,200 kilometers. EI7GL suspects a com-

Figure 1 — Well-known Dominican Republic 6-meter DXer David Lama, HI8DL, with his son, HI8DML, and wife, Annabel. David worked 2-meter sporadic E to the Midwest on July 13, 2021. [Buddy Morgan, WB4OMG, photo]

bination of sporadic E with TEP going across the geomagnetic equator. I, NØJK (EM28); AAØMZ (EM29), and NØLL (EM09) worked N4EME (FN57) on June 13. K7ULS (DN41) worked NH6Y (BL10) on June 16. He later had "waves of Japanese stations" coming in.

On June 18, KD2CYU and K1HTV worked the rare Märket Reef entity of OJØC (IOTA designator EU-053). WB2AMU (FN30) worked OK1CF on CW. W5LDA (EM15) worked 4O3A, OM5XX, T77C, Z37CXY, and others.

The last week of June was a disappointment. But on ARRL Field Day on June 27, E_s exploded. There were stations wall to wall on 6 meters for Field Day. I worked KP4JRS (FK68) and N4EME (FN66) with a 10 W fixed mobile setup on FT8. The N4EME grid expedition group reported preliminary results of 1,289 contacts from FN57, and 950 contacts from FN66. On June 28, Steve, NN4X (EL98), worked 39 Japanese stations on FT8. Larry, W5LDA (EM15), also made contacts with Japanese stations.

By the end of June, Ken, AC4TO (EM70), had worked 100 different countries in 2021 on 6 meters. LX1JX was the hundredth. He heard BD4WN on June 30, and the next morning, he worked 76 different European stations. Max, DK1MAX, worked K7TNT in Wyoming at 1438Z on July 2, completing a Worked All States achievement on 6 meters.

144 MHz. K7ULS (DN41) worked WQ5S (EM13) on tropo using Q65-30C on June 11.

Figure 2 — A map of the 2-meter sporadic-E opening on June 15. [**www.dxmaps.com**]

Sporadic E is the big news. On June 15, KCØV (DN70) made a contact with KO4MA (EL88) on E_s at 2,466 kilometers on FT8 (see Figure 2). Jay, W9RM (DM57), also worked KO4MA at 2,613 kilometers. This is one of the longest North America 2-meter sporadic-E contacts ever made.

From EM19, Greg, WQØP worked sporadic E to W1VD, K2ERG, and VE2DFO (see Figure 3). Chad, NØYK (DM98), worked E_s to Alabama. Dan, W5AFY (EM04), logged VE3ELL in W4, W8, and W9 on E_s FT8 (none on SSB). From (EN34), Rich, NØHJZ, worked KA5YEU (EL07) and N5WS (EL09) on E_s. K7EME (DM42) worked W7YOZ and KG7P (CN87) on SSB on June 17.

A major 2-meter sporadic-E opening occurred on Sunday, June 27. Pat, W5VY (EM34), noted hot conditions on 6 meters, then went to 2 meters. He made 26 sporadic-E contacts with stations in Connecticut, Maryland, and New York as new states. Jim, AAØMZ (EM29), made contacts in W3, W4, W8, and W9 from 1613 to 1716Z on both SSB and FT8.

Activity was high due to stations celebrating ARRL Field Day. AF5CC (EM04) worked N8AXB (EM89), K1RZ (FM19), and N8XQM (EN80) on E_s. K5SW (EM25) worked N8PUM (EN66) on SSB. AEØG (EN10) worked W3 and W4. NØYK made E_s contacts and Dan, W5AFY, made contacts with 69 stations on E_s, on both 144.195 MHz SSB and 144.174 MHz FT8. Dan's best DX contact was with K1TEO (FN31) at 2,523 kilometers. Shelby Ennis, W8WN (EM77), said the main 2-meter sporadic-E center was over southern Illinois and Indiana. Shelby worked WE7L (DM79) on E_s at 1618Z. Sam, K5SW, noted the first 2-meter sporadic-E contact was made on June 23, 1950.

432 MHz. On June 9, KCØV (DN70) worked K7ULS (DN41) on 432.074 MHz tropo using Q65B at 566 kilometers. On June 10, he worked W5LUA (EM13) on FT8 tropo at 1,128 kilometers.

Figure 3 — NØLD and K5SRT roving teams at the WQØP station on June 13, 2021. [Greg Cerny, WQØP, photo]

Here and There

In June, there were several grid expeditions, including those by AG6EE, K5N, NI5P, N4EME, and others. Thanks to these operations, the following operators are qualifiers for the Fred Fish Memorial Award (pending verification by ARRL): W9FF, K5WE, WQ5S, W9RM, WØLGQ, W7MEM, W7KNT, and KA9CFD.

On July 16, John Lock, KFØM, worked KL7NC to complete Worked All States (WAS) on 50 MHz.

Bob Carnahan, N3LL, became a Silent Key on June 16, 2021.

Strays

A New Version of AREDN® Firmware is Now Available

The Amateur Radio Emergency Data Network (AREDN®) Development Team announced the availability of a new stable production release of their software, version 3.21.4.0. This version supports new devices from the MikroTik, TP-Link, GL.iNET, and Ubiquiti product lines. A list of program changes, security updates, and new features since its previous production version can be found on the AREDN website at **www.aredn mesh.org**. Also, the project's source code is now located on GitHub at **github.com/aredn**.

Special Event Stations

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

July 30 – Aug. 20, 2000Z – 0000Z, W9ISF, Indianapolis, IN. Indiana State Fair Amateur Radio Club. **Indiana State Fair**. 14.240 7.240 3.800. QSL. Indiana State Fair ARC, 7405 E. County Rd. 900 N., Brownsburg, IN 46112-8858. **www.qrz.com/db/w9isf**

Aug. 14, 1600Z – 2300Z, NI6IW, San Diego, CA. USS *Midway* (CV-41) Museum Ship. **US Coast Guard Birthday**. 14.320 7.250; PSK and CW on various HF bands, D-STAR on various reflectors. QSL. USS *Midway* Museum Ship COMEDTRA, 910 N. Harbor Dr., San Diego, CA 92101. *Check spotting networks to find us on HF. To see what reflector we're using, look for NI6IW and Reporting Note at* **www.dstarusers.org**. **www.qrz.com/db/ni6iw**

Aug. 21 – Aug. 22, 0001Z – 2300Z, W5BMC, Patterson, LA. Bayouland Emergency Amateur Radio Service. **International Lighthouse/Lightship Weekend**. 14.275 7.275; EchoLink 507010. QSL. BEARS, 708 Front St., Morgan City, LA 70380.

Sep. 1 – Oct. 30, 0000Z – 2359Z, OE13ØKUK, Kirchberg am Wagram, Austria. ADL 305 Tulln-Stockerau. **130th Anniversary of the First K.U.K. Telegraphy Course**. 160 through 10 meters; CW, SSB, and FT8. QSL. See website for information on receiving a QSL. **www.qrz.com/db/oe130kuk**

Sep. 3 – Sep. 6, 2300Z – 2300Z, W4V, Normal, IL. Chicago Suburban Radio Association (W9SW). **HOOAH Deer Hunt for Heroes**. 14.320 7.260; 20, 40, and 80 meters. QSL. Ron Delpiere-Smith/W4V, 333 E. Vermont St., Villa Park, IL 60181-2267. **www.HooahDeerHuntforHeroes.com**. **www.w9sw.com**

Sep. 4, 1200Z – 1900Z, W9EBN, Marion, IN. Grant County Amateur Radio Club. **Fly/In Cruise/In**. 14.1800 DMR Talk Group 31189 D-STAR Ref 24B 146.790 (PL 141.3). Certificate. Grant County Amateur Radio Club/W9EBN, Attn: Fly/In Cruise/In, P.O. Box 1786, Marion, IN 46952. **www.grantarc.org**

Sep. 4 – Sep. 5, 1600Z – 2200Z, W7P, Plains, MT. Clark Fork Amateur Radio Club. **Sanders County Fair**. 50.313 50.323 7.074; DMR TG 31300 Brandmeister Network. QSL. Clark Fork Valley Amateur Radio Club, P.O. Box 1803, Thompson Falls, MT 59873. **cfvarc.org**

Sep. 4 – Sep. 6, 1800Z – 1800Z, K7RDG, Sierra Vista, AZ. Cochise Amateur Radio Association. **Return to Paradise**. 14.285 14.070 7.225 3.890; voice, FT8/FT4/JS8. Certificate. Cochise ARA, P.O. Box 1855, Sierra Vista, AZ 85636. **www.k7rdg.org**

Sep. 5, 1300Z – 2100Z, W4CA, Roanoke, VA. Roanoke Valley Amateur Radio Club. **Blue Ridge Bonanza**. 14.265 7.265. QSL. Roanoke Valley ARC, P.O. Box 2002, Roanoke, VA 24009. Multiple stations/frequencies on 20 and 40 meters. *Contact as many stations along the Blue Ridge Parkway during the event.* **https://blueridgebonanza.info**

Sep. 5 – Sep. 12, 0000Z – 2359Z, K4A, Cordova, AL. Alabama Contest Group. **20th Memorial of the 9/11 Attacks**. 21.325 14.250 7.250 3.850; FT8, CW 50 kHz up from the bottom of the band. QSL. Bob Beaudoin, 970 Mountain View Rd., Cordova, AL 35550**. www.alabamacontestgroup.org**

Sep. 6, 1700Z – 2259Z, W9EFU, Madison, IN. Clifty Amateur Radio Society. **Tommy Thevenow Day**. 28.347 14.247 7.247. Certificate. Jerry Barnes, 601 Spring St., Madison, IN 47250. **wjbarnes@cinergymetro.net** *or* **https://w9efu.wordpress.com**

Sep. 9 – Sep. 13, 1600Z – 0200Z, N7F, Albany, OR. American Legion Post 10 Amateur Radio Club. **September 11th 20th Anniversary: Never Forget**. 14.250; 20 and 40 meters; SSB, PSK31, and CW. QSL. N7F Never Forget, c/o American Legion Post 10, 1215 Pacific Blvd. SE, Albany, OR 97321. *Club members may operate from home.* **info@n7ala.org**

Sep. 10 – Sep. 13, 0000Z – 0003Z, WA2NYC, Staten Island, NY. Wireless Association of New York City. **In Remembrance of the 20th Anniversary of the Attack on the World Trade Center in New York City**. 28.450 21.350 14.340 7.238. QSL. Wireless Association of New York City, 233 Wolverine St., Staten Island, NY 10306. *We remember the over 2,900 souls that were lost on that day. D-STAR Reflector XLX020B will be monitored at the top of the hour.* **wa2nyc@yahoo.com**

Sep. 11, 1200Z – 2359Z, N3M, Stoystown, PA. Somerset County Amateur Radio Club and Nittany Amateur Radio Club. **Flight 93 20th Anniversary**. General portion of the 20- and 40-meter phone bands; 14.293 7.293 3.993. QSL. N3M c/o Nittany Amateur Radio Club, P.O. Box 614, State College, PA 16801. *Operating from the Flight 93 National Memorial, commemorating the passengers and crew of Flight 93, whose heroic actions on 9/11/2001 prevented a planned terrorist attack on the US Capitol.* **www.qrz.com/db/n3m**

Sep. 11, 1600Z – 2100Z, WØBU, Burnsville, MN. Twin Cities Repeater Club. **Burnsville Fire Muster 40th Anniversary**. 3.850 7.225 14.250 21.325. Certificate. TCRC, 4202 153rd St. W., Rosemount, MN 55068. *Weather permitting, we will be operating on solar power.* **info@tcrc.org** *or* **www.tcrc.org**

Sep. 11, 1600Z – 2300Z, NI6IW, San Diego, CA. USS *Midway* (CV-41) Museum Ship. **USS *Midway* Commissioning**. 14.320 7.250; PSK and CW on various HF bands, D-STAR on various reflectors. QSL. USS *Midway* Museum Ship COMEDTRA, 910 N. Harbor Dr., San Diego, CA 92101. *Check spotting networks to find us on HF. To see what reflector we're using, look for NI6IW and Reporting Note at* **www.dstarusers.org**. **www.qrz.com/db/ni6iw**

Sep. 11 – Sep. 19, 0000Z – 2359Z, K4MIA, Loxahatchee, FL. PBSEC. **National POW MIA Recognition Day**. 28.400 18.150 14.265 7.195; SSB, CW, FT8, and satellite. QSL. Michael Bald, 6758 Hall Blvd., Loxahatchee, FL 33470. *Stations K4MIA/1, K4MIA/5, K4MIA/7, and K4MIA/8 also operating. EME, microwave, and other less used digital modes possible. Please take time to remember our POWs and MIAs, as well as their families.* **www.qrz.com/db/k4mia**

Sep. 11 – Sep. 19, 0001Z – 2359Z, W6JBT, San Bernardino, CA. Citrus Belt Amateur Radio Club. **Route 66 On The Air**. 28.466 14.266 7.266 3.866. Certificate & QSL. Citrus Belt Amateur Radio Club, P.O. Box 3788, San Bernardino, CA 92413. *Twenty-one stations participating, operating in or around the major cities along Route 66 from Santa Monica, California, to Chicago, Illinois.* **www.w6jbt.org**

Sep. 17 – Sep. 18, 1700Z – 0459Z, KF5DFD, Henrietta, TX. Clay County Amateur Radio Club. **Clay County Pioneer Day**. 14.255 7.255. QSL. Brent Boydston, 103 N. Crockett St., Henrietta, TX 76365. *Bonus dates, times, and hours may be added.* **www.facebook.com/groups/skywarn.clay.county**

Sep. 17 – Sep. 19, 1300Z – 2359Z, W1W/W1B/W1Z, Billerica, MA. Billerica Amateur Radio Society and Hampden County Radio Association. **WBZ AM 1030 100th Anniversary**. 18.150 14.250 7.275 3.950. Certificate & QSL. Douglas A. Bruce, 67 John St., Reading, MA 01867-2701. **https://nediv.arrl.org/wbz100**

Sep. 18, 1000Z – 1600Z, NE1PL, Fall River, MA. USTNR. **80th Anniversary of the Launch of the USS *Massachusetts***. 14.258; 20 and 40 meters phone; digital and CW possible. QSL. Rick Emord, 135 Wareham St., Middleboro, MA 02346. **www.ne1pl.org**

Sep. 18, 1600Z – 2020Z, KT7RC, Tucson, AZ. Tortolita Radio Club. **Titan Missile Museum**. CW 14.040 7.040; SSB 14.250 7.200; FT8 18.100 7.074. Certificate. Request certificate at **contact@tortolita-rc.com**. *No paper QSLs*. **https://tortolita-rc.com**

Sep. 18 – Sep. 19, 1300Z – 2200Z, K9P, Danville, IN. Hendricks County Amateur Radio Society. **International Talk Like A Pirate Day**. 14.262 7.212 3.812. QSL. Tom Hansen, 410 W. US Highway 40, Clayton, IN 46118-9307.

Sep. 20 – Sep. 25, 0100Z – 0100Z, WØE, Lamar, MO. Kilowatt Amateur Radio Club (KØKWC). **Wyatt Earp Fest**. 14.250. QSL. Kilowatt ARC, 700 Hagny St., Lamar, MO 64759. **kilowattarc@hotmail.com**

Sep. 24 – Sep. 26, 1200Z – 1200Z, W2H, Speculator, NY. Hamilton County Radio Club. **Speculator Applefest**. 3.958 7.230 7.031 3.531. QSL. Peter Weaver, NYS Route 8, Lake Pleasant, NY 12108. **www.hamcoarc.org**

Sep. 25, 1200Z – 1800Z, K4S, Somerset, KY. Lake Cumberland Amateur Radio Association**. Somernites Cruise September**. 14.240 14.230 14.220 14.210. QSL. Wanda Munsey, 600 W. Hwy. 837, Nancy, KY 42544. **www.lcara.net**

Sep. 25, 1200Z – 2100Z, K9P, Peshtigo, WI. Marinette and Menominee Amateur Radio Club. **Peshtigo Fire 150th Anniversary**. 14.305 14.055 7.285 7.080. Certificate. Arden D. Nelson, 329 Brown Ave., Peshtigo, WI 54157. **w8pif.com/fire**

Sep. 25, 1200Z – 2200Z, K1SV, Arlington, VT. Southern Vermont Amateur Radio Club. **Covered Bridge Special Event**. 146.520 28.333 14.318 7.245. Certificate & QSL. Alden Jones, IV, 222 Northside Dr., Bennington, VT 05201. **www.sovarc.org**

Sep. 25, 1400Z – 2200Z, K1I, Reisterstown, MD. Ionic Lodge #145. **Masonic Lodges on the Air (CQ More Light)**. 3.825 7.200 14.250 21.300. Certificate & QSL. Mark Rauen, c/o Ionic Lodge #145, 85 Main St., Reisterstown, MD 21136. **www.gemeny.com/AA3NM/CQ-MoreLight.html**

Sep. 25, 1600Z – 2200Z, W4YK, Hendersonville, NC. Blue Ridge Amateur Radio Club. **Net Operator Recognition Event**. 14.238. QSL. David Day, 11 Mountain Spring Dr., Hendersonville, NC 28739. **www.radioclub.org**

Sep. 25 – Sep. 26, 1600Z – 2100Z, WC8VOA, West Chester, OH. West Chester Amateur Radio Association. **VOA Bethany Station 77th Anniversary**. 14.268 7.268. Certificate & QSL. West Chester ARA QSL Manager, P.O. Box 913, West Chester, OH 45071. *QSL direct or via the bureau; an electronic certificate will be available for download after the event is over.* **www.wc8voa.org**

Sep. 25 – Sep. 26, 1900Z – 1900Z, KL7HOM, Anchor Point, AK. South Peninsula Amateur Radio Club. **North America's Most Westerly Contiguous Highway Point**. 18.149 14.249 14.049 7.249. QSL. Thomas Kerns, 1189 Cook Way, Homer, AK 99603. **www.qrz.com/db/kl7hom**

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 (three 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. *Note: Some clubs may ask for a nominal fee to cover the cost of the certificate or QSL. Request will be made on air during the event or on the club's website.

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**. A plain-text version of the form is available at that site. You may also request a copy by mail or email. Off-line completed forms can be mailed, faxed (Attn: Special Events), or emailed.

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 **December** *QST* would have to be received by **October 1**. In addition to being listed in *QST*, your event will be listed on the ARRL Web Special Events page. Note: All received events are acknowledged. If you do not receive an acknowledgement 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**.

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 June 2021 activity report of the Volunteer Monitoring Program.

♦The FCC was requested to review a vanity call sign application filed by a Georgia licensee because of an apparently false answer to the question regarding a felony conviction.

♦A licensee in Massachusetts received an advisory concerning obscenity and harassment on 160 meters. The FCC will hold for review any renewal application filed by this licensee.

♦A General-class licensee in San Antonio, Texas, received an advisory for operation in the Amateur Extra-class portion of the 20-meter band.

♦Licensees in Pennsylvania, North Carolina, Georgia, and Virginia received advisories concerning failure to identify and other possible violations as part of a general audit of complaints about licensee conduct on 1.938, 3.860, 3.895, and 3.927 MHz.

♦In May, Volunteer Monitors logged 1,514 hours on HF frequencies and 2,072 hours on VHF frequencies and above.

The Volunteer Monitor Program Administrator had one meeting with the FCC, and two cases were referred to the FCC for further action. One case involves a taxi company in Alaska operating on 2 meters. — *Thanks to Volunteer Monitor Program Administrator Riley Hollingsworth, K4ZDH*

ARRL Foundation Presents the 2021 Scholarship Recipients

The ARRL Foundation is pleased to present the students selected to receive scholarship awards for 2021. Scholarships are made possible through the generosity of individuals and clubs. This year, 120 scholarships totaling over $561,000 were awarded. The ARRL Foundation Board of Directors offers these hams their best wishes for continued success as they pursue their college degrees. The 2022 application period is expected to open on September 1, 2021. For more information, please visit **www.arrl.org/scholarship-program**.

