Special Insert! 2021 ARRL Field Day Guide | June 26-27

QST

DIGITAL EDITION

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2021 FIELD DAY

QST Reviews

Yaesu FTDX10 MF/HF and 6-Meter Transceiver

Ciro Mazzoni
40 – 10 Meter
Baby Loop Antenna

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

* External Speaker SP-30: Optional

- 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

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

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Specifications subject to change without notice. Some accessories and/or options may be standard in certain areas. Frequency coverage may differ in some countries. Check with your local Yaesu Dealer for specific details.

YAESU
The radio

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FM Friendly Digital : AMS (Automatic Mode Select)

System Fusion II Compatible

WIRES-X Portable Digital Node Function

- **Wide Range RX Coverage : 108 ~ 999.99 MHz**
- **Easy to Operate II (E2O-II) : New User Interface for Easy Operation**
- **New Memory Auto Grouping (MAG) Function**
- **New Multi-Channel Standby (MCS) Function**
- **High-Speed 61 Channel Band Scope**
- **Easy Hands-Free Operation with Built-in Bluetooth® Unit**

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WIRES-X

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Cushcraft...Keeping You in Touch Around the Globe

MA-6B 6-Band Beam

Small Footprint – Big Signal

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

Cushcraft's latest MA-6B gives you *2-elements on six bands!* You get solid *signal-boosting directivity* in a bantam-size and weight.

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

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

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

MA-5B, $579.95. Like MA-6B but five bands: 20/17/15/12/10 Meters. 12 and 17 Meters is a single element trapped dipole.
***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, $549.95,** 12/17 M. **30/40 Meter** *add-on kits* available.

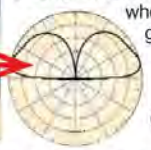
Cushcraft R9...80-6 Meters 80 Meters...No Radials...1500W

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!*

Its 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.

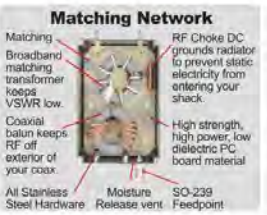
Rugged Construction: Thick fiberglass insulators, all stainless steel hardware and 6063 aircraft-aluminum tubing is double or triple walled at key stress points to handle anything Mother Nature can dish out.

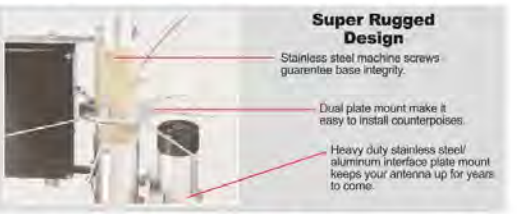
31.5 feet tall, 25 lbs. Mounting mast 1.25 to 2 inches. Wind surface area is 4 square feet.

R8, $599.95. Like R9 antenna but less 75/80 Meters.

R-8TB, $99.95. Tilt-base lets you tilt your antenna up/down easily by yourself to work on.

R-8GK, $79.95. Three-point guy kit for high winds.





Cushcraft Dual-Band Yagis

One Yagi for Dual-Band FM Radios

Dual-bander VHF rigs are the norm these days, so why not complement 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 Ringos Compact FM Verticals

W1BX's famous Ringo antenna has been around for a long time and remains unbeaten for solid reliability. The Ringo is broadbanded, lightning 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!

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1.8-500MHz

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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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Our Cover

Field Day 2021 is coming, June 26 – 27! This issue of *QST* will help you prepare, with articles about antenna options, as well as a pull-out *2021 ARRL Field Day Guide* that features helpful tips, a bonus points calculator, a handy Section checklist to keep near your operating position, and even a Field Day chili recipe! On this month's cover, members of the Nashua Area Radio Society, N1FD, in Nashua, New Hampshire, put their Field Day setup through its paces in preparation for the big event. From left to right are Connor Finchum, KC1GGX; Abby Finchum, AB1BY; Vice President Jamey Finchum, AC1DC; Treasurer Anita Kemmerer, AB1QB, and President Fred Kemmerer, AB1OC. [Lori Pedrick, photo]

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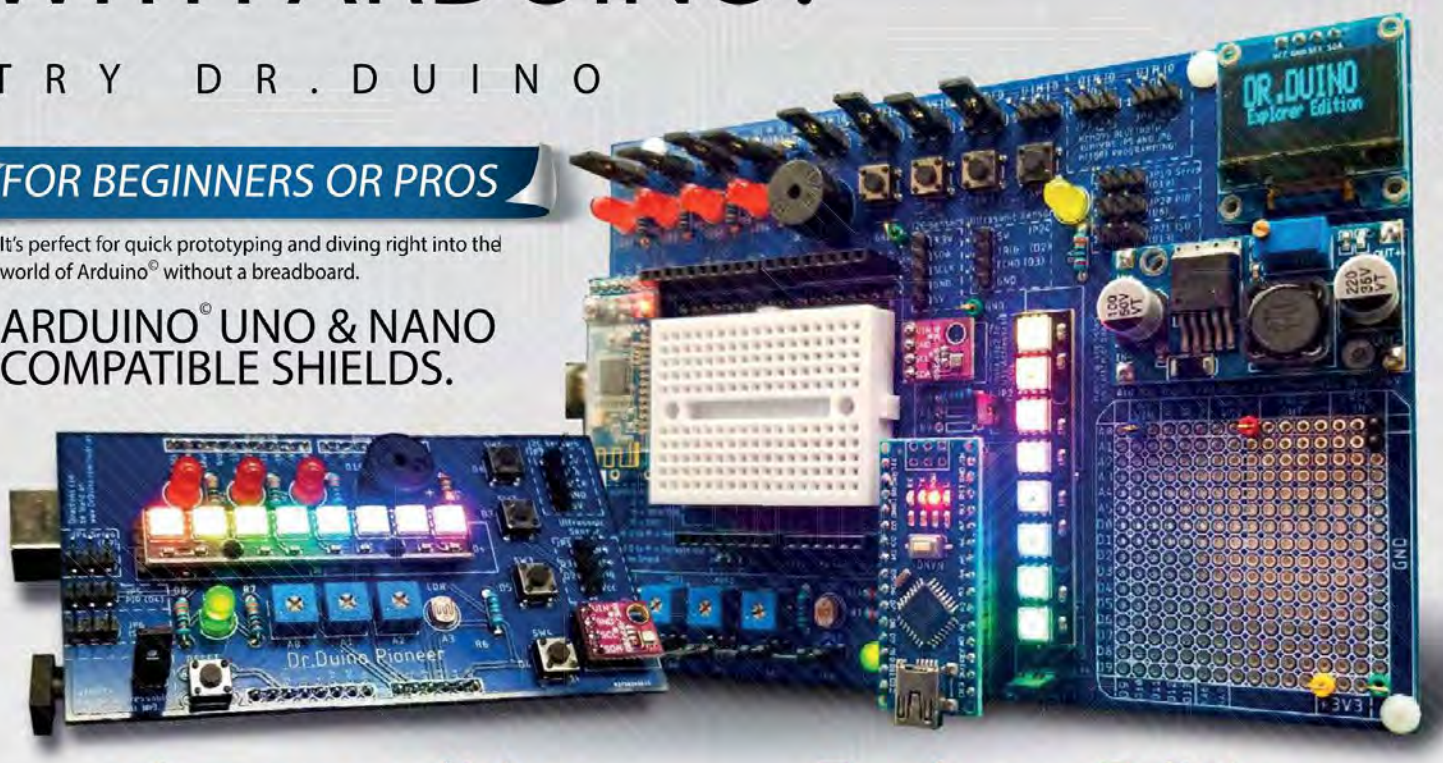

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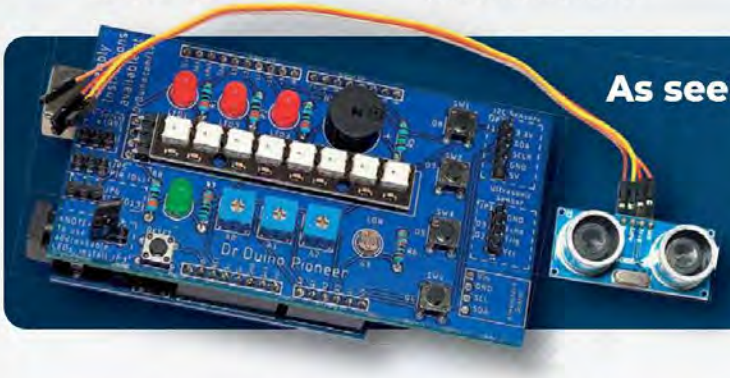

As seen in QST Magazine November 2020

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«The Pioneer Edition is an excellent learning platform to begin working with the Arduino»

Revied by Glen Popiel, KW5GP

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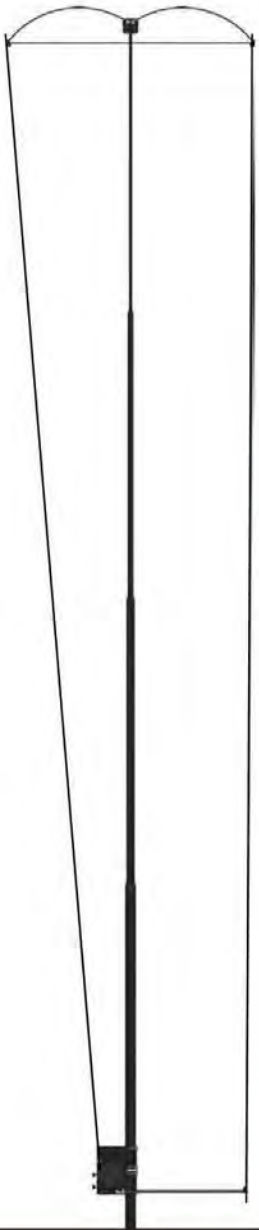

UrbanBeam

PORTABLE YAGI ANTENNA

The Urban Beam is excellent for use in the field where portability and easy setup is required, without sacrificing superior performance – all while maintaining a significantly smaller profile than traditional high-performance Yagi antennas. Covering 6.8 - 54 MHz, the Urban Beam is a dipole on 6.8-13.3 MHz and a 2 element Yagi from 13.3 - 54 MHz.

CrankIR

PORTABLE VERTICAL

The CrankIR is a lightweight, high-performance, ultra-portable 3.3 - 144 MHz vertical antenna rated at 1500 watts key-down with fully manual operation – no electrical power is required for this antenna system and it fits into an 8" x 8" x 24" included fabric carrying case.

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- Overlapping outer shells for added strength
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- Strong waterproof joint couplings
- Type-N cable connection
- Wideband performance
- Highest gain Dual-band Base Antenna!

Here is a small sample of our wide variety of antennas

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

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

Second Century

Getting Inspired for Field Day

ARRL Field Day 2021 is upon us, and it's a great opportunity to experiment with facets of amateur radio you may have never tried before. And the great thing about Field Day, beyond the diversity of ways to operate, is the diversity of the skill levels of the participants! This is a fun event for everyone involved, so why not jump into something new and give it a try, whether it's VHF, satellite, FT8, or using the National Traffic System to send your Section Manager a message about your operation.

One of my favorite Field Day outings was in 1989. A group of my friends — who are all well-known contesters today — and I set out for Skyline Drive in New Jersey for a mini-mountaintop experience. We had a couple of medium-sized tents, a generator, and a bucket truck with a triband Yagi pointed west, along with a dual-band dipole from atop a very tall fire tower. The two things that strike me about that Field Day are: if we were to do that outing today, we were certainly socially distanced enough to operate safely, and also that this was the first — and only — operation using FreddyPac. This was a 2-meter-based packet robot that I wrote, running on a Compaq "lunchbox" computer. Freddy sat and monitored 2 meters while making the occasional contact. Field Day had become my venue for experimentation!

As I look at Field Day this year, I would encourage you to take on an aspect of amateur radio you've never tried before. YouTube being what it is, there's a tremendous amount of material to research.

You can start with going into the field! Structured events like the various on-air programs that focus on everything from parks to summits to islands can give you very good ideas about making your first venture outdoors. These operators use one of many new-generation QRP radios and small, light antennas for their activations. The maker community has even created 3D-printed handles for antennas to be wound around for portability and convenience. This year, ARRL is offering a kit for Field Day: an end-fed half-wave antenna. This kit is intended to take the guesswork out of collecting the materials, but gives you the opportunity to build your own antenna for Field Day.

Perhaps you'd like to experiment by building a Moxon antenna. This simple antenna is a favorite amongst another community you can learn from: the VHF rovers. The 6-meter Moxon is a small but fantastic performing antenna for Field Day. You can also look at a 2-meter Moxon along with a short 70-centimeter Yagi on the same boom for satellite operation. Although some of the recent rock stars of low earth orbiting (LEO) satellites are now silent, there will be plenty of passes during Field Day for you to try making a contact.

Field Day is also a great opportunity to reach out to newcomers or friends who have been off the air for a while. The event brings out a sense of community for clubs, groups, and friends to get together and operate. This issue includes a Field Day insert that we hope helps you navigate the myriad ways to add bonus points to your score. You'll find that a newcomer can operate a GOTA station for your effort, and perhaps your inactive friend may find the pace of a VHF bonus station more appealing.

Last year, Field Day was directly impacted by very strict restrictions that states imposed to keep people far enough apart to prevent increased potential of spreading COVID-19. This year, the restrictions in many places have been reduced or even eliminated. Many groups and clubs are revisiting their options for coming together for Field Day in a socially responsible way.

Whether you decide to operate from home again this year, take a trip to a local park, experiment with something completely new, or operate safely with your club or group, Field Day is the best opportunity of the year for all of us to come together and enjoy the hobby!

Stay radio active, be that connector getting more people on the air, and we'll see you for Field Day!

David A. Minster, NA2AA
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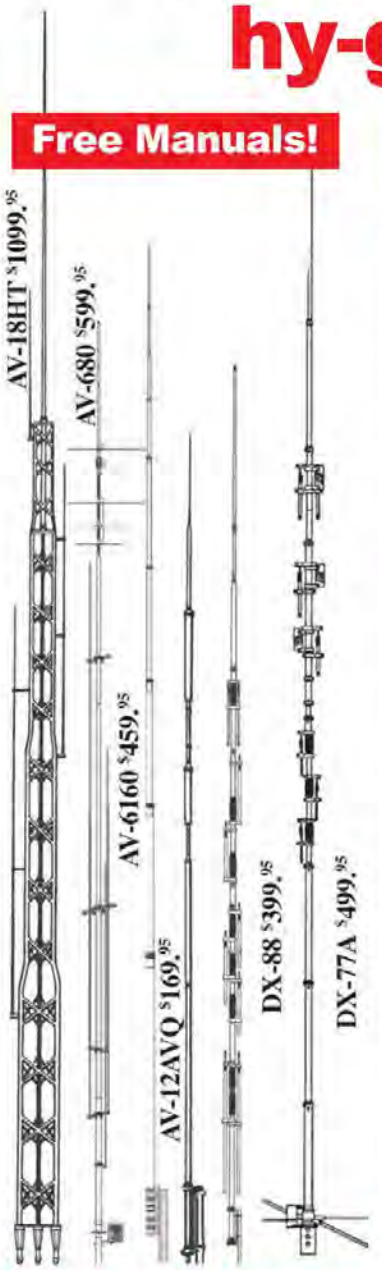

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AV-12AVQ, $169.95. (20, 15, 10 Meters). 13 ft., 9 lbs.
Automatic bandswitching, omnidirectional, low angle DX antenna. self-supporting. 1500 Watts.
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All bands are easily tuned with exclusive adjustable capacitors.
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DX-77A, $499.95. (40, 30, 20, 17, 15, 12, 10 Meters). 29 ft., 25 lbs.
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Off-center-fed Windom has 55% greater bandwidth than competitive verticals. Heavy-duty tiltable base. Each band independently tunable.

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Also ideal for shortwave listening. Sleek, low profile. Tiny footprint mounts anywhere! Included mounting bracket installs on short 1.5-1.625" diameter mast driven into ground. Requires at least one radial -- more the better.

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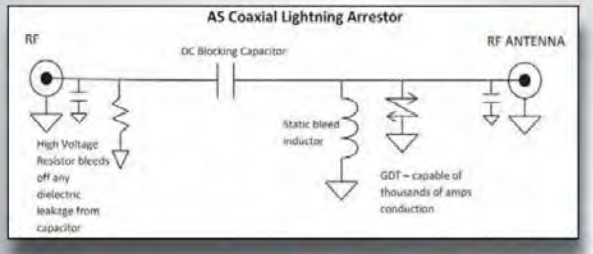

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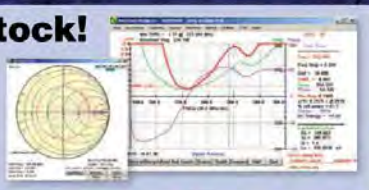

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Becky R. Schoenfeld, W1BXY, bschoenfeld@arrl.org

Member Spotlight

Gene Clark, W4AYK

Gene Clark, W4AYK, of Albany, Georgia was first beguiled by radio in the early 1940s, when he saw the movie *Men of Boys Town*, in which Mickey Rooney's character, Whitey Marsh, was a ham.

College, medical school, and marriage intervened soon after, but Gene did manage to edge toward the radio hobby by building a Heathkit A7E amplifier in the mid-1950s. By the time Gene was a Navy flight surgeon stationed in Pensacola, Florida, he also had a Heathkit DX100B transmitter and, as of 1958, a Conditional license — both of which had been as-yet unused. That all changed when he got to Pensacola.

"I moved in and I saw a 40-meter antenna next door," Gene recalled. "That was Maurice Wheeler, K4RMO. Maurice turned out to be one of the best Elmers you could ever find."

Getting to Work

Gene upgraded to Advanced, then Extra, enjoying the bands until the mid-1970s, when he first moved to Georgia and set up a solo practice as a nephrologist.

"There was no dialysis clinic, no nephrologist anywhere in all of south Georgia," Gene said. "I came in and got a nonprofit to help me start dialysis service. It started off like an explosion!"

Another long break from radio ensued, thanks to Gene's thriving practice. In 1997, nearing retirement, he decided to take a few steps back from work, and a few steps toward ham radio again. He had always maintained his license and his ARRL membership because, as he said, "I knew one day I'd be back."

Coming Full Circle

Gene got back on HF, checking in on nets like the Alabama ARES net (Gene describes himself as having "Alabama roots," particularly in Birmingham, where he went to college and medical school) and the Southern Country Cousins net, the latter of which brought him full circle.

"I checked back in and what happened? I heard K4RMO," Gene said. He and Maurice reconnected, and their friendship lasted until Maurice died 3 years ago.

A Passion for Serving Others

Gene's return to ham radio also marked the beginning of his involvement with ARES in the Georgia Section. He's worn many hats, including District Emergency Coordinator and Section Emergency Coordinator. Gene was Georgia Section Manager from October 2009 to November 2016, and still serves as Assistant Section Manager at the state level, as well as being Emergency Coordinator for Dougherty County, Georgia.

The Dougherty County ARES group has been very successful in partnering with the major hospital in the area, Phoebe Putney Memorial, partly because Gene saw patients there for years. This familiarity and credibility led to the group being able to establish station KK4LLV on the ninth floor of the hospital. The station has a D-STAR repeater, and is equipped for NBEMS and Winlink as well as FM and HF. KK4LLV is used for regular and emergency communications with other hospitals in the Georgia Hospital Association, and participates in all the Georgia Hospital Drills.

Gene has a special interest in digital communications, which has led him to arrange in-person and virtual workshops, as well as regular digital practice on the local nets and in the weekly Georgia Section Drills. He prides himself on being ahead of the curve regarding the recent pandemic-driven pivot to online meetings — for more than a decade, he's been using the GoToMeeting videoconferencing platform for many Section-wide meetings.

A past president of the Albany (Georgia) Amateur Radio Club, Gene has organized and (along with his fellow club members) participated in emergency drills with the local Marine Corps Logistics Base, and has provided communications for local marathons and other events — all at nearly 92 years of age.

When asked what keeps him involved in ham radio, Gene instantly said, "It's people. They're good people to get to know. Participation in these events provides a vital service to the community, as well as allowing club members to hone our emergency communications skills."

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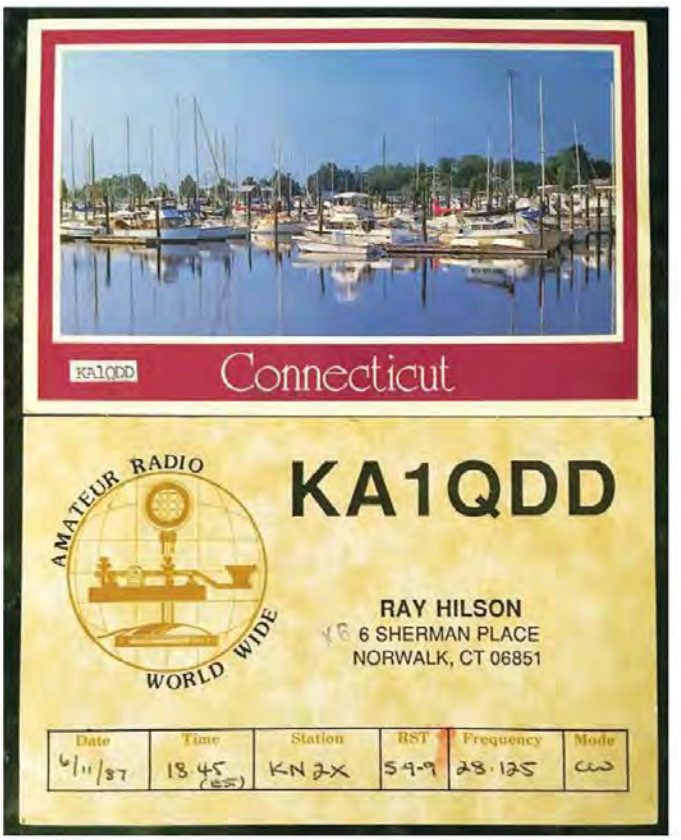
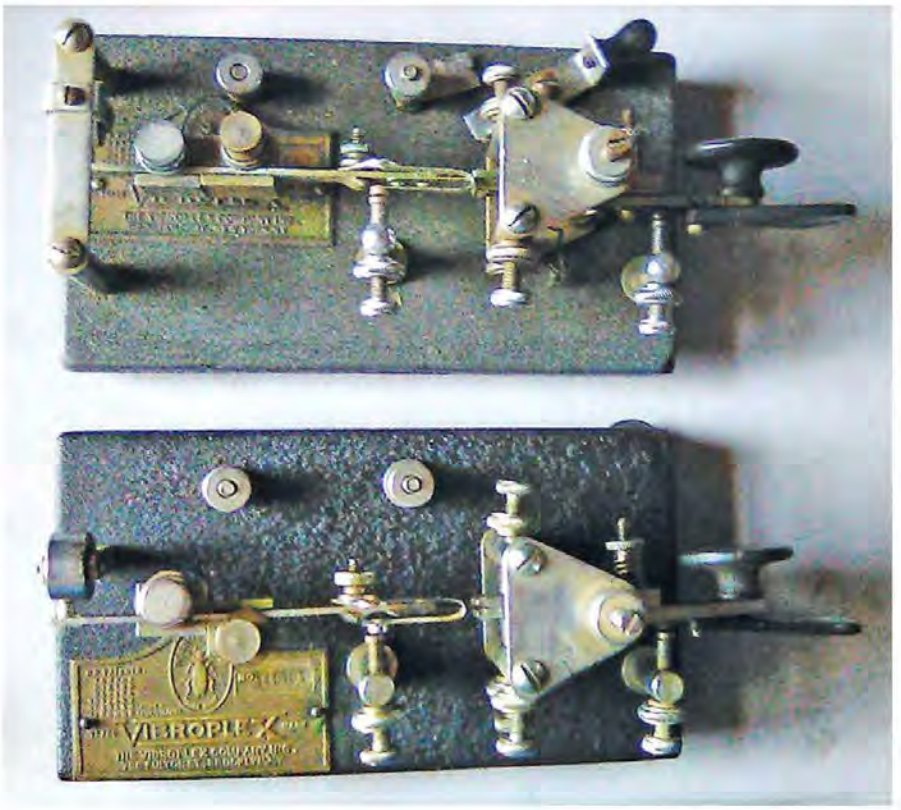
Up Front

An Original QSL Card

After approximately 25 years off the air, Ray, WB1U, got back into the world of ham radio. He did a Google search of his original call sign, and he found two of his early QSL cards being sold on eBay by a seller in Canada. Both cards were for the same contact with KN2X, located in Yonkers, New York, on June 11, 1987. It was one of his first contacts, so he purchased back the two cards (fortunately, there were no other bidders). The first card is from before he was able to make official QSL cards with his call sign on it. Ray sent a follow-up QSL card, after he had official ones made.





Timeless Bugs

Joe Falletta, W6UDO, first became fascinated with bugs, or semi-automatic Morse keys, in the mid-1960s, but he first purchased one around 2000, when his arthritic wrist could no longer take the up and down movements of a straight key. He found a 1940 Vibroplex Champion and a 1944 Lightning Bug. Both were in good shape, and he still uses them on the air. Additionally, he discovered Vibroplex still sells new bugs and offers service and replacement parts for most of their older models. At **www.vibroplex.com**, you can even date your bug by serial number and find helpful instruction on how to set it up.

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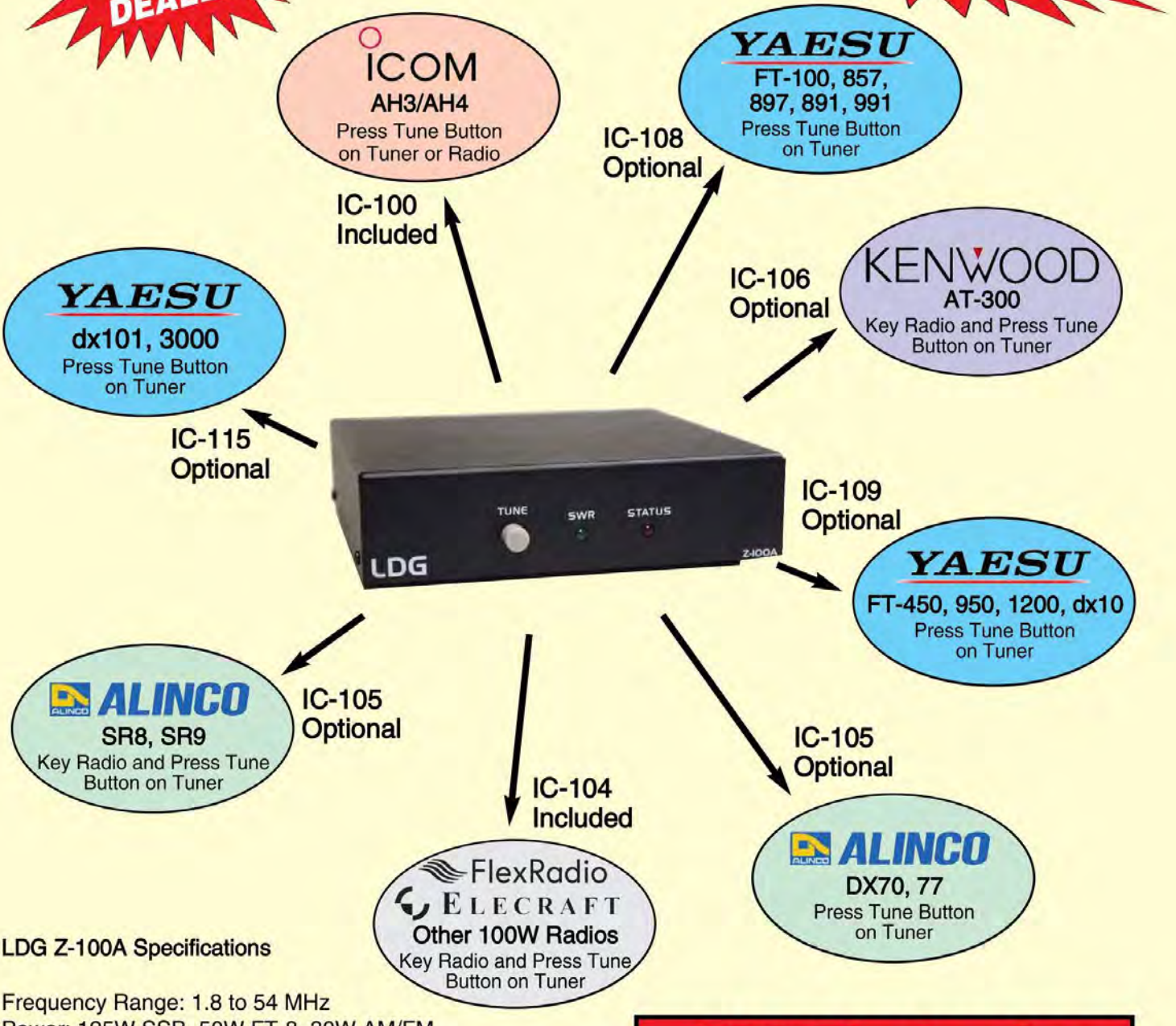

LDG Z-100A Specifications

Frequency Range: 1.8 to 54 MHz
Power: 125W SSB, 50W FT-8, 30W AM/FM
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
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Letters from Our Members

Challenge Yourself with WAS

As an active ham, I've already earned my WAS (Worked All States) Award on seven bands and a modest DXCC total. A few years ago, I started setting my WAS and DXCC counters back to zero each year on January 1. This challenges me to make WAS and DXCC by the end of the year. After a few months, I usually accomplish each of my goals. For the rest of the year, I break down my totals by mode and band. This gives me a lot of challenges — WAS and DXCC on each of the HF bands, by each mode and band/mode combination. Digital modes could be further broken down into RTTY, FT8, FT4, PSK31, etc. To limit the reports even more, I require the contacts to be confirmed.

I'm able to keep up with all of these challenges without too much effort by using the "Awards" tab in Glenn Davis's, N3FJP, *Amateur Contact Log* (*ACLog*) software. Setting the criteria to specific mode and band combinations provides me with the DXCC and WAS totals. Limiting the search to records of contacts after 0000Z January 1 gives the current year's totals. *ACLog* displays which states and entities have been worked and which are still needed.

All this data can be entered into a spreadsheet, which can serve as a helpful plan for HF operating. If you do this, after about mid-year, you'll find yourself looking at the spreadsheet and deciding to spend more time on certain bands or modes that are lagging behind. If you mostly operate SSB, you might decide to spend more time with CW or RTTY. If you manage to get WAS on FT8 in 2 – 3 months, try completing it on 12 meters. You can even make it a club challenge, comparing members' achievements and award certificates for the various bands and modes.

Stan Zawrotny, K4SBZ
Tallahassee, Florida

A Resurgence of Ham Radio

In the 34 years I've been a ham, I've never seen such a surge of interest in people earning their licenses the way I have during the COVID-19 pandemic. Even I'm more active than I was before. I've seen an increase in longer contacts in particular.

I've met so many new hams and enjoy being able to help them. I've even scheduled times and frequencies to help them practice Morse code and get comfortable on the air with CW. It feels so good to be able to help this hobby grow. I commend ARRL for all the work they're doing to help keep ham radio alive, including their work with spectrum defense (see **www.arrl.org/spectrum-defense-fund** for more information). I appreciate their handling of license renewals and organizing great on-air events.

I'm grateful for the ham radio hobby, as it's helped me deal with the effects of isolation due to the pandemic.

Lou Giovannetti, KB2DHG
Campbell Hall, New York

The Excitement of Operating FT8

FT8 is the perfect mode for when you feel like increasing one of your prospective award counts. This mode can become addictive and you can easily find yourself working it for hours at a time.

There's a certain challenge to running this mode. It's fun to reduce your power to 20 or 30 W and try making long-distance contacts, while dodging the obstacles of operators making CQ DX calls. I also enjoy finding a 40-meter band opening and making a –15 dB contact.

You can also try plugging a contact's town into an online map to see the photographic views. The other day, I looked up a contact's address and found a rural town that had laid out its borders in a circle! I've started putting pins on a map to represent where I've made contacts.

George Kuehn, N9AUP
Maple Park, Illinois

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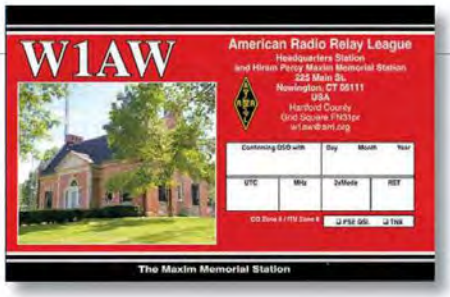
Every month, W1AW receives hundreds of QSL cards from hams all over the world, confirming contact with the Hiram Percy Maxim Memorial Station at ARRL Headquarters. Maybe you'll recognize an on-air friend — or even yourself — among these cards.



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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

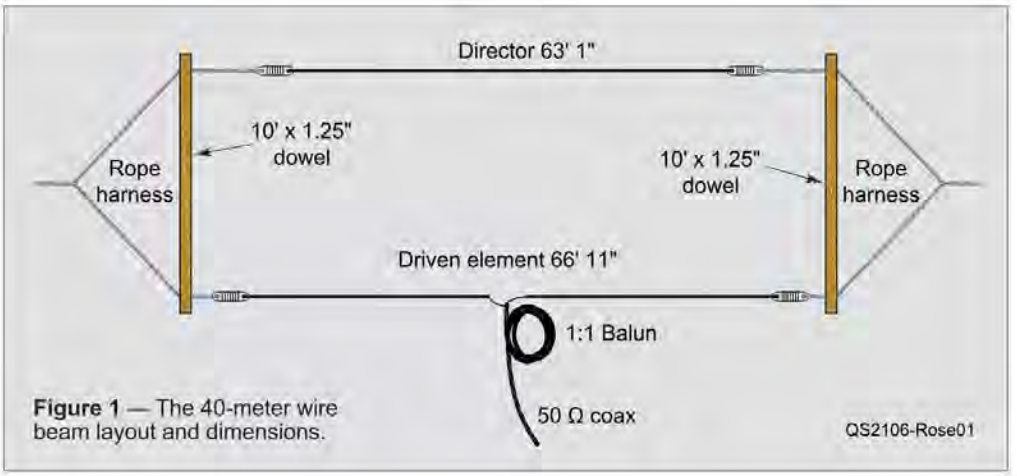

Figure 1 — The 40-meter wire beam layout and dimensions.

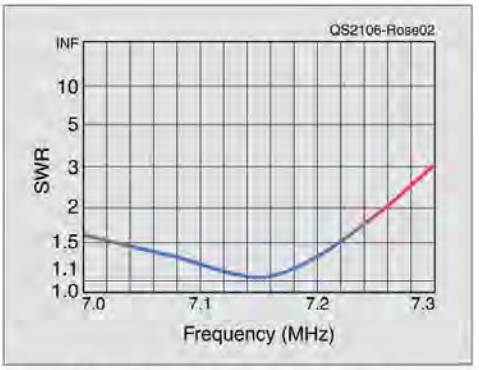

Figure 2 — The center-band optimized SWR curve.

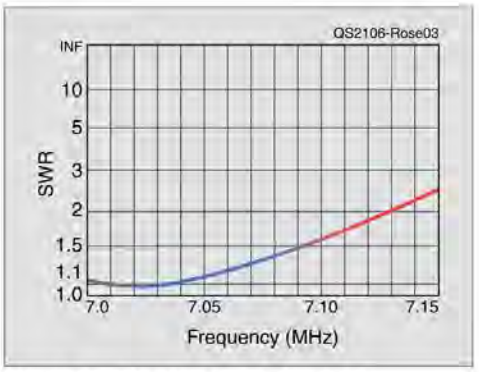

Figure 3 — The low-band optimized SWR curve.

While the antenna should work well using the dimensions in Figure 1, you may wish to tune the antenna for optimum performance. To tune the antenna, first raise the driven element to at least 30 feet and adjust the length for minimum SWR at 6.8 MHz. Then add the spreaders and director. Shorten the length of the harness between the attachment to the spreader harness and the support rope until the elements are level. Adjust the length of the director until the SWR is minimum at 7.16 MHz. You now have a portable 40-meter beam with good gain and a good front-to-back ratio on the upper half of the band. To optimize the antenna at the lower end of the band (½ – 1 dB more gain and up to 7 dB more for the front-to-back ratio), tune the driven element for minimum SWR at 6.7 MHz. Add the director and adjust its length for minimum SWR at 7.02 MHz.

Conclusion

A combination of simulation and testing led to the design of an effective, portable 40-meter beam that provides useful gain and a respectable front-to-back ratio. Incidentally, the antenna can also easily be rotated 180 degrees by pulling the coax and flipping the antenna.

Amateur Extra-class licensee Bob Glorioso, W1IS, was first licensed in 1955. He has a BSEE, MS, PhD, and he served in the military, managing a computer communications research group. After the military, he was a Professor of Electrical and Computer Engineering at the University of Massachusetts, Amherst. Later, he became Vice President of the Information Systems Business at Digital Equipment Corporation and was founder and CEO of Marathon Technologies Corporation. In 2004, he founded **batteryeliminatorstore.com** with his son, Scott, K1SRG, and Russ, WA1RKO (SK). His ham radio interests include CW, emergency communications, designing antennas, and operating during ARRL Field Day with the PART club of Westford, Massachusetts, where he is on the board. He is a Life Member of ARRL, and a fellow of the IEEE. Bob Glorioso can be reached at **rglorioso@me.com**.

Amateur Extra-class licensee Bob Rose, KC1DSQ, earned a BSEE in 1969 from the University of Maryland. He worked on radar signal processing at Raytheon, then multimedia chips and software at Digital Equipment Corp. He later worked on XEON CPU chips at Intel. He participates in his local ARES net and operates primarily on SSB and FT8 on the HF bands. Bob Rose can be reached at **b.rose@comcast.net**. Bob and Bob have collaborated on a number of antenna design projects. Their website is **www.ocfmasters.com**.

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40 – 20 – 15-Meter Inverted-V Antenna

This multiband antenna is easy to build and works well.

Jakin Messer, AG7WW

With this inexpensive 40 – 20 – 15-meter inverted-V antenna, you can be on the air in under an hour. After consulting with Joel Hallas, W1ZR, on how to get on HF with materials that I had around my shack (see Table 1), I was able to design and build my own antenna suitable for use with a 100 W transceiver. My antenna is an inverted V on 20 meters, and resonates on 40 meters by the addition of clip-on length extensions. The 40-meter configuration can be used on 15 meters with the aid of a tuner.

Building the Antenna

Step 1 — Cut an 18-foot piece from each of the two 60-foot-length wires for the 20-meter part of the antenna.

Step 2 — Use the ½-inch drill bit to bore a hole ¾ inch from each end of the piece of wood used as the center insulator. Drill a hole in the middle for the SO-239 connector. After drilling, dip the wood in paraffin wax.

Step 3 — Attach the SO-239 connector onto the insulator, then attach the coax to the connector.

Step 4 — Attach the 18-foot wires to the insulator and connect them to the SO-239 connector.

Step 5 — Erect the antenna, making an inverted V, and secure the ends near the ground tightly enough to prevent sliding, but loose enough to allow for trimming equally from each end. Trim the 20-meter band wires at 14.175 MHz first. My SWR was below 2:1 across the whole band. At the far ends of the 20-meter wires, crimp on female connectors (see Figure 1).

Figure 1 — The crimp-on male connector is on the right, and the female spade connector is on the left.

Step 6 — Cut ½ inch off the end of the remaining wire after you twist the ends of the antenna to the rope (used as the end insulators), and then crimp on a male spade connector (see Figure 1) on the end of each 40-meter wire.

Step 7 — Tighten the 20-meter portion, and readjust the SWR. Wrap the excess wire back on itself.

Step 8 — Join the male and female clips to extend the antenna length for 40-meter operation.

Step 9 — Trim the 40-meter part of the antenna to resonate at 7.15 MHz. I measured under 2:1 SWR across the 40-meter band.

Wire height affects the match bandwidth, so make sure that you always erect the antenna in the same way. Every time you put together the 40-meter part of

Table 1 — Materials

Quantity	Material	Comments
2	60 feet of #12 AWG stranded insulated wire	I used #12 and #16 AWG wires soldered together.
1	Wood, 4 × 1.6 × 0.2 inches	Used for the center insulator.
1	50 Ω coax, 25 – 50 feet	I used RG-214.
1	½-inch drill bit	Available from Harbor Freight.
1	SO-239 connector	Available from Universal Radio Inc.
2	¼-inch-wide male spade connectors	See Figure 1.
2	¼-inch-wide female spade connectors	See Figure 1.
1	21-foot-high center support	I used a non-conductive mast.
2	6-foot-high supports	Used on either side of, and 12 to 15 feet from, the center support.
1	30-foot-long rope	It must support at least 30 pounds.
2	Concrete stakes	Used for the anchors.

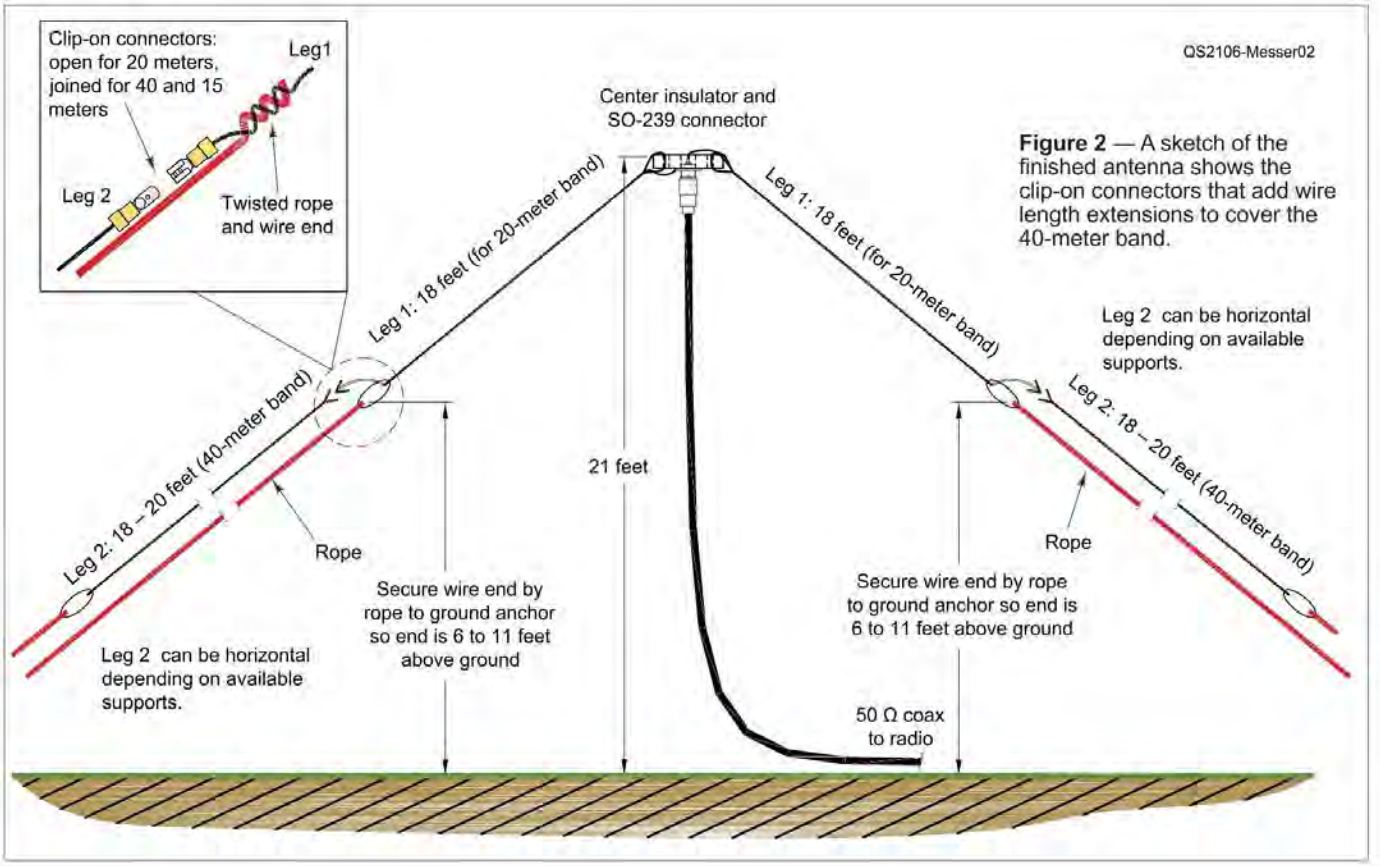

Figure 2 — A sketch of the finished antenna shows the clip-on connectors that add wire length extensions to cover the 40-meter band.

the antenna, sweep it with an antenna analyzer to make sure the SWR is correct.

Testing the Antenna

On 20 meters

The SWR was 1.5:1 at the bottom of the band, and 1.9:1 at the top. My first contact on 20 meters was with Harvey Motomura, AH6JA, in Hawaii. The 20-meter part of the inverted **V** functions as desired.

On 40 meters

The SWR was below 1.65:1 over the 40-meter band, with the lowest SWR at 1.03:1 on 7.150 MHz. The 40-meter antenna is the 20-meter antenna lengthened to resonate in the 40-meter band by the addition of clip-on wire extensions. My first contact on 40 meters was with Connor Black, W4IPC, in New York.

On 15 meters

This antenna will work on 15 meters in the full-length configuration, but the SWR will be 3:1 over most of the band. You should use an antenna tuner to achieve a reasonable SWR.

Conclusion

This antenna is fine on 20 meters, and seems to be good for short-range work on 40 meters. It's useful for temporary installations like ARRL Field Day, contests, and for use during an emergency.

Acknowledgments

I want to thank my parents for the wire scraps, access to a soldering iron, and for the antenna analyzer, and my brothers deserve thanks for helping me erect the antenna. The South Lane Amateur Radio Club (SLARA) members gave me support and encouragements, and Don Lounsbury, AC7KW, was helpful in loaning me the HF equipment. My sincere thanks also go to Joel, W1ZR, for responding to all my questions.

Amateur Extra-class licensee Jakin Messer, AG7WW, is a teenager working towards his Worked All States Award. He operates almost daily, weather permitting, from a table inside an outdoor tent. Jakin acts as a relay station for the Noontime Net on 7283.5 kHz (**thenoontimenet.org**) and is a director for his local club. You can email Jakin at **ag7ww@arrl.net**.

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Explaining Your Transceiver's ALC and AGC

ALC deals with transmitting, while AGC deals with receiving levels.

Rodrigo A. B. Freire, PY2RAF

I wrote this article to help radio amateurs to properly understand automatic level control (ALC) and automatic gain control (AGC) — two very important functions in amateur radio transceivers. I use my Yaesu FT-991A as an example. [Consult your specific radio manual, because ALC and AGC operations and settings vary with different transceivers. — *Ed.*]

ALC Functions

ALC is only active during transmission. It is a circuit that automatically levels a strong signal by reducing signal amplification due to excessive microphone gain or excessive digital mode signal drive. When the strong signal peaks cease, the ALC slowly increases the amplification (ALC release) to allow the output of lower level signals. Usually, ALC is quick to attack, and slow to release. Attack time, hold time, and release time are explained in the Maxim application note, **https://pdfserv.maximintegrated.com/en/an/AN3673.pdf**.

ALC is important in SSB voice and data modes; it is intended to keep the transmitted signal gain within a safe envelope — within the blue ALC bar range limit in Figure 1 — avoiding overdrive distortion and signal clipping. It also helps keep power amplifier non-linearity reined in.

The ALC bar graph on the FT-991A indicator provides a visual cue on how you are driving your equipment, so you can adjust your gain settings to an optimal range for the operating modulation mode.

Configuring the ALC Indicator

Select your radio meter/indicator to measure ALC. A bar graph above that blue bar indicates that the ALC level is selected. There are different ALC requirements for voice and for data modes. Some transceivers, like mine, integrate the ALC with the SWR reflected power signal, causing the radio to fold back the transmitter power in order to avoid damage to the equipment. My FT-991A manual states: "ALC meter deflection may be caused...by reflected power (SWR)...ALC meter action may be observed that is not related to the proper setting of the microphone gain." The manual further recommends that you "make microphone gain adjustments into a dummy load or antenna system presenting impedance very close to 50 Ω."

Settings for SSB Phone

Set the ALC level for voice modes with the Microphone Gain Control; there are different settings for SSB and other modulation modes. The object is to keep the bar graph meter within the blue bar ALC scale. Set your microphone gain so that your peak modulation reaches the end of the ALC scale, but does not exceed it. Signal distortion can be caused

Figure 1 — The red portion of the ALC bar graph, extending beyond the blue bar operating range, indicates an excessive ALC setting.

by an excessive ALC setting, like the red meter bars extending beyond the blue ALC scale in Figure 1.

Settings for Data Modes

Digital modes like PSK and *WSJT-X* modes, including FT8, have entirely different ALC requirements. [See the recommendations in **https://www.physics.princeton.edu/pulsar/K1JT/FT8_Operating_Tips.pdf**. — *Ed.*] Excessive signal drive can cause signal distortion and will likely result in the transmission of an undecipherable signal from your station.

An appropriate ALC level for digital modes is a none-too-slight indication. If you are getting past half the scale, you are way off the optimal settings.

AGC Functions

AGC is a receiver function that decreases amplification on a strong received signal, keeping the reception at a comfortable level. In the absence of a strong signal, the AGC increases the receive gain, so you can listen to weak signals.

On the flip side, a nearby signal will force the AGC to reduce the gain while you are trying to copy a weaker signal. Suppose that you are listening to a weak signal in 7105 kHz, and then suddenly a strong signal pops up on 7107 kHz, and it is within your receiving passband. That signal will force your AGC into reducing the receiver gain, and perhaps rendering your 7105 kHz signal unreadable. Many transceivers have adjustable and narrow-band filters, so they can reduce the radio receiving bandwidth, and position the offending signal outside the bandwidth.

