Build a Simple HF Communications Receiver

Page 33

QST

DIGITAL EDITION

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The Lightbulb QSO Party

QST Reviews

Icom IC-V86 2-Meter FM Handheld Transceiver

NanoVNA Vector Network Analyzer

mAT-Tuner mAT-10 Automatic Antenna Tuner

Pacific Antenna Volt Tattler 2 Voltage Monitor Kit

K1EL Systems Morse Tutor Kit

The radio... YAESU

Inherent Passion and Inspiration

Hybrid SDRs (Narrow Band SDR & Direct Sampling SDR)

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

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

2kHz Phase Noise −150dBc/Hz

VC-TUNE (Variable Capacitor Tune) signal peaking

Maximum Attenuation −70dB

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

TX Signal Purity

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

* Microphone M-1: Optional

In Homage to the Founder of Yaesu – Sako Hasegawa JA1MP

FTDX101MP 200W
HF/50MHz TRANSCEIVER

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

The Ultimate
FTDX101D 100W
HF/50MHz TRANSCEIVER

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

YAESU
The radio

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6125 Phyllis Drive, Cypress,
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C4FM/FM 144/430MHz Dual Band Mobile

High Visibility and Resolution QVGA Display with Exceptional Operability

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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
- High-Speed 63 Channel Band Scope
- Easy Hands-Free Operation with Built-in Bluetooth® Unit

C4FM/FM 144/430 MHz DUAL BAND
50 W DIGITAL MOBILE TRANSCEIVER

FTM-300DR

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R9

80-6 Meters! No Radials!

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

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

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

Use full 1500 Watts SSB/CW when the going gets tough to break through pileups and 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.

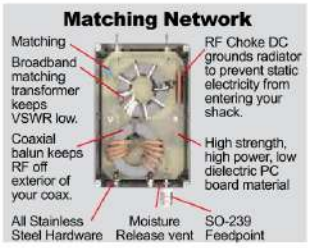
Rugged Construction: Thick fiberglass insulators, all stainless steel hardware and 6063 aircraft-aluminum tubing is double or triple walled at key stress points to handle anything Mother Nature can dish out.

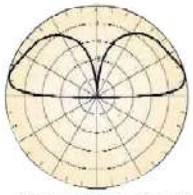
31.5 feet tall, 25 lbs. Mounting mast 1.25 to 2 inches. Wind surface area is 4 square feet.

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.





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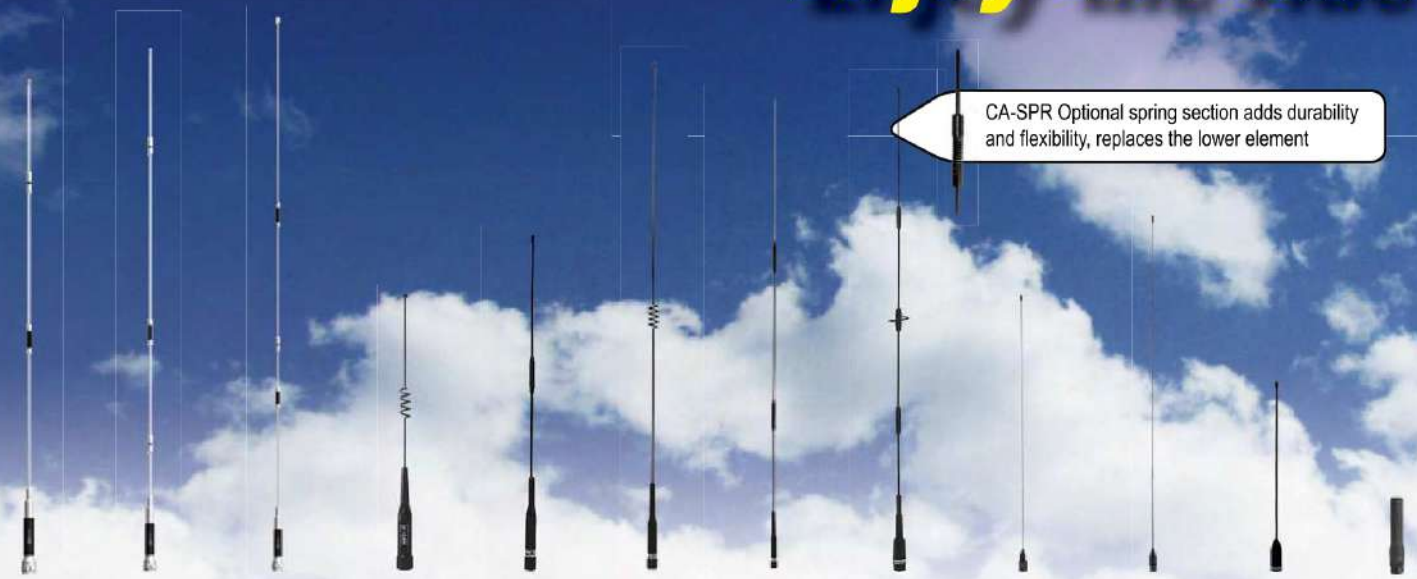

Mobile Antennas

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
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QST

Contents

May 2020 ♦ Volume 104 ♦ Number 5

Columns

Departments

Our Cover
The Blue Ridge Amateur Radio Club challenged operators to design their own working lightbulb antennas. Participants tested their flashy designs with a QSO party, competing to be Top Bulb in the Household and Freestyle categories. To illuminate yourself about the antennas and the event, read David Day's, N1DAY, article, "Lightbulb QSO Party," on page 57 of this issue.

Digital and Mobile Editions

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

Write for *QST*

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

QST (ISSN:0033-4812) is published monthly as its official journal by the American Radio Relay League, Inc, 225 Main St., Newington, CT 06111-1400, USA. Periodicals postage paid at Hartford, CT, USA and at additional mailing offices.

POSTMASTER: Send address changes to: *QST*, 225 Main St., Newington, CT 06111-1400, USA. Canada Post: Publications Mail Agreement #90-0901437. Canada returns to be sent to IMEX Global Solutions, 1501 Morse Ave., Elk Grove Village, IL 60007.

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Canada: Membership in the ARRL, including a 1-year subscription to *QST*, $62, payable in US funds. Life Membership, including a subscription to *QST* is available at $1,550.* Libraries and institutions, $62 per year.

All Other Countries: Membership in the ARRL, including a 1-year subscription to *QST*, $76, payable in US funds. Life Membership, including a subscription to *QST*, is available at $1,900.* Libraries and institutions, $76 per year.

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Indexed by Applied Science and Technology Index, Library of Congress Catalog Card No: 21-9421.

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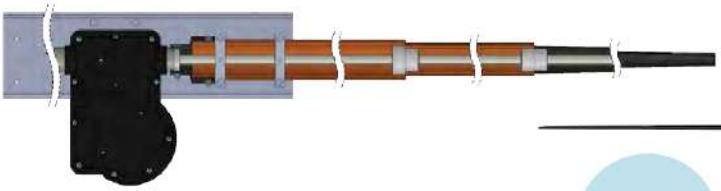
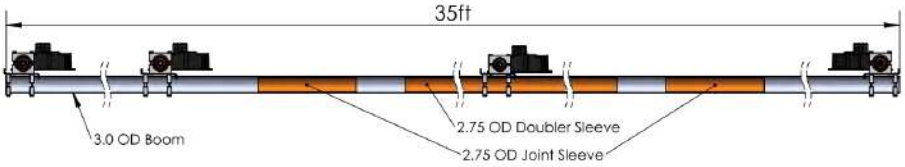
EIA-222-G Engineered Element Design with top/bottom truss system

The HFT435C employs a double-trussed, double wall tapered boom design, utilizing thick-wall, heavy duty seamless aluminum tubing, extreme-duty element mounting plates and a steep-pitch, truss support system.



EIA-222-G Engineered Tapered, Double Wall Boom Design

The HFT435C employs a double-trussed, double wall tapered boom design, utilizing thick-wall, heavy duty seamless aluminum tubing, extreme-duty element mounting plates and a steep-pitch, truss support system



SY435C SPECIFICATIONS:

Antenna Dimensions: 35ft x 70ft

Mast size required: 3 in

Turning Radius: 41.4 ft

Frequency range: 6.8-54 MHz*

***Options available for 3.5-6.8 MHz range**

HFC435 element wind ratings
137 MPH/220 KPH @ 100 ft (Dry)
91 MPH/146 KPH @ 100 ft (3/4" radial ice)

HFC435 boom wind ratings
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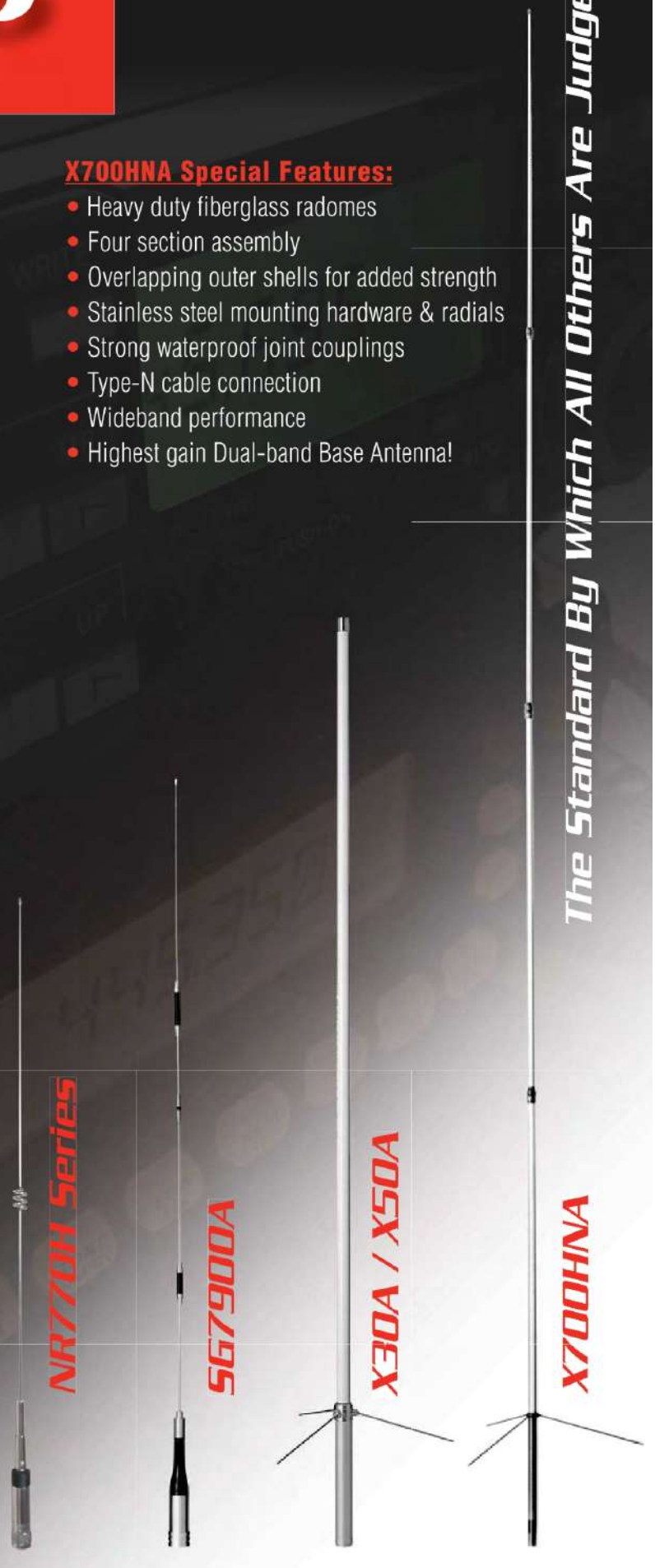
X510HD (3 Section)	2m/70cm	17.2	330/250	UHF or N
X300A (2 Section)	2m/70cm	10	200	UHF or N
X200A (2 Section)	2m/70cm	8.3	200	UHF
X50A (1 Section)	2m/70cm	5.6	200	UHF or N
X30A (1 Section)	2m/70cm	4.5	150	UHF
Monoband Base Station/Repeater Antennas				
F23H (3 Section)	144-174 MHz (W/ Cut Chart)	15	350	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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Steve Ford, WB8IMY, wb8imy@arrl.org

Second Century

The Future is Fragmented

Once upon a time, QST *magazine had something close to a monopoly when it came to amateur radio news, projects, product reviews, and much more. That's not to say there weren't alternative publications, but* QST *was clearly the 800-pound gorilla on the block.*

Amateur radio was more homogeneous in those days. When you got on the air you mostly operated SSB, CW, or FM. You attended hamfests, handled traffic, and exchanged QSLs in the mail. Morse code was a lingua franca that almost everyone understood to one degree or another.

As amateur radio has changed over the years, so has the publishing industry. In this month's column, QST *Editor Steve Ford, WB8IMY, explains how ARRL's publications are adapting to keep up.*

There was a time when amateur radio was a quasi-fraternal community and the content of *QST* reflected that community. Even as the hobby began to diversify with increasing digital activity in the 1980s, the community remained united, especially in the way in which it acquired information.

And then came the internet.

During the last 25 years, the internet has wreaked havoc across the media landscape by fragmenting audiences into almost infinite numbers of groups and subgroups. With content-filtering technology, individuals can easily pick and choose what they want to see according to their interests, no matter how narrow those interests may be.

Newspapers and magazines are struggling in this environment, desperate to adapt to a world that changed almost overnight. As a result, many are shrinking or going out of business entirely.

QST hasn't been immune to these disruptive forces, which is why we hired a media research company to investigate how members, and non-members, really felt about the magazine.

To no one's surprise, the vast majority of older hams were still quite content with *QST* and gave it high marks. However, younger hams — age 30 to 60 — were not happy. They felt the technical material was over their heads and they could not relate to the tradition-oriented tone the magazine seemed to project. For example, they told us they found discussions of ham history and vintage equipment boring and they were put off by other aspects of *QST* that had been standard fare for decades. I'll always remember the barbed comment from one study participant (age 41) who wrote concerning the "Silent Keys" column: "Who puts lists of dead people in a magazine? Yeah, that's what I want in my mailbox every month!"

The data sent a clear message: Our audience was fragmenting, particularly along generational lines. As we watched other publications scrambling to reposition themselves, we realized the ARRL media battleship needed to change course, and quickly.

The first result was the new *On the Air* magazine, which debuted in January. I'm happy to say that *On the Air* has hit the bullseye for the increasing number of amateurs who don't find a "home" in *QST*. The response has been overwhelmingly positive, and I only regret we didn't publish it sooner.

At the same time, we launched two new podcasts: *Eclectic Tech* and *On the Air*. Together with the weekly *ARRL Audio News*, these also appeal to a younger audience that consumes podcasts voraciously, although we're noticing that *Eclectic Tech* and *Audio News* have a growing audience among older amateurs as well.

Expect to see even more focused media offerings from ARRL. We are considering digital publications that will concentrate on specific activities in the way we do now with the *ARES E-Letter* and *Contest Update*. Speaking of digital publications, the weekly *ARRL Letter* now has a circulation of more than 107,000. If it continues to grow, it will someday rival *QST* as the most popular ARRL publication.

There is also the *National Contest Journal* and *QEX*. By the time you read this, both magazines will be available in digital formats to all ARRL members.

But what becomes of *QST*? Rest assured the magazine is not going away. If you are a veteran amateur, I believe you'll find even more to enjoy in the issues to come. Of course, *QST* will slowly evolve as today's veterans leave the ranks and a new crop replaces them. The future is about increasing fragmentation and, as with all media, *QST* will adapt.

Steve Ford, WB8IMY
Editor

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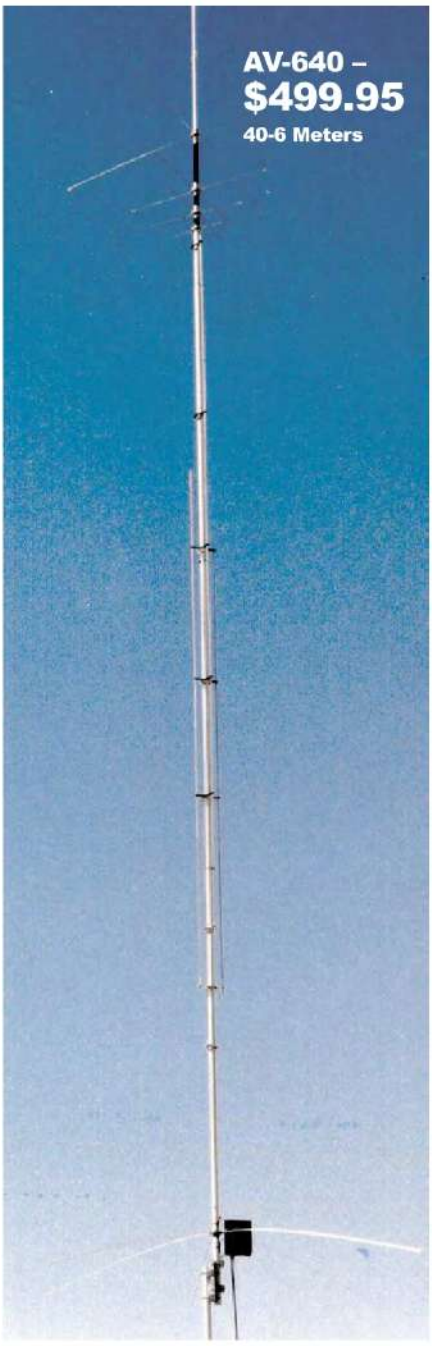
AV-620, $399.95. 6 bands: 20, 17, 15, 12, 10, 6 Meters. 22.5 ft., 10.5 lbs.

Inside of Matching Unit



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W1 HEADSET $179

INRAD W1 HEADSET

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DXPatrol is a tiny SDR covering 100 kHz-2 GHz that can be used with Windows, Mac, Linux, or Android. Not an 8-bit dongle! Full featured receiver. Want to add a panadaptor to your HF transceiver? Do it with DXPatrol. Great price at only $99.95!

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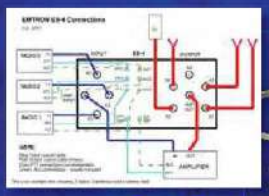

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Member Spotlight

Anne Dirkman, KC9YL

Anne Dirkman, KC9YL, wasn't exposed to ham radio until a few years before her retirement. She was introduced to the hobby 9 years ago and has been hooked ever since she spent several hours listening to ham traffic in 2011.

A Late Introduction to Radio

Anne grew up on a dairy farm in Wisconsin. "Back in the '60s and '70s, female education focused on the basics, with an emphasis on the domestic arts," she said. "Amateur radio? We were too busy milking cows and baling hay."

It wasn't until February 2011 that her close friend, Mike Hoffman, KE8IL, mentioned that the Marquette Repeater Club would be streaming live audio of ham operators manning volunteer checkpoints for Michigan's UP200 Sled Dog Race.

Anne listened for several hours to the hams passing traffic. Despite her interest, she knew nothing about electronics or Morse code and worried the necessary equipment would be bulky and expensive. Mike showed her that kids as young as 9 could pass the Technician-class license test and that she could find a radio "small enough to fit in her purse for less than $100."

In May 2011, at the age of 57, Anne passed her Technician exam and earned the call sign KC9UHH. In October of that year, she upgraded to a General-class license, and earned her Amateur Extra-class license in 2013. Soon after, she received her Volunteer Examiner Coordinator credentials.

Discovering the Young Ladies Radio League

In 2018, Anne discovered the Young Ladies Radio League (YLRL). "I had no idea there were specialty clubs for women," she explained. She joined immediately and frequently checked in to their HF nets when conditions allowed. Several of the YLRL members participate in a Thursday night Echolink net on the ALARA Conference node of 286905 at 1000Z (0000Z in the summer). Anne shared that this "ladies-only net is for YLs who have HF limitations — whether it be lack of equipment or propagation."

It wasn't long before Anne became DX Treasurer of YLRL. In that role, she processes dues for DX members and compiles news items for the group's bimonthly newsletter, *Harmonics*.

The Joys of Operating

Each summer, Anne attends the annual gathering of aviation enthusiasts, EAA AirVenture, in Oshkosh, Wisconsin, where Fox Cities Amateur Radio Club activates the special event station, W9ZL. "At last year's event, a young man asked if he could talk on the radio, so we wrote a short script to get him started," she said. "He operated non-stop for an hour!"

When it comes to contesting, Anne first saw it only as a means to fill her log, seek out new DX, and improve her operating skills, but after joining the Society of Midwest Contesters, she has another network of amateurs to learn from. "I have been primarily an SSB operator. The lure of operating CW is a recent challenge, as I wanted to contribute to my contest club's scores, and CW was the last holdout (after RTTY)," she shared.

Gaining Confidence Through Radio

Thanks to amateur radio, Anne has met people and shared experiences she otherwise wouldn't have. She's shaken hands with an astronaut, travelled to Oklahoma and Winnipeg, Canada, for amateur radio conventions centered around female operators, communicated with a scientist stationed in Antarctica, and downloaded pictures from the International Space Station (ISS).

"Amateur radio has fulfilled my search for a retirement hobby to help keep my brain busy," Anne shared. "Making contacts and talking to strangers has really helped my self-confidence and given me the impetus to try new things, radio-related or not."

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Up Front

Rainbows Over W1AW

Libby Delaune captured the aftermath of a rainstorm while visiting ARRL Headquarters in Newington, Connecticut. The rainbow appeared over the VHF/UHF antennas of W1AW, the Hiram Percy Maxim Memorial Station.

Homebrewed Safety Gear

Bob Sullivan, WØYVA, built two safety-related items that would be ideal additions to most workbenches. One cabinet houses an isolation transformer and a Variac™, and the other contains a Variac as well, but with a wattmeter.

He built both into 9 × 5 × 6-inch aluminum boxes made by Bud Industries, Inc. Bob found a 150 W isolation transformer and 10 A Variacs for sale on eBay. All other items were from his junk box.

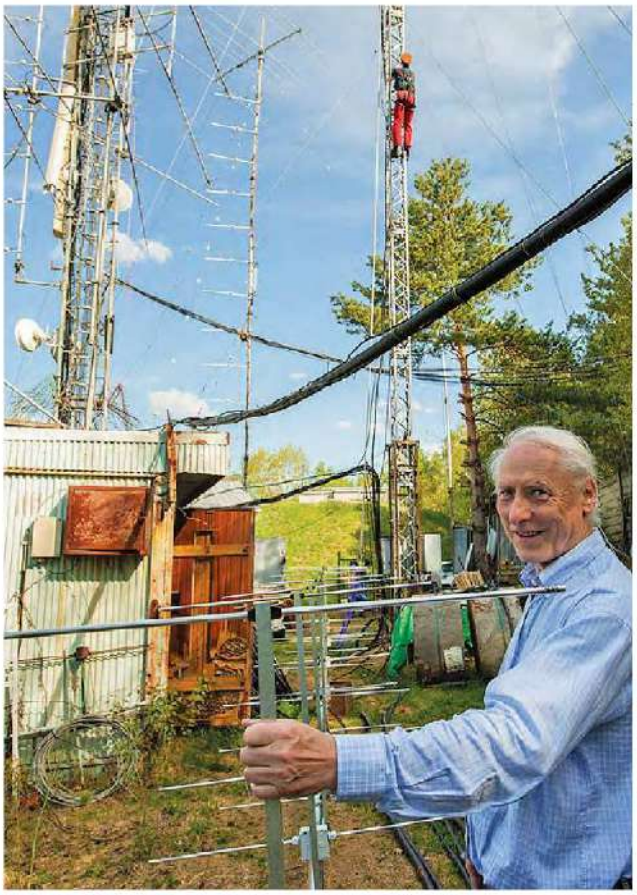
The Variac enclosure also includes a wattmeter as well as an in/out switch. On top of both units are standard duplex 120 V ac receptacles.

This enclosure holds a 150 W isolation transformer.

This Variac unit includes a wattmeter.

Getting Ready to Hunt Contacts

Henryk Kotowski, SMØJHF, took this photo of Vitek Štamberský, OK1AXD, preparing an eight-Yagi array for 144 MHz at the OL3Z club station near Prague.



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Correspondence

Letters from Our Members

Appealing to the Next Generation of Hams

As a new ham, I've been apprehensive about joining ARRL. I thought ARRL membership was geared toward the seasoned ham and I feared the content they produce would go over my head.

However, I recently watched *QST*/*On the Air* Editor Becky Schoenfeld, W1BXY, on "Ham Radio Crash Course," a YouTube livestream hosted by Josh Nass, KI6NAZ, discussing ARRL's new direction to bring the next generation into the hobby.

Since watching the video, I joined ARRL with a 3-year membership, and chose *On the Air* as my print magazine option.

My biggest challenge as a new, Gen X ham has been finding quality information. Eventually, I found a mentor on social media who provided information in a format that appealed to me. This really helped me get on the air as a new ham, and I hope ARRL membership will continue to help me on my radio journey.

I like the direction ARRL is heading in and I want to be a part of the next generation of ham radio.

Brian Wasson, KI5GKF
Hockley, Texas

Update Profile Info for Award Hunters

As the FT8 mode has gained tremendous popularity on the HF bands, I've found it great for "collecting" countries and grid squares. Many of us are also collecting states and US counties for awards. I've found **QRZ.com** to be the best tool for determining a station's state or county, but too many times the address shown for the station worked doesn't match the grid square they reported. That usually means that the state and county are incorrect as well.

I'd like to ask anyone operating FT8 (or any mode) to please check your record on **QRZ.com** for accuracy. If you're operating at a temporary location, it's easy to add that information to the bio section of your page. Please change your info as frequently as necessary to keep it accurate. Your ham friends will thank you.

Tom Workman, KØTW
Tucson, Arizona

Tracking Down Electrical Interference

In November 2019 there was bad interference in the ham bands here in Gulfport, Mississippi, so I called our power company. One of their technicians came to the house and listened to the S-9+ noise from my radio shack. I also took him down the street to the power pole the noise was coming from. He promised he would try to fix it.

My wife and I went to Poland for the Christmas holiday, and when we came back the interference was gone. While I thought it was coming from a bad transformer, the noise was the result of a bad streetlight. They replaced the light and now there's no noise! You never know what could be causing that interference.

Carl L. Noble, KAØIBF
Gulfport, Mississippi

Mentoring New (Old) Hams

Many of us who have been hams for years lament the lack of young hams getting into the hobby. However, here in Arizona, there's been significant growth in another demographic: new hams who are recent retirees. Upon retirement, these individuals rekindle or find an interest in radio. They get their Technician-class licenses, and often upgrade to General and Amateur Extra class.

Our club encourages these new hams to get involved in supporting public service events and join in other club activities. Our active mentor group helps club members install VHF/UHF and multiband HF antennas. Many of these hams start operating with FT8 and SSB.

With the dedication of a few experienced hams, any club can grow their membership and contribute to the amateur radio community by providing hands-on assistance to new hams of all ages.

Frank Bender, K8FB
Prescott, Arizona

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

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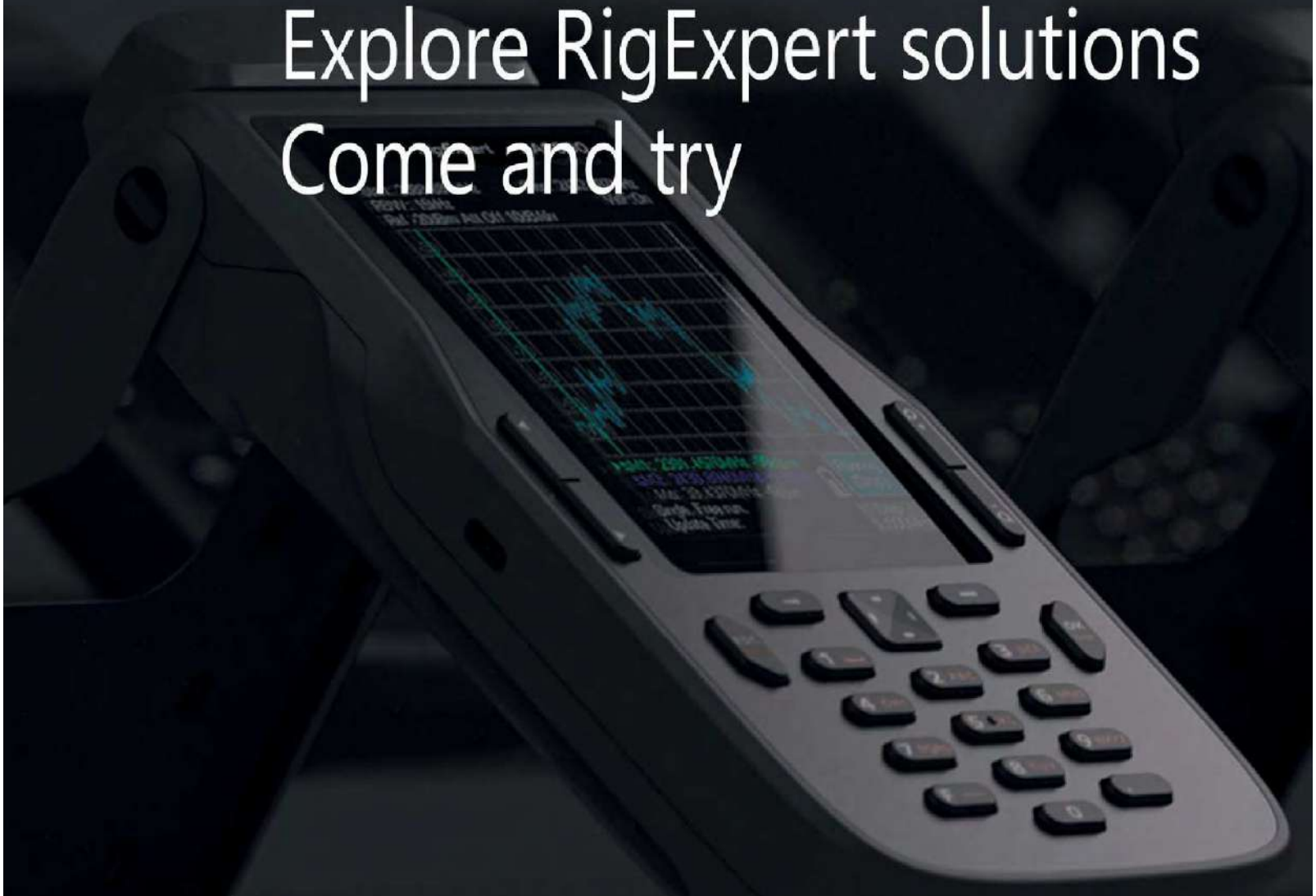

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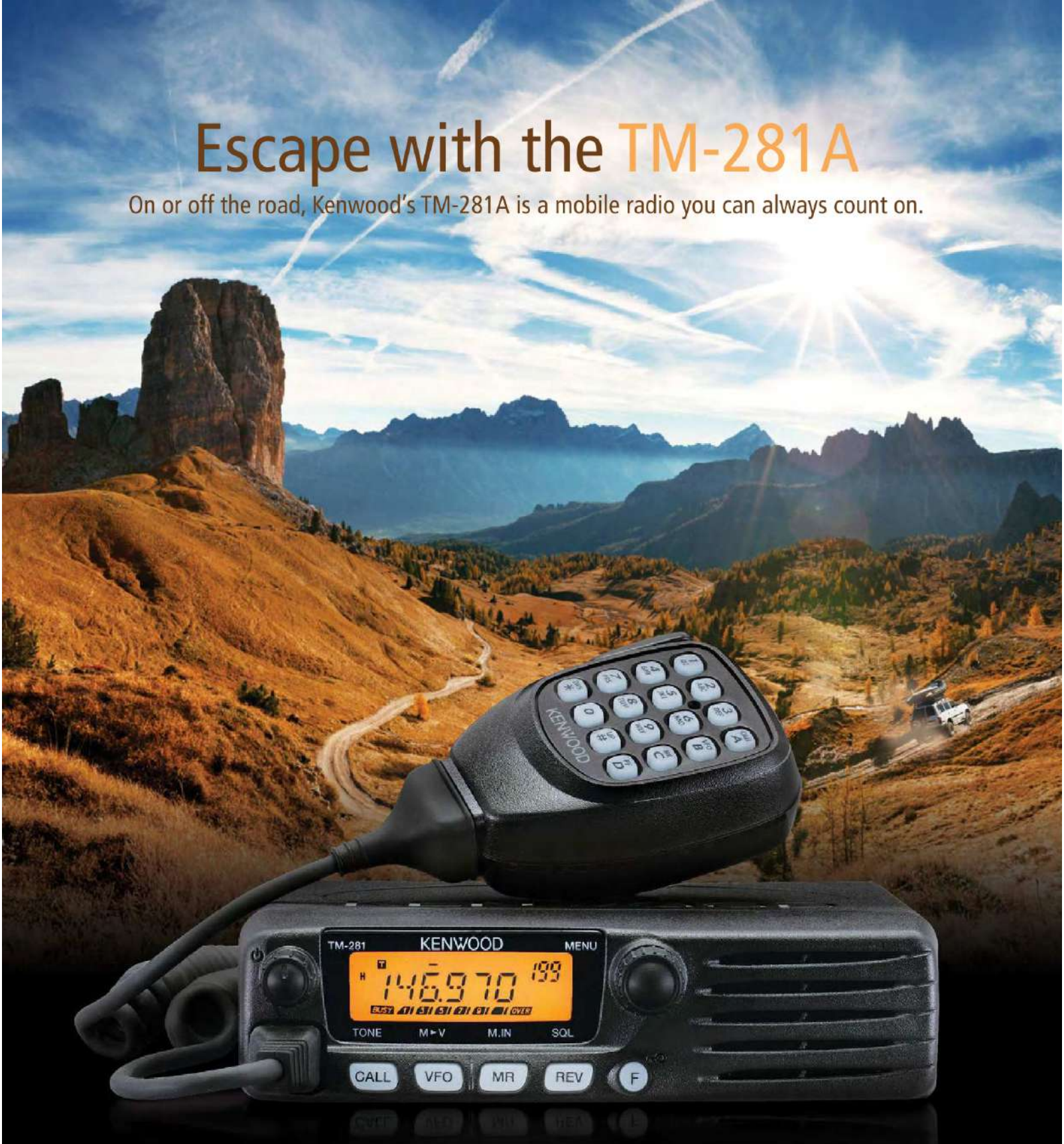

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The Fountain Antenna

The antenna elements and locations where they're secured. All elements are quarter wavelength. (Elements from left to right are for 60, 40, 20, and 30 meters.)

Ted Coyle, AA4AZ

This multiband antenna for portable or home use is easy to build and operate.

I recently decided to build an HF antenna that would let me simulate emergency conditions during both the build process and operation of the antenna. As I created the design, I assumed that the operator had no access to an existing antenna and needed to create one. My design goals included:

- ✔ Simple construction; relatively quick to build and deploy
- ✔ Use of materials that could be easily found
- ✔ Capability of portable or semi-permanent use as needed with minimal effort
- ✔ Reliable operation with little or no need to make physical adjustments for tuning or band changes
- ✔ Multiband capability without the use of tuners, traps, switches, etc.

I decided to build an HF multiband vertical with resonant elements for each band and a radial field that was relatively small for portable or semi-permanent use as needed.

The Fountain Antenna

The final design uses a common feed point on the ground with vertical and sloping elements going in different directions and secured to different points (see the lead photo). Viewed from the side, it suggests the appearance of individual streams of water coming out of a fountain. Each element is supported by a tree branch from a different nearby tree. The design can easily be duplicated as long as there are trees nearby.

I originally planned for 40 meters as the longest element, but I found I could also add an element for 60 meters. The performance was acceptable even with a slope of nearly 45 degrees and no changes to the radial field.

The final design has separate quarter-wave elements for each of the 60-, 40-, 30-, and 20-meter bands. As a bonus, I also get 15 and 6 meters, making this antenna

operational on six bands in total. Changing bands requires no effort, no tuning, and no switches. As with a fan dipole, the RF picks the path to the resonant element.

For the length of each quarter-wave element, I used the formula "length in feet = 234/frequency in MHz," cutting a little long to allow some trimming with my antenna analyzer. The formula numbers were close to the final lengths, meaning it should give good results even if an analyzer is not available. Interaction between up to four elements is minimal due to the separation of the elements. Tests with more than four elements led to difficult tuning due to interactions.

The feed point is secured to the ground by small bungee cords attached to two stakes (see Figure 1). The 40- and 15-meter element is vertical. Each of the other elements slope at various angles relative to the ground, and in different directions. The 60-meter element is the longest and is at about 50 degrees, due to the difficulty in securing it to a higher branch. The 30-meter element is at about 70 degrees, and the 20-meter element is at around 80 degrees. Despite the sloping elements, hundreds of contacts have shown that the patterns are nearly omnidirectional.

There is no magic in any of these angles or directions. I decided which bands I wanted, put the feed point where I had a clear spot, and located each element where I could find the best fit. The configuration will be different for each installation due to the unique conditions at each location. Again, this build is meant to simulate an emergency situation where the objective is to get on the air relatively quickly.

Cost

Total cost for the final multiband antenna using elements, radials, feed point, support lines, and connectors was about $25, not including the coax. The elements and radials are made of #16 AWG stranded, insulated wire from a surplus store. Other materials include a PVC box, stainless-steel hardware, support line to suspend the elements, and an SO-239 connector. Even with all new materials, this antenna could be built relatively inexpensively. A detailed parts list is available on the *QST* in Depth web page (**www.arrl.org/qst-in-depth**).

Feed Point

The feed point is built around a ¾-inch PVC type LR electrical conduit box, from the local home improvement store. This has a weatherproof access lid that's secured with two screws and has two openings that must be plugged, using ¾-inch PVC cap and a 2-inch length of ¾-inch PVC pipe.

Figure 1 — Antenna elements departing the feed point at various angles. (Elements from left to right are for 20, 40, 30, and 60 meters.)

Figure 2 — Details of connections to the feed point. Note the optional use of a pigtail linking the radials to the feed point, simplifying the disconnection and reconnection of radials to the system.

On the conduit box, I mounted the SO-239 for the coax feed and two ¼-inch stainless steel bolts, with nuts, washers, and lock washers — one for the ground radials and one for the antenna elements (see Figure 2). Red and black PVC tape was used to indicate antenna and ground sides. The SO-239 and stainless-steel bolts are connected inside the box with two short wires (see Figure 3). Lugs were soldered to the feed end of each element and attached to the feed point bolt.

Radials

I wanted to use the minimum number of short radials that would get me on the air quickly and reliably support communications, without needing to get every decibel of gain out of the system.

I experimented with various lengths and numbers of radials, but settled on using 16 radials, each 16 feet long. The wires are soldered into bundles of four onto each of four terminal lugs, which are attached to the ground bolt using wing nuts.

Securing the Wires

Each radiating element and radial is secured at the end opposite of the feed point with a short length of plastic pipe hanger strap, which has holes every ¾ inch. I cut a 3- or 4-inch length for each radial and driven element, then threaded the wire through the strap material a few times.

Figure 3 — Wiring and hardware detail of conduit box feed point.

At the other end of the plastic hanger strap, I tied the line used to suspend the element to the tree. For the radials, I inserted a large nail into the opposite end of the strap material after it was secured to the radial. I pulled the radial taut and pushed the nail into the ground by hand. This keeps the radials flat against the ground.

SWR

The elements are cut to favor the CW portions of the bands. SWR for those portions of the bands is 1.1:1 on 60, 40, and 30 meters, and 1.3:1 on 20 meters. SWR is also respectable on the "bonus" bands of 15 and 6 meters. SWR on 15 meters is 1.2:1 or better, and on 6 meters it's 1.4:1 on the CW portion and gradually goes to 2.5:1 at 54 MHz.

Fighting Wind

To deal with branches moving during windy days, I placed bungee cords at each end of the line that suspends any element where branch movement is a problem. Some experimentation was required in order to determine how much I needed to dampen the impact of movement while ensuring the element was sufficiently taut when the winds were calm.

Safety

Safety must be the first consideration of this or any other antenna. This being a ground-mounted antenna, I did no climbing and used no ladders during the project. All lines were thrown over branches by hand, which limited height and resulted in a greater slope in the case of the 60-meter element, but was consistent with the simulated emergency deployment where mechanical means to launch a line higher might not be readily available.

The antenna is fairly stealthy, and can be difficult to see depending on the location where it is used. However, safety is more important than stealth, so remember that within a certain distance of the feed point, it is possible to walk into the "hot" wires that make it look like a fountain. The radials are also a potential tripping hazard. Choose a location that has little or no foot traffic, and use some sort of marking to alert people as they approach it. Limit access of people and animals to the antenna while it is in operation.

Conclusion

I have made hundreds of two-way contacts using the fountain antenna. It is fun and inexpensive and has become my go-to antenna on the bands for which it was designed. Using 100 W, I'm pleased with the performance and the signal reports I have received.

I liked this well enough to build a second antenna, intended for portable operation. However, as band conditions improve, I plan to use it as a second semi-permanent antenna with elements for other bands and then build a third for portable operations.

All photos by the author.

Ted Coyle, AA4AZ, has been a licensed amateur radio operator for 52 years, and has had his Amateur Extra-class license for 47 years. He earned a BS degree from Stockton University, and a Master's of Engineering Management from Widener University. He is a retired Environmental, Health, and Safety professional, with related experience in ISO management systems and Six Sigma. He is active in the Straight Key Century Club, the Salem County NJ ARES/RACES group, and is a member of the Gloucester County, New Jersey, Amateur Radio Club. He can be reached at **aa4az@comcast.net**.

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

A Simple High-Frequency Communications Receiver

James Forkin, WA3TFS

I had to take a new approach for this 40-meter transceiver project, as many of my favorite components are no longer available as through-hole parts. Tiny surface-mount devices (SMD) and components are difficult for many builders to handle. Two modules I used for this project do have SMDs, but they are preassembled and just plug into the circuit board. This article explains the receiver portion of my transceiver project (see the lead photo). This receiver can also be built to receive 160 or 80 meters, but will require changes to the input band-pass filter.

Frequency control is based on an off-the-shelf DDS module and an Arduino Nano microprocessor. I also selected a 1.44-inch color LED display, but you can easily substitute a 1.8-inch display.

This elegantly designed radio includes a microcomputer controller.

The adjustable bandwidth crystal filter has a good response for AM, SSB, and CW signals, and is a unique feature for this design. This filter uses three 9 MHz crystals and some varactor diodes to control the bandwidth. A fourth 9 MHz crystal is used in an oscillator to generate the beat frequency oscillator (BFO) injection. Frequency stability is excellent. [Note: This receiver is designed for lower sideband (LSB) only, so it is not suitable for most digital modes, including FT4 and FT8, which require the use of upper sideband. — *Ed.*] Double-balanced diode mixers are used for front-end mixing and detection of the received signals.