Laura A. Accola, W9MBA
The Indianapolis Amateur Radio Association Scholarship

Lydia Anderson, KE8HPZ
The East Coast Amateur Radio Service (ECARS) Scholarship

Nathan J. Appel, KD8ZIA
The Amateur Radio Digital Communications (ARDC) Scholarship

Paul Bartolemea, N2IP
The Richard G. Kirkpatrick, K8WU, Memorial Scholarship

Allan J. Baum, K2AJB
The Scholarship of the Morris Radio Club of New Jersey

Ariel R. Berger, K2NYS
The L. B. Cebik, W4RNL, and Jean Cebik, N4TZP, Memorial Scholarship

Samuel Berry, AEØKH
The ARRL Foundation General Fund Scholarship

Ryan J. Bibby, KN4RQL
The Amateur Radio Digital Communications (ARDC) Scholarship

Cameron B. Blew, N6CAM
The ARRL Foundation General Fund Scholarship

David Bolt, KEØYJO
The Pikes Peak Radio Amateur Association (PPRAA) Memorial Scholarship

Frances E. Bonte, KE8HPA
The Amateur Radio Digital Communications (ARDC) Scholarship

Madison S. Boutwell, KG5ZAO
The Tom and Judith Comstock Scholarship

Christopher M. Brault, KD8YVJ
The Amateur Radio Digital Communications (ARDC) Scholarship

Rebecca C. Button, KM4PWB
The East Coast Amateur Radio Service (ECARS) Scholarship

Lucas E. Carlson, KM6RXW
The Amateur Radio Digital Communications (ARDC) Scholarship

Logan M. Chapman, KE8OIB
The East Coast Amateur Radio Service (ECARS) Scholarship

Stephen Chung, KC3ART
The Potomac Valley Radio Club (PVRC) Scholarship

Ethan J. Clay, KO4HTG
The Gary Wagner, K3OMI, Scholarship

Anthony L. Comanzo, KD2HJH
The Henry Broughton, K2AE, Memorial Scholarship

Caroline M. Conolly, KI7AJB
The Lois Manley, K7LMZ, and Randall Pitchford, WW7ZZ, Scholarship

Justin A. Contreras, KI5CKQ
The Walter Gallinghouse, K5DSL, Scholarship

Holden J. Correia-Fischer, KD2JPV
The Amateur Radio Digital Communications (ARDC) Scholarship

James C. Creamer, KN4TXF
The ARRL Foundation General Fund Scholarship

Michael A. Cullen, K6MAC
The FEMARA Scholarship

Catherine H. Deskur, KD2IDD
The Frankford Radio Club Scholarship

Caleb M. DeWitt, K8LZD
The William Gordon Buckner, WØVZK, Memorial Scholarship

Connor L. Dickey, KD9LSV
The Amateur Radio Digital Communications (ARDC) Scholarship

Steven M. Drabbant, K5ZL
The Amateur Radio Digital Communications (ARDC) Scholarship

Jaxon J. Dupre, NØXNN
The Dayton Amateur Radio Association Scholarship

Justin R. Ellis, KJ6PWP
The Dayton Amateur Radio Association Scholarship

Addison W. English, KO4IEJ
The Orlando HamCation® Scholarship

Jacob J. Feltz, K9TVG
The YASME Foundation Scholarship

Carissa L. Ferguson, KJ4EZA
The Fritz Nitsch, W4NTO, Memorial Scholarship

William T. Ferguson, KJ4EYZ
The Fritz Nitsch, W4NTO, Memorial Scholarship

Thomas R. Fike, KG7FXT
The Charles N. Fisher Memorial Scholarship

Joseph N. Fletcher, KM4PSL
The Metro Atlanta Telephone Pioneer Amateur Radio Club Scholarship

Anne E. Frank, KD9LRB
The L. B. Cebik, W4RNL, and Jean Cebik, N4TZP, Memorial Scholarship

Mackenzie S. Fravel, KO4JFZ
The Wayne Nelson, KB4UT, Memorial Scholarship

Joshua A. Garcia-Barreto, KM4OMX
The Atlanta Radio Club Scholarship

Jacob J. Gardner, KE8NIX
The Amateur Radio Digital Communications (ARDC) Scholarship

Samuel E. Gerhard, KC1NWR
The FEMARA Scholarship

Jacob A. Gionfriddo, KC1LYP
The New England Amateur Radio Festival (NEAR-Fest) Scholarship

Russell A. Goss, KD9FAL
The Amateur Radio Digital Communications (ARDC) Scholarship

Nesya G. Graupe, KD9JNT
The Ozaukee Radio Club, W9CQO, Scholarship

Brianna L. Greenberg, KK4VFP
The Gwinnett Amateur Radio Society Scholarship

Ryan P. Hall, KO4FVC
The Charles Clarke Cordle Memorial Scholarship

Peter Handler, KD9LPV
The Edmond A. Metzger Scholarship

Logan R. Heinzelman, KI5HXE
The Jake McClain Driver Scholarship

Tahmara N. Hendrickson, KC9UJM
The L. B. Cebik, W4RNL, and Jean Cebik, N4TZP, Memorial Scholarship

Daniel J. Hill, KD7WER
The Mary Lou Brown Scholarship

Catherine Hong, KC1MFU
The Amateur Radio Digital Communications (ARDC) Scholarship

Thomas C. Hubbard, KK6WRU
The Palomar Amateur Radio Club (PARC) Scholarship

Sarah J. Hull, W1SJH
The FEMARA Scholarship

Rachel C. Jones, KO4HLC
The Ernest L. Baulch, W2TX, and Marcia E. Baulch, WA2AKJ, Scholarship

Evan M. Kauffman, KC8EK
The William C. Winscott, N6CHA, Memorial Scholarship

Jonathan Z. Keiser, AG5SY
The Amateur Radio Digital Communications (ARDC) Scholarship

Sarah E. Keiser, AG5TJ
The Helen Laughlin AM Mode Memorial Scholarship

Alexandra C. Kemp, WD4BDQ
The K2TEO Martin J. Green, Sr., and K2PLF Martin J. Green, Jr. Memorial Scholarship

Julie Knappik, KB1YTT
The Amateur Radio Digital Communications (ARDC) Scholarship

Anthony R. Lazzazero, W2ZIA
The Dr. James L. Lawson Memorial Scholarship

Faith Hannah Lea, KD3Z
The Amateur Radio Digital Communications (ARDC) Scholarship

Zechariah J. Lea, WX4TVJ
The Amateur Radio Digital Communications (ARDC) Scholarship

Samuel H. Leigh, KEØGLI
The Paul and Helen L. Grauer Scholarship

Alisha M. Lin, K6AML
The Amateur Radio Digital Communications (ARDC) Scholarship

Truman M. Lindsey, N6TRU
The Harry A. Hodges, W6YOO, Scholarship

Steven T. MacLeroy, KN4STM
The Amateur Radio Digital Communications (ARDC) Scholarship

Zachary A. Martin, KC3EWK
The Chick Allen, NW3Y, Scholarship

Hunter Maslin, K4HMM
The Homer V. Thompson, W4CWV, and Annette P. Thompson, W4LKM, Memorial Scholarship

Mason W. Matrazzo, KM4SII
The Amateur Radio Digital Communications (ARDC) Scholarship

Allison K. Maurice, KH2AK
The Byron Blanchard, N1EKV, Memorial Scholarship

Flora G. McConkie, KB3VOF
The James Cothran, KD3NI, Scholarship

Collin A. McCoy, K3SVT
The You've Got A Friend in Pennsylvania Scholarship

McKenzie L. Menefee, KI5MHA
The Allen and Bertha Watson Memorial Scholarship

Christopher J. Mentele, WØLSB
The ARRL Foundation General Fund Scholarship

Jacob Nagel, ADØJA
The Amateur Radio Digital Communications (ARDC) Scholarship

Declan M. O'Hara, KG7HTE
The Amateur Radio Digital Communications (ARDC) Scholarship

Simon S. Page, KC1FJD
The FEMARA Scholarship

Allison H. Painter, KI7GIN
The Amateur Radio Digital Communications (ARDC) Scholarship

Clayton J. Paus, K4CJP
The IRARC Memorial, Joseph R. Rubino, WA4MMD, Scholarship

Jack F. Paylor, W5NIO
The North Texas Section Bob Nelson, KB5BNU, Scholarship

Philip N. Pierce, KD9NYH
The O.M. International Sideband Society (OMISS) Scholarship

Sarah M. Porter, KM4WLQ
The Amateur Radio Digital Communications (ARDC) Scholarship

David A. Puma, KG5UBB
The Amateur Radio Digital Communications (ARDC) Scholarship

Sankarsh R. Rao, KG5VKF
The Alfred E. Friend, Jr., W4CF, Memorial Scholarship

Kathryn G. Robertson, KC3NCT
The Amateur Radio Digital Communications (ARDC) Scholarship

Hannah E. Rosenfeld, W7HER
The Amateur Radio Digital Communications (ARDC) Scholarship

Michael G. Rubin, KDØPZI
The Irving W. Cook, WAØCGS, Scholarship

Kaleb T. Ruddle, KN4JGJ
The Alan G. Thorpe, K1TMW, Memorial Scholarship

Sadie M. Sarkisian, KK6VKV
The Medical Amateur Radio Council (MARCO) Scholarship

Emma R. Schaefer, KC9YGJ
The L. B. Cebik, W4RNL, and Jean Cebik, N4TZP, Memorial Scholarship

Jason Schlottman, KR7JAS
The Dayton Amateur Radio Association Scholarship

Matthew T. Self, KN4EDG
The Rfinder LLC – Arthur L. Greenberg, W2LH, and Madeline Greenberg, W2EEO, Memorial Scholarship

Noah J. Sevcik, K9BZY
The Amateur Radio Digital Communications (ARDC) Scholarship

Lukas J. Severinghaus, KK6AXQ
The Bill Salerno, W2ONV, and Ann Salerno Memorial Scholarship

Noah Severinghaus, KE8BGR
The Dayton Amateur Radio Association Scholarship

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The Betty Weatherford, KQ6RE, Memorial Scholarship

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The ARRL Scholarship to Honor Barry Goldwater

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The Donald Riebhoff Memorial Scholarship

Maya Tamir, KM6VKD
The Amateur Radio Digital Communications (ARDC) Scholarship

Sharon Tamir, W6TXT
The L. B. Cebik, W4RNL, and Jean Cebik, N4TZP, Memorial Scholarship

Nicola Thompson, KØMTC
The ARRL Foundation General Fund Scholarship

Daniel R. Thomson, KB7DRT
The Amateur Radio Digital Communications (ARDC) Scholarship

Oliver L. Trevor, KM6WOX
The Dick Warren, K6OBS, Memorial Scholarship

Benjamin W. Tyrrell, KEØAER
The Ray, NØRP, and Katie, WØKTE, Pautz Scholarship

Eryn P. Wagoner, KEØWEY
The Dayton Amateur Radio Association Scholarship

Rowen K. Warren, AEØCP
The Amateur Radio Digital Communications (ARDC) Scholarship

Jacob B. Weiser, KM6ZBU
The K6GO Gayle Olson and NA6MB Mike Binder Scholarship

Carolina M. Whitaker, KD9NKM
The Amateur Radio Digital Communications (ARDC) Scholarship

Emily E. Wilbourn, KM4JXB
The North Fulton Amateur Radio League (NFARL) Scholarship

Justin M. Wolters, N8FCC
The Ted, W4VHF, and Itice, K4LVV, Goldthorpe Scholarship

Elizabeth G. Ziemer, KD9ORR
The Rev. Paul E. Bittner, WØAIH, Memorial Scholarship

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
TI = Talk-in frequency
Adm = Admission

Alabama (Attalla) — Sept. 11 D F H R T V
8 AM – noon. *Spr:* Gadsden ARC. American Legion Fairgrounds, 404 Griffin St. *TI:* 146.670 (100 Hz). *Adm:* free. Email: **k4vmv1@charter.net**

Arizona (Payson) — Oct. 2 D F T V
9 AM – noon. *Spr:* Tonto ARA. Rumsey Park Ramada #5, 400 McLane Rd. *TI:* 147.39 (100 Hz). *Adm:* none. **www.tontoradio.org**

Arizona (Tucson) — Sept. 25 D F H Q R T V
7 – 11 AM. *Spr:* Radio Society of Tucson. Calvary Chapel of Tucson East Campus, 8711 E. Speedway Blvd. *TI:* 145.250 (156.7 Hz). *Adm:* free. **www.k7rst.org**

California (Lincoln) — Sept. 18 D F H R V
7 AM – noon. *Spr:* Western Placer ARC. McBean Park, 65 McBean Park Dr. *TI:* 147.300 (67 Hz). *Adm:* free. **www.wparc.us**

California (Sonoma) — Oct. 2 F H R T V
8 AM – noon. *Spr:* Valley of the Moon ARC. First Congregational Church of Sonoma, 252 W. Spain St. *TI:* 145.35 (88.5). *Adm:* free. **www.vomarc.org**

Florida (Crestview) — Oct. 8 – 9 D F H R V
Fri. 5 – 7 PM, Sat. 7 AM – 3 PM. *Spr:* North Okaloosa ARC. Crestview Community Center, 1466 Commerce Dr. *TI:* 147.360 (100 Hz). *Adm:* $7. **www.w4aaz.org/noarc-hamfest**

ARRL FLORIDA STATE CONVENTION

October 8 – 9, Melbourne, Florida
D F Q R S T V
Fri. 1 – 7 PM, Sat. 9 AM – 3 PM. *Spr:* Platinum Coast ARS. Melbourne Auditorium, 625 E. Hibiscus Blvd. *TI:* 146.610. *Adm:* $10. **www.pcars.org**

Illinois (Belvidere) — Sept. 26 D F H R T V
8 AM – 1 PM. *Spr:* Chicago FM Club. Boone County Fairgrounds, 8791 IL-76. *TI:* 146.760 (107.2). *Adm:* $8 advanced, $10 door. **www.chicagofmclub.org**

Illinois (Pekin) — Sept. 18 – 19 D F H Q R S T V
Gates open at 6 AM. Sat. 8 AM – 4 PM, Sun. 8 AM – 1 PM. *Spr:* Peoria Area ARC. Avanti's Dome, 3401 Griffin Ave. *TI:* 147.075 (156.7 Hz). *Adm:* $7 advance, $10 door. **www.w9uvi.org**

Indiana (Lafayette) — Sept. 11 D F H Q R T V
8 AM – 2 PM. *Spr:* Tippecanoe ARA. Tippecanoe County 4-H Fairgrounds, 1406 Teal Rd. *TI:* 147.135 (131.8 Hz). *Adm:* $5. Email: **chell1470@gmail.com**

Indiana (Mitchell) — Oct. 2 D F H R S T V
8 AM – noon. *Spr:* Hoosier Hills Ham Club W9QYQ. Lawrence County 4-H Fairgrounds, 11265 US-50 W. *TI:* 146.730 (107.2). *Adm:* $5. **www.w9qyq.org**

Kansas (Wichita) — Oct. 2 D F H R V
8 AM – 1 PM. *Spr:* Valley Center ARC. Riverwalk Church of Christ, 225 N. Waco Ave. *TI:* 146.940 (103.5). *Adm:* $5. **www.vcarc.org**

ARRL GREAT LAKES DIVISION CONVENTION

October 2, Bowling Green, Kentucky
D F H S V
8 AM – 4 PM. *Spr:* Kentucky Colonels ARC. Western Kentucky University Knicely Conference Center, 2355 Nashville Rd. *TI:* 147.330 (107.2 Hz). *Adm:* $6. **www.ky4bg.com**

Kentucky (Paintsville) — Sept. 25 F H R V
8 AM – 2 PM. *Spr:* Amateur Radio Community Services. Paintsville Recreation Center, 232 Preston St. *TI:* 147.225 (127.3). *Adm:* $5. Email: **grossl@bigsandybb.com**

Kentucky (Richmond) — Sept. 18 D F H R T V
8 AM – 2 PM. *Spr:* Madison County Fairgrounds. Madison County Fairgrounds, 3237 Old Irvine Rd. *TI:* 145.370 (192.8). *Adm:* $6. **www.ckars.org/hamfest**

Kentucky (Shepherdsville) — Sept. 11 D F H Q R S T V
8 AM – 2 PM. *Spr:* Greater Louisville Hamfest Association. Paroquet Springs Conference Centre, 395 Paroquet Springs Dr. *TI:* 146.700 (79.7 Hz), 443.700 (79.7 Hz). *Adm:* $7 advance, $8 door (cash only). **www.louisvillehamfest.com**

Maine (Windsor) — Sept. 18 D F H Q R T
8 AM – noon. *Spr:* Augusta ARA. Windsor Fairgrounds, 82 Ridge Rd. *TI:* 146.670 (100 Hz). *Adm:* $7. Email: **studebakerbill@yahoo.com**

Maryland (Hollywood) — Sept. 25 F H R T
8 AM – noon. *Spr:* St. Mary's County ARA. Hollywood Volunteer Fire Department Bingo Hall, 24801 Three Notch Rd. (MD Rte. 235). *TI:* 146.64 (146.2 Hz). *Adm:* free. **www.k3hki.org**

Maryland (West Friendship) — Oct. 3 D F H Q S T V
6 AM – 3 PM. *Spr:* Columbia ARA. Howard County Fairgrounds, 2210 Fairgrounds Rd. *TI:* 147.390 (156.7 Hz). *Adm:* $7. **www.carafest.org**

Michigan (Adrian) — Sept. 19 D F H R T V
8 AM. *Spr:* Adrian ARC. Lenawee County Airport, 2651 W. Cadmus Rd. *TI:* 145.37 (85.4 Hz). *Adm:* $5. **www.w8tqe.com**

Michigan (Cadillac) — Sept. 18 D H R V
8 AM – noon. *Spr:* Wexaukee ARC. Cadillac Junior High School, 500 Chestnut St. *TI:* 146.980 (no tone). *Adm:* $5. **www.wexaukeearc.org**

Michigan (Okemos) — Sept. 18 D H R S V
8 AM – 12:30 PM. *Spr:* Central Michigan ARC. Okemos Convention Center, 2187 University Park Dr. *TI:* 145.390 (100 Hz). *Adm:* $5. Email: **kd8yde@inbox.com**

Michigan (Shelby Township) — Sept. 18 D F
8 AM – 12:30 PM. *Spr:* GM Amateur Radio Club. Packard Proving Grounds, 49965 Van Dyke Ave. *TI:* 443.075 (123 Hz). *Adm:* $5 per carload, buying or selling. **www.gmarc.org**

Michigan (Wyoming) — Sept. 11 D F H Q R S T V
8 AM – 1 PM. *Spr:* Grand Rapids ARA. HSB, 5625 Burlingame Ave. SW. *TI:* 147.26 (94.8 Hz). *Adm:* $8. **www.w8dc.org**

Minnesota (Cologne) — Sept. 18 D F H Q R S V
8 AM – noon. *Spr:* SMARTS Radio Club. Cologne Community Center, 1211 Village Pkwy. *TI:* 147.165. *Adm:* $10. **www.smartsfest.org**

Minnesota (Lake Elmo) — Sept. 18 F H T
8 AM – noon. *Spr:* Metro Area Repeater Association. Helwig Farm (MARA Center), 8247 27th St. N. *TI:* 146.850. *Adm:* free. Email: **wb0wot@arrl.net**

Minnesota (Plymouth) — Sept. 25 R T
8 – 11:30 AM. *Spr:* Twin City FM Club. West Medicine Lake Community Club, 1705 Forestview Ln. *Tl:* 146.76 (114.8 Hz). *Adm:* $5. **www.tcfmc.org**

Minnesota (Rush City) — Sept. 11 F H T
9 AM – noon. *Spr:* East Central Minnesota ARC. Rush City High School, 51001 Fairfield Ave. *Tl:* 145.330 (146.2 Hz). *Adm:* free. **www.qrz.com/db/K0ECM**