Many transceivers provide AGC controls that range from fast to slow, so there are different circumstances to use each.

Slow AGC

If you are ragchewing and receiving medium-to-strong signals, you will find that your reception will be more comfortable with a slow AGC. The silence in SSB means there is no transmitted power, so during small pauses between spoken words, your slow AGC setting will increase the gain slowly, making these small pauses more silent instead of having a quick AGC recovery, where you would likely listen to the band noise. So, if you are are in digital modes or operating SSB voice mode, and receiving signals at a comfortable level, use slow AGC.

ALC is important in SSB voice and data modes; it is intended to keep the transmitted signal gain within a safe envelope.

AGC is a receiver function that decreases amplification on a strong received signal, keeping the reception at a comfortable level.

Fast AGC

Fast AGC is needed while using digital modes or in challenging voice reception conditions — like static crashes, and with strong nearby signals. Fast AGC will cause the receiver amplifier to raise its gain quickly, returning to the noise floor faster. So, if you are in digital modes or operating SSB voice with static crashes hampering the reception, use fast AGC.

Final Comments

Because of individual SSB voice modulation characteristics, differences in microphones, operating different phone or digital modes, and a variety of signal-hampering conditions, you should set your ALC and AGC levels so the transceiver can yield its best performance for each modulation mode.

If you want to make an SSB phone contact even more comfortable in medium-to-marginal conditions, use the RF gain/attenuation control to the point where the S-meter stops swinging during your contact partner's transmission.

Rodrigo Freire, PY2RAF, is a Brazilian amateur radio operator. He loves to study and explore the limits of his Yaesu FT-991A transceiver and to document the findings in his GitHub page. He's a Security Program Manager at Red Hat, an IBM subsidiary. You can reach Rodrigo at **py2raf@rf3.org**.

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

Protect Your Transceiver When Using an External Antenna Tuner

Build an attenuator that limits SWR to 3:1 when tuning.

Phil Salas, AD5X

While most transceivers have internal autotuners, there are cases when an external antenna tuner may be desired. First, internal transceiver autotuners are often limited to a 3:1 standing wave ratio (SWR) matching range. You could use a remote autotuner at the end of a long transmission line connected to an untuned antenna. You may also use a high-power antenna tuner located after a power amplifier in your home station.

With an external antenna tuner, the SWR can get pretty high during the tuning process. In particular, autotuner relays momentarily open as they switch in inductors and capacitors during the tuning process. Normally, tuning is performed at a low power level, so the transceiver finals aren't stressed too much. And most radios can put out power into a higher SWR when the transmitted power is low without folding back power. This is because most transceivers base foldback on reflected power rather than SWR.

I've been having a lot of fun using my Xiegu G90 transceiver (which I reviewed for "Product Review" in the March 2020 issue). This transceiver has an excellent internal autotuner. I have been using it with the PreciseRF HG3 loop antenna (which I reviewed in the January 2021 issue of *QST*). This antenna has an auto-assisted tuning feature, but there is a problem. The G90 folds back power with high SWR. So, even when transmitting at low power levels, the G90 cuts back power if the SWR exceeds the SWR protection threshold (3:1 default, 3.6:1 maximum). When the SWR exceeds the protection set point, the radio folds back, then goes to set power, then folds back, and so forth. This kept me from being able to autotune the HG3 loop antenna on 40 and 30 meters because the starting SWR exceeded 3:1 on those bands, even though the tuning power required was just 2 – 3 W.

Finding a Solution

You can control the SWR of any load by simply inserting a switchable attenuator in series with the load. With a 3 dB attenuator, the worst mismatch the radio should ever see is a 3:1 SWR. Figure 1 is the schematic of my 3 dB attenuator. It is not perfect, but it is very close. (Theoretically, it has 1.06:1 SWR when terminated in a perfect 50 Ω load, and 3.2 dB loss.)

The resistors are 1% Caddock 15 W thick-film resistors, which are purely resistive well up into the VHF range. A DPDT switch inserts the 3 dB attenuator when needed. Point-to-point wiring is used. The 10 pF capacitors help compensate for wiring inductance. Table 1 shows a full parts list.

For those who don't want to make the rectangular hole for the slide switch, a single round hole DPDT toggle switch would work. Use one that is rated at 1 A for QRP or 2 A for 100 W.

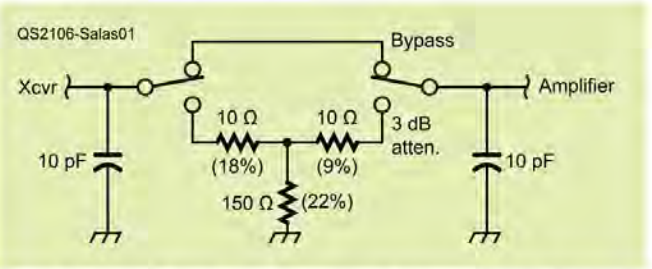

Figure 1 — The in-line 3 dB attenuator schematic. The numbers in parentheses are the percentages of transmit power dissipated in the resistors.

Table 1 — 3 dB Attenuator Parts List

Quantity	Description	Source/Part Number
2	10 Ω, 15 W thick-film resistor	Mouser 684-MP915-10
1	150 Ω, 15 W thick-film resistor	Mouser 684-MP915-150
2	10 pF, 200 V ceramic capacitors	Mouser 80-C315C100J2G
1	DPDT slide switch	Mouser 629-GF11261110
1	Aluminum box	Mouser 537-M00-P
2	SO-239 connectors	Mouser 601-25-7350

Note: #2 hardware for MP915 resistors, #4 hardware for the switch.

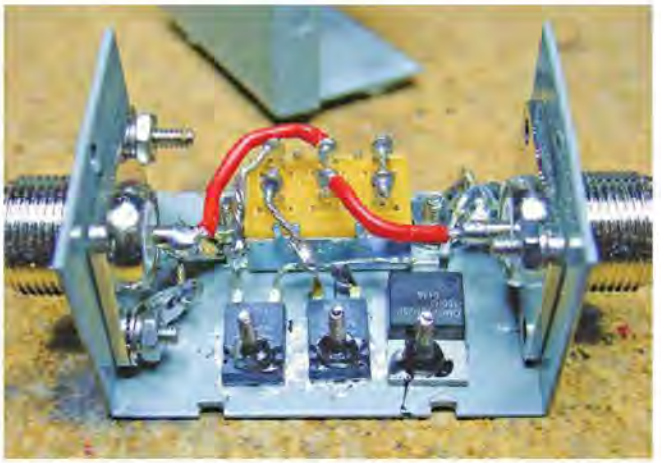

Figure 2 — The inside view of the 3 dB attenuator.

Figure 3 — The outside view of the 3 dB attenuator.

Figures 2 and 3 show the completed unit, and the wiring diagram is shown in Figure 4. Because I used a painted box, I scraped the paint beneath the resistors to make a better thermal path for the dissipated power. I also added stick-on rubber feet to the bottom of the unit.

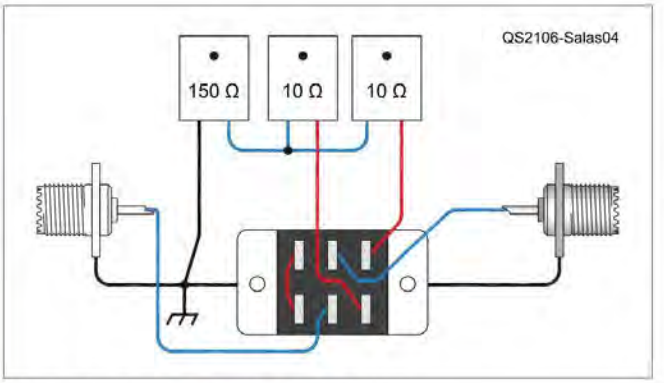

Figure 4 — The 3 dB pad physical wiring.

How It Works

VNA measurements gave the following results. Figure 5 shows the insertion loss of the 3 dB attenuator. The data includes up to 6 meters, because that is the worst case. While the G90 doesn't have 6-meter capability, most current transceivers, solid-state amplifiers, and autotuners do. Figure 6 shows that when terminated with a matched load, the pad adds very little to the SWR. Figure 7 shows that with the antenna shorted, perhaps by a grounding switch for lightning protection, the SWR will be no more than 2.6:1. This improvement from the theoretical 3.1:1 is from a combination of components and wiring. With an open antenna, the worst-case SWR is 3.25:1. If you duplicate my layout and wiring closely, your results should be similar.

Heat Dissipation

As you can guess from Figures 2 and 3, there is minimal heat dissipation capability provided by the small aluminum box I used. The HG3 auto-assisted tuner only requires 3 W, so only 3 W is dissipated during

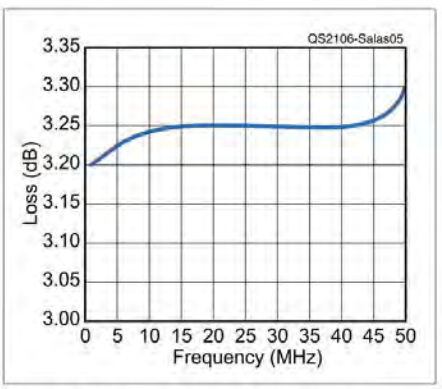

Figure 5 — The insertion loss of the 3 dB attenuator.

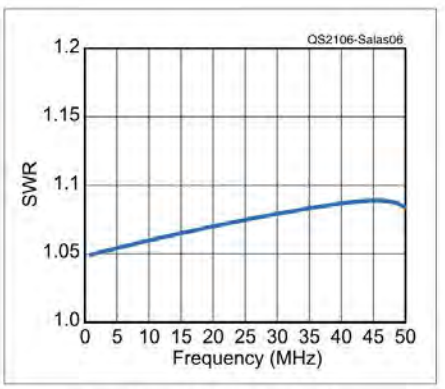

Figure 6 — The SWR of the 3 dB attenuator with a matched load.

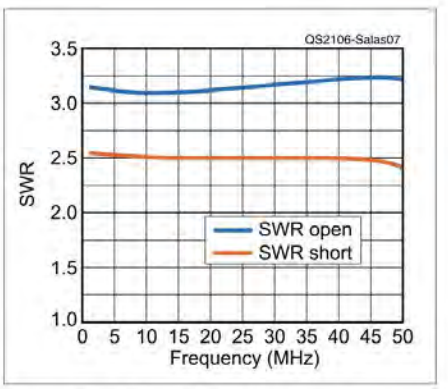

Figure 7 — The SWR when the attenuator output is an open or short circuit.

the tuning process. However, my KAT500 requires 10 W, so 10 W is dissipated in the attenuator during the tuning process. The saving grace is that these autotuners tune in 1 – 2 seconds, so there is no real problem with heat.

This may not always be the case. If you are using a manual tuner, you may take much more time to tune. Also, some high-power autotuners require 20 W for accurate tuning. You can scale this attenuator for use up to 100 W by changing the transceiver-side 10 Ω resistor and the 150 Ω shunt resistor to the Caddock 30 W versions (Mouser 684-MP930-10 and 684-MP930-150, respectively). These resistors can then be mounted in a denser cast-aluminum box, like the Mouser 546-1590B. You can also beef this up with an added heatsink, if desired.

Conclusion

I've described a simple means of limiting the SWR of an undetermined load to any transceiver during the tuning process when using an external tuner. The 3 dB attenuator described here is inexpensive, easy to use, and does the trick.

All photos by the author.

An ARRL Life Member, Phil Salas, AD5X, has been licensed since 1964. His interest in ham radio led him to pursue BSEE and MSEE degrees from Virginia Tech and Southern Methodist University, respectively, followed by a 35-year career in RF, microwave, and lightwave design, holding positions from design engineer to Vice President of engineering. Now retired, Phil enjoys tinkering with ham radio projects and spending time with his two grandsons.

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March 2021
QST Cover Plaque Award Winner

Ward Silver
NØAX

In his article, "About High-Voltage Safety," Ward explains how following some simple rules and maintaining a cautious approach can help you work safely near high voltages.

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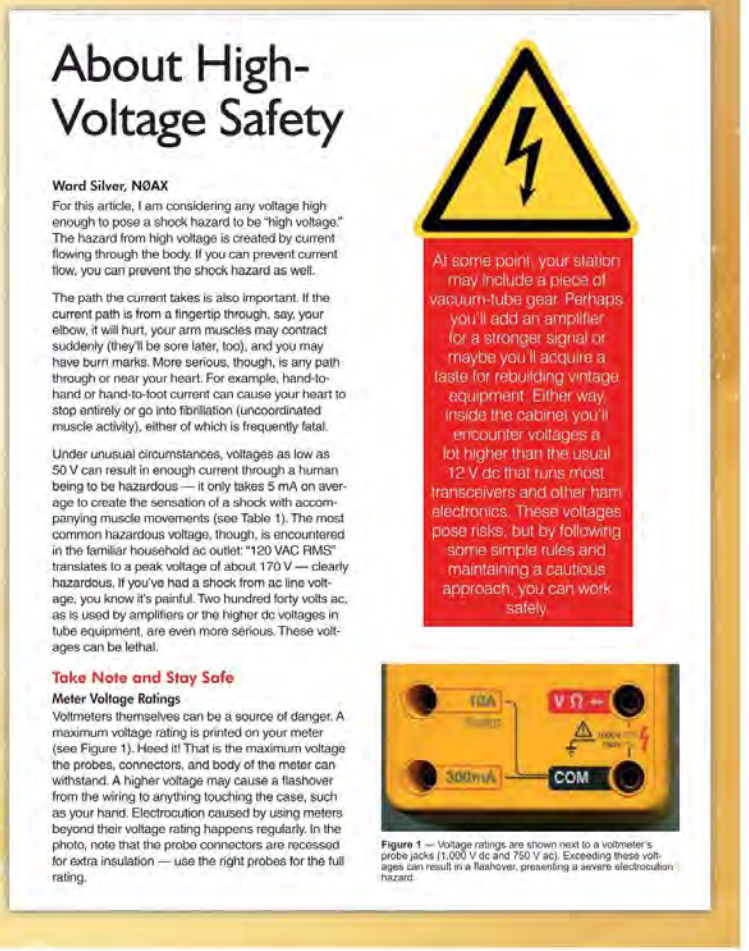


About High-Voltage Safety

Ward Silver, NØAX

For this article, I am considering any voltage high enough to pose a shock hazard to be "high voltage." The hazard from high voltage is created by current flowing through the body. If you can prevent current flow, you can prevent the shock hazard as well.

The path the current takes is also important. If the current path is from a fingertip through, say, your elbow, it will hurt, your arm muscles may contract suddenly (they'll be sore later, too), and you may have burn marks. More serious, though, is any path through or near your heart. For example, hand-to-hand or hand-to-foot current can cause your heart to stop entirely or go into fibrillation (uncoordinated muscle activity), either of which is frequently fatal.

Under unusual circumstances, voltages as low as 50 V can result in enough current through a human being to be hazardous — it only takes 5 mA on average to create the sensation of a shock with accompanying muscle movements (see Table 1). The most common hazardous voltage, though, is encountered in the familiar household ac outlet: "120 VAC RMS" translates to a peak voltage of about 170 V — clearly hazardous. If you've had a shock from ac line voltage, you know it's painful. Two hundred forty volts ac, as is used by amplifiers or the higher dc voltages in tube equipment, are even more serious. These voltages can be lethal.

At some point, your station may include a piece of vacuum-tube gear. Perhaps you'll add an amplifier for a stronger signal or maybe you'll acquire a taste for rebuilding vintage equipment. Either way, inside the cabinet you'll encounter voltages a lot higher than the usual 12 V dc that runs most transceivers and other ham electronics. These voltages pose risks, but by following some simple rules and maintaining a cautious approach, you can work safely.

Take Note and Stay Safe

Meter Voltage Ratings

Voltmeters themselves can be a source of danger. A maximum voltage rating is printed on your meter (see Figure 1). Heed it! That is the maximum voltage the probes, connectors, and body of the meter can withstand. A higher voltage may cause a flashover from the wiring to anything touching the case, such as your hand. Electrocution caused by using meters beyond their voltage rating happens regularly. In the photo, note that the probe connectors are recessed for extra insulation — use the right probes for the full rating.

Figure 1 — Voltage ratings are shown next to a voltmeter's probe jacks (1,000 V dc and 750 V ac). Exceeding these voltages can result in a flashover, presenting a severe electrocution hazard.

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

Product Review

Yaesu FTDX10 MF/HF and 6-Meter Transceiver

Reviewed by Steve Ford, WB8IMY
wb8imy@arrl.net

Yaesu made a splash in the higher-end transceiver market a few years ago with the introduction of the FTDX101D/MP, a radio widely praised for its outstanding receiver performance. In 2020, Yaesu announced another new model: the FTDX10. This one is designed to compete in the intermediate-price class.

With the FTDX10, Yaesu has made superb receiver performance available at a lower price point and has incorporated a number of intriguing features to go along with it.

The Basics

The FTDX10 comes in an attractive enclosure about 3½ × 10½ × 10½ inches, weighing a somewhat hefty 13 pounds. As with most 100 W transceivers, you'll need to add a dc power supply capable of providing 20 – 25 A when the radio is transmitting.

Transmit frequency coverage includes all amateur bands from 160 through 6 meters, with five preset CW and SSB channels on 60 meters. Receive coverage is continuous from 30 kHz through 75 MHz, with performance specified for the amateur bands. Operating modes include AM, FM, SSB, CW, and digital, with built-in decoders for CW, RTTY, and PSK31.

The FTDX10 arrives with a programmable handheld microphone, a dc power cable, and a printed manual that is about ¼ inch thick. Unlike so many transceiver packages these days, you won't be required to down-

Bottom Line

Yaesu's FTDX10 brings their hybrid receiver architecture and excellent performance to the mid-priced market. The transceiver is packed with features for operators interested in any aspect of amateur radio.

load PDF manuals; Yaesu has thoughtfully provided everything in a single paper publication.

That said, you will need to download driver software if you want to connect the FTDX10 to your computer. More about that later.

Front and Back

The front panel of the FTDX10 is dominated by a 5-inch TFT color touchscreen (see Figure 1) and a large VFO knob. Most of the remaining buttons and other controls are clustered around the VFO, along with a row of LED indicators above.

On the opposite side, there is the **ON/OFF** switch, the **TUNE** button (which triggers the operation of the built-in antenna tuner), a 3.5-millimeter headphone jack, and an RJ-45 modular-type microphone jack instead of the eight-pin round connector typically found on HF transceivers. The front panel also includes a slot for an SD memory card.

The rear panel is adorned with an impressive collection of connectors (see Figure 2). Note that the FTDX10 has a single antenna port (SO-239) and no provision for using a separate low-noise receive antenna, such as a Beverage or small loop. Other than the dc power jack, the rest of the ports are devoted to connecting a variety of external devices:

- A six-pin DIN jack is used for external digital-mode hardware for RTTY, PACTOR, packet, or other modes.
- An eight-pin DIN jack is compatible with an optional Yaesu FC-40 external antenna tuner.
- A 10-pin DIN jack includes linear amplifier connections (relay control and ALC for any amplifier, plus band data and other signals for Yaesu's VL-1000 amplifier). Separate phono jacks for amplifier relay control and ALC would be more convenient.
- The FTDX10 sports a total of three USB ports. There is a USB-B jack for computer-aided transceiver (CAT) communication, transmit/receive switching, and audio data, plus two USB-A jacks for a keyboard and a mouse. Keyboard functionality shouldn't be confused with the keypad-entry feature; it has a jack all its own.
- I was surprised to see a DB-9 RS-232 port for computer interfacing, because virtually all computer peripherals interconnect with USB lines these days. If you are using an older computer at your station, however, this jack will be a welcome sight.

Figure 1 — The FTDX10 features a highly customizable 5-inch color touchscreen.

Figure 2 — The FTDX10 rear panel has connections for a variety of accessories. There is only one antenna jack, and no provision for a separate receive antenna. Note that the fan cycles on and off at slow speed in receive.

- If you prefer your transceiver display king-sized, there is a DVI-D port to connect to an external monitor. Like the RS-232 jack, this one is a bit of an oddity because virtually all modern monitors have HDMI ports, dispensing with DVI entirely. If you own an HDMI-only monitor, you can purchase DVI-to-HDMI converters for less than $10.

Rounding out the back panel, you'll find the usual CW key and external speaker jacks. One notable item that's missing is an ethernet port for connecting the transceiver to a computer network. If you want to wire the FTDX10 for use on a network, such as for internet remote control, you'll need to purchase the Yaesu SCU-LAN10 interface (which was reviewed in the May 2021 issue of *QST*) and attach it to the rear-panel accessory jack. (Note that the accessory jack is separate from the RTTY/data jack.)

Receiver Design

It's obvious from the outset that Yaesu designed the FTDX10's receiver with an eye to maximizing performance under challenging conditions. All ARRL Lab dynamic range tests produced excellent results, as

seen in Table 1 and the Key Measurements summary graphic.

The FTDX10 has a sophisticated software-defined architecture but does initial signal processing using a hybrid approach. Received signals are first converted to 9 MHz and massaged in an analog stage that features three selectable roofing filters at 500 Hz, 3 kHz, and 12 kHz. These can be lifesavers in crowded conditions with strong nearby signals. A 300 Hz roofing filter is optional.

There are also two preamplifiers that can be particularly helpful on the higher frequency bands. On the other hand, if the reception environment becomes too hot, you have a choice of several levels of attenuation that you can bring in-line instantly.

All this conditioning takes place before signals are downconverted to 24 kHz, where the direct-sampling software-defined stage goes to work. It's here that you reap the benefits of enhanced software processing. For instance, the digital-signal processing (DSP) feature shows its considerable strength with a *contour* function. By adjusting the contour, you can slightly modify the response to reduce specific interference without sacrificing too much of the quality of the signal you're trying to hear.

Of course, FTDX10 signal processing software includes a deep manual notch filter. The digital notch filter (DNF) can seek and destroy more than one interfering carrier, and even track changes in the frequencies of interfering signals.

Taken as a whole, the result is remarkable receiver performance that you notice the moment you turn on the radio. This performance is also quite malleable, meaning that the FTDX10's design gives you the ability to tailor the reception characteristics to your needs.

Connecting the FTDX10

Being enamored with digital modes and CAT control, my first task was to get my station computer talking to the FTDX10. The virtual COM port drivers are available for download from Yaesu, and it is best to install them in your PC before you plug a USB-B cable into the radio. The drivers create two virtual COM ports that you can identify by opening the Microsoft Windows Device Manager. For my computer, they happened to be COM 4 and COM 5. Of course, they will be different on other PCs. I jotted down the numbers and then started configuring my software applications.

The FTDX10 appears to use the lower-numbered COM port for CAT control. The default signaling rate in the radio is set to 38,400 baud. I configured my logging program to communicate on COM 4 at 38,400 baud, but immediately discovered that the FTDX10 was too new to be included in my software's drop-down menu. Fortunately, I selected FT-991 instead and found that it worked; apparently these radios speak the same CAT dialect.

When setting up my *WSJT-X* application, I encountered the same issue. Once again, the FT-991 selection worked. For transmit/receive keying in *WSJT-X*, I chose COM 5, and it was flawless. Transmit and receive audio was available through the familiar USB audio codec, but I quickly learned that I had to go into the FTDX10's data mode menus and make sure that **REAR SELECT** was set for USB. If you fail to do this, you won't be able to get audio data into or out of the FTDX10 via the USB port.

I encountered an interesting situation while configuring the FTDX10 for RTTY contesting with *WriteLog*, my contest application of choice. *WriteLog* has a built-in RTTY send/receive module, known as *RTTYRite*. For years, I've operated my transceiver with *RTTYRite* using FSK — frequency-shift keying — so that I didn't have to worry about overmodulating the radio. With FSK, the computer sends only MARK/SPACE data to the radio, and the radio generates the corresponding MARK/SPACE RF signals. The alternative is AFSK — audio frequency-shift keying — where the computer generates MARK/SPACE audio tones that are applied to the audio input of the transceiver.

The FTDX10 manual states that the radio supports FSK for RTTY, which it does, but it required some experimentation to determine the correct settings that would be compatible with my software. In the FTDX10's **RADIO SETTING** menu, I had to access **MODE RTTY**, and then **RPTT SELECT**. I chose RTS for keying, but there wasn't a choice for which signal line the radio would use for the FSK data from my PC, and the manual was silent on this topic. I crossed my fingers, hoped the default was DTR, and then configured *RTTYRite* accordingly.

It took a combination of my experience with other radios, and a fair amount of trial and error, to finally resolve these computer entanglements. This is an area in which the manual isn't terribly useful; some additional text and illustrations would have been helpful. Just clarifying the terminology would ease some confusion.

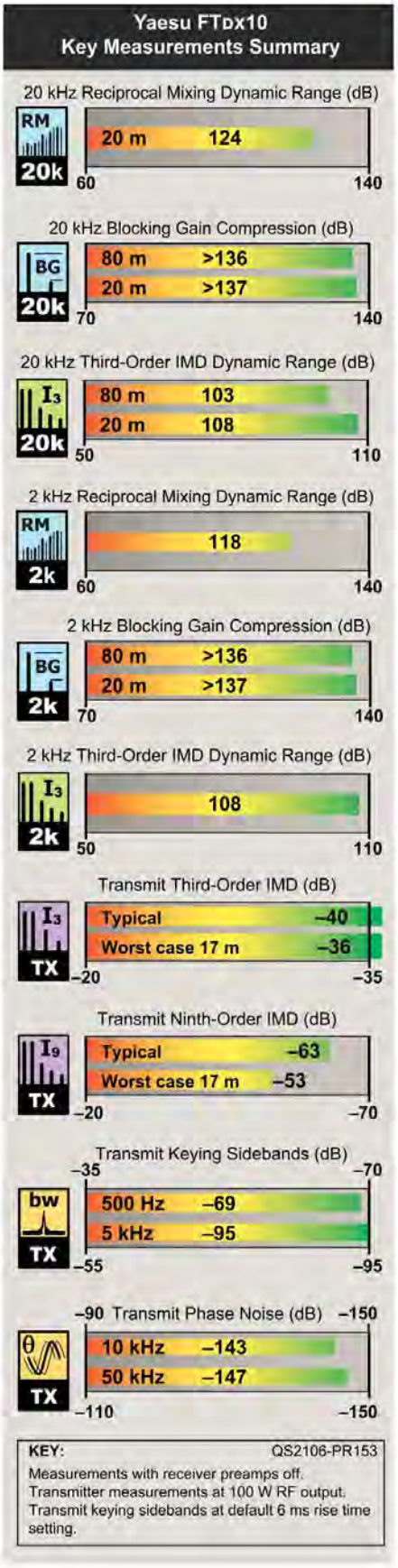


Table 1
Yaesu FTDX10, serial number 0N010008, V01-01

Manufacturer's Specifications

Frequency coverage: Receive, 0.030 – 75 MHz. Transmit, 1.8 – 54 MHz (amateur bands only).

Power requirements: 13.8 V ±15%. Receive, 2.5 A with no signal, 3 A with signal present. Transmit, 23 A at 100 W RF output.

Modes of operation: SSB, CW, AM, FM, FM-N (FM narrow), RTTY, PSK, digital.

Measured in the ARRL Lab

Receive and transmit, as specified. Five CW and five SSB memory channels programmed for 60-meter operation.

At 13.8 V dc: Receive, max. brightness, max. volume, no signal, 2.22 A. Transmit, 16.0 A (typical) at 100 W RF output; 6.5 A at 5 W output. No change in RF output at minimum specified supply voltage.

As specified.

Receiver

SSB/CW sensitivity, 10 dB (S+N)/N, 2.4 kHz filter, preamp 2 on:
0.16 µV (1.8 – 30 MHz)
0.125 µV (50 – 54 MHz).

Noise figure: Not specified.

AM sensitivity: 6 kHz BW, 10 dB (S+N/N), 30% modulation, 400 Hz tone:
7.9 µV (0.5 – 1.8 MHz, preamp off)
2.0 µV (1.8 – 30 MHz, preamp 2 on)
1.0 µV (50 – 54 MHz, preamp 2 on).

FM sensitivity: 12 dB SINAD, 12 kHz BW, 3.5 kHz deviation, preamp 2 on:
0.25 µV (28 – 30 MHz)
0.20 µV (50 – 54 MHz).

Spectral display sensitivity: Not specified.

Blocking gain compression dynamic range: Not specified.

Reciprocal mixing dynamic range: Not specified.

Receiver Dynamic Testing

Noise floor (MDS), 500 Hz bandwidth:

Preamp	*Off*	*P1*	*P2*
0.137 MHz	–107	–116	–110 dBm
0.475 MHz	–117	–126	–127 dBm
1.0 MHz	–120	–129	–132 dBm
3.5 MHz	–127	–135	–138 dBm
14 MHz	–127	–136	–139 dBm
50 MHz	–130	–140	–142 dBm
70 MHz	–126	–135	–138 dBm

Preamp Off/1/2: 14 MHz, 21/11/8 dB; 50 MHz; 17/7/5 dB.

10 dB (S+N)/N, 1 kHz tone, 30% modulation, 6 kHz BW:

Preamp	*Off*	*P1*	*P2*
1.02 MHz	6.45	2.16	1.66 µV
3.88 MHz	2.63	0.86	0.62 µV
29.0 MHz	1.40	0.52	0.49 µV
50.4 MHz	1.55	0.51	0.49 µV

For 12 dB SINAD, 3 kHz deviation, 12 kHz BW:

Preamp	*Off*	*P1*	*P2*
29 MHz	0.58	0.21	0.19 µV
52 MHz	0.69	0.23	0.20 µV
70 MHz	1.01	0.32	0.24 µV

Preamp off/P1/P2: Panadapter and waterfall, –106/–114/–124 dBm; 3DSS, –111/–119/–128 dBm.

Blocking gain compression dynamic range, 500 Hz BW:*

Preamp	*20 kHz offset Off/P1/P2*	*5/2 kHz offset Preamp off*
3.5 MHz	>136/145/138	>136/>136 dB
14 MHz	>137/147/140	>137/>137 dB
50 MHz	140/141/136	140/140 dB

14 MHz, 20/5/2 kHz offset: 124/122/118 dB.

ARRL Lab Two-Tone IMD Testing (500 Hz bandwidth)

Band/Preamp	*Spacing*	*Measured IMD Level*	*Measured Input Level*	*IMD DR*
3.5 MHz/Off	20 kHz	–127 dBm	–24 dBm	103 dB
		–97 dBm	–9 dBm	
		–65 dBm	0 dBm	
14 MHz/Off	20 kHz	–127 dBm	–19 dBm	108 dB
		–97 dBm	–9 dBm	
		–66 dBm	0 dBm	
14 MHz/P1	20 kHz	–136 dBm	–28 dBm	108 dB
		–97 dBm	–15 dBm	
14 MHz/P2	20 kHz	–139 dBm	–35 dBm	104 dB
		–97 dBm	–21 dBm	
14 MHz/Off	5 kHz	–127 dBm	–19 dBm	108 dB
		–97 dBm	–9 dBm	
14 MHz/Off	2 kHz	–127 dBm	–19 dBm	108 dB
		–97 dBm	–9 dBm	

Manufacturer's Specifications		Measured in the ARRL Lab		
50 MHz/Off	20 kHz	–130 dBm –97 dBm	–29 dBm –19 dBm	101 dB
50 MHz/P2	20 kHz	–142 dBm –97 dBm	–46 dBm –31 dBm	96 dB

Second-order intercept point: Not specified.	Preamp Off/P1/P2 14 MHz, +87/+77/+77 dBm 21 MHz, +91/+81/+81 dBm 50 MHz, +81/+75/+75 dBm
FM adjacent channel rejection: Not specified.	P2 on: 29 MHz, 84 dB; 52 MHz, 84 dB.
FM two-tone third-order IMD dynamic range: Not specified.	20 kHz offset, P2 on: 29 MHz, 84 dB;† 52 MHz, 84 dB.† 10 MHz offset, P2 on: 29 MHz, 99 dB; 52 MHz, 95 dB.
IF rejection: Not specified.	IF rejection: 7 MHz, 76 dB; 10.1 MHz, 69 dB; 14 MHz, >99 dB; 50 MHz, >141 dB.
Image rejection: ≥70 dB (1.8 – 29.7 MHz), ≥60 dB (50 – 54 MHz).	Image rejection: 7 MHz, 90 dB; 10.1 MHz, 92 dB; 14 MHz, 86 dB; 50 MHz, 70 dB.
DSP noise reduction: Not specified.	Adjustable, 5 to 15 dB.
Notch filter depth: Not specified.	Adjustable manual notch, 5 to 70 dB.
S-meter sensitivity: Not specified.	S-9 signal, preamp Off/P1/P2: 14 MHz, 97.6/33.9/12 µV; 50 MHz, 54.9/18.2/7.32 µV; Scaling: 3 dB per S-unit.
Squelch sensitivity: Not specified.	At threshold/maximum level, FM, P2 on: 29 MHz, 0.18/0.38 µV; 52 MHz, 0.2/0.4 µV. 14 MHz SSB, preamp off, 12 – 130 µV.
IF/audio response: Not specified.	Range at –6 dB points:‡ CW (500 Hz BW): 450 – 950 Hz; Equivalent Rectangular BW: 497 Hz; SSB (2.4 kHz BW): 360 – 2510 Hz; AM (6 kHz BW): 330 – 2980 Hz.
Audio output: 2.5 W into 4 Ω at 10% THD	As specified. THD 0.25% at 1 V_{RMS}.
Receive processing delay time: Not specified.	21 ms.

Transmitter	Transmitter Dynamic Testing
Power output: 5 to 100 W (AM, 5 to 25 W).	HF, as specified; 50 MHz, 5 to 95 W.
Spurious-signal and harmonic suppression: ≥50 dB (HF); ≥63 dB (50 MHz).	HF, >70 dB typical; worst case, 57 dB (30 m); 50 MHz, 70 dB. Complies with FCC emission standards.
Third-order intermodulation distortion (IMD) products: –31 dB at 14 MHz.	3rd/5th/7th/9th order, 100 W PEP: –40/–49/–57/–63 dB (HF typical) –36/–39/–43/–53 dB (worst case, 17 m) –37/–42/–51/–58 dB (50 MHz) At 50 W PEP RF output: –34/–40/–51/–55 dB (14 MHz) –42/–45/–55/–58 dB (50 MHz)
CW keyer speed range: Not specified.	4 to 56 WPM, iambic mode A, B, Y, semiautomatic (bug).
CW keying characteristics: Not specified.	See Figures A and B.
Transmit-receive turnaround time (PTT release to 50% audio output: Not specified.	S-9 signal, AGC fast, SSB: 48 ms; AGC fast, CW, full break-in: 70 ms.
Receive-transmit turnaround time (tx delay): Not specified.	SSB, 28 ms; FM, 15 ms (29 MHz), 16 ms (52 MHz).
Transmit phase noise: Not specified.	See Figure C.

Size (height, width, depth, including protrusions): 3.6×10.5×10.4 inches. Weight, 13 lbs.

Second-order intercept points were determined using S-5 reference.

"Preamp off" measurements are with the IPO (Intercept Point Optimization) setting.

*No blocking was observed with up to +10 dBm signal at the antenna jack, the maximum level used in ARRL Lab testing.

†Measurement was noise limited at the value indicated.

‡Default values; bandwidth is adjustable via DSP.

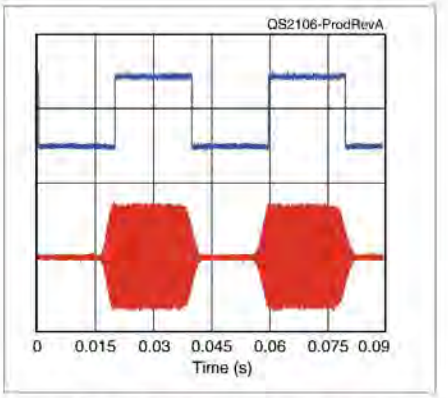


Figure A — The CW keying waveform for the Yaesu FTDX10, showing the first two dits in full-break-in (QSK) mode, using external keying and the default 6-millisecond rise time setting. Equivalent keying speed is 60 WPM. The upper trace is the actual key closure; the lower trace is the RF envelope. (Note that the first key closure starts at the left edge of the figure.) Horizontal divisions are 10 ms. The transceiver was being operated at 100 W output on the 14 MHz band.

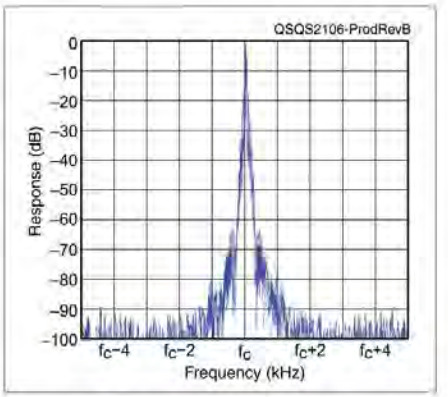


Figure B — The spectral display of the Yaesu FTDX10 transmitter during keying sideband testing. Equivalent keying speed is 60 WPM using external keying and the default 6-millisecond rise time setting. Spectrum analyzer resolution bandwidth is 10 Hz, and the sweep time is 30 seconds. The transmitter was being operated at 100 W PEP output on the 14 MHz band, and this plot shows the transmitter output ±5 kHz from the carrier. The reference level is 0 dBc, and the vertical scale is in decibels.

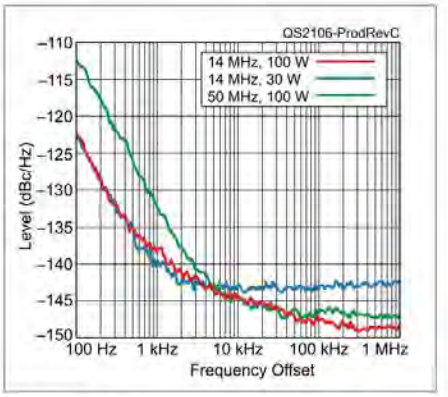


Figure C — The spectral display of the Yaesu FTDX10 transmitter output during phase-noise testing. Power output is 100 W on the 14 MHz band (red trace), 30 W on the 14 MHz band (blue trace), and 100 W on the 50 MHz band (green trace). The carrier, off the left edge of the plot, is not shown. This plot shows phase noise 100 Hz to 1 MHz from the carrier. The reference level is –110 dBc/Hz, and the vertical scale is 5 dB per division.

As I noted earlier, the other two USB jacks on the rear of the FTDX10 support a keyboard and mouse. Because the transceiver provides the ability to encode and decode RTTY and PSK31 signals, I thought I'd be able to use these ports and dispense with an external computer entirely. Alas, I discovered that the keyboard is only used for entering characters when needed, such as creating canned RTTY and PSK31 messages. You can't use the keyboard to engage in freeform chats. The mouse is still handy for menu access if you'd rather not poke at the touchscreen, or if you decide to display the screen on a separate monitor.

Having said all this, if you have no interest in CAT control or digital operating, these points are moot. If that is the case, just connect the coaxial cable feed line, the dc power supply, a microphone, and, if you use one, a key.

On the Air

Before taking the FTDX10 for another quick spin around the block, I thought it best to spend more time with the manual. I'm glad I did.

The FTDX10 offers a vast assortment of features, many of which have options within their functions. Operating the radio isn't a matter of simply toggling functions on or off. You are often faced with choices about how a given function should be configured. If you launch into a flurry of tweaking and button pushing without first understanding what you are doing, you run the risk of finding yourself thoroughly confused (and with the radio laboring under some odd settings). Should that happen to you, the manual helpfully describes the steps necessary to reset the radio to factory defaults.

Satisfied with my deeper dive into the manual, it was time again to apply power. The FTDX10's relays spring to life and the TFT display is always a marvel to behold. Selecting the 3DSS display mode, I'm treated to a mesmerizing three-dimensional field of signal spikes (see Figure 3). You can select a more traditional waterfall display, if you prefer, and even bring up inset displays for audio and more.

Picking at one minor nit, some pop-up screens, such as band selection, disappear if you don't make a choice within a couple of seconds. The radio soon trained me to think fast and not contemplate my options, but this was still an annoying behavior. It would be nice if all screens remained visible until you made your choice, however long that might take.

Figure 3 — The FTDX10's fascinating 3DSS display mode represents signals as receding spikes in constant motion. You can also opt for a more traditional waterfall display.

A smooth spin of the large VFO knob sent the cursor racing though the display. As I listened to SSB signals on 40 meters, the FTDX10's performance was striking. The band was crowded, which was just what I was hoping for, and I deliberately waded into intense interference, switching between roofing filters and manipulating the IF bandwidths. The transceiver did an amazing job of separating the garbage to the extent that it was technically possible, including interference from a couple of international broadcast signals.

As I adjusted the filtering, the results were displayed on a tiny inset window. This included the depiction of the DSP contour function and notch.

My initial foray into generating RF with the FTDX10 was on SSB, and I received outstanding audio reports. I also dared to dabble with the radio's parametric transmit audio equalizer while a friend listened to my signal. This is one feature that made me grateful for having read the manual. I alternated between giving the bass frequencies a boost and enhancing the crispness at the high end. The manual does a great job of explaining how the equalizer works.

Like most modern transceivers, the FTDX10 offers voice memories for use on AM, SSB, or FM. You can record up to five separate messages, each with a maximum time limit of 90 seconds, and then save them to the SD memory card for quick access. If you purchased Yaesu's FH-2 Remote Control Keypad, you could play back the recordings over the air with the press of a button. Otherwise, you must access the recordings from the screen.

You can also record received audio to the SD card, at least up to a maximum of 35 GB per file (that's a lot of audio). The recorded audio is saved in WAV format. I saved 60 seconds of audio from an SSB conversation on 20 meters, and that file occupied just under 3 MB

on the card. I was using an 8 GB memory card, which would probably have been able to store more than 40 hours (total) of recorded audio.

Speaking of receive audio, the FTDX10 allows an impressive amount of flexibility when it comes to tailoring the frequency response. The adjustable receive audio filter provides an array of high- and low-cut frequency settings for each mode, including the digital modes. I found that tweaking this feature often made an enormous difference in intelligibility, especially when operating CW or SSB.

MPVD

Among the plethora of FTDX10 features, you'll find one with an unusual moniker: *multipurpose VFO outer dial*. No wonder they abbreviated it MPVD.

MPVD takes the form of an unassuming ring at the base of the VFO knob; it almost looks purely decorative at first glance. Move the ring without doing anything else, and you'll go zipping across the band at 10 times the frequency step that's set for the main knob. This is convenient when you want to change frequencies fast. But that's not the only trick the MVPD ring can do.

You can instantly change the function of the ring by pressing the **BAND**, **STEP**, **MODE**, **CLAR RX**, or **CLAR TX** buttons. By doing so, a ring that once sped through the bands can be abruptly commanded to do something completely different.

For example, let's say you are operating SSB at the top end of 15 meters but want to switch to CW and operate at the bottom of the band instead. Give the MPVD a few twists, and you'll find yourself many kilohertz lower than where you started. Now punch the **MODE** button, and when the mode menu appears, twist the ring again to select CW. It's that easy.

I tested this on 10 meters, using the MPVD to jump from operating AM at 29.200 MHz to running RTTY at 28.090 MHz. It took 15 seconds to slide more than a megahertz and switch modes in the bargain. Covering the same distance by spinning the VFO knob required 60 seconds, not including the time necessary to change modes.

And if that wasn't enough, you can configure the MPVD to adjust one of 16 separate custom functions. My favorite was CW sending speed. I assigned that function to the MPVD and greatly enjoyed increasing or decreasing the sending speed of the built-in keyer with just a flick of my fingers.

Lab Notes: Yaesu FTDX10

Bob Allison, WB1GCM, ARRL Lab Test Engineer

Receiver test data for the Yaesu FTDX10 indicates a high level of performance, only slightly lower than the FTDX101D and FTDX101MP. Blocking dynamic range is greater than 137 dB at 2 kHz spacing, for example. The actual blocking signal needed to reduce the volume of the desired signal exceeds +10 dBm, the highest level we use for testing in the Lab. Even at +10 dBm, there was no sign of overloading with the preamp off. During initial testing, the IMD dynamic range at 3.5 MHz measured lower than expected. Yaesu found a defective filter and repaired the radio under warranty. Table 1 reflects measurements after repair.

The FTDX10 receiver offers plenty of flexibility with its use of preamps and attenuation, if needed. Sensitivity at 50 MHz, where it's needed most, is excellent. AM sensitivity is also good, especially on 6 meters, where there seems to be a resurgence of AM activity. S-meter calibration is the same as other Yaesu models, using 3 dB per S-unit scaling.

Transmitter performance is very good. Transmit phase noise is low, especially at the 30 W level, an RF output level typically used for driving a linear amplifier. Transmit IMD products are reasonably low, too.

As with many of today's transceivers, CW bandwidth varies with the **CW RISE TIME** menu setting, where the user can select the rise/fall time of the CW waveform. With the original firmware, the FTDX10 menu offered choices of 1, 2, 4, and 6 milliseconds rise time, as found on other current Yaesu models. After reviewing data and comments from the ARRL Lab that showed wide keying sidebands with the 1- and 2-millisecond settings, Yaesu modified the firmware (Main V01-05) to eliminate the 1- and 2-millisecond settings, add an 8-millisecond setting, and change the default to 6 milliseconds. (The Lab measured the actual rise/fall times for these settings to be 2.7/3.9, 4.2/4.6 and 5.4/6.6 milliseconds for the 4-, 6-, and 8-millisecond menu settings.)

Figures A and B elsewhere in this review show the CW waveform and bandwidth using the default setting of 6 milliseconds. A document comparing the FTDX10's CW keying waveform and bandwidth at all three current settings is available from **www.arrl.org/qst-in-depth**. You can see that the transmitted bandwidth is good at all three settings and that the transmitted signal narrows as the rise time setting increases. We are very pleased that Yaesu made these changes.

For the best quality transmitted signal, the ARRL Lab recommends loading the Main V01-05 firmware and setting the **CW RISE TIME** in the **MODE CW** menu to 6 or 8 milliseconds. Note that this recommendation is not unique to the FTDX10 and applies to any transceiver with adjustable rise time settings. For more information on this topic, see "It's Time to Clean Up our Transmitters," by Rob Sherwood, NCØB, in the November 2019 issue of *QST*.

Overall, the FTDX10 is a delight to use, ready to take on the biggest signals if your antenna farm is up to it.

Automatic Antenna Tuner

The FTDX10's internal automatic antenna tuner is designed to handle impedance mismatches that result in SWRs of 3:1 or less at the antenna port. The tuner activates with a push of the **TUNE** button, and the relays chatter madly for a couple of seconds as it attempts to find a match. Assuming an acceptable match is found, the tuner then appears to track across a substantial range within the band, adjusting quickly as necessary each time you transmit on a new frequency.

I can't help but mention that the FTDX10's autotuner was more generous in its matching ability compared to the tuner in my own transceiver. In one instance, the FTDX10's tuner found a match with my antenna system at a frequency and impedance that my current radio's tuner stubbornly refuses to accept.

CW Operation

The FTDX10 is a highly capable CW contest rig, especially considering its receive performance. If I spent the time necessary to tweak the filtering and DSP functionality, I was able to copy virtually any CW signal. As I became more proficient, it was uncommon not to be able to isolate a signal sufficiently to render it comprehensible.

Full-break-in (QSK) and semi-break-in operation is supported. The transmit-receive switching uses relays, with the clicking sound barely audible with the speaker volume at normal listening levels. The rear-panel ¼-inch key jack can be set up for a paddle to use with the internal memory keyer or for use with an external keyer, computer keying, or other key. As with the voice memories, the CW keyer memories can be sent by using virtual buttons on the display or an optional FH-2 remote control keypad.

The transceiver offers a CW decoder, but I found that it falls short of even my diminished skills. Not only do you have to carefully tune the signal to the proper frequency, but you must also adjust a control to match the speed at which you think the other operator is sending. There is little margin for error, and the algorithm doesn't seem too flexible in terms of tracking speed changes. Unless you get the adjustment in the bullseye, you'll see only gibberish crawling across the screen. To be fair, however, decoding CW in software has always been hit or miss. Even the best applications have yet to match the decoder nestled between your ears.

I consistently received excellent CW signal reports. Just to hear the quality myself, I accessed an online receiver and listened to my own signal as I sent a series of Vs. Tuning above and below the signal, I didn't hear clicks or anything else out of the ordinary. See the "Lab Notes" sidebar for more information on CW settings.

Digital Modes

As I mentioned earlier, I was able to configure my digital software to work with the FTDX10 and subsequently enjoyed making several FT8, Olivia, and Contestia contacts.

The radio truly shined during the BARTG RTTY Sprint Contest in January 2021. At one point, the activity in the RTTY portion of 20 meters was wall to wall, yet thanks to the FTDX10's receiver, my software had little trouble decoding signals, including those bracketed by strong stations.

Switching to the FTDX10's built-in RTTY decoder, it performed substantially better than the CW decoder, but still fell short of the *MMTTY* software I normally use (see Figure 4). With its versatile message memories, the FTDX10 has the potential to do RTTY contesting without an external computer, but only if the decoding quality is improved.

As I also mentioned, the FTDX10 has built-in PSK31 capability. With the advent of FT8, PSK31 activity has decreased. Yes, there are still contacts to be had, but as with its built-in RTTY feature, the FTDX10 supports only canned PSK31 messages (macros), not freeform conversational exchanges. There was a time when, to the irritation of many PSK31 operators, macro exchanges were the norm, but today the remaining PSK31 enthusiasts are trending back toward casual

Figure 4 — During the BARTG RTTY Contest, the FTDX10's RTTY decoder tries to render readable text, but with mixed results. The passband display to the right of the AGC indicator shows mark and space frequencies to aid in tuning.

chatting. Without the ability to type and send freeform text within the FTDX10's PSK31 function, those conversations will still have to take place with an external computer and software.