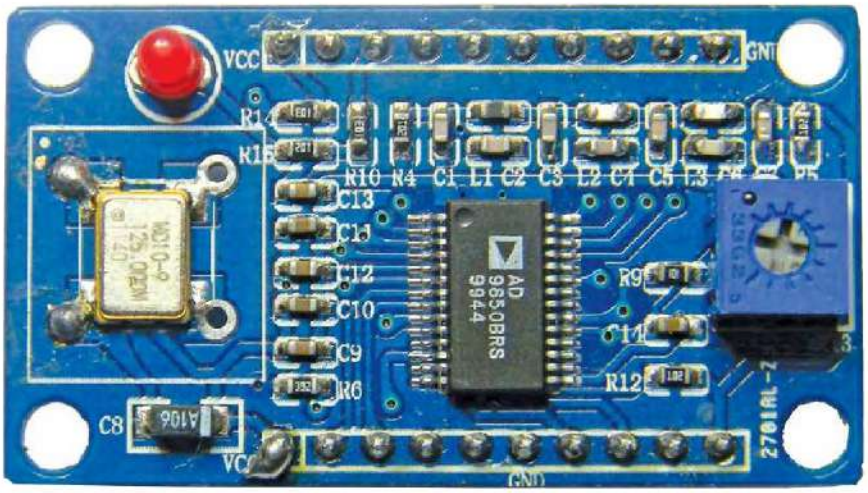


Figure 1 — The DDS module.

Circuit Design

The full receiver schematic, parts layout, input band-pass filter, and other details are on the *QST* in Depth web page, at **www.arrl.org/qst-in-depth**. An antenna connects to a broadband single-stage RF preamplifier and then to a multi-stage band-pass filter designed for the 40-meter band (7.0 MHz to 7.3 MHz). You must wind three toroidal coils for this filter on T37-2 toroid cores. The inductors for the pre-amp and the two IF stages are bifilar windings on FT37-43 toroid cores. The required number of turns is noted on the schematic. To use this receiver on another band, you need only substitute components in this section to incorporate values for that band. Refer to *The ARRL Handbook* for filter design details.

The software on the *QST* in Depth web page supports not only the 40-meter band, but other bands as well. The usable bandwidth of the receiver is limited by the front-end band-pass filter parameters. I found that I needed to add a broadcast band rejection filter at the antenna input; the design for this filter is also on the *QST* in Depth web page.

Output from the input band-pass filter feeds the RF input of an SRA-1 or SBL-1 double-balanced diode mixer. This type of mixer does not overload easily. Local oscillator RF from the DDS module (see Figure 1) is fed to the local oscillator (LO) input of the mixer. The LO frequency is 9 MHz above the desired receive frequency. For example, tuning to 7150 kHz requires an LO frequency of 16,150 kHz.

Output from the mixer (IF) connects directly to the input of the multi-stage adjustable bandwidth crystal filter. When a control voltage is applied to the crystal bandwidth control, the bandwidth of the filter will change from approximately 1 kHz to 4 kHz. Ideally, the three crystals should be exactly on the same frequency, however, a slight variation in frequency will minimally change the response. The varactor diodes will not be exactly the same either, and this variation will affect the overall response. Leaded varactor diodes may be difficult to find. I located them on eBay.

Some 330 Ω resistors terminate both the input and output of the crystal filter. This value is not critical, but changes to this value will affect the roll-off characteristics and the in-band ripple of the filter response. A lower resistance will increase filter roll-off rate but also increase ripple level within the passband.

Output from the filter couples to a two-stage IF amplifier using two 2N3904 transistors. Each RF amplifier stage requires a bifilar wound coil. Wind them on FT37-43 toroid cores exactly like the band-pass filter coils, but wind two wires at the same time. It will be easy to identify the windings if you use two different colored wires. My printed circuit board (PCB) layout is marked **R** and **G** to indicate red and green wires. The proper connections are handled by the PCB, so just connect the start windings on one side and the end windings on the opposite side. The schematic indicates the required number of turns.

The gain of the second amplifier stage is controlled from the front panel. I did not incorporate an automatic gain control (AGC) circuit in this design. AGC could be added at this control point if desired. Higher voltage (up to 12 V) applied here increases gain and lower voltage decreases gain.

The second stage of the IF amplifier is coupled to a second double-balanced diode mixer at the RF input. A 2N3904 transistor oscillator and a 9 MHz crystal supply the LO injection. Adjustable capacitor C25 allows frequency adjustment. This is the only adjust-

The full receiver schematic and other details are on the *QST* in Depth web page, at www.arrl.org/qst-in-depth.

ment required in the receiver. Frequency can be adjusted using another calibrated receiver, a frequency counter, or even by ear for best sounding SSB phone signal. The IF output from the mixer connects to a single-stage 2N3904 transistor audio preamp, and then to a 10 kΩ volume control. An LM386 audio amplifier configured for a gain of 200 completes the audio chain.

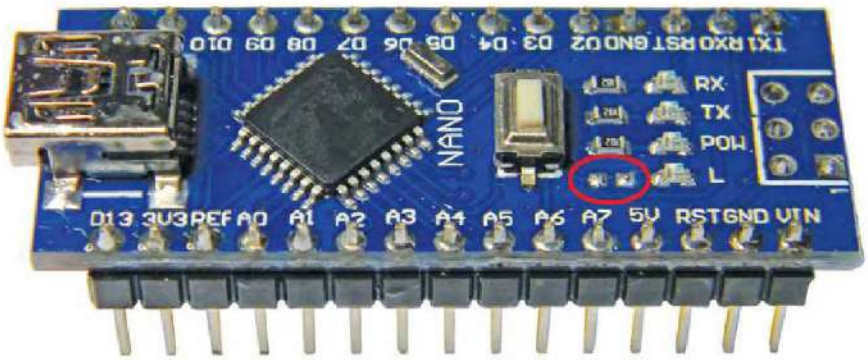


Figure 2 — Remove the circled resistor from the Nano board to disable the LED.

Software

Tuning, frequency control, and display are all handled by software loaded onto the Arduino Nano. I selected this microprocessor because it has enough capacity to support the application and it is inexpensive. I used a Nano and DDS module in my previous project, "Super Simple 6-Meter SDR Transceiver," in the March 2019 issue of *QST*. Download the software for programming this Arduino device and compile and load the control software before the receiver will function. Full instructions are available on the Arduino website.

Arduino programming software required to program the Arduino Nano microprocessor can be downloaded from **www.arduino.cc/en/Main/Software**. An inexpensive 1.44-inch diagonal LCD display module shows the receive frequency. A 1.8-inch LCD may be substituted, but requires more front panel space. Control software, **single_band_rcvr_R2_180.ino**, for the 1.8-inch display, and **single_band_rcvr_R2_144.ino** for the 1.44-inch display, are available on the *QST* in Depth web page and at **www.wa3tfs.com**.

Two low-cost encoders are connected to the microprocessor. One tunes the DDS module by way of the Nano for the desired receive frequency, and the other selects the tuning rate per step. Both incorporate a pushbutton switch function. Pushing the step encoder will switch the frequency step size to 100 Hz. The tune switch will return the receiver to 7150.000 kHz. The software handles the 9 MHz offset for the LO.

I decided to also add a notch filter function by incorporating the notch filter section from my article, "WA3TFS Audio Notch Filter and Clipper," published in the August 2015 issue of *QST*.

The receiver may be mounted in any enclosure you desire. The lead photo shows a simple cabinet constructed from wood and acrylic plastic.

Tuning, frequency control, and display are all handled by software loaded onto the Arduino Nano microprocessor.

Controls

Controls necessary for the receiver consist of two encoders, a volume control (10 kΩ recommended), a 10 kΩ RF gain control, and a bandwidth control (also 10 kΩ). 12 V power is internally regulated to 5 V by IC2, an on-board linear regulator, for powering the Nano and DDS modules. There is room to use a small heatsink on this part if desired. All parts on the board are easy-to-assemble through-hole components. The two modules containing surface-mount parts are pre-assembled and simply plug into the board. The rear panel requires a 12 V power connection, speaker jack, and an RF antenna connector of your choice. I used a BNC style for this project.

I designed a double-sided PCB to make this project easy to duplicate. The board measures 6.3 × 3.95 inches. The design lends itself for use as a standalone HF receiver or as the receiver section of a transceiver. The components necessary to assemble the circuit board are listed in a file on the *QST* in Depth web page.

Initial Setup

You must remove a resistor on the Nano board for it to function correctly (see Figure 2). Just heat one end of the resistor with a soldering iron and remove it. Program the Nano microprocessor by downloading the software, compiling it, and uploading it to the Nano using the Arduino software. Be sure to use the

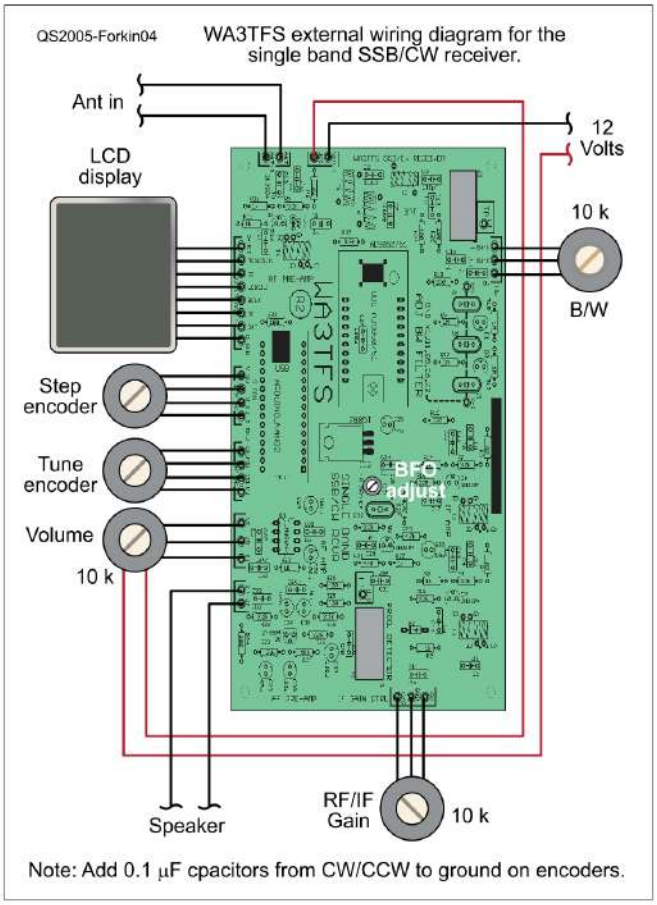


Figure 3 — The wiring external to the PCB.

version of the software that corresponds to the LCD size you're using for the project. You'll need to format the data to download to the LCD properly. Do this before mounting the Nano onto the circuit board. It will be powered by the USB connection during programming. When successfully programmed, mount it onto the circuit board. The proper orientation is shown on the circuit board.

After you have completed the assembly and checked the interconnection wiring external to the PCB (see Figure 3) to the volume, gain, and bandwidth controls and the two encoders, it's time to start up the receiver, laid out in steps on the *QST* in Depth web page. After that, the receiver is ready to use and no further adjustments are needed. You will find it useful for listening to SSB, CW, and AM signals.

The adjustable bandwidth allows copy under crowded conditions and the audio output is adequate for any situation. The bright display is readable under most lighting conditions. For best operation, set the audio gain to a wanted level and adjust the RF gain as necessary.

I have circuit boards available and a limited number of partial kits. The kits include a circuit board, crystals, diode mixers, and varactor diodes. The parts list specifies all required components to complete the assembly. Visit my website (**www.wa3tfs.com**) for details.

James Forkin, WA3TFS, learned code as a Boy Scout while working on his Eagle rank. He was licensed as a Novice (WH6HOC) in 1971 while stationed in Hawaii with the US Army. He made his first contact from there, reaching Alaska using a homebrew 5 W transmitter and vertical antenna on 15 meters. Jim retired as an electronics design engineer after 35 years of developing analog and digital products. He specialized in electromechanical design and EMI suppression techniques. Jim has been designing and building amateur radio devices since he was first licensed. You can find some of his projects at **www.wa3tfs.com**. He has published articles in *QST* and *Ham Radio* Magazine. He is active on 40- and 20-meter SSB using homebrew transceivers. You can contact Jim at **jforkin@verizon.net**.

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

Digital *NCJ* and *QEX* — Two New ARRL Member Benefits Coming Soon!

Beginning in late April, *The National Contest Journal*, better known as *NCJ*, and *QEX*, a magazine devoted to design and experimentation, will become available in digital format to all ARRL members *at no extra charge*. (Print editions of *NCJ* and *QEX* will remain available exclusively to paid subscribers.)

Both ARRL magazines have been favorites among select audiences for decades. Subscribers to *NCJ* enjoy in-depth articles about the competitive side of amateur radio, while *QEX* readers experience technical material written at a higher level than one would ordinarily find in *QST*.

If you read *QST* and our new *On the Air* magazines through the ARRL Magazines app on your iOS or Android device, you'll soon discover that the app has added the May/June issues of *NCJ* and *QEX*. You will also be able to read *NCJ* and *QEX* on your desktop or laptop computers. Unlike the printed versions of these magazines, the digital versions of *NCJ* and *QEX* will appear in color and contain "live" internet links.

Watch for announcements in the coming days on the ARRL website (**www.arrl.org**), in the *ARRL Letter*, and on ARRL social media such as Facebook, Twitter, and Instagram.

Now you have four magazines for your reading pleasure, just by being a member of ARRL!

Product Review

Icom IC-V86 2-Meter FM Handheld Transceiver

Reviewed by Dan Wall, W1ZFG
w1zfg@arrl.org

Icom's IC-V86 is an analog FM transceiver that covers 144 to 148 MHz on transmit and 136 to 174 MHz on receive. There are four power output levels: 0.5 W (Low), 2.5 W (Mid), 5.5 W (High), and 7.0 W (Extra High).

The radio is supplied with a flexible antenna, a belt clip, a connector cover (to seal the speaker/mic jack), and a 7.2 V, 2,250 mAh Li-ion battery pack. The supplied BC-240 rapid desktop charger can fully charge the battery in a few hours, using either the supplied ac adapter or an optional dc adapter. The charger has a selectable Extend Battery Life function, which stops charging at less than full capacity, in order to extend battery life.

The IC-V86 is well supported with optional accessories. As shown in the footnotes in Table 1, Icom offers four different battery packs compatible with this radio, as well as several different optional chargers and dc power cables. (There is no external power connector on the radio itself.) Several speaker/mics, headsets, programming cables, and cloning cables are available.

The included *Basic Manual* unfolds into a 16.5 × 23.5 inch sheet, printed on both sides. An *Advanced Manual* is available for free download from the Icom website, along with a color brochure.

Features

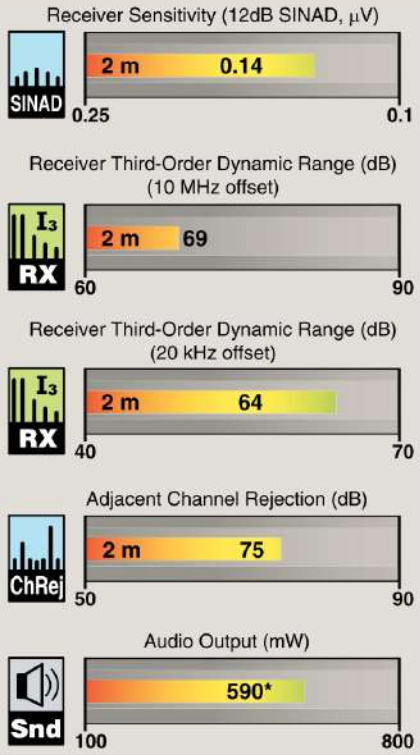
The IC-V86 has features often found in higher-priced radios, such as an integrated VOX function (voice-operated transmit), Continuous Tone-Coded Squelch System (CTCSS), and Digital-Coded Squelch (DCS).

The memory holds 207 channels (200 regular channels, six scan edge frequencies, and one call channel). There are also 10 preprogrammed NOAA Weather Radio channels in the US versions. Memories can be displayed by frequency, channel number, or alphanumeric name.

Bottom Line

The IC-V86 is a solidly built 2-meter FM handheld with great audio and a wide range of features and available accessories.

Icom IC-V86 Receiver Key Measurements Summary



KEY: QS2005-PR144
Measurements shown for FM mode. See Table 1 and expanded test results at **www.arrl.org/qst_in_depth** for additional measurements.
*Measured at the external speaker jack.

Table 1
Icom IC-V86, serial number 12001797-9

Additional ARRL Lab measurements are available at **www.arrl.org/qst_in_depth**.

Manufacturer's Specifications	Measured in the ARRL Lab
Frequency coverage: transmit, 144 – 148 MHz; receive, 136 – 174 MHz.	Receive and transmit as specified.
Modes: FM, FM narrow (FMN).	As specified.
Power requirements: Receive: 0.45 A (typical). Transmit, Ex Hi, 1.6 A; Hi, 1.4 A; Med, 1.0 A; Low, 0.5 A at 7.5 V dc.*	With 8.3 V dc (full charge): Receive, 400 mA (max volume, no signal, backlight on; 384 mA (backlight off); Standby, 53 mA. Battery saver on, 11 mA. Transmit: 1.66 A (Ex Hi); 1.42 A (Hi); 0.96 A (Med); 0.43 A (Low). Power off, 0 mA.
Receiver	**Receiver Dynamic Testing**
FM sensitivity: 12 dB SINAD, –124 dBm (0.14 µV).	For 12 dB SINAD: FM, as specified, FMN, –125 dBm (0.13 µV).
Adjacent-channel rejection: Not specified.	20 kHz offset: FM, 75 dB; FMN, 79 dB.
Squelch sensitivity: 0.22 µV (threshold).	At threshold, 0.21 µV (min), 0.69 µV (max).
S-meter sensitivity: Not specified.	1 bar, 0.27 µV; 2 bars, 0.52 µV; 3 bars, 1.19 µV.
Audio output: 550 mW into 8 Ω load (external speaker jack). 1.5 W with internal speaker).	At external speaker jack: 590 mW at 10% THD. THD at 1 V_{RMS}, 1.0 %.
Transmitter	**Transmitter Dynamic Testing**
Power output: Extra Hi/Hi/ Med/Low, 7.0/5.5/2.5/0.5 W.	Extra Hi/Hi/Med/Low power: At 8.3 V dc (full charge): 7.0/5.3/2.6/0.47 W. At 5.8 V dc: 5.0/4.1/2.3/0.47 W (shuts down at 5.7 V dc).
Spurious signal and harmonic suppression: >60 dB.	As specified. Meets FCC requirements.

Size (height, width, depth): 5.0 × 2.4 × 1.6 inches (with protrusions). Antenna, 7.5 inches. Weight, 11 ounces with belt clip and antenna.

*BP-298 2,200 mAh Li-ion battery, BC-240 desk charger, and BC-242 ac adapter included. Replacement BP-298, $60. BP-299 3,150 mAh Li-ion battery, $80. BP-264 1,400 mAh NiMH battery, $43. BP-263 alkaline battery case (6 AA cells), $30.

The radio supports a number of scanning modes, including various options for scanning selected VFO frequencies or memory channels. Details on the scanning modes can be found in the manual, which is available for download from the Icom website.

Frequency offset and duplex direction can be programmed manually, but the US versions have an automatic repeater offset function, which has priority over the manual duplex setting. There is also a reverse-duplex function to swap the normal transmit and receive frequencies.

By default, the **VOL** knob controls the volume of the received signal and the up/down arrow buttons change the frequency. That can be changed in a menu to swap the functions of those controls, so that the **VOL** knob controls the frequency and the arrow buttons control the volume.

One of the major features of this radio is the 1.5 W of audio output using the internal speaker. The speaker itself is larger than speakers in other handheld radios I have used. This feature does not disappoint. On-the-air testing demonstrated clear and crisp audio with no distortion, even at full volume.

However, the speaker takes up almost half of the front panel. This results in small display and keypad areas. The digits of the frequency display are large enough to be easily read, but the smaller icons that

Figure 1 — The IC-V86 LCD conveys a lot of information about transceiver settings and status. The frequency display is a good size and very readable, but the other icons are quite a bit smaller.

indicate other operating functions are difficult to read without additional magnification (see Figure 1). On the keypad, most of the keys are large enough for easy access, but I found the **MONI** and **PWR** keys to be quite small. For example, to change the squelch setting, you must press and hold the **MONI** key with one finger and press the up or down arrow with another finger. Given the small size of the **MONI** key and its close proximity to the up arrow key, I found it difficult to adjust the squelch level.

The LCD was very readable, in both sunlight and shadow. The backlight function can be set to always on, always off, or auto. In the auto mode, pressing any button will turn the backlight on for 4 seconds, and then it turns off. The display was still readable from an angle of around 45 degrees.

The manual indicates an impressive array of MIL-STD 810G and IP54 standards compliance for dust protection and water resistance. However, the manual states that these requirements are only met when the connector cover or optional speaker/microphone is connected, along with a battery pack and an antenna. The supplied connector cover is made of solid plastic and must be attached with two very tiny screws. This could make switching between internal and external speaker/microphones difficult in the field.

Final Thoughts

The IC-V86 is a solid performer. The radio has enough features that are found in higher-priced models to make it a good choice as a first unit for a new ham or an addition to an experienced ham's go-bag. The 7 W transmitter output, excellent audio, and high build quality make this analog 2-meter radio a standout in its price class. With the wide variety of optional accessories available, you can't go wrong.

Manufacturer: Icom America, 12421 Willows Rd. NE, Kirkland, WA 98034; **www.icomamerica.com**. Price: $125.

NanoVNA Vector Network Analyzer

Reviewed by Phil Salas, AD5X
ad5x@arrl.net

A two-port vector network analyzer (VNA) that covers 50 kHz to 900 MHz for about $50 to $75 seems too good to be true, and is worth a serious look. This review will focus on using the NanoVNA as an antenna analyzer. For a detailed description of the design and information on using the NanoVNA for other applications, see George

Bottom Line

The inexpensive NanoVNA is a true vector network analyzer that covers all ham bands from 1.8 to 500 MHz with a single, accurate instrument.

Steber's, WB9LVI, article, "An Ultra Low Cost Vector Network Analyzer," in the January/February 2020 issue of *QEX*.

Overview

The NanoVNA is available from numerous suppliers, including popular auction sites and Amazon. There are different manufacturers of this unit, and some amateurs have reported that the quality or operation of some NanoVNAs is sub-par. Look at the reviews for each supplier before ordering. The NanoVNA evaluated here came from a Chinese supplier on eBay and arrived in about 2 weeks.

The NanoVNA uses a 2.8-inch (320 × 240 pixel) color touchscreen display and includes an internal 400 mAh rechargeable Li-ion battery (battery capacity varies with supplier). You can display up to four different graphs simultaneously, including a Smith chart display. The NanoVNA does not include a case — it consists of three stacked printed circuit boards with soldered-on SMA RF connectors. (At least one eBay supplier offers a plastic case for this unit.) The review NanoVNA included two 13-inch SMA-to-SMA cables, an SMA barrel, and open, shorted, and 50 Ω SMA loads for calibration purposes. The kit also included a USB cable for charging, software updates, and computer interfacing. Everything is contained in a plastic box. Companion Windows software is available. Table 2 summarizes the NanoVNA's features and performance specifications.

Table 2
NanoVNA Manufacturer's Specifications

Measurement frequency range: 50 kHz to 900 MHz.

RF output: –13 dBm typical, –9 dBm maximum. Fundamental frequency used to 300 MHz; third harmonic from 300 to 900 MHz.

Dynamic range: 70 dB from 50 kHz to 300 MHz; 50 dB from 300 to 600 MHz; 40 dB from 600 to 900 MHz.

SWR accuracy: See Table 3.

Number of scanning points: 101 (fixed).

Display tracking: 4, markers: 4, calibration memories: 5.

Frequency tolerance: <2.5 ppm.

Frequency stability: <0.5 ppm.

Port SWR: <1.1:1.

Power: USB 5 V 120 mA; built-in 400 mAh lithium battery; maximum charging current: 0.8 A.

Dimensions: 2.1 × 3.4 × 0.4 inches without connectors, and switches. Weight: 3 ounces.

NanoVNA Testing

I began by measuring SWR accuracy. I first checked the NanoVNA against a precision 50 Ω load. Then I tested it with shorted microwave attenuators of 5 dB (1.92:1 SWR), 3 dB (3.01:1 SWR), 2 dB (4.42:1 SWR), and 1 dB (8.7:1 SWR). Because the pads are not perfect, I also compared the measurements to the results on my Array Solutions VNAuhf, which I reviewed in the July 2013 issue of *QST*. As you can see in Table 3, the NanoVNA SWR readings compare quite favorably to the VNAuhf readings.

I built lower impedance complex loads with an SWR of approximately 2:1 for 50, 146, and 222 MHz. Table 4 shows the measurements of these loads with the NanoVNA compared to VNAuhf measurements, which were almost identical.

Table 3
NanoVNA Resistive Load Measurements

NanoVNA compared to Array Solutions VNAuhf (see text)

Load (SWR)	1.0:1	1.9:1	3:1	4.4:1	8.7:1
Frequency	*Measurement with NanoVNA/VNAuhf*				
(MHz)	Nano	Nano/uhf	Nano/uhf	Nano/uhf	Nano/uhf
1.8	1.0	1.8/1.78	2.6/2.6	4.4/4.44	10.5/10.5
3.5	1.0	1.8/1.78	2.6/2.6	4.4/4.44	10.5/10.5
7	1.0	1.8/1.78	2.6/2.6	4.4/4.44	10.5/10.5
14	1.0	1.8/1.78	2.6/2.6	4.4/4.44	10.5/10.5
28	1.0	1.8/1.78	2.6/2.6	4.4/4.44	10.1/10.5
50	1.0	1.8/1.79	2.6/2.65	4.4/4.55	9.4/10.4
146	1.0	1.9/1.92	2.6/2.67	4.8/4.72	10.0/10.3
222	1.1	2.0/2.00	2.7/2.73	5.0/4.85	10.4/10.0
440	1.0	2.0/1.96	2.9/2.85	4.4/5.20	7.8/9.3
850	1.0	1.9/2.08	2.8/3.36	4.0/4.05	n/a

Using the NanoVNA

The NanoVNA user interface is not as friendly as many of the ham antenna analyzers on the market. I found it easier to use after going through the scan setup process once or twice. The device doesn't come with a manual, but the latest user guide, a quick-start manual, and other valuable information can be found in the Files section of the NanoVNA user group at **groups.io/g/nanovna-users**.

Also included in the Files section is information on firmware updates and computer interfacing with the downloadable *NanoVNASaver* Windows software. This program lets you control the NanoVNA from your computer, and it permits display and download of scans. *NanoVNASaver* even includes a time-domain reflectometer (TDR) function that is useful for locating faults in transmission lines.

Table 4
NanoVNA Complex Load Measurements

NanoVNA compared to Array Solutions VNAuhf measurements of SWR and series resistance/capacitance

Frequency (MHz)	nanoVNA SWR	nanoVNA Rs/Cs	VNAuhf SWR	VNAuhf Rs/Cs
50	1.95	47.4 Ω/96 pF	1.98	47.3 Ω/94 pF
146	1.81	45.2 Ω/38.7 pF	1.79	45.1 Ω/39 pF
222	1.75	42.2 Ω/29.2 pF	1.79	42.1 Ω/28.9 pF

Figure 2 — The adapters purchased for NanoVNA use.

Along the top side of the NanoVNA is a USB-C interface, an on/off switch, a momentary-contact rocker switch, and a power/charging LED. Charge the unit with the supplied USB cable before using it for the first time. The blue LED will flash during charging, and will light solid when charging is complete.

Because the SMA connectors are soldered to one of the PC boards and prone to damage, I don't recommend attaching any large adapters directly to these connectors. Always use the supplied 13-inch SMA/SMA cables. To interface with more common connectors, I purchased SMA-to-N, SMA-to-UHF, and SMA-to-BNC adapters — all readily available online (see Figure 2). SMA connectors are specified for 500 mate/unmate operations, so I attached SMA-male/SMA-female adapters to each port to protect the original SMA connectors.

The NanoVNA touchscreen is quite small, so a smartphone stylus may be helpful when using the device. The rocker switch can also be used for navigation, and I found it especially helpful for moving the markers on the screen. I prefer using the touchscreen for the settings and menu selections.

Out of the box, the NanoVNA is calibrated, but I recommend that you go through the calibration process. There are five calibration memory locations. In addition to a full-frequency calibration, which only takes a few seconds, I also calibrated and saved the configurations for the ham band ranges I am most interested in. I used my preferred adapters as part of the calibration procedure to eliminate any effect on measurements. I calibrated my NanoVNA and stored the settings for these ranges:

- C0: 50 kHz – 900 MHz (calibrated with the SMA connectors and cables only).
- C1: 1 – 55 MHz (calibrated with the UHF adapters and SMA cables).
- C2: 136 – 225 MHz (calibrated with the N adapters and SMA cables).
- C3: 410 – 460 MHz (calibrated with the N adapters and SMA cables).
- C4: Left unused for future custom calibration.

Figure 3 — The return loss and Smith chart swept-frequency measurements on 160 meters for the author's 43-foot vertical antenna with matching network, using the *NanoVNASaver* software.

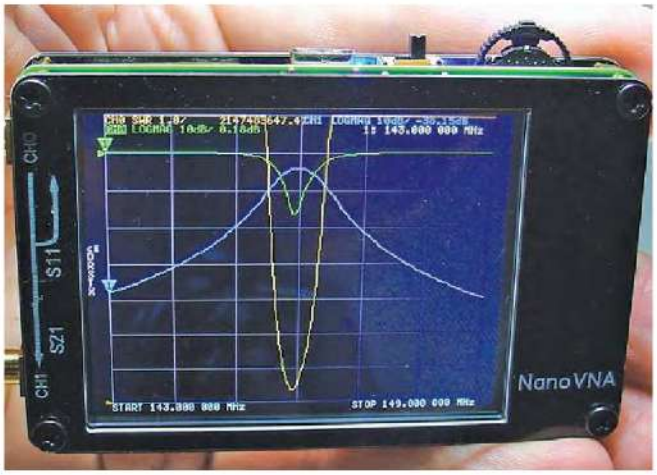


Figure 4 — SWR, return loss, and insertion loss measurements for a 2-meter band-pass filter, displayed on the NanoVNA.

Up to four graphs can be displayed at once, and either linear or logarithmic scaling can be selected. I always use linear displays for SWR, and logarithmic displays for return loss and insertion loss measurements. You can also select a Smith chart display.

My primary antenna is a 43-foot vertical with a 160/80-meter base-loaded matching network. Figure 3 shows *NanoVNASaver* screenshots of return loss measurements and Smith chart curves for this antenna on 160 meters. To read the data at any point, simply drag the cursor with your stylus to the desired frequency on the graph, or use the momentary rocker switch to move the cursor. The Smith chart data provides accurate impedance information, and this reading corresponded exactly with that of my RigExpert AA-55 ZOOM.

Finally, I wanted to provide a taste of what can be done with the two-port capabilities of this device. Figure 4 shows the NanoVNA display of the SWR (yellow), return loss (green), and transmission loss (blue) of a 2-meter band-pass filter. Figure 5 shows the *NanoVNASaver* scans of return loss, insertion loss, and Smith chart data for the same filter.

Conclusion

The NanoVNA is an inexpensive instrument that can be used as an antenna analyzer for all ham bands up to 450 MHz. And while small, the color LCD touchscreen provides easily read information over the swept frequency range. You can investigate the NanoVNA further by viewing the manual and reading through the discussion on the NanoVNA User Group. Typical prices range from $50 to $75 from eBay, Amazon, and other sources.

Larger versions of the *NanoVNASaver* screenshots are available on **www.arrl.org/qst_in_depth**.

The NanoVNA-F — Added Capability

During my review of the NanoVNA, the NanoVNA-F was introduced. The NanoVNA-F differs from the NanoVNA in several important ways. The first obvious difference is the larger 4.3-inch TFT LCD touchscreen, which also has a larger viewing angle and is easier to read in strong sunlight. (Figure A shows the NanoVNA and the NanoVNA-F side by side.) The upper frequency range has been increased to 1,000 MHz, so it includes the 902 MHz ham band. The NanoVNA-F also has a larger 5,000 mAh Li-ion battery, and the internal charger can handle up to a 2 A charging rate from higher-current USB chargers. A USB expansion port can be used for charging other items while simultaneously charging the NanoVNA-F.

A right-angle SMA adapter and a quick-start guide were also included with the NanoVNA-F, in addition to the regular NanoVNA loads and cables. Finally, the NanoVNA-F is enclosed in a metal case, which improves electromagnetic interference susceptibility and protects the SMA connectors and PC boards. The NanoVNA-F is a little over twice the price of the NanoVNA.

Operation of the NanoVNA-F is exactly the same as with the NanoVNA, so there was no learning curve. I re-ran several of my NanoVNA tests and found no difference in performance. However, I did find the larger display much easier to read, and I found it easier to drag the cursors on the touchscreen. The NanoVNA-F goes to 1,000 MHz, so I compared SWR measurements at 950 MHz to my Array Solutions VNAuhf and found the measurements very close.

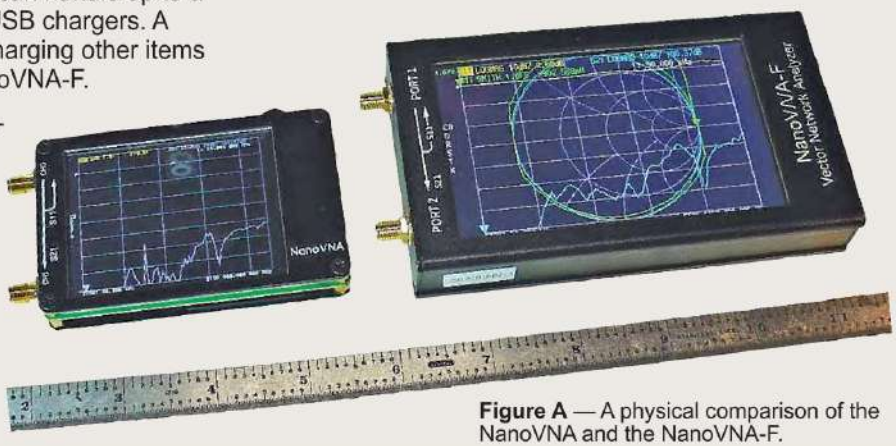


Figure A — A physical comparison of the NanoVNA and the NanoVNA-F.

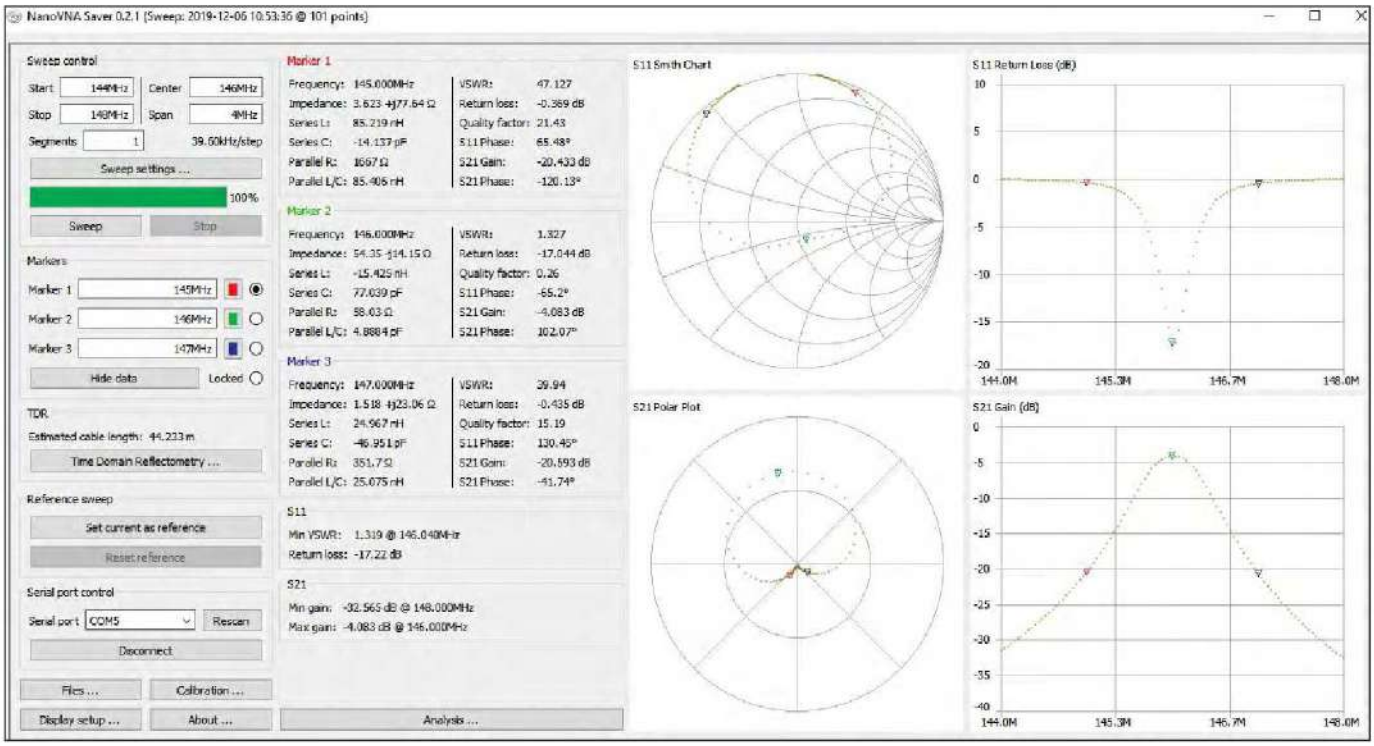


Figure 5 — The scans of the 2-meter band-pass filter displayed using the *NanoVNASaver* software.

mAT-Tuner mAT-10 Automatic Antenna Tuner

Reviewed by Sean Kutzko, KX9X
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As a QRP (low-power, 5 W or less) operator, I love gadgets that make my portable work easier and lighter. One of the biggest debates among field QRPers is the need for an antenna tuner. Some operators think using a resonant antenna is lighter and tuners only add extra weight. But there is also a need for flexibility to help you deal with propagation or unexpected openings. Having a lightweight antenna tuner in your backpack can help you make adjustments in the field and allow you to make more contacts.

The mAT-10 tuner is designed with QRP field operation in mind. With a single push of a button, it can match nearly any type of coax-fed antenna, from dipoles to verticals to random-length wires and counterpoises, from

Bottom Line

The mAT-10 is a good addition to a QRP portable station. It can compensate for less than optimum portable antenna installations, and it allows for operation on several bands with one antenna. It's able to match a broad range of impedances, although loss increases at very low impedances.

Table 5
mAT-TUNER mAT-10 Automatic Antenna Tuner

Manufacturer's Specifications

Frequency range: 1.8 – 54 MHz.
Power handling: 30 W PEP, 5 W digital modes.
Matching range: 5 to 1,500 Ω.
Tuning time: 0.1 – 5 seconds for full tune cycle; 0.1 second to recall memories.
Power requirements: Internal rechargeable #10440 lithium batteries.
Size (height, width, depth): 0.9 × 2.4 × 6.0 inches; weight 9.6 oz with batteries.

mAT-10 Resistive Load and Loss Testing in the ARRL Lab

Untuned Load		Power Loss (%) and Tuned SWR by Band (meters)					
SWR	(Ω)	160	80	40	20	10	6*
9.1:1	5.5	42%	32%	20%	8%	18%	
		2.5	2.0	1.3	1.6	1.6	1.4
7.4:1	6.8	34%	27%	31%	26%	6%	
		2.3	1.6	1.9	1.8	1.4	4.1
3.8:1	13.1	16%	15%	15%	18%	21%	
		1.4	1.2	1.1	1.2	1.5	2.7
2.0	25	9%	12%	10%	10%	19%	
		1.2	1.4	1.1	1.1	1.3	2.2
1:1	50	2%	4%	4%	5%	7%	
		1.0	1.0	1.1	1.1	1.2	1.5
2:1	100	13%	11%	9%	4%	11%	
		2.0	2.0	1.9	1.6	2.1	2.2
4:1	200	3%	3%	1%	1%	1%	
		1.2	1.4	1.2	1.2	1.1	1.3
8:1	400	3%	4%	1%	1%	1%	
		1.3	1.6	1.0	1.0	1.5	1.4
16:1	800	20%	4%	3%	9%	4%	
		3.0	1.6	1.3	1.8	1.7	1.5

*Our resistive load box is limited to a maximum frequency of 30 MHz and a maximum resistance of 800 Ω. Efficiency tests were not performed on 6 meters. The SWR indicator 6 meters showed yellow when a 2.5:1 SWR is present, and red at 3.5:1 and above. It is supposed to be green at 1.1 to 1.5; yellow at 1.5 to 2.0, and red above 3:1.

With no load connected, the mAT-10 found a match on 20, 10, and 6 meters. With the antenna jack shorted, the mAT-10 found a match on 10 and 6 meters.

Figure 6 — The mAT-10 top panel has BNC connectors for the antenna and radio. The multi-pin ACC jack is for the cable for use with a Yaesu FT-817/818 transceiver.

160 through 6 meters. This all comes in a 10-ounce package about the size of an average smartphone.

The mAT-10 can handle up to 30 W on SSB and CW, and up to 5 W on full-duty-cycle modes, such as FT8, PSK, or RTTY. It has a specified matching range of 5 to 1,500 Ω, which exceeds the capability typical of most internal transceiver tuners. However, as shown in Table 5, tuner loss is significant with some low-impedance loads. The mAT-10 is powered by rechargeable Li-ion batteries and comes with its own charger. A single charge can last months, even for very active operators. While the mAT-10 can function with any QRP transceiver, it comes with an interface cable for the Yaesu FT-817/818 radios, making operation even easier (see Figure 6). With 16,000 memories, any time the mAT-10 is at or near a previously-visited frequency that has been tuned, the tuner will recall the settings for that frequency. With a new antenna, the tuner will use another memory to store the new configuration.

Operation couldn't be simpler. Three LEDs on the upper half of the front panel serve as SWR indicators and internal battery life indicators. The lower portion of the front panel has a single button to turn the unit on or off, and to engage the tuner or bypass it. Press the button until the **POWER INDICATION** LED lights. Then press the button again to put the tuner into **ONLINE** or **BYPASS** status. To use the tuner, press the button until the **TUNING** light comes on. If you're using an FT-817/818, the tuner will talk to the radio, read the frequency, and tune the antenna automatically. If you use a different radio, set your radio to FM, RTTY, or CW; ensure your power is less than 5 W; transmit a signal, and press the button on the mAT-10 until the **TUNING** light comes on. Continue transmitting until the **TUNING** light goes out.