Nebraska (Bellevue) — Oct. 2 F R
8 AM – 1 PM. *Sprs:* Bellevue ARC and Ak-Sar-Ben ARC. Reed Community Center, 1200 Lord Blvd. *Tl:* 147.39 (131.8 Hz). *Adm:* $5. **www.bellevuearc.org**

ARRL SOUTHERN NEW JERSEY SECTION CONVENTION

September 12, Mullica Hill, New Jersey
D F H R S T V
8 AM – 1 PM. *Spr:* Gloucester County ARC. Gloucester County 4-H Fairgrounds, 235 Bridgeton Pike (Rte. 77). *Tl:* 147.180 (131.8 Hz). *Adm:* $10. Email: **sheldonparker@comcast.net**

New Jersey (Spring Lake) — Sept. 18 D F H R T V
7 AM – noon. *Spr:* Ocean Monmouth ARC, Inc. Spring Lake Heights Volunteer Fire Company Number One, 700 Sixth Ave. *Tl:* 145.110 (127.3 Hz). *Adm:* $5 kids, free ages 12 and under. **www.n2mo.org**

New Jersey (Tinton Falls) — Sept. 25 D F Q R V
8 AM – noon. *Spr:* Garden State ARA. Monmouth Ocean Educational Services Commission parking lot, 100 Tornillo Way. *Tl:* 147.045 (67 Hz). *Adm:* $10 vendors, $5 first table/buyers. **www.gsara.club**

New York (Chaffee) — Sept. 11 D F H R T V
9 AM – noon. *Spr:* Pioneer Radio Operators Society. Manion Park, 9999 Grove St. *Tl:* 145.39. *Adm:* $5. Email: **royschwedt@gmail.com**

New York (Horseheads) — Sept. 25 D F H R V
6 AM – 2 PM. *Sprs:* CCARES and ARAST. Chemung County Fairgrounds, Grand Central Ave. *Tl:* 146.700 and 147.360. *Adm:* $6 advanced, $8 door. **www.arast.info**

New York (Lockport) — Sept. 11 D F H R T
7 AM. *Spr:* Lancaster ARC. Transit Drive-In Theatre, 6655 S. Transit Rd. *Tl:* 147.255 (107.2 Hz). *Adm:* $8. **www.w2so.org**

New York (Scotchtown) — Sept. 12 D F H Q R S T V
8 AM – noon. *Spr:* Orange County ARC, Inc. Wallkill Community Center, 7-9 Wes Warren Dr. *Tl:* 448.325 (123). *Adm:* $6. **www.ocarcny.org**

ARRL DAKOTA DIVISION CONVENTION

September 25, West Fargo, North Dakota
F H R S V
8 AM – 2 PM. *Spr:* Red River Radio Amateurs. West Fargo Fairgrounds, 1805 Main Ave. W. *Tl:* 145.350 (123 Hz) and 444.875 (123 Hz). *Adm:* $10. **www.rrra.org**

Ohio (Berea) — Sept. 26 D F H Q R S T V
8 AM – 1 PM. *Spr:* Hamfest Association of Cleveland. Cuyahoga County Fairgrounds, 164 Eastland Rd. *Tl*: 146.73. *Adm:* $6. **www.hac.org**

Ohio (Findlay) — Sept. 12 D F H R S T
8 AM – 3 PM. *Spr:* Findlay Radio Club. Hancock County Fairgrounds, 1017 E. Sandusky St. *Tl:* 147.150 (88.5 Hz). *Adm:* $10. **www.findlayradioclub.org/hamfest**

Ohio (Miamisburg) — Sept. 18 F T
8 AM – noon. *Spr:* Mound ARA. Mound Park, 900 Mound Rd. *Tl:* 147.195. *Adm:* free. **www.w8dyy.org**

Ohio (Troy) — Sept. 18 F H R T
9 AM – 3 PM. *Spr:* Miami County ARC. Miami County Amateur Radio Club House, 728 Harrison St. *Tl:* 145.230 (100.0 Hz). *Adm:* $5. **www.w8fw.org**

Oklahoma (Tulsa) — Sept. 11 F H T V
8 AM – 3 PM. *Spr:* Green Country Hamfests, Inc. Asbury Church, east parking lot, 6767 S. Mingo Rd. *Tl:* 146.88 (88.5 Hz). *Adm:* free. **www.greencountryhamfest.org**

Pennsylvania (Butler) — Sept. 12 D F H R T V
8 AM – 1 PM. *Spr:* Butler County ARA. Unionville Volunteer Fire Company, 102 Mahood Rd. *Tl:* 147.360 (131.8 Hz). *Adm:* $5. **www.w3udx.org**

Pennsylvania (East Stroudsburg) — Sept. 26 D F H R T V
8 AM – 4 PM. *Spr:* Eastern Pennsylvania ARA. The American Legion Post 346, 126 E. 5th St. *Tl:* 147.045 (131.8 Hz). *Adm:* $7. **www.qsl.net/n3is**

Pennsylvania (New Holland) — Oct. 2 D F H R S T V
7 AM – noon. *Spr:* Red Rose Repeater Association. Garden Spot Fire Rescue, 339 E. Main St. *Tl:* 147.015 (118.8). *Adm:* $5. **www.w3rrr.org**

W4DXCC DX AND CONTEST CONVENTION

September 24 – 25, Pigeon Forge, Tennessee
D H Q R S V
Fri. 10 AM – 4 PM, Sat. 8 AM – 10 PM. *Spr:* The SouthEastern DX and Contesting Organization (SEDCO). Mainstay Suites and Convention Center, 410 Pine Mountain Rd. *Tl:* none. *Adm:* $40. **www.w4dxcc.com**

Texas (Belton) — Oct. 2 D F H R T V
7 AM – 1 PM. Temple ARC. Bell County Expo Center, 301 W. Loop 121. *Tl:* 146.820 (123.0). *Adm:* $5. **www.tarc.org**

Washington (Union Gap) — Sept. 18 F H Q R T
9 AM – 2 PM. *Spr:* N7YRC Group. Yakima Office of Emergency Management, 2403 S. 18th St. *Tl:* 147.06 (85.4 Hz). *Adm:* $5 donation. **www.n7cfo.com**

Wisconsin (Cedarburg) — Sept. 11 D F H R
6 AM – noon. *Spr:* Ozaukee Radio Club. Fireman's Park, 796 Washington Ave. *Tl*: 146.97 (127.3 Hz). *Adm:* $5, free ages 12 and under. **www.ozaukeeradioclub.org**

ARRL WYOMING SECTION CONVENTION

October 8 – 9, Cheyenne, Wyoming
F H S T V
8 AM – 5 PM. *Spr:* Shy-Wy ARC. Event Center at Archer, 3801 Archer Pkwy. *Tl:* 146.775 (114.8 Hz). *Adm:* $12 advance, $15 door. **www.wyhamcon.org**

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. See **www.arrl.org/hamfest-convention-application** for an online registration form.

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.

The deadline for receipt of items for this column is the **1st of the second month preceding publication date**. For example, your information must arrive at HQ by **October 1** to be listed in the **December** issue.

ARRL VEC Volunteer Examiner Honor Roll

The ARRL VEC Honor Roll recognizes the top five Volunteer Examiners in each ARRL Division according to the total number of ARRL exam sessions in which they have participated since their accreditations. Considering each session requires an average time commitment of 2 to 4 hours or more, the thousands of hours these VEs have invested represent extraordinary dedication! Whether you are one of our VE Teams that tests once a week, once a month, or once a year, we want to express our warmest appreciation to all volunteers for your generous contribution to the ARRL VEC program.

If you are an ARRL VE, you can view your session stats online at **www.arrl.org/ve-session-counts**.
If you are not a VE, become one today! See **www.arrl.org/become-an-arrl-ve**.

Examiner	Sessions	Accreditation Date
Atlantic		
Jobst Vandrey, AC0LP	324	23-Jun-08
James McCloskey, NS3K	320	14-Nov-94
Edward Genoino, WA2NDA	298	10-Jul-85
George Brechmann, N3HBT	286	01-Apr-91
William Klepser, Jr., WB2AIV	215	09-Jun-99
Central		
Ed Wagner, AB9FN	371	01-Jul-02
Allan Bukowski, N9ZD	324	01-Jun-92
Eldon Boehm, NK9U	316	21-Nov-86
Donald Hlinsky, N9IZU	314	01-Mar-91
Brian Eder, WB9UGX	283	01-Jan-92
Dakota		
Jeffrey Goodnuff, W0KF	315	17-Jun-03
John Schwarz, Jr., AE0AL	309	26-Oct-94
Shep Shepardson, N0NMZ	264	12-Mar-01
Daniel Royer, KE0OR	239	01-Jul-91
Dennis Ackerman, KB0OQQ	221	15-Jul-96
Delta		
Monvel T. Maskew, Jr., K9FQ	581	18-Jul-18
Arthur Parry, Jr., WB4BGX	270	01-May-91
Joe Lowenthal, WA4OVO	264	25-May-06
Roger Gray, N5QS	247	01-Mar-93
Bobbie Williams, W1BEW	237	01-Jun-92
Great Lakes		
David Potter, KE8OHG	771	03-Jun-20
Charles Tyrrell, KE8PCB	490	03-Sep-20
Charles Hall, W8HF	286	01-Jun-92
Lance Harvala, AB8Y	238	06-Nov-19
Archie Mack, Sr., AF4EB	235	19-Aug-97
Hudson		
Paul Maytan, AC2T	699	06-Sep-84
Stanley Rothman, WA2NRV	472	01-Mar-85
Fritz Boigris, KB2O	456	26-Oct-84
Alan Crosswell, N2YGK	452	26-Oct-94
Gerald Miller, Jr., AA2ZJ	402	05-Dec-95
Midwest		
David Bartholomew, AB0TO	740	22-Mar-02
Kevin Naumann, N0WDG	650	17-Nov-02
Harry Steger, Jr., W0HMS	579	26-Aug-08
Roland Kramer, W0RL	533	21-Jun-01
Jeanette Nordman, AB0YX	460	21-Aug-03
New England		
*Bob Phinney, K5TEC	1,386	20-Jan-14
*Paul Lux, K1PL	1,134	25-Jan-85
Phillip Temples, K9HI	510	12-May-89
Gregory Paul, KC1MND	452	03-Jun-20
Robert Beaudet, W1YRC	395	01-Aug-90
Northwestern		
Richard Morgan, KD7GIE	450	11-Aug-00
Loren Hole, KK7M	381	06-Sep-84
Scott Robinson, AG7T	352	01-Aug-91
S. Riley McLean, W7RIL	313	02-Sep-99
David Brooks, N7HT	308	10-Jun-87
Pacific		
Morris Jones, AD6ZH	503	27-Nov-01
Brian Torr, N6IIY	455	06-Sep-00
Dieter Stussy, KD6LVW	430	27-Jan-94
Gordon Fuller, WB6OVH	357	06-Sep-84
Bill Nichols, NN7K	337	01-Sep-93
Roanoke		
Judy Friel, AC4RG	298	01-Feb-91
Alan Ronald Moeck, WA2RPX	264	27-Sep-94
David Snyder, W4SAR	250	01-May-93
Terry Sanner, WV8V	220	06-Sep-84
Thomas Hill, KJ4IV	201	01-Jun-91
Rocky Mountain		
Robert Hamilton, N0RN	396	19-May-87
Jeffrey Weinberg, W0QO	306	01-Apr-93
David Avery, N0HEQ	302	13-Jan-88
Donald Baune, AC0EX	259	19-Sep-06
David Sharpe, KI0HG	257	02-Feb-98
Southeastern		
***Gary Lee Pike, KA4KBX	3,879	03-Sep-09
**Collin Pike, KJ4AXB	2,690	26-Apr-11
**Justin Lee Pike, KJ4AXF	2,653	12-Nov-12
*Anna Grogan Pike, KD4PCU	1,916	18-Aug-09
*Ryan Krenzischek, W4NTR	1,645	04-Jan-13
*Patrick Wyatt Pike, KJ4AXD	1,196	13-Oct-15
Southwestern		
*Bill Martin, AI0D	1,070	01-Nov-84
Fred Bollinger, AB7JF	538	17-Apr-95
David Morrill, N7TWT	448	20-Jul-00
Bruce Ziemienski, WA6BZ	321	25-Mar-02
Richard Buck, KC7OCT	312	21-May-97
West Gulf		
*Franz Laugermann, K3FL	1,044	01-Dec-91
Daniel Quigley, N7HQ	793	24-Apr-20
Gerald Grant, WB5R	496	04-Jan-85
Adolph Chris Koehler, K5VCR	481	29-Sep-95
Wilbert Cannonier, KK5JJ	469	03-Nov-95

Congratulations to Paul Lux, K1PL, from Cromwell, CT (New England Division) who is the latest VE to reach 1,000 sessions!

*Denotes participation in over 1,000 sessions. **Denotes participation in over 2,000 sessions. ***Denotes participation in over 3,000 sessions.

Feedback

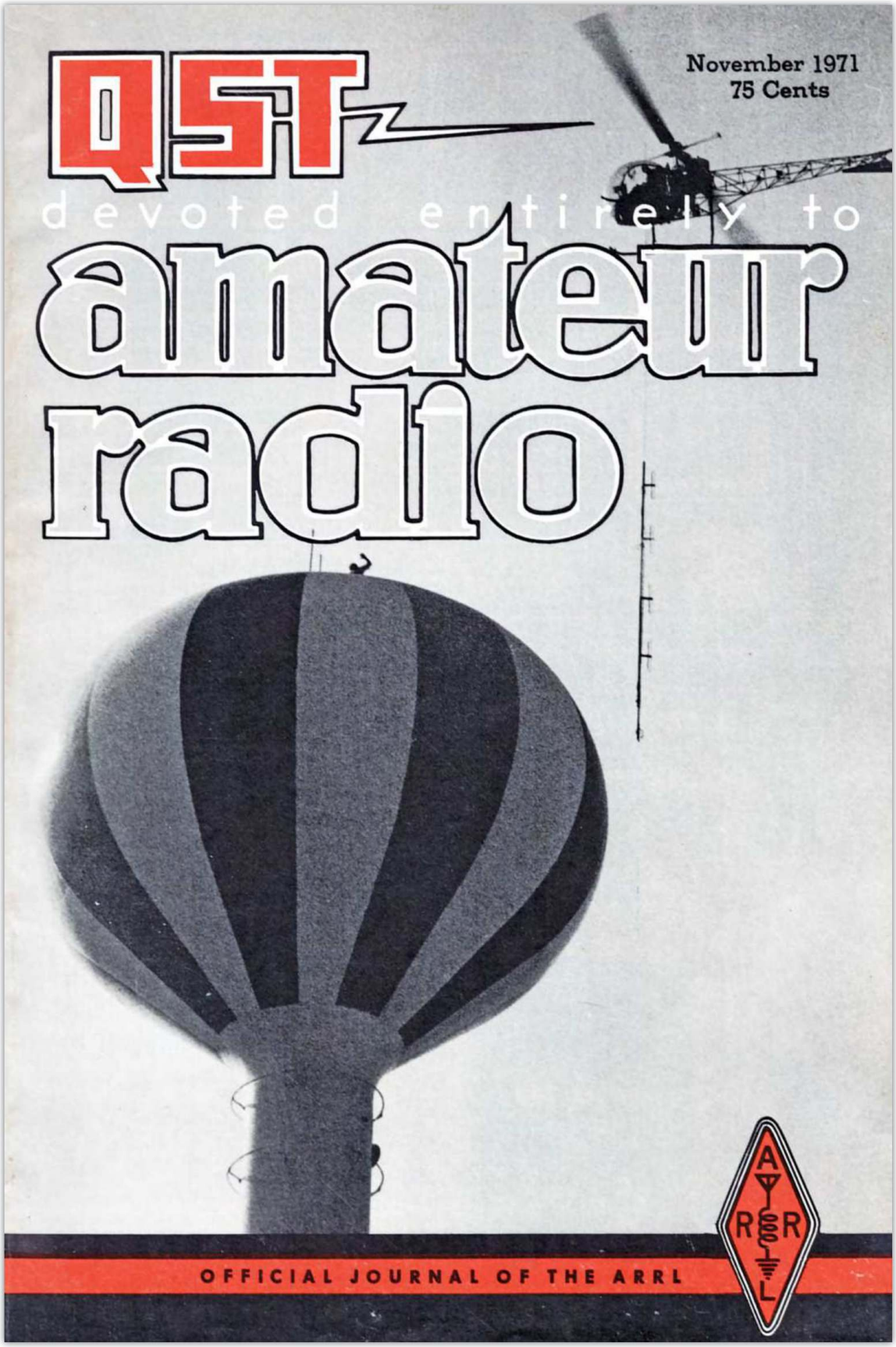
■ In Woody White's, KZ4AK, July 2021 *QST* article, "A Sensitive Field Strength Meter for Foxhunting," diode D2 should have been described as "1N4001 or similar." The connections to U2 should have been "In" (Pin 3) connected to C5, Pin 2 to ground, and "Out" (Pin 1) to C4. The left side of R5 should have connected to Pin 3 of the LM3900 along with R4, not to ground. *QST* regrets the errors.

■ In Ralph Gable's, WA2PUX, July 2021 article, "An Overvoltage Protection Circuit," the Figure 1 schematic needs some corrections. Q1 is a P-channel MOSFET, not N-channel, and it is pictured backwards. R1 is 402 W (shown correctly in the parts list). The unlabeled pin on U1 should be Pin 2, shown connected to Pin 5 and to ground. In the parts list, C2, C5, and C9 should be identified as electrolytic.

■ In the June 2021 "Product Review," Phil Salas, AD5X, reviewed the Ciro Mazzoni Baby Loop Antenna, but the RF exposure compliance distance at high power levels was not addressed. Kai Siwiak, KE4PT, analyzed a 1-meter-diameter small transmitting loop at 1500 W, which showed that the controlled compliance distance is about 20 feet, and the uncontrolled compliance distance is almost 43 feet on 10 meters and 1,500 W for a loop with higher losses. The Mazzoni Baby Loop is only rated to 1,000 W on 10 meters, so that may help. Please read Kai's "Technical Correspondence" item in the March 2012 issue of *QST* for more information if you're considering using a loop antenna at higher RF power levels.

■ In the July 2021 "Hints & Hacks" column, the schematic diagram shown in Figure 1 contains an error. The corrected schematic is available from the *QST* Feedback web page at **www.arrl.org/feedback**.

A Look Back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ARRL

Radiated Power Patterns for Multiband Dipoles

BY DALE W. COVINGTON,* K4GSX

IF ONE IS given both the azimuthal compass direction from the installed antenna and the vertical angle of elevation above ground which are optimum for transmitting via the ionosphere to any desired station in the world, the question naturally arises, "How well does the antenna radiate power in the direction defined by these two angular components?"[1] The answer to this question is of particular interest in a stationary, multiband wire antenna such as the popular W3DZZ.[2,3]

This article investigates the theoretical power-density pattern of a W3DZZ antenna installed at a feed height above ground of approximately ten meters, a height often encountered in practice. The same center height was used for a horizontal and an inverted-V form of the antenna in order that the effect of bending the legs could be directly compared.

Mathematical Approach

The actual W3DZZ antenna was represented mathematically by a collection of current elements located over a perfectly conducting ground plane. Current magnitudes for the elements were assigned for a simple sinusoidal current distribution which neglected the perturbing influences of the traps, the finite antenna diameter, and the feedline. The advantage of using incremental current elements was that the far-field patterns could be calculated by a computer for a rather general form of antenna with nonsymmetrical bends in the radiating elements. Table 1 summarizes the electrical details of the model while Fig. 1 gives the geometric details.