The FTDX10's PSK31 decoder seemed superior to the RTTY decoder. Successfully tuning a signal requires practice, but once you hit the sweet spot, the decoder does a reasonably good job.

Conclusion

The Yaesu FTDX10 is well positioned for competitive performance, but at a competitive price. My wish list for future updates includes improved RTTY and CW decoding, and if possible, the inclusion of FT8. I think the design of the FTDX10 would be particularly well suited to this mode. The ability to send freeform text from a keyboard would also be welcomed.

Manufacturer: Yaesu USA, 6125 Phyllis Dr., Cypress, CA 90630; **www.yaesu.com**. Price: $1,700.

Ciro Mazzoni 40 – 10 Meter Baby Loop Antenna

Reviewed by Phil Salas, AD5X
ad5x@arrl.net

Most of the currently available small magnetic loop antennas handle transmit powers of 20 to 100 W. This is not the case with the Ciro Mazzoni Baby Loop antenna, which can handle as much as 450 to 1,000 W, depending on frequency. This antenna is manufactured in Italy and is available in the US from DX Engineering.

Overview

The 1-meter-diameter Ciro Mazzoni Baby Magnetic Loop Antenna is continuously tunable from 40 through 10 meters. This is a very hefty and well-made antenna, constructed of aircraft-grade aluminum with a tubing diameter of about 2 inches. Almost all connections are welded, so most contact resistances are eliminated. The only mechanical contact is a stainless-steel blade attached to each half of the loop with stainless-steel bolts and antioxidant paste. The tuning capacitor is a large, interleaved, air-variable capacitor using aluminum plates welded to opposite loop halves at the top of the loop. The capacitor plate spacing is ½ inch, permitting operation at power levels up to 450 W from 40 through 15 meters, and 1,000 W for 12 and 10 meters.

The loop is tuned by changing the loop diameter, which adjusts the spacing of the interleaved variable capacitor plates at the top of the antenna. An automatic tuning unit (ATU) located inside the station controls the tuning process remotely. The ATU uses an accurate low-power direct digital synthesizer (DDS) oscillator to generate a tuning signal and an SWR algorithm to tune the loop for lowest SWR at the selected frequency.

Bottom Line

The Mazzoni Baby Loop is an effective small loop antenna designed for portable or fixed station operation at power levels from 450 to 1,000 W, depending on frequency.

Table 2
Mazzoni Baby Loop Specifications

Frequency range: 6.6 to 29.8 MHz
SWR: 1.3:1 typical. See Table 3
Diameter: 1.0 meter (3.28 feet)
Impedance: 50 Ω nominal (gamma matched)
Maximum power (PEP and CW): 450 W up to 21 MHz; 1 kW from 22 to 29.8 MHz
Front/back ratio: 6 dB
Front/side ratio: 25 dB
Wind loading: 2.70 square feet
Wind survival: 100 MPH
Control cable pair: #18 AWG up to 65 feet; #16 AWG up to 100 feet; #12 AWG over 100 feet
Antenna tubing diameter: 1.968 inches
Mast diameter: 2 – 2.3 inches
Weight: 26.4 pounds

Tuning does not require transmitting. Simply enter the desired frequency on the keypad and wait a few seconds for automatic tuning to complete. Once tuned, the current frequency and SWR are displayed.

To make tuning even easier, the ATU allows direct frequency control by radios with computer-aided transceiver (CAT) interfaces. Transceivers from ELAD-DUO, Elecraft, FlexRadio, Icom, Kenwood, and Yaesu are supported when using the appropriate optional interface cable. With the transceiver interface configured, the Baby Loop tuning automatically tracks the transceiver's band changes and operating frequency.

Note that although specific transceiver brands are mentioned, the interface depends on the specific CAT protocol of the transceiver. A transceiver not mentioned could interface with the ATU if the transceiver's CAT interface is compatible with one of the supported types. Check your radio's manual.

Table 2 lists the Baby Loop specifications. It is interesting to note that the Baby Loop has a 6 dB front-to-back ratio. Normally, radiation from a small loop antenna is expected to be equal from either side in the plane of the antenna. What is different is that the Baby Loop is fed with a gamma match, unlike the inductive coupling loop used in most small transmitting loop antennas. The gamma match provides a proper match to the unbalanced 50 Ω coaxial cable feed line, but it also results in an unbalanced radiation pattern. The main direction of radiation is toward the gamma match.

Installing the Baby Loop

The Baby Loop comes partially disassembled in a large shipping box weighing about 40 pounds (see Figure 5). The manual is provided on a CD-ROM, or it can be viewed on **www.loopantennai3vhf.com** or on DX Engineering's website. The assembly instructions

Figure 5 — The packaged Baby Loop antenna.

are clear. It took me about 1 hour to unpack and assemble the antenna. The finished antenna is shown in Figure 6.

The Baby Loop can be installed in portable or permanent locations. An optional tripod stand is available for portable operation. Because this is a relatively heavy antenna designed for high-power operation, I suspect that most buyers will install the Baby Loop in a more permanent location. In any case, because of the weight, the installation process should probably involve two people.

For best SWR performance, the manual recommends that the Baby Loop be mounted 5 to 8 feet above the ground, with at least a 7-foot clearance all around it. (DX Engineering also emphasizes the need to observe these clearances for best tuning and performance.) While there is no significant improvement in performance if you mount the antenna much higher, you may need to do so to clear nearby objects. A two-wire electrical cable is required for powering the loop actuator (#18 AWG wire for up to 65 feet, and larger wire for longer lengths), connected from the sealed housing at the Baby Loop's antenna base to the terminal block on the back of the ATU. There is an SO-239 connector on the Baby Loop's gamma match for attaching your 50 Ω coaxial feed line.

Figure 6 — The assembled Baby Loop. Note the massive capacitor plates at the top of the loop.

For permanent mounting, you'll definitely want a rotator. Because of clearance issues at my location, I mounted the Baby Loop at about the 15-foot level on a mast attached to the side of my house, and I rotated it with an inexpensive U-105 TV antenna rotator. Because of the Baby Loop's 26-pound assembled weight and 2.7 square foot wind loading, I also used a TB-105 thrust bearing with the rotator (unfortunately, the TB-105 is no longer available). So far, this setup has worked okay for me, but this is not a very robust rotator system for this antenna. If you don't have a suitable rotator, DX Engineering recommends the Yaesu G-450ADC medium-duty rotator and the GC-038 mast adapter clamp for a mast-mounted Baby Loop.

Operating with the Baby Loop

The Baby Loop ATU is powered by 24 V dc from the included 100 – 250 V ac adapter. The included keypad plugs into the USB port on the front of the ATU. The CAT interface (a DB-9M) is on the rear of the ATU. Your transceiver's RF output connects through the ATU to the coax feeding the Baby Loop. Maximum power through the ATU unit is 200 W, so if an amplifier is used it must be connected after the ATU. The ATU will tune the Baby Loop through a bypassed amplifier.

Operation of the Baby Loop is extremely easy. Simply press * on the keypad, enter your desired frequency, and hit **ENTER**. Within seconds, the Baby Loop will tune to that frequency without requiring you to listen for a peak in receive noise or transmit a signal. You do hear the ATU's oscillator in your receiver during the tuning process.

A red LED on the ATU shows when the loop is tuning, and a blue LED shows that the motor is drawing current. When the red LED turns off, the SWR and frequency are displayed on the ATU, and you are ready to transmit. Tuning is very fast — from fractions of a second within a band, to 2 to 3 seconds when moving to adjacent bands. Even going directly from 40 to 10 meters only takes about 10 seconds.

If you have the appropriate optional interface cable and transceiver, you can operate the Baby Loop in either a semiautomatic or full-automatic mode. In the semiautomatic mode, the ATU tracks the transceiver's frequency, but will not tune until you press **ENTER** on the keypad. In the full-automatic mode, the ATU constantly tunes the loop as you tune your transceiver's receive frequency.

I interfaced my Elecraft K3 transceiver to the ATU and tried both semiautomatic and full-automatic tuning. Semiautomatic tuning worked best for me. When jumping to a different band or band segment, I'd hit **ENTER**, and the antenna would tune. But then I could tune around that frequency without enabling the ATU's tuning oscillator (it can be a bit irritating to hear it come on while you are tuning around). When I found a frequency that I wanted to operate on, I'd hit **ENTER**, and the antenna would tune in a fraction of a second. The results were amazing. When I was ready to transmit, the Baby Loop was ready. Semiautomatic operation also makes sense for split-frequency operation because the SWR should be optimized for your transmit frequency, not your receive frequency.

Table 3 shows the Baby Loop's SWR after tuning on each of the bands, as measured through about 20 feet of RG-8X coaxial cable feed line, a PolyPhaser surge suppressor, a 1.5-foot cable to the house entry panel, a 1-foot jumper to the internal house panel, a 3-foot jumper to an A/B coax switch, and finally a 3-foot jumper to the ATU. I'm very happy with the results. Your

Table 3
Mazzoni Baby Loop SWR After Matching

Band (meters)	40	30	20	17	15	12	10
SWR	1.2:1	1.2:1	1.4:1	1.1:1	1.4:1	1.4:1	1.6:1

Measured at the station end of the feed line.

SWR will vary based on the antenna height and your own coax cable infrastructure.

Incidentally, if you think you need an external antenna tuner (maybe you have a solid-state amplifier and are uncomfortable with the tuned SWR on some band), keep in mind that any antenna tuner must always first be bypassed so the Baby Loop can be tuned by its ATU. Then the antenna tuner can be used to touch up the SWR on that frequency only.

On the Air

I operated mostly on 40 through 15 meters during the review period, as 12 and 10 meters weren't very active. I operated CW on 30 meters at 100 W, but used power levels up to 500 W on SSB on 40, 20, 17, and 15 meters with my Elecraft K3 transceiver and KPA500 amplifier. I could easily contact anyone I could hear.

I found the front-to-back and front-to-side directivities very obvious — signals rose and fell as I rotated the Baby Loop, similar to rotating a small beam antenna. I also made many A/B comparisons between the Baby Loop and my 43-foot vertical. I found that the Baby Loop averaged only about one S-unit below the 43-foot vertical on 40 and 30 meters, though frequently the performance was the same. On 20, 17, and 15 meters, however, the Baby Loop usually outperformed my 43-foot vertical. I do want to emphasize that I don't have the best vertical radial system due to physical restrictions in my backyard. And the angle of radiation of the 43-footer is suboptimum above 20 meters. So these factors may account for some of the improved performance I witnessed with the Baby Loop. The bottom line, though, was that I found myself using the 43-foot vertical to check band activity when changing bands, but then I'd change to the Baby Loop when I wanted to operate.

I also enjoyed the improved signal-to-noise ratio of the Baby Loop compared to the 43-foot vertical. The lower noise level on the loop helped with the listening fatigue I often encounter from ambient noise on 40 meters. And finally, all of the spurious signals from nearby consumer devices in the neighborhood that I am used to hearing on 40, 30, and 20 meters with the 43-foot vertical were completely absent on the Baby Loop.

Firmware Updates

The ATU firmware update procedure is very easy. Simply save the latest firmware (available at **www.ciromazzoni.com**) to a USB drive, insert the drive into the USB port on the front panel of the ATU that is normally used for the keypad, and then turn on the ATU. The ATU display will flash for about a minute, and then display **UPGRADE OK, REMOVE USB MEDIA**. After removing the USB drive, the ATU will start up, and you can reconnect the keypad to the USB port.

Figure 7 — Baby Loop keypad and ATU in author's station.

Maintenance

The Baby Loop comes with a 2-year warranty. This is a pretty pricey antenna, so you certainly want it to last a long time. According to the manufacturer, some Mazzoni Loop antennas have been in operation for more than 20 years with no maintenance whatsoever. Hams who live in environmentally adverse areas may want to clean the piston of the actuator with a soft cloth every few years, followed by a small squirt of a good silicon spray. Some replacement parts are available from DX Engineering.

Conclusion

The Mazzoni Baby Loop is a well-designed high-power loop antenna that is extremely easy to assemble and use. Its ability to automatically track your transceiver's frequency is a real advantage, as it makes loop tuning almost invisible to the operator. You can review the Baby Loop operation and installation manual on the DX Engineering website. Two other Ciro Mazzoni loop models are available. Additional photos are available from **www.arrl.org/qst-in-depth**.

Manufacturer: Ciro Mazzoni Radiocomunicazioni, Verona, Italy, **www.ciromazzoni.com**. For their magnetic loop antenna products, see **www.loopantennai3vhf.com**. Distributed in the US by DX Engineering, **www.dxengineering.com**. Price: Baby Loop antenna, $2,098. Transceiver interface cable, $50 to $90. Tripod stand, $150. Yaesu G-450ADC rotator, $300. Yaesu GC-038 mast adapter, $50.

The Best of "The Doctor is In"

While the column undergoes retooling in order to keep bringing you practical technical advice, *QST* presents some of the best questions and answers from past issues, with thanks to the Doctor himself, Joel Hallas, W1ZR.

Q Mike, WA9PIE, asks: I've got several transceivers in the shack as well as an HF linear amplifier that is running on 120 V ac house power. When I key a radio, the lights usually dim. This behavior isn't limited to just my shack. I'm tripping my arc fault circuit interrupter (AFCI) circuit breakers for other rooms (our building code now even requires AFCI breakers for bedrooms). What is the ideal configuration of electrical power in the shack? In newer, pre-built homes, is it possible to retrofit what's there to attain a better configuration?

A Power can be tricky, and what is feasible depends on how accessible your service entrance (breaker box) is, what the path is like between it and your station, and how much construction work you can tolerate. I am fortunate in that there is a single paneled wall with open studs on the back between my basement shack and the service entrance box.

While some medium-power linear amplifiers can be powered from a 120 V circuit, they usually require the whole circuit. If a new circuit is needed, it usually doesn't take much more to make it a 240 V dedicated circuit that, for the same wire size, will have half the voltage drop during key down. It can also be adapted later to a 1,500 W amplifier if desired. Thus, in my opinion, the ideal configuration is to run the linear from a dedicated (not powering anything else, and with its own pair of breakers in the service box) 240 V line that is as short as possible. This will reduce any light dimming to that occurring due to the resistance between the service entrance and the transformer on the pole — and that is beyond your direct control, although if it's still a problem, you may be able to get your power company to increase the size of their drop wire. I had to do that when I went from a 100 A to a 200 A service to support the addition of central air conditioning. There was no charge for this.

The next thing, which is often easy to do at the same time, is to run a dedicated 20 A, 120 V ac circuit directly (and only) to the shack just for radio equipment. That will minimize lots of potential problems with various kinds of coupling and noise.

An electrician should be able to give you an estimate of what it would take to do this, along with what, if any, damage there will be to walls and other structures. Consider also flush mounting wire carrier systems that can go on top of baseboards to avoid structural disruption, in some cases. The extent of effort and expense will depend on relative locations, and whether or not you have room in your service box for new single and double breakers.

That may or may not help the AFCI problem. If they are tripping due to RF picked up on their wires, or even picked up on the drop wire and coupled through the house wiring, it won't help. Then it becomes a matter of selecting AFCI equipment that is not susceptible. Fortunately, the ARRL Lab has found that most AFCI breakers are not particularly susceptible, although one run of AFCI breakers from Eaton were unusually sensitive to RF. The ARRL Lab worked with Eaton, and their new breakers no longer have the problem. If you are having trouble with those breakers, contact the manufacturer to find out which type you have.

Q Stanley, WA6LVC, asks: If I remember any rule, it is to never put a fuse in the negative lead of a power supply. Thus, I have been surprised to see that some (but apparently not all) manufacturers of amateur radio gear provide double-fused power cables.

Whether used in a base station or a mobile arrangement, it seems that if the rig is strapped to ground properly, there is no point in having a fuse in the negative line. Alternately, if the rig is not strapped to ground properly or that path fails, and the negative fuse blows, you are at best left with a faux ground through the coax that may fool you into thinking everything is fine, while putting the rig, and perhaps other equipment, at risk. What's the story?

A This is a question with some nuances. There are two schools of thought. My understanding of the reason for the fuse in the negative lead has to do with mobile operation in the usual vehicle. In that case, most recommend that the radio be connected directly to the vehicle battery, and with an additional fuse right at the positive terminal to protect against power wires that might short against the car infrastructure. I think that last extra fuse is the most important, be-

cause it can protect against a serious car fire in case the power wire gets pinched on the way to the fuses near the radio.

The fuse in the negative lead at the radio is intended to protect against an unusual failure mode, but it can happen. The negative battery lead in most vehicles connects directly to the engine block through a heavy braid that carries the starter motor current and everything else. Due to engine vibration, or other reasons, that connection can loosen or even corrode and break off. If so, when you turn the key, the starter current will try to return via other vehicle ground paths, particularly the path to your grounded antenna and through your radio chassis to the negative lead of your radio and then back to the battery.

The resistance will likely be far too high for the starter to actually crank, however, whatever current flows will flow through that path through the radio's internal ground wires. It won't be the 100+ A of the starter motor, but it will likely be higher than the connections inside your radio want to handle.

So, this negative power lead fuse is intended to protect your radio from a possible car problem, while the one in the positive lead near the battery will protect your car from a wiring problem.

Q Jim, W6JHB, asks: I built two W2FMI-designed 1 kW, 1:1 baluns, based on Jerry Sevick's book on baluns and ununs.[1] They use a 2.4-inch-diameter, mix-31 ferrite core and are wrapped with 10 turns of #12 AWG coated high-temperature wire with insulating tape on one wire. I put each of those baluns on my antenna analyzer to see how they came out, electrically. Both showed a fairly flat response from 1.8 up through 30 MHz, at very close to 50 Ω while driving a matched load. I connected one to a friend's medium-power linear amplifier via a short length of coax and then about 75 feet of 600 Ω open wire line to a 56-foot-long doublet at a height of 35 feet. He ran this configuration (without the amplifier) at 100 W and appeared to have no problems.

About 30 minutes after turning on the amplifier to about 425 W output on CW, the balun's ferrite core totally overheated and broke into several pieces. Subsequent SWR measurements on that antenna with the other, identical homebrew balun showed an SWR on 40 meters of about 15:1. His automatic antenna tuner was able to get a match, although it was about 1.7:1 or so.

My question is: how does one determine whether the balun's power level is capable of handling a load other than the design SWR?

A In the special case of a matched (SWR equal 1:1) transmission line, the voltage and current will be almost the same at any point along the line, with the exception of the usually small line loss. For your case, in which the SWR is higher than 1:1, instead of the current (and voltage) being roughly constant along the line, the current (and voltage) will vary with distance along the line. The places with maximum current will be the places with minimum voltage and vice versa. The problem comes up because ferrite, while having great electrical properties, is not particularly good at dissipating heat. The heat is a function of the wire loss in the balun times the current there. It sounds like you had the misfortune of having a high-current location that happened to be where the balun was. Note that the high-voltage regions can also cause problems with arcing, because the maximum voltage will also be the square root of the SWR times the matched voltage.

So the issue is not just what the SWR is on each band, but what the maximum voltage and current are at the location of the balun on each band. Your antenna analyzer can measure the actual impedance at the balun point on each band and you can then calculate the current and voltage at that location. Because of all the bands that such a multiband antenna can be used on, however, it seems likely that at least one band will be close to a maximum voltage point and another near a maximum current point.

It is pretty easy to calculate the maximum current based on SWR: it is just the square root of the SWR times the matched current. At 50 Ω, the 1:1 balun's design impedance, the matched current at 100 W would be 1.4 A, and at 15:1, it could be as high as 5.5 A — the same current that you would have with 1,500 W in a matched situation.

Let's consider an amplifier running at 600 W output and we'll substitute a 4:1 balun. The 4:1 balun is designed to feed a 200 Ω load, so the numbers on the antenna side will be somewhat different, but we can still analyze what's happening on the 50 Ω side, where the current will be highest. For a matched load, a 3 kW balun should be able to handle 7.75 A. At 600 W into a matched, the amplifier will be delivering about 3.5 A. You will be within that rating if your SWR is less than 5:1. At 400 W output, you will be within the matched current rating for a 7:1 SWR, 350 W for 8:1, and 250 W for an 11:1 SWR.

Going to a 5 kW balun should handle the current without problems. But be sure to check your balun specifications carefully.

[1] J. Sevick, W2FMI, "Building and Using Baluns and Ununs: Practical Designs for the Experimenter," *CQ Communications*, 1995.

Steve Ford, WB8IMY, wb8imy@arrl.net

Eclectic Technology

The HiFERs

Not everyone who transmits radio frequency (RF) energy in the US has an FCC license to do so. Consider the users of the citizens band (CB), the Family Radio Service, and countless others.

Of course, hams must be licensed because we generate signals at many different frequencies using various forms of communication. We've also been known to occasionally use serious amounts of power — as high as 1.5 kW — and sizable antennas. If you had to keep an eye on more than 700,000 people with these capabilities, you'd probably want them to have licenses, too.

But there is a community of hobbyists (many of whom are also hams) who spend their time exploring within frequency bands where the FCC allows unlicensed activity. The permitted power output levels at these frequencies are often extremely low, and the sizes and types of antennas are often restricted as well.

Take the *LowFERs* as an example. These hobbyists have been active between 160 and 190 kHz for decades. Despite the restrictions, LowFERs (short for "low-Frequency Experimental Radio") regularly make contacts over hundreds and even thousands of miles.

There are also the *MedFERs*, whose tiny signals cohabitate with AM broadcast stations between 510 and 1705 kHz. You'll occasionally pick up distant MedFER beacon signals on quiet winter nights.

Until recently, however, I was unaware of the *HiFERs* — an active group that hangs out in an industrial, scientific, and medical (ISM) allocation between 13553 and 13567 kHz, just below our 20-meter band.

Considering that HiFERs operate at HF frequencies, the long-range interference potential is much greater. With that in mind, FCC rules impose major restrictions on the amount of power they can radiate. John Andrews, W1TAG, has written an informative paper about calculating legal power levels for HiFER work, available at **www.w1tag.com/HiFER2.pdf**. Most amateurs lack the means to accurately measure RF field strengths, but John's calculations recommend limiting yourself to no more than 4.6 mW output to a half-wavelength dipole antenna if you can't perform the measurements.

A HiFER transmitter kit sold by Black Cat Systems at **www.blackcatsystems.com**.

As onerous as this restriction may be, any ham will tell you that a few milliwatts can take you pretty far when conditions are optimal. The HiFERs typically transmit CW beacon signals and often use weak-signal processing software to detect them. I've occasionally received HiFER beacons quite well without software assistance. As conditions on the HF bands improve in the coming years, I suspect I'll hear many more.

Tracking Down the HiFERs

The Longwave Club of America (LWCA) has a website at **www.lwca.net** that functions as an excellent resource for information on current LowFER, MedFER, and HiFER activities. While HiFERs count many hams among their ranks, those HiFERs don't use their amateur radio call signs. Instead, they usually create two- or three-letter identifiers for their beacon stations.

HiFER Hardware

As with the LowFERs and MedFERs, HiFERs often have to homebrew their equipment. Some ham HiFERs repurpose low-power HF transmitters, retuning them for use at 13.5 MHz and lowering the output to legal levels. This requires some expertise with the circuits in question, and the ability to measure RF output at such low levels.

There is some HiFER gear available for purchase, but the pickings are slim. I discovered that Black Cat Systems offers a HiFER transmitter kit for $25, which can be found at **www.blackcatsystems.com/rf-products/22_meter_band_part_15_beacon_kit.html**.

When you have an opportunity, spin the dial of your HF transceiver down to 13.555 MHz and then tune around carefully. It takes patience, but you may be surprised at what you hear.

Hints & Hacks

Easy RV Connections; Sneaky 2N2222s; Building a Coax Patch Panel, and a Powerpole Retrofit

Temporary RV Attachments

When roving in my recreational vehicle (RV), I prefer to use antennas that I can deploy quickly and temporarily, rather than relying on permanent installations that could lower the resale value of the vehicle. I use masts to support my antennas and I've found that these can be set up and taken down in a hurry.

For HF operating, I have a wire vertical antenna supported by a 33-foot collapsible mast. The mast is attached to the front pin box of my fifth-wheel trailer with two bungee cords (see Figure 1). The cords should be at least 38 to 40 inches long and can be found at local hardware stores. The arrangement is quite flexible, as the mast tapers at the top and has withstood winds of up to 40 MPH.

Figure 1 — Two bungee cords temporarily hold the HF antenna mast in place. [Art Horovitch, VE3AIH, photo]

For VHF/UHF operating, I use a collapsible fiberglass/metal pole that was part of a pool-cleaning net. It supports a dual-band **J**-pole antenna. The pole is attached to the slideout of the trailer using metal clamps (see Figure 2), available from hardware stores in a package of various sizes for about $10. They have plastic pads to avoid damage to the fiberglass finish and the slideout's rubber seal. *— 73, Art Horovitch, VE3AIH,* **suzanandart@gmail.com**

Figure 2 — Metal clamps hold the pole that supports the dual-band VHF/UHF antenna. [Art Horovitch, VE3AIH, photo]

Beware of 2N2222 Variants

I recently learned a surprising fact about the popular 2N2222 transistors: their pinouts are not standardized the way most other transistor pinouts are. I discovered this when a simple amplifier I built refused to amplify, but the transistor got very hot. A check of the device with a transistor tester and some online research provided an explanation.

It appears there are two variants of the 2N2222 in TO-92 small plastic packages. One is marked "PN2222" and has the common E-B-C pinout. The other is marked "P2N2222" and has its pins in reverse order: C-B-E.

Not all suppliers are aware of this issue, so you may find yourself buying a package of P2N2222 transistors while the seller's website shows the PN2222 datasheet, which will give you the wrong pinout. *— 73, Paul Koning, NI1D,* **ni1d@arrl.net**

Patching (RF) Leaks

The article "'Leaky' Antenna Switches" by Ellwood (Woody) Brem, K3YV, published in the March 2020 issue of *QST*, prompted me to send along my solution for the same problem. Rather than dealing with potential switch faults, I built a coax jumper panel instead. [ARRL's Hiram Percy Maxim Memorial Station, W1AW, uses a similar solution. *— Ed.*]

I happened to have a quantity of SO-239 barrel connectors in my junk box. I also had a nice piece of 3/16-inch aluminum sheet that I primed and spray-painted after drilling. Of

Figure 3 — The front and back view of the assembled jumper panel (the black object was used to support the panel for the photo). [Jerry Sobel, KØMBB, photo]

Figure 4 — The jumper panel installed and ready for use. [Jerry Sobel, KØMBB, photo]

course, I also had to assemble some short coax jumpers. My connectors are 2½ inches apart vertically and each jumper is 6 inches long.

The eight holes were sized to be a press fit for the center of the barrel connectors and were further secured with superglue. You could also use longer connectors and secure them with nuts and lock washers. Figure 3 shows the front and back of the panel.

The finished panel is shown in Figure 4, mounted next to my vintage Heathkit SB-200. I attached the selected input and output cables to the rear of the patch panel and placed labels on the front. I used inputs and outputs for the transceiver, amplifier, and antenna tuner, as well as HF, VHF, and UHF antennas. Of course, you may add as many connectors as you need and configure the connections however you prefer.

While a jumper panel may not be as convenient as a switch, it has its advantages, such as total shielding of coaxial feed lines; reduced or no impedance bumps in the coaxial feed lines; easy total disconnection of antennas during storms; ability to easily test new equipment and antennas or isolate problems, and inexpensive assembly and disassembly. — *73, Jerry Sobel, KØMBB,* **arsk0mbb@aol.com**

Reusing Hard Drive Magnets

I acquire old computers, refurbish them, and then donate them to various local charities. I often come across computers that are too old to be of use. However, every computer hard drive, whether it's a laptop or desktop, has two very strong magnets operating the actuator and head arms. I take the obsolete computer's hard drive, remove the magnets, and mount them around my work area so I can place my tools on them for ease of access while working on projects, thus eliminating clutter on the bench. For example, I have mounted some on the pegboard where I keep my screwdrivers (see Figure 5).

Figure 5 — Hard drive magnets repurposed as screwdriver hangers. [Mike Joyce, VE3LTN, photo]

To retrieve these magnets, keep in mind that every hard drive case opens differently. Torx, Phillips, or Robertson fasteners are all used. In some cases, you may have to drill out punched rivets. Once opened, you will see the magnets, with the actuator head hidden beneath the upper magnet. Simply remove the screws holding them and remove the magnets.

The next time you come across an obsolete hard drive, do some at-home recycling and get a neater workshop in return. — *73, Mike Joyce, VE3LTN,* **ve3ltn@gmail.com**

"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.

Strays

Bolingbrook ARS Nightly Net

The Bolingbrook Amateur Radio Society (BARS) in Chicago established a nightly health and welfare net to keep area hams in contact with one another during the pandemic. Each night has a regular net control operator, and there is usually a question to help prompt discussion. The BARS linked repeater system is 147.330 MHz with + offset / 107.2 Hz CTCSS and 443.525 MHz with + offset 114.8 Hz CTCSS. The repeater can also be found on EchoLink at K9BAR-R. The net is at 1930 Central Time every day. Visit **www.k9bar.org** for more information.

Rising Sunspot Numbers: It's Not All Good News

When we look at the whole picture, the D and E layers of the ionosphere may present some challenges.

John Stanley, K4ERO

The amateur radio community is getting excited about the start of Solar Cycle 25. Hams are operating on the higher frequency bands and getting some results, as well as talking about better conditions on the 20- through 10-meter bands. Higher sunspot numbers will bring the return of more signals on the higher frequency shortwave bands, however, higher solar activity also affects the lower frequency bands (and not always for the better). The worst effects occur during the day, so I'll focus on daytime paths in the mid-latitudes. The figures I've included were made for March conditions in the center of the US using data generated by the Voice of America Coverage Analysis Program (VOACAP) propagation predictions (**www.voacap.com**).

Any propagation tutorial will mention the three layers of the ionosphere: D, E, and F. As the solar activity rises, all three layers get "thicker," having more electrons per unit volume. The extra electrons in the F layer bend higher frequencies back to Earth, allowing long-distance contacts. This may seem positive, but we need to look at the whole picture, including the other two layers.

Daytime Radio Signals

The lowest region of the ionosphere is the D layer, and its effect on radio waves is not very good. When it gets thicker, the waves passing through to the E and F layers become weaker. This layer has more neutral atoms than electrons. As a wave passes through it, electrons are moved back and forth by the E field of the wave. The electrons collide with the neutral atoms and lose energy. The more electrons there are, the more lossy collisions occur, making signals weaker. The D layer mainly goes away at night, no longer weakening the low-band signals. Distant AM broadcasts and 160- and 80-meter signals get stronger.

A sunspot number (SSN) of 100 means the thicker D layer weakens the daytime signals more than when sunspots are low. Figure 1 is a plot of the total loss on a 200-mile path on 80 meters for high and low SSNs. The loss at 12 PM is 30 dB (1,000 times) more with an SSN of 100 than with an SSN of 10. If you've been operating 80 meters between 10 AM and 2 PM for the last 5 years, you'll be in for a shock when the SSN rises. You can blame the D layer for the major loss of daytime signals. Some weakening even continues into the evening, when many nets are active. The thicker D layer can weaken signals on other bands, but it's most serious on the 160-, 80-, and 60-meter bands, and still significant on 40 and 30 meters.

Effects of a Thicker E Layer

The E layer also gets thicker as sunspots rise. This causes another problem that adds to the D-layer loss. Figure 2 is a plot of signal-to-noise versus distance for 40 meters with high and low solar activity. For distances between 300 and 500 miles, the signal with an SSN of 10 (blue line) is about 10 dB stronger than the signal with an SSN of 100 (red line). This is that ugly D layer absorption again. In addition, both curves show a distance where a steep drop occurs. With an SSN of 10, this is at about 600 miles. With an SSN of 100, the steep drop-off point moves to about 460 miles. This represents a loss of nearly half the coverage area.

6 Meters Shines During Solar Cycle Peaks

Jon Jones, NØJK

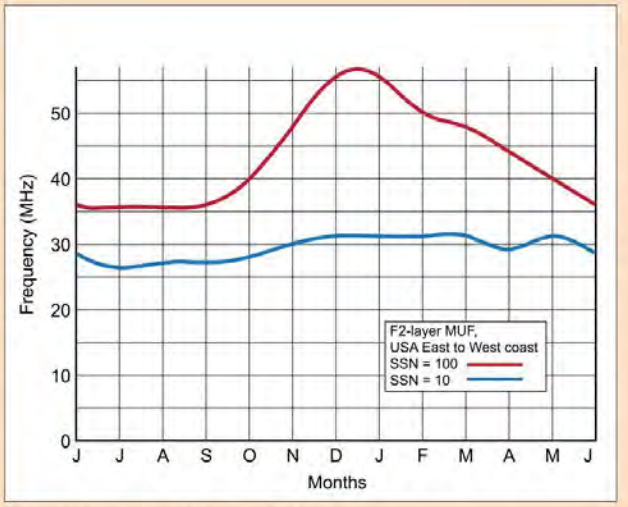
High sunspot numbers (SSNs) help VHF operators with F2 ionospheric propagation (F2 skip) on 6 meters. This type of propagation involves the refraction of radio signals off of the F2 layer of the ionosphere, which is about 200 miles (330 kilometers) above the Earth's surface. UV radiation from the sun can intensely ionize this layer, and signals can be refracted up to 2,000 – 3,000 miles (3,200 – 5,000 kilometers) from one refraction, or "hop." Multiple hops can occur under the right conditions, enabling signals to go over 12,000 miles (19,000 kilometers) with low loss. It's one of amateur radio's most exciting modes.

But there are downsides to VHF during a solar cycle peak. D-, E-, and F-layer ionospheric absorption, as well as Faraday rotation (polarization rotation of signals through ionospheric layers), increases. Solar flares can cause ionospheric radio "blackouts." The absorption decreases the already weak signals from Earth-moon-Earth (EME) communication, and Faraday rotation of radio signals can cause "lockout" with total loss of reception.

If Solar Cycle 25 is similar in magnitude to Cycle 24, some interesting propagation will occur on 6 meters, including F2 and transequatorial propagation (TEP). TEP involves refraction signals off highly ionized "bulges" located about 15 degrees north and south of the geomagnetic equator. This allows HF and VHF radio signals to cross the geomagnetic equator with low loss.

It'll be a couple of years before people can start expecting any F-layer propagation on 50 MHz. In the meantime, rare propagation is occurring now on 6 meters. Sporadic-E/TEP occurs when sporadic-E hops can link to TEP, potentially covering thousands of miles.

The high maximum usable frequency (MUF) in the F2 layer critical for 6-meter propagation occurs during the fall, winter, and early spring months in the Northern Hemisphere. Six meters will not open for F2 during the summer, even at solar cycle peak. This is called the winter anomaly. The graph shows a path from the east to west coast in the US with both lines representing the F2 layer. The red line is the MUF for an SSN of 100 and the blue line is the MUF for an SSN of 10. The generally accepted explanation for the anomaly is increased ionized oxygen relative to nitrogen in the F layer, due to seasonal circulation in the ionosphere.



The winter anomaly in the F2 layer.

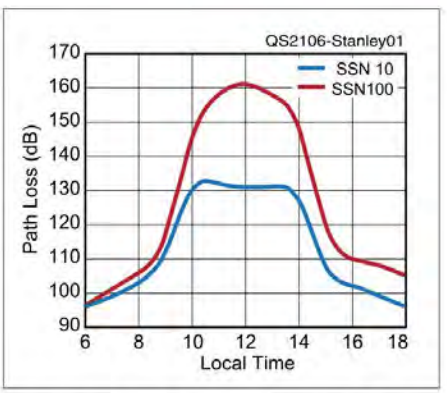


Figure 1 — Path loss versus time of day for the 75- and 80-meter bands.

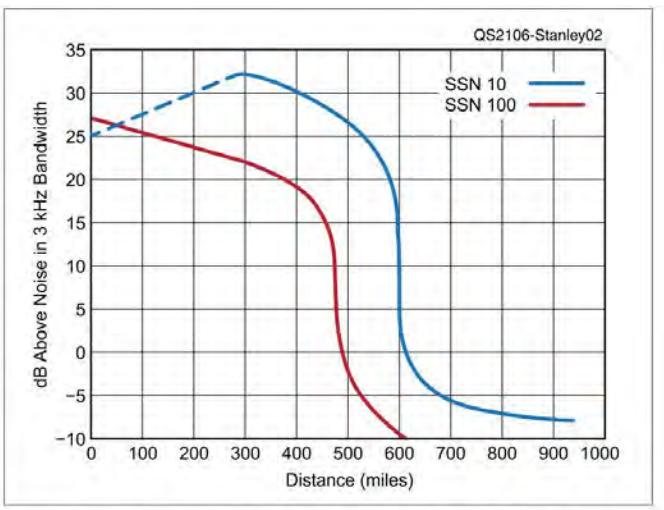


Figure 2 — Distance versus signal strength on 40 meters during the day.

For shorter paths, the curve representing SSN 10 drops (dotted line). This is because there isn't enough ionization in the F layer to give a solid return to high-angle signals. This can cause a close in a zone where signals aren't heard, even though distant signals are heard. This is called a "skip zone." With an SSN of 100, the daytime skip zone is gone on 40 meters, but overall the signals are weaker, and the maximum range is less. Nearby coverage is better, but distant stations are lost.

This sharp drop-off in signal at 460 and 600 miles is caused by the E layer, as shown in Figure 3. A 60° or 45° signal (near vertical incidence skywave) from the transmitter point (point T in the figure) goes through the D and E layers, bounces off the F layer, and comes down at points A or B. Signals sent out at 30° would arrive at point E if the E layer wasn't thick enough to reflect them. All lower-angle signals are also blocked. We can't reach point E via one hop from the F layer, and to reach point D or E, the E layer must be used. This passes through the lossy D layer via a longer, slanted path. For the distance where a critical angle at the E layer reflects rather than passes the wave, the signal strength drops drastically. Using two E or F hops would mean four trips through the D layer with double the loss.

While sporadic E can sometimes give unusual DX on 10 and 6 meters, a thicker E layer normally does more harm than good to shortwave propagation. By blocking signals from reaching the F layer, it limits the maximum distance covered. Forty-meter daytime nets may have to do some adjusting as the sunspots go from near 0 to maximum. This may mean changing the hours of operation or going to a higher band.

Choosing the Best Band for Daytime Operation

As the higher bands open up, the lower bands will get worse overall (especially in the daytime), due to higher D-layer losses and the greater blocking effect of the E layer. Anticipating these changes, operators can plan for and use the most appropriate band for a given activity. In propagation planning, FOT (frequency of optimum transmission) is used. This is the frequency predicted to be the most reliable between two points. It varies based on time of day, latitude, season, sunspot activity, and distance.

Figure 4 shows that the daytime FOT changes as the sunspots rise. It shows that with an SSN of 10, 5 MHz is optimum up to 250 miles, moving to 7 MHz for 400 miles, and 14 MHz for 1,000 miles. With an SSN of 100, 7 MHz is best up to 250 miles, 10 MHz for 470 miles, and 14 MHz at 800 miles. When the SSN goes from 10 to 100, the FOT rises by about the difference between one band and the next. Thus, by moving up one band during the high sunspot years, one should have similar coverage.

The problem with moving to the next higher band is that 60 and 30 meters have their limitations. One would ideally move from 75 to 60 meters, 60 to 40 meters, and 40 to 30 meters. However, SSB nets on 40 meters can't move to 30 meters, and there would be congestion if the 75-meter nets all tried to go to 60 meters. Moving from 75 to 40 meters is possible in some cases, and some nets have done that in the past. It's not ideal, as the frequency increase is more than what's needed to stay with similar coverage. A 40-meter CW net moving to 30 meters would work well.

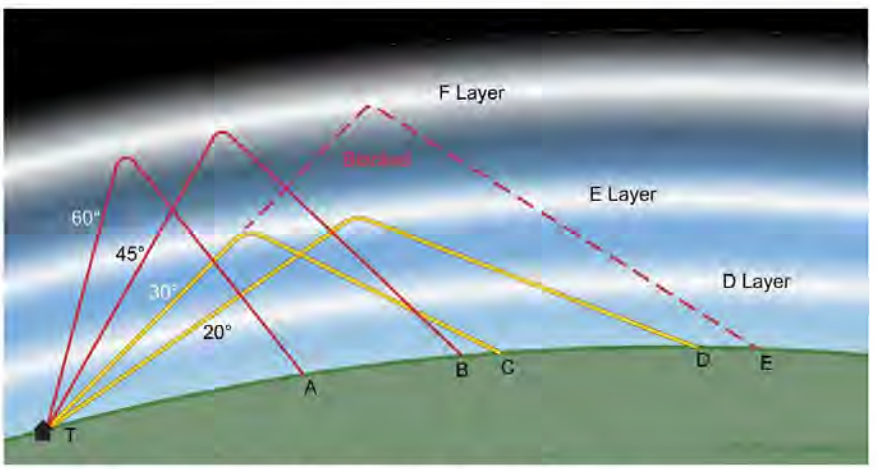


Figure 3 — The ionosphere's E layer blocks low-angle signals.

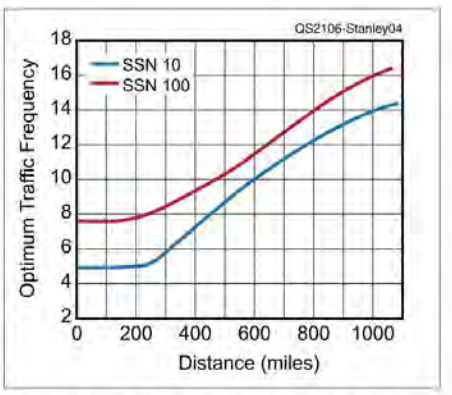


Figure 4 — Frequency of optimum transmission (FOT) versus distance, daytime, and mid-latitudes.

When going to a higher band is impractical, the next best option is to change the time of day. Operation on 160 meters will have to move toward the evening hours, because daytime propagation dies quickly with sunlight. Morning nets on 75 and 40 meters or longer-lasting contacts may have to move to earlier hours and early evening nets to later hours.

Conclusion

Whether the sunspots are high or low, we can work with propagation as opposed to waiting for it to improve. As we begin Solar Cycle 25, the lower bands will still be good at night. In the daytime and early evening, paths on the higher bands will be very exciting.

With the prediction and monitoring tools we have, we should be able to anticipate and keep track of what's going on. Doing what we can now will help us use the new conditions to our best advantage.

John Stanley, K4ERO, and Ruth Stanley, WB4LUA, did broadcast engineering for 45 years, performed ionospheric research, taught, and helped radio stations around the world find the best frequencies for their shortwave broadcasts. John and Ruth have held many call signs in some of the dozens of countries in which they've worked. As an ARRL Technical Advisor, John has contributed to many ARRL publications. Now retired in their off-grid, self-built home on Lookout Mountain in northwest Georgia, they're involved in church work, writing, and consulting. John keeps up with old friends on 75 meters and plays with digital modes on many bands. He can be reached at **jnrstanley@alum.mit.edu**.

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

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Ken Hart, K4KN
Gary D. Haynie, W0DBL
John E. Hearne, AF5EK
Joan Heinen, KB0YRX
Patrick J. Hogan, KK4NDY
Andre K. Hunt, N2JDH
Nina Hunt, KC1LWY
Patrick D. Hutton, KG5VKV
Charles A. Jackson, KN4FKF
Frandy Johnson, N1FJ
Robert J. Johnson, NQ5P
Susan M. Johnson, KD8BJW
Gary W. Lackey, N5GWL
Chris D. Long, N1CL
Colin Lord, KT4ATL
Robert T. Love, KE5FNA
Kevin J. Lynch, N1KL
Christopher Magelitz, K3BBC
Dale L. Martin, KG5U
Timothy A. Martin, WB2VVQ
Barry A. Mather, AD7CL
Jerome P. McDonald, W7FVB
Michael McGarvey
Russell J. Mckay, KC3RNM
Harry Mueller, W1HMM
Dan R. Oetting, N0BAF
Todd W. Oldenburg, KK2I
Joseph M. Pepe-Phelps, KL3JY
Christopher Porter, AA7KL
Richard Preston
Theodore C. Price, N5EYS
Bradley D. Prouse, KD0UED
Timothy S. Reed, W3HR
Chris Reich, WB2DYJ
Adam Rennison, AD0AM
David L. Rhodes, WK4T
Andrew Rizkalla, AD2BJ
David R. Robbins, K1TTT
Alan P. Rothermich, WB0QLU
Rachel M. Runion, KN6KGW
DJ Sandler, KD6JIX
Rachel L. Schmoyer, KC1OHY
Jack L. Sheldon, KN7Y
Earl F. Skelton, N3ES
Christopher Smith, K2WCS
Brian L. Stamper, W4ES
George A. Stone, WD4CYV
John C. Tobias, KD3OA
Craig D. Troop, N3GW
Barry M. Tucker, AG4GD
Jeremy M. Turner, N0AW
Fred B. Twigge, K7DTU
Suzanne C. Van Der Valk, ND0D
Asher Waldfogel, K0AU
Brent A. Washer, AJ6MQ
Richard Weber, K7EEY
Michael G. Williams, KJ7LDW

VHF Roving in a Compact Car

Pete Kobak, KØBAK

One week before the 2020 ARRL June VHF Contest, my van needed repairs. I was converting the van, which formerly belonged to a TV station, for roving radio operation, and I worried about roving without it. Not having the van and needing to social distance due to COVID-19 was challenging. My wife reminded me that, like most ham radio operations, VHF roving is a great way to engage with other hams while maintaining the social distancing guidelines. Although my TV van would've been optimal to use for roving because of its space, just about any car can be used for roving. I decided to use my Subaru WRX.

Modifying My Equipment

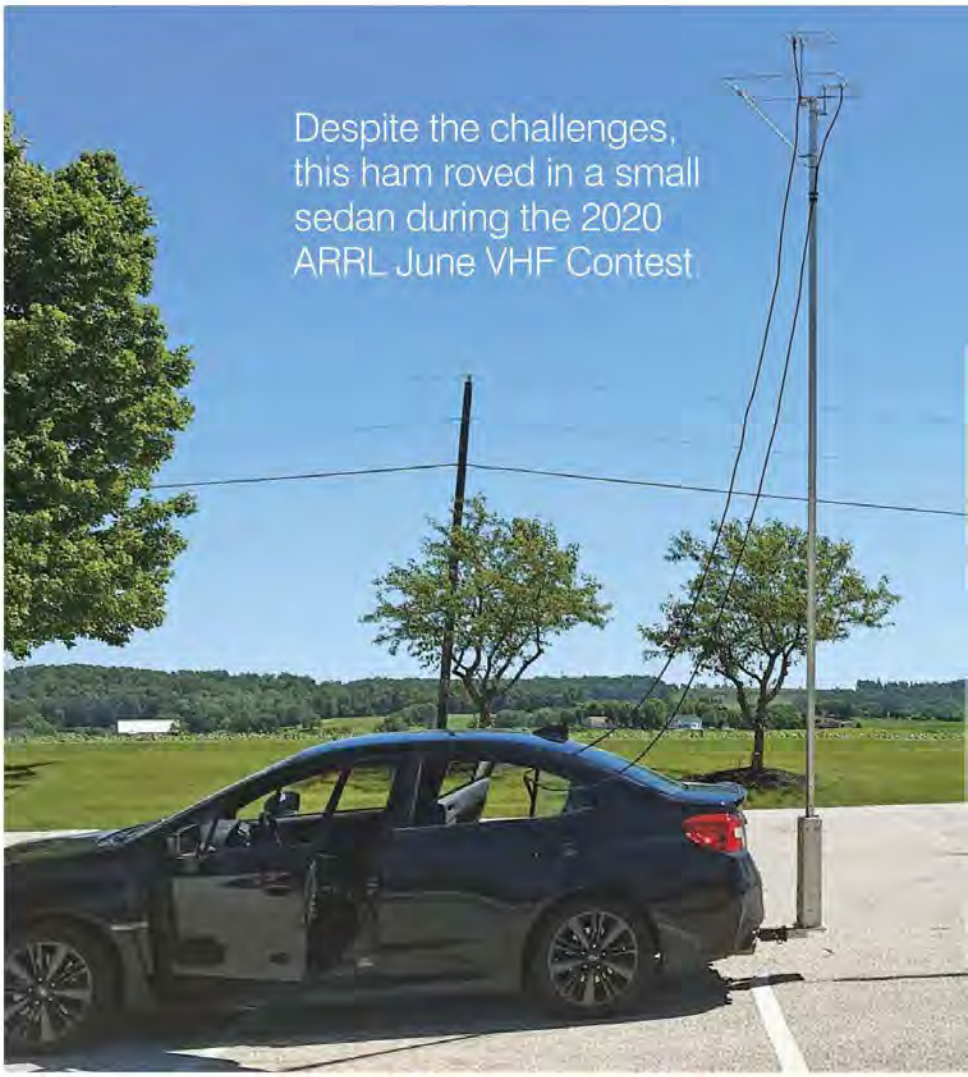
Due to the small interior space of my Subaru and its 1¼-inch trailer hitch receiver for antennas, I had to use 6- and 2-meter halo antennas on a nearly 20-foot walk-up mast assembled at each site. For quick, easy setup, I used my backpack-installed Icom IC-7100 transceiver, which I normally use for pedestrian portable operations. Although the backpack includes a 20 Ah battery, I decided to use my 60 Ah LiFePO4 battery because I thought operating FT8 would require more energy.

The USB connection from my laptop to the Icom transceiver provided both the computer-aided transceiver (CAT) connection for the *N1MM Logger+* and the audio connection for *WSJT-X*. This was one of my biggest concerns because I've always had issues with the IC-7100's USB connection dropping and requiring a computer reboot.