The tuner will flash an LED indicating your antenna system's standing-wave ratio (SWR), which is indicated in ranges; the exact SWR is not shown. But you will know if your antenna has been properly tuned. Once tuned, you're ready to go.

Field Testing

During the November 2019 CQ World Wide CW Contest, I took the mAT-10 out to the central Illinois prairie (see Figure 7). For testing, I used a 30-meter dipole on a 20-foot pushup mast in an inverted-V configuration and ran it through the mAT-10 to use on other bands. I was able to get a match of 1.5:1 or better on 40 through 10 meters; 80 meters was between 1.5:1 and 2:1. Operating QRP with a simple wire

antenna, I opted for the last day of the contest to make DX contacts. By that time, the high-power home stations had likely contacted each other, increasing my chance of success with a weaker signal. Even with poor propagation, I was able to contact several Caribbean and Central American stations on 15 meters using the dipole with the mAT-10 tuner. On 20 meters, I was able to make contacts with stations in Europe, Africa, Central America, and Hawaii. Operation was smooth and effortless.

A couple weeks later, I set up my FT-817 with a 25-foot vertical radiator with a single 25-foot wire for a counterpoise elevated about 3 feet off the ground. Again, the mAT-10 matched the antenna on all bands from 10 through 40 meters with a 1.5:1 SWR; 80 meters matched at between 2:1 and 3:1. Again, conditions weren't very good. From the Illinois prairie, I was able to contact stations from Virginia to Kansas on 40-meter CW, and as far west as Colorado and Montana on 20 meters, with signal reports ranging from 579 to 449.

I appreciate that the mAT-10 covers 6 meters. While I did not catch an opening on 6 meters during my testing, it's nice to have the ability to transmit on that band with a simple wire antenna. Seasoned 6-meter operators know that you don't need much of a station to make contacts on 6 meters during a good opening. I look forward to giving the mAT-10 another try during the summer sporadic-E season.

Figure 7 — The author's portable setup with the mAT-10 antenna tuner and Yaesu FT-817 during the CQ World Wide CW Contest, operating from Barnhart Prairie Preserve south of Champaign, Illinois. [Sean Kutzko, KX9X, photo]

Final Thoughts

Successful backpack QRP operating requires adapting to a variety of operating conditions, and the mAT-10 automatic antenna tuner gave me that flexibility. It's ruggedly built, weighs very little, and matched two simple but effective field antennas. Whether you enjoy operating from parks, islands, mountain summits, or your backyard, the mAT-10 is a solid piece of gear that belongs in your bag.

Manufacturer: Hengshui mAT-Tuner Communication Equipment Company, Hebei, China. Available from Vibroplex, 1001 N. Broadway St., Knoxville, TN 37917; **www.vibroplex.com**. Price: $229.95.

Pacific Antenna Volt Tattler 2 Voltage Monitor Kit

Reviewed by Paul Danzer, N1II
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Much of the ham radio equipment we use at home, in the car, or portable is powered by 12 V dc. Most modern transceivers have a power supply specification of 13.8 V dc ±15% (about 11.7 to 16 V), and a typical supply is about 13.8 V with no load. While a great deal of comparison and care is used to select station equipment, often much less attention is paid to the dc power source that is quietly running in the background. Power supply voltages can be higher than expected, or batteries can fade well below 12 V as they discharge.

If the power source fails or its output voltage drifts, either higher or lower, the result can be reduced performance or even damage to the connected equipment. Power supplies sometimes have meters for monitoring the output voltage, but certainly no one is going to pay attention to a power supply meter full time while operating. Most batteries offer no way of

Bottom Line

The Volt Tattler 2 kit from Pacific Antenna is easy to assemble and offers an easy way to constantly monitor your 13.8 V dc power supply, battery, or other low-voltage power source.

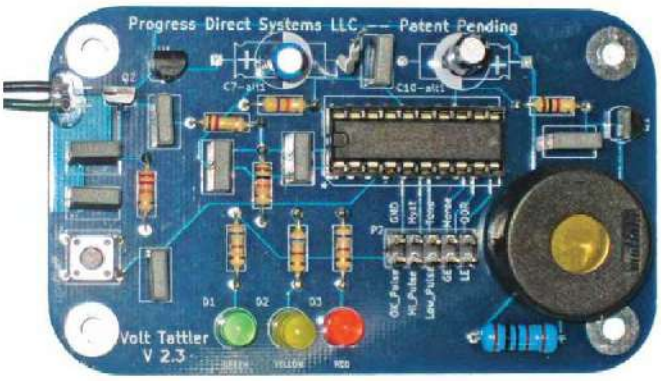

Figure 8— The assembled Volt Tattler 2 PC board. The kit includes a two-pin header to connect leads from the voltage source to be monitored, but I found it convenient to solder wires to the PC board at the upper left. At the very top, under the letters LLC, is a wire connected to the common side for circuit measurements.

knowing the voltage when the battery is fully charged or as it discharges.

Pacific Antenna/QRP Kits offers the Volt Tattler 2, a microcontroller-powered voltage monitor kit that tracks the power supply voltage. This 2 × 3.5 inch PC board (see Figure 8) assembles in one or two evenings and generates high- and low-voltage warnings. The warning threshold is adjustable with limits of 27.5 V on the high end, and 3.9 V on the low end. When the high- or low-voltage limit is reached, an LED begins to blink and an audible Morse code message sounds. If the voltage returns to a value within the limits, the audible alarm stops, but the LED continues to blink until you reset it. Thus, the voltage deviation can come and go, but it leaves a marker, so you will know there was a problem.

Building the Kit

There are a few things you should know ahead of time. You will need the usual 40 W soldering iron, but it must have a very narrow tip. The plated through holes on the board are very small, as are the surrounding solder pads. Thin-gauge solder is a must. The clear, well-illustrated instructions include many assembly tips. I recommend a thorough reading of the assembly instructions before starting the construction.

There are a few small things to note. The voltage regulator unit and transistor Q1 look alike, so examine them carefully. The pushbutton switch is not square. If the leads do not fit easily, rotate the switch 90 degrees, and see if that fixes it.

Many components come mounted on paper tape, and the tape residue has to be cleaned off completely for the leads to go into the holes. If you cut the leads just above the paper tape, you will have plenty of lead for insertion and won't have to deal with paper or glue residue.

Calibration and Use

The Volt Tattler 2 microcontroller integrated circuit comes preset with an upper warning limit of 16 V and a lower limit of 9 V — good values for typical 12 V ham gear. I tested my unit using a variable power supply and voltmeter and found that the preset values worked as expected.

As mentioned previously, you can change the upper and lower limits. A voltmeter and a variable power source make for the easiest calibration, but two fresh 9 V batteries and a few resistors can be used if a variable power supply is not readily available. The unit is calibrated (the high and low limits set) with a few long presses of the pushbutton and setting of the variable power supply for the desired limits, as measured by your voltmeter.

The Volt Tattler 2 samples voltage 20 times a second. Under normal conditions, the green LED blinks. Exceed the upper voltage limit, and the red LED blinks and sounds Morse letter H (for high). Go below the lower limit, and the yellow LED blinks and the Morse message is L (for low). If either limit is exceeded and then the voltage returns within limits, the corresponding LED keeps blinking, but the Morse message stops. To reset the Volt Tattler 2, press the button to shut off the red or yellow LED and restore operation to normal with the green LED blinking.

For a few hours' work and a few short measuring steps, you can protect expensive equipment — or at least find out that the equipment may be at risk.

Manufacturer: Pacific Antenna, P.O. Box 10301, Fayetteville, AR 72703; **www.qrpkits.com**. Price: $25 plus shipping.

K1EL Systems Morse Tutor Kit

Reviewed by Paul Danzer, N1II
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Though this kit functions as a very capable Morse code tutor with a number of practice modes, it is also a construction and soldering tutor. The very complete, well-illustrated manual makes it a good choice for an individual or club project.

The finished kit is a fully functional keyer, similar to the popular K1EL K16 keyer kit, which was reviewed in the February 2017 issue of *QST*. You can use the Morse Tutor to practice copying and sending Morse code, and you can even key a radio with it and use it on the air. In addition, you can network one or more kits for simulated contacts and on-the-air practice.

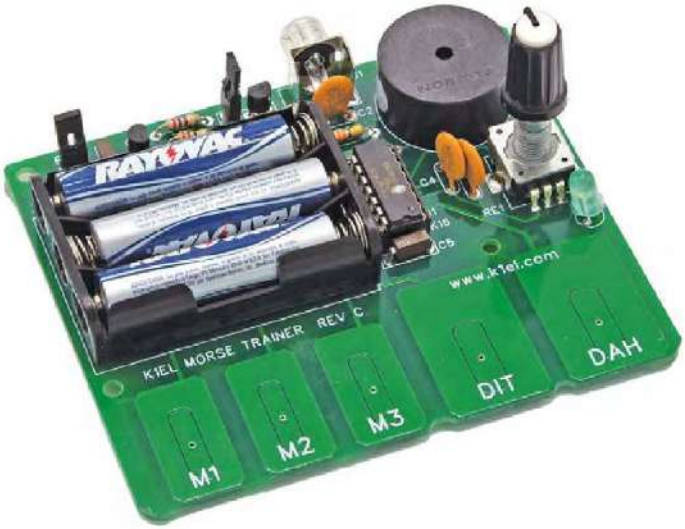
An interesting feature is the use of touch-sensitive pads on the PC board instead of an external paddle, simplifying setup and lowering the cost of a practice station. As with other K1EL keyers, the Morse Tutor includes a command mode to select a long list of options to customize the unit for your preferences.

Putting It Together

The K1EL Morse Tutor is built on a printed circuit board approximately 3⅞ × 3⅝ inches using through-hole components. The step-by-step instructions are thorough and well illustrated, with plenty of drawings and photos. This kit would be a good choice for first-time builders. It offers a good way to learn skills such as reading a functional block diagram, identifying parts and values, and installing components, such as integrated circuits and transistors correctly.

In addition to information specific to this kit, three appendices cover basic kit-building tips. Appendix A has general kit construction hints, including a list of useful tools. To that list, I would add a magnifying glass of some type to allow close inspection of solder joints. Appendix B offers several safety reminders. Appendix C, Soldering Basics, shows how to solder to a PC board and what a good solder joint looks like.

A preprogrammed microprocessor integrated circuit provides the "smarts" for the Morse Tutor. Five touch pads are used for the dit and dah inputs and to program and select message memories (M1, M2, and M3). A rotary encoder with an integral switch puts the unit in the command mode and controls the CW speed. Keyer output is through a transistor driver to a standard phono jack for use with a transceiver.



Another transistor amplifier feeds the sidetone to a miniature onboard speaker.

There are only a few parts to assemble. The review unit came with the battery holder and speaker already mounted to the board. Both of these have to be soldered during construction.

The PC board shown here is Revision C, Morse Tutor Version 1.1. K1EL Systems recently released Revision D, Version 2.0, which has a few changes to make the Morse Tutor easier to build and configure. In the new version, an on/off switch replaces the power jumper shown here, and a diode switch replaces the output configuration jumper.

Keyer Capabilities

Table 6 summarizes the key features and capabilities of the unit. The full feature list is quite impressive and worth a look. Full details are found in the manual, which is available online from K1EL Systems.

The keying modes and commands are very similar to those of the K1EL K16 keyer. Press and hold the knob on the rotary encoder, and Morse Tutor enters

Bottom Line

The Morse Tutor is a low-cost kit that is quickly assembled. In addition to learning and practicing Morse code, it offers a good introduction to soldering and kit building for individuals or as a club project.

Table 6
Selected Morse Tutor Features

- Keyer speed range: 5 – 99 WPM
- Built-in touch paddle with sensitivity calibration
- 34 different commands
- Continuously adjustable sidetone frequency
- Adjustable letter spacing and weighting
- Automatic letter space mode
- Non-volatile message memory with two banks of five slots
- Backspace supported on message entry
- Keying modes: Bug, Ultimatic, Iambic A or B, Straight Key
- Serial number generation
- Paddle swap command
- Speed control potentiometer
- Power consumption: 2 mA idle, 70 µA off

the command mode. Once in the command mode, enter a command letter in Morse on the paddles to select or change an option. For example, send A to toggle the sidetone off or on.

The memories have extended capabilities, such as inserting serial numbers. One feature I like in any keyer is the ability to back up and fix an error while loading a memory, rather than having to start again. The memories retain their contents when the power is shut off.

Using the Morse Tutor

Install three AAA cells and you are ready to go. The first step is calibrating the touch pads for your fingers. I followed the procedure in the manual, but later found that the default settings worked fine for me.

There are four levels for learning Morse code:

- Level 1 sends random letters using 14 letters of the alphabet.
- Level 2 adds the remaining letters.
- Level 3 adds numbers from zero to nine.
- Level 4 adds common punctuation, such as commas and periods, along with prosigns, such as **SK** and **AR**.

In addition to the four levels, there are two practice modes. In the receive practice mode, random characters are sent in groups of five, separated by two spaces. In the receive/respond mode, the Morse Tutor sends a random character from the selected level. You respond by sending that same character using the touch paddle. If you get it right, the Morse Tutor repeats the first character followed by a new character and you send both. The process repeats up to five characters and then starts again with a new group.

When using the Morse Tutor in practice mode or as a keyer, the speed, character spacing, word spacing, and other parameters can be adjusted. The Morse Tutor can be set for Farnsworth spacing, where the characters are sent at a higher speed with longer spacing between characters. The intent is to encourage recognition of Morse characters by their sound or rhythm, rather than trying to count individual dits and dahs.

One of the toughest things for hams new to CW is gaining the confidence to get on the air and make the first few contacts. In the QSO mode, two or more Morse Tutors can be tied together and everyone on this network can join in a practice contact.

Other Flavors

The Morse Tutor is intended to be a simple and inexpensive way to learn and practice Morse code. Although it can be used on the air with a transceiver, at some point you will probably want to move on to a keyer designed for on-air operation using external paddles. K1EL Systems offers a number of different keyers and kits, and they all use similar command sets, so you can build on the experience gained with the Morse Tutor. Additional photos are available online at **www.arrl.org/qst_in_depth**.

Manufacturer: K1EL Systems, **www.k1elsystems.com/K16tutor.html**. Price: $25 plus shipping.

Joel R. Hallas, W1ZR, w1zr@arrl.org

The Doctor is In

You Need to Look at the Whole Antenna System

Q Scott, KW4JM, asks: I just made and deployed a ZS6BKW multiband dipole (see Figure 1). The final trim length was 89 feet for the dipole flat top, and it was 42 feet above ground with a window line length of 39.5 feet to the 1:1 balun. It successfully resonates at 40, 20, 17, 12, and 10 meters. However, I also expected a standing-wave ratio (SWR) dip at the dipole's half-wave frequency, approximately 468/89 = 5.25 MHz, but there is no dip there. I was hoping to also use the antenna on 60 meters. Why would it not dip at 5.2 MHz or thereabouts?

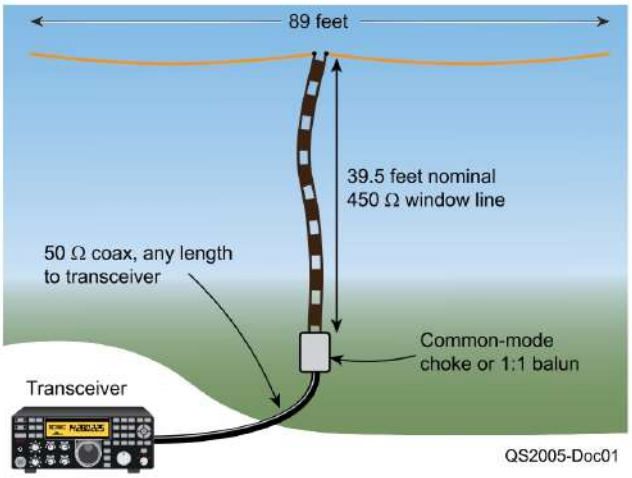


Figure 1 — Dimensions of the KW4JM version of the ZS6BKW multiband dipole. There are many variations with different dimensions shown on the internet, with the height and wire insulation type being a major variable in determining resonant frequencies. Such antennas can do a good job, but in my experience, they often need an antenna tuner on at least some bands or segments.

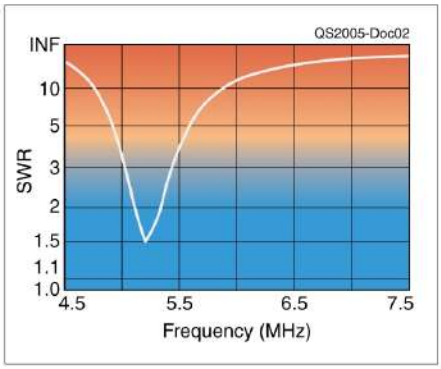


Figure 2 — *EZNEC* SWR plot of the impedance of the flat top portion of the ZS6BKW multiband dipole shown in Figure 1 from 4.5 to 7.5 MHz without a transmission line matching section. Note that as described, the resonance of the flat top is within the 60-meter band, but there is no 40-meter resonance, nor any for 20, 17, 12, or 10 meters.

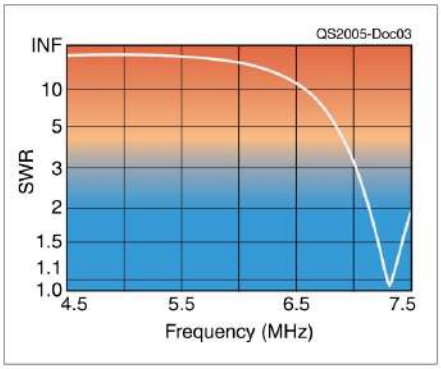


Figure 3 — *EZNEC* SWR plot of the impedance of the flat top portion of the ZS6BKW multiband dipole with the 39.5-foot matching section of nominal 450 Ω Z_0 window line in place. Note that as described, the resonance on 40 meters appears (along with resonances on 20, 17, 12, and 10 meters, not shown), but the 60 meter-resonance is no longer present.

A The usual center-fed wire dipole has an impedance that is a good match to 50 Ω coax at close to its electrical half-wave resonant frequency. At most other frequencies, the SWR is quite high and mismatched coax tends to be quite lossy.

Transmission lines have some interesting properties. The keys to answering your question are the following:

- A transmission line that is terminated in its characteristic impedance (Z_0), such as 50 Ω resistive for RG-213 and many other coax cables, will have the same impedance at any length from the termination. This is handy for feeding a resonant dipole with coax.
- A transmission line terminated in an impedance not equal to its Z_0 will have an impedance at the far end that varies depending on electric length. The variation will depend on the SWR — the higher the SWR, the wider range of variation.

Not yet part of your question, but part of a possible solution:

There is a special case: a transmission line that has an electrical length of a multiple of half-waves long will repeat the termination impedance whether the impedance is matched or not.

If we look at a plot of the SWR of an *EZNEC* (**www.eznec.com**) model of the ZS6BKW antenna, showing the SWR of the antenna itself and the antenna fed with the matching section of window line, we see what has happened (see Figures 2 and 3). The antenna itself would provide a nice

match to 50 Ω coax at 60 meters, but that's it. In the early days, there were just four HF ham bands — 80, 40, 20, and 10 meters — and many hams had separate dipoles for each. Now with nine HF bands, as well as 160 (MF) and 6 (VHF) meters on most transceivers, it takes a big yard to have antennas for each, so multiband antennas are popular.

The G5RV and ZS6BKW antennas take advantage of combinations of antenna impedance versus frequency and transformation ratios of mismatched transmission line that happen to have convenient resonances that result in the possibility of multiband operation. But once the transforming or "matching" section of line is inserted, they transform impedances so multiple bands will be matched, but the original ones are no longer matched — just as if you had changed the antenna length.

The short answer is no, the window-line transformer doesn't allow the system to work on the frequency of the antenna element itself. Fortunately, there are two easy solutions to this.

The easiest solution (if the window line reaches to your location and isn't hanging far from your window) is to patch in enough additional window line behind the balun to make the total window-line length ½ electrical wavelength. For 5.4 MHz, this would be a "free-space" length of about 300/5.4/2 = 27.8 meters or 91.1 feet. But the velocity of RF in window line is 0.915 times that in free space, so the electrical half-wave length is actually closer to 27.8 × 0.915 = 83.4 feet. So, if you can patch in 43.9 feet of additional window line between the end of what's there and your balun or common-mode choke, it should then work on 60 meters, but not on the other bands. By using ¾-inch spaced banana plugs, or other convenient connectors, you can easily change back and forth. Some versions of the ZS6BKW antenna include the ability to tune to desired band segments by patching in 1- or 2-foot lengths, so this line section would just go in the same place.

The only caution is that the extra window line won't work properly if coiled up, laid on the ground, or attached to lossy material. In an unfinished basement shack, I put my extra window line between cellar ceiling joists, selected to avoid copper pipes and electrical wiring, and held the line in place with TV-type screw-in standoff insulators designed for twinlead (available at hardware stores). If you are fortunate enough to be in a more civilized space, perhaps attach the same type of standoffs to the wooden trim boards that frequently surround windows. I like to make my holes in trim boards because they are generally over solid wall sections and are usually easy to patch and paint. If you're lucky, curtains will hide the cable.

If you're fortunate enough to have your antenna high enough so you can't reach the window line-to-coax transition, you can just run window line all the way back to the station to a balanced wide-range (10:1 SWR minimum) antenna tuner, and you will likely be able to use the antenna on all bands (some line trimming may be required to provide a matchable SWR at the tuner on all bands). It adds a box and an extra step when changing bands but will work slightly better than the original antenna.

Q Jim, KJ6KK, asks: In early summer, I was working many east coast and middle US stations from California with my triband vertical antenna, using FT8 mode on 6 meters.

I then took the antenna down to put up a 6-meter horizontal Yagi. After several months, I got the Yagi up. I no longer see east coast or middle US stations, but of course the season and temperatures have changed.

What about antenna polarization on 6 meters for non-local VHF propagation — does it matter?

A I would expect that for VHF ionospheric propagation modes, as on HF, the signal polarization will get rotated as it travels, so it can be considered as arriving in random polarization (any A/B test results would be appreciated). Often this is time-varying and is the cause of some fades that can be reduced by using circular polarization or by having separate H and V receive systems, and switching to the one with the best S/N (diversity reception).

Whether the propagation is different or not, the two polarizations will offer different results based on properties near the antenna.

The good news is that the Yagi will likely have significant gain compared to most vertical omnidirectional antennas. Even vertical Yagis are often compromised by coupling to vertically oriented conductive masts or coax shields, so I would expect your horizontal Yagi will give you better results. I find that my horizontal VHF Yagis work just fine into my local repeaters, with the Yagi gain at least partly offsetting the cross-polarization loss.

Do you have a question? Ask the Doctor! Send your questions to "The Doctor," ARRL, 225 Main St., Newington, CT 06111, or email your question to: **doctor@arrl.org**.

Also listen to the archives of episodes of the *ARRL The Doctor is In* podcast, sponsored by DX Engineering, on iTunes, Blubrry, Stitcher, or on the ARRL website at **www.arrl.org/doctor**.

Dr. Scott Wright, KØMD, drscott.wright@gmail.com

Eclectic Technology

Artificial Intelligence and Radio Contesting

Scott Wright, KØMD, is the Editor of National Contest Journal (NCJ). *I've asked him to share an interesting perspective on how artificial intelligence could someday impact at least one aspect of amateur radio.* — Steve Ford, WB8IMY

Imagine that it's 2030, and nearly all hams have a software-based transceiver, either alone or in combination with a superheterodyne architecture. A software-defined radio (SDR) is able to sample the spectrum of interest in parallel to what you're receiving off your antenna system. It can decode the CW signals and pre-populate the call signs like a spotting cluster. It also measures the received strengths of each signal it's identifying, and the "pileup rating" for each running station. These ratings can be color coded or have a small numerical rating. Some running stations have few stations calling them. They are rated as "5," meaning they would be easy to contact. Some are being called by hundreds of contesters and are rated as a "1," or a very difficult pileup to break.

You hear P5TT on 20 meters. This station has a signal strength of –125 dBm on your SDR and a pileup rating of 1. From experience, you know you can't work Asian stations below –100 dBm, so you decide to wait on trying to break the pileup.

Just as the popular *N1MM+* contest software now color codes stations per their point and multiplier value and identifies those you have already worked, an AI-enhanced version might add information about received strength and the pileup rating at that moment at your station.

One could also envision a feature that shows any degradations or enhancements of the signal path over the last 15 to 30 minutes, telling you whether the band is improving or deteriorating. In the past, operators have needed a sixth sense of when to change bands. Now, more data and information are incorporated into such a decision. All of this information will assist your strategy of attempting to work a station or waiting for better conditions.

Enhancing Contest Goals

In our 2030 scenario, you set up *N1MM+* for the weekend's contest and enable AI-assisted contesting. You open the log page for the CQ World Wide DX Contest and are asked:

What is your most important goal for this contest?

- Maximizing your score
- Maximizing your low-band DXCC totals
- Maximizing your 5-Band DXCC totals
- Maximizing the rate/hour for the amount of time you are on

You select "Maximizing your 5-Band DXCC totals."

A band map appears after you open the log for the CQ World Wide DX Contest. This map populates stations in a vertical list and instructs you to always click at the station at the top of the list. You do this for the first 4 hours and suddenly realize you have worked 125 DXCC entities, most of them on 10 through 20 meters. Now the stations are appearing on lower frequencies as the propagation has shifted. By the end of the contest you've worked enough new DXCC entities to complete your 5-Band DXCC award. You achieved your goal with less stress and with optimization of your contest time (and you had a lot of fun).

This was possible because *N1MM+* utilized the data from your rig and antenna system. It created an algorithm of new DXCC entities based on your need for them, the probability of successfully working them at a given time from your station, and the favorability of you breaking the pileup based on the data described in the first example. The AI didn't work the stations for you — you made the contacts — but AI functioned as an experienced contest advisor, suggesting which one to try next.

I believe the technology exists now to facilitate contesting in this manner. It's likely only a matter of time until someone creates these features and more, and contesting becomes even more enjoyable for any amount of time you can spend on the air.

Technical Correspondence

Satellite Ionization and Series Section Impedance Matching

The 60th Anniversary of the First Satellite Contact

In 1960, a flurry of good publicity for amateur radio followed an announcement by Massachusetts Institute of Technology (MIT) that two teenage amateurs may have accomplished the first two-way communication with the aid of artificial satellites: *Explorer VII* and *Sputnik 3*. The contact was between myself (K2QBW at the time and a student at MIT) in New York City and K3JTE (now W3PK) about 300 kilometers away in Bethesda, Maryland. We made use of a propagation mode first reported by the late Professor John D. Kraus, W8JK, of Ohio State University, a leading authority on antennas and propagation, which he called "the satellite ionization phenomenon." I described it and the contact itself in an article in the July 1960 issue of *QST*, titled "High-Frequency Satellite Scatter."

The *Explorer VII* satellite being prepared for launch.

As I mentioned in the article, W8JK's theory of ionization-trail reflection generated much controversy, because it appeared to contradict much of what, when he first reported his findings in 1958, was thought to be known about the ionosphere. The late George Grammer, W1DF, *QST*'s Technical Editor at the time, summarized the controversy in a "Technical Topics" note that accompanied my article. He wrote, "A mathematical analysis of the conditions necessary for sufficient ionization indicated that the chances of getting reflections from satellite trails were very slim… Reflections from meteor trails, for example, are not only indistinguishable from satellite reflections but are very much more common."

Not much was really known about the ionosphere in 1958 when W8JK published his first findings, or even in August 1959 when *QST* published additional observations of satellite ionization effects in an article by K2LMG, K2OUX, and W2YBP. This was especially true of the ionosphere's upper regions, where satellites such as *Sputnik 3* and *Explorer VII* flew.

Radar soundings, for example, were essentially a bottom-up affair, with the radar on the Earth's surface. The first topside-sounder satellite, *Alouette I*, was not launched until 1962. *Explorer VII*, the first satellite to carry radiation measurement experiments, was launched in October 1959, and flew in a slightly elliptical orbit, with a perigee of 501 kilometers and apogee of 722 kilometers, well above where most observers at the time thought the ionosphere extended. It proved an excellent tool for W8JK and others.

Later observations showed that the ionosphere extends much farther than had been believed, even as far as the Van Allen radiation belts thousands of kilometers from Earth. Satellite-related ionization turns out to be more com-

mon at times of high solar and geomagnetic activity. In addition, radar experiments showed that the effect is highly sporadic, often appearing when the satellite passes through highly ionized regions, a finding confirmed by the radiation measurements of *Explorer VII*. Radar observations also found that the reflected signals from these ionized regions experience Doppler shift substantially higher and lower in frequency than that of meteor bursts, which take place much lower in the atmosphere. This is consistent with the range of velocities exhibited by the sporadic high-altitude regions themselves. Unlike what was expected by some of the early skeptics, reflections from satellite-related ionization are actually quite different from meteor scatter.

In relation to the K2QBW-K3JTE contact on February 6, 1960, later analysis of the *Explorer VII* telemetry showed a large increase in measured radiation at the time of the signal burst, which enabled us to complete the contact, indicating that the satellite passed through one of those sporadic regions at just the right moment. — *73, Ray Soifer, W2RS,* **rsoifer1@aol.com**

The Series Section

Ward Silver's, NØAX, excellent article, "About Impedance-Matching with Transmission Lines," in the November 2019 issue of *QST* caught my attention. Perhaps the most underutilized method of antenna matching is the *series section*. The series section impedance-matching method is reasonably broadband and can be implemented using readily available coax or open-wire transmission line sections, commonly used connectors, and weatherproofing techniques.

There are three electrical parameters that must be accurately known or measured:

- The complex impedance of the antenna at the target frequency
- The impedance of the transmission lines being used at the target frequency
- The velocity factor of the transmission line sections used at the target frequency

Transmission line impedance and velocity factor vary significantly with frequency. Generally, the line will be slower at lower frequencies and, in the case of coax lines, will only reach the manufacturer's nominal value in the VHF. Closely related to the transmission line impedance is the velocity factor, which is required to calculate the electrical line lengths needed to implement any type of series section or stub impedance transformation. Transmission line characteristics may be measured in a variety of ways to sufficient accuracy, but those measurements invariably involve sacrificing expensive line in addition to buying or building specialized test aids in order to get an accurate measurement.

The complex antenna impedance can be determined once the transmission line characteristics are known using any of the many antenna analyzers available by measuring the impedance at the shack end of the transmission line, then correcting for the impedance transformation that occurs within the feed line.

The math may seem daunting, but there are free software tools available that produce excellent results. Dan Maguire, AC6LA, created *TLDetails*, a tool used to obtain accurate coax parameters for many commercially available cables. It can be found at **https://ac6la.com/tldetails.html**. *TLDetails* will accurately determine the coax velocity factor and impedance at a given frequency, which allows the antenna impedance to be accurately determined in situ and measured at the shack end of the cable. A few years ago, I measured four coax cables from different manufacturers and compared my results from *TLDetails*. The results were very close.

Next is the computation of the series sections, which can also be determined using freely available software tools. The first is *SimSmith* by Ward Harriman, AE6TY, available at **http://harriman.ddns.net/Smith_Charts.html**.

This is a Smith chart program with a few interesting twists. A model of the antenna system is created using drag and drop components, then simulated showing the results on the familiar Smith chart. The parameters of each of the components may be tuned using buttons on the display page while watching the results on the Smith chart update. Another great feature is that *SimSmith* contains the AC6LA coax database, which allows the user to select the specific coax lines used. The load (antenna) measured characteristics are easily entered.

If you don't like working with Smith charts, there is an alternative that directly calculates series section lengths. The antenna-modeling tool *4NEC2* will calculate a variety of matching networks of not only transmission line stubs and series sections, but also L networks and Pi networks in either low-pass or high-pass forms. *4NEC2* is free software and it's available at **www.qsl.net/4nec2**.

Finally, further series section background information is available in the article "Series-Section Transmission Line Impedance Matching" by Frank A. Regier, OD5CG, published in the July 1978 issue of *QST*. Regier explained the general case of the series section where lengths are unequal and the load is reactive. — *73, Randy Rogers, AD7ZU,* **ad7zu@yahoo.com**

Hints & Hacks

Build a Portable Antenna Mount, Harvest "Free" 5 V Power Supplies

A Portable Antenna Support

Erecting or supporting portable antennas has always been a challenge for field operators, so I decided to build my own. If you follow the illustrations with the accompanying text you should find this support to be easy to construct.

You will need the following:

- A single section of lumber (¾ × 5¾ × 70 inches)
- Wood glue
- 16 2-inch wood screws
- Two 1¼-inch wood screws
- Primer/undercoat and gloss paint (optional)
- A 3/16-inch drill bit
- A ⅜-inch drill bit

A short length of 1½-inch-diameter PVC or aluminum mast (select a diameter close to the size of the mast you wish to support)

Start by marking up the plank to outline the various pieces you'll need to cut (see Figure 1). It helps to number them as well. You'll draw a total of 10 sections on the board.

- Sections 1, 2, 3, and 4: 5½ × 8 inches each
- Sections 5 and 6: 2¾ × 29 inches each
- Section 7: 2¾ × 9 inches
- Sections 8, 9, and 10: 2¾ × 3 each

Carefully cut out the various sections. Assemble the base using sections 5, 6, 7, and 8. This mount is intended for use with a vehicle for stability, so section 7 is raised and sits behind

Figure 1 — All the wood parts are made by cutting the plank into numbered sections. Notice how the author marked the sections onto the board for easier cutting.

Figure 2 — Assemble the base using sections 5, 6, 7, and 8. Section 7 is raised and sits behind the inner tire wall when in use. Section 8 sits at the far end between sections 5 and 6. Prepare each screw by first drilling 3/16-inch pilot holes.

Rex Lester, G8UBJ, outdoors with his portable antenna mount.

the inner tire wall when in use (see Figure 2). Section 8 sits at the far end between sections 5 and 6.

Prepare each screw by drilling a 3/16-inch pilot hole. This allows for easy assembly. Once tight, the screws should be flush. You'll notice that the screws used for securing sections 5 and 6 to section 8 are too short. Use the 3/8-inch drill bit to create a countersink for these screws. It needs to be about 1¾ inches deep so the screw threads protrude by an inch. The support won't be strong enough if it's assembled only with screws, so use wood glue on all the joints.

Now cut out the four sections that will comprise the stand and take a length of PVC pipe (or whatever mast section you want to support) and use this as a template for the center (see Figure 3). Use a flat surface to mark up where the four sections touch and then drill two holes in each section. Screw the four pieces of wood together in a square formation, which will leave enough room for the pipe.

Once this is complete, secure the support to the base by attaching sections 9 and 10 to the protruding support sections (see Figure 4). Wait about a day before attempting to use the stand. This allows enough time for the glue to set. If you need it to last, give it a coat of paint in whatever color you prefer.

Using the support is very simple. Place it behind or in front of the wheel of your car that you choose to use. Position the stand so the raised section 7 is just behind the inner tire wall of the vehicle. Ask a friend to guide you as you drive your vehicle onto the support (see Figure 5).
— *73, Rex Lester, G8UBJ,* **g8ubj.io91uj@gmail.com**.

Figure 3 — Cut out the four sections that will create the stand. Take length of pipe and use this as a template for the center of the stand.

Figure 4 — Complete the assembly by attaching sections 9 and 10 to the protruding support sections. You can prime and paint everything if you wish.

Figure 5 — To secure the support in the field, simply roll one of your vehicle tires onto the flat portion.

"Free" 5 V Power Supplies

I have a large assortment of USB wall chargers. Most of these "wall warts" are from items that were recycled long ago. Most of them will charge anything. Some of them, although small, will provide up to 2.5 A at 5 V dc — perfect for just about any project. The bonus is they are very small and easy to implement. Also, these adapters almost always work from 80 to 240 V ac, which is perfect if you travel.

I've been disassembling some of these power supplies and removing the small printed circuit board inside. These units are often glue together, so disassembly can require a vise or hammer. With the circuit boards removed from the enclosure, I can include them in whatever homebrew project I'm working on at the time.

Because the circuit boards are so small, they rarely have holes in them for mounting in my project enclosure. My solution is to cut a small piece of rubber (slightly larger than the circuit board) and secure the rubber to the chassis with room-temperature vulcanizing (RTV) sealant. Then I use the RTV to hold the board to the rubber.

This method hasn't failed me yet. These boards are small enough to fit in some small, low-power transceivers and are capable of up to 2 W or so of continuous power. If you need 12 V, ± 5 V, ± 12 V, or even higher, you can use small board-mounted dc/dc converters. Quality dc/dc converters are available for under $10 from many distributors.
— *73, Clint Millett, VE3CMQ,* **ve3cmq@secrs.com**

All photos by Rex Lester, G8UBJ.

"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.

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.

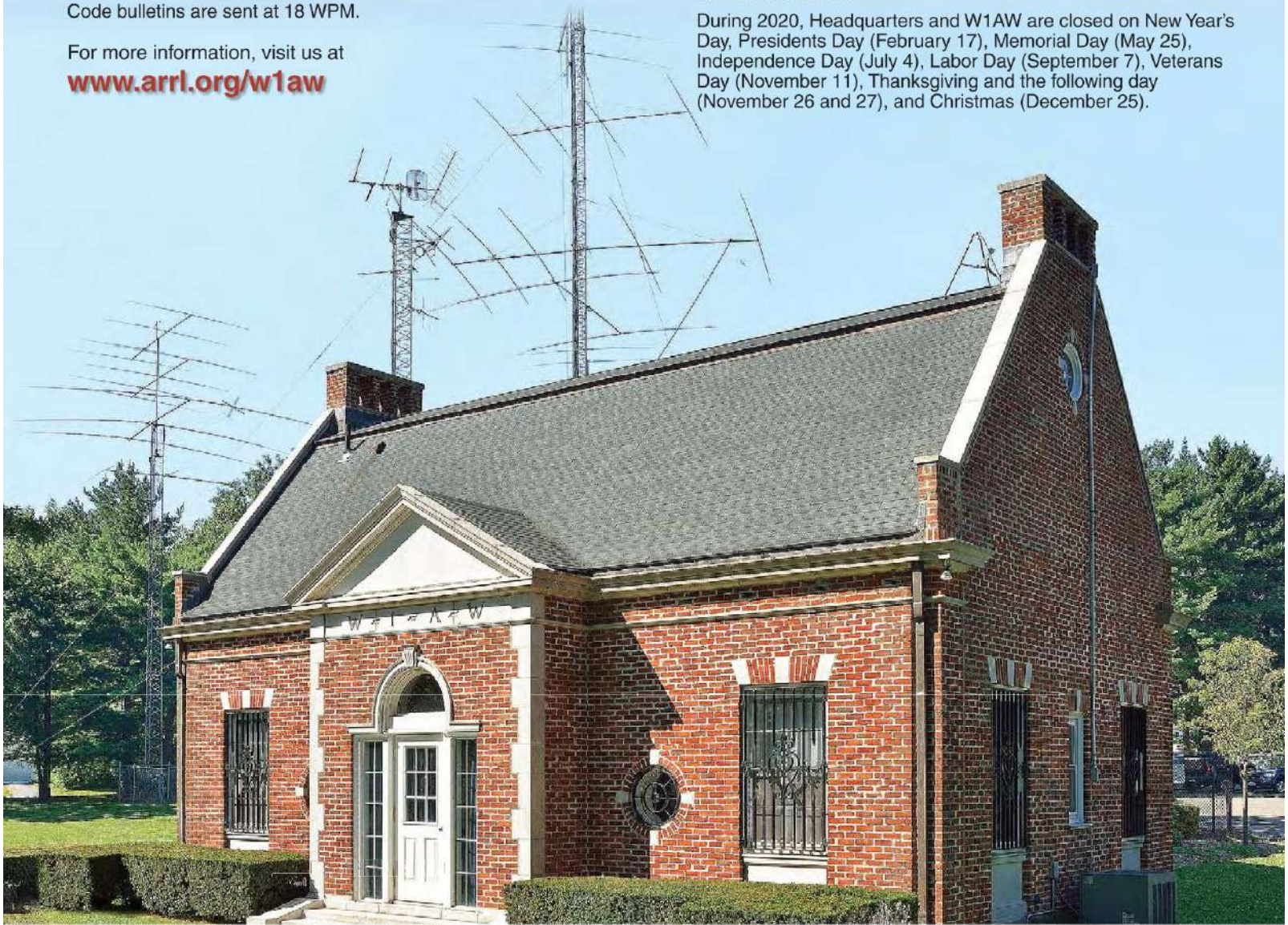
Keplerian elements for many amateur satellites will be sent on the regular digital frequencies on Tuesdays and Fridays at 6:30 PM Eastern time using Baudot and PSK31.

♦ 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 your current FCC amateur license or a photocopy. 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.