The computation proceeded as follows. First, the E and H fields radiated by each current element were found for every two-degree increment of azimuth and elevation in the first quadrant of the far-field hemisphere above the antenna. This yielded a matrix of the radiated power. Next the power matrix was searched for the maximum value of radiated power and all the remaining coordinates were referenced to it. The values in dB down from the maximum were printed out by the computer for each matrix coordinate. Contour lines for 3, 6, 9, 12, etc. dB down were then drawn from these data. With the symmetrical antennas being treated here, it was only necessary to find the power-density matrix for one quadrant of the hemisphere. Other quadrants are obtained by relabeling the azimuth axis as shown in Fig. 2A.

Computed Results

Unfortunately, lack of available computer time made it impossible to use enough increments to get

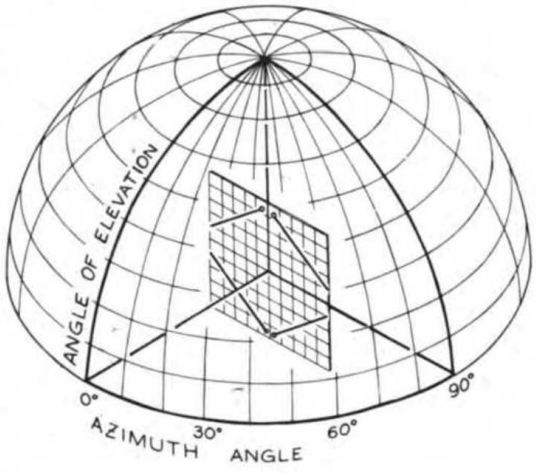


Fig. 1 — Isometric view of the multiband dipole and its image located at the center of the hemisphere which defines the angles of elevation and azimuth for the antenna. Patterns were computed for the outlined quadrant.

* 281 Vance Circle N.E., Marietta, GA 30060.

[1] It is relatively easy to obtain an estimate of these two angles. For any given circuit, the azimuth angle is found from the appropriate azimuthal world map or by mathematical calculations. Useful information and graphs relating ray paths and ionospheric layers to the angle of elevation are given in:
Chapter 12, "Propagation," *Radio Communication Handbook*, 4th Ed., Radio Society of Great Britain, 1968.
Davies, *Ionospheric Radio Propagation*, National Bureau of Standards Monograph 80, 1965.
Ionospheric Predictions, edited by M. Leftin, Institute for Telecommunication Sciences, Boulder, Colo., 1971.

[2] Buchanan, "The Multimatch Antenna System," *QST*, March, 1955.

[3] McCoy, "A Coax-Fed Trap-Dipole for 80 Through 10-Meters," *QST*, November, 1969.

TABLE 1

Electrical Model of W3DZZ Antenna Located 10.7 Meters above Perfect Ground

Freq. (MHz)	*h (height in λ)*	*l (length in λ)*	*No. Elements per length l*	*Δ(angle°)*	*Pattern*
3.5	λ/8	≈λ/2	18	180°	Fig. 2A
			18	120°	Fig. 2E
7.0	λ/4	λ/2	18	180°	Fig. 2B
			18	120°	Fig. 2F
14.0	λ/2	3λ/2	30	180°	Fig. 2C
			36	120°	Fig. 2G
21.0	3λ/4	5λ/2	30	180°	Fig. 2D
			–	120°	–

accurate results on the highest bands. The bands for which patterns were found are listed in Table 1. The patterns are plotted in Fig. 2. An angular-coordinate accuracy of two degrees appears to be consistent with the previously stated approximations regarding the quantized antenna and the hemisphere above it.

One should note that the horizontal antenna patterns could be computed manually by multiplying the free space pattern of the long wire, center fed antenna by the pattern for two isotropic point sources driven 180 degrees out of phase and separated by a distance of 2H. This procedure would not be valid, however, for the inverted V.

In the case of the horizontal antenna, Figs. 2A through 2D dramatically show the shift in the direction of maximum radiated power from the overhead direction at 3.5 and 7.0 MHz to end-fire, low-elevation-angle lobes at 14.0 and 21.0 MHz. The inverted-V form of multiband antenna (120 degrees), as the patterns of Figs. 2E through 2G indicate, is a more omnidirectional antenna. Performance off the ends at the lower frequencies should be better for the V than for the horizontal antenna. However, the horizontal form makes the better 14.0-MHz antenna except along an azimuth of about 20 degrees.

Conclusions

Patterns have been displayed of the variation of radiated power from a multiband antenna over perfect ground as a function of azimuth angle and angle of elevation. In practice, real ground will cause more decrease in the radiated power at the lowest angles of elevation than indicated by the patterns. Furthermore, polarization effects for both real ground and the ionosphere introduce additional complicating factors not treated here. Nevertheless the theoretical patterns do locate the directions in space through which most of the radiated power flows. Relative signal strengths in other directions can be determined from the charts. This information can be used either to position the antenna in such a way as to achieve the best results or to gauge the effectiveness of the present antenna on the various bands of operation.

QST

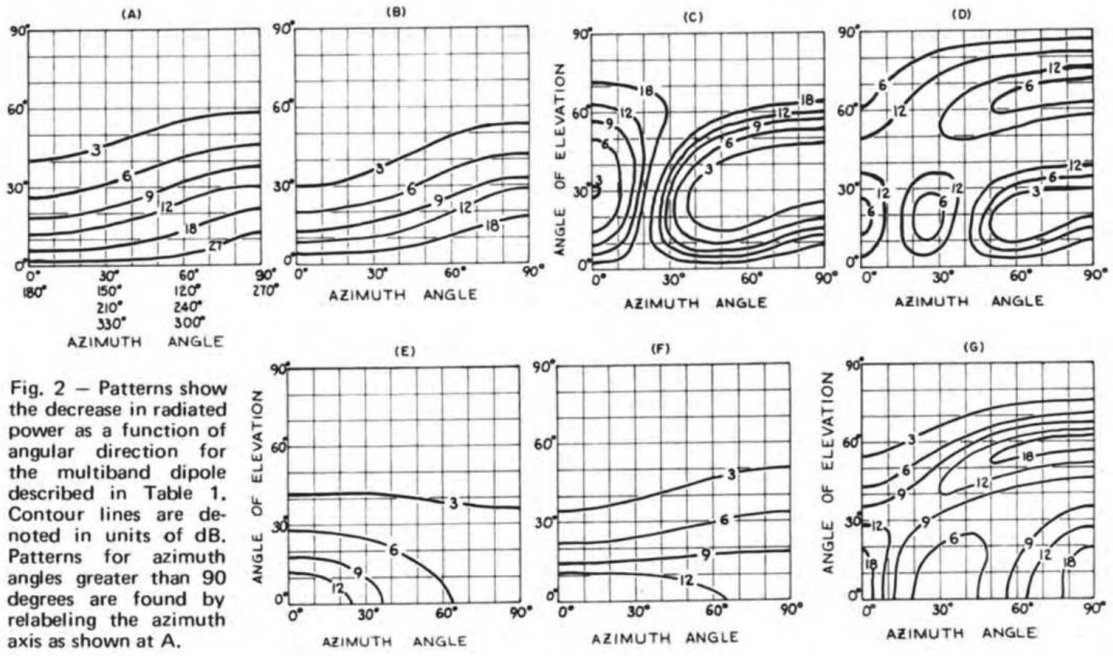


Fig. 2 — Patterns show the decrease in radiated power as a function of angular direction for the multiband dipole described in Table 1. Contour lines are denoted in units of dB. Patterns for azimuth angles greater than 90 degrees are found by relabeling the azimuth axis as shown at A.

The sixth point of the Amateur's Code states that the amateur will use his knowledge and his station " . . . for the service of his country and his community." If there is a prime justification for the existence of amateur radio it must be the service that we can perform for our fellow man, and service is the key word to the members of the Handicapper's Information Net. That's what makes them so typically amateurs in the fullest sense of the word's meaning.

Amateur Radio

– SERVING AND BEING SERVED

BY MIKE LeFAN,* WA5EQQ

MADE UP PRIMARILY of amateurs in Texas – but with check-ins from Oklahoma, Louisiana, and Colorado – the Handicapper's Net is pure public service in design and operation. The net's purpose is multi-faceted. First, it seeks to locate handicapped persons who might be interested in and could profit by being involved in amateur radio. Secondly, net members, about half non-handicapped, line up volunteer amateurs who are willing to assume responsibility for a disabled person in their vicinity. These volunteers see that their proteges get instruction and assistance in obtaining a license and getting a station on the air. It's not unusual, in fact, for a sponsor-ham to drive a hundred miles to check on his protege. All this time, the on-the-air net is scrounging the countryside for equipment that can be either given or loaned to handicapped people who cannot afford to purchase their own rigs.

Many net members are themselves disabled and know the value of having a knowledgeable helping hand to get started in amateur radio. As WA5VTA, net manager, puts it, "Radio means an awful lot to me. It gives me a chance to get out of my four walls to make new friends, and a way for me to help somebody else the same way I've been helped."

W5PCN (equipment manager), W5GBR (assistant equipment manager), WA5PRJ (records manager), WA5TIK (assistant net manager), and manager WA5VTA meet daily on 40 meters with other net members to coordinate the lists of new prospective amateurs with the catalog of available equipment and helpers. Net sessions include discussions of new prospects, the exchanging of ideas and helps concerning operating procedures for the handicapped plus the usual chit chat.

The handicapped individual is encouraged to purchase his own rig. However, if finances won't permit this, the net steps in with personal assistance and equipment. There are loans of code-practice tapes, code oscillators, Braille study material for the blind. After that, there are loans and gifts of entire rigs. Newly licensed and outfitted amateurs begin checking into the net as soon as they can, and the circle of helping starts revolving again.

The Handicapper's Information Net, believed to be the only one of its kind serving the disabled in the Southwest, can be heard Monday through Friday on 7270 kHz at 1400 in the Central time zone. The net has a continuing need for additional equipment – code practice equipment, transmitters, receivers, and operating aids for the blind and otherwise disabled. Outright donations are sought, but there's also a need for low-priced pieces that a disabled amateur with limited income can buy himself. W5PCN, equipment manager, indicates that serviceable receivers are really the hottest item needed, because these are that first step into the world of radio and prospective hams really crave a receiver to tune in on the action. QST

* 1802 South 13, Temple, TX 76501.

WA5VTA, Buddy Boyd of Conroe, Texas, is the organizer and manager of the Handicappers Information Net. His special rig was designed and built for him by WA5QKE.

WN5BOA, Nathan Smith of Corpus Christi, Texas, is a sightless amateur who got his ticket as a result of assistance from the Handicappers Net.

Celebrating Our Legacy

Fun with Shortwave

Brad Hulce, KR8P, and I received our Novice-class licenses in 1974. We shared a love of shortwave and medium-wave listening. In junior high, we started an informal shortwave listening group with a few kids at school. We would talk about the previous night's listening and place a marker on the US map each time we made a new contact.

I remember Brad reporting 800 AM, Trans World Radio (TWR), located in the Netherlands Antilles! After that, I went home and put up a 220-foot-long wire antenna between the house eaves and a huge white pine tree. I fiddled around in the back of my 1950s Bendix tube clock radio and attached the long random wire to the loop terminals, hearing strange sounds and foreign languages. I had overloaded the receiver's oscillator and it was now receiving shortwave. After a successful antenna installation on the roof, I too was picking up TWR on a regular basis and, strangely, shortwave stations as well!

My parents later bought me a used Hallicrafters SX-110 receiver with the matching speaker. After that, our group listened whenever we could. We heard world events on the British Broadcasting Corporation (BBC), Radio Australia, and Radio RSA in South Africa. Sometimes we shocked our teachers with information about what was happening in the world, that they hadn't heard about yet. They would read it in the newspaper the next day or hear it on national news.

Brad and I learned Morse code so we could earn our Novice-class licenses. We put our Heathkit code practice oscillators near the telephone receiver and sent blindly. We'd then pick up the telephone receiver and check our copy. We had so much fun!

After much anticipation, my Novice license arrived. Brad had already been on the air, getting ready to upgrade to his General-class license. I upgraded soon after that.

Dave W. Fleming, NS8S
Montague, Michigan

Lifelong Radio Friends

As Boy Scouts, Bill Shanney, W6QR, and I were interested in all things electrical — especially radios. Around 1959, we started listening to shortwave radio and building our own antennas. Bill joined the Radio Amateur Civil Emergency Service (RACES) in our town of Bogota, New Jersey, and by 1961, we both had our Novice-class licenses. The same year, we both earned our General-class licenses.

Nelson R. Gomm's, W1CN, old station, consisting of a Hallicrafters S-40B receiver and a Heathkit HX-11 transmitter.

Bill had a Hammarlund HQ-129X receiver and an Eico 723 transmitter, while I had a Hallicrafters S-40B receiver and Heathkit HX-11 transmitter. We immediately bought variable-frequency oscillators (VFOs) and set up more dipole antennas. Because TV stations were broadcast over the air at this time, we sometimes interfered with our neighbors' reception.

We became more proficient at Morse code, getting to over 30 words per minute (WPM) and operating mostly 40 and 20 meters (Bill periodically got down to 80 meters and up to 15 meters). Our high school years were spent working toward awards such as Worked All States (WAS) and Worked All Continents (WAC), as well as chasing DX. We both attended Newark College of Engineering, now known as the New Jersey Institute of Technology (NJIT), and enrolled in their electrical engineering program. As freshmen, we joined the school's amateur radio club, K2MFF. The club's radio needed to be updated and we were able to get the funds to buy and build a Heathkit SB-300 receiver and an SB-400 transmitter.

Bill earned his electrical engineering degree, while I changed my major and earned a degree in engineering science. During our careers, we both left the hobby for some time, but Bill still earned his Amateur Extra-class license.

After I retired in 2018, I decided to get back into the hobby, but it was different now — I had to start from the beginning. I studied exam questions for all three classes and passed them all in one sitting.

I was looking to buy a used transceiver when Bill graciously gave me his Kenwood TS-590. It was so sophisticated, it took me a month just to read through the manual. A few months later, Bill purchased an Icom IC-7610 and added it to his radio.

We both operate mostly CW on 40 meters. The hobby stays fresh and challenging with club activity, including Field Day. Bill is a member of the W6TRW Radio Club in Redondo Beach, California, and I'm a member of the Falmouth Amateur Radio Association in Falmouth, Massachusetts. Ham radio is one of the best retirement hobbies, and I'm glad to be returning to it.

Nelson R. Gomm, W1CN
Yarmouth Port, Massachusetts

Send reminiscences of your early days in radio to "Celebrating Our Legacy," ARRL, 225 Main St., Newington, CT 06111 or **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.

George Misic, KE8RN, ke8rn@comcast.net

Classic Radio

The Signal One CX-7 Complete Station

The Signal One CX-7 (see Figures 1 and 2) all-in-one transceiver had many accessories that could be used with a transceiver in a well-equipped amateur radio station. The only commonly used accessories missing from the Signal One were a linear amplifier and an antenna tuner. The Signal One was first advertised in *QST* in 1969 for $1,595, but most initial units were delivered in 1970.

Signal One Background

Richard Ehrhorn, W4EA (ex-W4ETO), and Don Fowler, W4YET, created Signal One. Signal One was initially located in Saint Petersburg, Florida, and was a part of Electronic Computer International, which was owned by National Cash Register (NCR) Company. Initially, the developers of the Signal One CX-7 thought it had a big future in government and military service, but that aspect of the CX-7's appeal did not pan out.

The CX-7 was upgraded several times. It became the CX-7A and then the CX-7B (see Figure 3). Later, it became the CX-11 and came with seven-segment LED readout devices designed into the frequency counter. The CX-11 version cost $2,600, then rose to $5,900. It was distributed by Payne Radio in September 1974, but they did not yet own the Signal One Company, as they later did.

CX-7 Operation

The Signal One CX-7 operated on 160, 80/75, 40, 20, 15, and 10 meters, plus three optional bands could be added by supplying optional crystals. The ranges were 2 – 4 MHz, 4 – 7 MHz, and 8 – 18 MHz. The CX-7 predated the addition of the World Administrative Radio Conference (WARC) bands, so it did not cover them. The Signal One ran 300 W peak envelope power (PEP) on SSB and CW. A speaker was included in the radio, as was an ac power supply, operating from 120 or 240 V ac.

The Signal One CX-7 had many built-in accessories. For transmitting, the CX-7 had a CW keyer variable from 5 to 60 words per minute, full-break-in CW operation, a transmit speech compressor to increase talk power, and broadband transmitter operation with no tune-up. For receive operation, it had a noise blanker, passband tuning, intermediate frequency (IF) shift, digital frequency readout, and the ability to receive on two different frequencies in the same band at the same time.

Split-Frequency and Dual-Receive

The first major innovation in the Signal One was the use of two VFO assemblies, which gave the CX-7 the ability to receive and transmit on two different frequencies in the same band or to transceive on one frequency. The VFOs each covered a full 1 MHz, so 10 meters was the only band covered where the two VFOs could not reach any

▲**Figure 1** — The front panel of the Signal One CX-7. [Dennis Kidder, W6DQ, photo]

▼**Figure 2** — The rear view of the Signal One CX-7. [Dennis Kidder, W6DQ, photo]

part of the band. The two VFOs could also be used to receive two different spots in the same band. In the dual-receive mode, the ratio of RF gain between the two receive signals could be adjusted, so one signal would not override the other.

Figure 3 — A modified CX-7 from the CX-7A and CX-7B upgrades. The modified one shown incorporates the CX-7B's power supply and LED keyer and counter board. [Dennis Kidder, W6DQ, photo]

IFs and Filters

The Signal One CX-7 upconverted the covered bands to 39 to 40 MHz, an early example of amateur radio upconversion. The final intermediate frequency was 8.8 MHz, which was unique to the CX-7 and its later versions. The radio was supplied with a crystal lattice filter at 8.8 MHz optimized for single-sideband (SSB) signals. Also available were two filters for CW use, a lower-cost 400 Hz wide filter, and a premium 300 Hz filter with a better shape factor for rejecting strong off-frequency signals. For radioteletype (RTTY) use, a 1,200 Hz wide filter was offered. The Signal One could accommodate two additional filters in addition to the SSB filter. The filtering for SSB used 16 poles for much better off-frequency rejection.

Frequency Counter and Display

The Signal One CX-7 had a built-in precision frequency counter. The display read down to the nearest 100 Hz, using neon Nixie tube readout devices. Later models of the original CX-7 used LED seven-segment readout devices adapted to replace the Nixie tubes. Even later versions were retrofitted to use the LED seven-segment display. The display automatically read the frequency of the VFO currently in use. Flicker of the 100 Hz digit was not an issue for the Signal One CX-7 (like it was for the Heathkit SB-104).

The Nixies are quite easy to read, but they are essentially impossible to find new now. The only way to get a replacement is to salvage a suitable Nixie tube from a donor piece of test equipment or an electronic calculator.

The Power Supply

The internal ac power supply operated from 120 or 240 V ac. No power supply for mobile use was included, because the CX-7 was a size and weight that made it inappropriate for mobile service. The choice of 120 or 240 V ac was made by the wiring of the detachable power cord. The supply delivered 1,500 V dc for the final amplifier tube plate supply, 300 V dc for the driver stage and the final amplifier screen, 60 V dc for final amplifier grid bias, and 34, 24, or 5 V for the solid-state stages and also ± 15 V dc.

The Driver and Final Amplifier Stages

The final amplifier used a type-8072 conduction-cooled tetrode. This tube was made by RCA's Transmitting Tube Division, and it was the conduction-cooled version of the axial forced air-cooled 8122 tube, which was used in the National Radio NCL-2000 and NCX-1000 and the Hallicrafters SR-2000 Hurricane transceiver.

The Transcom SBT-3 was the only amateur transceiver that had a solid-state driver stage for a vacuum-tube final. The CX-7 used two TRW RF power amplifier transistors, with one driving the other one. They were stud-mounted RF power transistors.

Broadband RF Power Amplifier Tuning

The final amplifier may be manually tuned for use with antennas having a voltage standing-wave ratio (VSWR) above 1.5:1. If the VSWR is below 1.5:1, a broadband mode, which required no operator tuning, could be used. The broadband tuning for vacuum-tube electronics was first seen on the mid-1950s Central Electronics vacuum-tube 100 V and 200 V SSB transmitters and the 600L linear amplifier.

