Build a 20-Meter Vertical Antenna for Your ARRL Field Day Station Page 30

QST

DIGITAL EDITION

ARRL The national association for AMATEUR RADIO®

June 2019 www.arrl.org

DEVOTED ENTIRELY TO AMATEUR RADIO

FIELD DAY 2019

QST Reviews

Kenwood TS-890S HF and 6-Meter Transceiver

SharkRF openSPOT2 Multimode Digital Hotspot

PreciseRF HG-1 Magnetic Loop Antenna

DIGITAL FEATURE

54 | See our Video Review of the **Kenwood** TS-890S HF and 6-Meter Transceiver.

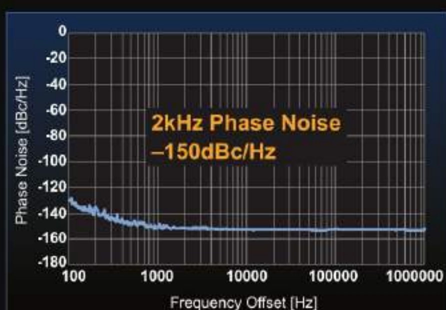
The Conclusive Choice

Transmit Signal Purity

High-Quality Transmission with Outstanding Phase noise characteristics

The excellent C/N characteristics provided by 400MHz HRDDS (High Resolution Direct Digital Synthesizer) used in the FTDX101 local oscillator circuit contribute significantly to the superb performance of both the receive and the transmitter sections. Yaesu conducted a thorough examination of each element in the transmission final stage such as clock distributor that divides/distributes the local signal from the 400MHz HRDDS circuit as a clock signal to each block, as well as FPGA, D/A converter, final power amplifier etc., and then carefully selected the latest circuit configuration to improve the C/N characteristics of the entire transmitter block. The transmission signal of the FTDX101 is generated directly from a 16-bit D/A converter without passing through the mixer circuit, therefore distortion and noise are significantly suppressed.

As a result, high-quality local signal characteristics are maintained without degradation to the final stage, and the transmission phase noise characteristics achieve an extraordinary –150 dBc/Hz at 2kHz separation. FTDX101 transceiver users will enjoy the outstanding performance as well as confidence and pride in the high-purity of their transmission signal.



TX Phase Noise (14MHz Band, Mode:CW)

TX Final Stage (MP Version)

In Homage to the Founder of Yaesu – Sako Hasegawa JA1MP

FTDX101MP 200W

HF/50MHz TRANSCEIVER

The Ultimate

FTDX101D 100W

HF/50MHz TRANSCEIVER

FTDX101MP: This device has not been approved by the FCC. This device may not be offered for sale or lease or be sold or leased until approval of the FCC has been obtained. The information shown is preliminary and may be subject to change without notice or obligation.

YAESU The radio

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

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

QST

Contents

June 2019 ♦ Volume 103 ♦ Number 6

Includes video
Includes audio
Additional content

Columns

Departments

Our Cover

The biggest ham radio event of the year is coming! ARRL Field Day 2019 will be held June 22 and 23, in parks, campsites, and parking lots, on beaches, islands, and mountaintops — and more. This issue contains instructions for a portable vertical antenna for 20 meters, an exploration of electric vehicle power, and more Field Day fun. [Jerry Clement, VE6AB, photo]

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.

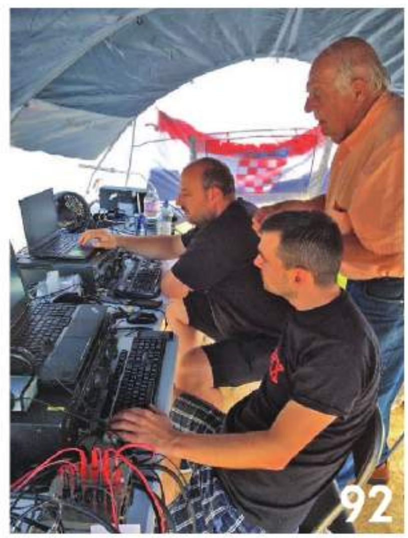
Interested in Writing for *QST*?

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


70


39

66


92

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.

US & Possessions: Membership in the ARRL, including a 1-year subscription to *QST*, is available to individuals at $49. Licensed radio amateurs age 21 and under and the eldest licensee in the household may qualify for the rate of $25. Life Membership, including a subscription to *QST* is available at $1,225.* Membership includes $21 per year for subscription to *QST*. Membership and *QST* cannot be separated. Libraries and institutions, $49 per year. Single copies $6.95.

International

To compensate for additional postage for mailing outside the US, the following rates apply:

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.

Membership without *QST* is available to the immediate family of a member living at the same address, and to anyone who is legally blind, for $10 per year.

Foreign remittances should be by international postal or express money order or bank draft negotiable in the US and for an equivalent amount in US funds.

Membership in the ARRL, including a 1-year subscription to Digital *QST* only, is available to Canadian and International members at $49.

QST is available to blind and physically handicapped individuals from the Library of Congress, National Library Service for the Blind and Physically Handicapped. Call 1-800-424-8567 or go to **www.loc.gov/nls/**.

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

*Payment arrangements available. Please write for details.

In order to ensure prompt delivery, we ask that you periodically check the address information on your mailing label. If you find any inaccuracies, please contact the Circulation Department at **circulation@arrl.org** or **860-594-0200** immediately. Thank you for your assistance.

Reprints and permissions:
permission@arrl.org

Details of our Online Privacy Policy can be found at
www.arrl.org/online-privacy-policy.

Telephone: **860-594-0200**
Fax: **860-594-0259**

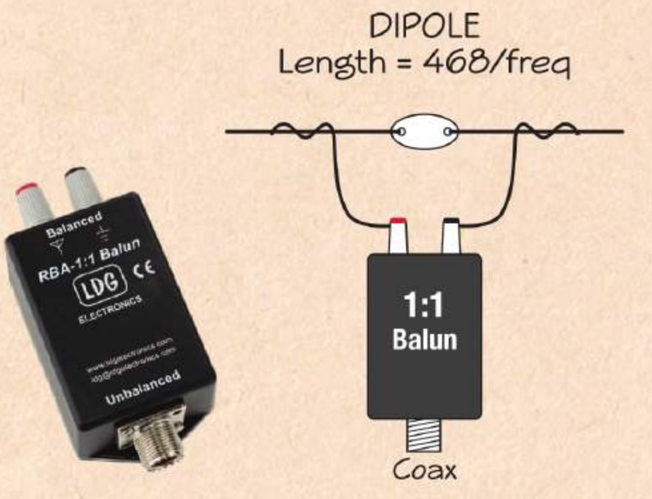
BEST SERVICE. BEST WARRANTY. BEST VALUE. NO ONE BEATS LDG! ***CONTACT YOUR FAVORITE DEALER TODAY!***

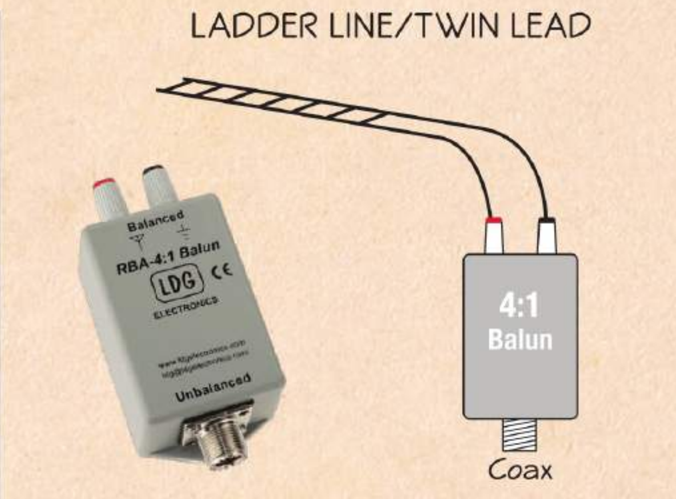
WHERE TO USE LDG BALUNS & UNUNS

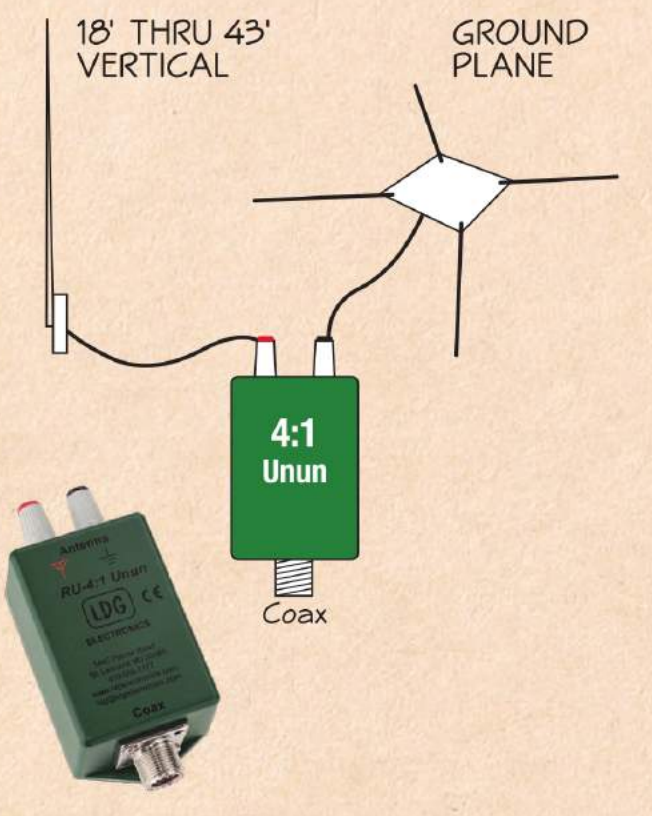
LDG

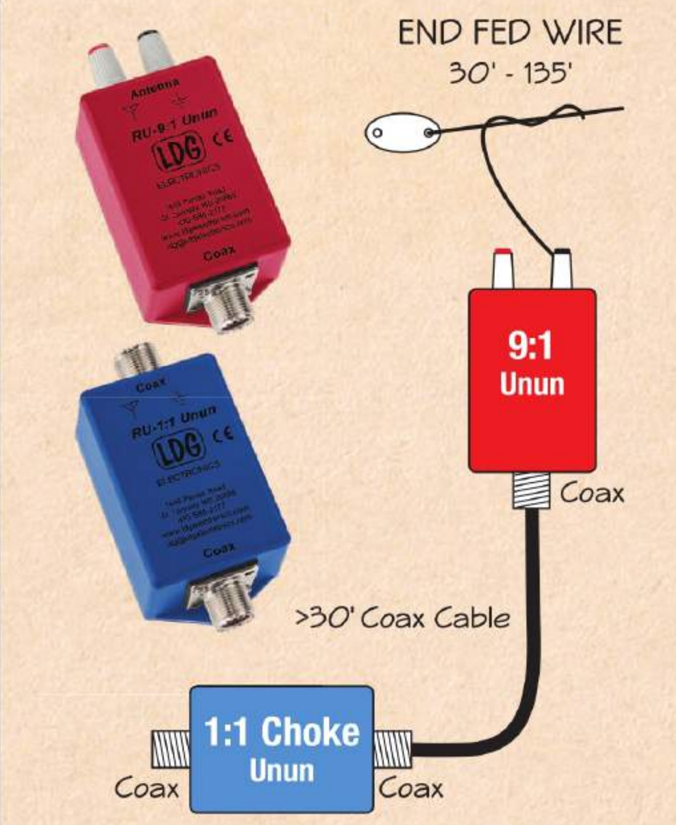
Not sure which balun or unun is right for your antenna? See our handy chart below to help you determine which is the best fit for your set-up. All LDG baluns and ununs handle up to 200 Watts PEP and cover frequencies from 1.8 to 30MHz. Visit us at www.ldgelectronics.com or see your favorite dealer today to learn more and to see our full line of products.

$30 ea. | 200 Watts PEP 1.8-30MHz





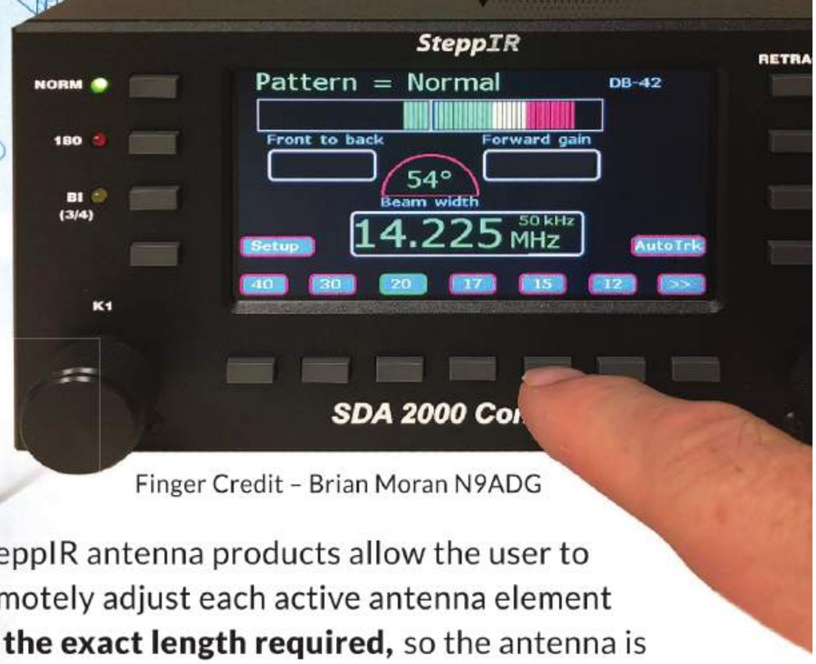




410-586-2177 **support@ldgelectronics.com** **www.ldgelectronics.com**

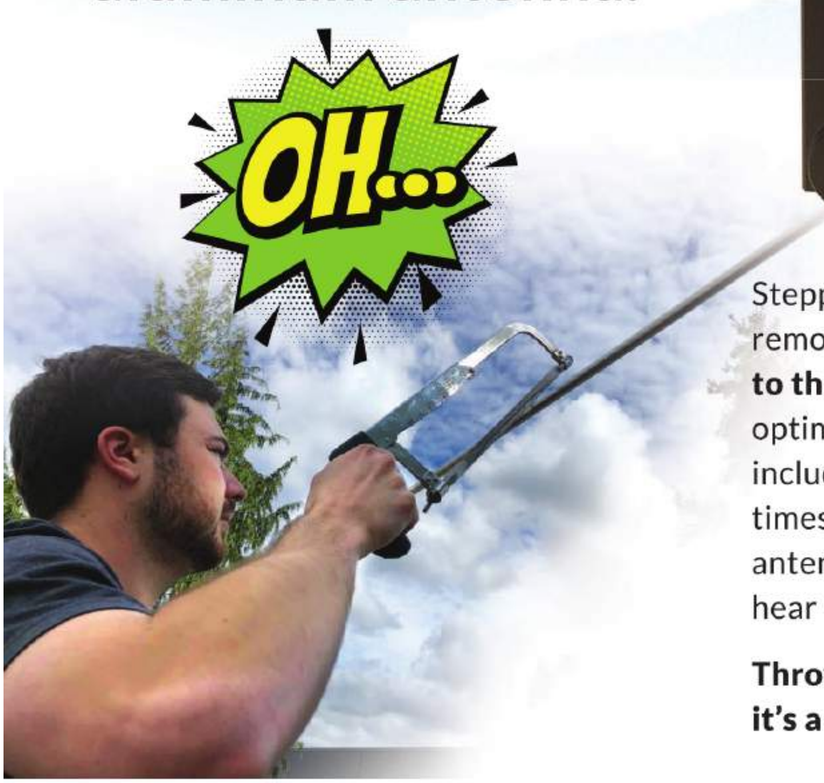
HOW TO TUNE A SteppIR

Changing frequencies on a SteppIR antenna is really easy – you can do it with a push of a button!



Finger Credit – Brian Moran N9ADG

It's not so simple with a fixed-length, aluminum antenna.



SteppIR antenna products allow the user to remotely adjust each active antenna element **to the exact length required,** so the antenna is optimized at every single frequency within its range, including non-ham band frequencies. In these current times of tough band conditions, having an optimized antenna can be the difference in whether you can hear a signal or not.

Throw away the hacksaw and step up to a SteppIR – it's a monoband antenna... on every frequency!

steppIR COMMUNICATION SYSTEMS

FOR DETAILS ON THESE PRODUCTS AND TO ORDER:

www.steppir.com 425-453-1910

DIAMOND ANTENNA

diamondantenna.net

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

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

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

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

X700HNA Special Features:

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

Here is a small sample of our wide variety of antennas

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

RF PARTS™ COMPANY

Diamond Antenna is a division of RF Parts Company

Howard E. Michel, WB2ITX, ARRL Chief Executive Officer, hmichel@arrl.org

Second Century

Field Day Thoughts

It's the June issue of QST, and naturally thoughts turn to ARRL Field Day. But just as there is a spectrum of hams, there is a spectrum of thoughts about Field Day.

My thoughts of ARRL Field Day always start with fond memories of my first club. I was a teenager, as were most of the members of the club. There were a few Elmers who really pulled the club together. We operated multiple stations simultaneously across the HF and VHF bands, all powered by the town's 25 kW emergency generator. I operated the 75/40 meter SSB station. But I was able to operate because others in the club kept the generator running, and cooked breakfast, lunch, and dinner for us. We operated as a team where each member's strengths were used to create something better than individual pieces.

Now when I think about Field Day, I think about the new banner ARRL is rolling out. It departs from previous campaigns in that "Radio Communications" takes the lead, not ARRL. If we are to grow Amateur Radio, we need to make Amateur Radio the message. And by growing Amateur Radio, we can grow ARRL.

And what aspects of Amateur Radio are we emphasizing? Skills, Service, and Discovery. These are ideas that should appeal to potential hams. These are ideas embodied in my Field Day memories. These are ideas that will take us forward.

"Back in the day," Amateur Radio required many skills. There was a skill in loading your final amplifier, alternating with dipping the plate, as you tried to coax every bit of power out of a pair of TV tubes not originally designed for that purpose. And to do it quickly so you did not melt the internal parts of the tube. But today, rigs are highly automated, and for normal operating, hams no longer think about changing frequencies from one end of the band to the other end.

But Amateur Radio still requires skills today. And everyone can take pride in mastering those skills. Hams need to understand the relationship between operating bands, conditions, and potential propagation distance. Hams still need to master the rules, regulations, and techniques for proper operating within a community of fellow hams and other competing interests for spectrum.

We are all familiar with "Part 97." Part 97.1 talks about the rules and regulations designed to provide an Amateur Radio Service, and 97.1(c) calls for the "Encouragement and improvement of the amateur service through rules which provide for advancing skills in both the communication and technical phases of the art." The FCC is encouraging us to improve our skills in operating and technology.

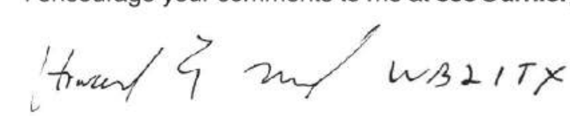
Where to Meet WB2ITX

May 31, June 1 – 2 SeaPac, Seaside, OR **https://www.seapac.org/**
June 4 IEEE International Microwave Symposium, Boston, MA. Howard will give the keynote address at the Amateur Radio Social. **https://ims-ieee.org/**
June 7 – 8 HamCom, Plano, TX **hamcom.org**
June 21 – 23 Ham Radio, Friedrichshafen, Germany **www.hamradio-friedrichshafen.de/ham-en/**

But skills to master something are hollow without a purpose. And that purpose is embodied in the second and third idea above — service and discovery. Many people today are motivated by service and discovery. Discovery and service drive us on. Who can forget the kick they get after mastering something new, or the feeling of satisfaction they get when helping someone in need. Ham radio is a natural avenue for both service and discovery.

So, the next time you talk to a potential ham, talk to them about the skills, service, and discovery of Amateur Radio.

I encourage your comments to me at **ceo@arrl.org**.



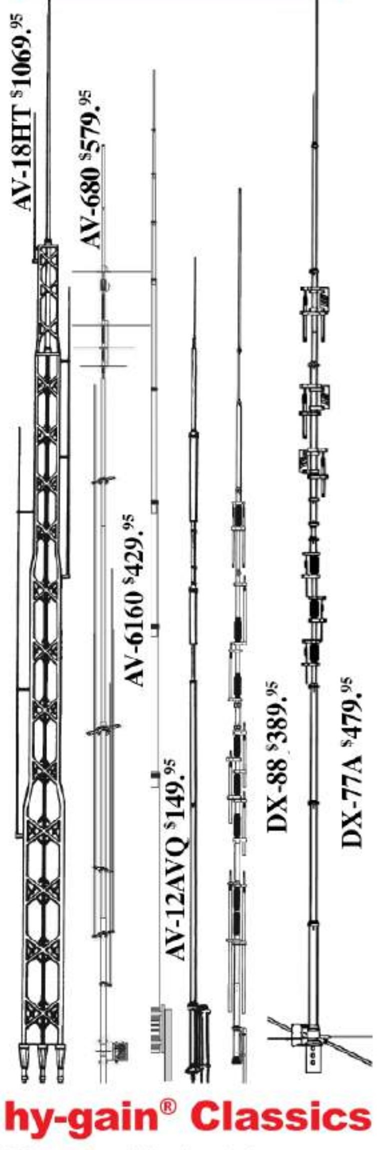
Free Catalog/Dealers/Manuals Online – Visit: www.hy-gain.com or call toll-free 800-973-6572

The First Choice of Hams Around the World!

hy-gain® HF Verticals

Free Manuals!

Self-supporting – no guys required . . . Remarkable DX performance – low angle radiation, omnidirectional . . . Handles 1500 Watts . . . Low SWR . . . Automatic band switching . . . Aircraft quality aluminum tubing . . . Stainless steel hardware. . . Recessed SO-239 connector . . . Two year limited Warranty . . .



hy-gain® Classics

All hy-gain multi-band vertical antennas are entirely self supporting -- no guys required.

They offer remarkable DX performance with their extremely low angle of radiation and omnidirectional pattern.

All handle 1500 Watts PEP SSB, have low SWR, automatic bandswitching (except AV-18VS) and include a 12-inch heavy duty mast support bracket (except AV-18HT).

Heavy duty, slotted, tapered swaged, aircraft aluminum tubing with full circumference compression clamps is used for radiators.

Includes all stainless steel hardware. Recessed SO-239 prevents moisture damage.

hy-gain verticals go up easily with just hand tools and their cost is surprisingly low.

Two-year limited warranty.

AV-18HT, $1069.95. (80,40,20,15,12,10 M, 160, 17 Meters optional). 53 ft., 114 lbs.

Standing 53 feet tall, the famous Hy-Gain HyTower is the world's best performing vertical!

Automatic band selection uses unique stub-decoupling which effectively isolates various sections of the antenna so an electrical 1/4 wavelength (or odd multiple) exists on all bands. 250 kHz 80 Meter bandwidth with 2:1 SWR. The addition of a base loading coil **(LC-160Q, $119.95)**, provides exceptional 160 Meter performance. **MK-17, $99.95**. Add-on 17 Meter kit. 24 foot tower is all rugged, hot-dip galvanized steel and all hardware is iridited for corrosion resistance. Special tiltover hinged base for easy raising & lowering.

AV-680, $579.95. (80, 40, 30, 20, 17, 15,12, 10, 6 Meters). 26 ft., 18.5 lbs.

No ground or radials needed.

Low 17 degree radiation angle and omni-directional gives world-wide coverage. 1500 Watts key down for two minutes. 1/4 wave stubs on 6, 10, 12, 17 Meters. Efficient end loading coil and capacity hats on 15, 20, 30, 40, 80 Meters. Wide low SWR bandwidth. End fed broadband matching unit wound with Teflon® wire. Auto band switching. Low 2.9 sq. ft. wind surface. Mounts on decks, roofs, patios. 65 mph wind survival. Aircraft aluminum tubing, stainless steel hardware.

AV-640, $479.95. 40/30/20/17/15/12/10/6M. 25.5 feet, 17.5 pounds.

AV-620, $369.95. 20/17/15/12/10/6M. 22.5 ft.

AV-6160, $429.95. (160, 80, 40, 30, 20, 17, 15, 12, 10, 6 Meters). 43 ft., 20 lbs.

Low profile, self-supporting 43 foot vertical assembles in less than an hour!

Blends in with sky and trees -- barely visible. Entire length radiates for exceptionally low angle radiation 160-20 Meters with very good performance on 17-6 Meters. A wide range automatic or manual antenna tuner at your rig easily matches this antenna for all bands. No physical adjustments. Includes ATB-65 base mount. Optimized balun design allows direct coax feed with negligible coax loss.

AV-6110, $319.95. 1.5 kW matching network improves efficiency on 160/80 Meters.

AV-12AVQ, $149.95. (20, 15, 10 Meters). 13 ft., 9 lbs.

Automatic bandswitching, omnidirectional, low angle DX antenna. self-supporting. 1500 Watts.

Hy-Q™ traps give full 1/4 wave performance with broadbanding top hat. SWR less than 2:1. Ground or roof mount. Requires radials.

AV-14RMQ, $99.95 roof mount.

DX-88, $389.95. (80, 40, 30, 20, 17, 15, 12, 10 Meters, 160 M optional). 25 ft., 18 lbs.

All bands are easily tuned with exclusive adjustable capacitors.

80/40 Meters tuneable from ground without lowering antenna. Super heavy-duty construction.

DX-88 OPTIONS:

KIT-160-88, $219.95.160 Meter add-on kit.

GRK-88, $109.95. Ground Radials System.

RRK-88, $109.95. Roof Radial System.

DX-77A, $479.95. (40, 30, 20, 17, 15, 12, 10 Meters). 29 ft., 25 lbs.

No ground radials required!

Off-center-fed Windom has 55% greater bandwidth than competitive verticals. Heavy-duty tiltable base. Each band independently tunable.

8 Bands

80, 40, 30, 20, 17, 15, 12, 10 Meters

Operate eight HF bands for $119.95!

AV-18VS $129.95

Covers 80 through 10 Meters continuous Easily change bands by manually moving bandchange wire at base loading coil. Handles 1500 Watts PEP.

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

18 ft tapered 6063-T6 aircraft aluminum tubing strength. 4 pounds. Stainless steel hardware. 80 MPH wind survival.

Automatic Bandswitching

40/20/15/10 Meters

Quickly work DX instantly with automatic bandswitching!

AV-14AVQ $199.95

AV-14AVQ is an automatic bandswitching, omni-directional low angle DX antenna. Self supporting. 1500 Watts PEP. Air dielectric Hy-Q™ traps with oversize coils give full 1/4 wave performance on every band and features a broadbanding top hat. SWR less than 2:1. Ground or roof mount, requires radials.

6063-T6 aircraft aluminum tubing, stainless steel hardware, 18 ft, 9 lbs., 80 MPH wind survival. DC ground for lightning. Heavy duty bracket with recessed SO-239 mounts on 1.5-1.625" diameter mast.

MK-80, $89.95.
80M add-on kit.

AV-14RMQ, $99.95.
Roof mount kit.

AV-12AVQ, $149.95.
3 band version, 13'.

For a Free hy-gain® Catalog and nearest Dealer...800-973-6572
Call your dealer for your best price!

hy-gain® Antennas, Rotators & Towers 308 Industrial Pk Rd, Starkville, MS 39759 USA
Sales/Tech: (662) 323-9538 ■ **FAX:** (662) 323-5803 Open 8-4:30 CST, Mon.-Fri.

AV18HT_AV18VS_101308_QST_040819DS

Free Shipping on orders over $100 in the Continental US

ABR Industries LLC

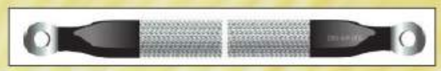
8561 Rayson Rd.
Houston, TX 77080
713-492-2722

www.abrind.com

American Built and Reliable

Buy With Confidence

ABR Industries manufactures all assemblies in our Houston facility, guaranteeing quality control from start to finish. Being a critical component of your system or station, it's important to know where and how your coax cable assemblies are built.



1" Tinned Copper Flat Ground Braid (PN:235-5X). 7ga 85/Amps w/1/4" Stud Ring Terminals. Quick & Easy Grounding Terminations.

Part #	Length/Ft
235-5X-20	20
235-5X-10	10
235-5X-5	5
235-5X-3	3

1ft to 25ft readily available
Custom lengths and Bulk available

1/2" Tinned Copper Flat Ground Braid (PN:233/2-4X). 10ga 53/Amps w/#10 Stud Ring Terminals. Quick & Easy Grounding Terminations.

Part #	Length/Ft
233/2-4X-12	12
233/2-4X-10	10
233/2-4X-5	5
233/2-4X-3	3
233/2-4X-1	1

1ft to 25ft readily available
Custom lengths and Bulk available

233/2-G4 Vehicle Ground Braid (PN:233/2-G4) Unique design (Nickel Grommets 4" Spacing) allows for easy attachment to a vehicle's body or truck bed to create a "ground plane" Good option as a buss-bar in the shack ½" wide tinned copper 38x48x8/34 10ga 53 amps

Part#	Length/Ft
233/2-G4-10	10
233/2-G4-5	5
233/2-G4-3	3
233/2-G4-1.5	1.5

1ft to 10ft readily available
Custom lengths and Bulk available

- All Cable Assemblies are Hi-Pot and Continuity Tested.
- Our Cables Have a Sunlight Resistant & Direct Burial Jacket.

ABR INDUSTRIES™
American Built & Reliable

Monthly Special ABR195WF Ultra Low Loss Cable

10% discount from list on ABR195W-UF assemblies.

ABR195W-UF (PN23195WF)	Attenuation per 100ft	Power Rating
Low Loss Gas Injected Foam (77% VP)	2.0dB @ 30MHz	0.70KW
95% Tin-Copper Braid 100% AL Foil	2.5dB @ 50MHZ	0.54KW
White UV Direct Burial Jacket	4.4dB @ 150MHz	0.31KW
Available with PL259, SO239, N-Type, TNC	7.8dB @ 450MHz	0.18KW
BNC, SMA, and Reverse Polarity connectors		

ABR213 (PN:2213A) MI-SPEC (.405" diameter) Stranded Center Conductor, 66% VP, 97% BC Braid. Type II Jkt (Direct Burial) Available in Bulk or with PL259s, BNCs, N Type, TNC, SMA, or 7-16 Din Connectors.

Attenuation per 100ft	Power Rating
0.6dB @ 10MHz	3.43kW
1.0dB @ 30MHz	1.95kW
1.4dB @ 50MHz	1.5kW
2.4dB @ 150MHz	0.83kW
4.5dB @ 450MHz	0.45kW

Stocked Lengths 1.5ft to 200ft
Custom assemblies and Testing services available.

ABR316/U (PN:23316)
Available in standard configurations in 3ft, 6ft, 9ft, and 12ft.

Connector Options
N Male to N Male
SMA Male to SMA Male
SMA Male to SMA Female
SMA Male to SO239
SMA Male to PL259
SMA Female to SO239
SMA Female to Pl259
Custom assemblies available

HAM RADIO OUTLET
Radioworld
universal radio inc.
MTC
GigaParts

ABR240-UF (PN:218XA) RG-8X size (.240") Stranded Center Conductor, 85% VP, 95% TC Braid / 100 Foil, Type II Jkt (Direct Burial) Available in Bulk, W/ PL259s, BNCs, N Type, TNC, SMA, or Reverse Polarity Connectors.

Attenuation per 100ft	Power Rating
0.9dB @ 10MHz	2.16kW
1.6dB @ 30MHz	1.24kW
2.1dB @ 50MHz	0.96kW
3.6dB @ 150MHz	0.55kW
6.3dB @ 450MHz	0.31kW

Stocked Lengths 1.5ft to150ft
Custom assemblies and Testing services available.

ABR400-UF (PN:24500F) RG-8/U size (.405") Stranded Center Conductor, 86% VP, 95% TC Braid / 100 Foil, Type II Jkt (Direct Burial) Available in Bulk, W/ PL259s, BNCs, N Type, TNC, SMA, or 7-16 Din Connectors.

Attenuation per 100ft	Power Rating
0.8dB @ 30MHz	2.77kW
1.1dB @ 50MHz	2.14kW
1.8dB @ 150MHz	1.22kW
3.3dB @ 450MHz	0.69kW

Stocked Lengths 1.5ft to 200ft
Custom assemblies and Testing services available.

ABR400 (PN:24400) RG-8/U size (.405") Solid Center Conductor, 86% VP, 95% TC Braid / 100 Foil, Type II Jkt (Direct Burial) Available in Bulk, W/ PL259s, BNCs, N Type, TNC, SMA, or 7-16 Din Connectors.

Attenuation per 100ft	Power Rating
0.7dB @ 30MHz	3.33kW
0.9dB @ 50MHz	2.57kW
1.5dB @ 150MHz	1.47kW
2.7dB @ 450MHz	0.83kW

Stocked Lengths 1.5ft to 200ft
Custom assemblies and Testing services available.

Allison McLellan, amclellan@arrl.org

Christian Cudnik, KØSTH

Baltimore-born Christian Cudnik's, KØSTH, influences include Orson Welles, Paul Harvey, and, most importantly, his father. The broadcaster first became interested in radio when his father got into the citizens band (CB) in the 1970s. He was drawn to the immediacy of it and loved listening to his dad's scanner to hear what was happening in the neighborhood. Although it was not Amateur Radio, the seed was planted, and Christian pursued radio as a career.

Around August 2012, after two decades in the broadcasting industry, Christian got curious about what happened on the other side of the microphone. He began studying and received his Technician license, but he realized he still did not know how to get started in actual operation, and that's what led to his podcast, *100 Watts and a Wire*.

100 Watts and A Wire

Christian's first forays into radio broadcasting were at rock music stations in Baltimore and Philadelphia, following his passion for music. He then moved to St. Louis, where he spent some time as a host in the National Public Radio circuit. However, as commercial radio changed over time, Christian found he needed a new outlet for creativity. "Traditional broadcast radio wasn't giving me this outlet — it became more homogenized. Amateur Radio gave me a new avenue," he said.

Christian first got the idea for his podcast around 2015. As the working father of two young daughters, aged 4 and 8, he found he did not have a great deal of time to explore the logistical aspects of operating. "I really hesitated because I didn't have the budget to just buy the wrong things, and I didn't have a built-in Elmering system," he said.

In a concept similar to ARRL's new podcast for beginner hams, *So Now What?*, Christian wanted to create a community for new amateurs where it was okay to not know everything. In his show, he frequently features specialized operators on the subject he wants to explore that week.

Described as a journal of experiences in the intersection between Amateur Radio and life, *100 Watts and a Wire* evolved into a three-part system. Following a new episode early in the week, listeners can visit the podcast's Facebook group (**www.facebook.com/groups/100wattsandawire**) for active mentorship and discussion, and at the end of the week, Christian encourages the community to join a Sunday evening net to apply what they've learned. However, he stresses that the main point is fostering an inclusive space for all radio amateurs to learn together.

Christian Cudnik, KØSTH, operating portable in Livingston, Montana.

Storytelling

When he wasn't working in radio, Christian pursued his love for storytelling by producing and directing eight documentaries, which have aired on PBS and earned him Emmy and Telly awards. Many explore the deep history of St. Louis, Missouri, such as *Seeking Freedom*, which tells the story of female slaves suing for their independence in the 1800s, and *Uncovering Ancient St. Louis*, which explores what can be garnered about the area's first known inhabitants based on Native American oral tradition and archaeological excavations under modern downtown St. Louis.

Outside of work, Christian stays busy with his family and lets his daughters absorb the goings on of radio with him in his radio shack. His favorite things to do include building and hanging antennas, chasing contacts from parks, and what first struck him on his father's CB radio: listening. While he values the innovation of newer digital modes, he says his love will always be for HF. "Some silly little wire antenna can get you across the globe on a good day and I can talk to you in real time," he said. "I just think you can hear the world going around when you listen to HF."

100 Watts and a Wire is available wherever you get your podcasts. For more information, visit **100wattsandawire.com**.

Guide to Member Benefits

Join or Renew
www.arrl.org/join

Donate
www.arrl.org/donate

Benefits
www.arrl.org/benefits

Shop
www.arrl.org/shop

ARRL Online | www.arrl.org/myARRL

Create an online ARRL Member Profile, and get access to members-only benefits. Register at **www.arrl.org/myARRL**. Already registered? Log in at the top of the ARRL website.

- ***QST* Digital Edition | www.arrl.org/qst**
  All members can access the digital edition of *QST* from a web browser. Apps are available for iOS, Android, and Kindle Fire devices. Members must have a valid myARRL account to access the current digital edition of *QST*, the *QST* Archive and Periodicals Search, and the Product Review Archive.
- **E-Newsletters | www.arrl.org/myARRL**
  Subscribe to the weekly **ARRL Letter** and a variety of other ARRL e-newsletters and announcements: ham radio news, radio clubs, public service, contesting, and more!
- **Email Forwarding Service**
  Email sent to your **arrl.net** address will be forwarded to any email account you specify.

Technical Information Service | www.arrl.org/tis

Call or email our expert ARRL Technical Information Service specialists for answers to all your technical and operating questions. This service is FREE to ARRL members.

Advocacy | www.arrl.org/regulatory-advocacy

ARRL supports legislation and regulatory measures that preserve and protect meaningful access to the radio spectrum. Our **ARRL Regulatory Information Branch** answers member questions concerning FCC rules and operating practices. **ARRL's Volunteer Counsel** and **Volunteer Consulting Engineer** programs open the door to assistance with antenna regulation and zoning issues.

Group Benefits* | www.arrl.org/benefits

- **ARRL Ham Radio Equipment Insurance Plan**
- **Liberty Mutual Auto and Home Insurance**

*US only

Find...

...a License Exam Session | **www.arrl.org/exam**
...a Licensing Class | **www.arrl.org/class**
...a Radio Club (ARRL-affiliated) | **www.arrl.org/clubs**
...a Hamfest or Convention | **www.arrl.org/hamfests**

Interested in Becoming a Ham?

www.arrl.org/newham
newham@arrl.org | Tel. 1-800-326-3942 (US)

Connect with ARRL

ARRL, the national association for Amateur Radio®
225 Main Street, Newington, CT 06111-1400 USA
1-860-594-0200, Mon. – Fri. 8 AM to 5 PM ET except holidays
FAX 1-860-594-0259, email **hqinfo@arrl.org**
Contact ARRL: **www.arrl.org/contact-arrl**

Website: **www.arrl.org**
Facebook: **@ARRL.org**
Twitter: **@arrl, @w1aw, @arrl_ares**
Instagram and Instagram TV: **@arrlhq**
YouTube: **ARRLHQ**
LinkedIn: **https://www.linkedin.com/company/american-radio-relay-league/**

The American Radio Relay League, Inc.

ARRL, the national association for Amateur Radio® in the United States: supports the awareness and growth of Amateur Radio worldwide; advocates for meaningful access to radio spectrum; strives for every member to get involved, get active, and get on the air; encourages radio experimentation and, through its members, advances radio technology and education; and organizes and trains volunteers to serve their communities by providing public service and emergency communications *(ARRL's Vision Statement, adopted in January 2016)*.

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

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

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

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

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

Officers, Division Directors, and Staff

As an ARRL member, you elect the Director and Vice Director who represent your Division on ARRL policy matters. If you have a question or comment about ARRL policies, contact your representatives listed below.

Officers

Founding President (1914-1936)
Hiram Percy Maxim, W1AW

President
Rick Roderick, K5UR*
P.O. Box 1463, Little Rock, AR 72203
(501-988-2527); **k5ur@arrl.org**

First Vice President
Gregory P. Widin, KØGW*
13457 Sixth St. N., Stillwater, MN 55082
(651-436-8811); **k0gw@arrl.org**

Second Vice President
Bob Vallio, W6RGG
18655 Sheffield Rd.
Castro Valley, CA 94546
(510-537-6704); **w6rgg@arrl.org**

International Affairs Vice President
Jay Bellows, KØQB
1925 Bidwell St., West St. Paul, MN 55118
(651-238-4444); **k0qb@arrl.org**

Chief Executive Officer and Secretary*
Howard E. Michel, WB2ITX

Treasurer
Rick Niswander, K7GM

Chief Financial Officer
Diane Middleton, W2DLM

Staff

Communications Manager
David Isgur, N1RSN

Development Manager
Lauren Clarke, KB1YDD

Director of Operations
Norm Fusaro, W3IZ

Laboratory Manager
Ed Hare, W1RFI

Bob Allison, WB1GCM
Assistant Laboratory Manager

Product Development Manager
Bob Inderbitzen, NQ1R

Marketing & Sales Manager
Yvette Vinci, KC1AIM

Membership Manager
Diane Petrilli, KB1RNF

Production & Editorial Manager
Steve Ford, WB8IMY

Advertising Sales Manager
Janet Rocco, W1JLR

Assistant Secretary/ Regulatory Information Manager
Dan Henderson, N1ND

VEC Manager
Maria Somma, AB1FM

Lifelong Learning Manager
Kris Bickell, K1BIC

Radiosport & Field Services Manager
Bart Jahnke, W9JJ

Business Staff

Controller
Thomas Bell

Information Technology Manager
Michael Keane, K1MK

*Executive Committee Member

Atlantic Division
www.atldiv.org

Tom Abernethy, W3TOM*
P.O. Box 73, Accokeek, MD 20607
(301-257-6225); **w3tom@arrl.org**

Vice Director: Robert B. Famiglio, K3RF
P.O. Box 9, Media, PA 19063
(610-359-7300); **k3rf@arrl.org**

Central Division
www.central.arrl.org

Kermit Carlson, W9XA
1150 McKee St., Batavia, IL 60510
(630-879-0983); **w9xa@arrl.org**

Vice Director: **Carl Luetzelschwab, K9LA**
1227 Pion Rd., Fort Wayne, IN 46845
(260-637-6988); **k9la@arrl.org**

Dakota Division
www.arrldakota.org

Matt Holden, KØBBC
P.O. Box 24544
Edina, MN 55424-0544
(952-232-1984); **k0bbc@arrl.org**

Vice Director: **Lynn Nelson, WØND**
3204 Willow Ln. SE, Minot, ND 58701
(701-833-1000); **w0nd@arrl.org**

Delta Division
arrldelta.org

David A. Norris, K5UZ
907 Evening Sunset Cir., Redfield, AR 72132
(870-613-1606); **k5uz@arrl.org**

Vice Director: **Ed B. Hudgens, WB4RHQ**
1441 Wexford Downs Ln., Nashville, TN 37211
(615-333-9859); **wb4rhq@arrl.org**

Great Lakes Division
arrl-greatlakes.org

Dale Williams, WA8EFK
291 Outer Dr., Dundee, MI 48131
(734-529-3232); **wa8efk@arrl.org**

Vice Director: **Thomas Delaney, W8WTD**
4632 Glenway Ave., Cincinnati, OH 45238
(513-921-7423); **w8wtd@arrl.org**

Hudson Division
www.hudson.arrl.org

Ria Jairam, N2RJ
P.O. Box 73, Sussex, NJ 07461
(973-594-6275); **n2rj@arrl.org**

Vice Director: **William Hudzik, W2UDT**
111 Preston Dr., Gillette, NJ 07933
(908-580-0493); **w2udt@arrl.org**

Midwest Division
www.arrlmidwest.org

Rod Blocksome, KØDAS
690 Eastview Dr., Robins, IA 52328-9768
(319-393-8022); **k0das@arrl.org**

Vice Director: **Art Zygielbaum, KØAIZ**
6601 Pinecrest Dr., Lincoln, NE 68516
(402-421-0839); **k0aiz@arrl.org**

How to Contact ARRL Staff

To send an email to any ARRL Headquarters staff member, put his or her call sign (or first initial and last name) in front of **@arrl.org**. For example, to send to Hiram Maxim, First President of the ARRL, use **w1aw@arrl.org**, or **hmaxim@arrl.org**.

New England Division

Fred Hopengarten, K1VR*
6 Willarch Rd., Lincoln, MA 01773
(781-259-0088); **k1vr@arrl.org**

Vice Director: **Mike Raisbeck, K1TWF**
85 High St., Chelmsford, MA 01824
(978-250-1235); **k1twf@arrl.org**

Northwestern Division
www.arrl.nwdiv.org

Mike Ritz, W7VO
33643 Burma Rd., Scappoose, OR 97056
(503-987-1269); **w7vo@arrl.org**

Vice Director: **Mark J. Tharp, KB7HDX**
P.O. Box 2222, Yakima, WA 98907
(509-952-5764); **kb7hdx@arrl.org**

Pacific Division
pacific.arrl.org

Jim Tiemstra, K6JAT*
13450 Skyline Blvd., Oakland, CA 94619
(510-569-6963); **k6jat@arrl.org**

Vice Director: **Kristen McIntyre, K6WX**
40711 Witherspoon Ter., Fremont, CA 94538
(510-703-4942); **k6wx@arrl.org**

Roanoke Division
arrl-roanoke.com

George W. "Bud" Hippisley, W2RU*
981 Circle Creek Rd., Penhook, VA 24137
(540-576-2527); **w2ru@arrl.org**

Vice Director: **Bill Morine, N2COP**
101 Windlass Dr., Wilmington, NC 28409
(910-452-1770); **n2cop@arrl.org**

Rocky Mountain Division
www.rockymountaindivision.org

Jeff Ryan, KØRM
9975 Wadsworth Pkwy. K2-275
Westminster, CO 80021
(303-432-2886); **k0rm@arrl.org**

Vice Director: **Robert Wareham, NØESQ**
300 Plaza Dr., Suite 200
Highlands Ranch, CO 80129
(720-592-0394); **n0esq@arrl.org**

Southeastern Division
www.facebook.com/ ARRLSoutheasternDivision

Greg Sarratt, W4OZK
321 Dupree Dr., Huntsville, AL 35806
(256-337-3636); **gsarratt@arrl.org**

Vice Director: **Joseph Tiritilli, N4ZUW**
4116 NW 1st St., Deerfield Beach, FL
33442-8033 (954-296-4234); **n4zuw@arrl.org**

Southwestern Division
www.kkn.net/n6aa

Richard J. Norton, N6AA
21290 West Hillside Dr., Topanga, CA 90290
(310-455-1138); **n6aa@arrl.org**

Vice Director: **Ned Stearns, AA7A**
7038 East Aster Dr., Scottsdale, AZ 85254
(480-948-5080); **aa7a@arrl.org**

West Gulf Division
arrlwgd.org

John Robert Stratton, N5AUS*
P.O. Box 2232, Austin, TX 78768-2232
(512-445-6262); **n5aus@n5aus.com**

Vice Director: **Lee H. Cooper, W5LHC**
2507 Autrey Dr., Leander, TX 78641
(512-658-3910); **lcooper@arrl.org**

ARRL Section Managers

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

Atlantic Division (DE, EPA, MDC, NNY, SNJ, WNY, WPA)

Delaware: Bill Duveneck, KB3KYH, 18682 Sunny Sky Blvd., Milton, DE 19968-2486 (302-537-4755); **kb3kyh@arrl.org**

Eastern Pennsylvania: George Miller, W3GWM, 293 Woods Rd., Wyalusing, PA 18853 (570-250-1007); **w3gwm@arrl.org**

Maryland-DC: Marty Pittinger, KB3MXM, 4 Pegram Rd., Owings Mills, MD 21117 (410-356-7899); **kb3mxm@arrl.org**

Northern New York: Thomas Dick, KF2GC, 11 Jenkins St., Saranac Lake, NY 12983 (518-891-0508); **kf2gc@arrl.org**

Southern New Jersey: Tom Preiser, N2XW, 177 Bowsprit Rd., Manahawkin, NJ, 08050-5001 (609-618-0224); **n2xw@arrl.org**

Western New York: Laura Mueller, N2LJM, 2011 E. Main St., Falconer, NY 14733 (716-338-3122); **n2ljm@arrl.org**

Western Pennsylvania: Joe Shupienis, W3BC, P.O. Box 73, Falls Creek, PA 15840-0322 (814-771-3804); **w3bc@arrl.org**

Central Division (IL, IN, WI)

Illinois: Ron Morgan, AD9I, 114 Herman St., East Peoria, IL 61611-4420 (309-397-9549); **ad9i@arrl.org**

Indiana: James Merry, Jr., KC9RPX, 7332 W. Mustang Dr., Ellettsville, IN 47429 (812-391-2661); **kc9rpx@arrl.org**

Wisconsin: Patrick Moretti, KA1RB, W349S3970 Waterville Rd., Dousman, WI 53118-9786 (262-354-2997); **ka1rb@arrl.org**

Dakota Division (MN, ND, SD)

Minnesota: Richard H. "Skip" Jackson, KSØJ, 1835-63rd St. E, Inver Grove Heights, MN 55077 (651-260-4330); **ks0j@arrl.org**

North Dakota: Nancy Yoshida, KGØYL, 1079 Harvest Ln. NE, Thompson, ND 58278-9408 (218-779-6596); **kg0yl@arrl.org**

South Dakota: Chris Stallkamp, KIØD, P.O. Box 271, Selby, SD 57472-0271 (605-870-1784); **ki0d@arrl.org**

Delta Division (AR, LA, MS, TN)

Arkansas: James D. Ferguson, Jr., N5LKE, 1500 Lauren Dr., Searcy, AR 72143-8477 (501-593-5695); **n5lke@arrl.org**

Louisiana: John Mark Robertson, K5JMR, 201 Madewood Ct., Bossier City, LA 71111-6325 (318-572-7917); **k5jmr@arrl.org**

Mississippi: Malcolm Keown, W5XX, 64 Lake Cir. Dr., Vicksburg, MS 39180 (601-636-0827); **w5xx@arrl.org**

Tennessee: Keith E. Miller Sr., N9DGK, 1635 Jarratt Dr., Rockvale, TN 37135 (615-631-9952); **n9dgk@arrl.org**

Great Lakes Division (KY, MI, OH)

Kentucky: Steve Morgan, W4NHO, 1124 W. 12th St., Owensboro, KY 42301-2975 (270-926-4451); **w4nho@arrl.org**

Michigan: Jim Kvochick, K8JK, 10366 Greystone Ct., Brighton, MI 48114-7650 (810-229-5085); **k8jk@arrl.org**

Ohio: Scott D. Yonally, N8SY, 258 Valley Hi Dr., Mansfield, OH 44904-9792 (419-512-4445); **n8sy@arrl.org**

Hudson Division (ENY, NLI, NNJ)

Eastern New York: John K. Fritze, Jr., K2QY, 4 Normanskill Blvd., Delmar, NY 12054-1335(401-261-4996); **k2qy@arrl.org**

NYC-Long Island: Jim Mezey, W2KFV, 38 Appletree Ln., Carle Place, NY 11514-1336 (516-315-8608); **w2kfv@arrl.org**

Northern New Jersey: Rob Roschewsk, KA2PBT, 104 Buckhorn Dr., Washington, NJ 07882 (908-916-2570); **ka2pbt@arrl.org**

Midwest Division (IA, KS, MO, NE)

Iowa: Lelia Garner, WAØUIG, 145 Front St., Robins, IA 52328-9718 (319-213-3539); **wa0uig@arrl.org**

Kansas: Ronald D. Cowan, KBØDTI, P.O. Box 36, LaCygne, KS 66040 (913-757-3758); **kb0dti@arrl.org**

Missouri: Cecil Higgins, ACØHA, 27995 County Rd. 220, Hermitage, MO 65668-8493 (417-399-5027); **ac0ha@arrl.org**

Nebraska: Matthew N. Anderson, KAØBOJ, 14300 NW 98th St., Raymond, NE 68428-4254 (402-480-5515); **ka0boj@arrl.org**

New England Division (CT, EMA, ME, NH, RI, VT, WMA)

Connecticut: Charles I. Motes, Jr., K1DFS, 22 Woodside Ln., Plainville, CT 06062 (860-747-6377); **k1dfs@arrl.org**

Eastern Massachusetts: Tom Walsh, K1TW, 9 Wildwood Dr., Bedford, MA 01730 (781-275-5882); **k1tw@arrl.org**

Maine: Bill Crowley, K1NIT, 150 Maple St., Farmingdale, ME 04344-4809 (207-623-9075); **k1nit@arrl.org**

New Hampshire: Peter Stohrer, K1PJS, 9 Gladstone St., Concord, NH 03301 (603-715-9539); **k1pjs@arrl.org**

Rhode Island: Bob Beaudet, W1YRC, 30 Rocky Crest Rd., Cumberland, RI 02864 (401-333-2129); **w1yrc@arrl.org**

Vermont: Paul N. Gayet, AA1SU, 11 Cherry St., Essex Junction, VT 05452 (802-878-2215); **aa1su@arrl.org**

Western Massachusetts: Raymond Lajoie, KB1LRL, 245 Leominster Rd., Lunenburg, MA 01462-2031 (978-549-5507); **kb1lrl@arrl.org**

Northwestern Division (AK, EWA, ID, MT, OR, WWA)

Alaska: Ray Hollenbeck, KL1IL, 1457 Pioneer Peak Dr., Wasilla, AK 99654 (907-373-6771); **kl1il@arrl.org**

Eastern Washington: Jack Tiley, AD7FO, 1806 S. Fawn Dr., Spokane Valley, WA 99206-3318 (509-951-7214); **ad7fo@arrl.org**

Idaho: Dan Marler, K7REX, 6525 W. Fairfield Ave., Boise, ID 83709 (208-914-8939); **k7rex@arrl.org**

Montana: George Forsyth, AA7GS, 212 Skyline Dr. NE, Great Falls, MT 59404 (406-868-2212); **aa7gs@arrl.org**

Oregon: David Kidd, KA7OZO, 21760 S. Larkspur Ave., Oregon City, OR 97045-9164 (503-320-3484); **ka7ozo@arrl.org**

Western Washington: Monte L. Simpson, AF7PQ, P.O. Box 3008, Silverdale, WA 98383 (360-633-7665); **af7pq@arrl.org**

Pacific Division (EB, NV, PAC, SV, SF, SJV, SCV)

East Bay: Jim Siemons, W6LK, 2308 Lomond Ln., Walnut Creek, CA 94598-3705 (925-330-0049); **w6lk@arrl.org**

Nevada: John Bigley, N7UR, 2420 Palora Ave., Las Vegas, NV 89121-2157 (702-673-0904); **n7ur@arrl.org**

Pacific: Joe Speroni, AHØA, 278 Kapiolani Blvd. #502, Honolulu, HI 96826 (808-955-2496); **ah0a@arrl.org**

Sacramento Valley: Dr. Carol Milazzo, KP4MD, P.O. Box 665, Citrus Heights, CA 95611-0665 (916-879-7449); **kp4md@arrl.org**

San Francisco: Bill Hillendahl, KH6GJV, P.O. Box 4151, Santa Rosa, CA 95402-4151 (707-544-4944); **kh6gjv@arrl.org**

San Joaquin Valley: Dan Pruitt, AE6SX, 4834 N. Diana St., Fresno, CA 93726 (559-779-2974); **ae6sx@arrl.org**

Santa Clara Valley: Brandon Bianchi, NI6C, P.O. Box 60128, Palo Alto, CA 94306 (559-313-3373); **ni6c@arrl.org**

Roanoke Division (NC, SC, VA, WV)

North Carolina: Karl Bowman, W4CHX, 5509 Shimer Farm Ln., Raleigh, NC 27614-6301 (919-669-6068); **w4chx@arrl.org**

South Carolina: Marc Tarplee, N4UFP, 4406 Deer Run, Rock Hill, SC 29732-9258 (803-327-4978); **n4ufp@arrl.org**

Virginia: Joseph Palsa, K3WRY, 9101 Arch Hill Ct., Richmond, VA 23236-2725 (804-350-2665); **k3wry@arrl.org**

West Virginia: Dan Ringer, K8WV, 18 W. Front St., Morgantown, WV 26501-4507 (304-292-1999); **k8wv@arrl.org**

Rocky Mountain Division (CO, NM, UT, WY)

Colorado: Jack Ciaccia, WMØG, P.O. Box 21362, Boulder, CO 80308-4362 (303-587-0993); **wm0g@arrl.org**

New Mexico: Bill Mader, K8TE, 4701 Sombrerete Rd. SE, Rio Rancho, NM 87124 (505-250-8570); **k8te@arrl.org**

Utah: Mel Parkes, NM7P, 2166 E. 2100 North, Layton, UT 84040 (801-547-1753) **nm7p@arrl.org**

Wyoming: Rick Breininger, N1TEK, 11 E. 2nd North St., Green River, WY 82935 (307-707-4010); **n1tek@arrl.org**

Southeastern Division (AL, GA, NFL, PR, SFL, VI, WCF)

Alabama: JVann Martin, W4JVM, 16 Baron Dr., Chelsea, AL 35043-6607 (205-281-4728); **w4jvm@arrl.org**

Georgia: David Benoist, AG4ZR, 190 Fox Hall Crossing East, Senoia, GA 30276 (404-290-0470); **ag4zr@arrl.org**

Northern Florida: Kevin J. Bess, KK4BFN, 908 Flagler Ave., Edgewater, FL 32132-2124 (386-547-2838); **kk4bfn@arrl.org**

Puerto Rico: Oscar Resto, KP4RF, HC 77 Box 8743, Vega Alta, PR 00692-9660 (787-883-6878); **kp4rf@arrl.org**

Southern Florida: Barry M. Porter, KB1PA, 13908 Via Nidia, Delray Beach, FL 33446 (561-499-8424); **kb1pa@arrl.org**

Virgin Islands: Fred Kleber, K9VV, P.O. Box 24275, Christiansted, VI 00824-0275 **k9vv@arrl.org**

West Central Florida: Darrell Davis, KT4WX, 6350 Mills Rd., Fort Meade, FL 33841 (863-245-9923); **kt4wx@arrl.org**

Southwestern Division (AZ, LAX, ORG, SDG, SB)

Arizona: Rick Paquette, W7RAP, 1600 W. Sunkist Rd., Tucson, AZ 85755-9561 (520-425-6877); **w7rap@arrl.org**

Los Angeles: Diana Feinberg, AI6DF, P.O. Box 4678, Palos Verdes Peninsula, CA 90274-9618 (310-544-2917); **ai6df@arrl.org**

Orange: Carl Gardenias, WU6D, 20902 Gardenias St., Perris, CA 92570 (951-490-2270); **wu6d@arrl.org**

San Diego: Dave Kaltenborn, N8KBC, 630 Alber St., Chula Vista, CA 91911 (619-616-8758); **n8kbc@arrl.org**

Santa Barbara: John Kitchens, NS6X, P.O. Box 178, Somis, CA 93066 (805-216-2569); **ns6x@arrl.org**

West Gulf Division (NTX, OK, STX, WTX)

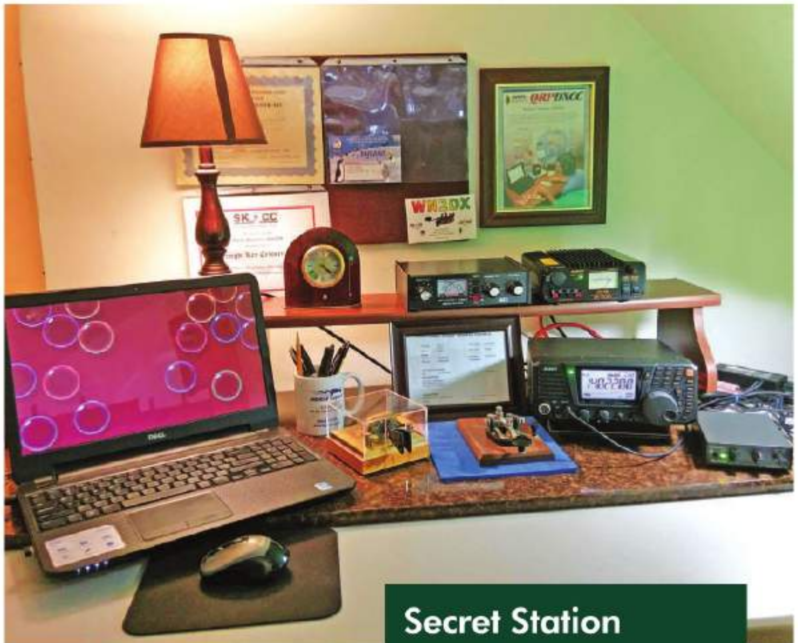
North Texas: Steven Lott Smith, KG5VK, 125 Contest Ln., Ben Franklin, TX 75415-3830 (318-470-9806); **kg5vk@arrl.org**

Oklahoma: Kevin O'Dell, NØIRW, 1718 South Fairgrounds, Stillwater, OK 74074 (580-220-9062); **n0irw@arrl.org**

South Texas: Paul Gilbert, KE5ZW, 1209 Doris Ln., Cedar Park, TX 78613-7067 (512-940-0441); **ke5zw@arrl.org**

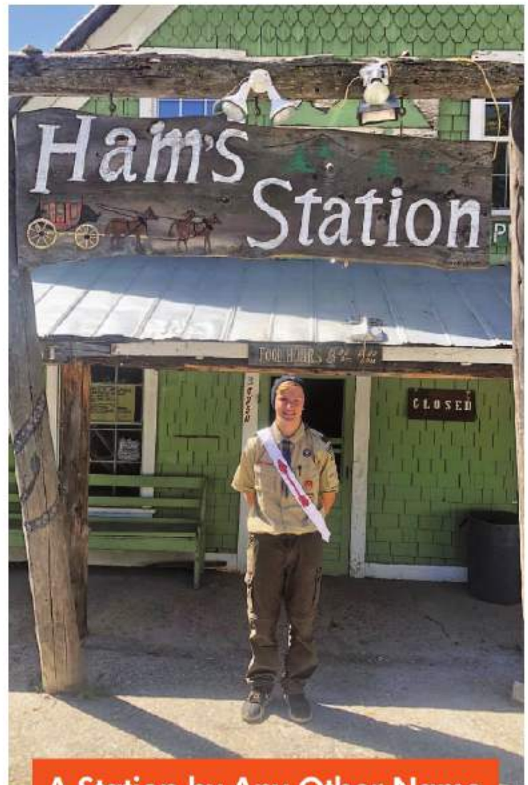
West Texas: H. Dale Durham, W5WI, P.O. Box 375, Buffalo Gap, TX 79508 (830-719-9000); **w5wi@arrl.org**

Up Front



Secret Station

Martin Szumera, WN2DX, avoided restrictions in his community by setting up this attractive station in the back of his garage. A 20-meter dipole antenna is tucked away in the attic area above the garage.

