



ARRL

The national association for AMATEUR RADIO®

April 2019

www.arrl.org

DEVOTED ENTIRELY TO AMATEUR RADIO

Annual Antenna Featuring Winners of

Featuring Winners of the 2018 QST Antenna Design Competition

QST Reviews

Xiegu Communication X5105 HF/6 Meter QRP Transceiver

Antenna Disconnectors from Paradan and INRAD

Heil Parametric Receive Audio System and Powered Speaker

Mortty Morse Code and RTTY Keying Interface Kit

DIGITAL FEATURE



53 | See our Video Review of the Xiegu Communication X5105 HF/6 Meter QRP Transceiver.

The Conclusive Choice

2- Intuitively grasp changes in the strength of the signals

3DSS (3-Dimensional Spectrum Stream)

Having an informative Waterfall display is one of the advantages of SDR technology. The FTDX101 utilizes our sensational newly developed 3DSS (3-Dimensional Spectrum Stream) system in addition to a conventional Waterfall display that flows from the top to the bottom.

The 3DSS display is a remarkable completely new system that displays the constantly changing band conditions in three dimensions (3-D) with the frequency as the horizontal axis (X axis), the signal strength as the vertical axis (Y axis), and the time axis as the Z axis. The operator can effectively view the constant changes in a signal's strength as the signal flows to the back of the screen giving you a sensation of traveling in Time Space.

The 3DSS exhibits a colorful easily viewed presentation that contains the outputs from both the Narrow band SDR and the Direct sampling SDR within one common screen. The display color of each SDR output can be selected to please the eye of each individual FTDX101 user. The operator can effectively see the close-in QRM situation from the Narrow band SDR output while at the same time easily observe activity across the whole band from the Direct sampling SDR output – On the same screen at the same time.





3DSS (3-Dimensional Spectrum Stream)



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.



C4FM/FM 144/430 MHz Dual Band 5W Digital Transceiver

FT-70DR

《 700 mW Loud and Clear audio, Commercial Grade Specifications >





C4FM/FM 144/430 MHz Dual Band 5 W Digital Transceiver

FT2DR

《Improved 66 ch GPS receiver included >>

C4FM Digital Pursuing Advanced Communications



C4FM/FM 144/430 MHz Dual Band 50 W Digital Transceiver

FTM-100DR

« Improved 66 ch GPS receiver included »



C4FM/FM 144 MHz 65 W Digital Transceiver

BING3200DR

« Genuine 65 Watts High Power »



C4FM/FM 144/430 MHz Dual Band Dual Receive Digital Repeater





C4FM/FM 144/430 MHz Dual Band 50 W Digital Transceiver

FTM-7250DR

《 Heavy Duty 50 Watts High Power 》



CW/SSB/AM/FM/C4FM HF/50/144/430 MHz Wide-Coverage 100 W All Mode Transceiver (144/430 MHz: 50 W)

FT-991 A

« Real-Time Spectrum Scope included »



C4FM/FM 144/430 MHz Dual Band 50 W Digital Transceiver

FTM-400XDR

« Improved 66 ch GPS receiver included »



C4FM/FM 430 MHz 55 W Digital Transceiver

BING3207DR

《 Heavy Duty 55 Watts High Power 》

System Fusion II Supports All C4FM Portables and Mobiles

· Firmware updates will enable System Fusion II compatibility with all existing C4FM products.



ping You in Touch Around the Globe



B *6-Band* Beam

Small Footprint - Big Signal

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

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

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

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

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

MA-5B, \$499.95. Like MA-6B but five bands: 20/17/15/12/10 Meters. 12 and 17 Meters is a single element trapped dipole.

See cushcraftamateur.com for gain figures.

& 20 Meter Tribander Beams

599.95

Only the best tri-band antennas become DX classics, which is why the Cushcraft World-Ranger A4S, A3S, and A3WS go to the head of the class. For more than 30 years, these pace-setting performers have taken on the world's most demanding operating conditions and proven themselves every time. The key to success comes from attention to basics. For

example, element length and spacing has been carefully refined over time, and high-power traps are still hand-made and individually tuned using laboratory-grade instruments. All this attention to



detail means low SWR, wide bandwidth, optimum directivity, and high efficiency - important performance characteristics you rely on to maintain regular schedules, rack up impressive contest scores, and

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

The 3-element A3S/A3WS and 4-element A4S are world-famous for powerhouse gain and super performance. **A-3WS**, **\$499.95**, 12/17 M. **30/40** Meter add-on kits available.

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



gives incredible

worldwide DX.

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

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

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

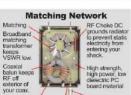
Use full 1500 Watts SSB/CW when the going gets tough to break through pileups/ poor band conditions.

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

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

Rugged Construction: Thick fiberglass insulators,

all stainless steel hardware and 6063 aircraftaluminum tubing is double or triple walled at key stress points to handle anything Mother Nature can dish out.



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

R8, \$539.95. Like R9 antenna but less 75/80 Meters.

R-8TB, \$79.95. Tilt-base lets you tilt your antenna up/down easily by yourself to work on.

R-8GK, \$59.95. Three-point guy kit for high winds.



Cushcraft Dual-Band Yagis





One Yagi for Dual-Band FM Radios

Dual-bander VHF rigs are the norm these days, so why not complement your FM base station with a dual-band Yagi? Not only will you eliminate a costly feed line, you'll realize extra gain for digital modes like high-speed packet and D-Star! Cushcraft's A270-6S provides three elements per band and the A270-10S provides five for solid point-to-point performance. They're both pretuned and assembly is a snap using the fully illustrated manual.

Cushcraft Famous Ringos Compact FM Verticals



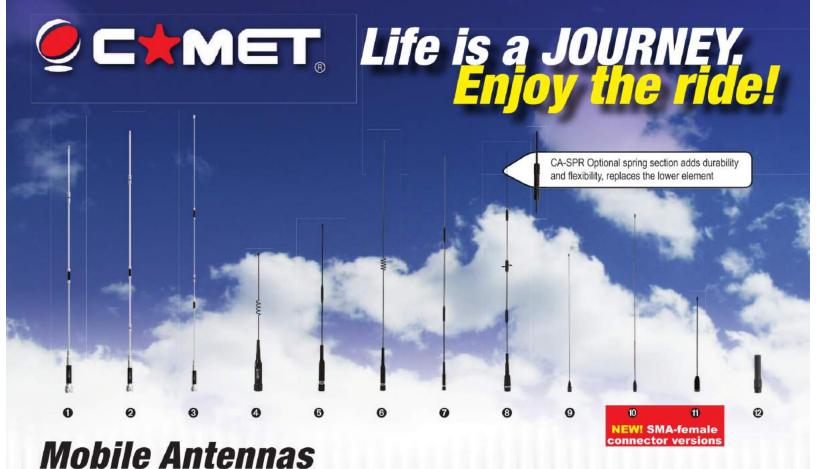
W1BX's famous Ringo antenna has been around for a long time and remains unbeat-en for solid reliability. The Ringo is broadbanded, lightning protected, extremely rugged, economical, electrically bullet-proof, low-angle, and more -- but mainly, it just plain works! To discover why hams and commercial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

Your New MFJ 2017 Ham Radio Catalog is HERE!

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O C★MET, CSB-750A DUAL-BAND 2M/440MHz w/FOLD-OVER

2M: 1/2 wave • 440MHz: 5/8 wave x 2 • VSWR: 1.5:1 or less • Length: 42" • Conn: PL-259 • Max. Pwr: 150W

② C★MET. CSB-770A DUAL-BAND 2M/440MHz w/FOLD-OVER

2M: 5/8 wave center load • 440MHz: 5/8 wave x 2 center load • VSWR: 1.5:1 or less • Length: 51" • Conn: PL-259 • Max Pwr: 150W

② C★MET. CSB-790A DUAL-BAND 2M/440MHz w/FOLD-OVER

2M: 7/8 wave center load • 440MHz: 5/8 wave x 3 center load • VSWR: 1.5:1 or less • Length: 62" • Conn: PL-259 • Max Pwr: 150W

○ C★MET, B-10/B-10NMO DUAL-BAND 2M/440MHz

2M: 1/4 wave • 440MHz: 1/2 wave • Length: 12" • Conn: B-10 PL-259, B-10NMO - NMO style • Max Pwr: 50W

⑤ C★MET SBB-2/SBB-2NMO DUAL-BAND 2M/440MHz

2M: 1/4 wave • 440MHz: 5/8 wave center load • VSWR: 1.5:1 or less • Length: 18" • Conn: SBB-2 PL-259, SBB-2NMO - MNO style • Max Pwr: 60W

□ ★MET, SBB-5/SBB-5NMO DUAL-BAND 2M/440MHz w/FOLD-OVER

2M: 1/2 wave • 440MHz: 5/8 wave x 2 • Length: 39" • Conn: SBB-5 PL-259, SBB-5NMO - NMO style • Max Pwr: 120W

② C★MET SBB-7/SBB-7NMO DUAL-BAND 2M/440MHz w/FOLD-OVER

2M: 6/8 wave • 440MHz: 5/8 wave x 3 • Length: 58" • Conn: SBB-7 PL-259, SBB-7NMO - NMO style • Max Pwr: 70W

⊕ C★MET, CA-2X4SR/CA-2X4SRNMO WIDE-BAND 140-160MHz 435-465MHz w/FOLD-OVER

2M: 5/8 wave • 440MHz: 5/8 wave x 3 • Length: 40" • Conn: CA-2x4S PL-259, CA-2x4SRNMO NMO style • Max Power: 150W

□★MET, BNC-24 DUAL BAND 2M/440MHz HT ANTENNA

RX range: 100-1200MHz • Length: 17" • SuperFlex featherweight whip • Conn: BNC

□ C★MET, SMA-24 NEW SMA-24J DUAL BAND 2M/440MHz HT ANTENNA

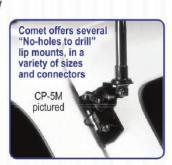
RX range: 100-1200MHz • Length: 17" • SuperFlex featherweight whip • Conn: SMA-24: SMA-male / SMA-24J: SMA-female

⊕ C★MET, SMA-503 NEW SMA-503 J DUAL BAND 2M/440MHz HT ANTENNA

RX range: 100-1200MHz • Length: 8.75" • Conn SMA-503: SMA-male, SMA-503J: SMA-female

@ Maidol MH-209, MH-209SMA DUAL BAND 2M/440MHz HT ANTENNA

Length: 3" • Conn: MH-209 BNC, MH-209SMA: SMA-male • Soft rubber cover, good performance in a small package!



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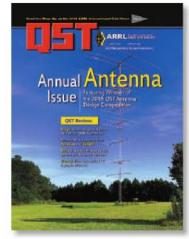
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www.arrl.org/qst-author-guide email: qst@arrl.org



Our Cover

John Small, W2VP, wanted to retire with the Amateur Radio antennas of his dreams, so he installed this 150-foot rotating tower at his home in Byron, Georgia, which graces the cover of *QSTs* annual Antenna issue. His labor of love took nearly a year to design and build. The tower supports a four-element 40-meter Yagi antenna, three triband Yagis for 20, 15, and 10 meters, two Yagis for 17/12 meters, and a 6-meter Yagi. All antennas were designed and built by JK Antennas. John Small, W2VP, photo]







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600 Watts to Mid Size Amps

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- 1.8 to 54MHz
- . 600W SSB / 200W Digital





AT-200PROIL

200 Watts Desktop

- Tunes 10:1 SWR
- · 2 Year Warranty
- . 250W SSB / 100W Digital

Desktop

Stand alone desktop tuner - works with most 100W HF radios.



AT-100PROII

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- · Auto / Semi-Auto Mode
- · 125W SSB / 30W Digital

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- · RBA 4:1 BALUN
- RBA 1:1 BALUN
- 200W SSB

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Designed for portable and low power applications - zero current draw once tuned.

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- 125W SSB/30W Digital



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- 10:1 SWR
- · 125W SSB/30W Digital

Z-817

- FT-817/818 Compatible
- · Operates on 4 AAs
- 20W SSB/5W Digital

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Tuner with built in Yaesu/antenna tuner interface.



YT-1200

- · 2000 Memories
- For FT-991A, FTdx-1200, FTdx-3000, FT-450 and FT-950
- · 125W SSB/30W Digital



YT-100

- · 2000 Memories
- For FT-100, FT-857 and FT-897
- · 125W SSB/30W Digital

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Remote tuners mounted at or near the feedpoint minimize coax SWR losses.

- · Includes Controller/Bias T
- · Control Over Coax
- . 600W SSB/200W Digital for RT-600
- 125W SSB/30W Digital for RT-100



RT-600 Shown

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W(IR)ELESS

NEW FROM STEPPIR!

No control cable between the operating room and antenna!

The all new SteppIR W(IR)ELESS remote driver board uses radio links to replace control cable normally required to operate the antenna. The radio link uses frequencies that operate at line-of-sight (2.4 gHz). A transmitter board is added to the OptimizIR or SDA 100 electronic controller, and the W(IR)ELESS remote board is placed at or near the antenna site.

Typical SteppIR control cable installations are either above ground or below ground. In above ground applications, the cable is usually resting on the ground or is routed in some other manner -and can be susceptible to damage from weather, nuisance animals, and of course, humans. In below ground applications, the control cable normally requires a conduit system to be installed in which to route the cable, which can be time consuming and expensive. With the W(IR)ELESS board, the control cable is eliminated from the radio operating room to the power source. A power and ground source is required for the W(IR)ELESS board, typical Yagi installation places the W(IR)ELESS board at the base of the antenna tower, with a short run of control cable to get from the W(IR)ELESS board, up to the antenna elements. The W(IR)ELESS board includes a mounted polycarbonate protection plate to allow for ability to handle the board without touching sensitive electronics. For outdoor applications a waterproof enclosure is required.

- · Save hundreds of dollars in control cable costs
- Eliminates the need for underground conduit installation
- Stops potential control cable issues on above ground installations
- · Greatly reduces potential for control cable wiring errors
- No need for control cable to be routed into operating room

• Retrofits to systems that already employ the OptimizIR or SDA 100 controller and remote (wired) driver board

 On-board LEDs make it easy to range test and determine ideal line of site mounting location

 GHE components are inherently stable and very reliable

 Protects the controller (and your operating room) from unwanted lighting hits

"The Steppir Wireless link is a fantastic product advancement by SteppIR. The cost of the wired link consisting of trencher, PVC conduit, and cable is significantly more than the W(IR)ELESS remote link. Before the W(IR)ELESS Remote was available, I had to use control cable - because of this, I have had driver chips fail in the electronic controller due to lightning hits. Disconnecting the wired link breaks the path for lightning and will greatly reduce the cost of damage should it happen again. The GHE components are as good as cable. I have many GHE links in my station and they are a solid partner with Steppir SDA controllers and remote boards. Highly recommend!"

- Craig Thompson, K9CT



A SteppIR SDA 100 or OptimizIR controller and a remote driver board are required for this system in addition to the W(IR)ELESS

COMMUNICATION SYSTEMS



teppiR

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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!

Here is a small sample of our wide variety of antennas

Model	Bands	Length Ft.	Max Pwr. Rating	Conn.
Dual	band Base Stati	on/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
Mone	band Base Stat	ion/Repeater	r 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 Mo	bile Antenn	as	
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 M	obile Anteni	nas	
NR22L	2m	96.8 in.	100	UHF
M285	2m	52.4 in.	200	UHF or NMO

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!

Diamond Antenna is a division of RF Parts Company

Second Century

The IARU and You

April 18 is World Amateur Radio Day. The International Amateur Radio Union (IARU) has selected the observance's theme for 2019: "Celebrating Amateur Radio's Contribution to Society." Some of you may ask, "What is the IARU, and why should I care?"

The International Amateur Radio Union is a federation of national Amateur Radio associations, founded on April 18, 1925 in Paris with representatives from an initial 25 countries. ARRL is the International Secretariat for the IARU, and also represents the United States in the IARU. The International Telecommunication Union (ITU), which is the United Nations specialized agency for information and communication technologies (ICTs), has recognized the IARU as representing the worldwide interests of Amateur Radio.

The ITU has three main areas of activity called sectors: radiocommunications, standardization, and development. Working through these sectors, ITU allocates global radio spectrum and satellite orbits, develops the technical standards that ensure that networks and technologies seamlessly interconnect, and "strives to improve access to ICTs to underserved communities worldwide." Directly relevant to Amateur Radio, ITU-R, the ITU's "Radiocommunications Sector," coordinates the international management of the radio-frequency spectrum.

The IARU works through the ITU. According to its constitution, the IARU's "objectives shall be the protection, promotion, and advancement of the Amateur and Amateur-Satellite Services within the framework of regulations established by the International Telecommunication Union, and to provide support to Member-Societies in the pursuit of these objectives at the national level..."

Protecting and Expanding Access to Spectrum

Since its founding in 1925, the IARU has fought to protect and expand Amateur Radio spectrum privileges worldwide, in frequency bands strategically located throughout the radio spectrum. In the 1927 International Radiotelegraph Conference in Washington, DC, Amateur Radio gained the allocations still recognized today — 160, 80, 40, 20, and 10 meters. That conference was chaired by Herbert Hoover, who was US Secretary of Commerce at the time, and had participants from 80 countries.

ITU's world radiocommunication conferences (WRC) are held every 3 to 4 years to review, and, if necessary, revise the international treaty governing the use of the radio-frequency spectrum. The next world radiocommunication conference, WRC-19, will happen this fall in Egypt.



ARRL and IARU have been preparing for this conference, and to protect Amateur Radio spectrum.

Because of this critically important service that IARU provides, it has grown to include 160 member-societies in three regions. These regions are organized to roughly mirror the structure of the ITU and its related regional telecommunications organizations. IARU Region 1 includes Europe, Africa, the Middle East, and Northern Asia. Region 2 covers the Americas, and Region 3 comprises Australia, New Zealand, the Pacific island nations, and most of Asia.

According to the IARU, there are about 3 million hams worldwide. There are about 700,000 hams in the US. ARRL has about 157,000 members.

Tell the World About Amateur Radio

What are you doing to celebrate World Amateur Radio Day? What are you doing to celebrate Amateur Radio's contributions to society? Visit www.iaru.org/world-amateur-radio-day.html to see what your fellow hams around the world are doing this year.

I have given a challenge to ARRL staff. April 18, 2020 will be the 95th anniversary of the founding of the IARU. Let's create a worldwide event — a non-competitive "contest" to publicize Amateur Radio. I can imagine an operation similar to ARRL Field Day. Clubs or ad hoc teams operate from schools, shopping centers, parks, or other highly visible locations. Stations get multipliers for social criteria, like having someone under the age of 20 make a contact. Let's have multipliers for press coverage, both in traditional media and on social media, and the number of placements or "likes" received. And another multiplier for demonstrating all aspects of Amateur Radio — contesting, DXing, emergency communications, homebrew equipment, and more — at your event. The goal of the contest is not to make as many contacts as possible, but to make the biggest impact enticing the next generation of hams into Amateur Radio.

These details are only my suggestions. As always, I invite your comments to me at **wb2itx@arrl.org**. Let's take advantage of this event to show the world what Amateur Radio is!

Hours & m/ WBZITX

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9 lbs. Classic AV-14AVQ uses same trap design as famous hygain Thunderbird beams. 3 air dielectric Hi-Q traps with oversize coils give superb stability and 1/4 wave resonance on all bands. Automatic bandswitching

AV-12AVQ, \$139.95. (10, 15, 20 Meters). 13 ft., 9 lbs. Lowest priced automatic bandswitching tri-band vertical! Uses Thunderbird beam design air dielectric traps for extremely hi-Q performance in limited space.

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HF Beams

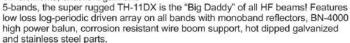
hy-gain beams are stronger, lighter, have less wind surface and last years longer. Why?

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11- elements, excellent gain and



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7-Elements gives you the highest average gain of any hy-gain tribander! Dual driven for broadband operation without compromising gain. SWR less than 2:1 on all bands. Combined monoband and trapped parasitic elements give you an excellent F/B ratio.

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HAM-VI, \$749.95. For medium arrays up to 15 sq. ft. wind load. Like HAM-IV but has new DCU-2 Digital Rotator Controller. Just dial in your beam heading or let your computer control your antenna.

HAM-VII, \$799.95. Like HAM VI but with DCU-3 digital controller with six programmable memories.

Tailtwister T-2X – \$799.95

For large medium antenna arrays up to 20 sq. ft. wind load. Choose DCU-2 digital controller (T-2XD2) or analog control box (T-2X) with new 5-second brake delay and new Test/Calibrate function. Low temperature grease, alloy ring gear, indicator potentiometer, ferrite beads on potentiometer wires, new weatherproof AMP connectors plus 8-pin plug at control box, triple bearing race with 138 ball bearings for large load bearing strength, electric locking steel wedge brake, N or S center of rotation scale on meter, low voltage control, 21/16" max. mast.

T-2XD2, \$899.95. Tailtwister with DCU-2 digital controller.

T-2XD3, \$949.95. Tailtwister with DCU-3 digital controller with six programmable memories.

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CD-45II, \$449.95. For antenna arrays up to 8.5 sq. ft. Bell rotator design gives total weather protection. Dual 58 ball bearing race.

Digital Rotator Controller with 6 Programmable **Beam Headings**



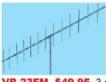
mast size of 21/16 inches.

DCU-3

New DCU-3 Digital Controller lets you program 6 beam headings! Gives you fully automatic or manual control of your hy-gain HAM or Tailtwister Rotators.

Push a memory button or dial in your beam heading or let Ham Radio Deluxe (or other program) control your DCU-3. Your antenna automatically rotates precisely and safely to your desired direction.

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40 ft - \$109 and \$119 / 60 ft - \$279 / 72 ft - \$479 / 85 ft - \$599, QST review: Feb. 2010

SPIDERBEAM ROTATABLE ALUMINUM MASTS - support for 13 to 25 lbs antenna weight. 33 ft - \$459 / \$485, 41 ft \$509, 47 ft \$629, 49 ft \$575, 60 ft \$749. Guy hardware, rotator adapters, other accessories available. QST review: May 2015

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DXPatrol is a tiny SDR covering 100 kHz-2 GHz that can be used with Windows, Mac, Linux, or Android. Not an 8-bit dongle! Full featured receiver. Want to add a panadaptor to your HF transceiver? Do it with DXPatrol. Compare to SDRPlay at \$169.95. Great price at only \$99.95!



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Part#	Length/Pt
235-5X-20	
235-5X-10	10
235-5X-5	5
235-5X-3	3
1ft to 25ft readily available	
Custom lengths and Bulk availa	ble



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/Pt
233/2-4)	<-12		12
233/2-4)			10
233/2-4>	<-5		5
233/2-4)	<-3		3
233/2-4)	<-1		1
1ft to 25	ft readily	available	
Ouston	lenaths:	and Bulk av	ailable



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 1/2" wide tinned

copper 38x48x8/34 10ga 53 a Part#	Length/Pt
233/2-G4-10	10
233/2-G4-5	5
233/2-G4-3	
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1ft to 10ft readily available Oustom lengths and Bulk ava	ilable

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Low Loss Gas Injected Foam (85% VP) 95% Tin-Copper Braid 100% AL Foil **UV Stabilized Jacket** Available with PL259, SO239, N-Type, TNC and 7-16DIN connectors

Attenuation per 100ft	Power Rating
0.4dB @ 30MHz	5.51KW
0.5dB @ 50 MHZ	4.24KW
1.0dB @ 150MHz	2.41KW
1.7dB @ 450MHz	1.35KW
2.5dB @ 900MHz	0.93KW
2.9dB @ 1200MHz	0.79KW



ABR213 (PN:2213A) Mil-SPEC (.405" diameter) Stranded Center Conductor, 66% VP, 97% BC Braid. Type II Jkt (Direct Burial) Available in Bulk or with PL259s, BNCs, NType, TNC, SWA, 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 Oustom assemblies available



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 210B @ 50MHz 0.96kW 3.6dB @ 150MHz 0.55kW 6.3dB @ 450MHz 0.31kW

Stocked Lengths 1.5ft to 150ft Oustom 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 277kW 1.1dB @ 50MHz 214kW 1.8dB @ 150MHz 1.22kW 3.3dB @ 450MHz

Stocked Lengths 1.5ft to 200ft Oustom 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, NType, TNC, SMA, or 7-16 Din Connectors.

Attenuation per 100ft Power Rating 0.7dB @ 30MHz 3.33kW

2.57kW 0.9dB @ 50MHz 1.5dB @ 150MHz 1.47kW 27dB @ 450MHz 0.83kW

Stocked Lengths 1.5ft to 200ft

Oustom assemblies and Testing services available.







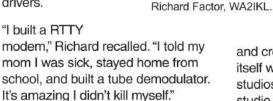
Member Spotlight

Richard Factor, WA2IKL

Richard Factor, WA2IKL, has had a ham license for more than 50% of the time that radio has been in existence. He was first licensed in 1959, and has retained his original call sign, despite

upgrading to Amateur Extra while a high school student in New York City.

Richard bought gear on New York's famous "Radio Row," built Heathkits, and also designed and built equipment of his own. Not having access to power tools, Richard, with true ham ingenuity, made do with hammers and screwdrivers.



Beginning a Business

These early experiences led to Richard's career in designing and selling recording equipment that's been used by everybody from Aerosmith to Emerson, Lake & Palmer. It began when Richard and friends Kenny Schaffer (now N2KS) and Steve Katz (ex-WA2RBX) were building a recording studio.

"At another studio, Steve had a very tiny control room, and needed to run a tape machine, but there was no room for an assistant," Richard said. To solve the problem, he built a locator that automatically rewound to a specific spot. They ended up selling the device to Ampex, which made big multitrack recorders. "Suddenly, we had a product and we had a business," Richard said.

They brainstormed other products and brought them to Audio Engineering Society conventions in the 1970s, when music recording and production was undergoing great change. Digital

was taking hold, and integrated circuits were brand new. A product that Richard and his partners called the "Instant Phaser" became the foundation of their company, Eventide. Until that point, phasing required an engineer to manipulate reel-to-reel tape by hand. The Instant Phaser changed all of that.

Another product — a digital delay line that slowed down audio

and created effects — practically sold itself when Richard lent it to recording studios. When it was time for the studio to give the delay back, they didn't want to. Sales were made, and Eventide continued to develop the product over the years.

An Eventide product called the Harmonizer® — designed by Tony Agnello — could change pitch, which was a revolutionary achievement. Eventide moved from New York City to Little Ferry, New Jersey, in 1984, and the company's success continued. "I don't remember the 1990s at all, I was so busy," Richard remarked.

DXCC and GRAMMY Honors

During Eventide's early years in New York City, Richard built a Heathkit SB-104 and used it with a vertical at the office. When the company moved to New Jersey, he put up towers and resumed what he calls his "DXing career." He'd earned DXCC back in

the 1960s, but his New Jersey station enabled him to make it to the top of the DXCC Honor Roll. "With the exception of North Korea," he laughed.

For the past several years, Richard has lived in Sedona, Arizona. He's still involved with Eventide, and he's on the air — mostly chasing DX, but occasionally for a ragchew or to hop into a contest for a few hours.

Eventide, which is coming up on its 50th anniversary, has been so successful that its innovations earned Richard and Tony Agnello a 2018 Technical GRAMMY Award, which, according to the Recording Academy's website, goes to "individuals who have dramatically pushed boundaries and made groundbreaking, important, outstanding, and influential contributions of technical excellence and innovation to the recording field throughout their lifetimes."

When asked what he received the Technical GRAMMY for, Richard said, "We were very early pioneers in digital equipment, and our fingerprints are all over most canonical records after the Beatles — David Bowie, Led Zeppelin. Almost every major recording studio in the US and UK had Eventide equipment."

When one considers that past winners of the Technical GRAMMY include Ray Dolby (1995), Les Paul (2001), Apple Computer (2002), Phil Ramone (2005), Yamaha (2007), and Thomas Alva Edison (2010), it's easy to understand the magnitude of Richard's contribution to the recording industry.

Richard and Tony attended the main GRAMMY ceremony in January 2018, and received their award at a July 2018 ceremony. Richard describes the feeling of winning a GRAMMY as "some part amazement at the unexpected honor, and some part 'let's get back to work, there's a lot to be done."

Keep an ear out for this industrious ham on the 40 - 10 meter bands.



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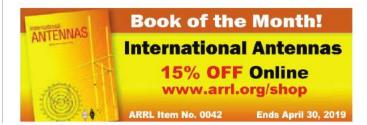
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ARRL, the national association for Amateur Radio® in the United States: supports the awareness and growth of Amateur Radio worldwide; advocates for meaningful access to radio spectrum; strives for every member to get involved, get active, and get on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

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

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

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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

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

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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, K0DAS

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

Vice Director: Art Zygielbaum, K0AIZ 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

www.pdarrl.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, K0RM

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

Vice Director: Robert Wareham, N0ESQ 300 Plaza Dr., Suite 200 Highlands Ranch, CO 80129 (720-592-0394); n0esg@arrl.org

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www.facebook.com/ ARRLSoutheasternDivision

Greg Sarratt, W4OZK

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

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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

arriwgd.org John Robert Stratton, N5AUS*

P.O. Box 2232, Austin, TX 78768-2232 (512-445-6262); n5aus@n5aus.com

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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

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 (518-891-5058); 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, KS0J, 1835-63rd St. E,
Inver Grove Heights, MN 55077 (651-260-4330); ks0j@arrl.org

North Dakota: Nancy Yoshida, KG0YL, 1079 Harvest Ln. NE, Thompson, ND 58278-9408 (218-779-6596); kg0yl@arrl.org
South Dakota: Chris Stallkamp, Kl0D, 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) lowa: Robert McCaffrey, K0CY, 1210 Noble Hills Pl., Boone, IA 50036 (515-432-2512); k0cy@arrl.org

Kansas: Ronald D. Cowan, KB0DTI, P.O. Box 36, LaCygne, KS 66040 (913-757-3758); kb0dti@arrl.org

Missouri: Cecil Higgins, AC0HA, 27995 County Rd. 220, Hermitage, MO 65668-8493 (417-399-5027); ac0ha@arrl.org

Nebraska: Matthew N. Anderson, KA0BOJ, 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, AH0A, 278 Kapiolani Blvd. #502, Honolulu, HI 96826

(808-955-2496); ah0a@arrl.org

(808-959-2496); anua@arn.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, WM0G, 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, HC77 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

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, Al6DF, 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: Jay T. Urish, W5GM, 1065 Overland Dr., Lowry Crossing, TX
75069-4727 (972-965-6229); w5gm@arrl.org

Oklahoma: Kevin O'Dell, N0IRW, 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

(512-468-0792); ke5zw@arrl.org

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Fwd/Ref PEP, PA Balance, ALC, V, I Metering



AMERITRON new ALS-1306 1.5-54 MHz solid state FET no-tune Amplifier gives you 1200 Watts PEP output on all bands, including 6 Meters. Automatic bandswitching! No tuning! No warm-up! No tubes! Quiet!

Eight rugged MRF-150 power FETs insure reliability. They are mounted on dual heavy duty heat sinks and properly arranged to spread heat out over a large surface.

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1200 Watts PEP Output on all bands 1.5-54 MHz including 6 Meters

ALS-1306 runs up to 1200 Watts of clean SSB output power (just 100 Watts drive gives you the full rated 1200 Watts output) for *continuous*

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

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

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

Front-panel ALC control!

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

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

Automatic Bandswitching!

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

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

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

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This hash-free fully regulated swtiching power supply is only 12 lbs. and measures a compact $10W \times 6^{1}/_{2}H \times 9^{1}/_{2}D$ inches. It can be placed conveniently out-of-the-way. Output is 50 VDC at 50 Amps to the ALS-1306. Wired for 220 VAC, selectable to 110 VAC. Draws less than 25 Amps at 110 VAC; 12 Amps at 220 VAC.



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600 Watts PEP/500W CW output, 160-6 Meters with automatic instant bandswitching from your transceiver. Fits on your desktop. 9.75W x 7H x 14.5D inches and weighs 14.2 lbs., but is only 4 dB below 1500 Watts – less than an S-unit!

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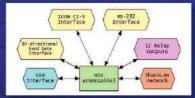




The BM-5 BandMaster V is a full featured unit that contains a universal band decoder and antenna switch controller. It features five communication channels. All channels are active simultaneously and provide data translation for your station accessories. In other words, if you are using an Icom radio on the CI/V interface the BandMaster V will output 4-bit band data as well as RS-232 data in Yaesu or Kenwood format. In reverse, when

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Six antenna remote switch with rotary switch controller. Push button controllers available. HF and 50 MHz. Power rating 5 kW CW.

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PowerMaster II



STACK MATCH

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The automatic amps can drive an antenna switch of up to 10 antennas andselect up to ten bandpass filters applies to all automatic models

successful and well established company in the production of amplifiers. OM Power amplifiers can be found on all continents and in almost every country of the world. All of the amplifiers have state of the art design, and are solidly built.

OM4000A - OM4000HF OM2500A - OM2500HF

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OM2000A+ - OM2000+

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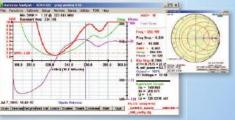


Frequency coverage: Amateur bands 1.8 – 29.7 MHz including WARC + 50 MHz

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- 1500 W
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- Fast, silent PIN diode T/R switching
- Built-in Antenna Tuner with dual antenna jacks
- Compatible with nearly any transceiver – custom cables available
- 160-6 meters



Separate remote-controlled power supply



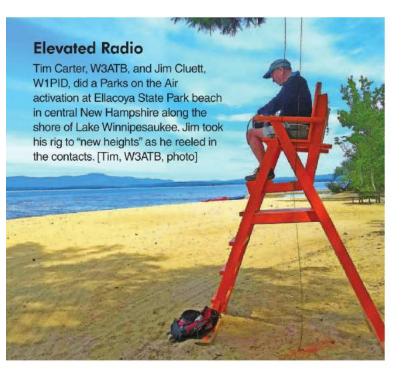
In addition to the K3s, Elecraft's K-Line includes the P3 panadapter, KPA500 500 W+ amplifier, KAT500 500 W+, or the KPA1500 W amplifier with built-in automatic antenna tuner. All can be used with the K3S or with other transceivers. The P3 panadapter adds a visual dimension to signal hunting, with fast, real-time spectrum and waterfall displays of band activity. Its superior sensitivity reveals signals to the noise floor of the K3S. The KPA500 amp features instant RF-based band switching, plus remote band selection that tracks the band of the K3S. It has bright alphanumeric status display and LED bar graphs, and a rugged, internal linear supply. The compact KAT500 ATU uses a fast, accurate tuning algorithm. Saved matching network settings can be recalled automatically as you tune the transceiver's VFO.