The Transceiver Circuitry

Analog integrated circuits (ICs) made by RCA were used in many places in the receiver and transmitter circuitry of the Signal One. The RCA CA3028A and CA3053 linear ICs were used in many locations. Getting replacements today is not an easy task, because RCA has not made one in well over 40 years.

Beryllium Oxide Warning for Final Amplifier

The conduction-cooled final amplifier tube, an RCA type-8072 dissipating 150 W, is attached thermally with parts made of beryllium oxide — which is a deadly poison — and a heatsink compound that is nearly as hazardous.[1] The Signal One uses an RCA transmitting tube type 8072. This is a derivative of their type-8122 axially cooled tube, which has 400 W of plate dissipation.

[1]Penson, C., *Heathkit: A Guide to the Amateur Radio Products*, CQ Communications, Inc., 2003, pp. 232 – 233. See Penson's warning about beryllium oxide in his discussion about the Heathkit SB-230 linear amplifier, which also used a conduction-cooled tube.

Al Brogdon, W1AB

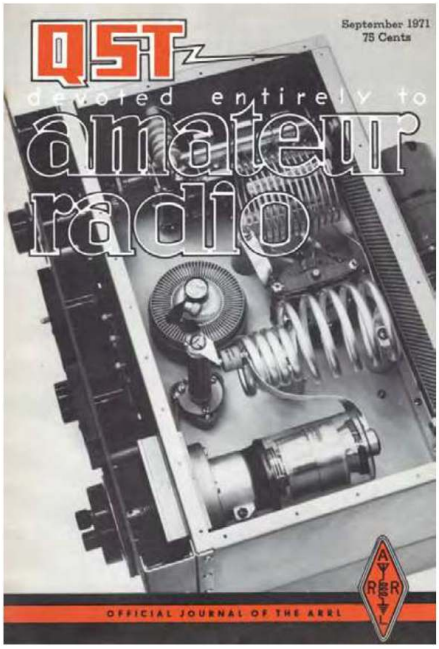
100, 50, and 25 Years Ago

September 1921

- The cover art shows airplanes and zeppelin airships converging on a large A.R.R.L. building in anticipation of the first A.R.R.L. National Convention, held in Chicago.
- The editorials cover the upcoming inaugural A.R.R.L. National Convention, "The Spark and the C.W.," and "The Coming of Fall" (and its reduced static).
- Paul F. Godley discusses "Simplified vs. Three-Circuit Regenerative Receivers."
- The A.R.R.L. Traffic Manager discusses the "Transatlantic Sending Tests," held December 8 – 17. This was the second organized attempt to span the Atlantic Ocean with radio signals.
- "The Static-Puncturing Contest" was set up to determine whether spark or C.W. was better in getting messages through the summer static of July. However, the contest period was blanketed with terrible thunderstorms and electrical displays all over the country, so only 14 logs were submitted.
- R. T. Cox and S. Kruse, 1OA, (of the Bureau of Standards) discuss "Portable Wave Meters for Short Wave Radio."

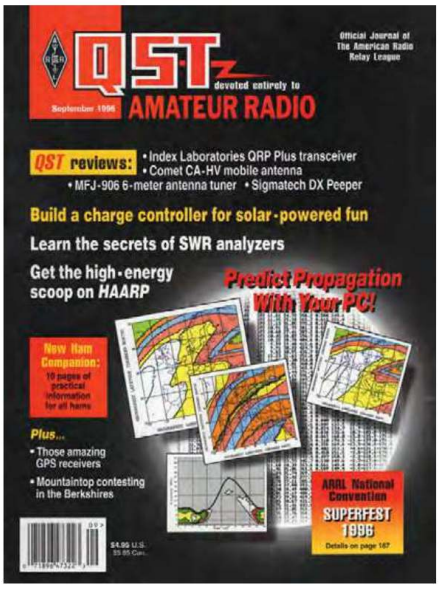
September 1971

- The cover photo is an inside view of Merle B. Parten's, K6DC, kilowatt amplifier, described in this issue.
- The editorial, "220 MHz CB?," discusses the Electronic Industries Association's petition to the FCC to reassign half of the 220 MHz amateur band for CB use.
- Douglas A. Blakeslee, W1KLK, and Augustus M. Wilson, W1NPG, report on their construction of "An 80 – 10-Meter FET Preselector."
- Ralph P. Ulrich, K7UVK, provides Part II of "A Semiconductor Curve Tracer for the Amateur."
- R. M. Mason, W8NN, discusses building "Another Transistor Tester" to check surplus bipolar transistors.
- Lewis G. McCoy, W1ICP, talks about "Low-Cost Hardware for 2-Meter FM Reception."
- Dale P. Clement, WA1FSZ, demonstrates "Using the Motorola TU-110 Series Transmitters on 420 MHz" for FM, AM, and C.W.
- D. C. Rife, WA2PGA, explains how to build "Low-Loss Passive Bandpass C.W. Filters" using loading coils.
- "The 1971 Space Conference" reports that the World Administrative Radio Conference for Space Telecommunications established a new Amateur Satellite Service with additional operating privileges.



September 1996

- The cover photo collage proclaims, "Predict Propagation With Your PC!"
- The editorial discusses the threat of frequency requests for low-Earth-orbit satellites to operate in the 2-meter and 70-centimeter bands.
- R. Dean Straw, N6BV, explains "Heavy-Duty HF Propagation-Prediction/Analysis Software" that can be used on home computers.
- Edward J. Kennedy, K3NS, and John Heckscher describe "The High Frequency Active Auroral Research Program" (HAARP), built in Alaska for active ionospheric research.
- "SWR Analyzer Tips, Tricks, and Techniques," collected from various amateurs, contains valuable ideas for modifications and uses of the now-common instrument.
- Michael Bryce, WB8VGE, presents "The Micro M — a Miniature Charge Controller" that will protect your batteries from being overcharged by your solar array.
- In "Tales of the South Pacific," Gregory Andracke, W2HRX, writes about his work-related travels across that region, and of the times he managed to spend operating.
- Jeff Reinhardt, KM6II, reports on the wonderful work that took place at "Malibu 1996 Handi-Hams Radio Camp."
- Steve Ford, WB8IMY, explains contesting on "Six Meters and Beyond on Mount Greylock," the highest point in Massachusetts.



Silent Keys

It is with deep regret that we record the passing of these radio amateurs:

N1AFY **Cournoyer**, Norman A., Sr., Holyoke, MA
WB1ASC **Brookfield**, John S., Jr., Charles Town, WV
WA1CIR **Heaney**, John H., III, Merrimack, NH
N1DKR **Litman**, Bradley C., Swampscott, MA
♦W1EQO **Ussailis**, James S. "Jim," Florence, MA
KC1GAK **Petersen**, Troy A., Enfield, CT
♦WA1HVK **Chagnon**, Mark P., Laughlin, NV
K1IIG **Tripp**, Stephen B., Wallingford, CT
♦K1JW **Weinstein**, Jeff, Yarmouth, ME
WN1M **Marinaro**, Michael W., South Glastonbury, CT
N1NA **Michaud**, Charles P., Cape Coral, FL
•WA1PJG **Kane**, Michael J., Bedford, NH
W1RHE **Eggleston**, Richard H., Diamond Point, NY
•KD1RW **Smith**, Lindsey, West Brookfield, MA
KB1STK **Wilder**, David R., Dennysville, ME
K1UL **Alexander**, Jack, Stamford, CT
W1ZSA **Turner**, Roger F., Jr., Walpole, MA
N2AIG **Chapek**, George V., Glenville, NY
N2CWI **Moore**, James F., Jr., Winnemucca, NV
K2CZD **Londell**, William J., Iselin, NJ
N2DRL **Meyer**, John K., Woodbridge, VA
WA2GNI **Olson**, Frederick A., Jr., Tomkins Cove, NY
KC2HAL **Souilliard**, Harold R., Lehigh Township, PA
W2HTI **Benkis**, Edwin, Franklin, NC
K2KAD **White**, William E., Webster, NY
♦KB2NLN **Goldstein**, Stanley D., Jamaica, NY
•W2NNJ **Hinkle**, Norman G., Syracuse, NY
WA2QHA **Woszczyna**, Joseph C., East Brunswick, NJ
WA2SJB **Herdic**, Warren W., Sr., Seneca, NY
W2SUW **Connell**, Audrey T., Almond, NY
♦WB2SXH **McCabe**, Rodney D., Syracuse, NY
KA2ZNZ **Roshia**, John V., Jr., "Jack," Liverpool, NY
KE3A **Kessinger**, William G. "Bill," Grand Island, FL
K3EQ **Queen**, Kenneth E., Sr., Bruceton Mills, WV
W3GO **Gibbs**, William H., Dumfries, VA
W3HGT **Rakow**, Paul C., Confluence, PA
W3IMJ **Hunt**, John B., Lebanon, PA
KB3NSZ **Riley**, Stephen J., Belsano, PA
NE3P **Evans**, Page K., Littlestown, PA
W3RGO **Etzel**, Howard W., Cary, NC
♦W3SMF **Crossley**, Edward D., Camp Hill, PA
•KD3XR **Sill**, William F., Tunkhannock, PA
W3YGI **Rickard**, Maurice H., Pittsburgh, PA
K4ABI **Lange**, Neal E., Deland, FL
•KA4AIJ **Anderson**, Max D., Old Hickory, TN
W4CCS **Scott**, Clyde, Jr., Moultrie, GA
KV4CT **Poorman**, Kevin L., Palm Harbor, FL
K4CWD **Stephens**, Daniel E., Rogersville, TN
•WA4DOG **Hunter**, Gary E., Cookeville, TN
N4EDE **Smith**, Dale T., Morganton, NC
W4FR **Borenstein**, Norman, Davie, FL
N4GNO **Newman**, Eugene L., Jr., Alabaster, AL
K4ICT **Hough**, Frank L., Macon, GA
•K4IWL **Carlson**, Nils T., Sarasota, FL
N4JJK **Heard**, John T., Dalton, GA
•KF4JNV **Dorsey**, William A., Flemingsburg, KY
W4JPO **Taylor**, Kenneth A., Bushnell, FL
KI4JSM **Aycoth**, Allen A., Gastonia, NC
KO4JY **Mahler**, Kevin S., Newport News, VA
KD4LOF **Wright**, Joseph F., Vernon, AL
K4MNS **Austin**, David E., Statesville, NC
KA4ONO **Michaud**, Vivian A., Ormond Beach, FL
WD4PAQ **Russell**, Robert D., Hiram, GA
KF4QYY **Fields**, Joseph P., Durham, NC
AK4S **French**, Richard B., Sr., Memphis, TN
WA4UIH **Campbell**, Michael A., New Albany, IN
WB4UQV **Hostetter**, John M., Stewart, TN
•W4VNK **Turner**, William L., Wilmington, NC
KD4WCJ **Pound**, Ralston M., Jr., Charlotte, NC
K4YNG **Barker**, Fletcher C., Easley, SC
W4ZSI **Sandlin**, Joe I., Tuscumbia, AL
W5AAM **McLean**, Anthony, Winnsboro, TX
♦W5ACM **MacAllister**, Andrew C., Houston, TX
N5CDU **Wilkinson**, Lee E., Vernon, TX
KF5ETN **Buckley**, Frank D., Enterprise, MS
WB5FGD **Grove**, Robert A. "Bob," Texas City, TX
N5FJY **Castorina**, Joseph A., Texas City, TX
N5IAC **Grinde**, Fritz J., Las Cruces, NM
N5IDD **Austin**, Jonathan M., Tomball, TX
K5LOM **Womack**, Robert B., Meridian, MS
WA5TEF **Miller**, Jimmy R., Saltillo, MS
♦W5VOA **Stansell**, Marion J. "Jerry," San Antonio, TX
•W5VUB **Koski**, Richard J. "Dick," Russellville, AR
K5WQG **Reynolds**, Edward M., Tomball, TX
KA6AED **Penrod**, Carey L., Rancho Santa Margarita, CA
NA6D **Matthews**, Ralph W., Lincoln, CA
KB6DDT **Keyes**, Doris M., Ventura, CA
KI6FKP **Stevens**, John B., Yucca Valley, CA
•WG6I **Babcock**, Allen R., Lebanon, OH
W6KOW **Martin**, David A. "Dave," Independence, OR
♦K6LT **Tudor**, Lauren J., Arnold, CA
WG6M **Dionizio**, Alvin E., Modesto, CA
WA6MMC **Schumacher**, Leonard "Len," Poway, CA
K6NEQ **Miller**, William E. "Bill," Granada Hills, CA
•N6ODH **Mobus**, Charlotte A., Cameron Park, CA
K6PQ **Cleminson**, George T. "Tom," Redding, CA
KF6QDG **Alexander**, Fay M., El Dorado, CA
WB6TA **Arnall**, Terry, Hayward, CA
KD6TRV **Hoge**, Ernest J., Fresno, CA
•KF6YTE **Piazza**, Clifford D., Redding, CA
N7CRS **Chorost**, Saul, Tucson, AZ
N7DGI **Megee**, Michael A. "Mike," Casper, WY
N7DOG **Reitz**, Carl J., Peoria, AZ
KD7EB **Simmons**, M. Lindsay, III, Sisters, OR
KC7HRZ **Swope**, Robert J., Yakima, WA
W7KER **Wood**, Robert L. "Bob," Gresham, OR
N7LYE **Sheppard**, Mark S., Seattle, WA
W7NDO **Casto**, William F., Edgewood, WA
W7PCR **Hill**, Daniel E., Lompoc, CA
•KF7QGW **Blood**, R. Alan, Syracuse, UT
♦WA7RF **Fisher**, Robert S., Deer Park, WA
•K7RKU **McMillan**, Danny R., Hawthorne, NV
KB7RNV **Breidt**, Frank J., Pinehurst, ID
K7TVE **Zabrocki**, James C., Miles City, MT
K7UA **Anderson**, Bryce K., American Fork, UT
N7VF **Vandiver**, Norman, Camp Verde, AZ
WB7WHN **Keene**, David A., Spokane, WA
N7ZTY **Jenkins**, Clifton W., Morgan, UT
AD7ZZ **Woodrow**, Thomas A. "Tom," Pullman, WA
•KB8CUR **Whitbeck**, Richard C., Toledo, OH
WW8DOB **Potts**, Cynthia S., Saint Helen, MI
W8ELE **Birle**, John D., Columbus, OH
•KB8EXA **Bauman**, Gloria A., Oregon, OH
•W8FTX **Biundo**, George D., Columbus, OH
W8GND **O'Dell**, Jerry W., Ypsilanti, MI
AB8IF **Fell**, Roger B., Avon Lake, OH
KA8IWD **Hermann**, Liselotte M., Lancaster, OH
K8KE **Morrell**, Michael D., Lyndhurst, OH
N8KNA **Wilson**, Richard R., Parkersburg, WV
♦W8KY **Trout**, James L., Jackson, MI
W8NED **Globe**, Paul F., Columbus, OH
N8OGX **Waits**, William G., Bellville, OH
W8RHM **Mayer**, Roger H., Milan, IN
•WB8SPV **Trustle**, Gary B., Waverly, OH
•W8WS **Smith**, William K., Mayfield Heights, OH
KB9CFH **Koelling**, James K., Ada, OK
N9CPU **Hicks**, Pershing, Jr., O'Fallon, IL
♦W9DF **Filmer**, David L., West Lafayette, IN
WB9GAD **Zillmer**, Thomas R., Oconomowoc, WI
KD9HIW **Baril**, Ellyn M., Manitowoc, WI
♦K9HT **Hutchison**, David J., West Lafayette, IN
♦K9IJ **Rice**, John F., Lake Zurich, IL
W9ITT **Gross**, Herman W., De Pere, WI
WA9JMU **Liedtky**, James W., La Crosse, IN
N9KNJ **Kaufman**, Ronald L., New Haven, IN
•W9KOT **Aspling**, Clyde E., Rockford, IL
WB9KQO **Clark**, Nelson T., Berne, IN
KB9MDR **Shull**, William H., Fort Wayne, IN
WA9MQD **Faivre**, Frank W., Franklin Grove, IL
W9PHF **Greisinger**, Ray J., Green Bay, WI
♦W9PW **Groover**, Danny R., Avon, IN
KD9SLF **Oliger**, Cody P., Greensburg, IN
K9ZVZ **Hanson**, David J., Mission, TX
KAØCYN **Wachs**, Daniel, Cambridge, MA
♦•KBØETU **Bowers**, Phillip J., Lillian, AL
KØFQM **Bailey**, Rex D., Lehi, UT
•KCØIUP **Eagle**, Wayne L., Topeka, KS
KWØLF **Brentlinger**, Kathleen F. "Kay," Terre Haute, IN
♦KØPP **Kopp**, Kenneth G., Anaconda, MT
KCØTF **Moffett**, Wallace J., Boulder, CO
♦KAØY **Kucera**, Kenneth, Riverside, IA
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VE3JUE **Stone**, Joseph A., Toronto, ON, Canada
•VA7NH **Henriksen**, Roy E., Pouce Coupe, BC, Canada
G4LNG **Hollis**, Frederick M. "Malcolm," Chesterfield, Derbyshire, Great Britain
G4TVC **Darby**, Jack C., Northgate, Crawley, Great Britain
G4VSR **Alston**, Stanley, Wingerworth, Chesterfield, Great Britain
ZL2BRS **Russell**, Stanley G., Palmerston North, New Zealand

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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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• 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-891 | *HF+50 MHz All Mode Mobile Transceiver*

Rugged Construction in an Ultra Compact Body • Stable 100 Watt Output with Efficient Dual Internal Fans • 32-Bit IF DSP Provides Effective and Optimized QRM Rejection • 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

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• Color display-green, blue, orange, purple, gray • GPS/APRS • Packet 1200/9600 bd ready • Spectrum scope • Bluetooth • MicroSD slot • 500 memory per band

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-3DR *C4FM/FM 144/430 MHz Xcvr*

• 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 • Simultaneous C4FM/C4FM Standby • Micro SD Card Slot

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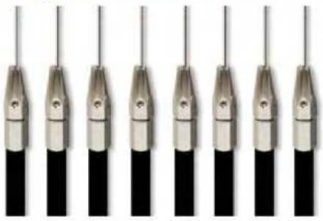

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For medium communications arrays up to 15 sq. ft. wind load area. 5-second brake delay, Test/Calibrate function. Low temperature grease permits normal operation down to -30 degrees F. Alloy ring gear for extra strength up to 100,000 PSI for maximum reliability. *Precision* indicator potentiometer. Ferrite beads reduce RF susceptibility. Cinch plug plus 8-pin plug at control box. Dual 98 ball bearing race for load bearing strength and electric locking steel wedge brake prevents wind induced movement. North/South center of rotation scale on meter, low voltage control, max mast $2^{1}/_{16}$".

HAM-VI **$909.95** with DCU-2

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T-2X **$969.95**

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T-2XD3 **$1139.95** with DCU-3

For large medium antenna arrays up to 20 sq. ft. wind load. 5-second brake delay, Test/Calibrate functions. Low temp grease, tough alloy ring gear, indicator potentiometer, ferrite beads on potentiometer wires, weatherproof AMP connectors plus 8-pin plug at control, triple bearing race (138 ball bearings) for large load bearing, electric locking steel wedge brake, North/South center of rotation scale meter, low voltage control, $2^{1}/_{16}$" mast.

MSHD, $149.95. Above tower heavy duty mast support. Accepts $1^{7}/_{8}$-$2^{5}/_{8}$" OD.