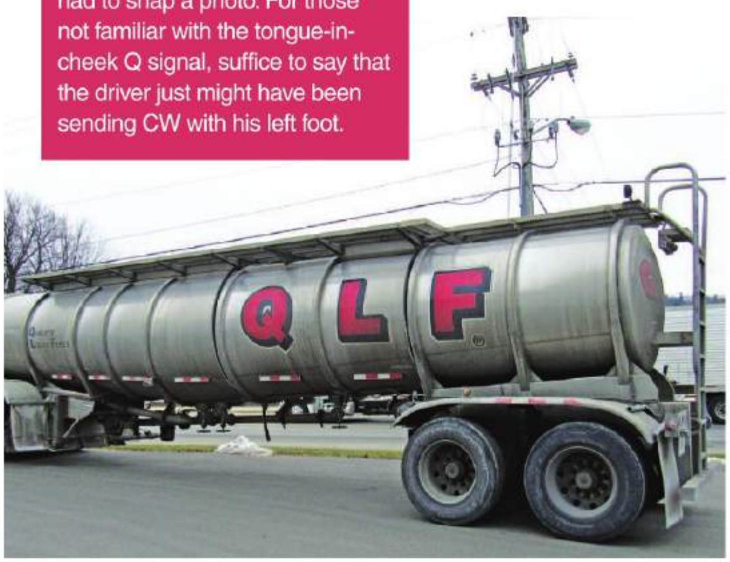


A Station by Any Other Name

Richard Karpinen, K6LJC, is the proud grandfather of Order of the Arrow Scout Matthew Zaech, who is shown here at the curiously named "Ham's Station." As it turns out, the "Ham" was Alonzo Ham, who purchased the property in the late 1800s to establish a stagecoach station in Amador County, California.

QLF?

Phil Van Heurck, W9XAN, spotted this tanker a while ago and had to snap a photo. For those not familiar with the tongue-in-cheek Q signal, suffice to say that the driver just might have been sending CW with his left foot.



Wouff Hong in the Sand

As Steve La Valley, WA7HAA, was walking along the beach in Maui, Hawaii, he came across this familiar-looking piece of wood, which immediately suggested the dreaded Wouff Hong of Amateur Radio legend. Steve said, "I admit I felt some fear at first, but when recounting my most recent operating practices, I realized that this may have just been a warning to continue to be a good ham."


BridgeCom SYSTEMS
Hamvention 2019
Come see us in booth
1103-1104
in the Maxim Hall
Turn-Key Public Service Repeater Systems
scom
7330 Repeater Controller
BridgeCom SYSTEMS
POWER
DC ON
LOW OUTPUT
HIGH VSWR
HIGH TEMP
Crescend TECHNOLOGIES
DuraComm
DC Power Supply
VOLT
AMP
We provide the best systems, best service, and the best support in the industry, hands down!
Go here to learn more:
www.BridgeComSystems.com/systems
"If you need FmComm, you need BridgeCom!"
-T.H. Merritt - KL5YJ
Repeaters • Duplexers • Power Amplifiers • Power Supplies • Antennas • Controllers
BridgeCom SYSTEMS
102 NE State Route 92 Hwy Ste C
Smithville, MO 64089 USA
(816) 532-8451
sales@bridgecomsystems.com
www.BridgeComSystems.com

Correspondence

Letters from Our Members

Connecting Hams Online

Often while driving, I have the mobile radio set to scan the VHF/UHF repeater subbands in search of new repeaters. Because my focus is on driving, I am not always able to catch the frequency of the repeater on the display, so I rely on voice or CW identification. However, when I get home, I then desire to research more info about the newly discovered machine but find that the repeater owner has no info on either a website or a common search engine like **QRZ.com**.

Or I might hear an interesting comment during a contact and would like to discuss more with that ham via email, but I find that the individual does not have an email address listed on **QRZ.com**, nor does that ham have an ARRL alias on file.

Therefore, I urge all repeater operators to list the details about their machines, such as location, CTCSS tone, and offset frequency, in their bio on **QRZ.com**. This suggestion can also apply to any Amateur Radio operator who plans to operate a special event station or does things like conducting regularly scheduled nets. Let's be able to reach out to other hams via the internet and not just by direct radio contact.

Ken Slusher, N2DF
Jackson Heights, New York

More Disaster Response Information

I read Rick Palm's, K1CE, article, "Hurricane Michael: Epic Trial for New SEC," in the January 2019 issue of *QST* with great interest.

I would like to see lists of materials and supplies taken by people who participated in the amateur response to natural disasters. The internet and other resources are littered with lists of what you need to survive and be self-sufficient, but nothing specifically itemized from people who have been there.

For example, I get the rule of thumb of 1 gallon of water per person per day to drink, but I would like to know how that was carried (seven 1-gallon jugs versus 56 half-liter bottles). I'm also curious about specifics for what food, beverages, clothing, sunscreen, insect repellent, and types of fuel were packed, and what was used for laundry and sanitation. I'd like to know how much was left over for items, and how much ran short.

Based on my own limited experience, I can put together most of what I imagine would keep me going for 7 days, but it would be really comforting to see written lists from people who have been there. I realize conditions and requirements change according to location, event type, time of year, etc., but a comprehensive core list from real experience would be helpful.

Robert Judy, KD5FEE
Nacogdoches, Texas

Correction to "The Joy of Soldering"

Being an Association Connecting Electronics Industries-certified solder trainer and solder professional in the defense industry, I especially enjoyed Joseph L. Lynch's, N6CL, "The Joy of Soldering" article in the April 2019 issue of *QST*. However, I wanted to point out one issue at the end of the article, which stated, "Lead/rosin solder has been outlawed and replaced with lead-free solder, which may be harder to work with, but is much safer."

Lead-bearing solder is banned in the EU, but is by no means banned in the US (except in plumbing applications) and is readily available from suppliers that I purchase it from.

Chris Waldrup, KD4PBJ
Tracy City, Tennessee

Chris, you are absolutely right. Thank you for sending in this correction. QST *regrets the error. — Ed.*

California ARES® Activations

Kudos to the Sacramento Valley Section Amateur Radio Emergency Service® (ARES) radio operators who responded to our need to support disaster communications during the Camp Fire. Many of these operators also responded when our call went out during the Carr Fire only a few months before. ARES activated at the request of our Director of Disaster Services, who was the Director of Operations for both responses.

He specifically wanted the radio operators at each of our shelters to augment communications should the day-to-day telecom infrastructure suffer an impact from the disaster. Their assignment was to pass daily shelter reports to our Disaster Operations Center via Winlink.

ARES more typically gets practice in message handling over phone circuits, but to facilitate our all-important partnership, I urge all ARES members to train using digital modes to handle longer message traffic.

Jim Piper, N6MED
Citrus Heights, California

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.

ARRL Field Day is June 22-23, 2019

Get Ready for Field Day—June 22-23!

DX ENGINEERING

Field Day Triplexer Combo

We've made it easy to work the 20, 15 and 10 meter bands with three different radios, using just a single tri-band antenna! Our Field Day Triplexer Combo includes Low Band Systems' (LBS) innovative 200W Triplexer (LBS-PB-TP200), LBS 20/15/10M band-pass filters, and coaxial cable jumpers. Eliminate the need (and cost) for extra antennas while enjoying fast setup and worry-free operation without RF interference. The system works with any tri-bander antenna, including DX Engineering's reliable Skyhawk. For more details, enter "200FD" at DXEngineering.com.

DXE-200FD-8X-P	With RG8X cables	**$662.93**
DXE-200FD-P	With RG400 cables	**$749.93**

ICOM YAESU KENWOOD ALINCO

See you at Hamvention®—Building One, Booths 1207-1210 & 1307-1311

REQUEST YOUR NEW CATALOG!

DX ENGINEERING

Showroom Staffing Hours:
9 am to 5 pm ET, Monday-Saturday

Ordering (via phone):
9:00 am to midnight ET, Monday-Friday
9:00 am to 5 pm ET, Weekends

Phone or e-mail Tech Support: 330-572-3200
8:30 am to 7 pm ET, Monday-Friday
9:00 am to 5 pm ET, Saturday
All Times Eastern I Country Code: +1
DXEngineering@DXEngineering.com

FAST FREE SHIPPING over $99*

800-777-0703 | DXEngineering.com

**A special handling surcharge per item applies to oversize items, truck freight fees are charged for products that are too large or too heavy for regular ground service—ask your sales rep for details.*

Email Support 24/7/365 at DXEngineering@DXEngineering.com

YouTube

Social Media Snapshot

Watch ARRL Lab Manager Ed Hare, W1RFI, and DX Engineering's Tim Duffy, K3LR, discuss Ed's work at **www.facebook.com/DXEngineering/videos/353443038598325**, or on ARRL's Facebook page.

Join ARRL's Field Day 2019 Facebook group at **www.facebook.com/groups/fd2019**.

ARRL attended the National Association of Broadcasters' NAB Show in Las Vegas this past April.

Your monthly peek at the best of ARRL's feeds. Follow us:

Facebook: **@ARRL.org** • Twitter: **@arrl, @w1aw, @arrl_ares** • Instagram and Instagram TV: **@arrlhq**
YouTube: **ARRLHQ** • LinkedIn: **www.linkedin.com/company/american-radio-relay-league**

Taking HF By Storm
KENWOOD
HF/50MHz ALL MODE TRANSCEIVER TS-480 DSP
The TS-480HX
KENWOOD
Customer Support: (310) 639-4200
Fax: (310) 537-8235
Scan with your phone to download TS-480HX brochure.
www.kenwood.com/usa
ISO9001 Registered
JVCKENWOOD Corporation
ADS#15015

A Compact 20-Meter Vertical Dipole for Stealth and Portable Applications

This antenna earned an Honorable Mention in the 2018 *QST* Antenna Design Competition.

Steve Appleyard, G3PND

While thinking about the design of a new antenna for a 30 × 50 foot plot of land, I wanted the antenna to be easily erected/dismantled for both stealth and portable operation. I subsequently decided on a free-standing half-wave 20-meter vertical due to it having a reasonable antenna length and no need for a counterpoise. However, as a 20-meter vertical dipole is about 33 feet high, this would still be outside my design parameters. There-fore, I decided to design a shortened loaded vertical dipole by making the bottom section an almost complete helically wound inductance, and the top section a self-supporting conductor with an appropriate amount of inductive loading.

Design

As I wanted to keep the total antenna length about 16 feet, I chose the main two elements to be a 10-foot-long, 1¼-inch-diameter PVC tube and a 6-foot-long, ½-inch-diameter copper pipe. Using antenna design software for this project was beyond my capability, so I decided on a trial-and-error process, taking advantage of help from Norfolk Coast Amateur Radio Society (NCARS) volunteers — in particular, Bruce, G4KZT, and Phil, G4PQP.

I began by erecting a full-size tuned 20-meter horizontal wire dipole with the center 7 feet above the ground. I then replaced the left-hand section of the dipole with my experimental bottom vertical section. After several iterations, I arrived at a dipole resonant at 14.128 MHz. Next, I replaced the right-hand dipole section with my first attempt at the top section. I adjusted the coil until I again achieved resonance. This gave me the basic pieces necessary for the vertical dipole.

Assembling the Compact Vertical Dipole

Originally, I was unable to achieve a low SWR at resonance. However, after much experimentation, I found that I needed to increase the winding separation closer to the feed point and then progressively reduce it down to the final 1-centimeter spacing. The coil winding details are

Parts List

- 10 foot × 1¼ inch PVC pipe
- 9-foot length of wood to insert in the PVC pipe to give it additional rigidity [A 1⁵⁄₁₆-inch-diameter wood dowel, available in 6-, 8-, and 10-foot lengths from a hardware store, perfectly fit the inside diameter of 1¼-inch PVC pipe — *Ed.*]
- 6-inch length of wood with a ½-inch hole drilled vertically through it
- 6-foot length of ½-inch diameter copper pipe
- ½-inch hose clamp
- 15 A terminal blocks, three-way (Bussman TB300-03 or equivalent) and one-way (Cinch 1-142 or equivalent), as shown in Figure 2
- Masking tape, double-sided tape, self-amalgamating tape, and electrical tape
- 50 feet of copper wire; #12 AWG stranded insulated wire was used in the prototype, but smaller diameter wire has been used in subsequent antennas
- Appropriate length of coaxial cable, terminated with a PL-259 connector

shown in Figure 2 [For those without a metric ruler, 1 centimeter = 0.4 inches. — *Ed.*]. The main issue is the high voltage at the bottom of the lower helical winding, as maximum voltage occurs at the ends of a half-wave dipole. The risk of arcing was minimized by fitting a 30 A terminal block at the wire end to provide the rounded edges of the terminal barrel.

Using the materials in the "Parts List" sidebar, I began assembly following these steps:

1 Stick a 6 foot × 5 inch strip of masking tape along the length of the 10-foot PVC pipe from the end you designate to be the top of the dipole.

2 Mark the masking tape with each turn of antenna wire as shown in Figure 2, starting from the top of the antenna.

3 Stick double-sided tape alongside the masking tape to keep the antenna wire from slipping.

4 Insert the reinforcing wood into the tube, ensuring a 12-inch clearance from the top.

5 Fix the three-way terminal block with the center contact removed, as shown in Figure 2, using two wood screws.

6 After taping the wire to the pipe so that 4 inches extends from the end (this end will connect to the copper tube), start winding the antenna wire from the top end of the PVC pipe so that each turn coincides with the markings on the masking tape. Wind it as far as the terminal block and terminate it into the block. Tape the winding every 6 – 8 inches with electrical tape to keep it secure.

7 Terminate the remainder of the antenna wire into the other half of the terminal block and start winding the lower section of the antenna (see Figure 2). Tape the wire at the last turn and then tape a 16-inch straight section along the length of the tube.

8 Fit the 6-inch wooden insert into the top end of the tube and secure with a small wood screw through the plastic tube (see Figure 3).

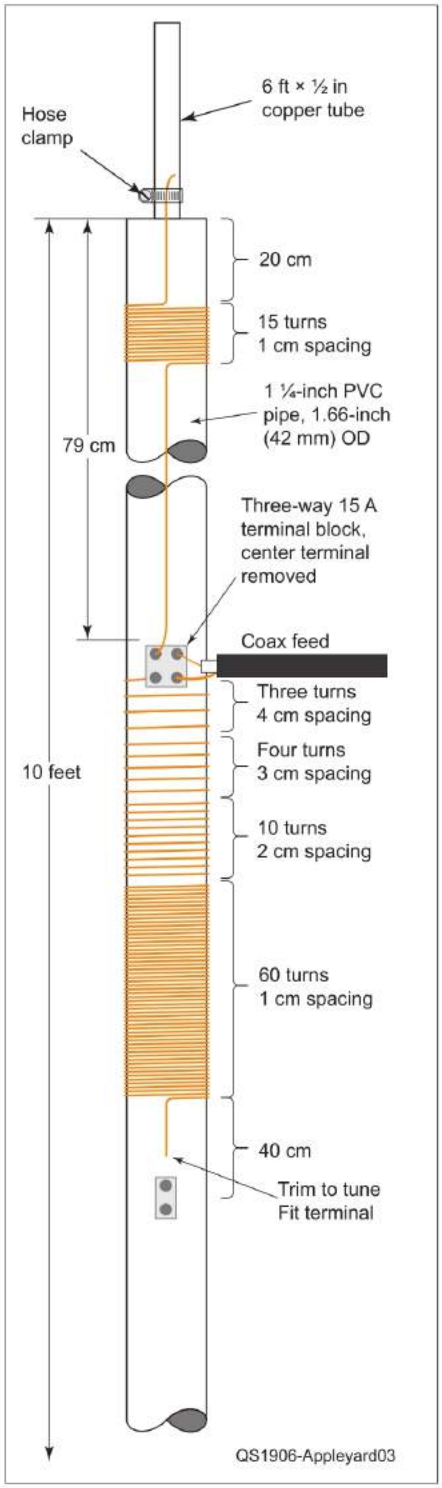


Figure 2 — Details of the dual coil assembly.

9 Insert 6 inches of the copper pipe into the pre-drilled wooden insert and fit the hose clamp with the tail of the previously stripped back wire under it (see Figure 4).

10 Attach the coaxial cable to the terminal block with the shield connected to the bottom section of the antenna. Make one turn of the coaxial cable around the tube at the center of the terminal block and tape to hold.

Tuning the Antenna

Mount the antenna, using an umbrella base, at least 10 feet from nearby objects. The coaxial feeder should be brought away perpendicular to the antenna for at least 3 feet before it can drop vertically. As the feed is unbalanced, a 1:1 choke balun was used to suppress any common-mode current during testing. Subsequently, I have not bothered with the balun as the common-mode current doesn't appear to cause any problems, at least up to 100 W.

►**Figure 3** — Drilled wooden insert installed in PVC pipe.

▼**Figure 4** — The copper pipe installed.

The antenna is tuned by trimming the bottom straight-wire section. The length is longer than required, so the antenna will be resonant below 14 MHz. It should not be necessary to trim more than 8 inches off this tail — it is important that at least 8 inches remain. If resonance is still below 14 MHz when 8 inches has been trimmed off, remove a turn from the bottom of the coil. At resonance, the SWR should be below 1.2. If it is not, then a small adjustment can be made to the top section by releasing the hose clamp and dropping the copper tube by a small amount. Strip back ½ inch of insulation from the bottom of the antenna and fit a single-way 15 A terminal block.

Once tuning is complete, replace or cover the temporary electrical tape with self-amalgamating tape. This should also be put liberally around the terminal blocks and the hose clamp. The open top of the copper tube should also be made waterproof.

The final result is an antenna with an SWR of less than 1.2:1 at 14.128 MHz, and less than 2:1 across the full 20-meter band. Several antennas have subsequently been constructed with almost identical results. I have tested the antenna up to a maximum of 400 W, measuring the temperature at various points. There was no noticeable temperature rise.

Warning — High voltages exist at the two ends of the antenna. If there is any risk of a person touching the copper tube, a non-conductive plastic pipe can be placed over it. A larger diameter, non-conductive tube can also be fitted over the bottom section of the dipole (see the lead photo). These tubes will only have a minimal effect on the SWR of the antenna.

On-Air Testing

I am a great advocate of using the Reverse Beacon Network (RBN) to compare antennas.[1] I currently have a 20-meter horizontal dipole with its center at 20 feet and a 130-foot multi-band end-fed antenna. Both antennas perform well given the conditions at the time. Tests on the compact vertical dipole were carried out from June 30 – August 5, 2018. In the tests, I used my call G3PND for the compact vertical and the NCARS calls MXØNCA and MØNCA for my existing antennas.

[1]S. Appleyard, G3PND, "Using the Reverse Beacon Network to Test Antennas," *RadCom*, Jun. 2018, pp. 26 – 30.

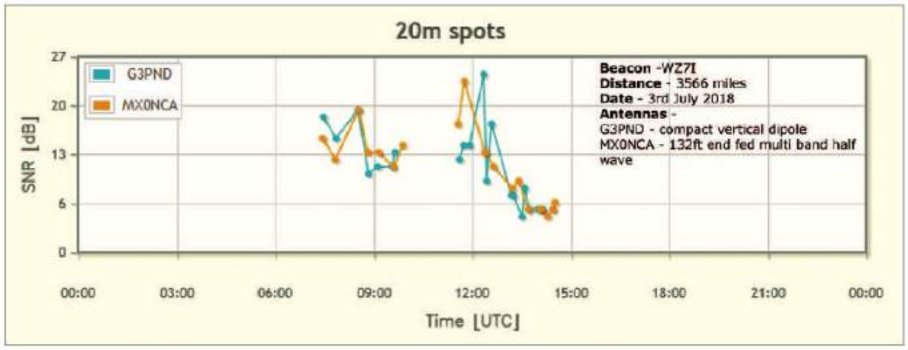


Figure 5 — An antenna comparison conducted on July 3, 2018.

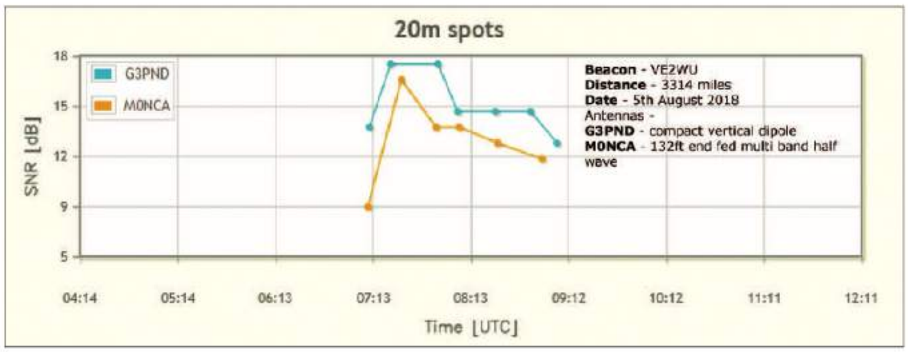


Figure 6 — An antenna comparison on August 5, 2018.

Given its small size, the compact vertical dipole performed amazingly well. For the most part, it matched the performance of the dipole and end-fed antennas and, on occasion, it was the best of the three. Figures 5 and 6 show a couple of the days during the testing period using the RBN Spot Analysis tool. The results from all the beacons that responded to the test transmissions are retained by the Reverse Beacon Network and can be accessed at **www.reversebeacon.net**. To do this, click **MAIN** on the opening page, then **DX SPOTS**, and fill in the date, the region, and the call signs to compare (e.g. G3PND, MXØNCA).

This antenna lends itself to further experimentation, such as determination of the optimum height above ground and versions for other HF bands.

Photos by the author.

Steve Appleyard, G3PND, was first licensed in 1961 while studying electronic engineering in college. He went on to work on the development of communication and navigation systems with the Marconi International Marine Company. In later years, he became the CEO of a number of electrical engineering companies. Now retired, he is secretary of the Norfolk Coast Amateur Radio Society. Steve edited the book *International Antennas*, published in 2017 jointly by ARRL and the Radio Society of Great Britain (RSGB), and he wrote the first chapter, "Using the Reverse Beacon Network to Test Antennas." He is co-author of *Getting Started in EME*, also published by the RSGB. You can contact Steve at **sfappleyard@btinternet.com**.

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

Mini Antenna for 630 Meters

This design earned an Honorable Mention in the 2018 *QST* Antenna Design Competition.

David Day, N1DAY;
Ernie Hollingsworth, KC4SIT, and
Sid Hendricks, W4IOE

This antenna operates on 630 meters from a 30- by 50-inch footprint and incorporates a cage-vertical element that acts electrically like a fat wire that improves its efficiency. The antenna uses an upper coil to tune the radiating elements and a lower coil to tune the ground radial system. This results in less ground resistance loss and improved overall antenna performance.

Modeling using *4nec2* software[1] shows that the antenna has an omnidirectional pattern with a peak gain of –12 dBi at 20-degree elevation.

Construction of the Mini Antenna

The antenna (see Figure 1) comprises radials, coils, a cage-vertical radiator, and a capacitive top hat. Table 1 shows the list of parts.

The Coils

We used a 48-inch-long by 12-inch-diameter cardboard cement-forming tube for the coil form. We then cut 2-inch-wide by 18-inch-long slots at each end to accommodate tapping of the wires with alligator clips for changing coil inductance. We applied four coats of acrylic deck paint to the coil form. The bottom and top halves of the form were each wound with 95 turns (about 300 feet) of

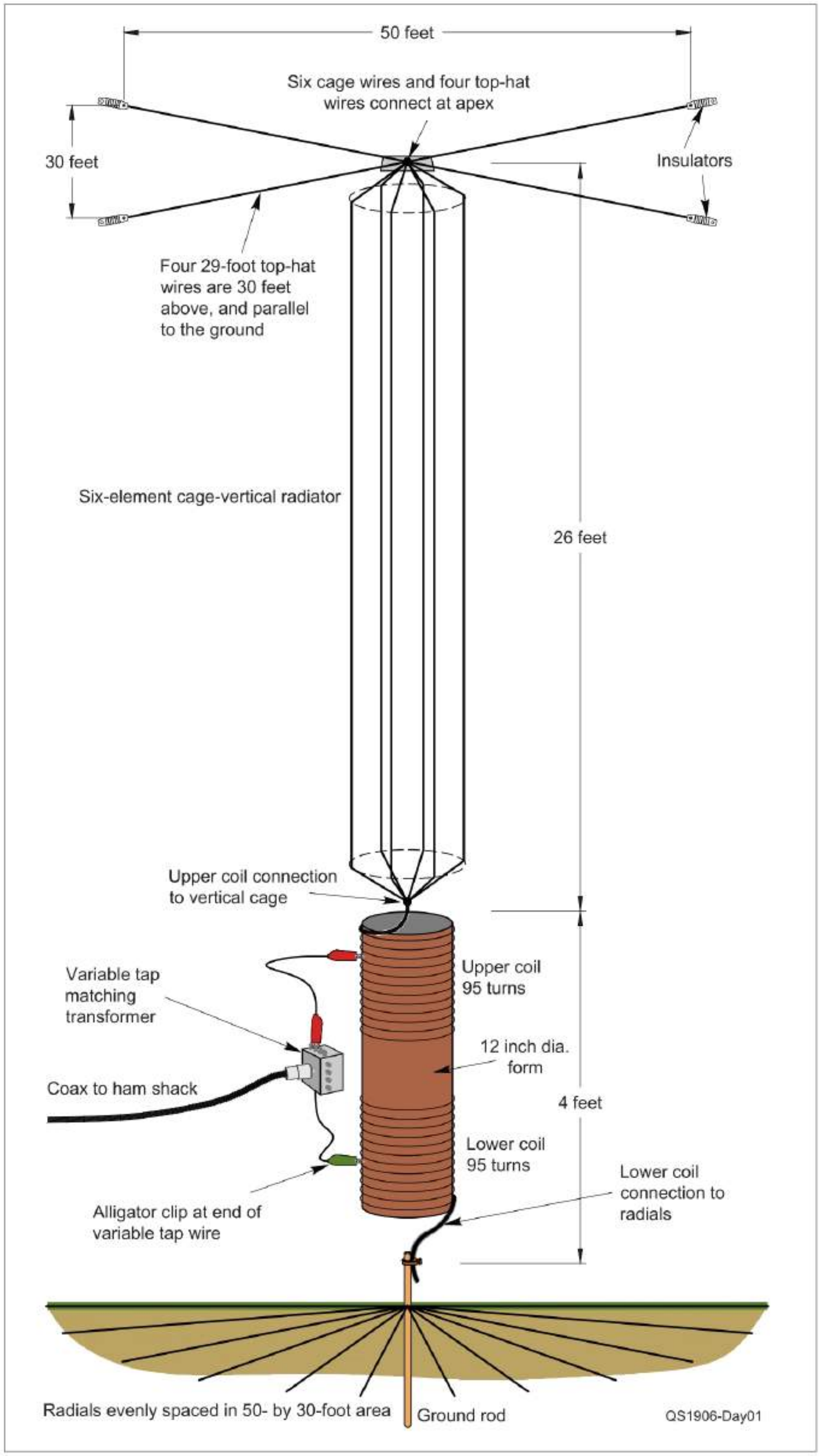


Figure 1 — Schematic of the 630-meter mini antenna.

Table 1
Parts list for the 630-meter mini antenna

Quantity	Item	Cost
2	500' rolls THHN #14 AWG stranded wire [1]	$83.20
1	50' roll THHN #14 AWG solid wire [2]	$12.99
1	12" × 48" cardboard concrete form tube	$13.75
2	12" snap-on plastic bucket lids	$5.96
1	8" PVC coupler [3]	$17.63
4	Nylon insulators	$9.99
1	500' Paracord 550	$34.95
4	Alligator clips	$5.66
1	Mix 77 toroid 61 mm × 35.55 mm × 12.7 mm	$4.26
1	5' of 0.5" copper pipe	$9.99
1	Junction box, 4" × 4" × 2"	$7.09
1	SO-239 connector	$3.89
4	Machine screw, #6-32 stainless-steel	$1.08
4	Nuts, #6-32, stainless-steel	$0.80
4	¼" × 1½" nylon bolts	$2.60
4	¼" nylon nuts	$2.00
4	¼" nylon washers	$1.72
13	8" plastic stake	$30.94
misc.	Various assembly supplies (solder, glue sticks, weatherproofing paint, etc.)	$18.00
	Total cost	**$266.50**

[1] Use a roll each for the ground and antenna coils, and remainders for the radials, the capacitance hat, and the vertical radiators.
[2] For the transformer coils and taps.
[3] Cut to length for apex wire junction.

Figure 2 — The upper coil tunes the radiating element, and the lower coil tunes the radial system. Each coil is comprised of 95 turns spaced one wire diameter apart.

Figure 3 — The bottom of the cage structure attaches to the top of the coil form.

#14 AWG stranded THHN coated wire, which was carefully spaced with one wire diameter. The wires were fixed in place using a hot glue gun. The wire at the base of the bottom coil attaches to the ground radial system, and the wire at the top of the upper coil attaches to the antenna radiating elements. The inner ends of the coils are left open. Once completed, we applied several coats of polyurethane for weatherproofing (see Figure 2).

The Radials

We laid out a 30- by 50-foot rectangle in an open area at David Day's, N1DAY, location, and drove a 5-foot-long, half-inch diameter copper pipe into the ground at the center of the rectangle to form the base of the radial system. Four radials extended 29 feet to each corner of the rectangle, then additional radials were evenly spaced around the perimeter of the rectangle. We staked and buried the ends of the radials 2 inches in the ground.

The Cage Vertical

We drilled six evenly spaced holes through the perimeter of a 12-foot plastic bucket lid, and an additional hole in the center. We also attached six 26-foot THHN #14 AWG stranded wires through each of the perimeter holes. The end of the upper coil wire was brought through the center hole. The lid was then attached to the top of the coil form and secured in place with hot glue. A wiring harness was formed just above the lid to create a common contact point for all six vertical elements. The end wire from the top coil was attached to this harness to serve as the feed to the radiating vertical element. A length of paracord rope was passed through the top of the lid, through the coil tube, and out through a hole in a second bucket lid, which served as the base for the coil form. The rope was eventually secured to a plastic stake and drawn to allow about 3 inches of play (see Figure 3). This limits any tilting and lifting of the coil form on windy days.

The Capacitive Top Hat

We drilled six evenly spaced holes in a 4-inch-deep, 8-inch-diameter ring made from scrap PVC. The top ends of each of the six vertical element wires were threaded one wire to each hole through the PVC ring. Four additional holes were then drilled at 90-degree intervals in the PVC ring to accommodate four 29-foot-long wires that served as the capacitive top hat. This PVC assembly became the antenna apex point for the radiating elements when the antenna was raised.

Two ⅜-inch holes were drilled through opposite sides of the PVC ring, and approximately 150 feet of 550 paracord was threaded through these holes to support the antenna. Nylon insulators at the end of each top-hat wire were attached to trees.

The Transformer

This antenna has about 220 Ω total resistance, so it was fed through an impedance transformer made from a 2½-inch-diameter mix 77 toroid. The primary winding is 10 closely spaced turns of #14 AWG solid THHN wire, wrapped in electrical tape. The secondary winding is wrapped tightly on top of the primary winding, starting with 10 turns. After turn 11, each turn is tapped (see Figure 4). Then all taps are covered with liquid electrical tape and allowed to dry.

An SO-239 connector was attached to the 4 × 4 × 2 inch junction box using stainless-steel bolts. Holes were drilled in the sides of the box for exiting the secondary coil taps. One end of the primary coil was soldered to the center of the SO-239 connector, and the other was firmly attached to one of the stainless-steel bolts and the SO-239 connector

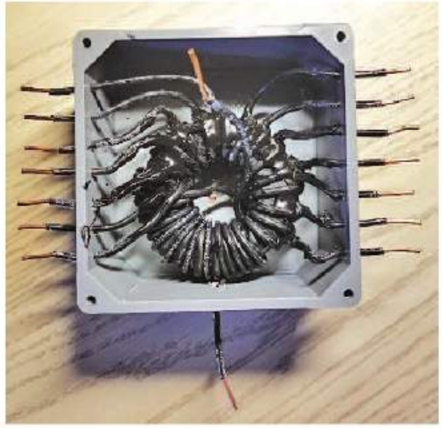


Figure 4 — The matching transformer has multiple secondary taps. All wires are stripped and connected to the coil taps via alligator clips.

frame. The last wrap of the secondary winding was then inserted through a hole to serve as the connector to the ground system coil. An alligator clip was soldered to the end of this wire. Alligator clips were then attached to each end of a 28-inch second wire, which connected any one of the transformer taps to the antenna coil. The transformer was secured to the coil form between the antenna coil and the ground coil (see Figure 2) using nylon bolts. The holes were sealed with liquid tape, both inside and out.

Tuning

Tuning and matching the antenna to 50 Ω coax was greatly simplified by using an antenna analyzer that displays *R* and ±*X* and SWR. Matching was by trial and error.

> *"The bottom and top halves of the form were each wound with 95 turns (about 300 feet) of #14 AWG stranded THHN coated wire, carefully spaced with one wire diameter."*

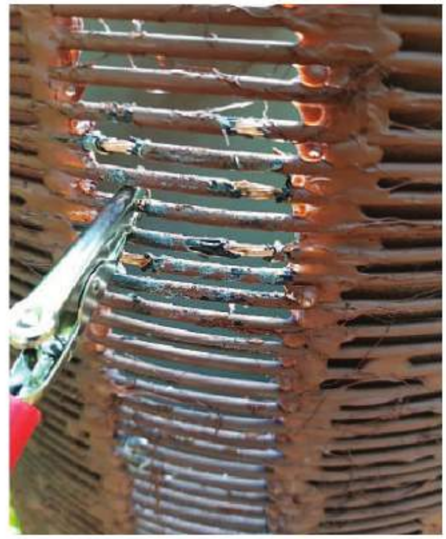


Figure 5 — Variable tap positioning on the loading coil. The wires are exposed on alternate sides of each coil turn, allowing a more secure alligator clip attachment.

We removed the insulation from a single wire at the midpoint of both the antenna and the ground system coils. We then attached the transformer ground wire to the ground coil and attached the antenna matching wire between the antenna coil and any one of the middle taps on the transformer. We attached the antenna analyzer to the SO-239 connector and generated a reading at 475 kHz. If *X* was negative, then we added inductance to either the antenna or ground system. If *X* was positive, we removed coil turns from the circuit.

Exposed wires on the coil (see Figure 5) allowed variable tap positioning. Once *X* was close to 0, we added coil turns to the ground side of the circuit while simultaneously taking coil turns out of the antenna portion of the circuit. An acceptable SWR of less than 1.2:1 could be found with a variety of tapping configurations. After minimizing *X*, we changed the transformer taps to bring the *R* as close to 50 Ω as possible.

Changes in ground moisture required retuning of the antenna. We observed that a finer tuning could be

Table 2
Power density improvement as inductance was moved from the antenna coil to the ground coil. The SWR ranged from 1.08 to 1.17:1.

Antenna coil tap turns; (est. µH)	Ground coil tap turns; (est. µH)	Power density, mW/cm^2
38; (421 µH)	0; (<1 µH)	0.006
14; (91 µH)	28; (264 µH)	0.020
9; (44 µH)	35; (372 µH)	0.020
3; (7 µH)	35; (372 µH)	0.040
0; (<1 µH)	37; (415 µH)	0.040

achieved by moving the tap on the antenna side coil just a turn or two at a time, whereas the ground side appeared to provide coarser tuning.

Testing and Measurement

We measured power density using a Heliognosis power meter positioned 30 feet from the antenna at the same level as the base of the vertical cage structure. We discovered that the RF radiated from the antenna could be improved by moving inductance out of the antenna coil and into the ground system coil (see Table 2). We don't know why, but we hypothesize that tuning the electrically short radial system through the ground coil did more to mitigate ground resistance losses than tuning the antenna solely through the antenna coil.

We configured the taps for a maximum power density response but left room in each coil for future tuning — three turns in the antenna coil and 35 turns in the ground system coil.

We estimated the effective isotropically radiated power (EIRP) of the antenna using methodology described on the NJDTechnologies[2] web page. Our estimates suggest an EIRP of 0.32 W, with a net transmitter power of 70 W.

Safety and End Comments

Be wary of potentially dangerous high voltages inherent to this compact antenna design. Because of the potential for interference with high-voltage electrical transmission lines, the 630-meter operator must gain approval from the Utilities Technology Council (UTC) prior to initiating transmissions.

[RF exposure compliance distance should be carefully evaluated, and can be calculated using *4nec2*. Be sure to evaluate both the *total* H- and *total* E-fields. — *K. Siwiak, KE4PT, for the ARRL RF Safety Committee*]

Operating on 630 meters in a space-restricted environment is both challenging and fun. Have fun getting on the band with the 630-meter mini antenna, but above all, do it safely and obey the rules.

Notes

[1]The *4nec2* NEC-based antenna modeler and optimizer, by Arie Voors, is available from **www.qsl.net/4nec2**.

[2]Estimating EIRP, **njdtechnologies.net/trying-to-figure-out-how-to-measure-the-eirp-of-your-short-vertical-antenna-heres-how/**.

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 participated in the testing of the 630-meter and 2200-meter bands prior to FCC approval for amateur use. Before retiring in 2012, David was employed in the pharmaceutical industry, where he developed and published database-driven evidence-based applications to assist healthcare professionals in individualizing medication therapies to treat a variety of diseases. He holds a Bachelor's and Master's degree in the pharmaceutical sciences from West Virginia University. You can reach Dave at **davidlday@yahoo.com**.

Ernie Hollingsworth, KC4SIT, has been an Amateur Radio operator for over 30 years. His radio activities center on the digital aspects of signal transmission and reception. He holds experimental license WI2XQU. Ernie was an early explorer of the 630-meter band and, with an ideal location atop the Eastern Continental Divide, continues to study propagation and antenna design for that band. He is an active lecturer on various aspects of digital radio communication in the Carolinas. His work includes SSTV transmissions through FM modes of operation and techniques for maximizing the ability to decode signal from both geostationary and low-Earth orbit satellites.

Sidney Hendricks, W4IOE, has been a licensed Amateur Radio operator since 2001 and inherited his call sign from his father. He is a retired truck driver and serves as a reference station in conjunction with local hams who conduct a variety of experiments on the 630-meter band. He has served as an officer in the Blue Ridge Amateur Radio Club and coordinates a number of the club's on-air activities.

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

Feedback

- In the article "State and Regional QSO Parties – Something for Everybody" by Hal Kennedy, N4GG, published in the April 2019 issue of *QST*, a photo caption states that the University of Michigan Amateur Radio Club was the winner of the 2014 Michigan QSO Party. This is incorrect. The Michigan State Amateur Radio Club was the winner of the Michigan QSO Party that year.

- In the article "The Joy of Soldering" by Joseph L. Lynch, N6CL, published in the April 2019 issue of *QST*, an editor's note at the end of the article states that lead/rosin core solder has been outlawed and replaced by lead-free solder. This is inaccurate. While certain restrictions have been imposed in California, Europe, and other areas, the prohibition against lead solder in the United States applies only to its use in plumbing.

3D-Printed Fixture Simplifies Ground-Plane Antenna Construction

A custom plastic framework supports the elements of a homebrew VHF/UHF antenna.

John Portune, W6NBC

Amateur Radio operators have a well-deserved reputation for the ability to repurpose everyday materials for the needs of our hobby. Now, with the wide availability of inexpensive 3D printers, small plastic parts such as dipole feed-point fixtures, antenna trap forms, and special mounting brackets can be purpose-designed and printed out at the amateur's desktop. Figure 1 shows such a fixture — a framework that supports all the elements of a VHF/UHF ground-plane antenna built around an SO-239 coax connector that also conveniently mounts the assembly atop a ¾-inch PVC mast. I have adapted this design from the one published by Laagvlieger at **www.thingiverse.com/thing:1938947**. The design files are available for downloading from my website at **w6nbc.com/3d**.

Ground-Plane Antennas

The antenna is comprised of a half-wavelength ($\lambda/2$), center-fed vertical dipole with the bottom half ($\lambda/4$ monopole) fanned out into two or more radials. Gain and radiation patterns are essentially the same as a vertical dipole. A ground-plane antenna's attractive features include its small size, easy mast-mounting, and direct connectivity to coax.

In order to be directly connectable to coax feed line, the antenna's feed-point impedance is adjusted to that of the coax by varying the angle between the vertical and radial elements.

A full-size $\lambda/2$ dipole in free space has a center impedance of roughly 72 Ω. A ground-plane antenna, with its radial elements perpendicular to the vertical element, has a feed-point impedance of 36 Ω. This is because with straight-out radials, the radial currents are equal in amplitude and phase but run effectively in opposing directions. Hence, radial currents oppose each other and do not contribute to the radiation or the feed-point impedance. Only the half-size monopole on top radiates with half the impedance.

However, if the radials are bent downward away from the vertical element, the radial currents begin to participate in the radiation and feed-point impedance. Think about it this way: If the radials were drooped all the way down, a ground-plane antenna would effectively be a 72 Ω dipole. So, if the radials are bent about halfway down, the antenna will exhibit a feed-point impedance of 50 Ω, making it ideal for direct connection to 50 Ω coax.

This antenna has excellent bandwidth (see Figure 2), but if you use larger diameter elements than described here, the bandwidth will be modestly greater. Figure 3 compares the radiation pattern and gain of this antenna (red) to a vertical dipole or J-pole (blue), with both mounted 10 feet above average soil. With elements

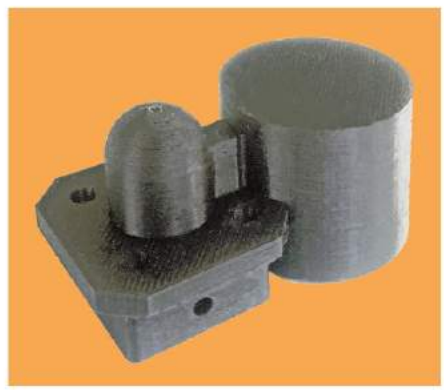


Figure 1 — Purpose-designed and 3D-printed plastic framework for an SO-239 VHF/UHF ground-plane antenna. The cylindrical cap at the right is sized to slip over the end of a ¾-inch PVC pipe mast. Four ground-plane radials bolt to the horizontal member at the left of the mast-mounting cap. The SO-239 coax connector bolts to the radial elements through the bottom of the radial mount with the antenna's vertical element soldered to the connector's center pin and projecting through the dome of the small cylinder atop the radial mounting plate. Silicone is injected through the small hole in the side of the radial mounting plate for waterproofing.

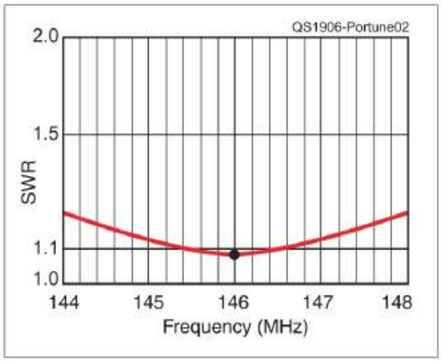


Figure 2 — SWR across the 2-meter band.

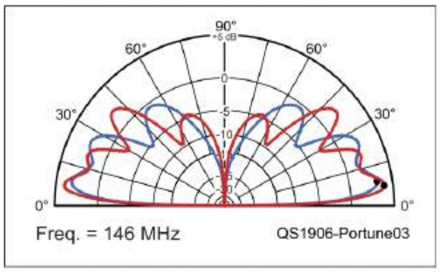


Figure 3 — Radiation pattern and gain of the ground-plane antenna (red) vs. a vertical dipole or J-pole (blue).

made of either wire or tubing, the efficiency is high.

Construction

There are many materials suitable for the whip and radials. The most convenient is solid copper wire, with or without insulation. The lead figure shows #10 AWG bare copper buss wire for the whip and #14 AWG insulated solid house wire for the radials. Attach the radials to the SO-239 connector with either crimp-on ring terminals or small loops bent at the ends.

Soft ¼-inch copper or aluminum tubing also make excellent radial materials. Just flatten ⅜ inch of one end and drill a hole for a 6-32 screw, as shown in Figure 4.

The vertical whip generally needs to be copper or brass so it can be soldered to the connector's center conductor. It is, however, possible with acid flux and liberal scraping to tin the end of a stainless-steel whip for soldering. Note that the plastic part is printed with a tiny hole for the vertical monopole, which must be enlarged to fit your choice of whip.

Table 1
Starting Element Lengths

Band (MHz)	Length (inches)
144	22
220	14
440	7

Four-hole chassis-mount Type N connectors also fit the printed part, and have the added advantage of being more weather resistant than SO-239 connectors. With either, complete the weatherproofing of the coax with vinyl electrical tape.

I added a six-turn 1:1 coiled-coax current choke balun onto the PVC mast (see the lead figure). Secure the balun coax with tie-wraps through $\frac{3}{16}$-inch holes in the mast. Alternately, you may run the coax inside the mast and out through a hole in the side. In that case, small mix-61 ferrite beads can be used for the balun inside the mast. Also, as this is a VHF/UHF antenna, use a minimum of small-diameter coax.

Table 1 gives starting lengths by band for both the radials and whip. The lengths are greater than needed to allow for tuning. Some antenna references show different lengths for radials and whip. This helps with impedance matching on ground-plane antennas with non-drooping radials. Equal lengths work just as well with drooped radials. Impedance is easily set by adjusting the radial droop.

Matching and Tuning

Begin with the radials bent down from the horizontal at roughly 45°. Use an antenna analyzer to find the initial resonant dip, which will be below the band due to the overlong elements. The first step when tuning and matching almost any antenna is to achieve a low SWR (i.e., a good match). Simply adjust the droop angle of the radials to obtain the minimum SWR.

The SWR will change only a little with frequency adjustment. Next, set the frequency (i.e., tune the antenna) by shortening the whip and radials in small increments, keeping all lengths equal. Note that each radial's 1-inch mounting screw is part of its length. As the last step, touch up the SWR by again adjusting the radial droop angle.

Figure 4 — Radials fashioned from ¼-inch metal tubing and attached to the fixture with 6-32 hardware.

Conclusion

The 3D-printed fixture eases construction while serving to align and precisely mount all the antenna elements and provide a convenient mast mount. It makes a great teaching tool because its setup procedure is readily demonstrated to a group.

Photos by the author.

John Portune, W6NBC, is an ARRL member and frequent contributor to *QST*. He has been licensed for 53 years and has held an Amateur Extra-class license since 1972. John has a BS in physics and also holds FCC Commercial General Radiotelephone Operator and FCC Radiotelegraph licenses. He retired as a broadcast television engineer and technical instructor at KNBC in Burbank and then from Sony Electronics in San Jose, California. You can reach John via email at **jportune@aol.com** or through his website at **www.w6nbc.com**.