Up Front



Catching Up on Some QST Reading

Late last year, Gurbux Singh, W6BUX, visited Yangon, Myanmar, formerly known as Rangoon, Burma. While touring downtown, he decided to relax with a copy of the November 2018 issue of *QST*. The photo was taken in the Independence Square with the famous Sule Pagoda in the background.



If the Shoe Fits...

Dave Newman, W2JFY, spotted these shoes during a visit to Venice, Italy. As Dave said, "I've never worked W6YZ, but I like his shoes!"

While there is indeed a W6YZ (Bob Treseder in North Salt Lake City, Utah), the call sign and the shoes are not related. W6YZ is a shoe brand marketed by the Italian company Wizz, LLC. The letter

"W" stands for the first name of the designer, Walter Van Beirendonck, and the numeral 6 represents "the Antwerp Six,"

a group of designers he attended college with in Antwerp, Belgium. According to Beirendonck, "...Y stands for young and Z is for zany, crazy. It's the final letter of the alphabet, but the start of something new."





Breakfast Ham(s)

This group of amateurs in Orland Park, Illinois, claims to have one of the longest-running breakfast meetings in the country. They've been meeting for breakfast since 1988! Late last year they had the good fortune of hosting Luca Della Giovampaola, IW0DJB, who is the trustee of the Vatican City station HV5PUL. Shown from left to right: Chuck Krezwick, WV9C; Mike Freitag, W9GYC; Luca Della Giovampaola, IW0DJB; Al Szoldatits, K9MDW; Tom Palmisano, W9AEB; Gerry Klotz, KB9PKI; Bill Will, WW9WW; Barry Cohen, N2BJ, and Bill "Jake" Jacobowski, KC9FJN.

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Letters from Our Members

Complete ESD Protection

I wanted to say that the article, "Protecting Shack Equipment from Electrostatic Discharge," by Dino Papas, KL0S, in the January 2019 issue of *QST* was a great start for most amateurs.

As an electromagnetic interference and compatibility engineer, I deal with this a lot, and I often perform audits of our production facilities to ensure that there are no potential electrostatic discharge (ESD) issues that might cause latent product failures.

While Dino's personal protection and touch-off concept is good, the overall workbench could be approved on even more. In the photo, I saw a large amount of plastic and wood items directly on the work surface — all of these non-conductive items can still build up a charge, even on an ESD mat. The nested plastic containers will build up a charge as they are separated. While I cannot begin to guess if that charge is enough to damage a component, it is a risk. The same is true of the bins on the side of the bench.

Just to illustrate why these items caught my attention, simply opening a poly three-ring binder with papers in it can generate 10,000 V. Of course, this depends on humidity and a host of other environmental concerns, but I would hate for someone to mistakenly believe they are fully ESD-protected and still damage equipment. As a rule of thumb in the defense industry, we keep a 1-meter standoff distance between an active ESD workstation (where exposed circuit cards are in work) and any non-conductive and non-ESD-safe materials. Additionally, chairs must have arms removed, and the operator must wear an ESD protective smock. This might be a bit excessive for the normal radio amateur, but it depends on what they're digging into. I certainly wouldn't open up an Icom 7300 without some level of protection!

Ken Cechura, KC9UMR Fenton, Missouri

Radio on the Rails

As soon as I saw the "Radio on the Rails" article by Steve Ford, WB8IMY, in the February 2019 issue of *QST*, I knew I had to share the story of how I got into ham radio.

I have been a rail fan since I was a child. In 1994, I had some extra money and decided to buy a scanner so I could listen to trains, but I was also aware of how many various states, counties, and municipalities had laws outlawing portable scanners.

Fortunately, I had a friend at work who was a ham. He told me that if I got a ham radio license, I could legally use a handheld transceiver as a scanner as long as it had ham radio frequencies on it. I researched and found out that it was true; FCC rules preempt state and local laws. I signed up for a Technician licensing class at the Skyview Radio Society, and in 1994, I got my license and bought a used Icom IC-2GAT (which I still have). But along the way, I also found out how much fun Amateur Radio is and how helpful and friendly hams are.

Joseph J. Birsa, N3TTE Pittsburgh, Pennsylvania

Offline Operation

Steve Ford's "Eclectic Technology" column in the December 2018 issue of *QST* gives a good understanding of "The Importance of Time" while operating WSJT modes, but it makes the basic assumption that you have internet service. I can give several scenarios where this is not the case, like camping in the Ozarks, where you lack internet service and most likely lack cell service, too.

With the release of WSJT 2.0, which allows the use of FT8 on field days, it becomes imperative that a source for a time standard be available. The global position system (GPS) is a great solution to this problem. For under \$50, you can use a GPS receiver to sync your computer clock to well within 1 second of accuracy. currently have two different setups: one using an Icom IC706 and computer running Windows 7, and another with an IC7300 and a computer running Windows 10. Each needs a slightly different software package because of the different GPS receiver.

First, you need a generic USB GPS receiver, which are available on Amazon for about \$20. Most common generic GPS receivers are based in the U-BLOX chipset. I use a software package developed by Monte Varakojis, KE6GQO, whose website has all the information needed to set up your computer for GPS sync at www.visualgps.net. There are other packages, but I have found this to be an easy setup, and if you run into any problems, you can email Monte and receive an immediate reply.

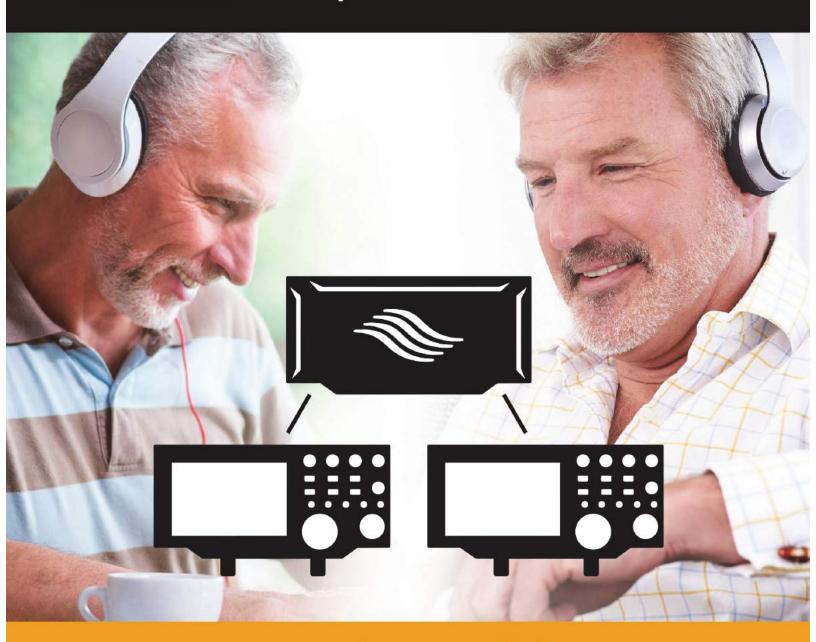
Al Nessel, K1GTK Eureka, Missouri

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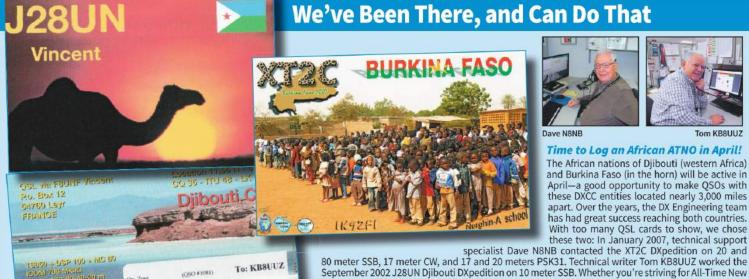
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for your shack.

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Time to Log an African ATNO in April!

The African nations of Djibouti (western Africa) and Burkina Faso (in the horn) will be active in April—a good opportunity to make QSOs with these DXCC entities located nearly 3,000 miles apart. Over the years, the DX Engineering team has had great success reaching both countries. With too many QSL cards to show, we chose

September 2002 J28UN Djibouti DXpedition on 10 meter SSB. Whether you're striving for All-Time New Ones or band fills this spring, rely on DX Engineering to help provide wise advice and just the right gear





Ready to Get Mobile this Spring?

DX Engineering carries the latest mobile rigs from leading brands, including Yaesu's FTM-7250DR C4FM/ FM Dual Band Digital Mobile Transceiver; ICOM's IC-7100 HF/VHF/UHF Base/Mobile Transceiver; Kenwood's TM-V71A Dual Band Transceiver; Alinco's DR-B185HT 2 Meter Transceiver; and many more. Enter "Mobile Transceiver" at DXEngineering.com for the full lineup.



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The TS-890S is Kenwood's most advanced DSP transceiver to date, providing HF enthusiasts with stellar receiver and audio performance. Features include 160-6 meter, 100 watt coverage in all modes; 7" TFT color display; full down-conversion superheterodyne; and extra-low phase noise local oscillator. KWD-TS-890S



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In 2005 LDG introduced the TW-1, an extraordinary wattmeter that spoke the power and SWR levels aloud via a self-contained speaker. It was intended primarily for visually impaired hams, and was quite popular. We sold quite a few of them, then dropped the product from our lineup as we moved on to other new products.

We recently learned that the TW-1 is still highly prized by visually impaired hams, and is even passed down from one to another as they become Silent Keys. LDG is proud to announce the return of the TW-1 Talking Wattmeter to our product lineup, and as a thank you to our loyal customers, we are offering it at its original 2005 price of only \$150.

The TW-1 Talking Wattmeter handles all power levels up to 2,000 watts, and speaks the power aloud when you press the button. You can select forward or reverse power, or the Standing Wave Ratio (SWR). The TW-1 will speak in English, Spanish or German as you select. You can also select Tone Mode, in which the TW-1 plays a continuous tone who's pitch varies with Forward or Reverse power, or SWR. This mode is ideal for manually adjusting a tuner, or a vacuum tube transmitter or amplifier. You can watch the plate current meter while listening to the power output.

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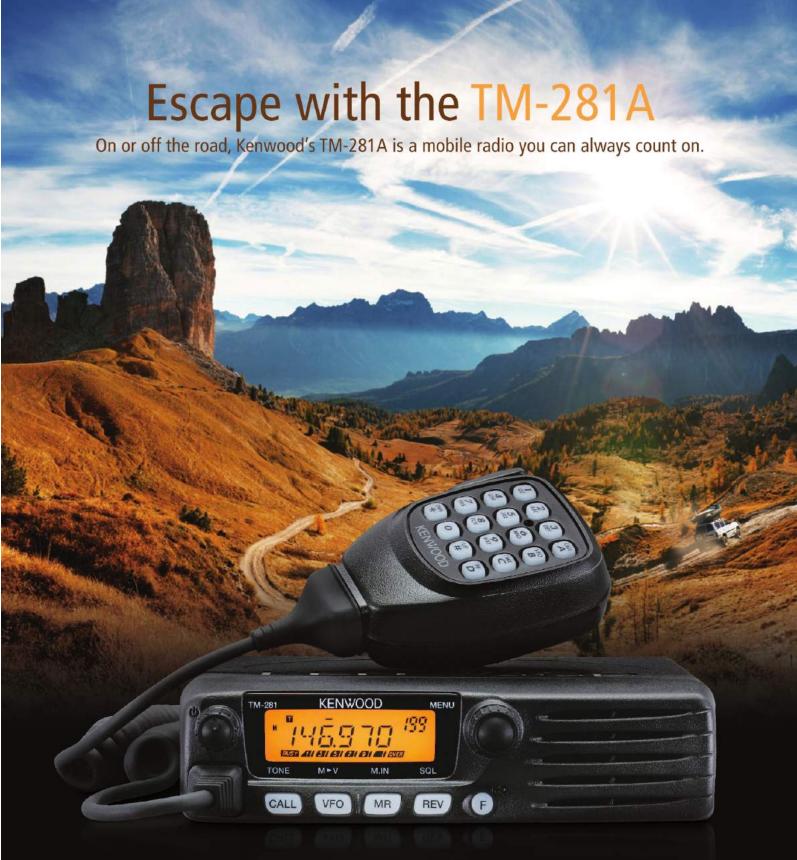
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A High-Power

160- and 80-Meter Transmitting Loop

Antenna

Steve Adler, VK5SFA

My journey building a transmitting magnetic loop antenna began in late 2015 after I decided to have a 160-meter, DX-capable antenna that I could install within my suburban block. There were many challenges to overcome, including space and radio frequency interference from the neighbors. Considering these issues, the idea to revisit the concept of a transmitting magnetic loop antenna was born.

I chose a magnetic loop primarily because it was physically small (able to fit into a 13-foot square footprint area of the backyard) and relatively immune to local E-field interference from within the near field. It can also radiate a reasonable amount of RF power between 20° and 45° elevation for DX operation, all while supporting near vertical incidence sky-wave radiation for short- to medium-distance communications.

Designing a practical loop that could achieve all these important requirements, including my desire to operate at full legal power (in Australia, that's 400 W PEP output) had its challenges. [At high power levels, 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



This compact loop was the first-place winner in the 2018 QST Antenna Design Competition.

be calculated using 4NEC2, but be sure to evaluate both the total H- and total E-fields. — K. Siwiak, KE4PT, for the ARRL RF Safety Committee.] Undaunted, I set about systematically approaching and overcoming each of the design challenges, with the satisfying result of a successful low-band antenna.

The Design Phase

A small magnetic loop antenna is defined as having a circumference of approximately 1/10 of a wavelength. This equates to approximately 54 feet on the 160-meter band. Using this circumference, the diameter of the loop would be approximately 17 feet. On the surface, this poses considerable mechanical challenges. After hearing about this project, Gus, KB0YH, wrote suggesting that there can be some flexibility in dimensions for a transmitting loop.

Ultimately, it was decided that this size was too large to be easily realizable, particularly given the need to have a nonmetallic supporting structure.

The Two-Turn Loop

I decided to make a two-turn loop, approximately 10 feet in diameter. This had several benefits; the structure would be far more manageable in size and the self-inductance of the loop quadruples the capacitance required to bring it into resonance, resulting in a less expensive and more easily obtainable vacuum variable capacitor.

The efficiency would also increase slightly because the overall circumference is now approximately 15% of a wavelength. The additional turn in the loop would help offset the loss in radiation resistance brought about by the smaller diameter.

The radiation resistance quadruples while the RF loss resistance merely doubles. On this point, it's worth noting that the efficiency-reducing loss resistance is directly proportional to the loop circumference. Meanwhile, the radiation resistance is proportional to the square of the loop area or the fourth power of the circumference. What this means is, although the smaller resulting diameter substan-

tially reduces the radiation resistance, the additional turn then increases it by a useful factor of four, clawing back about half of what was lost due to the loop area reduction.

Ultimately, a successful practical loop antenna design is all about attaining the oftentimes elusive sweet spot of maximizing the radiation resistance and simultaneously minimizing loss resistance to maximize antenna efficiency. In this design, this important objective is achieved on 160 meters as it is on 80 meters, where the antenna efficiency becomes impressively high due to the rapid rise in radiation resistance.

In addition, on the lower-frequency 160-meter band, one must be careful to not attain such a high Q factor that the resultant SWR bandwidth becomes too narrow to pass an SSB signal. The two-turn design, once realized, achieves a useable bandwidth of 4 kHz on 160 meters, more than enough for SSB transmission, demonstrating that the antenna is indeed practical for most activity on the 160-meter band (except perhaps double-sideband AM).

Modeling

Before setting out to construct the antenna, the first step was to model its performance. Special thanks must be given to Paul Lawson, VK5SL, for his skills with *4NEC2*. Paul produced the model used to assess the antenna's capabilities.

From the modeling, it became clear that the antenna would meet most of the objectives set for the project. The antenna pattern showed very usable radiation at angles as low as 30° above the horizon with respect to an isotropic radiator, only 3 dB down. To obtain equivalent performance from a half-wave dipole it must be mounted at least a quarter of a wavelength off the ground — that's 133 feet!

The modeling also revealed some of the other challenges the design would face. At 400 W, the circulating currents would reach 87 A. Careful attention would need to be paid to how the antenna was constructed, both mechanically as well as electrically, if the high-performance vision were to be realized.

The other physical aspect determined from modeling was the directionality the loop would provide, making it clear that it needed to be rotatable to be effective. This was an added advantage, as it assisted further with noise reduction. Physically, it would lead to some challenges with mechanical stability once installed that needed to be addressed, as will be discussed later in the article.

Materials and Assembly

Now that the theory had been reviewed, it was time to gather the required hardware and commence

assembly. One of the design objectives was to source as many of the parts from the local hardware store as possible. The design also had to be assembled using only common hand tools that the average amateur would have at hand. This drove a number of the material selections throughout the design.

Loop Material

One of the first things considered was what to make the primary loop element out of. Here is where I had a stroke of genius. I identified that the material needed to be lightweight, preferably insulated (to prevent corrosion), and semi-rigid. After giving it some thought, I identified that 7 GHz Heliax™ waveguide fulfilled all of these requirements perfectly. It has a solid-copper, corrugated outer

Table 1	
Bill of Materials	
Item	Quantity
12 V dc motor and 10:1 reduction gearbox	1
7 GHz waveguide or LDF550 coaxial cable	76 feet
Antenna rotator	1
Copper strap, 2 inches wide by 1/10 inch thick	40 inches
Connector for rigid coax, L44N for LDF450	1
Coaxial cable, rigid ½-inch diameter, LDF450, Heliax or equivalent	10 feet
Hardwood pole, 1.6 inches square	13.1 feet
Nylon mounting board, 10 × 16 inches	1
Pop rivets	As needed
Power cable, dc	As needed
Pulse width modulation dc motor controller	1
PVC cross fittings, 2-inch diameter	4
PVC end caps, 2-inch diameter	19
PVC pressure pipe, 2-inch diameter, 12 inches long	8
PVC pressure pipe, 2-inch diameter, 20 inches long	1
PVC pressure pipe, 2-inch diameter, 60 inches long	4
PVC pressure pipe, 2-inch diameter, 7 inches long	1
PVC saddles, 2-inch diameter	2
PVC T fittings, 2-inch diameter	8
Quick-set cement	90 – 120 pounds
RF suppression toroids or beads	5
RG-58 N connector, male	2
RG-58CU coaxial cable	7 feet
Rotator cable	as needed
Self-tapping screws	100
Steel pole, 2-inch diameter	10 feet
Toroid core, 3.5-inch diameter, type 43 75 mix	1
Vacuum variable capacitor ceramic coupling	1
Vacuum variable capacitor mounting hardware	1 set
Vacuum variable capacitor, 25 to 500 pF, 15 kV	1
Plastic water container, 5 gallons	1

conductor that is protected by a polyethylene sheath and is relatively flexible. However, unlike coaxial cable, it has nothing inside it but air. This makes it very lightweight, while still providing the required conductor cross-sectional surface area for good skin effect to support the high RF current flow. The waveguide used in this project weighed in at less than ½ pound per foot.

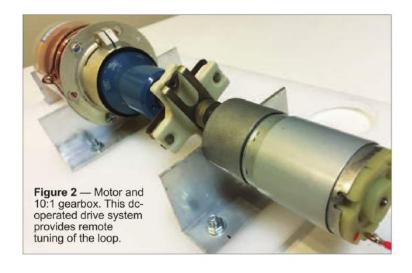
If you can't obtain Heliax waveguide, a somewhat heavier alternative is to use %-inch or even ½-inch coaxial cable similar to Andrew type LDF5-50, LDF4-50, or equivalents. While you are not interested in the inner conductor in this design, either type of feed line will provide enough surface area with their outer solid-copper jackets to work effectively in this type of antenna.

Tuning Capacitor

The next key element is the tuning capacitor. A transmitting magnetic loop antenna needs to be brought into resonance to work. This is done by connecting a capacitor in parallel with the loop inductor. I selected a



Figure 1 — Jennings 25 – 500 pF variable vacuum capacitor used to tune the loop to resonance.



Jennings 25 – 500 pF variable vacuum capacitor rated at 15 kV (see Figure 1). This is a high enough voltage rating to handle at least 400 W PEP of input power. (A single turn loop would have required a 750 – 1,000 pF unit, costing more than twice the price).

Remote Tuning Mechanism

The introduction of the tuning capacitor presents the next challenge of how to tune it from the operating position. When using high power, there are very high voltages and currents resulting in high energy circulating in the antenna, so it is not feasible to tune it by hand. Some form of remotecontrol drive system is required to make the antenna practical to use.

This was achieved by using an inexpensive dc motor coupled to a 10:1 reduction gearbox and a reversible pulse-width modulation (PWM) dc motor controller (see Figure 2). Both items were purchased from an online auction seller for a very modest cost. Many people use stepper motors for the purpose, but this simple system is also very effective, bringing the tuning rate down to 1 pF per second — the perfect speed to tune such a narrow-bandwidth antenna.

A ceramic insulator drive coupler should be used to isolate the RF from the dc motor. The capacitor, motor, and drive coupler can then be mounted to a nylon board (a kitchen cutting board makes a good source) using some suitably sized angle aluminum. Exact dimensions for how to do this will vary depending on the mechanical size of the vacuum capacitor you obtain.



Test-fitting the waveguide to the support frame will expose any issues.

Supporting Frame

Next, it is time to consider the construction of the supporting frame. As the coax loops must be supported by nonmetallic materials, it is important to carefully consider what to make the frame from. Ideally, the frame will be strong, reasonably lightweight, and easy to procure.

My solution was to use 2-inch, highpressure PVC water pipe and the associated fittings. The four-way cross pieces, the T pieces, and end-cap fittings were purchased from a specialist irrigation parts supplier, while the PVC pressure pipe was purchased from a local hardware store.

To assemble the main frame, start by building the hub and four 5-foot supports. Then thread an 11.2-foot hardwood timber pole through the main vertical support to add stiffness to the structure without adding too much weight. My pole was 1.6 inches square, but your timber may be of a somewhat different size (see Figure 3).

Once the spokes are attached, add a T-piece to the end of each spoke, and then two 11.8-inch lengths of PVC pipe, one on each side of the T-piece. Add two more T-pieces to the ends of the 11.8-inch pipes, which will then become the guides for the Heliax cable.

Next, make sure every joint is bolted or riveted together as shown in Figure 4. Don't just rely on PVC pipe glue because the weight of the finished antenna is enough to lead to long-term failures if glue alone is used. Once that is complete, you are ready to assemble, and test fit it to your rotator. Figure 5 shows the mechanical details of the support frame construction.

The next step is to test-fit the waveguide. You will need approximately 76 feet to construct the loop and to leave enough material for the connections to the tuning capacitor.



Figure 3 — Timber insert into the main vertical support. This hardwood pole adds stiffness to the structure.



Figure 4 — A close-up look at how the joints are assembled. Riveting or screwing the joints avoids structural failure due to loss of glue integrity.

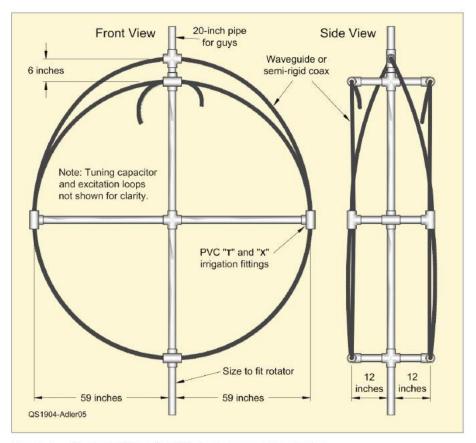


Figure 5 — Mechanical layout details for the support loop frame.

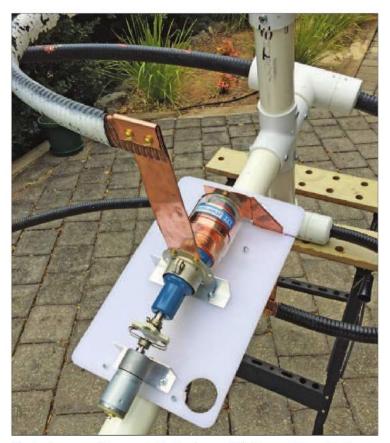


End cap and cable final assembly showing attachment method for waveguide.

To secure the end caps, 2-inch lengths of the 2-inch PVC pipe are cut, and an end cap is then fitted on one end. A 1.5-inch hole is then drilled in the end of the cap through which the waveguide will be threaded. You will need 18 of these assemblies. Next, you slide these onto the waveguide at the right moments while threading the cable through the main support frame.

The end-cap system is important as it allows you, with the use of large cable ties, to secure the waveguide within the frame structure once you have completed adjustments to set the shape of the primary loop. Only secure the cable ties once everything is in place. At this point, you are ready to stand the loop up and confirm you have correctly achieved the basic layout.

Next, the vacuum variable capacitor tuning assembly is mounted to the frame and connected to the waveguide. This was achieved with 2-inch saddle clamps and a 2-inch-wide flat copper strap. Note that brass nuts and bolts must be used to connect the copper strap to the waveguide to avoid dissimilar-metal corrosion problems. However, they are not sufficient to ensure a very low resistance connection within the primary loop. Remember, dc resistance loss is the natural enemy of a transmitting magnetic loop antenna. You must also braze, weld, or silver-solder every



The tuning assembly mounted to the frame. All joints must be welded, or otherwise low-resistance connected, to minimize resistive losses.

joint to maximize the end-to-end conductivity of your construction.

Further, do not be tempted to substitute thick copper wire or braided copper strap. The large RF current circulating around the loop is conducted on the outer surface by skin effect. Large conductor surface area and low resistance of all interfacing joints associated with the high-Q resonant loop are the keys to making this antenna work properly. You may need to perform some copper "origami" to route the connections cleanly from the primary loop to the tuning capacitor.

Next, install the rain hood over the tuning mechanism. The hood was made from a plastic water container with the top cut off, and then installed upside down. Slots are cut into the side to feed the connections through to the capacitor.

Waterproof the connections from the waveguide to the capacitor using many layers of UV-resistant PVC tape. This will help protect the copper from tarnishing, which can introduce losses into the antenna.

The Secondary Loop

The next step was to construct the secondary feed loop necessary to excite the primary loop. LDF4-50



Secondary loop construction. The loop diameter should be 35.43 inches.

Heliax coaxial cable was chosen because it has a solid-copper outer conductor that has better skin effect performance than a braided outer-conductor coaxial cable, such as RG-213. Any equivalent ½-inch semirigid cable would also be suitable.

The sizing of the secondary loop was found to be critical. After some experimentation, a 35.4-inch diameter loop yielded the best results. This delivered a return loss of approximately 17.5 dB, or an SWR of 1.3:1.

Secondary Loop Construction

To make the secondary loop, cut a 118-inch length of the 1/2-inch cable and terminate one end with a suitable connector. At the other end, strip back the outer insulation, jacket, and foam inner core, exposing approximately 2 inches of the center conductor. From the end of the remaining outer jacket, measure back along the cable 111.4 inches and expose approximately 2 inches of the outer shield conductor. Next, solder the center conductor from the far end to the outer conductor where you removed the insulation. This will form the secondary loop driven element of the antenna. Next, use the UV-resistant PVC tape to waterproof the joint.



Secondary loop soldering arrangement.

Finally, use cable ties to install the secondary loop on the main antenna frame. Be aware that this is where some empirical experimentation will be required to achieve the correct coupling. A good starting point is to mount it approximately 4 inches above the plane of the primary loops by strapping it to the main vertical support frame. You can expect to have to move it up and down or change its shape to more of an oval to achieve a good SWR.

Balun Construction

A common-mode choke is required to decouple the antenna structure by stopping extraneous RF currents from flowing down the outer conductor of the transmission line and to balance the Faraday-shielded secondary feed loop. You will need a 75-mix, 3.5-inch-diameter ferrite toroid and approxi-

mately 7 feet of suitable ¼-inch flexible coaxial cable (RG-58 is suitable — do not use foam dielectric cable).

First, wind seven turns on one side of the core, then cross over and wind a further seven turns on the other side. Next, connect your dc motor drive cable to the drive controller. You must also use ferrite beads or toroids around all the other conductors as well (dc motor control cable and rotator control cable) to break them up from RF induction, otherwise they will behave like ground radials. You should do this about every 15 feet.

Final Installation

Now the moment has been reached when all the elements come together, and the antenna can be tested. To mount the loop, first dig a hole about 3 feet deep and 1 foot in diameter.



Side view of the secondary loop placement relative to the primary loop element. Start with the secondary loop 4 inches above the main loop.

Place the rotator mounting pipe in the hole and pour in 90 – 130 pounds of quick-set concrete. Allow the necessary time for the concrete to cure and then mount the loop on the pole.

Normally, the ideal height is two loop diameters above ground to minimize ground losses. However, the practicalities of that height should not be underestimated. In the example shown here, the antenna is instead approximately 7 feet above ground. At that height, no serious compromises to performance have been observed.

It may also be necessary to add a few nonmetallic guy ropes to the top of the loop to stabilize it in high winds. This was achieved here with a modification of the top PVC adaptor. It was changed from a T to a cross piece to allow an additional 12-inch length of 2-inch pipe to be added. This provided an anchor point from which to attach the guys. Doing it this way did not impede the ability to rotate the antenna.

Testing and Tuning

Now we've reached the fun part of the project — tuning the antenna for the first time. The first step is to connect a receiver to the antenna and switch off the receive automatic gain control (AGC). This will make it easier to determine the antenna's resonant frequency.

Next, set the antenna tuning capacitor to maximum capacitance and then tune your receiver from 1 to 2 MHz. Monitor the receiver noise level by ear and on your radio's S-meter. As the loop's resonant frequency is approached, you should hear a pronounced rise in receiver noise, indicating that the antenna is at least working. Note down the frequency at which the noise peaks for future reference.

The next step is to move your receiver to your favorite 160-meter operating frequency. Repeat this receiver listening process, but this time, instead of tuning the receiver, adjust the antenna's tuning capacitor. Once the noise peaks on 160 meters, you are ready to move to the next stage — transmitting.

Be aware of your transmitter's settings. When first applying RF to the system, make sure you have an SWR meter capable of accurate 1.8 MHz operation in line. Set your transmit power level to no more than 1 or 2 W. The antenna will look like an almost infinite SWR until it is brought into resonance and its resonant point will be very narrow. If you are not careful, damage can be done to your transceiver power amplifier if you do not keep the power to a minimum at this early phase.

Next, key your transmitter and adjust the loop tuning using the motor drive. If you have peaked the loop first on receive, you should not have to change the tuning by much before finding a pronounced dip in the SWR. You should be able to achieve an SWR of around 1.3:1 when the loop is correctly adjusted. It is a good idea to set the motor speed to minimum using the PWM dc controller to easily see the transition through the resonant point.

You can then start to increase your transmit power, checking the SWR as you go. Fine adjustments may be required as more power is applied and the SWR measurement accuracy improves.

Finally, you should be able to transmit at full power — at which point you are ready for your first on-air contact.

Once you have confirmed it is working as expected on 160 meters, change your radio to 80 meters and start tuning the antenna capacitor again with the servo-motor (remember that you need to decrease capacitance to retune the antenna up to the 80-meter band). Repeat the peaking procedure and confirm you can also operate across all of 80 and 75 meters. On my antenna, I again achieved an SWR of 1.3:1.

Troubleshooting

If you can't find a resonant point, then it is back to some experimentation and fault finding. First, check that all the joints are properly soldered and brazed. Any increase in the resistive losses around the loop will destroy the Q and render the antenna useless.

You may need to experiment with your secondary loop's position. Try moving it vertically within the plane of the primary loops. You may also need to adjust the size or shape of the secondary loop. Try a larger, then smaller loop size to see if you can improve the coupling. It is sensitive to the materials used, so take some time at this point to experiment. Soon enough you should be able to find your own sweet spot for the loop to fall into resonance and start behaving like an antenna!

Steve Adler, VK5SFA, has been a licensed amateur since 1976. He worked in commercial radio broadcast engineering, heading up large AM, FM, and DAB networks.

He lives with his family in Adelaide, South Australia, and is a keen DXer with a sharp focus on the low-frequency bands and 6 meters. You can contact Steve at steve_adler@netspace.net.au.

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



A Reversible LF and MF EWE Receive Antenna for Small Lots

This antenna was the second-place winner of the 2018 *QST* Antenna Design Competition.

Michael K. Sapp, WA3TTS

The EWE antenna, originally developed by Floyd Koontz, WA2WVL, is one of several variants of low-noise, non-resonant receiving antennas with a resistive termination. The EWE provides a cardioid directional pattern with a deep rearward null and a broad forward beamwidth. The rear null zone can be used to reduce noise or attenuate strong interfering signals. The three-dimensional pattern shape of the null zone can be controlled to a certain extent by varying the termination resistance.

This version of the EWE was optimized for weak signal reception on the 2200- and 630-meter bands, but it is also useful on the 160- and 80-meter bands. It also maintains a useful measure of directivity into the 10,000-meter band (30 kHz range), and a reasonably low standing-wave ratio (1.3:1 typical) throughout the lower LF/MF range. Key features of this reversible LF/MF EWE include:

- Antenna transformers based on four BN73-02 binocular ferrite cores superglued together in a series-connected arrangement providing an 11:1 transformation ratio.
- Perimeter ground wire around the four antenna ground rods, as well as center x-wire ground wires and rods to improve consistency.
- A high-impedance binocular common-mode choke near each antenna transformer connection.
- Midpoint grounding of the 75 Ω coaxial feed-line pair.
- An opposing-phase, common-mode choke in the station location for the dual-receive feed lines.
- \blacksquare A 75 50 Ω isolation transformer to isolate the antenna system from the receive converter and ac service ground while antennas are in use (single-point common grounding provided when antennas are not used).

As with other EWE antennas, the dimensions are not critical and can be reduced to fit a small lot with some corresponding reduction in signal capture.

Basic EWE Antenna

A simple EWE antenna is comprised of a length of wire configured into an inverted-**u**. For 160- and 80-meter applications, the antenna is typically 12 to 15 feet tall and 35 to 50 feet long. One vertical seg-



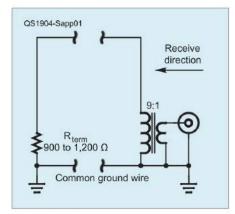


Figure 1 — Sketch of typical EWE receive antenna. Unidirectional low angle response is from the right side of the figure.