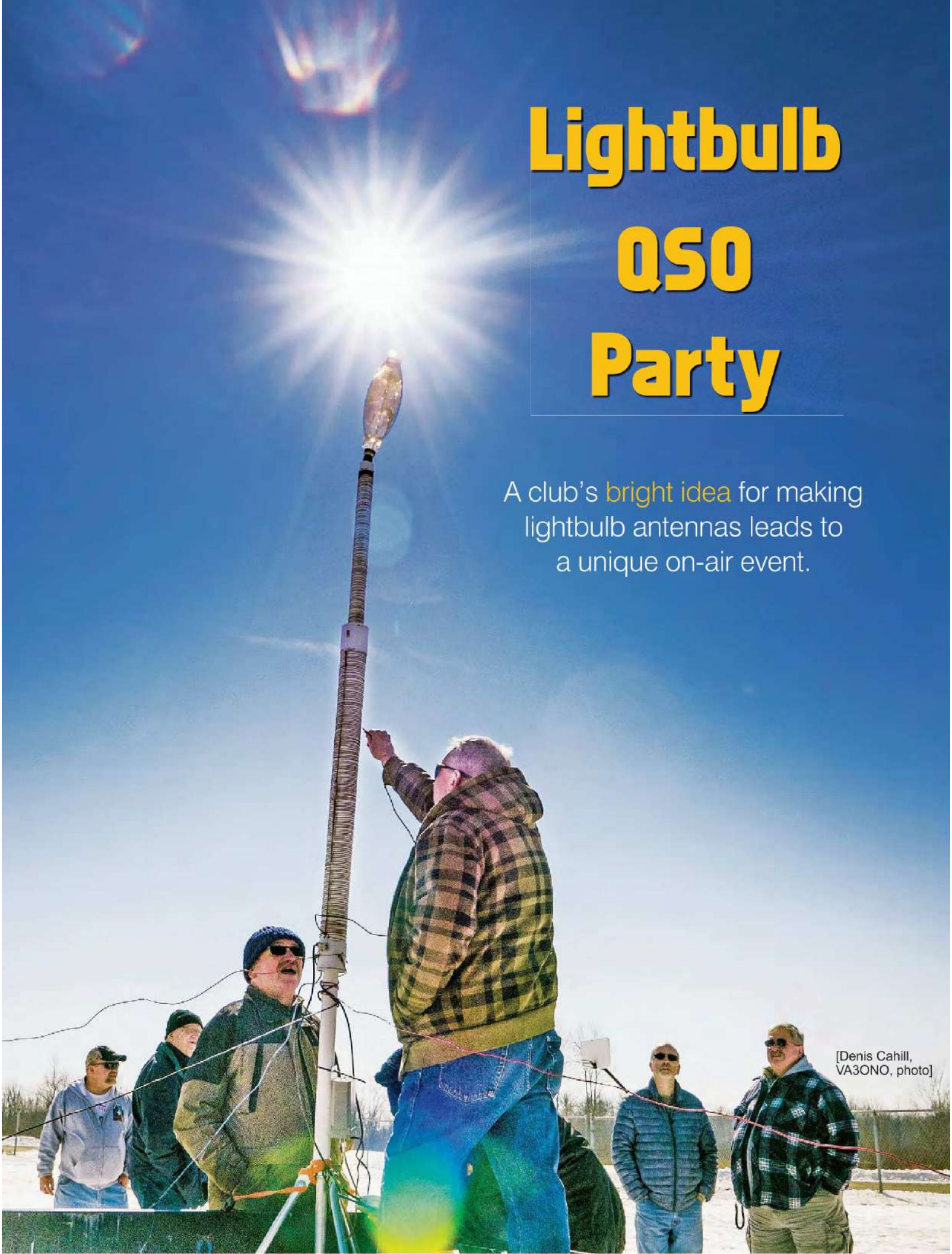
W1AW code practice and CW/digital/phone bulletin transmission audio is also available real-time via the *EchoLink Conference Server* W1AWBDCT. The conference server runs concurrently with the regularly scheduled station transmissions. The W1AW Qualifying Run texts can also be copied via the EchoLink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

During 2020, Headquarters and W1AW are closed on New Year's Day, Presidents Day (February 17), Memorial Day (May 25), Independence Day (July 4), Labor Day (September 7), Veterans Day (November 11), Thanksgiving and the following day (November 26 and 27), and Christmas (December 25).



Lightbulb QSO Party

A club's bright idea for making lightbulb antennas leads to a unique on-air event.



[Denis Cahill, VA3ONO, photo]

David Day, N1DAY

The Blue Ridge Amateur Radio Club of Hendersonville, North Carolina, challenged hams to tune their transmitters using a lightbulb antenna to make DX contacts. The idea caught on and, within several months, a number of amateurs in the United States and Canada began experimenting with lightbulb antenna designs. They discovered that some of the larger incandescent lightbulbs containing several feet of tungsten filament could serve as the radiator for these antennas, with enough efficiency to work DX in several digital modes.

QSO Party Points

This activity culminated in the Lightbulb QSO Party on March 9 – 10, 2019, on the 160-, 80-, 40-, 20-, 15-, and 10-meter bands. The event was designed to encourage amateurs to further develop their lightbulb antennas and test their designs in a contesting environment. Contacts were worth one point, unique grid squares were worth three points, and DX contacts were worth four points. CW, phone, and all digital modes were allowed.

Michael Moroney, KD7RF, and his completed lightbulb antenna. [Michael Moroney, KD7RF, photo]

The Niagara Peninsula ARC getting ready for the event. [Denis Cahill, VA3ONO, photo]

Top Bulb

In spite of the difficult weather-related operating conditions throughout much of North America, 12 individuals and two clubs participated in the event, vying for the award of Top Bulb in two divisions of competition. The first division was Household, with antennas constructed with a single lightbulb that could be used at home. The second division was Freestyle, where multiple lightbulbs available for household, commercial, industrial, or military applications could be used in the design. The most popular lightbulbs used were the Satco S2431 — a 15-inch bulb containing 84 inches of tungsten filament, and the GE Edison Squirrel Cage bulb with a 42-inch filament. Both lightbulbs are available through a variety of hardware stores and online retailers. They are generally marketed as lightbulbs for home decorative purposes.

After all logs were submitted and verified, a total of 569 contacts were completed by 12 participants. Ernie Hollingsworth, KC4SIT (SK), of Hendersonville, North Carolina, emerged as Top Bulb in the Household division with 66 contacts and a total of 213 points. Ted Rachwal, K8AQM, of Adrian, Michigan, took Top Bulb honors in the Freestyle division with 251 contacts and a total of 1,025 points.

Ernie Hollingsworth, KC4SIT (SK), antenna. [Ernie Hollingsworth, KC4SIT, photo]

Hollingsworth's antenna design consisted of a single Satco S2431 lightbulb sitting atop a loading coil and 12 × 50 foot radials. A remote antenna tuner was utilized to minimize RF on the coax feed line and taps at appropriate points on the loading coil allowed tuning from 80 meters through 15 meters. Rachwal's Freestyle antenna consisted of five Satco S2431 lightbulbs in parallel atop a Hamstick raised 16 feet with a PVC pipe. Two elevated radials were used for the 80-, 40-, and 20-meter bands of operation for his antenna.

Honorable Mentions

One honorable mention was Mike Moroney's, KD7RF, design with an extremely elegant combination of bulb, capacitance hat, and expertly wound loading coil. Although Mike did not take the Top Bulb award in the Household division, he was a competitor with 50 contacts and a total of 177 points.

But the story doesn't end with the Top Bulb award winners. Steve Riddle, VA3FLF, of the Niagara Peninsula Amateur Radio Club made a 4,162-mile contact with The Italian Costal Radio Station, II1IGG, in Genova, Italy, using FT8. The QSO Party also produced a new lightbulb-to-lightbulb contact distance record with Mike Moroney, KD7RF, of Flagstaff, Arizona, completing a 1,558-mile contact with Ted Rachwal, K8AQM.

Conclusion

A recurring theme among contesters was the fun that came with the out-of-the-box thinking required to meet the challenge of producing a working lightbulb antenna. Several participants also indicated that they were already improving on their antennas for the 2020 competition. With the unexpected lightbulb-to-lightbulb contact over a distance exceeding 1,500 miles, 2020's competition added a new award within each category for the longest-distant lightbulb-to-lightbulb contact.

More details about the evolution of the lightbulb antenna and information on the Lightbulb QSO Party for 2020 can be found at **www.hamsignal.com**.

David Day, N1DAY, has been a licensed Amateur Extra-class operator for 6 years. He also holds an experimental-class license to conduct low-band transmission research, and he participated in the testing of the 630-meter and 2200-meter bands prior to FCC approval for amateur use. Before retirement, David was employed in the pharmaceutical industry where he developed evidence-based applications to assist healthcare professionals in individualization of medication therapies. He holds Bachelor's and Master's degrees in the pharmaceutical sciences from West Virginia University. You can reach Dave at **davidlday@yahoo.com**.

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

Canadian NPOTA Maritimes Rove

Intrepid portable operator KØBAK recounts his experiences in the Canadian national parks.

Peter Kobak, KØBAK

Modeled on ARRL's 2016 National Parks on the Air (NPOTA) program, Canadian National Parks on the Air (CNPOTA) was a 2019 program to encourage amateur radio operations from Parks Canada units. Endorsed by the Radio Amateurs of Canada, CNPOTA was developed and maintained by a group of dedicated volunteer hams, who demonstrated how enthusiasm and hard work could create an impressive on-air program.

I'd participated in NPOTA as an activator, travelling and operating from different national parks, and I wanted to support CNPOTA in the same way. For New Year's Day, I activated from Kingston, Ontario, making CNPOTA's first contact. But that wasn't enough for me, especially having received so much positive feedback from my chasers — operators who made contacts with park activators. With special consideration on overlap with the international Parks on the Air (POTA) program, I planned a week-long spring Maritime Canada rove, a trip to operate ham radio from several defined locations, in this case New Brunswick, Nova Scotia, and Prince Edward Island.

Pete Kobak, KØBAK (left), and Doug Grace, VE1DFG (right), at the marker for D'Anville's Encampment.

Rover Preparation

An old electronic news-gathering truck with a Tarheel 200 screwdriver and 400 W amplifier served as my mobile HF station. I installed an Icom IC-7100 to

Maritimes rove plan, with park locations, which KØBAK posted in the CNPOTA and POTA Facebook groups.

accompany the FlexRadio FLEX-3000 radio for HF, and added an external antenna for a cell signal booster. To add to my station's dc power system, I purchased a Wen generator and other additions, including a Garmin InReach, an Anderson Powerpole extension, and a small inverter to power three different laptops. Before leaving, I also cleaned and weather-proofed the screwdriver's control pins.

The Adventure Begins

On Saturday, May 11, 2019, I left my suburban Philly home station a little after 3:30 AM EDT. With such an early departure, and a quicker-than-expected border crossing, I reached Saint Croix Island International Historic Site by 3 PM. I found a frequency on 20 meters, had a short pileup despite some SDR problems, then finished my activation on 40 meters.

Down the road, I activated St. Andrews Blockhouse National Historic Site, built to ward off an American invasion during the War of 1812. I made 33 contacts before finally driving to the hotel in Saint John, New Brunswick.

After a good nap, I went to nearby Carleton Martello Tower National Historic Site. Another fortification from the War of 1812, this impressive blockhouse was built of masonry on a commanding hill over the salt water bay. It should have had great signals, but I only made 16 contacts on 40 meters, with no luck on 20 meters.

Sunday Operation

Sunday operations began on the shore of a lake in the co-located Fundy Biosphere Reserve (part of POTA) and the Fundy National Park (part of CNPOTA). With 42 contacts, I made this stop count for both while appreciating the 80-square-mile stretch of land on the Bay. I then drove 90 minutes to my next hotel in Moncton, New Brunswick, took a short nap, and was back on the road to activate four parks to the south.

First, I went to Monument-Lefebvre National Historic Site, a large mid-19th century building located in the town of Memramcook, New Brunswick. Despite a lot of RF noise, I made 25 contacts on 20 meters. Next, I activated from Fort Lawrence National Historic Site just over the border of Nova Scotia. Despite the wind farm nearby, the isolated location made for a clear RF environment, and I was able to make 48 contacts before moving on to Fort Beauséjour in New Brunswick, where I made 32 contacts while overlooking a sweeping view to the southwest over flat salt marshes. Amidst more farmland and marshes was my last stop at La Coupe Dry Dock National Historic Site. In heavy winds, I set up a standard 100-inch steel whip beside a historical marker for an area of dykes built by Acadians. In less than a half hour, I made 34 contacts.

Van of Green Gables

Monday I began at Fort Gaspareaux National Historic Site in New Brunswick. This is an archeological and graveyard site on the shore, now mostly a picturesque view of Baie Verte. I made 32 contacts before moving on to the rest of the parks on Prince Edward Island (PEI).

I crossed Northumberland Strait on the surprisingly narrow 8-mile Confederation Bridge. I stopped to activate Skmaqn–Port-la-Joye–Fort Amherst National Historic Site at the mouth of Charlottetown Harbor. Though the sky was grey, it was a nice spot to walk along the shore and view the Harbor. Despite some SDR difficulty and having to use my backup radio, I made 33 contacts

Pete Kobak's, KØBAK, operating position from his portable HF station in his van.

Monument-Lefebvre National Historic Site.

between 40 and 20 meters, but was thrown off my schedule.

I drove the winding roads to the outskirts of Charlottetown to my hotel and rested before travelling an hour through rolling hills to the north shore of the sprawling Prince Edward Island National Park. Two smaller historic sites were enveloped in the larger park, Green Gables Heritage Place and L.M. Montgomery's Cavendish National Historic Site. Even with fading and some weak signals, I made contacts with a string of European DX entities on 20 meters.

Next up was Dalvay-by-the-Sea National Historic Site, a large formerly private mansion now run partly as a resort. I made 31 contacts in 30 minutes, but still had to cut one of the destinations, ending the day at Ardgowan National Historic Site. Starting just as the sun was setting, I was excited to log 50 contacts, including seven strong European stations.

Cruising to Sydney

On Tuesday, I left Charlottetown, Prince Edward Island, took a ferry ride from Woods Islands to Cape Breton Island, and drove to St. Peter's Bay. There I activated St. Peters Historic Site, which encompasses St. Peters Canal National Historic Site. I operated by the mouth of the canal, and despite my 400 W output, I received many Facebook complaints that I had a weak signal. Between 40 and 20 meters, I was able to make 58 contacts, and then made my 90-minute drive to Sydney.

Down-Shift Day

Wednesday brought wet and windy weather, with temperatures around 40 °F, which made operations in the driving rain unpleasant. I operated from the co-located Royal Battery National Historic Site and Fortress of Louisbourg National Historic Site, but with bad propagation, I only made 16 contacts, so I couldn't apportion enough to each park to make it count for POTA.

Next up was Marconi National Historic Site on Cape Breton Island, Nova Scotia, which is home to the famous radio pioneer's first transatlantic wireless station. With even stronger wind, I still made 28 contacts, and even had a mini pileup of European stations before I headed back to Sydney.

Halifax Headquarters

The first stop on Thursday's drive across Nova Scotia was Alexander Graham Bell National Historic Site. The museum featured artifacts from Bell's experimental work, such as his record-setting hydrofoil, and a replica of the aircraft that made Canada's first successful heavier-than-air flight. Radio conditions were not good, but I made 27 contacts.

After a 4-hour drive, I arrived at the Halifax Citadel National Historic Site. While operating from the grounds of the fort, I was pleasantly surprised to have a genuine pileup of both North American stations and DX entities, with 37 contacts in just 24 minutes. Another pleasant surprise was meeting two of the core team members that created and maintained CNPOTA, Doug Grace, VE1DFG, and Sheldon Hartling, VE1GPY. Doug joined me for my activation of York Redoubt National Historic Site, a key defense of the harbor up through World War II. There, I got 26 contacts. Local CNPOTA participant John Bignell, VE1JMB, then joined us for the activation of D'Anville's Encampment National Historic Site, which had a marker commemorating a failed military expedition from France.

Park Hopping to the Capital of Acadia

On Friday, I had seven activations on my agenda, so I woke up early and drove an hour, arriving at 9 AM to the first park of the day — Fort Edward National Historic Site. This blockhouse played a key role in the mid-18th century during the French and Indian War,

St. Andrews Blockhouse National Historic Site.

when the British attempted a forced removal of the Acadian people from the Canadian Maritime provinces. I made one contact per minute in 36 minutes.

My next activation was at Grand-Pré National Historic Site, which memorializes a major Acadian settlement destroyed by the British Crown. Even with flat terrain and low RF noise, I only made about 18 contacts.

After a 90-minute drive, I arrived at Bloody Creek National Historic Site, where a simple stone cairn marked a successful guerrilla attack by Acadians and Mi'kmaq against the British. With a risky setup on the side of a two-lane road surrounded by RF-absorbing trees, I still made less than 20 contacts.

Only 15 minutes away was Fort Anne National Historic Site and Charles Fort National Historic Site, co-located on a hill in the village of Annapolis Royal. With the exception of the renovated officers quarters (now a museum and visitors center), only the foundation remains of Fort Anne, along with a commemorative plaque marking the early Scottish settlement of Charles Fort. High RF noise levels made every contact a struggle. I barely made the 20 required contacts for the activation to count for both sites.

I stopped at my bed and breakfast in Granville Ferry, Nova Scotia, to rest and charge my station's batteries, then continued my rove southwest. As dusk approached, I stopped at Melanson Settlement National Historic Site, and with enhanced RF conditions, I made 40 contacts before moving on to Port-Royal National Historic Site. I operated in the parking lot of a replica of France's first settlement from 1605. I made 37 contacts, with a few DX contacts from Europe. Then I returned to my bed and breakfast to prepare for the final day of my rove.

Final Day

Kejimkujik National Park and the co-located Kejimkujik National Historic Site was the only activation for Saturday. I made it to the wooded park in Caledonia, Nova Scotia, which is home to Mi'kmaq cave drawings from the 1700s and nearby canoe routes the Mi'kmaq used to travel from the Bay of Fundy to the Atlantic shore of Nova Scotia. I made 52 contacts during a leisurely 2-hour operation, after which I got to meet another CNPOTA team member, Robert Ewert, VE1KS, as well as Janet Northrop, VE1JNT. I was glad I got to thank Robert and the other members in person for their work.

Arriving Home

After 33 CNPOTA parks activated, 892 total contacts, and 2,704 total miles driven, I was finally home. It had been an adventure I would never forget. Thank you, Maritime Canada, for a wonderful visit over the rolling hills of northern Prince Edward Island, through the vistas of the New Brunswick's southern shoreline, to the highlands of Cape Breton Island, and across Nova Scotia's historic Annapolis Valley. And thanks to my chasers and to all the hams who maintained CNPOTA.

All photos by the author.

Peter Kobak, KØBAK, has been active for 5 years, mostly as a portable operator. His interests include operating mobile in state QSO parties, VHF contests, and in park activation programs. He is a grateful member of the Pottstown Area ARC and the Mt. Airy VHF RC. Pete can be reached at **qst@k0bak.com**.

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

Rick Lindquist, WW1ME, ww1me@arrl.org

ARRL Foundation Announces ARDC Scholarship Matching Grant

ARRL Foundation President Dr. David Woolweaver, K5RAV, announced in March that the nonprofit Amateur Radio Digital Communications (ARDC) has generously agreed to award the ARRL Foundation a grant to match the Foundation's 2020 – 2021 scholarships on a dollar-for-dollar basis, up to a total of $200,000.

"The ARRL Foundation Board is honored to partner with ARDC to award ARDC's Amateur Radio Digital Communications' Brian H. Kantor, WB6CYT, Memorial Scholarship grant for 2020," Woolweaver said. "These scholarships, made possible by ARDC's generous contribution, will assist many young amateur radio operators in their pursuit of education at colleges, universities, and graduate schools."

Last July, ARDC announced it would use the proceeds from its sale of some 4 million unused consecutive AMPRNet internet addresses to fund its operations and to establish a program of grants and scholarships to support communications and networking research — with a strong emphasis on amateur radio. ARDC has said it intends to award "a total of several million dollars in grants of varied amounts" to qualified beneficiaries.

Earlier ARDC grants included a generous award to Amateur Radio on the International Space Station (ARISS), the Foundation for Amateur Radio scholarship program, the GNU Radio Project, TAPR, and The Yasme Foundation.

ARRL Comments in Opposition to FCC Plan to Delete the 3.4 GHz Band

ARRL has filed comments opposing an FCC *Notice of Proposed Rulemaking* (*NPRM*) in WT Docket 19-348, in which the FCC put forward a plan to remove "existing non-federal secondary radiolocation and amateur allocations" in the 3.3 – 3.55 GHz band and relocate incumbent non-federal operations. The FCC's proposal was in response to the MOBILE NOW (Making Opportunities for Broadband Investment and Limiting Excessive and Needless Obstacles to Wireless) Act, enacted in 2018 to make new spectrum available for mobile and fixed wireless broadband use. ARRL noted that amateur radio has a long history of successful coexistence with primary users of the band.

"There is no reason suggested by the Commission, or known to us, why the secondary status for amateur radio operations should not be continued for the indefinite future," ARRL said in its comments. "We understand that secondary commercial users are less flexible than amateur radio users and may desire to relocate to protect continued provision of services and service quality. Radio amateurs, by contrast, benefit from having technical knowledge and no customer demands for continuous service quality, more flexibility to make adjustments, and often have the technical abilities necessary to design and implement the means to coexist compatibly with the signals of primary users."

ARRL pointed to amateur radio's "decades-long experience observing and experimenting with radiowave propagation" in the 3.3 – 3.5 GHz band that includes mesh networks, amateur television networks, weak signal long-distance communication, Earth-Moon-Earth (moonbounce) communication, beacons used for propagation study, and amateur satellite communications, and argued that it would be "premature" to remove the current secondary amateur radio allocation.

"This spectrum should not be removed from the amateur radio secondary allocation and left unused," ARRL told the FCC. An informed assessment of sharing opportunities

would depend upon Congressionally mandated NTIA studies of sharing or relocation options, still pending at the time of ARRL's comments, "and if all or part of this spectrum is reallocated, the nature and location of buildout by the non-federal users," ARRL said. Radio amateurs have established extensive infrastructure for the current band and are engaged in construction and experimentation that includes innovative "mesh networks" and amateur television networks that can be deployed to support public service activities, ARRL noted.

"Even if suitable new spectrum could be found for the existing amateur uses — which is difficult before the spectrum musical chairs activity is concluded — the costs to radio amateurs would be significant and be borne with no countervailing public benefit," ARRL told the FCC. "If the advent of new primary licensees forecloses some types of secondary operations, the amateur community will reevaluate the situation when some certainty exists."

AMSAT also opposed deletion of the 3.4 GHz allocation and stressed the necessity of having adequate microwave spectrum available for future amateur satellite projects. AMSAT said a number of potential future uses for the band remain, however, as worldwide usage of other available allocations increases.

"The Amateur Satellite Service continues to provide immense value to the growing field of small satellites," AMSAT concluded. "Experiments conducted by amateur satellites... continue to inform the development of the commercial small satellite industry," and student participation in amateur satellite projects provides inspiration "to pursue careers in the commercial satellite industry and practical experience for those careers."

FCC Turns Down Amateur Licensee's Appeal

In a *Memorandum Opinion and Order* (*MO&O*) released on February 20, the FCC turned down an appeal by William F. Crowell, W6WBJ, of Diamond Springs, California, of an Administrative Law Judge's (ALJ) dismissal of Crowell's amateur radio license renewal application. Chief ALJ Richard L. Sippel ruled in 2018 that Crowell "failed to prosecute his application by refusing to attend a hearing scheduled by the judge," and that this warranted dismissal of Crowell's 2007 renewal application. The FCC Wireless Telecommunications Bureau had designated Crowell's renewal application for hearing based on allegations that he had violated the Communications Act and FCC rules by causing intentional interference and by transmitting one-way communications, indecent language, and music on amateur frequencies. The hearing was set to be held in Washington, DC, and Crowell filed a notice of appearance certifying that he would appear and present his case.

The case was interrupted by what the FCC in the *MO&O* called, "a hiatus of several years, during which Crowell's petition to disqualify the Judge was pending." When the renewal application litigation resumed in 2017, Crowell asked that the hearing be moved to the Sacramento, California, area, arguing that he could not afford to travel to Washington. Sippel denied the motion.

"In the *Dismissal Order*, the Judge responded to Crowell's refusal to attend a hearing in Washington, DC, by granting the Enforcement Bureau's motion to dismiss Crowell's application," the FCC said in its *MO&O*. The ALJ held that Crowell's refusal to attend a hearing in Washington, DC, "constituted a failure to prosecute and thereby effectively violated Section 1.221(c) of the rules, which requires dismissal if an applicant fails to commit to appear on the date fixed for hearing." The judge agreed with the Enforcement Bureau that many of the arguments Crowell raised on appeal "are not properly before us in reviewing the *Dismissal Order* and should be disregarded."

Yasme Foundation Announces Grants and Excellence Awards

The Yasme Foundation Board of Directors announced several grants in February. Financial support will go to:

- The SU8WRC/SU8X demonstration station at World Radiocommunication Conference 2020 in Egypt.
- The Youth on the Air and HamSCI exhibits at Dayton Hamvention 2020.
- Contest University at Dayton Hamvention 2020, for audio/visual equipment, student materials, and live internet streaming.
- The Croatian Amateur Radio Association (HRS) to support the Youngsters on the Air (YOTA) 2020 Region 1 annual summer camp.

The Board also announced recipients of the Yasme Excellence Award, which recognizes significant contributions to amateur radio through their service, creativity, effort, and dedication. Receiving the award are James Sarté, K2QI, and Adrian Ciuperca, KO8SCA, for their efforts in combining the latest state-of-the-art technology, diplomatic skills, persistence, and leadership in reactivating United Nations Headquarters club station 4U1UN. Additional help with gathering equipment and logistical support was provided by RA9USU, NT2Y, NT2X, K2LE, and N2UN (SK).

The Yasme Excellence Award is in the form of a cash grant and an individually engraved crystal globe.

The YASME FOUNDATION
www.yasme.org

Dayton Hamvention Names 2020 Award Winners

Dayton Hamvention® has named five radio amateurs and one ham radio club as the recipients of its 2020 awards.

Amateur of the Year

Yasuo "Zorro" Miyazawa, JH1AJT, was named Amateur of the Year. Licensed in 1964 at age 15, Miyazawa became interested in DXing and, later in his life, international humanitarian activities. He was inducted into the CQ DX Hall of Fame in 2015. His many DXpeditions focus not just on handing out contacts but cooperating with the local population to implement needed humanitarian activities. In 2010, he established the Foundation for Global Children (FGC). "His efforts have helped revolutionize education in Japan by creating the learning systems for children who had difficulties in ordinary schools because of dyslexia, developmental disabilities, and other issues," the Hamvention Awards Committee said.

Special Achievement Award

Jordan Sherer, KN4CRD, of Atlanta, Georgia, is the recipient of the Hamvention Special Achievement Award. A software engineer by day and digital amateur radio operator by night, Sherer started his journey into ham radio in 2017, exploring PSK31, JT65, and, later, FT8. Fascinated by the ability to connect with others using low power, he set about developing a protocol for weak-signal mesh networking and communication. The result was *JS8Call,* a free, open-source platform inspired by *WSJT-X* and *fldigi*. It allows for keyboard-to-keyboard, store-and-forward, and network relay-based communication.

Technical Achievement Award

Hamvention bestowed its Technical Achievement Award on a group of three radio amateurs who have become well-known for their development of the *WSJT-X* digital software suite. The 2020 award recipients are Steve Franke, K9AN; Bill Somerville, G4WJS, and Nobel Laureate Joe Taylor, K1JT. Over the past 7 years, the trio has collaborated on all aspects of *WSJT-X* — in particular the digital protocol FT8 and its contesting variant FT4. Introduced in July 2017, FT8 now accounts for a significant portion of all HF ham radio activity.

Club of the Year

The South Canadian Amateur Radio Society (SCARS) of Norman, Oklahoma, was named 2020 Club of the Year. An ARRL Special Service Club formed in 1977, the club has worked through its website, Facebook, YouTube channel, and weekly newsletter to expand its reach to thousands of hams from the local area to around the globe. The club takes emergency communication very seriously. NWS SKYWARN training and weekly ARES nets offer hams in central Oklahoma an opportunity to practice their skills before the next weather emergency. The club also sponsors an "Elmer Night" and monthly free license examination sessions, participates in community public service events, and works closely with the American Red Cross.

Section Manager Nomination Notice

To all ARRL members in Connecticut, Idaho, Minnesota, North Dakota, Ohio, Oklahoma, Southern Florida, Western New York, Puerto Rico, and the Virgin Islands: You are hereby solicited for nominating petitions pursuant to an election for Section Manager (SM). Incumbents are listed on page 16 of this issue.

To be valid, a petition must contain the signatures of five or more full ARRL members residing in the Sections concerned. It is advisable to have a few more than five signatures on each petition. A sample nomination form is available on the ARRL website at **www.arrl.org/section-terms-nomination-information**. Nominating petitions may be made by facsimile or electronic transmission of images, provided that upon request by the Field Services Manager, the original documents are received by the Manager within 7 days of the request.

We suggest the following format:

(Place and Date)
Field Services Manager, ARRL
225 Main St.
Newington, CT 06111

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

(Signature____ Call Sign____ City___ ZIP ___)

Any candidate for the office of Section Manager must be a resident of the Section, an amateur radio licensee of Technician class or higher, and a full member of the ARRL for a continuous term of at least 2 years immediately preceding receipt of a nominating petition. Petitions must be received at Headquarters by 4 PM Eastern Time on June 5, 2020. If more than one member is nominated in a single Section, ballots will be mailed from Headquarters no later than July 1, 2020, to full members of record as of June 5, 2020, which is the closing date for nominations. Returns will be counted August 18, 2020. Section Managers elected as a result of the above procedure will take office October 1, 2020.

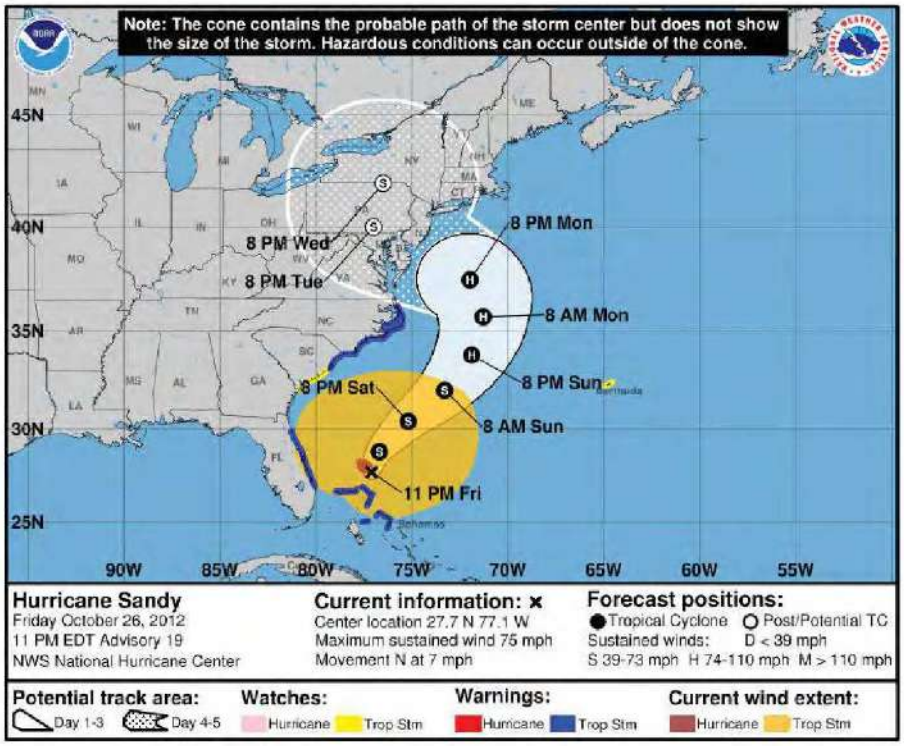
If only one valid petition is received from a Section, that nominee shall be declared elected without opposition for a 2-year term beginning October 1, 2020. If no petitions are received from a Section by the specified closing date, such Section will be resolicited in the October issue of *QST*. A Section Manager elected through the resolicitation will serve a term of 18 months. A Section Manager vacancy occurring between elections is filled through appointment by the Field Services Manager. — *Bart Jahnke, W9JJ, Field Services & Radiosport Department Manager*

Rick Palm, K1CE, k1ce@arrl.net

Public Service

SKYWARN® Storm Spotter Class:
Recommended for Radio Amateurs

After my recent SKYWARN spotter training class, I realized two things: how little I had known about basic meteorology and climatology, and the importance of hams becoming spotters. Radio amateurs are in a special position to provide what the National Weather Service (NWS) Weather Forecast Office — in my area, the Jacksonville, Florida, Weather Forecast Office (WFO) — needs most for their warning products, which is real-time spotter observations (known as *ground truths*) of severe weather to correlate with their Doppler radar and balloon radiosonde data. (A radiosonde is a telemetry device sent aloft on a balloon to collect and transmit data from different levels of the atmosphere.)



This sample cone graphic shows an approximate representation of coastal areas under a hurricane warning (red), hurricane watch (pink), tropical storm warning (blue), and tropical storm watch (yellow). The orange circle indicates the current position of the center of the tropical cyclone.

Our Value as Spotters

Radio amateurs offer a built-in means of communication that allows us to report and to receive requests for more information, and our value is increased when we utilize other means of communication. It's one thing to turn in a report of hail, and another to send a high-resolution photo of it.

NWS Doppler radars provide upper atmosphere wind speed, direction, and possible rotation of winds that may indicate tornado activity. They can go out of service. The training class instructor said, "That's when ground truth reports from spotters become even more valuable." She explained that the radar systems also lose sensitivity to weather signatures in lower levels of the atmosphere in outlying areas due to the curvature of the Earth, requiring more spotters in those areas. The Jacksonville WFO is most interested in spotter reports of severe thunderstorm and tornado/waterspout activity, because a warning goes out when there are damaging wind gusts greater than or equal to 58 MPH and/or hail that's 1 inch or larger. In other areas, the warning criteria may be different. In New England, snowfall amounts may be reportable. In the west, visibility may be reportable during wildfire season. Each Warning Coordination Meteorologist sets reportable criteria for their WFO area.

The Jacksonville Weather Forecast Office

My SKYWARN spotter training class was instructed by Jacksonville WFO Staff Meteorologist Angie Enyedi and hosted by Florida's Columbia County Emergency Manager Shayne Morgan at the county's Emergency Operation Center. ARES® Emergency Coordinator Richard Heston, KE4BQI, was also present. About 15 of the 30 attendees were radio amateurs.

In addition to the Jacksonville WFO's responsibility of issuing weather warnings, during major events (such as hurricanes) the office reviews the information of national weather centers. This includes the National Hurricane Center's (NHC) highly viewed "cone" projection (see the lead image) that shows where the center of

the storm is forecasted to be in hours or days. The cone projection does not show the impacted area, which is much wider (a common misconception of cone consumers). Combining that information with assessments of local conditions, the office can issue appropriate forecasts and warnings for its coverage area of responsibility.

Meteorology and Climatology 101

During the first 90 minutes of the 2-hour class, Enyedi gave a fascinating review of the basic science of moisture, cloud, thunderstorm, and tornado development. She discussed the development and effects of various fronts — cold, gust, sea breeze, etc. — and downbursts that result in extremely high-speed straight-line winds causing destruction that lay people mistakenly associate with tornadoes. She presented the dangers of lightning, such as going outside less than 30 minutes after the last rumble, and the risks of quickly rising water — depth, sinkholes, fast movement, contamination, reptiles, and electric shock.

Focus on Spotter Function and Safety

The crux of Enyedi's class was the role and function of the spotter, and the discussion focused on two prime directives. The first is safety. Second, we are spotters, not chasers. Under a warning, spotters do not leave a safe place to obtain an observation, even just to look around from the backyard.

The spotter's mission is to relay timely reports to their area's Weather Forecast Office. Amateur radio spotters checked in to a SKYWARN net (many local nets meet across the country regularly and during potentially severe weather) can report to the net control station or another station, who can then relay the report to the weather office. Many WFOs have amateur service stations within their facilities.

In addition to the ground truth reports, the meteorologist also wants to know:

- Who you are
- What weather is experienced
- Time and duration of the observation
- Damage caused, even after the storm is over
- Where it occurred, with specific details such as an address and GPS coordinates

For example, in a severe thunderstorm a spotter might report: "I am a spotter. One-inch sized hail at 1:30 PM, at address 123 Smith Drive in the town of High Water." GPS coordinates may be cited.

Media other than a landline or cell phone are available for spotter reporting, such as the NWS online storm report submission, social media, SKYWARN net as discussed above, and NWS Chat (in some locations). Reports should only contain factual observations — do not embellish or hype.

Conclusion

I recommend that every radio amateur take this course. Upcoming classes in your area can be found on your local Weather Forecast Office website. After my class, I registered with the Jacksonville forecast office's spotter database.

Field Organization Reports

February 2020

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**.

583
WA7PTM

380
N9VC

335
WA3EZN

290
KB2RTZ

279
W7PAT

265
KD8TTE

249
KE8BYC

240
KW9EMG

238
WØPZD

232
WB8RCR

231
KV4LY

230
KT2D
KE8KOC

211
WA2CCN

205
N8SY

202
W8IM

200
KK4PUX

198
AD8CM

195
WM2C
KØIBS

190
N3KRX

180
AG9G

175
W4DNA

174
N2WGF

172
AA7BM

170
WS6P
KC9FXE
K3JL

166
KD2LPM

160
W2PH
N2DW

156
W7GRG

151
KF4DVF

150
KØRCJ
KB8RCR

148
KB3YRU

145
W4CMH
WO2H
AD3J

141
WA2BSS

140
WC4FSU
ACØKQ
K4IWW
KK3F

139
WD8USA

135
KB3KYH

W3YVQ
AA3SB
WB3FTQ
ND8W

130
N2JBA
WB9WKO
KC8WH
NA7G
KW1U

120
WA4VGZ
W4NWT
K9LGU
WØLAW
WK4WC
KY2D
N7IE
W7EES

119
KY2MMM

115
N8CJS
N5MKY

110
WA3QLW
W1KX
K6HTN
K3FAZ
WB8YLO
KV8Z
K2RMF
KA2ZNZ
KA5AZK
KF5IOU
W1RVY
N1IQI
KD2JKV
WB8TQZ

107
KA8ZGY
WB8YYS

105
N1TF

100
W2PAX
WB4RJW
KZ8Q
NN7H
KN9P

NX9K
K3RC
WB8SIQ
KB2YAA
KC2ZUF
KD2IWN
K2TV
KE5YTA
KA2GQQ
KB2QO
N1LAH
KE1ML
K8ED

99
W4INK

95
AD4DO
KJ7BHO

93
KG5NNA
W7PHX
KI7TIG

92
N6IET
AB3WG

91
AA3N

90
KM4WHO
WD8DHC
KØFBS
KD4EAQ
K8KRA
N2LJM
KC1KVY
WB8WKQ

89
KB1NMO
K1XFC
KC1HHO
KC8YVF

88
W2CTG
N3RB

87
AC8NP
N3JET

86
KB8HJJ
N3SW
WA1LPM

85
K1HEJ

84
K3MIY
KF7GC
K8RDN

83
K8AMH

82
KBØDTI

81
W4TTO
K6JT
KC8ZCM

80
N2TSO
KT4WX
K8OVO
KA2JFU
W2JPS

79
KD8UUB

76
K6RAU
KC7ASA
W5XX

75
KL7RF
KA2HZP

73
KB1NAL

72
KD2MEN
W7MIN

71
KN4AAG

70
K3IN
AF4NC

The following stations qualified for PSHR in previous months but were not reported in this column: (Jan.) KB2RTZ 260, N2LJM 131, N1LL 130, KA9QWC 120, K2RMF 118, KA2ZNZ 110, W9BGJ 105, KB2YAA 100, K9DUR 94, W9EEU 92, AB9ZA 89, KD2IWN 85, W2JPS 80.

Section Traffic Manager Reports

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

Section Emergency Coordinator Reports

The following Section Emergency Coordinators reported: AR, CT, DE, EPA, GA, IA, ID, IN, KY, LA, MDC, MI, MN, MT, MO, ND, NLI, NM, NNJ, NV, OH, OR, PAC, RI, SFL, SJV, SNJ, STX, SV, VI, WCF, WMA, WPA, WV, WY.

Brass Pounders League

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

NX9K 1124, K6HTN 735, N1IQI 645, WB9WKO 541, KK3F 517.

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

Contest Corral

May 2020

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

Start - Finish Date-Time		Date-Time		Bands	Contest Name	Mode	Exchange	Sponsor's Website
1	1300	1	1900	3.5-28	AGCW QRP/QRP Party	CW	RST, serial, class (A or B)	agcw.org/index.php/en
2	0000	3	1600	50, 144	Araucaria World Wide VHF Contest	CW Ph	RS(T), 6-char grid square	www.avhfc.com
2	0001	3	2359	28	10-10 International Spring Contest, CW	CW	Name, mbr or "0," SPC	www.ten-ten.org
2	0300	2	0859	3.5-28	RCC Cup	CW Ph	RS(T), mbr or ITU zone	rcccup.ru
2	0600	3	2359	2.3 GHz and up	SBMS 2.3 GHz and Up Contest	CW Ph Dig	6-char Maidenhead locator	n6nb.com/sbmsrules.htm
2	0800	2	1400	All above 902	Microwave Spring Sprint	CW Ph Dig	6-char grid square	sites.google.com/site/springvhfupsprints
2	1200	3	1159	3.5-28	ARI International DX Contest	CW Ph Dig	RS(T), province or serial	www.ari.it
2	1300	3	0700	1.8-28	7th Call Area QSO Party	CW Ph	RS(T), 5-letter state/county code or SPC	7qp.org
2	1500	3	0300	1.8-28	Indiana QSO Party	CW Ph	RS(T), IN county or SPC	www.hdxcc.org/inqp
2	1700	2	2100	3.5-28	FISTS Spring Slow Speed Sprint	CW	RST, SPC, name, mbr or power	fistsna.org
2	1700	3	2359	1.8-VHF	Delaware QSO Party	CW Ph	RS(T), DE county or SPC	www.fsarc.org/qsoparty
2	2000	3	2359	3.5-28	New England QSO Party	CW Ph Dig	RS(T), county+state or SPC	www.neqp.org
4	1900	4	2030	3.5	RSGB 80-Meter Club Championship, SSB	Ph	RS, serial	www.rsgbcc.org/hf
4	2300	5	0300	All, no WARC	MIE 33 Contest	CW Ph	RS(T), age, "ME" or "MEJ"	www.ztv.ne.jp/isoda/33
5	0100	5	0300	3.5-28	ARS Spartan Sprint	CW	RST, SPC, power	arsqrp.blogspot.com
7	1700	7	2100	28	NRAU 10-Meter Activity Contest	CW Ph Dig	RS(T), 6-char grid square	www.nrau.net
7	1900	7	2100	1.8-50	SKCC Sprint Europe	CW	RST, SPC, name, mbr or power	www.skccgroup.com
9	1200	10	0800	50,70,144, 432,1296	SARL VHF/UHF Digital Contest	Dig	RST, 6-char grid locator	www.sarl.org.za
9	1200	10	1159	1.8-28	CQ-M International DX Contest	CW Ph	RS(T), serial	cqm.srr.ru/en-rules
9	1200	10	1200	3.5-28	VOLTA WW RTTY Contest	Dig	RST, serial, CQ zone	www.contestvolta.com
9	1200	10	2359	1.8-50	SKCC Weekend Sprintathon	CW	RST, SPC, name, mbr or "none"	www.skccgroup.com
9	1400	10	0200	3.5-28, 144	Arkansas QSO Party	CW Ph	RS(T), county or SPC	www.arkqp.com
9	1700	9	2100	3.5-28	FISTS Spring Unlimited Sprint	CW	RST, SPC, name, mbr or power	fistsna.org
9	2300	10	0300	50	50 MHz Spring Sprint	CW Ph Dig	4-char grid square	sites.google.com/site/springvhfupsprints
10	1000	10	1400	7	WAB 7 MHz Phone/CW	CW Ph	RS(T), serial, WAB square or country	wab.intermip.net
11	0000	11	0200	1.8-28	4 States QRP Group Second Sunday Sprint	CW Ph	RS(T), SPC, mbr or power	www.4sqrp.com
13	1900	13	2030	3.5	RSGB 80-Meter Club Championship, Data	Dig	RST, serial	www.rsgbcc.org/hf
16	0600	16	2100	1.8-28	UN DX Contest	CW Ph	RS(T), District code or serial	undxc.kz
16	0800	17	1100	3.5	NZART Sangster Shield Contest	CW	RST, serial, ZL Branch number (if ZL)	www.nzart.org.nz/activities
16	0900	18	1700	3.5-28	Portuguese Navy Day Contest	CW Ph Dig	RS(T), mbr or serial	www.nra.pt
16	1200	17	1200	1.8-28	His Majesty King of Spain Contest, CW	CW	RST, EA province or serial	concursos.ure.es/en
16	1200	17	1200	3.5-28	Aegean RTTY Contest	Dig	RST, serial	www.aegeandxgroup.gr
16	1600	16	2159	1.8-50	Feld Hell Sprint	Dig	RST, mbr, SPC, grid	sites.google.com/site/feldhellclub
17	1900	17	2359	1.8-28	Run for the Bacon QRP Contest	CW	RST, SPC, mbr or power	qrpcontest.com/pigrun
18	1900	18	2030	3.5	RSGB FT4 Contest Series	Dig	4-char grid square	www.rsgbcc.org/hf
21	0030	21	0230	3.5-14	NAQCC CW Sprint	CW	RST, SPC, mbr or power	naqcc.info
21	1600	21	2200	3.5, 7	QRP Minimal Art Session	CW	RST, class, number of components	qrpcc.de
23	2100	24	0200	3.5	Baltic Contest	CW Ph	RS(T), serial	www.lrsf.lt/en
25	0000	25	0100	1.8-28	QRP ARCI Hootowl Sprint	CW	RST, SPC, mbr or power	qrparci.org/contests
25	1300	26	0400	1.8-28	QCX Challenge	CW	RST, name, SPC, rig	qrp-labs.com/party.html
27	0000	27	0200	1.8-28	SKCC Sprint	CW	RST, SPC, name, mbr or power	www.skccgroup.com
28	1900	28	2030	3.5	RSGB 80-Meter Club Championship, CW	CW	RST, serial	www.rsgbcc.org/hf
29	0000	31	2359	1.8-50	PODXS 070 Club 3-Day Weekend Contest	Dig	Name, RST, SPC	www.podxs070.com
30	0000	31	2359	1.8-28	CQ WW WPX Contest, CW	CW	RST, serial	www.cqwpx.com

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.*

The largest on-air amateur radio event in the world returns June 27 – 28, 2020.