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

HF Magnetic Loop
for 80 Through 20 Meters

This small HF loop received an Honorable Mention in the 2018 *QST* Antenna Design Competition.

John Chappell, W3HX

This 5-foot-diameter small HF loop (magnetic loop) can be easily elevated to the roof line from an internal courtyard using a portable expandable mast. It can be tuned over its 80- to 20-meter operating range to an SWR of less than 1.4:1. With it, my signals in FT8 mode at 50 W are received by stations around the world. Careful tuning is needed because of the high quality factor (Q).

Design Details

I made the largest loop that I could manage for the target frequency range. It has a high-turn ratio vacuum variable capacitor to resonate the loop, and a stepper motor system with a micro-step driver and low-frequency pulse controller rotating at 0.1 r/min. I feed the loop using a wire-winding coupling method (see Figure 1) rather than the more common secondary feeding loop.

“I made the largest loop that I could manage for the target frequency range.”

The main loop (see Figure 2) is 15.7 feet in circumference, or 5 feet in diameter, and is tuned at the bottom with a wide-range capacitor.

The Feeding System

The loop is coupled to the feeding coax cable by a #10 AWG insulated stranded wire wound around the main loop over a span of 6 inches on each side of the top of the loop (see Figure 1). I used a total wire length of 38 inches — about 20% of the main loop circumference. When tuned to any frequency from about 3.5 MHz to 14.35 MHz, this feeding method results in less than 1.2:1 SWR when the antenna is elevated above ground. I had tried circular coupling loops but could not find a configuration that gave acceptable SWR readings over multiple bands.

Tuning System

The high Q of the antenna makes tuning a challenge. I used a vacuum variable capacitor and turned it with a precision stepper motor (see Figure 3) at 0.1 r/min. The low motor rotational speed was achieved with a 0.9° stepper motor, a 25,600 micro-step driver, and a low-frequency pulse from the stepper motor controller board. The resulting resolution provides very comfortable tuning.

The Tuning Capacitor

I purchased a Comet vacuum variable capacitor rated for 8 – 650 pF at 3.0/5.0 kV. That capacitor has a 10-turn ratio for up to a 3 – 17 MHz tuning range. You can see it at the top in Figure 3.

Figure 1 — Feeding arrangement for the loop.

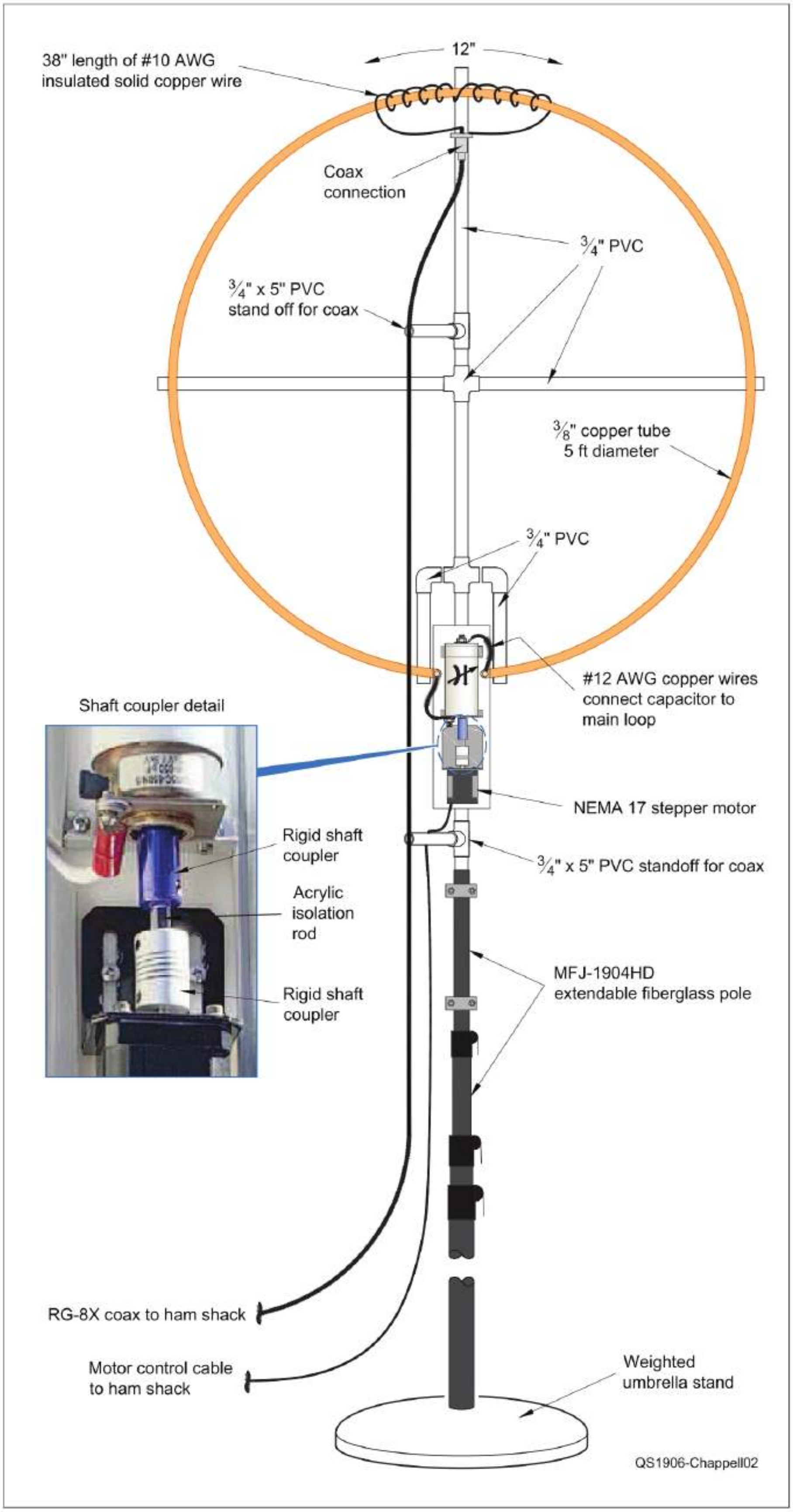


Figure 2 — Dimensions and details of the small HF loop.

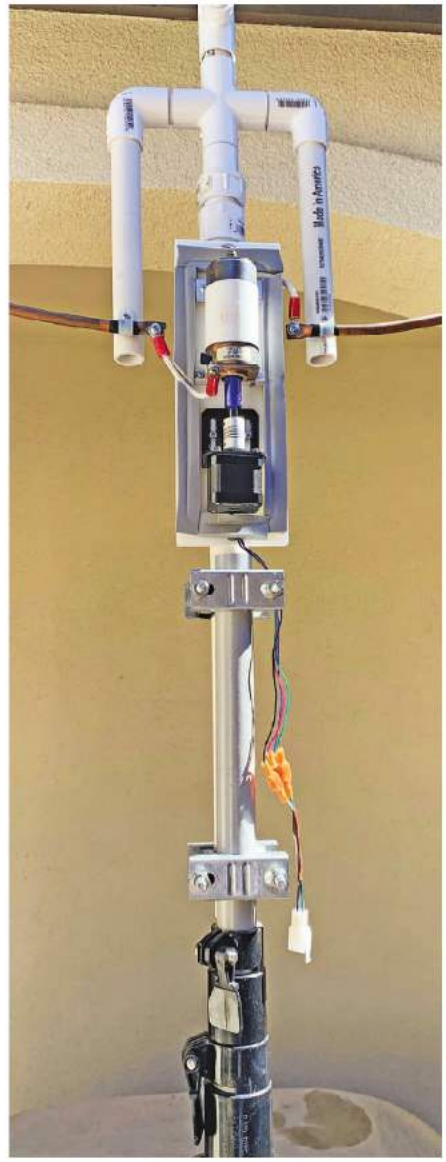


Figure 3 — The stepper motor and coupling (blue) attached to the tuning capacitor assembly, and the lower portion of the loop.

Stepper Motor and Driver

My stepper motor has 0.9° step resolution, which, with a precision driver (see Figure 4) on the most sensitive setting of 25,600 steps, resulted in an acceptable slowing of the motor.

The stepper controller board (see Figure 5) has a speed potentiometer and two switches — one for on/off, and one to toggle up/down tuning. Adjust the potentiometer to the lowest setting for fine tuning. The potentiometer can be set to allow 3 or 4 r/min for gross tuning to another band.

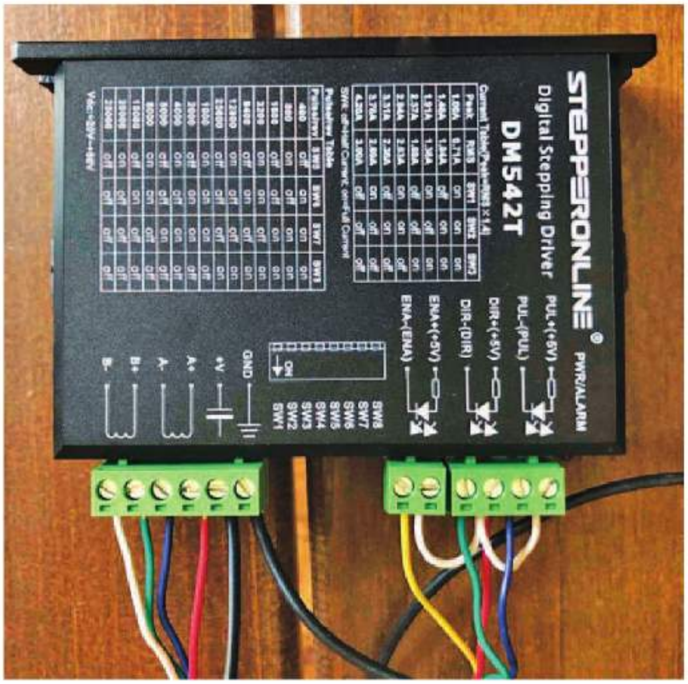


Figure 4 — Driver board for the stepper motor.

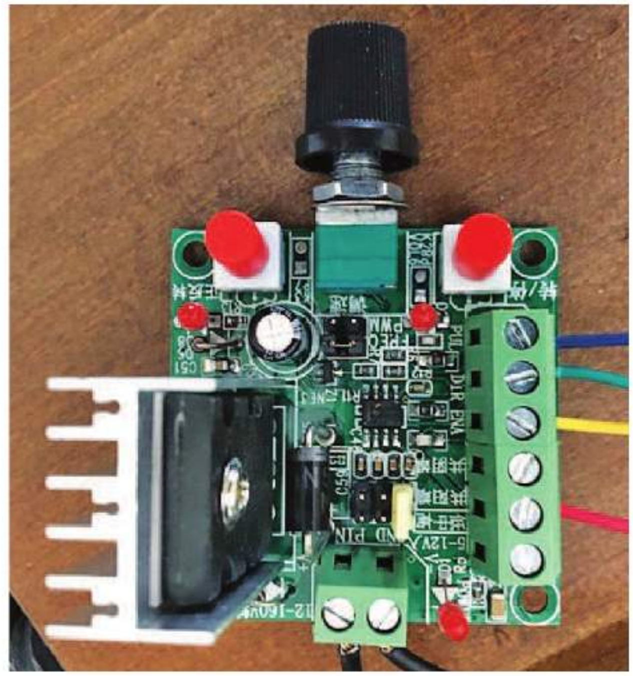


Figure 5 — The stepper motor controller has on/off and reversing switches, and a potentiometer for controlling the motor rotational speed.

Connections

The main loop is connected to the capacitor with #8 AWG solid copper wire, as seen in Figure 3. Isolation is needed between the motor and capacitor to prevent erratic swings in SWR. Typical flexible shaft couplers are undesirable because they produce significant rebound and erratic tuning when turning the shaft by the stepper motor. I used an acrylic rod connected to shaft couplers. Using rigid shaft couplers with a very short section of acrylic rod (see Figure 3) gives very tight coupling between the motor and capacitor, resulting in smooth tuning.

I used RG-8X coax to connect the antenna to the transceiver. The SWR becomes unstable if the coax touches any part of the antenna, so standoffs on the PVC structure (see Figure 2), hold the coax away from the antenna, motor, and capacitor.

Metal parts must be minimized and isolated from the motor, capacitor, and loops. I used plastic and non-conductive materials everywhere, including the PVC structure, motor isolation, loop-securing brackets, and weather cover.

The SWR of the antenna near the ground was typically less than 1.4:1 and decreases when the antenna is elevated. The antenna should be kept away from rain gutters and other parts

Table 1
Materials List

Item	Description	Source
Main loop	⅜-inch-diameter flexible copper tubing	Home improvement store
Coupling wire	#10 AWG insulated	Home improvement store
Tuning capacitor	Vacuum variable 8 – 650 pF at 5 kV, Comet CV05C-650N/5	**ebay.com**
Stepper motor	NEMA17, 0.9° step angle	**amazon.com**
Capacitor and motor mount	0.5 × 3.5 × 10.5 inch piece of nylon sheet	**amazon.com**
Motor controller	Stepper Motor Controller PWM Pulse Signal Generator Speed Regulator Board, DC 15-160V/5-12V	**amazon.com**
Motor driver	STEPPERONLINE DM542T, digital stepping driver, up to 25,600 steps	**amazon.com**
Power supply	24 V dc power supply for controller board, stepper driver, and motor	—
Coax connector	SO-239	**amazon.com**
Coax	RG-8X	GigaParts
Frame structure	¾-inch PVC components	Home improvement store
Weather cover	Plastic bin fit against the nylon sheet using weather stripping	The Container Store
Mast	MFJ-1904HD fiberglass pole	**mfjenterprises.com**
Mast base	Weighted umbrella stand	—

Figure 6 — The control box is to the right of the transceiver under the power supply. The two buttons activate loop tuning, while the potentiometer sets the tuning speed.

Table 2
Calculated Loop Data

Frequency	3.5 MHz	7 MHz	14 MHz
Efficiency	2.4%	22.1%	76.2%
3 dB bandwidth	5.18 kHz	9.2 kHz	42.5 kHz
Tuning capacitance	408 pF	92 pF	13.4 pF
Q	675	763	329

Design Calculations and RF Exposure Safety

I used the Small Magnetic Loop Antenna Calculator by Steve Yates, AA5TB, (available at **www.aa5tb.com/loop.html**) as modified by Dave Freese, W1HKJ, (**www.w1hkj.com/magloop/**) for the basic design. Table 2 summarizes the calculations.

[RF exposure compliance distance should be carefully evaluated on all three axes. For examples, see "RF Exposure Compliance Distances for Transmitting Loops, and Transmitting Loop Current (Technical Correspondence)," *QST*, May 2017, pp. 64 – 65. Compliance distances can be calculated using *4NEC2*, but be sure to evaluate both the *total* H- and *total* E-fields on all three axes. — *K. Siwiak, KE4PT, for the ARRL RF Safety Committee*]

of the house. My antenna is located in an internal courtyard of a one-story house and is elevated to the roof line (limited to 25 feet) when in use. I used a heavy-duty MFJ Enterprises MFJ-1904HD expandable mast seated in a weighted patio umbrella stand. Table 1 shows the loop antenna materials list.

Performance

Figure 6 shows the tuning control box to the right of an HF transceiver. The box houses the driver and controller. The tuning components are powered by the 24 V dc supply on top of the control box.

A small vertically oriented loop antenna near the ground has a figure-eight pattern at low elevation angles, with the maximum radiation in the plane of the loop. [The polarization of a small HF loop is aligned with the main loop conductor; it is vertical on the horizon and horizontal in the skyward direction. — *Ed.*] At higher elevation angles, the pattern becomes oval shaped, giving the impression of omnidirectional coverage.

Actual observed propagation seems fairly insensitive to antenna direction, implying that the propagation is via skywave from high elevation angles. Regardless of antenna direction, and with 50 W transmitted, my FT8 reports came from all directions and worldwide distances on 20 meters. It is similar on 40 meters, but over shorter propagation distances. Propagation on 80 meters covers the entire US regardless of antenna position, but very few propagation reports were received beyond the US.

The approximate costs of my antenna include $159 for the mast, $125 for the capacitor, $60 for the stepper motor, driver, and controller, and about $100 for various home improvement store items, for a total of $435. The antenna is completely invisible to neighbors.

John Chappell, W3HX, first held a General-class license in 1965. He took a long break, then renewed his license in December 2014. He holds a BS in mathematics and an MBA. During his professional career, he led various management positions within the medical device industry across manufacturing, engineering, quality, regulatory, and consulting departments. Recently, he has been designing and optimizing loop antennas, and operates FT8 to get feedback for testing system performance. You can reach John at **jchappell@cericon.com**.

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

Double-Topped Flagpole HF Antenna

This multiband design received an Honorable Mention in the 2018 *QST* Antenna Design Competition.

Don Crosby, W1EJM

The double-topped flagpole HF antenna (DTFA) covers 80/75 meters to 10 meters (except 30 meters), often with the use of only a transceiver internal tuner. This antenna uses a vertical mast/flagpole as the feed line and two wires of unequal lengths to resonate the antenna on 75/80 and 40 meters (see Figures 1 and 2). The DTFA functions well with wire angles between 60° and 180° and over a variety of radial footprints. A key benefit of the design is that it avoids using highly visible coax or window-line feeder, insulators, baluns, isolators, or traps.

Designing the Antenna

EZNEC software[1] allowed me to determine the flattop lengths for my first prototype antenna. Its performance is shown in Figure 3. During further testing, there was good agreement between the computer models and the experimental data measured on four installed

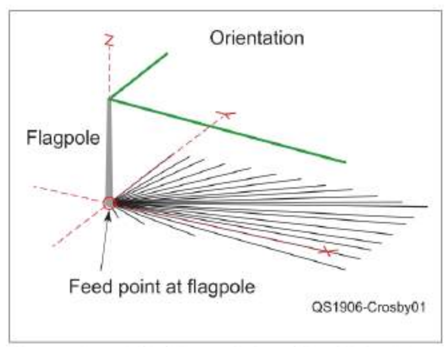


Figure 1 — The flagpole location. The thin horizontal wires are nearly invisible.

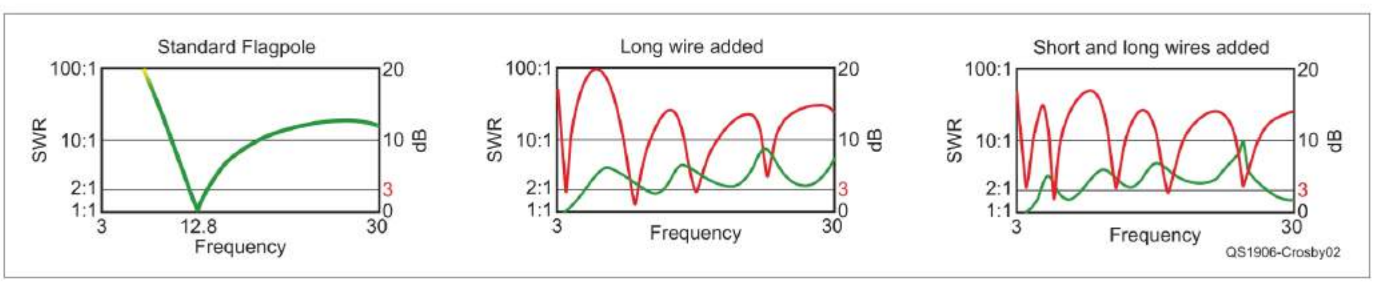


Figure 2 — The left curve shows a 20-foot flagpole with one SWR dip at quarter-wave resonance for a gain of 0 dBi (or less) on all bands. The middle graph shows the attachment of a 50-foot wire, creating four SWR dips (red curve), one in the 75/80-meter band and others harmonically related, with a gain (green curve) rising above 2 dBi on all bands above 5 MHz. On the right, 25-foot and 50-foot wires are attached, and a fifth SWR dip appears near 7 MHz, gain rising above 2 dBi on all bands above 5 MHz.

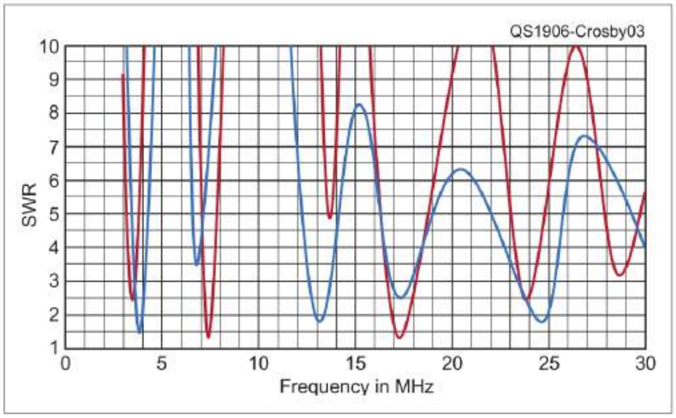


Figure 3 — The SWR at the base of the flagpole, as calculated by NEC, is shown by the red line. Actual measured values are shown by the blue line.

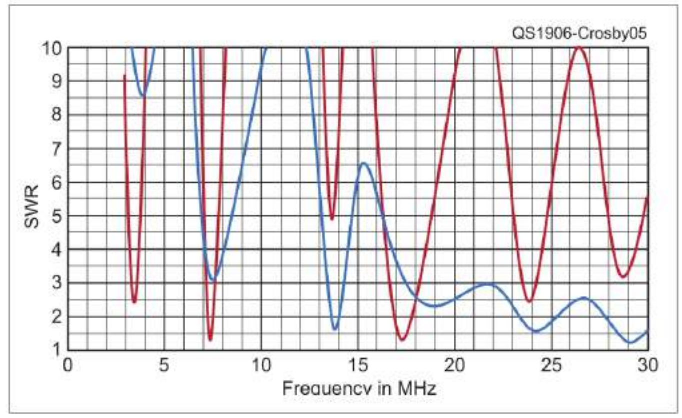


Figure 5 — The SWR feeding directly from a 50 Ω feed line is shown in red. The SWR as seen through a 50 to 200 Ω unun is shown in blue.

antennas. Various lengths for the top wires were explored using NEC simulations. Two unequal length wires could provide a six-band match on 75, 40, 20, 17, 12, and 10 meters.

There are four installations of the DTFA near my locale, each having variations in the mast/flagpole height and the radial footprints. Those variations are accommodated by trimming the flattop wires. See the "*QST* In Depth" web page, **arrl.org/qst-in-depth**, for the extensive test details and radial footprints.

For the 2018 *QST* Antenna Design Competition, maximum dimensions specified a 30 × 50 foot plot size with a 30-foot height limitation. The engineering test version of the DTFA used mast heights of 20 feet and 25 feet. The horizontal wires are not noticeable, being 0.03 inch in diameter. They are nominally 49.7 feet and 22.5 feet and ranged in separation angles of 30° to 180°. These thin wires handle the SSB legal-limit power with only about 0.2 dB in wire loss.

Figure 4 — The thin wires attach to the pole with a hose clamp, using soft sleeves to protect the wires.

The engineering test was conducted with 24 radials on ground within the competition-mandated 30 × 50 foot area. The mast/flagpole is insulated and fed at the base. Three driven ground rods 8 feet in length are also at the base.

Testing the Prototype

I standardized a 20-foot mast/flagpole height for use in the installations (see Table 1) where the antenna wires had an 85° to 110° angle between them to conform to the available plot size. I made my mast/flagpole from 2-inch-diameter aluminum with a .06-inch-thick wall that acts as a feed line for the horizontal wires. However, the mast can be any 20- to 25-foot-long conductive pole that is insulated from ground at the feed point, or a non-conductive mast with #16 AWG insulated wire as the vertical electrical member. The insulated base mounting is similar to that used in a previous project.[2] Stainless-steel hose clamps are used for connecting the horizontal wires to the mast (see Figure 4). Strain relief of the wires is important for reliability. Ideally, the wires are routed through 2-millimeter ID Teflon™ tubing, entering on the low side of the clamp. The bare wire ends must contact the mast. In use, the wire exits the clamp in the direction the wire would tend to run.

Table 1
Installed Dimensions, Feet

Location	Pipe height	Angle	Long wire length	Long wire end height	Short wire length	Short wire end height	Wire orientation
Site 1	21.25	110°	45.1	8.5	24.2	8.5	Slanted down
Site 2	20	80°	46	17	27	17	Slanted down
Site 3	25	180°	49.7	19.7	22.5	15	Drooping
Site 4	20	90°	50	10	26.5	20	Long droops, short flat

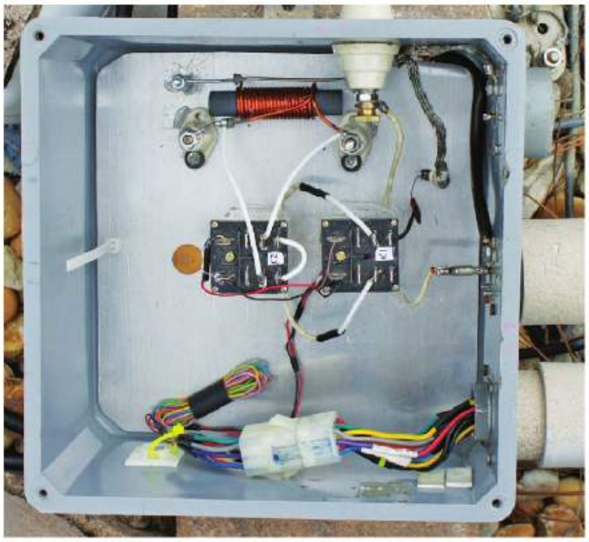


Figure 6 — The relays and step-up transformer are housed in a weatherproof box.

Safety Caution

Because high-voltage points and radiating parts of this antenna are close to areas where persons or pets might be present, danger from RF radiation must be considered. FCC rules require that an evaluation be performed if any antenna is used with more than 500 W PEP on 75 or 40 meters, 225 W on 20 meters, 125 W on 17 meters, 100 W on 15 meters, 75 W on 12 meters, or 50 W on 10 meters. Instructions for doing this evaluation can be found at **www.arrl.org/rf-exposure**. In addition, because direct contact with RF voltages can cause painful burns, unless provisions are made to prevent persons or animals from approaching the antenna during operation, the flagpole should be insulated up to a height of 10 feet and the ends of the wires should not be reachable from the ground. Place a low wall — such as that shown in the lead photo — to prevent close approach to the flagpole. This wall will conceal the switch box and insulating mount from view and make contact more difficult.

About 500 total feet of radials were installed within the available space. In three cases, the radials were installed in existing lawns by using an electric string trimmer to "scratch" a notch to the depth of the grass-earth level and the insulated radial wires were installed in the notch and held in place with radial anchor pins.

In the first prototype, I used 60 feet of direct burial 50 Ω coax with the center conductor connected to the mast/flagpole, and the sheath to the radials. The internal tuners in my transceivers (an Icom IC-7300 and Kenwood TS-570) were able to tune most bands (see Figure 3), but I opted to add a 1:4 unun as a step-up transformer (relay selected) to improve the match on the high bands where the antenna impedance is nearer to 200 Ω, as shown in Figure 5. The unun allows higher power operation by lowering the SWR and the losses on the coax. A remotely located auto tuner is another good solution but is costly if using legal-limit power.

I used double-pole, double-throw power relays with 12 V dc coils and housed them with the step-up transformer in an 8 × 8 × 4 inch weatherproof box, available at most hardware stores (see Figure 6). The schematic of the remote switch box and control switch is shown in Figure 7.

I used a RigExpert AA-55 Zoom Analyzer to collect data for various heights, angles, and wire lengths. The measured data confirmed that the angle between the wires can be varied between 180 degrees to as little as 60 degrees with minimal effect on the SWR curve. The ends of the flattop wires could be bent down to make the antenna fit into a smaller area. However, to prevent persons or pets from contacting a high voltage, wire ends would be kept at least 8.5 feet above the ground level (see the sidebar, "Safety Caution"). DTFAs are

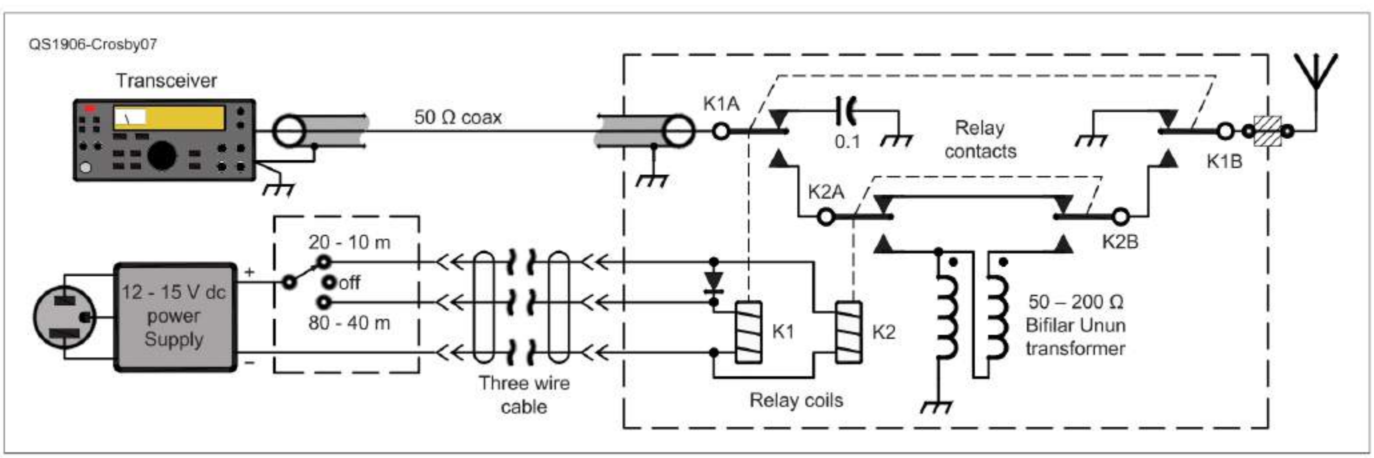


Figure 7 — Schematic diagram of the remote switch box and its control switch in the shack. The antenna and transceiver are grounded when the switch is off. The 80- to 40-meter position connects directly to the antenna. The 20- to 10-meter position connects via the 50 to 200 Ω transformer. Relay contacts are shown in the off position.

Trimming Procedure

1 Start with the 60-foot and 30-foot wire lengths. Lowering the wire at the far end, adjust the length and raise the wire back to position.

2 For the 75- or 80-meter frequency tuning, use an SWR meter to find the dip frequency, and write down the frequency and the wire length. Trim the long wire by folding it back on itself about 2 feet. Then find the new dip frequency and write that down. Continue until you are close to the desired dip frequency. Note that you should save your data in case a wire breaks someday.

3 For 40-meter frequency tuning, use an SWR meter to find the dip frequency, and write down the frequency and the length. Trim the short wire by folding it back on itself about 1 foot. Use the SWR meter to find the dip frequency and write it down. Then fold back 1 more foot of the short wire, and find and record the new dip. Continue until you are close to the desired dip frequency. Save the data.

4 Check the 75-meter frequency. It should not have changed by more than 10 or 20 kHz. If it is too high, unfold about 1 foot from the long wire and measure again. Repeat until you are on frequency on 75 meters. Save the data.

installed in our community as listed in Table 1. There are slight differences between them due to property limitations, but the performance is similar.

Calculated and Measured Performance

I compared the two-wire NEC model to the actual measured SWR for the prototype antenna using measurements from the Rig Expert AA-55 with a 50 Ω reference. The good agreement of the curves shown in Figure 3 showed that the antenna is working as expected. On 75/80 meters, the antenna functions with high currents in the mast and the long horizontal wire as a low current flows into the short wire. The longer wire length is used to set the center of the desired 200 kHz bandwidth within the 75/80-meter band. As with most 75/80-meter antennas, the band is wide compared to antenna bandwidth of about 200 kHz for low SWR. My in-shack tuner (Palstar AT2K) allows tuning anywhere in the 500 kHz band limits. On 40 meters, high current flows in the vertical mast and on to the short wire, which is used to resonate the antenna on 40 meters while less current flows on the long wire. The antenna is broadband on 40 meters, so I trimmed the short wire to the middle of the band (see the sidebar, "Trimming Procedure").

For both 75 and 40 meters, a number of patterns were run on NEC with angles between the two top wires varying between 60 and 180°. The 80/75-meter DTFA patterns were nearly omnidirectional with radiation at both high angles for NVIS and lower angles for further distances. The azimuth and elevation angles did not vary significantly between the various patterns. For intermediate distances, the 75-meter signal will be about 0.5 dB stronger in the direction of the short wire. On 40 meters, the DTFA showed a broad pattern steered by the longer wire with about a 5 dB front to side ratio.

We conclude that the design is very tolerant of various wire angles and they can be chosen to fit on the property and to use available supports at the far end. The antenna is also tolerant of some variations such as lower end heights, droop in the wires, or a shorter metallic pole.

Many patterns for 20 – 10 meters were plotted from NEC with a 90° angle between the two top wires. The antenna exhibits multilobe gain and notch patterns on the higher bands. These patterns are consistent with off-center-fed half-wave or longer dipoles with more energy at lower takeoff angles. The gain increased from near 0 dBi to as much as 7 dBi, increasing with frequency. The highest gain lobes were in somewhat random directions. Plots of the patterns produced by these tests can be found on the "*QST* in Depth" web page at **www.arrl.org/qst-in-depth.**

Notes

[1] I used *4nec2* and *Nec2Go* antenna modeling programs for detailed modeling and used EZNEC for display of currents in the wires.

[2] A similar antenna using this same flagpole is described in the May 2018 issue of *QST*, pp. 46 – 49. Details of the insulated base mounting are pictured there.

Photos by the author.

Don Crosby, W1EJM, first licensed in 1956 as KN2VVN, changed call district, and was assigned W1EJM in 1967. Don, a member of ARRL for 53 years, earned a BSEE from Fairfield University (BEI) in 1973 and holds two patents. Don's career was in the satellite optical system area, working on programs such as the pre-Apollo Lunar Orbiter mapping satellite cameras, the Hexagon Big Bird KH-9 Reconnaissance satellites, and the Hubble Space Telescope. Now retired, his ham interest has focused on stealthy HF antennas. Don and Marilyn reside in The Villages, Florida, have been married 56 years, and have two adult children. You can contact Don at **w1ejm@arrl.net** or through his website, **www.w1ejm.com**.

Don would like to thank Ken Olmstead, KA1NNR, for his contributions to this project. Licensed in 1985, Ken held a career in electronics and computer support, and is a hands-on problem solver. He provided hours of support on this and other antenna projects as a technical sounding board and measurement assistant.

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

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

Product Review

Explore the *QST* Product Review Archive
www.arrl.org/qst-product-review-and-short-takes-columns
Search reviews by year or issue of publication, or by manufacturer's name.

Kenwood TS-890S HF and 6-Meter Transceiver

Reviewed by Mark Wilson, K1RO
QST *Product Review Editor*
k1ro@arrl.org

The TS-890S slots into the middle of Kenwood's home station transceiver family, although in features and performance it's closer to the top-of-the-line TS-990S than to the TS-590SG. It covers 160 through 6 meters with a high-performance receiver on all bands and a very clean 100 W transmitter. There is one receiver, and it's a conventional down-conversion design with selectable roofing filters and DSP signal processing. The TS-890S is a fairly big desktop radio with a 7-inch TFT color display and large, nicely spaced front-panel controls. Voice guidance, which announces a number of operating parameters, and a high-stability oscillator are built in.

Typical of today's high-end transceivers, the TS-890S offers an astonishing array of features and customizable settings. The printed instruction manual is thorough, although there were times when I needed to play with the controls a bit to understand how to do something.

To learn more about specific features of interest to you, I recommend downloading the *Instruction Manual* from Kenwood's website. It offers color illustrations, and searchable text helps with locating information. There's also an active online group devoted to this radio at **groups.io/g/TS-890**.

Initial Setup

The shipping box includes the TS-890S, a dc power cable, seven-pin and 13-pin DIN plugs for accessory jacks, a couple of fuses, a printed *Instruction Manual*, and a set of schematic diagrams. This radio doesn't include a microphone, but many good choices are available.

The rear panel (see Figure 1) isn't particularly crowded. The two SO-239 antenna jacks are switchable from the front panel and remembered for each band. The **KEY** connector is for using a paddle with the internal CW keyer, or for connecting an external keying device. (This functionality is duplicated on the front-panel **PADDLE** jack.) The **EXT.SP** jack provides plenty of audio for an external 8 Ω speaker.

There's an **RX IN** phono jack for use with a separate receive antenna, and that can be paired with the **RX OUT** phono jack to install an external band-pass filter, preamplifier, or other device in the receive path. I used the **RX IN** jack for listening on the low bands with my K9AY loop antenna.

Bottom Line

Kenwood's TS-890S offers excellent RF performance on receive and transmit, and a wide range of features. The large front panel, nicely spaced controls, colorful display, and informative menus make it easy to interact with the radio.

Press the front-panel **RX ANT** button to switch between listening with the main antenna or receive antenna. The **ANT OUT** phono jack provides an antenna connection for a separate receiver. The **DRV** phono jack provides a low-level (1 mW) transmitter output for use with a transverter or for driving an external amplifier for the 630- and 2200-meter bands.

The seven-pin DIN **REMOTE** jack has connections for an external linear amplifier and is configured with the **LINEAR AMPLIFIER** menu. The solid-state switching option (Pin 7, **LKY**, on the **REMOTE** jack) is the one to use with modern amplifiers. Options are **ACTIVE LOW**, which will switch up to 50 V dc at 100 mA, or **ACTIVE HIGH**, which outputs 12 V at up to 100 mA.

If your amplifier control circuit exceeds those ratings, you can enable the transceiver's internal relay. Note that the TS-890S is silent when switching between transmit and receive using the solid-state amplifier switching, but clicking is audible when the internal relay is enabled.

The adjustable **TX DELAY** function introduces a delay between the time the amplifier control switches and RF output appears at the TS-890S antenna jack. The delay setting should be longer than your amplifier switching time.

The 13-pin DIN **ACC2** jack provides connections for digital mode operation and includes an FSK RTTY keying input, PTT control, fixed-level audio input and output for sound card digital modes, and other functions.

The **DISPLAY** jack is a DVI connector for using an external monitor to show the contents of the TS-890S display. It looked great on my 20-inch wide-screen computer monitor using the 840 × 480 pixel setting.

The USB-A connector is used with a flash drive for saving radio configurations, recorded audio messages, and other data, or with an external USB keyboard for sending text or programming message memories on CW, RTTY, or PSK. There's a second USB-A connector on the front panel.

I didn't try the BNC connector for use with an external 10 MHz reference oscillator or the 3.5-millimeter **METER** jack for viewing S-meter and transmit metering levels on an external display.

Computer Control and COM Ports

The USB-B connector is for connection to your station PC. You can use it for radio control, digital mode audio input and output, interfacing with Kenwood's companion *ARCP-890* software, firmware updates, and so on.

Figure 1 — The TS-890S rear panel.

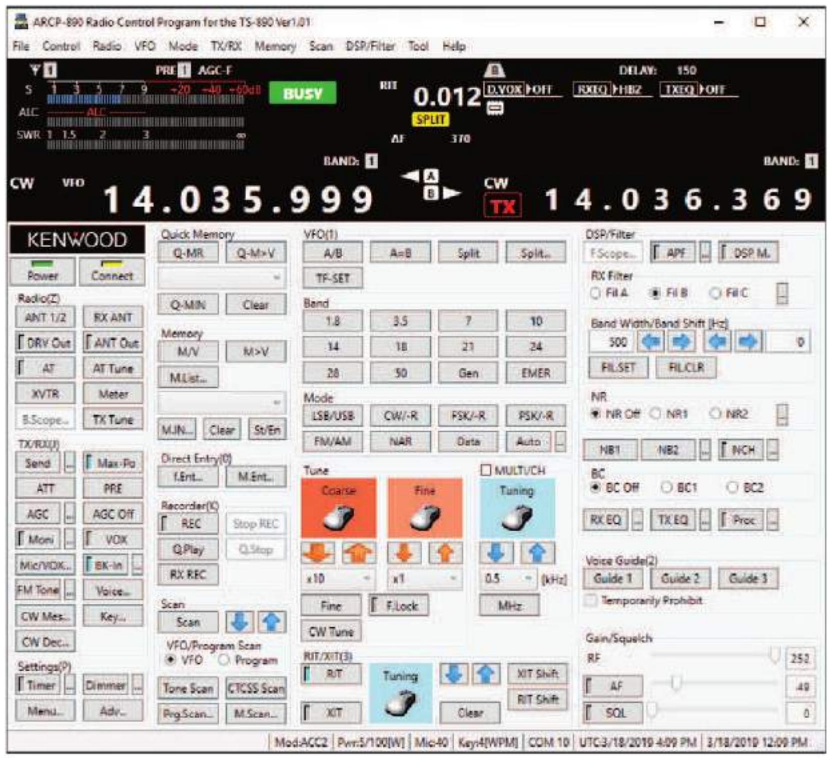


Figure 2 — The companion *ARCP-890* Windows software can be used for adjusting most transceiver features or operating the radio remotely.

To use the USB interface, before connecting the cable between radio and computer, you must download and install the Silicon Labs CP210x virtual COM port driver from Kenwood's website. Once this is installed, connect the TS-890S to your PC with a standard USB-A to USB-B cable and apply power to the radio. In your PC's **DEVICE MANAGER** screen, look under **PORTS (COM & LPT)** for **SILICON LABS CP210x USB to UART Bridge (COMxx)**. There will be two new virtual COM ports, one "standard" and the other "enhanced." Kenwood's online instructions show how to tell the difference.

I used the standard port (COM10 on my computer) and had no problems interacting with the radio using several logging and digital communications programs. The TS-890S also has a nine-pin RS-232 COM port that provides an alternative for computer control or interfacing with other station equipment, such as external antenna switches or band-pass filters. I used the USB connection with my station PC and the COM port for interfacing with my SPE solid-state automatic power amplifier. It all worked together seamlessly.

The *ARCP-890* software (see Figure 2) allows changing and saving many of the radio's settings. In conjunction with the Kenwood's Network Command System (KNS), it also allows remote operation of the radio over a home local area network (LAN) or via the internet. The rear-panel **LAN** jack is for an ethernet connection to a PC or router. The 73-page *Kenwood Network Command System Setting*

Manual available online shows how to set up and use this feature.

"Split Transfer A" allows interconnecting the TS-890S with a TS-590SG or TS-590S and then using the other radio as an external sub-receiver for split operation or dual-frequency reception. The radios share frequency and mode information via the COM port, and the antenna is shared through the **ANT OUT** and **RX ANT** jacks. (Note that you need to update the TS-590 firmware to use this feature; see **www.kenwood.com/i/products/info/amateur/software_download.html**.) "Split Transfer B" is a similar feature for older Kenwood transceivers.

Interacting with the TS-890S

The 7-inch color display on the left side of the front panel shows a wealth of information about the radio (see Figure 3). There are several background color, function key label, frequency display font, and screen saver options available.

The meter in the upper left corner can be a very good virtual representation of an analog meter with a white or black background, or it can be a digital bar graph meter. Touch the screen on the meter face to run through the options. The meter presentation changes automatically to a space-saving bar graph when other features require screen space.

In addition to the usual frequency and mode information, there's a "filter scope" in the upper right corner that shows signals in the receive filter passband, along with the filter characteristics. Response is quick enough to use it as a tuning aid for CW, PSK, or RTTY signals. The graphic changes as the filter bandwidth is narrowed or widened.

There are seven function keys along the bottom of the screen, and another seven along the right side. Labels for these keys are displayed on the screen, and their functions change when different modes of operation and other features are selected.

While exploring various menus and function keys, I pressed the **SWL** button and was rewarded with a display reminiscent of the classic shortwave receivers I grew up with (see Figure 4). Frequency labels are in "megacycles," completing the retro look.

For many of the front-panel pushbuttons, press once to turn the function on and off, and press and hold to adjust settings for that function. For example, press the **AGC** button to switch among fast/mid/slow, and press and hold for a menu to adjust the time constant for each setting or turn AGC off.

Press the **MENU** button, and the lower half of the screen displays a series of menus that control the radio's functions and behavior. There are many choices in the menus, but descriptions are in plain English, and the top level has a useful list of the types of adjustments available in each group. After using it a couple times, I found navigating the menu system and selecting and changing menu parameters to be straightforward, using the function keys along the bottom and right side or the **MULTI/CH** knob.

Three **PF** (programmable function) keys can be customized for one-touch access to a wide variety of features from a very long list. For example, I set one **PF** key for the **TUNE** function (transmits an adjustable low-power carrier for tuning an amplifier or external antenna tuner).

Band Scope

The TS-890S band scope uses a separate SDR-type receiver at the first IF, ahead of the roofing filters. With a press of the **SCP** button, you can switch among spectrum scope, combination spectrum scope/waterfall, or an extended (taller) spectrum scope/waterfall. You can also touch the screen to select signals in the band scope and the transceiver will tune there. A small version is available when other windows are active.

Frequency span can be as narrow as 5 kHz or as wide as 500 kHz. Waterfall scrolling speed is adjustable in four steps, taking about 45 seconds to fill the waterfall at the slowest

Figure 3 — The TS-890S display during SSB operation with the spectrum display/waterfall window set to show 50 kHz of the 20-meter band.

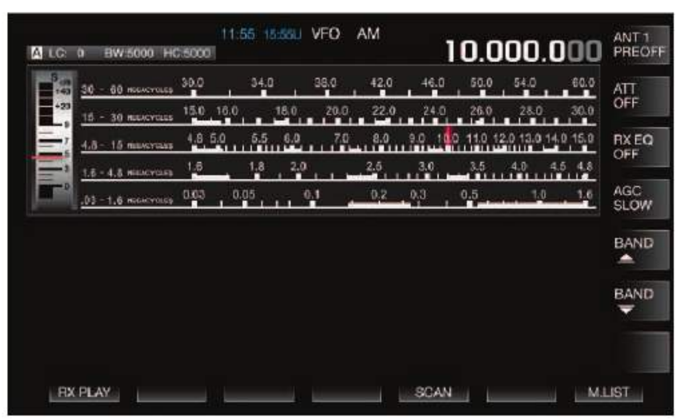


Figure 4 — Listening to WWV on 10 MHz with the display set to SWL mode, emulating a classic shortwave receiver.

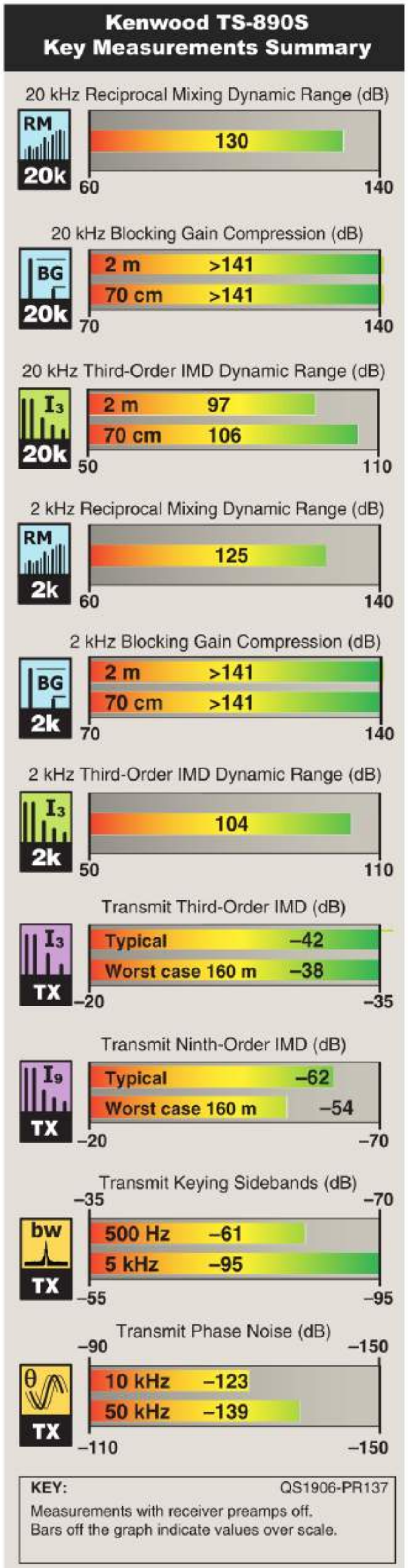


Table 1
Kenwood TS-890S, serial number B8830121

Manufacturer's Specifications	Measured in the ARRL Lab
Frequency coverage: Receive, 0.03 – 60 MHz; transmit, 160 – 6 meter amateur bands, including 5.25 – 5.45 MHz.	Receive and transmit, as specified.
Power requirement: Transmit, ≤22.5 A (maximum). Receive, ≤2.5 A at 13.8 V dc (±15%).	At 13.8 V dc: Transmit, 18 A (typical), 10 A (AM) at maximum RF power output; 6.5 A at minimum RF output. Receive, 1.7 A (maximum brightness), 1.57 A (minimum brightness). Power off, 3 mA
Modes of operation: SSB, CW, AM, FM, FSK, PSK, SSB-DATA.	As specified.
Receiver	**Receiver Dynamic Testing**
SSB/CW sensitivity: 0.5 µV (0.13 – 0.522 MHz) 4.0 µV (0.522 – 1.705 MHz) 0.2 µV (1.705 MHz – 24.5 MHz) 0.13 µV (24.5 – 30, 50 – 54 MHz).	Noise floor (MDS), 500 Hz bandwidth, 500 Hz roofing filter: *Preamp* *Off* *1* *P2* 0.137 MHz –130 –135 –137 dBm 0.475 MHz –129 –135 –138 dBm 1.0 MHz –113 –120 –122 dBm 3.5 MHz –131 –139 –142 dBm 14 MHz –131 –141 –143 dBm 50 MHz –129 –140 –143 dBm
Noise figure: Not specified.	Preamp off/1/2, 14 MHz: 16/6/4 dB; 50 MHz, 18/7/4 dB.
AM sensitivity: Not specified. 6.3 µV (0.13 – 0.522 MHz) 31.6 µV (0.522 – 1.705 MHz) 2.0 µV (1.705 – 24.5 MHz) 1.3 µV (24.5 – 30, 50 – 54 MHz).	10 dB (S+N)/N, 1 kHz tone, 30% modulation, 5 kHz BW: *Preamp* *Off* *1* *2* 1.0 MHz 14.9 6.68 5.30 µV 3.88 MHz 1.76 0.70 0.50 µV 29.0 MHz 2.02 0.62 0.45 µV 50.4 MHz 2.34 0.71 0.50 µV
FM sensitivity: Not specified. 0.22 µV (28 – 30, 50 – 54 MHz).	For 12 dB SINAD, 3 kHz deviation, 15 kHz BW: *Preamp* *Off* *1* *2* 29 MHz 0.72 0.23 0.16 µV 52 MHz 0.86 0.32 0.20 µV
Spectral sensitivity: Not specified.	Band scope display, preamp off/1/2 14 & 50 MHz, –107/–122/–131 dBm.
Blocking gain compression dynamic range: Not specified.	Blocking gain compression dynamic range, 500 Hz BW: *Preamp* *20 kHz offset Off/P1/P2* *5/2 kHz offset Preamp off* 3.5 MHz >141/146/132 >141/>141 dB* 14 MHz >141/147/134 >141/>141 dB* 50 MHz >139/148/137 >139/>139 dB*
Reciprocal mixing dynamic range: Not specified.	14 MHz, 20/5/2 kHz offset: 130/128/125 dB.

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

Band/Preamp	*Spacing*	*Measured IMD Level*	*Measured Input Level*	*IMD DR*
3.5 MHz/Off	20 kHz	–131 dBm	–34 dBm	97 dB
		–97 dBm	–9 dBm	
		–68 dBm	0 dBm	
14 MHz/Off	20 kHz	–131 dBm	–25 dBm	106 dB
		–97 dBm	–13 dBm	
		–60 dBm	0 dBm	
14 MHz/P1	20 kHz	–141 dBm	–37 dBm	104 dB
		–97 dBm	–22 dBm	
14 MHz/P2	20 kHz	–143 dBm	–46 dBm	97 dB
		–97 dBm	–30 dBm	
14 MHz/Off	5 kHz	–131 dBm	–26 dBm	105 dB
		–97 dBm	–13 dBm	
		–60 dBm	0 dBm	
14 MHz/Off	2 kHz	–131 dBm	–27 dBm	104 dB
		–97 dBm	–13 dBm	
		–60 dBm	0 dBm	
50 MHz/Off	20 kHz	–129 dBm	–29 dBm	100 dB
		–97 dBm	–12 dBm	
		–61 dBm	0 dBm	
50 MHz/P2	20 kHz	–143 dBm	–44 dBm	99 dB
		–97 dBm	–25 dBm	

Manufacturer's Specifications	Measured in the ARRL Lab
Second-order intercept point: Not specified.	Preamp off/1/2: 14 MHz, +79/+67/+45 dBm 21 MHz, +71/+69/+81 dBm 50 MHz, +69/+69/+69 dBm
IF and image rejection: IF, ≥70 dB. Image, ≥70 dB (HF), ≥60 dB (50 MHz).	IF rejection: 7 MHz, 74 dB; 10.1 MHz, 66 dB; 14 MHz, 71 dB; 50 MHz, 69 dB. Image rejection: 14 & 50 MHz, 72 dB.
Noise reduction: Not specified.	For S-5 level, ≈8 dB; S-9 level, up to 25 dB.
FM adjacent channel rejection: Not specified.	Preamp 2 on: 29 MHz, 85 dB; 52 MHz, 82 dB.
FM two-tone third-order IMD dynamic range: Not specified.	Preamp 2 on: 20 kHz offset, 29 MHz, 73 dB; 52 MHz, 74 dB. 10 MHz offset, 29 MHz, 125 dB; 52 MHz, 121 dB.
Squelch sensitivity: Not specified.	FM, preamp 2 on: 29 MHz, 0.13 – 0.44 µV, 52 MHz, 0.18 – 0.62 µV. HF squelch, 0.47 – 251 µV.
S-meter sensitivity: Not specified.	S-9 signal, preamp off/1/2: 14 MHz, 79.4/19.3/5.24 µV 50 MHz, 141/29.5/9.32 µV Scaling: 6 dB per S-unit.
Notch filter depth: ≥70 dB.	Tunable notch filter, 50 dB; BC (auto notch) >70 dB; attack time 96 ms for one or two tones.
IF/audio response: Not specified.	Range at –6 dB points:‡ CW (500 Hz BW): 355 – 845 Hz; Equivalent Rectangular BW: 481 Hz; USB (2.4 kHz BW): 242 – 2,594 Hz; LSB (2.4 kHz BW): 242 – 2,595 Hz; AM (5 kHz BW): 123 – 2,987 Hz.
Audio output: 1.5 W or more at 8 Ω.	1.93 W at 10% THD. 0.11% at 1 V_{RMS}.
Receive processing delay time: Not specified.	16 ms.
Transmitter	**Transmitter Dynamic Testing**
Power output: 5 – 100 W (SSB, CW, FM); 5 – 25 W (AM).	SSB, CW, FM: 1.8 – 30 MHz, as specified; 50 MHz, as specified. AM: 1.8 – 30 MHz, 4.6 – 24 W; 50.4 MHz, 4.2 – 22 W.
RF power output at minimum specified operating voltage: Not specified.	At 11.7 V dc: 14 MHz, 79 W; 50 MHz, 81 W.
Spurious-signal and harmonic suppression: ≥55 dB (HF); ≥63 dB (50 MHz).	HF, >69 dB typical; 60 dB (worst case, 12 m); 50 MHz, 70 dB. Complies with FCC emission standards.
Third-order intermodulation distortion (IMD) products: Not specified.	3rd/5th/7th/9th order, 100 W PEP: –42/–42/–51/–62 dB (HF typical) –38/–42/–46/–54 dB (worst case, 160 m) –38/–48/–51/–55 dB (50 MHz) At 50 W RF output: –40/–47/–60/–70 dB (14 MHz) –38/–48/–59/–70 dB (50 MHz)
CW keyer speed range: Not specified.	4 to 60 WPM, iambic mode A and B.
CW keying characteristics: Not specified.	See Figures 5 and 6.
Transmit-receive turnaround time (PTT release to 50% audio output): Not specified.	S-9 signal, AGC fast, SSB, 30 ms; AGC fast, CW, full break-in, 14 ms.
Receive-transmit turnaround time (TX delay): Not specified.	SSB, 16 ms; FM, 15 ms (29 MHz), 13 ms (52 MHz).
Transmit phase noise: Not specified.	See Figure 7.
Amplifier key line closure to RF output: Adjustable, 5 – 40 ms (CW/FSK/PSK); 5 – 50 ms (SSB/FM/AM).	12 ms when set to CW default value of 15 ms.