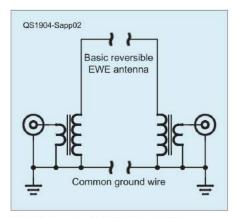


Figure 2 — LF/MF reversible EWE antenna at WA3TTS.

ment is connected to ground via a 9:1 transformer and the transformer end of the antenna becomes the forward receiving direction. The other vertical segment is terminated with a 900 to 1,200 Ω resistor to ground. The resistor end serves as the reflector end of the antenna. The horizontal wire section provides a phasing delay, and radio energy reflected from the termination resistor becomes additive at the matching transformer to provide the directional reception pattern across a relatively broad frequency range (see Figure 1).

A problem that can arise with the basic EWE antenna is that it can be very ground-dependent. Changes in ground conductivity cause the antenna pattern to be unstable over time with varying ground resistance.

Table 1 Parts List for MF/LF EWE Antenna

1. EWE Antennas (two) and Ground System

Quantity	Description				
200 feet	#14 AWG insulated stranded copper THHN wire per antenna. 100 feet per antenna				
240 feet	#14 AWG insulated stranded copper THHN wire for ground wires				
4	Ceramic antenna insulators (or equivalent made from PVC, Teflon, or similar material)				
250 feet	Nylon Paracord, 1/8- or 3/16-inch diameter for antenna tie-off supports				
4	Ground rods, 8 feet long, %-inch diameter, copper-clad, cut in half				
8	Ground rod lugs, brass or bronze, with stainless bolts				
500 feet	RG6QS coaxial cable				
25	Type F, male coaxial connectors, Belden SnapNSeal or equivalent				
1	SnapNSeal connector tool, if needed				
2	Dual type F grounding block for mid-point RG6QS cable ground				
1	SPST copper-blade knife switch (antenna system ground to ac mains ground)				
2	A/B coax switches, antenna type F, Pico Macom AB or equivalent, with internal 75 Ω termination resistors				
2	Refridgerator-type plastic boxes, or equivalent, for A/B switch weather protection				
	Scotch Brite pad and silicone oil for conductor preparation				

2. Antenna Transformers (four)

Description

Ougatitu

Description
NEMA boxes for antenna transformers
Ferrite cores, BN73-02, four per transformer
Kynar insulated #30 AWG, wire-wrapping wire
Single-sided PCB FR4 2 × 4 inch, for antenna transformer mounting
Superglue or quick-set epoxy for securing antenna transformers to board
Sets of 6-2 or 4-0 stainless hardware for mounting transformer board to inside of NEMA box lids
Through-hole mount double-female F-connectors
Stainless-steel bolts, 1/4 × 1 inch, for antenna and ground connections on antenna transformers, two each
Stainless-steel nuts and washers, for above
Large wire lugs (auto supply store) for wire connections to stainless hardware terminators

3. Antenna Transformer Common-Mode Chokes (four)

Quantity	Description
48	Ferrite cores, type FT-87A-W
32	Ferrite cores, type FT-82-75
8	Ferrite solid beads, type 43, 1/2-inch inner diameter
60 feet	Mini coax cable, Belden 9221
8	Through-hole mount double-female F-connectors
4	Electrical junction boxes, NEMA

4. Opposing Phase Common-Mode Choke

Quantity	Description
1	Electrical junction boxes and lids, commercial size, galvanized
4	BNC jacks, ground isolated
1	Ferrite core, Magnetics F-44932-TC, AsubL 7080 or equivalent
1	Ferrite core, 2.9-inch FT-90-W or equivalent

5. 75 – 50 Ω Isolation Transformer

Quantity	Description
8	FT50-75 ferrite cores cemented as a single 4 \times 4 toroid transformer core. 15 turns primary (75 Ω), 12 turns secondary (50 Ω), #24 enamel wire (for use in 10 – 500 kHz range).

38

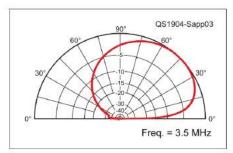


Figure 3 — Elevation radiation pattern of EWE antenna at 3.5 MHz.

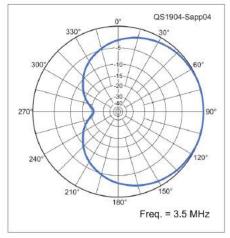


Figure 4 — Azimuth radiation pattern of EWE antenna at 3.5 MHz.

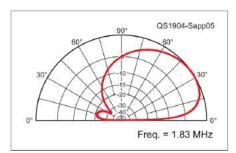


Figure 5 — Elevation radiation pattern of EWE antenna at 1.83 MHz.

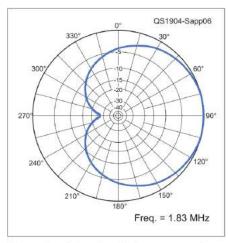


Figure 6 — Azimuth radiation pattern of EWE antenna at 1.83 MHz.

A simple remedy is to tie both ground rods together with a common ground wire.

The Two-Direction EWE Antenna

The original QST article describing the EWE suggests that it is possible to place an antenna transformer at both ends and send two receiving antenna feed lines to the radio station. This allows the termination resistor to be accessible at the radio location. Because the second antenna transformer steps down the ac impedance by a factor of the transformer impedance ratio, a lowvalue resistor can be used. Typically, it would be in the same resistance range as the characteristic impedance of the feed line used to connect the termination resistor to the antenna transformer (usually 50 or 75 Ω).

One can then swap the termination and receive feed-line positions at the radio receiver location to change receiving directions. One catch to this configuration is that the antenna transformers must have a common ground connection (primary and secondary) with the common ground wire at the antenna. I had the good fortune a few years back of exchanging emails with Floyd, who confirmed the need for a common ground wire on the EWE to make the antennas reversible, as well as to improve antenna pattern stability (see Figure 2). Typical EZNECmodeled antenna patterns are shown in Figures 3 through 10.2

LF/MF Antenna Transformers

The antenna transformers (see Figure 11) were made by gluing four BN73-02 cores end to end. I first tried using Teflon™ tape with a copper tube as the primary turn. This approach did not seem to make a measurable difference in insertion loss on back-to-back transformer tests versus three-turn wire transformer primary windings. The four-core BN73-02

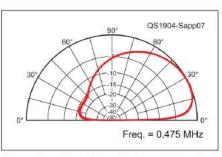


Figure 7 — Elevation radiation pattern of EWE antenna at 475 kHz.

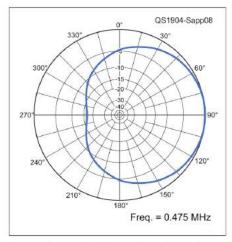


Figure 8 — Azimuth radiation pattern of EWE antenna at 475 kHz.

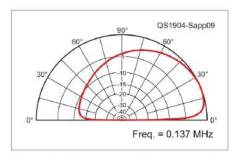


Figure 9 — Elevation radiation pattern of EWE antenna at 137 kHz.

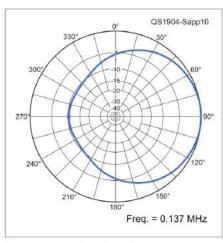


Figure 10 — Azimuth radiation pattern of EWE antenna at 137 kHz.



transformers have 0.1 dB insertion loss each at 500 kHz and 137 kHz. The insertion loss increases to 1 dB at 22 kHz. If you want the low-end transformer frequency response to roll off at around 100 kHz, then use three superglued BN73-02 cores instead. If you only want 630- and 160-meter operation, use a pair of superglued BN73-02 cores for the 3-to-10 turn ratio transformer. Kvnar insulated #30 AWG wire-wrap wire is a good match for the BN73-02 core size. The 3-to-10 turn ratio provides approximately an 11:1 impedance transformation (50 to 550 Ω , or 75 to 825 Ω , in 50 or 75 Ω systems). BN73-02 cores were selected on the basis of their superior IMD performance.3

Expanding to Four Directions

With two reversible EWE antennas positioned in a more or less orthogonal orientation, it is possible to have a four-way receiving setup. This arrangement can also be easily tested for SWR with an antenna analyzer and the dc loop resistance can be easily checked to ensure proper antenna operation.

I also find it useful to apply a momentary dc sealing current at a 12 or 24 V potential every few weeks via 100 Ω or so of current limiting resistance. This application of momentary sealing current keeps the coaxial and antenna connections at a low do resistance value. With 100-foot range feed lines, a dc loop resistance in the 8 to 10 Ω range (including choke resistances) has been shown to be a good indicator of proper antenna system operation.

Grounding Arrangements

For the EWE antenna ground system, a perimeter wire around the four outer ground rods made a worthwhile improvement in receive system performance. The idea is to equalize differences in ground potential at all four antenna-transformer locations, as well as to provide a measure of ground potential equalization across the antenna ground area. This limits ground potential differences that would otherwise contribute to common mode energy ingress into the antenna system.

Each ground rod is 4 feet long and each is made from an 8-foot-long, %-inch-diameter copper-plated ground rod. (Remember to call 811 before you dig or drive ground rods to ensure you won't hit underground utility lines.) For ground wire, I used #14 AWG vinyl-coated THHN house wire. I used brass/bronze ground rod

connectors, which have a single large stainless-steel fastener. I use scouring pads and silicone oil two or three times a year on the ground rod and wire connections to keep them clean and low resistance. It has been my experience that while attempting to receive WSPR 2.0 signals at 2,000 times below the average noise floor (–33 dB SNR), even small antenna and feed-line connection improvements make a noticeable difference.

Depending on the local noise environment at any given point in time, sometimes a lower noise solution is available by grounding the $75\,\Omega$ termination resistor to the station ac service ground (see Figure 12). At my particular location, the effect appears to be most noticeable on the 2200-meter band and in the lower to middle non-directional beacon band (190 to 300 kHz) to attenuate local noise sources.

Note that the horizontal and vertical gain values are in the -7 dBi range for 137 kHz, versus the -8 dBi range for 475 kHz. However, also keep in mind the 20 × Log(F) component of the free space path loss (FSPL) is 10.8 dB lower for far field signals arriving at the antenna at 137 kHz (-17.3 dB) versus 475 kHz (-6.5 dB).

Common-Mode Chokes

The opposing-phase common-mode choke uses ground-isolated BNC connectors and a commercial galvanized electrical junction box to also function as a magnetic shield. The electrical junction box is grounded to the ac mains, but the choke itself is floating relative to the ac-mains ground. Only the cable shields are shorted across the antenna side of the choke. This cable shield short stops the pair of coax feed cables from acting like an open-wire transmission line for common-mode suppression. Local 50 kW AM signal levels present as common-mode

energy and were noticeably attenuated with the cable pair shields tied together. Keep the two EWE feed lines as far away as possible from other RF cables and ac-power branch-circuit lines to minimize stray capacitive coupling. The schematic of the opposing-phase common-mode choke is shown in Figure 13, with a photo in Figure 14.

Reversible EWE Antenna Switching

I use 75 Ω A/B switches located outdoors near the antennas in plastic

Fitting the EWE Into Your Space

My real estate limitation is a 50×200 foot lot. My house is toward the front of the property and garage in the middle. This leaves about a 50×100 foot backyard to share antenna space with the two reversible EWEs at the back of the property and my HF vertical setup as a ground plane secured at the back of my garage. The EWE antennas are supported by available trees in a 30×40 foot space. This makes the diagonals 50 feet long, the length of the horizontal sections of the two EWE antennas.

The height of the EWE antennas is approximately 25 feet. I allow one horizontal EWE section to droop about 2 feet below the other to minimize capacitive and inductive coupling between the antenna wires. For LF weak signal receiving, it is essential to understand that in a high-impedance circuit (including nearby EWE antenna wires), it only takes a few picofarads of capacitance for conductors such as antenna wires or coaxial cables to share RF energy at LF/MF frequencies. Figure 12 details the essential design of this four-way LF/MF EWE antenna system.

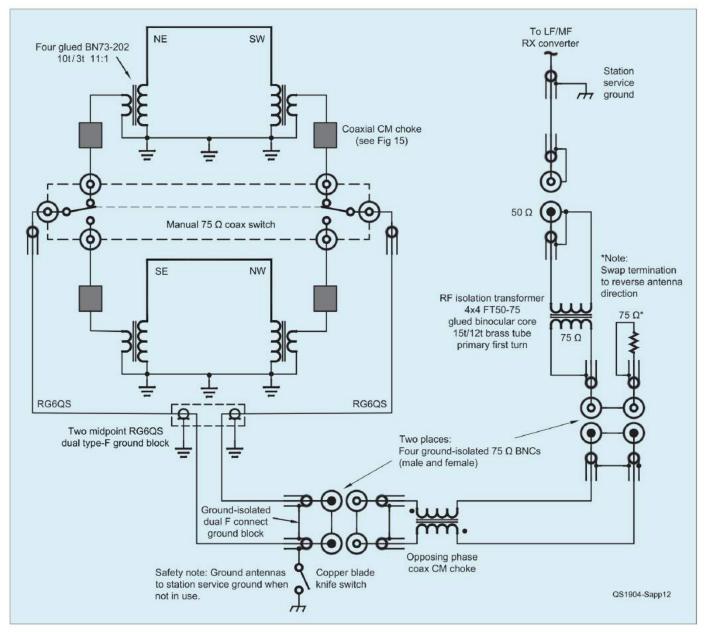


Figure 12 — The essential design details of the four-way LF/MF EWE antenna system.

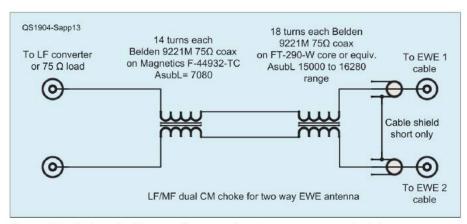


Figure 13 — Schematic diagram of the opposing-phase common-mode choke.



Figure 14 — Photograph of the opposing-phase common-mode choke.



Figure 15 — Photo of the coaxial common-mode choke, used on each antenna termination.

kitchen boxes for antenna switching. This arrangement works for me because I tend to use WSPR mode extensively and often leave the antenna directions the same for several hours or overnight. When I do make antenna switch changes, I do not mind walking out to the switches to reset antenna directions.

It is important to note that $75\,\Omega\,\text{TV}$ A/B switches are typically designed to automatically terminate the unused port in $75\,\Omega$. The internal switch termination is rather convenient in this two-EWE configuration. For example, if both antenna switches are set in the A position, then both ends of one EWE come back to the radio station location via the two cables. If A is the northeast/southwest antenna, then I have those two options for termination and receiver connections.

But, if I set one A/B switch to A and the other A/B switch to B. then there are two antenna transformers selected on two EWEs and the other two antenna ends automatically terminate in 75 Ω inside the A/B switches. Thus, you can run two separate receivers on the two EWE antennas. In my A/B switching setup, I can choose northwest and northeast or southwest and southeast for feeding individual receivers. With the aid of a two-port 180° LF/MF combiner, it is possible to combine northwest and northeast to obtain an east-west bidirectional pattern.

Trees and LF/MF EWEs

I support my LF/MF EWE antennas from available trees in my yard, with little choice but to live with the situation. A fishing reel and sling shot get the nylon support cord over the trees to the desired 25-foot level. A decision was made to close-couple the vertical sections of the EWEs to the trees, based in part on W5JGV's work with a tree-coupled antenna for LF/MF.⁶ For LF, if you view the live tree as a high-impedance RC circuit,

the EWE wire is capacitively coupled in near proximity. We also know that LF/MF energy can transfer via relatively small capacitance values at LF/MF in high-impedance circuits. My assumption is that the live tree both absorbs RF energy and reradiates a portion of the RF energy. Basically, I am attempting to minimize the tree RF absorption loss with close coupling of the EWE wire to the tree trunk.

Notable Reception Results

The EWE antennas have been used over several years with WSPR 2.0 reception reports on the 630-meter band as far away as Alaska, Hawaii, and Australia to the west, Europe to the east, and Cayman Islands to the south (ZF1EJ). Although my e-probe antenna is set up and works reasonably well, it has only made transcontinental receptions in the lower 48 states on the 630- and 2200-meter bands and at lower WSPR 2.0 capture rates versus what the EWE antennas are capable. ZF1EJ is regularly captured to the south with the e-probe on the 630-meter band. The southeast EWE seems to hear ZF1EJ much better than the southwest EWE, possibly from pattern skewing due to local objects in the nearby environment.

In one particularly good opening to the west, over 50 K9FD captures were made on my northwest EWE antenna in one overnight fall session on the 630-meter band. The northwest EWE always seems to capture K9FD signals better than the southwest EWE for some reason. I have had a transcontinental 630- to 80-meter CW cross-band contact with VE7SL, with reception on the northwest EWE. The farthest station received to the east has been DH5RAE in WSPR 2.0 mode in the 630-meter band on the northeast EWE. VE7BDQ was received at his estimated 200 mW ERP on the 137 kHz band on WSPR 2.0 mode on the northwest EWE in midwinter.

Additional performance and reception reports are found in the *QST*-in-Depth version of the article (www.arrl.org/qst-in-depth).

Conclusions

After several LF/MF-listening seasons, the EWE antennas have provided excellent weak-signal reception at my station location. Front-to-back (F/B) ratios have been observed to generally match the *EZNEC* model pattern predictions in the LF/MF range. At higher angle, short-hop D-layer paths, the F/B ratio is only 5 or 6 dB, which is consistent with the modeled antenna patterns. F/B ratios of 10 to 13 dB or more (137 and 475 kHz, respectively) occur on signals arriving at low angles.

For the 160- and 80-meter bands. the height of the antenna raises the peak front antenna pattern incoming signal angle more than what one would desire for long-distance weaksignal and low-angle reception. From casual reception observations made on the 160- and 80-meter bands, there is still a measure of useful directivity with the 25-foot-tall by 50-foot-long antenna size. For future testing, I may try some type of switch arrangement midway up each vertical section of the EWE wire and add a second horizontal wire. That arrangement would allow switching in a lower horizontal wire to improve the low-angle reception on 160- and 80-meter bands.

Notes

- ¹F. Koontz, WA2WVL, "Is this EWE for You," QST, Feb. 1995, pp. 31 – 33.
- ²Several versions of EZNEC antenna modeling software are available from developer Roy Lewallen, W7EL, at www.eznec.com.
- 3"Intermodulation in BroadBand Transformers," www.cliftonlaboratories. com/imd_in_broadBand_transformers. htm.
- 4"Sealing Current Generator for a Telephone Circuit," US Patent 5,131,033.
- 5"Grounding for the Control of EMI," https://m.eet.com/media/1114898/duff_ ch_5.pdf.
- ⁶See QST-in-Depth for additional performance results at www.arrl.org/qst-in-depth.

Mike Sapp, WA3TTS, studied electrical engineering at Pennsylvania State University for 3 years before switching to a business administration major in accounting at Robert Morris College, where he earned his Bachelor's degree. He then continued with 30 credits of graduate work in business administration at Robert Morris.

He is a Senior Researcher and Technical Writer for a Pittsburgh-based patent services enterprise.

Mike passed his Novice-class exam in 1972 and passed the Amateur Extra-class exam in 1974. He is a past president and past vice president of the Steel City Amateur Radio Club, a current member of the W3SO multioperator VHF/UHF contest team, and a current member of the Pittsburgh Antique Radio Society. You can reach Mike at wa3tts@verizon.net.

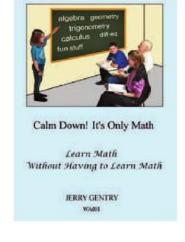
For updates to this article, see the QST Feedback page at www.arrl.org/feedback.



Strays

QST Congratulates...

ARRL Life Member Jerry Gentry, WA0H, on the publication of two new books: *Calm Down! It's Only Math* and *Calm Down! Learn to Program.* Both books are available on **Amazon.com**.



The 3/8-Wavelength Vertical A Hidden Gem

This vertical antenna design is the third-place winner in the 2018 QST Antenna Design Competition.

Joe Reisert, W1JR

As the solar cycle rapidly winds down, the upper HF bands will be less available, but 20 meters will still be plenty active during the day. Many 20-meter operators are always looking for a small or stealthy antenna with good performance, and the 3/8-wavelength vertical antenna is a good candidate to fill that role.

When my son, Jim, AD1C, was first licensed, he built a homebrew receiver and 5 W transmitter for 40 meters. Later, he wanted a simple but efficient antenna. As I looked for a solution, the %-wavelength vertical stood out. It is only about 50 feet in height on 40 meters. Because this vertical has a series impedance of about 200 Ω resistive, plus an inductive reactance of about 300 – 700 Ω , it is easily matched with a 4:1 step-up toroid transformer followed by a series matching capacitor. We strung up an approximately 50-foot wire in a nearby tree and four guarter-wavelength, ground-mounted radials to complete the installation and quickly matched the antenna. It worked quite well in contacting about 50 DXCC entities using Jim's 5 W.

Vertical Antenna Considerations

Ground planes are guite popular (see Figure 1). They are simple to construct and usually don't require matching networks, but do require some tie-down points. Elevated radials, however, can have several problems, including visibility and safety. The ends of the insulated radials are a high voltage point. A quarter-wavelength vertical with many radials on or near ground is also popular.

For maximum efficiency, they require a minimum of 16 quarterwavelength radials.1 Performance often suffers from ground clutter near the base. The typical EZNEC modeled radiation pattern with a takeoff angle of 26° is shown in Figure 2.2 The current distribution over the monopole is shown in Figure 3. Note that the region of highest current — the place where maximum radiation takes place — is at the bottom of the antenna.

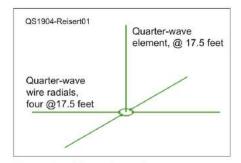


Figure 1 — Dimensions of a quarter-wave, ground-plane vertical antenna for 20 meters. The dimensions are similar for a groundmounted version, but more radials are required.



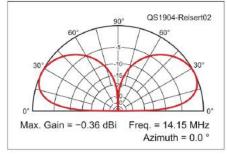


Figure 2 — Elevation pattern of a groundmounted, guarter-wave antenna for 20

Table 1 Parts List fo	or 20-Meter, ¾-Wave Vertical Monopole		
60 – 70 feet 1 2 1 4 – 6 feet	#14 AWG PVC insulated wire for radials Plastic electrical box for the matching network (see Figure 10) Capacitors, ceramic disc NPO 20 pFd 1 – 2 kV, as required Ferrite toroid core, T-240-61 2.4-inch OD #16 AWG PVC insulated twisted-pair wire for the toroid transformer RF coaxial socket to match coax cable		
Quantity	Material (for tubing version only)		
5 – 6 1 1	Aluminum tubing 1 – 1.5 inches diameter, 5 – 6 feet long I used a surplus MFJ-1792 vertical antenna Suitable base mount supported by around a 1-inch diameter stake Base insulator		
Quantity	Material (for wire version only)		
2 26 feet	Antenna insulators #12 AWG copper antenna wire		

Meet the 3/8-Wave Vertical

The %-wavelength vertical antenna (see Figure 4) is often an overlooked design. It has several advantages over the common quarter-wave vertical and just adds 50% to the height. Here are some advantages:

- It has a low takeoff angle of radiation at 23°, versus 26° for a ground-mounted, quarter-wave vertical (see Figure 5 and compare to Figure 2). This is a big advantage for working DX.
- It will work well even ground mounted because its maximum radiation point is ½ wavelength (about 8.7 feet at 20 meters) above the ground (see Figure 6). This is above the typical clutter present at ground level.

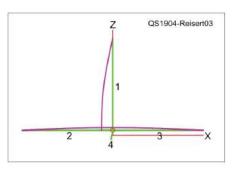


Figure 3 — Current distribution of a quarterwavelength vertical monopole. Note that for the ground-mounted version, the maximum current and location of the maximum radiation are near the base, where nearby objects can diminish radiation.

- It is easy to impedance match and, once matched, has a wide bandwidth with low SWR.
- Finally, it has a much higher radiation impedance. Therefore, four quarter-wavelength radials are all that is required for good performance.

Construction

This antenna can be easily constructed using either aluminum tubing or wire. I chose to modify a spare commercial vertical that I already had from a prior project. It had all the aluminum and hardware I needed, plus a good base and base insulator with tilt-over capability. It went together quickly (see Figure 7). Later, a wire equivalent was built at

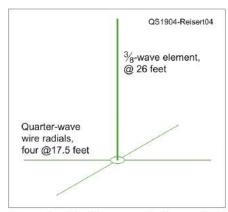


Figure 4 — The %-wave vertical, a practical alternative to the quarter-wave, with some advantages.

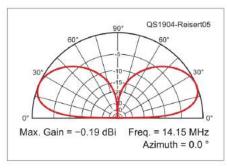


Figure 5 — Elevation pattern of a ground-mounted %-wave antenna for 20 meters.

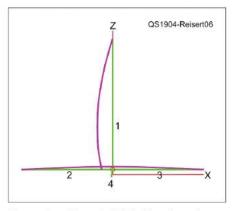


Figure 6 — Current distribution along the %-wave monopole. Note the maximum current, so maximum radiation is ½ wavelength up from the base. This is about 8 feet for 20 meters.

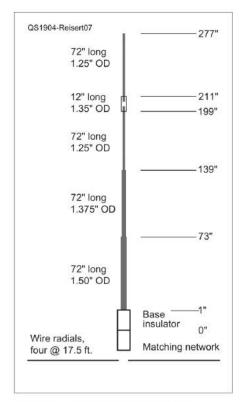


Figure 7 — Tubing construction for a %-wavelength vertical antenna.

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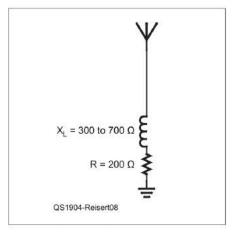


Figure 8 — Typical %-wavelength antenna base feed impedance.

the same location using ordinary seven-conductor #12 AWG copper antenna wire. It requires a top and bottom insulator and some higher structure such as a tree to hold it in place. It had a similar overall length.

Matching Network and Tuning

The %-wavelength vertical antenna has a series impedance of approximately 200 Ω resistive with a series inductive reactance of 300 to 700 Ω (see Figure 8). Therefore, a 4:1 stepup transformer will match the resistive component, and a series capacitor tunes out the inductive reactance (see Figure 9). Typically, the required series capacitance is approximately 40 to 50 pF at 14 MHz and is not critical. A photo of a typical matching network in a 4 × 4 × 2 inch plastic box from an electrical supplier is shown in Figure 10.

The matching network is easy to use. Figure 11 shows a typical setup using an antenna analyzer to adjust for minimum SWR on the wire version of the antenna. Connect the ground side of the antenna connector to the on-ground radials. Connect the upper terminal to the bottom of the vertical tubing or wire. Next put in the specified capacitors or a ceramic (or equivalent) variable capacitor set to approximately 40 pF. Connect an SWR meter to the base.

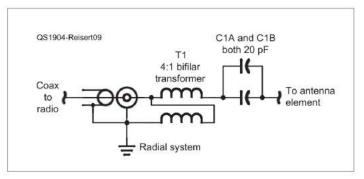


Figure 9 — Impedance-matching network for the ¾-wavelength vertical. T1 is bifilar twisted pair #16 AWG PVC-covered wire, seven turns on T-240-61 2.4-inch outside diameter toroid. C1A and B are typically 20 pF, 2 kV ceramic disk capacitors. Lower voltage capacitors are useable for low-power operation.

Ground Radials

For optimum performance, ground radials are required on most vertical monopoles. They can be made of wire of any gauge or material. I recommend #14 AWG copper wire with a PVC covering because the makeup of the ground material will have little effect on long-term performance. The 3/4-wavelength vertical only requires four quarter-wave radials, which can be installed on the ground. The best length is a quarter-wavelength, or approximately 15 - 17 feet at 20 meters, but length is not critical.3



Figure 10 — Construction of impedancematching network of Figure 9. The enclosure is a plastic electrical box.



Figure 11 — An antenna analyzer is used in this typical test setup to adjust the matching of the antenna. The wire version is shown.



Figure 12 — A ferrite in-line choke is installed on the coax feed line to minimize common-mode current effects.

To prevent radiation from the feed line, it is recommended that a ferrite inline choke (see Figure 12) be installed on the feed line. A 2.4-inch outside diameter ferrite toroid with type 61 ferrite and 10 – 12 turns of RG-303 PTFE coax, W1JR style, makes a good choke.⁴ You should now be ready to test.

First, measure the SWR. The upper tubing or wire height can be lengthened or shortened a few inches if required to minimize SWR in the 20-meter band. Next, if a variable capacitor is used, adjust it for best SWR. Continue back and forth until the desired SWR is obtained. Typical SWR results are shown in Figure 13. Then replace the variable capacitor (if used) with fixed capacitors as shown in Figure 9. Because current and voltage are high at this point, two

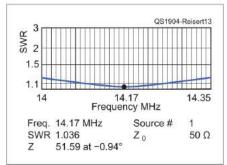


Figure 13 — Typical SWR curve for a 20-meter %-wavelength vertical antenna, tubing or wire, after the matching network is adjusted. Note the bandwidth is comfortably wide.

parallel high-voltage ceramic-disk capacitors are recommended.

Performance Results

With this antenna, I quickly qualified for Worked All Continents on 20 meters, running only 100 W. I was able to break through the TX5T Austral Islands pileup in short order to complete the objective.

This antenna can easily be scaled to other amateur bands using the %-wavelength principles. In less than 1 hour, I added two more tubing sections on the top of the 20-meter antenna to a total of approximately 33 feet of tubing. I lengthened the radials to a quarter wavelength, retuned the series capacitor (approximately 52 pF) for minimum SWR and was operational on 30 meters. Immediately, I contacted an African station while running 100 W. However, this modification is tall enough that I recommend a few insulated guy wires.

Notes

¹R. Severns, N6LF, "Radial System Design and Efficiency in HF Verticals," www.antennasbyn6lf.com.

2Several versions of EZNEC antenna modeling software are available from developer Roy Lewallen, W7EL, at www.eznec.com.

³See Note 1.

⁴J. Reisert, W1JR, "Simple and Efficient Broadband Balun," Ham Radio Magazine, Sep. 1978, pp. 12 – 15. Joe Reisert, W1JR, is an ARRL Life Member and Amateur Extra-class licensee. Joe was first licensed in 1951 as WN2HQL, one of the first holders of the new Noviceclass license.

He received his AAS degree in electronic technology from the State University of New York at Farmingdale, Long Island, in 1956. Over the years, he has been employed by Sperry, IBM, Lockheed Missiles and Space, Fairchild Microwave, The MITRE Corp., Wang Labs, and Cushcraft. In 1992, he formed Antennaco, Inc. and designed and manufactured commercial antennas for VHF, UHF, and microwave communications.

His Amateur Radio interests are primarily DX from HF through microwave. He was a pioneer on Earth-Moon-Earth communications, especially on 70 centimeters. He holds DXCC 392/340, DX Challenge 3160, 13BWAS, 11BDXCC, and IOTA 1100. In 2014, he was inducted into the CQ DX Hall of Fame.

Joe was at one time on the ARRL DX Advisory Committee and was also the Chairman of the VHF/UHF Advisory Committee that developed the present VHF/UHF Band Plans. He has published over 150 technical papers and given over 125 invited talks on various Amateur Radio subjects. You can reach Joe at w1jr@arrl.net.

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



Feedback

- In the article "A Force-Sensing CW Paddle" by Art Heft, K8CIT, in the February 2019 issue of QST, Pins 2 and 3 of U1A and Pins 5 and 6 of U1B should be swapped.
- In the article "An Arduino-Powered RF Detector" by Teri Bloom, AC5YL, in the March 2019 issue of *QST*, there are two errors in the schematic diagram shown in Figure 3. The Arduino Nano pin labeled "RAW" should have been labeled "VIN." The cathode of diode D1 should be connected to the Vin pin, not the 5.5 V pin.

Product Review

Xiegu Communication X5105 HF/6-Meter QRP Transceiver

Reviewed by Phil Salas, AD5X ad5x@arrl.net

For many years, I've enjoyed operating QRP (low power) portable with a number of popular commercial and homebuilt transceivers. I was looking forward to trying a new entry into the compact QRP transceiver field — the Xiegu X5105 — which is made in China and distributed and supported by MFJ Enterprises in the US.

Overview

The Xiegu X5105 is an attractive and very solid-feeling, compact transceiver that covers the 160- to 6-meter ham bands, along with a general-coverage receiver that tunes continuously from 500 kHz to 54 MHz. Transmit power is adjustable from 0.5 to 5 W in half-watt increments, and operating modes include SSB, CW, FM, AM (1.5 W carrier), as well as digital modes using an external computer.

The X5105 offers many features, including split-frequency operation, receiver incremental tuning (RIT), a built-in SWR bridge, an automatic antenna tuner (ATU), a receiver preamp and attenuator, a noise blanker, digital noise reduction, a notch filter, and variable band-pass audio filters. Additionally, there is a built-in automatic keyer with three memories, along with a CW trainer. And finally, there is a speech processor for the SSB operator.

A 3.6-inch, backlit LCD shows everything necessary during operation. In addition to the clearly marked X5105 operating controls, the included microphone's multifunction keypad permits access to most of the radio's features. There is a built-in speaker,



plus enough audio power to drive an external speaker if desired. There's even a built-in, front-panel microphone and manual transmit (PTT) switch, should you wish to operate the radio as a handheld.

Interfaces and Controls

The X5105 is loaded with controls and interface connectors, yet everything is easily accessible. Figure 1 shows the radio's top and side panels. On the left side are the BNC antenna jack, plus connectors for the first IF output, an external speaker or headphones (3.5-millimeter stereo), and do power (2.1 × 5.5 millimeters). On the right side, you'll find a mini-DIN eightpin ACC connector for digital mode interfacing and a 3.5-millimeter stereo jack for your CW key (manual, paddle,

Bottom Line

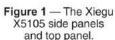
The Xiegu X5105 is a compact, feature-loaded, 5 W portable transceiver that should satisfy any QRP operator.

or external keyer). There is also an ATU interface for automatic band changing with external devices, and a COM serial port interface for computer control and firmware updates. Finally, there is an RJ45 microphone jack.

On the top of the radio are up/down (UP/DN) buttons for frequency band selection and volume control (labeled with large and small speaker icons), along with the aforementioned PTT switch. A small, front-mounted speaker is located just to the left of the LCD.