Equipment Troubleshooting

Early Saturday, on June 13, 2020, I bench-tested the radio and computer to verify *N1MM Logger+* and *WSJT-X* operation. I also test-built the walk-up antenna mast system but didn't have time for a full on-air systems check. Leaving an hour late without having made component connections, I arrived at a location near Gap, Pennsylvania — a grid corner. By the time I set up, it was an hour after the contest started.

I decided to listen on 2 meters, but only heard one caller. Even though I heard Thomas Valenti, K3AJ, he could barely hear me. I only had a halo antenna and 50 W, but I should've been stronger. With many repeats, we finally completed a contact. Not hearing anyone else on phone, I switched to FT8 on 2 meters. I was happy to see a number of stations calling CQ, but no one could hear me. After checking my connections, I found that during my rush to set up, I had reversed the coax connections to the radio. No wonder K3AJ could barely hear me. My radio was trying to push a 2-meter signal out of a 6-meter antenna,



Despite the challenges, this ham roved in a small sedan during the 2020 ARRL June VHF Contest.

reducing the power to almost nothing. After I connected the right antennas on the radio, my FT8 responses were now completed and I made a handful of 2- and 6-meter contacts in rapid succession.

Next, I drove 10 minutes to a common roving location: grid square FM19xx, located in a township park. Not surprisingly, I got similar results on 6 and 2 meters. My farthest 2-meter SSB contact was Russell Lamm, NN3Q/R, in FN21 in northern Pennsylvania, and my only rover-to-rover contact. I decided to drive home after a total of eight contacts in 50 minutes.

An Open Band

My next stop was FN30 in Sandy Hook, New Jersey. I woke up early Sunday morning to get there by 10 AM. When I arrived, every other parking lot was blocked off to enforce social distancing.

There was a major opening on 6 meters that morning, and I was surprised at the rate of SSB contacts I was getting with only an omnidirectional antenna and barefoot power (transmitting without an amplifier). Because I don't have a 6-meter station at home, I only get to experience the joy of a band opening if it happens during a contest rove.

When I switched over to 6 meters on FT8, I had problems with the USB connection dropping and also getting my laptop time synced. After making only three digital contacts, I switched to 2 meters, but connectivity was a problem again, so I listened for SSB. My previous problems with 6 meters on FT8 left my radio in digital mode, so modulation would only be accepted over the USB computer connection. I finally found the touchscreen button on the transceiver that switched out of digital mode.

My next intended stop was in FM29 in southern New Jersey. I used my grid square app to tell me when I crossed the FM29 border, then got off the next exit to find a nearby school without close trees to set up. I was able to make most of my contacts there. They were just about evenly split on 6 meters between SSB and FT8, as well as a small number on 2 meters on both digital and phone.

I decided to activate my home grid, FN20, before getting back home. I went to my usual high spot at a school. The 6-meter opening was over by then, but it gave me the opportunity to contact local hams. I made about a dozen more contacts on 6 meters on FT8. After some unanswered CQs on 6 meters, I tried to make 2-meter contacts on FT8, but I again had a USB connection failure, so I decided to call it a day.

◀Pete Kobak's, KØBAK, antenna setup for VHF operation in grid square FN10xa.

▼Antennas and a backpack radio stored in the back of Pete's Subaru WRX, while operating during the 2020 ARRL June VHF Contest.

Conclusion

I was glad I went out roving during the 2020 ARRL June VHF Contest, even with only two bands and all the frustrations of using a laptop. Although I missed operating in the space of my TV van, I was still able to rove and engage with other hams. It just goes to show that ham radio isn't always about the equipment or the setup, but what you make of it.

All photos by the author.

Pete Kobak, KØBAK, has been an active amateur radio operator since 2014, mostly as a mobile, rover, and portable operator. His interests include operating mobile in state QSO parties, VHF contests, and park activation programs. Pete is currently converting an old TV station news van into an HF and VHF mobile ham station. He is a member of the Pottstown Area Amateur Radio Club and the Mount Airy VHF Radio Club. Pete can be reached at **qst@k0bak.com**.

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

VOTE
If you enjoyed this article, cast your vote at www.arrl.org/cover-plaque-poll

Coffee and Radio: A Pandemic-Inspired Net

Dino Papas, KLØS

Many clubs have found innovative ways to stay in touch during the COVID-19 pandemic. In March 2020, the Williamsburg Area Amateur Radio Club (WAARC) in Williamsburg, Virginia, started a Coffee and Radio Net, which meets daily at 9 AM on our local 2-meter repeater. Our goal was to help our members maintain contact and share information about local conditions regarding the virus. Now, after more than a year, many benefits have arisen from this daily net.

The Williamsburg Area Amateur Radio Club has kept members engaged for an entire year while keeping members safe.

WAARC President Toby Papas, KLØSS, enjoying her turn as Net Control Station for the club's Coffee and Radio Net.

Dedicated Regulars

Our net slowly built a core group of regulars, mostly from our retired ham community. However, over the course of the past year, it has had more than 200 unique call sign check-ins from local club members, surrounding communities, and visitors to our area — well beyond the club's population of around 150 members. As the organizer and Chief Net Control Station (NCS), I've kept track of net rosters and topics discussed on most of those days, regularly recording check-in counts of over 40 members. We also found that our members use online listening apps such as Broadcastify (**www.broadcastify.com**). This allows them to continue listening to the net when they're away from their radios or traveling out of the area, often checking in via text to let us know they're still with the group.

Net Benefits

We usually engage in a topic or question of the day, ranging from technical radio topics to battling vermin in our yards or discussing our favorite desserts and music. We also have open-mic sessions and allow members to share what they're up to, ham radio-related or otherwise. Although I head the majority of the WAARC nets, other members have been generous enough to volunteer to do the NCS duties on the weekends. This is a great benefit to the volunteers. This is often their first time running a directed net, which gives them practice for operating in an emergency communications support environment.

We found that many local hams who might not have had an opportunity to interact previously have been able to establish both amateur radio relationships and personal friendships as a result of the net.

A New Way to Gather

Of course, we've missed getting together in person, but teleconferencing platforms like Zoom help us with monthly meeting attendance. In fact, attendance has averaged well past the numbers historically seen when we were able to meet in person. The breakout room function on Zoom allows for smaller groups to gather. During our "Virtual Builders Group," we discuss mutual projects and interests while remaining in the same larger virtual space (see the sidebar, "A Virtual Builders Group," for more information).

Over the last few years, our club has focused on our newest hams, and we continue to support them (as well as our more experienced hams) with special interest groups that meet on Zoom. For those comfort-

One of the WAARC Virtual Builders Group meetings via Zoom.

able with participating in COVID-safe activities (wearing masks and socially distancing), we find that popular activities include foxhunting and learning to work satellites and the Amateur Radio International Space Station (ARISS) with portable equipment. Some of these members have also helped keep our three annual special event stations on the air.

A Virtual Builders Group

In 2014, the Williamsburg Area Amateur Radio Club (WAARC) created the WAARC Builders Group (more information on this group can be found in "A Ham Radio Makerspace," by Dino Papas, KLØS, in the February 2015 issue of *QST*). Ever since it's creation, the group has met every spring and fall for four to six biweekly sessions at Dino's home. The club had just begun its spring 2020 session when the COVID-19 pandemic forced suspension of in-person activities. After using Zoom for meetings and staff work, the club decided to revive the group by forming a Virtual Builders Group on that platform.

Twenty-five members attended the first Virtual Builders Group session and experimented with how to share their technical projects with one another remotely. Some members even purchased dedicated video-streaming cameras and accessories to give better live demonstrations of projects and troubleshooting steps. Although meeting virtually isn't the same as gathering in person, the club found that it provides a welcome forum for technically minded members, spanning the experience level from beginner to expert, to continue to share their love for all things ham radio and electronic.

Although the WAARC Virtual Builders Group is in its infancy, the club has had great success and interest from its members thus far.

COVID-19 has forced radio clubs to rethink how to accomplish Field Day. With ARRL encouraging hams to participate from their homes without penalty, we found that the number of club members who actually participated on the air from home far exceeded the number of operators typically keying the mic or CW at our Field Days in years past.

Looking Ahead

I'm not sure what will happen to our club once we're able to meet safely in person again. One thing I know for sure is we've learned that computer teleconferencing platforms will continue to offer a means to help us keep in touch and interact in ways that may not have been possible before. Those activities should be retained and continue to be a valuable addition to club activities. If you're in the Williamsburg, Virginia, area, be sure to grab a cup of coffee and join us at 9 AM on the Coffee and Radio Net!

All photos by the author.

Dino Papas, KLØS, is a frequent *QST* and *On the Air* contributor, and has been an amateur radio operator for over 50 years. He can be reached at **kl0s@arrl.net**.

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

Operating ARRL Field Day as Therapy

With help from some friends, an active ham used Field Day to get back on the air after having a stroke.

C. K. "Skip" Walter, ADØH

There are hundreds of entries in the ARRL Field Day results every year, and each one has a unique story. The Field Day story of George Oster, NP2N, ARRL DXCC Honor Roll member and frequent contester from St. Croix in the US Virgin Islands, has been a little different these past 3 years.

The 2018 and 2019 Field Days marked his return to the airwaves after having a major stroke in January 2018. Getting back on the air may have helped him recuperate and settle into his new normal.

A Leave from Amateur Radio

When I first visited George in the hospital after his stroke, his mobility was severely limited. After weeks of physical therapy, he received news that he most likely would never walk again.

When he transferred out of the hospital to a healthcare center, he wasn't allowed to install an antenna on the roof of the eight-story building. George wanted to get back on the air for the 2018 ARRL Field Day, so we decided to arrange for him to operate from my car, which has an Icom IC-706MKII transceiver and a triple magnetic mount for an antenna.

Above — George Oster, NP2N/WØ, operating at the 2018 ARRL Field Day for the first time since his stroke, using Skip Walter's, ADØH, mobile station.

Preparing the Station

Because moving George into my car would require assistance from the healthcare center staff, we needed to find a location on the facility grounds that was at least two parking spaces wide, so we could park George's wheelchair beside my car. I found a one-story maintenance building down the street with a paved driveway and small parking pad, which was adjacent to enough open ground to tether a temporary covering for shade.

We decided to operate for Field Day on the morning of Sunday, June 24, 2018. We received approval from the resident social worker to set up our mobile station on the facility grounds and a Certified Nursing Assistant (CNA) was scheduled to monitor George.

Field Day Operation

I arrived at 8 AM to set up a blue tarp for shade. I packed notebooks for logging, as a computer screen would be unreadable in the sunlight.

At 9 AM, George's CNA wheeled him next to the car, and we experimented with the placement of the Icom transceiver control head on his tray. We decided to use an outboard speaker because we were out of hearing distance from other residents. I gave George a quick review of the audio and frequency controls and the Field Day exchange script in large print. We were ready for NP2N to return to 20 meters.

2021 ARRL FIELD DAY GUIDE

QST Supplement, June 2021
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SIX TIPS FOR FIELD DAY SUCCESS

1

BE SAFE

Practice social distancing and review the ARRL pandemic-modified Field Day rules at arrl.org/FDWaivers.

2

HAVE A PLAN

All successful endeavors begin with a plan. Decide in advance how many stations you'll set up, and what category you will be operating. Get commitments from your group and create a plan for packing, setup, and tear-down. Planning ensures that things go off without a hitch, which reduces frustration and increases the fun.

3

ASSIGN TASKS

Begin with the leadership roles. Some clubs use "band captains," who ensure that all aspects of the operation for their band/mode station are taken care of. Other clubs make assignments according to tasks, such as a power team that's in charge of providing power to the stations, and an antenna crew whose job is to safely erect and take down all antennas. It's also a good idea to assign people to provide meals, and to document the event with photos and video.

4

SCHEDULE OPERATORS

All too often, Field Day stations are off the air at night because nobody is there to run them. By scheduling operator time slots, your club can maximize the number of QSOs they put in the log.

5

BONUS POINTS

Teams that score high in Field Day do it by collecting the available bonus points. Look at the list of bonus point activities in the rules (or on page 3 of this guide), then decide which challenges your club wants to do.

6

SUBMIT YOUR SCORE

It's a good idea to assign one person to collect all the log information and bonus points. Have that person submit your group's Field Day entry via the web app at **https://field-day.arrl.org/fdentry.php**. Submissions must be in by July 27, 2021.

ZEPHYR_P/ADOBE STOCK (GRASS/SKY)

Field Day Safety

Field Day is supposed to be fun, and you can help keep it that way by planning a safety-conscious operation. Here are few tips to get you thinking about a few of the many aspects of Field Day safety.

Lightning Safety

- If you hear thunder, lightning is close enough to strike you.
- No place outside is safe when thunderstorms are in the area.
- When you hear thunder, immediately move to safe shelter: a substantial building with electricity or plumbing, or an enclosed, metal-topped vehicle with the windows up.
- Stay in safe shelter for at least 30 minutes after you hear the last sound of thunder.
- Stay away from objects that conduct electricity (antennas, power lines, windmills, etc.).
- Power down your radios and generators.

Antenna Safety

- Be aware of and avoid electrical power lines.
- Don't climb towers that use temporary guys.
- Don't climb ladders being used for antenna supports.
- Erect antennas far enough away from tents so there is no possibility of the antenna and structure falling on operators inside the tent.
- Regularly inspect guy ropes and stakes throughout the weekend.

Generator and Electrical Safety

- **NEVER** move or add fuel to a running generator.
- Fuel should be stored in approved containers away from generators and ignition sources, in well-ventilated areas away from direct sunlight.
- Centrally locate the generator to keep all branches to stations equal.
- Use an earth ground at the generator and at each station.

Physical Safety

- Avoid tripping hazards. Use fluorescent safety tape to mark guy ropes, stakes, and cables.
- Secure hazardous areas with caution tape to keep people away.
- Escort visitors around your Field Day site.

Medical Safety

- Avoid overexposure to sun.
- Stay hydrated — drink plenty of water.
- Know the signs of heat exhaustion and heat stroke (https://www.cdc.gov/disasters/extremeheat/warning.html).
- Keep a First Aid kit on hand.

CHUNNAPA (CLIPBOARD)

BONUS POINTS ADD UP!

Use this Bonus Points Calculator to keep track of your Field Day Bonus Points (see Rule 7.3 for details). All bonus points require submission of proof and will be verified before being added to your score. Maximum bonus points are listed unless otherwise noted.

POINTS	ACTIVITY	AVAILABLE CLASSES
	100% Emergency Power. *100 bonus points per transmitter; max. 20 transmitters, max. 2,000 points.* Bonus stations (such as the GOTA station and satellite station) do not count toward determining the number of transmitters for the class and do not qualify for transmitter bonus points.	A, B, C, E, and F
	Media Publicity. *100 bonus points.* A copy of a press release, or a copy of the actual media publicity received (newspaper article, news website post, etc.) must be submitted to claim the points.	All
	Set Up in Public Place. *100 bonus points.*	A, B, and F
	Public Information Table. *100 bonus points.* A copy of a visitor log, copies of club handouts, or photos are sufficient evidence for claiming this bonus.	A, B, and F
	Message to ARRL Section Manager or Section Emergency Coordinator. *100 bonus points.* See Rule 7.3.5 for message format. This message is separate from the messages handled in Rule 7.3.6 and may not be claimed for bonus points under that rule.	All
	W1AW Field Day Message. *100 bonus points.* Copy, via amateur radio, the special Field Day bulletin transmitted by W1AW or K6KPH and include an accurate copy of the message with your Field Day entry.	All
	Message Handling NTS/ICS-213. *0 to 100 points maximum, calculated by taking the Number of Messages (max. 10 messages): _____ × 10 bonus points for each formal message originated, relayed, or received and delivered during the Field Day period.* Copies of each message must be included with the Field Day entry. The message under Rule 7.3.5 does not count. All messages claimed for bonus points must leave or enter the Field Day operation via amateur radio RF.	All
	A Satellite QSO. *100 bonus points.* Satellite QSOs also count for regular QSO credit. List these contacts separately on the summary sheet as a separate "band." The QSO must be between two Earth stations through a satellite. Stations are limited to one (1) completed QSO on any single channel FM satellite.	A, B, and F
	Natural Power QSOs. *100 bonus points.* Complete at least five QSOs without using power from commercial mains or petroleum-driven generator. A separate list of natural power QSOs should be submitted with your entry.	A, B, E, and F
	Site Visit by Invited Elected Official. *100 bonus points.*	All
	Site Visit by Invited Served Agency Official. *100 bonus points.* Visits from ARRL officials (SM, SEC, DEC, EC, etc.) do not qualify for this bonus.	All
	Educational Activity. *100 bonus points.*	A, D, E & F. See website for D & E rules
	Youth Participation. ❑ For Class A, C, D, E, or F groups: *20 bonus points per participant age 18 or younger that completes at least one QSO; max. 100 points.* ❑ For a one-person Class B station: *20 bonus points if the operator is age 18 or younger; max. 20 points.* ❑ For a two-person Class B station: *20 bonus points for each operator age 18 or younger; max. 40 points.*	All (see specific points per class)
	GOTA Bonus. *See Rule 7.3.13 for the bonus point breakdown.*	A and F
	Use the Field Day Entry Web App. *50 bonus points. Submit the entry using the web app at https://field-day.arrl.org/fdentry.php.*	All
	Safety Officer Bonus. *100 bonus points.* Include a statement with the supporting documentation for your entry, verifying that a designated Safety Officer completed the ARRL Field Day Safety Check List.	A
	Social Media Bonus. 100 bonus points. Promote your Field Day activation to the general public via social media (Facebook, Twitter, Instagram, etc.). Individual participants do not qualify for this bonus. Club websites do not qualify as social media. Available to all classes who welcome visitors to their operation.	All
	TOTAL BONUS POINTS CLAIMED	

Build Your Field Day Antenna

ARRL has partnered with HF Kits to bring you this easy-to-build four-band antenna kit: an end-fed half-wave (EFHW) antenna. We built it in the ARRL Lab, set it up outside, trimmed the wire for the lowest SWR, and got it on the air. Now it's your turn!

What is an EFHW?

The ARRL Antenna Book says the EFHW antenna is a half-wavelength dipole fed at one end. It has become popular with portable operators because of its mechanical simplicity. You'll construct a 49:1 impedance matching network from the kit's included parts.

Why this antenna?

Every ham can benefit from learning how to build wire antennas. The advantages of an EFHW include the ease of construction, its versatility in a variety of installation configurations (sloping, horizontal, L, etc.), and the fact that no tuner is needed. This antenna works on four bands: 10, 15, 20, and 40 meters. We chose a 250-watt rated antenna so you can comfortably transmit the full output power from many off-the-shelf HF transceivers (typically around 100 watts).

Fred Kemmerer, AB1OC, launching the End-Fed Half-Wave antenna.

"But I've never built anything!"

We've got your back. ARRL will provide you with step-by-step assembly instructions, photos, and even videos. You'll drill, fasten, and solder (a small amount). Nearly everything goes into the included weather-proof box. Admire, then deploy!

Who needs this antenna?

- New licensees — Build something, and you're no longer a licensee — you're a ham!
- New HF operators — And anyone seeking an antenna that covers the bands that will become increasingly active with Solar Cycle 25.
- Every Field Day site.
- Experts — Because you'll appreciate a quality kit, and you'll end up with a great antenna you can take anywhere (think vacation).
- Radio clubs seeking a perfect kit for your next project building night!

Specifications

- Bands: 10/15/20/40
- 250 W
- Impedance network type: 49:1 with included ferrite toroid
- This kit contains all parts to make your antenna, plus 66 feet (approx.) of strong, flexible, low-weight wire (tinned copper braid, Kevlar-core, black UV resistant PE insulated wire). Coaxial cable feed line sold separately.

Order Today!

End-Fed Half-Wave Antenna Kit available at **arrl.org/shop**.

The End-Fed Half-Wave Antenna Kit includes everything shown here.

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Tips for Satellite Success

Making one contact via satellite is a 100-point bonus for your Field Day effort. If you've never operated the ham radio satellites before, it will take effort to be successful! Here are some helpful tips.

1 Learn all you can in advance of Field Day. There's a lot to learn about the exciting world of ham radio satellites. We recommend starting with the video by Tom Schuessler, N5HYP, at www.youtube.com/watch?v=yqch-Dt9V0c&t=1501s.

2 Know your grid square. Satellite operators expect to hear your Maidenhead grid square in your exchange. This information is usually given as two letters and two numbers, and is an indicator of your location. For example, ARRL Headquarters is in grid square FN31. Learn more about grid squares at www.arrl.org/grid-squares.

3 Get the apps. Smartphone apps are available for satellite scheduling and tracking, as well as grid square location. iPhone users can try *SatSat* or *GoSatWatch* for satellites, and *Maidenhead Converter* for location. Android users can try *Satellites* or *W1ANT Pro Satellite Tracker*, and *Grid Square Locator.*

4 Practice before Field Day! Practice scheduling a satellite pass, tracking the satellite during the pass, and copying stations. Once you've done that, try to make contacts on subsequent passes. Try late-night passes, as the satellite will not be busy and you can experiment.

5 Wear headphones. If you are using a full duplex radio (which you should), you'll need headphones to keep feedback out of the microphone. They will also help you stay focused if your Field Day site is busy with other activities.

6 Don't transmit if you can't hear the satellite. The satellite may be hearing much better than you! Transmitting "in the blind" may cause interference to other stations trying to make a contact.

7 Find open space. When trying to make your contact, stay clear of buildings, trees, and other obstructions, if possible. Ideally, put yourself somewhere where you can see from horizon to horizon. If that's not possible, find a spot where you can see as much of the sky as possible.

8 Move on once you've made your contact. There will be many stations trying to get their one contact too, so don't get in the way.

ACTIVE FM SATELLITES

SO-50: 2 meters up/70 centimeters down, 67 Hz CTCSS tone.

AO-27: 2 meters up/70 centimeters down, no tone. Each pass is only 4 minutes long!

PO-101: 70 centimeters up/2 meters down, 141.3 Hz CTCSS tone. Turned on by a schedule, which is posted at http://phl-microsat.upd.edu.ph/diwata2.

ISS: The cross-band repeater on the International Space Station (ISS) may be active on Field Day. 2 meters up/70 centimeters down, 67 Hz tone.

CAS-7A (expected launch May 2021)

CAS-7C (expected launch May 2021)

CAS-5A (expected launch June 2021)

3DSCULPTOR/ADBOE STOCK (SATELLITE)

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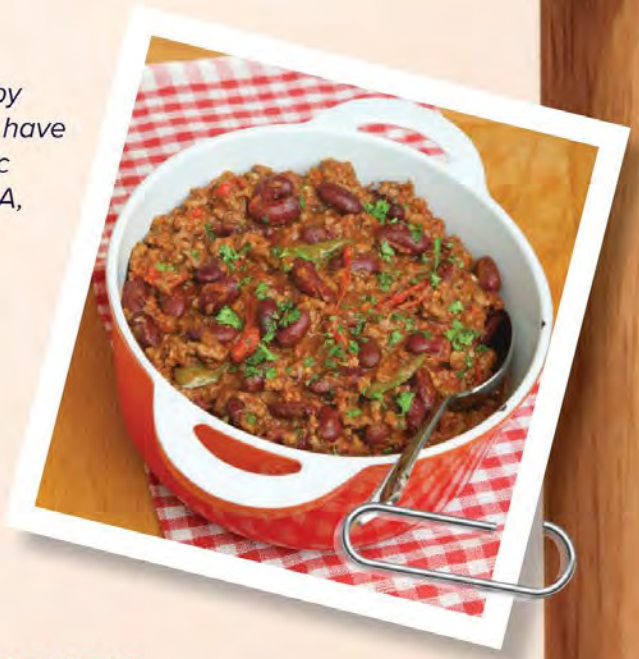
Uncle Grant's Field Day Chili

It's easy to feed the whole hungry Field Day crew by simmering up a satisfying pot of chili. Whether you have 8877s running hot or 807s freezing cold, this classic chili recipe from ARRL CEO David Minster's, NA2AA, Uncle Grant will get the bands hopping for sure!



INGREDIENTS

- **1.5 pounds ground beef (80% lean)**
- **1 medium onion, diced**
- **1 green bell pepper, diced**
- **1 tablespoon vegetable oil**
- **1 28-oz. can whole tomatoes, stems removed, diced**
- **2 8-oz. cans tomato sauce**
- **3 tablespoons ARRL's Field Day Chili Seasoning or chili powder (add more to taste)**
- **1 teaspoon salt**
- **½ teaspoon cayenne pepper**
- **1 tablespoon dark brown sugar**
- **2 14-oz. can red kidney beans, rinsed and drained**

OPTIONAL

- **1 jalapeño, seeded and minced (to make your chili medium spicy)**
  OR
- **1 teaspoon habanero hot sauce (to make your chili very spicy)**

SUGGESTED TOPPINGS

Shredded cheddar cheese
Sour cream
Sliced jalapeños
Avocado slices or guacamole
Lime wedges

INSTRUCTIONS

1. Place the oil in a large pot over medium heat, and cook the onions and green peppers (and jalapeño, if using) until soft. Remove vegetables from the pot and set aside.
2. Brown the ground beef in the pot. Depending on how much fat has rendered, drain excess fat from the pot.
3. Add the onions and peppers, the diced whole tomatoes, and the tomato sauce. Stir well and allow the chili to get hot.
4. Add the salt, pepper, and brown sugar (and habanero hot sauce, if using).
5. Stir in the cans of kidney beans.
6. Completely cover the surface of the chili with Field Day Chili Seasoning or chili powder. Stir in completely. Add more seasoning to taste.
7. Reduce heat to low. Allow the chili to cook at least 4 hours, stirring occasionally.
8. Serve in a bowl with shredded cheese or on a grilled hot dog. Enjoy!

MAGLARA/ISTOCK (KITCHEN); JOE GOUGH/ISTOCK (CHILI); KVECTOR/ADOBESTOCK (PAPERCLIP)

FIELD DAY 2021

JUNE 26–27

10,213

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2021 FIELD DAY

ARRL/RAC Section Checklist

UNITED STATES

- ❑ ALABAMA · AL
- ❑ ALASKA · AK
- ❑ ARIZONA · AZ
- ❑ ARKANSAS · AR

CALIFORNIA

- ❑ EAST BAY CA · EB
- ❑ LOS ANGELES CA · LAX
- ❑ ORANGE CA · ORG
- ❑ SACRAMENTO VLY CA · SV
- ❑ SAN DIEGO CA ·SDG
- ❑ SAN FRANCISCO CA · SF
- ❑ SAN JOAQUIN VLY CA · SJV
- ❑ SANTA BARBARA CA · SB
- ❑ SANTA CLARA VLY CA · SCV

- ❑ COLORADO · CO
- ❑ CONNECTICUT · CT
- ❑ DELAWARE · DE

FLORIDA

- ❑ SOUTHERN FL · SFL
- ❑ NORTHERN FL · NFL
- ❑ WEST CENTRAL FL · WCF

- ❑ GEORGIA · GA
- ❑ HAWAII/PACIFIC · PAC
- ❑ IDAHO · ID
- ❑ ILLINOIS · IL
- ❑ INDIANA · IN
- ❑ IOWA · IA
- ❑ KANSAS · KS
- ❑ KENTUCKY · KY
- ❑ LOUISIANA · LA
- ❑ MAINE · ME
- ❑ MARYLAND/DC · MDC

MASSACHUSETTS

- ❑ EASTERN MA · EMA
- ❑ WESTERN MA · WMA

- ❑ MICHIGAN · MI
- ❑ MINNESOTA · MN
- ❑ MISSISSIPPI · MS
- ❑ MISSOURI · MO
- ❑ MONTANA · MT
- ❑ NEBRASKA · NE
- ❑ NEVADA · NV
- ❑ NEW HAMPSHIRE · NH

NEW JERSEY

- ❑ NORTHERN NJ · NNJ
- ❑ SOUTHERN NJ · SNJ

- ❑ NEW MEXICO · NM

NEW YORK

- ❑ EASTERN NY · ENY
- ❑ NORTHERN NY · NNY
- ❑ WESTERN NY · WNY
- ❑ NYC/LONG ISLAND · NLI

- ❑ NORTH CAROLINA · NC
- ❑ NORTH DAKOTA · ND
- ❑ OHIO · OH
- ❑ OKLAHOMA · OK
- ❑ OREGON · OR

PENNSYLVANIA

- ❑ EASTERN PA · EPA
- ❑ WESTERN PA · WPA

- ❑ PUERTO RICO · PR
- ❑ RHODE ISLAND · RI
- ❑ SOUTH CAROLINA · SC
- ❑ SOUTH DAKOTA · SD
- ❑ TENNESSEE · TN

TEXAS

- ❑ NORTH TX · NTX
- ❑ SOUTH TX · STX
- ❑ WEST TX · WTX

- ❑ US VIRGIN ISLANDS · VI
- ❑ UTAH · UT
- ❑ VERMONT · VT
- ❑ VIRGINIA · VA

WASHINGTON

- ❑ EASTERN WA · EWA
- ❑ WESTERN WA · WWA

- ❑ WEST VIRGINIA · WV
- ❑ WISCONSIN · WI
- ❑ WYOMING · WY

CANADA

- ❑ ALBERTA · AB
- ❑ BRITISH COLUMBIA · BC
- ❑ GREATER TORONTO AREA · GTA
- ❑ MANITOBA · MB
- ❑ MARITIME · MAR
- ❑ NEWFOUNDLAND/LABRADOR · NL
- ❑ NORTHERN TERRITORIES · NT
- ❑ ONTARIO EAST · ONE
- ❑ ONTARIO NORTH · ONN
- ❑ ONTARIO SOUTH · ONS
- ❑ PRINCE EDWARD ISLAND · PE
- ❑ QUEBEC · QC
- ❑ SASKATCHEWAN · SK

Due to his stroke, George had a noticeable time delay between hearing someone call CQ and taking action, as his information processing was slower. But after a little time, he repeated his call until he received a response. I pointed to the line on the script for what to do next: send his report. He sent, "1C Iowa," and at 1420Z, I logged George's first post-stroke contact.

George was getting his rhythm back. After 10 contacts, I put a 40-meter antenna on the magnetic mount and George worked eight more stations in 15 minutes. He even taught his CNA how to make a contact. At 11 AM, we switched back to 20 meters and George made four more contacts. His total 2018 ARRL Field Day score was 22 contacts, 294 points (when bonus points were added), and 2 hours of operation. He was glad to be back.

One Year Later

The 2019 ARRL Field Day was different for George. Although George was still at the healthcare facility, Chuck Brudtkuhl, WAØROI, had been installing a remote operating system from George's room, with the objective of eventually connecting it by internet to George's transmitter and antenna in St. Croix. Initially, it was set up to use Chuck's antenna. George reserved a lounge area in the building near his room to allow space for more operators and to provide visibility of the hobby for his fellow residents.

We planned to operate on Saturday, June 22. Chuck moved the transceiver control head, interface, and laptop for the logging program from George's room to the lounge and plugged into the electric and internet outlets. However, shortly before the 1 PM start time, medical staff notified us that George wasn't feeling well. Chuck and I decided to begin operations anyway and asked the staff to report back to us if his condition improved.

Eventually, George felt well enough for some microphone time with logging assistance from the group (which now also included Elizabeth Cowley, KDØKQX). Operations and demonstrations to residents continued for 2 hours, and we agreed to meet again the next morning for more.

On Sunday morning, our internet connectivity had become spotty, which was not very conducive to making rapid contacts. All connections appeared to be tight and there were no controllable variables that we could find. After five difficult contacts, Field Day 2019 ended for NP2N/WØ at 194 contacts (for a net of 161 after other Class D contacts were eliminated) and 376 total points. Human frailty and internet reliability aside,

Elizabeth Cowley, KDØKQX, and George Oster, NP2N/WØ, operating Class D at George's healthcare facility during the 2019 ARRL Field Day.

George's condition had definitely improved since the year before.

Lessons Learned

Field Day provided plenty of hams to contact and was done in a more relaxed environment than in contest pileups. For George and others rebounding from medical conditions, Field Day can be more helpful than a contest. I observed that George's response times (and smoothly receiving and sending the scripted exchange) were faster after just a few hours. Additionally, his comprehension and confidence in handling these basic communication steps were stronger after 2 years, and contributed to increasing his overall abilities, especially motor control. George's improved outlook led him to move (during Field Day 2020) to a facility that offered more flexibility and independence as he continued therapy.

For those in a position of helping other amateurs recuperate after major setbacks, here are some lessons I learned:

1. Have someone log for the recuperating ham.
2. Provide a voice-operated exchange (VOX) control with a headset or mic stand.
3. Do a test run prior to Field Day.

C. K. "Skip" Walter, AD0H, retired in 2010 as Professor Emeritus of Supply Chain Management at Iowa State University. He has a BS in electrical engineering from Case Institute of Technology, an ME from Penn State University, and an MBA and PhD from Ohio State University. Skip was first licensed in 1957, as KN8IBP. Other call signs that he's held include K8IBP, WØOYW, and G5CUF. He lives in Ames, Iowa, with his miniature dachshund, Romeo.

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

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Rick Lindquist, WW1ME, ww1me@arrl.org

Updated Radio Frequency Exposure Rules in Effect

Amateur radio licensees will have to determine whether any existing facilities previously excluded under the old rules now qualify for an exemption under the new rules. Most will, but some may not.

Rule changes detailed in a lengthy 2019 *Report and Order* governing RF exposure standards went into effect on May 3, 2021. The new rules do not change existing RF exposure (RFE) limits but do require that stations in all services, including amateur radio, be evaluated against existing limits, unless they are exempted. For stations already in place, that evaluation must be completed by May 3, 2023. After May 3 of this year, any new station, or any existing station modified in a way that's likely to change its RFE profile — such as different antennas or placement or greater power — will need to conduct an evaluation by the date of activation or change.

"In the RF *Report and Order*, the Commission anticipated that few parties would have to conduct reevaluations under the new rules and that such evaluations will be relatively straightforward," the FCC said in an April 2 *Public Notice*. "It nevertheless adopted a 2-year period for parties to verify and ensure compliance under the new rules."

The Amateur Service is no longer categorically excluded from certain aspects of the rules, as amended, and licensees can no longer avoid performing an exposure assessment simply because they are transmitting below a given power level.

"For most amateurs, the major difference is the removal of the categorical exclusion for amateur radio, which means that ham station owners must determine if they either qualify for an exemption or must perform a routine environmental evaluation," said Greg Lapin, N9GL, chair of the ARRL RF Safety Committee and a member of the FCC Technological Advisory Council (TAC).

"Ham stations previously excluded from performing environmental evaluations will have until May 3, 2023, to perform these. After May 3, 2021, any new stations or those modified in a way that affects RF exposure must comply before being put into service," Lapin said.

The December 2019 RF *Report and Order* changes the methods that many radio services use to determine and achieve compliance with FCC limits on human exposure to RF electromagnetic fields. The FCC also modified the process for determining whether a particular device or deployment is exempt from a more thorough analysis by replacing a service-specific list of transmitters, facilities, and operations for which evaluation is required with new streamlined formula-based criteria. In addition, the *R&O* addressed how to perform evaluations where the exemption does not apply, and how to mitigate exposure.

Amateur radio licensees will have to determine whether any existing facilities previously excluded under the old rules now qualify for an exemption under the new rules. Most will, but some may not.

The ARRL Laboratory staff is available to help amateurs to make these determinations and, if needed, perform the necessary calculations to ensure their stations comply.

FCC Agrees with ARRL and Allows Partial Reprieve on 3.5 GHz

Pending future FCC action, amateur radio secondary use of the 3.3 – 3.45 GHz band segment may continue indefinitely. The FCC, as part of a lengthy *Second Report and Order* (*R&O*) for commercial licensing of 3.45 – 3.55 GHz adopted on March 17, agreed with ARRL that continued access by amateur radio to 3.3 – 3.45 GHz should be allowed until consideration of the 3.1 – 3.45 GHz spectrum in a later proceeding. The FCC action in WT Docket 19-348 represents a partial — and temporary — reprieve from the FCC's December 2019 proposal to remove amateur radio from the entire band, and it makes available an additional 50 MHz than an FCC proposal last fall to allow amateur temporary use of 3.3 – 3.4 GHz.

Amateur secondary operation in the 3.45 – 3.50 GHz band must cease 90 days after public notice that the spectrum auction has closed and licensing has begun. That is expected to happen early in 2022. The FCC opened the auction of 3.45 – 3.55 GHz to commercial 5G interests on March 17.

The FCC adjusted its proposal to bifurcate the band and set 3450 MHz as the frequency at which it will be split. This allows amateur operations to continue in the lower portion of the band while the FCC and federal government users continue to analyze whether that spectrum can be reallocated for flexible use.

"There is no expectation that such operations will be accommodated in future planning for commercial wireless operations in this spectrum, or that amateur operators will receive more than a short period of notice before their operations must cease," the FCC said.

Cooperative Effort Under Way to Resolve Potential 70-Centimeter Interference Issue

ARRL, the FCC, and the US Department of Defense are cooperating in an effort to eliminate the possibility of amateur radio interference on 70 centimeters to a future missile control system at White Sands Missile Range (WSMR) in New Mexico. The Defense Department's Regional Spectrum Coordinator contacted the FCC in March, seeking information on whom to contact regarding amateur transmissions operational on 70-centimeter frequencies slotted for use on the new control system. The FCC, in turn, asked ARRL to oversee the coordination efforts. It is to be noted that the Amateur Radio Service is a secondary service on the band.

Investigation revealed that the potential problem was not with individual operators or repeaters, but with RF control links at 420 – 430 MHz used to establish a linked repeater system within New Mexico. "Based on the investigation, and with the support of the FCC, the owners of the RF control links being used in the 420 – 430 MHz portion of the amateur allocation within a certain proximity to WSMR are being asked to re-coordinate the link frequency to a new one above 430 MHz," explained ARRL Regulatory Information Manager Dan Henderson, N1ND.

ARRL enlisted the assistance of the state's designated repeater frequency coordinator for information on specific links in that part of the band. New Mexico Repeater Frequency Coordinator Bill Kauffman, W5YEJ, agreed to work with the control link operators to find new frequencies that will meet the needs of the link operators.

"Time is a factor in this request," Henderson said. "The new WSMR systems are in advanced testing and will become fully operational by early summer 2021." The negotiated deadline for the affected control links to change frequencies was set for May 31, 2021.

Letters have gone out to 32 affected RF control link operators to advise them of the DoD's request. Links unable to be relocated by May 31 will have to be shut down until the situation can be resolved. Henderson said the changes should have no direct impact on the use of any local repeater, but certain links may be temporarily inoperative.

FT8 Accounts for Nearly Two-Thirds of HF Activity

Since zooming to prominence after its debut in mid-2017, the FT8 digital protocol has become the mode of choice for some 60% of HF operators, according to Club Log's latest activity report, compiled by Michael Wells, G7VJR. FT8 is one of the protocols in the *WSJT-X* suite of programs. Wells says FT8 activity level sits at nearly 85% on 6 meters. The dramatic FT8 upswing has come at the expense of other modes. Over the same period, the number of FT8 contacts logged each year per active call sign has continued to climb to about 60% between 2015 and 2021, with the most dramatic increase being nearly 29% in the past year. FT8 occupies vastly less spectrum than the more traditional ham radio operating modes.

The FT8 protocol in the *WSJT-X* suite of programs.

FCC Not Yet Collecting $35 Application Fee

The majority of the FCC's revised Part 97 rules (adopted in December 2020) establishing new application fees become effective on April 19, but the new amateur radio application fees likely will not become effective until summer. The FCC announced on March 19 that the amateur radio application fees, including those associated with Form 605 filings, would not become effective until the "requisite notice has been provided to Congress, the FCC's information technology systems and internal procedures have been updated, and the Commission publishes notice(s) in the *Federal Register* announcing the effective date of such rules."

The $35 fee, when it becomes effective, would apply to new, modification (upgrade and sequential call sign change), renewal, and vanity call sign applications, as well as applications for a special temporary authority (STA) or a rule waiver. All fees will be per application. Administrative updates — such as a change of mailing address, email address, or name — are exempt.

ARRL Volunteer Examiner Coordinator (VEC) Manager Maria Somma, AB1FM, said VECs and Volunteer Examiner (VE) teams will not have to collect the $35 fee at exam sessions, once it takes effect. New and upgrade applicants will pay the $15 exam session fee to the VE team as usual, and pay the $35 application fee directly to the FCC via the Fee Filer System or License Manager System.

Oklahoma SM Kevin O'Dell, NØIRW, Stepping Down; Mark Kleine, N5HZR, Appointed as OK SM

Kevin O'Dell, NØIRW, Oklahoma's long-serving Section Manager (SM) — serving two terms from 2010 to 2014 and again serving since 2016 — has decided to step down effective April 9, 2021. Although he is stepping down as Oklahoma SM, O'Dell will continue to serve amateur radio and ARRL as a member of ARRL's Public Relations Committee. Prior to becoming SM, O'Dell served as both a Public Information Officer and as the Public Information Coordinator for the Oklahoma Section for many years.

Mark P. Kleine, N5HZR, a resident of Norman, Oklahoma, has been appointed to replace O'Dell as Oklahoma Section Manager effective April 9, and will serve out the balance of O'Dell's term, which extends to September 30, 2022.

Kleine has been a very active member of the Oklahoma amateur radio community for many years, currently serving as an Oklahoma Assistant Section Manager, a leader of the South Canadian Amateur Radio Society (SCARS), and as President of the Central Oklahoma Radio Amateurs (CORA), a group of nine amateur radio clubs that host the Oklahoma City Hamfest "Ham Holiday." An ARRL Life Member, Kleine is also an amateur radio license class instructor and Volunteer Examiner for three different Volunteer Examiner Coordinators.

Oklahoma Section Manager Mark P. Kleine, N5HZR

ARRL Radiosport and Field Services Manager Bart Jahnke, W9JJ, made the appointment based on the recommendations of ARRL West Gulf Division Director John Robert Stratton, N5AUS; O'Dell, NØIRW; West Gulf Vice Director Lee Cooper, W5LHC, and leaders of the Oklahoma Section.

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.

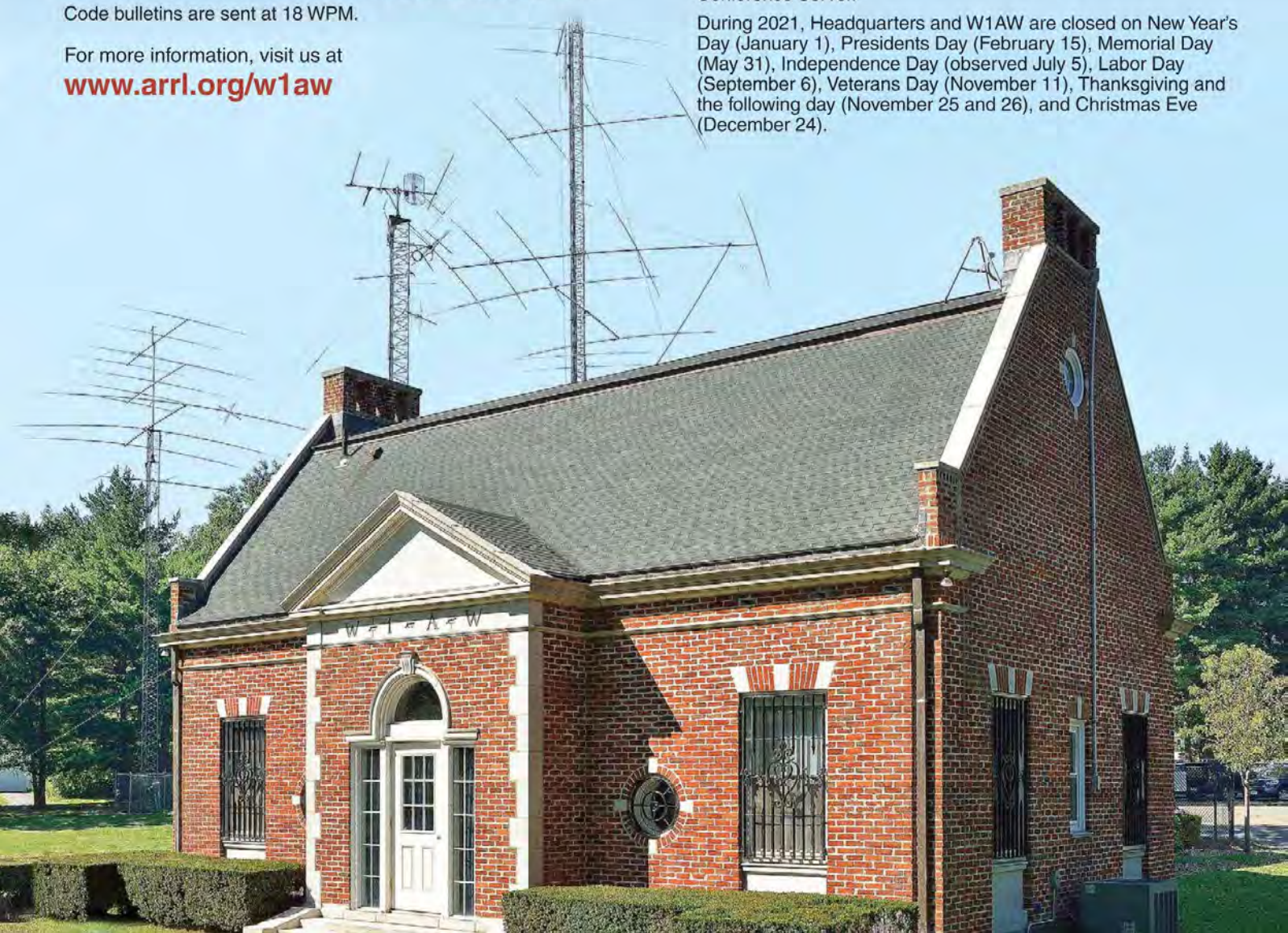
Keplerian elements for many amateur satellites will be sent on the regular digital frequencies on Tuesdays and Fridays at 6:30 PM Eastern time using Baudot and PSK31.

♦ 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).



Rick Palm, K1CE, k1ce@arrl.net

Public Service

The Florida "Whirlwind Boom" Communications Exercise

I registered for and played a small part in the March 29, 2021 "Whirlwind Boom" exercise. This emergency communication training drill was compliant with the Homeland Security Exercise and Evaluation Program (HSEEP), and involved multiple volunteer and professional response organizations. The mock scenario was a severe weather event complicated by terrorist action. The exercise, sponsored by Florida Baptist Disaster Relief, drew interest in the southeastern US and beyond.

Primary direction came from Gordon Gibby, KX4Z, who has previously conducted successful full-deployment exercises and training workshops. The host, ARRL Northern Florida Section Emergency Coordinator Karl Martin, K4HBN, briefed Amateur Radio Emergency Service® (ARES) coordinators. Other key officials included emergency management agency (EMA) managers from several northern Florida counties and Homestead, Florida; Robert Little of the Florida Division of Emergency Management, and Doug Lynch, who helped promote the new SHAred RESources (SHARES) HF Radio program (visit **www.cisa.gov/shared-resources-shares-high-frequency-hf-radio-program** for more information). Ross Merlin, WA2WDT, Director of SHARES, also offered support.

Levels and Objectives

At the neighborhood level, radio amateurs forwarded simulated structured shelter status reports to a local net. Aggregated at their county emergency operations center (EOC), the reports then headed to a state data input port. Hams also moved survivor messages out of the disaster zone. These functions would manifest in an actual hurricane disaster situation.

Among the seven specific objectives, these three held the primary focus:

1 Antenna Deployment

Each team needed to deploy backup antennas within 30 minutes of a declared antenna failure, which was an exercise "inject."

2 Emergency Power

Teams needed to switch to backup power within 30 minutes of a declared power outage, another exercise inject.

3 Voice/Data Net Structure

This needed to be modified quickly, as simulated conditions were changed by the injects.

Greg Lueck, KN4VJL, a Florida Baptist Disaster Relief volunteer, participated in the "Whirlwind Boom" exercise. [Gordon Gibby, KX4Z, photo]

All objectives fell under Mass Care Services or Operational Communications, which are two Federal Emergency Management Agency (FEMA) core capabilities served by amateur radio communicators, as well as others.

An Amateur Resource Net accepted incoming amateur radio volunteers not associated with a specific team, provided briefings, and made assignments. Unconnected volunteers, sometimes known as *spontaneous volunteers* (such as myself), were specifically welcomed in this exercise. An Amateur Command Net coordinated amateur radio teams and maintained interoperability communications with the SHARES-based Command Net via the 60-meter interoperability channels open to radio amateurs on a shared, secondary basis.

A Florida County ARES Team Success

The Madison County EMA and ARES worked together to establish command and control when the EOC was unavailable due to local simulated disaster area conditions. EMA and ARES personnel determined functionality, paths, and ranges of local public safety and amateur repeaters, as well as public safety and amateur simplex frequencies. Interoperability between Madison County EMA and ARES was preserved and resulted in an unbreakable line of communication through which all emergency management traffic was passed.

My Volunteer Experience

As a local operator outside the disaster area who wasn't associated with a team, my assignment was to

receive messages and enter them into the internet email system for the affected counties, relay survivor messages, and send a simulated-situation report to my county EOC. Instead of sending the report to the county EOC, I mistakenly sent it to the state EOC. I was supposed to send it by voice or VHF Winlink to the Alachua County EOC group, which was tasked with receiving messages from individual volunteers, aggregating them, and sending structured reports to the state EOC. I also should have checked into the Amateur Resource Net, which might have prevented my mistake. However, this is why we have drills: to practice.

Although I sent the report to the wrong place, I had success with Winlink. Thanks to experience gained in previous exercises (including the ARES and American Red Cross weekly messaging exercise — Winlink Thursday — and nationwide drills), I was able to quickly bring up my *Winlink Express* software, start a new message, select and complete the SHARES-developed spot report template, and use the high-speed VARA HF mode to send it to an out-of-disaster area Radio Mail Server (RMS) on 40 meters for introduction into the internet email system.