Size (height, width, depth, including protrusions): 6.2 × 16.2 × 15.4 inches; weight, 34.8 lbs. Second-order intercept points were determined using S-5 reference.

*Blocking dynamic range exceeds these values. No blocking was observed with up to +10 dBm signal at the antenna jack, the maximum level used in ARRL Lab testing.
‡Default values; bandwidth is adjustable.

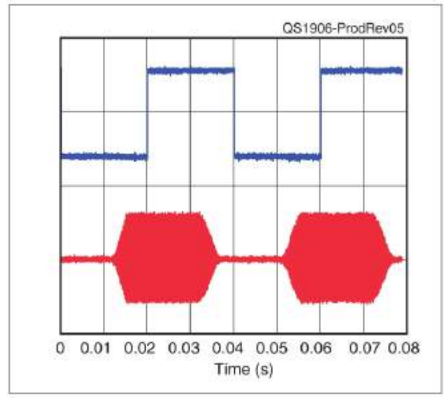


Figure 5 — CW keying waveform for the Kenwood TS-890S showing the first two dits in full-break-in (QSK) mode using external keying and the default rise time setting. Equivalent keying speed is 60 WPM. The upper trace is the actual key closure; the lower trace is the RF envelope. (Note that the first key closure starts at the left edge of the figure.) Horizontal divisions are 10 ms. The transceiver was being operated at 100 W output on the 14 MHz band.

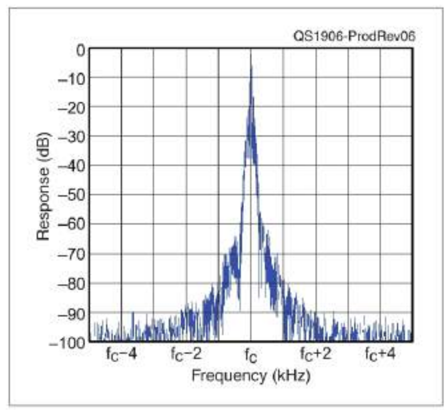


Figure 6 — Spectral display of the Kenwood TS-890S transmitter during keying sideband testing. Equivalent keying speed is 60 WPM using external keying and the default rise time setting. Spectrum analyzer resolution bandwidth is 10 Hz, and the sweep time is 30 seconds. The transmitter was being operated at 100 W PEP output on the 14 MHz band, and this plot shows the transmitter output ±5 kHz from the carrier. The reference level is 0 dBc, and the vertical scale is in decibels.

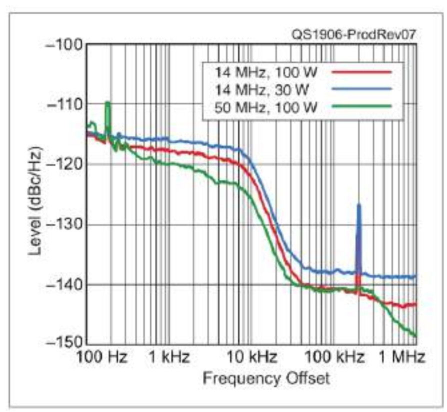


Figure 7 — Spectral display of the Kenwood TS-890S transmitter output during phase-noise testing. Power output is 100 W on the 14 MHz band (red trace), 30 W on the 14 MHz band (blue trace), and 100 W on the 50 MHz band (green trace). The carrier, off the left edge of the plot, is not shown. This plot shows transmitted phase noise 100 Hz to 1 MHz from the carrier. The reference level is –100 dBc/Hz, and the vertical scale is 10 dB per division.

speed and about 5 seconds at the fastest. Scrolling mode options include fixed frequency width, automatic scrolling as you tune, and a centered mode that keeps the cursor in the center and moves the display. The band scope has its own attenuator to adjust sensitivity.

I found the band scope to be very sensitive and responsive, and used it a lot. I tended to leave it in auto-scroll mode to follow along as I tuned around. I really liked that the signals in the waterfall didn't smear or otherwise distort as I tuned; the waterfall just moved left or right with existing signals intact. The wider frequency spans are useful when looking for activity at quiet times. On a crowded band, such as during a CW or RTTY contest, setting the span to 5 kHz gives a detailed look at the tightly-packed signals.

Filter width is highlighted in the waterfall while tuning, and the highlight disappears when you stop tuning (although it still shows up in the spectrum scope). Change the filter bandwidth setting, and the width of the highlight changes. I found I could quickly tune from station to station on any mode using the band scope and the filter scope.

Press and hold the **SCP** button, and the display changes to an audio scope that displays two views of the waveform of received and transmitted signals. The display on the left is similar to what you would see on a spectrum analyzer, and the one on the right is similar to an oscilloscope.

Lab Notes: Kenwood TS-890S

Bob Allison, WB1GCM, ARRL Laboratory Assistant Manager

The Kenwood TS-890S transmitter greatly exceeds FCC spectral purity requirements, has narrow keying sidebands, and has relatively low transmit phase-noise characteristics. Transmit intermodulation distortion (IMD) is very good at full RF power output, as well as at half power — the 50 W typically needed to drive a linear amplifier. Though all linear power amplifiers generate their own distortion products, it is always desirable to have the cleanest possible exciter. At half power, the seventh- and ninth-order products are 60 and 70 dB below PEP, where they need to be the lowest to minimize interference to nearby stations.

The TS-890S dual-conversion receiver performance overall is excellent, with high reciprocal mixing (RMDR), blocking (BDR), and two-tone, third-order IMD (3 IMD DR) dynamic ranges. The lowest of the three dynamic ranges is 3 IMD DR, measured at 104 dB at 2 kHz spacing at 14 MHz. With the excellent blocking and reciprocal mixing characteristics, the TS-890S will hold up well during ARRL Field Day or other operating events when amateur transmitters are operating in close physical proximity.

In a quiet RF location (with low man-made noise), the Kenwood TS-890S will hear a pin drop on 6 meters, where sensitivity counts the most. AM sensitivity on the amateur bands is excellent, especially on 6 meters, where signals as low as 0.5 μV are readable. On 630 and 2200 meters, there is plenty of sensitivity to work with, especially when using receiving loops that lack a preamp, as well as a 1 mW transmitter output from the **DRV** jack.

Of note, the total harmonic distortion (THD) of the receiver audio is only a small fraction of a percent at a normal listening level. In addition to pleasant listening, that's very desirable for extended operating sessions when audio distortion can cause fatigue.

The receiver processing delay time is only 16 milliseconds, and the receiver recovers quickly for high-speed, full-break-in (QSK) CW operation. The signal strength meter uses a scale of 6 dB per S-unit, though it reads a little low with a 50 μV (S-9) signal at the antenna jack. Turning the preamp(s) on makes the S-meter read higher, but the induced signal voltage from the antenna is not higher. Finally, the current draw with power off is only 3 mA, which is very reasonable if using the TS-890S with a battery backup system.

Receiver

The receiver is among the best measured in the ARRL Lab, as seen in Table 1 and described in the "Lab Notes" sidebar. It uses down conversion on all bands, with 15 kHz, 6 kHz, 2.7 kHz, and 500 Hz roofing filters standard (and 270 Hz optional).

Bandwidth filtering is adjustable at any time using the **HI/SHIFT** and **LO/WIDTH** controls, but it's convenient to set up filter choices for each mode and switch among them using the **IF FIL** button. Pressing and holding that button brings up a configuration screen where you can specify roofing, IF, and audio filter bandwidths, as well as skirt shapes (sharp/medium/soft), for each of two or three filters (menu selectable) for each mode. You can change the preset filter bandwidth at any time with the **HI/SHIFT** and **LO/WIDTH** controls, and return to the preset values by pressing **FIL CLR** button.

The TS-890S offers adjustable DSP noise reduction, noise blanker, and notch filter features. I live in a rural area without much power line or other man-made noise, and so I was not able to give the noise blankers a good workout. If noise is a problem for you, it would be worth checking comments from owners online at **groups.io**. The noise reduction worked well, although I heard some digital artifacts with the level turned up high enough to significantly reduce the background noise.

I found the automatic notch filter (called the *beat canceler*) to be very effective at reducing AM shortwave broadcast carriers on 40 meters in the evening. The manual notch filter is very effective in attenuating interfering signals in the passband. When it's engaged, a marker in the filter scope window shows the position of the notch in relation to the desired and interfering signals.

The 18-band receiver audio equalizer (EQ) settings can be different for each mode. There are a number of preset options (off, flat, high boost, and so on), along with three user-customizable settings. Touch the screen to slide the level control for each audio segment up and down, or use the **+/–** function keys or **MULTI/CH** knob.

Transmitter and Antenna Tuner

As shown in Table 1 and Figures 5, 6, and 7, the TS-890S transmitter is very clean, with low intermodulation distortion (IMD) products on SSB and very narrow CW keying sidebands. Transmitted phase noise is good. Note that the CW rise time is adjustable, and the waveform shown in Figure 5 is with the default 6-millisecond setting. As the rise time decreases, the keying waveform corners sharpen and the keying sidebands increase, potentially interfering with stations operating on nearby frequencies. Avoid the 1- and 2-millisecond settings.

The **POWER** control adjusts transmitter output power in 1 W or 5 W steps (menu selectable). Using the **MAX PO** feature, from a menu you can set the maximum power output separately for each band and for the SSB, CW, FSK/PSK, FM/AM, and SSB-DATA modes. For example, you might have a 6-meter amplifier that requires only 30 W drive maximum. Set the **MAX PO** limit for that band and you won't have to worry about accidentally overdriving it. The **TUNE** power described earlier is adjustable by band from this same menu.

The internal antenna tuner is rated for loads from 16.7 to 150 Ω (3:1 SWR). I had no trouble matching my antennas, most of which have an SWR of 2.5:1 or less across the band. My 160-meter inverted-**V** has an SWR close to 4:1 at the very top of the band, and the tuner matched that as well. Antenna tuner settings are memorized, so tuning is nearly instantaneous after the initial tune.

Voice and CW Operation

The TS-890S offers upper and lower sideband, AM, and FM operation. I got a number of good audio reports using the INRAD W1 headset reviewed last month. The transmit equalizer works nearly identically to the receive equalizer described previously, and after adjusting everything using the transmit monitor, I recorded my transmit audio in another receiver to make sure I was happy with it. Transmit equalizer settings are used for all voice modes, and automatically turned off for the SSB-DATA modes. Transmit monitor settings are separate for voice modes, data modes, and FSK/PSK, and these are separate from the CW sidetone.

On SSB, the transmit filter bandwidth can be set from about 2,000 to 4,000 Hz by adjusting the **LOW CUT** and **HIGH CUT** menus. I just used the default setting of 2,800 Hz (100 – 2,900 Hz). Transmit filter bandwidth can be set separately for the SSB-DATA modes, up to 4,000 Hz.

Voice-operated transmit control (VOX) settings are separate for the various audio inputs — microphone, rear-panel **ACC2** jack, USB, and LAN — and VOX is available in the SSB-DATA modes. VOX delay time can be changed quickly with the front-panel **DELAY** knob.

Although band conditions did not allow me to try it, the TS-890S is equipped for 10- or 6-meter FM operation. Split-frequency offsets can be applied by using the two VFOs, and CTCSS tone encoding and decoding are available for repeater access.

You can record up to six voice messages for transmission, with a maximum recording time of 100 seconds total. You can also record received audio, with storage in the internal memory or on an external flash drive. File selection and playback options are handled via menus and function keys. I didn't see a way to play back recorded audio on the air.

The TS-890S supports full-break-in (QSK) or adjustable delay, semi-break-in operation. The transmit-receive switchover is silent — no annoying relay clicking unless you enable the amplifier control relay as described earlier. The built-in keyer can be adjusted from 4 to 60 words per minute. The eight message memories can include incremental serial numbers for contests.

A built-in CW decoder displays received CW signals in a window that replaces the band scope. This feature also allows use of a USB keyboard for sending CW, and shows the CW message memories in a small window on the right. I found that the decoder works best on strong, well-timed CW signals, and there is a slight delay in displaying the decoded signal.

Digital Modes

The TS-890S offers a number of options for digital mode operation. The radio has an internal decoder for RTTY and PSK31 or 63, and you can plug in a standard USB keyboard to transmit on those modes. Connections are also available to use the radio with digital mode software running on an external PC.

RTTY and PSK with the Internal Decoder

Press the **FSK/PSK** button once for RTTY or twice for PSK, then press **F3** to bring up the **DECODE** screen in the lower portion of the display (see Figure 8).

The left side of the screen displays received and transmitted text, with two lines of buffered text awaiting transmission below that. You can use the keyboard to compose your next transmission in the buffer while you are receiving a message, and then press F12 to transmit when it's your turn.

You can also use the keyboard to program eight message memories, which are sent by pressing the corresponding function key on the keyboard or on the radio's front panel. This is perfect for routine information such as location, name, equipment, and so on. You could also use it to store RTTY contest exchange information, although I didn't see a way to include an incrementing contact number for contests that require one. Message memories are separate for RTTY, PSK, and CW.

Figure 8 — The PSK decoder screen shows up to seven lines of decoded text in green in the larger window, and two lines of text to be transmitted in white below that. The tuning indicator on the right can be switched to a vector scope. Note the small version of the band scope above the decode window, and the compact bar graph meter at the upper left.

As characters are sent from the buffer window, they change from white to red and appear in the upper window. Each time you switch between transmit and receive, the radio adds a line showing the transition, and it can include date, time, and frequency (menu settable). You can save RTTY, PSK, or CW communication screen contents to internal memory or a USB flash drive by turning on the Communication Log function. The log is essentially a running transcript of whatever sent and received text appears on the decoding screen.

The right side of the screen has a tuning indicator that can be switched between an FFT/waterfall and tuning scope display. Switch between the tuning indicator styles by touching that area of the screen. You can show a small version of the band scope above the **DECODE** window, or press **F7** (**EXTEND**) to increase the height of the **DECODE** window.

The internal RTTY and PSK features worked very well, decoding quickly and accurately. The tuning indicators were quite responsive and a joy to use. It took a few minutes to get used to tuning around for PSK stations, rather than clicking on signals in a wide waterfall using PC software, but the small spectrum scope above the **DECODE** window made it easy to locate stations on the band. Many operators will find the integrated features useful for RTTY and PSK conversations, as well as for DXing and casual RTTY contesting.

Digital Modes Using External Devices

You can connect an external computer or terminal unit to the TS-890S radio through the **ACC2** connector on the rear panel. Connections for audio in and out, transmit-receive switching, and FSK RTTY keying are available. Audio levels can be set via menus and are independent of the mic gain and receiver volume controls. I used the **ACC2** connector to integrate the radio with my RTTY contesting setup, which includes *WriteLog* station management/logging software, *MMTTY* and *2Tone* software for decoding, and FSK keying through a COM port interface on my computer. The TS-890S default settings all worked fine, except that I needed to change the FSK keying polarity in a menu.

Through the transceiver's USB port, you can also set up a connection to the radio's internal sound card for digital modes, such as FT8, PSK, JT65, or AFSK RTTY, as well as SSTV — any of the "sound card modes." Setup couldn't be simpler. Install the virtual COM port software (as described earlier), then install a USB cable between radio and computer. When power is applied to the radio, Windows installs a driver and **USB AUDIO CODEC** shows up as a sound device on the computer. For FT8, I selected that device for receive and transmit audio in the *WSJT-X* **SETTINGS** menu, and set up the radio control screen. Then I checked the audio levels in *WSJT-X* and, if necessary, adjusted the receive audio output level in the TS-890S menu system to get into the recommended range. Next, I set TS-890S mode switch to USB and pressed **D** for data, and enjoyed many FT8 contacts using this setup.

Wrapping Up

With its high-performance receiver, clean transmitter, and array of features for all modes, Kenwood's TS-890S appeals to a wide range of operators. The radio is highly customizable through its extensive menu system, and I found the default settings to be an excellent starting point. I could use the radio right out of the box, while I explored the many settings and options.

Manufacturer: JVCKENWOOD USA, Communications Sector, 1440 Corporate Dr., Irving, TX 75038; **www.kenwood.com/usa**. Price: $3,900.

Visit https://youtu.be/1gNFh160RpE to see our review of the Kenwood TS-890S HF and 6-Meter Transceiver on YouTube.

SharkRF openSPOT2 Multimode Digital Hotspot

Reviewed by
Pascal Villeneuve, VA2PV
va2pv@arrl.net

I've been using the original SharkRF openSPOT digital hotspot since August 2016, and I love it. (A hotspot is an internet gateway for digital-mode amateur transceivers, such as DMR, D-STAR, and System Fusion, so that they can connect to various amateur networks.) In the October 2017 issue of *QST*, I reviewed the original openSPOT, and in my conclusion, I mentioned my desire for a Wi-Fi interface. SharkRF heard user requests, and the new openSPOT2 includes Wi-Fi.

The openSPOT2 builds on the success of the original version. This standalone hotspot works on the 70-centimeter band, is simple to operate and small in size, has low consumption, and is reliable. The web interface is very well done and works on any platform — even on my iPhone. Figure 9 shows how it appears on a mobile device.

The original openSPOT and the openSPOT2 are similar in many ways, so in this review, I will cover only the main differences between the two versions. Please refer to the October 2017 review for more information on the features they have in common. Also, the SharkRF website has a lot of detailed information about the device, including an online manual and video tutorials.

Overview

The first thing I noticed about the openSPOT2 is that there is no ethernet port and no external antenna jack, and the power connector is now a USB-C type. This unit is very light and surprisingly compact. It's thin enough that a photo on the SharkRF website shows someone carrying it in the small watch pocket in a pair of jeans.

On the outside, there's only one control button. When you press and hold it for more than 3 seconds, it switches the openSPOT2 into Wi-Fi AP (access point) mode (more on this later). If you hold the button for more than 30 seconds, it will reset the unit to its factory default.

The LED status indicator is hidden inside the white plastic enclosure. When you connect power, the LED glows and is visible through the case. Different colors are used to indicate the current status, and I found it intuitive. For example, when the device receives a signal, it turns green. When it transmits, it turns red. Other status indicators are well described in the manual.

Like the original model, the openSPOT2 supports multiple digital modes: DMR, D-STAR, and Yaesu System Fusion/C4FM. Two new modes were added: NXDN (a digital voice mode), POCSAG/DAPNET (a paging system), and P25 (another VHF/UHF digital wireless standard). They also added a special background connector for APRS, which can be

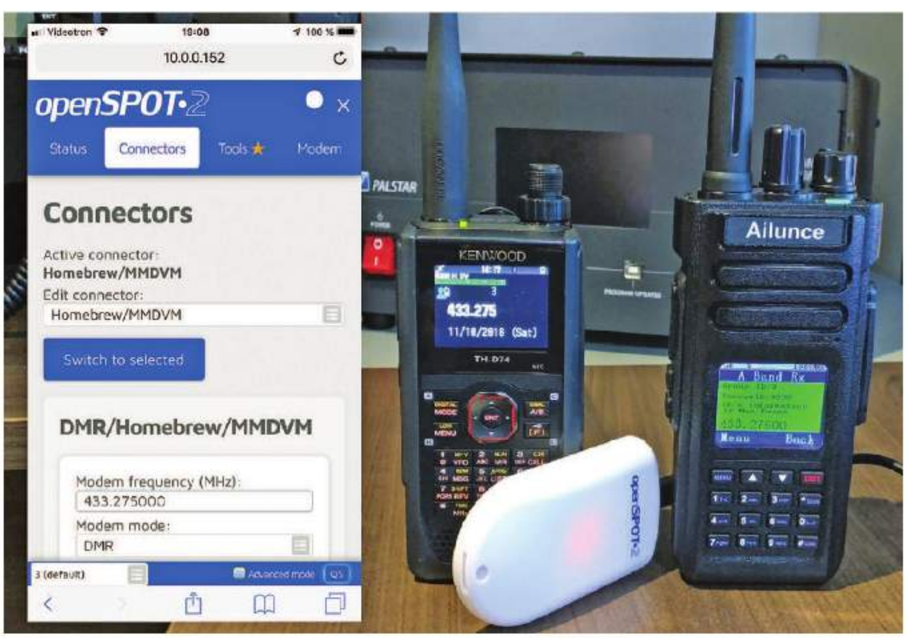


Figure 9 — The small SharkRF openSPOT2 in between two digital handhelds with the web interface running on my iPhone. The device is in DMR mode.

Bottom Line

Smaller and lighter than the original version, the SharkRF openSPOT2 multimode digital hotspot moves the antenna inside the case, adds a Wi-Fi interface, and simplifies operation.

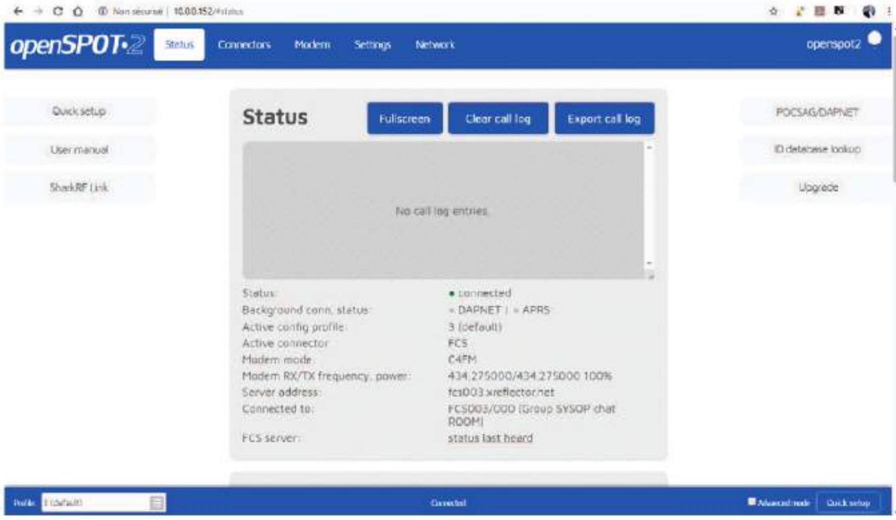


Figure 10 — The openSPOT2 web interface screen.

used for setting up a connection to the APRS network. This enables device location broadcasting, forwarding GPS data from transceivers, and messaging (APRS chat).

The new version still supports cross-mode contacts between DMR and C4FM, so you can talk from a 70-centimeter C4FM radio to a DMR reflector or the other way around (a reflector is the equivalent of a repeater in the IP world). This unit does not convert analog FM signals to any digital mode, so you need at least one digital radio to use it. Also, you can still create your own radio network using their open-source server application.

Setting Up the Device

When you receive the openSPOT2, by default, it will be in AP mode for Wi-Fi, and this is the only way you can access the web interface and do the initial configuration. You can use any internet device for the setup, such as a tablet, phone, or PC.

After connecting power to the openSPOT2, you set it up just like you would normally do with new Wi-Fi devices. Scan for a new Wi-Fi network and you will see **openSPOT2 AP** listed. After connecting to the unit, the first thing you have to do is connect the device to the internet via your home Wi-Fi router. Remember, without internet access, the openSPOT2 is useless.

When connected to the internet, log in to your home router and look for the IP address assigned to the openSPOT2. I strongly suggest reserving this address for the hotspot, so it will never change. Then reconnect to the web interface using that address. It's also a good idea to upgrade the device the first time you connect to the internet.

Managing Multiple Wi-Fi Networks

After the initial setup, if you move out of reach of your initial Wi-Fi network, you simply use the button to switch the openSPOT2 back into AP mode, connect to the web interface directly with your phone or tablet, and select a new Wi-Fi network. Doing this does not affect your hotspot configurations, and you won't lose the other Wi-Fi setup as long as you do not hold the button more than 30 seconds (which resets the device).

You can also use the openSPOT2 as a mobile or portable hotspot with your cell phone Wi-Fi as an internet connection. You will need to press the openSPOT2's external button to switch the unit back in Wi-Fi AP mode, and then you can connect your cell phone directly to it and select the new Wi-Fi network.

You only need to go through the setup procedure the first time you connect to a new Wi-Fi network. After the first time, it will connect to the best available registered network automatically. You can store up to five Wi-Fi SSIDs (network names).

Web Interface

The main screen of the web interface, shown in Figure 10, is very similar to the original openSPOT, except for the left and right menus. All you need to use it is your favorite browser on any desktop or mobile device. Windows, macOS, iOS, or Android all work. This interface is used to configure the openSPOT2 for use with your transceiver and set up a connection to your digital network.

The menu at the left has buttons for **QUICK SETUP**, **USER MANUAL** (a link to the online manual), and **SHARKRF LINK**, for setting up access to the openSPOT2 via the web interface.

QUICK SETUP offers the simplest way to configure the openSPOT2 for your transceiver and connect to a network. You select your type of radio (such as DMR, D-STAR, or C4FM) and fill in some basic settings that vary with the mode of operation. Then you select a digital network and enter some settings, such as your call sign or network ID. Then click **CONNECT**, and you're ready to start using the network with your radio. Advanced users can select the **ADVANCED MODE** and have more configuration options.

On the right menu, you have **POCSAG/DAPNET** setup, DMR **ID DATABASE LOOKUP**, and an **UPGRADE** button for loading the latest firmware. Upgrading this device is easy. Just click **UPGRADE**, and it's all automatic. With the original version, you had to download a file and switch to bootloader mode.

Along the top, we have the same tabs — **STATUS**, **CONNECTORS**, **MODEM**, **SETTINGS**, and **NETWORK**.

STATUS Page

After you are logged in, this page is shown by default. You will find the latest activities, the hardware and software versions, and some other useful information, such as the uptime and network performance.

CONNECTORS Page

This is the page where you select the mode, local frequency, and reflector or gateway to connect. You have to enter your call sign, your DMR ID, and a frequency for each mode.

MODEM Page

This page is normally used to set up a sub mode to be used in cross-mode operations. There are more settings when the **ADVANCED MODE** is selected.

SETTINGS Page

This section is used for more advanced and specific configuration of profiles, location, radio network settings, and other parameters.

NETWORK Page

Information about the Wi-Fi and internet connections, a traffic monitor, IP settings, and other parameters.

Every time you modify or select an option, click on the **SAVE** button. Then the web page will refresh to reflect the new configuration.

Conclusion

I really like the openSPOT2 and I think it is an ideal portable/mobile hotspot. You do not have to worry about damaging a microSD card because you didn't shut down properly — it doesn't have any. There's nothing to break outside the enclosure, as there's only one small button and a USB-C power connector, which is sturdier than a Micro USB port. The original openSPOT offered a wired ethernet port (RJ-45) and an external antenna connector, but the new version is smaller, has Wi-Fi, and boots up very fast.

If you're looking for a simple and reliable mobile digital hotspot, this one is a great option, as it doesn't require any special skills to operate, uses a simple and easy-to-use web interface, and works with any device that has a web browser.

For more about digital voice operation and a detailed video showing the openSPOT2 during setup and operation, check out my YouTube channel, **Laboenligne.ca** (or search for VA2PV).

Manufacturer: SharkRF, Tallinn, Estonia; **www.sharkrf.com**. Available from the online shop, **shop.sharkrf.com**. Price: $230.

PreciseRF HG-1 Magnetic Loop Antenna

Reviewed by Phil Salas, AD5X
ad5x@arrl.net

Small magnetic loop antennas are popular for portable/QRP operation due to their small size and ease of deployment. A recent entry into this market is the PreciseLOOP HG-1 from PreciseRF.

Overview

The HG-1 is rated at 45 W PEP and covers 7 to 30 MHz. Optional 80- and 60-meter, high-voltage/high-current resonating capacitors are available, though the maximum power rating is reduced to 10 W PEP on those two bands. The website cautions that the HG-1 is not waterproof.

The basic (Express) package includes a 38-inch-diameter radiation loop made from LMR400 coaxial cable; a copper tube induction loop; a manually adjusted loop tuning unit with a precision 6:1 reduction dial and calibrated dial marking (see Figure 11); a three-section PVC mast, and a basic carrying bag. The Deluxe package adds the 80M-1 resonator for operation on 80 meters; the MLA-1 desktop tripod with tripod adapter; a 12-foot coaxial cable feed line, and a premium padded nylon carrying case (see Figure 12) that easily fits the antenna and accessories.

Assembling the HG-1 takes just 1 to 2 minutes. If you wish to operate on 80 or 60 meters, simply plug the resonating capacitor assembly into the bottom of the tuning unit, as shown in Figure 13.

Bottom Line

For portable or low-profile home operation, the Precise RF HG-1 magnetic loop antenna offers ease of deployment, good performance and directivity at a low height, and easy tuning.

Figure 11 — The HG-1 manual loop tuning unit uses a 6:1 reduction drive with amateur bands marked on the dial.

Figure12 — The Deluxe HG-1 package in the supplied carrying case. The entire package, including antenna, mast, tabletop tripod, and controller weighs about 8 pounds.

Figure 13 — The 80-meter resonating capacitor plugs into the bottom of the tuning unit.

A new addition is the HG-1 remote tuning unit, which permits tuning from a remote control head connected to the loop with up to 100 feet of CAT-6 cable (see Figure 14). The remote tuning option includes a dc motor assembly that mounts on the manual tuning unit, a pulse width modulated (PWM) motor controller, and 25-foot coax and CAT-6 cables. The controller shown in Figure 15 uses either an internal 9 V battery or an external 9 V dc wall power supply (included with the remote tuning unit).

Adding the remote tuning option requires removing the tuning knob and pointer, opening up the manual tuning unit, removing the vernier assembly mounting screws, and attaching the tuning motor assembly. It is not difficult and only requires a few minutes. The ARRL review antenna included the HG-1 Deluxe package and the remote tuning unit.

Operating the HG-1

Like all small transmitting loops, the HG-1 radiates a bidirectional signal with maximum radiation in the plane of the loop, and it exhibits deep nulls perpendicular to the loop when vertically mounted. I use this knowledge to position myself perpendicular to the HG-1 when I am in close proximity to it when transmitting. That can occur often with a manually tuned loop, as you must retune the antenna with even fairly small frequency changes due to the very narrow bandwidth of the antenna.

The Deluxe package include a desktop camera tripod that supports the HG-1 just fine, but I prefer a full-size tripod that places the HG-1 several feet above the ground without having to use a table. The picnic tables are all metal in the city park where I operated, and sometimes tables are not available. My 50-inch camera tripod collapses to 15 inches and easily fits within the padded carrying case. The PreciseRF tripod adapter works with any camera tripod, or you can build your own adapter (see the sidebar, "Making a Tripod Adapter").

Figure 14 — The remote-control motor on the tuning box replaces the manual tuning knob.

Figure 15 — The controller for the remote-tuned loop.

I first checked the SWR on the different bands. I began with the basic manual tuning unit, and then added the remote tuning option. I found that I could easily adjust the SWR to less than 1.5:1 on 40 through 12 meters. My best SWR on 80 meters (with the 80-meter resonating capacitor) was 2.2:1. On 10 meters, the best SWR I could realize was 2:1.

It was easy to tune the HG-1 by adjusting the tuning capacitor for maximum receiver noise, then transmitting a low-power CW carrier and touching up the tuning for best SWR,

Using the HG-1 on 80 Meters

Mark Wilson, K1RO

Phil, AD5X, didn't hear any signals on 80 meters in his noisy location in Texas, so I set up the HG-1 at my station in New Hampshire to give it a try. Over the course of two evenings, with 10 W and the HG-1 on a tripod outside my station window, I made a couple dozen 80-meter FT8 and CW contacts, mostly with stations in the eastern half of the US. The best DX contact was with V31MA in Belize. As you might expect, only the strongest stations copied me, and I generally got weak signal reports, but I thought the results were impressive for a 3-foot loop, 3 feet off the ground on 80 meters.

The HG-1 worked even better on receive. I heard a number of European stations on 80-meter CW and FT8, and I even decoded a couple of Australian FT8 stations at sunrise. Under the right conditions, 80 meters is viable with this antenna.

Making a Tripod Adapter

Phil Salas, AD5X

A standard camera tripod uses a ¼-20 screw for mounting the camera. To build a tripod adapter for a magnetic loop, purchase the following from your local home center or online: a ¼-20 × ⅞ inch threaded coupling nut and two in-ground sprinkler fittings — a ½-inch plastic barb coupling (Orbit part #94349) and a ½ × 6 inch plastic cut-off riser (Orbit part #37227).

Cut the 6-inch riser to 4 inches. Using a bench vise, press the ¼-20 × ⅞ inch coupling nut into the ½-inch barb coupling, and then press this assembly into the ½ × 4 inch riser.

This assembly easily screws onto the camera tripod, and then you can slip the lower tube of the HG-1 support mast over the adapter. You may wish to wrap a few turns of electrical tape around the adapter to create a friction fit between the adapter and the HG-1 lower tube.

The finished adapter on a camera tripod. The loop support mast slips over the adapter.

The parts for the tripod adapter are shown on the right, with the finished adapter on the left. (A standard ½-inch PVC barb is shown, and it had to be filed down to fit inside the riser without splitting it. Use a matching sprinkler system barb if available.)

if necessary. And incidentally, I found that removing my hand from the tuning knob had no noticeable effect on the loop tuning.

Tuning the antenna with the remote option was also quite easy. The remote tuning controller provides stall warning lights when you hit the tuning capacitor extremes. Normally, I would tune the unit for a stall at the lower or upper end of the frequency range, and then tune up or down from that spot in order to obtain the receiver noise peak. The remote tuning controller has a **SPEED** control, which makes it easy to tweak the tuning once you get close to the desired frequency. With just a bit of practice, I was remotely tuning the HG-1 as easily as I could tune it with the manual unit.

I operated primarily on 40, 30, and 20 meters due to band conditions during the review period. Transmit power was 10 W with my Elecraft KX3 portable transceiver. On CW, I could pretty much work anyone I could hear. In fact, my first contact occurred when I was just familiarizing myself with setting up the HG-1 in my ground-floor family room. I heard a station in Michigan calling CQ on 20 meters, so I answered him, and we had a surprisingly good contact. He said that my signal was peaking at S-6. SSB was challenging on 40 meters, though I did have success calling some strong stations. SSB contacts were much easier on 20 meters.

Conclusion

The PreciseRF HG-1 is an effective antenna worth considering for lightweight quick setup/tear-down portable operation at power levels up to 45 W. I particularly liked the remote tuning option, which keeps the high-intensity RF field well away from the operator, and would be convenient for tuning a balcony-mounted HG-1 from inside an apartment or condo. Finally, a PreciseLOOP application note on the PreciseRF website provides detailed technical information on the HG-1.

[As this issue of *QST* went to press, PreciseRF announced the HG-1 WR remote tuner intended for outdoor use; a new HG-2 controller that replaces the HG-1 controller; and the AR-1 remote antenna rotator suitable for use with portable antennas. — *Ed.*]

Manufacturer: PreciseRF, 960 S. Gribble Rd., Canby, OR 97013; **www.preciserf.com**. Price: Express PreciseLOOP HG-1, $299.50. Deluxe PreciseLOOP HG-1, $435. HG-1 Remote Loop Tuner, $195.50. 80-meter resonator, $65. 60-meter resonator, $65. CMB-300 common-mode 1:1 balun: $65.00. MLA-1 desktop tripod with adapter, $79. Tripod adapter only, $19.95.

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

The Doctor is In

Current Draw is Only Half the Story

Q Bob, KK6YLW, asks: A book I'm reading said that for a single-operator station with a radio, 500 W power amplifier, dummy load, and tuner, a single 20 A, 120 V ac circuit should be sufficient.

However, my radio specs say that at 100 W output, the transceiver will want 21 A. How is it that when transmitting at that level, with or without engaging any of the other pieces of equipment, I'm not blowing the 20 A circuit breaker in my main panel all the time? Can you explain to me how one 20 A circuit will handle a 100 W radio, a 500 W amplifier, a dummy load/wattmeter, a tuner, a laptop linked to the radio, and an external monitor without blowing a gasket?

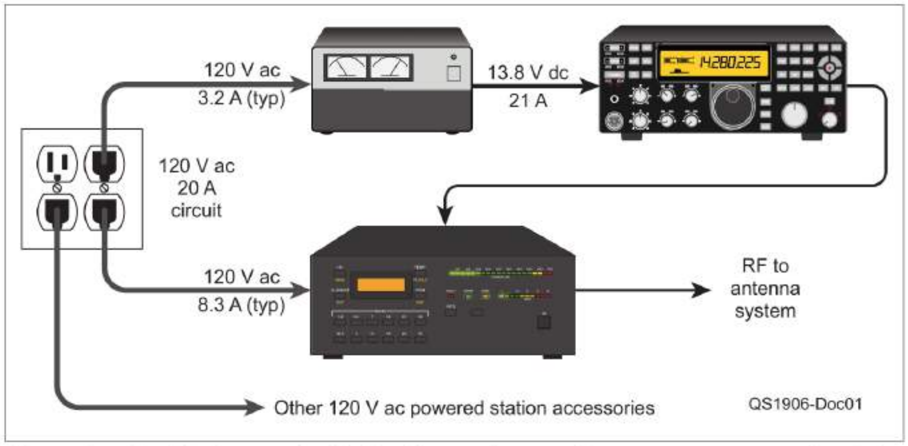


Figure 1 — Simplified power distribution diagram for a medium-power amateur station. It is important to keep track of the requirements of the different parts of the system separately.

A The transceiver's 21 A spec is for the 13.8 V coming from the dc power supply, not directly from the ac socket (see Figure 1). I haven't found any input current requirements specified for power supplies that I've looked at. If we assume 75% efficiency, we have dc power supplied = 13.8 V × 21 A = 290 W. If the supply is 75% efficient, that's 387 W. At 120 V ac, that is 3.2 A. This seems reasonable, because one 25 A supply I looked at is protected by a 5 A fuse.

Regarding the 500 W linear amplifier, my solid-state Elecraft KPA500 requires approximately 8.3 A at 120 V ac for 500 W output.

An Ameritron AL-811, 600 W vacuum-tube amplifier requires 8 A at 120 V, according to the manufacturer's specifications. Note that neither of these amplifiers requires the full 100 W drive from the transceiver to reach full output, so if using an amplifier, the transceiver will have a lower current requirement than the 3.2 A shown.

So, we're up to 11 A for the transmitter and amplifier — add an auto tuner, a PC, and a light or two and you'll blow a 15 A circuit, but a dedicated 20 A should be feasible if you can keep other things off it.

A word about dedicated circuits may be in order. When I refer to a dedicated circuit, I mean one that starts at the power distribution box and ends at a single or dual outlet at your station. The fact that a circuit has nothing else in use when you check doesn't mean it will be fully available whenever you need it — in fact, most household 20 A circuits were installed, rather than the usual 15 A, for specific functions such as refrigerators or laundry areas. If you just jump on one of those by measuring it when not in use, for sure someone will start the washing machine just as you are about to try to break through a pileup!

I recently upgraded my station to support a linear amplifier. Because I needed to run a new dedicated circuit and had the breaker-box slots available, I opted to install a 240 V, 20 A circuit instead of a 120 V one. For the cost of an extra breaker and a run of four-wire #12 AWG, rather than three-wire, I not only have more headroom in case I want to go to the legal limit someday, but because the key-down line current at 240 V is half what it is at 120 V, I have less voltage fluctuation during operation. A disadvantage is that I need to use a separate 120 V circuit for my other equipment, but I had that covered here.

Q Jack, NI8N, asks: I have a friend who routinely uses two antenna tuners in cascade — one is the radio's internal automatic antenna tuner, the other a manual tuner. I have to think that this adds unnecessary loss to his signal. Is there a reason why this could be a good idea?

A A good question. Fortunately, tuner losses in most tuners, manual or automatic, are quite low. Still, if the tuners are in about the same place, your friend will have extra unneeded losses compared to using one or the other.

There is a major exception to this, and that is if the manual tuner happens to be near the antenna and the antenna SWR is high. In that case, if only the radio's tuner were used, the transmission line between the antenna and the tuner may have very high losses. If a tuner were inserted at the antenna and got the SWR down to 2 or 3:1, compared to say 10:1, the loss in the extra tuner would be much less than the loss in the badly matched line.

Another consideration is operating convenience. Many internal tuners can't handle a wide SWR range; some, for example, are limited to 3:1. If your friend's SWR were higher than that, he could use only the manual tuner, but then may have to manually retune as he shifted frequency across the band, perhaps missing a contact in the process. By presetting the manual tuner for midband, it is likely that the automatic internal tuner can quickly trim up the SWR as he changes frequency, making the contact and accepting perhaps 0.5 – 1 dB of extra loss in the process — not a bad trade.

Q Dave, K6DHL, asks: I have a ground-mounted vertical monopole that can be continuously adjustable from 0 to 75 feet high. I've tried using it as a ⅝-wave monopole, but haven't seen much benefit, so I plan to stick with using it as a straightforward quarter-wave antenna covering 80 through 20 meters. Can I replace my current L-network with a 2:1 balun and just adjust the antenna length to achieve a 50 Ω match? It would be nice to get rid of the auto-tuner to simplify the system and eliminate any potential losses.

A That should work well, although I don't believe you will even need the balun. A direct connection to the coax should give a better match, however, a common-mode choke on your coax at some distance from the feed will help keep RF from your shack and act like an additional radial. If your ground system is perfectly lossless, the quarter-wave resonant vertical will have an impedance of 36 Ω for an SWR of 1.4:1. With the balun, it will be 72 Ω for an SWR of 1.44:1. But with a real ground, any ground loss will add to the antenna impedance. Say you have a fairly typical loss resistance of 10 Ω — your quarter-wave antenna plus ground will have an impedance of 36 + 10, or 46 Ω, with an SWR of 1.09:1. With the balun, it will be 92 Ω, or 1.84:1.

I have had a number of amateurs express surprise and disappointment after adding radials to their ground system and observing a change in SWR from 1:1 to 1.5:1. In this instance, the slightly mismatched system with the better ground will make an improvement in their antenna performance. Continuing with the numbers in our example, to have that 1:1 SWR implies a ground-loss resistance of 14 Ω. This will result in an efficiency of 36/(36 + 14) or 72%, meaning that 28% of the transmitted power will warm worms instead of being radiated — a loss of 1.4 dB.

Q Dick, W1REJ, asks: I have a new tower that is ready to have antennas mounted. The problem is that it is about 160 feet from where the station is in the house. I have a run of low-loss LMR-400 coax all the way to the tower. Recently I read an article that stated it is not a good idea to run UHF antennas that far from stations due to coax losses. Can you please shed some light on this for me? I know there will be losses even with LMR-400, but I did not think it would be that restrictive. The 2-meter antenna would be on a 33-foot tower and is at the top of the hill behind my house with sloping land in all directions, which is why I would really like to take advantage of this location.

A All transmission line has loss, and the higher the frequency and longer the run, the more the loss. The serious V/UHF operator, such as those involved with moonbounce or competitive contesting, would put power amplifiers and receive preamplifiers right on the tower and just run power and low-level signals back to the station, eliminating coax loss from the equation, but that is a big undertaking and probably not warranted for most of us.

Looking at your case, 160 feet of matched LMR-400 has a loss of about 2.5 dB at 145 MHz — less than half an S-unit. If much of what you do is line-of-sight limited, then raising the antenna above obstacles by putting it on your tower will have much more effect than a loss of about 44% of your power.

As an example, I had a 50 W 2-meter FM transceiver in the kitchen that I used to work into local repeaters. For an unknown period, the final amplifier module had failed, and it was actually only putting out 0.1 W. My roof-mounted vertical was still working fine into every repeater that I could hear — and that's 27 dB loss!

So I would go with it. If you decide you can't stand it, there are other solutions that may be less extreme, such as shifting up to LMR-600 (1.53 dB), or ⅞-inch heliax (0.74 dB). For casual and most contest operation, I think you will be very happy, and you can always improve if desired. Adding VHF and UHF preamps at the antenna with appropriately time-sequenced switching is not a big deal, and would significantly improve your receive sensitivity of weaker signals.

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 "ARRL The Doctor is In" podcast, sponsored by DX Engineering, on iTunes, Blubrry, Stitcher, or on the ARRL website at **www.arrl.org/doctor**.

Hints & Hacks

An External Speaker for Field Day, an Antenna Sleeve for Handheld Users, and More

An Easy, Portable External Speaker

The internal speakers in radios need to be small enough to fit inside the radio enclosure and are often on the top or bottom of the radio, sacrificing a bit of sound quality due to the location. External speakers, however, are often used to improve the audio and have the option of a front-firing speaker, which can enhance audio and make it easier to hear.

I decided to construct an external speaker that was easy to take into the field for public service events or Field Day outings (see Figure 1). I planned out what I was looking for. A handle would help with easy portability, and a rugged enclosure would help keep the speaker from getting beaten up in the field. The parts to build the unit would have to be readily available at a reasonable cost. And, of course, it had to sound good.

First, I needed to find a speaker. I wanted a speaker that was self-enclosed to make construction easier. I kept in mind how I'd be mounting it in the enclosure and the need for some sort of protective grill in front of the speaker cone to keep it from getting damaged. I found that Parts Express (**www.parts-express.com**) sold a 5-inch sealed back mid-range speaker (model number GRS 5SBM-8) that fit the bill. It also had a built-in mounting ring with holes to easily mount the speaker unit to the enclosure.

As for the enclosure, a small plastic ammo box seemed like a simple, inexpensive solution. The plastic would also make it easier to cut out the hole to fit the speaker into the box.

Finally, I needed to select a connector to connect the speaker to the radio equipment. I chose red and black binding posts from Parts Express (part number 090-475) for their versatility, and easily identifiable polarity (see Figure 2). They only required two ⅛-inch holes, spaced ¾ inch apart, to mount them to the box. If desired, you could use a pigtail type of connection cable to attach the required connector to mate with the radio's external speaker jack. The pigtail could be stored in the ammo box enclosure when not in use. Of course, any other user-preferred connection could be employed to connect the external speaker to the radio equipment.

In summary, the project worked out well. The external speaker met my design goals and looks appealing. It's been used with different radio equipment and sounds good. It may fit your need for a portable external speaker for Field Day or for everyday use.
— *73, Don Varner, WB3CEH,*
wb3ceh@yahoo.com

Figure 1 — The finished portable external speaker. [Don Varner, WB3CEH, photo]

Figure 2 — The red and black binding posts on the rear of the speaker unit connect the speaker to the author's radio equipment. [Don Varner, WB3CEH, photo]

Wooden Battery Pack Holders

Ever since becoming devoted to QRP, I found it difficult to make many CW contacts at my slow Morse speed. I decided to try and go for the Field Day bonus points awarded for alternative energy (i.e., my solar panel).

I bought lithium-ion batteries and found ten-cell holders at American Battery Company (**www.americanbatterycompany.com**). The holders needed some protection from my rough handling, so I constructed wooden boxes for them, about 6½ × 3½ × 1 inches (outside dimensions). My solar panel's controller coincidentally had the same spatial needs, though a bit thicker. Its box is 1¼ inches high.

The boxes include space for dc power plugs. A lid was unnecessary

Figure 3 — The author's homemade wooden boxes help protect the battery holders (left and right) and solar panel controller (center) from being knocked around during handling. [Charles Hooker, VE3CQH, photo]

for my use. The patch cord for my tribanders is connected to one battery pack. These boxes have helped keep my battery holders and controller safe from bumping around too much (see Figure 3).
— *73, Charles Hooker, VE3CQH,*
chuckcynthia@gmail.com

A Safety Vest Antenna Sleeve

Amateur Radio operators need to wear safety vests when they volunteer in support of fun runs, marathons, and other public service events. The vest not only provides personal safety, but also serves as the carrier for handheld radios when moving around the event. However, with the radio simply clipped onto the vest, the antenna is at risk of snagging on branches or hitting the operator in the face or eye. I wanted to find a solution that provided better security for my radio, a stronger signal, and prevented any eye injuries or antenna snagging. I came up with an antenna sleeve that allows the operator to keep their handheld secure in a vest pocket and use longer antennas without safety risks.

Figure 4 — A small antenna sleeve sewn alongside a vest pocket allows for the use of longer antennas without potential safety risks. [Peyton Barnes, KE5ZDZ, photo]

Construction of the antenna sleeve was easy. I fashioned an open-ended cloth tube — 2.6 inches long and ½ inch in diameter — from material similar to that of the safety jacket (see Figure 4). The sleeve is several times the diameter of the antenna to allow vertical movement and easy removal of the antenna. I sewed the tube along a vertical line just lateral to the right breast pocket. With the radio in the lower pocket location, a longer antenna can be employed safely, providing a stronger signal. Also, a raincoat can be donned over the antenna and radio, protecting both while still allowing operation. This small sleeve holds the antenna in a vertical position, against the chest and away from the face.

In the field, this antenna sleeve allows me freedom of movement and effective communication. I hope this is useful for any amateurs who like to go out into the field this Field Day and during public service events throughout the year.
— *73, Peyton Barnes, KE5ZDZ,*
skaevola@hotmail.com

Protecting Antenna Support Rope from Wildlife

Like many hams, I use trees as antenna supports. After three unexplained line (rope) failures, I discovered that squirrels had been chewing through the line where it passed over the tree limb.

I solved this problem by using a 6-inch loop of small-diameter stainless-steel aircraft cable screwed to the tree holding a pulley for the antenna support rope. Alternatively, you could form the loop using ordinary stranded copper wire (such as #14 AWG) and either crimping or soldering the ends together.

While setting this up, it occurred to me that instead of using a single piece of rope through the pulley, I made it a loop. A rope through a pulley means that the bottom end is susceptible to running free out of the pulley unless it is always held. The rope loop ensures a bit more security.

The insulator is fastened with a heavy tie-wrap where the ends of the loop through the pulley are tied together. This allows me to lower the antenna

Figure 5 — Enlarge the diameter of the plug's clamping jaws. [Barry Shackleford, W6YE, photo]

Figure 6 — Use a vise and **C**-clamp to close the clamshell while screwing the halves together. [Barry Shackleford, W6YE, photo]

Figure 7 — The completed installation, snug and secure. [Barry Shackleford, W6YE, photo]

from ground level for repairs or changes without climbing. Plus, the antenna support rope is now out of reach of the squirrels' sharp little teeth. — *73, Doug McCray, K2QWQ,* **k2qwq@comcast.net**

Installing Heavy-Duty Power Plugs

Heavy-duty power plugs, such as the Leviton 5256-VY, typically feature a clamping piece or clamshell closure to effect a strong grip on the attached power cord. The halves of the closure are held together by two screws threaded into the opposing piece, which is typically nylon or plastic. When installing a heavy-gauge power cord, achieving a complete closure by means of the two screws alone is likely to be problematic.

I have found a procedure that ensures an easy and neat installation of heavy-gauge power cords. First, measure the diameter of the power cord and select a drill bit of the next smallest diameter. Next, enlarge the diameter of the plug's clamping jaws with the selected bit. It's best to hold the plug closed in a vise while drilling, with caution not to drill past the clamping jaws (see Figure 5). After connecting the power cord wires to the plug blades, use a vise and possibly an additional clamp to close the clamshell tightly around the power cord sleeve while screwing the two halves together (see Figure 6).

The result is a snug and secure fit to the power cord (see Figure 7). — *73, Barry Shackleford, W6YE,* **w6ye@arrl.net**

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

QST invites you to share your hints with fellow hams. Send them to "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.

New Products

Mastrant's New Size of Guy Rope

Mastrant introduces a new 9/64-inch-diameter rope for the Polyester product line (Mastrant-P). The new size of Mastrant-P rope fills the gap between the 2.6-millimeter-diameter (size 3) rope and the 4.4-millimeter-diameter (size 4) rope. It is called "size 3+" and has a 3.5-millimeter diameter (9/64 inches). The breaking strength is 300 daN (about 300 kilograms or 660 pounds), with a safe working load of 100 daN (about 100 kilograms or 220 pounds). Size 3+ is ideal for guying of vertical antennas, light masts, truss support, and heavier wire antennas.

It is available in standard Mastrant colors (black and blue), as well as the new camouflage tan and brown design. You can get it on spools of 102 feet (31 meters), 330 feet (100 meters), 660 feet (200 meters), and 1,650 feet (500 meters). Mastrant ropes are designed for guying — they are resistant to UV, any weather, acids, and alkali. They also have high strength and negligible elongation. For more information, visit **www.mastrant.com**.