The four buttons under the display are soft keys with functions that change based on the menu item selected. The soft key functions are displayed on the LCD screen. The functions of all other buttons are clearly marked. The tuning knob is dual purpose in that it is also used to change parameters when the menu is selected. The other buttons are not multipurpose — what is labeled is what you get, which makes operating the radio very straightforward. There are also three status LEDs: T/R (transmit/receive









indicator), **DATA** (a signal is present), and **LINK** (external equipment is connected).

Power Requirements

The internal 3,800 mAh lithium battery permits 6 to 8 hours of operation between charges. Of course, the X5105 can operate from an external 13.8 V dc, 2.5 A power supply. With an external power supply connected, the X5105 automatically powers itself from that power supply.

Charging requires an external power supply of at least 13.5 V dc. When the X5105 is off and an external power supply of 13.5 V dc or greater is connected, the radio automatically begins charging the internal battery. CHARGING... is displayed, along with the external input voltage and the internal battery voltage. A fully discharged battery takes about 10 hours to charge. When the battery is charged, the display shows CHARGE ... FINISH. When the X5105 is turned on. you must select CHG ON in the menu to charge the internal battery while receiving. However, you cannot transmit during the charging process.

Firmware Updates

MFJ maintains links to the latest X5105 firmware and documentation on their website. A USB serial cable with a 3.5-millimeter phone plug on one end is provided with the radio for firmware upgrades. Updating the firmware requires numerous steps, including downloading a freeware terminal emulator program. All of the programming steps are detailed in the X5105 user manual. While this is a somewhat tedious process, it is not at all difficult.

Testing

Table 1 and Figures 2, 3, and 4 show the results of testing in the ARRL Lab, with additional comments in the "Lab Notes" sidebar. In addition to the ARRL Lab tests, I did detail testing on transmit power versus transmit power setting and found that the power setting is reasonably accurate.

Next, I did some automatic antenna tuner (ATU) loss testing. There is no information given on the ATU's capability, so I ran tests to determine its resistive matching range using a precision setup. The results were interesting. From 160 to 40 meters, the loss characteristics follow what I normally expect to see — tuner loss increases with SWR. On 20 to 6 meters, however, in some cases, the loss at a higher SWR measured less than at a lower SWR. I did check the X5105 RF output spectrum and verified that the unit was not oscillating.

I can't precisely measure the power into the auto tuner because the ATU is internal to the X5105, and so my reference power is the bypassed power. I suspect that on the higher bands, the actual impedance of the tuned ATU may impact the RF output of the X5105. In some cases, the transmitter output power may be higher when the SWR is not precisely tuned at 1:1.

I also performed open/short circuit testing. Ideally a tuner should not be able to match an open or short. If it does, this means that it is tuning into its own internal losses. No antenna tuner is lossless, because it is built with real-world components, and so most wide-range antenna tuners can find a match on one or more frequencies when connected to an open or a short. However, I found no instances where the X5105 ATU would match an open or short. This implies that the X5105 ATU has low internal losses obviously a desirable characteristic. See the QST in Depth web page (www.arrl.org/qst-in-depth) for detailed tables with my power level and ATU loss rest results.

General Operation

Operating the X5105 is a pleasure. As mentioned earlier, the controls and buttons are self-explanatory. The menu system is well thought out. Tap the MENU button, and you enter the FUNCTION menu for setting frequently used parameters, such as split-frequency operation, noise reduction, filter bandwidth, break-in, and so on. Press and hold the MENU button, and you enter the SYSTEM menu where you will find parameters that are changed infrequently, such as beep

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level, sidetone frequency, compression level, and others.

The X5105 internal antenna tuner is very easy to use. Tap the ATU button once to engage the ATU, and a TUNE icon appears at the top of the screen. Then press and hold the ATU button to start the tuning process. When tuning is complete, the radio automatically switches back to receive mode. To disengage the tuner, press ATU once and the TUNE icon will disappear.

CW Operation

The X5105 includes a number of features tailored to the CW operator, which was of major interest to me as CW is my favorite mode. The internal keyer speed range is rated for 5 to 100 WPM. Because I adjust keying speed frequently, I leave FUNCTION MENU 4 displayed on the soft keys. Then, to change speed, I simply tap the KSP (keying speed) soft key, adjust the speed, and tap the soft key again.

CW pitch is adjustable from 50 to 1,200 Hz (800 Hz default), and the sidetone sounds during adjustment. You can select either CW or CWR (reverse) depending on interference conditions. The default CW filter bandwidth is 500 Hz, but this can be set to 2.4 kHz or 6 kHz by tapping the FIL soft key in the FUNCTION menu. You can also customize the filter bandwidths by adjusting the characteristics in the SYSTEM menu. There is also an audio notch filter for eliminating a close-in interfering tone, and the three CW message memories are each capable of up to 100 characters.

There are, however, a few anomalies with CW operation. First, the X5105 is supposed to be capable of full-break-in operation. This is not the case. If you set break-in delay to zero, the keying becomes very erratic at higher speeds. Adding just 5 milliseconds of break-in delay cures this problem, but the receiver does not recover between Morse code characters as it should with just 5 milliseconds of delay. This is due to the 116-millisecond receive processing delay, as measured in the ARRL Lab.

Table 1
Xiegu Communication X5105, serial no. X0300623, v1.0.06

Manufacturer's Specifications	Measured in the ARRL Lab		
Frequency coverage: Receive, 1.0 – 54 MHz, transmit, 160 – 6 meter, amateur bands.	Transmit, as specified. Receive, 0.5 – 54 MHz.		
Power requirement: 13.8 V nominal at 500 mA max. (receive) and 2.5 A max. (transmit). Operating voltage: 9 – 15 V dc. Internal battery: 12 V dc, 3,800 mAh.	At 13.8 V dc: Transmit, 2.1 A (max). Receive: 533 mA (no signal, max. volume, max lights); 433 mA backlight off). Off, charging internal battery, 407 mA.		
Modes of operation: SSB, CW, AM, FM, data.	As specified.		
Receiver	Receiver Dynamic Testing [†]		
SSB/CW sensitivity: 1.0 – 1.8 MHz, 0.35 μV; 1.8 – 30 MHz, 0.25 μV; 50 – 54 MHz, 0.25 μV.	Noise floor (MDS), 500 Hz BW: Preamp Off On 1.0 MHz -124 dBm -127 dBm 3.5 MHz -122 dBm -129 dBm 14 MHz -124 dBm -135 dBm 50 MHz -123 dBm -130 dBm		
AM sensitivity: 1 – 1.8 MHz, 10 μV; 1.8 – 30 and 50 – 54 MHz, 2 μV.	10 dB (S+N)/N, 1 kHz tone, 30% modulation: 6 kHz BW: Preamp Off On 1.02 MHz 3.89 μV 2.14 μV 3.8 MHz 3.42 μV 1.70 μV 29 MHz 3.31 μV 1.19 μV 50.4 MHz 11.1 μV 3.84 μV		
FM sensitivity: For 12 SINAD, 28 – 30 MHz and 50 – 54 MHz, 0.35 μV.	For 12 dB SINAD, 3 kHz deviation, 15 kHz BW: Preamp Off On 29 MHz 4.51 μV 0.56 μV 52 MHz 1.84 μV 0.66 μV		
Blocking gain compression dynamic range: Not specified.	Blocking gain compression dynamic range, 500 Hz BW; 20 kHz offset		

ARRI Lah Two-Tone IMD Testing (500 Hz handwidth)

Reciprocal mixing dynamic range:

Not specified.

ARRL Lab Two-To	ne IMD Testing	(500 Hz band	lwidth)	
Band/Preamp 3.5 MHz/off	Spacing 20 kHz	Measured IMD Level -122 dBm -97 dBm -34 dBm	Measured Input Level -33 dBm -24 dBm 0 dBm	IMD DR 89 dB
14 MHz/off	20 kHz	-124 dBm -97 dBm -42 dBm	-32 dBm -17 dBm 0 dBm	92 dB
14 MHz/on	20 kHz	-135 dBm -97 dBm	–43 dBm –28 dBm	92 dB
14 MHz/off	5 kHz	-124 dBm -97 dBm -13 dBm	-53 dBm -43 dBm 0 dBm	71 dB
14 MHz/off	2 kHz	-124 dBm -97 dBm -10 dBm	-55 dBm -44 dBm 0 dBm	69 dB
50 MHz/on	20 kHz	−130 dBm −97 dBm	-38 dBm -26 dBm	92 dB
Second-order intercept point: Not specified.			Preamp off/on: 14 MHz, +37/+37 dBm; 21 MHz, +39/+39 dBm; 50 MHz, +47/+47 dBm.	
FM adjacent channel rejection: Not specified. Preamp on: 29 MHz, 59 dB; 50 MHz, 66 dB.				, 59 dB;

14 MHz, 20/5/2 kHz offset: 91/91/70 dB.

Manufacturer's Specifications FM two-tone, third-order IMD dynamic range: Not specified. S-meter sensitivity: Not specified. For S-9 65.2/1 Squelch sensitivity: Not specified. At thres 1.32 µ pream Receiver processing delay time: Not specified. Spurious and image rejection: IF rejection, 60 dB. Image rejection, 70 dB. IF/audio response: Not specified. Range a CW (5 SSB (6

AM (6 kHz BW): 2 - 3,830 Hz. **Transmitter Transmitter Dynamic Testing** Power output: 5 W (CW, SSB, FM); At 13.8 V dc: HF, 0.5 to 5 W (typical CW, 1.5 W (AM). SSB, FM): 50 MHz, 0.4 to 3.7 W. At minimum operating voltage: HF, 4.75 W (typ.); 50 MHz, 3.7 W. Spurious and harmonic suppression: 45 dB. HF, 68 dB typical; 51 dB worst case (15 m); 50 MHz, 67 dB. Meets FCC requirements. Third-order intermodulation distortion (IMD) 3rd/5th/7th/9th order, 5 W PEP: -37/-43/-48/-51 dB (HF, typical) -26/-35/-44/-49 dB (worst case, 160 m) products: Not specified. -36/-40/-45/-48 dB (50 MHz) CW keyer range: 5 to 100 WPM. Tested at 3.4 to 40 WPM, iambic modes A and B. See text. CW keying characteristics: Not specified. See Figures 2 and 3. Transmit-receive turnaround time (PTT SSB and CW, AGC fast, 214 ms. release to 50% audio output): Not specified.

Size (height, width, depth): 2.0 × 7.1 × 3.8 inches (including protrusions); weight, 2.0 lbs.

Measured in the ARRL Lab

59 dB;* 52 MHz, 66 dB.

Preamp on: 20 kHz offset, 29 MHz,

For S-9 signal, preamp off/on: 14 MHz, $65.2/10.0~\mu V$; 50 MHz, $70.7/12.3~\mu V$.

At threshold: Preamp on, FM, 29 MHz, 1.32 μV; 52 MHz, 1.35 μV. SSB, preamp off/on, 14 MHz, 0.66/0.11 μV.

IF rejection: 14 MHz, 96 dB; 50 MHz, 86 dB. Image rejection: 14 MHz, 76 dB;

CW (500 Hz BW): 492 – 822 Hz; SSB (2.4 kHz BW): 310 – 2,720 Hz;

SSB, 184 ms; FM, 29 MHz, 100 ms;

52 MHz, 122 ms.

See Figure 4.

50 MHz, 69 dB.

Range at -6 dB points:**

10 MHz offset, 114 dB; 52 MHz, 116 dB.

The X5105 is an excellent semibreak-in performer if you leave the break-in delay set at the default 200 milliseconds.

Receive-transmit turnaround time (TX delay):

†Receiver tests with 500 Hz IF filter and 300 - 800 Hz audio filter.

*Measurements are noise limited at the value indicated.

Transmit phase noise: Not specified.

Not specified.

**DSP is adjustable

Another CW issue is that glitch at the beginning of the first dit on any new transmission, as can be seen in Figure 2. This glitch does not reoccur until you pause long enough for the receiver to recover and then transmit again. However, I could not hear anything funny with that first dit when listening on an adjacent receiver. So this is more of an "observable on an oscilloscope" problem and not so much of a real-world problem.

The last issue has to do with the CW rise and fall times. Although the CW keying waveform has improved significantly since initial testing (see the "Lab Notes" sidebar), the rise time is only about 1.5 milliseconds, and the fall-time is even less. Typically, rise/fall times shorter than about 4 milliseconds lead to key clicks. As you can see in Figure 3, the keying sidebands are stronger below the intended frequency.

I cabled a sampled S-7 signal from the X5105 into a separate monitor receiver (an IC-706MKIIG with 500 Hz CW filter). Key clicks were noticeable up to

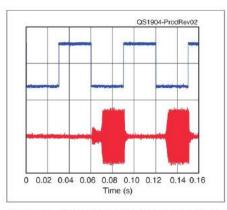


Figure 2 — CW keying waveform for the Xiegu X5105, showing the first two dits in full-break-in (QSK) mode using external keying and the default rise time setting. Equivalent keying speed is 40 WPM. The upper trace is the actual key closure; the lower trace is the RF envelope. (Note that the first key closure starts at the left edge of the figure.) Horizontal divisions are 10 ms. The transceiver was being operated at 5 W output on the 14 MHz band.

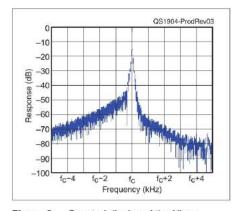


Figure 3 — Spectral display of the Xiegu X5105 transmitter during keying sideband testing. Equivalent keying speed is 40 WPM using external keying and the default rise time setting. Spectrum analyzer resolution bandwidth is 10 Hz, and the sweep time is 30 seconds. The transmitter was being operated at 5 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.

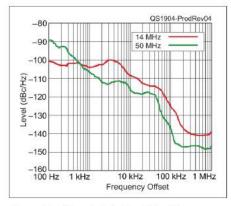


Figure 4 — Spectral display of the Xiegu X5105 transmitter output during phase-noise testing. Power output is 5 W on the 14 MHz band (red trace), and 3.7 W on the 50 MHz band (green trace). The carrier, off the left edge of the plot, is not shown. This plot shows composite transmitted noise 100 Hz to 1 MHz from the carrier. The reference level is -80 dBc/Hz, and the vertical scale is 10 dB per division.

5 kHz below the X5105's transmit frequency, and 2 kHz above the transmit frequency with this quiet setup. As a comparison, when my Elecraft KX3 was connected into the same setup, I heard no key clicks.

Of course, with the typically low signal levels of QRP transmitters, the key clicks will fall below the normal band noise floor. During numerous contacts, I asked the receiving stations to tune off to the side, and they were unable to hear the clicks. Regardless of whether they can be heard or not, the key clicks contribute to the noise floor, and the problem will undoubtedly show up if an external amplifier is used. I hope that Xiegu will continue to improve the rise/fall times in a future firmware update.

Voice Operation

Speech compression is turned on and off via a soft key in the FUNCTION menu. Compression level and microphone gain are set in the SYSTEM menu. While there is no transmitter audio equalizer, the transmit audio is excellent, as monitored on a separate transceiver as well as on-the-air reports.

The default SSB filter bandwidth is 2.4 kHz, but you can select a 6 kHz bandwidth for receiving extended SSB (ESSB). You can also adjust the low- and high-pass receive. I found that the default receive audio passband response was very pleasant.

Digital Modes

The X5105 can be operated with a computer and sound card for FT8, RTTY, PSK, or any of the other popular digital modes. You will need to build or buy an interface cable with a mini-DIN eight-pin connector for the radio and appropriate connectors for your computer sound card. The interface connections are well documented in the X5105 user manual.

The X5105 does have a built-in receive modem, enabled via the **SYSTEM** menu, for copying PSK31 signals without using a computer.

Lab Notes: Xiegu X5105 HF/6-Meter Transceiver

Bob Allison, WB1GCM, ARRL Lab Assistant Manager

The Xiegu X5105 is the first HF and 6-meter transceiver from China that we have tested with acceptable results at the ARRL Laboratory. These results didn't come easily, with much testing in the ARRL Lab and with great cooperation from US distributor MFJ and the manufacturer.

Initial testing in early 2018 showed that the X5105 had several issues. The CW keying had no shaping whatsoever, with resulting key clicks and a broad keying spectrum. It also transmitted high harmonic levels, with a total harmonic power greater than the fundamental power. It transmitted on all frequencies that it could receive on. MFJ worked with the manufacturer to clear up these issues and make the radio legal for use by US amateurs. The current X5105 reviewed here complies with FCC spurious emission suppression requirements and transmits only within the amateur bands, and these changes have been made in current production radios.

The X5105's receiver has adequate SSB and CW sensitivity; it can hear signals at or below a typical rural listening environment (about –120 dBm). FM sensitivity is also adequate, but AM sensitivity could be a bit better on 6 meters.

The lowest dynamic range at 2 kHz spacing is blocking at 58 dB, which is not great compared to current desktop radios. With the AGC off (our standard test condition), a single signal at –66 dBm (S-9 plus 7 dB), 2 kHz away, will start to lower the intended (tuned) signal's audio level. A stronger adjacent signal will significantly lower the audio level of the tuned signal. This may not be a problem during portable operation, but more of a problem when using a substantial antenna during good band conditions or if you live near other stations that are using the same band. Third-order IMD dynamic range and reciprocal mixing dynamic range are on par with other economy transceivers. Image and IF rejection are adequate.

The X5105's transmitter has reasonably low transmit audio IMD. The transmit phase noise is a bit high up to 11 kHz away from the transmitted signal, but not the highest we've seen in the Lab. As discussed in the text, the keying waveform lacks the fall time needed for narrow keying sidebands, but transmissions are free from audible key clicks. Because of the higher-than-normal keying sidebands and transmitted phase noise, I would not recommend using a power amplifier with the X5105.

Despite some shortfalls, radio amateurs should be able to enjoy using the Xiegu X5105 for portable operation at a park, beach, or picnic table in the backyard on a sunny day.

When a PSK31 signal is centered on the display, the modem locks to it and begins displaying up to three lines of streaming text below the LCD screen. As PSK31 tuning is critical, the automatic frequency control (AFC) correction option can be turned on to ensure the decoder stays locked to the incoming signal.

Other Features

The X5105 can drive the internal speaker, an external speaker, or external headphones. When using headphones, press the **SPK** soft key in the **FUNCTION** menu to attenuate the audio output because the 600 mW normal speaker output is too high for headphones and your ears. A speaker or headphone icon appears on the screen, so you know which audio level mode is selected.

The X5105 receiver includes a preamp and attenuator. It also has an adjustable noise blanker and DSP noise reduction. Split-frequency operation is available, and the split operation can be set for the same band — or even different bands. There is even a scan receive mode that will

sweep the selected band and graphically display band activity.

There are 100 memory channels available, each of which may be custom labeled. I used 10 of these for the five CW and five SSB center frequencies for 60 meters.

The X5105 accessory port (labeled ATU) provides dc voltage levels that may be used to drive remote bandswitching devices, such as amplifiers and antenna switches. However, the well-documented voltages do not conform to any current band voltage standard, so you must create your own interface circuitry if you use external, non-Xiegu products.

Finally, the X5105 can plot SWR within any given ham band. This is a neat feature that makes tweaking a portable antenna easy in the field — no antenna analyzer needed. The default scan width is 100 kHz in 1 kHz steps (±50 kHz of center). Both the step spacing and center frequency are displayed. One complete scan requires about 15 seconds. Five scan width settings are available, each with

100 sampling points (100/200/300/400/500 kHz). The X5105 continuously scans until **QUIT** is pressed.

Conclusion

The Xiegu X5105 is a well-thoughtout package that will interest the QRP operator. Everything needed is built in, including a lithium battery, so it is particularly easy to carry along on vacation or in the field. There are no options necessary, and no external devices to cable up for normal CW and SSB operation. Just connect your antenna and mic or key, and operate.

Manufacturer: Xiegu Technology Co. Ltd., www.cqxiegu.com. Distributed and supported in the US by MFJ Enterprises, 300 Industrial Park Rd., Starkville, MS 39759, www.mfjenterprises.com. Price: \$600.



Visit https://youtu.be/QxVI2VPpaC4 to see our review of the Xiegu Communication X5105 HF/6-Meter QRP Transceiver on YouTube.

Antenna Disconnectors from Paradan and INRAD

Reviewed by Ward Silver, NOAX QST Contributing Editor n0ax@arrl.org

In the August 2014 issue of *QST*, Phil Salas, AD5X, described a feed line control box that included lightning and static discharge protection for his Elecraft KAT500 amplifier's three outputs. Relays grounded the antenna lines when power was removed, and a gas discharge tube (GDT) acted as a voltage clamp for transients on the feed line when power was on. At the time, I thought it was a great idea to automatically protect the equipment outputs.

Bottom Line

These Paradan and INRAD antenna disconnect devices offer an easy way to automatically ensure that your antenna is disconnected from your radio when not in use, offering some protection against transients from nearby lightning strikes. For best results, careful attention to station grounding and bonding practices is required.

After I got serious about building my station in rural Missouri, where lightning is common, the idea of protecting the transceivers resurfaced. Operating the station by remote control is also something I want to do, and I am not at the station all the time

to connect and disconnect cables. Lightning protectors are installed on all of the feed lines, but leaving the radios and amplifiers connected seemed too risky. Then I discovered the single-line INRAD Antenna Disconnect Actuator (DCA) and the

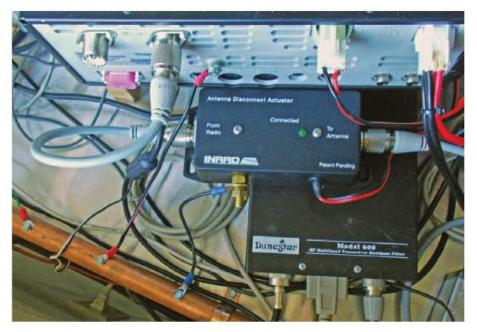


Figure 5 — The single-line INRAD DCA protection unit installed at the back of the reviewer's Kenwood TS-590S transceiver. Power is supplied from the TS-590S antenna tuner connector. Both the radio and disconnect unit are connected to the station ground bus (see text). A more effective location would be at a station's grounded entry point for feed lines with a short connection to the ground system.

Paradan Radio Dual Antenna Disconnector. (Paradan also offers a single-line model, and as this review went to press, INRAD announced that they would be adding a dual-line unit to their product line.) These units simulate unplugging the feed line from the radio and grounding the antenna when the radio is not in use.

How It Works

Both the INRAD and Paradan manuals include schematic diagrams, and the INRAD DCA manual is available online. Operation of all models is similar. When power is off, a relay shorts the **TO ANTENNA** connector to the unit's case. The relay also disconnects the **FROM RADIO** connector shell from the case. As a result, the output connector is completely disconnected from the radio and the feed line to the antenna is shorted. When power is on, the input and output are directly connected, with the shell connected through the relay and the case.

A GDT is connected across the input connector to protect the radio if a transient occurs while power is applied. (The GDT is shorted by the relay when power is off.) The GDT breakover voltage is not specified, but

it must be high enough to not trigger on normal RF output. If the unit is rated to handle 1.5 kW, that's 385 VPK at 50 Ω and higher as SWR increases (33% increase for an SWR of 2:1). I asked Paradan and learned that the GDT is rated at 600 V. Lower-voltage transients will not trigger the GDT and will be passed through (if power is on). That won't faze an RF power amp, but it might cause problems for a 100 W transceiver. Once the GDT fires, it will clamp the transient to about 15 V until the arc quenches from lack of energy. A low-power version of the protector might be a good addition to this product line. Remember that this product only protects the RF port and not accessory inputs and outputs, such as USB computer interfaces or control signals.

The single-line unit draws 60 mA at 12 V dc when power is on (120 mA for the dual-line version), driving the relay(s) continuously. In most cases, 12 V power is available from an accessory jack on the radio. This allows the unit to be switched automatically by turning on the radio. The Paradan and INRAD units both come with a phono plug installed on the power leads. Anderson Powerpole connectors and barrel crimp terminals are also supplied if you need to change connectors or add length — a nice touch.

The antenna disconnector can be wired directly to a radio power supply rather than powered from the transceiver. In this case, turning on the power supply will also power the dis-

Table 2 INRAD Antenna Disconnect Actuator

Manufacturer's Specifications

Frequency range: 1.8 to 54 MHz.

Power requirements: 10 - 18 V dc at 60 mA when turned on to connect antenna.

Insertion loss: <0.05 dB at 29 MHz, <0.1 dB at 54 MHz.

Power rating: 1.5 kW. Relay contact rating: 15 A.

Size: 4.8 × 2.6 × 1.6 inches, not including mounting tabs. Weight, 13 oz. INRAD division of Vibroplex, 1001 North Broadway St., Knoxville, TN 37917; www.vibroplex.com. Price: \$109.95.



connector and connect the radio to the antenna. If you want to leave the power supply on all the time but turn the radio on and off, you'll need Paradan's optional Radio ON Sensor. The sensor can turn the disconnector on and off by sensing the radio's current draw. I did not test the sensor, as it was unneeded in my station.

The Ground Connection

The ground terminal is certainly heavy enough — a ¼-inch brass stud. A crimp terminal to fit the stud is also included with the unit. The instructions direct you to *not* connect the ground stud directly to the transceiver ground. Rather, the connection is supposed to be made directly to an external ground, such as a ground rod. A connection to the radio's ground terminal or local RF bonding bus creates a path around the unit, so the feed line shield remains connected to the transceiver, although the center conductor is shorted to the case.

I understand the reasons for this instruction, but it's probably impractical if the unit is installed inside the station. My initial connection of the INRAD Antenna Disconnect Actuator is shown in Figure 5. This is a likely behind-the-radio installation with the ground stud connected to a grounding RF bonding bus. This configuration does protect the radio, but the amount of protection depends on the quality of the overall ground system.

A long connection to an external ground will have a lot of inductance,

even if heavy wire or a strap is used. That means a sharp transient on the feed line will result in a transient on the case, as well. For this reason, it is best to install the unit on or near a feed line point of entry or on a single-point ground panel (SPGP) with a very short, direct connection to an external ground system.²

The Dual-Line Version

Paradan's Dual Antenna
Disconnector is intended for radios
with two antenna jacks that are used
with two separate antennas. Think of
it as two separate single-line disconnectors in one box. I decided to try
using it to protect both radios in my
two-radio station, replacing the singleline unit I had been using previously
on one of the transceivers.

I have two transceivers and two amplifiers connected to a 2 × 6 antenna selector (two radios, six antennas). Each output of the selector is connected to a four-position remote coax switch. The Dual Antenna Disconnector was installed between the amplifiers and the 2 × 6 switch. Both transceivers are connected to the antenna system through the amplifiers and the disconnector all the time. Two single-line units could be installed here, as well.

All of these devices are mounted in and bonded to a 19-inch rack cabinet that serves as the central connection for the station's ground system. There is also an SPGP where all of the outside feed lines enter the station that is



Figure 6 — The Paradan Radio Dual Antenna Disconnector protection unit installed on a grounded rack panel. Cables at the top connect to the amplifier outputs. Cables at the bottom routed to the nearby 2 × 6 antenna switch are also bonded to the rack. The panel is grounded to the station perimeter ground with a short length of #6 AWG wire.

connected to the perimeter ground. Figure 6 shows the dual-line unit mounted on the rack panel that also serves as the station's main inside ground point. The ground panel is connected to the external perimeter ground system with about 5 feet of #6 AWG wire.

Table 3 Paradan Dual Antenna Disconnector

Manufacturer's Specifications

Frequency range: 1.8 to 54 MHz.

Power requirements: 10 - 18 V dc at 120 mA when turned on to connect antennas.

Insertion loss: <0.05 dB at 29 MHz, <0.3 dB at 54 MHz.

Power rating: 1.5 kW (each line). Relay contact rating: 15 A.

Size: $5.5 \times 3.5 \times 2.5$, not including mounting tabs. Weight, 2 lb.

Paradan Radio, 1221 Seminole Dr., Satellite Beach, FL 32937; paradanradio.com. Price: Dual Antenna Disconnector, \$190; Radio On Sensor, \$90; Antenna

Disconnect (single line), \$110.



Disconnector Performance

Specifications for the INRAD and Paradan units are shown in Tables 2 and 3. For both units, the extra length of the connection from the output connector shell through the relay to the case does not raise the SWR on any of the HF bands or on 6 meters, the highest frequency specified for the disconnect devices. Insertion loss was unnoticeable from 1.8 through 54 MHz for either the single- or dual-line units.

Isolation from input to output with the disconnector off is not specified, but I could estimate it by unplugging the unit's power while monitoring a strong

signal. On 14 MHz, an S-9 signal dropped well below S-1 when the disconnector power was removed. That's at least 40 dB of attenuation at 5 dB per S-unit, and 48 dB at 6 dB per S-unit. On 80 and 160 meters, signals dropped completely into the residual noise floor. On 6 meters, the signal was still slightly audible but not strong enough to move the S-meter, even with the preamp on.

The final proof for this product is what happens during a lightning storm. The Paradan manual clearly states there have been no "direct strike" tests. That would be beyond the resources available to most small manufacturers of

gear for amateurs. I can say, though, that since installing the disconnectors, there have been several severe weather events around my station with lots of lightning, but the equipment is unscathed. I've had some damage previously, so I know it's possible. This isn't a conclusive test, of course, but I do feel better with this extra level of protection for the transceiver and amplifiers.

Notes

¹P. Salas, AD5X, "Antenna Feed Line Control Box," QST, Aug. 2014, pp. 40 – 44.
²My recent book Grounding and Bonding for Radio Amateurs (www.arrl.org/shop/ Grounding-and-Bonding-for-the-Radio-Amateur) covers this and related subjects in detail and will explain unfamiliar jargon and abbreviations such as SPGP.

Heil Parametric Receive Audio System (PRAS) and Powered Speaker

Reviewed by Joel R. Hallas, W1ZR QST Contributing Editor w1zr@arrl.org

The Heil PRAS package includes a compact parametric control preamplifier and a 24 W amplified, two-way speaker with a 5-inch, low-frequency driver and 2-inch tweeter in a medium-sized bookshelf enclosure, as shown in Figure 7. The preamplifier allows significant control of frequency response. It is intended to improve articulation of received audio, especially for those with hearing impairments, but provides better receive audio for all listeners.



The PRAS is quite different from the usual parametric equalizer, which typically allows control of audio response in multiple narrow ranges. Instead, this system is focused specifically on maximizing the articulation of received voice signals. The frequency range is divided into just three ranges: HIGH, centered on 6 kHz; LOW, centered on 160 Hz; and MID, with adjustable focus from 800 Hz to 4 kHz. It is the middle range that is most impor-



tant to articulation, and by being able to adjust the frequency of the peak of the response, and its level there, the system is said to be able to improve the readability of the received voice signal. While designed for voice, the CW response works very well also.

Even for those of us with reasonably unimpaired hearing, the adjustments can definitely improve the audio quality, particularly of voice signals. I suspect there could be a more significant improvement to those with

some kinds of hearing impairments that could use a boost or cut in some portions of the audio spectrum. If you have a particular hearing issue, I suggest you try to find someone with a PRAS and see if it helps. Alternately, your audiologist or hearing specialist may be able to compare your needs to the benefits provided by the PRAS.

Documentation

The PRAS comes with a six-page instruction booklet that provides inter-

Bottom Line

The Heil Parametric Receive Audio System and companion HPS-5 two-way speaker can provide enhanced articulation to your transceiver's receive audio system. This can help compensate for some hearing limitations or significantly improve the sound of your received audio.



Figure 7 — The Heil HPS-5 amplified speaker.

connection diagrams and suggestions on how to adjust the preamp to solve different kinds of issues. In addition, a single sheet indicates the suggested starting positions of all the controls.

The manual does not include specifications, such as the range of cut and boost levels, which might be helpful with those wishing to overcome specific hearing limitations. That information is provided on the Heil website, however.

Setup

I set up the PRAS to use with my Elecraft K3 transceiver. The connections, shown in Figure 8, are straightforward, with cables provided in the package. The preamplifier has INPUT connections sized for 1/4-inch or 1/8-inch stereo plugs, as well as for a three-pin balanced XLR plug. While one might expect the three input choices to have equal response, at least on our unit, the 1/4-inch input had significantly less gain than the 1/8-inch jack. I didn't have a cable or adapter to allow checking the XLR input. The instructions recommend using the 1/6-inch jack, but they don't say why.

An input cable with 1/8-inch stereo plugs is provided, along with an adapter for 1/4-inch plugs, but as noted above, that is best used on the transceiver end if needed. The preamplifier output is provided via an XLR or

¼-inch jack, and an XLR-to-XLR cable is provided to interconnect to the speaker. The speaker also has a ¼-inch input jack that makes it easy to use the supplied cable to bypass the preamp, if desired. While the speaker sounds nice by itself, inserting the preamplifier can make a major improvement by being able to shape the response.

I should mention that the PRAS is a monoaural system, as are many HF transceivers. The K3 transceiver has two audio channels, which can be used in multiple ways, but with the PRAS, the two channels are combined at the input, resulting in a single audio channel going toward the speaker. For many, this won't be an issue at all, but it is important to understand what you will be getting. If you find the PRAS helpful to your hearing and want to receive two channels separately, for example to listen on two frequencies from separate receivers, a second PRAS system with its speaker on the other side of the radio would be an option.

Using the PRAS

The audio out of the PRAS definitely sounded easier to listen to and comprehend than audio either from the K3's internal speaker, or from the pair of relatively inexpensive stereo bookshelf speakers that I generally use with the K3. Operating the PRAS is quite straightforward. Once the tonal balance is set the way you want it, all speaker reception operations can be carried out from the front panel controls of the transceiver, as with any other speaker.

While not even close to the bandwidth limiting that a DSP filter can provide,

during reception of weak signals, the PRAS system offers some signal-tonoise improvement by reducing the high-frequency level response, as well as by shifting the peak of the midrange to a somewhat lower frequency.

You can also use the PRAS with headphones. Instead of plugging your headphones into the transceiver, they plug into headphone jack 1 or 2 on the front panel of the preamp. Use of these jacks doesn't disable the speaker. Instead, there are separate HEADPHONE LEVEL controls for each jack on the preamplifier front panel. The OUTPUT LEVEL control just adjusts the speaker level, so all three outputs can be adjusted separately, which is nice for use by multiple listeners with different hearing sensitivity.

There is also a front-panel jack for use with a media recorder. This %-inch stereo jack also has its own REC LEVEL control.