CD-45II

CD-45II **$519.95**

For antenna arrays up to 8.5 sq. feet mounted inside tower or 5 sq. ft. with mast adapter. Low temperature grease good to -30 F degrees. *New* Test/Calibrate function. Bell rotator design gives total weather protection, dual 58 ball bearing race gives proven support. Die-cast ring gear, stamped steel gear drive, heavy duty, trouble free gear train, North center scale, lighted directional indicator, 8-pin plug/socket on control unit, snap-action control switches, low voltage control, safe operation, takes maximum mast size to $2^{1}/_{16}$ inches. MSLD light duty lower mast support included.

HAM IV and HAM V Rotator Specifications	
Wind Load capacity (inside tower)	15 square feet
Wind Load (w/mast adapter)	**7.5 square feet**
Turning Power	800 in.-lbs.
Brake Power	**5000 in.-lbs.**
Brake Construction	Electric Wedge
Bearing Assembly	**dual race/96 ball bearings**
Mounting Hardware	Clamp plate/steel U-bolts
Control Cable Conductors	**8**
Shipping Weight	26 lbs.
Effective Moment (in tower)	**2800 ft.-lbs.**

TAILTWISTER Rotator Specifications	
Wind load capacity (inside tower)	20 square feet
Wind Load (w/ mast adapter)	**10 square feet**
Turning Power	1000 in.-lbs.
Brake Power	**9000** in.-lbs.
Brake Construction	Electric Wedge
Bearing Assembly	**Triple race/138 ball brngs**
Mounting Hardware	Clamp plate/steel U-bolts
Control Cable Conductors	**8**
Shipping Weight	31 lbs.
Effective Moment (in tower)	**3400 ft.-lbs.**

CD-45II Rotator Specifications	
Wind load capacity (inside tower)	8.5 square feet
Wind Load (w/ mast adapter)	**5.0 square feet**
Turning Power	600 in.-lbs.
Brake Power	**800 in.-lbs.**
Brake Construction	Disc Brake
Bearing Assembly	**Dual race/48 ball brings**
Mounting Hardware	Clamp plate/steel U-bolts
Control Cable Conductors	**8**
Shipping Weight	22 lbs.
Effective Moment (in tower)	**1200 ft.-lbs.**

hy-gain Programmable DCU-3 Digital Rotator Controller

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DCU-3 **$519.95**

Hy-gain DCU-3 Digital Controller lets you program 6 beam headings! Gives you full automatic or manual control of your hy-gain HAM or Tailtwister Rotators.

Press a memory button or dial in your beam heading or let *Ham Radio Deluxe* (or other) take control. Your antenna auto rotates precisely and safely to your DX.

DCU-3 automatically jogs your antenna free and safely unlocks it before rotating begins *(great for older rotators with "sticky" brakes)* then turns off your motor before reaching its final heading. Your antenna *gently* coasts to a stop before the brake re-locks -- greatly reducing damaging overshoots and extending rotator life.

Simply press *Left* and *Right* buttons for *full* manual control and fine tuning.

Bright blue LCD shows current, dialed-in and computer controlled beam headings in one degree increments and your call.

Calibrate lets you accurately match your display to your *true* beam heading. Has USB/RS-232 ports for computer control. Adjustable LCD sleep time. Field upgradeable firmware. 8.5Wx4.3H x9D". 110 VAC. Order **DCU-3X** for 220 VAC.

DCU-2 Digital Rotator Controller

$479.95. Like DCU-3, but less programmable memories. 110 VAC. Order **DCU-2X**, for 220 VAC.

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YRC-1 **$399.95**

Hy-gain YRC-1 gives you more features and a much more robust controller that is far less prone to lightning damage. Costs less than repairing your original Yaesu controller!

Easy-to-use -- dial in your beam heading and tap *GOTO* button. *Exclusive* 180 degree *AutoReversal*™ for fast longpath operation.

Has all features of DCU-2. Bright blue LCD shows current, dialed-in and computer controlled beam headings and your call. USB port for computer control. Extra heavy-duty AC power supply.

Variable DC motor speed for minimizing damaging antenna overshoot and fast operation. Intuitive menu for calibrating, offsetting, or changing parameters. Field upgradeable firmware. Use with Yaesu G-800/1000/2800/G450/650. For AC or DC motors.

AR-40

AR-40 **$419.95**

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AR-40 Rotator Specifications	
Wind load capacity (inside tower)	3.0 square feet
Wind Load (w/ mast adapter)	**1.5 square feet**
Turning Power	350 in.-lbs.
Brake Power	**450 in.-lbs.**
Brake Construction	Disc Brake
Bearing Assembly	**Dual race/12 ball bearings**
Mounting Hardware	Clamp plate/steel bolts
Control Cable Conductors	**5**
Shipping Weight	14 lbs.
Effective Moment (in tower)	**300 ft.-lbs.**

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MFJ-4225MV Switching power supply gives 25A surge, 22A continuous. Adjustable 9-15 VDC output, 85-260 AC input. Large 3" dual Amp/Volt meters, binding posts, cigarette lighter socket. 3.7 lbs., 5¼Wx4½Hx6D".

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Add a pair of *PowerPoles*(R) **MFJ-4230MVP, $124.95** *PowerPoles*(R) on back.

MFJ-4230MPF, $114.95 *PowerPoles*(R) on front of unit.

MFJ-4230DMP, $164.95 Like MFJ-4230MVP but has bright orange digital Volt/Amp display.

35-Amps, $154.95

MFJ-4235MV switching power supply. 35A surge, 30A continuous. 4-16 VDC, 1% voltage regulation. <9 mV peak-to-peak ripple. AC in: 90-125 or 200-240V. 7Wx4¼Hx8¾D", 4 lbs.

25-Amps, $104.95

MFJ-4125 gives 25A surge, 22A continuous. 13.8 VDC switcher has 5-way binding posts on front and quick connects on back. 3.5 lbs.

35-Amps, $179.95

MFJ-4035MV 19.2 lb. transformer, 35A max, 30A continuous. 1-14 VDC out, 110 VAC in. Highly regulated, 1% load, 1 mV ripple. 5-way posts, cig lighter. 9½Wx6Hx9¾D".

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MFJ-4125P. 25A surge, 22A continuous. 13.8 VDC switcher has 2-pair *PowerPoles*(R), 5-way posts, quick connects. 3.5 lbs.

15-Amps, $84.95

MFJ-4115. 17A surge, 15A cont. 13.8 VDC. 110/220 VAC. 3¾Wx2¼Hx7¾D", 1.5 lb. 5-way posts. **MFJ-4215MV, $74.95.** Like MFJ-4115 but has backlit volt/amp meters.

28-Amps, $104.95

MFJ-4128. 28A surge, 25A cont. 13.8 VDC. AC: 85-135/170-260 VAC. 5-ways, cig sock. **MFJ-4218MV, $129.95.** 0-24 VDC,18A@13.8/9A@24VDC.

MFJ *PowerPole*(R) Splitters

MFJ-1104, $59.95 *PowerPole*(R) Splitter, 30 Amp fused input, outputs fused at 25, 10, 5A. Open fuse indicator. 2¾Wx3¼Hx1½D".

MFJ-1107, $69.95 40A fused binding posts input, 4 fused *PowerPole*(R) outputs, two 2.1 mm center positive power jacks.

MFJ-1106, $59.95 One in, six out *PowerPoles*(R). 30A total. 7 sets of mating conectors included.

MFJ High Current DC Multi-Outlet Strips

Power multiple transceivers/accessories from a single DC power supply

MFJ-1118, $109.95 **Power** two HF and/or VHF rigs and six accessories from rig's 12 VDC supply. 35A high-current and 15A accessory binding posts, Voltmeter, on/off switch. Master fuse, RF bypass. 12½Wx2¾Hx2½D".

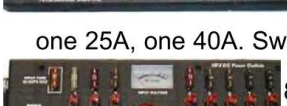
MFJ-1116, $74.95 **Like** MFJ-1118 but 15A total, 8 pairs 5-ways."On" LED, 0-25 VDC voltmeter.

MFJ-1112, $59.95 **Like** MFJ-1116 but 6 pairs 5-way posts, no meter/switch. 12½Wx2¾Hx2½D".

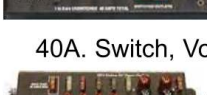
MFJ-1117, $84.95 **High-current.** Powers four HF/VHF radios simultaneously -- 2 at 35A each, 2 at 35A combined. 8Wx2Hx3D".

MFJ-1129, $144.95 **10 outlets.** Installed fuses: two 1A, three 5A, three 10A, two 25A, one 40A. Outlets 1, 2, 4-8 are *PowerPoles*(R). Outlet 3 is a 35A high current post, outlet 9, 10 are 15A posts. Switch, voltmeter. 12½Wx1¼Hx2½D".

MFJ-1128, $134.95 12 fused *Power Poles*(R), three 1A, four 5A, four 10A, one 25A, one 40A. Switch, Meter.



MFJ-1126, $104.95 8 fused *PowerPoles*(R): a 1A, three 5A, two 10A, one 25A, one 40A. Switch, Voltmeter. 9Wx1½Hx2¾D".



MFJ-1124, $89.95 4 pairs 35A PowerPoles(R), 2 pairs 35A high current posts.

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MFJ . . .the World Leader in Ham Radio Accessories!

MFJ G5RV Antennas

Operate all bands 10 thru 160 Meters with a single wire antenna!

MFJ-1778
$79.95

***The** famous G5RV antenna is the most popular ham radio antenna in the world!*

It's an efficient, *all band* 102 foot long antenna -- shorter than an 80 Meter dipole. Has 32.5 foot ladder line matching section ending in SO-239 connector for your coax feedline.

Use horizontally or as Inverted Vee or Sloper with just one support. 1500 Watts.

Operate all bands 80-10 Meters with an antenna tuner and even 160M with ground.

Fully assembled with *ceramic* end and fiberglass center insulators. *Hang and Play™* -- add coax, rope to hang and you're on air!

MFJ-1778M, $69.95. *Half-size, 52 foot G5RV JUNIOR for limited space.* 40-10 Meters with tuner. Full 1500 Watts.

MFJ All Band Classic Doublet

MFJ-1777
$89.95

MFJ 102 foot *all band* doublet covers 160-6 Meters with balanced line tuner. Super strong custom fiberglass center insulator relieves stress on 100 foot ladder line. *Glazed ceramic* end insulators. 1500 Watts.

RF Isolator

MFJ-915
$49.95

MFJ-915 *RF Isolator* prevents unwanted RF from traveling on the outside of your coax shield into your transceiver. This unwanted RF can cause painful RF "bites" when you touch your microphone or volume control, cause your display or settings to go crazy, lock up your transceiver or turn off your power supply. In mobile installations, stray RF could cause your car to do funny things even blow your car computer. Clear up these problems, plug an MFJ-915 between your antenna and transceiver. 1.8-30 MHz, 1500 Watts. 5x2 inches.

MFJ-919, $74.95. 4:1 current balun,1.5 kW.

MFJ-913, $49.95. 4:1 balun, 300 Watts.

True 1:1 Current Balun & Center Insulator

MFJ-918
$44.95

True *1:1 Current Balun/ Center Insulator* forces equal radiator currents in dipoles for true dipole radiation pattern. Reduces coax radiation and field pattern distortion -- your signal goes where *you* want it. Reduces TVI, RFI and RF hot spots. *Don't build a dipole without one!* 50 hi-permeability ferrite beads on high quality RG-303 *Teflon*® coax and *Teflon*® SO-239. 1.5kW 1.8-30 MHz. Stainless steel hardware. 14 gauge stranded copper wire is *directly* connected to your antenna. 5x2 inches. Heavy duty weather housing.

2-Position Antenna Switch

MFJ-1702C, $54.95. 2-position antenna switch, lightning surge protection, center ground. SO-239s.

Lightning surge protectors. MFJ-270, $29.95. 400W. **MFJ-272, $44.95.** 1500 W. Gas discharge tube shunts 5000 amps peak.< 0.1 dB loss. 1 GHz. SO-239s.

MFJ-16C06, $8.95. 6-pack *glazed ceramic* end/center ant. insulators.

MFJ-16B01, $29.95. Molded high-strength center insulator. SO-239.

MFJ-16D01, $11.95. 450 Ohm fiberglass end/center insulator with ladder line stress relief and SO-239 mount.

MFJ-18H100, $49.95. 100 feet, 450 Ohm ladder line, 18 gauge copper clad.

80-10 Meter End-Fed Half Wave antenna

Cover all HF bands with one single wire and no tuner!

MFJ-1982HP, $119.95

No tuner needed!
All band 80-10M EFHW antenna

Get-on-the air on all bands 80-10 Meters with just one wire and one support (pole or tree) and no tuner or long counterpoise.

Installs anywhere in minutes! Rugged *insulated*-wire radiator prevents detuning when contacting limbs/branches. *"No-snag"* end insulator slides over branches, leaves.

Toss over a high limb for inverted-V or sloper or go vertical with an inverted-L.

Dark jacketed wire is virtually invisible -- *don't let antenna restrictions keep you off the air!* Great for emergencies.

EFHWs naturally resonate on the 1/2-wave fundamental frequency and odd/even harmonics. Covers 80/40/30/20/17/15/12/10 Meters without traps, stubs or resonators.

Broad-band matching transformer at feed point gives SWR so low you may never need a tuner. Compensating inductor optimizes SWR. 800 Watts SSB/CW. 132 feet jacketed antenna wire.

MFJ-1984HP, $99.95. Like MFJ-1982HP but 40-10M. 66 feet jacketed wire.

See www.mfjenterprises.com for 30 Watt QRP and 300 Watt models.

Dual Band Dipoles

MFJ-17758
$119.95
80/40 Meters

MFJ-17758, $119.95. Operate 80/40 Meters with a short 85 foot dipole. *Full-size* on 40 Meters with ultra-efficient end-loading on 80 Meters. 1500 Watts. Super-strong custom molded center insulator with SO-239 connector and hang hole. Ceramic end insulators. 7-strand, 14 gauge hard copper wire. *No tuner needed!*

MFJ-17754, $79.95. Like MFJ-17758 but is only 42 feet. Operate 40/20 Meters. *Full-size* on 20 Meters, ultra-efficient end-loading on 40 Meters. 1500 Watts.

Single Band Dipoles

MFJ-1779A
$89.95
160M, 265 ft.

MFJ-1779B
$69.95
80-40M, 135 ft.

MFJ-1779C
$49.95
20-6M, 35 ft.

Ultra high quality center fed dipoles give years of trouble-free service. Custom injection-molded UV-resistant center insulator has built-in SO-239 and hanging hole. *Glazed* ceramic end insulators. 7-strand, 14-gauge hard copper antenna wire. 1500 Watts. Use horizontally or as sloper or inverted vee. Simply cut to length with provided cutting chart.

OCFD Dipoles

MFJ-2012
$99.95
1500 Watts

MFJ-2010
$79.95
300Watts

No tuner needed! MFJ ***Off-Center Fed Dipoles*** use MFJ's exclusive *ExactRatio™* RF broadband transformer to give low SWR and maximum bandwidth on 40/20/10/6 Meters. A Guanella current balun kills feedline radiation, pattern distortion, SWR shifts, RFI and noise pickup. Install anywhere and get the same predictable performance regardless of feedline length. You get ground reinforced gain over verticals. Use horizontally, inverted vee, sloper. 98% efficient, 14 gauge, 7-strand copper wire, ceramic end insulators.

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MFJ *Magnetic Loop* Antennas

MFJ 36-inch magnetic loop antenna lets you operate 7 to 22 MHz or 10 to 30 MHz continuously -- including the WARC and MARS bands! Easily handles a full 150 Watts on SSB/CW/Digital for any transceiver.

Ideal for limited space. Apartments, small lots, motor homes, attics, trailers.

Work exciting DX with low angle radiation and local close-in contacts with high angle radiation when mounted vertically.

Super easy-to-use! MFJ remote control auto tunes to your desired band. Fast/slow tune buttons, Cross-Needle SWR/Wattmeter 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 -- gives you highest possible 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 protection.

MFJ-1782, $469.95. Like MFJ-1786 but has fast/slow tune manual control.

MFJ-1780, $379.95. 20-10 Meters, 150 Watt *Portable* *24x24x24" box fan loop with carry handle.* Fast/slow tune control. *See QST July 2019.*

***New* 40-15M and 30-10M 300W *High Efficiency* Welded Loop Antennas**

Carry it anywhere! Easy carry handle, fold-out feet, tripod mount bracket. Portable, lightweight 36x36x4". Deluxe semi-auto controller with SWR/Wattmeter, no control line needed. Welded Low loss *butterfly* air-variable capacitor. 300W SSB.

MFJ-1784, $699.95. 40-15 Meters.

MFJ-1783, $649.95. 30-10 Meters.

Build your own Mag loop!

Motorized Butterfly Capacitors

Super low loss butterfly capacitors, no rotating contacts, all plates welded with no mechanical electrical contacts. Anti-backlash mechanism. DC motor with gear reduction box. Handles at least 150 Watts SSB/CW/Digital.

1. p/n: 282-1786, $189.95. 11-128 pF.

2. p/n: 282-1788, $249.95. 15-260 pF.

3. p/n: 80-1786-2SM, $249.95. Auto band selecting remote controller with SWR/Wattmeter.

4. p/n: 80-1782-2, $79.95. Manual remote control, fast/slow tune buttons.

Butterfly Capacitors

5. MFJ-19, $79.95. 12-67 pF.

6. MFJ-23, $109.95.18-136pF.

7. p/n: 729-0142, $19.95. 6:1 vernier gear reduction drive for loop tuning capacitor.

8. 36-inch Aluminum Circular Loop with Integrated welded capacitor and mast mounting brackets
p/n: 10-1786-11, $129.95. 1.05 inch

MFJ Magnetic Loop Tuners, 150 Watts

Turns wire or coax into a small, high efficiency multi-band transmitting magnetic loop antenna!

Work the world 3.5 to 30 MHz with a *full 150 Watts* SSB/CW/Digital. No ground, radials or counterpoises needed.

New larger matching capacitor is 313 pF. Increases matching range. Butterfly capacitor has no rotating contacts.

Very quiet receiving antenna -- you'll hardly notice static crashes. High-Q reduces QRM, overloading, harmonics. Perfect for apartments, antenna restricted areas and portable operation.

A 13' wire loop covers 30-20 Meters (4' for 17-10M; 7' for 20-15M; 28' for 60-40M; 50' for 80M). Tune *any* shape loop -- circle, square, rectangle, *etc.*

A wire length gives about 1.5 to 1 frequency range (i.e.7-10, 18-28 MHz).

Easy-Carry handle. Mount for PVC Cross loop support on cabinet top. Included tripod/mast mount.

A. MFJ-936C, $349.95. Antenna current meter, Cross-Needle SWR/Wattmeter. 9¼Wx5½Hx9½D".

B. MFJ-935C, $299.95. Antenna current meter. 6¼Wx5½Hx9½D".

C. MFJ-933C, $249.95. 6¼Wx5½Hx9½D".

MFJ Low-Noise Receiving Mag Loop

Clearly hear signals 50 KHz to 30 MHz you never knew existed. Power line noise and static disappears. Rotating MFJ-1886 eliminates interfering signals or greatly peaks desired signals. Excellent antenna and preamplifier balance gives deep null. Gives excellent strong and weak signal performance without overload. Fully protected state-of-the-art push-pull Gali MMICs preamplifier gives you high dynamic range, low IMD and 25 dB of low noise gain. Use inside or outside.

QRP Mag Loop Tuner

MFJ-9232
$74.95

Turns wire around a bookcase, window, tree, etc. *into a small, high efficiency transmitting loop antenna!* Operate 40-10 Meters with included flexible wire loop (80/60 Meters with your bigger loop). No counterpoises, radials, ground needed. 25 Watts. Very quiet reception. Hi-Q reduces QRM, overload, harmonics. Great for apartments, antenna restrictions, portable ops.

VIDEOS: https://m.youtube.com/results?search_query=MFJ-9232

Antenna Rotator

Perfect for magnetic loops, VHF/UHF, small HF beams, TV, FM antennas. Weather-proof cast aluminum housing with precision all metal gears, steel thrust bearings and automatic braking. Includes rotator, controller, remote control, clamps, hardware. 12 Memories. Digital display. 110/220 VAC.