Close Up

Coaxial Connectors

This family portrait of coaxial cable connectors includes the most common versions in Amateur Radio use today. All the connectors shown here were provided by ABR Industries (**www.abrind.com**) and are designed for use with crimping tools rather than soldering.

- **A — Right-angle SMA**
- **B — Female chassis-mount BNC**
- **C — Male BNC**
- **D — Female N**
- **E — Male N**
- **F — TNC chassis mount**
- **G — Male PL-259**
- **H — TNC**

Steve Ford, WB8IMY, wb8imy@arrl.org

ARM Radio

Alberto di Bene, I2PHD, developed a fascinating software-defined receiver based on an STM32F429ZIT6 "Discovery Board" manufactured by STMicroelectronics. These boards are designed for experimenters and even include color LCD displays. Best of all, they are surprisingly inexpensive. At the time of this writing, Digi-Key was selling them for only $29.95 (part no. 497-16140-ND; **www.digikey.com**).

Figure 1 — Alberto di Bene's ARM Radio, an inexpensive software-defined receiver that covers 8 to 900 kHz. Full details are available at **www.weaksignals.com**. [Alberto di Bene, I2PHD, photo]

The board features an ARM microprocessor that sports three 12-bit analog-to-digital converters (ADCs), each capable of a sampling frequency of 2.4 MHz. Considering its capabilities, Alberto realized that the Discovery board could be turned into a software-defined radio receiver for low- and medium-wave frequencies. He needed to add only two outboard circuits, both of which are quite simple.

Anti-Aliasing and DAC "Reconstruction" Filters

You could connect the Discovery Board's ADC directly to an antenna, but it wouldn't work well. For proper operation, the board needs an anti-aliasing filter between the ADC input and the antenna. Alberto designed his filter to attenuate all frequency components greater than 893 kHz, which sets the upper limit of reception. He also included a 10 dB preamplifier. The filter consists of less than 20 components.

At the other end of the process, the audio output is intended to be fed to an amplified speaker. Before you can do that, however, the output of the digital-to-analog converter (DAC) must be filtered to remove the sampling frequency component. Alberto calls this his "reconstruction filter." Once again, it is a simple design with less than 15 components.

Alberto has posted a detailed PDF on his website at **www.weaksignals.com**, where you'll find the filter diagrams and much more.

Software

On Alberto's website, you'll also find the source code (written in *C*) that enables the Discovery Board to work its magic.

Be sure to read the "Read Me First" file after downloading the code. In there, you will discover that you'll need to compile the code using a *Keil MDK* compiler, available at **www2.keil.com/mdk5/**, and add the legacy support packs. Once the object code is ready, you can load it to the ARM chip's flash memory using the *ST-Link* utility found at **www.st.com/en/development-tools/stsw-link004.html#**.

When the code is loaded, and power is applied to the radio, you're rewarded with an SDR receiver that covers from 8 to about 900 kHz, with AM, LSB, USB, and CW demodulation modes, narrow and wide bandwidths, and fast or slow automatic gain control. As you can see in Figure 1, the LCD touchscreen is nicely designed with pushbutton controls, a large frequency display, and an audio volume slider.

On his website, Alberto provides a few audio recordings so that you can hear how well his ARM Radio performs. In fact, Alberto entered the project in an ARM microcontroller design contest.

Depending on where you purchase your parts, you could probably build your own ARM Radio for less than $100 — probably much less. It could even become part of a station for 2200 and 630 meters.

Welcome to 21st century homebrewing!

Hams Support
A Carriage-Driving Competition

Bob Ballard, KG5SQJ

The 2018 North Texas Whip Sunrise Ridge Ranch Carriage Driving Competition, which took place on April 7 and 8, was the 15th year the Tri-County Amateur Radio Club has supported this event. The competition has three categories, with the dressage and cones driving course taking place on the first day, and the obstacle maneuverability course on the second day. Over the course of the 2-day event, Mike Burns, KE5NCS, serves as the primary Amateur Radio Communications Facilitator, coordinating 17 volunteer hams and two additional volunteers.

On Saturday, hams aided in covering the dressage course — where the competitors perform a series of predetermined carriage movements — as well as the cones driving course — where carriage drivers move through a series of 20 gates. On Sunday, eight additional Tri-County ARC volunteer hams were needed to cover the obstacle course, with stations at the start, the finish, and each of the six obstacles. The obstacle course occurs in a heavily forested area that prevents an open view of competitor progress. The primary duty of these additional hams was to report when each competitor exits the assigned obstacle, as well as to report any penalties, safety issues, or injuries that occurred at their location.

Dwain and Caroline Gaus and their pony, Duke, at the North Texas Whip Sunrise Ridge Ranch Driving Trial Obstacle 1. [Tim Branam, N5SWG, photo]

At a unique Texas event, hams volunteer to provide tactical net operations services.

Repeater Solution to Simplex Issue

While preparing for the 2018 event, we had to address simplex operation performance issues that had occurred during the 2017 event. Reportedly, several volunteers had difficulties with handheld-to-handheld communication using 2-meter simplex because of the topography of the course. Elevation differences, high-power electric service lines, and the dense forest around Sunrise Ridge Ranch adversely impacted simplex communications between handheld radios, which led to interference. The Net Control station's antenna was 36 feet and above the elevation barrier that disrupted handheld-to-handheld communication.

After considering several solutions, we settled on employing club member Paul Finch's, WB5IDM, 6 W, 70-centimeter repeater and duplexer. A week prior to the event, the repeater's output frequency, offset, and tone specifications were emailed to all club members to enable volunteer hams to program the necessary duplex memory channel into their handheld radios in advance. I also volunteered to arrive early on the first day to help volunteers manually program the duplex channel into their handheld radio, if necessary.

Net Control and Repeater Station Preparations

On Friday, April 6, Paul Finch, WB5IDM; Aaron Finch, KC5ZUC; Mike Burns, KE5NCS; Mike Heusser, KL7SG; Gayla Heusser, KL1WG, and I traveled to the Sunrise Ridge Ranch in Paradise, Texas. We configured the communications trailer for the Net Control station and mounted the club's 40-inch and 48-inch computer monitors to the interior trailer walls. The repeater station was then set up on the next-to-highest elevation point on the property. We deployed a N9TAX Slim Jim dual-band antenna mounted atop a 20-foot telescoping fiberglass mast. Paul and Aaron configured the repeater and duplexer, also carefully sealing all the coax cable connections, and then anchored the cable to the mast with electrical tape. In preparation for expected wind and rain, we attached three guy ropes to secure the mast.

When we finished the setup, I tested the repeater using my handheld radio, once from directly under the antenna and again 200 yards away from the repeater station. Before leaving, we turned the repeater off and disconnected the batteries to reserve the power for the event.

Saturday's Weather and Simplex Operations

On Saturday, April 7, the weather had turned unusually cold — at 38° F — and rainy for April in north central Texas. Upon arrival, I discovered that the overnight temperature change and heavy winds had caused the repeater station's telescoping mast to collapse to a 6-foot elevation, shearing the electrical tape that was securing the coax cable. Fortunately, because the electrical tape applied directly below the antenna's coax connector remained intact, no damage occurred to the antenna or the coax cable. Because Saturday's activities all occurred within a 300-yard area, with clear line of sight between all stations, we decided to employ only simplex operation that day, thus deferring re-erecting the repeater station's antenna until the next day.

Tri-County ARC hams (equipped with a handheld transceiver radio) were paired with event officials to serve as radio communications liaisons, providing real-time radio communications between all event officials. Despite the cold, the event's dressage and cones competitions went as planned, with our volunteers operating for 9 hours. Event officials were pleased with the Tri-County ARC's support keeping all officials constantly in touch.

Sunday's Duplex Operations

Sunday brought better weather, and upon arrival at the Sunrise Ridge Ranch, Mike Burns and Mike Heusser tackled cranking up the Net Control Station in the Tri-County ARC communications trailer for Sunday's operations. They mounted an Ed Fong dual-band 2-meter/70-centimeter antenna to the trailer's 36-foot telescoping mast. They then fed the coax cable into the trailer and connected it to the club's Icom ID-5100A dual-band 2-meter/70-centimeter radio that was programmed with the repeater's 70-centimeter duplex channel. They also activated the club's Kenwood TM-D710GA dual-

Figure 1 — Bob Ballard, KG5SQJ, in the Tri-County Amateur Radio Club communications trailer, where he served as Net Logger. [Bob Ballard, KG5SQJ, photo]

Figure 2 — Mike Heusser, KL7SG, explains how the obstacle course and ham location icons were configured to display over the Google Earth satellite photo. The ham's cell phones running the APRS.fi application enabled real-time monitoring of their physical location on Mike's integrated map. [Bob Ballard, KG5SQJ, photo]

band radio and configured it to operate on the simplex 2-meter frequency at 50 W. This second radio was connected to a Diamond dual-band 2-meter/70-centimeter antenna elevated approximately 10 feet. A Honda inverter generator powered the trailer, and the repeater used a 12 V automobile jump starter unit wired parallel to a large AGM battery.

My first assignment on Sunday was to get the repeater station working by re-elevating the mast and antenna, connecting the batteries, testing the station, and reporting it as operational. I then quickly hiked the 200 yards to the communications trailer Net Control station to prepare for my Net Logger assignment.

Room for Improvement

For logging data, I developed two Microsoft *Excel* spreadsheets to record our operational support. The time tracking log was meant to capture the data for carriage obstacle exit times and penalties in real time, while the communications activity log would simultaneously be used to record all other net traffic (see Figure 1). However, because of the disjointed incoming net traffic, I missed several carriages' obstacle course exit times and penalty reports. Fortunately, Jon Diner, N5JLD, and his daughter, Shelby, were recording obstacle reports on paper, and together, we kept the data up to date in virtually real time.

As for the repeater solution, it was successful overall, with one exception at Obstacle 2, which was located in a low area. Net Control had trouble communicating with the assigned volunteer, Randy Thompson, KF5RRF. After several attempts to solve the problem, Net Control decided to use simplex operation during the remainder of the event to communicate with Randy.

Lessons Learned

In spite of a few hiccups, the Tri-County Amateur Radio Club's support of the 2018 event was effective, and we plan to apply what we learned while supporting future events. Multitasking is not effective, and because of so much simultaneous net traffic, we plan to assign one volunteer to each activity log next year. Additionally, fully testing the repeater from every obstacle on the course would have brought the duplex operations problem to our attention earlier, so we will fully test the repeater from every obstacle location, using a low-power handheld radio prior to the event. We also plan to deploy the repeater station to the top of the highest point on the ranch property and to use a much higher-gain 70-centimeter antenna on the repeater.

Acknowledgments

The Tri-County Amateur Radio Club Tactical Net Operations support effort for this event was truly rewarding and enjoyable. Kate Morgan and other directors of the competition were impressed with our professional communications, as well as the utilization of the monitors to display the tracking log and the Google Earth map of the obstacle course (see Figure 2). Kate also thanked Jon, who had acted as Net Control, along with appreciation for all of the TCARC ham volunteers: Mike Heusser, KL7SG; Gayla Burns Heusser, KL1WG; Paul Finch, WB5IDM; Aaron Finch, KC5ZUC; Mike Hunter, KC5AMN; Tim Branam, N5SWG; Stacy Branam, W5ORD; Randy Thompson, KF5RRF; Richard Marx, KE5ZGZ; Jeff Rooks, K5JJR; James Tulloh, KG5PMN; Bob Overton, WD5ILB; Jay Cox, KG5BZW; Wayne Morris, KB5UQ; Mike Norton, KG5SRG; Bob Ballard, KG5SQJ; Rebecca Rooks, and Shelby Diner.

Bob Ballard, KG5SQJ, lives in Texas and is a retired Aerospace Information Technology Project/System Integration Manager. He was licensed in 2017 and now holds his General-class license. He is a member of the Tri-County Amateur Radio Club (**WC5C.org**), the Kilocycle Club of Fort Worth (**W5SH.org**), and the Amateur Radio Club of Parker County (**W5PC.org**). Bob has supported several community events as a radio amateur volunteer, and he has developed and conducted more than two dozen sessions of his hands-on radio training class for manually programming simplex and duplex memory channels into Baofeng handheld radios. He is excitedly preparing to take his Amateur Extra-class license exam.

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

As a result of a multi-pronged Kids Day effort, this Nevada club has taken on youth involvement with a passion, generating excitement for hams of all ages.

Kids Day at the Outfitters

Barry Bettman, K6ST

The Sierra Nevada Amateur Radio Society (SNARS) club is lucky to have families with kids in our Reno/Tahoe, Nevada-based club, but we wanted to engage more kids on a significant level.

Kids Day turned out to be the perfect launching point. We started planning about 7 weeks out from the January 5, 2019 Kids Day event, which coincided with the next SNARS meeting.

Making Connections, Shaping a Plan

The first step for launching our Kids Day effort was a banner on our club website (**snars.org**) that linked to the **arrl.org/kids-day** web page. This allowed us to begin outreach to club members and the larger ham radio community in the greater Reno/Tahoe areas of the Sierra Nevadas. We also promoted Kids Day on our local nets and distance nets throughout the world, creating excitement for youth involvement in Kids Day.

As a result of the interaction among hams, we got in contact with a Scoutmaster and other Scouting troops that were interested in Kids Day. With a little coordination, a Scouts on the Air event about 30 miles away became part of our Kids Day celebration.

The SNARS setup at Cabela's was open and engaging, using signs, a sandwich board, Kids Day certificates, and welcoming volunteers to encourage kids to come learn about ham radio. [Chuck Farnham, WD6CHC, photo]

Greg, KG7DMI, helped one child get on the air, earning himself an ARRL Kids Day Certificate of Participation to commemorate his first contact. [Aline Dodge, N7JWL, photo]

We had three events planned for January 5:

1) SNARS club breakfast with a presentation about Kids Day

2) Kids Day pavilion at Cabela's

3) Scouts on the Air with Kids Day

Planning the Breakfast Meeting

SNARS offers a family membership, so the whole family can be part of Sierra Nevada Amateur Radio activities, including the breakfast meetings.

The ham volunteers from the Sierra Nevada Amateur Radio Society (SNARS) encouraged kids to get on the air during a Kids Day event. [Aline Dodge, N7JWL, photo]

At the January 5, 2019 SNARS breakfast meeting I gave an overview of youth involvement in ham radio, plus Kids Day itself, then I invited kids from the audience to talk to other kids on the air. Three kids took me up on the offer. One was not a licensed ham, one was a General-class license holder who was only somewhat active, and one was an active Amateur Extra-class licensee. I had previously set up two schedules during the breakfast meeting — one with Danielle Edgington, KE8JNU, who runs the Young Amateur Radio Digital Voice Net, and one with YACHT: Young Amateurs Communications Ham Team, K8KDZ.

Adventure at Cabela's

The Cabela's event began to take shape when I realized that an event out in the community would be great for engaging kids.

The SNARS club had previously used our local Cabela's parking lot for one of our ham swap meets. It made sense to have Kids Day there because, as an outdoor recreation retailer, Cabela's has a big following of families that come in to look at sporting and outfitting gear. After reaching out to our contact at Cabela's and a few phone calls to the store manager and the company's events specialist, we were approved to have the event.

Cabela's was very supportive of our event in general. When we realized a big winter storm coincided with our event, we talked to Cabela's management about conducting the event inside the store. They were very amenable. All it took was being respectfully communicative, and we obtained approval in less than a week. We didn't even have to pay a fee — all we had to do was set up, host our event, and clean up after — super easy!

Setting up at Cabela's took about 45 minutes. We had five hams doing most of the work, with other club members pitching in too. In the weeks prior to the events, we did have a few planning calls with the core Kids Day team, which included Wes, KG7QXE; Greg, KG7DMI; Subrina, KI7OAL; Brian, KG7PDC, and me.

At the Cabela's Kids Day pavilion, we had two radio stations — HF and VHF using a Yaesu FT-891 and FT-991 that were supplied by club members. For antennas, we had a Diamond VHF/UHF vertical and a Buddipole in a dipole configuration. We had CW practice oscillators — the old Boy Scout type with sounds and flashing lights, so they were quite engaging for the kids.

All About Kids Day

June 15 is 2019's second Kids Day — the time to get youth on the air to share in the joy and fun that Amateur Radio has to offer.

Kids Day begins at 1800 UTC and concludes at 2359 UTC. Sponsored by the Boring (Oregon) Amateur Radio Club, this event has a simple exchange suitable for younger operators: first name, age, location, and favorite color. After that, the contact can be as long or as short as each participant prefers.

Look for activity on these frequencies:

10 meters: 28.350 – 28.400 MHz
12 meters: 24.960 – 24.980 MHz
15 meters: 21.360 – 21.400 MHz
17 meters: 18.140 – 18.145 MHz
20 meters: 14.270 – 14.300 MHz
40 meters: 7.270 – 7.290 MHz
80 meters: 3.740 – 3.940 MHz

Repeater contacts are okay with permission of the repeater owner.

As with any on-the-air activity that includes unlicensed individuals, control operators must observe third-party traffic restrictions when making DX contacts. Additional details are on the ARRL website at **www.arrl.org/kids-day**.

The kids that came to our Cabela's Kids Day event were a combination of kids connected to the Sierra Nevada Amateur Radio Society club, and members of the public just coming into Cabela's on their own that day. Club members encouraged kids to come over as they walked into Cabela's.

We had sign-in logs for kids and adults, and we distributed ARRL youth material, including Kids Day certificates downloaded from **www.arrl.org/kids-day**. I put my contact info on all the materials, so kids and adults had a way to find when they were ready to take their next steps into the world of ham radio.

Scouts on the Air

Later in the day, we held our third Kids Day event with boy and girl Scouts at a regional fire department. Club members brought a Yaesu FT-736R for VHF/UHF analog and a Motorola XPR 4550 UHF DMR, along with two J-poles placed outside the metal building. The kids were able to make local and DX contacts. They really loved it and learned a lot.

SNARS volunteers explained how Morse keys worked and showed the kids how to use one. [Julie Dodge, N7JWL, photo]

The adult Scout leaders learned a few things, too. It turned out one of the adults was interested in getting back into ham radio, as he had been a ham many decades ago and had let his license lapse. We are working with the Scouts on several more projects. On the third full weekend in October 2019, we have an event coinciding with the Jamboree On The Air (**www.scouting.org/jota/**), where Scouts will have the opportunity to earn their Radio Merit Badge.

Further Interest, Weeks Later

This memorable Kids Day allowed SNARS club members to engage with youth in new ways. Several weeks later, the General-class youth who'd gotten on the air at the SNARS breakfast meeting upgraded to Amateur Extra, and the unlicensed kid became a Technician.

One week after the Cabela's event, we did an event at the Boys & Girls Club in Reno, Nevada, with 15 eager middle school students. I mentored them for a bit, acting as control operator on the SNARS Noon Net, and then got some of the kids on the air to act as net control. The hams checking into the net loved interacting with these kids. Four of the kids from the Boys & Girls Club wanted to get their license, so we are looking to bring a ham radio class to them.

Sierra Nevada Amateur Radio Society

Chuck Farnham, WD6CHC

SNARS (Sierra Nevada Amateur Radio Society), an ARRL Special Services Club based in Reno, Nevada, was formed in April 1968 by F. William Rett, III, WA7FBU; Ronald E. Cerveri, WA7EKN; John Reinhold, K7JJS; Ray Bass, W7YKN; Robert Dickerson, W7VD; Frank Cherne, WA7DUL, and Larry Oakley, W7AB.

SNARS has members and repeater coverage all over northern Nevada and the Sierras, with 25 repeaters under the W7TA call sign. The club meets the first Saturday of the month at the Boomtown Casino. There are 351 active members, 232 of which are ARRL members.

The club provides monthly educational classes on a variety of technology subjects, and it even has a lending library of the latest ham radio equipment that members can check out to see what fits their needs and budget.

Primary activities include ARRL Field Day, two swap meets, the Reno Air Races, and various bike and running events between Reno and Lake Tahoe that are staffed by SNARS members. Communication is provided by the club's repeater network.

SNARS is the host club and founder of the popular Nevada State Amateur Radio Convention, which is attended by hams from the surrounding states, as well as other counties, making it one of the premiere events for hams to attend every year.

Reach Out to Kids

The next ARRL Kids Day is June 15, 2019. SNARS has sent a proposal to the Discovery Museum in Reno, Nevada, asking for them to host Kids Day. Kids Day is a great opportunity for introducing ham radio to younger generations, but you don't have to wait for Kids Day. Engaging with youth can be done any time — now is a great time to begin!

Barry Bettman, K6ST, has been licensed for 46 years. He is a very active ham in contesting, is on the board of directors of the Sierra Nevada Amateur Radio Society, and serves as ARRL Nevada Section Youth Coordinator. Barry is an executive coach, helping clients with their goal, action plan, and positive mindset. He is passionate about giving back to the Amateur Radio community by supporting youth projects as a legacy to ham radio. Barry can be reached at **k6st@arrl.net**.

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

24th
WORLD SCOUT
JAMBOREE
SCOUT MONDIAL
NORTH AMERICA
2019

This event happens every 4 years, with 2019 marking the 24th World Jamboree.

Jim Wilson, K5ND

Taking place from July 22 to August 1, 2019, the World Scout Jamboree will be held at The Summit Bechtel Scout Reserve in West Virginia. Nearly 45,000 Scouts from over 160 countries will gather in the mountains to learn about other countries and cultures, to make new friends, and even to experience adventures like rock climbing and ziplining.

Demonstration Station NA1WJ

Hosted by a team of North American Scouting organizations, including Scouts Canada, Asociación de Scouts de México, and Boy Scouts of America, the demonstration station will use the call sign NA1WJ and will be on the air using 10 operating locations on HF, VHF, UHF, satellites, D-STAR, and Echolink.

Additionally, we'll be running Amateur Radio Direction Finding (ARDF) using 80 meters and 2 meters. Though it will mainly have simple courses meant to introduce newcomers to this aspect of the hobby, it will be open to all levels of experienced foxhunters.

We're also planning an ARISS contact with an astronaut on the International Space Station (pending successful scheduling), as well as contacts with LEO satellites. Plus, we'll be launching three Pico balloons with WSPR payloads that are expected to drift over the Atlantic during the Jamboree and perhaps around the world long after the Jamboree is over. We'll provide information on the launches and tracking from our website and social media. You can learn about our operation at **na1wj.net** and **https://groups.io/g/na1wj**, or via the real-time updates on our Facebook and Twitter pages.

NA1WJ Equipment

Stations are equipped with the Icom IC-7300, IC-9700, and ID-5100A, along with hexbeams, Yagis, verticals, and dipoles. But propagation is expected to be challenging.

ICOM

The station will be staffed approximately 18 hours each day and operating using SSB, CW, and digital modes. Working the world will be a challenge, as we will only have 100 W, but we will be using directional antennas to enhance our signal as much as possible.

NA1WJ Staff

Of the 9,000 adult Scouts on the Jamboree's International Service Team (IST), 40 staff members have been allocated for the Amateur Radio team. All are active dedicated Scouting volunteers and nearly all of them are licensed operators from their home countries, which include the US, Australia, Canada, Chile, Finland, Germany, Liechtenstein, Malaysia, Nepal, the Netherlands, Norway, Taiwan, Japan, Switzerland, and the United Kingdom.

Thank You to Our Supporters

The NA1WJ World Scout Jamboree operation is powered by Icom America radios and repeaters; MFJ rotators, antennas, and headphones; DX Engineering antennas, cables, triplexers, and filters; JK Antennas Yagis; a portable Aluma Tower; GeoChron Digital 4K UHD, and the K2BSA Amateur Radio Association.

RADIO SCOUTING

How You Can Help

We'll have one staff member operating each station, along with four or more Scouts listening in and getting on the microphone. We need you on the other side, engaging in questions about Scouting and the Jamboree, and commenting on your own experiences in Scouting.

Single stations will work great, but there is a great opportunity to get more Scouts on the air and talking to the NA1WJ station by scheduling a Scout summer camp, Radio Merit Badge Workshop, or a campout to match the days/times of the World Jamboree. For example, the Philmont Amateur Radio Association, K5PSR, will be using Amateur Radio to connect local Scouts on the Philmont Scout Ranch to those at the World Scout Jamboree.

Mark your calendars for July 22 to August 1, 2019, and help us introduce Amateur Radio to the next generation of hams across the globe.

Jim Wilson, K5ND, is a retired communications and publishing executive, serving in those capacities with Boy Scouts of America for more than 2 decades. He is a Scouting volunteer in all things related to Amateur Radio at the national and international levels. He can be reached at **k5nd@arrl.net**.

Electric Vehicle Power for ARRL Field Day

Janelle Brisbine, NØMTI

Since 1933, ARRL Field Day has given radio operators a chance to demonstrate Amateur Radio's science, skill, and service to the community. Participating groups are encouraged to use power sources other than commercial electric power. In the past, the St. Louis Metro Amateur Radio Emergency Service (ARES) team has experimented with solar power and alternate battery sources. For Field Day 2018, Norm Guittar, the husband of St. Louis Metro ARES member Dolores Guittar, KDØCIV, suggested using his 2013 Chevrolet Volt to power our station.

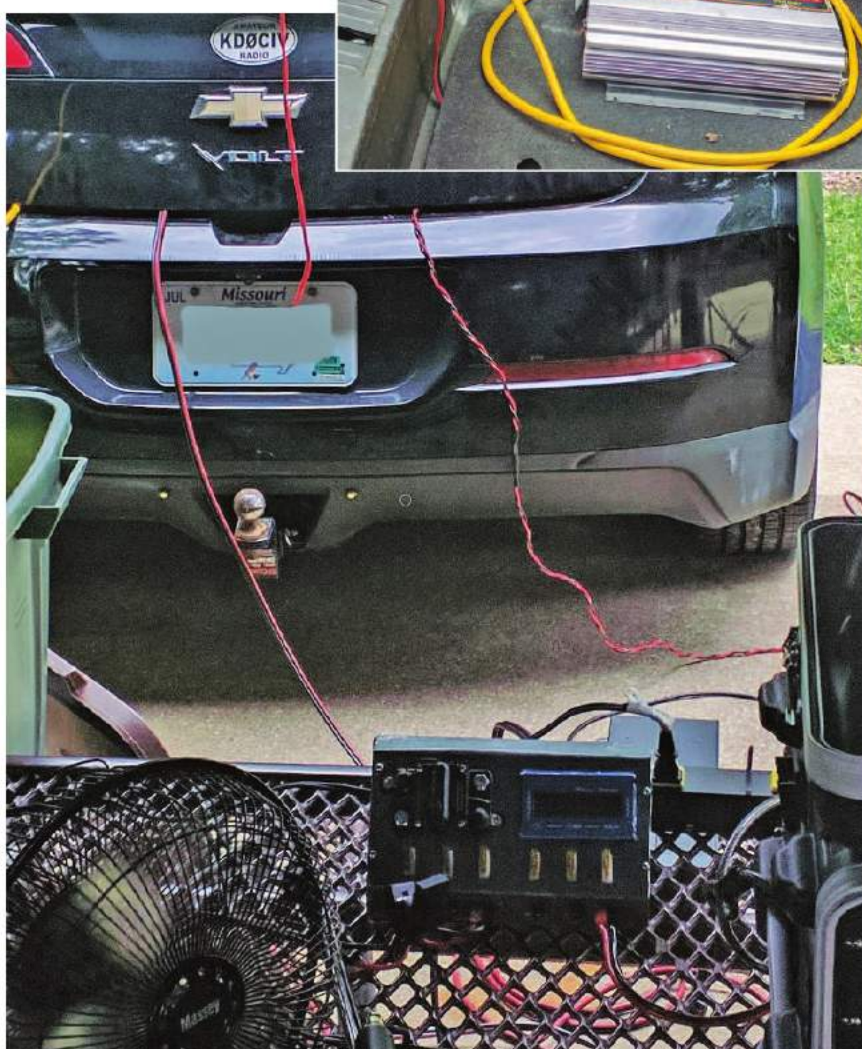
Setting It Up

Attached to the 12 V battery under the trunk, Guittar had permanently wired in 300 A Anderson Powerpoles® that power an inverter with 2,000 W continuous and 4,000 W peak power. The inverter supplies 120 V power, which would be used to cook our food on Field Day (see Figure 1). To generate power for the radios, Guittar attached additional alligator clips to the battery to route power to a distribution hub that included a wattmeter to monitor output from the car (see Figure 2).

The plan was to leave the car turned on, allowing the electronics to draw from the 12 V battery system. When power levels fell too low, the car would automatically recharge the 12 V system from the main battery pack that ran the car. When the main pack ran low, the car would start the backup generator, better known as the car's engine. But a safety feature of the car required the addition of the wattmeter to ensure radio operations wouldn't be knocked off the air.

A St. Louis ARES team uses ARRL Field Day as the stage for this experimental power setup.

▶ **Figure 1** — The inverter in the Chevy Volt's trunk to run our 110 V accessories.



▼ **Figure 2** — The electrical distribution from the Chevy Volt.

2018 Field Day Results

St. Louis Metro ARES operated under the call sign NØARS, powered by the Chevrolet Volt. Our 2018 ARRL Field Day team made 516 contacts, with 130 on Morse code or CW, and 386 on voice (see Figure 3).

A total of 44 people attended the event. We covered the event on three social media platforms. Two press releases were put out, and our setup received proclamations from the St. Louis Mayor, the St. Louis County Executive, and the Missouri Governor (see Figure 4).

Figure 4 — Matt Gabrian from the St. Louis County Office of Emergency Management presented a St. Louis County Proclamation to Peter Brisbine, NØMTH, and Bob Gale, WA4GDX. [George Siede, KDØPMW, photo]

Figure 3 — The field station owned by Brian Oester, KEØEYA, who operated from the primary voice station for NØARS during Field Day 2018.

Technical Challenges

One problem we faced was that, after an extended period of no movement, the car automatically turned off, allowing the 12 V battery to run down. To get around this problem, Norm provided the power meter on the power distribution panel to give a readout of the 12 V system. When the meter fell below 12 V, we had to turn the car back on.

We also had unexpected drains on the battery system. These power parasites, which included the air conditioner, the dome light, the headlights, and the car's dashboard display, tipped the energy usage upward until each was discovered and eliminated as much as possible.

Operating the radios with the varying power available from the 12 V system did impact radio performance. At full power, the radios exhibited some fluctuations and stability issues in output performance. Dropping the radios to about 80 W stabilized their performance when operating with less than 13 V applied.

Total available power at the start of the event was 4.4 kWh. A solar panel provided about 250 W to supplement the 12 V system. The car was restarted three times from when setup began around 9 AM on Saturday through teardown at 11 AM Sunday. The system maintained three radios operating on standby or actively transmitting throughout the event, as well as the appliances needed for cooking.

Future Modifications

The lessons learned in 2018 will likely result in a few changes for Field Day 2019. The St. Louis Metro ARES group is considering moving the power needs for the logging laptops onto the car's 12 V system as well. The computers could be recharged using their traditional 120 V charging cords connected to the inverter. However, to eliminate any possible power losses, Guittar suggested using Powerpole adapters and powering them directly from the power distribution panel.

Another improvement will be to keep the car off for the majority of the event to avoid the car's systems putting a load on the electrical system. This will require operators to monitor power levels throughout the event, while capping the transmit power on the radios. They appear to be fully functional at 80 W power, and the lowered power levels will draw more consistent performance when the battery levels start to drop off.

The group is also considering a second tent reserved for low-power operations. The group may also have a location in St. Louis city to better showcase the group to served agencies.

Photos by the author unless stated otherwise.

Amateur Extra-class licensee Janelle Brisbine, NØMTI, was first licensed in 2013. A former Emmy® Award-winning news producer, she holds a BA in Communications from the University of Northern Iowa, has completed the Professional Development Series with FEMA, and is working toward her Advanced Professional Series with Missouri State Emergency Management Agency. Janelle is the Public Information Officer for the St. Louis Metro Amateur Radio Emergency Service (ARES), a member of the St. Louis Amateur Radio Club (SLARC), and a member of the St. Louis and Suburban Radio Club (SLSRC). She also works on the Halloween Hamfest committee and serves the Cliff Cave VE Team. You can contact Janelle at **n0mti.jh@gmail.com**.

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

ARRL Field Day

3 Best Field Day Frequency Bands

80 and **40** meters at nighttime

40 meters (for regional contacts)

20 meters during daytime

Fifteen and 10 meters are unlikely to be productive, although some daytime openings may occur on 15 meters. Be on alert for sudden long-range openings on 6 meters during daylight hours. (According to long-range propagation forecasts.)

Best FM Repeater Satellites
for Field Day Bonus Points

SO-50, AO-91, and AO-92

Program these frequencies into your transceiver's memories so that you can compensate for Doppler shifting simply by changing memory channels. Just switch the memory channels for the strongest and least distorted signals.

For satellite pass predictions, see the AMSAT-NA website at **www.amsat.org/track/**.

SO-50

Time	Transmit (MHz)*	Receive (MHz)
AOS (start)	145.840	436.805
Zenith –3 minutes	145.845	436.800
Zenith (maximum)	145.850	436.795
Zenith +3 minutes	145.855	436.790
LOS (end)	145.864	436.785

AO-91

Time	Transmit (MHz)*	Receive (MHz)
AOS (start)	435.240	145.970
Zenith –3 minutes	435.245	145.965
Zenith (maximum)	435.250	145.960
Zenith +3 minutes	435.255	145.955
LOS (end)	435.250	145.950

AO-92

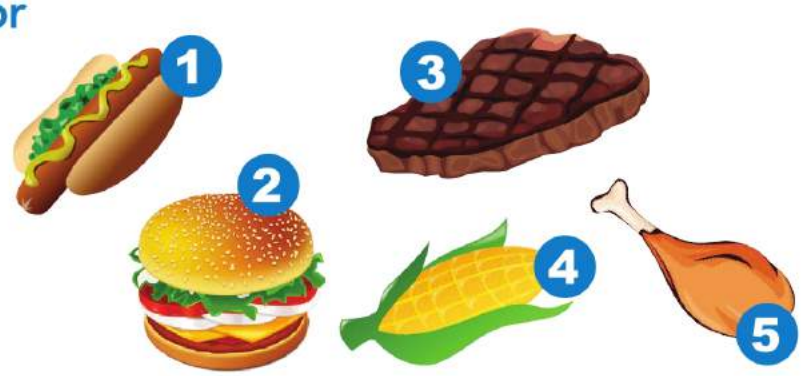
Time	Transmit (MHz)*	Receive (MHz)
AOS (start)	435.340	145.890
Zenith –3 minutes	435.345	145.850
Zenith (maximum)	435.350	145.880
Zenith +3 minutes	435.355	145.875
LOS (end)	435.360	145.870

*Transmit with a 67 Hz CTCSS tone.

5 Most Popular Outdoor Field Day Foods

(According to ARRL social media.)

1. Hot dogs
2. Hamburgers
3. Steak
4. Corn on the cob
5. BBQ chicken



By the Numbers

Best SSB/CW Satellites

for Field Day Bonus Points

You can work these sats with a minimal setup. Transmit using LSB on the uplink and receive using USB on the downlink. If you transmit at the high end of the passband, the satellites will repeat your signal at the low end of the passband.

	Uplink Passband (LSB)	Downlink Passband (USB)
FO-29	145.900 – 146.000 MHz	435.800 – 435.900 MHz
AO-73	435.150 – 435.130 MHz	145.950 – 145.970 MHz
XW-2A	435.030 – 435.050 MHz	145.665 – 145.685 MHz
XW-2B	435.090 – 435.110 MHz	145.730 – 145.750 MHz
XW-2C	435.150 – 435.170 MHz	145.795 – 145.815 MHz
XW-2D	435.210 – 435.230 MHz	145.860 – 145.880 MHz
XW-2F	435.330 – 435.350 MHz	145.980 – 146.000 MHz

4 Effective Mosquito Repellents

1 Off! Deep Woods Insect Repellent V

2 Repel Dry Family Insect Repellent

3 Sawyer Picaridin Insect Repellent Spray

4 Cutter Lemon Eucalyptus Insect Repellent

(According to research conducted by *Consumer Reports*; listed in descending order by overall effectiveness.)

3 Essential Web Pages

1 The Field Day page on ARRL's website has all sorts of resources, including the rules, entry forms, press kit, handouts, logos, PSAs, tips, and more at **www.arrl.org/field-day**.

2 Find Field Day operations near you with ARRL's Field Day Station Locator — **www.arrl.org/field-day-locator**.

3 The Field Day Facebook group is the place to promote your activation, exchange tips and solutions, and post photos. Share the fun of Field Day weekend at **https://www.facebook.com/groups/fd2019/**.

Tag your photos with #ARRLFD

6 Tips for Getting the Most Out of 6 Meters on ARRL Field Day

1 **Find SSB activity**
You'll hear SSB from 50.125 – 50.200 MHz. If the band is packed, you may hear signals as high as 50.300 MHz.

2 **Check the CW beacons**
Per FCC rules, the 50.000 – 50.100 MHz range is CW only. Listen for CW beacons from 50.000 – 50.080 MHz to see if the band is open.

3 **Go digital**
Find digital meteor-scatter FSK/MSK activity from about 50.250 – 50.290 MHz, and FT8 users between 50.300 – 50.330 MHz (with a primary focus on 50.313 MHz).

4 **Give DXers space**
Stay out of the DX window from 50.100 – 50.125 MHz. It's the courteous thing to do!

5 **Be kind to the calling frequency**
If you spin the dial and don't hear many callers, you can call CQ on the 6-meter SSB calling frequency, 50.125 MHz. Take any resulting contact to a clear frequency above 50.125 MHz. Take care not to monopolize the calling frequency. If the band is open, find a clear frequency above 50.125 and call CQ there.

6 **Know where to beam**
If 6 meters is open, point your antenna in the direction of stations you're hearing. If there isn't a big opening, rotating your antenna in different directions every 15 minutes or so will increase your chances of being heard in different parts of the country. Under poor conditions, try to aim your antenna toward large population centers.

QEX Morse Input Design Challenge

The use of a paddle to input text to a personal computer in Morse format seems like a promising solution to the age-related and disabilities-related keyboard handicap. With that in mind, *QEX* — *QST*'s sister publication for experimenters — announces the ***QEX* Morse Input Design Challenge**.

Official Rules

1) Each entry must appear in the form of a *QEX* construction article that adheres to the *QEX* author's guide and must include:

- Detailed plans (hand drawings are acceptable) and schematics that implement the Morse key input, along with a control box or other adjunct implementing **SHIFT**, **BACKSPACE**, **ENTER**, **TAB**, and other non-Morse characters.
- A list of materials and sources.
- Copy of all software needed to implement the solution.
- Photographs of the completed Morse input solution.

2) The Morse input device and control box adjunct must be an independent device, not an integral part of another device such as a keyboard or a PC.

3) Only one entry per individual or team will be accepted. Entrants must be ARRL members. ARRL Head-quarters staff and commercial manufacturers, or those associated with commercial manufacturers, are not eligible.

Send your entry article electronic files (photos, text, drawings) to the postal address ARRL, 225 Main St., Newington, CT 06111, or via email to **qex@arrl.org** with "*QEX* Morse Input Challenge" and your call sign in the subject line. Do not send zip files, as our email system will reject these.

4) Non-commercial designs only; Morse input devices must be the sole creations of the entrants.

5) Submission deadline: December 1, 2019.

6) Judging and prizes: The first five complete articles received (postmark for postal submissions, email timestamp for electronic submissions), which satisfy all of the listed criteria, will be awarded a 1-year subscription, or extension of your subscription to *QEX*, and will be considered for publication in *QEX*. The decisions of the judges and *QEX* editorial staff are final.

7) Disclaimer: By participating in the competition, you are verifying that you are the owner and producer of the *QEX* Morse Input Challenge device and its software, and that no third-party ownership rights or patents apply to your design. ARRL acquires no rights to your design, but through your participation you are granting ARRL a perpetual, worldwide, non-exclusive, royalty-free right to publish your entry materials in all media now known or hereinafter created, anywhere in the world, for any lawful purpose.

A range of Amateur Radio articles and technical notes are coming up in the May/June 2019 and future issues of *QEX*.

- Maynard Wright, W6PAP, measures the characteristic impedance of coax cable.
- Grant Saviers, KZ1W, designs an antenna that covers the 160-meter band in four switchable band segments.
- Ryan Gedminas, WW6RAG, shows how to hunt and track weather balloons.
- Stefan Scholl, DC9ST, describes a TDOA system for transmitter localization.
- George Steber, WB9LVI, turns an arbitrary waveform generator into a WSPR transmitter.
- Jim Koehler, VE5FP, measures crystal parameters using a vector impedance meter.
- Scott Roleson, KC7CJ, constructs a receiver step attenuator.
- John Westmoreland, AJ6BC, describes THEMIS, an experimental GPS-disciplined oscillator.
- John Stensby, N5DF, calculates coax loss directly from impedance measurements.

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

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

Happenings

ARRL and FCC Sign Memorandum to Implement New Volunteer Monitor Program

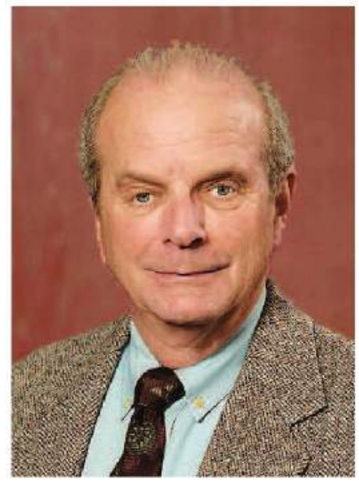
ARRL and the FCC have signed a *Memorandum of Understanding* (*MOU*) that paves the way to implement the new and enhanced Volunteer Monitor program. The memorandum establishes the Volunteer Monitors as a replacement for the Official Observers (OO) program. Current OOs have been encouraged to participate in the new program.

"We are excited by the opportunity to codify our partnership with the FCC and to work together to achieve our mutual interests of protecting the integrity of our Amateur Radio bands," said ARRL President Rick Roderick, K5UR. "This *Memorandum of Understanding* will serve as the foundation for a new level of partnership on this very important issue."

ARRL has contracted with retired FCC Special Counsel and former Atlantic Division Vice Director Riley Hollingsworth, K4ZDH, to oversee ARRL's role in the development and implementation of the Volunteer Monitor program.

Approved by the ARRL Board of Directors at the July 2018 Board meeting, the new Volunteer Monitor program is a formal agreement between the FCC and ARRL in which volunteers trained and vetted by ARRL will monitor the airwaves and collect evidence that can be used to correct misconduct or recognize exemplary on-air operation. Cases of flagrant violations will be referred to the FCC by ARRL for action in accordance with FCC guidelines.

> *"We are excited by the opportunity to codify our partnership with the FCC and to work together to achieve our mutual interests of protecting the integrity of our Amateur Radio bands."* — ARRL President Rick Roderick, K5UR



Riley Hollingsworth, K4ZDH.

The intent of this program is to re-energize enforcement efforts in the Amateur Radio bands. It was proposed by the FCC in the wake of several FCC regional office closures and a reduction in field staff.

"Under this program, the FCC will give enforcement priority to cases developed by the Volunteer Monitor program, without the delay of ARRL having to refer cases through the FCC online complaint process," Hollingsworth said.

Hollingsworth has identified three phases to the program: Development, Solicitation and Training, and Implementation. He has committed to FCC and ARRL officials to ensure the adequacy of training for the new positions, to review the quality and utility of Volunteer Monitor submissions to the FCC for enforcement actions, and to advocate for rapid disposition of cases appropriately submitted to the FCC.

ARRL officials have estimated that the first Volunteer Monitors will be in place and ready to begin their duties within 6 to 9 months.

Petition for Rule Making Calls for "Amateur Digital Mode Transparency"

By mid-April, some 1,100 comments had been filed on a *Petition for Rule Making* (RM-11831) seeking to amend FCC Part 97 rules that require all ham radio digital transmissions to use techniques "whose technical characteristics have been documented publicly." The *Petition*, filed by Ron Kolarik, KØIDT, of Lincoln, Nebraska, expressed concerns that some currently used digital modes are not readily and freely able to be decoded, and it asks the FCC to require all digital codes to use protocols that "can be monitored in [their] entirety by third parties with freely available, open-source software," per §97.113(a)(4).

Kolarik said his petition also aims to reduce levels of amateur-to-amateur interference from automated controlled digital stations (ACDS) on HF. Kolarik wants the FCC to delete §97.221(c), which permits automatic control of digital emissions provided the station "is responding to interrogation by a station under local or remote control, and [n]o transmission from the automatically controlled station occupies a bandwidth of more than 500 Hz." The petition did not call for eliminating ACDS, however. Under current rules, ACDS are allowed in specific subbands.

In his *Petition*, Kolarik maintains that interference from ACDS continues to be "a major problem on the amateur bands." He suggested that an absence of formal complaints may be due to the fact that such stations are "difficult to identify."

The *Petition* also proposed to amend §97.309(a)(4) to ease monitoring of certain digital transmissions. "Without open, over-the-air interception capability for all transmissions in the Amateur Radio spectrum, there is no way to determine if there is commercial or other prohibited, inappropriate content in ongoing communications..." Kolarik's *Petition* asserted. He said problems arise when "protocols and devices used in commercial, government, and marine services are used in the Amateur Service with no adequate means to fully decode transmissions," thwarting any efforts at self-policing of such transmissions. He said simplifying the language "would remove ambiguity about what constitutes 'publicly documented technical characteristics' by requiring any protocol to be freely decodable," and lead to "amateur digital mode transparency, present and future."

Earlier this spring, the FCC accepted comments on three other Amateur Radio-related *Petitions for Rule Making* (*PRM*):

- Jerry Oxendine, K4KWH, of Gastonia, North Carolina, wants the FCC to clarify that state and localities should have no authority to regulate Amateur Radio with respect to enacting "distracted driving" statutes. In his *Petition for Rule Making*, RM-11833, Oxendine contended that such statutes violate FCC rules on scope and operation of equipment by licensees; violate the intent of the FCC and Congress with respect to Amateur Radio's role in disasters, and hinder emergency operations using mobile equipment.

- Edward C. Borghi, KB2E, of Farmington, New York, in RM-11834, petitioned to prohibit vanity applicants from requesting call signs outside of their call sign districts. Exceptions would be made for call signs applied for under rules governing call signs previously held by family members.

- Jeffrey Bail, NT1K, of West Springfield, Massachusetts, submitted a similar *Petition*, RM-11835, asking that the FCC give residential preference in competing applications to applicants whose listed FCC address is within the same district/region as the applied call sign.

Department of Defense to Transmit Interoperability Exercise Info via WWV/WWVH

The US Department of Defense (DOD) has begun making use of a provisional time slot on WWV and WWVH to announce upcoming HF military communication exercises and how the Amateur Radio community can become involved in them. Such announcements will occur at 10 minutes past on WWV and at 50 minutes past on WWVH. WWV and WWVH transmit on 2.5, 5, 10, 15, and 20 MHz.

"DOD's use of the broadcast time slot on WWV/WWVH will benefit the MARS program's mission of outreach to the Amateur Radio community," said US Army Military Auxiliary Radio System (MARS) Program Manager Paul English, WD8DBY. "The actual messages to be broadcast are coordinated by the DOD Headquarters that the MARS program supports."

The initial announcements were set to coincide with the "Vital Connection" interoperability exercise to be held in Wisconsin in April and May. Future time slots will coincide with the Ohio Vital Connection exercise in June; DOD COMEX 19-3 in August, and the DOD COMEX 19-4 in October. Following the proof of concept this year, DOD anticipates making use of the WWV/WWVH broadcast time slot full-time, year-round.

The messages will direct listeners to a specified website to provide reception reports and feedback. The reception report will also ask the listener to submit a survey that will be shared among DOD, MARS, and WWV/WWVH personnel. "We want to provide feedback to WWV/WWVH to improve situational awareness of who is using their service and how it's being used, as well as future considerations," English said.

FCC Agrees to 90-Day Pause in Consideration of WT Docket 16-239

It has been almost 6 years since the ARRL requested the FCC to consider changes to the Amateur Radio digital rules in Docket 11-708 and almost 3 years since ARRL filed comments in the resultant proceeding, identified by the FCC as 16-239. The Commission's proposed changes differed from the ARRL's initial filing and caused ARRL to be concerned about possible interference to current users resulting from the deletion of ARRL's requested 2.8 kHz bandwidth limitation. Due to those concerns, ARRL filed comments with the FCC opposing the deletion of the requested bandwidth.

Since ARRL's initial filing, many individuals and groups have commented to the FCC publicly regarding issues and potential consequences they passionately believe are implicated by the FCC's proposals embodied in 16-239/11-708.

Additionally, in the 6 years since the initial filing of 11-708, new information has been presented by individuals and groups who support and oppose the FCC's proposed adoption of 16-239. Due to the time that has elapsed since ARRL's initial digital rules change request, the new information that has become available, and the extent of both support and opposition to the proposed rules change, ARRL asked the FCC to grant a delay in its consideration of the proposed rules change to provide ARRL with the opportunity to clarify the issues and determine whether a consensus can be reached on some or all of the issues raised by the FCC's proceeding. At ARRL's request, the FCC staff has agreed to a 90-day pause in the consideration of WT Docket 16-239.

FCC Cites Amateur Service Rule Violations in Unlicensed Broadcasting Case

An FCC Enforcement Bureau *Notice of Unlicensed Operation* (*NoUO*) issued last fall to a California Technician-class licensee for alleged unlicensed FM broadcasting on 95.7 MHz has now been upgraded to a *Notice of Violation* (*NoV*) that cites violations of the Part 97 Amateur Service rules. The March 15 *NoV* sent to Daryl Thomas, KE6MWS, of Carmichael, also specifically acknowledges Thomas as an Amateur Radio licensee — something not done in last November's *NoUO*. The FCC Enforcement Bureau warned that it could progress to a *Notice of Apparent Liability for Forfeiture* (*NAL*), "if warranted."

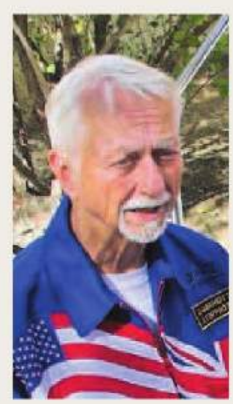
Last October 10, an Enforcement Bureau agent responded to a complaint of an unlicensed FM station operating on 95.7 MHz in Carmichael. The agent confirmed by direction-finding techniques that a signal on 95.7 MHz was emanating from a residence, and Thomas subsequently admitted that he was the operator of this station, the FCC said in the *NoUO*. Despite FCC warnings last fall, the transmissions apparently continued into this year.

On January 31, 2019, an FCC Enforcement Bureau agent monitored transmissions on 95.7 MHz from Thomas' station in the FM broadcast band and observed violations of §97.103 — not operating in accordance with FCC rules; §97.113(b) — prohibited transmissions, i.e., broadcasting, and §97.301 — operation outside frequency bands authorized for Amateur Radio. The FCC ordered Thomas to respond in writing within 20 days, explaining each violation and actions taken to correct them and prevent their recurrence.

In Brief...

- **Robert B. "Bob" Famiglio, K3RF, of Media, Pennsylvania, is once again the ARRL Atlantic Division Vice Director.** Famiglio, an attorney, was appointed by ARRL President Rick Roderick, K5UR, to fill the vacancy left by the departure of Riley Hollingsworth, K4ZDH. He will serve with Atlantic Division Director Tom Abernethy, W3TOM. Famiglio, who was initially Atlantic Division Vice Director from 2015 until 2017, is a past Eastern Pennsylvania Section Manager and an ARRL Volunteer Counsel. He served as a District Emergency Coordinator from 2006 until 2011. Licensed since 1967, Famiglio is also an electrical engineer and former broadcast station owner and engineer.

- **Former US astronaut and radio pioneer Owen K. Garriott, W5LFL, died April 15 at his home in Huntsville, Alabama.** He was 88. Garriott's ham radio activity ushered in the formal establishment of Amateur Radio in space, first as SAREX (the Shuttle Amateur Radio Experiment), and later as ARISS (Amateur Radio on the International Space Station). While aboard *Spacelab-1* during a 1983 Space Shuttle *Columbia* mission, Garriott thrilled radio amateurs around the world by making the first contacts from space. Thousands of hams listened on 2-meter FM, hoping to hear him or to make a contact. Garriott ended up contacting stations around the globe, among them such notables as the late King Hussein, JY1, of Jordan, and the late US Senator Barry Goldwater, K7UGA.



Rick Palm, K1CE, k1ce@arrl.org

The Cornerstone Exercises: After-Action Report/Improvement Plan, and a Case Study

Last month, we discussed the design and execution of effective exercises, using the model of the 2019 Northern Florida "Viral Duo" exercise sponsored by Alachua County ARES®, the North Florida Amateur Radio Club, and the Santa Fe College Amateur Radio Society.

The 3-hour exercise was conducted in Gainesville on February 2 as part of the Northern Florida Amateur Radio Emergency Communications Conference. The scenario was twofold: a deadly disease outbreak with the response aggravated by state-sponsored malware that downed the internet, cell service, and public safety communications on a wide scale. Amateur Radio operators were tasked with providing communications for two area shelters, led by strike team leaders reporting to shelter managers and a central Amateur Radio Service management team.

This month, we'll discuss the "Viral Duo" exercise architects' after-action report and improvement plan (AAR/IP) in the context of the Federal Emergency Management Agency's (FEMA) vision of effectiveness for this critical portion of the overall result report.[1]

The Florida exercise planners used FEMA's published Exercise Evaluation Guides (EEGs) to accomplish several goals: to streamline data collection; enable assessments of the participant and team efforts; capability developments, and overall preparedness gains.[2] Let's see how they did.

Viral Duo After-Action Report/Improvement Plan

The AAR/IP, produced by the "Viral Duo" exercise architects and executors, includes an overview of the exercise, the incident briefing provided to team leaders and participants, the incident radio communications plan, medical plan, master scenario event list with specific objectives — all formatted on the appropriate ICS forms — initial tasks, rules of the game, exercise injects (contrived problems/issues presented to players to deal with in real time), and most important, the results analysis. Results were assessed in terms of objectives categorized by core capabilities and eventually used as the basis for performance improvements.

Analysis of Core Capabilities

The report's summary table (see Table 1) presented exercise objectives matched to core capabilities, with specific performance ratings based on observations during the exercise and determined by the evaluation team. There were four rating classifications: Performed without challenges (P); Performed with Some Challenges (S); Performed with Major Challenges (M), and Unable to Perform (U). For example, an objec-

Safety First

The first priority is always safety, which, appropriately, was covered at the outset of the results section of the "Viral Duo" AAR/IP: the exercise had been conducted with no known injuries, but the Safety Officer noted the importance of better marking antenna wires and ropes.