A potential operational concern I observed is that, if using the supplied power adapter, both the speaker and preamplifier must be turned on and off using switches on the rear panels of each unit. This might be inconvenient in some installations. Both specify that the power required is 12 V dc, so an alternative might be to supply power from your station's 12 V dc power supply and make use of its POWER switch instead. Bob Heil confirmed that the usual station 13.8 V dc supply is suitable to the task. Another option would be the use of a switchcontrolled power strip that you probably have anyway.

I also found that, while running keydown CW at 1,500 W PEP output, I had RFI pickup on most bands,



Figure 8 — PRAS rear panel, showing the connections described in the text.

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resulting in a hum showing up in the speaker and overwhelming the CW sidetone note. There was also a bit of chatter during SSB voice peaks. The effect wasn't there at 100 W, and it was reduced considerably after I put a heavy, unidentified snap-on RFI bead found on my workbench around the speaker input and power cables. Based on this success, I would expect normal RFI remediation techniques could eliminate or reduce the problem. My amplified computer speakers act the same way, if turned on. Of course this doesn't impact the quality of the receive audio, but it is annoying.

Final Thoughts

There is no question that the PRAS preamplifier and speaker can make some very nice sound. Improvement in articulation compared to what you would get by using a good quality speaker directly connected to your transceiver will depend on the capabilities built into your transceiver. For example, my transceiver has an eightband parametric equalizer that can be adjusted to change the level within each of the bands by ±16 dB. While it would take a bit longer, and would be less convenient, I'm sure I could come up with the same response I

would want from the PRAS using my built-in system. On the other hand, this functionality is not provided in many other amateur transceivers, which could be beneficial.

Then there's the speaker. While there are many high-quality, low-distortion speakers around, Heil has made the selection simple by providing the whole matched package.

Manufacturer: Heil Sound; 5800 North Illinois, Fairview Heights, IL 62208; www.heilsound.com. Price \$490.

Mortty Morse Code and RTTY Keying Interface Kit

Reviewed by Rich Cady, N1IXF n1ixf@arrl.net

Interfacing your computer to your radio for keying CW, RTTY, or both just got a little easier and more convenient. Even better, the device reviewed here produces keying that may be superior to typical serial COM port solutions, because it doesn't rely on that port, your logging program, Windows, or your computer's processing capabilities to generate the proper timing. Utilizing open-source software that runs on the popular Arduino Nano microcontroller, Larry Gauthier, K8UT, and Steve Smith, N8AR, are offering a hardware computer-to-radio interface kit called Mortty — for sending CW or RTTY (frequency shift keying, FSK)

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from your computer logging program. In keeping with the open-source concept, they have even made their schematic and hardware design available as copyrighted freeware, and provide a complete parts list with Mouser part numbers.

Bottom Line

Once assembled, the Mortty kit results in a very compact and professional-looking CW and/or FSK RTTY interface at a cost that would be hard to match if you tried to acquire all the discrete parts yourself.

Mortty Advantages

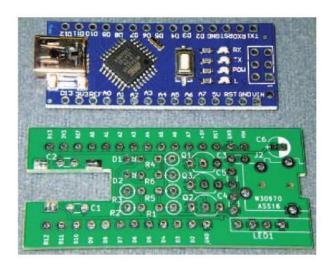
While there are many ways to generate CW and FSK keying, the Mortty interface provides three distinct advantages. First, it doesn't rely on the increasingly rare serial COM port, instead using a USB interface to your computer. Second, the Mortty kit allows your logging program and computer to offload the production of per-

fect CW/FSK timing to its built-in Arduino Nano microcontroller, thereby minimizing the impacts of other competing tasks your operating system might deal with. Third, it is compact, offering a small "cable-like" connection with only a $2 \times 1 \times 1$ inch box between your radio and computer.

The Mortty kit provides the hardware platform for any of three different Arduino software programs (called "sketches"):

- K3NG's Arduino CW Keyer (blog. radioartisan.com/arduino-cwkeyer/) for Winkeyer CW interface protocol emulation;
- KOSM's TinyFSK An FSK Keyer for the Arduino Platform (www. frontiernet.net/~aflowers/tinyfsk/) for a RTTY transmit solution; or
- W1HKJ's NanolO (www.w1hkj. com/files/nanolO/) for dual-mode configuration — CW and FSK — with fldigi. Note that solder bridge jumpers on the PC board are required to support software switching between CW and RTTY modes with the NanolO sketch.

When you purchase the Mortty kit, you specify which of these programs you would like pre-loaded on your kit's Arduino Nano microcontroller,



- ◄ Figure 9 The Arduino Nano (top) will connect to the main PC board (bottom) with headers, so no point-to-point wiring is required.
 - ▶ Figure 10 The completed Mortty interface with its enclosure. The miniature phone jack is for the cable to the transceiver's CW or FSK RTTY keying input.



although at any time, you can easily reprogram your Mortty's Arduino Nano to use any one of the other sketches. Instructions and a comprehensive video describing how to do this can be found on the Mortty website (hamprojects.info/mortty/).

Building the Kit

The kit (version 3) arrives with all the parts neatly packaged in a 6 × 9% inch plastic bag. That bag includes the Arduino Nano, pre-programmed as ordered and in an anti-static package; a two-piece aluminum enclosure; 3D printed plastic end caps along with two aluminum end caps if you wish to construct your own; a small parts bag with components (all through-hole parts except for a surface-mounted phone jack); and a high-quality, double-sided, through-plated PC board designed by N8AR (see Figure 9). That PC board is silk-screened, clearly showing the part locations.

As you begin assembly, you will immediately notice the attention that has been taken to develop a high-quality kit. It is evident in the well-documented assembly instructions with photographs of each construction step and the fit of the PC board/ Arduino Nano assembly to the enclosure. The result is a finished package that is compact and professional in appearance. The labeling adds polish and the appearance of a commercially produced product to your assembly.

Nothing in the construction of the Mortty kit requires special skill beyond the ability to follow instructions and basic soldering experience. The kit is designed using headers to connect the Arduino Nano to the PC board. This means that there is no point-to-point wiring required and makes for secure connections. Additionally, the headers help ensure that the PC board/Nano assembly fits squarely into the enclosure. One caution: be sure to carefully follow the header assembly instructions or the assembly won't fit in the enclosure.

There's no need to fear the surfacemounted miniature phone jack. I first placed a little solder on one PC board pad, then simply reheated the solder once I had the jack positioned correctly on its pads. That held the phone jack in alignment while I soldered the other pads. I then touched up the first pad with a bit of fresh solder to ensure a good connection. Figure 10 shows the completed kit.

Using the Mortty

You'll need to supply a radio-specific cable connecting your rig's push-to-talk (PTT) and CW or FSK RTTY keying lines to the Mortty jack. Again, the manual provides suggestions to guide you in constructing this cable. In addition to sending messages from your logging software, you can connect a CW paddle to the Mortty for manual sending.

To use the Mortty after you've connected it between your radio and computer, you'll need to configure your logging/radio control program to utilize it. It is best to follow the instructions of your specific logging program and/or search the web for configuration details.

If you are configuring your logging program for the CW version of Mortty, you should follow that program's instructions for setting up a Winkeyer. For the RTTY version, you'll need to follow instructions for a TinyFSK setup in both your logging program and RTTY software (such as MMTTY, 2Tone, or GRITTY).

Don't expect all the bells and whistles of a dedicated CW keyer or RTTY interface. For example, the Mortty uses the features of your logging program to set the CW speed rather than adding a speed potentiometer, and for RTTY, you will still need to separately interface the receive audio from your radio to your computer soundcard so that you can decode RTTY signals. What the Mortty does provide is a simple and effective keying solution for CW and FSK.

Manufacturer: Mortty — K8UT and N8AR Morse Code and RTTY Keyer; hamprojects.info/mortty/. Additional information and support is also available through the Mortty email reflector: groups.io/g/mortty. Price: \$18 plus shipping.

The Doctor is In

Two Ways to Provide a Ground for a Monopole

Rich, W3OFD, asks: I have a commercial four-band trap vertical antenna currently mounted just above a buried radial field (with 17 radials) in place from a previous installation. I would like to mount it on top of a 12-foot mast that will be in the clear and above my roofline.

Can I just attach a ground wire from the antenna base to the existing radial field? How well will the antenna system work? Will the azimuth pattern still be omnidirectional? Will I need to use a remote tuner at the antenna base?

There are two ways to set up the ground system for an antenna such as yours. The first is to ground-mount the antenna and use a large number of non-resonant buried or on-ground radials, as you have now. In that configuration, the electric field from the monopole will terminate at ground, the antenna will act like a quarter-wave monopole on each band, and off you go.

The alternate approach is to elevate the antenna base and use insulated, resonant (quarter-wave) radials, in place of the actual ground. In addition to getting the antenna "in the clear," raising it up (a reasonable amount) will also provide a lower peak radiation angle, which is better for long-range operation. Even two insulated radials (opposite each other) per band will provide higher efficiency than a fairly large number of buried radials. So, raising it up would be a good thing, but only if you can add the insulated radials built just like antennas — insulated from ground, except at the center.

Your idea of providing a ground by connecting the base to your existing ground field might work, but it won't be what you expect. The wire from the base to the ground field will act like part of the antenna itself, making it a kind of off-center-fed something.

I recommend you use at least two radial wires per band. Note that they don't have to be horizontal, but can droop downward if more convenient. It is best if the pair for each band be opposite each other to preserve the omnidirectionality. While three or four per band might be even better, any difference will not likely be noticeable. If you make some strong enough and keep them insulated, they could also do double duty as guy wires to hold up your mast. Note that the outward ends of the radials are a high-RF voltage point, so protect them from accidental contact, especially if they get below 8 feet above the ground.

The EZNEC-modeled performance is shown in Figures 1 and 2 for a representative band.1 Figure 1 is the elevation pattern of a 20-meter guarter-wave fed against a ground radial system of 16 quarter-wave buried radials (EZNEC medium ground, conductivity 0.005 S/m, dielectric constant 13). The azimuth pattern is omnidirectional. Note that while that is a close match to what you had, the performance of a monopole with buried radials could be improved with more radials. It becomes diminishing returns after perhaps 30 to 60 radials, depending on ground conductivity. An important rule of thumb is that for any limited length of radial wire, more short radials work better than a few longer ones, but 30 to 60 long ones are even better.

Figure 2 is a similar plot of the same monopole with a base of 12 feet above the same ground, but without the buried radials, instead using two

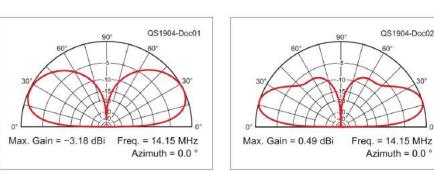
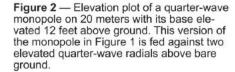


Figure 1 — EZNEC elevation plot of a ground-mounted quarter-wave monopole on 20 meters. The antenna version is fed against 16 buried quarter-wave radials.



Several versions of EZNEC antenna modeling software are available from developer Roy Lewallen, W7EL, at www.eznec.com.

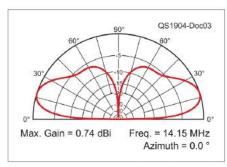


Figure 3 — The same as Figure 2, except that the buried radials of Figure 1 are still in place and tied to the antenna base. In addition to providing a lightning ground, this actually adds a bit of additional gain. So, if you have the ground field in place, there's no need to remove it.

quarter-wave, insulated, resonant (quarter-wave-long) and elevated wire radials. Note the improvements in performance:

- The peak gain has increased from -3.2 dBi to +0.49 dBi, an increase in intensity of almost 3.7 dB. That's about ¾ of an S-unit — not too shabby for a piece of pipe!
- Of possibly more significance for the DXer, the peak elevation angle has been reduced from 26° to 18°. This will provide additional longdistance coverage.

In another piece of good news, you don't have to remove the old radial field. As long as you have provided the elevated radials as a termination for the transmitted electric field, you can leave the buried radials in place beneath the antenna and drop a vertical wire from the base to the center of the radial field. It will provide some lightning protection and even give you a few tenths more of a dB gain! See Figure 3.

The lower the frequency band, the more likely it is that the ground-mounted approach will be the one selected, because both the required height and width of the elevated radials can be a problem for the elevated system, especially on 80 and 160 meters.

Ken, K0KS, asks: How does an autotuner cause such poor propagation? I got a call from a friend who was having trouble making contacts with his regular antenna, being fed by his autotuner. While he was transmitting with 600 W, the tuner tuned fine, but nobody would answer him. When I got a call from him and listened, the 40-meter band seemed alive, so why was his propagation so bad? A short trip to his house and a look at the meters indicated that the antenna SWR was 10:1 and the tuner was doing its job.

I'm wondering how many of us take that autotuner for granted and don't realize when the antenna has changed, blaming lack of activity on the band, instead. Many autotuners, including mine, don't provide any feedback about the match.

You raise a good point!
Automatic antenna tuners are very convenient, but they can mislead us. Let's face it — an antenna that the tuner can tune when it's in the air, can often also be tuned while it's on the ground. This is usually not a problem with manual tuners, especially if we log the settings for each antenna at a number of frequencies within each band. Not only does this allow us to change settings for new frequencies quickly, but it gives us early warning that something is awry.

Another technique to use to make sure all is well is to record the antenna SWR on each band segment with the tuner bypassed, if that can be done with your tuner. I also try to have more than one antenna that can at least hear on every band. If I can't hear anything on one, but can on another, the band probably isn't dead. A simple field-strength meter can also be used to check that you are transmitting. While most do not offer calibrated readings, they should read the same anytime you

check — as long as your antenna is still working.

Ken, N2DF, asks: It seems that repeater offsets typically increase as the frequency of the repeater increases. For example, a 10-meter repeater would have an offset of 100 kHz, while a 440 MHz repeater typically has an offset of 5 MHz. It seems that the 6-meter repeater band may have two offsets; 0.5 MHz for repeaters on 51 MHz and 1.0 MHz for repeaters with an output of 53 MHz. Is there any technical reason for this difference?

The tough part of making a repeater is to keep the repeater's transmitted signal out of the repeater's receiver, because they both have to operate at the same time. All things being equal, the further apart the frequencies, the easier it is to make filtering with enough stop-band attenuation to be successful at keeping the repeater's transmitted signal from overwhelming the repeater's receiver.

One limitation is that both frequencies have to be in the same band (actually they don't, but most repeaters are set up that way). Thus, the 5 MHz spacing at 440 won't work on any lower frequency band, because they are all narrower than that. If you think about filters, the key is the fraction of bandwidth difference between the two frequencies. So, filters for frequencies separated by 600 kHz at 2 meters are similar in complexity to filters with about 210 kHz spacing on 6 meters, and about 119 kHz on 10 meters.

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.

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Microwavelengths

VSWR, Return Loss, and Antennas

The last "Microwavelengths" column, in the January 2019 issue of *QST*, mentioned a return loss or VSWR (voltage standing wave ratio) shorted-aperture test for the 3D-printed horn antennas. There seems to be some confusion about return loss, so I thought it merited revisiting.

What we are really talking about is reflected power on a transmission line that is carrying RF power to a load, an antenna, or some electronic device. If the load is perfectly matched to the transmission line's characteristic impedance, then no power is reflected, and all the power gets to the load or antenna. More often, the load is not perfect, and some power is reflected and travels back from the load toward the transmitter. While this could easily be expressed as n% reflected, it is more common to measure the ratio of power reflected to power transmitted, so that absolute power measurement is not needed. The usual ways to express this ratio are VSWR or return loss.

Voltage Standing Wave Ratio

Voltage standing wave ratio refers to the standing waves created on the transmission line, shown in Figure 1. The power reflected from the load travels back along the line, adding in phase and subtracting out of phase with the transmitted or forward power traveling toward the load. Each load creates a unique pattern of standing waves that repeats every half-wavelength (an animated GIF illustrating standing waves may be found at www.wa1mba.org/ StandingWaves.htm). The VSWR is the ratio of the maximum voltage (V_{max}) to the minimum voltage (V_{min}) .

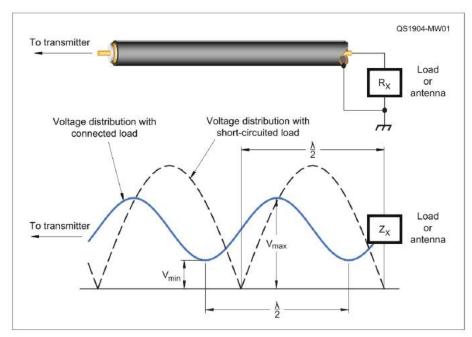


Figure 1 — The standing wave voltage along a transmission line for a typical mismatched load and for a short circuit.

In the worst case, a short circuit reduces V_{min} to zero, so the VSWR is V_{max} divided by zero, or infinite. A perfectly matched line with a VSWR of 1.0 would have no voltage variation along the line.

These standing waves are measured using a slotted line (see Figure 2) which samples the voltage at points along the line with a small probe inserted through a narrow slot in the coax outer conductor or the broad wall of a waveguide. Some typical coax and waveguide slotted lines are shown in Figure 3. By sliding the probe along the slot, the voltage on the line may be sampled to detect the standing wave. The ratio of the maximum to the minimum voltage is the VSWR. Slotted lines have been supplanted by the vector network analyzer (VNA), but are still a much less expensive way to make measurements in waveguide, if you can

find or make a slotted line.1

Return Loss

Rather than VSWR, microwave engineers usually use return loss (RL), which compares the power flowing toward the load with the power reflected from the load in decibels. Since only the difference matters, absolute power accuracy is not required. A matched load will reflect no power at all (high return loss) and the worst possible load, a short or an open, will reflect all the power (low return loss).

In order to measure return loss, we need to measure the power flowing from the source to the load, while at the same time, we measure power reflected from the load back to the source. All this power is travelling on the same transmission line. A directional coupler (see Figure 4) sorts out the forward energy from the

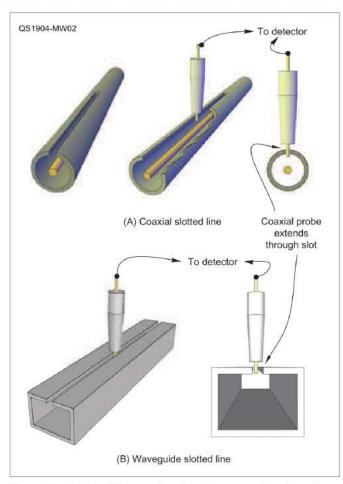


Figure 2 — A slotted line samples the voltage at points along the line with a small probe inserted through a narrow slot in the coax or the broad wall of a waveguide.

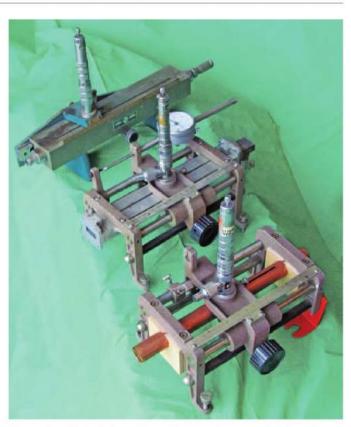


Figure 3 — Typical slotted lines. The top shows coaxial slotted line, the middle is a waveguide slotted line, and the bottom is a homebrew circular waveguide (water pipe) slotted line on surplus carriage.

reflected energy and extracts a small fraction of the power travelling in one direction on the transmission line. The coupler may be reversed for the other direction; a dual coupler can sample both directions simultaneously. A typical directional coupler extracts the sampled energy 20 dB or 30 dB below the power level in the transmission line — if the sampled power from one watt is 1 mW, the coupling is -30 dB. Directional couplers are available with coupling from 6 dB to 50 dB. The common Bird Model 43 Thruline® directional wattmeter indicates forward and reverse power by reversing the directional coupler in the slug, using slugs with different coupling for different power levels.

The important thing about a directional coupler is not the coupling

ratio, but the directivity. No directional coupler is perfect — some power from the opposite direction always leaks through. Directivity compares the power sampled in the desired direction to the power leakage in the opposite direction. For instance, if the sampled forward power from one watt is 1 mW with a -30 dB coupling, and the sampled reverse leakage power is .01 mW and 50 dB down. then the directivity is 20 dB. But the leakage also makes the apparent return loss 20 dB, the difference between forward and reverse sampled power. The directivity limits the maximum return loss that can be accurately measured with a directional coupler — the leakage can add in phase with actual reflected power, making the measured return loss higher than actual, or it can add out of phase with actual reflected

power, making the measured return loss lower than actual. Tuning for perfection could be making things worse rather than better.

Commercial directional couplers are often designed for flat coupling over a broad frequency range rather than high directivity. As a result, they typically have 15 dB to 25 dB of directivity over the broad bandwidth, but it can be better at some frequencies. With careful design and construction, it is possible to make homebrew directional couplers with higher directivity.2 A VNA uses a calibration procedure and software correction to compensate for the directivity of internal directional couplers. The antenna analyzers used by hams also have limitations, but they are rarely documented.

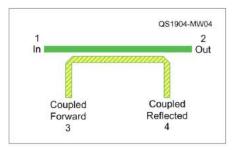


Figure 4 — Sketch of a directional coupler. Many commercial versions have one coupled port terminated internally.

Conversion

Because VSWR and return loss are expressions of the same quantity, we can convert from VSWR to return loss:

$$RL = -20 log \left[\frac{VSWR - 1}{VSWR + 1} \right]$$

And from return loss to VSWR:

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

Figure 5 gives a better idea of the relationship between RL and VSWR. Most antenna analyzers will display either quantity, so you can compare as you measure.

Shorted Aperture Test

When a transmission line is terminated in a short circuit, whether planned or not, all the power is reflected, and the return loss is close to 0 dB (or infinite VSWR). If the transmission line has loss and we are measuring from the other end, then the return loss is twice the loss of the line — for instance, if the line loss is 2 dB, then the power is reduced by 2 dB on the way to the short and 2 dB more on the way back, so the return power is 4 dB down for 4 dB return loss. This is an easy way to measure loss of a length of transmission line.

Shorting the aperture of a horn or feedhorn with aluminum foil, as Glenn Robb, KS4VA, suggested in

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the January 2019 "Microwavelengths" column, is a clever way of ensuring that the horn is an antenna and not a resistor. The shorted aperture is the same as a shorted transmission line because there is nowhere else for the power to go except back down the line. A good metal antenna should have almost no loss, so the return loss will be close to 0 dB. But if the printed horn is lossy from a poor metal coating or other problem, then the return loss will be higher and power would be wasted in heating up the horn. Glenn suggested that a swept-frequency test is best - an enclosed cavity, like the shorted horn, may have resonances which can produce unexpected results near the resonant frequency.

Potential Error

Amateurs can be obsessive about VSWR, but there is the matter of when it actually causes an effect. A return loss of 20 dB, or VSWR of 1.22:1, is 1% of the transmitted power coming back — such a small amount that it may not have a great impact. On the other hand, a 2:1 VSWR, or return loss of 9.5 dB, implies that the impedance the transmitter sees can be anywhere between 25 Ω and 100 Ω , or have a large reactive component. This could easily upset some solid-state power amplifiers by causing larger-than-normal voltages or currents in expensive transistors. Because antenna tuners are rarely used at VHF and above, we try to tune our antennas for reasonably good return loss. But, due to the fact that directional couplers typically limit accurate RL measurement to about 20 dB, it doesn't make sense to try and make it much better.

Another device that is sensitive to the antenna impedance is the low-noise amplifier (LNA) or preamp. Gallium arsenide field-effect transistor (GaAsFET) devices are often tuned for the best noise figure in a 50 Ω test system, but the noise figure can change dramatically when connected

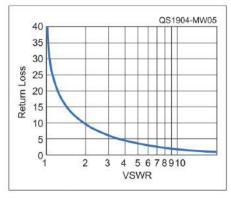


Figure 5 — Curve showing inverse relation between VSWR and return loss.

to a mismatched antenna. Good return loss is also important on receive.

Another frequent source of error is harmonics generated by the transmitter or signal generator. The power at harmonic frequencies may be reflected by the antenna and appear as extra reflected power. Instruments using diodes as detectors, such as the Bird wattmeter and many amateur VSWR meters, are particularly susceptible to harmonics, as diodes detect peak voltage, and the voltage waveform is distorted by harmonics, leading to false indications.

Summary

VSWR and return loss are different ways of expressing the same thing — unwanted reflected power. We usually measure return loss, but hams prefer VSWR. We can use either to be sure that our antennas are well matched. Using a shorted aperture test to see that they have low loss adds confidence that our power is being radiated. Where it goes then is a matter of antenna design.

Notes

¹Paul Wade, W1GHZ, "Understanding Circular Waveguide — Experimentally," QEX, Jan./Feb. 2001, pp. 37 – 48. Available at www.w1ghz.org/QEX/ circular_wg.pdf.

²Paul Wade, W1GHZ, "High-Power Directional Couplers with Excellent Performance," DUBUS, II/2010, p. 9. Available at http://w1ghz.org/coupler/ High-Power_Directional_Couplers_ with_Excellent_Performance.pdf.

Eclectic Technology

Whither Digital Radio Mondiale?

Even before the turn of the century, it had become obvious that the internet was having a severe impact on traditional shortwave broadcasting.

Audiences were quickly shrinking as listeners abandoned analog shortwave for the high-fidelity digital audio that the internet could provide. Many broadcasters responded by closing their transmitting facilities, or at least re-directing their signals to areas of the world the web had yet to reach.

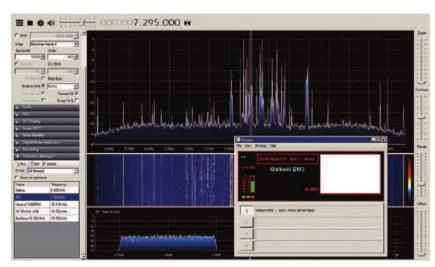
In response to the looming threat, broadcasters, equipment manufacturers, regulators, and others came together in 1998 to form a consortium known as *Digital Radio Mondiale* (DRM). Their first task was to create a specification for digital shortwave broadcasting that, they hoped, could compete with the internet and revive listener interest. DRM promised a high-fidelity, FM-quality signal that also carried text information such as program titles and news headlines.

DRM Transmissions

You've probably heard a few DRM signals as you've tuned through the shortwave broadcast bands, but you may not have realized it. A DRM transmission sounds like wide-bandwidth noise.

The DRM signal carries three separate data channels. The primary channel, the one that transports the audio information, is the Main Service Channel. Then there are two subsidiary channels: the Fast Access Channel (FAC) that provides the essential data required to fully decode the signal, and the Service Description Channel (SDC).

DRM transmissions rely on a form of modulation known as coded orthogonal frequency division multiplex (COFDM). While it is highly resilient to interference and fading, the complex



An All India Radio shortwave DRM broadcast being decoded with a software-defined receiver and *DREAM* software.

COFDM signal requires a significant amount of processing at the receiving end to extract the data from the carriers and reassemble everything in the correct fashion. I dabbled with DRM reception using *DREAM* software (https://sourceforge.net/projects/drm/) about 10 years ago and I needed to use a powerful PC (well, powerful by 10-year-old standards) to reliably decode signals. With today's hardware, processing horse-power is no longer an issue.

DRM Today

Unfortunately, Digital Radio Mondiale failed to halt the decline of shortwave broadcasting; it was too little, too late. It didn't help that consumer electronics manufacturers lacked enthusiasm for the new shortwave format. Without an abundance of affordable off-the-shelf receivers, the audience for DRM never coalesced. Those who remember attempts to popularize AM stereo in the United States in the 1980s, and quadraphonic FM in the 1970s, will recognize the pattern.

However, there are still shortwave broadcasters using DRM on a regular

basis today. The list includes the BBC, Radio France International, and All India Radio, to name just a few.

The rise of software-defined radio (SDR) has provided new avenues for DRM shortwave listening. For example, it is possible to decode DRM signals with inexpensive SDR "dongle" receivers. Various tutorials are available online, like the RTL-SDR tutorial available at www.rtl-sdr.com/tutorial-drm-radio-using-rtl-sdr/.

DRM's future may lie in domestic digital broadcasting rather than international shortwave. India has invested heavily in DRM for its local and regional broadcast services; Brazil is doing the same.

And I cannot fail to mention that amateurs were on the DRM bandwagon quite early, experimenting with a derivative of DRM using a software application known as *WinDRM*. Much has changed over the intervening years and today, the HF digital voice application of choice is *FreeDV* (https://freedv.org). If you hear buzzing signals at 14.236 MHz, chances are you're hearing a FreeDV conversation.

Hints & Hacks

Tool-Free Mobile Radio Installation, Folding Antenna Support, and More

Install or Remove Mobile Radios Without Tools

Every so often, I need to remove my mobile radio to use it in the shack, or for security reasons. I didn't like needing a screwdriver nearby and keeping track of the small screws every time I did this. I wanted to find a way to remove the screws by hand.

For my Yaesu FT-1900, the screws are metric, but I was able to find the screws needed at a home improvement store. I used Phillips pan-head machine screws, size M4-.7 × 10, and purchased the wing nuts with threads to match. I simply inserted the screws backwards through the wing nuts. I also put a little glue under the screw head to keep it from backing out during use (see Figure 1), but a lock washer would also work.

This has made the process of removing and reinstalling my mobile radio much more convenient for me. — 73, Joe Hopkins, K4BKI, ihopkins1938@gmail.com

New Life for Weller Soldering Guns

I have two Weller soldering guns, a 100 W and a 300 W. I use them often and started having problems with



Figure 1 — The wing nut installed for toolfree removal and installation. [Joe Hopkins, K4BKI, photo]

both, especially the larger one. I decided to repair the issue, and hopefully make the guns better than before.

The problem was the screws holding the tips in place were always getting loose. The smaller gun was easy to fix. I just enlarged the hole for the screw and re-tapped it, using a larger screw. This worked quite well. The larger screw now has better bite into the tip and can apply more force, producing better contact.

The larger gun had aluminum electrodes, and the contact screws stripped out the threads quickly. I first tried the drilling/tapping trick, but the stripped threads returned. I knew there had to be a better way.

I found two steel nuts large enough that I could drill out the threads and fit both of them onto the electrodes, still leaving enough of a gap so there wasn't a possibility of them shorting together. I then drilled and tapped a hole in the side of the bolt, so a 10-32 steel screw could be used as the new tip contact. I drilled the original hole in the electrode large enough that the 10-32 screw would slip through it.

This modification turned out great, and it can be done on both models of gun. The new screws could even be put through the side of the electrodes, but I was in a hurry and went through the top and bottom. Going through the side would have meant grinding off a corner of the nuts to make room for them between each other when installed. On the smaller gun, you could use a large nut so you have more thread to work with, and ground the side of the nut that faces the other electrode so there's enough space between the electrodes when both

nuts are installed. I haven't needed to do this on my small gun yet, but I will eventually.

Also, I know that new tips can be hard to find when the shops are closed. In a pinch, I have used #14 and #12 solid wire successfully as tips in the smaller gun. #10 or #8 should work for the larger gun, but I have never had to replace this tip. To do this, form a loop of wire and tightly twist the curved end of the loop to form the tip. Only two or three turns are needed.

Both of these Weller guns have been trusty tools of mine for over 40 years, and I am sure that my grandchildren will appreciate them for many more.

— 73, Clint Millett, VE3CMQ, cmillett@prairiemobile.com

A Foldable Wooden Antenna Support

As soon as my son earned his General-class license, I wanted to get him an antenna system outside for HF, VHF, and UHF that he could easily maintain himself. Fortunately, he owns a home in the country, so antenna installation is not an issue. My two antennas of choice to start with were an end-fed wire for HF and a dual-band J-pole antenna for 2 meters and 70 centimeters.

I set out to design a structure from pressure-treated two-by-fours that would be simple to build, inexpensive, and would support both of these antennas (see Figure 2). The chosen location behind the house dictated that the bottom two "tower" two-by-fours would need to be 12 feet in length to clear the edge of the roof. In addition, I wanted a tip-up/down mast added to the top of this tower that would use one additional 12-foot two-

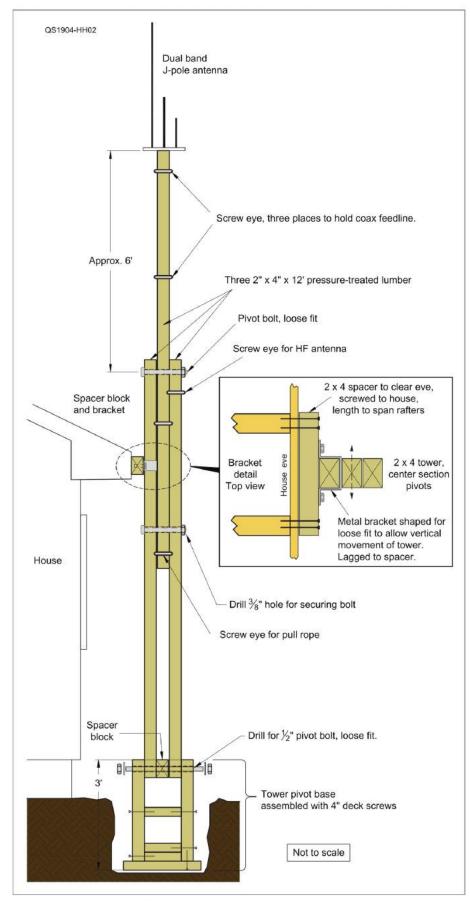


Figure 2 — A schematic of the author's wooden, foldable antenna support.

by-four. This would give me a total height of about 19 feet. If one person was to do any antenna work at this height, the tower and mast would have to be designed to fold down to the ground for safety reasons (see Figure 3).

The materials list for this build was short. It required:

- Four pressure-treated two-by-fours, at 12 feet long
- One ½ x 12 inch threaded steel rod with flat washers and nuts
- Two ¾ × 5 inch bolts with flat washers and nuts
- Four large eye screws (sized to pass a PL-259 connector through)
- Two ¼ x 1½ inch lag screws and a small box of 4-inch long #10 deck screws

To hold the tower against the house, we needed a metal **U**-shaped bracket that fit loosely around the three sides of one of the two-by-fours. It was made from a 10-inch length of 3/2-inch-thick steel that was 1½ inches wide. This bracket would allow the completed assembly to settle into the dug hole in the ground while not pulling down on the attachment point at the house.