$189.95

MFJ Tripods/Masts

Strong, black *steel* triangular braced base. Non-skid feet, strong mast locks.

MFJ-1919, $119.95, Supports 100 lbs. Extends a *whopping* 7.8 ft. Base spreads up to 4.8 sq. ft. 1.4" dia. mast. Collapses to 54" by 6" diameter. 9¾ lbs.

MFJ-1919EX, $189.95. Tripod *plus* mast. 18' extended. 5' collapsed. 1/8" wall, 3/4" dia. top, 1½" dia. bottom.15 lbs.

MFJ-1918, $79.95, 6'extended. 38" collapsed, 6¾ lbs.

MFJ-1918EX, $119.95. Small tripod with extension mast. 9½', 3.8 ft. collapsed. ¾"top, 1" bottom. 6.5 lbs.

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TIMEWAVE TECHNOLOGY INC.

New!!
ANC-4+

Timewave Products available at:
- HRO
- R&L Electronics

*NEW! ANC-4+

ANC-4+ Antenna Noise Canceller

The familiar, rugged ANC-4 now with:
- *External TX/RX control*
- *Adjustable TX hang time*
- *Noise amp front end protection*
- *TX LED indicator*
- *SMT construction*

Kill Noise before it reaches your receiver! Great for supressing power line noise, plasma TV noise & many other local electrical noises.

Estmated availability June 2021. Check Timewave & our Dealers Websites. Get on the list for this popular item!

Navigator

The Premier Sound Card Modem!

See QST Short Takes Review - May 2014-P. 62

- **Quiet - hear what others miss!**
- **Proven USB Sound Card built-in**
- **Precise FSK**
- **Genuine K1EL Winkeyer CW IC**
- **Complete - Six FTDI COM ports**
- **Universal Rig Control for every radio**
- **Works well with HRD, M110A, Fldigi, FT8 & many more software programs**
- **Front-Panel Audio & CW controls**
- **USB connected and powered**
- **Convenient - No annoying jumpers!**

PK-232SC+

Multimode Data Controller*

- **RTTY**
- **Packet**
- **Pactor**
- **CW**
- **PSK31 & all the Sound Card modes!**

**Upgrade any PK-232 to the PK-232SC with New Lower Combo Pricing for SC & DSP Upgrade!*

Customize your PK-232 installation with our complete line of upgrades, accessories and cables.

100,000 sold - All-time top selling data controller!

- **Single USB connection to computer**
- **USB Sound Card built-in**
- **3-Way Rig Control built-in - logic level, RS-232 & USB!**
- **Computer isolated from radio**
- **Real FSK & AFSK**
- **keyboard CW - send and receive**
- **Dual Port - two radios at same time!**

■ PK-96/100 USB Packet TNC

1200/9600 bps AX.25 Packet
Available with USB or RS-232 connection

■ HamLinkUSB™ USB-to-RS-232 Adapter

Proven FTDI Chip. 9 and 25 pins for all radios, TNCs, Rotor Controllers & more!

■ HamLinkUSB™ Rig Control+

C-IV, CAT, RTS (PTT, FSK or CW) for sound card software
Perfect for HRD owners with simple sound card adapters

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MFJ Cobweb Antenna

6-Bands: 20/17/15/12/10/6 M . . . Outstanding Performance!

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, $149.95. Add-on kit adds 40/30 Meters to MFJ-1835/1835H cobweb.

40-6 Meter Cobweb
Super Heavy-Duty, 1.5 kW

MFJ-1838 **$469.95**

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.**

BigStick™
Portable Vertical

MFJ-2286 **$129.95**

Strongest, loudest portable signal on the band!

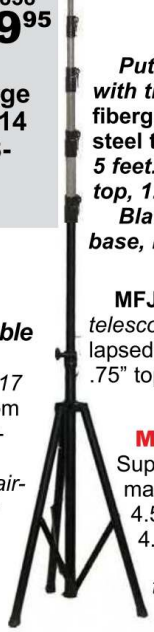
Rugged stainless steel *17 foot* whip telescopes to *full 1/4 wave* from 20 to 6 Meters -- gives you *full-size* performance for stronger, louder signals.

17-feet and ultra low loss, high-Q *air-wound* loading coil gives high efficiency on 30/40 Meters. Low SWR. 1 kW.

Includes: 17 foot whip, (27 in. collapsed), loading coil, counterpoise kit, SO-239 mount for mast up to 1 inch dia. Fits backpacks, suitcases! 2 lbs.

MFJ-2289, $219.95. 40-6M V-Dipole. Full size 20-6M.

18 foot Telescopic Fiberglass Mast with Tripod



MFJ-1919EX, $189.95.

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 inch wall, .75" top, 1.5" bottom dia. 15 lbs.***

Black steel tripod has braced triangle base, non-skid feet, mast lock.

MFJ-1918EX, $119.95.

MFJ-1918 *tripod with super strong 9.5 foot telescoping fiberglass mast.* 3.8 feet collapsed. *Quick-Clamps*™. Thick 1/8 inch wall, .75" top, 1" bottom diameters. 6.5 lbs.

Tripods Only

MFJ-1919, $119.95, *Large tripod.* Supports 100 pounds. 1.4 inch diameter mast extends 7.8 feet. Collapses to 4.5Hx.5D feet. Triangle base spreads to 4.8 feet sides for extra strength. 9.75 lbs.

MFJ-1918, $79.95, *Smaller tripod.* Support 66 lbs. 1" dia. mast. 6 ft extended, 3.2Hx.3D ft. collapsed. Base sides spread to 2.75 feet, weighs6.75 lbs.

17 foot
Stainless Steel Telescoping Whip

MFJ-1979, $74.95. Super-strong, super long *17 foot stainless steel* telescoping whip. 27 in. collapsed. 10 sections. 3/8-24 threaded base.
MFJ-1977, $59.95/12ft;
MFJ-1976, $54.95/10ft;
MFJ-1974, $49.95/8ft;
MFJ-1972, $24.95/4 1/2ft.

MFJ Rotatable Mini Dipoles

Light-weight, *isolated* mini-dipoles for imited space, temporary or permanent set-up. Rotate to null QRM, noise, direct your signal. 14 ft. long. Use mast up to 1.25" dia. **For** 40/30/20/17/15/12/10/6 Meters. Order **MFJ-22XX** (*insert band in "XX"*) **$79.95**. 75/60 Meters, $89.95 each.

MFJ-1704, $119.95
Heavy duty *antenna switch.* Select 4 antennas or ground. Unused ant. grounded. Lightning protection. Up to 500 MHz. 60 dB isolation at 30 MHz. 2.5 kW. <.2 dB loss,

MFJ-1702C, $54.95. Like MFJ-1704 but 2 antennas.

MFJ-1700C, $149.95
Antenna/Transceiver Switch selects 1 of 6 ant-ennas and 1 of 6 xcvrs in any combination. Unused terminals grounded. Lightning protection. 1.8-30 MHz. 2 kW SSB. SO-239s.

MFJ-1701, $109.95.
Select 1 of 6 antennas.

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, $44.95.
True 1:1 Current balun & center insulator forces equal antenna currents in dipole elements.

33 ft. Telescoping Fiberglass Mast

MFJ-1910 **$109.95**

3.8 feet collapsed, 3.3 lbs. Super strong. Huge 1 3/4 inch bottom section. Flexes to resist breaking. Resists UV. Put up *full size* inverted Vee or vertical in minutes for *full size performance!*

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MFJ Weather-Proof Window Feedthrough Panels

Weather-proof window feedthrough panels bring coax, balanced lines, HF/VHF/UHF antennas, random wire antennas, ground, rotator/antenna switch cables and DC/AC power into your hamshack without drilling through walls!

MFJ Weather-Proof Window Feedthrough Panels mount in your window sill. Lets you bring all your antenna connections into your hamshack without drilling holes through walls.

Simply place in window sill and close window. One cut customizes it for any window up to 48 inches. Use horizontally or vertically. Connectors are mounted on inside/outside stainless steel plates and attached to a 4 foot long, $3\frac{1}{2}$ inch high, $\frac{3}{4}$ inch thick pressure-treated wood panel.

Real Western Red Cedar wood is naturally resistant to rot, decay and insects -- lasts longer, maintenance-free. Pitch and resin free for a wide range of beautiful finishes or leave it in its naturally beautiful raw finish. Edges sealed by weather-stripping. Seals and insulates against all weather conditions. Includes window locking rod.

Inside/outside stainless steel plates ground all coax shields. Stainless steel ground post brings ground in.

MFJ-4603 Universal Window Feedthrough Panel

MFJ-4603
$119.95

Four 50 Ohm Teflon® SO-239 coax connectors lets you feed HF/VHF/UHF antennas at full legal power limit.

A 50 Ohm Teflon® coax N-connector lets you use any antenna up to 11 GHz, including 450 MHz, UHF, satellite, moon bounce and 2.4/5.8 GHz Wi-Fi antennas.

A 75 Ohm, 1 GHz F-connector makes it easy to bring in television, Satellite, HD, cable TV and FM radio signals.

A pair of high-voltage ceramic feedthru insulators lets you bring in 450/300 Ohm balanced lines directly to your antenna tuner.

Has random/longwire antenna ceramic feedthru insulator.

5-way binding posts lets you supply 50 Volts/15 Amps DC/AC power to your outside antenna tuners/relays/switches.

Stainless ground post brings in ground connection, bonds inside/outside stainless steel panels together and drains away static charges.

MFJ's exclusive Adaptive Cable Feedthru™ lets you bring in rotator/antenna switch cable, etc. without removing connectors (up to $1\frac{1}{4}$ X $1\frac{5}{8}$ in). Adapts to virtually any cable size. Seals out rain, snow, adverse weather.

3 Coax, Balanced Line, Random Wire

Best Seller! 3 Teflon® coax connectors for HF/VHF UHF antennas. Separate high voltage ceramic feed-thru insulators for balanced lines and longwire/random wire, Stainless steel ground post.

MFJ-4602
$89.95

6 Coax

6 high quality Teflon® coax connectors for HF/VHF/UHF antennas. Stainless steel ground post. Full 1500 Watt legal limit.

MFJ-4601
$79.95

4 Balanced Line, 2 Coax

4 pairs of high-voltage ceramic feed-thru insulators for balanced lines and 2 coax connectors.

MFJ-4600
$99.95

5 Cables, any-size

5 Adaptive Cable Feedthrus™. Pass any cable with connector: 2 cables with large connectors up to $1\frac{1}{4}$ x $1\frac{5}{8}$ inches and 3 cables with UHF/N size coax connectors. Seals out weather.

MFJ-4604
$124.95

All-Purpose FeedThru/CableThru™

Stacks MFJ-4603 and MFJ-4604! Gives you every possible cable connection you'll ever need through your window without drilling holes in wall – including UHF, N and F coax connectors, balanced lines, random wire, ground, DC/AC power and cables of any size for rotators, antenna switches, etc.

MFJ-4605
$189.95

Bring cables through the eave of your house

MFJ-4616
shown with standard full size vent (not included) it replaces. For 6 Cables
$39.95

MFJ-4613
shown with standard half size vent (not included) it replaces. For 3 Cables
$24.95

Replace your standard air vents on the eave/sofitt of your house with these MFJ AdaptiveCable™ Air Vent Plates and...

Bring in coax, rotator, antenna switch, power cables, etc. with connectors up to $1\frac{1}{4}$ x $1\frac{5}{8}$ inches!

Sliding plates and rubber grommets adjust for virtually any cable size to seal out adverse weather, insects and varmints. Use existing vent hole, mounting screws and screw holes.

AdaptiveCable™ Wall Plates

MFJ-4614
For 4 Cables
$49.95

Bring nearly any cable -- rotator, antenna switch, coax, DC/ AC power, etc. -- through walls without removing connectors (up to $1\frac{1}{4}$x$1\frac{5}{8}$ inches). Sliding plates and rubber grommets adjust hole size to weather-seal virtually any size cable.

Includes stainless steel plates for each side of wall, sliding plates, rubber grommets, weather stripping and screws.

MFJ-4612
For 2 Cables
$39.95

MFJ-4611
For 1 Cable
$24.95

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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 **$429.95**

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, $24.95.

MFJ-269DPRO™ SWR Analyzer

MFJ-269DPro, $469.95. 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 **$329.95** ***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, $24.95. Rugged metal cabinet, 4x2x6¾". **MFJ-249D, $309.95.**

MFJ-249D does everything MFJ-259D does with digital display only.

MFJ-223 1-60 MHz Color Graphic VNA Analyzer

This *pocket-sized wonder* breaks the mold for analyzer design with user-friendly convenience, top notch accuracy, and a vivid TFT multi-color display. Don't let the size fool you, it's packed with VNA features and performance you need!

MFJ-223 **$349.95**

- **Single-frequency** and *swept-frequency* operation
- **Truly accurate** SWR, R, X, and Z measurements
- **Seamless DDS** coverage, 100-Hz resolution from 1-60 MHz
- **Smooth "skip-free"** encoder tunes fast or slow without missing a step
- **Powerful +5-dBm** stimulus generator
- **Field-strength meter**
- **DDS generator** precision signal source
- **Vivid 1600-pixel/inch** color graphics on a 2x2 inch non-glare TFT screen

MFJ-225 1.5-180 MHz *continuous* Two-Port Graphic Analyzer

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.

MFJ-225 **$349.95**

SWR Analyzer Accessories

A. MFJ-29D/MFJ-39D, $44.95. Carrying Pouch for MFJ-259D/269D.

B. MFJ-92AA10, $44.95. 10-Pk 2500 mAh Ni-MH Supercells.

C. MFJ-66C, $44.95. Dip coils, set of two covers 1.8-230 MHz.

D. MFJ-731, $124.95. Tunable Analyzer Filter, 1.8-30 MHz, for strong RF fields.

E. MFJ-917, $44.95. 1:1 Current balun for SWR Analyzers to test balanced line antennas, other loads.

F. MFJ-7737, $7.95. PL-259 to BNC Female.

G. MFJ-7727, $7.95. PL-259 to SMA Female.

H. MFJ-5510C, $19.95. 12VDC cigarette lighter adapter.

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Comet's primary tool for any antenna adjustment or diagnostic project...

CAA-500MarkII Antenna Analyzer

1.8-500MHz

The CAA-500MarkII combines the simplicity and accuracy of an analog instrument, PLUS…a full color LCD graphic display Resistive (R) and Reactive (X) components of impedance graphed and displayed numerically SWR readings in both graphic and numerical results.

Functions:
In addition to the display of antenna properties, SWR curves are plotted quickly, easily and accurately!

Auto band-sweep function:
Switch to the amateur band of choice and press "Sweep Center". The chosen band is swept and the SWR graphed in seconds!

Manual band-sweep function:
Select the band, select the center frequency, and select the bandwidth. Manually sweep the chosen frequency range and display the SWR graph.

Multiple Manual Band-Sweeps
Manually graph the user defined bandwidth multiple times and see the results overlaid in 5 selectable colors! Make antenna length, position, height above ground, gamma match adjustments, etc…and graph each adjustment in seconds, in a new color, without losing the previous graph!

The perfect combination of analog and graphic information, designed in particular for antenna diagnostics and adjustments while on the roof, tower or in the field!

Features:
Operates on 8-16VDC external power, 6 AA Alkaline or NiMH rechargeable cells • Trickle charger built in (only when using NiMH batteries) • Typical battery life: 9 hours of continuous operation • Battery level indicator • Selectable auto power-off time limit preserves battery capacity • SO-239 connector for 1.8-300MHz range • N-female connector for 300-500MHz range • Optional soft carry case sold separately: CAA-5SC

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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-998 Legal Limit IntelliTuner™ lets you tune any antenna automatically -- ultra fast and handles a full 1500 Watts SSB/CW and Digital!

made in USA

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-998
$749.95
Full Digital Power!

MFJ's exclusive *IntelliTuner*™, *Adaptive Search*™ and *Instant Recall*™ algorithms give you *ultra fast* automatic tuning with over 20,000 *VirtualAntenna*™ Memories. You get a highly efficient L-network, 12-1600 ohm matching at 1500 Watts SSB/CW and digital, 1.8-30 MHz coverage, Cross-Needle *and* digital meters, audio SWR meter, and *backlit* LCD. MFJ-998 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!* Use 12-15 VDC/1 amp or 110 VAC with **MFJ-1316, $34.95**. 13Wx4Hx15D". Radio interface cables. See ***www.mfjenterprises.com***

600 Watt MFJ Automatic Antenna Tuner

MFJ-994B, $389.95. 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

MFJ-993B
$309.95
Full Digital Power!

Automatically tunes unbalanced/balanced antennas, ultra fast and has 20,000 memories. Has antenna switch, efficient L-network, select 300 Watts (6-1600 Ohms or 150W 6-3200 Ohms. 1.8-30 MHz, 4:1 balun, backlit LCD.

300 Watt ...Extra Wide Range

SWR/Wattmeter, 10000 VA Memories

Extra *wide matching range at less cost.* MFJ-991B
$269.95
Full Digital Power!

MFJ's *exclusive* dual power level: 300 Watts for 6-1600 Ohms; 150Watts for 6-3200 Ohms. Cross-Needle SWR/Wattmeter.

200 Watt ...Compact

Digital Meter, Ant Switch, Wide Range

MFJ-929
$279.95
Full Digital Power!

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.

200 Watt *MightyMite*™

Matches IC-706, FT-857D, TS-50S

Full Digital Power!

MFJ-939KIY
$179.95

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. 6½Wx2⅞Hx8⅜D".

MFJ *Remote* AutoTuners

Get greatly reduced losses and high efficiencies with long coax runs and high SWR antennas. ***Full Digital Power!***

MFJ-926B, $339.95. 200W.
MFJ-993BRT, $349.95. 300W.
MFJ-994BRT, $469.95. 600W.
MFJ-998BRT, $879.95. 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
$79.95

MFJ-1778M, $69.95. 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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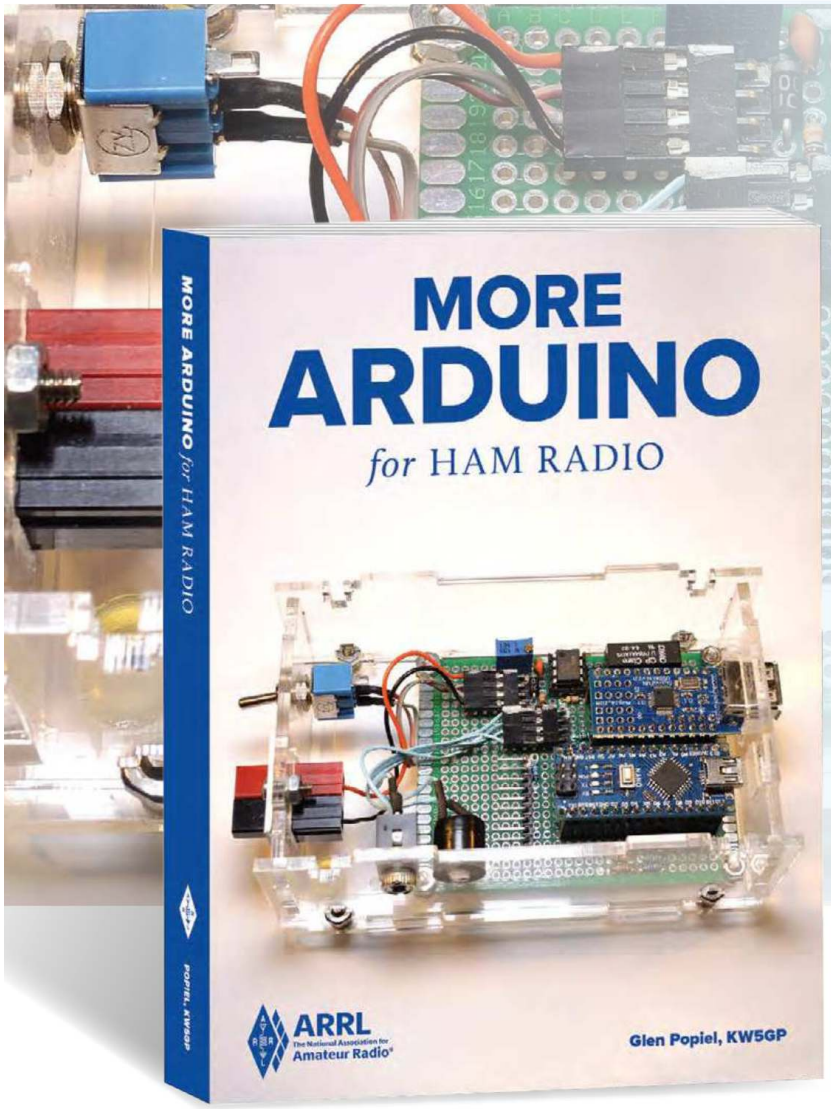
Learn how to build Arduino microcontroller projects for your ham radio station!