The "hotwash" — the immediate post-exercise discussion among participants and leaders — was covered, along with the participants' individual written evaluations, which showed an enthusiastic response and overall satisfaction with exercise conduct.

The communications log (ICS form 309) was examined with particular attention given to transferred messages, including 30 voice and 48 digital, encompassing both informal and formal message traffic. An in-depth analysis of the messages and reporting requirements was conducted; for example, the following assessment was noted: "Email message notifying the FLSWIC [Florida Statewide Interoperability Coordinator] that Shelter #26 had one resident with a fever and painful neck, and was requesting assistance. This was a great example of an inject to the manager of Shelter #26, which evidently was passed to the Strike Team 2, and from there to the FARPOC [Florida Amateur Radio Point of Contact] and from the FARPOC to the FLSWIC — excellent work of moving critical information up the chain."

Table 1 — Sample of Summary Table of Core Capability Performance

Objective	Core Capability	Performed without Challenges (P)	Performed with Some Challenges (S)	Performed with Major Challenges (M)	Unable to be Performed (U)
Programming VHF transceivers	Transact multiple types of information by radio	P			
Operate radios throughout the exercise without utility power	Provide electrical power for radios independent of commercial utilities		S		

tive was having the "ability to read and understand ICS-201, ICS-205, ICS-205A forms," with its matching core capability being "functioning in an ICS Framework." As reported in the "Viral Duo's" summary table, the evaluation team determined this objective and corresponding capability earned an "S" rating. As another example, the objective of "deploying a VHF antenna" with the matching core capability being "creating antennas in a devastated deployment location" was met, receiving a "P" rating from the evaluation team. Other objectives (with ratings) included, but were not limited to, the following:

- Operating radios throughout the exercise without utility (commercial) power (S)
- Operating within a VHF FM net (P)
- Connecting to Winlink gateways (S)
- Transacting email in the Winlink system (S)
- Programming VHF transceivers (P)
- Transacting voice message traffic (S)

Strengths and Weaknesses, Areas for Improvement Identified

Tasks performed well, improvements indicated, and analyses were appropriately discussed. For example, one exercise objective was to "connect to Winlink gateways" ("S" rating), with strengths and areas for improvement noted for the core capability of "transacting multiple types of information by radio." The report stated one strength in this category being that the participants have a high capability level. Evaluators noted, "Multiple participants succeeded well at this, transferring dozens of messages of formal traffic." Among areas for improvement to achieve the full capability level was, "Participants would be well advised to obtain higher speed modems, including VARA and PACTOR, for true disaster preparation."

This analysis followed: "This was an area of strength in the participants of three out of four teams, with urgent inject material well communicated using WINMOR and other soundcard modes. PACTOR speeds are often twice that of soundcard modes, and connections are often made with far less signal required. [Participants] may wish to move to this preeminent digital protocol while keeping their competency at soundcard modes."

An Improvement Plan summary table follows the in-depth analysis. The AAR/IP can be found online at **https://qsl.net/nf4rc/2019Conference/CreateSpaceViralDuoAARIP1.2BlackInk.pdf.**

Personal Conclusions

I played a small part in this exercise as a communicator on Strike Team 1 at Shelter #10. This exercise brought to life the material from the many FEMA Independent Study courses, the lessons from the ARRL's *Introduction to Emergency Communications* course, and the DHS/OEC's Auxiliary Communications (AUXCOMM) 3-day course. Every participant, from the exercise planners and leaders to the small players, met the challenges of setting up antennas, running cables and powering on radios, getting on the air quickly, and passing messages among the two shelters and the central management team stations, all while operating under the Incident Command System. The multiple injects of likely real-world problems and issues to be resolved on the fly ratcheted up the stress — and the fun!

Thanks go to the conference/exercise leaders and my fellow communicators in the trenches who made the experience so valuable, not only to the radio amateurs and ARES members involved, but also to the stakeholding agencies, including the state and local county EMAs, and the Red Cross. The exercise contributed to a better, more prepared amateur community in Florida, a disaster-prone region.

Notes

[1]**https://preptoolkit.fema.gov/web/hseep-resources/evaluation**

[2]**https://preptoolkit.fema.gov/web/hseep-resources/eegs**

George Misic, KE8RN, ke8rn@comcast.net

Classic Radio

The Hallicrafters S-76 Receiver

The Hallicrafters S-76 was the first receiver to use a very low-frequency last intermediate frequency (IF) to facilitate getting good selectivity with conventional inductor/capacitor components. It sold for $169.50 when it came out (see the lead photo). Produced from 1951 – 1954, the S-76 used a 50 kHz last IF, which was well below the more common 455 kHz IF at the time. The S-76 was a dual-conversion receiver using a 1650 kHz first IF, which helped provide better image rejection than a single 455 kHz IF would. Hallicrafters and other manufacturers used the low-frequency IFs with good results for some time. The later Hallicrafters SX-101, SX-117, and other models still used the 50 kHz final IF.

The S-76 covered the AM broadcast band from 535 kHz to 1580 kHz and general coverage shortwave from 1720 kHz to 32 MHz with ham bandspread. The gap was due to the use of 1650 kHz as the first IF frequency. The ham bandspread dial added 15 meters during the production life of the S-76, as 15 meters became a ham band during the early 1950s.

An original ad from the April 1951 issue of *QST* for the Hallicrafters S-76, with its famous "giant" S-meter.

Distinctive S-Meter

The most distinctive feature of the Hallicrafters S-76 was the very large S-meter on the front panel. The S-meter only operated on AM reception, as the S-76 did not have a product detector for SSB and CW, and had no automatic gain control (AGC), except when receiving AM. Product detectors were not found on any ham radio receivers in 1951, when the S-76 came out. SSB was virtually unknown for ham radio operation at the time. Collins Radio's A-line and V-line radios operated on CW and AM only. The company didn't begin to promote SSB until about 5 years later. Central Electronics was ready to bring out their first SSB transmitters and receiving adapters in 1952, one year after the S-76 came out.

CW reception was handled by using a BFO to produce a beat note with the CW signal. Getting good-quality reception of CW signals was much less difficult than getting good-quality audio with SSB signals. The selectivity offered by the S-76 provided improved results on CW signals and was easier to get good results from than the single crystal filters offered as a selectivity tool on many high-end receivers in the early 1950s.

Tubes

The Hallicrafters S-76 used a mixture of seven-pin miniature tubes and octal-based tubes. A gaseous VR-150 octal regulator tube was used to regulate the plate voltage for the local oscillator to improve stability in light of variations in the 115 V ac power line. The high voltage to operate the vacuum-tube circuitry was rectified using a 5Y3GT octal tube. Octal tubes were used in the audio preamplifier, audio output stage, and the BFO oscillator. All the tubes in the RF and IF stages were seven-pin miniature types.

The S-76 used an RF amplifier stage using a 6CB6 pentode. The first mixer and the tunable local oscillator used two separate tubes — a 6BE6 as the mixer and a 6C4 triode as the tunable oscillator. Two 6BA6 pentodes were used as 50 kHz IF amplifiers. As with most Hallicrafters receivers, an external loudspeaker was required. Hallicrafters recommended the large model R-46 speaker, which was also recommended for the premium model SX-71.

Design Influence

The S-76's revolutionary use of the 50 kHz last IF led to other manufacturers adopting a similar design. R.L. Drake Company started producing receivers specific to ham radio in 1957, and made all their early receivers using a final IF of 50 kHz. The historic Drake 1A, along with the 2A, 2B, 2C, and the popular 4-line family of receivers all used a 50 kHz final IF in a triple-conversion design to provide very good, versatile selectivity for CW, SSB, and AM reception. Several ham radio manufacturers — including Barker & Williamson and Central Electronics — produced receiving adapters to make older high-quality receivers work better receiving SSB and CW.

Hammarlund created the HC-10 receiving adapter, which used a 60 kHz last IF. Hammarlund also used a last IF of 60 kHz on their HQ-160, HQ-170, and HQ-180 receivers. National used a similar triple-conversion design on their NC-300 and NC-303 receivers, with a final IF of 80 kHz. RME used a 57 kHz low-frequency IF on their attractive model 6900. Collins Radio seemed to avoid using a low-frequency IF, relying instead on their own invention — the patented mechanical filter often working at 455 kHz — to provide excellent selectivity. The crystal lattice filter soon became the most popular means of getting very good selectivity for most manufacturers by the mid-1960s. However, Collins continued to use their mechanical filter and Drake stuck to low-frequency IFs for their receivers.

Strays

Following Radio to Space, College, and Beyond

Seventeen-year-old Laura Floyd, KC3GWL, recently finished her high school research project, which involved using radio telescopes to try and detect exoplanets — planets beyond our own solar system. The 4-year project culminated in Laura's front yard being filled with radio telescopes for 2 weeks. Her research was funded in part by her local Amateur Radio club, the Warminster Amateur Radio Club, K3DN, of Warminster, Pennsylvania. Laura's findings will be presented at Penn State in May.

Laura is also part of a group of students invited to present their research about a radiation-proof vest to NASA this spring for potential use on the International Space Station. In the fall, she will attend Valparaiso University on a full scholarship, majoring in Engineering and Physics, in addition to receiving a Secondary Education teaching certification and a German language major.

Laura Floyd, KC3GWL, in her yard with her radio telescopes. [Sarah Floyd, photo]

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

Contest Corral

June 2019

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

Start Date-Time		Finish Date-Time		Bands	Contest Name	Mode	Exchange	Sponsor's Website
1	0000	2	0200	1.8-28	PVRC Reunion	CW Ph	PVRC Member: 1st year of membership, name, SPC, call sign when joined PVRC; non-member: name, SPC	pvrc.org/reunion
1	0000	2	2359	28	10-10 International Open Season PSK Contest	Dig	Name, SPC, mbr	www.ten-ten.org
1	0400	2	2000	3.5-28	DigiFest	Dig	RST, 4-char grid square	www.mixw.net
1	0600	1	0800	7-14	Wake-Up! QRP Sprint	CW	RST, serial, suffix of previous QSO	qrp.ru/contest/wakeup
1	1200	2	1200	3.5-28	SEANET Contest	CW Ph	RS(T), serial	www.seanet2019.com
1	1300	2	1300	50	UKSMG Summer Contest	CW Ph Dig	RST, serial, 6-char grid square	uksmg.org
1	1400	2	0200	1.8-144	Kentucky QSO Party	CW Ph Dig	RS(T), county or SPC	www.kyqsoparty.org
1	1500	2	1459	1.8-28	IARU Region 1 Field Day, CW	CW	RST, serial	darc.de/der-club/referate/conteste
1	1500	2	1500	7-50	Dutch Kingdom Contest	CW Ph	RS(T), serial	dkars.nl
1	1500	2	1500	1.8-28	RSGB National Field Day	CW	RST, serial	www.rsgbcc.org/hf
4	0100	4	0300	3.5-28	ARS Spartan Sprint	CW	RST, SPC, power	arsqrp.blogspot.com
6	1700	6	2100	28	NRAU 10-Meter Activity Contest	CW Ph Dig	RS(T), 6-char grid square	nrau.net/activity-contests
6	1900	6	2100	1.8-28	SKCC Sprint Europe	CW	RST, SPC, name, mbr or power	www.skccgroup.com
7	1900	7	1959	3.5-7	HA3NS Sprint Memorial Contest	CW	RST, mbr or "NM"	radioamator.honlapepites.hu
8	0000	9	1559	3.5-28	DRCG WW RTTY Contest	Dig	RST, CQ zone	www.drcg.de/drcgww
8	0600	9	0600	3.5-28	VK Shires Contest	CW Ph	RS(T), VK shire or CQ zone	wia.org.au/members/contests
8	1100	8	1300	14-21	Asia-Pacific Sprint, SSB	Ph	RS, serial	jsfc.org/apsprint/aprule.txt
8	1200	9	1200	3.5-28	Portugal Day Contest	CW Ph	RS(T), CT district or serial	rep.pt/portugal_day_contest
8	1200	9	2359	1.8-50	SKCC Weekend Sprintathon	CW	RST, SPC, name, mbr or "none"	www.skccgroup.com
8	1500	9	1500	3.5-28	GACW WWSA CW DX Contest	CW	RST, CQ zone	www.wwsatest.org
8	1600	9	1600	50	REF DDFM 6-Meter Contest	CW Ph	RS(T), serial, 4-char grid square	concours.r-e-f.org
8	1800	10	0259	50 and up	ARRL June VHF Contest	CW Ph Dig	4-char grid square	www.arrl.org/june-vhf
9	1700	9	2200	All	Cookie Crumble QRP Contest	CW Ph Dig	RS(T), SPC, cookie #, name	w3atb.com/cookie-crumble
10	0000	10	0200	1.8-28	4 States QRP Group Second Sunday Sprint	CW Ph	RS(T), SPC, mbr or power	www.4sqrp.com
10	1900	10	2030	3.5	RSGB 80-Meter Club Championship, Data	Dig	RST, serial	www.rsgbcc.org/hf
12	0030	12	0230	3.5-14	NAQCC CW Sprint	CW	RST, SPC, mbr or power	naqcc.info
15	0000	16	2359	50	SMIRK Contest	CW Ph	Mbr, 4-char grid square	www.smirk.org/contest.html
15	0000	16	2359	1.8-28	All Asian DX Contest, CW	CW	RST, 2-digit age	www.jarl.org/English
15	1200	16	1159	3.5-28	Ukrainian DX Classic RTTY Contest	Dig	RST, 2-letter oblast or serial	urdxc.org/rtty/eng.htm
15	1200	16	1200	1.8-28	ARR BPSK63 Contest	Dig	RST, serial	ct1arr.org
15	1400	15	1800	144-432	AGCW VHF/UHF Contest	CW	RST, serial, power class, 6-char grid	agcw.org/index.php/en
15	1400	16	1400	50	IARU Region 1 50 MHz Contest	CW Ph	RS(T), serial, 4-char grid	concours.r-e-f.org
15	1500	16	1500	1.8	Stew Perry Topband Challenge	CW	4-char grid square	www.kkn.net/stew
15	1600	16	0400	3.5-28	West Virginia QSO Party	CW Ph Dig	RS(T), county or SPC	qsl.net/wvsarc/wvqp/wvqp.html
15	1800	15	1959	1.8-50	Feld Hell Sprint	Dig	RST, mbr, SPC, grid	sites.google.com/site/feldhellclub
15	1800	15	2359	3.5, 7, 14, 18, 21, 24, 28 ,14	ARRL Kids Day	Ph	Name, age, QTH, favorite color	www.arrl.org/kids-day
16	0800	16	1400	50	WAB 50 MHz Phone	Ph	RS, serial, WAB square or country	wab.intermip.net
17	0100	17	0300	1.8-28	Run for the Bacon QRP Contest	CW	RST, SPC, mbr or power	qrpcontest.com/pigrun
19	1900	19	2030	3.5	RSGB 80-Meter Club Championship, CW	CW	RST, serial	www.rsgbcc.org/hf
20	0030	20	0230	3.5-14	NAQCC CW Sprint	CW	RST, SPC, mbr or power	naqcc.info
22	1200	23	1200	3.5-28	Ukrainian DX DIGI Contest	Dig	RST, 2-letter oblast or serial	www.izmail-dx.com
22	1200	23	1200	1.8-28	His Majesty King of Spain Contest, SSB	Ph	RS, EA province or serial	concursos.ure.es/en
22	1800	23	2100	All	ARRL Field Day	CW Ph Dig	Number of xmtrs, operating class, ARRL/RAC section or "DX"	www.arrl.org/field-day
24	1300	25	0400	1.8-28	QCX Challenge	CW	RST, name, SPC, rig	www.qrp-labs.com/party.html
26	0000	26	0200	1.8-28	SKCC Sprint	CW	RST, SPC, name, mbr or power	www.skccgroup.com
27	1900	27	2030	3.5	RSGB 80-Meter Club Championship, SSB	Ph	RS, serial	www.rsgbcc.org/hf
29	0000	29	2359	1.8-50	Feld Hell Sprint	Dig	RST, mbr, SPC, grid	sites.google.com/site/feldhellclub
29	0000	29	2359	7-28	Battle of Carabobo International Contest	CW Ph Dig	RS(T), YV state or serial	www.radioclubvalenciaac.org.ve
29	0600	29	1700	3.5-28	UFT QRP Contest	CW	RST, QRP/QRO, mbr or "NM"	uft.net/reglement/eng.pdf

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.*

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

2018 ARRL November Sweepstakes — Phone

Last year's ARRL November Sweepstakes phone weekend was held November 17 – 19, 2018.

Top Ten

Single Operator, High Power

K5TR	355,738
W7RM (W7WA, op)	320,380
WC6H	280,374
NC1I (K9PW, op)	263,276
W2RQ	253,814
KD4D	250,328
N4OX	243,356
K5TA	241,032
K2PM	217,136
N9RV	215,496

Single Operator, Low Power

W4AAA (KK9A, op)	204,180
WØEWD	191,224
N4PN	178,284
N4OO	174,300
NP4G	163,016
ACØW	134,460
K9WZB	127,428
K9ZO	123,172
VE4VT	122,958
VE5SF	120,682

Single Operator, QRP

NDØC	48,048
W6YX (N7MH, op)	46,136
N5EE	43,450
VE6EX	31,144
KA8SMA	28,016
AA7V	25,650
KJ2G	18,144
N1XIH (GWØNVN, op)	16,714
N7JI	16,200
N7FLT	14,706

Single Operator Unlimited, High Power

KH7XS (K4XS, op)	329,842
VY2TT	285,196
N5ZC	281,702
W7RN (WX5S, op)	279,378
K9CT	264,604
K3MM	248,004
W1SJ	246,178
NØXR	240,534
W6PZ	224,024
W3IDT	212,872

Single Operator Unlimited, Low Power

WB2P	186,252
VE3PJ	117,588
KK7AC	104,814
KS4AA	93,440
W9XT	90,138
K5KJ	82,336
KØACP	72,090
W9QL	70,356
KØNEB	69,822
K2DFC	67,732

Multioperator, Single Transmitter, High Power

K6AM	323,036
WØNO	302,784
K4OV	302,286
WØSD	280,706
W5WZ	279,292
W1XX	270,248
NV9L	242,858
ND8DX	230,076
N3OC	222,772
KRØP	216,132

Multioperator, Single Transmitter, Low Power

K7IR	179,908
K5KU	164,164
WW4LL	152,222
WZ8P	148,570
NØAT	145,632
K9KE	106,240
KØUK	90,200
WX4W	87,482
WR5O	86,994
K9DA	80,032

School Club

KØHC	196,876
W4AQL	169,818
WØEEE	69,700
KF5CRF	33,824
W8EDU	32,562
W9JWC	30,932
K5LSU	7,426
VE9UNB	6,952

Thirteen-year-old Aidan helped his grandfather, Albert Jr., KI9A, during the 2018 November Sweepstakes (phone weekend). During the contest, Aiden's first contact was with his great-grandpa, Albert Sr., AD9P. [Albert Schneebeli, Jr., KI9A, 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 2019 ARRL November Sweepstakes phone weekend will be held November 16 – 18, 2019.

ICOM

PRINCIPAL AWARDS SPONSOR

Plaque Sponsors

ARRL is pleased to award a Sweepstakes Plaque to the Overall and Division Leaders in each category, thanks to Icom America and clubs and individuals who sponsor these awards. For more information on plaque sponsorship or to order a duplicate plaque, contact the ARRL Contest Branch at 860-594-0232 or **contests@arrl.org**. Plaques cost $75, which includes all shipping charges.

Winner	Division	Category	Sponsor
K5TR	Overall	Single Operator, High Power	Icom America
W4AAA (KK9A, op)	Overall	Single Operator, Low Power	ARRL Contest Branch – Ken Adams, K5KA, Memorial
NDØC	Overall	Single Operator, QRP	Icom America
KH7XS (K4XS, op)	Overall	Single Operator Unlimited, High Power	Icom America
WB2P	Overall	Single Operator Unlimited, Low Power	Icom America
K6AM	Overall	Multioperator, High Power	Icom America
K7IR	Overall	Multioperator, Low Power	Icom America
KØHC (WØBH, op)	Overall	School Club	Robert Tuttle, N8YXR, and Jennie Tuttle, KCØRBV
KD4D	Atlantic	Single Operator, High Power	Icom America
NM2O	Atlantic	Single Operator, Low Power	Potomac Valley Radio Club
WK3A	Atlantic	Single Operator, QRP	Icom America
K3MM	Atlantic	Single Operator Unlimited, High Power	Icom America
WB2P	Atlantic	Single Operator Unlimited, Low Power	Icom America
N3OC	Atlantic	Multioperator, High Power	Icom America
NO3U	Atlantic	Multioperator, Low Power	Icom America
KØPJ	Central	Single Operator, High Power	Society of Midwest Contesters
K9ZO	Central	Single Operator, Low Power	Society of Midwest Contesters
AF9J	Central	Single Operator, QRP	Icom America
K9CT	Central	Single Operator Unlimited, High Power	Society of Midwest Contesters
W9XT	Central	Single Operator Unlimited, Low Power	Society of Midwest Contesters
NV9L	Central	Multioperator, High Power	Icom America
K9KE	Central	Multioperator, Low Power	Icom America
W9JWC	Central	School Club	Icom America
KØIDX	Dakota	Single Operator, High Power	Minnesota Wireless Association – in memory of Tod Olson, KØTO
ACØW	Dakota	Single Operator, Low Power	Minnesota Wireless Association
NDØC	Dakota	Single Operator, QRP	Icom America
KØCN	Dakota	Single Operator Unlimited, High Power	Minnesota Wireless Association – in memory of Jim Dokmo, KØFVF
K4IU	Dakota	Single Operator Unlimited, Low Power	Minnesota Wireless Association
WØSD	Dakota	Multioperator, High Power	Icom America
NØAT	Dakota	Multioperator, Low Power	Icom America
KØEJ	Delta	Single Operator, High Power	Icom America
WD5DJW	Delta	Single Operator, Low Power	Icom America
N5EE	Delta	Single Operator, QRP	Icom America
KC4NX	Delta	Single Operator Unlimited, High Power	Icom America
WBØRUR	Delta	Single Operator Unlimited, Low Power	Icom America
W5WZ	Delta	Multioperator, High Power	Icom America
K5KU	Delta	Multioperator, Low Power	Icom America
K5LSU	Delta	School Club	Icom America
K2PM	Great Lakes	Single Operator, High Power	Icom America
WB8WKQ	Great Lakes	Single Operator, Low Power	Icom America
KA8SMA	Great Lakes	Single Operator, QRP	Icom America
W8MJ	Great Lakes	Single Operator Unlimited, High Power	Icom America
KØACP	Great Lakes	Single Operator Unlimited, Low Power	Icom America
ND8DX	Great Lakes	Multioperator, High Power	Icom America
WZ8P	Great Lakes	Multioperator, Low Power	Icom America
W8EDU	Great Lakes	School Club	Robert Tuttle, N8YXR, and Jennie Tuttle, KCØRBV
W2RQ	Hudson	Single Operator, High Power	Icom America
KS2G	Hudson	Single Operator, Low Power	Icom America
KD2RD	Hudson	Single Operator Unlimited, High Power	Icom America
K2DFC	Hudson	Single Operator Unlimited, Low Power	Icom America
N2NC	Hudson	Multioperator, High Power	Icom America
NY6DX	Hudson	Multioperator, Low Power	Icom America
N7WY	Midwest	Single Operator, High Power	Icom America
WØEWD	Midwest	Single Operator, Low Power	Icom America
N5SEZ	Midwest	Single Operator, QRP	Icom America
NØXR	Midwest	Single Operator Unlimited, High Power	Icom America
KØNEB	Midwest	Single Operator Unlimited, Low Power	Icom America
WØNO	Midwest	Multioperator, High Power	Icom America
KØTSA	Midwest	Multioperator, Low Power	Icom America
KØHC (WØBH, op)	Midwest	School Club	Icom America
NC1I (K9PW, op)	New England	Single Operator, High Power	Icom America
KC1SQ	New England	Single Operator, Low Power	Icom America
KJ2G	New England	Single Operator, QRP	Icom America
W1SJ	New England	Single Operator Unlimited, High Power	Icom America
W1HS	New England	Single Operator Unlimited, Low Power	Icom America
W1XX	New England	Multioperator, High Power	Icom America
WA1BXY	New England	Multioperator, Low Power	Icom America
W1YK	New England	School Club	Icom America
W7RM (W7WA, op)	Northwestern	Single Operator, High Power	Icom America
N7LOX	Northwestern	Single Operator, Low Power	Icom America
N7JI	Northwestern	Single Operator, QRP	Icom America
K7RL	Northwestern	Single Operator Unlimited, High Power	Icom America
W7ZRC	Northwestern	Single Operator Unlimited, Low Power	Icom America
KZ1W	Northwestern	Multioperator, High Power	Icom America
K7IR	Northwestern	Multioperator, Low Power	Icom America
WC6H	Pacific	Single Operator, High Power	Icom America
WB6POT	Pacific	Single Operator, Low Power	Icom America
W6YX (N7MH, op)	Pacific	Single Operator, QRP	Icom America
KH7XS (K4XS, op)	Pacific	Single Operator Unlimited, High Power	Icom America
K6GHA	Pacific	Single Operator Unlimited, Low Power	Icom America
NW6P	Pacific	Multioperator, High Power	Icom America
N6ACL	Pacific	Multioperator, Low Power	Icom America
K4ZW	Roanoke	Single Operator, High Power	Icom America
W4AAA (KK9A, op)	Roanoke	Single Operator, Low Power	Icom America
N4ZAK	Roanoke	Single Operator, QRP	Icom America
NN3W	Roanoke	Single Operator Unlimited, High Power	Icom America
KS4AA	Roanoke	Single Operator Unlimited, Low Power	Icom America
K4OV	Roanoke	Multioperator, High Power	Icom America
N2VA	Roanoke	Multioperator, Low Power	Icom America
K5TA	Rocky Mountain	Single Operator, High Power	Icom America
KBØVHA	Rocky Mountain	Single Operator, Low Power	Icom America
N1XIH	Rocky Mountain	Single Operator, QRP	Icom America
K7UT	Rocky Mountain	Single Operator Unlimited, High Power	Icom America
N7MZW	Rocky Mountain	Single Operator Unlimited, Low Power	Icom America
NN5K	Rocky Mountain	Multioperator, High Power	Icom America
KØUK	Rocky Mountain	Multioperator, Low Power	Icom America
N4OX	Southeastern	Single Operator, High Power	Icom America
N4PN	Southeastern	Single Operator, Low Power	Icom America
KJ4M	Southeastern	Single Operator, QRP	Icom America
KT4Q	Southeastern	Single Operator Unlimited, High Power	Icom America
K4QY	Southeastern	Single Operator Unlimited, Low Power	Icom America
N4SVC	Southeastern	Multioperator, High Power	Icom America
WW4LL	Southeastern	Multioperator, Low Power	Icom America
W4AQL	Southeastern	School Club	Icom America
W6AFA	Southwestern	Single Operator, High Power	Icom America
W1PR	Southwestern	Single Operator, Low Power	Icom America
AA7V	Southwestern	Single Operator, QRP	Icom America
W6TK	Southwestern	Single Operator Unlimited, High Power	Icom America
KK7AC	Southwestern	Single Operator Unlimited, Low Power	Icom America
K6AM	Southwestern	Multioperator, High Power	Icom America
AB7YQ	Southwestern	Multioperator, Low Power	Icom America
K5TR	West Gulf	Single Operator, High Power	Icom America
WD5K	West Gulf	Single Operator, Low Power	Icom America
AC5D	West Gulf	Single Operator, QRP	Icom America
N5ZC	West Gulf	Single Operator Unlimited, High Power	Icom America
K5KJ	West Gulf	Single Operator Unlimited, Low Power	Icom America
KG5VK	West Gulf	Multioperator, High Power	Icom America
WR5O	West Gulf	Multioperator, Low Power	Icom America
KF5CRF	West Gulf	School Club	Icom America
VE3YT	Canada	Single Operator, High Power	Icom America
VE4VT	Canada	Single Operator, Low Power	Icom America
VE6EX	Canada	Single Operator, QRP	Icom America
VY2TT	Canada	Single Operator Unlimited, High Power	Icom America
VE3PJ	Canada	Single Operator Unlimited, Low Power	Icom America
VA2CZ	Canada	Multioperator, Low Power	Icom America
VE9UNB	Canada	School Club	Icom America

Affiliated Club Competition

Club	Score	Entries
Unlimited		
Potomac Valley Radio Club	16,694,489	281
Society of Midwest Contesters	7,414,944	136
Yankee Clipper Contest Club	4,637,618	78
Minnesota Wireless Assn.	4,251,602	110
Frankford Radio Club	4,238,734	67
Northern California Contest Club	2,404,492	56
Medium		
Mother Lode DX/Contest Club	4,139,454	48
Mad River Radio Club	2,650,330	43
Southern California Contest Club	2,550,090	37
Arizona Outlaws Contest Club	2,442,818	35
DFW Contest Group	2,240,248	35
Contest Club Ontario	2,226,064	43
Florida Contest Group	2,209,914	33
Western Washington DX Club	1,738,218	26
Tennessee Contest Group	1,548,996	28
Alabama Contest Group	1,478,500	19
Central Texas DX and Contest Club	1,321,838	18
South East Contest Club	1,029,556	17
Big Sky Contesters	931,920	12
Kentucky Contest Group	885,230	19
North Coast Contesters	859,972	13
Grand Mesa Contesters of Colorado	849,788	16
CTRI Contest Group	827,322	13
Hudson Valley Contesters and DXers	801,438	15
North Texas Contest Club	772,914	9
Georgia Contest Group	688,392	10
Willamette Valley DX Club	661,820	17
Niagara Frontier Radiosport	651,620	16
Sussex County ARC	577,216	5
Kansas City Contest Club	553,540	6
Orca DX and Contest Club	466,948	8
Radiosport Manitoba	342,864	5
Order of Boiled Owls of New York	276,566	9
Northeast Wisconsin DX Assn.	237,400	3
Delara Contest Team	197,722	3
Alberta Clippers	192,008	4
South Jersey Radio Assn.	188,576	9
Maritime Contest Club	188,186	7
Rochester (NY) DX Assn.	181,052	7
Sierra Foothills ARC	166,754	6
Swamp Fox Contest Group	161,618	7
Allegheny Valley Radio Assn.	159,990	4
Badger Contesters	133,388	3
Driftless Zone Contesters	126,558	4
Northeast Maryland Amateur Radio Contest Society	115,682	6
Texas DX Society	87,822	3
Mississippi Valley DX/Contest Club	65,884	5
Granite State ARA	62,568	4
Spokane DX Assn.	59,130	3
Carolina DX Assn.	47,064	3
Great South Bay ARC	24,396	3
Southern Berkshire ARC	9,448	3
Local		
New Mexico Big River Contesters	1,159,734	10
Iowa DX and Contest Club	550,986	3
Radio Amateurs of Northern Vermont	492,454	4
Bristol (TN) ARC	299,382	9
Redwood Empire DX Assn.	193,372	3
Hilltop Transmitting Assn.	170,290	4
Metro DX Club	106,806	6
Silver Comet Amateur Radio Society	98,640	6
Medina 2 Meter Group	95,822	3
Alexandria Radio Club	48,926	4
Seneca Radio Club	46,902	6
Stoned Monkey VHF ARC	35,212	3
The Villages Amateur Radio Club	34,752	4

Division Winners

Single Operator, High Power

Atlantic	KD4D	250,328
Central	KØPJ	208,662
Dakota	KØIDX	146,610
Delta	KØEJ	129,120
Great Lakes	K2PM	217,136
Hudson	W2RQ	253,814
Midwest	N7WY	131,638
New England	NC1I (K9PW, op)	263,276
Northwestern	W7RM (W7WA, op)	320,380
Pacific	WC6H	280,374
Roanoke	K4ZW	187,248
Rocky Mountain	K5TA	241,032
Southeastern	N4OX	243,356
Southwestern	W6AFA	110,484
West Gulf	K5TR	355,738
Canada	VE3YT	137,280

Single Operator, Low Power

Atlantic	NM2O	106,108
Central	K9ZO	123,172
Dakota	ACØW	134,460
Delta	WD5DJW	53,682
Great Lakes	WB8WKQ	104,912
Hudson	KS2G	36,354
Midwest	WØEWD	191,224
New England	KC1SQ	61,650
Northwestern	N7LOX	81,300
Pacific	WB6POT	72,226
Roanoke	W4AAA (KK9A, op)	204,180
Rocky Mountain	KBØVHA	33,136
Southeastern	N4PN	178,284
Southwestern	K9WZB	127,428
West Gulf	WD5K	107,568
Canada	VE4VT	122,958

Single Operator, QRP

Atlantic	WK3A	7,050
Central	AF9J	912
Dakota	NDØC	48,048
Delta	N5EE	43,450
Great Lakes	KA8SMA	28,016
Midwest	N5SEZ	4,224
New England	KJ2G	18,144
Northwestern	N7JI	16,200
Pacific	W6YX (N7MH, op)	46,136
Roanoke	N4ZAK	11,526
Rocky Mountain	N1XIH (GWØNVN, op)	16,714
Southeastern	KJ4M	8,976
Southwestern	AA7V	25,650
West Gulf	AC5D	10,670
Canada	VE6EX	31,144

Single Operator Unlimited, High Power

Atlantic	K3MM	248,004
Central	K9CT	264,604
Dakota	KØCN	143,664
Delta	KC4NX	182,574
Great Lakes	W8MJ	135,270
Hudson	KD2RD	207,168
Midwest	NØXR	240,534
New England	W1SJ	246,178
Northwestern	K7RL	163,836
Pacific	KH7XS (K4XS, op)	329,842
Roanoke	N1LN	161,186
Rocky Mountain	K7UT	187,616
Southeastern	KT4Q	161,186
Southwestern	W6TK	155,210
West Gulf	N5ZC	281,702
Canada	VY2TT	285,196

Single Operator Unlimited, Low Power

Atlantic	WB2P	186,252
Central	W9XT	90,138
Dakota	K4IU	31,350
Delta	WBØRUR	63,246
Great Lakes	KØACP	72,090
Hudson	K2DFC	67,732
Midwest	KØNEB	69,822
New England	W1HS	45,892
Northwestern	W7ZRC	43,608
Pacific	K6GHA	57,760
Roanoke	KS4AA	93,440
Rocky Mountain	N7MZW	67,340
Southeastern	K4QY	31,652
Southwestern	KK7AC	104,814
West Gulf	K5KJ	82,336
Canada	VE3PJ	117,588

Multioperator, Single Transmitter, High Power

Atlantic	N3OC	222,772
Central	NV9L	242,858
Dakota	WØSD	280,706
Delta	W5WZ	279,292
Great Lakes	ND8DX	230,076
Hudson	N2NC	213,974
Midwest	WØNO	302,784
New England	W1XX	270,248
Northwestern	KZ1W	207,846
Pacific	NW6P	209,756
Roanoke	K4OV	302,286
Rocky Mountain	NN5K	132,184
Southeastern	N4SVC	134,644
Southwestern	K6AM	323,036
West Gulf	KG5VK	166,460
Canada	VE4EA	135,456

Multioperator, Single Transmitter, Low Power

Atlantic	NO3U	61,320
Central	K9KE	106,240
Dakota	NØAT	145,632
Delta	K5KU	164,164
Great Lakes	WZ8P	148,570
Hudson	NY6DX	51,356
Midwest	KØTSA	14,364
New England	WA1BXY	73,470
Northwestern	K7IR	179,908
Pacific	N6ACL	35,416
Roanoke	N2VA	53,464
Rocky Mountain	KØUK	90,200
Southeastern	WW4LL	152,222
Southwestern	AB7YQ	31,376
West Gulf	WR5O	86,994
Canada	VA2CZ	73,964

School Club

Central	W9JWC	30,932
Delta	K5LSU	7,426
Great Lakes	W8EDU	32,562
Midwest	KØHC	196,876
Southeastern	W4AQL	169,818
West Gulf	KF5CRF	33,824
Canada	VE9UNB	6,952

Strays

QST Congratulates...

John Reisenauer, KL7JR, on editing the "Arctic and Antarctic DX" (AADX) column, a supplement to the *Canadian International DX Club Messenger*, since the late 1980s. The column specializes in DX info, QSLs, stories, and news related to Alaska, Antarctica, and all other polar and sub-polar locations. For more information, see **https://swling.com/blog/2014/12/the-canadian-international-dx-club-cidx-messenger/**. You can join the distribution list for AADX by emailing John at **johnkl7jr@gmail.com**.

Mark Beckwith, N5OT, n5ot@arrl.net and Bart Jahnke, W9JJ, w9jj@arrl.net

2018 ARRL 160-Meter Contest Results

Last year's contest was held November 30 – December 2, 2018.

Top Ten — DX

Single Operator, High Power

PJ2T (W8WTS, op)	120,640
ZF9CW	115,128
TM6M (F1AKK, op)	45,828
HGØR (HAØNAR, op)	21,600
GM4Z (GM4ZUK, op)	14,520
TF3SG	9,840
DF2PY	7,488
UYØZG	5,974
RW3PZ	5,740
JH7XMO	5,580

Single Operator, Low Power

XE2MVY	7,280
R7NW	2,450
OK1CZ	1,672
OK6Y (OK2PTZ, op)	1,400
LY4ZZ (LY2BMX, op)	1,386
US8UA	1,320
DL5CL	1,302
JE1SPY	1,224
JA1BJI	986
PAØTCA	918
SP9FMP	918

Single Operator, QRP

JK1TCV	20
RC7B	8
OLØA (OK1CZ, op)	2

Single Operator Unlimited, High Power

4M1K (YV1KK, op)	76,896
XE2S	53,250
P4/DL6RAI	50,544
OM3RM	46,726
OK7Z (OK2ZI, op)	29,052
G4AMT	28,050
XE2T	25,742
SK3W (SM3SGP, op)	23,358
F6AGM	21,708
UX1UA	18,308

Single Operator Unlimited, Low Power

IK2CLB	6,552
LZ2ZG	1,872
XE2B	1,748
OK2BFN	1,610
DL3TU	1,596
SP1D	1,554
LA5LJA	988
DL6MHW	896
OK2VV	736
G3RLE	646

Single Operator Unlimited, QRP

DL2SAX	260
JG1LFR	12

Multioperator, Single Transmitter, High Power

VP2MSK	54,002
LY7Z	25,648
S51V	20,600
RL3A	18,100
PP5JR	16,356
FS/K9EL	11,954
SN8B	11,610
OK6O	4,234

Multioperator, Single Transmitter, Low Power

VP9I	47,200
V31MA	6,880
C6ADM	280

Top Ten — US and Canada

Single Operator, High Power

VY2ZM (K1ZM, op)	695,556
NO3M	582,632
AA1K	533,596
VA2EW	487,080
K1KI	478,035
K1LT	423,500
WF2W	418,572
NA8V	392,868
W3BGN	342,672
K3ZO	333,114

Single Operator, Low Power

K9PG	193,076
WB8JUI	156,980
K7SV	143,170
WØUO	135,300
KG9X	128,520
WD8DSB	126,795
K9IG	123,660
NJ3K	119,972
ACØW	115,866
W1QK	110,320

Single Operator, QRP

W3TS	57,053
N7IR	54,375
W8GP	46,438
N3CO	41,600
K1EP	16,946
KN1H	12,578
K4WY	12,267
N5EE	11,184
W9CC	10,906
K6EI	9,880

Single Operator Unlimited, High Power

VE3EJ	556,640
NN2DX (KO7SS, op)	441,462
NR4M	427,050
KVØQ	402,570
K3WW	378,852
N3QE	361,368
W8MJ	353,256
KØRF	350,625
WB9Z	342,773
AB3CX	309,034

Single Operator Unlimited, Low Power

NE9U	229,020
VE3MGY	205,712
W9XT	130,032
N9CK	122,820
AA4XA	121,800
WØDLE	115,456
NY3B	107,015
KØTI	101,736
W3KB	101,070
K5KJ	81,810

Single Operator Unlimited, QRP

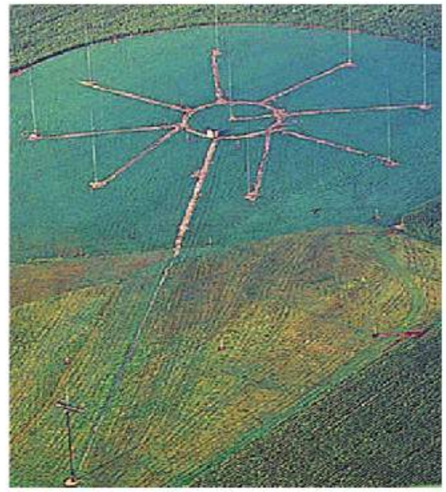
N3CZ	31,080
NK8Q	29,952
K8ZT	25,069
K2QO	13,040
NØUR	12,330
WE9R	8,880
KP2DX (KP2BH, op)	3,450
K2FF	180

Multioperator, Single Transmitter, High Power

W2GD	619,190
NØNI	495,618
N1LN	474,089
W5MX	404,500
K9CT	391,356
W3UA	388,212
W4MYA	380,672
KC1XX	370,311
K9RS	356,000
NA7TB	352,110

Multioperator, Single Transmitter, Low Power

W2FU	258,944
N2KW	149,856
WQ3N	124,608
W4GZX	36,608
K1RQ	36,225
W5WTM	24,660
KN4DUA	9,045
N9MT	2,520



The K9DX ultimate nine-element 160-meter array is no longer in place, but it remains a dream of many hams. Read more about it at **https://nidxa.org/memberWWW/k9dx_antennas.htm**, or its related presentation from the 2008 Dayton Hamvention Contest Forum, available at **https://www.kkn.net/dayton2008/contesting_with_28_miles_of_feedline**. [NIDXA and K9DX, 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.

Affiliated Club Competition

Club	Score	Entries
Unlimited		
Potomac Valley Radio Club	7,252,431	92
Frankford Radio Club	6,711,488	67
Yankee Clipper Contest Club	5,492,214	65
Society of Midwest Contesters	4,227,350	59
Minnesota Wireless Assn.	2,603,300	56
Medium		
Contest Club Ontario	2,212,305	26
North Coast Contesters	2,109,797	17
Mad River Radio Club	1,634,587	11
Arizona Outlaws Contest Club	918,326	23
Hudson Valley Contesters and DXers	756,285	9
Northern California Contest Club	688,560	24
Grand Mesa Contesters of Colorado	665,084	8
Kentucky Contest Group	651,227	9
Tennessee Contest Group	544,863	12
Western Washington DX Club	482,073	10
Florida Contest Group	468,382	14
Central Texas DX and Contest Club	422,131	8
Big Sky Contesters	385,323	5
DFW Contest Group	383,278	10
Mother Lode DX/Contest Club	378,409	7
North Texas Contest Club	321,193	4
Southern California Contest Club	309,084	12
Alabama Contest Group	301,361	3
South East Contest Club	290,628	9
Willamette Valley DX Club	262,515	6
Georgia Contest Group	250,709	4
Kansas City Contest Club	214,904	5
Orca DX and Contest Club	169,232	6
Maritime Contest Club	160,613	4
Delara Contest Team	145,960	3
Rochester (NY) DX Assn.	132,401	6
Northeast Wisconsin DX Assn.	88,326	3
Northeast Maryland Amateur Radio Contest Society	85,105	4
Spokane DX Assn.	76,175	4
Swamp Fox Contest Group	39,925	3
Driftless Zone Contesters	27,068	3
Local		
Central Virginia Contest Club	514,067	6
CTRI Contest Group	406,667	5
Niagara Frontier Radiosport	403,392	7
Bristol (TN) ARC	150,060	5

Continental Winners

Africa

Single Operator Unlimited, High Power	EA8DO	4,620

Asia

Single Operator, High Power	JH7XMO	5,580
Single Operator, Low Power	JE1SPY	1,224
Single Operator, QRP	JK1TCV	20
Single Operator Unlimited, High Power	RAØFF	10,496
Single Operator Unlimited, Low Power	JQ1EPD/1	16
Single Operator Unlimited, QRP	JG1LFR	12

Europe

Single Operator, High Power	TM6M (F1AKK, op)	45,828
Single Operator, Low Power	R7NW	2,450
Single Operator, QRP	RC7B	8
Single Operator Unlimited, High Power	OM3RM	46,726
Single Operator Unlimited, Low Power	IK2CLB	6,552
Single Operator Unlimited, QRP	DL2SAX	260
Multioperator, Single Transmitter, High Power	LY7Z	25,648

North America

Single Operator, High Power	ZF9CW	115,128
Single Operator, Low Power	XE2MVY	7,280
Single Operator Unlimited, High Power	XE2S	53,250
Single Operator Unlimited, Low Power	XE2B	1,748
Multioperator, Single Transmitter, High Power	VP2MSK	54,002
Multioperator, Single Transmitter, Low Power	VP9I	47,200

Oceania

Single Operator, High Power	VK2GR	286
Single Operator, Low Power	VK3IO	200

South America

Single Operator, High Power	PJ2T (W8WTS, op)	120,640
Single Operator, Low Power	HK6J	384
Single Operator Unlimited, High Power	4M1K (YV1KK, op)	76,896
Multioperator, Single Transmitter, High Power	PP5JR	16,356

AC7ZN/VP2MZN, manned the VP2MSK station at sunset, looking out over the ocean. VP2MSK (with operators VP2MSK, VP2MLB, VP2MSA, and VP2MZN) won 1st place in the DX, Multi-Single, High Power category in the 2019 ARRL 160-Meter Contest. [Louis Barrett, K7NM, photo]

Division Winners

Single Operator, High Power

Atlantic	NO3M	582,632
Central	K9NR	279,896
Dakota	NEØU	183,635
Delta	WD5R (N5ECT, op)	108,936
Great Lakes	K1LT	423,500
Hudson	K2XA	297,360
Midwest	KIØI	37,204
New England	K1KI	478,035
Northwestern	WJ9B	185,442
Pacific	N6TQ	30,814
Roanoke	N4XD	301,698
Rocky Mountain	WD5COV	165,480
Southeastern	KV4FZ	332,580
Southwestern	W6AYC	133,472
West Gulf	K5RX	156,600
Canada	VY2ZM (K1ZM, op)	695,556

Single Operator, Low Power

Atlantic	NJ3K	119,972
Central	K9PG	193,076
Dakota	ACØW	115,866
Delta	K3IE	57,618
Great Lakes	WB8JUI	156,980
Hudson	W2EG	33,464
Midwest	NZØT	30,837
New England	W1QK	110,320
Northwestern	K7QBO	31,280
Pacific	N6NF	23,851
Roanoke	K7SV	143,170
Rocky Mountain	K6XT	40,625
Southeastern	WA1FCN	50,991
Southwestern	AC7A	38,640
West Gulf	WØUO	135,300
Canada	VE3VSM	105,300

Single Operator, QRP

Atlantic	W3TS	57,053
Central	W9CC	10,906
Dakota	NDØC	616
Delta	N5EE	11,184
Great Lakes	W8GP	46,438
Hudson	W2JEK	1,374
Midwest	WØYJT	1,804
New England	K1EP	16,946
Northwestern	K6EI	9,880
Pacific	K6MI	2,880
Roanoke	K4WY	12,267
Southwestern	N7IR	54,375
West Gulf	N5OE	7,030
Canada	VE7VV	6,150

Single Operator Unlimited, High Power

Atlantic	K3WW	378,852
Central	WB9Z	342,773
Dakota	KØKX	210,600
Delta	AD4EB	162,588
Great Lakes	W8MJ	353,256
Hudson	N2GC	223,288
Midwest	NØAV	166,963
New England	NN2DX (KO7SS, op)	441,462
Northwestern	K4XU	197,395
Pacific	N6RK	137,238
Roanoke	NR4M	427,050
Rocky Mountain	KVØQ	402,570
Southeastern	N4PN	154,562
Southwestern	WA7AN (K9DR, op)	94,095
West Gulf	W5TM	138,572
Canada	VE3EJ	556,640

Single Operator Unlimited, Low Power

Atlantic	NY3B	107,015
Central	NE9U	229,020
Dakota	KØTI	101,736
Delta	W4TTM	33,350
Great Lakes	K8BL	81,650
Hudson	W2DPT	32,576
Midwest	KØVBU	8,077
New England	NC1CC (WA1BXY, op)	75,383
Northwestern	NR7RR	7,831
Pacific	N6GEO	11,544
Roanoke	AA4XA	121,800
Rocky Mountain	WØDLE	115,456
Southeastern	K3TW	10,948
Southwestern	N6BT	19,337
West Gulf	K5KJ	81,810
Canada	VE3MGY	205,712

Single Operator Unlimited, QRP

Atlantic	NK8Q	29,952
Central	WE9R	8,880
Dakota	NØUR	12,330
Delta	K2FF	180
Great Lakes	K8ZT	25,069
Roanoke	N3CZ	31,080
Southeastern	KP2DX (KP2BH, op)	3,450

Multioperator, Single Transmitter, High Power

Atlantic	W2GD	619,190
Central	K9CT	391,356
Great Lakes	W5MX	404,500
Midwest	NØNI	495,618
New England	W3UA	388,212
Northwestern	W6OFM	7,062
Pacific	K6DAJ	183,400
Roanoke	N1LN	474,089
Rocky Mountain	NØKE	61,864
Southeastern	WA1T	335,916
Southwestern	NA7TB	352,110
West Gulf	K5ZO	218,960
Canada	VE2OJ	215,602

Multioperator, Single Transmitter, Low Power

Atlantic	W2FU	258,944
Central	N9MT	2,520
Delta	W4GZX	36,608
Hudson	K1RQ	36,225
New England	N2KW	149,856
West Gulf	W5WTM	24,660

The 2019 ARRL 160-Meter Contest will be held December 6 – 8.

The 2019 IARU HF World Championships

1200 UTC Saturday, July 13 – 1159 UTC Sunday, July 14

♦ The objective is to contact as many other amateurs (especially IARU member-society HQ stations) around the world as possible using the 160-, 80-, 40-, 20-, 15-, and 10-meter bands.

♦ Exchange is a signal report and your ITU zone.

♦ Single Operator entrants choose from High, Low, or QRP power and Mixed Mode, CW Only, or Phone Only.

♦ Stations from IARU member-societies all around the world will be active. How many HQ stations can you contact?

♦ New 5-day log submission deadline: Upload Cabrillo-formatted logs to the web app **contest-log-submission.arrl.org** no later than 1200 UTC, July 19. Or mail paper logs (postmarked by July 19) to IARU HF Championships c/o ARRL Contest Branch, 225 Main St., Newington, CT 06111 USA.

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

Dave, 9A1UN, and Hrvoje, 9A6XX, prepared their 2018 WRTC station under the watchful eye of their referee, Kurt, W6PH. Dave and Hrvoje operated as Y81U and finished in 16th place. [Kurt Pauer, W6PH, photo]

W1AW Schedule

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.

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				

♦ 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.

♦ 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 2019, Headquarters and W1AW are closed on New Year's Day, Presidents Day (February 18), Good Friday (April 19), Memorial Day (May 27), Independence Day (July 4), Labor Day (September 2), Thanksgiving and the following day (November 28 and 29), and Christmas (December 25). For more information, visit us at **www.arrl.org/w1aw**.

Bernie McClenny, W3UR, w3ur@arrl.org

The South Orkney Islands

The South Orkney Islands are located in the South Atlantic Ocean, approximately 1,370 kilometers (850 miles) northeast of the Palmer Peninsula on Antarctica. Coronation Island is the largest island, measuring 46 kilometers (28 miles) long and between 5 – 15 kilometers (3 – 9 miles) wide. The highest peak on the island is 1,265 meters (4,150 feet). Looking on a world map, you can find the South Orkney Islands at 60° 32' S 46° 52' W.

The islands were discovered by British and American sealers in 1821. The group was originally named the Powell Group, after British sealer George Powell, and the largest island got its name, Coronation Island, in honor of King George IV, who was crowned that year. Other islands in the South Orkney chain include Inaccessible, Monroe, Signy, Mathews, Robertson, Powell, Fredriksen, and Laurie.

In 1823, James Weddell renamed the islands to the South Orkney Islands, after the Orkney Islands of Scotland, which are located at a similar latitude farther north. The islands were not thoroughly surveyed until 1903, by William Speirs Bruce, who worked from Laurie Island. A meteorological station was built and later sold to Argentina in 1904. The station, named Orcadas in 1951, is still open today as the oldest working research base in the Antarctic.

QS1906-HDX01

During the early 1980s, there were multiple Amateur Radio operators stationed at the British Antarctic Survey station on Signy Island. Shown are (from left to right) Ali, VP8AOG; Alan, VP8AOF (front row); Steve, VP8AOC; Steve, VP8AOB (second row); Nick, VP8AOD; Roland, VP8AOH; John, VP8AOE, and Dennis, VP8ZR (third row). [Photo courtesy of Steve Wilson, KØJW]

In 1908, the British declared sovereignty for areas below 50° S between 20° and 80° W, including the South Orkneys, which were later administered by the Falkland Islands Dependencies. In 1947, the British Antarctic Survey (BAS) set up a biological research station on Signy Island, which was staffed year-round until 1996, when the research team switched to having a smaller crew only during summer in the Southern Hemisphere. The islands are currently claimed by the British Antarctic Treaty of 1962 and Argentina, and they are part of the Antarctic Treaty of 1959.

DXCC History of South Orkney Islands

The Orkney Islands appeared on the original post-World War II DXCC list dated November 15, 1945. Shortly after the DXCC program restarted following its wartime suspension, LU1ZA showed up on the air from Islas Orcadas del Sud (Laurie Island).

As described in the September 1949 issue of *QST*, the LU1ZA QSL cards were rejected at first by the DXCC desk, citing "South Orkneys are officially a dependency of the Crown Colony of the Falkland Islands, and as such are under the direct jurisdiction of the British Common-wealth."

Afterwards, the DXCC desk received many queries. According to the July 1952 issue of *QST*:

> …we have found that no claims of individual countries to the Falkland Islands Dependencies or any part of the Antarctic mainland are recognized by the US Government. Therefore, a ruling by the ARRL, to be consistent with our government's stand, should provide for the crediting of all confirmations from this area, without regard to prefixes or nationalities of stations.

Afterwards, those rejected QSLs were accepted for DXCC credit.