ARRL FIELD DAY 2020

1800 UTC Saturday, June 27 through 1759 UTC Sunday, June 28.

Bands and Modes: Participants may only operate on the 160-, 80-, 40-, 20-, 15-, and 10-meter HF bands, and may use all bands 50 MHz and above using phone, CW, and/or digital modes.

Setup: Class A and B stations that wish to operate for only 24 hours may begin their setup at 0000 UTC on the Friday (Thursday afternoon or evening local time) preceding the ARRL Field Day period. Cumulative setup time for those stations may not exceed a total of 24 hours. Class A and B stations that wish to operate the full 27-hour Field Day period may not begin setup until 1800 UTC on Saturday.

The Boulder Amateur Radio Club, WØDK, erected a 55-foot retractable tower in the Rocky Mountains in Colorado for 2019 Field Day. The tower supports a SteppIR three-element beam, along with a 30- and 40-meter loop. [Jack Ciaccia, WMØG, photo]

Reporting Your Score: All entries must be received at ARRL HQ no later than Tuesday, July 28, 2020. Participants are strongly encouraged to use the online ARRL Field Day score reporting system at **www.field-day.arrl.org**. Online entrants will receive an email confirmation that their entry was accepted, as well as 50 bonus points for submitting their score electronically.

Changes for 2020: For Class A and F stations that operate a GOTA (get-on-the-air) station, the limit for GOTA station QSOs has been raised from 500 to 1,000. In addition, Prince Edward Island (Canada) is now its own section (PE). For more information, see the complete Field Day rules at **www.arrl.org/field-day**.

Tell the world where your club will be for Field Day by using the Field Day Locator at **www.arrl.org/field-day-locator**. It can also be used to find a Field Day site in your area, or an operation to join if you're travelling out of town.

Other bonus point options are available, including newer additions like the social media bonus. Groups (not individuals) who actively promote their Field Day event on a social media platform (such as Facebook, Instagram, or Twitter) earn 100 bonus points. Use the hashtag **#ARRLFD** to share your group's plans and tips for a successful Field Day.

Participants should download and review the material found in the 2020 Field Day packet (including information about the available bonus points) at **www.arrl.org/field-day**. Email any questions to **fdinfo@arrl.org**.

Rick Rosen, K1DS, rick1ds@hotmail.com

2019 ARRL International EME Contest

Last year's EME Contest 2.3 GHz and up weekend was held September 21 – 22. The 50 – 1296 MHz weekends took place October 19 – 20 and November 16 – 17.

Multioperator Scores by Category

Call Sign	Score	QSOs	Mults
Multioperator, CW/Phone Only, All Band			
SP6OPN	12,000	12	10
WD5AGO	2,000	5	4
Multioperator, CW/Phone Only, 1.2 GHz			
F5KUG	145,800	54	27
9A5AA	102,900	49	21
F6KRK	20,800	16	13
Multioperator, All Mode, All Band			
K2UYH	4,305,000	287	150
RA3EME	4,065,600	308	132
LU1C	990,000	132	75
NØAKC	466,100	79	59
OZ9KY	291,100	71	41
Multioperator, All Mode, 144 MHz			
RX1AS	2,584,400	284	91
RU3GX	1,146,100	157	73
KG6NUB	874,200	141	62
LZ1KU	291,100	71	41
F6HEO	217,600	64	34
W9VW	154,000	55	28
VE3MIS	27,300	21	13
LR5F	600	3	2
Multioperator, All Mode, 1.2 GHz			
K6MG	391,300	91	43
SKØUX	351,000	90	39
VA7MM	348,000	87	40
OH1LRY	307,800	81	38
IK5VLS	288,600	78	37
Multioperator, All Mode, 2.3 GHz			
OK1KIR	42,500	25	17
Multioperator, All Mode, 10 GHz			
W3SZ	17,600	16	11

Single Operator Scores by Category

Single Operator, CW/Phone Only, All Band			
G3LTF	917,600	124	74
OZ4MM	744,200	122	61
KL6M	731,600	118	62
OK1CA	680,400	108	63
WA6PY	470,400	84	56
SP3XBO	182,000	52	35
IW2FZR	104,000	40	26
Single Operator, CW/Phone Only, 432 MHz			
I2FHW	66,000	33	20
DK5OZ	58,900	31	19
GØJLO	25,200	18	14
SP9VFD	10,800	12	9
F6HLC	4,200	7	6
DL8UCC	3,000	6	5
JAØTJU	3,000	6	5
JA9BOH	1,200	4	3
RA4UAT	100	1	1
Single Operator, CW/Phone Only, 1.2 GHz			
SM4IVE	366,600	94	39
G4CCH	295,200	82	36
LZ2US	192,000	64	30
W4OP	164,700	61	27
IK1FJI	153,400	59	26
IK3COJ	85,800	39	22
F6ETI	66,000	33	20
N4PZ	59,400	33	18
DJ8FR	58,900	31	19
JH1KRC	36,800	23	16
WK9P	27,300	21	13
BD4SY	20,800	16	13
DJ3JJ	18,000	15	12
K8ZR	3,600	6	6
Single Operator, All Mode, All Band			
UA3PTW	6,142,200	353	174
YL2GD	2,513,200	206	122
OK1DFC	648,000	108	60
ES3RF	398,400	83	48
US7GY	340,000	68	50
KNØWS	315,000	70	45
4Z5CP	272,800	62	44
JA6AHB	225,500	55	41
WA3RGQ	219,600	61	36
W3CJK	193,800	51	38
PA2CHR	171,500	49	35
PAØPLY	130,500	45	29
VK4CDI	106,400	38	28
YL2FZ	81,600	34	24
W5LUA	46,800	26	18
UA3TCF	45,000	25	18
DL9LBH	28,500	19	15
K1DS	5,600	8	7
K1OR	4,200	7	6
K7ULS	3,600	6	6
K3GNC	2,500	5	5
KG5CCI	2,500	5	5
KBØHNN	1,200	4	3
Single Operator, All Mode, 144 MHz			
OK1DIX	1,742,500	205	85
S51ZO	1,514,700	187	81
K7CA	1,203,600	177	68
PA5Y	1,192,900	151	79
WA1NPZ	1,104,000	160	69
DF2ZC	730,300	109	67
RZ4A	715,000	143	50
VE6XH	535,300	101	53
LZ1DP	529,200	98	54
I2FAK	406,700	83	49
R3PA	400,200	87	46
G8RWG	346,500	77	45
7K3LGC	340,400	74	46
KØTPP	281,400	67	42
TI2CDA	277,500	75	37
AI1K	275,200	64	43
N4DX	273,600	72	38
W4TAA	264,600	63	42
RK9JR	260,000	65	40
W2LPL	231,800	61	38
K7MAC	220,500	63	35
N4HB	205,200	57	36
EB1DNK	188,700	51	37
JP3EXR	169,200	47	36
TA2NC	162,000	54	30
K1DG	161,700	49	33
W8KEN	145,700	47	31
UA1OEJ	139,500	45	31
WP4G	129,000	43	30
UT2EG	124,200	46	27
CX2SC	120,000	40	30
HG5BMU	118,800	44	27
AG4W	101,200	44	23
5BØEME	41,600	26	16
RA6C	40,800	24	17
UA9CFH	39,100	23	17
K8DIO	34,500	23	15
RX6AIA	33,000	22	15
KG7P	32,000	20	16
PA5MS	31,500	21	15
KD7UO	27,000	18	15
UT5IG	26,600	19	14
OK2AB	26,000	20	13
UT5EL	16,500	15	11
YB2MDU	15,000	15	10
WØXG	14,300	13	11
PE1ITR	14,000	14	10
W8TN	12,000	12	10
BX2AI	11,000	11	10
SP2FRY	11,000	11	10
YU7MS	9,600	12	8
R3UG	7,700	11	7
RA4SD	7,000	10	7
UT9UR	7,000	10	7
CT7ABA	5,500	11	5
G8TTI	4,800	8	6
YO6XK	3,000	6	5
LY2WR	2,500	5	5
GW3TKH	2,400	6	4
WS3C	1,600	4	4
KA9CFD	900	3	3
NA5C	900	3	3
WQ5S	600	3	2
HI8DL	100	1	1
N2AMC	100	1	1
PT9IR	100	1	1
Single Operator, All Mode, 432 MHz			
DL7APV	629,200	121	52
LZ1DX	344,400	82	42
PA2V	269,800	71	38
UT5DL	244,800	72	34
VK4EME	105,000	42	25
UB4UAA	102,500	41	25
OK1TEH	77,000	35	22
RD3FD	58,900	31	19
DK1KW	55,100	29	19
SM5EPO	30,400	19	16
A65BR	9,900	11	9
JE2UFF	8,100	9	9
BD9BU	4,900	7	7
YO2NAA	4,200	7	6
OK2POI	1,600	4	4
W7TZ	1,600	4	4
KJ7OG	900	3	3
MXØCNS	400	2	2
AK4WQ	100	1	1
Single Operator, All Mode, 1.2 GHz			
OK2DL	625,000	125	50
DL3EBJ	585,600	122	48
SM4GGC	448,800	102	44
PA3FXB	401,800	98	41
RA4HL	304,200	78	39
KA1GT	296,400	76	39
SM6CKU	291,600	81	36
DL7UDA	276,900	71	39
FR5DN	231,000	70	33
N5BF	230,400	64	36
YO2LEL	214,400	67	32
W8MQW	129,600	48	27
SP5GDM	123,200	44	28
WA2FGK	97,500	39	25
ES6FX	95,000	38	25
VE2UG	95,000	38	25
W1PV	91,200	38	24
OK1YK	88,200	42	21
VE3KRP	69,600	29	24
RN6MA	68,000	34	20
AA4MD	60,800	32	19
WA3GFZ	47,500	25	19
SV1CAL	31,500	21	15
4X1AJ	15,400	14	11
IØNAA	6,400	8	8
UA3RAW	1,600	4	4
W3HMS	900	3	3
Single Operator, All Mode, 10 GHz			
OZ1LPR	56,000	28	20
DLØEF	30,000	20	15
OK2AQ	14,300	13	11

Total Reported QSOs by Mode

Digital	7,832
CW/Phone	2,393
Total	10,225

Total Reported QSOs by Band

50 MHz	0	2.4 GHz	156
144 MHz	4,890	3.4 GHz	27
222 MHz	6	5.7 GHz	22
432 MHz	1,159	10 GHz	174
1296 MHz	3,791	Total	10,225

This year's 2020 International EME Contest weekends are scheduled for September 12 – 13 (2.3 GHz and up weekend), as well as October 10 – 11 and November 28 – 29 (50 – 1296 MHz weekends).

Full Results Online

You can read the full results of the contest online at **http://contests.arrl.org** or **www.arrl.org/contest-results-articles**. 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.

Kelly Taylor, VE4XT, ve4xt@mymts.net

2019 ARRL November Sweepstakes — CW

Last year's ARRL November Sweepstakes (CW weekend) was held November 2 – 4, 2019.

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 ARRL Contest Branch at 860-594-0232 or **contests@arrl.org**. Plaques cost $80, which includes all shipping charges.

Winner	Division	Category	Sponsor
W7RN (N6TV, op)			
	Overall	Single Operator, High Power	Trey Garlough, N5KO
N2IC	Overall	Single Operator, Low Power	Radiosport Manitoba – VE4VV Memorial
NØNI (AG9A, op)			
	Overall	Single Operator, QRP	Icom America
KØEU	Overall	Single Operator Unlimited, High Power	Icom America
N4ZZ	Overall	Single Operator Unlimited, Low Power	Icom America
KØRF	Overall	Multioperator, High Power	Icom America
NP2X	Overall	Multioperator, Low Power	Icom America
KØHC	Overall	School Club	Icom America
AA3B	Atlantic	Single Operator, High Power	Icom America
K3UA	Atlantic	Single Operator, Low Power	Icom America
NK8Q	Atlantic	Single Operator, QRP	Icom America
K3MM	Atlantic	Single Operator Unlimited, High Power	Icom America
K3MD	Atlantic	Single Operator Unlimited, Low Power	Icom America
W3NX	Atlantic	Multioperator, High Power	Icom America
W9RE	Central	Single Operator, High Power	Society of Midwest Contesters
K9UIY	Central	Single Operator, Low Power	Society of Midwest Contesters
N9SE	Central	Single Operator, QRP	Icom America
WT2P	Central	Single Operator Unlimited, High Power	Society of Midwest Contesters
N9CO	Central	Single Operator Unlimited, Low Power	Society of Midwest Contesters
KA9VVQ	Central	Multioperator, Low Power	Icom America
K9IU	Central	School Club	Icom America
NEØU	Dakota	Single Operator, High Power	Minnesota Wireless Assoc. – in memory of Tod Olson, KØTO
NAØN (@WØZT)			
	Dakota	Single Operator, Low Power	Minnesota Wireless Assoc.
KEØZ	Dakota	Single Operator, QRP	Minnesota Wireless Assoc.
KTØA	Dakota	Single Operator Unlimited, High Power	Minnesota Wireless Assoc. – in memory of Jim Dokmo, KØFVF
KØAD	Dakota	Single Operator Unlimited, Low Power	Minnesota Wireless Assoc.
NØAT	Dakota	Multioperator, High Power	Icom America
AEØEE	Dakota	Multioperator, Low Power	Icom America
W5YD (N4OGW, op)			
	Delta	Single Operator, High Power	Icom America
K5KU	Delta	Single Operator, Low Power	Icom America
N5EE	Delta	Single Operator, QRP	Icom America
AD4EB	Delta	Single Operator Unlimited, High Power	Icom America
N4ZZ	Delta	Single Operator Unlimited, Low Power	Icom America
N4FR	Delta	Multioperator, Low Power	Icom America
NA8V	Great Lakes	Single Operator, High Power	Icom America
W1NN	Great Lakes	Single Operator, Low Power	Icom America
K8MM	Great Lakes	Single Operator, QRP	Icom America
N4QS	Great Lakes	Single Operator Unlimited, High Power	Icom America
K8BKM	Great Lakes	Single Operator Unlimited, Low Power	Icom America
NT8V	Great Lakes	Multioperator, High Power	Icom America
W8SH	Great Lakes	School Club	Icom America
N2NT (N2NC, op)			
	Hudson	Single Operator, High Power	Icom America
N2GA	Hudson	Single Operator, Low Power	Icom America
KR2Q	Hudson	Single Operator, QRP	Icom America
KD2RD	Hudson	Single Operator Unlimited, High Power	Icom America
K2TW	Hudson	Single Operator Unlimited, Low Power	Icom America
WA2JQK	Hudson	Multioperator, High Power	Icom America
K1RQ	Hudson	Multioperator, Low Power	Icom America
NSØR	Midwest	Single Operator, High Power	Icom America
NØAC	Midwest	Single Operator, Low Power	Icom America
NØNI (AG9A, op)			
	Midwest	Single Operator, QRP	Icom America
NØXR	Midwest	Single Operator Unlimited, High Power	Icom America
WØEWD	Midwest	Single Operator Unlimited, Low Power	Icom America
KØWA	Midwest	Multioperator, High Power	Icom America
KØHC	Midwest	School Club	Icom America
K5ZD	New England	Single Operator, High Power	Icom America
K1XM	New England	Single Operator, Low Power	Icom America
NN1AA (W1MJ, op)			
	New England	Single Operator, QRP	Icom America
W1SJ	New England	Single Operator Unlimited, High Power	Icom America
K1TR	New England	Single Operator Unlimited, Low Power	Icom America
AJ1I	New England	Multioperator, High Power	Icom America
W1FM	New England	Multioperator, Low Power	Icom America
N9RV	Northwestern	Single Operator, High Power	Icom America
WJ9B	Northwestern	Single Operator, Low Power	Icom America
W7YAQ	Northwestern	Single Operator, QRP	Icom America
K7RL	Northwestern	Single Operator Unlimited, High Power	Icom America
W7ZRC	Northwestern	Single Operator Unlimited, Low Power	Icom America
K7RI	Northwestern	Multioperator, High Power	Icom America
W7RN (N6TV, op)			
	Pacific	Single Operator, High Power	Icom America
N3ZZ	Pacific	Single Operator, Low Power	Icom America
W6YX (N7MH, op)			
	Pacific	Single Operator, QRP	Icom America
WA6O (@N6XG)			
	Pacific	Single Operator Unlimited, High Power	Icom America
K6JS	Pacific	Single Operator Unlimited, Low Power	Icom America
N6RO	Pacific	Multioperator, High Power	Icom America
K6MI	Pacific	Multioperator, Low Power	Icom America
N4AF	Roanoke	Single Operator, High Power	Potomac Valley Radio Club
K7SV	Roanoke	Single Operator, Low Power	Icom America
AD8J	Roanoke	Single Operator, QRP	Icom America
K2AV	Roanoke	Single Operator Unlimited, High Power	Icom America
W4AAA (KK9A, op)			
	Roanoke	Single Operator Unlimited, Low Power	Icom America
W4ZYT	Roanoke	Multioperator, High Power	Icom America
W4TG	Roanoke	Multioperator, Low Power	Icom America
WØTM (WØETT, op)			
	Rocky Mountain	Single Operator, High Power	Icom America
N2IC	Rocky Mountain	Single Operator, Low Power	Icom America
KØFX	Rocky Mountain	Single Operator, QRP	Icom America
KØEU	Rocky Mountain	Single Operator Unlimited, High Power	Icom America
WØZA	Rocky Mountain	Single Operator Unlimited, Low Power	Icom America
KØRF	Rocky Mountain	Multioperator, High Power	Icom America
KK5OV	Rocky Mountain	Multioperator, Low Power	Icom America
NX4N	Southeastern	Single Operator, High Power	Icom America
N4OO	Southeastern	Single Operator, Low Power	Icom America
K3TW	Southeastern	Single Operator, QRP	Icom America
N4BP	Southeastern	Single Operator Unlimited, High Power	Icom America
KY4F	Southeastern	Single Operator Unlimited, Low Power	Icom America
K1MM	Southeastern	Multioperator, High Power	Icom America
NP2X	Southeastern	Multioperator, Low Power	Icom America
W4AQL	Southeastern	School Club	Icom America
K6LA	Southwestern	Single Operator, High Power	Icom America
W6AYC	Southwestern	Single Operator, Low Power	Icom America
N7IR	Southwestern	Single Operator, QRP	Icom America
N5ZO	Southwestern	Single Operator Unlimited, High Power	Icom America
K6WSC	Southwestern	Single Operator Unlimited, Low Power	Icom America
KY7M	Southwestern	Multioperator, High Power	Icom America
W8TK	Southwestern	Multioperator, Low Power	Icom America
NR5M (K5GA, op)			
	West Gulf	Single Operator, High Power	Icom America
WØUO	West Gulf	Single Operator, Low Power	Icom America
K5NZ	West Gulf	Single Operator, QRP	Icom America
N5NA	West Gulf	Single Operator Unlimited, High Power	Icom America
N5DO	West Gulf	Single Operator Unlimited, Low Power	Icom America
K5CM	West Gulf	Multioperator, High Power	Icom America
WDØGTY	West Gulf	Multioperator, Low Power	Icom America
N5XU	West Gulf	School Club	Icom America
VY1AAA (VE1RM, op)			
	Canada	Single Operator, High Power	Icom America
VE5SF	Canada	Single Operator, Low Power	Icom America
VE3VN	Canada	Single Operator, QRP	Icom America
VE3NNT	Canada	Single Operator Unlimited, High Power	Icom America
VE3YT	Canada	Single Operator Unlimited, Low Power	Icom America
VA7DZ	Canada	Multioperator, Low Power	Icom America

Top Ten

Single Operator, High Power

W7RN (N6TV, op)	218,124
N9RV	215,136
NR5M (K5GA, op)	212,812
W7RM (N6TR, op)	208,662
WXØB (AD5Q, op)	207,500
W9RE	206,836
AA3B	206,172
W5YD (N4OGW, op)	203,184
NX4N	201,690
K5TR (K5OT, op)	198,204

Single Operator, Low Power

N2IC	208,828
K5KU	159,526
WJ9B	154,548
W1NN	149,898
NAØN (@WØZT)	149,234
K2PO	145,914
K7SV	145,914
WØUO	142,926
W8WTS	140,934
K4XU	140,436

Single Operator, QRP

NØNI (AG9A, op)	126,160
VE3VN	97,908
NN1AA (W1MJ, op)	87,156
N5EE	84,960
N7IR	83,996
N9SE	78,732
W6YX (N7MH, op)	78,368
W6JTI	73,872
W7YAQ	63,990
VE6EX	63,840

Single Operator Unlimited, High Power

KØEU	209,658
N4BP	193,722
N5ZO	192,892
K6LL	192,560
K7RL	192,228
K3MM	189,074
N4QS	168,264
WT2P	166,166
NY3A	165,148
WR3Z	163,510

Single Operator Unlimited, Low Power

N4ZZ	175,296
W4AAA (KK9A, op)	154,214
N9CO	145,960
K3MD	144,918
NE9U	141,764
K1TR	135,788
WØEWD	127,264
VE3YT	125,828
N5DO	123,172
K8BKM	121,512

Multioperator, Single Transmitter, High Power

KØRF	215,800
KØWA	198,038
W3NX	191,880
K5CM	189,738
KY7M	186,086
N6RO	181,438
NX6T	177,454
NØAT	176,792
K1MM	174,798
K2NNY	137,116

Multioperator, Single Transmitter, Low Power

NP2X	152,222
W8TK	149,234
K6MI	93,152
AEØEE	92,628
W1FM	85,440
W4TG	82,944
VA7DZ	72,384
KA9VVQ	60,830
N4FR	57,348
WDØGTY	35,850

School Club

KØHC	166,830
W4AQL	136,286
K9IU	61,074
W9JWC	50,512
W4UAL	32,964
N5XU	23,850
W8SH	6,708

Division Winners

Single Operator, High Power

Atlantic	AA3B	206,172
Central	W9RE	206,836
Dakota	NEØU	142,400
Delta	W5YD (N4OGW, op)	203,184
Great Lakes	NA8V	158,260
Hudson	N2NT (N2NC, op)	194,718
Midwest	NSØR	151,060
New England	K5ZD	187,746
Northwestern	N9RV	215,136
Pacific	W7RN (N6TV, op)	218,124
Roanoke	N4AF	172,474
Rocky Mountain	WØTM (WØETT, op)	110,044
Southeastern	NX4N	201,690
Southwestern	K6LA	187,414
West Gulf	NR5M (K5GA, op)	212,812
Canada	VY1AAA (VE1RM, op)	150,562

Single Operator, Low Power

Atlantic	K3UA	111,884
Central	K9UIY	108,000
Dakota	NAØN (@WØZT)	149,234
Delta	K5KU	159,526
Great Lakes	W1NN	149,898
Hudson	N2GA	46,060
Midwest	NØAC	108,398
New England	K1XM	132,348
Northwestern	WJ9B	154,548
Pacific	N3ZZ	54,312
Roanoke	K7SV	145,914
Rocky Mountain	N2IC	208,828
Southeastern	N4OO	131,638
Southwestern	W6AYC	138,776
West Gulf	WØUO	142,926
Canada	VE5SF	123,504

Single Operator, QRP

Atlantic	NK8Q	62,046
Central	N9SE	78,732
Dakota	KEØZ	41,020
Delta	N5EE	84,960
Great Lakes	K8MM	23,302
Hudson	KR2Q	49,126
Midwest	NØNI (AG9A, op)	126,160
New England	NN1AA (W1MJ, op)	87,156
Northwestern	W7YAQ	63,990
Pacific	W6YX (N7MH, op)	78,368
Roanoke	AD8J	46,816
Rocky Mountain	KØFX	53,428
Southeastern	K3TW	63,360
Southwestern	N7IR	83,996
West Gulf	K5NZ	22,100
Canada	VE3VN	97,908

Single Operator Unlimited, High Power

Atlantic	K3MM	189,074
Central	WT2P	166,166
Dakota	KTØA	153,550
Delta	AD4EB	100,098
Great Lakes	N4QS	168,264
Hudson	KD2RD	158,364
Midwest	NØXR	47,888
New England	W1SJ	161,020
Northwestern	K7RL	192,228
Pacific	WA6O (@N6XG)	162,514
Roanoke	K2AV	139,772
Rocky Mountain	KØEU	209,658
Southeastern	N4BP	193,722
Southwestern	N5ZO	192,892
West Gulf	N5NA	137,596
Canada	VE3NNT	161,684

Single Operator Unlimited, Low Power

Atlantic	K3MD	144,918
Central	N9CO	145,960
Dakota	KØAD	117,860
Delta	N4ZZ	175,296
Great Lakes	K8BKM	121,512
Hudson	K2TW	102,828
Midwest	WØEWD	127,264
New England	K1TR	135,788
Northwestern	W7ZRC	103,916
Pacific	K6JS	92,496
Roanoke	W4AAA (KK9A, op)	154,214
Rocky Mountain	WØZA	121,014
Southeastern	KY4F	103,812
Southwestern	K6WSC	89806
West Gulf	N5DO	123,172
Canada	VE3YT	125,828

Multioperator, Single Transmitter, High Power

Atlantic	W3NX	191,880
Dakota	NØAT	176,792
Great Lakes	NT8V	58,644
Hudson	WA2JQK	31,616
Midwest	KØWA	198,038
New England	AJ1I	132,136
Northwestern	K7RI	125,164
Pacific	N6RO	181,438
Roanoke	W4ZYT	26,052
Rocky Mountain	KØRF	215,800
Southeastern	K1MM	174,798
Southwestern	KY7M	186,086
West Gulf	K5CM	189,738

Multioperator, Single Transmitter, Low Power

Central	KA9VVQ	60,830
Dakota	AEØEE	92,628
Delta	N4FR	57,348
Hudson	K1RQ	18,480
New England	W1FM	85,440
Pacific	K6MI	93,152
Roanoke	W4TG	82,944
Rocky Mountain	KK5OV	8,568
Southeastern	NP2X	152,222
Southwestern	W8TK	149,234
West Gulf	WDØGTY	35,850
Canada	VA7DZ	72,384

School Club

Central	K9IU	61,074
Great Lakes	W8SH	6,708
Midwest	KØHC	166,830
Southeastern	W4AQL	136,286
West Gulf	N5XU	23,850

The crew at Hickory Lake Contest Club, K2NNY, used a utility bucket truck to support their antennas for the 2019 CW Sweepstakes. They scored a second-place finish in the Multioperator, Single Transmitter, High Power category in the Northeast Region. [David Farnsworth, WJ2O, photo]

Full Results Online

You can read the full results of the contest online at **http://contests.arrl.org** or **www.arrl.org/contest-results-articles**. 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.

The 2020 ARRL November Sweepstakes (CW weekend) will be held November 7 – 9, 2020.

The 2020 ARRL June VHF Contest

1800 UTC Saturday, June 13 – 0259 UTC Monday, June 15

The warmer weather approaching can only mean one thing: the ARRL June VHF Contest is right around the corner! This weather brings enhanced tropospheric ducting and meteor scatter. Plus, it's the peak of sporadic-E season. Take advantage of these propagation enhancements and have some fun on the VHF and UHF bands.

With several different categories to participate in, there's something to match everyone's specialties and interests.

Here are some things to remember for this contest:

- The exchange is simple: just the Maidenhead grid square you're operating from. For more info on grid squares, visit **www.arrl.org/grid-squares**.
- Assistance is permitted in all ARRL VHF Contests — so you can spot yourself or see others' spots during the contest, make announcements, or chat with others about activity (as long as the contact is completed over the air).
- Log submissions: Upload your Cabrillo log file to the contest web app at **http://contest-log-submission.arrl.org**. Paper logs can be mailed to: ARRL – June VHF Contest, 225 Main St., Newington, CT 06111.
- Ten-day deadline: all logs must be uploaded or postmarked no later than 0300 UTC, June 25.
- Share your photos and VHF contest stories on the ARRL Contest Soapbox page at **http://contests.arrl.org/contestsoapbox.php**.

Ken Carlson, K2ET, earned a top-ten finish in the Atlantic Division for the Classic Rover category in the 2019 June VHF Contest. Pictured is his seven-band station at sunset just outside of Rochester, New York, in grid square FN02.

Complete rules can be found at www.arrl.org/june-vhf

June 2020 Kids Day

1800 UTC – 2359 UTC Saturday, June 20, 2020

The third Saturday in June is the time to encourage youngsters to get on the air and share in the excitement and fun that amateur radio can provide!

Sponsored by the Boring (Oregon) Amateur Radio Club, this event has a simple exchange suitable for a younger operator: first name, age, location, and favorite color. After that, the contact can be as long or short as each participant likes.

Kids Day is the perfect opportunity for you or your club to open your shack doors and invite kids over to discover what amateur radio is all about.

Complete rules can be found at www.arrl.org/kids-day

Six-year-old Lizzy Busch makes a contact during Kids Day at the WonderLab Museum of Science, Health and Technology in Bloomington, Indiana. The event was held in conjunction with the Bloomington Amateur Radio Club. [Helen Busch, photo]

Certificate of Code Proficiency

Recipients

Sponsored by VIBROPLEX
www.vibroplex.com

This month, ARRL and Vibroplex recognize 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 2020

Floyd E. Cureton, Jr., WO5S	10
John M. Dziedziejko, W9QP	10
David C. Hustvedt, KØDCH	10
Mahlon G. Justice, Jr., WF5J	10
Marlo Montanaro, KA2IRQ	10
Michael A. Penzo, WM4X	10
David P. Shugar, KD8EVN	10
Gerald D. Thomas, AG7GZ	10
Warren D. Zimmer, KC7ND	10
Scott J. Bertrand, AI4TT	15
Michael W. Geoghegan, KX6A	15
James T. Griffin, N4JG	15
Robert L. Heider, WØEJO	15
Ishan Kumaraswami, AC2MX	15
James D. Russ, AB4KA	15
Philip Burrington, W7ZIP	20
Glen S. Johnstone, NK1N	20
Harry McAlister, VE3HMF	20
Peter Van Eenenaam, KD2OMV	20
David W. Rice, AD8WR	20
William J. Rollison, WA7WJR	20
Carl W. Davis, W8WZ	25
Robert E. Gardner, Jr., WA8PCW	25
Carl J. Sibilski, III, KB9DKR	25
Jay P. Jenkins, WE2KEY	30
Eugene J. Suslowicz, AD4UB	30

February 2020

Scott B. Hedberg, NØZB	10
Thomas F. Miller, W1PDI	10
James A. Poulette, WQ2H	10
Mark D. Thorn, KN4HYV	10
Kristopher P. Davis, N5KPD	15
John M. Dziedziejko, W9QP	15
Robert W. Jorgenson, N4OUD	15
Gerald Lemay, VA2GLU	15
Stacey D. Sonneland, KG5KGU	15
Frank P. Arciuolo, W1ZAH	25
Timothy M. Cherrone, WK9P	25
Thomas M. Dickhudt, WØLGU	25
Michael P. Malone, N5WNG	25
Kurt T. Meyers, W8IQ	30
Thadeus H. Niemira, K6TET	40

March 2020

Paul A. Gierow, KN4NVU	10
Michael S. Lundy, W4MSL	10
Robert B. Brown, K6AAQ	20
Robert S. Zarges, Jr., K2MZ	20

Congratulations to all the recipients.

May 2020 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.

May 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 will be transmitted by K9JM on Wednesday, May 27 at 9 PM PDT (0400 UTC on May 28) on 3590 and 7047.5 kHz. Unless indicated otherwise, sending speeds are from 10 to 35 WPM.

Amateur radio operators who participate in Qualifying Runs may submit proof of 1 minute of the highest speed they have copied in the hope of qualifying for the Certificate of Code Proficiency, or an endorsement to their existing certificate.

Legibly copy at least 1 minute of text by hand, and mail the sheet to: W1AW Qualifying Runs, 225 Main St., Newington, CT USA 06111.

Include $10 (check or money order) if this is a submission for your initial Code Proficiency certificate; $7.50 if you are applying for an endorsement (available for speeds up to 40 WPM). Your test will be checked against the actual transmissions to determine if you have qualified.

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 — May 2020
(All times in Eastern Daylight Time)

Monday	Tuesday	Wednesday	Thursday	Friday
5/4 4 PM – 2000Z 10 – 35 WPM	**5/5** 7 PM – 2300Z 35 – 10 WPM		**5/7** 10 PM – 0200Z **(5/8 – UTC)** 10 – 40 WPM	**5/8** 9 AM – 1300Z 10 – 35 WPM
	5/12 4 PM – 2000Z 10 – 35 WPM	**5/13** 7 PM – 2300Z 10 – 40 WPM	**5/14** 9 AM – 1300Z 35 – 10 WPM	**5/15** 10 PM – 0200Z **(5/16 – UTC)** 10 – 35 WPM
	5/19 9 AM – 1300Z 10 – 35 WPM	**5/20** 10 PM – 0200Z **(5/21 – UTC)** 35 – 10 WPM	**5/21** 7 PM – 2300Z 10 – 35 WPM	**5/22** 4 PM – 2000Z 10 – 40 WPM
Memorial Day		**5/27** 9 AM – 1300Z 35 – 10 WPM	**5/28** 4 PM – 2000Z 35 – 10 WPM	**5/29** 7 PM – 2300Z 10 – 35 WPM

Bernie McClenny, W3UR, w3ur@arrl.org

How's DX?

Clash of the DXpeditions

If you're a seasoned DXer, you've probably wondered why two groups would go to the same location at either the same time, or within a few days or weeks of each other. This has been happening since long before I started DXing (over 40 years) and I suspect it'll continue well after I stop.

Here's an example of what typically happens: a team announces they're going to a rare or semi-rare DXCC entity. They set a date for their trip. Months later, a second group announces they're going to the same place as the first team. Many in the DX community are happy to have two chances to work a rare DXCC entity. Some of the DXers question why resources are being used to fund two DXpeditions to the same location, or ask why one of the groups doesn't pick another rare location.

After it's become public knowledge that a second group is going to the same DX location as the first, questions and allegations typically arise. Both teams will say they had been planning to go to the DX location before the other. When asked, the second group will say they were waiting for something to happen before they announced it to the public, or that they wanted to surprise everyone.

I'd like to suggest one way to avoid this type of conflict: notify the editors of various DX outlets and ask if anyone is planning to go to the DX entity you're considering. The DX editor doesn't have to say who's going or when, but can suggest picking another location or time frame if needed.

DX News From Around the Globe

8Q – Maldives

Kasimir Bastian, DL2SBY, is going to Meedhupparu Island in the Maldives, where he plans to operate as 8Q7KB from May 4 – 12. He will be running a Kenwood TS-480SAT with a Juma PA1000 amplifier using an inverted **V**. Activity will be on 3.5 – 50 MHz on SSB, CW, and the digital modes. He plans to upload the contacts to Logbook of The World (LoTW) and Club Log. QSL direct to DL2SBY.

Kasimir Bastian's, DL2SBY, QSL card from his 2014 DXpedition to the Maldives. He will be back there from May 4 – 12, operating again as 8Q7KB.

A2 – Botswana

Look for Dave Johnson, VE7VR, to be back in Botswana for his third time. He'll be operating for 3 weeks as A25VR and on a "self-driving 4 × 4 camping safari." He'll have a 40-foot Spiderpole to support 40- and 20-meter inverted **V** antennas, and will be running an Elecraft KX2 with 10 W and an Icom IC-7100 running 100 W, between May 1 – 22. QSL via VE7VR.

FJ – St. Barthelémy Island

French operators Thierry Mazel, F6CUK, and Gerard Lagier, F6EHJ, plan to operate from Adolphe Brin's, FJ5AB, station in St. Barts, using the call signs FJ/F6CUK and FJ/F6EHJ respectively, from May 4 –16. Listen for them on CW and SSB on all bands. They're also planning to operate from Tintamarre Island of St. Martin (NA-199) during a side trip. Adolphe plans to join them. They have requested a special call for this activity.

Col McGowan, MMØNDX, is also expected there in early May. He and his team will be located on a hilltop in a villa with a good takeoff to Asia.

Col McGowan, MMØNDX; Paul Tittensor, G4PVM, and Jonathan Bowes, MMØOKG, will be operating with the special call 4V5H from one of the islands in the Haiti Coastal Island group (NA-149) from May 9 – 15.

HH – Haiti

While in the Caribbean (see FJ above), Col McGowan, MMØNDX; Paul Tittensor, G4PVM, and Jonathan Bowes, MMØOKG, will be operating with the special call 4V5H from one of the islands in the Haiti Coastal Island Group (NA-149). They'll be there from May 9 – 15 and will operate on CW, SSB, and FT8 on 3.5 – 21 MHz. QSL via EB7DX.

J8 – St. Vincent

Oleh Kernytskyy, KD7WPJ/UR5BCP, will be operating from IOTA NA-025 from May 20 – 27 using the call sign J8/UR5BCP. He'll have 100 W from an ICOM IC-7100, along with verticals and dipoles. He mainly plans to be active on FT8 and FT4 on 40 through 6 meters, with some CW and SSB expected. Contacts will be uploaded to LoTW. QSL via KD7WPJ, for paper confirmations.

Coronavirus Outbreak

In February, shortly after the outbreak of the COVID-19 virus, several DXpeditions to the Pacific had to be cancelled or postponed. Shoji Igawa, JA7HMZ, had to cancel his February 14 – 21 V63DX operation for the 2020 ARRL DX CW Contest. The March 2020 W8S DXpedition to Swains Island was postponed until October, and the V6J IOTA DXpedition to OC-253 was postponed until next year. Also put on hold were the VE3LYC and KO8SCA IOTA DXpeditions to OC-155 (V62P) and OC-299 (V62S), which were supposed to happen in May. Some of the DXpeditions reported that they had to tack on an extra 2 weeks to be quarantined in Hawaii before continuing to their destination.

Wrap-Up

That's it for this month, with thanks to DL2SBY, F6CUK, KD7WPJ, MMØNDX, and VE7VR for their input. I'm looking forward to seeing everyone at Dayton Hamvention®. Until next month, see you in the pileups! — *Bernie, W3UR*

Jon Jones, NØJK, n0jk@arrl.org

The World Above 50 MHz

Elevating a Yagi for EME Operation

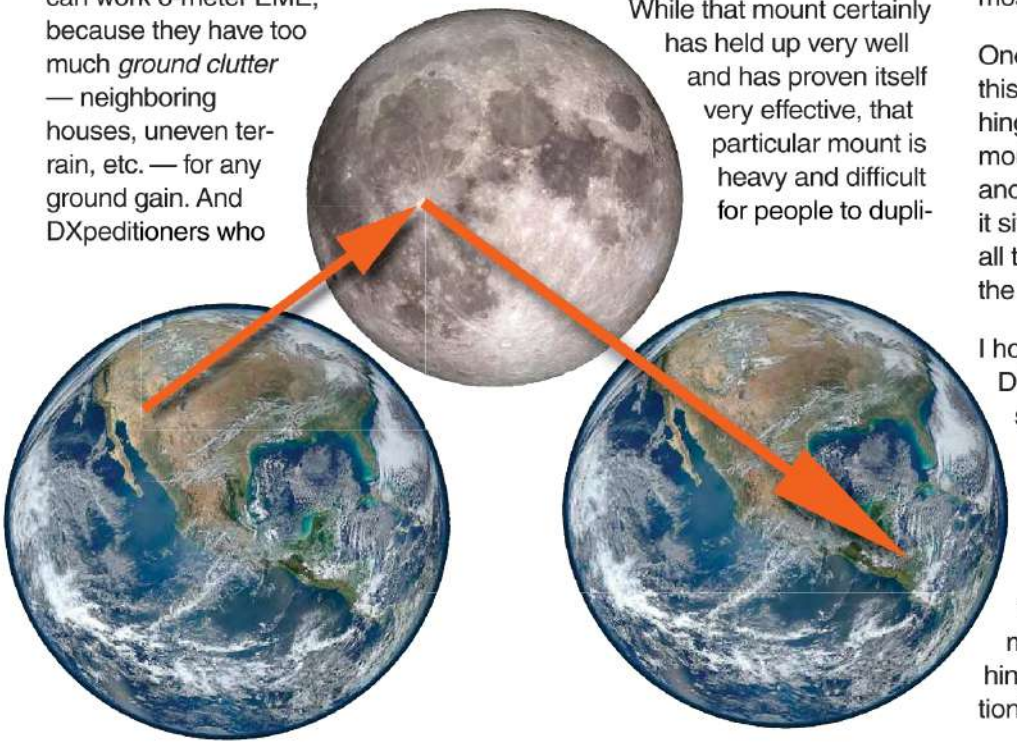
Most people starting on 50 MHz EME use a single, long Yagi fixed on the horizon. It is the easiest to put up and benefits from ground gain — reflections off the ground. But elevating the Yagi can be beneficial and also extend the amount of time you may use the moon. This month, Lance Collister, W7GJ, shared his antenna project for 50 MHz EME (Earth-Moon-Earth) work.