For tools, I used a powered miter saw to make all the necessary cuts and a battery-powered hand drill to drill the holes. Accurate saw cuts and perpendicularly drilled holes for the bolts were essential for proper fit and alignment. A drill press would have been perfect here, but none was available. One two-by-four was cut into all of the required pieces, and the other three required no cutting at all.

With all materials procured, I started the build early in the morning with my sons — Mark, N8KPV, and Alan, KN4IJR. I measured out the wood pieces and made the cuts while the boys drilled holes for the bolts. We then started the assembly on the ground, screwing and bolting the various pieces together. Three screw eyes were spaced down from the top



Figure 3 — This wooden fold-over antenna support allows for easy antenna work. [Karl Schwab, KO8S, photo]



Figure 4 — The completed wooden antenna support. [Karl Schwab, KO8S, photo]

of the mast to hold the coax and endfed antenna wire. The last screw eye was attached at the bottom for a pulldown rope. At this point, all the building was complete.

We dug a hole in the ground about 2 feet deep that would except the 3-foot-long fold-over base assembly. Directly above this hole, we attached a 24-inch length of two-by-four at the fascia using 4-inch-long deck screws. This two-by-four would space the tower out from the house in order to clear the edge of the roof shingles.

We placed the fold-over base in the hole and got the tower assembly (minus the mast) raised and held to its vertical position against the house. We made adjustments by moving the base in the hole and tweaking its position against the house to make sure everything was plumb.

Next, we attached the metal bracket to the house with two lag screws securing the towers inside the two-by-four to the house. The hole we dug was then filled with dirt and the mast was bolted in its center position in the tower and pivoted down for attaching the two antennas. We easily raised the mast into its vertical position by pulling down on the rope, and secured it using a single $\% \times 5$ inch long bolt and then removed the rope. At this location, the pivoting mast

could be pivoted down in either of two directions if needed. The far end of the end-fed wire antenna was then pulled up high in a nearby tree, thus completing all this antenna work in a single day (see Figure 4).

If this assembled unit ever needs to be brought down to the ground for any reason, only the two lag screws that secure the metal bracket to the house need to be removed and then it will fold down. Careful planning made this a quick, inexpensive ham radio project.

After this antenna work was completed, it was time to try it out. For the first time, good signal reports were given on the local repeater. On 20-meters SSB, our first contact was with Ecuador, and the second with an aircraft flying at 38,000 feet over Ecuador! It was a nice reward for a good day's work. — 73, Karl Schwab, KO8S, ko8s@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.

Strays

Six New American Amateurs in South Korea

Last summer, Dale Tongue, AC7NP, conducted an 8-week Technician-class license course for a group of Americans living in Seoul, South Korea. The result was six new Technician licensees. At the end of the exam, the Volunteer Examiners and

the proud new amateurs posed for a photo. Front row, left to right: Michael Garvey, KE0SQZ; Jessica Robertson-Tucker, KE8KIS, and Dale Tongue, AC7NP (VE). Back row, left to right: Jason Vlasak, W2VLA (VE); Brian Chad O'Rourke, K4UL (VE); Melinda Thayer, KM6VBG; Cyril Rodriguez, KM6VBQ; David Sheets, KI7ZZH, and Stephen Reep, KD2QHM.



The Joy of SOLDERING

A look at a time-honored skill that continues to serve us well.



Joseph L. Lynch, N6CL

Many old-school hams feel that there is nothing sweeter than the smell of boiling rosin — the flux used for making solder connections. Usually, soldering was the first skill acquired after obtaining an Amateur Radio license, and I still remember my mentor, Earl Wiederhold, K6SMT (SK), teaching me the basics.

Building a Dipole

After taking the licensing exam, which was administered by Earl, I got my Novice license in January 1961. But before I could get on the air, I had to construct an antenna. Because I had crystals for 40 meters, I chose a dipole for that band.

Quickly, I learned that constructing the antenna was not simple. For parts, I needed two egg insulators, a longer glass insulator, 67 feet of solid copper wire, and a length of RG-8 coaxial cable.

Earl showed me how to run the wire through the egg and glass insulators, both of which had holes in each end. I watched as he connected the coaxial cable to the wire attached to the glass insulator.

After cutting 33½ feet of copper wire, Earl used sandpaper to shine 2

ff | watched

added solder,

the remaining

surface. "

carefully as Earl

slowly moving the

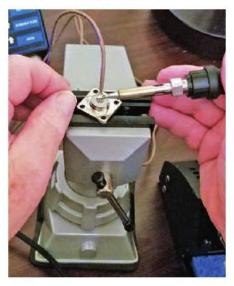
iron gently across

inches of the wire, which he then threaded through the egg insulator, being careful to wrap it along the insulator's grooves. I watched carefully as he went through the process of pulling the wire through the insulator, wrapping it around the wire entering the insulator. After using the

sandpaper on the part of the wire to be wrapped, he used needle-nose pliers to tightly wind the other section of wire around the now-shiny part.

Learning to Solder

Earl took his time, methodically going through the process slowly as



Joe Lynch, N6CL, soldering one end of a VHF loop antenna to the center conductor of a PL-259 coax connector.

he instructed me along the way. Before beginning, he laid out the materials, informing me that the first step of the process was choosing the type of soldering flux, because while acid flux worked better on plumbing, rosin flux worked better on electrical connections because it prevented corrosion.

Next, he showed me how to hold the egg insulator and the wire so as not to get burned while soldering. Then he started his work on the antenna,

and I was mesmerized, watching and retaining all of the information. He explained, "Heat the rosin so it is boiling by touching the iron onto the wire where you applied the rosin. While it is boiling, it is cleaning the copper of any remaining impurities. Next, while holding the iron in

place, apply the solder to the wire, waiting for it to be hot enough to flow across the wire." He stressed the importance of the wire being hot enough, warning that if done improperly, it could cause a dry solder joint.

I watched carefully as Earl added solder, slowly moving the iron gently across the remaining surface. He carried on with his instruction, saying, "After you've applied enough solder, gently remove the solder and the iron, making sure to not move or jiggle the wire until after it has cooled." I noted the importance of this last instruction, as it would ensure a solid connection was made.

After he assembled half of the dipole antenna, under his careful tutelage he had me construct the other half.

Finishing the Job

Next, Earl used his knife to strip the end of the coaxial cable. He made sure I understood how important it was to not nick either the center conductor or the braid with the knife. "Because," he explained, "a nick weakens the wire, thereby subjecting it to the possibility of breaking."

Continuing his careful movements, he explained how to weave the center conductor of the coaxial cable into the twist of the wire at the glass insulator. He did the same with the braid and the other wire on the glass insulator. Finally, my antenna was ready to be raised.

Testing My Skills

One of my most memorable soldering jobs occurred in Cifuentes, Cuba, in February 1995. On my third humanitarian trip to Cuba, I reconnected with some ham radio friends from the previous year, including Humberto Diaz, CM6HH.

To replace his very austere 20 W, 40-meter transceiver that he'd shown me on a prior visit, I brought him a Kenwood TS-520 transceiver.

Hours after I'd given it to him, Humberto told me the radio did not work, and my heart sank, knowing what the new transceiver had meant to him. I began troubleshooting it and found that it had a cracked printed circuit board, which caused a split between circuits. I gathered my necessary supplies, including a sol-

dering iron, hookup wire, and a volt ohm meter (VOM), and went to work.

Turning the VFO knob, I noticed the receiver was cutting out across the band, so I used the VOM and located a loose connection between the variable capacitor and the frame. I soldered a wire between the shaft and the frame and fixed the problem — much to Humberto's pleasure.

Feeling Nostalgic

Over the decades, I constructed several wire antennas, often remembering Earl's solder lessons. My most recent recollection occurred 2 years ago. On a trip to San Antonio with my wife, Carol, W6CL, we'd planned to spend the weekend in Tulsa, Oklahoma, visiting family. This also gave me the chance to operate in the ARRL DX Phone Contest, but in order to save some space packing, I only brought my Icom IC-7300 and switching power supply and planned to build a 20- and 40-meter dipole antenna once we arrived in Tulsa.

I bought a tool box, an SO-239 connector, a box of RG-58 coaxial cable,

If I soldered a wire between the shaft and the frame and fixed the problem.

a soldering iron, #14 THHN house wire, jumper cables, a rope and painter poles (from which to hang the antenna), ½-inch PVC T-connectors for the insulators, and a roll of rosincore solder.

While constructing my last-minute HF dipole, I paused long enough to appreciate how Earl taught me decades earlier the correct way to construct my first dipole antenna. Then, glad that rosin-core solder still existed, I thought to myself, "There is nothing sweeter than the smell of boiling rosin."

[Years ago, solder, as mentioned in the text, contained lead. Inhaling fumes from the boiling rosin could therefore lead to inhaling dangerous levels of lead. Lead/ rosin solder has now been outlawed and replaced by lead-free solder, which may be harder to work with, but is much safer. — Ed.]

Life Member and ARRL VE Joseph L. Lynch, N6CL, was first licensed in 1960 and upgraded to General class in 1961. He has served as Emergency Coordinator for South San Diego County, a MARS operator in Vietnam (eventually becoming NCOIC of the Cu Chi, Vietnam MARS Station, AB8AJ), and ARRL Oklahoma Section Manager from 1988 to 1996. Joe was responsible for the more than 300 Amateur Radio volunteers who supported emergency communications in the aftermath of the April 19, 1995 Murrah Building bombing in Oklahoma City. He was VHF Editor for CQ magazine for 22 years, Editor of CQ VHF magazine for 12 years, and Editor of QCWA Journal for 2 years, and is presently a columnist for The Spectrum Monitor. Joe is a director of religious education for the US Army Garrison at West Point, New York, where he volunteers for the USMA Cadet Amateur Radio Club, W2KGY, and has assisted in the testing and licensing of more than 60 US Military Academy Cadets. He is married to Carol, W6CL. Joe can be reached at n6cl@arrl.net.

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





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

- Phil Salas, AD5X, builds a highly linear two-tone test generator for transceiver IMD testing.
- Jim Koehler, VE5FP, automates a simple toaster oven for reflow soldering.
- Braddon Van Slyke, ACØZJ, makes a base-band quadrature modulator that operates over multiple bands.
- Jan M. M. Simons, PAØSIM, uses noise-cancelling and noise-reduction

techniques to extract signals from noise.

- Maynard Wright, W6PAP, shows another approach to measure the characteristic impedance of coax cable.
- John Stensby, N5DF, calculates coax loss directly from impedance measurements.
- Grant Saviers, KZ1W, covers the 160-meter band in four switchable band segments.

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State and Regional QSO Parties

Something for Everybody

Whether you approach them as a contest or just some on-air fun, it's easy to get involved with these events that enliven the bands year 'round.



Hal Kennedy, N4GG

Highly appreciated by those that know about them, state and regional QSO parties are an on-air activity that many operators have yet to discover. All 50 states have one, and operators can choose how they want to participate in these events, treating them as if they are low-key parties, contests, or both. There will be a few stations going allout, but even if you dislike contesting, QSO parties are still an activity for you.

Benefits of Participation

There are many reasons to take part in a state or regional QSO party. As a low-key operating event, its biggest draw is to have fun with it, whether you're participating to say hello to old friends, encourage newcomers, or you're looking to fill in some counties or grid squares in your logbook.

Most QSO parties also provide the benefit of having one or more rover (mobile) stations that travel through different counties, and they can be worked each time they enter a new one (see the sidebar, "Increase Your Score County by County"). Following their progress is a lot of fun, can sharpen your state geographic knowledge, and can develop new friendships. Rovers drive many hours to give operators new counties, and supporting their efforts can go a long way toward increasing your score.

No one should fear jumping in, because these events are often seen as a casual way to make contacts. There is a lot of participation by operators that only get into one on-air activity a year — the QSO party for their state. Even as a hardcore contester, I find that these events are the perfect opportunity to sharpen old skills or build new ones, all at a relaxed pace. If you are a newbie or an old-timer getting rusty, the parties provide the perfect learning atmosphere. Leisurely and hardcore participants mix very well in state QSO parties, and the high-speed all-out guys will invariably slow down for beginning operators.



Hal Kennedy, N4GG, received the New England QSO Party plaque for his efforts in the event. [Hal Kennedy, N4GG, photo]

Awards

If you're interested in pursuing awards, the easiest way to win them is by participating in state QSO parties. Many contacts in state QSO parties are casual because many participants aren't trying to win anything, but sometimes, operators will win something without even trying.

Every state and regional QSO party issues dozens of paper certificates for various achievements. In 2014, I won a beautiful plaque from the New England QSO Party (NEQP), which arrived as a complete surprise.



The plaque (on right) awarded to the W8UM operating team after winning the 2014 Michigan QSO Party. As an added bonus, the University of Michigan Amateur Radio Club and rival Michigan State University Amateur Radio Club have developed their own trophy (on left) to be held by the winner each year. [Dan Romanchik, KB6NU, photo]

September

State and Regional QSO Party Schedule

New Mexico,

North Dakota

January Montana New England QSO May Party (ME, NH, VT, MA, Vermont, Minnesota, **February** CT, RI), 7th Call Area North Carolina, QSO Party (WY, UT, South Carolina OR, WA, NV, MT, ID, March Idaho, Louisiana, AZ), Arkansas, Oklahoma, Virginia, Delaware, Indiana Wisconsin Kentucky, West Virginia June April Florida, Georgia, Maryland/DC, Hawaii, August Michigan, Mississippi, Ohio, Kansas Missouri, Nebraska,

State Salmon Run,
New Hampshire,
Maine, Texas,
Colorado, Iowa,
New Jersey,
Tennessee

October
California, Arizona,
Pennsylvania,
Illinois, New York,
South Dakota

For dates, times, and rules, check www.
contestcalendar.com/stateparties.html.

Alabama, Washington



Hal, N4GG, enjoying a coffee break during leisurely participation in the

Georgia QSO Party. [Hal Kennedy, N4GG, photo]

Other awards are more extravagant and specific to the state. For instance, the California QSO Party (CQP) awards a bottle of California wine to each of the top 20 scorers from outside the state, and the NEQP flies a lobster dinner for two overnight to the out-of-state winner. Other states send handmade plagues shaped like their state, and Hawaii awards plaques shaped like surfboards. These awards are often won without much effort, but they can be very special and meaningful, offering an added incentive to join in the fun.

When you do win a plaque or award in any contest or QSO party, it would be nice to send a thank-you note to the award sponsor. Email is fine these days, but I still mail handwritten thankyou notes via the USPS. I've gotten comments about how appreciated those are, and when I sponsor plaques, the thank-you notes mean a great deal to me.

Choosing a QSO Party

There are state and regional QSO parties many weekends of the year (see the sidebar, "State and Regional QSO Party Schedule"), so you can schedule which ones you want to

Increase Your Score County by County

Working counties is important! Every state QSO party is scored using a formula that includes number of QSOs × number of counties contacted. The details vary however, so check the rules. Some QSO parties let you count a county twice on each band once for an SSB contact and once for CW. Working as many counties as possible on as many bands and modes as possible is a time-tested way to earn a plaque for your wall. Contacting the roving mobile stations is your key to maximizing county totals.

> participate in, and your options are abundant.

Times and days may vary, with some events running for a few hours throughout the weekend, and some taking place all day. Based on when you want to operate and the time you're willing to commit to the event, there will always be options for you. It is important to check the event's website for rules and times before operating in the QSO party.

See you in the next state or regional QSO party!

Amateur Extra Hal Kennedy, N4GG, has been licensed and on the air for 57 years. He received his BSEE from Lafavette College and an MS in management from the Sloan School at MIT. Now retired, Hal worked in the aerospace and defense industry for 30 years. Hal has won numerous awards as an active contester and DX chaser on all HF and VHF bands, and he particularly likes building and experimenting with wire antennas. Hal has written articles for NCJ and QST, and he is a contributor to both The ARRL Handbook and The ARRL Antenna Book. In 2010, Hal built "Blue Lightning," a replica 1910 rotary sparkgap transmitter that has been displayed at several hamfests. Hal can be reached at n4gg@arrl.net.

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



Tips on Deciphering Exchanges

For operators new to state QSO parties, it is important to understand the concept of directed CQs. A directed CQ is one where the CQing station is looking for a reply from a specific place. For example, in the Georgia QSO party (GQP), stations outside Georgia want to make contacts with Georgia, so they call "CQ GA" on CW, or "CQ Georgia" on SSB.

Stations inside Georgia would call "CQ GQP" on CW, or "CQ Georgia QSO Party" on SSB. In the GQP, I will sometimes call "CQ GQP de N4GG/CHER" on CW, indicating I am in Georgia, specifically in Cherokee County for those looking for my county.

When I am out of state and the QSO party is in a "4" calling area. known as the "4-land" (including Kentucky, Virginia, Tennessee, North Carolina, South Carolina, Alabama, Georgia, and Florida), I usually sign N4GG/GA to help other operators know that, while I have a "4-land" callsign, I'm not in the state they are looking for.

Nearly every logging program supports the state QSO parties and every county in the US has a four-letter abbreviation. Logging programs have the county lists built in. Keep the counties list close by to use as a cheat sheet during exchanges.

A Y R S R

ARRL Board of Directors Addresses Ambitious Agenda

Rick Lindquist, WW1ME

A demanding agenda faced the ARRL Board of Directors when it convened for its annual meeting on January 18 – 19 in Windsor, Connecticut. President Rick Roderick, K5UR, chaired the session. Several new faces were around the table, with four newly elected ARRL Directors, one newly elected Vice Director, and one recently appointed Vice Director.

Attending for their first [Michell meeting as Board members were Hudson Division Director Ria Jairam, N2RJ; New England Division Director Fred Hopengarten, K1VR; Northwestern Division Director Mike Ritz, W7VO, and Roanoke Division Director George "Bud" Hippisley, W2RU. Also present were Northwestern Division Vice Director Mark Tharp, KB7HDX, and Rocky Mountain Division Vice Director Robert Wareham, N0ESQ, who was appointed last fall to fill a vacancy.

Amateur Radio Parity Act Petition

The Board adopted a resolution to withdraw, without prejudice to refiling, ARRL's December 18 Petition for Rule Making to the FCC, which sought to amend the Part 97 Amateur Service rules to incorporate the provisions of the Amateur Radio Parity Act (ARPA). The Directors determined that ARRL needs to "review, re-examine, and reappraise ARRL's regulatory and legislative policy with regard to private land-use restrictions." The resolution also asked members of Congress who had refiled Parity Act legislation to refrain from seeking to advance



The ARRL Board of Directors met for its annual meeting on January 19 – 21 in Windsor, Connecticut. [Michelle Patnode, W3MVP, photo]

that legislation, pending further input from ARRL.

ARRL has been pursuing congressional approval of the Amateur Radio Parity Act for several years, and measures were twice passed by the US House. "While everyone understands that getting Congressional approval on any matter can be a lengthy process, the difficulty getting the ARPA approved has been a source of frustration to the organization and its members," the Board said in a postmeeting statement. "A majority of the Board now believes that there is a need to reassess the organization's approach to this issue."

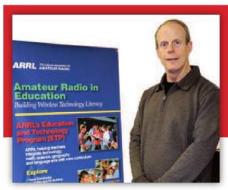
The Board said the hiatus should not be interpreted as an abandonment of ARRL's efforts to obtain relief from private land-use restrictions. The intent is "to renew, continue, and strengthen ARRL's effort to achieve relief from such restrictions" and that the action "represents a chance to get the best product possible for all US Amateur Radio operators."

The Board expressed appreciation to the thousands of ARRL members who contacted their representatives in Congress to urge them to support the Amateur Radio Parity Act. The Board also thanked members of Congress who consistently supported the rights of US Amateur Radio operators.

Lifelong Learning Initiative

On a voice vote, the Board set the Lifelong Learning Initiative in motion, endorsing and funding the program and retaining Connecticut consultants Mintz + Hoke to work with ARRL Lifelong Learning Manager Kris Bickell, K1BIC, and other ARRL staffers to build this learning environment. The Board authorized \$485,000 to fund the Lifelong Learning Initiative, which will seek to provide a series of learning tracks that will serve the needs of the various interest groups within the Amateur Radio community. While designed for everyone with an interest in learning more about Amateur Radio, the initial focus will be on creating online learning opportunities for newer hams.

75



We are building a new learning environment.

— Lifelong Learning Manager Kris Bickell, K1BIC

Mintz + Hoke will conduct the research necessary to identify the different educational needs within the broader Amateur Radio community and develop lifelong learning strategies and programs aimed at attracting and retaining ARRL members, especially newly licensed radio amateurs.

Bickell noted that youth education will be a critical component of this Learning Initiative, but he also believes that overall opportunities in this area are huge, as many individuals are looking to expand their knowledge of Amateur Radio, Where appropriate, he said, learning tracks will build upon the knowledge base that already exists within ARRL, such as the material in QST and QEX magazines, as well as other ARRL publications and manuals. The Learning Initiative will also offer resources that allow individuals to delve further into a subject, rather than them relying solely on ARRL content.

"We are building a new learning environment," Bickell said. "It will take a lot of work to put this all together, but we believe that this initiative will firmly establish ARRL as an educational leader in Amateur Radio." He expects the online Lifelong Learning platform to launch in the fall of 2019.

Headquarters Reorganization

The Board received the report of ARRL CEO Howard Michel, WB2ITX, who outlined plans to reorganize and refocus the activities at ARRL Headquarters. Michel said providing better value to membership is a top priority, and he sees value creation and value delivery as key components to long-term membership retention and growth.

"I see ARRL as a membership association, a business, and a 501(c)(3) public charity," Michel said after the meeting. "As CEO, I intend to strengthen all three aspects. And all three must remain in balance for ARRL to function effectively."

Michel said that, as a business, ARRL is not just *QST*, *The ARRL Handbook*, DXCC, or the VEC program. "We can't allow ourselves to continue to think within those traditional parameters," he continued. "ARRL's businesses are value creation, value delivery, and advocacy."

The reorganization would involve three key components. A Management Council will be established to discuss ideas, operations, and long-term planning and to foster horizontal lines of communication within the organization. A Product Development

Manager will be retained to create new ideas for products and services, develop pilot programs to quickly test those ideas, and then — if the pilot programs are successful — transition them to operations. A Marketing Communications Manager will be hired to promote "a coordinated and consistent message, across all forms of media" that will resonate both with current and potential members. "Our brand works with our traditional members," Michel observed. "It is not working for newly licensed hams."

The Board also endorsed the purchase of a modern association management software system that should dramatically improve ARRL members' experiences, Michel said.

Amateur Radio Emergency Service

The Board adopted an Amateur Radio Emergency Service (ARES) Plan, as recommended by the Programs and Services Committee. Committee Chair Dale Williams, WA8EFK, said the ARES Plan will establish training programs and three levels of ARES membership. It also revises ARES appointment definitions and designates the Emergency Coordinator (EC) as the lead person in local activations. Section and District Emergency Coordinators will serve as resources.

The Board further established an Emergency Preparedness Manager Requirements Committee, charged with setting the requirements for

**ARRL's businesses are value creation, value delivery, and advocacy. **J*
— ARRL CEO Howard Michel, WB2ITX



Other Business

The Board's agenda also addressed the following:

- Elevated the ad hoc Logbook of The World (LoTW) Committee to permanent status, reporting to the ARRL Administration and Finance Committee.
- Received the report of ARRL's investments for 2018 from ARRL Treasurer Rick Niswander, K7GM, who said ARRL's portfolio recorded a small loss for the year, "consistent with market-derived expectations."
- Heard from Chief Financial Officer Diane Middleton, W2DLM, who reported that "a financially strong balance sheet generated a larger-than-expected gain from operations for 2018." Cash flow also continued to be favorable.
- Received the report of EMC Committee chair Kermit Carlson, W9XA, who told the Board his panel is working to raise awareness of a variety of issues stemming from major technological advances, such as wireless power transfer systems for charging electric vehicles. Carlson said that while new systems need spectrum, protection of other bands for other services is necessary. He invited the Board's vigilance in alerting the EMC Committee to potential concerns.
- Affirmed its support of the National Traffic System and all amateurs involved in traffic handling, and their role as partners to ARES in ARRL's public service tool kit.
- Considered recommendations of the Administration and Finance Committee and adopted the ARRL 2019 – 2020 Plan.
- Elevated past New England Division Director Tom Frenaye, K1KI, to Director Emeritus, commending him for his more-than-30 years of service to Amateur Radio "as a leader in his community, ARRL Division, and nationwide." Since 1975, Frenaye has served as an ARRL employee, Director, and Vice President, and as President of the ARRL Foundation.
- Elevated retiring West Gulf Director Dr. David Woolweaver, K5RAV, to ARRL Honorary Vice President, in recognition of "providing outstanding leadership" throughout his 19 continuous years as a Vice Director and Director.
- Directed the ARRL Secretary to cast ballots in support of the re-election of IARU President Timothy Ellam, VE6SH, and IARU Vice President Ole Garpestad, LA2RR, for additional 5-year terms.
- Received greetings from IARU Secretary David Sumner, K1ZZ, on behalf of IARU President Tim Ellam, VE6SH, and from Radio Amateurs of Canada President Glenn MacDonell, VE3XRA.

the staff position of ARRL Emergency Preparedness and Response Manager.

ARRL Governance and Legal Matters

Addressing an ARRL governance issue, the Board repealed the ARRL Policy on Board Governance and Conduct of Members of the Board of Directors and Vice Directors, commonly known as the "Code of Conduct," on an 11 – 3 vote with one abstention.

The Board voted unanimously to create a Legal Structure Review Committee to study and make recom-

mendations to update ARRL's legal structure "to reflect ARRL's current operational needs."

Amateur Radio on the International Space Station

A permanent Amateur Radio on the International Space Station (ARISS) Committee was approved "to develop an interactive relationship" with ARISS, which sponsors voice contacts between ISS crew members and school groups and gatherings on Earth, "bringing together STEM program objectives and local Amateur Radio groups." The Board motion said ARISS "has demonstrated very posi-

tive public relations benefits to ARRL, and that it's in ARRL's best interests to support ARISS."

ARRL Bill Leonard, W2SKE, Media Awards

The Directors named the recipients of two ARRL Bill Leonard, W2SKE, Professional Media Awards, as recommended by the ARRL Public Relations Committee, with the concurrence of the Programs and Services Committee.

Tom Knapp of www.lancasteronline. com and the LNP Media Group Inc. of Lancaster, Pennsylvania, was named as the 2018 Bill Leonard, W2SKE, Professional Media Award for Print Reporting recipient. The Board said Knapp "went above and beyond to capture the workings of Field Day at W3RRR, the Red Rose Repeater Association."

The Board named Andrew Schmertz and New Jersey Television (NJTV) as recipients of the 2018 Bill Leonard, W2SKE, Professional Media Award for Video Reporting. The Board cited Schmertz and NJTV for "outstanding coverage" of the February 23 - 24, 2018, HamSCI (www.hamsci.org) conference at New Jersey Institute of Technology (NJIT). NJTV, which is New Jersey's public television network, covered the conference. Schmertz interviewed Frissell, numerous faculty members, attendees, and members of NJIT's Amateur Radio station, K2MFF, "all with an eye to explain clearly to the public the significance of measuring the effects of solar activity on communications," the Board said.

The ARRL Bill Leonard, W2SKE, Award honors professional journalists or journalistic teams whose outstanding coverage highlights the enjoyment, importance, and public service value of Amateur Radio.

Minutes of the annual meeting have been posted. — Thanks to ARRL Communications Manager David Isgur, N1RSN, who provided some material for this report

Happenings

Riley Hollingsworth, K4ZDH, to Oversee Volunteer Monitors Development and Implementation

Riley Hollingsworth, K4ZDH, will oversee the development and implementation phases of ARRL's new Volunteer Monitors (VM) program, which will replace the Official Observers (OO) program. Hollingsworth, who once handled Amateur Radio enforcement for the FCC, stepped down in February as ARRL Atlantic Division Vice Director to avoid any appearance of a conflict of interest. The development phase of the program is already under way.

"I am grateful for the Atlantic Division ARRL members supporting me, but I think I can better serve the Atlantic Division and all ARRL divisions by working in the Volunteer Monitors program," Hollingsworth said in his resignation letter.

ARRL President Rick Roderick, K5UR, said that Hollingsworth was the ideal person to lead ARRL's efforts in the development and implementation of this joint program with the FCC. "I support Riley's decision to concentrate his efforts on this very valuable project on behalf of the ARRL," he said.

Approved by the ARRL Board of Directors last July, the Volunteer Monitors will work in cooperation with the FCC. Volunteers trained and vetted by ARRL will monitor the amateur bands for possible instances of misconduct or to recognize exemplary on-air operation. Cases of flagrant violations or noncompliance will be directed to the FCC for action, in accordance with FCC guidelines. The program, which aims to re-energize Amateur Radio enforcement efforts, was proposed by the FCC following the closure of several FCC regional offices and reductions in field staff.

Hollingsworth has identified three phases to the program — development, solicitation and training, and implementation.

The development phase will include drafting a mission statement, clearly defining ARRL's and the FCC's requirements and needs as part of the program, drafting a Volunteer Manager job description, and developing a training manual for volunteers.

The solicitation and training phase will involve identifying the geographical locations where volunteer monitors will be most needed, soliciting

applications, and screening applicants. Current Official Observers will be invited to apply for appointment as Volunteer Monitors (VMs).

Implementation will involve having the volunteers provide field reports, and ARRL staff offering guidance to volunteers to ensure that the information gathered meets FCC requirements. Continuing education will be provided to the volunteers as part of the program.

Hollingsworth has committed to ensuring training adequacy for new VMs, reviewing the quality and utility of Volunteer Monitor submissions to the FCC for enforcement action, and advocating for rapid disposition of cases appropriately submitted to the FCC.

ARRL officials estimated in February that it would take up to 1 year before the first Volunteer Monitors begin filing reports.



Riley Hollingsworth, K4ZDH.

I am grateful for the Atlantic Division ARRL members supporting me, but I think I can better serve the Atlantic Division and all ARRL divisions by working in the Volunteer Monitors program.

US Navy Explores Amateur Radio as a Training Adjunct

The US Navy's Naval Air Warfare Center Weapons Division (NAWCWD) has adopted Amateur Radio training as a possible new approach to basic RF and electronics instruction. More than 20 NAWCWD employees took part in a week-long class in Point Mugu, California, in December. The class, which culmi-

nated in an examination session for the Technician license, offered NAWCWD employees a novel approach to teaching radio propagation, said Brian Hill, KF4CAM, the lead for electromagnetic maneuver warfare experimentation in the Avionics, Sensors, and E*Warfare Department. Hill, who got his license

while he was still in high school, is also the department's "innovation ambassador."

"I looked at the breakdown of current new hires and saw that many had degrees in computer science and thought that their classwork might not have covered things like RF propagation," Hill said. Rather than have employees sit through hours of *PowerPoint* briefings, Hill thought that a licensing course might be a more dynamic, hands-on approach to convey the basics — and cover areas such as directional antennas, signal propagation, and modulation that are necessary for their work.

Initially, Hill had 10 class slots funded, but then Target Design Engineering Branch Head Ian Mann, KI6YVO, got wind of the class, saw its potential, and helped get funding to expand participation. Mann, a General-class licensee and a ham for nearly 10 years, said he's been able to apply knowledge learned in the class to his NAWCWD work.

Target Systems Division Head Milton Gabaldon also saw merit in the



Some of the 23 NAWCWD Amateur Radio class members hold their Certificates of Successful Completion of Examination (CSCEs).

approach. He sat in on the licensing classes, took the exam, and is now KM6YPA. For him, it's about connecting the dots.

"It's about introducing people to electronics, to start understanding what RF is all about ...so when we talk about it in the test and evaluation world, [students] know what we're talking about," Gabaldon said. "They get a better view than 'I just do software.' Now they see 'My software controls this piece, which sends out RF jamming signals that protect the warfighter.' That's the most important takeaway."

In all, 23 employees who took the Technician exam passed, and several also successfully tested for General and Amateur Extra-class licenses during the initial test session. Hill hopes to offer more hands-on classes in the future, and he's planning a foxhunt for additional hands-on training.

— Thanks to NAWCWD and Public Affairs Officer Kimberly Brown; some information from C4ISRNET

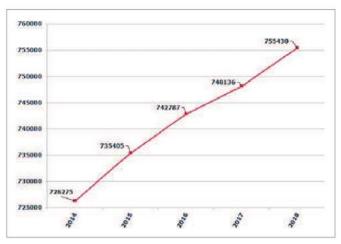
US Radio Amateur Population Grows Slightly in 2018

The US radio amateur population once again grew by about 1%, based upon 2017 and 2018 year-end FCC database statistics provided by Joe Speroni, AH0A. The 755,430 total licensees represent nearly 7,300 more license holders than those that were in the database at the end of 2017. Nearly 51% of the Amateur Radio population in the US — 384,145 — hold a Technician license. Generals are second with 175,949, and Amateur Extraclass holders number 147,369. Advanced and Novice licensee populations continue to decline, with 39,607 Advanced and 8,360 Novices, as the FCC no longer issues Advanced or Novice licenses. A more significant statistic is 31,576 new FCC licenses last year, although that's 620 fewer than came aboard in 2017.

"New amateur licenses granted by FCC are down 2% over last year," noted ARRL Volunteer Examiner Coordinator (VEC) Manager Maria Somma, AB1FM, "but this is the fifth year in a row the total has been greater than 31,000. I predict that the number of new licensees will be more than 30,000 at the end of this year as well, and I'm optimistic this trend will continue."

Upgrades are also down slightly, compared to last year — 9,456 in 2018 versus 9,576 in 2017, she added. "For the fifth year in a row, we have conducted more than 7,000 Amateur Radio exam sessions in a year — an important milestone for the ARRL VEC," Somma recounted.

ARRL VEC filed a total 30,393 license application forms last year, compared to 31,014 in 2017. That includes new, upgrade, modification, renewal, and club station filings. At 7,035 in 2018, the number of exam sessions conducted by ARRL VEC marginally trailed the 7,075 held in 2017. ARRL VEC served 34,493 exam applicants in 2018, compared to 35,352 in 2017. Exam elements administered by ARRL decreased from 47,152 last year to 45,817 this year, Somma said.



The growth of the US radio amateur population since 2014.



FCC Reaches \$900,000 Settlement in Unauthorized Satellite Launch Case

The FCC has settled an investigation into an alleged unauthorized launch and operation of small satellites by Swarm Technologies. The company agreed to a *Consent Decree* that included a \$900,000 penalty, an extended period of FCC oversight, and a requirement of pre-launch notices to the FCC, among other stipulations.