VP8AP was probably the first accredited operation from the South Orkney Islands around 1948; however, LU1ZA operations took place during 1947. There have been at least two operations throughout every decade since the beginning of DXCC, including as many as 10 in the 1980s. The last big operation from the Orkneys was the 2011 VP8ORK Micro-Lite Penguin DXpedition team, who made 63,643 contacts, of which 17,679 were unique. Since then, there has been some sporadic activity. As of press time, South Orkney ranks number 16 on the Club Log DXCC Most-Wanted List.

2020 South Orkney Islands DXpedition

After the highly successful Perseverance DX Group's 2018 VP6D Ducie Island DXpedition (see Gene Spinelli's, K5GS, article, "VP6D Ducie Island DXpedition Recap," in the April 2019 issue of *QST*), the team has announced plans for its next DXpedition to Signy Island, in

the South Orkneys. The opportunity came much earlier than the team anticipated, as the MV *Braveheart* will be in the Falkland Islands area in January of next year.

As of press time, the team was securing landing permission, including an exact location to set up two extreme weather tents in efforts to preserve the island's natural habitat. The team has been receiving valuable assistance from Dr. Ralph Fedor, KØIR, a member of the 2011 Micro-Lite Penguin VP8ORK DXpedition.

The team consists of expedition leader Dave, K3EL; co-team leader Les, W2LK; co-organizer Gene, K5GS; Arliss, W7XU; Heye, DJ9RR; Laci, HAØNAR; Vadym, UT6UD; Walt, N6XG; Rob, N7QT; Rodolfo, PY2OT; Steve, W1SR, and Mike, WA6O. They will depart from Punta Arenas, Chile, in February of next year. The February/March 2020 South Orkney Islands DXpedition team pilots will be Thomas, KE4KY (NA and Chief); Mason, KM4SII (NA assistant); Björn, ON9CFG (EU); Al, 4L5A (EU and Russian-speaking); Hiroo, JA1WSX (Japan); Cesar, PY2YP (South America); Luke, VK3HJ (Oceania), and Andre, V51B (Africa).

The group plans to be on Signy for 15 days, from February 21 – March 5, and to be active on 1.8 through 28 MHz on SSB, CW, RTTY, and FT8. The team will have seven stations, Elecraft K3S transceivers, KPA-500 amps, SPE Linear amps, and OM Power amps. Antennas for this DXpedition will include two-element vertical dipole arrays (VDAs) for 14 – 28 MHz, two-element Yagis on 14 – 28 MHz at 10 meters above the ground, a 30-meter four-square, a 40-meter four-square, and separate verticals for 160 and 80 meters. In addition, the team will have receive antennas for the low bands.

Budget

This DXpedition is budgeted at $325,000 with the ship transportation being the most expensive, trailed by freight costs. The opportunity arose more quickly than the team anticipated, but the cost will be lower than if the MV *Braveheart* was going to be located farther away. The call sign for this DXpedition has not yet been decided and will be announced.

More South Orkney News

The team's website, **www.sorkney.com**, has more DXpedition information, including operator biographies, propagation forecasts, transmit frequencies, and details on support and donations. You can also follow the team on Twitter **@SouthOrkneyDX** and on Facebook at **www.facebook.com/South-Orkney-DX-pedition-2020-312303479470837**. Email the team with further questions at **info@sorkney.com**, and watch your favorite DX outlet for any future updates.

Wrap-Up

That's it for this month, with thanks to K5GS and the Perseverance DX Group for helping to make this month's column possible. Don't forget to send your DX news, photos, and club newsletters to **bernie@dailydx.com**. Until next month, see you in the pileups!
— *Bernie, W3UR*

Jon Jones, NØJK, n0jk@arrl.org

The World Above 50 MHz

The Quiet Sun Roared

I discussed in last month's column how the sun has become quiet as we enter the minimum of Solar Cycle 24. But the sun decided to greet Spring 2019 with a bang! Sunspot AR2736 spawned a C-4 class solar flare with an Earth-directed CME on March 20 at 1118Z. Hopes were high for aurora and perhaps even some F2 propagation on 6 meters. On March 24 at 2151Z, the CME arrived, but it was brief, with only a glancing blow against the Earth's geomagnetic field. A weak G1-class geomagnetic storm took place; this was a big disappointment for aurora watchers and VHF DX operators. Unfortunately, the majority of CMEs are not Earth directed.

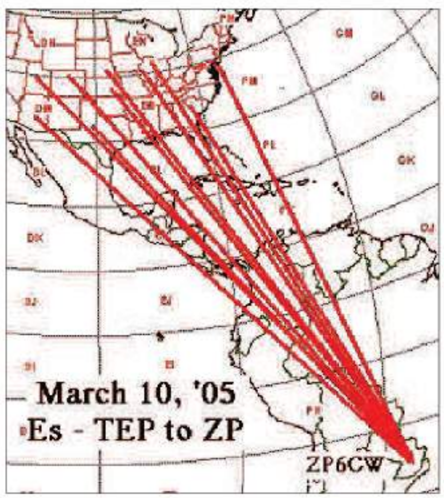
On the Bands

50 MHz. Sporadic E and any terrestrial DX were very scarce on 6 meters in March 2019. EME is workable year-round, as shown by Mike, K7ULS, who logged JG1TSG (QM05) via EME on March 10.

An interesting opening took place on March 12. Earlier that day, K7ULS (DN41) worked W5LDA (EM15) via E_S on FT8. E_S was observed from Florida to Puerto Rico that afternoon. TEP was present from the Caribbean to Brazil, as shown by PY2GTA spotting Frans, J69DS, via TEP (trans-equatorial propagation). Then an E_S-to-TEP link was set up. Graham, KW4BY (EL96), copied J69DS on E_S, and PT9FD, ZP5SNA, and PY2KP via an E_S-to-TEP opening, all on FT8, from 0030 to 0120Z.

Graham heard no beacons or stations on SSB or CW. "FT8 is amazing," he noted. PT9FD spotted Carl, WC4H, on FT8. WD4AB (EL95) spotted Jose, KP4EIT, "59" and Jose, KP4JLA, "55" on SSB via one-hop sporadic E at 0125Z. I suspect there was E_S present from Florida on to the northern TEP zone as well. TEP is a robust mode and propagates 6-meter signals across the geomagnetic equator, even with a solar flux of only 70. With help from sporadic E, Gulf Coast stations were able to work interesting DX deep into South America. E_S is rare in March, but if present, it can set up interesting links. A review of a similar opening 14 years ago illustrates how.

On March 10, 2005, a much more extensive E_S-to-TEP opening took place. From 0020Z to 0200Z, strong sporadic-E openings occurred across the southeast states and the Gulf of Mexico. Stations in the midwest were able to use the E_S to link on to TEP toward South America. Doug Wooley, ZP6CW, put rare Paraguay in many eager DXers' logs on 6 meters from Arizona to New York that evening.



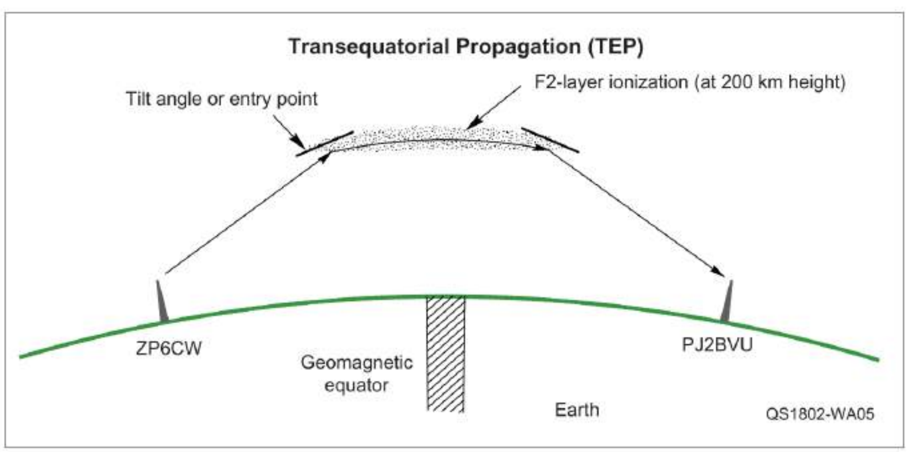
Sporadic-E trans-equitorial propagation to Paraguay on March 10, 2005.

Doug was operating on CW and worked many modest stations, including mine, which operates with 100 W and a small Yagi. The sunspot number then was higher at 77. On March 12, 2019, it was just 11. Remarkable openings like these can occur throughout the solar cycle, waiting for alert and observant DXers. FT8 can help you take advantage of these fleeting openings.

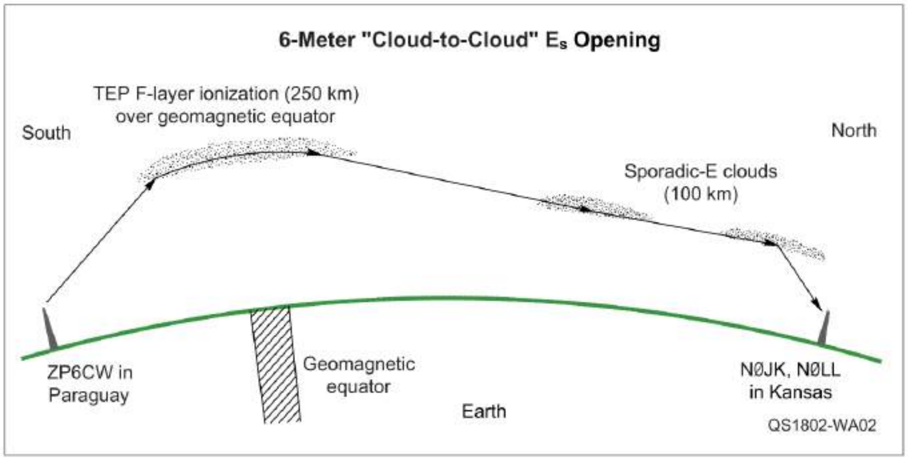
On March 20, Mike, K7ULS, worked Alex, EA8DBM, on JT65 EME at 2256Z with "–33 dB signals."

On March 21, Peter, WA2GFN (FN20), worked Howard, W4HLR (EM56), on SSB via E_S. This was only the second time Peter had worked E_S in March in his many years on 6 meters.

The morning of March 24, I (EM28) had a partial MSK144 meteor scatter contact with Gary, KE8FD (EM64).



ZP6CW's contact with PJ2BVU on 50.110 MHz via TEP on March 8, 2005. [Ken Neubeck, WB2AMU, graphic]

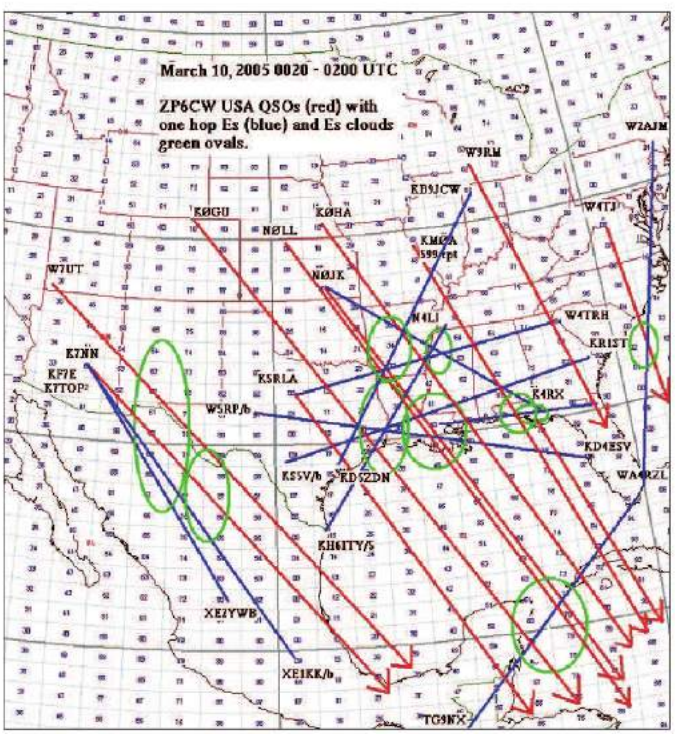


F-layer ionization over the geomagnetic equator (TEP) during a combination TEP and cloud-to-cloud E_s opening contact from the midwest US to Paraguay on 6 meters on March 10, 2005. [Ken Neubeck, WB2AMU, graphic]

There is some disappointing news for those seeking Hawaii on 6 meters this summer. One of the most active Hawaiians on 50 MHz, Jim Kennedy, KH6/K6MIO, will be moving to Florida by the time you read this. Jim related equipment issues that rendered FT8 inoperable during the Australia and New Zealand openings in January 2019. Jim had a great station north of Hilo on the Big Island. A new 6-meter station may be on from West O'ahu. Kimo Chun, KH7U, related that the KH6YY/KH6J contest station may be on 6 meters this year. Plans are tentative to get a high, long Yagi.

Pat, KE3WN, sent the following account of his 6-meter activity from rare grid EM92:

> I was vacationing at Edisto Beach, South Carolina, from January 18 to 27, 2019. I brought my RCI 5054 DX 6-meter 25 W SSB rig along with a magnet-mount antenna on a Chevy Spark. I've always done this, ever since my wife and I began vacationing at Edisto 12 years ago (grid EM92). I had never experienced a 6-meter opening at Edisto until the late afternoon of January 20, 2019. I worked W1AIM in FN34, K1GUP in FN54, and WA1T in FN43, all on SSB, from 2140 UTC to 2201Z.



144 MHz. On March 2, Graham, KW4BY (EL96), worked tropo along the Atlantic Seaboard to Virginia, Pennsylvania (N3BBI, N3DT, K3HQS), and Georgia. Byron, W5FH, is now in EM21. He is putting up several tall towers with Yagi stacks on the VHF and UHF bands. He prefers operating with CW and SSB.

Here and There

With more 6-meter stations using FT8 these days, Rich, K1HTV, noted 50.313 MHz will be very crowded for DX during times when the 6-meter band is wide open. Consider going to 50.323 MHz. Russ, K6KLY, will be operating in the ARRL June VHF Contest from Bermuda (VP9GE's home station). Russ will be using a Yaesu FT-920 and 6M5X Yagi.

The Central States VHF Conference will be held on July 25 – 28, 2019, in Lincoln, Nebraska. Check the website, **2018.csvhfs.org**, for further details. If you are interested in presenting at the conference, check out the guidelines. Suggested topic areas include operating, including contesting, roving, and DXpeditions.

The 2019 Six Meter International Radio Klub (SMIRK) contest will be held on June 15 – 17, 2019. This contest will be held in honor of Bill Tynan, W3XO/5. More information will be on the ARRL Contest landing page and the SMIRK website.

Sam, K5SW, also sent in a new link for the APRS VHF propagation page, at **aprs.mennolink.org**.

Special Event Stations

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

Mar. 1 – Jan. 1 (2020), 0500Z – 0500Z, various, West Central Florida. ARRL West Central Florida Section. **County Parks On The Air**. HF/VHF/UHF and satellite. Certificate. Darrell Davis, KT4WX, 6350 Mills Rd., Fort Meade, FL 33841-9584. *See website for details.* **arrlwcf.org/wcf-special-events/county-parks-on-the-air**

Apr. 1 – Dec. 31, 0000Z – 2359Z, W5TAL, Sugar Land, TX. American Legion Amateur Radio Post 942. **The American Legion 100th Anniversary**. 14.275 14.225 7.275 7.225. Certificate. Bob Hawkins, 311 Ulrich St., Sugar Land, TX 77498. **www.legion.org** *or* **www.legion.org/hamradio**

May 17 – May 27, 0000Z – 2359Z, W9A, Wisconsin Rapids, WI. Wood County ARES/RACES. **EMS Week 2019**. 14.275 7.275 3.975; WI WX Tac-Brandmeister 31550. QSL. Wood County ARES, Attn: W9A, 3530 Bohn Dr., Wisconsin Rapids, WI 54494. **w9wca@winlink.org** *or* **w9wca.com**

May 26, 0300Z – 1100Z, K3DN, Warminster, PA. Warminster Amateur Radio Club. **Poland Through the Ages**. 14.225. Certificate. Warminster Amateur Radio Club, P.O. Box 113, Warminster, PA 18974. **www.k3dn.org**

June 1, 1400Z – 2000Z, W5WQ, Tylertown, MS. Southwest Mississippi Amateur Radio Club. **Walthall County, MS Dairy Festival**. 28.480 21.280 14.280 7.280. QSL. W5WQ, 2862 Wallace Dr. SW, Bogue Chitto, MS 39629. **www.w5wq.net**

June 1 – June 2, 0000Z – 2359Z, N1S, Groton, CT. Generations Amateur Radio Club. **First Nuclear Submarine USS *Nautilus* SSN 571**; Museum Ships Weekend Participant. 21.340 14.264 7.250 50.5. QSL. Via K3LBD bureau or direct to Generations ARC, 110 Vinegar Hill Rd., Gales Ferry, CT 06335. Nautilus information: **www.ussnautilus.org**. **www.qrz.com/db/n1s**

June 1 – June 2, 0000Z – 2359Z, W1M, Vergennes, VT. Lake Champlain Maritime Museum. **Museum Ships Weekend**. 14.260 7.260. Certificate. Robert A. Brown, W4YFJ, 5 Repa Dr., Essex Junction, VT 05452. **https://www.qsl.net/w/wa2tvs/museum**

June 1 – June 2, 0001Z – 2359Z, NJ2BB, Camden, NJ. Battleship *New Jersey* Amateur Radio Station. **Museum Ships Weekend Event**. 14.262 14.040 7.262 7.040. Certificate & QSL. Margaret Burgess, KB2BRR, 150 Schooner Ave., Barnegat, NJ 08005. *Those who work at least 15 different ships of those listed as participating will receive a certificate by sending a copy of their log entries.* **www.nj2bb.org**

June 1 – June 2, 1100Z – 2100Z, K8E, Toledo, OH. Toledo Mobile Radio Association and National Museum of the Great Lakes. **Museum Ships Weekend**. 14.260 14.039 7.260 7.039. QSL. SS Col. James M. Schoonmaker, Team K8E, P.O. Box 9673, Toledo, OH 43697. **www.tmrahamradio.org**

June 1 – June 2, 1400Z – 2100Z, NB9QV, Manitowoc, WI. USS *Cobia* Amateur Radio Club. **World War II Submarine USS *Cobia* On the Air**. 14.240 7.250. QSL. Fred Neuenfeldt, W6BSF, 4932 S. 10th St., Manitowoc, WI 54220-9121. **www.qrz.com/db/nb9qv**

June 1 – June 2, 1421Z – 1417Z, W9I, Paoli, IN. Orange County Amateur Radio Club. **Initial Survey Point**. SSB:14.250 7.180 3.820; CW: 7.055. QSL. Larry B. Jones, 1475 S. State Rd. 37, Paoli, IN 47454. **www.wb9fhp.com**

June 1 – June 2, 1500Z – 2000Z, NY3EC, Pittsburgh, PA. USS *Requin* SS 481 Amateur Radio Club. **Museum Ships on the Air**. 14.0481 7.250 7.0148. QSL. Art Mueller, WA3BKD, 1532 Millers Run Rd., McDonald, PA 15057. **www.qrz.com/db/ny3ec**

June 1 – June 5, 0000Z – 0000Z, W5T/W5C, Cleburne, TX. Club KC5NX. **Museum Ships Weekend**. 14.260 14.045 7.202 7.045. QSL. Club KC5NX, 9200 Summit Ct. W., Cleburne, TX 76033. **club.kc5nx@gmail.com** *or* **www.qrz.com/db/kc5nx**

June 1 – June 9, 1300Z – 2200Z, W2W, Baltimore, MD. The Amateur Radio Club of the National Electronics Museum (K3NEM). **W2W D-Day Commemoration**. 14.244 14.044 7.244 7.044; 80 meters (3.544, 3.844) and digital modes possible. Certificate & QSL. W2W D-Day, P.O. Box 1693, MS 4015, Baltimore, MD 21203. **www.ww-2.us**.

June 1 – June 10, 1400Z – 1400Z, K3J, Butler, PA. Butler County Amateur Radio Association. **Bantam Jeep Heritage Festival**. 14.074 7.230. QSL. BCARA, P.O. Box 1787, Butler, PA 16003. **www.w3udx.org**

June 1 – June 14, 0000Z – 2359Z, K4D, Dog Island Florida (EL79), FL. Dog Island DXpedition. **Dog Island IOTA DXpedition and VHF Party**. 144.200 50.125 14.275 7.180. QSL. Bruce Brady, 208 Mt. Tabor Rd., Hot Springs National Park, AR 71913. *Digital modes and SSB on VHF for the ARRL VHF Contest. SSB/CW/digital modes all others during the time frame. Activating IOTA Island (NA-085) and rare grid EL79. Contacts uploaded to LoTW, send SASE for QSL.* **rockradio1@aol.com** *or* **www.qrz.com/db/k4d**

June 5 – June 9, 1500Z – 2359Z, K5TUP, Tupelo, MS. Tupelo Amateur Radio Club. **Elvis Presley Festival Special Event**. CW, FT8, and SSB on all bands, check the cluster. Certificate*. TARC, P.O. Box 3104, Tupelo, MS 38803. **tupeloradioclub@gmail.com** *or* **www.tupeloarc.org**

June 6 – June 9, 1200Z – 1700Z, WW2DDM, Bedford, VA. Old Dominion Chapter 202 QCWA. **75th Anniversary D-Day Invasion**. AM: 7.285 3.880; CW: 3.585; SSB 14.245. QSL. WW2DDM c/o H. A. Boaz, Jr., 1389 Budd Ln., Montvale, VA 24122.

June 8, 1300Z – 2000Z, KG4KRB, Rocky Mount, VA. Blue Ridge Emcomm. **30th Annual Rosebud Sioux Ministry Trip**. 146.520 14.250 7.250 3.925. Certificate & QSL. Ron Shiflett, KG4KRB, 805 Patti Rd., Rocky Mount, VA 24151. **wawokiya@b2xonline.com** *or* **www.rosebudsiouxministry.org**

June 8, 1830Z – 2030Z, W9ZL, Appleton, WI. Fox Cities Amateur Radio Club. **Appleton Flag Day Parade**. 14.246 145.33. QSL. FCARC, P.O. Box 2346, Appleton, WI 54912. **www.fcarc.club**

June 8 – June 9, 1400Z – 2100Z, K2M, Brooklyn, NY. Kings County Radio Club. **USS *Missouri* (BB-63) — 75th Anniversary of Her Commissioning**. 14.225 7.180 3.810. QSL. Lloyd Westerman, K2JVX, 80 8th Ave., Suite 1001, New York, NY 10011. **www.kingscountyradioclub.com**

June 8 – June 9, 1400Z – 2000Z daily, W3BMD, Indiana, PA. Indiana County Amateur Radio Club. **Jimmy Stewart Airshow**. 14.270 7.230. QSL. Indiana County Amateur Radio Club, P.O. Box B, Robinson, PA 15949. **www.qsl.net/w3bmd**

June 8 – June 10, 1300Z – 0000Z, W3W, Cumberland, MD. Mountain Amateur Radio Club. **Whiskey Rebellion/Cumberland Heritage Days**. 14.322 7.222 3.855. QSL. MARC, P.O. Box 234, Cumberland, MD 21501. *Contacts confirmed via LoTW; send SASE for QSL card.*

June 15 – June 16, 0000Z – 2359Z, K8H/K8O/K8S/K8W, Waynesville, OH. SouthWest OH DX Association. **W8DXCC DX Convention.** 14.245 14.074 7.245 3.535. Certificate & QSL. Bill Salyers, AJ8B, 8275 Cierra Way, Waynesville, OH 45068. *QSL for working each station, and a certificate for working all four.* **www.w8dxcc.com**

June 15 – June 21, 1800Z – 1800Z, K4C, Cookeville, TN. National Speleological Society. **78th Annual Convention of the National Speleological Society**. 14.285 7.195. QSL. Bill Frantz, AE6JV, 16345 Englewood Ave., Los Gatos, CA 95032. **www.nss2019.caves.org**

June 15 – June 30, 0000Z – 2300Z, N4T, Chattanooga, TN. Tennessee Valley DX Association. **30th Anniversary**. 14.250 14.045 7.190 7.040; all bands and frequencies as available. QSL. Howard K. Moll, Jr., WB4ZBI, 8174 Coventry Ln., Chattanooga, TN 37421-1120. **molljr@comcast.net**

June 16 – June 30, 0000Z – 2359Z, W1C, Newport, RI. Providence Radio Association. **Centennial Event 1919 – 2019 — W1C**. 14.250 7.250 3.850 7.025. QSL. Providence Radio Association, W1OP, 1 Ludlow St., Johnston, RI 02919. **www.qrz.com/db/w1op** *or* **www.w1op.com**

June 20 – June 24, 1900Z – 2359Z, N6R, Simi Valley, CA. Ventura County Amateur Radio Society, Simi Settlers Amateur Radio Club, and other area Amateur Radio Operators. **Field Day 2019, Commemorating the Lives of President Ronald and Mrs. Nancy Reagan**. 21.320 14.255 7.260 3.810. QSL. Peter S. Heins, 1559 Norwich Ave., Thousand Oaks, CA 91360. **www.qrz.com/db/n6r**

June 22 – June 23, 1800Z – 1800Z, W7U, Cedar City, UT. Rainbow Canyons Amateur Radio Club. **Field Day**. 14.225 7.235 3.925 3.530. QSL. Don Blanchard, 2666 North 400 West, Cedar City, UT 84721. **blanchard@awinets.com** *or* **www.rcarc.info**

June 24 – June 28, 1330Z – 1700Z daily, K2BSA/8, Lewis Center, OH. Delaware Amateur Radio Association, K8ES. **Simon Kenton Council, Delaware District, Cub Scout Day Camp**. 14.290 7.190. QSL. Ed Jones, 2965 Seaway Ct., Lewis Center, OH 43035. *We'll have hundreds of scouts on the air over the course of the week.* **www.k8es.org**

June 28, 1300Z – 2000Z, W8S, Sault Sainte Marie, MI. Eastern Upper Peninsula Amateur Radio Club. **Soo Locks Engineer's Day – 2019**. 14.240 7.220; 147.21 PL 107.2; 147.33 PL 107.2; other frequencies possible depending on conditions. QSL. W8S, Sault Area Contesting Klub, P.O. Box 533, Sault Sainte Marie, MI 49783.

June 29 – July 10, 1200Z – 0500Z, WO4L, East Berlin, PA. Bob Hess. **156th Anniversary of The Battle of Gettysburg**. 14.275 3.830 7.185 1.930. Certificate & QSL. Bob Hess, 74 Curtis Dr., East Berlin, PA 17316. *Please follow QSL instructions on website.* **www.qrz.com/db/wo4l**.

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 Event 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**.

June 2019 W1AW Qualifying Runs

Earn your Code Proficiency certificate or endorsements by listening to W1AW Qualifying Runs. 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.

June Qualifying Runs will be transmitted by W1AW in Newington, Connecticut at 10 PM EDT on Wednesday, June 5 (0200 UTC on June 6) and at 7 PM EDT on Tuesday, June 18 (2300 UTC) 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 K6KPH on Saturday, June 29 at 2 PM PDT (2100 UTC) on 3581.5, 7047.5, 14047.5, 18097.5, and 21067.5 kHz. Unless indicated otherwise, sending speeds are from 10 to 35 WPM.

Life Members

Elected May 20, 2019

Gary W. Alberstadt, KA3FZO
Richard L. Altherr, KC8APF
Matt Ames, VK2LK
Mark A. Amorim, KC3IUN
David Andrews, KB1YHM
Robert C. Antal, KC3HRV
Thomas D. Antil, AB1GF
David J. Badley, KE7KJR
Stephen A. Baranowski, N1SB
Karen Barsamyan, EK6KB
Vince Bednarz, AC8XO
Doron S. Ben Chaim, K1DBC
Mark G. Bevan, WY1G
Christopher G. Bloxsom, AA4CB
Candace Boggs, KA7NDI
Steven J. Bomba, K9IER
Lawrence R. Brandt, AA1EA
L. Glenn Brazzel, Jr., NQ5X
Tyson D. Brooks, KI7FXJ
Charles W. Brown, WD6AOU
David Brown, NØBTC
Ronald R. Cade, W6ZQ
Clarence E. Canterbury, KB8ABJ
Terrance Castillo, KH6KC
Lucindia E. Claghorn, KI4ZCJ
Wesley G. Clark, AC3DY
Jeremy R. Cook, K7VFO
Brooks M. Crenshaw, K4ATA
Robert E. Darlington, III, N3XKB
Satyajeet Dass, KK4CCA
Gordon A. Davids, WJ3K
Jason R. De La Cruz, K4FLY
Carlos De Los Santos, CX6DAM
Houston Dewey, W6BV
Shane H. Driskill, KG5SRO
Eric Farrow, W9EO
Raymond H. Ferreira, Jr., KH6GGC
David P. Finell, N7LRY
James G. Fisher, AJ3DI
Nathanael T. Fisher, NØZYC
Jonathan D. Frisch, K8JDF
Yuriy Fuks, AC6A
Roger Garrett, Sr., KL4EC
Max George, NG7M
Dee L. Gordon, KI7NUR
Ronald M. Grossman, AF5Q
Andrew J. Gusek, NC4AG
Richard S. Harris, KF5EOX
Chuck Heath, K6ZIZ (SK)
William G. Heckeroth, N7WGH
Bruce G. Hensler, W3GZ
Jeffrey D. Herman, KH6O
Phillip E. Hicks, KEØTK
William J. Howard, WB3V
Karlan L. Hutchison, W7KLC
Frank S. Kaleyiasm, KV5FD
Sandra C. Kalman, AG5QJ
Eric Kaminsky, KD2JYQ
Brian Kanis, AK8BK
James W. Kelley, AC6XG
Sean W. Kelley, WM1L
Michael W. Keltner, K4MWK
Arnold J. Klein, WB6OEE
Taff E. Klepinger, KT1SGK
Gary R. Kloss, KU5FZN
Jamie R. Kriner, KC3NAP
Joseph S. Kriner, KC3NAQ
Robert K. Kuegemann, KCØIVW
Ray LaFrance, W1PDX
Justin A. Leishman, KC3BJT
Liz Leonhardt, K6LIZ
Peter M. Leonhardt, AE6PL
Brian Levens, KM4HCQ
Donald J. Lewis, III, KW4UP
Roy R. Lippin, KA2MME
James R. Litton, KEØVEZ
Luther R. Lloyd, II, KJ4RUA
Nathan J. Lockhart, KEØHTD
Joseph A. Lukaitis, Sr., KA3GEK
Jerry R. Lutgring, W5JRL
Kurtis T. Mabe, WH6KM
Dennis G. Major, NØABC
Chuck Maris, W9KCM
Richard H. Marx, AF7RM
Joelle Maslak, N7XUC
John V. Matthews, N7MRM
Aaron E. McKnight, KD8ILV
Diane Meador, KD5QNN
William S. Merritt, KB4QAA
William A. Meyers, KE5HDY
Nicolas A. Middendorff, KB3PGV
Juan Munoz, TG9AJR
James R. Nash, Jr., KG4TKA
Charles R. Netherby, KI6IIT
Robert L. Neyhard, KC3ICT
Mark M. Noble, KE8BZW
John W. O'Brien, III, N1NJI
Bohdan Olesnicky, KK6TJY
Michael D. Packett, KC3JIG
John C. Peterson, KØOUT
Frank E. Philipp, NØYKA
Steven E. Phillips, WA1ZKN
Larry Price, W7EWL
Aaron Quinto, AAØQQ
Lance E. Rasmussen, K7LER
Mark Rauen, W8MWR
Andrew E. Reid, KC2WUG
Erin Reid, WGØNZO
Aaron C. Renner, N8ACR
Carl J. Reynolds, N7CJR
Benjamin P. Richardson, II, K4ITQ
Jason Riddle, KC3CSV
Alexander J. Rosen, N2LR
David H. Rosenfeld, KG5NLA
Ari D. Rubinstein, KM6MQL
Scott Russell, N1SER
Gilbert D. Rymer, W5GLR
Ray Salaiz, AG6SB
Adam Sandler, KD2KYX
James E. Schwinn, KG5YPE
Craig B. Shackelford, W7FM
Steven D. Sherman, AEØCL
Barry L. Sherwood, N5HW
Michael A. Shuman, NP2AG
Douglas C. Sicker, ADØVT
Karl Simonson, KS9E
William E. Sousa, KM4JYL
John Spitznagel, Jr., KD4IZ
Wesley Stanaland, Jr., NS4CC
Evan Stinson, WØERS
John E. Stone, KC9VGG
Nathan Tiller, K3DEJ
Jason K. Turner, W8LST
Jennie L. Tuttle, KCØRBV
Rik Van Riel, AB1KW
Robert B. Tuttle, N8YXR
Tighe V. Vroman, K7TVV
Dennis L. Wade, KG6ZI
Jeremy Wells, KC9WMV
Brandon L. West, K4BLW
Mark R. Wilson, KC7VZS
Paul T. Wintler, KC6PDS
Albert R. Wolff, W6ELD
Richard A. Woodward, KA4JXY
John H. Wright
Charles Zurenko, N2TFS

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**.

Convention and Hamfest Calendar

Abbreviations

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

Alabama (Helena) — June 14 – 15
D F H R S V

Friday 4 – 7 PM, Saturday 8:30 AM – 3 PM. *Spr:* Shelby County ARC. Helena Sports Complex, 110 Sports Complex Drive. *TI:* 146.98. *Adm:* $5. **helenahamfest.com**.

Illinois (Wheaton) — June 16
D F H Q R V

7 AM. *Sprs:* Six Meter Club of Chicago. DuPage County Fairgrounds, 2015 Manchester Rd. *TI:* 146.97 (107.2 Hz), 146.52. *Adm:* Advance $6, door $10. **www.k9ona.com**.

Maryland (Upperco) — June 16
D F H Q R T

7 AM – 2 PM. *Spr:* Baltimore ARC. Arcadia Fairgrounds, 16920 Carnival Ave. *TI:* No talk-in. *Adm:* $5. **http://w3ft.com/**.

Michigan (Midland) — June 15
D F H S T V

8 – 11 AM. *Spr:* Midland ARC. Salvation Army Building, 330 Waldo Ave. *TI:* 147.0. *Adm:* $5. **www.w8kea.org**.

Michigan (Monroe) — June 16
D F H Q R T

7:30 AM – 1 PM. *Spr:* Monroe County Radio Communications Assn. Monroe County Fairgrounds, 3775 S. Custer Rd. *TI:* 146.72/12 (100 Hz). *Adm:* $6. **www.mcrca.org**.

New Jersey (Piscataway) — June 15
D F H Q R T V

8 AM – noon. *Spr:* Raritan Valley RC. Piscataway High School, 110 Behmer Rd. (Lots 11 – 12). *TI:* 146.52, 146.625 (141.3 Hz). *Adm:* $7. **www.w2qw.org**.

New York (Chaffee) — June 8
D F H R T V

8 AM. *Spr:* Pioneer Radio Operators Society. Manion Park, 9999 Grove St. *TI:* 145.39. *Adm:* $5. **www.facebook.com/pioneerradiooperatorssociety.pros**.

New York (Queens) — June 2
D F H Q R T V

9 AM – 2 PM. *Spr:* Hall of Science ARC. New York Hall of Science parking lot, Flushing Meadows Corona Park, 47-01 111th St. *TI:* 444.2 (136.5 Hz). *Adm:* $5. **http://hosarc.org/**.

North Carolina (Salisbury) — July 6
D F H R T V

8 AM – 2 PM. *Spr:* Rowan ARS. Salisbury Civic Center, 315 Martin Luther King Ave. S. *TI:* 145.41 (136.5 Hz). *Adm:* Advance $4, door $5. **https://www.rowanars.com/events**.

Ohio (Austintown) — July 7
D F H Q R S T V

8 AM – 1 PM. *Spr:* 20/9 RC, Inc. Austintown Senior Center, 112 Westchester Dr. *TI:* 147.315. *Adm:* Free. **20over9.org**.

W8DXCC CONVENTION

June 15, Owensville, OH

D F H Q R S V

1 – 6 PM. *Sprs:* SouthWest Ohio DX Assn. Clermont County Fairgrounds, 1000 Locust St. *TI:* 147.345 (123 Hz). *Adm:* $10. **https://www.swodxa.org/w8dxcc/**.

Ohio (Owensville) — June 15
D F H Q R S T V

8 AM – 1 PM. *Spr:* Milford ARC. Clermont County Fairgrounds Multipurpose Building, 1000 Locust St. *TI:* 147.345 (123 Hz). *Adm:* $5. **www.w8mrc.com**.

Pennsylvania (Plains) — July 7
F H R T V

8AM – noon. *Spr:* Murgas ARC. Polish American Veterans Club, 2 S. Oak St. *TI:* 146.61 (82.5 Hz). *Adm:* $7. **hamfest.murgasarc.org**.

Tennessee (Knoxville) — June 15
D F H R S T V

8 AM – 3:30 PM. *Spr:* Radio Amateur Club of Knoxville. Kerbela Temple, 315 Mimosa Ave. *TI:* 147.3 (100 Hz). *Adm:* Advance $8, door $10. **www.w4bbb.org**.

Texas (Texas City) — July 6
D F H Q R S T V

9 AM – 1 PM. *Spr:* Tidelands ARS. Doyle Convention Center, 2010 5th Ave. N. *TI:* 147.14 (167.9 Hz), 442.025 (103.5 Hz). *Adm:* Advance $4, door $5. **www.tidelands.org**.

Virginia (Manassas Park) — June 15
D H Q R S T V

6:30 AM – 2 PM. *Spr:* W4OVH Ole Virginia Hams. Manassas Park Community Center, 99 Adams St. *TI:* 146.97 (100 Hz). *Adm:* $10. **www.qsl.net/wa9txe**.

Washington (Dryden) — June 7 – 9
H R T

Friday and Saturday 6:30 AM – 9 PM, Sunday 6:30 AM – noon. *Spr:* Apple Valley ARC. Dryden Gun Club, Saunders Rd. *TI:* 146.68 (156.7 Hz). *Adm:* $7. **applecityarc.com**.

Wisconsin (Oak Creek) — July 7
D F H R

7 AM – 1 PM. *Spr:* South Milwaukee ARC. American Legion Post #434, 9327 S. Shepard Ave. *TI:* 146.91 (127.3 Hz). *Adm:* $5. **www.qsl.net/wa9txe**.

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

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**.

ARRL VEC Volunteer Examiner Honor Roll

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

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

Examiner	Sessions	Accreditation Date
Atlantic		
Jobst Vandrey, ACØLP	322	23-Jun-08
James McCloskey, NS3K	306	14-Nov-94
Edward Genoino, WA2NDA	298	10-Jul-85
George Brechmann, N3HBT	270	01-Apr-91
Robert Benna, N3LWP	230	21-May-97
Central		
Ed Wagner, AB9FN	318	01-Jul-02
Eldon Boehm, NK9U	303	21-Nov-86
Allan Bukowski, N9ZD	300	01-Jun-92
Donald Hlinsky, N9IZU	291	01-Mar-91
Timothy Pechtold, AA9BV	268	01-Nov-92
Dakota		
John Schwarz, Jr., AEØAL	298	26-Oct-94
Jeffrey Goodnuff, WØKF	286	17-Jun-03
Shep Shepardson, NØNMZ	232	12-Mar-01
Daniel Royer, KEØOR	229	01-Jul-91
Dennis Ackerman, KBØOQQ	219	15-Jul-96
Delta		
Arthur Parry, Jr., WB4BGX	263	01-May-91
Glenn King, N5GK	233	05-Jun-86
Edward Scheufele, AB5RS	224	19-Jan-94
Roger Gray, N5QS	222	01-Mar-93
Joe Lowenthal, WA4OVO	218	25-May-06
Great Lakes		
Charles Hall, W8HF	272	01-Jun-92
David Schmidt, KI4QH	250	15-Feb-85
Dale Pritchett, KC8HJL	223	26-Mar-98
Christian Anderson, K8VJ	217	09-Feb-90
Archie Mack, Sr., AF4EB	215	19-Aug-97

Examiner	Sessions	Accreditation Date
Hudson		
Paul Maytan, AC2T	624	06-Sep-84
Stanley Rothman, WA2NRV	435	01-Mar-85
E. Drew Moore, W2OU	428	01-Aug-90
Gerald Miller, Jr., AA2ZJ	398	05-Dec-95
Fritz Boigris, KB2O	388	26-Oct-84
Midwest		
David Bartholomew, ABØTO	699	22-Mar-02
Kevin Naumann, NØWDG	616	17-Nov-02
Harry Steger, Jr., WØHMS	530	26-Aug-08
Roland Kramer, WØRL	515	21-Jun-01
Jeanette Nordman, ABØYX	460	21-Aug-03
New England		
Robert Beaudet, W1YRC	367	01-Aug-90
Lawrence Polowy, KU1L	331	02-Jan-85
Paul Lux, K1PL	326	25-Jan-85
Stefan Rodowicz, N1SR	326	20-Nov-84
Bruce Anderson, W1LUS	325	11-Feb-88
James Mullen, KK1W	323	01-Mar-91
Northwestern		
Richard Morgan, KD7GIE	450	11-Aug-00
Loren Hole, KK7M	371	06-Sep-84
George Ftikas, N7TQZ	294	01-Dec-92
David Brooks, N7HT	282	10-Jun-87
S. Riley McLean, W7RIL	273	02-Sep-99
Pacific		
Morris Jones, AD6ZH	455	27-Nov-01
Dieter Stussy, KD6LVW	387	27-Jan-94
Gordon Fuller, WB6OVH	330	06-Sep-84
Bill Nichols, NN7K	312	01-Sep-93
Jim Brunk, N6BHX	266	13-Jul-95

Examiner	Sessions	Accreditation Date
Roanoke		
Judy Friel, AC4RG	277	01-Feb-91
Alan Ronald Moeck, WA2RPX	255	27-Sep-94
David Snyder, W4SAR	238	01-May-93
Sheila Frank, KT4YW	221	30-Oct-96
Terry Sanner, WV8V	202	06-Sep-84
Rocky Mountain		
Robert Hamilton, NØRN	371	19-May-87
David Avery, NØHEQ	289	13-Jan-88
Jeffrey Weinberg, WØQO	281	01-Apr-93
Philip O'Kunewick, ABØJR	274	24-Feb-00
Frank Goddard, WØAJY	267	01-Feb-92
Southeastern		
Victor Madera, KP4PQ	452	01-Mar-92
Pablo Soto, KP4SJ	369	01-May-92
Val Jacyno, AK4MM	363	08-Nov-11
Robert Cumming, Sr., W2BZY	336	29-Jan-97
Joseph Patti, N4UMB	314	01-Sep-90
Southwestern		
Bill Martin, AIØD	973	01-Nov-84
Fred Bollinger, AB7JF	513	17-Apr-95
Steve Gurley, KY7W	408	19-Apr-96
Joseph Cutitta, WØSLL	399	09-Nov-99
David Morrill, N7TWT	396	20-Jul-00
West Gulf		
Franz Laugermann, K3FL	1,023	01-Dec-91
Wilbert Cannonier, KK5JJ	454	03-Nov-95
Adolph Chris Koehler, K5VCR	444	29-Sep-95
Gerald Grant, WB5R	441	04-Jan-85
David Fanelli, KB5PGY	425	01-Oct-91

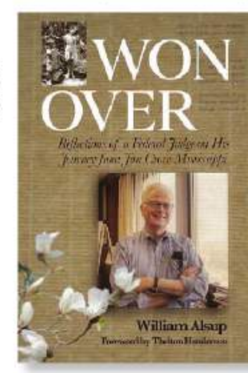
Strays

Founders Honored For 20 Years of Ham Radio University

ARRL Long Island Section Manager Jim Mezey, W2KFV (center), presented special recognition awards to the founders of Ham Radio University (**www.HamRadioUniversity.org**) to mark the 20th anniversary of the annual day-long Amateur Radio educational conference. The event was established in 2000 for hams in the ARRL New York/Long Island Section and beyond to share ideas, knowledge, and fellowship. Held each January, Ham Radio University now draws more than 300 attendees who benefit from over 30 presentations, forums, and hands-on workshops. Pictured are Neil Heft, KC2KY; Tom Carrubba, KA2D; George Tranos, N2GA; Diane Ortiz, K2DO; Phil Lewis, N2MUN, and Mel Granick, KS2G.

QST Congratulates...

Judge William Alsup, N6XMW, on the publication of his memoir *Won Over*. Alsup was born in Mississippi to parents who believed in segregation and grew up during the epic events of the civil rights movement, finding his way to the right side of history. Alsup graduated from Mississippi State, and went on to Harvard Law School, then to clerk for Justice William O. Douglas, and eventually became a United States District Judge in San Francisco. The book is available at **Amazon.com** and from other retailers. For more information, see **www.newsouthbooks.com**.



100, 50, and 25 Years Ago

June 1919

The Treaty of Versailles formally brought World War I to an end on June 28, 1919. *QST* resumed publication that same month, reporting on technical progress made during The Great War and where Amateur Radio and ARRL stand.

- The cover of this "Re-Opening Number" is a greeting from ARRL President Hiram Percy Maxim, W1AW, with the news that "the restrictions on amateur transmitting will be lifted as soon as the President of the United States announces that a state of peace exists."
- The editorial, "A.R.R.L. Loan," explains the plan to borrow working capital from the membership to get *QST* started again and to have a Headquarters office.
- "Receiving Permitted" announces that the federal prohibition against amateurs listening to their receivers has now been lifted.
- "New Developments," by Dr. Radio, explains the vacuum tube discovery made during wartime and how it can be used by hams.
- "The Old Man" returns to cathartically complain about operator problems, this time discussing "Rotten Starting."

June 1969

- The cover cartoon art shows how hams will be heading for the ARRL's National Convention in Des Moines, Iowa, later this month.
- The editorial reminds us how ARRL's "QSL Bureau" functions.
- Lewis McCoy, W1ICP, tells us to "Clean Up Your Harmonics!" so you won't get a dreaded FCC notice for spurious signals.
- Wayne Overbeck, K6YNB, discusses "Three Innovations for Field Day" — a battery-recharging system, a tilt-over portable tower, and an operating desk for a car.
- Following a growing interest in ultra-high frequencies, Dolph Vilardi, WA2VTR, describes "Easily-Constructed Antennas for 1296 MHz" to tackle feed-line efficiency concerns.
- Perry Klein, K3JTE, and William Tynan, W3KMV, give us a quick look at "AMSAT…The Radio Amateur Satellite Corporation," which took form early this year.

June 1994

- The cover photos show "Outdoors and Amateur Radio," while promoting ARRL Field Day and the June VHF QSO Party.
- The editorial discusses "Responsibility," following the FCC's relaxation of rules regarding repeater control operators' accountability for the message content originated by other stations, effective June 1.
- "St. Paul Revisited," by Fred Archibald, VE2SEI, describes how eight hams from Montreal put the Nova Scotian island on the air as CY9CWI, making 5,500 contacts.
- Alan Bloom, N1AL, describes his "Inexpensive Interference Filters," useful for multi-transmitter field days and other contest operations.
- In "Beginner's Boomers: Two Phased Vertical Arrays for 30 Meters," Gary Borich, W5UDV, and Robert Logan, NZ5A, tell us how to easily build low-profile antennas with gain.
- In "Simple, Effective, Elevated Ground-Plane Antennas," Thomas Russell, N4KG, tells us how to use our grounded towers as a vertical antenna on 160 or 80 meters.

Field Organization Reports

March 2019

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**.

914 K9CSA

625 KD8TTE

455 WA3EZN

451 WA7PTM

420 WØKCF

417 W7PAT

354 WM8A

315 WM2C

305 WS6P

303 N3KRX

260 KT2D, KW9EMG

248 KD2PLM

235 KK4PUX, WD8MWD, KC5ZGG

233 KK7TN

231 KI6LNB

225 WØPZD

224 WA2CCN

220 K8LPC

218 KB5PGY

205 N8SY

200 N2WGF, WØDSF

195 WO2H

190 W8IM

187 KE8CYC

186 KØIBS

184 AD5CQ

179 WB8RCR

175 KT5SR, ALØY

165 K3JL

160 W4CMH, AG9G, W4DNA, K7WXW

159 AD8CM

155 WB9WKO, WC9CW

150 ACØKQ, WB9QPM

145 W2PH, KC1CIC

141 WA2BSS

140 W3CB, KK3F, WK4WC

139 KD2IWN

135 W3YVQ, K8RDN

132 N2LJM

130 W5DY, K9LGU, KA8ZGY, KW1U, AD3J, KA9QWC, N1LL, N2JBA, NA7G, K4IWW, WD8USA, N5MKY

125 K2TV

124 KA5DON, N7IE

123 W2CTG

120 W4NWT, KIØJO, KD2JKV, KC8WH, WB8YYS, WØLAW, WB4ZIQ, KY2D, KB8RCR

118 K4VWK

115 N1TF, KØPTK, KY2MMM, KW4GU, KE8CEH

113 N2DW

111 WA4VGZ

110 W1KX, WD4FSU, WA3QLW, K4GK, W1RVY, N1IQI, WB8YLO, K6HTN, K3IN, KA5AZK, KF5IOU, KO4OL, K2RMF, KA2ZNZ, WB8TQZ, WB6OTS

109 KI4UDZ

106 KB3KYH, W9EEU, AA7BM

105 N8CJS, KC4BQK

104 W9BGJ

103 WB8QLT

102 K6JGL

101 K8AMH

100 NN7H, WB4RJW, KZ8Q, KN9P, N9VC, NX9K, N1LAH, KB8MAF, WB8SIQ, KD8UUB, AC8NP, KD2MDV, AB9ZA, AA3SB, K6JT, KE5YTA, KA2GQQ, KB2QO, KØVTT, K1HEJ, KB2YAA, AA3N, WB6UZX, K8ED, NDØCW, W7PHX

97 KB1NMO, KD8ZCM

96 K9DUR, NI2W

95 KØEK, K1XFC, W4TTO

90 W2PAX, KM4VTK, KM4WHO, KD4EAQ, WA1LPM, K8KRA, N2TSO, WDØBFO, WB3FTQ, K3YAK, WBØB, WB8WKQ

88 W8CPG

86 KB8PGW

84 WS4P

82 KAØDBK, KC5OZT, KG5NNA

81 KA9IKK, KE5HYW

82 KD8KBX, N3RB, W4INK, KN4AAG

80 AA4XZ, KB4CAU, KL7RF, K8OVO, KA2HZP, KT4WX, KB1NAL, KF7GC

79 KC1HHO, N6IET

78 KA1G

75 K6RAU, AB3WG

73 KD2MEN

71 N3JET

70 KC7ASA

The following stations qualified for PSHR in previous months but were not reported in this column: (Feb.) KI6LNB 414, N3KRX 186, KC1CIC 140, KW1U 130, N1TF 115, N1IQI, W1RVY, KD2JKV 110, WB6UZX 100, N1LAH 99, WA1LPM 90, KC1HHO 78.

Section Traffic Manager Reports

The following Section Traffic Managers reported: AL, AR, AZ, CO, CT, DE, EMA, ENY, GA, IA, IL, IN, KY, LA, LAX, MDC, ME, MI, MN, MS, MT, NC, NE, NFL, NLI, NM, NNJ, NTX, OH, OR, SC, SFL, SJV, SNJ, STX, TN, UT, VA, WCF, WI, WMA, WNY, WV, WY.

Section Emergency Coordinator Reports

The following Section Emergency Coordinators reported: AR, AZ, CT, DE, ENY, EPA, EWA, GA, IA, ID, IL, IN, KY, LA, MI, MDC, ME, MN, MO, MS, ND, NLI, NM, NNJ, NNY, NV, OH, OR, PAC, RI, SFL, SJV, SNJ, STX, SV, TN, UT, WCF, WI, WPA, WV, WWA.

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.

WS6P 2077, KK3F 1903, K6HTN 1056, NX9K 1047, WB9WKO 861, KIØJO 713, WA3EZN 683, KE5YTA 541, N1LL 519.

The following stations qualified for BPL in previous months, but were not reported in this column: (Feb) N1IQI 631, KW1U 517.