Benefits of Elevation

Although most of the single Yagi stations who work 6-meter EME utilize ground gain while keeping their Yagis aimed at the horizon, there are situations when elevation can help. As KB7Q demonstrated in Aruba, larger stations can even work a good five-element Yagi station when it is elevated. Furthermore, home stations with a long Yagi can benefit from lowered noise level, and may find that elevation is, in fact, the only way they can work 6-meter EME, because they have too much *ground clutter* — neighboring houses, uneven terrain, etc. — for any ground gain. And DXpeditioners who are planning to try 6-meter EME can benefit from elevation (if they have a good long Yagi) to extend their moon time.

Usually, stations with a single Yagi need to keep their antennas aimed at the horizon and utilize ground gain antenna lobes while the moon is below 20 degrees elevation. That's because the gain of their Yagis is too small without that extra ground gain. I recommend that an antenna have 14 dBd free space gain if it's going to be elevated. However, when I've been on 6-meter EME DXpeditions (during optimal conditions) with my single 6M8GJ Yagi (with just over 12 dBd free space gain), I've worked patient operators using elevated antennas as small as the 6M7JHV Yagi.

I previously published construction details on my web page for the elevation mount I have used on all my 6-meter EME DXpeditions. While that mount certainly has held up very well and has proven itself very effective, that particular mount is heavy and difficult for people to duplicate. It is also difficult to use that mount above 60- or 65-degree elevation. Furthermore, it mounts on the side of the mast, and puts the antenna even further out to the side of the mast, causing small-diameter, lightweight masts to want to bend — especially in high winds.



Building an Elevation Mount

This month, I spotted a heavy-duty hinge in a hardware store and decided to build an improved elevation mount using it. This mount is strong, lighter weight, can be elevated higher, and is centered directly over the mast, so there is no tendency for the Yagi and mount to put sideways stress on the mast. It is also simple to build in an evening, with common hand tools. Several people have expressed interest in a manual elevation mount, but the complexity of the original mount was too much for most people to handle.

One of the things I like most about this approach is the fact that if the hinge ever fails, you just unbolt the mount and re-assemble it with another hinge. Also, I like the fact that it sits directly on top of the mast and all the weight is supported directly by the mast.

I hope to use it on my future EME DXpeditions. I will test it out with the separate extension mast when I set up at the grid confluence of DN55/56/65/66 near the end of June.

There is no friction control with the lightweight simple hinged mount, because a store-bought hinge forms the basis for the elevation. It all has to be controlled by the

Figure 1 — A 432 MHz 4 × 2 curtain array built by Joe, WA8OGS, and Richard, WC8RK, pointing north toward Dayton, Ohio, for its first contact. The antenna is now an exhibit at the National Voice of America Museum of Broadcasting in West Chester, Ohio. [Joe, WA8OGS, photo]

Yagi steering lines. I usually use one on the front of the Yagi (which comes down to a screw eye in the mast around 4 feet off the ground) and two on the rear that are tied off to various ground stakes. That way, with slip knots, I can keep the antenna from being pulled up too high, and also hold it at a steady elevation.

This 3-pound mount is almost half the weight of the original 6-pound version. But it probably could be even lighter if 3⁄16-inch aluminum plates were used instead of ¼-plates. I tend to overbuild these things, because I know that when you are out in the middle of nowhere, you can't afford to have something fail.

Complete information for this mount (including photos) is now on my web page at **www.bigskyspaces.com/w7gj/HingedMount.pdf**.

On the Bands

50 MHz. February was slow for sporadic-E. KA1W worked a short opening to Illinois on February 6. On the 8th, WA2GFN caught a short, but strong, opening to KF4WE (EM56) and KC5ML (EM54) at 1600Z.

On February 22, Larry, NØLL, went on another EN20 grid DXpedation to Plattsmouth, Nebraska. He completed 11 MSK144 contacts on 6 meters that morning. Larry runs 70 W to a three-element Yagi on a 15-foot-high mast. He had great results for random meteors. The month of February has the lowest occurrence of random meteors of any month. The summer months, June through August, have the highest.

144 MHz. Larry, NØLL (EM09), worked K7MAC (DN17) on MSK144 on February 19 at 1357Z. Persistence paid off as he said the contact took almost an hour to complete

222 MHz. Charlie, NØAKC, reported that he "worked Mark, W7MEM, in Idaho (DN17) via EME for his 20th state on 222 MHz. 30 minutes later, I worked Steve, K5DOG, in Texas (EM00)" on February 2 at 2056Z.

432 MHz. On February 1, NØAKC worked K5DOG on EME. Mike, K7ULS (DN41), also worked K5DOG on EME on February 10. On the 28th, K7ULS logged DF3RU and DL7APV on EME. Greg, WQØP (EM19), west of Topeka, Kansas, installed a 15 W beacon to a big wheel antenna on 432.350 MHz. The 432.250 MHz beacon frequency is locked to a 10 MHz OCXO source that is within 10 Hz accuracy on 432.350 MHz when compared to a spectrum analyzer that is locked to a disciplined oscillator in turn locked to GPS. It could prove handy as a regional signal to calibrate radios.

Joe Burke, WA8OGS, built a scale 432 MHz curtain antenna that is modeled on the Voice of America HF curtain array (see Figure 1). Richard Kreuter, WC8RK, and Joe built this for an exhibit at the National Voice of America Museum of Broadcasting in West Chester, Ohio. In the picture, Richard is using his battery-powered Icom IC-9700 VHF/UHF radio during this initial 2/19/20 contact with Mike Suhar, W8RKO, in Dayton, Ohio. Richard said, "The contact distance was just 25 miles, with strong S-9+ signals. We will try longer contacts once warmer weather arrives, and also measure the actual gain of the antenna."

Here and There

Rick, NE8Z, said he will be back in Ecuador at Capay on Hill Lighthouse (ECU-017) on 6 meters at HC1MD/2 on April 6 – May 9 with a two-element Moxon antenna. This is a good time for sporadic-E openings to North America. On May 10, 2010, OA4TT had a sporadic-E opening to most of North America all that afternoon.

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!

Because of the COVID-19 pandemic, many organizations are canceling or rescheduling events. This is the information we had at the time we went to press. We suggest you contact the event organizer to confirm. — *Ed.*

Through Dec. 31, 0000Z – 2359Z, W5YD, Mississippi State, MS. W5YD Mississippi State University Amateur Radio Club. **W5YD Centennial Celebration**. 80, 40, 20, and 17 meters. QSL. Mississippi State University Amateur Radio Club, Dept. of Physics & Astronomy, P.O. Box 5167, Mississippi State, MS 39762-5167. **www.w5yd.org.msstate.edu**

Through Dec. 31, 0000Z – 2359Z, various call signs, various cities, IA. Great River Amateur Radio Club. **Iowa State Parks On-the-Air Centennial Celebration**. All bands, all frequencies, as available. Certificate & QSL. IASPOTA-2020, c/o Great River Amateur Radio Club, P.O. Box 1384, Dubuque, IA 52004. *Members will operate with their own call signs from state parks throughout Iowa. Operating as time permits, mostly weekends. QSL for contact; certificate for five parks. See website for complete information.* **www.w0dbq.org/iaspota**

Apr. 11 – Apr. 17, 0000Z – 2359Z, NN4SA (and other NASA clubs), Huntsville, AL. NASA Amateur Radio Clubs. **Apollo 13 50th Anniversary**. 14.271. QSL. Check **qrz.com** for individual clubs. *NASA clubs will be on the air. Check DX cluster for frequencies and call signs. Contact the appropriate club for QSL information.* **https://nasaontheair.wordpress.com**

Apr. 18, 1500Z – 2100Z, K9K, Durand, IL. Winnebago County Illinois ARES/SKYWARN. **April in Durand**. 14.270 7.190 3.840. QSL. Randy Long, 212 E. Main St., Durand, IL 61024. **www.ecom1.com**

Apr. 25, 1300Z – 2200Z, W5HSV, Hot Springs Village, AR. Hot Springs Village Amateur Radio Club. **50th Anniversary of Hot Springs Village**. 14.240 7.240 147.015 PL tone 114.8 EchoLink node: 869766. Certificate. David Johnson, 28 Descollar Cir., Hot Springs Village, AR 71909. **www.w5hsv.weebly.com**

May 1 – May 3, 0001Z – 2359Z, W4T, Dickson, TN. Dickson County Amateur Radio Club. **Old Timers Day**. 14.280 7.245 3.980 146.520. QSL. Vollie Miller, 1755 E. Piney Rd., Dickson, TN 37055-3835. **www.wc4dc.org**

May 2, 1400Z – 2200Z, W0ARC, Washington, IA. Washington Area Amateur Radio Club, Inc. **Iowa State Parks On The Air, Lake Darling**. 14.275 14.070 7.225 7.080. QSL. Mark Lukins, 802 N. 2nd Ave., Washington, IA 52353. **www.waarc.net**

May 2, 1500Z – 2300Z, K7L, Fallon, NV. Amateur Radio of Churchill County. **Lahontan Dam 105th Anniversary**. 14.280. eCertificate. Send request to: **nv7ccfallon@gmail.com**.

May 2 – May 3, 1400Z – 2100Z, WW8MRN, Marion, OH. Marion Amateur Radio Club. **Marion County Ohio Bicentennial — Celebrating 200 Years**. 147.300 14.300 14.030 7.250 7.030 3.950 3.530; digital 7.040 3.590 1.070. Certificate and QSL. Dustin Holbrook, P.O. Box 252, Marion, OH 43301.

May 3 – May 9, 0400Z – 0400Z, W9IMS, Indianapolis, IN. The Indianapolis Motor Speedway Amateur Radio Club. **The INDYCAR Grand Prix**. 18.140 14.245 7.245 3.840. Certificate & QSL. Indianapolis Motor Speedway Amateur Radio Club, P.O. Box 30954, Indianapolis, IN 46230. *See website for details.* **www.w9ims.org**

May 5, 0001Z – 2359Z, W2H, Forked River, NJ. K2JSS. **World Pulmonary Hypertension Day**. 14.250 14.074 7.074 3.573. QSL. Jack Bartky, 2209 Longwood Dr., Forked River, NJ 08731. **k2jss@arrl.net**

May 8 – May 9, 0900Z – 1700Z, K7UVA, Orem, UT. Utah Valley Amateur Radio Club. **Utah Valley Hamfest 2020**. 14.280 7.200 7.080. QSL. Utah Valley Amateur Radio Club, P.O. Box 1288, Orem, UT 84059-1288. **https://utahvalleyhamfest.com**

May 8 – May 23, 1800Z – 2359Z, W2V, Ansonia, CT. VOA Radio Club. **75th Anniversary of the Victory in Europe**. 14.345 21.345 7.245 3.845. QSL. Dave Arruzza, 32 Benz St., Ansonia, CT 06401. **w2v.se@yahoo.com** *or* **www.qrz.com/db/w2v**

May 9, 1400Z – 2000Z, K4RC, Jamestown, VA. Williamsburg Area Amateur Radio Club. **Jamestown Landing Day Event**. 14.265 7.265. QSL. QSL Manager, K4RC, P.O. Box 1470, Williamsburg, VA 23187. **www.k4rc.net**

May 9, 1400Z – 2000Z, W8LT, Columbus, OH. Friends of W8LT. **COSI Big Science Celebration**. 14.250 14.074. QSL. Larry Feth, 40 Bevis Hall, 1080 Carmack Rd., Columbus, OH 43210. **www.qrz.com/db/w8lt**

May 9, 1400Z – 2200Z, WW1USA, Kansas City, MO. National World War I Museum and Memorial. **World War I Armistice Commemoration**. SSB 14.225 7.250 CW 14.060 7.060. Certificate. WW1USA Amateur Radio Station, 2 Memorial Dr., Kansas City, MO 64108. *Operating from the south lawn of the museum; visitors welcome.* **ww1usa@theworldwar.org** *or* **www.qrz.com/db/ww1usa**

May 10, 1400Z – 2300Z, WW2ADT, Dyess AFB, TX. World War II Airborne Demonstration Team. **2020 Dyess Big Country Air & Space Expo**. 14.250 7.250. QSL. David Snell, KE7EK, 13640 Kenosha Ave., Glenpool, OK 74033-3829. **www.wwiiadt.org**

May 16, 1300Z – 1900Z, N3M, Fort George G. Meade, MD. National Cryptologic Museum. **Armed Forces Day at the National Cryptologic Museum**. 7.200. QSL. Charles Dorcey, 9210 Dewberry Ln., College Park, MD 20740. *In the event of hazardous weather, the station will be a static display inside the museum.* **www.qrz.com/db/ab3na**

May 16, 1300Z – 1900Z, W1M, Russell, MA. Western Mass Council — Scouting USA. **WHOA/SCOTA**. 14.290 14.060 7.190 7.060. QSL. Tom Barker, 329 Faraway Rd., Whitefield, NH 03598. *Paper logging is used; there will be a delay in sending out QSL cards.*

May 16, 1400Z – 2000Z, W4BSF, Oneida, TN. Big South Fork Amateur Radio Club. **Tennessee Mountain Laurel Festival**. 7.245. QSL. Big South Fork Amateur Radio Club, P.O. Box 334, Sunbright, TN 37872. **www.bsfarc.com/index.php/mtnlaurel**

May 16, 1400Z – 2200Z, W4D, Sevierville, TN. Sevier County Emergency Radio Service. **May in the Mountains**. 7.180 LSB. QSL. Thomas Baxter, W9TPB, 2054 James Rd., Sevierville, TN 37876. **www.eventqsl.webs.com**

May 16, 1630Z – 2130Z, W5KID, Baton Rouge, LA. Baton Rouge Amateur Radio Club. **Armed Forces Day Observance**. 14.250 14.035 7.225 7.035. QSL. USS *Kidd* Amateur Radio Club, 305 S. River Rd., Baton Rouge, LA 70802. *Operating aboard the USS* Kidd, *DD-661, World War II Fletcher-class destroyer.* **www.qrz.com/db/w5kid**

May 16 – May 17, 1430Z – 1930Z, W2GSB, Farmingdale, NY. Great South Bay Amateur Radio Club. **American Airpower Museum**. 14.280 14.050 7.265 7.050. QSL. Great South Bay ARC, P.O. Box 1356, West Babylon, NY 11704. **www.gsbarc.org**

May 16 – May 24, 0000Z – 2359Z, W9A, Junction City, WI. Wood County ARES/RACES, W9WCA. **2020 Emergency Medical Services Week**. 14.275 7.275 3.975; DMR 31550/ WiresX K9WCA. QSL. Wood County ARES/RACES, Attn: W9A Special Event, 3530 Bohn Dr., Wisconsin Rapids, WI 54494. *All modes will be in play on HF along with digital modes — DMR, WiresX, Fusion, NXDN, P25, and possibly D-STAR.* **kb9stb@gmail.com** *or* **www.facebook.com/WoodCoARESRACES**

May 16 – May 25, 1400Z – 0600Z, W7AIA, Vancouver, WA. Clark County Amateur Radio Club. **Club's 90th Anniversary and Mt. St. Helen's Eruption 40th Anniversary Special Event Station**. 14.225 14.030 7.185 7.030. Certificate & QSL. Clark County Amateur Radio Club, P.O. Box 1424, Vancouver, WA 98668. **www.w7aia.org**

May 18 – May 24, 0400Z – 0400Z, W9IMS, Indianapolis, IN. The Indianapolis Motor Speedway Amateur Radio Club. **The Indianapolis 500**. 18.140 14.245 7.245 3.840. Certificate & QSL. Indianapolis Motor Speedway Amateur Radio Club, P.O. Box 30954, Indianapolis, IN 46230. *See website for details.* **www.w9ims.org**

May 22 – May 26, 0100Z – 1000Z, K5E, Rockdale, TX. KI5DQ. **Memorial Day**. 144.250 14.265 7.265. QSL. James Hunt, 1026 Valentine Dr., Sherman, TX 75090. *To honor and remember those who made the ultimate sacrifice in service to our nation.*

May 23 – May 25, 0001Z – 2359Z, KØS, Springfield, MO. Erik Weaver, NØEW. **Strange Antenna Challenge**. 28.400 14.300 7.200 3.900. QSL. Erik Weaver, 4857 E. Farm Rd. 136, Springfield, MO 65809. *Antennas for the Strange Antenna Challenge are constructed of unusual, makeshift, or debris material that may be on hand following a natural disaster. Join the fun and be your own special event station, just append /KØS to your call sign. You'll need to respond to your own QSL requests. Don't forget to contact the media. For more details, contact NØEW.* **erikeweaver@gmail.com** *or* **www.qrz.com/db/n0ew**

May 23 – May 27, 0001Z –2359Z, AG5Z, Purvis, MS. Larry Morgan. **Gulf Coast Hurricanes Special Event 2020**. 21.300 14.255 7.250 3.862. Certificate. Larry Morgan, 96 Oak Haven Rd., Purvis, MS 39475. *Stations include W4F Florida, W4A Alabama, W5M Mississippi, W5L Louisiana, W5T Texas, bonus station K5H (Katrina 5 Hurricane). Hurricane experience discussions are encouraged; for this reason FT8 contacts will not count. This event is to increase awareness of the hurricane season that starts on June 1.*

May 23 – May 24, 1400Z – 2200Z, WBØSFT/KCØVYS, Overland Park, KS. William Becknell Santa Fe Trail Heritage Days. **4th Annual William Becknell Heritage Days Special Event — Founder of the Santa Fe Trail**. 21.365 14.265 7.265 3.865 1.830; SSB CW FT8. Certificate & QSL. See website for information on receiving a certificate or QSL. *On the trail 1 x 1 calls, WØB through W9B, and Parks on the Air (K-4579) activation. See website for details.* **www.wb0sft.org**

May 25, 1600Z – 2130Z, W5KID, Baton Rouge, LA. Baton Rouge Amateur Radio Club. **Memorial Day Observance**. 14.250 14.035 7.225 7.035. QSL. USS *Kidd* Amateur Radio Club, 305 S. River Rd., Baton Rouge, LA 70802. *Operating aboard the USS* Kidd, *DD-661, World War II Fletcher-class destroyer.* **qrz.com/db/w5kid**

May 30, 1300Z – 2200Z, W2A, Christiansburg, VA. New River Valley Amateur Radio Club. **Audie Murphy**. 14.262 7.262 3.860. QSL. Danny Wylam, 710 Mc Daniel Dr., Christiansburg, VA 24073. *Operating from Brush Mountain, VA, on the Appalachian Trail near the Audie Murphy Memorial.* **dannywylam@gmail.com**

May 30, 1500Z – 2000Z, K2G, Kingston, NY. Overlook Mountain Amateur Radio Club. **Girl Scout Camporee**. 14.240; DMR TG 31630; local talk-in 146.805, – 0.6, PL 103.5. QSL. Overlook Mountain Amateur Radio Club, P.O. Box 48, Hurley, NY 12443. **www.omarcclub.org**

May 30, 1600Z – 2359Z, WØOM, Fruita, CO. Western Colorado Amateur Radio Club. **Mike the Headless Chicken Festival**. 14.235 14.074 7.230 7.074; phone and FT8 on 20 and 40 meters; local 2-meter repeater 146.940. QSL. WCARC, Mike the Headless Chicken, 2695 Patterson Rd. Ste. 2 Box 118, Grand Junction, CO 81506-8815, or LoTW. *History of Mike*: **www.miketheheadlesschicken.org**. **www.w0rrz.org**

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 **August** *QST* would have to be received by **June 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**.

Convention and Hamfest Calendar

Because of the COVID-19 pandemic, many organizations are canceling or rescheduling events. This is the information we had at the time we went to press. We suggest you contact the event organizer to confirm. — *Ed.*

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

Alaska (Wasilla) — May 9 F H R S T V
10 AM – 5 PM. *Spr:* Matanuska ARA. Church of Christ, 2061 N. Merciful Cir. *Tl:* 146.85, 146.33 (103.5 Hz). *Adm:* $5. **www.kl7jfu.com**

California (Loomis) — May 21 D F H R T V
7 AM – noon. *Spr:* Sierra Foothills ARC. Historic Loomis Train Depot Plaza, 5775 Horseshoe Bar Rd. *Tl:* 145.43 (162.2 Hz). *Adm:* Free. **www.w6ek.org**

Connecticut (Goshen) — May 16 D F H R T V
8 AM – noon. *Spr:* Southern Berkshire ARC. Goshen Fairgrounds, 116 Old Middle St. (Rte. 63). *Tl:* 147.285+600 (77 Hz). *Adm:* $5. **www.sberk.org**

Florida (Dade City) — May 9 F H T V
7 AM – noon. *Spr:* East Pasco ARS. Church Avenue overflow parking lot, 37746 Church Ave. *Tl:* 146.88 (146.2 Hz). *Adm:* $5. **www.eparsonline.org**

Florida (Pinellas Park) — May 23 F H R T
8 AM – noon. *Spr:* The Glorious Society of the Wormhole. Freedom Lake Park, 9990 46th St. N. *Tl:* 146.85 (146.2 Hz). *Adm:* Free. **www.w4orm.org**

GEORGIA STATE CONVENTION

JUNE 6, MARIETTA, GA
D F H Q R S T V
8 AM – 2 PM. *Sprs:* Atlanta Radio Club, Kennehoochee ARC. Jim R. Miller Park, 2245 Callaway Rd. SW. Atlanta Hamfest. *Tl:* 146.82 (146.2 Hz). *Adm:* Advance $6, door $8. **www.atlantahamfest.com**

Illinois (Princeton) — June 7 D F H R T V
8 AM – 3 PM. *Spr:* Starved Rock RC. Bureau County Fairgrounds, 811 W. Peru St. *Tl:* 146.955 (103.5 Hz). *Adm:* $7. **www.w9mks.org**

Iowa (Boone) — May 23 D F H Q R S T V
8 AM – 1 PM. *Spr:* 3900 Club. Boone County Fairgrounds Community Building, 1601 Industrial Park Rd. *Tl:* 146.85. *Adm:* Adults $7, children 14 and under are free. **www.3900club.com**

Kentucky (Princeton) — June 6 D F H Q R T V
8 AM – 1 PM. *Spr:* Princeton Ham Radio Club. KY State Fire and Rescue Training Center, 2001 Training Center Dr. *Tl:* 145.23 (179.9 Hz). *Adm:* $5. **www.w4kbl.org**

Maryland (West Friendship) — May 24 D F H Q R T V
8 AM – 2 PM. *Spr:* Maryland FM Assn. Howard County Fairgrounds, 2210 Fairgrounds Rd. *Tl:* 146.76, 224.76, 444.0 (107.2 Hz). *Adm:* $10. **www.marylandfm.org**

Michigan (Hudsonville) — June 6 F H R T V
8 AM – noon. *Spr:* Independent Repeater Assn. Hudsonville Fairgrounds, 5235 Park Ave. *Tl:* 147.16 (94.8 Hz) *Adm:* $6. **www.w8ira.org**

Michigan (Newberry) — June 6 D F H Q R V
9 AM – noon. *Spr:* Luce ARS. Pentland Township Hall, 15474 Highway M-28. *Tl:* 146.61/01 (114.8 Hz) *Adm:* $5.

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

New Jersey (Spring Lake) — June 6 D F H R T V
7:30 AM – noon. *Spr:* Ocean-Monmouth ARC. Spring Lake Heights Volunteer Fire Company #1, 700 Sixth Ave. *Tl:* 145.11 (127.3 Hz). *Adm:* Adults $5, children 12 and under are free. **www.n2mo.org**

New Jersey (Township of Washington) — May 23 D H Q R T V
8 AM – 1 PM. *Spr:* Bergen ARA. Westwood Regional High School, 701 Ridgewood Rd. *Tl:* 146.79 (141.3 Hz). *Adm:* $5. **www.bara.org**

New York (Depauville) — May 16 F H R T V
8 AM – noon. *Spr:* Thousand Island Repeater Club. 15191 School St. *Tl:* 147.03 (151.4 Hz). *Adm:* $2. **www.tirepeaterclub.com**

New York (Hilton) — June 6 D F H Q R S T V
7 AM – 2 PM. *Spr:* Rochester ARA. Hilton Exempt Club, 137 S. Ave. *Tl:* 146.61 (110.9 Hz). *Adm:* $10. **www.rochesterham.org**

North Carolina (Durham) — May 30 D F H R T V
8:30 AM – 12:30 PM. *Spr:* Durham FM Assn. Durham Public Schools Staff Development Center, 2107 Hillandale Rd. *Tl:* 145.45 (82.5 Hz), 442.15 (131.8 Hz). *Adm:* $5. **www.dfma.org**

Ohio (Wauseon) — June 6 D F H R V
8 AM – 1 PM. *Spr:* Fulton County ARC. Roth Family Park, 105 Hill Ave. *Tl:* 147.195 (103.5 Hz). *Adm:* $5. **www.k8bxq.org/hamfest**

DAYTON HAMVENTION®

May 15 – 17, Xenia, OH
D F H Q R S V
Fri 9 AM – 5 PM, Sat 9 AM – 5 PM, Sun 9 AM – 1 PM. *Spr:* Dayton ARA. Greene County Fairgrounds & Expo Center, 120 Fairgrounds Rd. *Tl:* 146.940 (123 Hz). *Adm:* Advanced $26, door $31. **www.hamvention.org**

NORTHWESTERN DIVISION CONVENTION

June 4 – 6, Seaside, OR
D F H Q R S V
Fri (workshops only), Sat 9 AM – 4 PM, Sun 9 AM – 1 PM. *Sprs:* Oregon Tualatin Valley ARC, Clark County ARC. Seaside Civic & Convention Center, 415 First Ave. SEA-PAC. *Tl:* 145.45 (118.8 Hz), 146.52 simplex. *Adm:* Advance $10, door $15, student $5, children 12 and under are free. **www.seapac.org.**

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

WESTERN PENNSYLVANIA SECTION CONVENTION

June 6 – 7, Prospect, PA

D F H Q R S T V

Sat 8 AM – 5 PM, Sun 8 AM – 3 PM. *Spr:* Breeze Shooters ARC. Big Butler Fairgrounds, 1127 New Castle Rd. (Rte 422). *Tl:* 146.52. *Adm:* $10 for both days.
www.breezeshooters.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 **June 1** to be listed in the **August** 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.**

Write for *QST*

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

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

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

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

Please note that *QST* only considers complete manuscripts — we do not evaluate concepts or ideas for manuscripts. The best way to find out whether the editors of *QST* are interested in your idea is to write the article and send it in for consideration via postal mail or email (no phone calls, please).

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

Melissa Stemmer, KA7CLO, mstemmer@arrl.org

At the Foundation

Annual Board Meeting Elections and Technical Writing Award

The ARRL Foundation's Annual Board Meeting was held on January 29, 2020. Hudson Division Director Ria Jairam, N2RJ, was elected to the ARRL Foundation Board for a 3-year term by the ARRL Board of Directors at their January 17 – 18, 2020 Annual Meeting. Jim Fenstermaker, K9JF, and Tim Duffy, K3LR, were both re-elected for 3-year terms on the ARRL Foundation Board. Tom Abernethy, W3TOM; Brian Mileshosky, N5ZGT; Rick Niswander, K7GM; David Norris, K5UZ; Dick Norton, N6AA, and Mike Ritz, W7VO, remain on the ARRL Foundation Board to complete their terms. During the ARRL Foundation Annual Meeting, Dr. Woolweaver, K5RAV, was re-elected as President, Mr. Mileshosky was re-elected as Vice President, Mr. Niswander was re-elected as Trea-surer, and ARRL Development Mana-ger Melissa Stemmer, KA7CLO, was elected as Secretary.

Dr. Woolweaver appointed Mr. Fenstermaker to serve as the Scholarship Committee Chair, with Mr. Abernethy, Mr. Duffy, Ms. Jairam, Mr. Norris, and Mr. Ritz also serving on the committee. Dr. Woolweaver appointed Mr. Mileshosky to serve as the Proposals Committee Chair, with Mr. Norton and Dr. Woolweaver also serving.

The Foundation Board unanimously approved Randy E. Standke, KQ6RS, as the recipient of the 2019 Bill Orr, W6SAI, Technical Writing Award for his May 2019 *QST* article, "Identify and Track Down RFI," as recommended by the *QST* editorial staff.

ARRL Foundation Scholarship recipients will be announced in May 2020.

Celebrating Our Legacy

Code Runs in the Family

When I was a teenager, my uncle, Lou Ockenhouse, W3DCR (SK), was a dedicated Heathkit CW operator. He never had elaborate antenna systems (just some wire dipoles), but he always worked the world!

My friend Craig and I started attending Novice classes offered by the local radio club on Friday nights. Back then, they offered code practice followed by theory. Eventually, we earned our Novice tickets. My call sign was WB3IIY and Craig's was WB3IJO.

Soon I had a brand-new Kenwood TS-520 sitting on my desk and a vertical antenna ground-mounted in the backyard. My uncle liked the receiver so much that he eventually got a TS-820S — his first non-Heathkit or homebrew rig. Following in his footsteps, I got a CW key and mastered its technique.

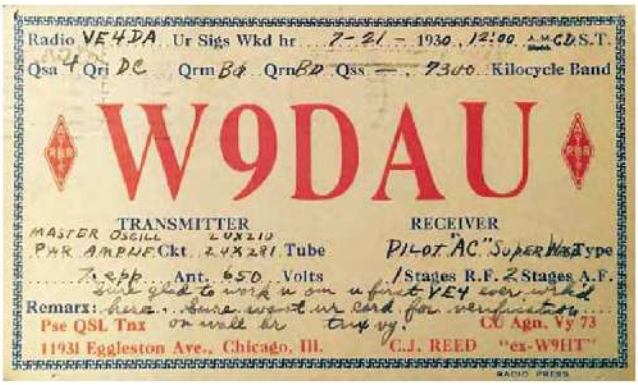
Over time, I became more involved in the hobby and eventually earned my General and Amateur Extra-class licenses and am now KG3I. Sadly, my uncle Lou passed away many years ago, but I will always be in his debt for pushing me to learn code. I pride myself in using it whenever I can, just like he did.

Doug "Rusty" Deutsch, KG3I
Effort, Pennsylvania

Continuing My Grandfather's Legacy

In the town of Yellow Grass in Saskatchewan, Canada, on July 21, 1930, my grandfather, R.J. Baker, VE4DA (SK), made contact with W9DAU from Chicago, Illinois. The US operator used a master oscillator power amplifier (MOPA) laser transmitter running 650 V into a Zepp antenna, and a Pilot AC Super Wasp two-stage receiver. This was the era of Hartley oscillators, high-voltage amplifiers, and 6-foot-high transmitters.

By the early 1970s, my grandfather was living in Quebec operating as VE2UE, and running a Heathkit SB-101 into a beam antenna. He also used an Atlas 210X for operating in his Cessna 180 float plane, and the popular Heathkit HW-7 for portable operation at a fishing camp he frequented in northern Quebec. This is the same equipment I used when I earned my license in 1990.



R.J. Baker's, VE2UE (SK), 1929 QSL card sent from Chicago, Illinois to Saskatchewan, Canada.

Amateur radio operators around the world know the thrill of hearing their call sign coming back through the static and I was no exception. I entered contests, made many friends, and worked stations all over the world. While the Atlas was the radio I used in my first shack in Sudbury, Ontario, the two Heathkits were the rigs I used the most. I felt the personal connection between my grandfather and myself, gaining an appreciation for the glow and smell of vacuum-tube radios and the spirit of home-built equipment.

Ron Baker, VE3SIF
Guelph, Ontario

Remembering a Mentor

I first met Bill Welsh, W6DDB (SK), in the 1960s, when I was a high school student. He taught amateur radio licensing classes at Lockheed Martin Amateur Radio Club, W6LS, in Sunnyvale, California, and I had become interested in ham radio by listening to shortwave broadcast stations.

The classes were one night a week and lasted a couple months. We learned electronics and drew schematics, memorized FCC rules and regulations, learned Morse code, and even had homework. When I finished the class, my dad drove me to the FCC Field Office in downtown Los Angeles to take the test.

I was always amazed to see Bill sending and receiving CW while carrying on a conversation. Even today, if my wife has something to tell me while I'm working CW, I have to ask either her or the ham to repeat themselves.

Bill's wife Marie, W6JEP (SK), later recounted how he had been a commercial CW operator, often working more than one station at a time when he operated the coastal stations.

Over the years, Bill probably taught thousands of people like me and always joined in the FISTS Operating Club and Straight Key Century Club (SKCC) CW operating frequencies, encouraging beginners to gain speed and confidence.

He was 85 years old and still active on the air when I contacted him again in the early 2000s. After 40 years, it was a thrill for me to get to copy Bill's still-solid fist. He and Marie inspired a love of ham radio and CW that has lasted to this day.

Joe Falletta, W6UDO
Terrebonne, Oregon

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.

Al Rabassa, NW2M, nw2m@arrl.net

Classic Radio

The Yaesu FT-101 Turns 50

In 1970, Yaesu released a new breed of HF radios: the FT-101 HF transceiver. It was a modular design with 10 solid-state circuit boards on a common chassis and a two-tube RF amplifier. The solid-state features of the radio offered high-performance, low-noise, and low-current characteristics, while the two-tube power amplifier provided a nearly bulletproof transmitter and tuner stage. Yaesu offered a variety of station accessories so operators could enjoy the 160-meter through 2-meter bands in style (see Figure 1). The supported modes were USB, LSB, CW, and AM, with auxiliary connections for external support (RTTY, for example). It also had a built-in speaker and universal power supply.

Figure 1 — Al Rabassa's, NW2M, complete Yaesu station, which is fully operational. From left to right: YP-150 dummy load/wattmeter, YO-100 station monitor, FL-2100B 1,200 W amplifier, SP-101 desktop external speaker, YD-844 dynamic desk microphone, FT-101F transceiver, DD-1 digital frequency display, QTR-24 station clock, FV-101B remote VFO, FTV-250 2-meter transverter, FTV-650 6-meter transverter, SP-101PB external speaker with telephone patch. [Al Rabassa, NW2M, photo]

Many Yaesu models and submodels ("early," "mid," and "late" production runs) proudly display the FT-101 logo. Yaesu offered the FT-101, FT-101B, FT-101E, and the fully refined FT-101F. There were no A, C, or D model units produced. To keep costs down and to match the operating privileges for the operator, there were E (economy) and X (extreme economy) suffix models offered. The longer the FT-101 model number, the less capability it had to offer. Table 1 shows the modular

Table 1 — FT-101 Board Complement by Model Number

FT-101 Version	VFO	REG	HF/IF	LO/IF	AUDIO	RF	MOD	RECT	BLANKER	PROCESS
FT-101 (Early) S/N 25,000 & Down	PB1056	PB1079A	PB1084C	PB1080A	PB1081C	PB1077B	PB1078A	PB1076A	Part of PB1080A	None
FT-101 (Late) S/N 25,001 & Up	PB1056	PB1185	PB1180	PB1183	PB1189	PB1181A	PB1184	PB1076B	PB1182	None
FT-101B (Early) S/N 6,000 & Down	PB1056	PB1185	PB1180	PB1183B	PB1315	PB1181B	PB1184A	PB1076B	PB1292	None
FT-101B (Late) S/N 6,000 & Up	PB1056	PB1314A	PB1180B	PB1183B	PB1315A	PB1181B	PB1184A	PB1076B	PB1292	None
FT-101E/EE/EX (Early) S/N 15,000 & Down	PB1056	PB1314A	PB1180B	PB1183B	PB1315A	PB1181B	PB1184A	PB1076B	PB1292	PB1494
FT-101E/EE/EX (Mid) S/N 15,000 – 20,000	PB1056	PB1314A	PB1180B	PB1183B	PB1315A	PB1181B	PB1184A	PB1076B	PB1292	PB1534
FT-101E/EE/EX (Late) S/N 20,001 & Up	PB1056	PB1314A	PB1180B	PB1183C	PB1315A	PB1181B	PB1184A	PB1076B	PB1582	PB1534A
FT-101F/FE/FX (All) S/N All Numbers	PB1056	PB1547	PB1180B	PB1183	PB1315B	PB1181B	PB1184A	PB1076B	PB1582B	PB1534A

board numbers for each of the FT-101 submodels.

When buying or selling an FT-101 radio, you must indicate the full serial number, so the capabilities and limitations of each radio can be known. For help decoding your radio's serial number, visit **www.qsl.net/nw2m/ft101.html**.

A Necessary Performance Revision

The original FT-101 suffered from strong transmitter spurs and severe overload on receive. The factory responded with major upgrades to address these issues. It was a tumultuous time for owners — many analyzed and improved each circuit board to enhance its overall performance.

Versatile Modular Circuit Boards

Each of the 4-inch-wide modular circuit boards had a specific function. Many boards operated on both transmit and receive, so fixing a receive problem often resolved a transmitter problem. Yaesu also offered extender boards so any board could be extended out of the chassis for troubleshooting, repair, or alignment. Alternatively, the boards could be sent out for repair individually, instead of having to ship a 32-pound steel transceiver chassis with glass tubes (see Figure 2).

Figure 2 —This full-page Spectronics advertisement in the January 1971 issue of *QST* was the first print advertisement for the FT-101 transceiver.

The FT-101's Tubes

The selection of a pair of Toshiba 6JS6C vacuum tubes may have been a weakness of the FT-101 transceiver. These horizontal deflection sweep tubes were used in TVs. Although not meant for transmitting, they exhibited sufficient RF performance to be used through 28 MHz, and each tube could dissipate 30 W.

Figure 3 — An original pair of Toshiba green stripe sweep tubes used for RF power amplification from 160 meters through the 10-meter band. [Al Rabassa, NW2M, photo]

Although Toshiba's green stripe tubes (see Figure 3) are no longer available, cold cathode neutralization should be performed before any modification is made within the original tank circuitry to accommodate aftermarket tubes. If they neutralize, then no further modification is necessary.

A Community Newsletter

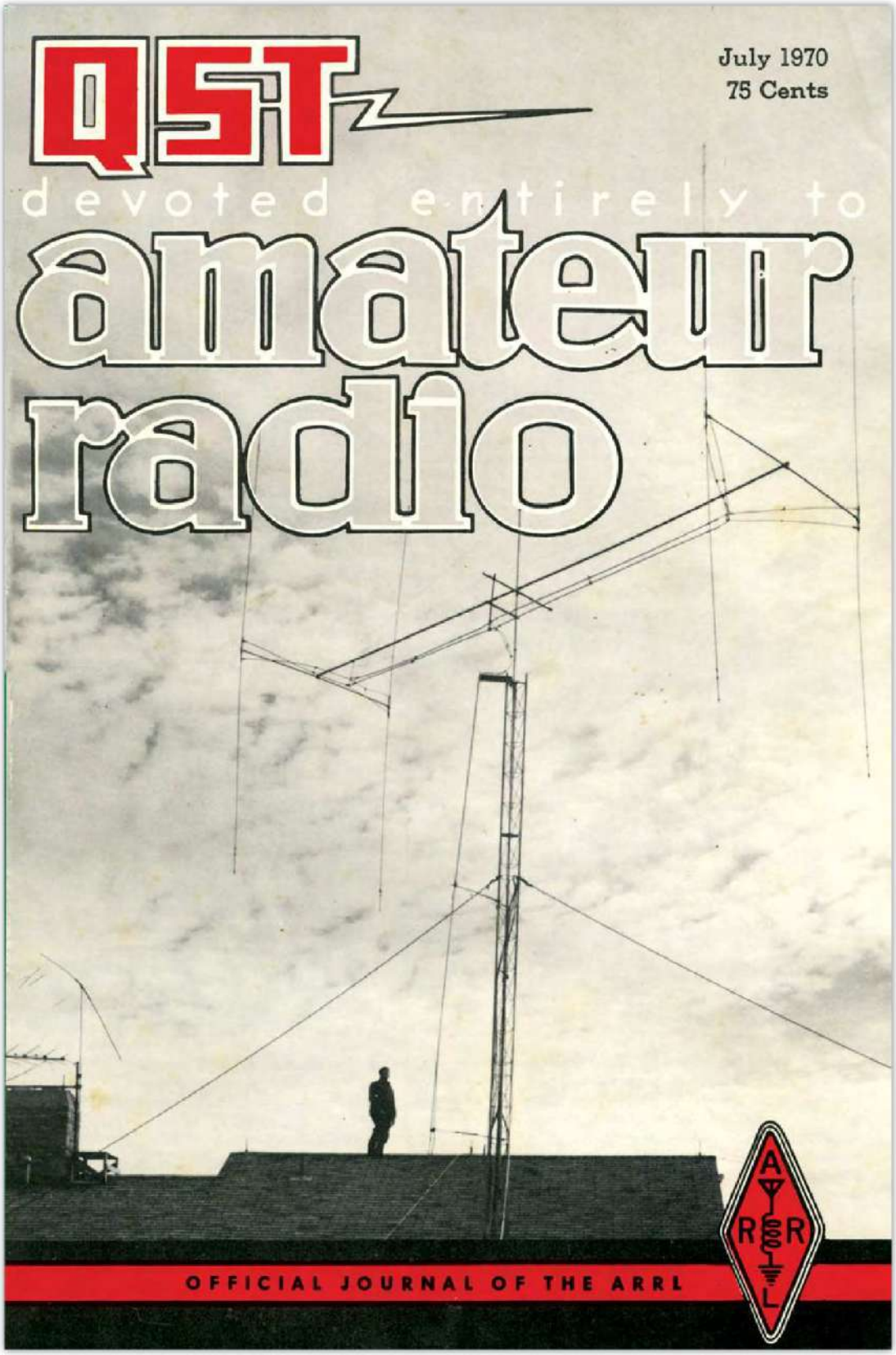
Milton "Milt" Lowens, N4ML (SK), was a proud owner of an early FT-101 transceiver and he learned firsthand about the radio problems by writing to the factory for solutions. Milt wanted to ensure that all FT-101 owners could benefit from that knowledge as well, so he started the on-air Fox Tango Club in 1971, and published its first newsletter in January 1972 (**www.qsl.net/nw2m/foxtango.html**). The factory translated every newsletter and offered solutions. This exchange lasted for 14 years.