I learned that the importance of these kinds of drills was to practice for when a real incident occurs, so trained operators can be ready. I also learned that the Winlink system works in such incidents by means of data transfer among peers inside the disaster area with modes such as traditional packet (or newer VARA FM), as well as the transfer of messages out of the disaster area via HF.

After-Action Report

"Whirlwind Boom" was a large HSEEP-compliant exercise with about 85 people involved, and at least 431 messages passed (not counting the tactical messages). A comprehensive improvement plan was part of the after-action report.

An example of an area for improvement under the Antenna Deployment objective was excessive noise reported from various counties and stations — most likely local noise. The corrective action stated, "Affected counties to study noise sources and reduce noise or find alternative antennas. Utilize better low-noise techniques."

Under Communications Planning, it was noted that there was "difficulty finding volunteer HF voice net controls." The corrective action suggested that section leadership receive training for HF voice net control stations.

The *After-Action Report & Improvement Plan* is now available at **https://qsl.net/nf4rc/FBDR/2021/WhirlwindBoomAARIP.pdf**. The document covers objectives, standards, results, comments from participants, evaluations, summarized tasks that were done well or need adjustments, and ideas for improvement. The report also covers the design, promotion, and execution of the exercise to help future similar HSEEP exercise planners.

Principal exercise architect Gordon Gibby, KX4Z, thanked team members. He said, "Without your hard work, enthusiasm, and willingness to jump in and try, the exercise would not have fulfilled its potential. I'm hoping many other local and state leaders will apply this exercise's principles to their own local areas, spurring the development of stronger volunteer resources and relationships with the professional public safety communities."

Field Organization Reports

March 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**.

614
WA7PTM
475
N9VC
WA3EZN
465
W7PAT
367
KE8BYC
327
WA2CCN
285
ND8W
290
W9GRG
270
KE8KOC
266
KK6GXG
254
KB5PGY
250
KT2D
225
W0PZD
220
KB8RCR
215
K8RDN
210
KM8V
KW9EMG
200
KD2NMG
N5MKY
191
AD8CM
175
AI9F
173
K7OED
161
N2WGF
160
W2PH
K8AMH
KF5OMH
AL0Y
159
KB1TCE
157
AC8NP
155
AB8MW
150
W7EES
W8MAL
WA2BSS
K0RCJ
W4DNA
148
KC8YVF
147
WM2C
145
WO2H
W3EDN
WM5N
140
AC0KQ
KD2LPM
K4IWW
WB9QPM
136
KB3YRU
135
N4CNX
132
N8SY
KD8ZCM
130
N2JBA
N1LL
WD4WC
KW1U
125
KD0HHN
AG9G
K9ILG
K9LGU
WB9WKO
WD8USA
124
KY2MMM
123
W8IM
120
WC4FSU
KC5FXE
WA3QLW
K2TV
K3JL
AD3J
KA9QWC
W0LAW
KE5YTA
KF5IOU
KG5NNA
KY2D
WA4VGZ
117
KF5IVJ
115
W4CMH
WB4RJW
KD2GRS
N1TF
111
K8MDA
110
KC8WH
WB8YLO
K1HEJ
N2DW
KA5AZK
KB2QO
KB8PGW
K8BKM
K8ED
KI7TIG
K6HTN
KA9MZJ
N1IQI
KD2JKV
W1RVY
109
WA1URS
105
W2PAX
W9EEU
AA3N
102
WB8TQZ
101
N0UMP
100
W1KX
KZ8Q
KN9P
NX9K
AC8RV
WB8SIQ
K3RC
WB6UZX
KB1NMO
W3CJD
KB2YAA
K2MZ
97
AD4DO
KT5SR
95
K1XFC
KA9IKK
94
KD2IWN
92
W4TTO
91
W7PHX
90
KM4WHO
AA4XZ
KB9GO
K0WAV
N2LC
K8KRA
KB8HJJ
KA1G
KL7RF
N8MRS
KD2GXL
WX2DX
AB9ZA
N4ZM
KI5GRH
K2MJF
KA2HZP
W2AH
WB8WKQ
K2EAG
N6IET
KC1KVY
WA1LPM
KC1MSN
89
KE8DON
KC1HHO
87
KE4DRF
86
WB8YYS
K6JT
85
K1STM
N3RB
82
KA2GQQ
81
W9BGJ
80
AJ7B
KR4ST
KF0BPN
KD8UOT
KB1NAL
KF7GC
KG7QWR
KJ7BHO
79
W8GSR
WB8R
78
N8CJS
WB2VUF
76
W2ARP
KV8Z
KD8UUB
N2TSO
75
K4FHR
74
KC1FLU
KB0DTI
72
KD8KBX
NV1N
71
K6RAU
KN4AAG
70
KA2JFU
KC2RTE
K7ASA
N5PK
WB6YJJ

The following stations qualified for PSHR in previous months, but were not reported in this column. (Feb.) WA5LEE 181, WM5N 128, KB5PGY 119, N5TCB 115, KT5SR 112, KE4DRF 92, KA9IKK 89. (Jan.) KE4DRF 112, KB5PGY 99, KA9IKK, WM5N 95.

Additional February 2021 PSHR Honorees

The following radio amateurs achieved PSHR during February 2021 and were reported properly. Because of an error, these reports were not listed in the May issue of *QST*, and we apologize.

264 WA2CCN; **240** KT2D; **213** WM2C; **210** KD2NMG; **160** K8AHH; **150** KI5GRH, KF5OMH, AL0Y, WO2H; **147** WA2BSS; **140** KK3F; **135** W3YVQ; **134** KY2MMM; **130** KG5NNA, N2JBA, KW1U; **120** KE5YTA, KY2D; **115** N1TF; **110** KA5AZK, KF5IOU, W3GWM, N3SW, AF4NC, KB2QO, N1IQI, W1RVY, K3IN; **104** K2MZ; **102** NI2W; **101** AB3WG; **100** W3CJD, N1LAH, KC1HHO, AA3SB; **90** KA2HZP, W2AH, KC1KVY, WA1LPM; **88** KA2GQQ, KC1MSN; **83** KA0DBK; **81** K6JT; **80** N3XMB, K2MJF, KD2JKV; **77** N3RB; **76** N2TSO; **74** W3ZR; **73** KE1ML, NV1N; **72** KC1OIP; **71** WB2VUF.

Section Traffic Manager Reports

The following Section Traffic Managers reported: AK, AR, AZ, CO, CT, DE, EB, EMA, ENY, IL, IN, KS, LA, LAX, MDC, ME, MI, MN, MO, MT, NC, ND, NFL, NLI, NM, NNJ, NTX, NV, OH, OR, SFL, SJV, STX, TN, WCF, WI, WMA, WNY, WPA, WTX, WV, WWA, WY.

Section Emergency Coordinator Reports

The following Section Emergency Coordinators reported: AR, ENY, EPA, KY, MDC, ME, MI, MO, MS, ND, NLI, NM, NNJ, NNY, NV, OH, PAC, SCV, SFL, SJV, SNJ, STX, UT, VI, WCF, WPA, WY.

Brass Pounders League

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

KY2D 1,705, K6HTN 1,687, NX9K 1,671, N9CK 980, WB9WKO 866, KW1U 570, N1IQI 533.

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

Contest Corral

June 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				Bands	Contest Name	Mode	Exchange	Sponsor's Website
Date	Time	Date	Time					
1	0100	1	0159	1.8-50	Worldwide Sideband Activity Contest	Ph	RS, age group (OM, YL, or youth)	wwsac.com/rules.html
1	1700	1	1900	3.5-14	RTTYops Weeksprint	Dig	Other's call, your call, serial, name	rttyops.wordpress.com
2	1300	2	1400	1.8-28	CWops Mini-CWT Test	CW	Name, mbr or SPC	cwops.org/cwops-tests
2	1700	2	2000	144	VHF-UHF FT8 Activity Contest	Dig	4-char grid square	ft8activity.eu/index.php/en
2	1900	2	2000	1.8-28	CWops Mini-CWT Test	CW	Name, mbr or SPC	cwops.org/cwops-tests
3	0300	3	0400	1.8-28	CWops Mini-CWT Test	CW	Name, mbr or SPC	cwops.org/cwops-tests
3	1700	3	2100	28	NRAU 10-Meter Activity Contest	CW Ph Dig	RS(T), 6-char grid square	nrrlcontest.no
3	1900	3	2100	1.8-50	SKCC Sprint Europe	CW	RST, SPC, name, mbr or "none"	www.skccgroup.com
4	0000	6	2359	1.8-50	PODXS 070 Club 3-Day Weekend Test	Dig	Name, RST, SPC	www.podxs070.com
4	0145	4	0215	1.8-21	NCCC RTTY Sprint	Dig	Serial, name, QTH	www.ncccsprint.com
4	0230	4	0300	1.8-21	NCCC Sprint	CW	Serial, name, QTH	www.ncccsprint.com
4	2000	4	2100	1.8-14	K1USN Slow Speed Test	CW	20 WPM max. Name, SPC	k1usn.com/sst.html
5	0000	5	2359	3.5-28	VK Shires Contest	CW Ph	RS(T), VK Shire or CQ zone	wia.org.au/members/contests
5	0000	6	2359	28	10-10 International Open Season PSK Contest	Dig	Name, SPC, mbr	www.ten-ten.org
5	0400	6	2000	3.5-28	DigiFest	Dig	RST, 4-char grid square	rigexpert.com/digifest
5	0600	5	0800	7, 14	Wake-Up! QRP Sprint	CW	RST, serial, suffix of previous QSO	qrp.ru/contest/wakeup
5	0600	6	0600	1.8-UHF	KANHAM Contest	CW Ph	RST, prefecture (if JA)	jarl.gr.jp/kanhamcontest/en
5	1200	6	1159	1.8-28	Tisza Cup CW Contest	CW	RST, CQ zone	tiszacup.eu/index.php/en
5	1300	6	1300	50	UKSMG Summer Contest	CW Ph	RST, serial, 6-char grid	uksmg.org
5	1400	6	0200	1.8-144	Kentucky QSO Party	CW Ph Dig	RS(T), KY county or SPC	www.kyqsoparty.org/rules
5	1500	6	1500	1.8-28	RSGB National Field Day	CW	RST, serial	www.rsgbcc.org/hf
6	1700	6	2200	All	Cookie Crumble QRP Contest	CW Ph Dig	RS(T), SPC, cookie #, name	w3atb.com/cookie-crumble
7	1900	7	2030	3.5	RSGB 80-Meter Club Championship, Data	Dig	RST, serial	www.rsgbcc.org/hf
8	0100	8	0300	3.5-28	ARS Spartan Sprint	CW	RST, SPC, power	arsqrp.blogspot.com
9	0030	9	0230	3.5-14	NAQCC CW Sprint	CW	RST, SPC, mbr or power	naqcc.info
9	1700	9	2000	432	VHF-UHF FT8 Activity Contest	Dig	4-char grid square	ft8activity.eu/index.php/en
12	0000	13	1559	3.5-28	DRCG WW RTTY Contest	Dig	RST, CQ zone	www.drcg.de/drcgww
12	0000	13	2359	50	SMIRK Contest	CW Ph	4-char grid square, mbr	smirk.org/contest.html
12	1100	12	1300	14, 21	Asia-Pacific Sprint, SSB	Ph	RS, serial	jsfc.org/apsprint/aprule.txt
12	1200	13	1200	3.5-28	Portugal Day Contest	CW Ph	RS(T), CT district or serial	portugaldaycontest.rep.pt
12	1200	13	2359	1.8-50	SKCC Weekend Sprintathon	CW	RST, SPC, name, mbr or "none"	www.skccgroup.com
12	1400	12	1800	144, 432	AGCW VHF/UHF Contest	CW	RST, serial, power, 6-char grid	alt.agcw.de/index.php/en
12	1500	13	1500	3.5-28	GACW WWSA CW DX Contest	CW	RST, CQ zone	contest.com.ar/gacw-wwsa
12	1600	13	1600	50	REF DDFM 6-Meter Contest	CW Ph	RS(T), serial, 4-char grid	concours.r-e-f.org
12	1800	14	0259	50 and up	ARRL June VHF Contest	CW Ph Dig	4-char grid square	www.arrl.org/june-vhf
14	0000	14	0200	1.8-28	4 States QRP Group 2nd Sunday Sprint	CW Ph	RS(T), SPC, mbr or power	www.4sqrp.com
16	0030	16	0230	3.5-14	NAQCC CW Sprint	CW	RST, SPC, mbr or power	naqcc.info
16	1200	16	1400	7	SARL Youth Sprint	Ph	RS, age	www.sarl.org.za
16	1900	16	2030	3.5	RSGB 80-Meter Club Championship, CW	CW	RST, serial	www.rsgbcc.org/hf
19	0000	20	2359	1.8-28	All Asian DX Contest, CW	CW	RST, age	www.jarl.org/English
19	1200	20	1159	3.5-28	Ukrainian DX Classic RTTY Contest	Dig	RST, 2-letter oblast or serial	urdxc.org/rtty/eng.htm
19	1400	20	1400	50, 70	IARU Region 1 50/70 MHz Contest	CW Ph Dig	RS(T), serial, 6-char grid	www.iaru-r1.org
19	1500	20	1500	1.8	Stew Perry Topband Challenge	CW	4-char grid square	www.kkn.net/stew
19	1600	20	0400	3.5-28	West Virginia QSO Party	CW Ph Dig	RS(T), WV county or SPC	www.qsl.net/wvsarc
19	1800	19	1959	1.8-50	Feld Hell Sprint	Dig	RST, mbr SPC, grid	sites.google.com/site/feldhellclub
19	1800	19	2359	3.5-14, 18, 21, 24, 28, 144 repeaters	ARRL Kids Day	Ph	Name, age, QTH, favorite color	www.arrl.org/kids-day
20	0800	20	1400	50	WAB 50 MHz Phone	Ph	RS, serial, WAB square or country	wab.intermip.net
20	2300	21	0100	1.8-28	Run for the Bacon QRP Contest	CW	RST, SPC, mbr or power	qrpcontest.com/pigrun
23	0000	23	0200	1.8-50	SKCC Sprint	CW	RST, SPC, name, mbr or "none"	www.skccgroup.com
24	1900	24	2030	3.5	RSGB 80-Meter Club Championship, SSB	Ph	RS, serial	www.rsgbcc.org/hf
26	0600	26	1700	3.5-28	UFT QRP Contest	CW	RST/ QRP/QRO, mbr, or "NM"	uft.net/concours-qrp-uft
26	1200	27	1200	3.5-28	Ukrainian DX DIGI Contest	Dig	RST, oblast or serial	www.izmail-dx.com
26	1200	27	1200	1.8-28	His Majesty King of Spain Contest, SSB	Ph	RS, EA province or serial	concursos.ure.es/en
26	1800	27	2059	All, no WARC	ARRL Field Day	CW Ph Dig	Number of xmtrs, operating class, ARRL/RAC section or "DX"	www.arrl.org/field-day
28	1900	28	2030	3.5-14	RSGB FT4 Contest Series	Dig	4-char grid square	www.rsgbcc.org/hf

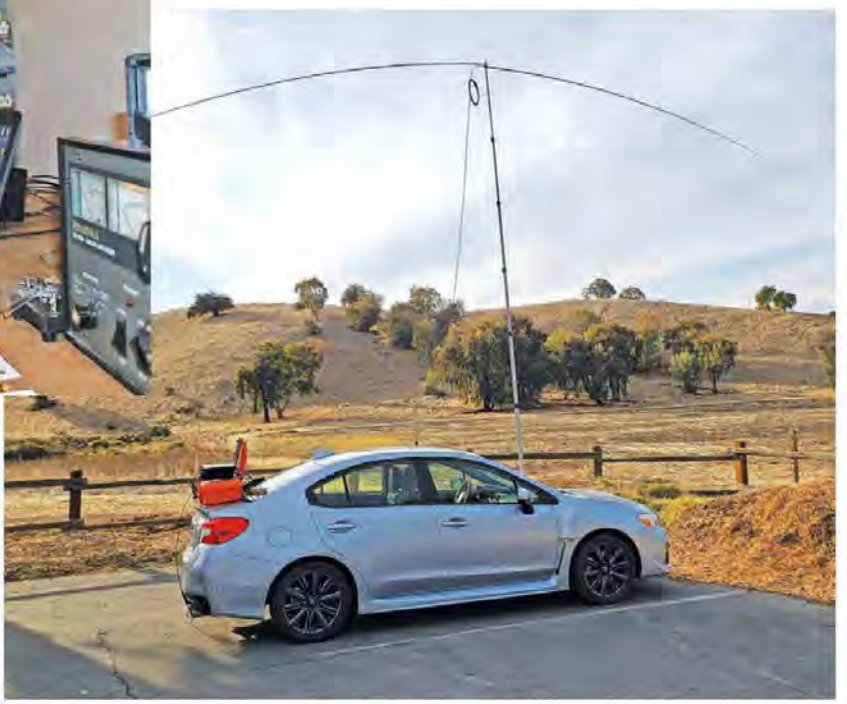
There are a number of weekly contests not included in the table above. For more info, visit: **www.qrpfoxhunt.org**, **www.ncccsprint.com**, and **www.cwops.org**. All dates refer to UTC and may be different from calendar dates in North America. Contests are not conducted on the 60-, 30-, 17-, or 12-meter 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.*

Bruce Draper, AA5B, bruceaa5b@gmail.com, and Scott Davis, K5TA, scottk5ta@gmail.com

2020 ARRL November Sweepstakes — Phone

Last year's ARRL Sweepstakes phone weekend was held November 21 – 23, 2020.

Cheryl Pratt, KM4TYV, operated alongside Michael Furrey, WA5POK, during the 2020 ARRL November Sweepstakes phone weekend. Together, they operated using the 6L6 Contest Club's call sign, W5ACQ, finishing in second place in the West Gulf Division for the Multioperator, High Power category. [Michael Furrey, WA5POK, photo]



Jacob Zelek, KG6MWI, operated from Santa Teresa County Park in San Jose, California, for the 2020 ARRL November Sweepstakes phone weekend. He contacted 54 stations in 29 Sections using his portable station. [Jacob Zelek, KG6MWI, photo]

Top Ten

Single Operator, High Power

K5TR	383,128
W7WA	349,264
K3LR (K3UA, op)	318,720
K4ZW	306,264
W2RQ	303,744
KW8N	301,456
K5TA	295,812
K7RL	292,248
N4OX	283,528
WC6H	282,408

Single Operator, Low Power

K6JO	211,068
W0EWD	210,276
N8II	203,524
VE4VT	201,920
W4AAA (KK9A, op)	198,912
N4OO	174,636
AF1T	155,358
WD5K	153,218
KU2M	149,364
AC0W	148,878

Single Operator, QRP

WZ8P	56,544
VE5MX	55,948
ND0C	42,750
KA8SMA	37,808
N4TOL	33,288
AC5O	25,568
N5EE	24,822
VE6EX	22,790
K0TEA	22,066
K9WZB	19,840

Single Operator Unlimited, High Power

K0EU	334,656
K5RT	309,120
K9CT	299,464
K3MM	290,666
K6LA	276,556
KD4D	270,414
W7RN (WX5S, op)	265,944
WB0TEV	257,376
W1SJ	256,122
K2RD	242,858

Single Operator Unlimited, Low Power

K2DRH	184,464
NT5V	176,064
N4TP (W4LT, op)	144,088
N0HJZ	140,270
KK7AC	135,880
N4ZZ	131,692
W6TK	128,152
VE3PJ	125,874
K3MD	116,532
N7MZW	110,292

Single Operator Unlimited, QRP

N0UR	33,232
NO5V	9,300

Multioperator, Single Transmitter, High Power

ND7K	401,184
W0NO	299,298
N6WM	291,984
N2NT	287,180
NG3R	274,700
KR0P	263,384
W5RRR	244,776
N3OC	237,384
WA1J	225,624
W4NF	217,958

Multioperator, Single Transmitter, Low Power

WW4LL	174,216
NX6T	171,708
K0UK	158,364
K9KE	122,634
WX4W	102,222
W4TG	91,798
K0AJW	77,578
N8YXR	74,844
K5LRW	63,936
W1FM	59,598

School Club

K0HC	247,800
W4AQL	178,948
W0EEE	159,408
N0UNL	148,678
K7UAZ	45,816
KF5CRF	36,952
K9IU	26,296
W9JWC	22,304
W6BB	5,320
W5YM	1,750

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.

ICOM
PRINCIPAL AWARDS SPONSOR

Plaque Sponsors

ARRL is pleased to award a Sweepstakes Plaque to the Overall and Division Leaders in each category, thanks to Icom America, clubs, and individuals who sponsor these awards. 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	Division	Category	Sponsor
K5TR	Overall	Single Operator High Power	Icom America
K6JO	Overall	Single Operator Low Power	Icom America
WZ8P	Overall	Single Operator QRP	Icom America
K0EU	Overall	Single Operator Unlimited High Power	Icom America
K2DRH	Overall	Single Operator Unlimited Low Power	Icom America
N0UR	Overall	Single Operator Unlimited QRP	Icom America
ND7K	Overall	Multioperator High Power	Icom America
WW4LL	Overall	Multioperator Low Power	Icom America
K0HC (W0BH, op)	Overall	School Club	Robert Tuttle, N8YXR, and Jennie Tuttle, KC0RBV
K3LR (K3UA, OP)	Atlantic	Single Operator High Power	Icom America
WR3R	Atlantic	Single Operator Low Power	Potomac Valley Radio Club
KN3A	Atlantic	Single Operator QRP	Icom America
K3MM	Atlantic	Single Operator Unlimited High Power	Icom America
K3MD	Atlantic	Single Operator Unlimited Low Power	Icom America
NG3R	Atlantic	Multioperator High Power	Icom America
K2APD	Atlantic	Multioperator Low Power	Icom America
K9ZO	Central	Single Operator High Power	Society Of Midwest Contesters
KD9MS	Central	Single Operator Low Power	Society Of Midwest Contesters
W9VQ	Central	Single Operator QRP	Icom America
K9CT	Central	Single Operator Unlimited High Power	Society of Midwest Contesters
K2DRH	Central	Single Operator Unlimited Low Power	Society of Midwest Contesters
WD9CIR	Central	Multioperator High Power	Icom America
K9KE	Central	Multioperator Low Power	Icom America
K9IU	Central	School Club	Icom America
WA0CSL	Dakota	Single Operator High Power	Minnesota Wireless Assn. – In memory of Tod Olson, K0TO
AC0W	Dakota	Single Operator Low Power	Minnesota Wireless Assn.
ND0C	Dakota	Single Operator QRP	Icom America
K1KD	Dakota	Single Operator Unlimited High Power	Minnesota Wireless Assn.
N0HJZ	Dakota	Single Operator Unlimited Low Power	Minnesota Wireless Assn.
N0UR	Dakota	Single Operator Unlimited QRP	Icom America
K0HB	Dakota	Multioperator High Power	Icom America
K0AJW	Dakota	Multioperator Low Power	Icom America
K0EJ	Delta	Single Operator High Power	Icom America
WQ5L	Delta	Single Operator Low Power	Icom America
AC5O	Delta	Single Operator QRP	Icom America
KC4NX	Delta	Single Operator Unlimited High Power	Icom America
N4ZZ	Delta	Single Operator Unlimited Low Power	Icom America
W5GAD	Delta	Multioperator High Power	Icom America
W5YM (WJ5V, op)	Delta	School Club	Icom America
KW8N	Great Lakes	Single Operator High Power	Icom America
N8BV	Great Lakes	Single Operator Low Power	Icom America
WZ8P	Great Lakes	Single Operator QRP	Icom America
ND4Y	Great Lakes	Single Operator Unlimited High Power	Icom America
W8GX	Great Lakes	Single Operator Unlimited Low Power	Icom America
KE8PUB	Great Lakes	Multioperator High Power	Icom America
WX4W	Great Lakes	Multioperator Low Power	Icom America
W2RQ	Hudson	Single Operator High Power	Icom America
KU2M	Hudson	Single Operator Low Power	Icom America
K2YG	Hudson	Single Operator QRP	Icom America
N2HMM	Hudson	Single Operator Unlimited High Power	Icom America
N2SQW	Hudson	Single Operator Unlimited Low Power	Icom America
N2NT	Hudson	Multioperator High Power	Icom America
KB2KDY	Hudson	Multioperator Low Power	Icom America
NJ8M	Midwest	Single Operator High Power	Icom America
W0EWD	Midwest	Single Operator Low Power	Icom America
W8MZ	Midwest	Single Operator QRP	Icom America
N0IRM	Midwest	Single Operator Unlimited High Power	Icom America
K0NEB	Midwest	Single Operator Unlimited Low Power	Icom America
W0NO	Midwest	Multioperator High Power	Icom America
K0USA	Midwest	Multioperator Low Power	Icom America
K0HC (W0BH, op)	Midwest	School Club	Icom America
NC1CC (WA1BXY, op)	New England	Single Operator High Power	Icom America
AF1T	New England	Single Operator Low Power	Icom America
W1MR	New England	Single Operator QRP	Icom America
W1SJ	New England	Single Operator Unlimited High Power	Icom America
K1EP	New England	Single Operator Unlimited Low Power	Icom America
WA1J	New England	Multioperator High Power	Icom America
W1FM	New England	Multioperator Low Power	Icom America
W7WA	Northwestern	Single Operator High Power	Icom America
K2PO	Northwestern	Single Operator Low Power	Icom America
N7JI	Northwestern	Single Operator QRP	Icom America
KA6BIM	Northwestern	Single Operator Unlimited High Power	Icom America
WZ8T	Northwestern	Single Operator Unlimited Low Power	Icom America
NK7J	Northwestern	Multioperator High Power	Icom America
W9MPX	Northwestern	Multioperator Low Power	Icom America
WC6H	Pacific	Single Operator High Power	Icom America
WB6POT	Pacific	Single Operator Low Power	Icom America
K2GMY	Pacific	Single Operator QRP	Icom America
W7RN (WX5S, op)	Pacific	Single Operator Unlimited High Power	Icom America
K6JS	Pacific	Single Operator Unlimited Low Power	Icom America
N6WM	Pacific	Multioperator High Power	Icom America
N6ACL	Pacific	Multioperator Low Power	Icom America
W6BB	Pacific	School Club	Icom America
K4ZW	Roanoke	Single Operator High Power	Icom America
N8II	Roanoke	Single Operator Low Power	Icom America
WR4I	Roanoke	Single Operator QRP	Icom America
K3DNE	Roanoke	Single Operator Unlimited High Power	Icom America
WT8WV	Roanoke	Single Operator Unlimited Low Power	Icom America
W4NF	Roanoke	Multioperator High Power	Icom America
W4TG	Roanoke	Multioperator Low Power	Icom America
K5TA	Rocky Mountain	Single Operator High Power	Icom America
WA1FMM	Rocky Mountain	Single Operator Low Power	Icom America
WC7S	Rocky Mountain	Single Operator QRP	Icom America
K0EU	Rocky Mountain	Single Operator Unlimited High Power	Icom America
N7MZW	Rocky Mountain	Single Operator Unlimited Low Power	Icom America
K2KR	Rocky Mountain	Multioperator High Power	Icom America
K0UK	Rocky Mountain	Multioperator Low Power	Icom America
N4OX	Southeastern	Single Operator High Power	Icom America
N4OO	Southeastern	Single Operator Low Power	Icom America
N4TOL	Southeastern	Single Operator QRP	Icom America
AB4EJ	Southeastern	Single Operator Unlimited High Power	Icom America
N4TP (W4LT, op)	Southeastern	Single Operator Unlimited Low Power	Icom America
W4MLB	Southeastern	Multioperator High Power	Icom America
WW4LL	Southeastern	Multioperator Low Power	Icom America
W4AQL	Southeastern	School Club	Icom America
N7GP	Southwestern	Single Operator High Power	Icom America
K6JO	Southwestern	Single Operator Low Power	Icom America
K9WZB	Southwestern	Single Operator QRP	Icom America
K6LA	Southwestern	Single Operator Unlimited High Power	Icom America
KK7AC	Southwestern	Single Operator Unlimited Low Power	Icom America
ND7K	Southwestern	Multioperator High Power	Icom America
NX6T	Southwestern	Multioperator Low Power	Icom America
K7UAZ	Southwestern	School Club	Icom America
K5TR	West Gulf	Single Operator High Power	Icom America
WD5K	West Gulf	Single Operator Low Power	Icom America
W5DPH	West Gulf	Single Operator QRP	Icom America
K5RT	West Gulf	Single Operator Unlimited High Power	Icom America
NT5V	West Gulf	Single Operator Unlimited Low Power	Icom America
NO5V	West Gulf	Single Operator Unlimited QRP	Icom America
W5RRR	West Gulf	Multioperator High Power	Icom America
W5AFV	West Gulf	Multioperator Low Power	Icom America
KF5CRF	West Gulf	School Club	Icom America
VE3YT	Canada	Single Operator High Power	Icom America
VE4VT	Canada	Single Operator Low Power	Icom America
VE5MX	Canada	Single Operator QRP	Icom America
VE4GV	Canada	Single Operator Unlimited High Power	Icom America
VE3PJ	Canada	Single Operator Unlimited Low Power	Icom America
VE3UZ	Canada	Multioperator High Power	Icom America

Affiliated Club Competition

Club	Score	Entries
Unlimited		
Potomac Valley Radio Club	16,291,264	265
Society of Midwest Contesters	7,404,410	143
Frankford Radio Club	6,796,474	108
Yankee Clipper Contest Club	5,500,804	94
Minnesota Wireless Assn.	5,426,414	132
Contest Club Ontario	3,027,398	51
Florida Contest Group	2,978,258	52
Northern California Contest Club	2,777,268	53
Medium		
Mother Lode DX/Contest Club	4,781,288	48
Southern California Contest Club	3,375,212	43
Arizona Outlaws Contest Club	3,183,916	43
Tennessee Contest Group	2,306,268	37
Grand Mesa Contesters of Colorado	2,293,130	30
Western Washington DX Club	2,039,486	27
DFW Contest Group	1,849,596	25
Mad River Radio Club	1,666,102	31
Central Texas DX and Contest Club	1,521,882	21
Willamette Valley DX Club	1,521,604	22
South East Contest Club	1,433,142	22
Big Sky Contesters	1,175,942	12
Kentucky Contest Group	1,158,974	23
North Coast Contesters	1,030,518	14
Great Places Contest Club	828,178	10
North Texas Contest Club	750,856	6
Hudson Valley Contesters and DXers	739,878	18
Georgia Contest Group	707,394	7
Alabama Contest Group	701,296	11
Swamp Fox Contest Group	670,352	13
CTRI Contest Group	573,868	13
Orca DX and Contest Club	526,002	7
Northeast Maryland Amateur Radio Contest Society	464,186	19
Radiosport Manitoba	457,740	4
Bay Area DXers	409,782	5
Northeast Wisconsin DX Assn.	386,656	3
Order of Boiled Owls of New York	386,056	10
Mississippi Valley DX/Contest Club	336,340	5
Rochester (NY) DX Assn.	333,884	8
Niagara Frontier Radiosport	309,160	12
Saskatchewan Contest Club	255,166	4
Kansas City Contest Club	253,124	3
Louisiana Contest Club	229,656	4
Texas DX Society	182,630	9
DELARA Contest Team	182,104	3
Bolingbrook ARS	140,250	5
Pacific Northwest VHF Society	139,250	4
South Jersey Radio Assn.	136,626	6
Spokane DX Assn.	106,358	4
Carolina DX Assn.	98,648	8
New Providence ARC	88,342	7
Driftless Zone Contesters	83,212	5
L'anse Creuse ARC	81,564	5
Silver Comet Amateur Radio Society	76,794	4
Granite State ARA	54,972	4
Edmonds Woodway ARC	31,362	7
Maritime Contest Club	17,316	3
Southern Berkshire ARC	15,180	3
Portage County Amateur Radio Service	9,212	3
Long Island Mobile ARC	4,192	4
Local		
Pizza Lovers 259	1,541,736	10
New Mexico Big River Contesters	1,104,262	8
Redwood Empire DX Assn.	974,744	10
Iowa DX and Contest Club	871,778	6
Radio Amateurs of Northern Vermont	537,194	4
Bristol (TN) ARC	289,878	6
West Park Radiops	216,564	4
Midland ARC	214,268	3
Jefferson ARC	157,272	3
The Villages ARC	125,106	6
Boeing Employees ARS – St. Louis	94,400	3
Metro DX Club	88,320	8
Central Michigan ARC	57,020	5
TX Emergency Amateur Communicators	53,920	3
Hazel Park ARC	50,064	5
Meriden ARC	41,616	5
Stoned Monkey VHF ARC	40,714	4
Alexandria Radio Club	40,574	3
Bellbrook ARC	32,664	5
Woodmont ARA	32,424	5
Hilltop Transmitting Assn.	24,964	3

Division Winners

Single Operator, High Power

Atlantic	K3LR (K3UA, op)	318,720
Central	K9ZO	265,844
Dakota	WA0CSL	164,800
Delta	K0EJ	225,500
Great Lakes	KW8N	301,456
Hudson	W2RQ	303,744
Midwest	NJ8M	206,240
New England	NC1CC (WA1BXY, op)	169,008
Northwestern	W7WA	349,264
Pacific	WC6H	282,408
Roanoke	K4ZW	306,264
Rocky Mountain	K5TA	295,812
Southeastern	N4OX	283,528
Southwestern	N7GP	188,800
West Gulf	K5TR	383,128
Canada	VE3YT	185,328

Single Operator, Low Power

Atlantic	WR3R	137,268
Central	KD9MS	73,786
Dakota	AC0W	148,878
Delta	WQ5L	135,722
Great Lakes	N8BV	93,062
Hudson	KU2M	149,364
Midwest	W0EWD	210,276
New England	AF1T	155,358
Northwestern	K2PO	119,658
Pacific	WB6POT	123,840
Roanoke	N8II	203,524
Rocky Mountain	WA1FMM	27,216
Southeastern	N4OO	174,636
Southwestern	K6JO	211,068
West Gulf	WD5K	153,218
Canada	VE4VT	201,920

Single Operator, QRP

Atlantic	KN3A	2,688
Central	W9VQ	2,856
Dakota	ND0C	42,750
Delta	AC5O	25,568
Great Lakes	WZ8P	56,544
Hudson	K2YG	9,660
Midwest	W8MZ	9,632
New England	W1MR	3,180
Northwestern	N7JI	19,380
Pacific	K2GMY	17,898
Roanoke	WR4I	12,876
Rocky Mountain	WC7S	16,836
Southeastern	N4TOL	33,288
Southwestern	K9WZB	19,840
West Gulf	W5DPH	10,070
Canada	VE5MX	55,948

Single Operator Unlimited, High Power

Atlantic	K3MM	290,666
Central	K9CT	299,464
Dakota	K1KD	229,744
Delta	KC4NX	190,512
Great Lakes	ND4Y	234,890
Hudson	N2HMM	104,960
Midwest	N0IRM	190,568
New England	W1SJ	256,122
Northwestern	KA6BIM	176,956
Pacific	W7RN (WX5S, op)	265,944
Roanoke	K3DNE	239,276
Rocky Mountain	K0EU	334,656
Southeastern	AB4EJ	170,586
Southwestern	K6LA	276,556
West Gulf	K5RT	309,120
Canada	VE4GV	200,818

Single Operator Unlimited, Low Power

Atlantic	K3MD	116,532
Central	K2DRH	184,464
Dakota	N0HJZ	140,270
Delta	N4ZZ	131,692
Great Lakes	W8GX	57,600
Hudson	N2SQW	58,618
Midwest	K0NEB	96,720
New England	K1EP	100,440
Northwestern	WZ8T	81,312
Pacific	K6JS	48,818
Roanoke	WT8WV	63,180
Rocky Mountain	N7MZW	110,292
Southeastern	N4TP (W4LT, op)	144,088
Southwestern	KK7AC	135,880
West Gulf	NT5V	176,064
Canada	VE3PJ	125,874

Single Operator Unlimited, QRP

Dakota	N0UR	33,232
West Gulf	NO5V	9,300

Multioperator, Single Transmitter, High Power

Atlantic	NG3R	274,700
Central	WD9CIR	164,000
Dakota	K0HB	78,064
Delta	W5GAD	94,720
Great Lakes	KE8PUB	4,218
Hudson	N2NT	287,180
Midwest	W0NO	299,298
New England	WA1J	225,624
Northwestern	NK7J	142,352
Pacific	N6WM	291,984
Roanoke	W4NF	217,958
Rocky Mountain	K2KR	90,080
Southeastern	W4MLB	91,482
Southwestern	ND7K	401,184
West Gulf	W5RRR	244,776
Canada	VE3UZ	55,748

Multioperator, Single Transmitter, Low Power

Atlantic	K2APD	38,766
Central	K9KE	122,634
Dakota	K0AJW	77,578
Great Lakes	WX4W	102,222
Hudson	KB2KDY	10,700
Midwest	K0USA	22,378
New England	W1FM	59,598
Northwestern	W9MPX	17,812
Pacific	N6ACL	20,212
Roanoke	W4TG	91,798
Rocky Mountain	K0UK	158,364
Southeastern	WW4LL	174,216
Southwestern	NX6T	171,708
West Gulf	W5AFV	34,272

School Club

Central	K9IU	26,296
Delta	W5YM	1,750
Midwest	K0HC	247,800
Pacific	W6BB	5,320
Southeastern	W4AQL	178,948
Southwestern	K7UAZ	45,816
West Gulf	KF5CRF	36,952

The 2021 ARRL November Sweepstakes phone weekend will be held November 20 – 22, 2021.

Mark Beckwith, N5OT, n5ot@arrl.net

2020 ARRL 160-Meter Contest Results

Last year's contest was held December 4 – 6, 2020.

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.

Top Ten — DX

Single Operator, High Power

ZF5T (ZF9CW, op)	229,744
CT9ABO (OM3GI, op)	83,148
XE2S	66,780
CR6K (CT1ILT, op)	27,560
OM2VL	20,502
G4FAL	9,152
JA5DQH	7,630
UX1UA	2,856
RM2E	2,200
GM4Z (GM4ZUK, op)	2,028

Single Operator, Low Power

CO2AN	39,520
XE2RT	13,152
XE2T	12,470
CO8RH	3,024
JE1SPY	720
JA7KPI	572
JI1RXQ	532
OLØA (OK1CZ, op)	504
4A50CRH	224
OZ1AAR	60

Single Operator, QRP

IZ3NVR	32
E71A	18
JH7UJU	12
SP6IHE	1

Single Operator Unlimited, High Power

XE2X	165,600
EA7X	34,810
TF3SG	24,024
GW3YDX	15,980
EA6SX	13,254
OK1CF	11,880
SK3W (SM5IMO, op)	11,644
EA1DAV	11,074
DR5X (DL8LAS, op)	10,912
OL1A (OK1CW, op)	10,332

Single Operator Unlimited, Low Power

OM2XW	4,550
OZ0B (OZ1ISY, op)	1,536
SP2EWQ	864
LY4ZZ	540
OK6Y (OK2PTZ, op)	264
IT9ZZO	216
JK1OLT	208
JA1SVP	156
LZ2ZG	128
SC7DX (SM7GIB, op)	112

Multioperator, Single Transmitter, High Power

C6AGU	205,000
F5UTN	7,760
DK4WW	2,968
OK6O	1,554
PA5CT	18
RY6Y	4

Multioperator, Single Transmitter, Low Power

V31MA	87,900
YT1Z	2

Top Ten — US and Canada

Single Operator, High Power

VY2ZM	693,495
K3ZM	435,543
NA8V	428,520
WB9Z	424,446
VE3DZ	421,632
AA1K	410,522
W9RE	361,008
W5MX	349,044
NP2J (K8RF, op)	347,160
NR4M	329,590

Single Operator, Low Power

KG9X	228,137
WB8JUI	219,925
WØUO	199,405
K8NVR	199,182
VE3VN	183,489
K4FT	180,780
K8FH	177,480
KØTI	176,349
W8WTS	171,626
K2XA	170,079

Single Operator, QRP

W3TS	79,065
N7IR	47,679
KSØMO	37,157
WB4MSG	33,930
W1WBB	27,232
KØKT	26,523
WC4X	25,194
KH6KG/W5	24,552
KN3A	24,144
AD4TJ	23,912

Single Operator Unlimited, High Power

K9CT	484,840
VE3EJ	482,706
K1A (KO7SS, op)	472,940
K3WW	435,375
VA2WA	432,375
W1UE	404,334
N1LN	360,927
AB3CX	353,764
KØRF	352,404
W3UA (NU3C, op)	350,779

Single Operator Unlimited, Low Power

VE3MGY	265,946
NE9U	230,670
W9XT	183,936
N3HEE	170,715
W9AV	162,870
N9JF	157,644
NJ3K	155,720
K9MMS	150,696
K3MD	141,866
K8BL	141,540

Single Operator Unlimited, QRP

WØGJ	112,880
KEØL	64,480
KKØU	43,500
WE9R	35,217
N2WK	32,385
K8ZT	27,392
WC7S	17,664
WØYJT	8,854
KØCD	5,456
K2GMY	1,170

Multioperator, Single Transmitter, High Power

W2GD	514,540
NØNI	461,380
KØDI	393,231
K3AJ	346,203
NA7TB	325,500
K3CT	315,666
W4MYA	271,662
K2AX	255,920
WA1Z	244,310
W4RN	234,208

Multioperator, Single Transmitter, Low Power

NØUR	193,410
N4WW	185,606
NC1CC	105,952
KA9VVQ	49,464
W5WTM	35,632
NJ1F	22,686

Affiliated Club Competition

Club	Score	Entries
Unlimited		
Potomac Valley Radio Club	8,213,140	96
Frankford Radio Club	7,788,615	75
Society of Midwest Contesters	6,503,440	74
Minnesota Wireless Assn.	4,812,645	76
Yankee Clipper Contest Club	4,615,296	67
Medium		
Contest Club Ontario	3,554,610	40
Central Texas DX and Contest Club	1,669,720	27
North Coast Contesters	1,546,196	16
Mad River Radio Club	1,438,302	12
Tennessee Contest Group	1,334,064	21
Florida Contest Group	1,282,170	22
Kentucky Contest Group	996,226	14
Arizona Outlaws Contest Club	954,302	18
South East Contest Club	789,438	13
Hudson Valley Contesters and DXers	751,030	12
Grand Mesa Contesters of Colorado	683,071	8
DFW Contest Group	677,382	12
Northern California Contest Club	659,924	24
Southern California Contest Club	649,198	15
Kansas City Contest Club	582,122	9
Rochester (NY) DX Assn.	580,819	10
Willamette Valley DX Club	533,991	8
Alabama Contest Group	447,791	5
Big Sky Contesters	383,027	4
Carolina DX Assn.	380,303	6
North Texas Contest Club	350,701	4
Mother Lode DX/Contest Club	347,645	5
Bay Area DXers	338,401	4
Western Washington DX Club	278,756	9
Not Quite Workable Contest Club	253,973	4
Great Places Contest Club	252,348	4
Swamp Fox Contest Group	168,570	6
Northeast Maryland AR Contest Soc.	157,044	6
Orca DX and Contest Club	156,421	8
Driftless Zone Contesters	139,807	4
Order of Boiled Owls of New York	137,574	6
Spokane DX Assn.	100,887	4
Texas DX Soc.	96,284	4
Saskatchewan Contest Club	53,174	3
Pacific Northwest VHF Soc.	31,740	4
New Providence ARC	23,518	3
Local		
Central Virginia Contest Club	673,345	7
Niagara Frontier Radiosport	396,938	9
CTRI Contest Group	289,140	5
Metro DX Club	148,216	4
Hilltop Transmitting Assn.	100,378	3
Meriden ARC	9,316	4

Dan Kovatch, W8CAR, made 1,096 contacts during the 2020 ARRL 160-Meter Contest. He finished in third place in the Single Operator, High Power category in the Great Lakes Division. [Dan Kovatch, W8CAR, photo]

The 2021 ARRL 160-Meter Contest will be held December 3 – 5.

Continental Winners

Africa

Single Operator, High Power	CT9ABO (OM3GI, op)	83,148

Asia

Single Operator, High Power	JA5DQH	7,630
Single Operator, Low Power	JE1SPY	720
Single Operator, QRP	JH7UJU	12
Single Operator Unlimited, High Power	JF2MBF	1,280
Single Operator Unlimited, Low Power	JK1OLT	208

Europe

Single Operator, High Power	CR6K (CT1ILT, op)	27,560
Single Operator, Low Power	OLØA (OK1CZ, op)	504
Single Operator, QRP	IZ3NVR	32
Single Operator Unlimited, High Power	EA7X	34,810
Single Operator Unlimited, Low Power	OM2XW	4,550
Multioperator, Single Transmitter, High Power	F5UTN	7,760
Multioperator, Single Transmitter, Low Power	YT1Z	2

North America

Single Operator, High Power	ZF5T (ZF9CW, op)	229,744
Single Operator, Low Power	CO2AN	39,520
Single Operator Unlimited, High Power	XE2X	165,600
Multioperator, Single Transmitter, High Power	C6AGU	205,000
Multioperator, Single Transmitter, Low Power	V31MA	87,900

Oceania

Single Operator, Low Power	VK3IO	2

South America

Single Operator, High Power	PY2OP	8
Single Operator Unlimited, High Power	YV4ABR	6,624

Paul Schaffenberger, K5AF, and Tim Kresky, ABØS, rented a farmhouse in west Texas and operated as K5M during the 2020 ARRL 160-Meter Contest. They earned first place in the Multioperator, High Power category in the West Gulf Division. [Tim Kresky, ABØS, photo]

Division Winners

Single Operator, High Power

Atlantic	AA1K	410,522
Central	WB9Z	424,446
Dakota	WØSD (WØDB, op)	310,896
Delta	W5ZN	312,104
Great Lakes	NA8V	428,520
Hudson	W2XL	222,456
Midwest	NØTT	293,055
New England	K1DG	307,165
Northwestern	K7RAT (N6TR, op)	216,690
Pacific	N6RK	125,460
Roanoke	K3ZM	435,543
Rocky Mountain	WD5COV	231,182
Southeastern	NP2J (K8RF, op)	347,160
Southwestern	W8KA	167,349
West Gulf	N5OT	259,766
Canada	VY2ZM	693,495

Single Operator, Low Power

Atlantic	N2EM	96,933
Central	KG9X	228,137
Dakota	KØTI	176,349
Delta	W4DAN	93,528
Great Lakes	WB8JUI	219,925
Hudson	K2XA	170,079
Midwest	KTØK	133,547
New England	K1EP	109,125
Northwestern	W7TMT	58,765
Pacific	W7XZ	23,140
Roanoke	N3AC	99,134
Rocky Mountain	WØDLE	51,204
Southeastern	WA1FCN	109,275
Southwestern	W6AYC	99,535
West Gulf	WØUO	199,405
Canada	VE3VN	183,489

Single Operator, QRP

Atlantic	W3TS	79,065
Central	W9QL	11,234
Dakota	WBØCFF	17,400
Delta	KH6KG/W5	24,552
Great Lakes	AA8OY	10,148
Hudson	K2MIJ	15,444
Midwest	KSØMO	37,157
New England	W1WBB	27,232
Northwestern	N7VS	18
Pacific	K6EI	13,760
Roanoke	WB4MSG	33,930
Rocky Mountain	WY7N	3,078
Southeastern	WC4X	25,194
Southwestern	N7IR	47,679
West Gulf	N5ESE	4,123
Canada	VE7KW	8,228

Single Operator Unlimited, High Power

Atlantic	K3WW	435,375
Central	K9CT	484,840
Dakota	KØMD	175,914
Delta	AA4DD	92,790
Great Lakes	W8MJ	266,526
Hudson	N2NT	230,478
Midwest	KØVXU	159,906
New England	K1A (KO7SS, op)	472,940
Northwestern	KA6BIM	142,133
Pacific	W6DR	93,183
Roanoke	N1LN	360,927
Rocky Mountain	KØRF	352,404
Southeastern	NO9E	236,363
Southwestern	N6WIN	104,832
West Gulf	K5NA	333,384
Canada	VE3EJ	482,706

Single Operator Unlimited, Low Power

Atlantic	NJ3K	155,720
Central	NE9U	230,670
Dakota	KØRC	104,016
Delta	WF7T	132,430
Great Lakes	K8BL	141,540
Hudson	WA2JQK	49,266
Midwest	KØVBU	30,872
New England	K1NZ	39,715
Northwestern	AK6A	36,144
Pacific	WE6Z	32,054
Roanoke	N3HEE	170,715
Rocky Mountain	WØGAS	544
Southeastern	N4TOL	6,364
Southwestern	W7RH	22,336
West Gulf	K5LJ	25,688
Canada	VE3MGY	265,946

Single Operator Unlimited, QRP

Atlantic	N2WK	32,385
Central	WE9R	35,217
Delta	KEØL	64,480
Great Lakes	K8ZT	27,392
Midwest	WØGJ	112,880
Pacific	K2GMY	1,170
Rocky Mountain	WC7S	17,664

Multioperator, Single Transmitter, High Power

Atlantic	W2GD	514,540
Dakota	KØHB	48,048
Delta	K4TCG	210,078
Midwest	NØNI	461,380
New England	WA1Z	244,310
Northwestern	K7RL	107,695
Pacific	NT6V	206,513
Roanoke	W4MYA	271,662
Rocky Mountain	ADØLI	94,874
Southeastern	KØDI	393,231
Southwestern	NA7TB	325,500
West Gulf	K5M	195,868
Canada	VE3FAS	49,500

Multioperator, Single Transmitter, Low Power

Central	KA9VVQ	49,464
Dakota	NØUR	193,410
Hudson	NJ1F	22,686
New England	NC1CC	105,952
Southeastern	N4WW	185,606
West Gulf	W5WTM	35,632

The 2021 IARU HF World Championship

1200 UTC Saturday, July 10 – 1159 UTC Sunday, July 11

Ahan Akbar, YC7UVB, is among the increasing number of Indonesian hams entering the IARU HF World Championship. He finished first place in Indonesia in the Single Operator, Phone Only, QRP Power category. [Ahan Akbar, YC7UVB, photo]

The objective of this contest is to support amateur self-training in radiocommunications, including improving amateur operating skills, conducting technical investigations, and communicating with other amateurs around the world (especially IARU member-society headquarters stations) using the 160-, 80-, 40-, 20-, 15-, and 10-meter bands.