"We will aggressively enforce the FCC's requirements that companies seek FCC authorization prior to deploying and operating communications satellites and earth stations," FCC Enforcement Bureau Chief Rosemary Harold said. "These important obligations protect other operators against radio interference and collisions, making space a safer place to operate."

In April 2017, Swarm Technologies applied for an Experimental license to deploy and operate two Earth stations and four tiny ¼ U CubeSats called SpaceBEEs. The FCC denied the application in December 2017 over concerns about the ability to track the satellites. Swarm nevertheless launched the satellites on January 12, 2018, on a vehicle that also carried an Amateur Radio satellite into space. After reports of the unauthorized SpaceBEEs launch surfaced, the FCC began an investigation in March 2018.

The FCC determined that Swarm had launched the four SpaceBEEs from India and had unlawfully transmitted signals between Earth stations in Georgia and the satellites for more than a week.

The FCC issued an *Enforcement Advisory* last April to remind satellite operators that they must obtain FCC authorization for space station and Earth station operations. — *FCC Media Release*

FCC Seeks Comment on Amateur Radio-Related Petition

The FCC in February invited public comments on a *Petition for Rule Making* (RM-11826) from an Ohio radio amateur seeking to amend the Part 97 station identification rules to better accommodate and simplify station identification during an emergency net, drill, or activation. ARRL member Robert A. Dukish, KK8DX, filed the petition in December.

Dukish seeks a change to Section 97.119(a) of the rules, which requires an amateur station to transmit its "assigned call sign on its transmitting channel at the end of each communication, and at least every 10 minutes during a communication." He noted that during emergency networks, requiring participating stations — often portable — to use their assigned call signs during each transmission could prove "burdensome and can hinder the flow of emergency traffic on the channel."

Specifically, he suggested a simple approach would be to permit the net control station or other designated participant to announce from a single point the call signs of every station taking part in the net or exercise when tactical call signs are often in use — at 10-minute intervals, using automatic CW identification. Dukish suggested amending Section 97.119(a) to add, "except during a local emergency network activation or drill," and providing that in such situations, a net control or designations station would be "authorized to announce all participating stations' assigned call signs at no more than 10-minute intervals while the net is in progress."

In Brief...

- ■The Amateur Radio on the International Space Station (ARISS) packet system is back on the air with new equipment. The replacement gear arrived last November and was installed on February 2. ARISS hardware team members on the ground were able to locate a functional duplicate of the old ISS packet terminal node controller (TNC) module that had been in operation for 17 years and had become intermittent; the RF gear remains the same. The ISS packet system, located in the ISS Columbus module, went down in July 2017, but it unexpectedly came back to life the following summer. The packet system operates on 145.825 MHz. ARISS is an official back-up system for astronauts to talk with Mission Control in the unlikely failure of the station's primary communication systems. In 2017, hams relayed nearly 89,000 packet messages via the ISS; response to its recent return has been enthusiastic, ARISS said. - Thanks to ARISS
- ■Following the partial government shutdown early this year, the FCC speedily tackled a backlog of applications already in the queue. Although it at first sought to hold back the flood of applications, asking that Volunteer Examiner Coordinators (VECs) give the agency a little breathing room before submitting additional new files, the FCC was ultimately able to work through its backlog very quickly, reported Assistant ARRL VEC Manager Amanda Grimaldi, N1NHL. The ARRL VEC had piled up some 2,700 pending Amateur Radio applications, many of them from 425 ARRL VEC examination sessions that took place during the shutdown or immediately prior to it. These do not include files that the other 13 VECs may have ready to upload. The large volume of filings submitted during the partial government shutdown were entered into the Universal Licensing System (ULS) in batches and assigned a January 29 receipt date, the FCC said. That included Amateur Radio vanity call sign applications filed between January 3 and January 29.

■A WWV 100th anniversary special event is in the planning stages. The WWV Centennial Committee has a tentative agreement with the National Institute of Standards and Technology (NIST) to mount a special event station this fall adjacent to the site of WWV in Colorado to mark the 100th anniversary of the time and frequency standard station. WWV is the world's oldest continuously operating radio station. Dave Swartz, W0DAS, of the Northern Colorado Amateur Radio Club (NCARC) heads the committee, which is developing plans for an NCARC special event from September 28 through October 2, with a NIST centennial observance tentatively set for October 1. After fears were raised that funding for the NIST radio stations might be cut, the Fiscal Year (FY) 2019 NIST budget for WWV, WWVH, and WWVB will remain level for the next year, which ends on September 30. Swartz said NIST management is "on board" with the celebration, and Deutch plans to attend Hamvention May 17 – 19 to promote the centennial event.



The WWV building near Fort Collins, Colorado. [Photo courtesy of NIST]

■Several new ARRL Foundation Board members joined the Foundation's annual meeting on January 29. ARRL Foundation Board members elected by the ARRL Board of Directors at its January 18 – 19 annual meeting include Atlantic Division Director Tom Abernethy, W3TOM, for a 3-year term; Northwestern Division Director Mike Ritz, W7VO, for a 2-year term; Pacific Division Director Jim Tiemstra, K6JAT, for a 1-year term, and Southwestern Division Director Dick Norton, N6AA, for a 3-year term. Past West Gulf Division Director Dr. David Woolweaver, K5RAV, who stepped down from the ARRL Board in January was elected to remain on the ARRL Foundation Board for another 3-year term and will serve as president. Others on the ARRL Foundation Board are Tim Duffy, K3LR; Jim Fenstermaker, K9JF; Brian Mileshosky, N5ZGT, and David Norris, K5UZ. Mileshosky was elected Vice President; Rick Niswander, K7GM, was re-elected as Treasurer, and Lauren Clarke, KB1YDD, was re-elected as Secretary. Woolweaver appointed Fenstermaker to chair the Scholarship Committee with Abernethy, Duffy, Norris, Ritz, and Tiemstra as members. Mileshosky was tapped to again head the Proposals Committee, with Norton and Woolweaver as members. Woolweaver will chair the Audit and Financial Committee, with Mileshosky and Niswander as members.

Section Manager Nomination Notice

To all ARRL members in the Colorado, Eastern Washington, Georgia, Los Angeles, Sacramento Valley, San Francisco, South Texas, West Virginia, and Western Washington Sections: You are hereby solicited for nominating petitions pursuant to an election for Section Manager (SM). Incumbents are listed on page 16 of this issue.

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

We suggest the following format:

(Place and date)

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

(Signature____ Call Sign___ City___ ZIP_

Any candidate for the office of Section Manager must be a resident of the Section, an Amateur Radio licensee of Technician class or higher, and a full member of ARRL for a continuous term of at least 2 years immediately preceding receipt of a nominating petition. Petitions must be received at Headquarters by 4 PM Eastern Time on June 7, 2019. If more than one member is nominated in a single Section, ballots will be mailed from Headquarters no later than July 1, 2019, to full members of record as of June 7, 2019, which is the closing date for nominations. Returns will be counted August 20, 2019. Section Managers elected as a result of the above procedure will take office October 1, 2019.

If only one valid petition is received from a Section, that nominee shall be declared elected without opposition for a 2-year term beginning October 1, 2019. If no petitions are received from a Section by the specified closing date, such Section will be resolicited in the October 2019 issue of *QST*. A Section Manager elected through the resolicitation will serve a term of 18 months. A Section Manager vacancy occurring between elections is filled through appointment by the Field Services Manager. — *Norm Fusaro*, *W3IZ*, *Radiosport Department Manager*

SM Nomination Petition Resolicitation

Because no nomination petitions were received for the Montana Section Manager election by the nomination deadline of December 7, 2018, nominations are hereby resolicited. See above for details.



Amateur Radio World

Bulgaria to Host the 2019 Youngsters
On The Air Summer Camp

The ninth Youngsters On The Air (YOTA) summer camp will be held in Bulgaria, with the Bulgarian Federation of Radio Amateurs (BFRA) hosting the event.

"In this YOTA Camp, we will be continuing with our train-the-trainer program, which will be the main theme of the week," IARU Region 1 Youth Working Group Chair Lisa Leenders, PA2LS, said in announcing the annual event. "Participants will be working on the future of Amateur Radio and will be involved in workshops where they gain skills to start similar Amateur Radio youth events back home. With this, we are aiming to create a snow-

ball effect [to inspire] more and more YOTA events all over the world."

Leenders said time will be set aside for the up-to-80 campers to enjoy Amateur Radio and become acquainted with Bulgaria. "Previous events have shown that all participants [have] an unforgettable week, where many new friendships are started," she said.

While primarily an IARU Region 1 event, young radio amateurs from Region 2 and Region 3 have also attended. "We are open for teams outside Region 1," Leenders told ARRL. "Depending on the number of applications we receive, we will decide how



many participants outside the Region we can support."

Individual IARU member-societies select candidates aged 15 to 25 for the summer camp, which will take place August 11 – 17 near the Bulgarian capital city of Sofia. — Thanks to IARU Region 1 Youth Working Group Chair Lisa Leenders, PA2LS, via IARU Region 1 News

Wireless Institute of Australia No Longer Providing Exam and Call Sign Services

The Wireless Institute of Australia (WIA) is handing over Amateur Radio exam provision and call sign management to a new provider. The Australian Communications and Media Authority (ACMA) has selected the University of Tasmania and Australian Maritime College (AMC) to handle these functions. The WIA said it would assist in the transition to the new provider.

"It is the view of the WIA Board and the WIA Education Group that anything other than a smooth transition to the AMC will damage the already fragile Amateur Radio community," the WIA said in a statement.

The WIA National Office was in the process of trans-

ferring all call sign applications, assessments, and other activities that were in progress as of February 1, 2019, to the ACMA. WIA had provided these services for some 20 years.



WRTC 2022 Organizing Committee Unveils New Website, Initial Qualification Rules

The World Radiosport Team Championship 2022 (WRTC 2022) Organizing Committee has debuted its official website, www.wrtc2022.it, as well as final qualification rules to be selected as a WRTC 2022 team leader. While 2022 may seem a long way off, the qualifying events — 24 in all — take place

between February 2019 and November 2020. Each qualifying event has a point value that's used in calculating qualifying scores, and each entry category has been assigned a weighting factor.



"Please don't think that WRTC is only for 'top guns," the announcement said. "You might have a chance." According to the announcement, WRTC 2022 selection areas are much smaller, so operators on all continents will have more chances to qualify. Team leaders, once established, will select a team member from among the top applicants who did not qualify as team leaders. "WRTC 2022 is now for everybody. The only things that you will need are commitment, motivation, and skill," the announcement said.

The first qualifying event was the ARRL International DX Contest (CW) in February. WRTC 2022 will be held in Bologna, Italy.

Public Service

Partners of Excellence in Service: A Roundup of Current Events

Much of the work of ARRL volunteers, especially ARES® members, is performed under the umbrella of mutually beneficial, formal written agreements (memoranda of understanding) with national organizations and federal agencies that provide service, safety, and response in the public interest.

Perhaps the grandfather of the ARRL's twelve partners of excellence is the American Red Cross — ARRL signed the initial agreement in 1940. Their field work is conducted by state and local chapter levels, where ARRL Section and local Emergency Coordinators engage with their counterparts. The best known Red Cross/ARES interface occurs at shelters, with amateurs providing communications for shelter managers and residents.

For the second year in a row, the Red Cross with support of its partners, including ARRL, served millions affected by record-breaking major-scale disasters — wildfires, hurricanes, tornadoes, etc. These outreach services are well known, but I did not know that home fires are the nation's most frequent disaster, accounting for the vast majority of disasters that the Red Cross responds to.

A perfect service opportunity for ARRL members is to participate in the Red Cross's Home Fire Campaign. With support from local partners, volunteers go door-to-door to install free smoke alarms and help families create home fire escape plans. In 2018, nearly 400,000 smoke alarms were installed, and more than 165,000 homes were made safer through home fire safety visits. Participating ARRL/ARES members garner the collateral benefit of pre-

senting themselves as radio communications resources within their neighborhoods.

FEMA and Citizen Corps

ARRL is an affiliate (as of June 2003) under FEMA's four charter Citizen Corps programs — Neighborhood Watch, Volunteers in Police Service, Community Emergency Response Teams (CERT), and Medical Reserve Corps. The functions and training (provided by professional responders and qualified volunteers) for CERTs teams of neighbors and other community members organized to provide immediate disaster response — have been expanded to include Disaster Preparedness, Fire Suppression, Medical Operations, Light Search and Rescue, Psychology, and Team Organization.

A critical role on CERTs exists for ARES members, because radio communications is a cornerstone of disaster response, and not just for the Amateur Service. It's important for us to be familiar with, to own, and know how to operate radios in the personal

radio services that are commonly found in the hands of neighbors. Lloyd Colston, KC5FM, a professional emergency manager in Oklahoma, wrote, "For a ham radio response to a 911 outage, I would propose an operator investing in a pair of family radio service (FRS) handheld transceivers tuned to FRS channel one with no PL tone. Monitoring the channel for calls from the neighborhood, the ham could either relay the call for help or advise the caller of the direct line to call for help."

Review the CERT training module for emergency communications online.¹

ARRL/FEMA Tests Interoperability

FEMA Region 10 (Pacific Northwest states) recently conducted a monthly communications exercise (COMMEX), with amateurs taking part. The intent of these exercises is to test and exercise interoperable communication (among federal, state,

https://www.fema.gov/media-library/ assets/documents/28059

ARRL Partners of Excellence

American Red Cross: www.redcross.org
APCO-International: www.apcointl.org
Boy Scouts of America: www.scouting.org
Citizen Corps: www.ready.gov/citizen-corps
Civil Air Patrol: www.gocivilairpatrol.com

Federal Emergency Management Agency: www.fema.gov

National Voluntary Organizations Active in Disaster: www.nvoad.org

REACT International: www.reactintl.org

Salvation Army and SATERN: www.salvationarmyusa.org, www.satern.org

SKYWARN (National Weather Service): www.weather.gov/skywarn/

Society of Broadcast Engineers (SBE): www.sbe.org
United States Power Squadron: www.usps.org



local, tribal, and Amateur Radio assets) during a major disaster in which the communication infrastructure is significantly damaged or destroyed.

In another example, an item from Public Safety and Emergency Communications News Clippings, (Vol. 7, issue 19, October 1 − 15, 2018) reported the FEMA Region IV (southeastern states) Regional **Emergency Communications Coor**dination Working Group (RECCWG) discussed lessons learned from Hurricane Florence, North Carolina mobilized ESF-2 (Communications) for 16 days. Every state in Region IV contributed resources, including personnel and equipment, to support response efforts, which North Carolina heralded as a benefit partially derived from the RECCWG. Information-sharing and relationshipbuilding fostered by the Region IV RECCWG resulted in a more coordinated response from COMLs and COMTs, partners from the PSAP community, Amateur Radio personnel, and federal partners.

SATERN

ARRL and The Salvation Army's Team Emergency Radio Network (SATERN) have a rigorous, long-standing, and close working relationship at the national level as well as with their field organizations and on major-scale disaster responses.

SATERN is a major player in disaster response. The Alaskan earthquake (7.0 M) of November 13, 2018, struck as the Alaska-Pacific Emergency Preparedness (A-P) Net was beginning its daily net on 14.292 MHz. The A-P Net immediately began monitoring the situation, receiving reports from locally affected amateurs. Net member Ken Gilliland, AG6SV, who is also International SATERN SSB Net Manager, provided situation reports to National SATERN Liaison Bill Feist, WB8BZH. Feist then passed the reports to Western Territory Disaster Coordinator John Berglund; Western

Territory SATERN Coordinator Ian Anderson, KO2IAN, and National Disaster Specialist Tameka Sharp. Feist also began monitoring the A-P Net frequency from the WB5ALM SATERN station at the ALM (Alabama, Louisiana, and Mississippi) Division's Emergency Disaster Services center in Jackson, Mississippi. More SATERN members relayed additional information to SATERN leadership. Berglund and Sharp thanked SATERN for communication services rendered.

National Weather Service and SKYWARN

Since the '70s, trained SKYWARN® spotters coupled with Doppler radar, satellite, and other technology have helped the NWS issue more timely and accurate warnings for tornadoes, severe thunderstorms, and flash floods. Under the formal ARRL/NWS agreement, first inked in 1986 and since updated, the National Weather Service works with ARES volunteers at the local level to establish SKYWARN nets and specialized weather emergency alert and relief systems. In this context, radio amateurs serve as communicators and spotters. NWS Warning Coordination Meteorologists are responsible for maintaining this working partnership, which has served the public so well.

SKYWARN Recognition Day (SRD) was developed in 1999 by the NWS and ARRL to celebrate the contributions that volunteer SKYWARNprepared radio operators make to the country's severe weather warning system. The 2018 event took place in December, with many special event stations on the air from NWS offices, contacting radio amateurs around the world. Stations exchanged their call sign, a signal report, and their location, plus a quick description of the weather. "Amateur Radio operators comprise a large percentage of the SKYWARN volunteers across the country," an NWS announcement said, adding that they can "provide



Gordon Gibby, KX4Z, demonstrates sending and receiving email messages via HF Winlink at the 2019 Florida statewide Amateur Radio Emergency Communications Conference held in Gainesville on February 2 – 3. [Rick Palm, K1CE, photo]

vital communication between the NWS and emergency management."

VolP Hurricane Net

Another partner in excellence under the weather service umbrella is the Voice over Internet Protocol (VoIP) Hurricane Net that handled a number of critical reports for supporting WX4NHC, and emergency traffic for a high-water rescue in the affected area of storm Florence in eastern North Carolina in 2018. It was a case where a life was directly saved by the net's efforts.

For the net's Hurricane Michael activation, manager Rob Macedo, KD1CY, noted the net was often very quiet. Because the winds were so powerful, amateur operators had to take cover as the worst hit their region. Reports of winds sustained at 100 MPH with gusts over 115 MPH were received by monitoring weather stations before they were no longer visible online or were damaged by the winds.

VoIP Hurricane Net reps met with partners at the 2018 National Hurricane Conference in Orlando, Florida, and supported the WX4NHC Communications Test at the start of the 2018 Atlantic Hurricane Season. The National Hurricane Center station WX4NHC is the net's principal client.

Classic Radio

Six-Meter AM Radios of the 1960s

In the 1960s, there were many different low-cost, low-power 6-meter transmitter/receiver units available for AM operation. Lafayette Radio Electronics, World Radio Laboratories (WRL), and Olson Electronics marketed 6-meter AM rigs for fixed station or mobile use, while Allied Radio Knight Kits and Heathkit offered similar radios in kit form. Here's a breakdown of some of these popular rigs by manufacturer.

Gonset

Gonset sparked the 6- and 2-meter AM marketplace with their popular family of Communicator products, starting around 1950. The Communicator I, II, and III all featured an ac and dc mobile power supply that used a vibrator to make mobile operation possible. A crystal-controlled transmitter with a 2E26 tube in the final served as the transmitter. A lever switch on the front panel selected transmit or receive.

Gonset made a larger, higher-power radio for 6 or 10 meters: the 6-meter G-50 or the 10-meter G-28. These radios ran nearly 50 W input, but still used class-A Heising modulation. Of course, no mobile power supply was included, and transmit/receive switching was still accomplished with a lever switch.

Gonset went on to develop the Communicator IV, which included PTT transmit/receive switching and a transistorized power supply for mobile operation. The Communicator IV had the size and shape of the model G-76, the only lowband AM transmitter/receiver that also included 6-meter operation.

Gonset finished their many years as a ham radio equipment manufacturer by producing 6- and 2-meter SSB, AM, and CW radios that were largely solid state and were initially called the Sidewinders. The radios quickly developed a bad reputation and Gonset came out with updated versions.

The Knight Kit TR-106 included internal speakers

and PTT transmit/receive

switching.

Lafayette Radio Electronics

Lafayette Radio Electronics offered the HE-35, a very minimalistic 6-meter radio without PTT transmit/receive switching and no internal dc power supply. Lafayette also sold the popular HE-45, which did include PTT transmit/receive operation, a built-in ac and dc vibrator that operated power supplies, and a final amplifier stage using a 2E26 tube. The HE-45 was a single-conversion design with a 1,650 kHz IF. Later models had a rearpanel power socket for a VFO also sold by Lafayette. The company marketed a 10-meter version of the HE-45, known as the HE-50.

Later, Lafayette offered the Japanesebuilt HA-460 for 6-meter AM and the HA-410 for 10-meter AM. These included a solid-state dc power supply and a built-in VFO plus crystal control. They were dual conversion, offering better selectivity and stability than the other models. Lafayette also made a few different imported 6-meter AM radios that were all solid state.

Allied Radio Knight Kits

Allied Radio produced 6- and 2-meter AM transmitter/receiver kits in their popular Knight Kit line: the 6-meter TR-106 and the 2-meter TR-108. Both kits included a double-conversion receiver and a crystal-controlled transmitter with a 2E26 final amplifier tube. Both had a built-in ac and dc power supply for mobile or fixed station use. Internal speakers and PTT transmit/receive switching were included. Allied also made the V-107 matching VFO,



The Gonset Communicator II, part of the company's popular Communicator line. which could be built for either 6 or 2 meters, but not both.

Utica and Olson Electronics

Olson Electronics sold a 6-meter AM radio built by Utica Communications. The Olson model RA-570 had a built-in ac and vibrator-type dc power supplies. It was a reduced-cost version of the Utica 650. Both these radios had dual-conversion receivers with crystal-controlled first conversions using a 40 MHz crystal and only covered 50.0 – 52.0 MHz.

Clegg

Clegg started in VHF equipment with the compact 99er 6-meter AM transceiver. The 99er had only a power supply for home station use, but the vacuum tubes used could be lit directly from a 12 V automotive electrical system, and the ac power supply could be used for mobile with a 50 W dc-to-ac inverter. Clegg went on to produce the higher-power Thor 6 with a separate ac or dc power supply and modulator unit for fixed or mobile use. The Thor 6 was unique in that it automatically transmitted on the receive frequency, making it technically a transceiver, rather than a transmitter/ receiver.

Clegg also marketed a high-power 6- and 2-meter transmitter, the Clegg Zeus, and the companion receiver, the Clegg Interceptor. The Clegg Venus, a transceiver for SSB, AM, and CW, soon followed. Clegg later produced essentially the last 6-meter AM-only transmitter/receiver — the Clegg 66er,

which had an internal ac and solidstate transistorized dc power supply built in.

Heathkit

Following the initial design of their first CB radio, the CB-1, Heathkit developed and refined the 10- and 6-meter versions, the Tener and Sixer. They went on to develop the 2-meter version, the Twoer, as well. The original HW-29 Sixer used 50 MHz fifth overtone crystals, which were expensive and hard to find. The improved HW-29A replaced the earlier model and used the more readily available 8.367 - 9.0 MHz crystals. The Sixer and Twoer had a super-regenerative receiver and an internal ac supply and speaker. Transmit/receive switching was done by a lever switch and no internal dc power supply was provided. They sold well and introduced many hams to VHF operation well before 2-meter FM became popular.

The Shawnee and Pawnee 6- and 2-meter transmitter/receivers were a significant step up from the Sixer and Twoer. Both units had a double-conversion superheterodyne receiver, a built-in speaker, internal ac and dc power supplies, internal VFOs for the transmitter, internal BFOs for CW and SSB reception, and PTT transmit/receive switching.

Hallicrafters

Major radio companies of the 1960s did not develop AM 6-meter transmitter/receivers, aside from Hallicrafters. Hallicrafters first marketed the SR-34 6- and 2-meter transmitter/receiver, then the SR-42 2-meter transmitter/receiver and the SR-46 6-meter transmitter/receiver, plus a transmit VFO to use with them. Hallicrafters sold a mobile kit for use with the SR-42 and SR-46 that included a mechanical vibrator for the dc power supply, a dc power cord for connecting the radios to a mobile 12 V dc power source, and a mobile mounting bracket.

Poly-Comm

The Poly-Comm Company built only three products for AM radio: a 6-meter transmitter/receiver, a 2-meter version of the same radio, and a radio covering both 6 and 2 meters. All the Poly-Comm radios had a built-in ac and 12 V dc nominal power supply, so they could be used for base station or mobile use. The Poly-Comm products had a built-in transmit VFO but could also be crystal controlled with common crystals in the 8 - 9 MHz range. The unit had PTT operation and included a handheld microphone. The 6-meter version was a doubleconversion receiver with a first IF of 5.405 MHz and a second IF of 455 KHz. The 2-meter version was triple conversion and used 6 meters as the first IF. The 6- and 2-meter version used the same stages as the separate 6- and 2-meter versions.

WRL

WRL's low-cost Tech-Ceiver was a low-power transmitter/receiver for 6 meters. It had no internal power supply, but WRL sold one for ac use. The receiver was a single-conversion design with no squelch or noise limiter. The transmitter ran about 5 W input power with crystal control. Transmit/receive switching was done by a rotary switch. It was a low-end radio, but not a bad value for only \$39.95 in kit form, without the ac power supply.

All photos by the author.



Contest Corral

April 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.

Date	Start - -Time		sh e-Time	Bands	Contest Name	Mode	Exchange	Sponsor's Website
1	0800	7	2000	All	IQRP Quarterly Marathon	CW Ph Dig	RS(T)	www.arimontebelluna.it
1	1900	1	2030	3.5	RSGB 80-Meter Club Championship, CW	CW	RST, serial	www.rsgbcc.org/hf
2	0100	2	0300	3.5-28	ARS Spartan Sprint	CW	RST, SPC, power	arsgrp.blogspot.com
3	2000	3	2100	3.5	UKEICC 80-Meter Contest	Ph	4-char grid square	www.ukeicc.com
4	1700	4	2000	3.5	SARL 80-Meter QSO Party	Ph	RS, serial, grid locator	www.sarl.org.za
4	1700	4	2100	28	NRAU 10-Meter Activity Contest	CW Ph Dig	RS(T), 6-char grid square	www.nrau.net
4	1900	4	2100	1.8-28	SKCC Sprint Europe	CW	RST, SPC, name, mbr or power	www.skccgroup.com
6	0400	6	0800	7	LZ Open 40-Meter Sprint Contest	CW	Serial, serial received from previous QSO	www.lzopen.com
6	1000	7	0400	14	PODXS 070 Club PSK 31 Flavors Contest	Dig	SPC, mbr or name	www.podxs070.com
6	1000	7	1000	50-1296	SARL VHF/UHF Digital Contest	Dig	RST, 6-char grid locator	www.sarl.org.za
6	1400	7	0200	3.5-UHF	Mississippi QSO Party	CW Ph Dig	RS(T), county or SPC	www.arrlmiss.org
6	1400	7	2000	1.8-UHF	Missouri QSO Party	CW Ph Dig	RS(T), county or SPC	www.w0ma.org
6	1400	7	2200	3.5-28	Florida State Parks on the Air	CW Ph Dig	Park ID SPC	flspota.org/rules
6	1500	7	1500	1.8-28	SP DX Contest	CW Ph	RS(T), SP province or serial	pzk.org.pl
6	1600	7	1600	3.5-28	EA RTTY Contest	Dig	RSQ, province or serial	concursos.ure.es/en
7	1900	7	2030	3.5	RSGB RoLo SSB	Ph	RS, previous 6-char grid square received	www.rsgbcc.org/hf
,	1900	,	2030	3.3	NOOD HOLO SOD		no, previous o-criai grid square received	
8	1900	8	2300	144	144 MHz Spring Sprint	CW Ph Dig	4-char grid square	sites.google.com/site/ springvhfupsprints
10	0030	10	0230	3.5-14	NAQCC CW Sprint RSGB 80-Meter Club	CW	RST, SPC, mbr or power	naqcc.info
10	1900	10	2030	3.5	Championship, SSB	Ph	RS, serial	www.rsgbcc.org/hf
13	0000	13	2359	1.8-28	QRP ARCI Spring QSO Party	CW	RS, SPC, mbr or power	qrparci.org
13	0700	14	1300	1.8-28	JIDX CW Contest	CW	RST, Prefecture number or CQ Zone	www.jidx.org
13	1200	14	1200	1.8-28	OK/OM DX Contest, SSB	Ph	RS, 3-letter county code or serial	okomdx.crk.cz
13	1200	14	1200	3.5-28, 144	F9AA Cup, PSK	Dig	RST, serial	www.site.urc.asso.fr
13	1200	14	2359	1.8-50	SKCC Weekend Sprintathon	CW	RST, SPC, name, mbr or "none"	www.skccgroup.com
13	1400	14	0200	1.8-50	New Mexico QSO Party	CW Ph Dig	Name, county or SPC	www.newmexicogsoparty.org
13	1400	14	2000	All	Texas State Parks on the Air	CW Ph Dig	RS(T), park abbreviation or SPC	www.tspota.org
13	1800	14	1800	1.8-144	North Dakota QSO Party	CW Ph Dig	RS(T), county or SPC	www.kg0yl.net/QSO.html
13	1800	14	2359	1.8-50	Georgia QSO Party	CW Ph Dig	RST, county or SPC	www.georgiaqsoparty.org
13	2100	14	2100	1.8-28,	Yuri Gagarin International DX Contest	CW	RST, ITU Zone	gc.qst.ru/en/section/32
14	1000	14	2200	Sats 3.5-14	WAB 3.5/7/14 MHz Data Modes	Dig	RS, serial, WAB square or country	wab.intermip.net/Contests.php
14	1200	14	1800	3.5-14	International Vintage Contest HF	CW Ph	RS(T), 4-char grid square	contestvintage.beepworld.it
14	1500	14	1700	3.5	Hungarian Straight Key Contest	CW	RST, serial, power code	hskc.ha8kux.com
17.					the state of the s		Name, 2-digit year licensed, state/	
14	1800	14	2359	3.5-50	ARRL Rookie Roundup, SSB	Ph	province/XE area/"DX"	www.arrl.org/rookie-roundup
15	0000	15	0200	1.8-28	4 States QRP Group Second Sunday Sprint	CW Ph	RS(T), SPC, mbr or power	www.4sqrp.com
16	1900	16	2300	222	222 MHz Spring Sprint	CW Ph Dig	4-char grid square	sites.google.com/site/ springvhfupsprints
19	2100	20	2100	1.8-28	Holyland DX Contest	CW Ph Dig	RS(T), 4X area or serial	www.iarc.org
20	0500	20	0859	3.5-7	ES Open HF Championship	CW Ph	RS(T), serial	www.erau.ee/en
20	0600	21	0559	3.5-28	Worked All Provinces of China DX Contest	CW Ph	RS(T), BY province or serial	www.mulandxc.org
20	0800	20	1800	3.5-28	QRP to the Field	CW Ph	RST, SPC, name	www.zianet.com/grp/grpttf
20	1200	21	1159	3.5-28	YU DX Contest	CW Ph	RS(T), YU/YT county or serial	yudx.yu1srs.org.rs
20	1200		2359	3.5-28	CQMM DX Contest	CW	RST, continent, category	www.cqmmdx.com
20	1300	21	2200	1.8-UHF	Nebraska QSO Party	CW Ph Dig	RS(T), county or SPC [FT8: S/N, grid]	www.gcwa.org/chapter025.htm
20	1600		0400	3.5-28	Michigan QSO Party	CW Ph	Serial, county or SPC	www.miqp.org/Rules.htm
20	1700	21	1300	3.5-28	EA-QRP CW Contest	CW	RST, category, "M" if member	www.eaqrp.com
20		20	2159	1.8-50	Feld Hell Sprint	Dig	RST, mbr, SPC, grid	sites.google.com/site/feldhellclub
20	1800	21	1800	1.8-144	Ontario QSO Party	CW Ph	RS(T), county or SPC	www.va3cco.com/oqp
22	0100		0300	1.8-28	Run for the Bacon QRP Contest	CW FII	RST, SPC, mbr or power	
24	0000	24	0200	1.8-28		CW	RST, SPC, mame, mbr or power	qrpcontest.com/pigrun
24	1900	24	2300	432	SKCC Sprint 432 MHz Spring Sprint	CW Ph Dig	4-char grid square	www.skccgroup.com sites.google.com/site/
								springvhfupsprints
24	2000	24	2100	3.5	UKEICC 80-Meter Contest	CW	4-char grid square	www.ukeicc.com
25	1900	25	2030	3.5	RSGB 80m Club Championship, Data	Dig	RST, serial	www.rsgbcc.org/hf
	0001	28	2359	28	10-10 International Spring Contest, Digital	Dig	Name, mbr or "0," SPC	www.ten-ten.org
27		00	1200	3.5-28	SP DX RTTY Contest	Dig	RST, province or serial	pkrvg.org/strona,spdxrttyen.html
was a	1200	60		0.0 50	O. DATITI OUTION			
27	1200			18-28	Helvetia Contest	CW Ph Dia	BS(T) Canton or serial	www.ueka.ch
27 27 27 27	1200 1300 1600	28	1259 2159	1.8-28 7-28	Helvetia Contest Florida QSO Party	CW Ph Dig	RS(T), Canton or serial RS(T), county or SPC	www.uska.ch floridagsoparty.org

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

US Amateur Radio Bands

US AMATEUR POWER LIMITS — FCC 97.313 An amateur station must use the minimum transmitter power necessary to carry out the desired communications. (b) No station may transmit with a transmitter power exceeding 1.5 kW PEP.

Amateurs wishing to operate on either 2,200 or 630 meters must https://utc.org/pic-database-amateur-notification-process/. first register with the Utilities Technology Council online at You need only register once for each band.



630 Meters (472 kHz)

137.8 kHz

1 W EIRP maximum

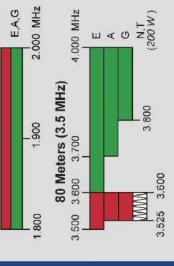
135.7 kHz

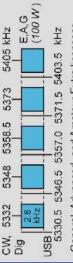
miles of Russia where the power limit is 1 W EIRP. 5 W EIRP maximum, except in Alaska within 496



160 Meters (1.8 MHz)

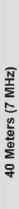
Avoid interference to radiolocation operations from 1.900 to 2.000 MHz

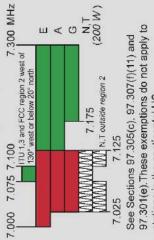




60 Meters (5.3 MHz)

may operate on these five channels on a secondary Permitted operating modes include upper sideband (ERP) of 100 W PEP relative to a half-wave dipole. General, Advanced, and Amateur Extra licensees modes such as PACTOR III. Only one signal at a voice (USB), CW, RTTY, PSK31 and other digital basis with a maximum effective radiated power time is permitted on any channel.