More Arduino for Ham Radio

Glen Popiel, KW5GP, introduces many of the new Arduino boards and add-on modules, followed by an overview of the software, tools, and techniques needed to bring projects to life. Ten practical projects showcase a wide variety of applications and include detailed descriptions of how the software "sketches" work.



Projects:

- Yaesu FH-2 Keypad
- Peltier Cooler Controller
- Rotator Turn Indicator
- Rotator Position Indicator
- Build Your Own AR-40 Rotator Controller
- Modified AR-40 Rotator Controller
- USB CW Keyboard
- Yaesu CAT Display
- CDE/HyGain Keypad Rotator Controller
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MFJ Tuners

New, Improved MFJ-989D 1500 Watt legal limit Antenna Tuner

World's most popular 1500 Watt Legal Limit Tuner just got better -- much better -- gives you more for your money!

New, improved MFJ-989D legal limit antenna tuner gives you better 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 and 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 $479.95

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.

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. $12^{7}/_{8}$W x 6H x $11^{5}/_{8}$D inches.

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.

More hams use MFJ tuners than all other tuners in the world!

MFJ-986 Two knob Differential-T™

MFJ-986 $429.95

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. 15W x $4^{1}/_{2}$H x $10^{3}/_{4}$D in.

MFJ-962D compact kW Tuner

MFJ-962D $369.95

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, pk/avg lighted Cross-Needle SWR/Wattmeter, antenna switch, balun, Lexan front, 1.8-30MHz. $10^{7}/_{8}$W x $10^{3}/_{4}$H x $4^{1}/_{2}$D in.

MFJ-969 300W Roller Inductor Tuner

Superb, AirCore™ Roller Inductor tuning. Covers 6 Meters thru 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 panel. $10^{1}/_{2}$W x $3^{1}/_{2}$H x $9^{1}/_{2}$D inches.

MFJ-969 $269.95

MFJ-949E deluxe 300 Watt Tuner

More hams use MFJ-949s than any other antenna tuner in the world! Handles 300 Watts Full 1.8 to 30 MHz coverage, custom inductor switch, 1000 Volt 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. $10^{5}/_{8}$W x $3^{1}/_{2}$H x 7D inches. **MFJ-948, $199.95**. Economy version of MFJ-949E, less dummy load, Lexan front panel.

MFJ-949E $229.95

MFJ-941E Super Value Tuner

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. $10^{1}/_{2}$W x $2^{1}/_{2}$H x 7D in. **MFJ-941EK, $159.95.** Tuner Kit -- Build your own!

MFJ-941E $179.95

MFJ-945E HF/6M mobile Tuner

Extends your mobile antenna bandwidth so you don't have to stop, go outside and adjust your antenna. Tiny 8W x 2H x 6D in. Lighted Cross-Needle SWR/Wattmeter. Lamp and bypass switches. Covers 1.8-30 MHz and 6 Meters. 300 Watts PEP. **MFJ-20, $11.95**, mobile mount.

MFJ-945E $169.95

MFJ-971 portable/QRP Tuner

Tunes coax, balanced lines, random wire 1.8-30 MHz. Cross-Needle Meter. SWR, 30/300 or 6 Watt QRP ranges. Matches popular MFJ transceivers. Tiny $6^{1}/_{2}$W x $2^{1}/_{2}$H x 6D in.

MFJ-971 $159.95

MFJ-901B smallest Versa Tuner

MFJ's smallest (5W x 2H x 6D in.) 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-901B $129.95

MFJ-902B Tiny Travel Tuner

Tiny $4^{1}/_{2}$W x $2^{1}/_{4}$H x 3D inches, full 150 Watts, 80-6 Meters, has tuner bypass switch, for coax/random wire. **MFJ-904H, $179.95**. Same but adds Cross-needle SWR/Wattmeter and 4:1 balun for balanced lines. $7^{1}/_{4}$W x $2^{3}/_{4}$H x $2^{3}/_{4}$D inches.

MFJ-902B $139.95

MFJ-16010 random wire Tuner

Operate all bands anywhere with MFJ's reversible L-network. Turns random wire into powerful transmitting antenna. 1.8-30 MHz. 200 Watts PEP. Tiny 4W x 2H x 3D in.

MFJ-16010 $84.95

MFJ-9201 QRPocket™ Tuner

80-10 Meters, 25 Watts. 12 position inductor, tune/bypass switch, wide-range T-network, BNCs. 4W x $2^{5}/_{8}$H x $1^{1}/_{2}$D inches. **MFJ-9201, $64.95**

MFJ-9201 $64.95

MFJ-921/924 VHF/UHF Tuners

MFJ-921 covers 2 Meters/220 MHz. **MFJ-924** covers 440 MHz. SWR/Wattmeter. 8W x $2^{1}/_{2}$H x 3D in.

MFJ-921/924 $114.95

MFJ-931 Artificial RF Ground

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, $259.95**, Artificial ground/300 Watt Tuner/Cross-Needle SWR/Wattmeter.

MFJ-931 $139.95

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New! Ver. 2.0 MFJ-1234B . . . Remotely operate your transceiver from anywhere in the world!

MFJ-1234B has RigPi version 2 software with new powerful Raspberry Pi 4B with 2 GB RAM. Loaded with 30 new features and updates and provides remote CW keying over the internet, support for over 27 new radios, PTT and frequency control knob from the Contour Shuttle controller and Flic Bluetooth PTT switch, antenna switching, power amp control and much more!

New!
MFJ-1234B
$329.95

Apple iPhone operating your rig remotely from anywhere in the world!

Remotely operate your station! Use any web browser on your mobile phone, iPad, tablet, laptop, desk-top even a Kindle!

Use nearly any transceiver with CAT control, old or new. Operate all modes SSB, CW, FM, digital. WSJT-X, Fldigi are installed.

Control from anywhere via the internet using any browser -- radio, rotor, CW keying, VoIP, digital modes, logging, spot monitoring, callbook lookups, more.

Look-up calls using included FCC database or optional QRZ subscription. Monitor DX spots for un-worked or unconfirmed calls.

Design, maintain multiple logs. Upload ADIF logs to ARRL LoTW server. Send CW from a mobile device, keyboard or paddle.

32 programmable macros.

Two or more hams from different locations can operate different radios at the same time using one MFJ-1234.

Single-click updating, I/Q Input for SDR radios, onboard VoIP server gives outstanding 2-way audio.

Includes email, word processing, spreadsheet programs, 1000's of Linux programs, including many for ham radio. Modify, program RigPi Station Server features using a text editor.

HARDWARE

RSS is a Raspberry Pi™ computer running Linux and RigPi Keyer and Audio boards. RigPi Keyer uses K1EL WinKeyer3 integrated circuit for keyboard/paddle input. RigPi Audio is used for VoIP for remote, digital modes and I/Q spectral display (Panadaptor).

OPTIONS

MFJ-1305RP, $29.95. 5V, 3A Pwr Supl.
MFJ-1234BSD,$59.95. RigPi 2.0 software on SD Card only.
MFJ-1234BOS, $29.95. Rig Pi Version 2.0 software download.
MFJ-1234AB, $79.95. Audio Board.
MFJ-1234KB, $79.95. Keyer Board.
MFJ-1234BC, $29.95. Metal cabinet for Raspberry Pi 4B, audio, keyer boards.

TECH HELP

- RigPi forum is *https://rigpi.groups.io*
- RigPi website is *https://rigpi.net*

** RigPi trademarked, Howard Nurse, W6HN. Raspberry Pi is a trademark of the Raspberry Pi Foundation.*

MFJ CW Reader and Keyer Combination

Plug MFJ's CW Reader with Keyer into your transceiver's phone jack and key jack.

Now you're ready to compete with the world's best hi-speed CW operators -- and *they won't even know you're still learning the code!* Sends and reads 5-99 WPM.

Automatic speed tracking. Large 2-line LCD shows send/receive messages. Use paddle or computer keyboard.

Easy menu operation. Front panel speed, volume controls. 4 message memories, type ahead buffer, read again buffer, adjustable weight/sidetone, speaker. RFI proof.

MFJ-551, $39.95. RFI suppressed keyboard, a must to avoid RFI problems.

MFJ-464
$249.95
(Keyboard, paddle not included.)

MFJ Pocket-Size *CW Reader*™ and *Code Tutor*

MFJ-461, $119.95. Place this tiny pocket size MFJ Morse Code Reader near your receiver's speaker and watch CW turn into solid text messages as they scroll across an easy-to-read LCD. No cables to hook-up, no computer, no interface, nothing else needed! Practice by copying along with the MFJ-461. Learn the code and increase your speed as you instantly see if you're right or wrong. Eavesdrop on interesting Morse QSOs from hams all over the world. MFJ's *AutoTrak*™ automatically locks on, tracks and displays CW to 99 WPM. Serial port lets you display full screen CW text on your computer monitor with your computer and terminal program. Tiny $2^{1}/_{4}$x$3^{1}/_{4}$x1", $5^{1}/_{2}$ oz. Fits in your shirt pocket, take it anywhere. Use 9 Volt battery.

MFJ-418, $119.95. Morse Code Tutor. Learn Morse code anywhere! Copy letters, numbers, prosigns or any combination or words or QSOs. ARRL/VEC format. Go from zero code speed to a high speed *CW Pro!* High contrast LCD, built-in speaker.

Plug & Play FT-8 and all Digital Modes!

MFJ-1205, $119.95. *Plug&Play* all digital modes! Specify your radio when ordering and just plug USB cable into your computer. Download *free* software from internet and operate: FT-8, JT4, JT-65, JT6M, FSK441, WSPR, PSK-31, EchoLink, APRS, CW, RTTY, packet, Amtor, more. Easy-to-set transmit/receive levels. Transformer isolated audio, PTT sensing eliminates adjustments. Universal, never obsolete.

MFJ-407E Deluxe CW Keyer $129.95

MFJ Curtis-Keyer has all modes, dot-dash memories, jam-proof spacing, weight, sidetone, built-in speaker. Speed, weight and tone controls and tune, semi-auto and on/off are on front panel.

MFJ-557 Code Oscillator/Key $54.95

Practice sending Morse code. Telegraph key, code oscillator, speaker on heavy non-skid steel base. Volume/tone controls. Use 9V battery.

MFJ-550, $24.95. Key only.

MFJ-561 Tiny Iambic paddle $39.95

Tiny *Iambic paddle* is just $1^{3}/_{4}$W x $^{3}/_{4}$H x $1^{3}/_{4}$D", just $2^{1}/_{2}$ oz. Precision paddle formed from phosphorous bronze, rugged metal base, non-skid rubber feet, wired.

MFJ-401E *Econo* CW Keyer $99.95

Front-panel volume/speed controls (8-50 wpm), tune switch. Internally adjust weight/tone. Solid state keying. Tiny 4x2x$3^{1}/_{2}$ inches.

MFJ-564 Iambic Paddles $119.95

Deluxe Iambic paddles. Tension/contact spacing adjustments, steel bearings, precision frame, non-skid feet. Crome (MFJ-564) or Black (MFJ-564B).

MFJ-422E *Keyer/Paddle* $239.95

MFJ *CW keyer and Iambic Paddle* combo lets you send smooth, easy CW. Front panel volume/speed (8-50 WPM), built-in dot-dash memories, speaker, sidetone.

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ARRL Handbook 2022

AVAILABLE IN SOFTCOVER AND SIX-VOLUME BOOK SET

Reach for the Sky Mister!

MFJ **Get that antenna up where it belongs, high in the sky with MFJ *heavy-duty* Telescopic Masts and accessories. We got all you need for temporary, portable or permanent antenna installations.**

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, $109.95. 33 ft., light duty w/top tie ring.
MFJ-1911, $119.95. 20 ft., light duty w/top tie ring.
MFJ-1913, $119.95. 28 ft., lightweight w/top tie ring.
MFJ-1915, $159.95. 25 ft., for heavier duty use.
MFJ-1916, $189.95. 34 ft., for heavier duty use.
MFJ-1917, $199.95. 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, $299.95 is 48' ext., 7.75-ft. collapsed, has 2½" OD bottom, 1" OD top, seven 7.75-ft. sections, 24 lbs.
MFJ-1906HD, $259.95 is 38' extended, 6 feet collapsed, has 2½" OD bottom, 1" OD top, seven 6-foot sections, 24 lbs.
MFJ-1904HD, $189.95 is 25' extended, 4 feet collapsed, has 2½" OD bottom, 1" OD top, seven 4-foot sections, 14 lbs.
MFJ-1904H, $169.95. 22' ext., 5' collapsed, 9 lbs. 2½" OD.
MFJ-1902H, $149.95, 10' ext., 38" collapsed, 5 lbs. 2½" OD

Standard Models: H models have QuickClamps™

MFJ-1906, $169.95/MFJ-1906H, $219.95, 33 feet, ext., 6 ft. collapsed, six 6-ft. sections, 13 lbs. 2" bottom, 3/4" top OD.
MFJ-1908, $209.95/MFJ-1908H, $259.95, 41' ext., 7.75-ft. collapsed, six 7.75-ft. sect., 16 lbs. 2" bottom, 3/4" top OD.

Mast Accessories

MFJ-1900, $89.95. Mount clamps mast to mounting pipe.
MFJ-13, $79.95. 5 Military Quick*Clamps*™. Fit 3/4" to 2" OD.
MFJ-13HD, $79.95. Extra set clamps, 1- 2½" masts.

Mast Guy Ring Sets

Fits masts 3/4" to 1¼" dia OD. **MFJ-2830X, $11.95,** *fiberglass*; **MFJ-2840X, $14.95,** *aluminum.*

Left: *Stainless Steel Hose Clamps* recommended for permanent installations. Fiberglass is slotted.

Right: UV protected Military grade *QuickClamps*.Guy 2 levels when fully extended.

18' Telescopic Mast/Tripod

MFJ-1919EX, $189.95. ***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.***

MFJ-1918EX, $119.95. **MFJ-1918** *tripod with 9.5 ft. telescoping fiberglass mast.* 3.8 feet collapsed. 6.5 lbs.

Tripods Only

MFJ-1921, $209.95, *Giant tripod* base spreads to 8 feet! Supports massive antennas. Adjustable length non-skid legs accommodates uneven ground surfaces. Optional foot anchors, *see bottom right* 14 lbs.

MFJ-1919, $119.95, *Large tripod* base spreads to 4.8 ft. Support 100 pounds. 7.8 ft, 9.75 lbs.

MFJ-1918, $79.95, *Smaller tripod* base spreads to 2.75 ft. Support 66 lbs. 6.75 lbs.

80-6 Meter Antenna

3.8 ft. fiberglass mast telescopes to a 31ft. self-supporting *high performance* 80-6 Meter vertical 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 M. 600W SSB/CW.

Use as temporary, portable or permanent antenna for home, RVs, camping, field day, hamfest, DX-pedition.

Includes four 12 foot radials. Current balun reduces feedline radiation and pattern distortion.

MFJ-2980
$129.95
40-6 Meters

MFJ-2982
$179.95
80-6 Meters

MFJ "HamStick" Isolated Dipole

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.

MFJ-347
$29.95

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

MFJ-1907
$59.95

Mount *multiple* HF/VHF hamsticks, verticals, dipoles vertically or horizontally on your balcony. High-strength aircraft aluminum extends out 14". Two U-bolts mount to 1½"dia.

Tripod Anchors

MFJ-1905, $39.95. 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"OD.

Portable Mast Supports

New!

MFJ-1912, $119.95. 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.

New!

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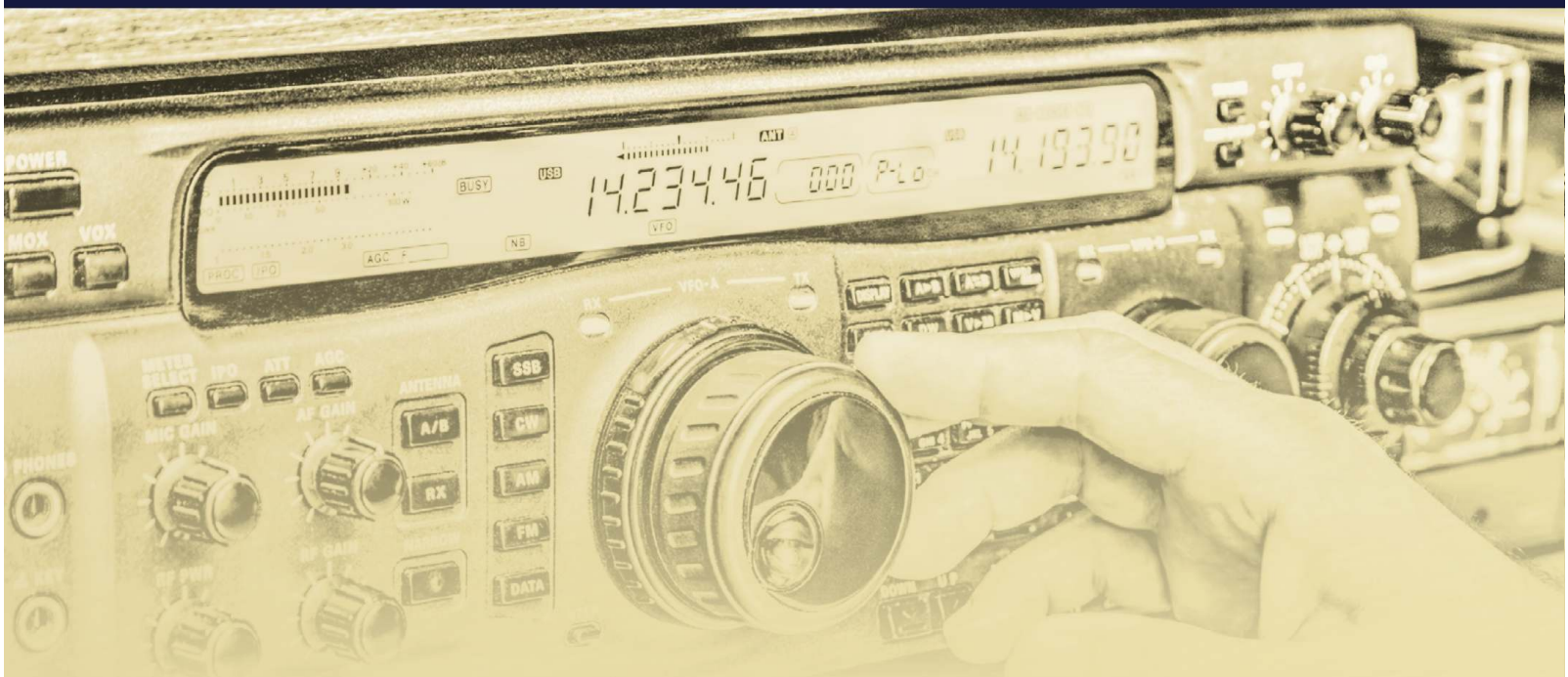

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