In the last newsletter, Milt commented that there were 4,000 Fox Tango members spanning 42 countries. It purported to be the largest collection of user data and factory support information for any radio at any time. There are 140 issues, not including supplements and addenda.

Additional Information

For more information and history about this legacy transceiver, read the *Yaesu FT-101 Series Service Manual* (**www.radiomanual.info/schemi/YAESU_HF/FT-101_series_serv.pdf**).

A Look Back


QST
July 1970
75 Cents
devoted entirely to
amateur radio
OFFICIAL JOURNAL OF THE ARRL
A R R L

Correspondence From Members-

The publishers of *QST* assume no responsibility for statements made herein by correspondents.

SIN – SINNER OR SINNED AGAINST?

● The National Student Information Net was set-up here during the week of May 4 at Brandeis University to provide information regarding the status of other schools during the National Student Strike to any college or university ham station requesting it. (The strike was a spontaneous response to the escalation of the war into Cambodia and the murders at Kent State University.) Brandeis is acting as National Strike Information Center, so accurate up-dated info has been available upon request through the net.

The net and its operation has been non-political. The net has provided information in response to specific requests. The ready availability of accurate information has facilitated understanding, good-will, and prevented false rumors. Typical of the requests answered were questions dealing with specific strike action by schools, telephone numbers of campus fm broadcasting stations, confirmation of demonstrations planned, etc.

We students and the local hams who came down to assist us at K1WGM operated almost around the clock the first few days. The amount of deliberate interference and jamming (whistling, telephone beeps, music, etc.) was unbelievable. Often we were attacked as, "Commie b------, the FCC will hear about this." They did – we called them.

Serious violations such as obscenity, deliberate QRM, not identifying, etc. – is this how amateurs respond to a situation which they dislike? It seems as though many amateurs are unaware also that third party traffic in the states is legal! By the way, we understand that the FCC has responded to our complaints by apprehending several of the jamming stations. I hope their prosecution will serve to remind any other amateur engaged in such blatantly illegal operations which may jeopardise amateur privileges for our whole fraternity.

As a league member and participant in NTS, I only regret that all the operations weren't on cw! *Ralph Katz, K2AJA, Brandeis University Waltham, MA*

● On Monday, 11 May, from approximately 2100z-2150z I was listening to 7260 kc and heard the following stations: W2UC, W1VPY, WA3FXJ, W3EAX and others identifying themselves as the "National Student Information Net". W2UC, acting as net control, made the statement several times that the net was sanctioned by the FCC and American Radio Relay League. He also mentioned the fact that FCC was taping their conversations and they (FCC) were issuing citations to other stations for "deliberate interference" to their net operations. Other topics brought up were – boycott Coca Cola and substitute another brand; a demonstration to be held at Fort Dix at 1230 on 16 May; trying to solicit students to don female attire this time to agitate the construction workers in New York City like they did the latter part of the week of 4 May. W2UC also asked for a estimate of the crowd and number of police cars at the demonstration near the University of Maryland where they were attempting to block route No. 1. W3EAX was his contact on this. W2UC was forwarding any info to some "clearing center" although no mention was made as to its location. Since this, in my opinion, is a national security matter I notified the Baltimore FBI office.

Somewhere along the line it strikes me as odd that this is a "public service" of any nature or "PICON" if you prefer. It is very amusing, I'm sure, to some countries. *Walter O. Carr, W3LDD, Havre de Grace, MD*

● I am sure that you will receive some letters from other amateurs claiming that the operation of that net was somehow "unAmerican", and boasting that they did their "patriotic duty" by intentionally throwing carriers onto the net frequency, calling the net operators loyalty to their country and their parentage into question, etc. I cannot subscribe to that point of view.

First of all, let me state that I am *not* a college student, but rather a middle-class working citizen who believes that this is a nation of laws; laws which should be enforced by the duly constituted authorities, not vigilantes! I had occasion to monitor both of the net frequencies for about 4 to 5 hours on Sunday. In that time I heard nothing going on within the net which would justify the vicious attacks made by the "brave" amateurs who refused to identify themselves! I heard only an exchange of factual information concerning what was happening at various campuses. This information would very probably have been available to anyone who had access to an AP or UPI machine. At no time did I hear anyone connected with the net voice any sort of political opinion.

I heard the net operators accused of burning buildings, etc. I do not believe that these persons are the ones who have burned buildings; those persons have no time for amateur radio, they are too busy destroying. I do believe that the great majority of our college students wish to work for change by peaceful means. It is only the radical fringe which get the publicity. I can understand, however, their frustration. We tell them to be peaceful, and when they are, they are vilified as happened over the past weekend.

I urge the League to take a firm stand against intentional interference of this sort! In the future, if the interfering parties are so convinced that they are right and that the net (or whatever) is operating illegally, let them give their calls (as they did not do this weekend) and let the FCC decide to whom to send the citations! *Richard W. Steinfeldt, K2UCJ, Dunkirk, NY*

● I protest the use of amateur radio for coordinating student activities between U.S. Universities and Colleges. In my opinion the operation of the National Student Information network violates the intent of part 97.1 of the Communications Act of 1934 and the basic philosophy of amateur radio. I do not consider this activity to be in the best interest of the United States or Amateur Radio. If action is not initiated to curtail this or similar activities a dangerous precedent will be established and the future of

bona fide amateur operations could be jeopardized. *Thomas E. Furrey Jr., WA7HAG/6, San Jose, CA*

● A resident in surgery at Boston City Hospital, I am presently studying for my Novice ticket. On May 9 and 10 I was listening on my receiver to the National College Information Net which was operating from Brandeis University here in Waltham. A moderate Conservative, I was skeptical about the legality of their operation, and I was puzzled by the enormous number of ham amateurs who were trying to jam them. Accordingly I got in my car and went to Brandeis where I watched them run their net. I can truthfully say that theirs was in fact a completely non-political, legal operation. I became increasingly appalled by the language and persistence of the illegal interference, much of which I have recorded on tape. Mine was always the impression that the Ham radio operators were a dignified fraternity, yet as I listen to my tape to those incorrugable, flagrant violators who were jamming the network, I get so disgusted and disappointed that I am honestly thinking about abandoning Ham Radio. *Ronald Ripps, M.D., Watertown, MA.*

● These students justify this little "net" by saying that they are not a political group, merely a public service, an information central. Who are they kidding? Who are they supposed to be providing a public service to? They are just using an amateur frequency for the relaying of political information to the heads of the national strike. Information relayed included the number of students who are handing in their draft cards and telephone numbers of the various strike centrals.

I urge that the American Radio Relay League reprimand these "public servants" in accordance with the editorial in the February, 1969, issue of *QST*. *Paul J. Schaefer WA3LCC, Baltimore, MD*

● How valuable a service could have been performed by the net had it been allowed to operate by the jammers and self-styled "Guardians of America"!

The fellows and gals running the net deserve a lot of credit for staying cool under all kinds of undeserved abuse. I don't know how they did it; a few hours of listening to misdirected comments from the lunatic fringe of the Silent Majority (they claim to be a majority, anyway) made me a nervous wreck. *Dave Sumner, K1ZND, Michigan State University, East Lansing, MI*

● I noticed a tremendous silence around 14.294MHz, where the National Student Information Network was trying to pass traffic across the nation via this clear channel frequency.

This should clearly demonstrate that polite and considerate amateurs with an open mind shall always prevail and that the ham bands will never degenerate to the deplorable condition of CB *Richard A. Peterson, WAØJNC, Denver, CO*

[Editor's Note: The letters above were selected to present a cross-section of views on the National Student Information Net; most have been shortened considerably. Of the letters not chosen for the column, the majority (12 to 6) opposed the use of amateur radio for what the writers considered were political purposes, but there were additional letters dealing with intentional interference to what *these* writers in their turn thought was legitimate third-party traffic. The editor's views were expressed in the editorial, "Conversation Discipline," February, 1969, and are reiterated on page 9 of this issue.]

HAM SPIRIT

● Please turn off the bubble-machine— the usual "Ham Spirit" came thru again!

I asked you to mention in Strays that I needed some Taylor TZ-40 tubes, and you ran it in the April issue, page 50.

I received about 20 replies and a donation of 4 tubes – which I have shipped on to OZ7UU, who needed them. I think it is really wonderful how the hams come forward with an assist on something like this. *George S. Maxey, W6BIL, Redding, CA*

OLDEST NOVICE?

● I claim to be the oldest Novice in the state. I was 69 years old on April 5, 1970. *Thomas L. Fitzmaurice, Norwich CT*

[Editor's Note: Any counterclaims?]

GETTING THERE, HALF THE FUN?

● *QST* is welcomed *when it gets here.* Anticipated, yes, but if it shows a trifle late, the contents are still fresh. Should the 'trifle late' stretch a bit so that two issues arrive together – perhaps there IS difficulty with the – 'and snow and dark of night' – who forgets how to read so quickly? *W. P. Gearhiser, W5EPW, State College, MS*

● I look forward to receiving my *QST* every month and go back through them quite often referring to old articles on antennas, rigs and even advertisments. My *QSTs* usually don't arrive until about the 10 or 12 of the month but they do come every 30 days right on schedule and there's not another Ham magazine going that can compete with the quality or quantity of current information found in each *QST*. Please keep the good work coming. *Sim Oefinger Jr., WN5YOA, Austin, TX*

● Finally received April *QST*, it was worth waiting for. *Tom Mangels, WA1JVV, Danbury, CT*

● The April issue arrived at my QTH on April 4th! I saw the wrapper sticking out of the mailbox and thought, "Now that looks like *QST* but, no, it can't be. This is only the 4th and *QST* usually arrives around the 20th". You can imagine my surprise and shock when I found that it really was *QST*. Maybe the local post office employees read your April editorial and had guilty thoughts! *Dwight W. Sorensen, WAØITU, Kansas City, MO*

● With an editorial deploring the poor mail situation and letter upon letter airing gripes about poor deliveries, I thought you might like to hear from the "other side of the fence". In short, my May issue of *QST* arrived at home on April twenty-ninth! Since my May copy of *QST* did arrive on time (and it is a rare exception here when they are late). . .I was ready to defend you to the hilt. . .among other hams with whom I work.

Then came a rebuttal. One fellow who lives in a rural area southwest of Detroit said: "I can't fully fault the post office. Griping there isn't the answer. Why is it that my two other ham publications from New England are *never* late. . .but *QST* is?"

That one. . .I couldn't answer. *Ed Bruening, W8DTY, Ann Arbor, MI*

[Editor's Note: *QST* still mails at the same time we have used for years. The other two, to the best of our knowledge, some months ago decided to move their deadlines and thus their mailing dates a week or so earlier.]

TURN THE KNOB!

● Happy to renew membership for another year; I've been on the records for the past 30 years. To the guys who work sideband like W6DGT and I do, why not try the cw bands for a change? QRM on phone is bad. The cw bands are wide and lots of room, so let's turn the knob! *Mervin R. Critchlow, W7GIJ, Bothell, WA*

Want to start a pile-up?

The New Heathkit® SB-102

Direct descendent of the most popular sideband rigs ever produced — the famous "100" & "101" Series. With an ancestory of top performance, high reliability and unbeatable value, you expect the new "102" to be a better rig ... and it is.

The frequency stability and linearity of the "101" were second to none. The "102" is even better. An all solid-state Linear Master Oscillator cuts stabilization time in half; offers far greater tracking accuracy.

Hot new receiver circuitry delivers improved sensitivity ... now less than 0.35 uV for 10 dB signal plus noise to noise. This increase gives you solid copy longer when the band is on the way out.

The new "102" brings you all the flexibility and performance that made the "101" the standard of comparison on the air, plus important new features. Start your Maxi-Rig now ... with the SB-102 — from the Hams at Heath, of course.

SB-102 SPECIFICATIONS — RECEIVER SECTION: Sensitivity: Better than 0.35 microvolt for 10 dB signal-plus-noise to noise ratio for SSB operation. **SSB selectivity:** 2.1 kHz minimum at 6 dB down, 5 kHz maximum at 60 dB down — 2:1 nominal shape factor — 6:60 dB. **CW Selectivity:** (With optional CW filter SBA-301-2 installed) 400 Hz minimum at 6 dB down, 2.0 kHz maximum at 60 dB down. **Input impedance:** Low impedance for unbalanced coaxial input. **Output impedance:** Unbalanced 8 and 600 ohm speaker, and high impedance headphone. **Power output:** 2 watts with less than 10% distortion. **Spurious response:** Image and IF rejection better than 50 dB. Internal spurious signals below equivalent antenna input of 1 microvolt. **TRANSMITTER SECTION: DC power input: SSB:** 180 watts P.E.P. continuous voice. **CW:** 170 watts — 50% duty cycle. **RF power output:** 100 watts on 80 through 15 meters; 80 watts on 10 meters (50 ohm non-reactive load). **Output impedance:** 50 ohms to 75 ohms with less than 2:1 SWR. **Oscillator feedthrough or mixer products:** 55 dB below rated output. **Harmonic radiation:** 45 dB below rated output. **Transmit-receive operation: SSB:** Push-to-talk or VOX. **CW:** Provided by operating VOX from a keyed tone, using grid-block keying. **CW side-tone:** Internally switched to speaker in CW mode. Approx. 1000 Hz tone. **Microphone input impedance:** High impedance. **Carrier suppression:** 50 dB down from single-tone output. **Unwanted sideband suppression:** 55 dB down from single-tone output at 1000 Hz reference. **Third order distortion:** 30 dB down from two-tone output. **Noise level:** At least 40 dB below single-tone carrier. **RF compression (TALC):** 10 dB or greater at .1 ma final grid current. **GENERAL: Frequency coverage:** 3.5 to 4.0; 7.0 to 7.3; 14.0 to 14.5; 21.0 to 21.5; 28.0 to 28.5; 28.5 to 29.0; 29.0 to 29.5; 29.5 to 30.0 (megahertz). **Frequency stability:** Less than 100 Hz per hour after 10 minutes warm-up from normal ambient conditions. Less than 100 Hz for ±10% line voltage variations. **Modes of operation:** Selectable upper or lower sideband (suppressed carrier) and CW. **Visual Dial Accuracy — "resettability":** Within 200 Hz on all bands. **Electrical dial accuracy:** Within 400 Hz after calibration at nearest 100 kHz point. **Dial mechanism backlash:** Less than 50 Hz. **Calibration:** 100 kHz crystal. **Audio frequency response:** 350 to 2450 Hz ±3 dB. **Phone patch impedance:** 8 ohm receiver output to phone patch; high impedance phone patch input to transmitter. **Front panel controls:** Main (LMO) tuning dial; Driver tuning and Preselector; Final tuning; Final loading; Mic and CW Level Control; Mode switch; Band switch; Function switch; Freq. Control switch; Meter switch; RF gain control; SSB-CW filter switch. Audio Gain control. **Internal controls:** VOX Sensitivity; VOX Delay; Anti-Trip; Carrier Null (control and capacitor); Meter Zero control; CW Side-Tone Gain control; Relative Power Meter Adjust control; P.A. — Bias; Phone Vol (headphone volume); Neutralizing. **Rear Apron Connections:** CW Key jack; 8 ohm output; Spare A; Spare B; Phone patch input; ALC input; Power and accessory plug; RF output; Antenna switch; Receiver Antenna. **Power requirements:** 700 to 800 volts at 250 ma; 300 volts at 150 ma; —115 volts at 10 ma; 12 volts at 4.76 amps. **Cabinet dimensions:** 14 3/16" W x 6 5/16" H x 13 5/16" D.

• New all solid-state Linear Master Oscillator features 1 kHz dial calibration • Bandspread equal to 10 feet per Megahertz • Less than 100 Hz per hour drift after 10 minute warm up • Dial resettable to 200 Hz • New receiver circuitry provides sensitivity of better than 0.35 uV for 10 dB S+N/N • 180 watts PEP SSB input — 170 watts CW input • 80 through 10 meter coverage • Switch-selection of USB, LSB or CW • Built-in CW sidetone • Built-in 100 kHz crystal calibrator • Triple Action Level Control™ reduces clipping and distortion • Front panel switch selection of built-in 2.1 kHz SSB or optional 400 Hz CW crystal filters • Operate with built-in VOX or PTT • Fast, easy circuit board-wiring harness construction • Run fixed or mobile with appropriate low cost power supplies

SB-102, 23 lbs.....**$380.00***
SB-600, Communications Speaker, 6 lbs.....**$19.95***
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SBA-301-2, 400 Hz CW Crystal Filter, 1 lb.....**$21.95***
SBA-100-1, Mobile Mounting Kit, 6 lbs.....**$14.95***

100

100, 50, and 25 Years Ago

May 1920

- The cover art shows a smiling ham wearing headphones and sending Morse code with his key.
- The editorial, under the heading "Fighting Fading," discusses how fading of the signal from a given station occurs at different times and receiving locations — a puzzle yet to be solved.
- "An Experimental C.W. Transmitter" explains how to make a small undamped transmitter using vacuum tubes for C.W., modulated telegraphy, or telephony.
- L.M. Clement shares Part 2 of a paper presented before the Radio Club of America, "The Vacuum Tube as a Detector and Amplifier."
- H.G. Mathews reports on his "Summer Work with Regenerative Receivers."
- Elliott A. White describes how to use "Combination Crystal and VT Detectors Without Switches."
- In "Whither Are We Whencing," Charles Wolfe shares how much ham radio equipment had changed during his 4-year absence from the hobby.

May 1970

- The cover photo shows the 2-meter QRP transceiver described in the issue.
- The editorial, "It Seems to Us…," continues to examine postal delays of *QST* delivery.
- Richard Preiss, W7HCV, discusses how he built "The '2-Meter QRP Mountain-Topper,'" which gave him a 200-mile range using a portable five-element Yagi.
- Joe Hertzberg, K3JH, details how he built "A Nearly Full Size, Rotatable, Two-Element Quad for 80 Meters."
- Douglas Blakeslee, W1KLK, explains how to build "The IC-TT Generator," and how to use it to test SSB transmitters.
- Doug DeMaw, W1CER, offers "Some Tips on Solid-State VFO Design" that will lessen the harmonic output, improve the stability, and increase the output.
- Richard Fenwick, W5KTR, reports on building "A Lightweight 10- and 15-Meter Beam with 5 Elements on Each Band."

May 1995

- The cover photo shows WD4FAB and W4AT, framed by part of the AMSAT Phase 3D satellite structure.
- The editorial, "A Red-Letter Day," reports that the FCC announced that 219 to 220 MHz will once again be available to amateurs.
- Steve Ford, WB8IMY, provides a rundown on "Phase 3D: The Ultimate *EasySat*," including how to use it when it's launched.
- "'9600-Ready' Radios: Ready or Not?" by Jon Bloom, KE3Z, explains how the ARRL Lab looked at some of the new VHF/UHF transceivers to see if they were ready for 9600-baud packet.
- James Craswell, WBØVNE, offers a simple but excellent project, using very-large-scale integration to build the "Weekend DigiVFO."
- Frank Witt, AI1H, explains how he used an SWR tester and dummy load to evaluate several antenna tuners in "How to Evaluate Your Antenna Tuner — Part 2."
- In "Let the Games Begin!" Brian Battles, WS1O, reports on how hams play important roles in providing communication for the 1995 Olympic Games.
- Lauren Rudd, KD8PZ, explains how to "Let Your PC Do the Logging."
- Al Brogdon, K3KMO, reveals how to "Recycle Those Rabbit Ears" to make simple VHF antennas.

Silent Keys

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

KC1ADY **Ledwith**, Robert D., Haverhill, MA
N1AJI **Fisher**, Raymond P., Cheshire, MA
WA1BAA **Wilson**, John T., Sanbornton, NH
•KA1CFA **Schwartz**, Allan B., Cheshire, CT
KA1CNG **Whitten**, Dennis R., Scarborough, ME
KB1CZB **Menkello**, Richard M., Bourne, MA
W1DBD **Heath**, Edward I., Summerfield, FL
•W1ERJ **Hartke**, Jerome L., Westborough, MA
♦W1GUU **Ames**, Donald R., Milledgeville, GA
N1HJF **Rappaport**, Laurence M., Canaan, NH
N1PUZ **Lawler**, Albert M., Pensacola, FL
N1QAM **Shea**, Philip J., West Townsend, MA
♦K1QIZ **Austin**, Richard A., West Springfield, MA
W1QMK **Merrill**, Richard W., North Monmouth, ME
WA1VAV **Marchant**, William E. "Bill," Newton Center, MA
W1WLS **Woolwine**, Emmons H. "Skip," Nashville, TN
W1YUT **Robitaille**, Albert H., Jr., Pawtucket, RI
WA1ZTR **Barrett**, John J., West Hartford, CT
NJ2A **Horton**, Robert A., Sr., Columbus, NJ
WB2FBC **Patterson**, Donald R., Sr., Red Bank, NJ
AB2FZ **Jezierski**, Paul W., Ballston Lake, NY
W2KTT **Valentine**, Charles O., Jr., Englewood, NJ
N2LUE **McGrath**, James J. "Bud," Troy, NY
K2MQH **Holland**, Daniel M., Trumansburg, NY
•K2RLG **Scaglione**, Frank, Dalton, PA
W2RW **Wells**, Richard R. "Rick," Rochester, NY
AA2SV **Merwin**, William H., Brick, NJ
WB2UIE **Tomesch**, Frank J., Poughkeepsie, NY
N2UUT **Spade**, Kenneth A., Sr., Chittenango, NY
N2XM **Muha**, George M., Metuchen, NJ
KX2Y **Kingsley**, Neil W., North Hero, VT
KB2ZMM **Peacock**, Holly, Dumont, NJ
N3BPB **Kristoff**, William E., Jr., Wexford, PA
N3CHS **Gurskey**, Jack A., Sunderland, MD
KC3DAL **Sherwood**, Thomas S., Sr., Easton, MD
KB3EFV **Lichtinger**, Richard W., Lake City, PA
WB3FKP **Sklaney**, Mark P., Nanticoke, PA
AA3GE **Jablonowski**, Robert E., South Abington Township, PA
•W3INC **Carver**, Roger N., Freedom, PA
W3IVQ **Ragen**, Jack R., Santa Cruz, CA
•KA3JUQ **Baker**, John R., Monrovia, MD
•KB3JVF **Taylor**, Albert G., Langhorne, PA
N3LWP **Benna**, Robert W., Ross Township, PA
W3OUF **Moratis**, Christy J., Oakmont, PA
W3PPS **Dzwonczyk**, Joseph G., Wayne, PA
W3RM **Moll**, Richard A., Abington, PA
KB3UPP **Kostelnik**, Michael J., Dalton, PA
K3VJ **DiGalbo**, Dennis J., Phoenix, MD
•N3XQD **Lasher**, William D., Corry, PA
KS4AA **De Young**, Edward W., Clearwater, FL
AC4AB **DiCiccio**, Vincent J., Sunrise, FL
•W4AEL **Coffey**, Frank J., Jr., Norcross, GA
N4BOY **Kirkland**, Kenneth S., Valdosta, GA
WD4EWB **McCardell**, David L., Jr., "Mac," Chattanooga, TN
W4GFG **Guler**, George F., Tavares, FL
KK4IGB **O'Rear**, Nick, Morris, AL
♦K4IOQ **Bell**, J. Wallace, Chattanooga, TN
•K4KJZ **Blankenship**, Gerald E. "Gene," Auburn, AL
•KJ4KUK **Guynn**, Wallace E., Thomasville, GA
N4LCH **Morton**, Thomas V., III, Athens, AL
KJ4LCP **Bergman**, Jolene M., Fort Myers, FL
W4MEG **Wright**, Forrest D., Sr., "Redd," Louisville, KY
•N4QAX **Al-Salam**, Sue Gray, Newport News, VA
W4OC **Crain**, Mayse D., Jr., Boiling Springs, SC
K4OF **Renfro**, Robert R., Jr., Mount Pleasant, NC
W4OIT **Goddard**, Floyd W., Titusville, FL
KA4PNT **Stuckey**, Ronald K., Naples, FL
KR4Q **Vaughan**, Tony J., Bushnell, FL
KB4QIE **Jones**, Richard J., Granite Quarry, NC
W4RLA **Talley**, Earl W. "Watt," Lynchburg, VA
KJ4RWH **Robertson**, Jeffrey C., Bedford, VA
NM4T **Behrens**, Craig W., Huntsville, AL
W4TPP **Carbee**, Carolyn M., Palm Bay, FL
•N4UAN **Pepper**, Frederick F., Yadkinville, NC
KI4UCH **Marsh**, Stephen D., Ararat, NC
♦•WA4UTP **Fournier**, Robert N., Cantonment, FL
•KC4WEF **Woodbury**, Eugene B., Wilmington, NC
WB4YSQ **Sylvester**, Ellen J. "Ellie," Cross Junction, VA
•KC5AQB **Fuller**, Richard R. "Rick," Elgin, TX
AC5BB **Reichert**, William E., Altus, OK
W5CC **Grimes**, Sammy L., Tool, TX
KE5CUB **Schlanger**, Lee Philip, Sand Springs, OK
KF5DA **Reed**, Darrell B., Ada, OK
WB5DEC **Reddy**, Robert W., Wernersville, PA
KA5ESE **Fullen**, George W. "G.W.," Jasper, TX
KC5JAX **McIntyre**, Paul E., Sacramento, CA
K5JU **Briggs**, James S. "Shannon," Russellville, AR
K5JVT **Tortorici**, Joseph V., Tampa, FL
KE5KJD **LeBlanc**, Larry James, Breaux Bridge, LA
KF5MPP **Holden**, Gerald D., Abilene, TX
K5OLF **Cobb**, James R., Kaufman, TX
KG5OPB **Romano**, David L., Slidell, LA
N5PNB **Mullins**, Joe S., Emerson, AR
KB5RFA **Wayland**, Milton C. "Tony," Waco, TX
KB5RVC **Barker**, George S., Jr., "Buddy," Hot Springs National Park, AR
KB5RX **Skaggs**, Samuel R., Santa Fe, NM
KB5SY **Singleton**, Warren B., Groves, TX
KK5VW **Johnson**, John C., Geronimo, OK
K5YDX **Springer**, Thomas E., Los Alamos, NM
NV5Z **Thomas**, Edwin S., Albany, OH
KH6A **Johnson**, Gene H., Cypress, TX
♦•WA6DCP **DeLay**, David M., Cedar Rapids, IA
N6DQM **Mancebo**, Mary K., Atwater, CA
KA6DSY **Booth**, Richard B., Independence, MO
♦•KH6DX **Stribling**, Donald W., Hilo, HI
KI6HOA **Whitman**, John B., Sonora, CA
KO6IIH **Soutar**, Jock A., Barstow, CA
N6JQL **Dinsmoor**, Roland H., Salem, OR
KJ6KZD **Gee**, Victor H., Santa Rose, CA
KJ6MIB **Craig**, Richard L., Vacaville, CA
K6OKB **Black**, Guy H., Concord, CA
KD6QDA **Chapman**, John E., Placerville, CA
N6TG **Gunther**, Thomas J., Pasadena, CA
N6WGZ **Yoho**, Bruce A., Anza, CA
WG6X **Petschonek**, Raymond W., Pensacola, FL
•WL7ARN **Cook**, June A., Fairbanks, AK
KB7ARO **Thompson**, Michael C., Yakima, WA
♦•KL7CC **Wiley**, James B., Chugiak, AK
♦KD7CWY **Loose**, Donald J., Great Falls, MT
K7CYZ **Hazelmyer**, Richard E., Spokane, WA
•KF7GGR **Tanner**, Donald C., Elko, NV
WL7IJ **Brantingham**, Fred L., Anchorage, AK
W7KUY **Lee**, Allen D. "Al," Jerome, ID
♦W7NI **Griffiths**, Stanley A., Aloha, OR
K7OFT **King**, Robert M., Seattle, WA
KE7QFG **Traber**, Patricia L., Munds Park, AZ
W7SXA **Broman**, Glen L., Bremerton, WA
KC7THF **Burrup**, Jerald E., Idaho Falls, ID
N7WBA **Ashby**, Robert E., Seattle, WA
KC7YCX **Tompkins**, Vallier W., Sun Valley, NV
W8ADX **Donegan**, James H., San Jose, CA
♦KA8BGR **Lytton**, Lawrence C., Lecanto, FL
WT8C **Tonsi**, Reno M., Mentor, OH
•KC8DNL **Aberts**, Randy L., Mansfield, OH
K8DCN **Lebo**, Donald W., Jackson Township, OH
KC8EKF **Lawrence**, Joe F., Paducah, KY
WD8EPA **Marshall**, Edward T., Sr., Akron, OH
♦W8ESW **Wilush**, Edward S., Winter Springs, FL
♦WI8F **Nicely**, David A., Bellevue, OH
N8GKX **Holtsberry**, Dennis W. "Butch," Richmond, OH
W8GMH **Regal**, Ronald R., Parma, OH
WD8ISB **Dell**, Richard A., Macedonia, OH
K8LPC **Caskey**, Lawrence P., Chardon, OH
♦W8NAY **Nay**, Carl E., Tiffin, OH
K8NVY **Lashure**, Raymond P., Austintown, OH
KB8NXA **Filyo**, David A., Oregon, OH
♦W8RC **Nathanson**, Leonard M., White Lake, MI
WA8RZK **Peters**, Rudy L., Huntington, WV
KC8UQU **Nash**, Allen P., Delta, OH
W8WLO **Losey**, W. Marvin, Dublin, OH
W8XB **Miller**, Hal V., Campbell, MO
W9AM **Boe**, Robert E., Des Plaines, IL
KB9CKR **Watling**, Russell W., Rothschild, WI
♦WA9DOL **McCoy**, Loren T. "Sonny," Muncie, IN
WA9EEI **Trimnell**, Harold E., Jr., Taylorsville, IN
W9FCX **Dunlap**, Lyle W., Abingdon, IL
N9HWK **Spindler**, James R. "Dick," Mountain Home, AR
KA9HZH **Bull**, Edwin T., Jr., "Peter," Joliet, IL
WD9IVE **Colangelo**, Daniel J., West Brooklyn, IL
N9JIE **Gulling**, Nicholas R., Greenfield, IN
N9KM **Marker**, Janet S., Richmond, IN
WA9MGX **Becker**, Paul W., Belleville, IL
KA9NFD **Elliott**, Joyce, Martinsville, IN
K9OGZ **Wesolowski**, Ferdinand, Waukesha, WI
•KB9SMH **Valentine**, Barry L., Marengo, IL
W9SRX **Schmertman**, Dale E., Freeport, IL
WU9T **Chinnery**, Donald G., Marinette, WI
KC9VQX **Rohde**, Matthew R. "Buddha," Sheboygan, WI
NØAHU **Kopp**, Robert W., Marine on Saint Croix, MN
WØCCO **Stone**, Joseph L., Mission Hills, KS
•WBØPWE **Klouzek**, Dennis W., Fruita, CO
KØIUC **Spencer**, John L., Oak Park Heights, MN
ABØJR **O'Kunewick**, Philip E., Wheat Ridge, CO
WWØKRP **Chilton**, Jeffery P., Laguna Niguel, CA
NØOTL **Fischer**, William C., Northfield, MN
♦KØQQS **Johnson**, Jerald L., Fergus Falls, MN
•WØRFD **Kramer**, Kermit D., Minneapolis, MN
KØTGU **Hallberg**, Mary J., Overland Park, KS
ADØW **Lippert**, H. Philip, Austin, MN
•NØWHL **Davidson**, Jeffery A., Iowa Falls, IA
•KØWNR **Overton**, Roy W., Des Moines, IA
•WAØYDI **Kelley**, Michael O., Brush, CO
WXØYYZ **Brown**, Timothy S., Arvada, CO
LU6DRY **Bazzola**, Jose Jesus, Salinas, CA
VA3BRN **Burney**, Gerald, Thunder Bay, ON, Canada
VE3CCO **McDermott**, Audrey R., Scarborough, ON Canada
♦VE3FGL **Pluister**, John H., Whitby, ON, Canada
VE3HAP **Johnson**, David G., Burlington, ON, Canada
ZL1AIX **Robinson**, Warren John, Auckland, New Zealand

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

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• VHF/VHF, UHF/UHF simultaneous receive • 50 watts of output on VHF and UHF • Optional VS-3 Bluetooth® headset • Easy-to-See large white backlight LCD • Controller attachment to the main Unit

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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

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• 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

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FTDX101MP | *200W HF/50MHz Transceiver*

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FTDX3000 | *100W HF + 6M Transceiver*

• 100 Watt HF/6 Meters • Large and wide color LCD display • High Speed Spectrum Scope built-in • 32 bit high speed DSP /Down Conversion 1st IF

FT-991A | *HF/VHF/UHF All Mode Transceiver*

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

FTM-100DR | *C4FM FDMA/FM 144/430 MHz Xcvr*

• Power Packed System Fusion Transceiver • High Audio Output Power • Rugged Powerful Transmitter • Integrated 66ch High Sensitivity GPS • 1200/9600 APRS Data Communications

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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Navigator

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See QST Short Takes Review - May 2014-P. 62

- Quiet - hear what others miss!
- Proven USB Sound Card built-in
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- Complete - Six FTDI COM ports
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PK-232SC+

Multimode Data Controller*

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- Single USB connection to computer
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ANC-4 Antenna Noise Canceller *See & hear a demo on YouTube!*

Kill Noise before it reaches your receiver!
Great for supressing power line noise, plasma TV noise & many other local electrical noises.

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1200/9600 bps AX.25 Packet
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Proven FTDI Chip. 9 and 25 pins for all radios, TNCs, Rotor Controllers & more!

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To all our Hamvention Friends Worldwide,

Clearly an incredibly tough decision to make to cancel HV20. All the best medical experts predict this will go on beyond May. With only two months left we want to be responsible to all of our stakeholders.

The Hamvention family is hurting. We all put our hearts, souls, and our backs into the Great Gathering, Hamvention.

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Vy 73,

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The First Choice of Hams Around the World!

hy-gain® HF Rotators

HAM-IV – $709.95

The Most Popular Rotator in the World!

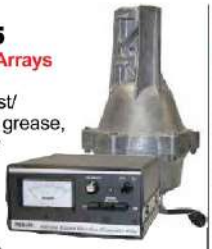
For medium communications arrays up to 15 square feet wind load area. Has 5-second brake delay, Test/Calibrate function. Low temperature grease permits normal operation down to -30 degrees F. Alloy ring gear gives extra strength up to 100,000 PSI for maximum reliability. *Precision* indicator potentiometer. Ferrite beads reduce RF susceptibility. Cinch plug plus 8-pin plug at control box. Dual 98 ball bearing race for load bearing strength and electric locking steel wedge brake prevents wind induced movement. North/South center of rotation scale on meter, low voltage control, max mast $2^{1}/_{16}$".

HAM-VI – $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 light-weight ham antennas. Rotator is built in a weather-proof 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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Sales/Tech: (662) 323-9538 ■ **FAX:** (662) 323-5803 Open 8-4:30 CST, Mon.-Fri.

MFJ G5RV Antennas

Operate all bands 10 through 160 Meters with a single wire antenna!

***The famous** G5RV antenna is the most popular ham radio antenna in the world!*

It's an efficient, *all* band 102 foot long antenna – shorter than an 80 Meter dipole. Has 32.5 foot ladder line matching section ending in SO-239 connector for your coax feedline.

MFJ-1778
$69.95

Use horizontally or as Inverted Vee or Sloper with just one support. 1500 Watts.

Operate all bands 80-10 Meters with an antenna tuner and even 160M with ground.

Fully assembled with *ceramic* end and fiberglass center insulators. *Hang and Play*™ – add coax, rope to hang and you're on air!

MFJ-1778M, $59.95. *Half-size,* 52 foot *G5RV JUNIOR for limited space*. 40-10 Meters with tuner. Full 1500 Watts.

MFJ All Band Classic Doublet

MFJ 102 foot *all band* doublet covers 160-6 Meters with balanced line tuner. Super strong custom fiberglass center insulator relieves stress on 100 foot ladder line. *Glazed ceramic* end insulators. 1500 Watts.

MFJ-1777
$79.95

RF Isolator

MFJ-915 *RF Isolator* prevents unwanted RF from traveling on the outside of your coax shield into your transceiver. This unwanted RF can cause painful RF "bites" when you touch your microphone or volume control, cause your display or settings to go crazy, lock up your transceiver or turn off your power supply. In mobile installations, stray RF could cause your car to do funny things even blow your car computer. Clear up these problems, plug an MFJ-915 between your antenna and transceiver. 1.8-30 MHz, 1500 Watts. 5 x 2 inches.

MFJ-915
$39.95

MFJ-919, $69.95. 4:1 current balun,1.5 kW.
MFJ-913, $39.95. 4:1 balun, 300 Watts.

True 1:1 Current

Balun & Center Insulator

True 1:1 *Current Balun/Center Insulator* forces equal radiator currents in dipoles for true dipole radiation pattern. Reduces coax radiation and field pattern distortion – your signal goes where *you* want it. Reduces TVI, RFI and RF hot spots. *Don't build a dipole without one!* 50 hi-permeability ferrite beads on high quality RG-303 *Teflon*® coax and *Teflon*® SO-239. 1.5kW 1.8-30 MHz. Stainless steel hardware. 14 gauge stranded copper wire is *directly* connected to your antenna. 5 x 2 inches. Heavy duty weather housing.

MFJ-918
$39.95

2-Position Antenna Switch

MFJ-1702C, $49.95. 2-position antenna switch, lightning surge protection, center ground. SO-239s.

Lightning surge protectors

MFJ-270, $24.95. 400W. **MFJ-272, $34.95.** 1500 W. Gas discharge tube shunts 5000 amps peak.< 0.1 dB loss. 1 GHz. SO-239s.

MFJ-16C06, $9.45. 6-pack *glazed ceramic* end/center ant. insulators.

MFJ-16B01, $24.95. Molded high strength center insulator. SO-239.

MFJ-16D01, $9.95. 450 Ohm fiberglass end/center insulator with ladder line stress relief and SO-239 mount.

MFJ-18H100, $44.95. 100 feet, 450 Ohm ladder line, 18 gauge copper clad.

80-10 Meter End-Fed Half Wave antenna

Cover all bands with one single wire and no tuner!

MFJ-1982HP
$109.95

No tuner needed!
All band 80-10M EFHW antenna

Get-on-the air on all bands 80-10 Meters with just one wire and one support (pole or tree) and no tuner or long counterpoise.

Installs anywhere in minutes! Rugged *insulated*-wire radiator prevents detuning when contacting limbs/branches. "*No-snag*" end insulator slides over branches, leaves.

Toss over a high limb for inverted-V or sloper or go vertical with an inverted-L.

Dark jacketed wire is virtually invisible – *don't let antenna restrictions keep you off the air!* Great for emergencies.

EFHWs naturally resonate on the 1/2-wave fundamental frequency and odd/even harmonics. Covers 80/40/30/20/17/15/12/10 Meters without traps, stubs or resonators.

Broad-band matching transformer at feed point gives SWR so low you may never need a tuner. Compensating inductor optimizes SWR. 800 Watts SSB/CW. 132 feet jacketed antenna wire.

MFJ-1984HP, $89.95. Like MFJ-1982HP but 40-10M. 66 feet jacketed wire.

See *www.mfjenterprises.com*
for 30 Watt QRP and 300 Watt models.

Dual Band Dipoles

MFJ-17758, $99.95. Operate 80/40 Meters with a short 85 foot dipole. Full-size on 40 Meters with ultra-efficient end-loading on 80 Meters. 1500 Watts. Super-strong custom molded center insulator with SO-239 connector and hang hole. Ceramic end insulators. 7-strand, 14 gauge hard copper wire. No tuner needed!

MFJ-17758
$109.95
80/40 Meters

MFJ-17754, $69.95. Like MFJ-17758 but is only 42 feet. Operate 40/20 Meters. Full-size on 20 Meters, ultra-efficient endloading on 40 Meters. 1500 Watts.

Single Band Dipoles

Ultra high quality center fed dipoles give years of troublefree service. Custom injection-molded UV resistant center insulator has built-in SO-239 and hanging hole. Glazed ceramic end insulators. 7-strand, 14-gauge hard copper antenna wire. 1500 Watts. Use horizontally or as sloper or inverted vee. Simply cut to length with provided cutting chart.

MFJ-1779A
$79.95
160M, 265 ft.

MFJ-1779B
$59.95
80-40M, 135 ft

MFJ-1779C
$39.95
20-6M, 35 ft.

OCFD Dipoles

MFJ-2012
$89.95
1500 Watts

MFJ-2010
$69.95
300 Watts

No tuner needed!
MFJ *Off-Center Fed Dipoles* use MFJ's exclusive *ExactRatio*™ RF broadband transformer to give low SWR and maximum bandwidth on 40/20/10/6 Meters. A Guanella current balun kills feedline radiation, pattern distortion, SWR shifts, RFI and noise pickup. Install anywhere and get the same predictable performance regardless of feedline length. You get ground reinforced gain over verticals. Use horizontally, inverted vee, sloper. 98% efficient, 14 gauge, 7-strand copper wire, ceramic end insulators.

MFJ Enterprises, Inc. 300 Industrial Pk Rd, Starkville, MS 39759
Phone: (662) 323-5869 ■ **Tech Help:** (662) 323-0549 ■ **FAX:** (662) 323-6551 8-4:30 CST, Mon.-Fri.

MFJ ANTENNAS

MFJ Wire Antennas

G5RV -- *Most popular antenna in the world!*

Operate 80-10 or 40-10M with tuner. 14 gauge, 7-strand copper antenna wire. 1.5kW. 32.5' ladder line matching section with SO-239 for coax.
MFJ-1778, $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.

2-Position Antenna Switch

MFJ-1702C, $49.95. 2-position antenna switch, lightning surge protection, center ground.

MFJ Enterprises, Inc. 300 Industrial Pk Rd, Starkville, MS 39759
Phone: (662) 323-5869 • Tech Help: (662) 323-0549 • FAX: (662) 323-6551 8-4:30 CST, Mon.-Fri.

MFJ Magnetic Loop Antennas

MFJ 36-inch magnetic loop antenna lets you operate 7 to 22 MHz or 10 to 30 MHz continuously -- including the WARC and MARS bands! Easily handles a full 150 Watts on SSB/CW/Digital for any transceiver.

Ideal for limited space -- apartments, small lots, motor homes, attics, or mobile homes.

Work exciting DX with low angle radiation and local close-in contacts with high angle radiation when mounted vertically.