Silent Keys

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

W1AZG	**Grossman**, Marvin, Newton, MA
W1BJ	**McCaffrey**, Paul F., Dracut, MA
W1CAN	**Hathaway**, John W., Westford, MA
K1CNC	**Hammond**, Ernest H., Rockland, ME
N1CSQ	**Reynolds**, Wayne H., Scarborough, ME
KA1FFY	**Adriano**, Ronald J., Bradford, RI
KB1FHJ	**Bursch**, Lowell, Natick, MA
KC1IOX	**Conland**, Henry H., Storrs, CT
W1IZQ	**Hyman**, Harold, Acton, MA
K1QS	**Smith**, Walter P., Naples, ME
WA1TKA	**Graham**, John L., East Durham, NY
K2ARW	**Sanford**, George A., Norman, OK
KA2EGV	**Jenkins**, Alvin E., Hopewell, VA
K2EJN	**Lansing**, David, Johnstown, NY
N2GPP	**Rappaport**, Charlotte A., Holmes, NY
W2NQB	**Wantuck**, Chris C., Red Bank, NJ
KA2OHX	**Lapetina**, Joseph M., Albany, NY
♦WX3A	**Collins**, Raymond A., Sterling, PA
♦N3AZ	**Stowell**, Frederick W., Ramer, AL
KB3CAB	**Moore**, Richard B., Fort Myers, FL
•KB3CGL	**Hardy**, William A., Georgetown, DE
K3CKT	**Barrett**, James I., Takoma Park, MD
KC3EYL	**Burton**, David C., Pottstown, PA
N3FRO	**Dalton**, Simon, Elkton, MD
W3FVI	**Bergey**, Charles K., Bethlehem, PA
K3GBA	**Smith**, Samuel C., Jr., Rushland, PA
N3GT	**Slye**, W. Russell, Millersville, MD
♦W3LF	**Murray**, Randy, Millsboro, DE
KA3RCS	**Messerschmidt**, Karl F., Myerstown, PA
W3STW	**Tribble**, Alfred T., Warminster, PA
AB3TQ	**Mohler**, Glenn R., Mohnton, PA
WA4BZX	**Williams**, Thomas S., Pinellas Park, FL
N4CBI	**Rich**, Thomas G., Jr., Garner, NC
WD4DIH	**Smith**, Tom H., Campbellsville, KY
K4DKQ	**Elder**, James "Lem," Phenix City, AL
N4DYN	**Little**, John H., Stephens City, VA
W4EIR	**Rhoden**, Jess B., Maynard, MA
KG4FJR	**Feld**, Marc L., Jeffersontown, KY
•KA4HHZ	**Campbell**, James S., Campbellsville, KY
W4HRR	**Reidenbach**, David R., Manassas, VA
♦K4JAH	**Hurst**, Jack A., Jr., Hudson, OH
WA4LBI	**Frey**, James G., North Bend, OH
AF4LG	**Randall**, Gary D., Muncie, IN
♦NC4LR	**Royster**, Larry H., Raleigh, NC
W4LVL	**Cull**, Duncan E., Louisville, KY
♦WB4LYR	**Bryant**, James E., Sr., Chatchee, AL
♦N4MI	**Long**, Madison M., Crozier, VA
K4NSG	**Baker**, William T., Jr., Saint Augustine, FL
•KB4OPV	**Hunt**, Jerry R., Yorktown, VA
KD4PER	**Guy**, Lyndell "Coley," Central City, KY
AK4PI	**Modlin**, Carol W., Jr., Savannah, GA
NF4R	**Hathaway**, David A., Sr., Hodgenville, KY
K4RBD	**Baldini**, Ernest A., Rockledge, FL
KA4RDY	**Selby**, Robert W., Sr., Shelby, NC
WA4TFE	**Berry**, John P., Winfield, AL
KA4TXY	**Garrett**, Stuart "Dave," Jr., Palm Coast, FL
KI4UPX	**McLemore**, Garry S., Hampton, VA
♦WU4W	**Osborn**, Hilary H., Jr., Loudon, TN
W4YV	**Brafford**, Melvin "Mickey" G., Goode, VA
W4ZWE	**Shelton**, Thomas B., Toney, AL
KF5ARK	**Haines**, William C., Jr., Aransas Pass, TX
N5BFG	**Johnson**, Earl V., II, Dallas, TX
WD5CGS	**Skrogstad**, Merlin "Jim," Tulsa, OK
N5DRA	**Saale**, Maurice A., Sr., Elsberry, MO
W5GBX	**Breaux**, Brandon G., Beaumont, TX
N5IAG	**Thompson**, Charles A., Dallas, TX
W5JYJ	**Lobaugh**, Robert J., Jr., Sinton, TX
♦W5KRH	**Van Der Weide**, Sam W., San Antonio, TX
K5LD	**Carpenter**, L. D., Garland, TX
♦W5LQU	**Cummings**, Forest M., Corinth, TX
♦W5PDG	**Belham**, John, Jr., Gulfport, MS
N5SAC	**Le Friant**, Andre L., New Orleans, LA
♦•WA5TAW	**Graham**, Donald E., Norman, OK
W5TGM	**Domiano**, Carlo J., Gretna, LA
KF5U	**Lambright**, J. D., Montgomery, TX
•WA5UNF	**Jensen**, Arnold R., Houston, TX
KF5WKL	**Hill**, Paul D., Cache, OK
K5WKR	**Borgeson**, Karl M., Garland, TX
KB5WMY	**McNair**, Carl, Bossier City, LA
W6AN	**Nakamura**, Yoshio S., Los Angeles, CA
WD6CKT	**Prader**, Gary, Salinas, CA
N6DKG	**Bullis**, Danny E., Lake Havasu City, AZ
W6ERV	**Sly**, Ervin L., Spokane Valley, WA
KO6FK	**Meyers**, Andrew R., San Diego, CA
WB6GMU	**Leitzel**, Gail J., Lake Havasu City, AZ
N6JAE	**Stollar**, Marvin D., Fresno, CA
K6LAK	**Cameron**, Wilfred "Al," Evergreen, CO
K6LXH	**Rosenberg**, Phillip A., Saint James City, FL
N6MMF	**Law**, Norma, Claremont, CA
AF6PZ	**Lovelace**, Gerald M., Milpitas, CA
KR6R	**Mullett**, Charles E., Santa Paula, CA
NM6T	**Bertacchi**, Jerome J., Sacramento, CA
AA6TV	**Apte**, Donald R., Broomfield, CO
•KC6TZU	**Girard**, Paul W., Concord, CA
KE6VRD	**Elton**, Le Rae, Lake Isabella, CA
K7BNQ	**Crossman**, Clair "Sam" A., Burlington, WA
♦W7DQM	**Maricle**, James A., Bellingham, WA
K7KI	**Jorden**, Bruce W., Jr., Tucson, AZ
•KF7LS	**Frank**, Harold W., Valrico, FL
W7MH	**Heenan**, Michael L., Modesto, CA
WA7NDD	**Griffith**, James L., Rigby, ID
N7ODN	**Myers**, John "Jack" E., Bozeman, MT
KC7ORH	**Burns**, James W., Port Angeles, WA
KG7QK	**Dombrosky**, Richard M., Las Vegas, NV
KF7SGM	**Boswell**, Randolph W., Poulsbo, WA
K7VQF	**Gilbert**, Ray T., Sequim, WA
WA7ZZZ	**Etchamendy**, John B., Carson City, NV
K8BAS	**Sheffer**, Brent A., Westerville, OH
W8BYB	**Busard**, Roderick J., Livonia, MI
K8DT	**Panyard**, Joseph L., Suttons Bay, MI
♦W8EDR	**Campanella**, Dr. Angelo J., Hilliard, OH
K8HEP	**Lyke**, Emerson "Ray," La Salle, MI
•N8KZX	**Slepecky**, John, Jr., Brooklyn, OH
♦K8LZ	**Gillispie**, Stephen A., Hurricane, WV
N8MXU	**Salem**, William R., Brook Park, OH
W8NPU	**Orr**, William, Columbus, OH
N8OB	**Brown**, Robert A., Marion, OH
•K8OMW	**White**, Opal M., Mentor, OH
W8PIT	**Shenk**, William G., Interlochen, MI
WD8Q	**Koenig**, Henry L., Lucas, OH
KD8QE	**De Verna**, Stanley E., Lambertville, MI
KC8SGG	**Clem**, Philip E., De Graff, OH
K8STK	**Creech**, Thomas D., Kent, OH
♦K8TX	**Merrick**, Dan, III, Reynoldsburg, OH
AI8U	**Degroat**, John A., Bay City, MI
W8UGG	**Wolfe**, Paul B., Plain City, OH
N8UW	**Blair**, Charles, Dayton, OH
KB8VCT	**Burton**, Eddie D., Ironton, OH
WW8W	**Paar**, Daniel L., Trezevant, TN
N8WMN	**Cruce**, Duane "Cof" H., Philadelphia, TN
K8ZJU	**Stoner**, Beverley "West" M., Ann Arbor, MI
AC9BW	**Lowney**, Bernard "Bo" W., Waverly, NE
KB9COH	**Bishop**, Brenda, Mason, IL
•KA9DOD	**Bleifield**, Robert D., Morris, IL
WB9GCU	**Leatherman**, Bob, Avilla, IN
♦WD9ITQ	**Geiger**, Robert H., Columbia City, IN
KC9LSG	**Anway**, Dorothy, Superior, WI
•W9MLP	**Parrish**, Martin L., Crystal Lake, IL
♦NN9O	**Pape**, Earl E., Decatur, IL
WA9OJC	**Champion**, Norman E., Rochester, IL
♦K9QA	**Lochner**, Richard A., Knox, IN
K9RRX	**Mejia**, Paul A., Kalamazoo, MI
W9RWS	**Smith**, Richard W., Fort Atkinson, WI
W9VCS	**Northern**, Robert, Fishers, IN
N9ZFG	**Sherwin**, Major W., Greencastle, IN
•KØBE	**Heimerl**, Donald A., Madison, MN
KØBZ	**Wamhoff**, Jon R., Longmont, CO
•KØDVZ	**Scholten**, John J., Ames, IA
♦KAØIQT	**Johns**, James R., Jr., Tioga, TX
WØKFS	**Hohlfeld**, David H., Derby, KS
KDØKHC	**Barwick**, William A., Denver, CO
WBØOOL	**Halley**, James A., O'Fallon, MO
WBØSFZ	**Holder**, Roland, Hinton, IA
•WAØSON	**Foster**, Norman D., Liberty, MO
KBØTLC	**Currie**, Jim M., Sac City, IA
•WØTOM	**Brereton**, Thomas F., Colorado Springs, CO
KØWGN	**Thompson**, Judith, Sun City West, AZ
DL6DQW	**Fendler**, Reinhard, Boxdorf, Germany
GM4JJJ	**Anderson**, David, Dunfermline, Fife, United Kingdom
VE6BV	**Frauscher**, Hellmut, Calgary, AB, Canada

♦ Life Member, ARRL

• Former call sign

For information on how to list a Silent Key in *QST*, please visit **www.arrl.org/silent-key-submission-guidelines**.

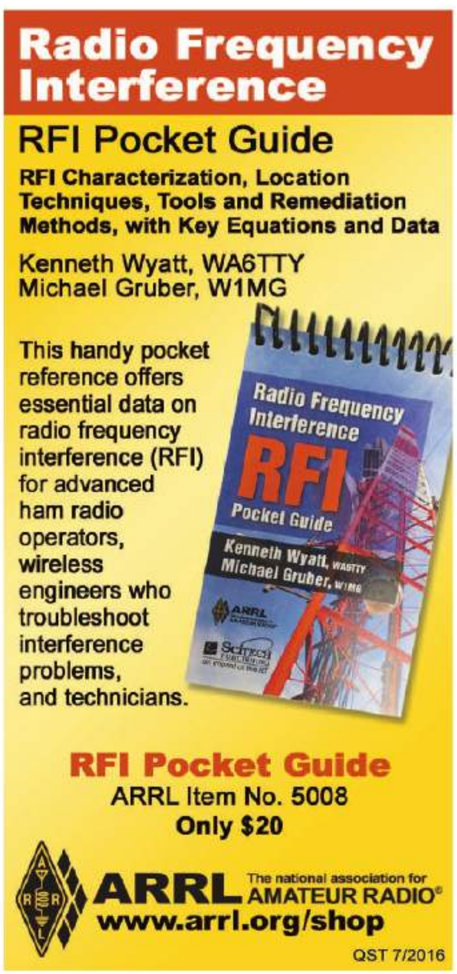
Note: Silent Key reports must confirm the death by one of the following means: a copy of a newspaper obituary notice, a copy of the death certificate, or a letter from the family lawyer or the executor. Please be sure to include the amateur's name, address, and call sign. Allow several months for the listing to appear in this column.

Many hams remember a Silent Key with a memorial contribution to the ARRL Foundation or to ARRL. If you wish to make a contribution in a friend or relative's memory, you can designate it for an existing youth scholarship, the Jesse A. Bieberman Meritorious Membership Fund, the Victor C. Clark Youth Incentive Program Fund, or the General Fund. Contributions to the Foundation are tax deductible to the extent permitted under current tax law. Our address is: The ARRL Foundation Inc., 225 Main St., Newington, CT 06111.


It's Field Day...
is your gear up for
the challenge?
BM-17
HEiL
For more information visit WWW.HEILSOUND.COM


Twice monthly!
ARRL The Doctor is In
Podcast!
ARRL The Doctor is In
Podcast
Available on iTunes, Stitcher, & Blubrry
Sponsored by
DX ENGINEERING
www.DXEngineering.com
ARRL
The Doctor is In
Ham Radio Troubles?
E-mail the Doctor!
doctor@arrl.org
Joel R. Hallas, W1ZR
QST Contributing Editor,
"The Doctor"
Sponsored by
DX Engineering
FREE download on iTunes, Stitcher, Blubrry, and the ARRL website.
www.blubrry.com/arrl_the_doctor_is_in/
ARRL The national association for AMATEUR RADIO®
www.arrl.org/doctor
QS6 2019


Boost your receive audio and hear more clearly..
..with a bhi noise cancelling product!
bhi
DESKTOP
ParaPro EQ20 Audio DSP Range with Parametric Equalisation
- Precise audio tailoring for age related hearing loss
- Fine-tune the audio to maximise your enjoyment
- Simple control of all DSP functions - Mono or stereo
- 4 models: EQ20, EQ20B, EQ20DSP, EQ20BDSP
- Latest bhi DSP noise cancelling technology
If you can't hear it, you can't work it!
DSPKR
New bhi HP-1 folding stereo headphones
10W Amplified DSP noise cancelling speaker - Easy to use controls - 8 DSP filter levels - "Real time" audio adjustment - Suitable for all radios incl' SDR
Dual In-Line
Fully featured amplified DSP noise cancelling in-line module - Mono or stereo input and outputs - Headphone socket - Latest bhi DSP noise cancelling technology - - Suitable for all radios, receivers and SDR - Ideal for DXing and club stations
Compact In-Line
Compact easy to use in-line unit with simple control of all functions
10W amplified DSP noise cancelling speaker - Easy control of DSP filter - Headphone socket - Supplied with user manual and fused DC power lead - Use base station or mobile
- Use mobile or in the shack with phones or a speaker - Latest bhi noise cancelling - 2 x AA cells or 12V DC input
DX ENGINEERING
DXEngineering.com -1-800-777-0703
Manufactured in the UK by bhi Ltd
www.bhi-ltd.com
E & O.E.


Radio Frequency Interference
RFI Pocket Guide
RFI Characterization, Location Techniques, Tools and Remediation Methods, with Key Equations and Data
Kenneth Wyatt, WA6TTY
Michael Gruber, W1MG
This handy pocket reference offers essential data on radio frequency interference (RFI) for advanced ham radio operators, wireless engineers who troubleshoot interference problems, and technicians.
RFI Pocket Guide
ARRL Item No. 5008
Only $20
ARRL The national association for AMATEUR RADIO®
www.arrl.org/shop
QST 7/2016


LARGE Tactical Radio Carrier
Fits: K3s
KPA500
IC-7200
IC-7300
FT-991A
FT-450
FT-857
FT-897
+Others
IC-7300
Tac-Comm.com


WAVECOM© HF/VHF/UHF Decoder
Professional decoder, more than 250 Protocols/ Decoder/ Demodulators, Analyzer, Classifier, Code Check, etc.. W-CODE, W-PCIe/PCI-LAN, W-Classifier, etc.
COMPUTER INT'L, St. Johns, MI 48879
www.wavecomusa.com


"THE COAXMAN"
Quality Coax and Wire for Amateur Radio
Amateur Radio Coax, Baluns, Assemblies of Any Length, Wireman Coax, Antenna Wires & Accessories
www.coaxman.com
orders@coaxman.com
Clear Signal Products, LLC
405-376-9473
TM


PROMOTING THE USE OF TEN METERS SINCE 1962
Ten-Ten International Net, Inc.
Awards - QSO Parties - Special Events - Paperchasing
NETS DAILY (except Sunday) on 28.380 and 28.800 at 1800z
CHECK US OUT ON THE WEB
www.ten-ten.org / www.10-10.org
1349 Vernon Ter San Mateo CA 94402-3331


Dual Band 2M/440 and other models
EmComm, Satellite work, long distance simplex and repeater use.
Elk Log-Periodic Antennas for the Radio Amateur
Antennas
925-330-0049
www.ElkAntennas.com
ELK ANTENNAS


Debco Electronics, Inc.
RF Patch Cables
Coax Crimping & Stripping Tools
RF Connectors
Powerpole Crimpers and Connectors
Full Line of Crimpers & RF Connectors at...
www.Debcoelectronics.com

Free Catalog/Dealers/Manuals Online – Visit: www.hy-gain.com or call toll-free 800-647-1800

The First Choice of Hams Around the World!

hy-gain® HF Rotators

HAM-IV – $689.95

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 – $789.95 with DCU-2
HAM-VII – $839.95 with DCU-3

M V Rotator Specificati	
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 – $844.95

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, $109.95**. Above tower heavy duty mast support. T2X, HAM-IV, HAM-V, HAM-VI. Accepts 1 7/8-2 5/8" OD.

T-2XD2 – $949.95 with DCU-2
T-2XD3 – $1009.95 with DCU-3

ER Rotator Specifi	
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 – $479.95

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 – $579.95 with DCU-2
CD-45D3 – $639.95 with DCU-3

Rotator Speci	
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**

AR-40 – $369.95

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.

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**

New!

Hy-Gain Programmable DCU-3 Digital Rotator Controller

DCU-3 – $479.95

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 – $429.95
Like DCU-3, but less programmable memories. 110 VAC. Order **DCU-2X**, for 220 VAC.

Replace your Yaesu Rotator Controller

YRC-1 – $349.95

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, $429.95. Like YRC-1 and adds 6 memories.

AR-500 Rotator/Controller – $159.95

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.

hy-gain® Antennas, Rotators & Towers 308 Industrial Pk Rd, Starkville, MS 39759 USA
Sales/Tech: (662) 323-9538 ■ **FAX:** (662) 323-5803 Open 8-4:30 CST, Mon.-Fri.

HAMIV_DCU3_052113_QST_040819DS

MFJ-1234 . . . Remotely operate your transceiver from anywhere in the world!

Apple® iPhone connected to RigPi Station Server from anywhere via the Internet

Tuner: RigPi Tuner window with KX3 at 14.025.000 CW.

Keyer: RigPi Keyer controlling onboard K1EL WinKeyer3. CW Macros fill first 2 button rows.

Log: RigPi Log shows worked QSOs.

Spots: RigPi Spots using K1TTT Telnet site as a source. Graphic Bandspotter is on the right.

RigPi Web: W1AW Data from QRZ XML subscription. Rig-Pi also has onboard FCC database.

https://www.mfjenterprises.com/Product.php?productid=MFJ-1234

MFJ-1234
$299⁹⁵

Remotely operate your station! Use any web browser on your mobile phone, iPad, tablet, laptop, desk-top or even Kindle! The MFJ-1234 is as easy to use as 1-2-3.

Use nearly any transceiver with CAT control, old or new, no computer or computer knowledge needed.

Operate all modes SSB, CW, FM, digital -- any transceiver modes.

Control your station from anywhere via the internet using any browser -- radio, rotor, CW, SSB, FM, VoIP, digital modes, logging, spot monitoring, callbook lookups and more.

Here's what else you can do:

Operate digital modes including FT8 and RTTY. WSJT-X, Fldigi are installed.

Look-up calls using the included FCC database or optional QRZ XML subscription.

Monitor DX spots and watch for unworked or unconfirmed calls.

Design, maintain multiple logs. Up-load ADIF logs to ARRL LoTW server.

Send Morse code from a mobile device, keyboard or paddle.

32 user programmable macros gives great control flexibility.

Single-click updating.

Has I/Q Input for SDR radios.

Onboard VoIP server gives outstanding 2-way audio.

Includes email, word processing and spreadsheet programs.

Thousands of Linux programs, including many for ham radio available.

Modify and program *RigPi Station Server*™ (RSS) features using a text editor.

Multi-Operators, Multi-Radios

Use any internet browser on Windows, Mac, Chromebook, Android, iOS, Linux computers, laptops, tablets and phones.

Open as many web pages as you like on one or more devices: iphone, tablets, computers.

One browser can control one radio while a second can control another radio, etc.

Two or more hams from different locations can operate different radios at the same time using one MFJ-1234.

In addition to using a browser, you can use these apps: CommCat Mobile for iOS and CommCat for Windows.

What is the RSS?

***RigPi Station Server™* (RSS)** is a computer system that controls your station and handles on-the-air activities.

It's a *radical* new way of station control using a *server*. It allows multiple users and radios to interact simultaneously using any internet browser.

HARDWARE

RSS is a Raspberry Pi™ computer running Linux and RigPi Keyer, RigPi Audio boards.

RigPi Keyer board uses the K1EL WinKeyer3 IC for keyboard or paddle input.

RigPi Audio board is used for VoIP for remote operations, digital modes and I/Q spectral display (Panadaptor).

RADIO/ROTOR SOFTWARE

RSS radio and rotor control uses Hamlib, a library of over 200 radios and 30 rotors. Update when new radios/rotors are added.

OPTIONS

MFJ-1234MB, $159.95. RigPi box, Raspberry Pi with OS firmware only.
MFJ-1234KB, $69.95. Keyer board.
MFJ-1234AB, $69.95. Audio board.
MFJ-1234SD, $39.95. RigPi Operating system on SD Card.
MFJ-1305RP, $17.95. 5V/3A Pwr Supply.
More Options: *https://www.mfjenterprises.com/Product.php?productid=MFJ-1234*

RigPi TECH SUPPORT

- **Forum** - *https://rigpi.groups.io*
- **Website** - *https://rigpi.net*
- *http://www.mfjenterprises.com/custsupport.php*

Phone: *662-323-0549*

RigPi™ by Howard Nurse, W6HN.
Raspberry Pi™ by Raspberry Pi Foundation.

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.

Add shipping. Prices and specifications subject to change. ©2016 MFJ Enterprises, Inc.
• 1 Year No Matter What™ warranty • 30 day money back guarantee (less s/h) on orders direct from MFJ

MFJ-1234_040819_QST_041619DS

Free Catalog/Dealers/Manuals Online – Visit: www.mfjenterprises.com or call toll-free 800-647-1800

MFJ...the World Leader in Ham Radio Accessories!

MFJ *Cobweb* Antenna

6-Bands: 20/17/15/12/10/6 M...Outstanding Performance!

Restricted space spoiling your operating fun? MFJ Cobweb puts your call back on the map!

This six-band (20, 17, 15, 12, 10, 6 Meters) full half-wave *Cobweb Antenna* is perfect for restricted space or portable operation. Sky-gray fiberglass spreaders and *nearly invisible* wire elements (flat 9 x 9 x 1/2 feet square. 8 pounds), blend in with your surroundings while standing tough against nasty weather.

Outstanding performance! Horizontally polarized for less local noise pickup plus solid gain over verticals will allow you to work DX easily – even on QRP. Omni-directional. No radials needed! Works great at low heights. Low SWR is due to MFJ's exclusive *Spider-Match*™ broadband network. Use lightweight TV hardware to mount on your chimney, balcony, mast.

Low in cost, but big on performance. MFJ *Cobweb Antenna* turns your space problem into a stack of QSL cards from far away places.

MFJ-1836HK34, $129.95. Add-on kit adds 40/30 Meters to MFJ-1835/1835H and MFJ-1836/MFJ-1836H cobweb antennas.

40-6 METER Cobweb

Super Heavy-Duty, 1.5 kW

MFJ-1838 $429.95

***New! Super heavy-duty* 40-6 Meter Cobweb Antenna. Built to survive harsh northern winters, heavy snow, ice and strong winds – has super-strong large diameter fiberglass and heavy-duty 14 gauge stranded hard copper wire. 8-bands: 40, 30, 20, 17, 15, 12, 10, 6 Meters, 1500 Watts. Turning radius: 12 feet, 23 lbs.**

BigStick™

Portable Vertical

Strongest, loudest portable signal on the band!

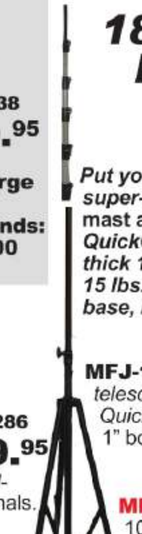
MFJ-2286 $109.95

Rugged stainless steel *17 foot* whip telescopes to *full 1/4 wave* from 20 to 6 Meters – gives you *full-size* performance for stronger, louder signals.

17-feet and ultra low loss, high-Q *air-wound* loading coil gives high efficiency on 30/40 Meters. Low SWR. 1 kW.

Includes: 17 foot whip, (27 in. collapsed), loading coil, counterpoise kit, SO-239 mount for mast up to 1 inch dia. Fits backpacks, suitcases! 2 lbs.

MFJ-2289, $194.95. 40-6M V-Dipole. Full size 20-6M.



18 Foot Telescopic Fiberglass Mast with Tripod

MFJ-1919EX, $169.95.

Put your antennas up high anywhere with this super-strong* 18 foot telescoping fiberglass mast and MFJ-1919 heavy duty steel tripod *QuickClamps™ lower mast to 5 feet. Mast has thick 1/8 inch wall, .75" top, 1.5" bottom dia. 15 lbs. Black steel tripod has braced triangle base, non-skid feet, mast lock.

MFJ-1918EX, $99.95.

MFJ-1918 *tripod with super strong 9.5 foot telescoping fiberglass mast.* 3.8 feet collapsed. *Quick-Clamps*™. Thick 1/8 inch wall, .75" top, 1" bottom diameters. 6.5 lbs.

Tripods Only

MFJ-1919, $99.95, *Large tripod.* Supports 100 pounds. 1.4 inch diameter mast extends 7.8 feet. Collapses to 4.5H x .5D feet. Triangle base spreads to 4.8 feet sides for extra strength. 9.75 lbs.

MFJ-1918, $59.95, *Smaller tripod.* Support 66 lbs. 1" dia. mast. 6 ft. extended, 3.2H x .3D ft. collapsed. Base sides spread to 2.75 ft. weighs 6.75 lbs.

17 Foot

Stainless Steel Telescoping Whip

MFJ-1979, $64.95. Super-strong, super long *17 foot stainless steel* telescoping whip. 27 in. collapsed. 10 sections. 3/8-24 threaded base.
MFJ-1977, $49.95/12ft;
MFJ-1976, $44.95/10ft
MFJ-1974, $39.95/8ft;
MFJ-1972, $15.95/4 1/2ft

MFJ Rotatable Mini Dipoles

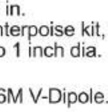
Lightweight, *isolated* mini-dipoles for imited space, temporary or permanent set-up. Rotate to null QRM, noise, direct your signal. 14 ft. long. Use mast up to 1.25" dia. For 40/30/20/17/15/12/10/6 Meters. Order **MFJ-22XX** (insert band in "XX") **$59.95.** 75/60 Meters, $69.95 each.

33 ft. Telescoping fiberglass Mast

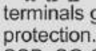
MFJ-1910 $89.95 3.8 feet collapsed, 3.3 lbs. Super strong. Huge 1 3/4 inch bottom section. Flexes to resist breaking. Resists UV. Put up *full size* inverted Vee or vertical in minutes for *full size performance!*

MFJ-1704, $99.95 Heavy duty *antenna switch.* Select 4 antennas or ground. Unused ant. grounded. Lightning protection. Up to 500 MHz. 60 dB isolation at 30 MHz. 2.5 kW. <.2 dB loss.

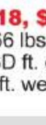
MFJ-1702C, $44.95 Like MFJ-1704 but 2 antennas.



MFJ-1700C, $129.95 *Antenna/ Transceiver Switch* selects 1 of 6 antennas and 1 of 6 xcvrs in any combination. Unused terminals grounded. Lightning protection. 1.8-30 MHz. 2 kW SSB. SO-239s.



MFJ-1701, $89.95 Select 1 of 6 antennas.



MFJ-915, $34.95 Stop *RF* traveling down coax line, painful RF "bites" and erratic operation. 1.5 kW 1.8-60 MHz. 2Wx5H". SO-239s.

MFJ-918, $34.95 True 1:1 Current balun & center insulator forces equal antenna currents in dipole elements.

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.

Add shipping. Prices and specifications subject to change. ©2016 MFJ Enterprises, Inc.
• 1 Year No Matter What™ warranty • 30 day money back guarantee (less s/h) on orders direct from MFJ

MFJ_1836_021417_QST_040819DS

Free Catalog/Dealers/Manuals Online – Visit: www.mfjenterprises.com or call toll-free 800-647-1800

MFJ...the World Leader in Ham Radio Accessories!

MFJ SDR T/R Protection Switch

Turn your SDR into a panadapter to see entire bands on frequency/waterfall displays...

New!

An inexpensive wide-band SDR dongle receiver lets you see entire bands on frequency/waterfall computer displays!

MFJ-1708B-SDR $109.95 **If** you want to know where the activity is, who's generating splatter, what's in the DX window, how wide your audio is or what frequencies are clear, it's all right there! While receiving on your transceiver, MFJ-1708B-SDR switches your SDR to your antenna showing the entire band. On transmit your SDR is switched out and grounded to protect your SDR. PTT and a failsafe RF sense switches MFJ-1708B-SDR. For HF/VHF/UHF. Monitor multiple bands with multiple SDRs and a multi-coupler.

MFJ-1708B-SDR-S, $109.95. SMA connector for your SDR.

MFJ-1708SDR, $89.95. Original model for HF/VHF.

New B series improvements... The original MFJ-1708 series used one relay and wires to connect the SO-239s. The new B-series uses four relays and connectors on a *single* pc board. This gives you > 50 dB isolation at 300 MHz and > 68 dB at 50 MHz. SWR < 1.16:1 at 50 MHz and < 1.75:1 at 450 MHz at the transmit port. Mute output is a selectable short or open to ground. Use "boat anchors" or modern receivers or key a linear amplifier. Receiver input protection prevents overload from nearby high power signals and from receive to transmit. A hybrid splitter on SDR models reduces loading effect and gives > 15 dB isolation between the SDR REC and XCVR ports to reduce interference. The original MFJ-1708 series is still available.

MFJ Low Noise VLF/HF Receiving Loop

Pull weak signals out of static crashes, atmospheric, man-made and power line noise!

Hear signals 500 KHz to 30 MHz cleaner, quieter than ever before! Power line noise disappears. Rotate its figure 8 pattern and its extremely deep null to completely eliminate an interfering signal or greatly peak a desired one. Fully protected state of-the-art Gali MMICs in push-pull gives you a preamp with extremely high dynamic range, low IMD and 25 dB of low noise gain. Excellent performance on strong and weak signals without overload. 36-inch dia. loop. 1-in. OD 6061 aluminum.

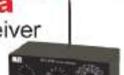
MFJ *wideband* SDR *Discone* Antenna

Receives 25-1300 MHz

MFJ ultra wide-band *Discone* Antenna receives 25-1300 MHz. Perfect for all band SDR reception. Covers 10, 6, 2 Meters, 220 and 440 MHz and 33/23 CM ham bands and everything in between. It is excellent for monitoring multiple bands simultaneously using multiple SDRs and a multi-coupler. Also test any transmitter 50-1300 MHz using a single discone and single coax. Handles 200W. Includes 50 feet coax, stainless steel elements and mounting hardware.

MFJ-1866, $54.95. Like MFJ-1868 but transmits 144-1290 MHz. Coax and mounting hardware not included.

Tuned Indoor SDR Active Antenna



MFJ-1020C $109.95

Make your SDR receiver come alive with HF signals, .3-40 MHz, while rejecting interference with MFJ-1020C *tuneable* indoor active antenna! Gain control, telescoping whip.

Untuned Indoor SDR Active Antenna

MFJ-1022, $73.95. Hear weak, noisy VLF to UHF signals. Noise-less feedback gives excellent low noise reception. Handles strong signals.

Active Outdoor Antenna

MFJ-1024 $169.95 ***World Radio TV Handbook*** says "MFJ-1024 is a *first rate, easy-to-operate active antenna, quiet, excellent dynamic range, good gain, very low noise factor, broad frequency coverage, excellent choice...*" **Outdoor** mounted 54-inch whip/preamp gives maximum signal and minimum noise. Covers .05-30 MHz. **Indoor** unit: 20 dB attenuator, gain control, 2 receiver and 2 antenna switches.

HF SDR Preselector

MFJ-1040C $129.95

Tuneable MFJ-1040C lets you copy weak, noisy SDR signals from 1.8 to 54 MHz. Greatly tunes out and reject out-of-band interference. Up to 20 dB gain. Has gain control. Cascode FET/bipolar transistor gives low noise, high gain without overloading. Switches for 2 antennas and 2 receivers. SO-239s. Has 20 dB attenuator. Automatically bypasses when transmitting or use PTT. 6 1/2W x 2 1/2H x 4D inches.

MFJ LW/MW/SW SDR Preselector/Tuner

MFJ-956 $74.95

Highly rated series-tuned MFJ-956 boosts your desired signals while greatly rejecting interference and preventing serious overload. **Greatly** improves reception 0.15 to 30 MHz. Incredibly effective below 2 MHz. **Super** easy to operate, select band and tune! **Bypass** tuner and ground receiver switch positions. **Compact** 2 x 3 x 4 inches. SO-239 connectors.

MFJ RF Sense Transmit/Receive Switch

MFJ-1708B, $109.95.

Switches your antenna from receiver to transmitter using a relay. Shorts your receiver to ground during transmit. Use RF sensing with adjustable delay or PTT line. Has selectable open/short mute.

Auto switch XCVR between 2 antennas

MFJ-1707B, $109.95.

Switches switches separate transmit and receive antennas on transceivers with only one antenna port. *Example*: Efficient 75M dipole for XMIT and MFJ-1708B low noise MFJ loop for receive -- *no static crashes*!

MFJ

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.

VISA PayPal

Add shipping. Prices and specifications subject to change. ©2016 MFJ Enterprises, Inc.
• 1 Year No Matter What™ warranty • 30 day money back guarantee (less s/h) on orders direct from MFJ

MFJ_1708B-SDR_032818_040819DS

Free Catalog/Dealers/Manuals Online – Visit: www.mfjenterprises.com or call toll-free 800-647-1800

MFJ...the World Leader in Ham Radio Accessories!

MFJ *Low-Noise Receiving* Loop

Work DX and ragchew through horrendous noise!

Pull weak signals out of static crashes, atmospheric, man-made and power line noise!

Hear 50 KHz to 30 MHz signals clearer than ever and stations you never knew were there. Power line noise and static just disappears.

The MFJ-1886 drastically reduces noise and interference by receiving the magnetic field and rejecting the electric field. Its figure 8 pattern and deep null can be rotated to completely eliminate an interfering signal or greatly peak a desired one.

Excellent antenna and preamplifier balance gives a very deep null. An inexpensive antenna rotator can position this null to eliminate interference.

State-of-the-art Gali MMICs in push-pull give you a preamp with extra wide dynamic range, low IMD and 25 dB of low noise gain. You'll get excellent performance on both strong and weak signals without overload.

Fully protected preamplifier -- magnetically coupled voltages up to 40 Volts and capacitively coupled voltages up to 20 Volts will not damage the preamplifier. The output is protected from transmission line surges induced by distant lightning.

Use it anywhere, inside or outside. Your 50 Ohm coax and included Bias-Tee provides signal and power.

Ruggedly built to withstand extreme weather. 1-inch OD diameter 6061 aluminum tubing. 36-inch loop diameter. $2^1/_2$ pounds. SO-239 connector. Use masts up to $1^3/_4$ inches. **MFJ-1886TR** has built-in T/R switch, Bias-Tee.

Antenna Rotator

AR-500/X
$159.95

Perfect for MFJ1886/1786/1788 loop, VHF/UHF, small HF beams, TV, FM antennas.

Weather-proof one piece cast aluminum housing with precision all metal gears, steel thrust bearings and automatic braking. Includes rotator, controller, remote control, clamps, hardware. Remembers up to 12 directions! Digitally displays position. Order AR-500X for 220VAC.

Wipe out RFI

MFJ-1026
$219.95

Wipe out RFI, noise, interference from any direction at any frequency with a 60 dB notch before it gets into your receiver!

Eliminate power line noise, fluorescent lamps, light dimmers, computers, TVs, lightning, motors, industrial processes.

Null out QRM on rare DX and work him! Null out local ham or AM station to prevent receiver overload. Works on SSB, AM, CW, FM, digital from BCB to lower VHF.

Plugs between antenna and transceiver. 12 VDC, 110 VAC with MFJ-1312D, $17.95.

MFJ *Super High-Q™ Transmitting* Loop Antennas

MFJ 36-inch diameter transmitting loop antenna lets you operate 10-30 MHz continuously including WARC bands!

Ideal for limited space, HOA.

Work DX with low angle radiation and local close-in contacts with high angle radiation when mounted vertically. 150 watts.

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

World's *most efficient small loop antenna has all welded construction, welded butterfly capacitor with no rotating contacts, large 1.050 inch diameter aluminum radiator – 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 ultra-violet inhibitor.

Cover 40-15 Meters.
MFJ-1788, $529.95.
Like MFJ-1786 but covers 40-15 Meters continuous. Includes remote control.

Portable Loop

MFJ-1780,
$349.95.

Box fan loop with carrying handle, 24 x 24 x $5^3/_4$".
20-10 Meters continuous, 150 Watts. Fast/slow tune remote control. Highly efficient all-welded construction

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.

QST QuickStats

Online QuickStats Poll Results for January 1 through February 1, 2019.
Get on the web and vote today at **www.arrl.org/quickstats**!

Did you participate in ARRL Field Day in 2018?

Yes. 53%
No. 47%

If you operated during ARRL Field Day last year, were you alone or with a group?

Alone. 13%
With a group. 40%
I didn't operate Field Day last year. 47%

Have you begun planning for ARRL Field Day 2019?

Yes. 48%
No. 32%
I don't intend to participate in Field Day this year. 20%

[Robert Hamrick, WA4RH, photo]

If you've started making plans for this year, will you operate solo or with a group?

With a group. 42%
Solo. 6%
I haven't made plans yet. 32%
I don't intend to participate in Field Day this year. 20%

Free Catalog/Dealers/Manuals Online – Visit: www.mfjenterprises.com or call toll-free 800-647-1800

MFJ...the World Leader in Ham Radio Accessories!

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 $94.95

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 $74.95

6 Coax

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

MFJ-4601 $64.95

4 Balanced Line, 2 Coax

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

MFJ-4600 $84.95

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.

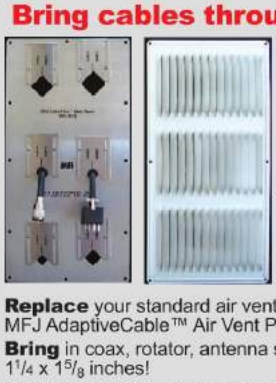
MFJ-4604 $104.95

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 $169.95

Bring cables through the eave of your house



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

$29.95

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

$16.95

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
$39.95

Bring nearly any cable -- rotator, antenna switch, coax, DC/ AC power, etc. -- through walls without removing connectors (up to $1^1/_4$x$1^5/_8$ 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 2Cables
$29.95

MFJ-4611
For 1 Cable
$16.95

Free Dealer/Catalog/ Manuals/Instructions – Visit: www.mfjenterprises.com or call toll-free 800-647-1800

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.

VISA Discover PayPal

Quicksilver Radio

WHY CRIMP?

- ✓ Solid mechanical & electrical connection
- ✓ No melted dielectric
- ✓ Connect all the braid, not just a few strands
- ✓ High reliability
- ✓ More info on our website

Crimp-On Connectors

Excellent quality, no bargain basement stuff here. Adapters & connectors for most applications.

Powerpole Connectors

The standard for DC power connections. Power distribution, pre-built cables, mounts & more.

HAMMO-CAN™ Go Box

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!

Play-Series™ System

Check out our new Play-Series™ USB modules. New body & LED colors & styles. Aluminum body available. Spruce up your Ham shack, car, etc.

Large variety of Powerpole cables for all of your needs.

Power Plugs & Cables for Most Radios

Coax & Connector Weather Protection

Dayton Hamvention Booths:
3503-3504-3505-3506-3603-3604-3605-3606

www.qsradio.com


Quicksilver Radio
Low Loss Coax
Poor quality coax can easily eat up half of your signal or more. We carry a wide variety of high quality low loss feedline. And it's 100% USA made!
DAYTON HAMVENTION
Make sure to see our huge display in Marconi building 3 at the new Hamvention location. We will have all the great ham radio products you've come to expect from us.
Coax Crimp Kit
The Complete Coax Strip, Crimp & Installation Kit. For all common cables.
HF, VHF & UHF Antennas
Red & Black Power Wire #22 through #6
AC & DC Volt & Amp Meters
Dacron Antenna Rope, Antenna Wire and Accessories
Digital Temperature Sensors
USB Microscopes
Up to 1000X magnification. Capture still images and record live video. Built in LED Lighting. New models available!
Anderson Powerpole Mounts
Soldering Irons, Stations and Supplies
Test Equipment For DC, AC and RF
Great prices on great irons. Many models to choose from.
The Best in Ham Radio Products from Quicksilver Radio. Safe and Secure Ordering at:
www.qsradio.com
Follow us on Facebook

Ham Ads

Please contact the Advertising Department at 860-594-0255 or hamads@arrl.org for further information or to submit your ad.

Before considering a ham ad please read.

1. Advertising must pertain to products and services which are related to Amateur Radio.

2. The Ham-Ad rate for commercial firms offering products or services for sale is $2.25 per word. Individuals selling or buying personal equipment: ARRL member 1.00 per word. Non-ARRL member $1.50 per word. **Bolding** is available for $2.50 a word. Prices subject to change without notice. You may pay by check payable to the ARRL and sent to: Ham-Ads, ARRL, 225 Main St., Newington, CT 06111. Or, you may pay by credit card sending the information by fax to 860-594-4285 or via e-mail to hamads@arrl.org. The credit card information we need is: the type of credit card, the exact name that appears on the credit card, the credit card number, the expiration date and the credit card billing address.

3. Remittance in full must accompany copy since Ham-Ads are not carried on our books. Each word, abbreviation, model number and group of numbers counts as one word. Entire telephone numbers count as one word. No charge for postal Zip code. No cash or contract discounts or agency commission will be allowed. Tear sheets or proofs of Ham-Ads cannot be supplied. Ads submitted in writing should be typed or printed clearly on an 8 1/2" X 11" sheet of paper.

4. Closing date for Ham-Ads is the 15th of the second month preceding publication date. No cancellations or changes will be accepted after this closing date. Example: Ads received December 16th through January 15th will appear in March *QST*. If the 15th falls on a weekend or holiday, the Ham-Ad deadline is the previous working day. Please contact the Advertising Department at 860-594-0255 or hamads@arrl.org for further information or to submit your ad.

5. No Ham-Ad may use more than 200 words. No advertiser may use more than three ads in one issue. Mention of lotteries, prize drawings, games of chance etc is not permitted in *QST* advertising.

6. New firms or individuals offering products or services for sale must check with us to determine if a production sample (which will be returned) should be submitted for examination. Dealers are exempted, unless the product is unknown to us. Check with us if you are in doubt. You must stand by and support all claims and specifications mentioned in your advertising.

The publisher of *QST* will vouch for the integrity of advertisers who are obviously commercial in character and for the grade or character of their products and services. Individual advertisers are not subject to scrutiny.

The American Radio Relay League does not discriminate in its advertising on the basis of race, color, religion, age, sex, sexual orientation, marital status or national origin. The League reserves the right to decline or discontinue advertising for any other reason.

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.

QST Ham Ads on the Web
Updated Monthly!

www.arrl.org/ham-ad-listing

Club/Hamfests/Nets

CW INSTRUCTION via internet video conference classes. VISIT longislandcwclub.org

Friend of Bill W? HAAM Net daily 10:30 CT. Internet mode, download and install qsonet.com Find us at 21.350MHz

FRIEND OF BILL W?? http://www.qsl.net/haam HF Net 12:30 Eastern Sat 14.290, Sun 14.340 Mon-Fri 14.316 QSO Net 11:30 Eastern 21:350

MARCO Medical Amateur Radio Council. Professionals enjoying ham radio. Free newsletter & info: secretary@marco-ltd.org

NYCDXA NYC DX Assoc. To join email subscribe@nycdxa.org

Property/Vacation/Rentals

A DX Apartment available in VP9 with rigs and antennas. Email: ed@vp9ge.com for details.

AL7HG helps hams buy/sell a QTH anywhere in Florida. Now with Pebble Pointe Realty. Email: Kaiserdr@yahoo.com, (352)321-0364

COLORADO CHALET with ham gear for weekly rental, www.lostcreekcabin.com. WØLSD, Buena Vista, CO.

HAM QTH FOR SALE Nice 3/2 home with separate custom ham shack, crank up tower, beams. Southern Nevada location $179K. RadioRanchNV.com 702-803-4862

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

HAWAII DX RENTAL STEPP-IRs KH6RC. 808-929-7101 info@leilanibedandbreakfast.com

Need a NEW QTH on Florida's east coast? Contact Greg Bowman, N4EN, Realtor Associate, Pioneer Properties USA, Melbourne FL. 321-305-9142

Operate N4USA in Virginia's high Blue Ridge Mountains www.n4usa.com

WA2PIF - Waterfront Home in New Smyrna Beach, FL. Well maintained 3 Bd/3Bth pool home with over 3400 sq. ft. Includes complete Antennas and Shack. For more info visit QRZ.com. View listing/photos on Zillow.com. Contact Lisa DiSario, Realtor (386) 295-1131. Lisadisario1@gmail.com/ Website:LisaDiSario.com Oceans Luxury Realty Full Service, LLC.

www.peidxlodge.com

Antique/Vintage/Classic

ANTIQUE WIRELESS ASSOCIATION - the largest international organization for historic radio enthusiasts. Publishes the quarterly AWA Journal and annual AWA Review on all aspects of collecting and history of communications. AWA produces the famous annual AWA Convention and sponsors the world renowned Antique Wireless Museum. Only $35/year USA, $40/year elsewhere. Antique Wireless Association, PO Box 421, Bloomfield, NY 14469. Website: http://www.antiquewireless.org

Six Decades of Amateur Radio www.kk4ww.com

The Society of Wireless Pioneers archive (www.SoWP.org), documenting wireless and radio since 1900, is now live --and growing-- as a program of the California Historical Radio Society (CHRS). The SoWP archive features SOS and CQD calls, West Coast, East Coast and world marine wireless, spark and arc transmitters, etc. with lols of Bill Marconi, Lee DeForest, and the wireless telegraphy radio pioneers' photographs and memories. It's radio history, the real deal, at your fingertips. Take a look! 73 de CHRS and its archivists (K6VK & KJ6SBR).

Vintage Radio, Ham Radio and Military Radio Repair. www.mcveyelectronics.com 845-561-8383

QSLCards/Call Sign Novelties

CALLSIGN NAME CARDS Deputypatch.com

CALLSIGN PLAQUES www.HamPlaques.com

CallSign Stuff www.HamQRU.com KTØMMY

Engraving, **QSL's,** Memo's, Stamps, Plaques since 1962, Full Service Printing. Samples. WA2WAO@CornerPress.com www.CornerPress.com 425 286-5952

Get **Top Quality Full Color UV-Coated QSL Cards** direct from the printer. Chester QSL Cards is now Star Cards, Inc. Call (800) 748-7089 for info or visit www.star-cards.net

Log QSOs, Create, & E-Mail PDF QSL Cards. FREE. No ads. hamradiolog.com

WWW.THESIGNMAN.COM
RICK@THESIGNMAN.COM / 225.757.1545

General

#1 AMATEUR CALLSIGN DVD! HamCall contains over 2,400,000 world-wide callsigns, 10,400,000 archive callsigns. Supported by most logging programs. Six FREE monthly internet updates and HamCall.net Gold online access included. Visa/MC/Discover 800-282-5628 http://hamcall.net

2019 USA Veteran Patriots Project. Send "Thank-you" on QSL/Postcard to (Service Branch) % K4CLA, 562 Oak Dr. Lexington SC 29073-9536

All kinds aluminum antenna plates, hugs, u-bolts… **http://stores.ebay.com/yz4iz0**

Amateur and top line audio equipment repair/test/calibration. "Kenwood/ICOM/Yaesu/ Pioneer/Technics/Akai" Charles AJ4UY - email: seecumulus@gmail.com

AMSAT - WHO DECIDES THE FUTURE OF AMATEUR RADIO IN SPACE? YOU DO! Since 1969 AMSAT has pioneered dozens of spacecrafts that have brought operating enjoyment to thousands. Your membership in AMSAT will support exciting projects planned for launch in the years to come. In addition, you'll receive the bimonthly AMSAT Journal and substantial discounts on software distributed by AMSAT. Join now! From the US call toll free at (888) 322-6728. From all other locations call 1-301-822-4376. Or visit the AMSAT Web site at www.amsat.org AMSAT®, 10605 Concord St, #304 Kensington MD 20895, USA.

ATTENTION YAESU-FT 10218,000hrs, 25yrs, 800+ FT-102's Repaired. Have all parts. AM and Roofing Filters available. 25/hr, parts at cost. 954-961-2034 NC4L www.w8kvk.com/nc4l

Beacons 10W for bands 28-903 MHz aa7dj@arrl.net

COAXIAL CONNNECTORS, ADAPTERS & CABLE. HIGH QUALITY, LOW COST, HAM FRIENDLY. **WWW.RFSUPERSTORE.COM**

GAIN the EDGE with NARTE Certification – NARTE gives you the competitive edge with individual certification in Electromagnetic Compatibility, Electromagnetic Discharge Control and Telecommunications. Industry-recognized certification required or desired by more than 400 corporations nationwide. Call 1-800-89-NARTE or visit www.narte.org. NARTE offers the premier EMC/EMI, ESD, Telecommunications and Wireless certification to professional technicians and engineers.

Get the F.C.C. "Commercial" Radiotelephone License! Fast, inexpensive home study course. Command Productions. **www.LicenseTraining.com** Free info: (800) 932-4268

GINPOLE KITS-ALL TYPES WWW.W9IIX.COM 708-337-8172

Glen Martin Hazer Tower Trams & Roof Top Towers. Same Day Shipping. www.antennapartsoutlet.com

HAM KITS for sale at www.HecKits.com L/C Meter, SWR Bridge, ESR Meter, 2-Tone Gen, FET DIP Meter.

Help with International Goodwill www.n4usa.org

ISOTRON ANTENNAS FOR 160 - 6 METERS! Efficient, rugged and resonant. Please visit **WWW.ISOTRONANTENNAS.COM.** wd0eja@isotronantennas.com 719/687-0650.

KB6NU'S "NO NONSENSE" LICENSE STUDY GUIDES have helped 1000's get their first license and upgrade to General or Extra. They can help you, too. KB6NU.COM/STUDY-GUIDES/

LEARN CODE by Hypnosis, www.success-is-easy.com 561-302-7731

LED DESK SIGN - www.Gifts4Hams.com

Limited Time! Handwritten Callsign/Name/Both personalized 3" x 1/8" unstained wood Round2it. $5. Send order to:K4CLA 562 Oak Dr. Lexington SC 29073-9536

MicroLog-By-WA0H .. Easy to use logging program .. Free download .. **www.wa0h.com**

Preamplifiers LNA for 50-1296 NHz. aa7dj@arrl.net

PRINTED CIRCUIT BOARDS for projects shown in QST, QEX, HR, ARRL HB, 73 and more. Custom boards available. FAR Circuits, 18N640 Field Ct, Dundee, IL 60118; fax/phone 847-836-9148; www.farcircuits.net; mail@farcircuits.net

RF CONNECTORS & GADGETS - Parts - Products and More! www.W5SWL.com

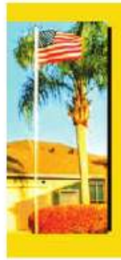
Rohn Tower, telescoping poles, tripods and antenna parts delivered to your door. **www.antennapartsoutlet.com**

Tactical Portable Accessories for Yaesu 817ND, 857D, 897D, 891, 991A, ICOM 7300, 7200, 7000, 706/703. W0MSN www.portablezero.com

Vibroplex Bug s/n 1121124 (1939) Contact W5SQA blinktex@gmail.com

We are putting FUN back into ham radio! http://HamRadioFun.com

Xcellent **Amateur** and **Monitor Logging** from **DXtreme!** Click **www.dxtreme.com**



FLAGPOLEANTENNA.COM

HOA Approved DX FLAGPOLE Real DX 80-6M No Radials!

Free Shipping in USA!
435-200-4902

Advertising Department Staff:

Janet Rocco, W1JLR, Advertising Sales Manager
Lisa Tardette, KB1MOI, Account Executive
Diane Szlachetka, KB1OKV, Advertising Graphic Design

QST Index of

Your Customers are Reading...QST!

If your company provides products or services of interest to our Members, please contact the ARRL Advertising Department today for information on building your business.

Support those who support ARRL! Please patronize our ARRL Advertisers.

Contact Information:

Toll Free: 800-243-7768
Fax: 860-594-4285
E-mail: ads@arrl.org
Web: www.arrl.org/ads

Additional advertising information is available on the web at:
www.arrl.org/ads

Advertisers

QST Advertising Deadlines:

Issue	Reservation Date	Materials Due Date
July 2019 *QST*	Friday, May 10, 2019	Wednesday, May 15, 2019
August 2019 *QST*	Monday, June 10, 2019	Thursday, June 13, 2019

For links to the Web sites of all ARRL advertisers, visit www.arrl.org/shop-our-advertisers

Good Times Await
BridgeCom Makes DMR Easy
AnyTone
ExSprgs BYRG
BYRG
Menu Zone List
DMR Plug N' Play Package
Programmed with the most popular talk groups on Brandmeister and your state-wide talk group.
Visit BridgeComSystems.com/GOODTIMES for full details, and watch our video to learn more.
PTT
NEW
AnyTone AT-D878UV PLUS ®
(Bluetooth module included)
Bluetooth Push-to-talk Button
DVMEGA Hotspot
102 NE State Route 92 Hwy
Ste C
Smithville, MO 64089
816-532-8451
sales@bridgecomsystems.com
www.BridgeComSystems.com
BridgeCom SYSTEMS

KENWOOD

3rd IMDR **110** dB*
RMDR **122** dB*
BDR **150** dB*

Performance Exceeding Expectations.

The most happy and sublime encounters happen in the worst circumstances and under the harshest conditions.

There are enthusiasts who know this all too well because of their love of HF radio.

Results born of certainty and not circumstance. Delivered through impeccable performance. This is our offering to you.

"The Kenwood TS-890S has the highest RMDR of any radio I have ever measured."
- Rob Sherwood - NC0B - December 2018

HF/50MHz TRANSCEIVER
TS-890S
NEW

Top-class receiving performance

3 kinds of dynamic range make for top-class performance.

- Third order intermodulation Dynamic Range (3rd IMDR) 110dB*
- Reciprocal Mixing Dynamic Range (RMDR) 122dB*
- Blocking Dynamic Range (BDR) 150dB*

*Values are measured examples. (2kHz spacing:14.1 MHz, CW, BW 500 Hz, Pre Amp OFF)

- Full Down Conversion RX
- High Carrier to Noise Ratio 1st LO
- H-mode mixer

4 kinds of built-in roofing filters

500Hz / 2.7kHz / 6kHz / 15kHz (270Hz Option)

7 inch Color TFT Display

- Roofing frequency sampling band scope
- Band scope auto-scroll mode
- Multi-information display including filter scope

Clean and tough 100W output

Built-in high-speed automatic antenna tuner

32-bit floating-point DSP for RX / TX and Bandscope

*: 2 kHz spacing measurement standard - Receiver frequency 14.2 MHz, MODE CW, BW 500 Hz, PRE AMP OFF

Customer Support: (310) 639-4200

www.kenwood.com/usa

ISO9001 Registered
JVCKENWOOD Corporation

ADS#02019