- The exchange is a signal report and your ITU Zone.
- Single-Operator entrants choose from High, Low, or QRP Power and Mixed Mode, CW Only, or Phone Only.
- Stations from IARU member-societies all around the world will be active. Get on the air to find out how many headquarters stations you can work.
- Seven-day log submission deadline: Upload Cabrillo-formatted logs to the web app at **contest-log-submission.arrl.org** no later than 1200 UTC July 18. Or mail paper logs (postmarked by July 18) to IARU HF Championships, c/o ARRL Contests, 225 Main St., Newington, CT 06111 USA.

Up-to-date rules, paper log forms, and ITU zone maps can be found at www.arrl.org/iaru-hf-world-championship

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QEX
A Forum for Communications Experimenters

All ARRL members can now enjoy the digital edition of *QEX* as a member benefit. Coming up in the May/June 2021 and future *QEX* issues are articles and technical notes on a range of amateur radio topics. These are at the top of the queue.

- Bill Dzurilla, NZ5N/OM9AJK (formerly OM3BD), works QO-100, the first amateur radio satellite in geostationary orbit.
- Maynard A. Wright, W6PAP, discusses transmitter output impedance.
- Joe Purden, W6AYC, uses a classic matching technique for adding 80 meters to a 160-meter receiving array.
- John E. Post, KA5GSQ, discusses SA602A IC Hartley oscillators.
- Tony Brock-Fisher, K1KP, describes a fixture for measuring Q of inductors.
- Brian R. Callahan, AD2BA, sends arbitrary binary data using a novel CW record protocol.
- Carl Luetzelschwab, K9LA, describes the effect of a tree near a vertical 80-meter antenna.
- Jacek Pawlowski, SP3L, investigates the design of antennas considering common-mode currents on the transmission line.
- In his essay series, Eric Nichols, KL7AJ, explains Kirchhoff's current and voltage laws.
- Eric Nichols, KL7AJ, explains the Versatile Double Balanced Mixer — Part 3.

QEX, a forum for the free exchange of ideas among communications experimenters, is edited by Kazimierz "Kai" Siwiak, KE4PT, (**ksiwiak@arrl.org**) and is published bimonthly. The printed edition annual subscription rate (six issues per year) for members and non-members in the US is $29. First-class delivery in the US is available at an annual rate of $40. For international subscribers, including those in Canada and Mexico, *QEX* can be delivered by airmail for $35 annually; see **www.arrl.org/qex**.

Would you like to write for *QEX*? We pay $50 per published page for full articles and *QEX* Technical Notes. Get more information and an Author Guide at **www.arrl.org/qex-author-guide**. If you prefer postal mail, send a business-size self-addressed, stamped (US postage) envelope to: *QEX* Author Guide, c/o Maty Weinberg, ARRL, 225 Main St., Newington, CT 06111.

Certificate of Code Proficiency

Recipients

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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.

January 2021

Rene M. Beland, KE8NPD	10
Victor Denisov, N6DVS	10
Dale L. Martin, KG5U	10
Michael M. Piehl, K7LNT	10
David J. Redanz, N9HX	10
Frances R. Rogers, AC3GH	10
Burton D. Wizeman, K4SRQ	10
Norman R. Cox, KE0ZT	15
Clifford P. Culpepper, W4VN	15
Justin C. Jackson, Jr., WB4ABY	15
Kenneth A. Knox, KD2KEH	15
Robert T. Marston, AA6XE	15
Dale L. Martin, KG5U	15
Frances R. Rogers, AC3GH	15
Glenn E. Sigler, N8IJY	15
Galen L. Babcock, Sr., AG5LS	20
Edward G. Corbett, AA1ZX	20
Leonard G. Crispino, WB2MJH	20
Nyles McKeithan, KS4S	20
Dennis G. Martin, WA2USA	25
Robert S. Zarges, Jr., K2MZ	25
Robert S. Zarges, Jr., K2MZ	30
Frank P. Arciuolo, W1ZAH	35
Lahra "Flip" Svare, KT9X	35

February 2021

Kevin M. Brouelette, AJ6EE	10
Alton R. DeWeese, Jr., N4IDH	10
Michael L. Jones, KG6UBG	10
Daniel Lasorso, KD8OFT	10
Lawrence A. Lisle, K9KZT	10
James P. Long, N9EET	10
Kenneth L. Powell, KG4LLQ	10
Thomas S. Watson, W5ZBT	10
William N. Massie, AA8KY	15
Matthew J. Mikolay	15
Christopher G. Pearson, G5VZ	25

March 2021

David A. Hewitt, WA9AVZ	10
Richard J. Berezanich, WB3HUS	10
Ben Bowers, KE3KQ	10
Thomas L. Hardy, K6TLH	10
David O. Krovetz, K4KXA	10
Thomas W. Porter, W8KYZ	10
Brett H. Sharpton, KD2SZW	10
Remell A. Spencer, Jr., KA6DOY	10
Thomas P. Stelmach, N0QBX	10
Rene M. Beland, KE8NPD	15
Mark Anthony Isom, KI5JH	15
Michael S. Lundy, W4MSL	15
Thomas W. Porter, W8KYZ	15
Paul A. Miller, W5RES	20
Brian K. Moore, KM6ZX	25

Congratulations to all the recipients.

June 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.

June 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, June 19 at 2 PM PDT (2100 UTC) on 3581.5, 7047.5, 14047.5, and 18097.5 Hz. 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 — June 2021
(All times are in Eastern Daylight Time)

Monday	Tuesday	Wednesday	Thursday	Friday
Memorial Day	**6/1** 4 PM – 2000Z 10 – 35 WPM	**6/2** 7 PM – 2300Z 35 – 10 WPM	**6/3** 10 PM – 0200Z **(6/4 – UTC)** 10 – 40 WPM	**6/4** 9 AM – 1300Z 10 – 35 WPM
	6/8 4 PM – 2000Z 10 – 35 WPM	**6/9** 7 PM – 2300Z 10 – 40 WPM	**6/10** 9 AM – 1300Z 35 – 10 WPM	**6/11** 10 PM – 0200Z **(6/12 – UTC)** 10 – 35 WPM
	6/15 9 AM – 1300Z 10 – 35 WPM	**6/16** 10 PM – 0200Z **(6/17 – UTC)** 35 – 10 WPM	**6/17** 7 PM – 2300Z 10 – 35 WPM	**6/18** 4 PM – 2000Z 10 – 40 WPM
6/21 10 PM – 0200Z **(6/22 – UTC)** 10 – 40 WPM		**6/23** 9 AM – 1300Z 35 – 10 WPM	**6/24** 4 PM – 2000Z 35 – 10 WPM	**6/25** 7 PM – 2300Z 10 – 35 WPM

Bernie McClenny, W3UR, w3ur@arrl.org

How's DX?

June Means 6-Meter DX

As we approach June in the northern hemisphere, we enter the prime weeks of DXing on 6 meters, which is considered by many to be "the Magic Band." Sporadic E, or E_S, is the most popular form of 6-meter DX propagation, and it takes place when signals refract off of ionized clouds in the E region of the ionosphere. While single-hop E_S typically ranges to only about 2,300 kilometers (1,400 miles), multi-hop E_S often provides propagation to about 8,000 kilometers (5,000 miles), and sometimes to distances of more than 11,000 kilometers (7,000 miles) during June and July. Propagation from eastern North America to Japan and the Middle East and from western North America to Europe typically occurs for at least a few days during June and July.

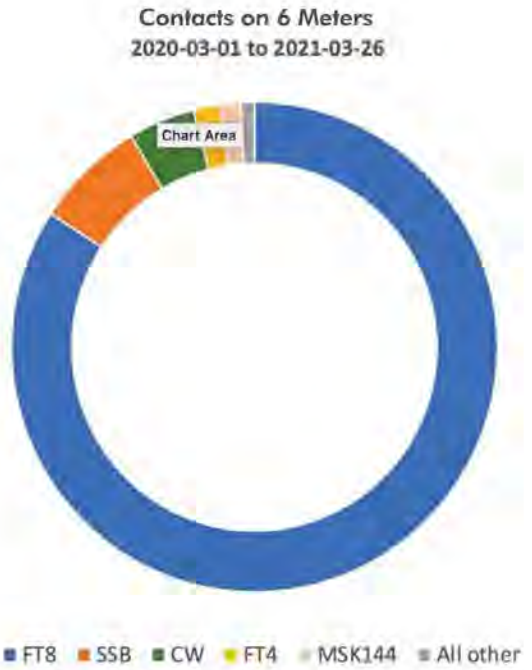


Figure 1 — Michael's, G7VJR, compiled Club Log data and analysis of 6-meter contacts.

DX and FT8

Soon after it was introduced in 2017, FT8 quickly became the mode of choice for most 6-meter DXers. From March 2020 to March 2021, nearly 85% of all 6-meter contacts were on FT8. This data came from Michael, G7VJR, who analyzed data from Club Log. Only about 7% were on SSB and 4.4% were on CW (see Figure 1). FT8 is where the 6-meter DX and 6-meter DXing activity has increased dramatically over the last few years. Most DXers will tell you, "I'm on FT8 because it's where the DX is."

It's critically important that 6-meter DXers transmit during the correct FT8 sequence. The UK Six Metre Group (UKSMG) put together an "FT8 Intercontinental DX Code of Practice" (available at **www.uksmg.org/ft8-code-of-practice.php**), which has become widely accepted. In it, UKSMG recommends that European stations transmit during even periods, 00 and 30 seconds past each minute, and Asian and North American stations should transmit during the odd periods, 15 and 45 seconds past each minute. Unfortunately, some DX stations transmit during the opposite sequence, so it's important to occasionally listen during both sequences. The main thing is that you must be in sequence with the DX station you are trying to work. Most 6-meter FT8 activity takes place on 50.313 MHz; however, when the band is crowded with intercontinental DX activity, it's a good idea to also go to 50.323 MHz.

Just as important is that you should be transmitting as much as possible during the same sequences as your local FT8 operators to avoid mutual interference. Last season, my neighbor Frank Donovan, W3LPL, and I routinely operated simultaneously on 6-meter FT8 with Yagis only 183 meters (600 feet) apart without interference, because we always use the same transmit sequences. If all local FT8 operators coordinate to use the same transmit sequences, DX can easily be worked by everyone with no mutual interference.

As a reminder, the DX window for 6-meter CW and SSB activity goes from 50.100 to 50.125 MHZ. In the US, the SSB calling frequency is 50.125 MHz. Once you make a contact on the calling frequency, operators should always move up the band to a clear frequency to finish their contact. This allows others the opportunity to share the calling frequency.

Remember, just because you can't hear anyone on the US calling frequency doesn't mean it's not in use. Also remember that US stations cannot operate on SSB below 50.100 MHz, because that's reserved for CW only.

PSK Reporter (**https://pskreporter.info**) is an extremely valuable tool for 6-meter DXers. You can set the band to 6 meters (or any other band). Next, you can decide if you want to see spots just for a specific call sign (yours or someone else's) for a specific country or grid locator. The map also gives you the choice of specific modes or all digital modes, including CW. You can also choose a time frame, from 15 minutes to 24 hours. Once you have all the parameters set, you can view the resulting map.

An excellent FT8 operation guide for DXers on every band, including 6 meters, is available at **www.g4ifb.com/FT8_Hinson_tips_for_HF_DXers.pdf**.

Propagation Tools for DXers and Contesters

- The Reverse Beacon Network (**http://beta.reversebeacon.net/main.php**) provides near real-time propagation information via a new map display. You can check current propagation conditions for a specific call sign, DXCC entity, CQ zone, ITU zone, band, mode, and other parameters.
- The Space Weather Prediction Center (SWPC, **https://services.swpc.noaa.gov/images/planetary-k-index.gif**) provides the latest planetary Kp index, updated every 3 hours in a graphic display.
- The German Research Centre for Geosciences (GFZ, **https://spaceweather.gfz-potsdam.de/fileadmin/ruggero/Kp_forecast/forecast_figures/KP_FORECAST_CURRENT.png**) provides a graphical 3-day Kp index forecast.
- The Daily DX (**www.dailydx.com**) includes a daily detailed propagation forecast.

Intrepid-DX Group's Upcoming DXpedition

According to an announcement from the Intrepid-DX Group, the operators are planning a DXpedition to Bouvet Island in early 2023. The press release said, "Our target is the Norwegian island, Bouvet. This is the #2 most-wanted DXCC entity." It went on to say, "We have joined forces with Intrepid Norwegian DXpeditioner Ken Opskar, LA7GIA, in our quest to activate Bouvet."

In January 2023, 14 men will depart from Cape Town on the MV *Braveheart* to make the voyage to Bouvet Island. The group plans to spend 20 days on Bouvet Island, and depending on weather conditions, they will operate for 14 to 16 days during their stay.

Their goal is to make 100,000 contacts or more from Bouvet, taking advantage of the best propagation and modes on 10 – 160 meters. The DX group is confident they will reach this goal, saying, "We pledge to assemble the strongest team possible and to use good operating practices to optimize your ability to reach our stations."

"This will be an arduous and expensive mission," the announcement said. "Our budget is $764,000 USD, and the 3Y0J team will fund much of this mission. We desperately need the global DX community to support our mission and help us make this important activation of the #2 most-wanted DXCC entity. It is only through this kind of support that we can achieve our mission."

The Intrepid-DX Group is thankful to those who have already contributed to their mission. They said, "We especially wish to recognize and thank the Northern California DX Foundation and the International DX Association as our premier donors. Without the support of the NCDXF and INDEXA, operations to the world's rarest entities would not be possible."

For more information, the Intrepid-DX Group gives updates on their website at **www.3y0j.com** and on the 3Y0J Facebook page at **https://www.facebook.com/groups/901378553769436**.

Wrap-Up

That's all for this month, with special thanks to LA7GIA, N6PSE, and W3LPL for helping with this month's column. Don't forget to send in your DX news, contest expeditions, IOTA activities, and photos. Until next month, see you in the pileups!
— Bernie, W3UR

Jon Jones, NØJK, n0jk@arrl.org

The World Above 50 MHz

Solar Cycle 22 and 6-Meter FM F2

On a crisp November afternoon in 1991, I had a 6-meter, 5 W FM handheld transceiver with a rubber duck antenna set to 52.525 MHz. From the Midwest, my wife, NØHKT, and I, NØJK, were able to make separate 6-meter contacts with Al, KL7NO (SK), in Fairbanks, Alaska. This was 6-meter F2 propagation at the second peak of Solar Cycle 22. The smoothed sunspot number (SSN) was around 180. The Midwest-to-Alaska F2 hop was a reliable path for 6 meters and open midafternoons in November 1991. Similar conditions may be in store for Solar Cycle 25.

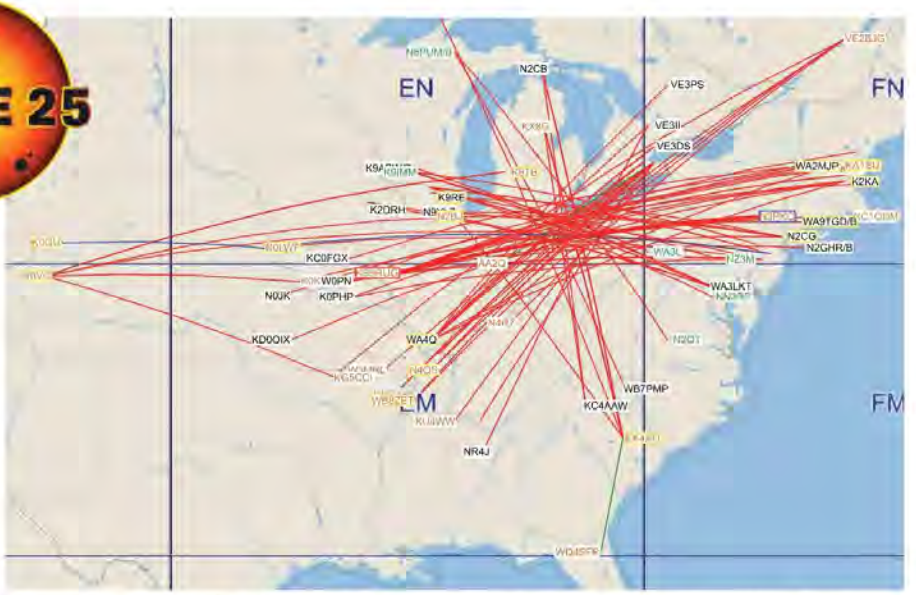


Figure 1 — The 50 MHz DX map, showing the rare 6-meter sporadic-E opening that took place on March 13, 2021. Note the classic starburst patten of the E_S center. [Graphic courtesy of **dxmaps.com**]

Rare March 2021 Sporadic E

Solar Cycle 25's co-rotating interaction region (CIR) impacts enhanced rare sporadic-E openings for March 13, 2021. The surprisingly strong and long-lasting 6-meter sporadic-E opening took place over eastern North America. Sporadic E was first reported around 1525Z, with Ron, K3FR (FM18), working K9MU (EN44) on FT8. More stations got on as word of the opening spread and 50.313 MHz got busy.

Many contacts were reported between W1, W2, VE2, W3, and VE3 to W8, W9, and WØ. K3FR made 16 contacts, six new grids, and found ACØRA (EN41) in Iowa for his 31st state. At 1832Z, WA8FTA (EN52) heard WA3LKT (FM19) "35 dB over S-9" on 50.092 MHz on CW. Around 1850Z, I logged WA1EAZ (FN42) on 50.313 MHz on FT8, receiving a –15 dB report with 10 W and a ¼-wave whip. Many other W1, W2, and W3 stations were received (see Figure 1). Mike, KA3JAW (FN20), noted strong E_S to the Midwest. His best long-distance contact was with WQØP (EM19) at 1,640 kilometers with just 15 W to a dipole at 6 feet on FT8. The E_S continued until around 1945Z. It was almost a 4-hour opening. The E_S opening may have been sparked by the impact of a CIR on Earth's geomagnetic field earlier that morning. A CIR is a transition zone between slow and fast solar wind streams and contain dense clouds of solar plasma, which can spark geomagnetic storms, aurora, and sporadic-E when they impact Earth's magnetic field. Bright aurora was reported over New Zealand when the impact occurred.

Sporadic E is very rare in March, and the month of March has the lowest occurrence of E_S of any month. The CIR may have played a role in this opening. Intense high-altitude winds, traveling in opposite directions at different altitudes in the E layer, can produce wind shear. It is believed that these wind shears in the presence of Earth's geomagnetic field can force ions into compressed thin, ion-rich layers, approximately ½ to 1 mile in thickness, causing sporadic E. Activity in the Earth's geomagnetic field from disturbances like a CIR or coronal mass ejection (CME) impact can alter these E-layer winds, creating wind shears and sporadic E.

Similarities to March 1989

On March 13, 1989, as Solar Cycle 22 ramped up, two powerful CMEs struck the Earth's magnetic field. The sunspot that hurled the CMEs toward Earth (region 5395) was one of the most active sunspot groups ever observed. Two of the explosions (an X4.5 on March 10 and an M7.3 on March 12) targeted Earth directly with CMEs. The first "cleared a path for the second, allowing it to strike with unusual force," said Dr. David Boteler, head of the Space Weather Group at Natural Resources Canada. About 90 seconds after the second CME hit, the

Hydro-Québec electric power grid failed. During the 9-hour blackout that followed, millions of people found themselves with no light or heat. Strong aurora occurred across North America, with visual aurora observed as far south as Florida and Cuba. The K index went to 9.

Bill Tynan, W3XO/5 (SK), noted the amazing VHF and UHF aurora contacts made by VHF operators in the "World Above 50 MHz" column from the June 1989 issue of *QST*. Bill wrote, "This is one of those times that it is impossible to chronicle more than just a few of the happenings. The huge aurora of March 13 – 15, 1989, produced so many worthwhile reports for all of the bands from 50 – 902 MHz that it exhausted the space available." Highlights included K5SW (EM25) making contacts in 54 grids with 2-meter aurora. Al Ward, W5LUA, made a 222 MHz aurora contact with WC2K at 2,094 kilometers, a record distance that still stands today.

Figure 2 — Dave, KG5CCI, operated portable in eastern Colorado for a 6-meter FFMA grid expedition in March. [David Swanson, KG5CCI]

On the Bands

50 MHz. Dave, KG5CCI, went on a grid expedition the first weekend of March to help Fred Fish Memorial Award (FFMA) seekers with rare grids. He activated eight grids in western Kansas, Oklahoma, eastern Colorado, and New Mexico, while driving 1,489 miles. Dave logged 76 contacts with 36 unique stations. The first grid activated was EM05 on March 6. He said the most-needed grid was DM87, and he operated from it for 2 hours, making 25 contacts (see Figure 2). The majority of his contacts were via meteor scatter using the MSK144 mode, and a few contacts using Q65. Jim, K5ND (EM12), worked Dave in three new grids, including one contact on Q65.

Larry, NØLL, went on a mini grid expedition to EN01 the same weekend. He ran 70 W to a five-element Yagi (see Figure 3). On Saturday, March 6, Larry made 16 contacts from 1230 – 1609Z. His first contact was with W4IMD (EM84), and the last was with KØKBR (DN70). He felt MSK144 activity was down, due to people "experimenting with Q65."

On March 21, trans-equatorial propagation (TEP) from the Caribbean, Mexico, and south Florida to deep South America occurred. KD4ESV (EL87) worked CE6TK on 50.125 MHz on SSB. KV4HV (EL94), KW4BY (EL96), and KM4NS (EL96) worked CX and LU stations on FT8 around 2100Z. PY3KN (GF49) heard W4AS (EL95) at –16 dB. KØGU (DN70) in Colorado copied LU9FVS (FF99) on a possible E_s-to-TEP link. The K index was 5, indicating geomagnetic storm conditions.

Figure 3 — Larry, NØLL (EN01), went portable for a 6-meter MSK144 operation on March 6, 2021. [Larry Lambert, NØLL, photo]

TEP was present again on March 22. Dale, CE2SV (FF47), worked stations in southern California on FT8. Chip, K7JA (DM03), worked CE2SV at 2224Z. He noted it "seemed to be a very low-angle opening." On March 23, KØGU worked LU9FF (FF99) on FT8 TEP.

144 MHz. FØFYF reported receiving signals from ZD7GWM/b (IH74) on 144.475 MHz via TEP on March 5.

Here and There

Joe, K1JT, suggested Q65-15A for TEP and noted 9Y4D found it very effective on TEP to Argentina, Brazil, and Uruguay.

Joe Muscanere, W5HNK (ex-WA5HNK), passed away on March 23. He made the first 6-meter EME contact on July 30, 1972.

Maty Weinberg, KB1EIB, events@arrl.org; www.arrl.org/special-event-stations

Special Event Stations

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

Through Dec. 31, 0000Z – 2359Z, all calls, all areas. VE2GT and VE2NCG. **Quebec Parks on the Air (QCPOTA)**. Certificate. *This is an operating event. See website for details.* **qcpota.ca**

Mar. 15 – Nov. 30, 0000Z – 2300Z, II3VE, Venezia, Italy. ARI Venezia. **1,600 Years of the Foundation of Venice**. All bands. Certificate & QSL. Sezione ARI Venezia, S. Croce 1776/B, Venezia 30135, Italy. *Detailed rules on ARI Venezia website and* ***QRZ.com*** *for II3VE call. Both II3VE and club call IQ3VE are valid. QSL via eQSL or bureau.* **www.arivenezia.it**

May 15 – May 23, 0000Z – 2359Z, W9A, Junction City, WI. Wood County ARES/RACES. **EMS Week 2021**. AllStar 52770/Echo-Link W9WCA-L 14.250 7.250 3.970. QSL. Wood County ARES/RACES, Attn: EMS Week SES, 3530 Bohn Dr., Wisconsin Rapids, WI 54494. *QSL via W9WCA.* **kb9stb@gmail.com**

May 16 – May 31, 0000Z – 2359Z, K1A, Cleburne, TX. Club KC5NX. **Memorial Day 2021**. 14.255 14.045 7.240 7.235. QSL. Jay D. Stanfield, 9200 Summit Ct. W., Cleburne, TX 76033. **www.qrz.com/db/kc5nx**

May 20, 1400Z – 2000Z, K2CAM, Garden City, NY. Long Island Mobile Amateur Radio Club. **Celebrating Lindbergh's Transatlantic Flight**. 14.240 72.40. QSL. LIMARC, P.O. Box 392, Levittown, NY 11756. *Held at the Cradle of Aviation Museum.* **https://limarc.org/special-events**

June 1 – June 8, 0001Z – 2359Z, 5J39FUL/5K48LRB/5J85FJR, Bogota, Colombia. Liga de Radio Aficionados de Bogota. **48th Anniversary of Liga Radio Bogota (HK3LRB) and Dr. Jorge Reynold's 85th Birthday, and 39th Anniversary of Los Libertadores University Foundation**. SSB CW FT8 RTTY; 28 24 21 18 14 10 7 3.5 MHz. Certificate & QSL. LoTW, **QRZ.com**, and eQSL, or via bureau. **www.qrz.com/db/5k48lrb**, **www.qrz.com/db/5j39ful**, or **www.qrz.com/db/5j85fjr**

June 3 – June 16, 1300Z – 2200Z, W2W, Baltimore, MD. Amateur Radio Club of the National Electronics Museum. **D-Day Commemoration**. 14.244 14.044 7.244 7.044. Certificate & QSL. W2W D-Day, P.O. Box 1693, MS 4015, Baltimore, MD 21203. *If the museum is closed, club members will operate from their home stations. Primary operation June 5 – 7; additional operation possible June 3 – 4 and 8 – 16, as operator availability permits. Operation on 80 meters (3.544, 3.844), additional bands, and digital modes possible.* **www.ww-2.us**

June 4, 1500Z – 2300Z, KØSAL, Lincoln, NE. SATERN Lincoln, NE. **Salvation Army Donut Day**. 14.318. Certificate & QSL. Charles Bennett, P.O. Box 67181, Lincoln, NE 68506. **kd0ptk@gmail.com**

June 4 – June 5, 1600Z – 2300Z daily, NI6IW, San Diego, CA. USS *Midway* (CV-41) Museum Ship. **Museum Ship Weekend**. 7.250 14.320 14.070 (PSK31) D-STAR via PapaSystem repeaters. QSL. USS *Midway* CV-41 COMEDTRA NI6IW, 910 N. Harbor Dr., San Diego, CA 92101. **www.qrz.com/db/ni6iw**

June 4 – June 5, 1900Z – 1900Z, N3YUG, Leedstown, VA. The Virginia Fone Net. **87th Anniversary**. 7.220 3.947. QSL. Jason Rearick, P.O. Box 372, Patuxent River, MD 20670. **n3yug@arrl.net** *or* **www.vfn3947.net**

June 5, 1500Z – 2100Z, WØERH/KSØKS, Edgerton, KS. Santa Fe Trail Amateur Radio Club and Johnson County Amateur Radio Club. **80th Anniversary of Paley Award Presented to Marshall Ensor**. 14.250 14.025 7.250 7.020; 30 meters as conditions change. QSL. KSØKS, Santa Fe Trail Amateur Radio Club, P.O. Box 3144, Olathe, KS 66063. *We will be spotting as well.* **www.w0erh.org** *and* **www.sftarc.org**

June 5 – June 6, 0000Z – 2359Z, N1S, Groton, CT. Generations Amateur Radio Club. **USS *Nautilus* — First Nuclear Submarine**. 50.5 14.275 7.225 3.850. QSL. N1S Generations Amateur Radio Club, 110 Vinegar Hill Rd., Gales Ferry, CT 06335, or via bureau to K3LBD. Nautilus *information:* **www.ussnautilus.org**. *Event information:* **www.qrz.com/db/k3lbd** *or* **www.qrz.com/db/n1s**

June 5 – June 6, 0000Z – 2359Z, WA5DTK, Houston, TX. USS *Houston* Special Operation Group. **USS *Houston* Memorial**. 14.260 14.040 7.250 7.030. QSL. Barry Brewer, 601 Wagon Wheel Tr., Pflugerville, TX 78660-3824. *Operating during Museum Ships Weekend.*

June 5 – June 6, 0001Z – 2359Z, NJ2BB, Camden, NJ. Battleship *New Jersey* Amateur Radio Station. **Museum Ships Weekend Event**. 14.262 14.044 7.262 7.044. QSL. Margaret Burgess, 150 Schooner Ave., Barnegat, NJ 08005. *Check website for updates and a list of participating ships. No certificates this year due to COVID-19.* **nj2bb.org**

June 5 – June 6, 1421Z – 1621Z, K8E, Toledo, OH. Toledo Mobile Radio Association. **Museum Ships Weekend**. 14.260 14.039 7.260 7.039. QSL. K8E Col. James M. Schoonmaker Team, P.O. Box 9673, Toledo, OH 43697. **www.tmrahamradio.org**

June 5 – June 12, 0000Z – 2359Z, W1AGR, various cities, MA. Norfolk County Radio Association. **100 Year Anniversary**. 21.285 14.235 7.225 3.825. QSL. Dick Bean, 422 Everett St., Westwood, MA 02090. *Members will operate their own stations using the club call, W1AGR.* **www.qrz.com/db/w1agr**

June 7 – June 18, 0001Z – 2359Z, K4D, Dog Island, FL. K5TEN. **Dog Island DXpedition**. 40 through 6 meters, SSB, CW, and digital; 50.130 28.310 21.285 14.260 10.110 7.188. QSL. K5TEN, Dog Island DXpedition, 208 Mount Tabor Rd., Hot Springs National Park, AR 71913. *IOTA Island NA-085, FL005S.* **www.qrz.com/db/k4d**

June 11, 0000Z – 2359Z, K6K, Kaneohe, HI. KH6ML. 14.268 7.188 146.505. **King Kamehameha Celebration**. Certificate. Michael, 44-096 Keaalau Pl., Kaneohe, HI 96744-2531. **https://sites.google.com/view/k6khawaii**

June 12, 0100Z – 0500Z, N2B, N2H, N2U, N2D, N2S, N2O, N2N, and N2V, Beacon, NY. Hudson Valley Digital Network. **Hudson River Radio Relay Featuring Bannerman's Island**. 50.130 18.128 14.250 7.200. Certificate. Hudson Valley Digital Network, 106 Cedar Ave., C/O HR3 2021 Special Event, Poughkeepsie, NY 12603. **www.hudsonriverradiorelay.com/for-radio-amateurs.html**

June 12, 1300Z – 1900Z, W1M, Russell, MA. Western Massachusetts Council BSA. **Woronoko Heights Outdoor Adventure**. 14.290 14.060 10.115 7.190. QSL. Tom Barker, 329 Faraway Rd., Whitefield, NH 03598. *Operating from Moses Scout Reservation.*

June 12, 1400Z – 2200Z, NØG, Topeka, KS. Kaw Valley Amateur Radio Club. **Kansas Heartland Military Day**. 14.250 7.250. QSL.* KVARC NØG Special Event, P.O. Box 750016, Topeka, KS 66675-0016. **www.kvarc.org/specialevent.html**

June 12 – June 20, 1200Z – 2100Z, K3USI, Fredericksburg, VA. US Island Awards Program. **1st Annual US Island Special Event Week**. 28.460 21.260 14.260 7.260. Certificate. Jay Chamberlain, 27 Fox Run Ln., Fredericksburg, VA 22405. *(US Island Chasers/Activators.) See website for information. This is an operating event.* **w4ybv@yahoo.com** *or* **www.usislands.org**

June 15 – June 20, 1400Z – 2100Z, N5A, Springdale, AR. Razorback Contest Club. **185th Anniversary of Arkansas Statehood**. 14.260 14.040 7.220 7.040. QSL. Razorback Contest Club, 3407 Diana St., Springdale, AR 72764. **rccw5yo@cox.net**

June 25 – June 28, 0000Z – 2359Z, N6R, Simi Valley, CA. Ventura County Amateur Radio Society. **Field Day 2021**. 21.320 14.255 7.260 3.810. QSL. Peter Heins, N6ZE, 1559 Norwich Ave., Thousand Oaks, CA 91360. *Commemorating the lives of President Ronald and Mrs. Nancy Reagan. N6R is hoping to operate from the Reagan Presidential Library. Please check website for updated information.* **www.qrz.com/db/n6r**

June 26 – July 2, 1800Z – 1800Z, K6V, Weed, CA. National Speleological Society. **NSS Annual Convention**. 14.285 14.050 7.195. Certificate & QSL. Sam Rowe, 2749 Commercial Ave., Madison, WI 53704. *Slow CW Saturday only.* **www.caves.org**

June 27 – July 11, 1200Z – 2359, K9U, Liberty, IN. Union County Indiana Bicentennial Board. **Union County Indiana Bicentennial**. 14.040 3.540 7.185 7.035. QSL. Howie Huntington, K9KM, 25350 N. Marilyn Ln., Hawthorn Woods, IL 60047. *Visitors are welcome to participate.* **k9km@arrl.net**

Certificates and QSL cards: To obtain a certificate from any of the special event stations offering them, send your QSO information along with a 9 × 12 inch self-addressed, stamped envelope (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 **September** *QST* would have to be received by **July 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**.

Steve Ewald, WV1X, sewald@arrl.org; www.arrl.org/hamfests-and-conventions-calendar

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 (Northport) — June 19 D F H Q R S T V
8:30 AM – 2 PM. *Spr:* Black Warrior Hamfest. Tuscaloosa County High School, 12500 Wildcat Dr. *TI:* 145.35 (91.5 Hz). *Adm:* $10. **www.blackwarriorhamfest.org**

Colorado (Montrose) — June 5 T
8 AM – noon. *Spr:* Montrose ARC. Lions Club Pavilion, 510 Palmer St. *TI:* 147.195 (107.2 Hz). *Adm:* free. **www.montrosehamradio.org**

Florida (Pinellas Park) — May 29 D F H R T
8 AM – noon. *Spr:* The Glorious Society of the Wormhole ARC. Freedom Lake Park, 9990 46th St. N. *TI:* 146.850 (146.2 Hz). *Adm:* free. **www.w4orm.org**

Florida (Dade City) — June 12 D F H R T V
8 AM – noon. *Spr:* Dade City Masonic Lodge. Dade City Masonic Lodge #48, F & AM of Florida, 13642 21st St. S. *TI:* 147.135, 146.20, 146.52. *Adm:* $6 general admission, $5 with a COVID-19 vaccination card. **www.dadecitymasoniclodge.com**

Florida (Orlando) — June 12 F H T
6 AM – noon. *Spr:* South Conway Baptist Church. South Conway Baptist Church, 6099 S. Conway Rd. *TI:* none. *Adm:* free.

Illinois (Mendota) — June 6 D F R T V
8 AM – 3 PM. *Spr:* Mendota Tri-County Fairgrounds, 503 First Ave. *TI:* 147.120 (103.5 Hz). *Adm:* $7 advance with two stubs, $8 door with one stub. **www.w9mks.org**

ARRL INDIANA STATE CONVENTION
July 9 – 10, Indianapolis, IN
D F H Q R S T
Fri. 2 PM – 7 PM, Sat. 6 AM – 2 PM. *Spr:* Indianapolis ARA. Marion County Fairgrounds, 7300 E. Troy Ave. *TI:* 146.76, no tone. *Adm:* $8. **www.indyhamfest.com**

Indiana (Auburn) — July 10 D H T
9 AM – 2 PM. *Spr:* Northeastern Indiana ARA. Auburn Cord Duesenberg Museum,1600 S. Wayne St. *TI:* 147.015, no tone. *Adm:* $5 raffle ticket purchase. **www.w9ou.org**

Iowa (Creston) — June 12 D F H R T V
8 AM – noon. *Spr:* SWIARA. Union County Emergency Management, 705 E. Taylor St. *TI:* 146.790 (136.5 Hz). *Adm:* free. **www.facebook.com/groups/327085807349791**

Kentucky (Cave City) — July 10 D F T
8 AM. *Spr:* MCARC. Cave City Convention Center, 502 Mammoth Cave St. *TI:* 146.94. *Adm:* $5. **www.ky4x.org**

Louisiana (West Monroe) — June 5 D F H Q R S T V
8 AM – 1 PM. *Spr:* Louisiana Delta Radio Club. Cheniere Lake Area 1, 104 Cheniere Lake Dr. *Tl:* 147.135 (127.3 Hz). *Adm:* $5. **www.kc5dr.com**

Maine (Hermon) — June 5 F H R T V
8 AM – 1 PM. *Spr:* Pine State ARC. Hermon Mountain, 441 Newburgh Rd. *Tl:* 146.94 (136.5 Hz). *Adm:* $5, kids 12 and under free. **www.n1me.com**

Maryland (West Friendship) — May 30 F H T
6 AM – 2 PM. *Spr:* Maryland FM Association. Howard County Fairgrounds, 2210 Fairgrounds Rd. *Tl:* 146.76, 224.76, 444.0 (107.2 Hz). *Adm:* $10. **www.marylandfm.org**

Maryland (Upperco) — June 20 D F H Q R T
7 AM – 2 PM. *Spr:* Baltimore ARC. Arcadia Fairgrounds, 16920 Carnival Ave. *Tl:* 146.67 (107.2 Hz). *Adm:* $5. **www.w3ft.com**

Michigan (Chelsea) — June 6 D F H Q R T V
8 AM – noon. *Spr:* Chelsea ARC. Chelsea Community Fairgrounds, 20501 W. Old US Highway 12. *Tl:* 145.450, 146.980 (100 Hz). *Adm:* $5. **www.wd8iel.com**

Michigan (Newberry) — June 12 D F H R V
9 AM – noon. *Spr:* Luce ARS. Pentland Township Hall. 15474 Highway M-28. *Tl:* 146.61 (114.8 Hz). *Adm:* $5. **www.w8nby.org**

Michigan (Shelby Township) — June 19 D F
8 AM – noon. *Spr:* General Motors ARC. Packard Proving Grounds, 49965 Van Dyke Ave. *Tl:* 443.075 MHz (123 Hz). *Adm:* $5 per carload buying or selling. **www.gmarc.org**

Michigan (Monroe) — June 20 D F H Q R T
7 AM – 1 PM. *Spr:* Monroe County Radio Communications Association. Monroe County Fairgrounds, 3775 S. Custer Rd. *Tl:* 146.72 (100 Hz). *Adm:* $6. **www.mcrca.org**

Minnesota (Plymouth) — June 19 F H R T
8 AM – noon. *Spr:* Twin City FM Club. West Medicine Lake Community Club, 1705 Forestview Ln. N. *Tl:* 146.76 (114.8 Hz). *Adm:* $5. **www.tcfmc.org**

Minnesota (Roseville) — July 10 H R T V
8 AM – noon. *Spr:* Magic Repeater Group. Galilee Lutheran Church, 145 N. McCarrons Blvd. *Tl:* 145.170 (100 Hz). *Adm:* free. **www.magicrepeater.net/fest.htm**

ARRL NEBRASKA STATE CONVENTION

June 19, Lincoln, NE
D F H R S V
8 AM – 3 PM. *Spr:* Lincoln ARC. Lancaster Event Center, 4100 N. 84th St. *Tl:* 146.760. *Adm:* $8 for 16 and over, $5 for LARC members. **www.lincolnhamfest.org**

New Jersey (Fair Lawn) — June 5 D F H R T
8 AM. *Spr:* Fair Lawn ARC. Fair Lawn Recycling Center, 19-25 Saddle River Rd. *Tl:* 145.470 (167.9 Hz). *Adm:* $5. **www.fairlawnarc.org**

New Jersey (Piscataway) — July 10 D F H Q R T V
8 AM – noon. *Spr:* Raritan Valley Radio Club, W2QW. Piscataway High School, 110 Behmer Rd. *Tl:* 146.625 (141.3 Hz). *Adm:* $7. **www.w2qw.org**

New York (Bethpage) — June 6 D F H Q R
8 AM – noon. *Spr:* Long Island Mobile ARC. 1055 Stewart Ave. *Tl:* 146.850 (136.5 Hz). *Adm:* $6. **www.limarc.org**

New York (Cortland) — June 12 F H R T
7 AM – noon. *Spr:* Skyline ARC of Cortland. Cortland County Fairgrounds, 4301 Fairgrounds Dr. *Tl:* 147.180 (71.9). *Adm:* $5. **www.skylineradioclub.org**

Ohio (Mansfield) — July 10 F H R T V
8 AM – 3 PM. *Spr:* Intercity ARC. Richland County Fairgrounds, 750 N. Home Rd. *Tl:* 444.700, DMR313920/443.100 (110.9 Hz), 146.460 simplex. *Adm:* $15 per space. **www.iarc.club**

ARRL PENNSYLVANIA STATE CONVENTION

July 3, Harrisburg, PA
D F H Q R S T
6 AM – 2 PM. *Spr:* Harrisburg Radio Amateurs Club. Harrisburg Postal Picnic Grounds, 1500 Roberts Valley Rd. *Tl:* 147.075 (123 Hz). *Adm:* $5. **www.w3uu.org**

Pennsylvania (Plains) — July 4 D F H R T V
8 AM – noon. *Spr:* Murgas ARC. Polish American Veterans Club, 2 South Oak St. *Tl:* 146.61 (82.5 Hz). *Adm:* $7. **www.hamfest.murgasarc.org**

ARRL TENNESSEE STATE CONVENTION

June 19, Knoxville, TN
D F H Q R S T V
8:30 AM – 3 PM. *Spr:* Radio Amateur Club of Knoxville. Kerbela Temple, 315 Mimosa Ave. *Tl:* 147.300 (100 Hz). *Adm:* $8. **www.w4bbb.org**

Texas (Texas City) — July 10 D F H Q R S T V
9 AM – 1 PM. *Spr:* Tidelands ARS. Doyle Convention Center, 2010 5th Ave. N. *Tl:* 147.14 (167.9 Hz), 442.025 (103.5 Hz). *Adm:* $4. **www.tidelands.org**

Virginia (Manassas) — June 12 T
9 AM – 1 PM. *Spr:* Ole Virginia Hams ARC. Field across from Signal Hill Park, 9300 Signal View Rd. *Tl:* 147.960. *Adm:* $5. **www.w4ovh.net**

Wisconsin (Kaukauna) — June 19 D F H R T
7 AM – noon. *Spr:* Fox Cities ARC. Starlite Club, W2091 County Rd. JJ. *Tl:* 146.760 (100 Hz). *Adm:* $6. **www.fcarc.club/sunshineswap.php**

Wisconsin (Oak Creek) — July 10 F H R
6:30 AM – 3:30 PM. *Spr:* South Milwaukee ARC. American Legion Post 434, 9327 S. Sheppard Ave. *Tl:* 146.91 (127.3 Hz). *Adm:* $5. **www.wi9sm.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. You are also encouraged to register your event with HQ as far in advance as your planning permits. See **www.arrl.org/hamfest-convention-application** for an online registration form. Dates may be recorded up to 2 years in advance.

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

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 **July 1** to be listed in the **September** issue. Information in this column is accurate as of our deadline; contact the sponsor or check the sponsor's website for possible late changes, driving directions, and other event details. Please note that postal regulations prohibit mention in *QST* of games of chance, such as raffles or bingo.

Promoting your event is guaranteed to increase attendance. As an approved event sponsor, you are entitled to special discounted rates on *QST* display advertising and ARRL web banner advertising. Call ARRL's toll-free number at 1-800-243-7768, or email **ads@arrl.org**.

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	283	01-Apr-91
William Klepser, Jr., WB2AIV	215	09-Jun-99
Central		
Ed Wagner, AB9FN	366	01-Jul-02
Allan Bukowski, N9ZD	321	01-Jun-92
Eldon Boehm, NK9U	316	21-Nov-86
Donald Hlinsky, N9IZU	309	01-Mar-91
Brian Eder, WB9UGX	278	01-Jan-92
Dakota		
Jeffrey Goodnuff, W0KF	311	17-Jun-03
John Schwarz, Jr., AE0AL	309	26-Oct-94
Shep Shepardson, N0NMZ	259	12-Mar-01
Daniel Royer, KE0OR	239	01-Jul-91
Dennis Ackerman, KB0OQQ	221	15-Jul-96
Delta		
Monvel T. Maskew, Jr., K9FQ	568	18-Jul-18
Arthur Parry, Jr., WB4BGX	270	01-May-91
Joe Lowenthal, WA4OVO	258	25-May-06
Roger Gray, N5QS	244	01-Mar-93
Bobbie Williams, W1BEW	231	01-Jun-92
Great Lakes		
David Potter, KE8OHG	668	03-Jun-20
Charles Tyrrell, KE8PCB	334	03-Sep-20
Charles Hall, W8HF	286	01-Jun-92
Archie Mack, Sr., AF4EB	232	19-Aug-97
Dale Pritchett, KC8HJL	223	26-Mar-98

Examiner	Sessions	Accreditation Date
Hudson		
Paul Maytan, AC2T	690	06-Sep-84
Stanley Rothman, WA2NRV	469	01-Mar-85
Fritz Boigris, KB2O	447	26-Oct-84
Alan Crosswell, N2YGK	426	26-Oct-94
Gerald Miller, Jr., AA2ZJ	402	05-Dec-95
Midwest		
David Bartholomew, AB0TO	735	22-Mar-02
Kevin Naumann, N0WDG	645	17-Nov-02
Harry Steger, Jr., W0HMS	574	26-Aug-08
Roland Kramer, W0RL	530	21-Jun-01
Jeanette Nordman, AB0YX	460	21-Aug-03
New England		
*Bob Phinney, K5TEC	1,305	20-Jan-14
Paul Lux, K1PL	965	25-Jan-85
Phillip Temples, K9HI	478	12-May-89
Gregory Paul, KC1MND	406	03-Jun-20
Robert Beaudet, W1YRC	392	01-Aug-90
Northwestern		
Richard Morgan, KD7GIE	450	11-Aug-00
Loren Hole, KK7M	381	06-Sep-84
Scott Robinson, AG7T	331	01-Aug-91
S. Riley McLean, W7RIL	310	02-Sep-99
David Brooks, N7HT	305	10-Jun-87
Pacific		
Morris Jones, AD6ZH	491	27-Nov-01
Dieter Stussy, KD6LVW	427	27-Jan-94
Brian Torr, N6IIY	377	06-Sep-00
Gordon Fuller, WB6OVH	356	06-Sep-84
Bill Nichols, NN7K	336	01-Sep-93

Examiner	Sessions	Accreditation Date
Roanoke		
Judy Friel, AC4RG	295	01-Feb-91
Alan Ronald Moeck, WA2RPX	264	27-Sep-94
David Snyder, W4SAR	250	01-May-93
Terry Sanner, WV8V	217	06-Sep-84
Thomas Hill, KJ4IV	201	01-Jun-91
Rocky Mountain		
Robert Hamilton, N0RN	393	19-May-87
Jeffrey Weinberg, W0QO	303	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	3,399	03-Sep-09
**Collin Pike, KJ4AXB	2,279	26-Apr-11
**Justin Lee Pike, KJ4AXF	2,236	12-Nov-12
*Anna Grogan Pike, KD4PCU	1,737	18-Aug-09
*Ryan Krenzischek, W4NTR	1,511	04-Jan-13
*Patrick Wyatt Pike, KJ4AXD	1,161	13-Oct-15
Southwestern		
*Bill Martin, AI0D	1,068	01-Nov-84
Fred Bollinger, AB7JF	538	17-Apr-95
David Morrill, N7TWT	445	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	779	24-Apr-20
Gerald Grant, WB5R	490	04-Jan-85
Adolph Chris Koehler, K5VCR	476	29-Sep-95
Wilbert Cannonier, KK5JJ	469	03-Nov-95

Congratulations to the Pike family from Roanoke, Alabama (Southeastern Division), for their service to the community!
The ARRL VEC would like to thank all our VEs for their generosity and volunteerism.

*Denotes participation in over 1,000 sessions. **Denotes participation in over 2,000 sessions. ***Denotes participation in over 3,000 sessions.

Volunteer Monitor Program Reports

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

The Volunteer Monitor Coordinator issued 14 Advisory Notices. An Advisory Notice is an attempt to resolve rule violation issues informally before FCC intervention:

- An advisory was sent to the owner of a remote amateur station in California advising him that he is responsible for deliberate interference transmitted by any station over his remote facility.
- An operator in Ripley, Tennessee, received an advisory concerning deliberate interference and failure to identify on 75 meters.
- An operator in Jefferson, Georgia, received an advisory concerning failure to identify on 40 meters.
- Operators in Tiburon, Petaluma, and Manteca, California, and Grants Pass, Oregon, received advisories concerning interference to 75 meters.
- General advisories were sent to operators in West Virginia, Michigan, Iowa, North Carolina, Pennsylvania, Texas, and Wyoming, concerning operation on 7.200, 3.927, and 3.860 MHz.