Super easy-to-use! MFJ remote control auto tunes to your desired band. Fast/slow tune buttons, Cross-Needle SWR/Wattmeter lets you quickly tune to your exact frequency. No control cable needed.

***World's** most efficient small loop antenna has all welded construction, welded butterfly capacitor with no rotating contacts, large 1.050 inch diameter aluminum radiator -- gives you highest possible efficiency.*

Every capacitor plate is welded for extremely low loss and polished to prevent high voltage arcing. Nylon bearing, anti-backlash mechanism, limit switches, continuous no-step DC motor gives smooth precision tuning. Heavy-duty ABS plastic housing has ultraviolet inhibitor protection.

MFJ-1782, $459.95. Like MFJ-1786 but with fast/slow tune manual remote control.

MFJ-1780, $369.95. 20-10 Meters, 150 Watt *Portable* *24x24x24" box fan loop with carrying handle.* Highly efficient all-welded contstruction, no-rotating contact butterfly capacitor. Fast/slow tune remote control. No control cable needed. *See QST July 2019 review.*

MFJ-1780XX, $449.95. Like MFJ-1780 with auto band tune remote control, SWR/Wattmeter.

Build your own Mag loop!

Motorized Butterfly Capacitors

Super low loss butterfly capacitors, no rotating contacts, all plates welded with no mechanical electrical contacts. Anti-backlash mechanism. DC motor with gear reduction box. Handles at least 150 Watts SSB/CW/Digital.

1. **p/n: 282-1786, $189.95.** 11-128 pF.
2. **p/n: 282-1788, $249.95.** 15-260 pF.
3. **p/n: 80-1786-2SM, $249.95.** Auto band selecting remote controller with SWR/Wattmeter.
4. **p/n: 80-1782-2, $79.95.** Manual remote control, fast/slow tune buttons.

Butterfly Capacitors

5. **MFJ-19, $79.95.** 12-67 pF.
6. **MFJ-23, $109.95.**18-136pF.
7. **p/n: 729-0142, $19.95.** 6:1 vernier gear reduction drive for loop tuning capacitor.

8. 36-inch Aluminum Circular Loop with Integrated welded capacitor and mast mounting brackets
p/n: 10-1786-11, $129.95. 1.05 inch OD heavy duty tubing.

See MFJ Youtube reviews at: *https://m.youtube.com/results?search_query=mfj*

MFJ Magnetic Loop Tuners, 150 Watts

Turns any wire loop into a small, high efficiency multi-band transmitting magnetic loop antenna! Work the world on 3.5 to 30 MHz with a full 150 Watts SSB/CW/Digital. No ground, radials or counterpoises needed. Very quiet receiving antenna -- you'll hardly notice static crashes. High-Q reduces QRM, overloading, harmonics. Perfect for apartments, antenna restricted areas and portable operation.

A 13' wire loop covers 30-20 Meters (4' for 17-10M; 7' for 20-15M; 28' for 60-40M; 50' for 80M). Tune *any* shape loop -- circle, square, rectangle, *etc.*

A wire length gives about 1.5 to 1 frequency range (i.e.7-10, 18-28 MHz).

MFJ low loss *Butterfly* loop tuning capacitor has no rotating contacts. *Easy-Carry* handle. Mount for PVC Cross loop support on cabinet top.

MFJ-936B, $299.95. Antenna current meter, Cross-Needle SWR/Wattmeter. 9¼Wx5½Hx9½D inches.

MFJ-935B, $249.95. Antenna current meter. 6¼Wx5½Hx9½D inches.

MFJ-933, $209.95.6¼Wx5½Hx9½D".

MFJ Low-Noise Receiving Mag Loop

Clearly hear signals 50 KHz to 30 MHz you never knew existed. Power line noise and static disappears. Rotating MFJ-1886 eliminates interfering signals or greatly peaks desired signals. Excellent antenna and preamplifier balance gives deep null. Gives excellent strong and weak signal performance without overload. Fully protected state-of-the-art push-pull Gali MMICs preamplifier gives you high dynamic range, low IMD and 25 dB of low noise gain. Use inside or outside.

QRP Mag Loop Tuner

MFJ-9232
$69.95

Turns wire around a bookcase, window, tree, etc. *into a small, high efficiency transmitting loop antenna!* Operate 40-10 Meters with included flexible wire loop (80/60 Meters with your bigger loop). No counterpoises, radials, ground needed. 25 Watts. Very quiet reception. Hi-Q reduces QRM, overload, harmonics. Great for apartments, antenna restrictions, portable ops.

VIDEOS: https://m.youtube.com/results?search_query=MFJ-9232

Antenna Rotator

Perfect for magnetic loops, VHF/UHF, small HF beams, TV, FM antennas. Weather-proof cast aluminum housing with precision all metal gears, steel thrust bearings and automatic braking. Includes rotator, controller, remote control, clamps, hardware. 12 Memories. Digital display. 110/220 VAC.

MFJ Tripods/Masts

Strong, black *steel* triangular braced base. Non-skid feet, strong mast locks.

MFJ-1919, $109.95, Supports 100 lbs. Extends a *whopping* 7.8 ft. Base spreads up to 4.8 sq. ft. 1.4" dia. mast. Collapses to 54" by 6" diameter. 9¾ lbs.

MFJ-1919EX, $179.95. Tripod *plus* mast. 18' extended. 5' collapsed. 1/8" wall, 3/4" dia. top, 1½" dia. bottom.15 lbs.

MFJ-1918, $69.95, 6'extended. 38" collapsed, 6¾ lbs.

MFJ-1918EX, $109.95. Small tripod with extension mast. 9½', 3.8 ft. collapsed. ¾"top, 1" bottom. 6.5 lbs.

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Get rid of noise and interference with... ...a bhi DSP noise cancelling product!

bhi

ParaPro EQ20 Audio DSP Range with parametric equalisation

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- DSP noise cancelling and Bluetooth versions
- Easy to use with simple control of all DSP functions
- Use with passive speakers or headphones
- Greatly improves the clarity of you receive audio
- Four models: EQ20, EQ20B, EQ20-DSP, *EQ20B-DSP

Read the excellent review in December 2019 QST!

High-performance audio processing...
...with first class DSP noise cancelling...
...for a great listening experience

Dual In-Line

Fully featured flexible dual channel DSP noise cancelling unit - 8 Filter levels 9 to 40dB - 3.5mm mono or stereo inputs - Line level input/output - 7 watts mono speaker output - Headphone socket - Suitable for all types of radio incl' SDR - Easy to use controls for quick and easy operation - Enjoy clear intelligble "noise-free"speech from your radio - Replacement for bhi NEIM1031 In-Line

Compact In-Line

Easy to use in-line DSP noise cancelling unit with simple "real-time" control of audio and functions accross the whole audio bandwidth

- Powerful high-performance audio processor
- Unique DSP noise cancelling technology - Remove noise and interference - Hear weak signals clearly
- Rotary encoders perform all functions
- Easy to use with "real time" adjustment
- Use with headphones or a loudspeaker
- 3.5mm line level and speaker level inputs

New NES10-2MK4

New improved design

- 5W audio power
- Latest bhi DSP noise cancelling 8 to 40dB
- Up to 65dB tone reduction
- Single switch on top of speaker for power, audio and DSP
- Headphone socket
- Base station or mobile use

DESKTOP

10W Amplified DSP noise cancelling base station speaker
- Easy to use "real-time" control of all functions
- 8 filter levels 9 to 40dB
- Suitable for all radios incl' SDR, Elecraft and FlexRadio products
- Headphone socket
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MFJ Weather-Proof Window Feedthrough Panels

Weather-proof window feedthrough panels bring coax, balanced lines, HF/VHF/UHF antennas, random wire antennas, ground, rotator/antenna switch cables and DC/AC power into your hamshack without drilling through walls!

MFJ Weather-Proof Window Feedthrough Panels mount in your window sill. Lets you bring all your antenna connections into your hamshack without drilling holes through walls.

Simply place in window sill and close window. One cut customizes it for any window up to 48 inches. Use horizontally or vertically. Connectors are mounted on inside/outside stainless steel plates and attached to a 4 foot long, 3 1/2 inch high, 3/4 inch thick pressure-treated wood panel.

Real Western Red Cedar wood is naturally resistant to rot, decay and insects -- lasts longer, maintenance-free. Pitch and resin free for a wide range of beautiful finishes or leave it in its naturally beautiful raw finish. Edges sealed by weather-stripping. Seals and insulates against all weather conditions. Includes window locking rod.

Inside/outside stainless steel plates ground all coax shields. Stainless steel ground post brings ground in.

MFJ-4603 Universal Window Feedthrough Panel

MFJ-4603
$109.95

Four 50 Ohm Teflon® SO-239 coax connectors lets you feed HF/VHF/UHF antennas at full legal power limit.

A 50 Ohm Teflon® coax N-connector lets you use any antenna up to 11 GHz, including 450 MHz, UHF, satellite, moon bounce and 2.4/5.8 GHz Wi-Fi antennas.

A 75 Ohm, 1 GHz F-connector makes it easy to bring in television, Satellite, HD, cable TV and FM radio signals.

A pair of high-voltage ceramic feedthru insulators lets you bring in 450/300 Ohm balanced lines directly to your antenna tuner.

Has random/longwire antenna ceramic feedthru insulator.

5-way binding posts lets you supply 50 Volts/15 Amps DC/AC power to your outside antenna tuners/relays/switches.

Stainless ground post brings in ground connection, bonds inside/outside stainless steel panels together and drains away static charges.

MFJ's exclusive Adaptive Cable Feedthru™ lets you bring in rotator/antenna switch cable, etc. without removing connectors (up to 1 1/4 X 1 5/8 in). Adapts to virtually any cable size. Seals out rain, snow, adverse weather.

3 Coax, Balanced Line, Random Wire

Best Seller! 3 Teflon® coax connectors for HF/VHF UHF antennas. Separate high voltage ceramic feed-thru insulators for balanced lines and longwire/random wire, Stainless steel ground post.

MFJ-4602
$79.95

6 Coax

6 high quality Teflon® coax connectors for HF/VHF/UHF antennas. Stainless steel ground post. Full 1500 Watt legal limit.

MFJ-4601
$69.95

4 Balanced Line, 2 Coax

4 pairs of high-voltage ceramic feed-thru insulators for balanced lines and 2 coax connectors.

MFJ-4600
$89.95

5 Cables, any-size

5 Adaptive Cable Feedthrus™. Pass any cable with connector: 2 cables with large connectors up to 1 1/4 x 1 5/8 inches and 3 cables with UHF/N size coax connectors. Seals out weather.

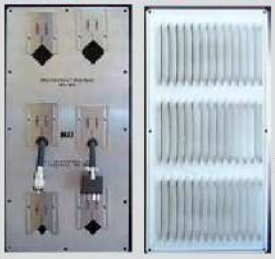
MFJ-4604
$114.95

All-Purpose FeedThru/CableThru™

Stacks MFJ-4603 and MFJ-4604! Gives you every possible cable connection you'll ever need through your window without drilling holes in wall – including UHF, N and F coax connectors, balanced lines, random wire, ground, DC/AC power and cables of any size for rotators, antenna switches, etc.

MFJ-4605
$179.95

Bring cables through the eave of your house



MFJ-4616
shown with standard full size vent (not included) it replaces. For 6 Cables
$34.95

MFJ-4613
shown with standard half size vent (not included) it replaces. For 3 Cables
$19.95

Replace your standard air vents on the eave/sofitt of your house with these MFJ AdaptiveCable™ Air Vent Plates and...

Bring in coax, rotator, antenna switch, power cables, etc. with connectors up to 1 1/4 x 1 5/8 inches!

Sliding plates and rubber grommets adjust for virtually any cable size to seal out adverse weather, insects and varmints. Use existing vent hole, mounting screws and screw holes.

AdaptiveCable™ Wall Plates

MFJ-4614
For 4 Cables
$44.95

Bring nearly any cable -- rotator, antenna switch, coax, DC/ AC power, etc. -- through walls without removing connectors (up to 1 1/4x1 5/8 inches). Sliding plates and rubber grommets adjust hole size to weather-seal virtually any size cable.

Includes stainless steel plates for each side of wall, sliding plates, rubber grommets, weather stripping and screws.

MFJ-4612
For 2 Cables
$34.95

MFJ-4611
For 1 Cable
$19.95

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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.

75-Amps, $289.95

MFJ-4275MV high-current switching power supply gives 75A max/70A continuous. Great for ALS-500M amplifier. Adjustable output 4-16 VDC. 110/220 VAC. Binding posts, quick connects, *PowerPoles*™, cigarette lighter socket on front. Battery charger gives charging current of 20A max, 5A continuous. 9¾W x 5½H x 9½D". Only 10.5 lbs.

MFJ-4230MV $99.95 — 30 Amp, 4-16 Volts Adjustable, Volt/Amp Meter, 5W x 2½H x 6D"

Ham Radio's Best Seller!

MFJ-4230MV is ham radio's best selling and most compact switching power supply – just 5W x 2½H x 6 D" and 3 lbs. Takes up little room at your operating position and perfect for home station, Field Day, DXpeditions, camping, hiking, or for your next business trip or vacation.

MFJ-4230MV gives 25 Amps continuously or 30 Amps surge at 13.8 VDC. Voltage is front-panel adjustable from 4 to 16 VDC.

Add a pair of *PowerPoles*™

MFJ-4230MVP, $119.95. *PowerPoles*™ on back.

MFJ-4230MPF, $109.95. *PowerPoles*™ on front.

MFJ-4230DMP, $159.95. Same as MFJ-4230MVP but has bright orange LCD digital volt/amp display.

Selectable input voltage of 120 or 240 VAC at 47-63 Hz lets you carry it with you and use it worldwide.

Front-panel rocker switch lets you choose Amp or Volt meter for continuous monitoring. Cool operation with excellent 75% efficiency. Extra low ripple and noise is less than 100 mV.

It's quiet! Continuous air-flow gently cools the power supply and a heat sensor increases the fan speed if the temperature rises above 70 degrees celsius.

Over-voltage and over-current protection fully protects your transceiver and has ALARM LED. DC output is 5-way binding posts on the back so you can power your HF, VHF, UHF transceiver and accessories with ease.

45-Amps, $169.95

MFJ-4245MV Switching power supply gives 45A surge/40A continuous. 9-15 VDC out. 85-260 VAC in. Low ripple, highly regulated. 5-way posts, cig lighter, quick connects. 5 lbs., 7½W x 4¾H x 9D".

35-Amps, $149.95

MFJ-4235MV switching power supply gives 35A surge and 30A continuous. 4-16 VDC with 1% voltage regulation. < 9 mV peak-to-peak ripple. AC input 90-125 or 200-240V. 7W x 4¼H x 8¾D", 4 lbs.

35-Amps, $169.95

MFJ-4035MV *19.2 lb. transformer* delivers 35A max, 30A continuous. 1-14 VDC out, 110 VAC in. Highly regulated, 1% load regulation. 1 mV ripple. 5-way binding posts, quick connects. 9½W x 6H x 9¾".

15-Amps, $79.95

MFJ-4115 Tiny! 17A surge, 15A cont. 13.8 VDC. 110/ 220 VAC. 3¾W x 2¼H x7 ¾D", 1.5 lb. 5-way posts. Switcher.
MFJ-4215MV, $79.95. 4-16 VDC, 15A surge, 13A cont., backlit volt/amp meters. 90-125V/200-240 VAC. Switcher.

25-Amps, $119.95

MFJ-4225MV Switching power supply gives 25A surge, 22A continuous. Adjustable 9-15 VDC output, 85-260 AC input. Large 3" dual Amp/Volt meters, Binding posts, Cigarette lighter socket. 3.7 lbs. 5¼W x 4½H x 6D inches.

25-Amps, $99.95

MFJ-4125 gives 25A surge, 22A continuous. 13.8 VDC switching power supply has 5-way binding posts on front panel and quick connects on back. 3.5 lbs. Super compact 5½W x 2½H x 5¾D inches fits anywhere.

25-Amps, $109.95

MFJ-4125P gives 25A surge, 22A continuous. 13.8 VDC switching power supply front has 2 pair of *Anderson PowerPoles*™ and 5-way binding posts on front. Quick connects on back. 3.5 lbs. Super compact 5½W x 2½H x 5¾D".

28-Amps, $99.95

MFJ-4128 28A surge, 25A cont. at 13.8 VDC. AC input voltage 85-135/170-260 VAC. 5-way binding posts, cigarette lighter socket, 7W x 2¼H x 7½D", 4 lbs.
MFJ-4218MV, $119.95. 0-24 VDC, 18A@13.8/9A@24 VDC. Backlit V/A meter. 110/220 VAC.

MFJ *PowerPole*™ Splitters

MFJ-1104, $54.95. *PowerPole*™ Splitter. 30 Amp fused input. Outputs fused at 25, 10, 5A. Open fuse indicator. 2¾W x 3¼H x 1½D".

MFJ-1107, $59.95. 40 Amp fused binding posts input. 4 fused *PowerPole*™ outputs. Two 2.1 mm center positive power jacks.

MFJ-1106, $49.95. One in, six out *PowerPoles*™ 30A total. 7 sets mating connectors included.

MFJ High Current DC Multi-Outlet Strips

Power multiple transceivers/accessories from a single DC power supply

MFJ-1118, $99.95. Power two HF and/or VHF rigs and six accessories from rig's 12VDC supply. 35A high-current and 15A accessory binding posts, Voltmeter, on/off switch. Master fuse, RF bypass.

MFJ-1116, $69.95. Like MFJ-1118 but 15A total, 8 pairs 5-way posts. "On" LED, 0-25 VDC voltmeter.

MFJ-1112, $54.95. Like MFJ-1116 but 6 pairs 5-way binding posts, no meter or switch. 12½W x 2¾H x 2½D".

MFJ-1117, $79.95. High-current. Powers four HF/VHF radios simultaneously -- two at 35A each and two at 35A combined. 8W x 2H x 3D".

MFJ-1129, $139.95. 10 outlets. Installed fuses: two 1A, three 5A, three 10A, two 25A, one 40A. Outlets 1, 2, 4-8 are PowerPoles™. Outlet 3 is a 35A high current binding post, outlet 9, 10 are 15A binding posts. On/off switch, 0-25 VDC voltmeter. 12½W x 1¼H".

MFJ-1128, $129.95. 12 fused *PowerPoles*™: three 1A, four 5A, four 10A, one 25A, one 40A. Switch. Meter.

MFJ-1126, $99.95. 8 fused *PowerPoles*™: One 1A, three 5A, two 10A, one 25A, one 40A. Switch. Voltmeter. 9W x 1¼H x 2¾D".

MFJ-1124, $79.95. Four pairs 35A *PowerPoles*™, two pairs 35A high current binding posts.

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MFJ Analyzers

MFJ-259D...World's Most Popular Antenna Analyzer!

MFJ-259D
$319.95

Super easy-to-use!

Dual analog meters, LCD – New and improved, now covers 280 KHz-230 MHz plus 2200 Meter band!

NEW!

World famous MFJ-259D gives you a complete picture of your antenna's SWR and Complex Impedance.

MFJ-259D is a complete ham radio test station including – frequency counter, RF signal generator, *SWR Analyzer*™, RF Resistance/Reactance Analyzer, Coax Analyzer, Capacitance/Inductance Meter and more!

You can read Complex Impedance as series resistance and reactance (R+jX) or as magnitude (Z) and phase (degrees).

Determine velocity factor, coax cable loss in dB, length of coax and distance to short/open.

You can read SWR, return loss and reflection coefficient at any frequency simultaneously.

MFJ No Matter What™ Warranty

Every MFJ Analyzer is protected by MFJ's famous one year **No Matter What**™ limited warranty. We will repair or replace your MFJ analyzer (at our option) for a full year.

Read inductance (uH) and capacitance (pF) at RF frequencies.

Large easy-to-read two line LCD screen and side-by-side meters clearly display your information.

Built-in frequency counter, Ni-MH/Ni-CD charger circuit, battery saver, low battery warning, smooth reduction drive tuning.

Super easy to use! Just set the bandswitch and tune the dial – just like your transceiver. SWR and Complex Impedance are displayed instantly!

Fully portable, take it anywhere – remote sites, up towers, on DX-peditions. Use 10 AA or Ni-Cad or Ni-MH batteries (not included) or 110 VAC with **MFJ-1312D, $19.95**. Rugged metal cabinet only 4 x 2 x 6 3/4 inches.

MFJ-249D, $299.95.

If digital display is all you need MFJ-249D does everything MFJ-259D does without analog meters.

More hams use MFJ analyzers than all others in the world!

MFJ-269D

280 KHz - 230 MHz *plus* 415-470 MHz, 280-230 MHz plus 2200Meters!

MFJ-269D
$419.95

NEW!

MFJ-269D is a *super* MFJ-259D that adds 415-470 MHz and 12-bit A/D converter that gives you much better accuracy. *Complex Impedance Analyzer* reads series/*parallel* equivalents and magnitude/phase *CoaxCalculator*™ gives line length from electrical degrees and vice-versa for any frequency, Velocity Factor, coax loss in dB. Use any characteristic impedance 10-600 Ohms. Has LCD log SWR bargraph, N-connector.

MFJ-223

1-60 MHz Color Graphic VNA Analyzer

MFJ-223
$339.95

This *pocket-sized* wonder breaks the mold for analyzer design with user-friendly convenience, top notch accuracy, and a vivid TFT multi-color display. Don't let the size fool you, MFJ-223 is packed with all the VNA features and performance you need!

- **Single-frequency** and *swept-frequency* operating modes
- **Truly accurate** SWR, R, X, and Z measurements
- **Seamless DDS** coverage with 280-Hz resolution from 1-60 MHz
- **Smooth "skip-free"** encoder tunes fast or slow without missing a step
- **Powerful +5-dBm** stimulus generator overrides local interference
- **Field-strength meter** measures local signals, detects potential interference
- **DDS generator** precision signal source
- **Vivid 1600-pixel/inch** color graphics on a 2x2 inch non-glare TFT screen

MFJ-225

1.5-180 MHz *continuous* Two-Port Graphic Analyzer

Out in the field, MFJ-225 is a compact completely *self-contained handheld graphing analyzer*. On the bench it becomes a full-fledged two-port (S21) desktop machine when teamed up with your PC. Using powerful IG-miniVNA freeware, you'll run detailed data analysis and print out stunning color-graphic plots to document your work!

MFJ-225
$339.95

Built-in back-lighted *3-inch LCD graphic* display. Make fine adjustments using fullscreen easy-to-view SWR bargraph, capture vivid swept displays for SWR, impedance, return loss, phase angle, more. DDS generator.

MFJ-269DPRO™ Analyzer

MFJ-269DPro, $459.95

Like MFJ-269D, but UHF range covers ***430 to 520 MHz*** to include commercial and industrial frequencies. Rugged protective shell protects knobs, switches, meters, digital display for commercial, industrial and lab work.

MFJ VNA Antenna Analyzer

MFJ VNA Antenna Analyzer covers 1 to 230 MHz, 1Hz resolution.

- ***Frequency sweep plots:*** *SWR, Impedance, Resistance, Reactance, Phase Angle, Complex Return Loss, Smith Chart*
- ***Sign of reactance*** positively identifies inductive or capacitive reactance
- ***Amazing accuracy with OSL (Open-Short-Load) calibration*** – calibrate through feedline/test cable at different frequencies and store in memory. Measure directly or through feedline with exceptional accuracy, correcting for line loss/phase angle. ***Smith Chart*** plots S11 magnitude/phase over any frequency span. ***Capture screens*** in 32 memories to download to PC via USB.

MFJ-226
$359.95

MFJ SWR Analyzer Accessories

A. **MFJ-29D/MFJ-39D, $39.95.** Carrying Pouch for MFJ-259D/269D.

B. **MFJ-92AA10, $39.95.** 10-Pack 2500 mAh Ni-MH Supercells.

C. **MFJ-66C, $39.95.** Dip coils, set of two covers 1.8-230 MHz.

D. **MFJ-731, $119.95.** Tunable Analyzer Filter, 1.8-30 MHz, for strong RF fields.

E. **MFJ-917, $39.95.** 1:1 Current balun for SWR Analyzers to test balanced line antennas, other loads.

F. **MFJ-5510, $15.95.** 12VDC cigarette lighter adapter.

G. **MFJ-7737, $9.95.** PL-259 to BNC Female.

H. **MFJ-7727, $9.95.** PL-259 to SMA Female.

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More hams use MFJ tuners than all other tuners in the world!

World's most advanced Automatic Antenna Tuners feature world renowned MFJ AdaptiveSearch™ and AutomaticRecall™ algorithms -- world's fastest ultra-wide range tuning. Nine World Class models! Choose your features: Digital/Analog/Audio SWR-Wattmeter, Antenna Switch, Balun, Radio Interface, Digital Frequency Readout, Remoteable, Coax/Balanced Lines/Wire Tuning, Field Upgradeable...

MFJ-998 1500 Watt Legal Limit IntelliTuner™

Only the MFJ-998 gives you fully automatic antenna tuning for your legal limit full 1500 Watts SSB/CW linear amplifier!

Ultra-fast Automatic Tuning
Instantly match impedances from 12-1600 Ohms using MFJ's exclusive IntelliTune™, Adaptive Search™ and InstantRecall™ algorithms with over 20,000 VirtualAntenna™ Memories.

Safe auto tuning protects amp
MFJ's exclusive Amplifier Bypass Control™ makes tuning safe and "stupid-proof"!

Digital/Analog Meters
A backlit LCD meter displays SWR, forward/reflected power, frequency, antenna selected, an auto-ranging bargraph power indication, and much more.

Has quick-glance auto-ranging Cross-Needle SWR/Wattmeter.

MFJ VirtualAntenna™ Memory
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 23/4H 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 Watt 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! Matches virtually any antenna.

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/6-1600 Ohms; 150W/6-3200 Ohms. Cross-Needle 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 virtually any antenna with near perfect SWR.

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 -- it's all you need for a completely automated station using *any* antenna! Just tune and talk!

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.

MFJ Enterprises, Inc. 300 Industrial Pk Rd, Starkville, MS 39759
Phone: (662) 323-5869 ■ **Tech Help:** (662) 323-0549 ■ **FAX:** (662) 323-6551 8-4:30 CST, Mon.-Fri.

Comet's primary tool for any antenna adjustment or diagnostic project...

CAA-500MarkII Antenna Analyzer

1.8-500MHz

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

Functions:
In addition to the display of antenna properties, SWR curves are plotted quickly, easily and accurately!

Auto band-sweep function:
Switch to the amateur band of choice and press "Sweep Center". The chosen band is swept and the SWR graphed in seconds!

Manual band-sweep function:
Select the band, select the center frequency, and select the bandwidth. Manually sweep the chosen frequency range and display the SWR graph.

Multiple Manual Band-Sweeps
Manually graph the user defined bandwidth multiple times and see the results overlaid in 5 selectable colors! Make antenna length, position, height above ground, gamma match adjustments, etc…and graph each adjustment in seconds, in a new color, without losing the previous graph!

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

Features:
Operates on 8-16VDC external power, 6 AA Alkaline or NiMH rechargeable cells • Trickle charger built in (only when using NiMH batteries) • Typical battery life: 9 hours of continuous operation • Battery level indicator • Selectable auto power-off time limit preserves battery capacity • SO-239 connector for 1.8-300MHz range • N-female connector for 300-500MHz range • Optional soft carry case sold separately: CAA-5SC

Call or visit your local dealer today!
www.natcommgroup.com | 800-962-2611

COMET®

MFJ Tuners

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.

No Matter What™ Warranty

Every MFJ tuner is protected by MFJ's famous one year **No Matter What™** limited warranty. We will repair or replace your MFJ tuner (at our option) for a full year.

More hams use MFJ tuners than all other tuners in the world!

MFJ-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!

MFJ-941E $169.95

MFJ-945E HF/6M Mobile Tuner

Extends your mobile antenna bandwidth so you don't have to stop, go outside and adjust your antenna. Tiny 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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MFJ QRP!

QRPocket™ Loop Antenna Tuner

MFJ-9232
$69.95

Drape a wire around a bookcase, window, tree or other object and attach both ends to this *MFJ QRPocket™ Loop Antenna Tuner. It instantly turns into a small, high efficiency multi-band transmitting loop antenna!*

Operate 40-10 Meters with included flexible wire loop (80/60 Meters with your bigger loop). No ground, radials or counterpoises needed. 25 Watts.

It's a very quiet receiving antenna. Its hi-Q reduces QRM, overload, harmonics.

Perfect for apartments, antenna restricted areas and portable operation. Tune *any* shape loop -- circle, square, rectangle, *etc.*

Adjust tuning and matching capacitors for minimum SWR and operate.

BNC for transmitter, wing nut posts for loop wire. Tiny 2¼Wx4Hx2¼D inches.

MFJ-9234, $69.95. Like MFJ-9232 but connects directly to your transceiver SO-239 antenna connector.

VIDEOS: https://m.youtube.com/results?search_query=MFJ-9232

QRP Antenna Tuner

MFJ-9201, $59.95. *Tunes any antenna* 80-10 Meters, 25 W. 12-position hi-Q inductor, tune/bypass, variable antenna and transmitting matching capacitors, BNC connectors. Tiny 4Wx2⅝Hx1½D inches -- MFJ-9201, rig and antennas easily fit into a backpack or briefcase for vacation, SOTA, hikes, etc.

MFJ *Walk-About* 80-6M Antenna

MFJ-1899T, $99.95. Perfect for QRP radios like FT-817, KX3, Xiegu, others. Covers *all* bands 80-6 Meters including WARC. Ten section telescoping whip (52" extended, 7" collapsed). 12" base loading coil with *Wander Lead*. Whip/coil unscrews for easy storage. 25Watts. BNC.

MFJ-7703, $8.95, BNC/PL-259 elbow mounts antenna directly on radio.

MFJ Single Band *Walk-Abouts*

Each is 51 inches extended and collapses to 5.5 inches. Handles 25 Watts. BNC.

MFJ-1806T (6M) $34.95
MFJ-1810T (10M) $34.95
MFJ-1812T (12M) $34.95
MFJ-1815T (15M) $34.95
MFJ-1817T (17M) $34.95
MFJ-1820T (20M) $34.95
MFJ-1830T (30M) $44.95
MFJ-1840T (40M) $44.95
MFJ-1880T (80M) $44.95

MFJ HF SSB *Travel Radios*

12-Watts, proven on-air design, hot receiver, analog S-meter, CW option, great sensitivity, 8 poles tight IF filtering, smooth VFO, powerful audio, 15, 17, 20, 40 & 75-Meter models. **$279.95**

Xiegu X5105 5W HF Transceiver

X5105, $599.95. ***Mention this QST ad for $50 off!***

Transmits 160-6 Meters, receives .5 - 54 MHz, all modes:USB, LSB, CW, AM, FM, digital. DSP. Built-in automatic antenna tuner, 3800 mAH battery pack, plots SWR graphically. Deluxe keypad microphone included.

80-10M End-Fed Half Wave Antenna

MFJ-1982LP, $54.95. Get on the air quick! 30W, 132' wire. No tuner needed.

33' Telescopic Portable Mast

MFJ-1910, $99.95. Fiberglass. 3¾ ft collapse, 3.3 lbs.

17' Telescopic Whip

MFJ-1979, $69.95. Stainless steel, collapses to 27".

MFJ *Mini* Switching QRP Power Supply

MFJ-4103, $69.95. Delivers reliable regulated 13.8 VDC at 2.89 Amps (40 Watts) to anywhere in the world (100-240 VAC/47-63Hz input). Overvoltage, over-current, over-temperature protected. Tiny 4⅛x2⅝x1⅜", 10 oz; 2.1 mm ID, 5.5mm OD coaxial DC connector. FT-817 adapter included. **MFJ-5513, $5.95.** 2.1 mm to *PowerPoles*™.

MFJ 500 MHz Dummy Load

MFJ-261, $34.95. Finned aluminum, air-cooled heatsink 50 Ohm dummy load. 100W peak, 15W average. DC to 500 MHz, 1.15:1 SWR. 1⅝" dia. by 3" long.

CW Straight Key

MFJ-550, $19.95. Morse Code straight key. Adjustable spacing and spring tension. Durable plastic base with mounting holes.

SWR/Wattmeter Dummy Load

MFJ-9218, $54.95. Resistive SWR Meter protects output transistors with 3:1 maximum SWR when tuning your antenna. 5/10/20 Watt power ranges. Tune/Bypass switch, BNC input and output connectors. Covers 1.8 to 60 MHz. Rugged tiny case fits any where 4½Wx2¼Hx2¾D".

QRP WattMeter/ Dummy load

MFJ-9214, $39.95. Check *true* QRP output power with this sensitive QRP Wattmeter with *built-in* 50 Ohm dummy load. Also tests battery condition. Reads 5W full scale 1.8-150 MHz. BNC male connects directly to your rig. 2Wx2¼Hx1½D". **MFJ-7737, $6.95.** BNC female to PL-259 adaptor.

QRP SWR/Wattmeter

MFJ-9213, $49.95. Read SWR, forward, reflected power in three ranges: 5, 30, 100 Watts on calibrated meter scale. *Bruene* bridge insures uniform accuracy over 1.8-50 MHz and allows you to leave in-line for continuous monitoring without insertion loss. BNC for transmitter/antenna. 4½Wx2¼Hx2¾D inches.

MFJ *QRPPocket* ™ 4:1 Balun

MFJ-9211, $29.95. **4:1** current balun for feeding balanced dipole/antenna to 50 Ohm coax. Binding post, BNC.

Artificial Ground

MFJ-9231, $69.95. **Tune** your counterpoise and ground to greatly increase your radiated power.

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TH-D74A 144/220/430 MHz Tribander

The TH-D74A represents the ultimate in APRS and D-STAR performance. KENWOOD has already garnered an enviable reputation with the TH-D72A handheld APRS amateur radio transceiver. Now it has raised the bar even further with the TH-D74A, adding support for D-STAR, the digital voice & data protocol developed by the JARL, and enabling simultaneous APRS and D-STAR operation – an industry first.

- APRS compliance using packet communication to exchange real-time GPS position information and messages
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- IF Filtering for improved SSB/CW/AM reception
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- Compliant with Bluetooth, microSD & Micro-USB standards
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- Free software for Memory and Frequency Control Program
- Data Import / Export (Digital Repeater List, Call sign, Memory Channel)
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- Dust and Water resistant IP54/55 standards

APRS (The Automatic Packet Reporting System) is a registered American trademark of WB4APR (Mr. Bob Bruninga).
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MFJ-4416C Super Battery Booster

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®* and high-current 5-way binding posts for DC input, regulated output. $7\frac{3}{4}$W x 4H x $2\frac{1}{8}$D inches. **MFJ-4416BRC, $84.95.** 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. *PowerPoles®* 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®*.

Digital Volt/Amp Meter

MFJ-4442
$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. 3 x 2 x 1".

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, $2\frac{3}{4}$W x $3\frac{1}{4}$H x $1\frac{1}{2}$D inches.

MFJ Low Pass Filter

MFJ-704
$109.95

High attenuation above 40 MHz. 1.5kW, 1.8-30 MHz. SWR<1.3. Nine Chebyshev poles, *Teflon®* dielectric capacitors, high-Q inductors, ground plane shielding, RF tight.

Lightning Surge Protector

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, $44.95.** 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. 5W x $2\frac{1}{2}$H x 6D in., 3 lbs.

High-efficiency Loop Turner

MFJ-935B
$249.95

Instantly turn any wire into a small, high-efficiency multi-band transmitting loop antenna. Full 150W, 5.3-30 MHz.

Frequency Counter

MFJ-886B
$149.95

300 Hz - 2.8 GHz. 1 Hz resolution, 10-digit backlit LCD, signal strength bargraph, lithium battery.

MFJ Field Strength Meter

MFJ-801B
$39.95

Relative field-strength readings .1-500 MHz. Sensitivity control, $1\frac{3}{4}$ inch meter. 20-inch telescoping whip. Finger contact increases sensitivity.

Tuned Indoor Active Antenna

MFJ-102C
$119.95

Rival outside wire antennas hundreds of feet long and pick up signals loud and clear from all over the world. 0.3-40 MHz.

25-1300 MHz Discone Ant

MFJ-1868
$79.95

Receives 25-1300 MHz. Transmits 50-1300 MHz up to 200 Watts. Test various Xmitters on one coax. 50 ft. coax, stainless steel elements.

17-foot Telescopic Whip

MFJ-1979
$69.95

17-foot stainless steel whip collapses to 27". Full 1/4 Wave on 20/17 Meters, 30-160 Meter operation with loading coil. Fits any standard 3/8-24 threaded mount.

Telescopic Fiberglass Mast

MFJ-1906HD
$249.95

Super-strong heavy-duty mast with *QuickClamps™*. 38 ft. ext., 6 ft. collapsed. $2\frac{1}{2}$" OD bottom, 1" OD top. .125" thick wall. Supports "*real*" weight.

Giant $2\frac{1}{2}$ inch LED Clock

MFJ-117
$49.95
New Low Price!

Giant $2\frac{1}{2}$ inch super bright LEDs – see from across the street day or night. 12/24 switch, 110VAC, 9V battery backup.

MFJ 2-Position Remote Antenna Switch

MFJ-4712
$89.95

MFJ 2-position *remote* antenna switch uses a *single* coaxial feedline to feed two antennas, DC power and control signals. Remotely switch HF and/or VHF antennas. Covers 1.8 MHz to 150 MHz and handles 1500 Watts. Impedance is 50-75 Ohms. Compact 4W x $2\frac{5}{8}$H x $1\frac{1}{2}$D". *Outside Switch Box* is fully enclosed and weather protected. Three quality *Teflon®* SO-239 connectors for transmitter, antenna one and antenna two. Stainless steel $1\frac{1}{2}$" tall bracket with a U-bolt for masts up to $1\frac{1}{2}$ in. O.D. *Inside biastee* control is $2\frac{1}{4}$W x $2\frac{1}{2}$H x $1\frac{1}{4}$ in. Use 12 VDC or 110 VAC with **MFJ-1312D, $19.95.**

MFJ Artificial RF Ground

MFJ-931
$129.95

By tuning out ground wire reactance RF hot spots disappear and your rig is at actual earth ground. Improve signals by resonating a wire into a tuned counterpoise.

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Ready to go, a complete VHF-UHF station in a box. New! Get them with or without radios installed. Fits most FM mobiles & several HF radios, too. Powerpoles, USB, lighter socket & Voltmeter included!

Crimp-On Connectors

Excellent quality, no bargain basement stuff here. Adapters & connectors for most applications.

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Check out our new Play-Series™ USB modules. New body & LED colors & styles. Aluminum body available. Spruce up your Ham shack, car, etc.

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New Item!! HybridDX™ HF antenna. Get on 80M in less than 80 ft.

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7. AN IMPORTANT NOTICE TO ALL HAM AD POSTERS AND RESPONDERS, FROM THE ARRL ADVERTISING DEPARTMENT Greetings from ARRL HQ! Please note that we have received reports from many ARRL members who have placed classified ads in these listings, and have received responses from individuals proposing "creative" payment schemes. These particular instances involved offers of overpayments for goods by bank check, followed by instructions to deduct the cost of your item from the overpayment, and to transfer the overage back or to another individual. This is a well-known scam. Unfortunately, we have no control over this and other scams of this type. Once your email address is posted, you are vulnerable to those individuals seeking to provide you with questionable information.

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CW INSTRUCTION via internet video conference classes. VISIT longislandcwclub.org

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MARCO Medical Amateur Radio Council. Professionals enjoying ham radio. Free newsletter & info: secretary@marco-ltd.org

Texas Ham Radio Net - Forums, Discussions, Resources, Public/Private Groups and Classifieds for Texas Hams. https://texashamradio.net

Property/Vacation/Rentals

A DX Apartment available in VP9 with rigs and antennas. Email: ed@vp9ge.com for details.

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Hams Looking to purchase or sell real estate in Connecticut? Please contact Licensed Ham and Realtor, Claude Cousins, Sr. N1QAE, Berkshire Hathaway Home Services, claudecous@gmail.com, 860-989-2113

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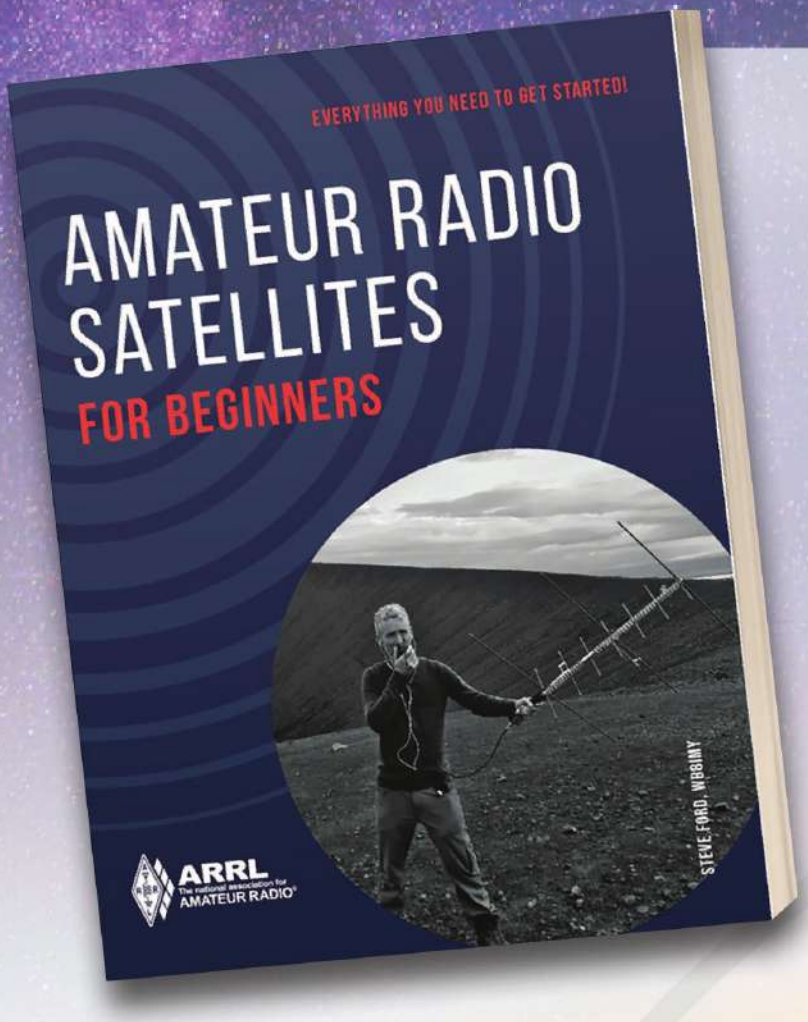

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