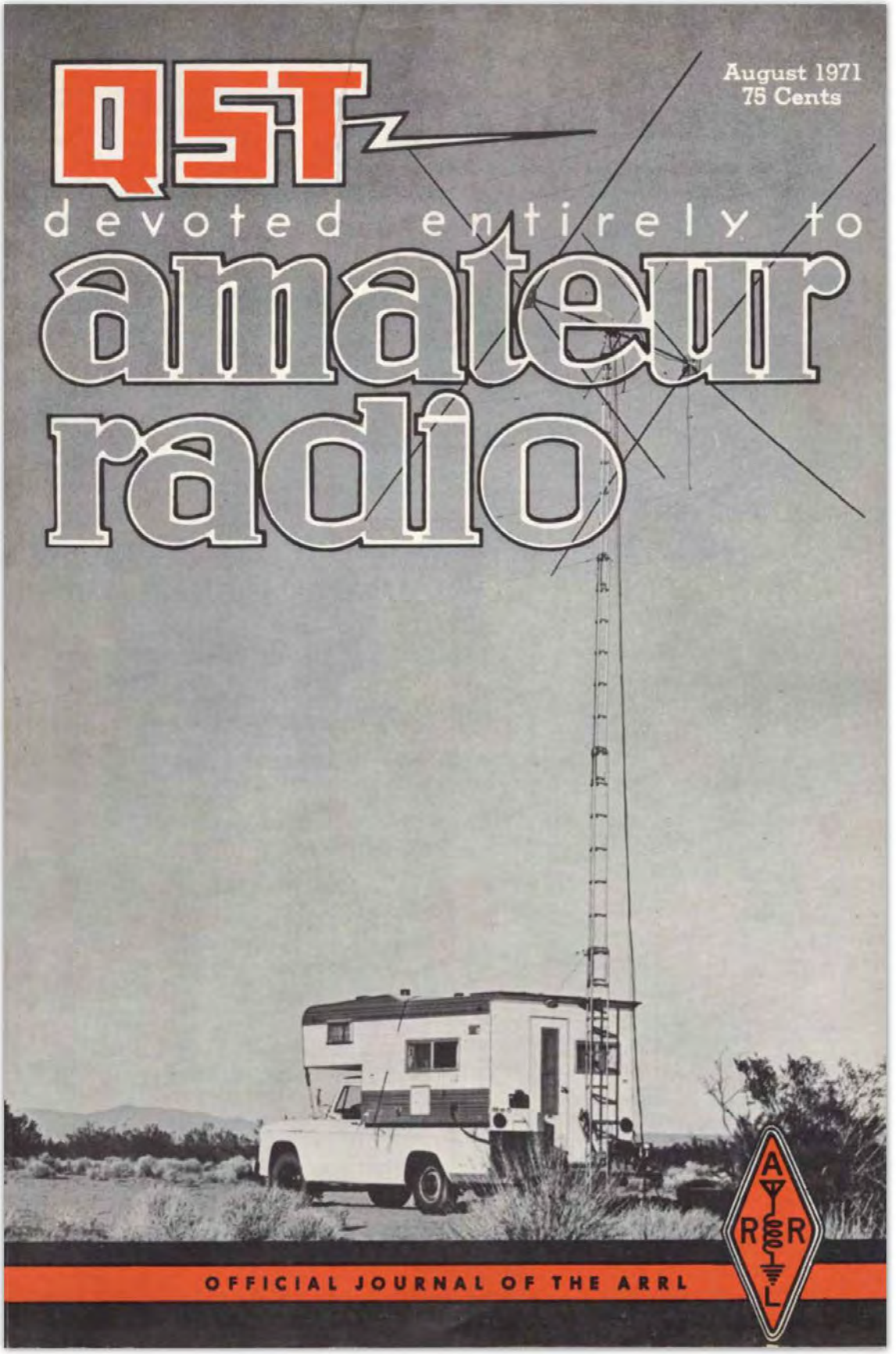
A Good Operator Commendation was sent to a husband-and-wife team in Perryopolis, Pennsylvania, for excellent net and 2-meter operations.

The FCC delayed action on the renewal application of a General-class licensee in Quakertown, Pennsylvania, in order to review allegations of repeated transmission of obscenities and failure to identify.

The Volunteer Monitor Administrator had two meetings with FCC Enforcement Bureau personnel.

The final totals for VM monitoring in February were 2,185 hours on HF frequencies, and 2,512 on VHF frequencies and above. *— Thanks to Riley Hollingsworth, K4ZDH, Volunteer Monitor Program Administrator*

A Look Back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August 1971
75 Cents
devoted entirely to
amateur
radio
OFFICIAL JOURNAL OF THE ARRL
ARRL

Fig. 1 — Unmodified surplus navy "bug."

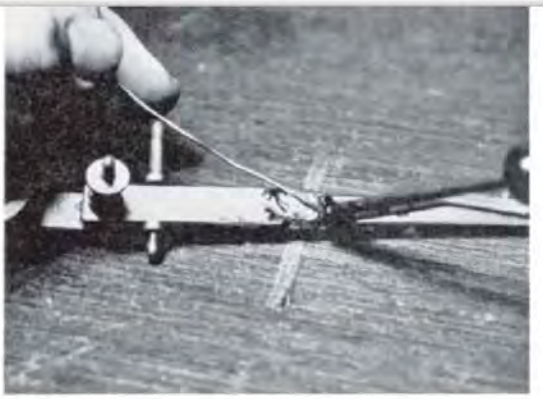


Fig. 2 — A thick flow of solder is used to stiffen the flexible key arm.

• *Beginner and Novice*

How to Make a Low-Cost Keying Mechanism

While we don't recommend that a Novice start off with an electronic keyer, there is no doubt that as the newcomer's cw ability increases so does his interest in automatic keyers. Some Novices are ready for this article, and for those who are not this is one issue of QST *you'll want to save.*

Building a Better Shack for Less

BY A. K. WEIS,* WA5VQC (ex-WB4GIH)

IT'S A REAL pleasure to work cw with someone who has an electronic keyer and is using it correctly. It may not be as personal as the friendly swing of the operator using a straight key or bug, but it is a lot easier to copy, especially in QRM.

With the coming of low-cost integrated circuits, keyers are no longer a luxury around the shack. A fully self-completing keyer can be had for $15 or less. A paddle for your keyer will cost at least $20. It seems that if you can get a keyer at such a low cost, you can probably do the same with a paddle.

* 13502 Westport Lane, Houston, TX 77024.

Chances are that you already have a "bug," or know someone who has one and doesn't use it. If you ask him, he'll probably give it to you, or at least sell it for a couple of dollars. I obtained a navy surplus bug (Fig. 1) at an auction for three bucks and decided to convert it to a keyer paddle.

Modifications

If you want to do the same, the main thing that must be done is to fix the dot-generating mechanism so that the contact is solidly fixed allowing the dot-generation section in the keyer a chance to stay on when you are making dots. The first thing you should do is to make the arm of the bug rigid. I did this by applying a large glob of solder to the flexible piece of thin metal which allows the arm

Fig. 3 — The dot contactor is soldered into a fixed position.

Fig. 4 — The band of spring metal on the dot contactor is cut off after the soldering is completed.

Fig. 5 — Photo of the modified, shortened bug key in position for use in its new "life style."

of the bug to vibrate. Make sure the metal is clean before you solder (Fig. 2). The same could be accomplished using stiff pieces of metal and bolts, but this would involve drilling and other problems. If you wish, you can make a new arm, but since the glob of solder works so well, it really isn't necessary. The next step is to take the contact that generates dots and solder it shut. Here again there are other ways, but the solder works fine (Fig. 3). The next job is to cut the flexible band of metal which held the dot contact. This step is not necessary since the solder has made the contact solid, but the end result is much neater (Fig. 4). The modification can be done with a large pair of wire cutters. If you remount the contact on the arm, and the arm on the pivot, you will find that the bug now functions as a paddle. In other words, it doesn't vibrate anymore.

There are still some things to do. If you want your paddle to look like one, you will have to saw off the back part of the base. This is only logical since now it is of no value anyway. This, however, takes a long time because these bases are usually made of cast iron. If you have a sabre saw with a metal-cutting blade, it is much easier. After you finish this modification, you will also want to saw off the dot arm projecting off the back. I cut mine off right behind the dot contact. If your bug is like mine, it will need some cleaning up. I first removed all the parts and sanded and spray painted the base a glossy black. Next, I took a fine wire brush and cleaned all of the parts. I then relocated the rubber feet so that the paddle balanced properly. I didn't have to drill a single hole. I just removed the shorting bar and put one of the feet in the hole.

Using the Paddle

Before the paddle is ready to use, you must first separate the dot and dash contacts, since they were connected together on the bug. After this is done you will have three screws underneath to which you can connect the three wires coming from the keyer — the ground, dot contact, and dash contact. When you close the dot contact, the dot wire from the keyer should be connected to the ground wire. When the dash contact is closed, the same condition should exist. If you wish, you can put three terminal posts or a three-terminal barrier strip on the back of the paddle. I merely connected the wires to the screws under the paddle. Fig. 5 shows the finished paddle. Everything is ready now, but if you have never used a keyer before, it is a good idea to practice before you go on the air. At first it will feel strange, but you will quickly adapt to it. You will find you can send cw longer and better, and cw will become even more enjoyable. You will probably be a little proud of your finished product. You will have a good time when your ham friends enter your shack and say, "Hey, where didja get that keyer paddle?"

QST

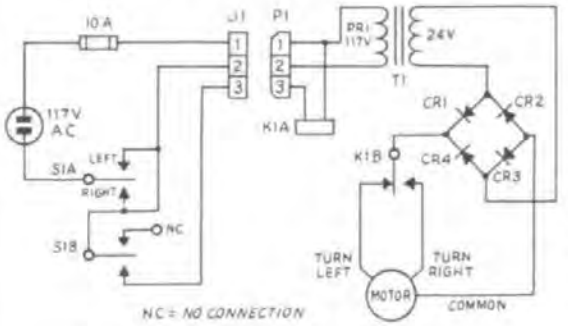
ARRL TECHNICAL INFORMATION SERVICE RULES

1 Before writing for technical assistance, search your files of *QST* and other ARRL publications. The answer you need is probably there. Consult the annual index of articles in each December issue of *QST*.
2 Do not ask for comparisons between commercial products.
3 Do not ask for advice on repairing in-warranty commercial equipment. Write the manufacturer for assistance.
4 Please do not request custom designs for amateur gear.
5 Be reasonable in the number and kind of questions you ask. Limit the number of questions to three per letter.
6 Include a self-addressed, stamped *business-size* envelope with each request for aid. No stamp required for foreign inquiries. Include Zip code.
7 Make your inquiry legible. Use a typewriter if possible. Otherwise, write or print *clearly*. Use only one side of each sheet. Circuit diagrams should be on separate sheets. Write your name and address on each sheet, not just your call. Staple or clip the pages together.
8 All inquiries must relate to amateur radio. We cannot respond to questions about CB, marine radio, hi-fi, etc. unless they concern TVI or RFI caused by amateur gear.
9 Please do not send commercial or homemade equipment to us for evaluation or repair.
10 Do not ask for advice or information on articles published in other amateur magazines. Write to the magazine editor or the author of that article.
11 We may refer you to a back issue of *QST*. If so, and if that issue is still available, you may purchase it. If not, photocopies of a particular article are available at 25 cents per page. *Include payment with your order.*
12 Address all technical questions to: Technical Information Service, American Radio Relay League, 225 Main Street, Newington, CT. 06111. Non-technical questions should be addressed to the appropriate ARRL Hq. department.

Hints and Kinks For the Experimenter

PROP-PITCH ROTOR CONTROL CIRCUIT

I use a simple control system for my prop-pitch motor assembly which requires only one relay, one transformer, and three wires. The diagram shows my hookup. – *Bob De Bragga, WIYNP*



Circuit diagram of the prop-pitch rotor control.
CR1-CR4, incl. – 50-V, 25-A silicon rectifier.
J1 – Three-connection jack (Cinch Jones S-303-CCT).
K1 – Spdt power relay (Potter and Brumfield PR6AY).
P1 – Three-connection plug (Cinch Jones P-303-CCT).
T1 – 24-V, 10-A.

ANOTHER SEALER FOR ANTENNA CONNECTIONS

If you have problems with water getting into coaxial cable at the antenna connection, Dow Corning has just the product to remedy the situation. It is called Aquarium Sealer. While remaining flexible, it keeps the water out. – *Wayne Tope, WN4TUP*

MOBILE WRITING BOARD

The photograph shows a writing base made from a small piece of sheet aluminum. It is secured to the horn rim by means of two cable clamps. The spring clips allow the paper to be changed easily. – *O. W. H. Johnson, W1JY/6*

DIFFICULT-TO-FIND ARTICLES

As an avid *QST* reader, I have found a need to search through back issues looking for a specific article. Since you publish a detailed index only once a year, a long search is sometimes necessary to find a particular article. Have you ever considered publishing a detailed index every quarter, or even twice a year?

If not, then I have a suggestion for amateurs in the same fix. When an issue arrives, I make index cards for every feature in the magazine. This includes Hints and Kinks, Technical Correspondence, and Strays (if they appear to have reference value). Example: In the April 1971 issue of *QST*, I made a card for the article "The Two-Meter Eggbeater." This card was then filed under *Antenna VHF*. Some articles call for more than one card. I have included a short synopsis of the article too. These cards are kept in a 3 x 5-inch file box for handy reference. The nice thing about this idea is that the file can be expanded to include more than just *QST* magazine. – *William D. Bowen, WB9EDJ*

[EDITOR'S NOTE: At the moment there are no plans to publish a quarterly or semiannual index. The space needed to do the job would require that some other part of the magazine be reduced (or eliminated) in these issues. The problem would compound itself several years hence when the reader would have to consult four different indexes each year in search of a particular article. Hq. maintains a cumulative index, however, covering the period from 1950 to 1970. It is available for 50 cents, postpaid. Although the publication is a reprint of the index in each December issue, it does put all of the indexes in one place and eliminates the necessity for cutting up the issues or filing them all together.]

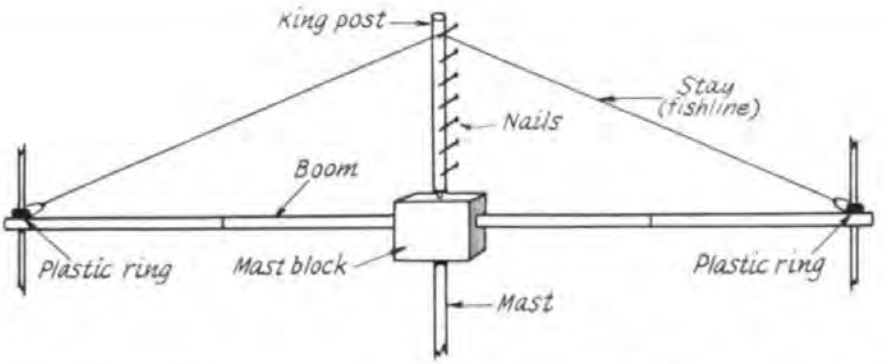
COILED CORD FOR THE SOLDERING IRON

There must be a special section of Murphy's Law covering soldering irons. No matter how carefully you set the iron down, you always end up burning holes in its cord – or the schematic that you are working on. One cure is to replace the present cord on your soldering iron with one of the coiled appliance cords available at electrical supply houses. The cords stretch out to five feet, but coil up to about nine inches when the iron is not in use. – *W1KLK*.

ANOTHER WAY TO REMOVE PARTS FROM PRINTED-CIRCUIT BOARDS

In a recent issue of *QST* there was a short article about saving parts from old printed-circuit boards.[1] I have a different way of doing the job. The foil on most boards is only a few thousandths of an inch thick and can be removed, along with the solder, using an emery sanding disc mounted in a hand drill. Most of the parts fall of the board during the sanding process. The few stubborn pieces can be removed easily with a small punch or soldering aid. – *Robert M. Patton, WA3HOW*

[1] Hints and Kinks, *QST*, May, 1971.

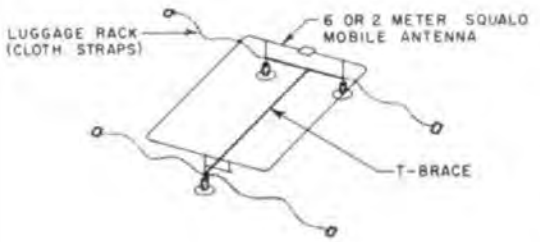


MORE ON THE TWO TOTER

The two-meter beam described in *QST* last month works fine as it is. However, it has been found that, in spite of being pinned, the boom section "plugs" become increasingly sloppy with use and the boom tends to droop. An effective remedy now used by the author is a king-post stay shown in the sketch. The king post is an 8-inch section of 3/8-inch dowel with a 1-inch 4-40 machine screw attached to one end. Hammer several nails or brads at 1-inch intervals up the side of the king post. The stay is a 4-foot piece of fishing line with small plastic rings tied to each end (ask the XYL for a couple of knitting markers). During antenna assembly, put the end elements through the plastic rings so that the rings rest between the element collets and boom. Screw the king post into the mast clamp. The wing screw mentioned in the article will not be needed. Now lift the stay until the boom is straight and hang the stay over a nail on the king post. – *W1CUT*

SQUALO MOUNTING

The Cush Craft 6- and 2-meter Squalos work well, but the method of auto roof-top mounting leaves a bit to be desired. Luggage-carrier straps, available from most automotive stores, can be used to hold the antenna in place, and the suction cups act as bumpers to keep from scratching the car. – *Dennis Silage, WB2LGJ*



TRANSMATCH ARCING

I built the Transmatch described in July 1970 *QST*. Some arcing occurred while running high power on 20 and 15 meters. The problem was corrected by grounding the unused supporting rods which hold the roller inductor together. – *Louis A. Gerbert, W8NOH*

VOX AND ALC PROBLEMS WITH THE SB-102

While troubleshooting my SB-102, I discovered that my homemade power supply was causing problems in the alc and VOX circuits. Hum in the cw tone oscillator triggered the VOX, even with the switch in the PTT position. A constant alc action, with no modulation applied, was caused by a low ripple in the voltage line. Heath's alc system samples variations in screen current and sees the ripple as a signal.

Both of these problems were cured by adding another filter section to the low-voltage supply. – *Steve Hocheiser, WA2QDJ*

Strays

QST congratulates . . .

Harvey L. Bryant, Jr., WA4LPM, elected president of the Beta Toastmasters Club of Norfolk, VA.

Richard Regent, K9GDF, selected for participation in the undergraduate research honors program in Stevens Point State University's physics department.

Lloyd Eberhart, K2CVT, upon his promotion to Associate Publisher, Magazine Division, Boy Scouts of America.

Leonard Jaffe, ex-K3NVS, NASA Deputy Associate Administrator, named a Fellow in the IEEE.

John Kitts, WB2TSX, recipient of the First Army Commander's Annual Mars Trophy for 1970.

Frank A. Gunther, W2ALS, named Chapter Man of the Month by the Armed Forces Communications and Electronics Association.

Marianne Payton, W3LQY, and Doris Dennstaedt, WA3HEN, recipients of the Department of the Army Certificate of Achievement Award.

Bishop Nevin W. Hayes, OA7Q, appointed as an Auxiliary to John Cardinal Cody, the Roman Catholic Archbishop of Chicago.

R. V. Raabe, W4ZV, upon receiving a plaque from the Richmond Amateur Radio Club for his 50 years of service to amateur radio.

Kenneth Richardson, ex-W6KMD, recipient of the Marconi Gold Medal from the Veteran Wireless Operators Association.

Paul R. Behrman, K3WEU, who received a letter from President Richard Nixon praising him for his volunteer ham radio work.

Katashi Nose, KH6IJ, who marks his 36th year writing the ham radio column for his local newspaper.

Celebrating Our Legacy

A Ham Radio Biography

In 1971, I earned my Novice-class license after spending several years on citizens band (CB) radio. After my high school graduation, a friend and I went to New York City to take our General- and Advanced-class license tests, and passed both exams.

The following year, I went off to college at the University of Central Missouri (UCM), where I briefly worked as a disc jockey and radio station engineer for UCM's radio station. I had an Austin America with a Swan Electronics mobile radio and a Hustler whip antenna with changeable coils for each band. I would drive to an elevated spot and get on the air.

After graduating from college, I married my wife, who I met on CB radio. Our shared interest in electronics caused us to join the United States Air Force (USAF), and I became a ground radio equipment repairman. After going through basic training together at the Keesler Air Force Base in Mississippi, we were assigned to the Minuteman Ballistic Missile Squadron, where we maintained the radios in one of the launch control facilities. The radios operated on the Survivable Low Frequency Communications System (SLFCS), HF, and UHF. I remember my first time at a launch control facility, about 100 feet below ground, testing the radios. On that particular day, we were unable to make contacts on the military frequencies used for testing, so I dialed into 20 meters and called CQ. This radio was about 500 W, fed into a huge rhombic antenna. For the first time, I immediately had a pileup from around the world. I made a few contacts, including one to a station in Russia.

After our time in the Air Force, we moved to Phoenix, Arizona, in 1980. I began working at Motorola as an engineering assistant, where I would build a pre-designed circuit on a board for testing. In 1983, I earned my Amateur Extra-class license and had a home station with an all-band vertical antenna.

In 1995, I moved to Memphis, Tennessee, where I currently reside. After finally having trees tall enough for a wire in my backyard, I installed a 10 – 80 meter end-fed dipole antenna, added an Ameritron ALS-600 amplifier and my Icom IC-746PRO, and had lots of luck operating.

In all my years in ham radio, 2016 was the most fun. I was very active in the ARRL National Parks on the Air (NPOTA) program and upgraded to an Icom IC-7300, which is the best radio I've ever owned. This allowed me to continue participating in NPOTA, which I still actively work today. Because of those programs, I was able to obtain the ARRL Triple Play WAS (Worked All States) Award.

I'm currently focused on DXCC and operate SSB, FT8, and CW, as well as beginning digital VHF/UHF with System Fusion and Digital Mobile Radio (DMR). DMR had a steep learning curve for me, but I'm having a blast!

Warren Zimmer, KC7ND
Bartlett, Tennessee
Life Member

Jean-Pierre Venembre's, F6BGV, AM station. [Jean-Pierre Venembre, F6BGV, photo]

An Early Love of Radio

Ever since I was 6 years old, I've been hooked on amateur radio. Growing up in Algeria, I was fascinated by my family's valve-operated broadcast receiver and would spend my time talking back to the announcer on Radio Algeria.

I eventually obtained my own crystal radio receiver and installed a wire antenna on the roof of the house (my parents were terrified). I built my first crystal-controlled transmitter when I was 14, and my first transmissions could be heard on all the neighboring farms.

When I was 18, I fired up my homebrewed station the day after Algeria's declaration of independence. I went on the air using the invented call sign AL2MD, because there were no regulations in place at that time. To my great surprise, I made contact with Bill, AL2VX/K1YPE (now SK), who turned out to be William J. Porter, the US ambassador to Algeria! In 1963, a group of friends and I set up the Association of Algerian Radio Amateurs (ARA). I was issued an official call sign in 1964.

I later moved to France, where I was issued the call sign F6BGV. While I'm still passionate about working DX, I also enjoy working AM with my homebrewed station.

Although I've never been professionally involved in radio, it has been a lifelong hobby!

Jean-Pierre Venembre, F6BGV
Bouillargues, France

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.

John Ellis, NP2B, john.np2b@gmail.com

Classic Radio

The All-Band Gotham V-80 Vertical

The Gotham V-80 vertical antenna was a simple, inexpensive, and uncomplicated antenna for the newbie and experienced ham alike, but not without a few caveats.

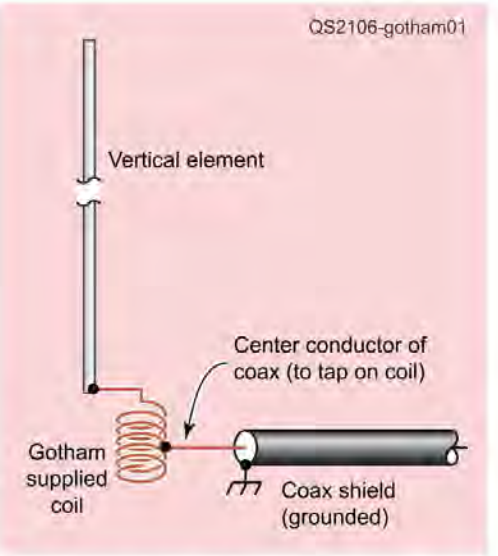


Figure 1 — A sketch of the Gotham V-80 vertical antenna.

Gotham's Background

The Gotham Antenna Company was formed in Gotham, New York, by Bob Weinstein, K3KXR (SK), and his brother, Harry. Bob and his wife moved to the warmer climate of south Florida in 1953, due to his wife's health. The company continued to operate into the 1970s, when it was sold. They were headquartered in Miami and specialized in manufacturing inexpensive antennas for the amateur radio market.

Gotham's V-80

The company's model V-80 vertical was their flagship product. Well-advertised and easily produced, it was their most popular antenna, and rightly so. At $16.95 plus shipping, it was very economical. Some folks were too afraid to buy the V-80, because it couldn't be high-quality at such a low price. Gotham also manufactured a model V-40 and a V-160, but those were basically the same as the V-80, just with changes to the coil stock.

The V-80 was 23 feet of aluminum tubing with a coil at the base, electrically similar to the flagpole antennas that are so popular these days (see Figure 1). While we use weatherproof remote-control automatic tuners today to tune our non-resonant flagpoles, back then, you had to go out into the freezing rain or snow and change the tap on the coil of your Gotham V-80 to switch bands. There were no such things as weatherproof automatic tuners available back then.

Contrary to popular belief, this little $17 antenna would work very well, if you used it with a decent counterpoise. Today, with our popular flagpole antennas, we spend some serious time and money putting hundreds of feet of wire into the ground. Few would consider doing that for such an inexpensive antenna, yet that would have been the thing that would have made this vertical work much better.

Advertisements

Gotham's advertisements were generally very non-technical in nature (see Figures 2 and 3). Few electrical or mechanical specifications were given, and there was little, if anything, that referred to RF grounding or lightning protection. Their advertisements primarily concentrated on who you could work with a Gotham antenna, how little power was used, how inexpensive the product was, and how easy it was to install. No actual performance specifications were included, and nothing was ever mentioned regarding structural integrity!

FACTS
ON THE GOTHAM V-80 VERTICAL

- If K6INI can do it, so can you.
- Absolutely no guying needed.
- Radials not required.
- Only a few square inches of space needed.
- Four metal mounting straps furnished.
- Special B & W loading coil furnished.
- Every vertical is complete, ready for use.
- Mount it at any convenient height.
- No relays, traps, or gadgets used.
- Accepted design—in use for many years.
- Many thousands in use the world over.
- Simple assembly, quick installation.

Figure 2 — Claims made in an advertisement from a 1959 issue of *QST*.

Some of the ads that ran in *QST* or *CQ* also claimed that the V-80 vertical required no radials. I'm not quite sure how they got by with that, because if there was ever an antenna that required a radial field or counterpoise, it was the V-80.

V-80 and SWR Meters

When Gotham first produced the V-80, there were no inexpensive SWR meters on the market. It wasn't until 1958 — when Heathkit came out with their inexpensive and easy-to-use SWR bridge for $14.95 — that many hams got their first look at how their antennas were really performing. Most transmitters of that genre had wide-range pi-network output circuits, and they had so much range that you could load a bedspring. Granted, the bedspring wouldn't work very well, but the transmitter would load it. It was pretty much of the same situation with the coil on the V-80. So, with the advent of the SWR bridge, it became much easier to find the right places on the coil to tap to achieve a low SWR on the desired band.

Gotham's Yagis and Quads

In addition to verticals, Gotham also produced Yagis and quads. The prices were incredibly low, but the quality and structural integrity required for longevity just wasn't there. Ordinary inexpensive non-stainless-steel hardware was used, the booms were very small in diameter, and the lightweight aluminum tubing supplied made for a fragile and droopy antenna. This would be similar to a three-element 20-meter beam with a 20-foot boom selling for only $22 (plus shipping), as listed in the June 1968 issue of *CQ* Magazine. Assuming the antenna was purchased in June 1968, $22 would be equivalent to $142.56 today.

Anyone who has ever seen a three-element 20-meter beam on the ground prior to being installed on a tower will attest to the fact that the antenna is big. Big means a lot of aluminum, and structural-quality aluminum isn't cheap. Stainless-steel hardware isn't cheap either. Buying a quality antenna of that size for such a low price seemed too good to be true — and it was.

Declining Reputation

Gotham subsequently earned a bad reputation over the years. The problems were not so much with the way the products worked, as the electronic theory was technically sound. However, the flimsy construction as a result of trying to meet a price point earned them a less-than-stellar reputation. The manuals that came with the antennas were sparse to say the least. There was little explanation about how the antennas worked or why a counterpoise was not needed for their verticals. Their marketing was primarily geared to newer hams with little practical antenna experience.

Little is known about what actually happened to Gotham. The market was taken over by Cushcraft, KLM, and others, while veteran manufacturers, such as Mosley and Hy-Gain, remained. Many still remember the Gotham antennas, their advertisements, where you could purchase an antenna, and how you could work the world for little more than pocket change.

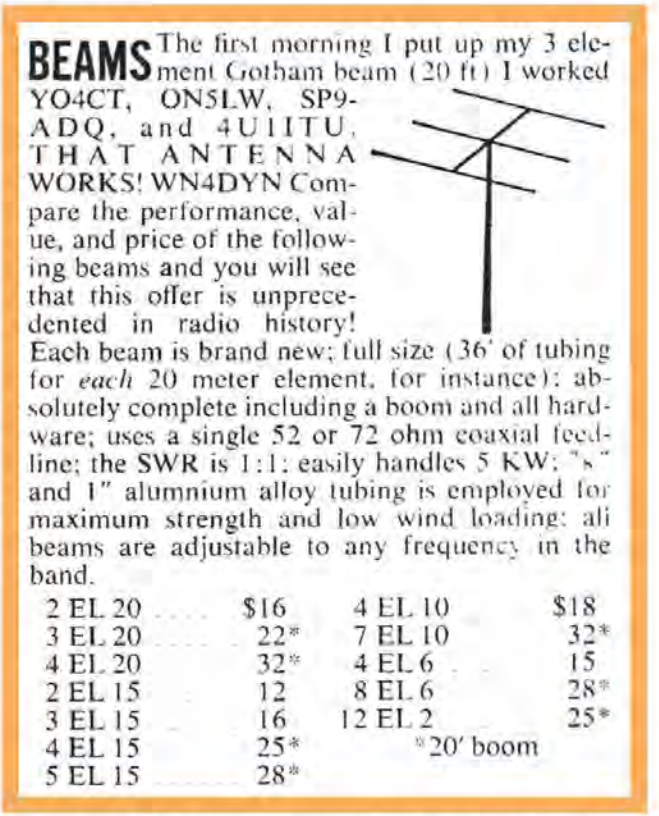


Figure 3 — An advertisement in a 1968 issue of *QST*. Note the price of the three-element 20-meter beam.

Al Brogdon, W1AB

100, 50, and 25 Years Ago

June 1921

- The cover art shows a ham looking over his station's equipment.
- The editorial, "The Aurora," notes how recent auroral effects disrupted amateur communications, and asks members to send copies of their logs for the disturbed period to ARRL Headquarters to determine the extent of the radio disruption.
- "A Receiving Tuner for C.W." points out that tuning in a CW signal is easier than tuning in a spark signal, and describes the tuner used by John Reinartz, 1QP.
- R. C. Denny, 6CS, provides Part 1 of "The Ideal Relay Spark Station."
- H. E. Bussey, 4AI, describes "A Radiophone Employing A.C. and a Chemical Rectifier."
- "Coming — The Static-Puncturing Contest!" urges hams to get on the air and overcome the summer static noise for the upcoming contest.
- A short item proclaims, "Amateurs Wanted to Join Signal Reserve Corps."

June 1971

- The cover photo montage shows K6UMV and WA6ZKL, two of the hams who were instrumental in performing post-earthquake communications in southern California.
- The editorial notes that, although 17,000 new hams joined the hobby, the total ham population remained the same as before, due to so many license expirations. It urges readers to promote amateur radio and recruit new hams.
- Doug DeMaw, W1CER, explains how to build a "High Performance 2-Meter Converter."
- Charles W. Schecter, W8UCG, wants hams to take their "First Steps in RTTY," by building the local-loop circuit.
- Douglas A. Blakeslee, W1KLK, provides detailed information on "Converting the GE MTS Progress-Line Transceiver for Amateur Service."
- Gordon H. Weiler, W9ZQK, shares how to build "A 42-Foot Crank-Up, Fold-Over Tower" like his.
- "The Southern California Earthquake" is a compilation of information sent to ARRL Headquarters of the communications work performed by hams following the earthquake.

June 1996

- The cover photo shows some of the antennas and towers of AA9D, one of the many multioperator groups who were active in the 1995 June VHF QSO Party.
- The editorial, "FCC Enforcement: Glimmers of Hope," reports that FCC enforcement of the amateur regulations has been lenient, but there's hope that will change.
- In "North Country Island-Hopping," John Reisenauer, Jr., NL7TB, reports on the activation of rare islands, such as Fox Island and Douglas Island (in Alaska) by Rick Kaplan, N6IV, and Larry Biederman, KF6XC.
- In "Electrical Safety," L. VanProoyen, K8KWD, provides an excellent review of safety basics.
- Hams looking for a small but powerful audio amplifier should read "SMALL: A Surface-Mount Amplifier that's Little — and LOUD!" by Sam Ulbing, N4UAU.
- Rick Lindquist, KX4V, shares advice on "Low-Power Transceiver Kits You Can Build."

Silent Keys

It is with deep regret that we record the passing of these radio amateurs:

•WK1B	**Letourneau**, Corinne P., Port Saint Lucie, FL
W1BFN	**Honer**, Arthur M. "Mike," Asheboro, NC
W1BFZ	**Shalna**, Anthony J., Jr., South Weymouth, MA
KD1CA	**Lauzon**, Dennis A., Woonsocket, RI
•KB1DRJ	**Andrews**, Raymond J., Jr., Norwich, CT
•WA1GEG	**Dumais**, Eleanor K., Marlborough, MA
WB1GSB	**Brown**, Donald T., Leicester, MA
K1JFD	**Dould**, John F., Athol, MA
W1JHU	**Reeves**, Alfred J., Ocala, FL
♦N1JL	**McAllister**, Joseph P., Cranston, RI
KB1JNY	**Wisniewski**, Robert A., New Haven, CT
N1JZO	**Chartier**, Robert P., Ware, MA
W1LJL	**Lizotte**, Leonard J., Newport, VT
KB1LUF	**Gregory**, James P., Jr., Manchester, CT
AB1PF	**Palochko**, Robert D., Glastonbury, CT
W1QW	**Angle**, Stacy L., Acton, MA
N1SJA	**Clinton**, David E., Kingston, MA
WA1SRX	**Rayne**, George F. "Fred," Jr., Lady Lake, FL
W1TKS	**Hieken**, Charles, Boston, MA
•W1TM	**Burmaster**, David E., Watertown, MA
AC2BX	**Van Etten**, David John, Canandaigua, NY
KK2C	**Kirmayer**, Thomas D., Jr., Norwalk, CT
K2DEM	**Moss**, David E., Columbia, KY
WA2DKJ	**Stillinger**, Andrew M., Chatham, NJ
KC2DTQ	**Jones**, Thomas T., Lake Katrine, NY
♦K2FL	**Heisey**, John M., Palmyra, NJ
WE2G	**Cody**, Thomas J., Stottville, NY
KA2GLG	**Nelson**, Ronald F., Pittsford, NY
WA2HGU	**McPartland**, William L. "Bill," Venice, FL
•W2IFA	**Groh**, Robert H., Wilkes-Barre, PA
♦•W2JRI	**Janowski**, Zenon J., Endwell, NY
W2JVF	**Dehn**, Rudolph A., Schenectady, NY
KB2KTD	**Trube**, Carolyn R., Long Beach, NJ
W2MEP	**Conlon**, William J., Jr., Cleveland, WI
K2ONP	**Wilner**, George D., Wall Township, NJ
KF2QA	**Peterson**, Donald R., Sun City, AZ
K2SQM	**Wyatt**, Joseph T., Venice, FL
K2SRX	**Jordan**, Edwin E., Sr., Massena, NY
K2SYW	**Jeffery**, Stuart S., Los Altos, CA
KC2TQU	**Depraida**, Michael J., Manhasset, NY
WA2VDO	**Mazzucca**, Val S., Wood Ridge, NJ
KB2VZP	**Wolfram**, Randy L., Algiers, LA
WA2YFL	**O'Brien**, David G., Rochester, NY
K2ZAA	**McIntyre**, Marvin H., Rochester, NY
KT3A	**Bailey**, Cameron C. R., Manchester, PA
WB3BGG	**Labor**, Charles S., State College, PA
N3BGN	**Bailey**, Kenneth K., Jr., Milton, FL
W3CEI	**Robbins**, Lawrence E., Middletown, PA
W3CR	**Ralph**, Charles E., Moline, IL
W3DYS	**Dury**, Frank J., Jr., Hartly, DE
W3EN	**Lang**, Ronald K., Malvern, PA
AA3GB	**Paul**, Eugene I., Spring Hill, FL
W3HAH	**Wicks**, Robert B., Carlisle, PA
W3HEA	**Hinds**, William G., Hilton Head, SC
N3HQF	**Norton**, William, Allentown, PA
•KB3IFK	**McGinley**, Andrew, Dundalk, MD
WB3JLK	**Sperling**, Richard L., Pittsburgh, PA
WD3L	**Burkland**, Harry L. "Moose," Mifflinburg, PA
N3MEF	**McGinnis**, Ralph E., II, Ligonier, PA
•WA3MIF	**Timmins**, Byron H. "Barry," Hummelstown, PA
K3MSH	**Funkhouser**, James H., Sr., Mechanicsburg, PA
N3RNJ	**Kearney**, William R., Dagsboro, DE
W3RT	**Thompson**, Emil T. "Red," Jr., Fairless Hills, PA
N3SXI	**Rice**, Dennis D., Allen Township, PA
K3UCR	**Orrin**, Mitchell E., Folsom, PA
KB3UIM	**Anderson**, Dennis C., Mercer, PA
♦W3WTO	**Mitchell**, Kent A., Hagerstown, MD
W4AHA	**Darden**, Holt, Jr., Columbus, GA
♦W4APV	**Eberwine**, James A., Saint Petersburg, FL
WD4AQV	**Mason**, John H., Naples, FL
WB4BAD	**Lindsley**, Nathaniel L., Lebanon, TN
W4CDR	**Kerr**, John T., Durham, NC
W4CFI	**Slaton**, James M., Vinemont, AL
K4CRT	**McDaniel**, Wyman L., Jr., Greenville, SC
KJ4DTH	**Newberg**, George E., Middleburg, FL
KF4ERE	**Gray**, Charles J., Virginia Beach, VA
WB4EZ	**Belvin**, John T., Church Road, VA
KK4FT	**Thompson**, Fred I., Rock Hill, SC
KF4HPY	**Cravey**, Edward J., Dacula, GA
W4IIQ	**Hucaby**, George R., Lexington, KY
K4ILH	**Neville**, George B., Dacula, GA
KJ4IOV	**Billings**, Daniel E., Elizabethtown, KY
KE4JIT	**Brown**, David W., Franklin, NC
KD4JPF	**Ford**, Roger D., Bowling Green, KY
KY4MA	**Adams**, Mitchell L., Island, KY
WA4MKO	**Schaffer**, Harold J. "Tink," Pfafftown, NC
WA4NOH	**York**, Vernon B., Columbia, KY
•WB4PDC	**Washington**, Zack W., Hampton, VA
♦N4PIB	**Jinkins**, John T. B., Nashville, TN
KD4POE	**Handy**, Joseph D., Fieldale, VA
W4RHY	**Schwarz**, Lawrence H., Fayetteville, NC
WB4RQD	**Ellison**, Bobby, Williston, FL
KM4RSC	**Wilson**, Samuel E. "Ed," Palm Coast, FL
K4SFI	**Reed**, Robert W., Charlotte, NC
♦•WB4SSP	**Welker**, Daniel W., Hollywood, FL
W4TVH	**Henson**, Bobby B., Huntsville, AL
KX4TY	**Winberg**, Jack Sherwin, Sarasota, FL
KC4VKV	**Britton**, Harold V. "Hal," Panama City, FL
KC4WFN	**Love**, George M. "Marshall," Jr., Bowling Green, KY
•KB4WIC	**Bodine**, Robert L., Jr., Melbourne, FL
W4WLW	**Wilson**, Walter L., Lexington, NC
WB4WOM	**Rogers**, Boyce G., Jr., Rural Hall, NC
KQ4ZB	**Davis**, Glenn A. "Pappy," Sylacauga, AL
KG5BOG	**Tallent**, Robert W., Sr., Texarkana, TX
WD5DYV	**Fitts**, Alexander, Jr., Abilene, TX
K5DZP	**Connell**, Kenneth C., San Angelo, TX
WA5EEP	**Coston**, Felton W. "Wayne," Sr., Durant, OK
KA5LLJ	**Simmons**, Bruce W., Wilmer, LA
•N5LQD	**Malehorn**, Gary R., Baton Rouge, LA
KC5PTG	**Stuckey**, Daniel A., Jacksonville, AR
KF5QIK	**Roberts**, Michael D. "Mike," Elida, NM
K5REK	**Clements**, Calvin J., Lubbock, TX
KA5UDF	**McAfee**, Thomas A., Corinth, MS
KF5VHB	**Matlock**, James K., Sapello, NM
W5VYY	**Gammon**, John F., Lucas, TX
WB5YPE	**Stephens**, David W., Corpus Christi, TX
KG5ZI	**Jones**, Thomas D., Huber Heights, OH
KB6AH	**Pieper**, Hans D., Prescott, AZ
WA6COT	**Dunlap**, Clarence E., Thousand Oaks, CA
KH6CTQ	**Demmer**, Peter L., Chiloquin, OR
WA6IO	**McKeown**, James R., Redding, CA
KA6QLQ	**McNew**, James R. "Jim," Bakersfield, CA
•WA6RLW	**King**, Dana W., Visalia, CA
KK6WHO	**Fukuchi**, Stephen M., San Jose, CA
K6WRF	**Reynolds**, David R., Woodland, CA
♦W6XD	**Goddard**, Arthur E., Costa Mesa, CA
WR7A	**Laconto**, Edward W., Tucson, AZ
♦W7ACD	**Doty**, Archibald C. "Arch," Jr., Portland, OR
KD7BCG	**Fox**, Roy L., Salem, OR
N7DDR	**Funk**, Marjorie E. "Peggy," Cottonwood, AZ
W7DQU	**Napper**, David H., Idaho Falls, ID
WB7DSM	**Millbauer**, Donald M. "Don," Bothell, WA
K7EOG	**Skinnell**, James F., Phoenix, AZ
W7FGB	**Hecox**, Donald L., Bozeman, MT
KC7GZC	**Richins**, Dennis J. "Joe," Ammon, ID
W7JE	**Evans**, J. D., Ellensburg, WA
WA7JLA	**Peterson**, Donald A., Great Falls, MT
KI7JZZ	**Keemer**, Bruce D., Sandy, UT
KE7MVO	**Austin**, James W., Yuma, AZ
WB7NML	**Williams**, Lewis N., Oregon City, OR
N7NUV	**Ross**, Donna D., Vancouver, WA
♦KL7PA	**Arvin**, Paul G., Sitka, AK
WB7TNH	**Heyde**, Joseph P., Great Falls, MT
WA7VAK	**Freshwater**, Frank E., Naches, WA
N7VRW	**Olson**, Dale O., Cottonwood, AZ
W7WE	**Emerson**, Ralph H., Reno, NV
•WA7ZGK	**Robinson**, Richard T., Hudson, MA
WB8ACU	**Simashkevich**, James C., Amherst, OH
K8AQZ	**Firlik**, Donald F., Grand Rapids, MI
N8BES	**Niswander**, Larry V., Findlay, OH
KC8CNT	**Hurd**, Walter L., Marengo, OH
WD8CPW	**Long**, Willard G. "Skip," Chillicothe, OH
K8EMT	**Kirklin**, James D., Kalamazoo, MI
KC8HJG	**Benson**, Barbara L., Middletown, OH
KE8IC	**Pieri**, Denis J., Richwood, WV
KE8KKU	**Sigley**, Shannon B., Richwood, WV
KD8L	**Weimer**, Charles A., III, Florence, KY
•N8OUX	**Post**, Herman B., Jr., Salt Lake City, UT
•KD8PQF	**Langerman**, Paul T., Hendricks, WV
KD8PZK	**Hayes**, William C. "Bill," Sparta, MI
K8RJM	**McFadden**, Robert J., Cuyahoga Falls, OH
K8SHX	**Panicci**, Vincent T., Morley, MI
•KB8SL	**Clark**, William G., Marion, OH
KC8ZI	**Coolidge**, Thomas E., Elida, OH
WA9AIU	**Reno**, Douglas I., Zion, IL
K9CMO	**Engdale**, Arvid C., Alton, IL
•KB9CSO	**Williams**, Paul A. "Goose," Edinburgh, IN
KF9FB	**Kocar**, Jerome F., Lufkin, TX
WD9FMI	**Roggenkamp**, Bruce, Seminole, FL
KC9HHH	**Nicholson**, Roger A., Richland Center, WI
♦K9HYZ	**Ceney**, Frank A., Jr., Hillsboro, IL
♦WB9IJZ	**Garton**, Michael D., Eau Claire, WI
W9JMY	**Mudd**, Clemence P., Jr., Belleville, IL
W9KBD	**Reynolds**, Gary R., Federal Way, WA
♦W9KX	**Nold**, Dean E., Delray Beach, FL
W9LIO	**Spears**, Lionel, Gary, IN
K9PLG	**Goslin**, Paul, Greendale, IN
KB9QFD	**Bradley**, Ambus W., Jr., Metropolis, IL
WA9SXN	**Dal Santo**, Dennis J., Suamico, WI
♦K9WRU	**Mushel**, Lee A., Gays Mills, WI
K9ZPT	**Jansma**, Louis, Waupun, WI
KDØAES	**Golden**, James W., Nevada, MO
KØAYF	**Shye**, Michael J., Washington, MO
WAØAZA	**Ives**, Robert, Saint John, KS
KCØCIO	**Noon**, Virginia M., Wichita, KS
KAØFGY	**Coughlin**, Joseph F., Colorado Springs, CO
KEØIUV	**Brayton**, Duane W., Prescott, AZ
•KCØKAC	**Olson**, Robert A., Fort Pierce, FL
NØKJ	**McCall**, Bill M., Ames, IA
KØMPD	**Wykoff**, Russell D., Farmington, NM
WAØNMK	**Johnson**, Winton F., Red Wing, MN
♦WØRA	**Colby**, Ted W., Jr., Lewisville, TX
♦WØUD	**Wood**, Robert W., Vermillion, SD
NWØX	**Trotter**, Charles F. "Bud," Fort Madison, IA
WØXII	**Heald**, Robert L., Jefferson City, MO
NØYCJ	**Sprout**, Lois E., Elgin, NE
KCØYEE	**Stanga**, Michael M., Otsego, MN

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• 1.2kHz "Optimum" roofing filter • New local oscillator design • Improved phase noise • Improved spectrum scope • Dual scope function • Enhanced mouse operation for spectrum scope

IC-7300 | *HF/50MHz Transceiver*

• RF Direct Sampling System • New "IP+" Function • Class Leading RMDR and Phase Noise Characteristics • 15 Discrete Band-Pass Filters • Built-In Automatic Antenna Tuner

IC-7610 | HF/50 MHz *All Mode Transceiver*

• Large 7-inch color display with high resolution real-time spectrum scope and waterfall • Independent direct sampling receivers capable of receiving two bands/two modes simultaneously

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IC-705 | HF/50/144/430 MHz *All Mode Transceiver*

• RF Direct Sampling • Real-Time Spectrum Scope and Waterfall Display • Large Color Touch Screen • Supports QRP/QRPp • Bluetooth® and Wireless LAN Built-in

IC-7100 | *All Mode Transceiver*

• HF/50/144/430/440 MHz Multi-band, Multi-mode, IF DSP • D-STAR DV Mode (Digital Voice + Data) • Intuitive Touch Screen Interface • Built-in RTTY Functions

IC-2730A | *VHF/UHF Dual Band Transceiver*

• VHF/VHF, UHF/UHF simultaneous receive • 50 watts of output on VHF and UHF • Optional VS-3 Bluetooth® headset • Easy-to-See large white backlight LCD • Controller attachment to the main Unit

ID-5100A Deluxe

VHF/UHF Dual Band Digital Transceiver

• Analog FM/D-Star DV Mode • SD Card Slot for Voice & Data Storage • 50W Output on VHF/UHF Bands • Integrated GPS Receiver • AM Airband Dualwatch

ID-4100A | *VHF/UHF Dual Band Digital Xcvr*

• Compact, Detachable Controller for Flexible Installation • DV/FM Near Repeater Search Function • Apps for iOS™ and Android™ devices • Wireless Operation with VS-3 & UT-137 Bluetooth® Headset & Module • MicroSD Card Slot

IC-2300H | *VHF FM Transceiver*

• 65W RF Output Power • 4.5W Audio Output • MIL-STD 810 G Specifications • 207 alphanumeric Memory Channels • Built-in CTCSS/DTCS Encode/Decode • DMS

IC-V86 | *VHF 7W HT*

• 7W OutputPower Plus New Antenna Provides 1.5 Times More Coverage • More Audio, 1500 mW Audio Output • IP54 & MIL-STD 810G–Rugged Design Against Dust & Water • 19 Hours of Long Lasting Battery Life • 200 Memory Channels, 1 Call Channel & 6 Scan Edges

IC-R30 | *Digital/Analog Wideband Xcvr*

• 100 kHz to 3.3 GHz Super Wideband Coverage • P25 (Phase 1), NXDNTM, dPMRTM, D-STAR Mode • 2.3" Large LCD Display & Intuitive User Interface • MicroSD Card Slot for Voice & Data Storage • USB Charging & PC Connection

NEW

ID-52A | *VHF/UHF D-STAR Portable*

• Bluetooth® Communication • Simultaneous Reception in V/V, U/U, V/U and DV/DV • Enriched D-STAR® Features Including the Terminal Mode/Access Point Mode • UHF (225~374.995MHz) Air Band Reception

Prerelease. This device has not been approved by the F.C.C.

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• Hybrid SDR Configuration • Unparalleled 70 dB Max. Attenuation VC-Tune • New Generation Scope Display 3DSS • ABI (Active Band Indicator) & MPVD (Multi-Purpose VFO Outer Dial) • PC Remote Control Software to Expand the Operating Range • Includes External Power With Matching Front Speaker

FTDX10 | *HF/50MHz 100 W SDR Transceiver*

• Narrow Band and Direct Sampling SDR • Down Conversion, 9MHz IF Roofing Filters Produce Excellent Shape Factor • 5" Full-Color Touch Panel w/3D Spectrum Stream • High Speed Auto Antenna Tuner • Microphone Amplifier w/3-Stage Parametric Equalizer • Remote Operation w/optional LAN Unit (SCU-LAN10)

FT-991A | *HF/VHF/UHF All ModeTransceiver*

Real-time Spectrum Scope with Automatic Scope Control • Multi-color waterfall display • State of the art 32-bit Digital Signal Processing System • 3kHz Roofing Filter for enhanced performance • 3.5 Inch Full Color TFT USB Capable • Internal Automatic Antenna Tuner • High Accuracy TCXO

FTDX101D | *HF + 6M Transceiver*

• Narrow Band SDR & Direct Sampling SDR • Crystal Roofing Filters Phenomenal Multi-Signal Receiving Characteristics • Unparalleled - 70dB Maximum Attenuation VC-Tune • 15 Separate (HAM 10 + GEN 5) Powerful Band Pass Filters • New Generation Scope Displays 3-Dimensional Spectrum Stream

FT-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

FTM-300DR | *C4FM/FM 144/430MHz Dual Band*

• 50W Reliable Output Power • Real Dual Band Operation (V+V, U+U, V+U, U+V) • 2-inch High-Res Full Color TFT Display • Band Scope • Built-in Bluetooth • WiRES-X Portable Digital Node/Fixed Node with HRI-200

FT-2980R | *Heavy-Duty 80W 2M FM Transceiver*

• Massive heatsink guarantees 80 watts of solid RF power • Loud 3 watts of audio output for noisy environments • Large 6 digit backlit LCD display for excellent visibility • 200 memory channels for serious users

FT-818ND | *HF/6M/2M/440 All Mode Portable Xcvr*

• Ultra-Compact/Portable • Multi-Color Easy to See LCD • 208 Memory Channels/10 Memory Groups • Built-in Electronic Keyer • Internal Battery Operation Capability • Two Antenna Connectors • Built-in High Stability Oscillator ±0.5 ppm

FTM-400XD | *2M/440 Mobile*

• 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

FT-65R | *144/430 MHz Transceiver*

Compact Commercial Grade Rugged Design • Large Front Speaker Delivers 1W of Powerful Clear Audio • 5 Watts of Reliable RF Power Within a compact Body • 3.5-Hour Rapid Charger Included • Large White LED Flashlight, Alarm and Quick Home Channel Access

FT-60R | *2M/440 5W HT*

• Wide receiver coverage • AM air band receive • 1000 memory channels w/alpha labels • Huge LCD display • Rugged die-cast, water resistant case • NOAA severe weather alert with alert scan

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HAM-VI – $809.95 with DCU-2
HAM-VII – $959.95 with DCU-3

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 SERIES II – $869.95

For Large Medium Antenna Arrays up to 20 sq. ft. wind load.

Has 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 box, triple bearing race with 138 ball bearings for large load bearing, electric locking steel wedge brake, North/South center of rotation scale meter, low voltage control, $2^{1}/_{16}$" max mast. **MSHD, $139.95**. Above tower heavy duty mast support. T2X, HAM-IV, HAM-V, HAM-VI. Accepts $1^{7}/_{8}$-$2^{5}/_{8}$" OD.

T-2XD2 – $979.95 with DCU-2
T-2XD3 – $1039.95 with DCU-3

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 bearings**
Mounting Hardware	Clamp plate/steel U-bolts
Control Cable Conductors	**8**
Shipping Weight	31 lbs.
Effective Moment (in tower)	**3400 ft.-lbs**

CD-45II – $499.95

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.

CD-45D2 – $599.95 with DCU-2
CD-45D3 – $659.95 with DCU-3

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 bearings**
Mounting Hardware	Clamp plate/steel U-bolts
Control Cable Conductors	**8**
Shipping Weight	22 lbs.
Effective Moment (in tower)	**1200 ft.-lbs**

New!

Hy-Gain Programmable DCU-3 Digital Rotator Controller

DCU-3 – $499.95

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 – $459.95
Like DCU-3, but less programmable memories. 110 VAC. Order **DCU-2X**, for 220 VAC.

AR-40 – $399.95

For compact antenna arrays and large FM/TV up to 3.0 square feet wind load area.

Dual 12 ball bearing race. Automatic position sensor never needs resetting. Fully automatic control -- just dial and touch for any desired location. Solid state, low voltage control, safe and silent operation. $2^{1}/_{16}$ inch maximum mast size. MSLD light duty lower mast support included.

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 U-bolts
Control Cable Conductors	**5**
Shipping Weight	14 lbs.
Effective Moment (in tower)	**300 ft.-lbs**

Replace your Yaesu Rotator Controller

YRC-1 – $369.95

Hy-gain YRC-1 – more features, more robust, far less prone to lightning damage. Costs less than repairing!

Easy-to-use -- dial in your beam heading and tap GOTO button. Exclusive 180 degree *AutoReversal*™ for fast longpath operation. All DCU-2 features. Bright blue LCD shows current, dialed-in, computer controlled beam headings, call. USB port for computer control. Extra heavy-duty AC power supply. Fast variable DC motor minimizes overshoot. Intuitive menu. Field upgradeable. For Yaesu G-800/1000/2800/G450/650. AC or DC motors.

YRC-3, $449.95. Like YRC-1 and adds 6 memories.

AR-500 Rotator/Controller – $169.95

UHF/VHF/6-Meter, MFJ-1886 Rotator/Controller and Remote. For use of small VHF/UHF, 6M, TV, FM, the MFJ-1886 wide band receiving loop and other lightweight ham antennas. Rotator is built in a weatherproof one piece cast aluminum housing with precision all metal gears, steel thrust bearings and automatic braking. Includes rotator, controller, remote, clamps, and all hardware.AR-500 remembers up to 12 directions even after a power outage! Use remote control or direct console. Displays location and relative position.

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Got Noise?!

MFJ has answers

Noise-Cancellers Wipe Out Interference

Null out all types of noise!!! Severe power line noise from arcing transformers and insulators, fluorescent lamps, dimmers, touch controlled lamps, computers, TV birdies, lightning, garage door openers, electric drills, motors, industrial processes. It's much more effective than a noise blanker because interference much stronger than a desired signal can be completely removed without affecting the desired signal. All modes -- SSB, AM, CW, FM, frequences from BCB to lower VHF.

Null out strong QRM on top of weak rare DX ! Null out a strong local ham or AM broadcast station to prevent your expensive receiver from overloading.

Use as an adjustable phasing network. Combine two antennas to give you a powerful receive station and have a variety of directional patterns.

MFJ-1026 **$239.95**

MFJ-1026 simply plugs between your transmitting antenna and your transceiver. To null, you adjust the amplitude and phase potentiometer controls for a minimum S-meter reading or low noise. To peak, push reverse.

Use built-in active or external antenna. *Constant Amplitude Phase Control*™ makes nulling super easy -- snag that rare DX you have missed.

RF-sense T/R switch auto bypasses your rig when you transmit. Adjustable T/R delay time. Use 12 VDC or 110 VAC with **MFJ-1312D, $19.95**. 6½X1½X6¼ inches.

MFJ-1025, $209.95. Like MFJ-1026, less the built-in active antenna. Use external antenna connection.

MFJ *Ultrasonic* Receiver with parabolic reflector *pinpoints* power line noise

HF and VHF operation can be affected by noise, makes it hard to hear weak stations, adds to fatigue. Often, noise comes from power lines. Power companies are willing to help with issues, but don't have equipment or trained personnel to locate it. MFJ aids in finding noise generated by corona discharge and arcing components. Acoustic receiver is tuned to 40 KHz. 18" diameter plastic dish gives a narrow beamwidth to pinpoint noise sources less than 12" at 50 feet. Also listen to nature: bats, birds, and insects!

MFJ-5008 **$199.95**

MFJ Power Line Noise Finder

MFJ-852 **$139.95**

Walk or drive around with these *handheld* power line noise meters to search out leaky insulators, loose hardware and corroded ground lines quickly. Track noise right down to the pole,transformer or insulator, or other source. Operates in 135 MHz region where activity is minimum and radiation from corona/arcing is more localized. 0.3 uV sensitivity and wide-range AGC for noise level meter -- *over 70 dB!*

MFJ-1767, $99.95. Adds 3-element beam to MFJ-852.

MFJ-856, $179.95. Combination of MFJ-852 noise finder and MFJ-1767 three-element beam antenna.

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 the 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 high dynamic range, low IMD and 25 dB of low noise gain. Use inside or outside.

MFJ-1886 **$289.95**

Receive Loop with Biastee

Reduce Harmonics, Avoid TVI with MFJ Low Pass Filters

Suppress TVI, RFI, telephone, other interference by reducing unwanted harmonics to your antenna. Your HF signal still passes through with low loss so you snag that rare DX! *Keep the wife and neighbors happy!*

MFJ-702B, $44.95. 200W. SWR below 1.5 to 30 MHz.

MFJ-704, $109.95. 1500W. SWR below 1.3 to 30 MHz.

MFJ-705, $159.95. 2500W. SWR below 1.3 to 30 MHz.

MFJ Clamp-on RF Ammeters

MFJ-854 **$139.95**

Clamp-On RF Ammeters quickly snap over wires and cables to measure RF currents flowing in antenna elements, radials, ground wires and on outside of coax. Tune counterpoises, radials, ground systems. Study/optimize antennas for peak performance. Find peaks/nulls. MFJ-854 has five calibrated ranges to 3 Amperes, including sensitive 30 mA range.

MFJ-853, $69.95. Like MFJ-854, Ranges: 0.3, 1, 3 A. Mini size.

MFJ-853H, $79.95. 3/10/30 A ranges.

MFJ-805, $119.95. Check RFI on cables up to 1/4" dia. VLF to VHF.

MFJ AC Line Filter/Protector

MFJ-1164B **$89.95**

Filters and reduces AC power line RFI, hash, noise, transients, surges generated by computers, motors, RF transmitters, static/lightning by 30 db and up to 60-80 dB with ground. Fast, *nano-second* overvoltage protection. Provides inductive isolation, capacitive decoupling, RFI rejection, overvoltage protection of common mode, differential signals. Rejects/shunts undesired signals to ground. 12Wx3½Hx2D".

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MFJ-700A4, $14.95. .275" diameter 4-Pack
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NES10-2MK4

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Operate 80-10 or 40-10M with tuner. 14 gauge, 7-strand copper antenna wire. 1.5kW. 32.5' ladder line matching section with SO-239 for coax.
MFJ-1778, $69.95. 80-10M. 102 feet long.
MFJ-1778M, $59.95. 40-10M. 52 feet long.

End Fed Half Waves

Operate 80-10 or 40-10M with one support/no tuner.
80-10 Meters, 132 feet:
MFJ-1982HP, $109.95. 800 Watts.
MFJ-1982MP, $79.95. 300 Watts.
MFJ-1982LP, $59.95. 30 Watts.
40-10 Meters, 66 feet:
MFJ-1984HP, $89.95. 800 Watts.
MFJ-1984MP, $69.95. 300 Watts.
MFJ-1984LP, $49.95. 30 Watts.

Off Center Fed Dipoles

Lightweight, virtually invisible. Gives you directivity and gain (*see MFJ website*).
MFJ-2012, $89.95, 40/20/10/6 Meters, 1500 Watts. 67 ft.
MFJ-2010, $69.95. 40/20/10/6 Meters, 300 Watts. 67 ft.
MFJ-2014, $119.95. 75/40 Meters, 1500 Watts. 122 ft.
MFJ-2016, $149.95. 160/75/40 Meters, 1500 Watts. 240 ft.
MFJ-2013, $89.95. 60/30 Meters, 300 Watts. 86 ft.

Dual Band 80/40 or 40/20 Dipoles, 1.5 kW

MFJ-17758, $109.95. 80/40 Meters, 95 feet long, ultra-efficient end-loading on 80 Meters. No tuner needed. Super-strong center insulator, built-in SO239, hanghole.
MFJ-17754, $69.95. 40/20M, 42 ft.

MFJ All Band Doublet

MFJ-1777, $79.95.102 foot, 160-6 Meters with tuner/balun. *Extremely low feedline loss.* Super strong fiberglass center insulator provides stress relief for included 100 feet ladder line. *Ceramic* end insulators. 1500 Watts SSB/CW/Digital.

MFJ 1.5 kW Dipoles

7-strand, 14-ga. copper wire.*Ceramic* insulators. Center insulator with SO-239
MFJ-1779C, $39.95. 20-6M, 35 feet.
MFJ-1779B, $59.95. 80-40M,135 feet.
MFJ-1779A, $79.95. 160M, 265 feet.

20M Extended Double Zepp

MFJ-1742, $99.95. See web for gain. 90 ft. long, 100 ft. ladder line. 7-strand, 14-ga. wire. 80-10M with tuner/balun. 1500 Watts SSB/CW/Digital.

80M End-Fed Zepp

MFJ-1748, $99.95. 125 feet long, 100 foot ladder line included. 7-strand, 14-ga. wire. Use tuner/balun. 1500 Watts SSB/CW/Digital.

MFJ Vertical Mounted Antennas

MFJ 6-Band Cobweb Antenna

MFJ-1836H, $299.95. Six-bands: 20/17/15/12/10/6 Meters, 1.5 kW. *Perfect for restricted space.* Nearly invisible. 9x9x1/2 feet, 8 lbs. Outstand-ing performance! Horizontally polarized gives less noise, more gain over verticals. Omni-directional. No radials needed! Works great at low heights. Low SWR.
MFJ-1836, $269.95. Like MFJ-1836H, but 300 Watts.

MFJ *4-Band* Dipole Octopus Antenna

***Octopus** antenna hub turns hamsticks into four balanced* HF/VHF/UHF *dipoles!* Rotate for maximum signal, minimum QRM/noise. Mount low for local NVIS, high for DX. Perfect for portable, limited space, HOAs, camping, ARES. Balun. No tuner needed.
MFJ-2104, $289.95. Includes 8 hamsticks for 75/40/20/15 M.
MFJ-2100, $119.95. Hub only. Use eight hamsticks.

MFJ Multi-Band Verticals, no radials needed!

Low angle radiation lets you easily work far-away, rare DX!
Efficient end loading gives maximum radiated power.
1500 Watts SSB/CW/Digital. Low SWR. Omni-directional. No radials or antenna tuner needed.
Low profiles blend into any surroundings. Mount them anywhere ground level, roof tops, apartments, houses, small lots.
Efficient high-Q coils. High power air-wound choke balun.
Built-to-last. Solid fiberglass rod, aircraft aluminum tubing.
5 models: Choose your bands 80-2 Meters
MFJ-1796, $339.95. 6 bands: 40/20/15/10/6/2M, 12 feet.
MFJ-1797, $369.95. 7 bands:40/30/20/17/15/12/10M. 23 ft.
MFJ-1797LP, $339.95. Like MFJ-1797, but only 9 feet tall. Narrower bandwidth on 40 Meters.
MFJ-1799, $449.95.10 bands: 80/40/30/20/17/15/12/10/6/2M. 20 ft.
MFJ-1799X, $399.95. Like MFJ-1799, but less 80M.

MFJ 43-foot Vertical, 160-6 Meter

MFJ-2990,$399.95. High performance 43 foot vertical operates 160-6 Meters, 1500 Watts SSB/CW/Digital. 2 square feet wind load. Self-supporting, no guy wires needed. 6063 aircraft aluminum tubing, bottom section 2" OD, .120" wall thickness. 20 lbs. Requires antenna tuner, ground/counterpoise.

BigStick ™ Vertical

MFJ-2286, $119.95. 7-55 MHz, *full 1/4 wave* 20-6M, 40M coil. 17 ft. extended, 28" collapsed. 2 lbs. 1 KW. Mount, radial kit included.

BigEAR ™ Dipole

MFJ-2289, $209.95. 7-55 MHz. *Full-size* 20-6 Meter dipole, 40M air loading coil. Two 17 ft. telescopic whips, 28" collapsed.

MFJ-915, $39.95 RFI Isolator

Prevents unwanted RF from traveling on your coax shield into your expensive transceiver. Prevents painful RF "bites" and erratic operation. 1.5 kW. 1.8-30 MHz.

MFJ-918, $39.95 4:1 Balun

True 1:1 current balun/center insulator. High-permeability ferrite beads on RG-303 *Teflon*(R) coax. 2" dia.x6" long. 14 gauge 7-strand copper wire. 1.5 kW 1.8-30 MHz.

MFJ-913, $39.95, 300W
MFJ-919, $69.95, 1.5 kW

True 4:1 current baluns/antenna center insulators transform 200 ohms to 50 ohms, 1.8-30 MHz. Transmission line transformer, low permeability ferrite cores, SO-239, stainless steel hardware with direct 14 gauge stranded copper wire to antenna.

Lightning surge protectors

MFJ-270, $24.95. 400W.
MFJ-272, $39.95. 1500W.
Gas discharge tube shunts 5000 amps peak.< 0.1 dB loss. 1 GHz. SO-239s.

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The Alpha Delta TT3G50 Series Coax Surge Protector Design Concept

It was previously thought that lightning discharge energy was in the VLF, Very Low Frequency, spectrum and that a narrow band bandpass DC blocked surge protector in that range provided adequate protection.

However, in a study under the auspices of the U.S. Department of Energy utilizing the satellite FORTE carrying VHF lightning discharge sensors, it was determined that there can be damaging lightning energy emissions throughout the 30-300 MHz VHF spectrum. Therefore the damage threat can be anywhere from VLF through VHF.

Through careful design of the **Alpha Delta Model TT3G50 series broadband** precision constant impedance thru-line and ARC-PLUG™ module, allowing proper firing characteristics, this state of the art surge protector design allows effective protection throughout this entire spectrum.

- **Depending** on the connector style we provide excellent broadband performance through **3 GHz**, compared to narrowband DC blocked designs.
- **The impedance** compensated thru-line cavity design allows control voltages to pass through the device, instead of the "wire around" requirement of DC blocked designs. Our design also allows in circuit cable sweeps.
- **The innovative** field replaceable gas tube ARC PLUG™ module can be removed and replaced in the field with no tools required and without removing the surge protector from the circuit. The knurled knob does the trick. Connectors and knob are O ring sealed for environmental protection.
- **DC blocked** designs require the entire unit to be removed and discarded if hit with a surge beyond its rating. They are not field repairable.
- **As a result** of extensive testing and approvals within the military agencies, the Defense Logistics Agency (DLA) has assigned NSN numbers to our devices. Cage Code 389A5. All of our products are manufactured in the U.S.A. in our ISO-9001 certified facility for highest quality. Various connector styles available.

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www.alphadeltaradio.com
for product technical details, installation requirements, pricing, dealers and contact information

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, $99.95. 33 ft., light duty w/top tie ring.
MFJ-1911, $109.95. 20 ft., light duty w/top tie ring.
MFJ-1913, $109.95. 28 ft., lightweight w/top tie ring.
MFJ-1915, $149.95. 25 ft., for heavier duty use.
MFJ-1916, $179.95. 34 ft., for heavier duty use.
MFJ-1917, $189.95. 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, $289.95 is 48' ext., 7.75-ft. collapsed, has 2½" OD bottom, 1" OD top, seven 7.75-ft. sections, 24 lbs.
MFJ-1906HD, $249.95 is 38' extended, 6 feet collapsed, has 2½" OD bottom, 1" OD top, seven 6-foot sections, 24 lbs.
MFJ-1904HD, $179.95 is 25' extended, 4 feet collapsed, has 2½" OD bottom, 1" OD top, seven 4-foot sections, 14 lbs.
MFJ-1904H, $159.95. 22' ext., 5' collapsed, 9 lbs. 2½" OD.
MFJ-1902H, $139.95, 10' ext., 38" collapsed, 5 lbs. 2½" OD

Standard Models: H models have QuickClamps™

MFJ-1906, $159.95/MFJ-1906H, $219.95, 33 feet, ext., 6 ft. collapsed, six 6-ft. sections, 13 lbs. 2" bottom, 3/4" top OD.
MFJ-1908, $199.95/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, $79.95. Mount clamps mast to mounting pipe.
MFJ-13, $69.95. 5 Military Quick*Clamps*™. Fit 3/4" to 2" OD.
MFJ-13HD, $69.95. Extra set clamps, 1- 2½" masts.

Mast Guy Ring Sets

Fits masts 3/4" to 1¼" dia OD. **MFJ-2830X, $9.95,** *fiberglass*; **MFJ-2840X, $12.95,** *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, $179.95. ***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, $109.95. **MFJ-1918** *tripod with 9.5 ft. telescoping fiberglass mast.* 3.8 feet collapsed. 6.5 lbs.

Tripods Only

MFJ-1921, $199.95, *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, $109.95, *Large tripod* base spreads to 4.8 ft. Support 100 pounds. 7.8 ft, 9.75 lbs.

MFJ-1918, $69.95, *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
$119.95
40-6 Meters

MFJ-2982
$169.95
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.

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$24.95

3/8-24 Hamstick Mount

MFJ-342T **$15.95** Mount 3/8-24 HF/VHF hamsticks vertically or horizontally on masts to 1 inch. Built-in SO239.

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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, $34.95. 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.

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MFJ new VirtualAntenna™ Memory system gives you 4 antenna memory banks for each of 2 switchable antenna coax connectors. Select up to 4 antennas on each antenna connector. Each antenna has 2500 memories, 20,000 total. Has binding post for end-fed long wire antennas.

MFJ-998 $739.95

Download & Upgrade Remotely
Download from internet and upgrade your MFJ-998 firmware as new features are introduced.

Plus Much More!
Built-in radio interface controls most transceivers.

Automatically bypasses with excessive tuning power.

Use balanced line antennas with external **MFJ-912, $69.95**, 1.5 kW 4:1 balun.

Small 13W x 4H x 15D inches easily fits into your ham station. 8 pounds. Requires 12-15VDC at 1.4 amps maximum or 110 VAC with **MFJ-1316, $29.95**.

For 600 Watt amps
AL-811/ALS-600/ALS-500

MFJ-994B $379.95
For 600 Watt amps like Ameritron AL-811/ALS-600/ALS-500M. Matches 12-800 Ohms. 10,000 Virtual Antenna™ memories. Cross-Needle SWR/Wattmeter. 10W x 2.75H x 9D 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.

300/150W Best Seller
Digital Meter, Ant Switch, Balun

MFJ-993B $299.95
The world's best selling automatic antenna tuner is highly acclaimed the world over for its ultra high-speed, wide matching range, reliability, ease-of-use! 300/150W on SSB/CW/Digital!

300 Watt Extra Wide Range
SWR/Wattmeter, 10000 VA Memories

MFJ-991B $259.95
Extra-wide matching range at less cost. Exclusive dual power level: 300 Watts SSB/CW Digital. 6-1600 Ohms. 150W SSB/CW and Digital. SWR/Wattmeter.

200 Watt Compact
Digital Meter, Ant Switch, Wide Range

MFJ-929 $269.95
World's fastest compact auto tuner uses MFJ Adaptive Search™ and InstantRecall™ algorithms. 132,072 tuning solutions instantly match any antenna. 200W SSB/CW/Digital.

200 Watt *MightyMite*™ *Matches IC-706, FT-857D, TS-50S*

MFJ-939KIY $169.95

***No** extra space needed!* Just set your IC-706/7000, FT-857D, TS-50S on top of this matching low-profile automatic tuner -- 200 Watts SSB/CW and DIGITAL. It's all you need for a completely automated home station that will match any antenna!

G5RV Antenna

MFJ-1778 $69.95
Covers all bands, 160-10 Meters with antenna tuner. 102 ft. long. Can use as inverted vee or sloper. Use on 160 Meters as Marconi.1500 Watts. Super-strong fiberglass center/feedpoint insulators. Glazed ceramic end insulators. All hand-soldered connections. Add coax, some rope and you're on the air! **MFJ-1778M, $59.95.** G5RV Junior. Halfsize, 52 ft. 40-10M with tuner, 1500 Watts.

200W Weather-sealed
For Remote/Outdoor/Marine

Fully weather-sealed for remote Outdoor/Marine use! Tough, durable, built to last the elements for years.

MFJ-926B $329.95

300W BRT Tuner

MFJ-993BRT $339.95
300 Watt remote automatic antenna tuner matches widerange 6-1600 Ohms impedances 1.8 to 30 MHz Handles 300W SSB/CW. Tough, durable, weather-sealed, includes power injector.

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Phone: (662) 323-5869 ■ **Tech Help:** (662) 323-0549 ■ **FAX:** (662) 323-6551 8-4:30 CST, Mon.-Fri.

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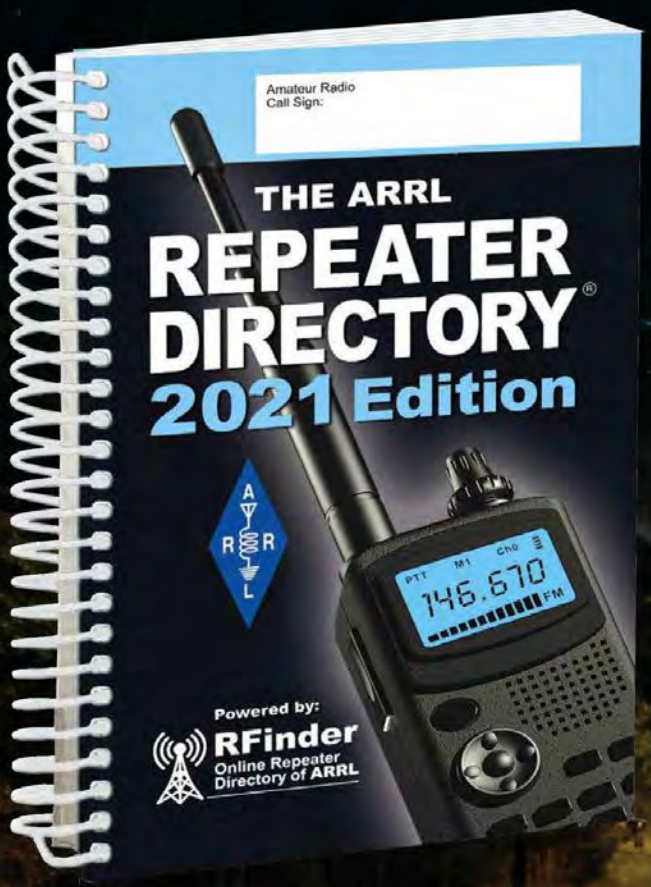

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Ham Radio's Most Popular 300 Watt Antenna Tuner

MFJ-949E $219.95

More hams use MFJ-949s than any other antenna tuner in the world!

Why? Because the world's leading tuner has earned a worldwide reputation for being able to match just about anything.

Full 1.8-30 MHz Operation

Tune your antenna for minimum SWR! Works 1.8-30 MHz on dipoles, verticals, inverted vees, random wires, beams, mobile whips, shortwave receiving antennas...Use coax, random wire, balanced lines. Has heavy-duty 4:1 balun for balanced lines.

Custom inductor switch

Custom designed inductor switch, 1000 volt tuning capacitors, Teflon® insulating washers and proper L/C ratio gives you arc-free no worries operation up to 300 Watts PEP transceiver input power.

The MFJ-949E inductor switch was custom designed to withstand the extremely high RF voltages and currents that are developed in your tuner.

8-Position Antenna switch

Antenna switch lets you select two coax fed antennas, random wire/balanced line or dummy load through your MFJ-949E or direct to your transceiver.

Lighted Cross-Needle Meter

Full size 3-inch lighted Cross-Needle Meter. Lets you easily read SWR, peak or average forward and reflected power simultaneously. Has 300 Watt or 30 Watt ranges.

QRM-Free PreTune™

MFJ's QRM-Free PreTune™ lets you pre-tune your MFJ-949E off-the-air into its built-in dummy load! Makes tuning your actual antenna faster and easier.

Plus Much More!

Full size built-in non-inductive 50 Ohm dummy load, scratch-proof Lexan multi-colored front panel, $10^5/_8$ x $3^1/_2$ x 7 inches. Superior cabinet construction and more!

MFJ-948, $189.95. Econo version MFJ-949E. Has all features except for dummy load.

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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-989D Legal Limit Tuner

MFJ-989D $469.95

New, improved MFJ- 989D legal limit antenna tuner gives you better efficiency, lower losses and a new true peak reading meter. Easily handles full 1500 Watts SSB/CW, 1.8-30 MHz, including MARS/WARC bands. Six position antenna switch, dummy load. New 500 pF air variable capacitors. New improved AirCore™ Roller Inductor. New high voltage current balun. New crank knob. $12^7/_8$W x 6H x $11^5/_8$D inches.

MFJ-986 Two knob Differential-T™

MFJ-986 $419.95

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. $10^3/_4$W x $4^1/_2$H x 15 in.

MFJ-962D Compact kW Tuner

MFJ-962D $359.95

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. $10^3/_4$ x $4^1/_2$ x $10^7/_8$ 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 $259.95

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, $149.95.** Tuner Kit -- Build your own!

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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 8 x 2 x 6 in. Lighted Cross-Needle SWR/Wattmeter. Lamp and bypass switches. Covers 1.8-30 MHz and 6 Meters. 300 Watts PEP. **MFJ-20, $9.95**, mobile mount.

MFJ-945E $159.95

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 x $6^1/_2$ x $2^1/_2$ in.

MFJ-971 $149.95

MFJ-901B Smallest Versa Tuner

MFJ's smallest (5 x 2 x 6 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 $119.95

MFJ-902B Tiny Travel Tuner

Tiny $4^1/_2$ x $2^1/_4$ x 3 inches, full 150 Watts, 80-6 Meters, has tuner bypass switch, for coax/random wire. **MFJ-904H, $169.95**. Same but adds Cross-needle SWR/Wattmeter and 4:1 balun for balanced lines. $7^1/_4$ x $2^1/_4$ x $2^3/_4$ inches.

MFJ-902B $129.95

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 2 x 3 x 4 in.

MFJ-16010 $79.95

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, $59.95**

MFJ-9201 $59.95

MFJ-921/924 VHF/UHF Tuners

MFJ-921 covers 2 Meters/220 MHz. **MFJ-924** covers 440 MHz. SWR/Wattmeter. 8 x $2^1/_2$ x 3 in.

MFJ-921/924 $109.95

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, $249.95**, Artificial ground/300 Watt Tuner/Cross-Needle SWR/Wattmeter.

MFJ-931 $129.95

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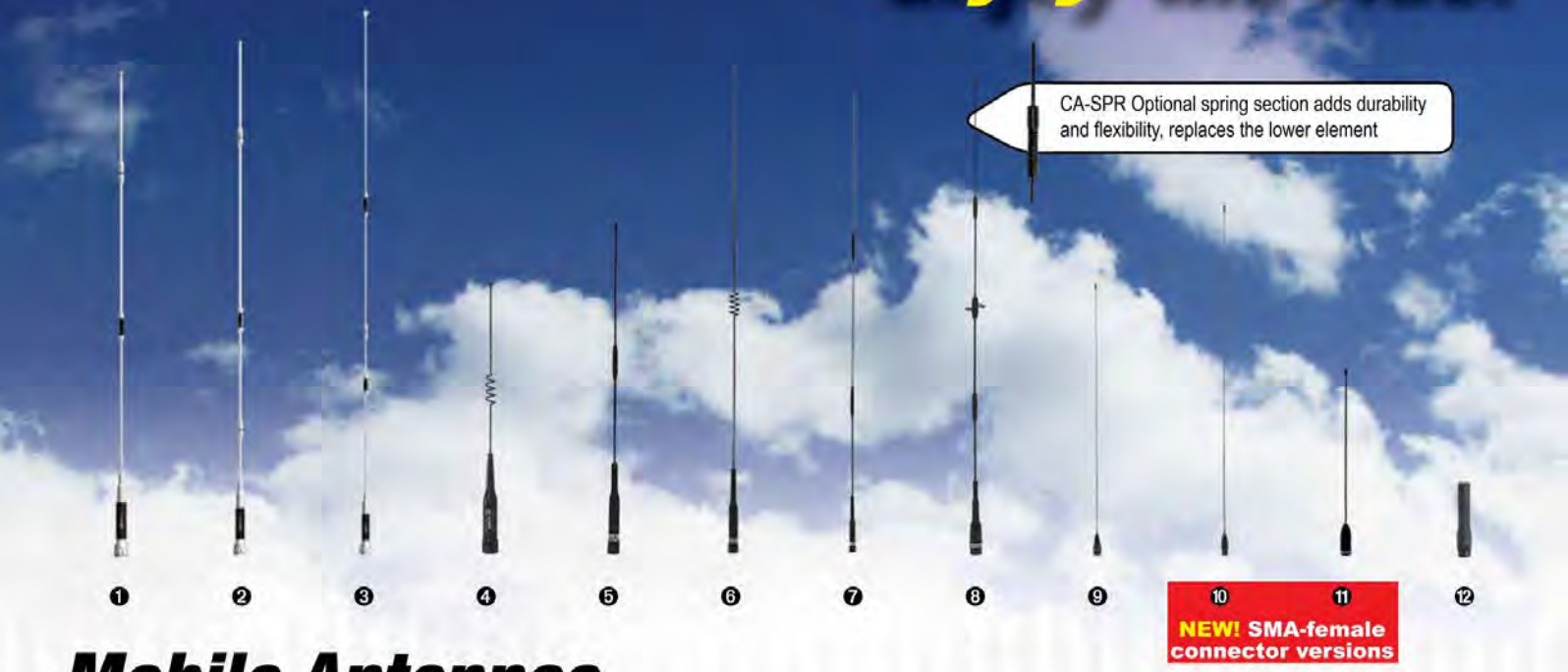

Mobile Antennas

❶ **COMET CSB-750A** DUAL-BAND 2M/440MHz w/FOLD-OVER
2M: 1/2 wave • 440MHz: 5/8 wave x 2 • VSWR: 1.5:1 or less • Length: 42" • Conn: PL-259 • Max. Pwr: 150W

❷ **COMET CSB-770A** DUAL-BAND 2M/440MHz w/FOLD-OVER
2M: 5/8 wave center load • 440MHz: 5/8 wave x 2 center load • VSWR: 1.5:1 or less • Length: 51" • Conn: PL-259 • Max Pwr: 150W

❸ **COMET CSB-790A** DUAL-BAND 2M/440MHz w/FOLD-OVER
2M: 7/8 wave center load • 440MHz: 5/8 wave x 3 center load • VSWR: 1.5:1 or less • Length: 62" • Conn: PL-259 • Max Pwr: 150W

❹ **COMET B-10/B-10NMO** DUAL-BAND 2M/440MHz
2M: 1/4 wave • 440MHz: 1/2 wave • Length: 12" • Conn: B-10 PL-259, B-10NMO - NMO style • Max Pwr: 50W

❺ **COMET SBB-2/SBB-2NMO** DUAL-BAND 2M/440MHz
2M: 1/4 wave • 440MHz: 5/8 wave center load • VSWR: 1.5:1 or less • Length: 18" • Conn: SBB-2 PL-259, SBB-2NMO - MNO style • Max Pwr: 60W

❻ **COMET SBB-5/SBB-5NMO** DUAL-BAND 2M/440MHz w/FOLD-OVER
2M: 1/2 wave • 440MHz: 5/8 wave x 2 • Length: 39" • Conn: SBB-5 PL-259, SBB-5NMO - NMO style • Max Pwr: 120W

❼ **COMET SBB-7/SBB-7NMO** DUAL-BAND 2M/440MHz w/FOLD-OVER
2M: 6/8 wave • 440MHz: 5/8 wave x 3 • Length: 58" • Conn: SBB-7 PL-259, SBB-7NMO - NMO style • Max Pwr: 70W

❽ **COMET CA-2X4SR/CA-2X4SRNMO** WIDE-BAND 140-160MHz 435-465MHz w/FOLD-OVER
2M: 5/8 wave • 440MHz: 5/8 wave x 3 • Length: 40" • Conn: CA-2x4S PL-259, CA-2x4SRNMO NMO style • Max Power: 150W

❾ **COMET BNC-24** DUAL BAND 2M/440MHz HT ANTENNA
RX range: 100-1200MHz • Length: 17" • SuperFlex featherweight whip • Conn: BNC

❿ **COMET SMA-24** NEW! **SMA-24J** DUAL BAND 2M/440MHz HT ANTENNA
RX range: 100-1200MHz • Length: 17" • SuperFlex featherweight whip • Conn: SMA-24: SMA-male / SMA-24J: SMA-female

⓫ **COMET SMA-503** NEW! **SMA-503J** DUAL BAND 2M/440MHz HT ANTENNA
RX range: 100-1200MHz • Length: 8.75" • Conn SMA-503: SMA-male, SMA-503J: SMA-female

⓬ **Maldol MH-209, MH-209SMA** DUAL BAND 2M/440MHz HT ANTENNA
Length: 3" • Conn: MH-209 BNC, MH-209SMA: SMA-male • Soft rubber cover, good performance in a small package!

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Dummy Loads

World's most popular Dry 300 Watt HF/VHF Dummy Load

Air-cooled, non-inductive resistor in a perforated metal housing; Has SO-239 connector. Full 300W for 30 seconds. Derating curve to 5 minutes. SWR below 1.1:1 to 30 MHz, 1.5:1 30 to 650 MHz. Compact 2¼ x 2¼ x 7 inches. **MFJ-260CN, $59.95.** With type "N" connector.

MFJ-260C $49.95

Dry 1.5 kW HF/VHF/UHF Dummy Load

Ham radio's most versatile 1.5 kW 50 ohm *dry* dummy load covers DC through 650 MHz. SWR 1.1:1 to 30 MHz and 1.3:1 to 650 MHz. Handles 1500 Watts for ten seconds, 100 Watts for 10 minutes. 3W x 3H x 9D in. SO-239 connector. **MFJ-264N, $109.95.** With type "N" connector.

MFJ-264 $89.95

Oil-Cooled 1 kW CW, 2 kW SSB 50-Ohm VersaLoad™

Run 1kW CW or 2 kW PEP for 10 minutes. Run *continuous duty* with 200 Watts CW or 400W PEP. Transformer oil included. SWR 1.2:1 to 30 MHz. Low SWR to 400 MHz. SO-239 connector. Safety vent with cap, carrying handle. 7½H x 6⅝D in. **MFJ-250X, $69.95.** No transformer oil.

MFJ-250 $79.95

500 MHz, 100 Watt Dummy Load

Connects directly with built-in PL-259. Finned aluminum air-cooled heatsink. 15 Watts continuous, 100W peak. SWR <1.5:1, DC-500 MHz. 15/8 inch round by 3 inches long. **MFJ-262B, $69.95.** PL-259. 35 Watts continuous, 200W for 5-seconds. SWR< 1.2;1 DC-1 GHz.

MFJ-261 $34.95 *with PL-259* DC to 500 MHz

MFJ 2500W *fan-cooled* Dry Load

MFJ's 2500 Watt *fan cooled* load handles legal limit amps, 2500W average one minute on, ten minutes off, 300W continuous. DC- 6 Meters. SWR <1.25, 30 MHz; <1.4, 30-60 MHz. Detailed power curve. 12 VDC or 110 VAC. 8¼W x 4H x 9½D in. SO-239s. 5 pounds.

MFJ-265 $249.95

Switchable RF Dummy Load

Select 16.6, 25, 50, 100, 150 Ohm dummy loads. Test/calibrate your wattmeters, SWR accuracy. At 50 Ohms it handles 300 Watts for 30 seconds with SWR < 1.1, 60 MHz. SO-239. 4½W x 2¼H x 6½D in. Optional 12 VDC/110 VAC adaptor, **MFJ-1312D, $19.95**.

MFJ-251 $169.95

3 GHz, 300 Watts Dry Dummy Load

New high-tech metal film resistor on large heavy-duty air-cooled heatsink. 300 Watts for ten seconds and 125W continuously. SWR < 1.1, 1 GHz; <1.2, 1.5 GHz; <1.5, 3 GHz. N-connector. 10¾W x 2¼H x 5¼D inches.

MFJ-263 $139.95

1.5kW Dry DummyLoad/SWR/Wattmeter

Tune up your transceiver, linear amplifier or antenna tuner into a safe 50 Ohm dummy load at *full power*. Then instantly switch to your antenna and monitor SWR, forward and reflected power on lighted cross-needle meter. 300/3000 Watt ranges. DC-60 MHz.Test/tune Xceivers, amps, tuners, baluns, filters, coax, stubs.

MFJ-267 $179.95

SWR/Wattmeters

Compact Cross-Needle SWR/Wattmeters

Large 3-inch lighted Cross-Needle meter covers 1.8-200 MHz in 30/300W power ranges. Read forward, reflected power, SWR *simultaneously*. 3¼W x 3¼H x 3¼D in. SO-239 connectors. **MFJ-842, $69.95.** 140-525 MHz, 15/150W.

MFJ-822 $69.95

High-accuracy 1.8-60 MHz Digital SWR/Wattmeter

Highly accurate! Auto-ranging select 25W, 250W, 1500W ranges with *full 10-bit* resolution. Frequency compensated data insures highest accuracy. *True peak*/average forward/reflected power, SWR and frequency are *simultaneously* displayed on backlit LCD and large 3-inch lighted cross needle meter. Peak hold. LED, buzzer, amplifier-by-pass alerts and protects your amplifier when SWR is high and toggles extra relay. 6½W x 2⅝H x 6D". **MFJ-826B, $199.95.** No meter, ampr bypass, control relay.

MFJ-828 $269.95

MFJ GrandMaster™ SWR/Wattmeters

GrandMaster™ SWR/Power Meters are the *Cadillacs of ham radio!* Large 3¼ x 1¼ inch precision illuminated meter gives easy wide-angle viewing of SWR, forward or reflected power. 7½W x 3⅛H x 4¼D in. SO-239s. **MFJ-870, $89.95.** 1.6-60 MHz. 30/300/3000 Watt ranges. **MFJ-874, $129.95.** 1.8-525 MHz. 5/20/200 Watt ranges.

MFJ-870 $89.95

MFJ *giant* 6.5 inch SWR/Wattmeter

World's *largest* HF+6M SWR/Wattmeter has giant 6½ inch meter! Extra-long scales gives highly accurate SWR/power 1.8-54 MHz. Huge numbers make reading easy. *True* peak or average forward and reflected power. 20/200/2000 Watt ranges. 9 Volt battery, 12 VDC or 110 VAC with **MFJ-1312D, $19.95.** 7W x 5½H x 5D in. SO-239s.

MFJ-868B $179.95

VHF SWR/Wattmeter plus Field Strength

World's most popular – and most affordable – VHF SWR/Wattmeter. Read SWR, forward and reflected power over 144-220 MHz in two ranges, 30/300W. Built-in field strength meter for 1-220 MHz. 4½W x 2¼H x 3D".

MFJ-812B $49.95

Compact Digital SWR/Wattmeters

Displays forward, refelected power, SWR (1.6-60 MHz) and battery *all in a single glance!* Large ½" forward power digits and 5/8" reflected/SWR digits! 0-200W. Power/backlight on/off. SO-239s. **MFJ-847, $114.95.** 125-525 MHz, 0-120W. **MFJ-849, $189.95.** Large 3.5" bright orange LCD displays SWR, forward/reflected power. 1.5-525 MHz, 200W, HF/VHF-UHF switch.

MFJ-845 $114.95

MFJ-849 $189.95

MFJ HF *QRP* SWR/Wattmeter

Read forward, reflected power 1.8- 50 MHz, 0-5W. Also reads SWR, relative power 100 mW to 50W. SO-239s. 4½W x 2¼ H x 3D in.

MFJ-813 $49.95

VHF/UHF SWR/Wattmeter

Lighted Cross-Needle,SWR/Watts,144/220/440 MHz, 30/300W Forward power, 6/60W Reflected power.

MFJ-862 $79.95

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Boost battery voltage as low as 9 Volts back up to 13.8 VDC! Keeps your transceiver at full power output, compensates for run down battery, wiring voltage drop, car off . . .

MFJ-4416C **$199.95** **Keeps** your transceiver at full power output, provides full performance, high efficiency, prevents output signal distortion and transceiver shutdown. Compensates for run-down battery, wiring voltage drop or when car is off. Provides up to 25 Amps peak with 90% efficiency. Selectable 9/10/11 Volts minimum input voltage prevents battery damage from over-discharging. RF sense turns MFJ-4416C off during receive to save power, increases efficiency and reduces noise. Adjustable 12 to 13.8 VDC output pass-through improves efficiency and lets transceiver run cooler. Has output over-voltage crowbar protection. *Anderson PowerPoles*(R) and high-current 5-way binding posts for DC input, regulated output. 7 3/4Wx4Hx2 1/8D inches. **MFJ-4416BRC, $89.95.** Booster Remote Control.

Super Heavy Duty Battery Booster

MFJ-4418 **$249.95** **Super** robust with heavy duty transistors, rectifier, improved switch-mode transformer, larger heatsink. Input and output EMI filters reduce noise to minimum. Rugged construction. *Power-Poles*™ and 5-way binding posts. MFJ software adjusts output voltage, measure load current, set minimum voltage level, over-current trip level, ignition control, more. External boost enable, remote input/output voltage sampling, remote controllable with MFJ-4416BRC.

RFI Filter for DC power

MFJ-1142 **$74.95** **Connects** between rig and 12/ 24/50 VDC power supply/battery. Reduces RFI, hash, transients, motor noises, alternators, fuel pump whine, power windows, more! Binding posts/*PowerPoles*(R).

Digital Volt/Amp Meter

MFJ-4422 **$49.95** **Connect** in-line. Displays 4.5-30 VDC and up to 30A simultaneously. .01-.1V resolution. Dual .28" red/blue LED digits. *Anderson PowerPoles*™. Reverse polarity protection. 3x2x1 inches.

RFI Ferrite Chokes

MFJ-700A4 **$14.95** **Suppress** RFI. Snap and locks on DC power line, coax, wires. Effectively removes RFI and noise. Install end-to-end or loop multiple turns for more suppression. .275" hole dia. 4 in package.

PowerPole™ DC Outlet Box

MFJ-1104 **$54.95** **One** fused 30 Amp input and 25, 10, 5 Amp fused outputs *with Anderson PowerPoles*™. Has open fuse indicator. Sturdy metal construction, 2 3/4Wx3 1/4Hx1 1/2D inches.

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MFJ-704 **$109.95** **High** attenuation above 40 MHz. 1.5kW, 1.8-30 MHz. SWR<1.3. Nine Chebyshev poles, *Teflon*(R) dielectric capacitors, high-Q inductors, ground plane shielding, RF tight.

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MFJ-270 **$24.95** **Protect** your expensive equipment from lightning induced surges on 50 Ohm coax. Use for transceivers up to 400 Watts, 1000 MHz. **MFJ-272, $39.95.** 1.5 kW.

MFJ 30-Amp Power Supply

MFJ-4230MV **$99.95** **World's** most compact 30 Amp switching power supply. Switchable Volt/Amp meter. Adjustable 4 to 16 VDC output. Select 120/240 VAC input. 5Wx2 1/2Hx6D in., 3 lbs.

High-efficiency Loop Tuner

New! MFJ-935C **$249.95** **Instantly** turn wire or coax into a small, high-efficiency multi-banded loop antenna. 150W, 5.3-30 MHz. Tripod/mast mount included.

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MFJ-886B **$169.95** **300** Hz - 2.8 GHz. 1 Hz resolution, 10-digit backlit LCD, signal strength bargraph, lithium battery.

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MFJ-801 **$39.95** **Relative** field-strength readings .1-500 MHz. Sensitivity control, 1 3/4 inch meter. 20-inch telescoping whip. Finger contact increases sensitivity.

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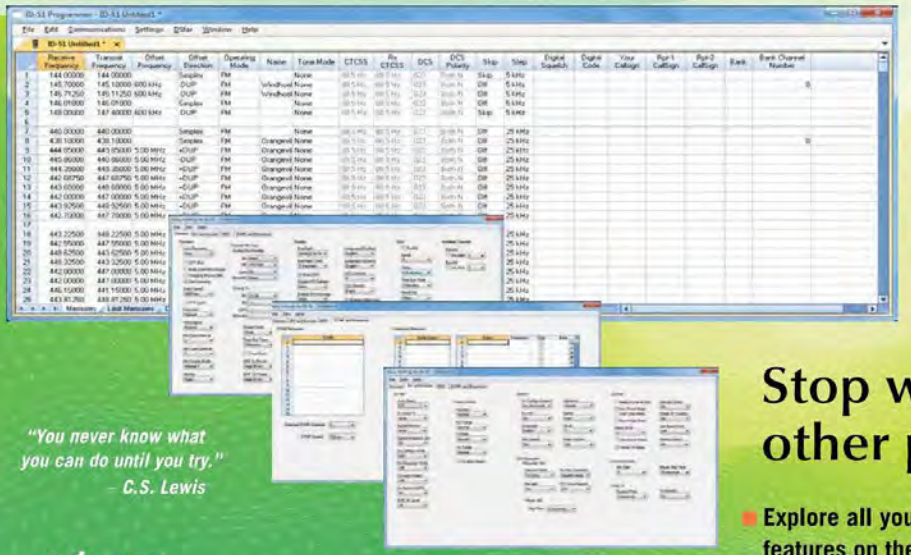

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