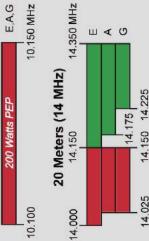


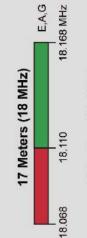


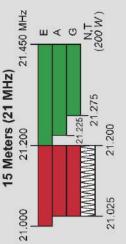
See Sections 97.305(c), 97.307(f)(11) and stations in the continental US.

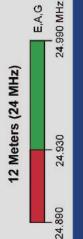
30 Meters (10.1 MHz)

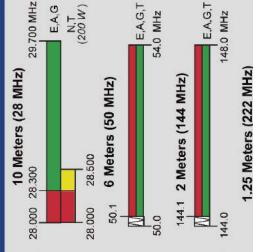
Avoid interference to fixed services outside the US



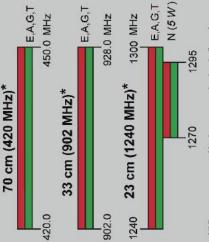








*Geographical and power restrictions may apply to all bands above 420 MHz. See The ARRL Operating Manual for information about your area



122.25-123.0 GHz 134-141 GHz All licensees except Novices are authorized all modes 241-250 GHz 10.0-10.5 GHz ‡ 24.0-24.25 GHz on the following frequencies: 2300-2310 MHz 2390-2450 MHz 3300-3500 MHz

ARR L AMATEUR RADIO*

CW operation is permitted throughout all amateur bands. except for 144.0-144.1 and 219-220 MHz Test transmissions are authorized above 51 MHz, except for 219-220 MHz









forwarding systems only

E = Amateur Extra

A = Advanced



N (25 W)

225.0 MHz

222.0

219.0 220.0

E.A.G.T

N = Novice

See ARRLWeb at www.arrl.org for detailed band plans.

We're At Your Service

ARRL Headquarters. 860-594-0200 (Fax 860-594-0259)

www.arrl.org/shop Toll-Free 1-888-277-5289 (860-594-0355)

email: membership@arrl.org Membership/Circulation Desk: www.arrl.org/membership

Toll-Free 1-800-326-3942 (860-594-0355) Getting Started in Amateur Radio: email: newham@arrl.org Exams: 860-594-0300 email: vec@arrl.org

All above 275 GHz

76.0-81.0 GHz

5650-5925 MHz

‡ No pulse emissions

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The 2018 ARRL International Grid Chase Wrap-Up

ARRL International Grid Chase 2018

The 2018 International Grid Chase (IGC) has come to a close. What started during the fireworks over Greenwich, England, at 0000 UTC January 1, 2018, ended with an exciting flurry of last-minute contacts — and even some last-minute unique grids — at 2359 UTC on December 31, 2018.

Detailed summaries will follow on the ARRL website. Go to the IGC page at https://igc.arrl.org/index.php to see our detailed full results.

IGC Facebook Activity

In conjunction with the 2018
International Grid Chase, ARRL
established a Facebook group for
participants in the IGC to stay in
touch all year long. This turned into a
popular place to share tips and photos, and served as another avenue for
connecting with radio operators
around the world. Perhaps the most
valuable aspect of the Facebook
group was the ability to alert fellow
chasers to upcoming grid square activations. Go to www.facebook.com/
groups/IGC2018 to revisit the year's
activity.

Based on comments in the Facebook group, the IGC also encouraged a number of individuals to get their Amateur Radio licenses and get on the air. The event also brought some inactive hams back to the hobby, like Pat Freeman, N3GWZ, who posted this message on January 1, 2019:

Thank you, fellow grid chasers. For the first time since the '89 peak Join the discussion on Facebook at https://www.facebook.com/groups/IGC2018 and check out the #IGC hashtag on Twitter.



The IGC Facebook page was a fun place for participants to stay in touch and cheer each other on.

of sunspot numbers, I got addicted to ham radio for an entire year. Put up a second stealth long-wire antenna and got on 160 meters (I'm antenna restricted). Bought an amp so I could be heard by DX. Got Worked All States (WAS) on many bands. Currently, ranked 311 on the leaderboard... I never thought any of this was possible. IGC participating hams helped make all of this happen. Thank you!

On January 2, 2019, Joe Donnelly, KA0KVW, wrote:

First off, I would like to say thanks! Thanks to the ARRL for putting on the Grid Chase, and thanks to everyone that participated. I had a blast... it got me on the radio (a lot). I looked forward to firing up the rig and trying to make a lot of contacts.

Looking Forward

In recent years, ARRL has had a pattern of year-long events every other year — the 2014 Centennial, 2016
National Parks on the Air, and the
2018 International Grid Chase. There
are no current plans for an upcoming
year-long event, but who's to say
what could develop in the future?
At present, we are immersed in
bringing the 2018 IGC to its close,
developing in-depth year-end reporting, including summaries with
recognition of activity levels and
categories. Watch the IGC page
(https://igc.arrl.org/index.php) and
its leaderboard for more information
about all the activity in 2018.

For now, stay tuned and feel free to share your future event ideas by sending them to **contests@arrl.org**. We hope participants continue to get on the air and enjoy all the bands and modes have to offer, and share our hobby with newcomers. Keep up that grid chase spirit!

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2018 September VHF Contest Results

Check out the results of the event, held September 8 – 10, 2018.

Ralph Bowen, N5RZ (wb5aar@gmail.com)



Jarred, KF2MR/R, activated grids FN12, FN13, FN02, and FN03 — driving his score to 1st place in the Classic Rover category — during the 2018 September VHF Contest. This photo was taken in FN13 as he lined up his antennas to work the Toronto area. [Jarred Jackson, KF2MR, photo]

W	
Top Ten	
Classic Rover KF2MR/R 63,602 VE30IL/R 46,835 NF2RS/R 44,166 NTGP/R 24,067 N6MTS/R 21,586 K0DI/R 21,576 W5VY/R 21,505 AG4V/R 20,349 W3ICC/R 16,695 KT5TE/R 13,020 Limited Rover ACORA/R 121,264 K2EZ/R 42,536 WW7D/R 33,440 KJ2G/R 20,928 WB5IDDY/R 12,950 AESP/R 12,570 N6RH/R 12,450 K0BBC/R 12,215 W1RGA/R 9,947 K7BDB/R 8,811 Unlimited Rover N0LD/R 117,824 K5SRT/R 109,610 VE3SMA/R 49,880 N2SLN/R 31,047 K6M/R 24,300 KCOSKM/R 16,665 KD5IKG/R 11,340 N6JET/R 8,736 KJ1K/R 1,840 K7ATN/R 1,148 Single Operator, High Power K1RZ 157,435 K1TEO 108,500 W0UC 79,051 VA3ELE 56,448 K3TUF 41,216 K1KG 30,705 K1TR 30,685 N4QWZ 28,971 WZ1V 28,530 W3IP 27,390 Single Operator, Low Power AF1T 72,390 WB1GQR (W1SJ, op) Single Operator, Low Power AF1T 72,390 WB1GQR (W1SJ, op) Single Operator, Low Power AF1T 72,390 WB1GQR (W1SJ, op) Single Operator, Low Power AF1T 72,390 WB1GQR (W1SJ, op) Single Operator, Low Power AF1T 72,390 WB1GQR (W1SJ, op) Single Operator, Low Power AF1T 72,390 WB1GQR (W1SJ, op) Single Operator, Low Power AF1T 72,390 WB1GQR (W1SJ, op) Single Operator, Low Power AF1T 72,390 WB1GQR (W1SJ, op) Single Operator, Low Power AF1T 72,390 WB1GQR (W1SJ, op) Single Operator, Low Power AF1T 72,390 WB1GQR (W1SJ, op) Single Operator, Low Power AF1T 72,390 WB1GQR (W1SJ, op) Single Operator, Low Power AF1T 72,390 WB1GQR (W1SJ, op) Single Operator, Low Power AF1T 72,390 WB1GQR (W1SJ, op) Single Operator, Low Power AF1T 72,390 WB1GQR (W1SJ, op) Single Operator, Low Power AF1T 72,390 WB1GQR (W1SJ, op) Single Operator, Low Power AF1T 72,390 WB1GQR (W1SJ, op) Single Operator, Low Power AF1T 72,390 WB1GQR (W1SJ, op) Single Operator, Low Power AF1T 72,390 WB1GQR (W1SJ, op) Single Operator, Low Power AF1T 72,390	Single Operator, Portable W4DVE 8,525 VE7FYC 1,040 VE2NCG 1,037 WB2AMU 987 AA6XA 784 AG7NC 488 N2YTF/P 468 K7ZOO 208 W7MTL 192 AC2GJ 150 Single Operator, Three-Band K09A 14,773 KG6IYN 9,792 K3SFX 5,250 KA2BPP 4,158 N7IR 3,612 K2RMX 3,570 WA4GPM 2,376 N7RK 1,892 N3ALN 1,738 AF6SA 1,617 Single Operator, FM Only KM4KMU 14,154 W6IA 920 WB9WOZ 847 K1FJM/6 (N6ZE, op) 432 W7AIT 266 N9HRT 162 K7IMA 150 VA2DG 132 KX1W 98 NC6Q 90 KM6PHB 90 Limited Multioperator N2NT 93,900 K2LIM 89,780 AA4ZZ 80,618 W3SO 69,432 K5QE 43,420 W2LV 38,000 K0DAS 12,530 W9RVG 10,640 NESBO 7,068 K2BAR 4,884 Unlimited Multioperator W2SZ 275,315 W2EA 143,735 W2CP 61,204 W4NH 50,794 N8ZM 38,735 W1XM 14,352 WS9V W3RFC 4,522 W3RFC 4,522
	W3ARO 4,452

Classic Rover			Single Operator,	Portable	
Atlantic	KF2MR/R	63,602	Atlantic	AC2GJ	15
Dakota	KC0P/R	9,842	Great Lakes	AA8CH	2
Delta	W5VY/R	21,505	Hudson	WB2AMU	98
Hudson	WB2SIH/R	7,854	Midwest	NOJK	1
Midwest	KS0TRC/R	480	New England	N1PRW	8
Northwestern Pacific	KE7MSU/R	11,790	Northwestern Pacific	W4DVE AA6XA	8,52 78
	N6MTS/R KK6MC/R	21,586 3,402	Southwestern	K7ZOO	20
Rocky Mountain Southwestern	N7GP/R	24,067	West Gulf	W5RST	20
West Gulf	KT5TE/R	13,020	Canada	VE7FYC	1,04
Canada	VE3OIL/R	46,835	Ounda	127770	1,01
Limited Rover			Single Operator,		F 0.5
Atlantic	K2EZ/R	42,536	Atlantic Central	K3SFX KO9A	5,25 14,77
Central	WD9HBF/R	42,536	Dakota	AA0AW	22
Dakota	ACORA/R	121.264	Delta	KS4X	22
Delta	WA4JA/R	20	Great Lakes	K8AB	16
Great Lakes	K8JH/R	2.478	Hudson	KA2BPP	4,15
Hudson	KD2BKD/R	456	Midwest	KOCQ	15
Midwest	K9JK/R	2,912	New England	N1ZN	47
New England	KJ2G/R	20,928	Northwestern	WB7FJG	1,40
Northwestern	WW7D/R	33,440	Pacific	AF6SA	1,61
Pacific	NI6G/R	8,130	Roanoke	WA4LDU	1,24
Roanoke	W7IY/R	495	Rocky Mountain	N5EPA	64
Rocky Mountain	W0AMT/R	1,340	Southeastern	WA4GPM	2,37
Southeastern	W4POT/R	28	Southwestern	KG6IYN	9,79
Southwestern	N6GP/R	4,848	West Gulf	KV5W	92
West Gulf	WB5IDY/R	12,960	Canada	VA2BN	64
Canada	VE7AFZ/R	748	Single Operator,	FM Only	
Unlimited Rover			Central	WB9WOZ	84
Atlantic	N2SLN/R	31,047	Dakota	NOSUW	4
Dakota	KC0SKM/R	16,665	Delta	K4NRT	1
Midwest	N0LD/R	117,824	Great Lakes	WN8P	
New England	KJ1K/R	1,840	Hudson	KX1W	9
Northwestern	K7ATN/R	1,148	Northwestern	K7IMA	15
Pacific	K6MI/R	24,300	Pacific	W6IA	92
West Gulf	KD5IKG/R	11,340	Roanoke	KM4KMU	14,15
Canada	VE3SMA/R	49,880	Southeastern	K3TW	7F\ 10
Single Operator,	High Power		Southwestern West Gulf	K1FJM/6 (N6Z N5LUL	ZE, op) 43 5
Atlantic	K1RZ	157,435	Canada	VA2DG	13
Central	WOUC	79,051	11 11 1 1 1 1 1 1 1		
Dakota	W0ZQ	23,463	Limited Multiope	rator	
Delta	N4QWZ	28,971	Atlantic	K2LIM	89,78
Great Lakes	KB8U	4,930	Central	W9RVG	10,64
Hudson	W2BVH	11,505	Dakota	Wostv	59
Midwest	KFOM	12,474	Delta	NE5BO	7,06
New England	K1TEO	108,500	Hudson	N2NT	93,90
Northwestern	KE7SW	16,324	Midwest	KODAS	12,53
Pacific	AE6GE	17,697	New England	NE1C	4,28
Roanoke	W3IP	27,390	Northwestern Roanoke	WW7LW AA4ZZ	28
Rocky Mountain Southeastern	W7QQ KE8FD	5,248	Rocky Mountain	K5LRW	80,61 8
Southwestern	N1RWY	24,130 16,320	Southeastern	WB4WXE	4,81
West Gulf	K5LLL	22,194	West Gulf	K5QE	43,42
Canada	VA3ELE	56,448	West dull	NOGE	40,42
	Laur Daves		Unlimited Multio		(7)00000000
Single Operator,		47 775	Atlantic	W2EA	143,73
Atlantic	WASEOQ	17,775	Central	WS9V	4,69
Central	K9MU	33,152	Great Lakes	N8ZM	38,73
Dakota Dolta	WBOLJC	429 770	Hudson	WE1P	25,65
Delta Great Lakes	K5OMC K8MR	770 819	Midwest New England	WQ0P W2SZ	61,20 275,31
Hudson	WB2JAY	15.576	Pacific	W6YNO	39
Hudson Midwest	NOLL NOLL	10,080	Roanoke	W4NH	50,79
New England	AF1T	72,390	Southwestern	KJ6KK	25
Northwestern	WZ8T	10,080	West Gulf	KC5MVZ	53
Pacific	KC6ZWT	9,184	(155, Sidii)		50
Roanoke	WA7TOF/4	3,000			
Rocky Mountain	N7DBW	126			
Southeastern	W4RAA	2,898			
	W4RAA W6IT	2,898 3,190			

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.

Regional Leaders

Boxes list call sign, score, and class: LM = Limited Multioperator; R = Classic Rover; RL = Limited Rover; RU = Unlimited Rover; SO3B = Single Operator, Three-Band; SOFM = Single Operator, FM Only; SOHP = Single Operator, High Power; SOLP = Single Operator, Low Power; SOP = Single Operator, Portable, and UM = Unlimited Multioperator.

Continue Continue	West Coas	t Region	i	Midwest Region		
N6MTS/R 21,586 R KCOP/R 9,842 R KODI/R 21,576 R KGSUCA/R 7,680 R KE7MSU/R 11,790 R KK6MC/R 3,402 R N0HZO/R 2,548 R N0HZO/R 2,548	Southweste Alberta, Br	ern Divi	sions;	Mountain, Divisions;	and We Manitob	st Gulf a and
K7BDB/R	N6MTS/R K0DI/R	21,586 21,576	R R	KC0P/R KG5UCA/R KK6MC/R	9,842 7,680 3,402	R R R
NGJET/R 8,736 RU NOLD/R 117,824 RU RU KTATN/R 1,148 RU KSSRT/R 109,610 RU KCOSKM/R 16,665 RU AE6GE 17,697 SOHP KD5IKG/R 11,340 RU KE7SW 16,324 SOHP KD5IKG/R 11,340 RU NTEPD 13,677 SOHP WOZQ 23,463 SOHP KTYDL 8,388 SOHP KSLLL 22,194 SOHP WZ8T 10,080 SOLP KOTPP 11,375 SOHP KC6ZWT 9,184 SOLP KOTPP 11,375 SOHP KC6ZWT 9,184 SOLP KOTPP 11,375 SOHP WGZ 4,500 SOLP KOTPP 11,375 SOHP WGZ 4,500 SOLP KSTRA 4,250 SOLP W4DVE 8,525 SOP KBOHNN 312 SOLP W4DVE 8,525 SOP KBOHNN	K7BDB/R NI6G/R N6GP/R K7JSG/R	8,811 8,130 4,848 4,082	RL RL RL RL	WB5IDY/R AE5P/R N6RH/R	12,960 12,570 12,450	RL RL RL
KE7SW	N6JET/R K7ATN/R	8,736 1,148	RU RU	K5SRT/R KC0SKM/R	109,610 16,665	RU RU
WZ8T 10,080 SOLP KOTPP 11,375 SOHP KC6ZWT 9,184 SOLP NOLL 10,080 SOLP K2GMY 6,475 SOLP NOLL 10,080 SOLP NTQOZ 5,162 SOLP K5TRA 4,250 SOLP WB6Z 4,500 SOLP KV5TX 2,058 SOLP WBDLJC 429 SOLP WBBLJC 429 SOLP W4DVE 8,525 SOP KBOHNN 312 SOLP W5DV 924 SOB SOP KSOP KBOHNN 312 SOLP K75W 9,722 SO3B N5EPA 646 SO3B SOB	KE7SW N1RWY N7EPD	16,324 16,320 13,677	SOHP SOHP	WOZQ K5LLL K0SIX	23,463 22,194 15,120	SOHP SOHP
VE7FYC 1,040 SOP AAGXA 784 SOP NOJK 12 SOP AAGXNC 488 SOP W5RST 8 SOP K7ZOO 208 SOP W5RST 8 SOP KGGIYN 9,792 SO3B N5EPA 646 SO3B N7IR 3,612 SO3B AE5B 513 SO3B N7IR 1,892 SO3B AA0AW 221 SO3B W6KKO 1,420 SO3B K0CQ 154 SO3B W6KKO 1,420 SO3B N5LUL 54 SOFM W6IA 920 SOFM NOSUW 48 SOFM K1FJM/6 (N6ZE, op) SOFM NBOT 48 SOFM W7AIT 266 SOFM KOBE 43,420 LM K1MBPHB 90 SOFM KODAS 12,530 LM WW7LW 288 LM WODAS 12,530 LM W6YNO <td>KC6ZWT K2GMY N7QOZ</td> <td>9,184 6,475 5,162</td> <td>SOLP SOLP SOLP</td> <td>NOLL K5TRA KV5TX</td> <td>11,375 10,080 4,250 2,058</td> <td>SOLP SOLP SOLP</td>	KC6ZWT K2GMY N7QOZ	9,184 6,475 5,162	SOLP SOLP SOLP	NOLL K5TRA KV5TX	11,375 10,080 4,250 2,058	SOLP SOLP SOLP
KG6IYN 9,792 SO3B N5EPA 646 SO3B N7IR 3,612 SO3B A45B 513 SO3B N7RK 1,892 SO3B A40AW 221 SO3B AF6SA 1,617 SO3B K0CQ 154 SO3B W6IA 920 SOFM NSUU 48 SOFM K1FJM/6 (N6ZE, op) 432 SOFM AE0EE 1 SOFM W7AIT 266 SOFM KDFM AE0EE 1 SOFM K7IMA 150 SOFM KDAS 12,530 LM KM6PHB 90 SOFM WODAS 12,530 LM WW7LW 288 LM WOOP 61,204 UM W6YNO 390 UM WOOP 61,204 UM	VE7FYC AA6XA AG7NC	1,040 784 488	SOP SOP	NOJK	12	SOP
W6IA 920 SOFM N0SUW 48 SOFM K1FJM/6 (N6ZE, op) 432 SOFM NR0T 8 SOFM W7AIT 266 SOFM AE0EE 1 SOFM K7IMA 150 SOFM K5QE 43,420 LM NG6Q 90 SOFM K0DAS 12,530 LM KM6PHB 90 SOFM W0STV 598 LM WW7LW 288 LM W0OP 61,204 UM W6YNO 390 UM VM S0PM VM S0PM VM	N7IR N7RK AF6SA	3,612 1,892 1,617	SO3B SO3B SO3B	N5EPA AE5B AA0AW	646 513 221	SO3B SO3B SO3B
K7IMA 150 SOFM K5QE 43,420 LM NC6Q 90 SOFM K0DAS 12,530 LM KM6PHB 90 SOFM WOSTV 598 LM WW7LW 288 LM K5LRW 81 LM W7DK 253 LM WQ0P 61,204 UM W6YNO 390 UM KC5MVZ 539 UM	W6IA K1FJM/6 (N6	920 SZE, op) 432	SOFM SOFM	NOSUW NROT	48 8	SOFM SOFM
W7DK 253 LM WQOP 61,204 UM KC5MVZ 539 UM	K7IMA NC6Q KM6PHB	150 90 90	SOFM SOFM SOFM	K0DAS W0STV	12,530 598	LM LM
	W7DK	253	LM			
	W6YNO KJ6KK	390 250	UM			

Central Re	gion		Southeast Region (Delta, Roanoke, and Southeastern Divisions)			
(Central a	Ontario	East,				
Ontario N South, and Area Section	Greate		W5VY/R AG4V/R	21,505 20,349	R R	
VE3OIL/R	46,835	R	W7IY/R KJ4ZYB/R	495 228	RL	
K8JH/R	2,478	RL	W4PH/R	220	RL	
AC8W/R	210	RL	KM4OZH/R	50	RL	
VA3TO/R	108	RL	W4POT/R	28	RL	
WD9HBF/R	88	RL				
			N4QWZ	28,971	SOH	
VE3SMA/R	49,880	RU	W3IP	27,390	SOH	
			KE8FD	24,130	SOH	
WOUC	79,051	SOHP	N4JQQ	8,004	SOH	
VA3ELE	56,448	SOHP	N3MK	1,638	SOH	
W9EWZ	8,845	SOHP	WW. TOEW	MATTOE	an)	
K9EA	6,804	SOHP	WA7TOF/4 (3.000	SOLE	
KB8U	4,930	SOHP	W4RAA	2.898	SOLI	
KOMI	00.450	001.0	K4FJW	1,400	SOLF	
K9MU VE3DS	33,152 32,528	SOLP	K5OMC	770	SOLF	
W9GA	7,000	SOLP	WG4I	473	SOLE	
WA9DU	1.410	SOLP	TTG-III		COL	
KO0Z	1.176	SOLP	WA4GPM	2.376	SO3E	
NOUZ	1,170	SOLF	WA4LDU	1,242	SOSE	
VE3EG	44	SOP	KK4BZ	243	SO3E	
AA8CH	20	SOP	N5SMQ	108	SOSE	
			K3YDX	48	SOSE	
	A Particular Control					

Ontario No South, and Area Section	Greate		W5VY/R AG4V/R	21,505 20,349	R R
VE3OIL/R	46,835	R	W7IY/R KJ4ZYB/R	495 228	RL RL
K8JH/R AC8W/R VA3TO/R WD9HBF/R	2,478 210 108 88	RL RL RL	W4PH/R KM4OZH/R W4POT/R	220 50 28	RL RL RL
VE3SMA/R	49.880	RU	N4QWZ W3IP	28,971 27,390	SOHE
VESSIVIA	45,000	no	KE8FD	24,130	SOH
WOUC VA3ELE W9EWZ	79,051 56,448 8,845	SOHP SOHP	N4JQQ N3MK	8,004 1,638	SOHE
K9EA KB8U	6,804 4,930	SOHP	WA7TOF/4 (3,000	SOLF
K9MU	33,152	SOLP	W4RAA K4FJW K5OMC	2,898 1,400 770	SOLF SOLF
VE3DS W9GA WA9DU	32,528 7,000 1,410	SOLP	WG4I	473	SOLF
KO0Z	1,176	SOLP	WA4GPM WA4LDU	2,376 1,242	SO3E
VE3EG AA8CH	44 20	SOP	KK4BZ N5SMQ K3YDX	243 108 48	SO3E SO3E SO3E
KO9A W9ZB VE3SST N9OBB VE3IQZ	14,773 522 510 352 210	SO3B SO3B SO3B SO3B SO3B	KM4KMU K4NRT AD4TJ W4LAN K3TW	14,154 15 12 12 5	SOFN SOFN SOFN SOFN
WB9WOZ N9HRT WN8P	847 162 2	SOFM SOFM SOFM	AA4ZZ NE5BO WB4WXE	80,618 7,068 4,815	LM LM LM
W9RVG	10,640	LM	WX4PC W4AQL	736 680	LM LM
N8ZM WS9V N2BJ	38,735 4,698 3,706	UM UM UM	W4NH	50,794	UM



Buff, WB2SIH/R, drove his Rover to a 1st-place finish in the Hudson Division by activating five grids in the Classic Rover category. [William "Buff" Fisher, WB2SIH, photo]

W3RFC

4,522

UM

2019 Straight Key Night Results

More than 185 hams around the world joined in ARRL's classic New Year's Day event.

Bart Jahnke, W9JJ, bjahnke@arrl.org

ARRL Contest Branch Manager

During the 2019 Straight Key Night (SKN), more than 185 participants made over 1,200 contacts around the world, all enjoying sending Morse code manually (using code keys or bugs).

Soapbox Comments

Here are just a few of the highlights shared by SKN participants on the ARRL Soapbox page (www.arrl.org/soapbox):

- Ralph Bane II, KC9PKF, enjoyed his first CW contact. He said, "Jim, W1IK, came in after a while of calling... I told him right away that he was my first CW QSO and he was very patient with me."
- Paul Huff, N8XMS, had a goal of making one contact per straight key he could find. His keys consisted of a Codemaster toy key from the 1960s; a homebrew hacksaw key; a 1941 J5A Signal Corps flameproof key; a RadioShack plastic practice key; a Straight Key Century Club Marconi key; a Speed-X key; an antique strap key, and a Whiterook MK-11 micro key.
- Scott McDonald, KA9P, said that he "really enjoyed five great ragchews with all homebrew stuff and a Type 51 RAF key as used on the venerable Vulcan bomber aircraft."
- Roger Rauvola, NA6DX, said he only had time for one contact during SKN 2019, "but it was a good one." He connected with Greg Triplett, WA6HNA. Roger said, "As it turns out, we are the same age and were Novices in the same year (1973)."
- Carl Young, K5HK, said he used six different straight keys this year, including a J-38; a Wesclox
 No. 9; a Winslow 66150 KY-116/U,

and a Spanish Llaves Telegraficas Artesanas mini key.

Karl Zuk, N2KZ, reminisced that the event marks a special occasion for him. He said, "It is the anniversary of my very first QSO on January 1, 2000, and my becoming a ham — now 19 years ago... How could I not love Straight Key Night?"

Best Fist and Most Interesting QSO

Each year, SKN participants are asked to vote on who had the Best Fist and who gave them their Most



Joe, KA4WJB, made four contacts using this T-784A. This unit (later designated GRC-109) first appeared during the Cold War and was intended for use by CIA agents. Joe said, "The rig even has a built-in key." [Joseph Scoglio, KA4WJB, photo]

Interesting QSO. This year, Best Fist was a four-way tie between Richard Geordan, W6SGJ; Clifford Marks, KB3VQU; Camilo Castillo, HP1AC, and last year's winner, Thomas Warren, K3TW. Most interesting QSO went to Henry Wyatt, W2QF.

Remember, you don't have to wait a year to enjoy hand-sent CW. Get on the air, have fun, and enjoy what your straight key has to offer! ARRL will

hold the next Straight Key Night on January 1, 2020.

Participating Stations

AA2MX, AA4AI, AA4Q, AA4TB, AA5KV, AA7FV, AA8UU, AA0QZ, AB6QK, AB7MP, AB8FJ, AC6AC, AC7AF, AD0BI, AD0KH, AE1T, AE3A, AE7AX, AE7CG, AE8EA, AI9IN, HP1AC, HP1IBF, HP1RIS, K1APJ, K1EEE, K2GBH, K2HT, K2NPN, K2PQ, K2TV, K3AFS, K3BVQ, K3MD, K3SWZ, K3TW, K4DS, K4EOR, K4HGX, K4RT, K4TRH, K5HK, K5LDA, K5MBA, K5SOH, K6GPB, K6KQV, K6LQ, K6PBQ, K6SQL, K7NTW, K7SU, K7ZYV, K8JV, K8NB, K9VKY, K9YA, K9ZTV, KA4WJB, KA7T, KA8NNY, KB5NJD, KB8TL, KB0LMB, KC2LM, KC4HW, KC7YE, KC9PKF, KC0GXX, KD2BD, KD6WKY, KE7LOY,

KG4KGY, KI0G, KJ4M, KN5L, KN7NN, KO8S, K0CVN, KQ7TJ, KQ9J, KT3A, KW6G, KZ3W, N2BE, N2BZD, N2KZ, N2RC, N3HCN, N4HA, N4HAI, N4NYK, N5XE, N6FVY, N6JJA, N6TCZ, N8DNA N9BOR, NC6Q, NF8M, NIOR, NJ3K, NN7A, NOOV, NOUMP, NR4M, NV6W, NW3V, NW0M, NYOO, VA3AMX, VE3AIH/W5, VE3CBK, VE7AHT, VE7NI, VK6GX, VO1MRC, W1DUW, W1GF, W1PID, W1TPB, W1TS, W1UJ, W1WEF, W2EB, W2GIW, W2IY, W2LID, W2NTN, W2VTV, W2WSC (WS2C & N2HM, ops), W4RK, W4SGP, W4YE, W5AKU, W5CYF,

W5LRP, W5NZ, W5PDW, W5QLF, W5ROS (+ club ops), W5XW, W6JHQ, W6KN, W6KOW, W7AIT, W7EEE, W7FOX, W7OS, W8DPK, W8FDV, W8WTS, W8WZ, W9ABD (W4RK, op), W9KMP, WA1CFX, WA1PMA, WA2ALY, WA2CHV, WA2ELW, WA3VXJ, WA4KFZ, WA5FRF, WA6ARA, WA6HNA, WA7OET, WA9PWP, WA9ZBW, WA0VQY, WB3CEG, WB3JKQ, WB6AAJ, WB8CFO, WB9AYW, WB9DLC, WB9HFK, WB0B, WB0CJB, WD4ERM, WD8RIF, W0AAA, W0FUN, W0KIZ, W0YBS, and WU4B.

DX stations included HP1AC, HP1IBF, and HP1RIS.

April 2019 Frequency Measuring Test

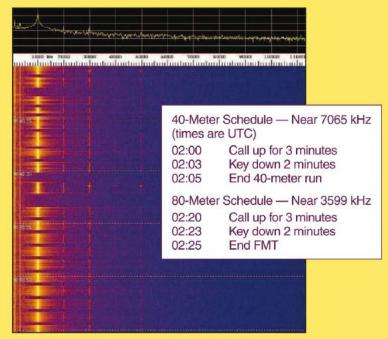
0200 - 0225 UTC, April 12

The format of the April Frequency Measuring Test (FMT) will be to measure a single-frequency signal transmitted first on 40 meters then on 80 meters from one station in eastern Oklahoma: K5CM.

The FMT will begin at 0200 UTC, April 12 (Thursday evening in North America). Measure the transmitted frequency and report your results at the new ARRL FMT page, **fmt.arrl.org**. Results must be submitted by 0200 UTC on April 15, at which time the results will be published on the website.

To be listed in the "Green Box" of the results, submit a measurement with an accuracy of better than 1 Hz.

Although the "call up" is scheduled to start at a very specific time, K5CM will try to start earlier. Every effort will be made to start the key-down measurement period at the published time.



Measuring audio frequencies with Spectrum Lab.

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	MIN	CENT	EAST	UTC	MON	TUE	WED	THU	FRI
6 AM	7 AM	8 AM	9 AM	1300		FAST CODE	SLOW	FAST CODE	SLOW
7 AM- 1 PM	8 AM- 2 PM	9 AM- 3 PM	10 AM- 4 PM	1400-1600 1700-1945	(1		IG OPERA I/OLOSED		
1 PM	2 PM	3PM	4 PM	2000	FAST CODE	SLOW	FAST CODE	SLOW	FAST CODE
2PM	3 PM	4 PM	5 PM	2100		α	DE BULL	ETIN	211
3PM	4 PM	5 PM	6PM	2200	1	DIG	TAL BULL	EΠN	
4 PM	5 PM	6PM	7PM	2300	SLOW	FAST CODE	SLOW	FAST CODE	SLOW
5PM	6PM	7PM	8PM	0000	CODE BULLETIN				
6PM	7PM	8PM	9 PM	0100	DIGITAL BULLETIN				
645 PM	7 ⁴⁵ PM	8 ⁴⁵ PM	9 ⁴⁵ PM	0145		VO	CE BULLE	TIN	
7 PM	8 PM	9PM	10 PM	0200	FAST CODE	SLOW	FAST CODE	SLOW	FAST CODE
8PM	9PM	10 PM	11 PM	0300		∞	DE BULLE	TIN	7.

♦ 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.

How's DX?

VP6D Ducie Island DXpedition Recap

On the weekend of October 13, 2018, 14 team members from six countries met in Papeete, Tahiti, to prepare for their journey to Ducie Island. On October 16, we flew from Papeete to Mangareva, the easternmost major island of French Polynesia, where the expedition ship *Braveheart* (a DX-pedition veteran) waited. The vessel provided the camp logistics, tents, generators, gas, and power grid, which reduced our shipping costs.

On to Ducie

Sailing eastward, we entered the Pitcairn Islands Marine Reserve, the world's largest marine reserve. Established by the British government in September 2016, the 324,000-

square-mile (834,000-squarekilometer) reserve offers protection to some of the most pristine waters and coral reefs on Earth.

During our passage, the seas were calm and the weather cooperated. We arrived at Ducie Island 12 hours ahead of schedule. On the morning of October 19, we began offloading people and equipment.

Of the four inlets that make up Ducie, we selected Acadia for our DXpedition. Unlike other Pacific atolls we've visited, much of Ducie is heavily treed, its beaches narrow and covered mostly with broken coral and shells.

Fortunately, our skipper, Matt Jolly,

and his brother and crew member, Daniel, had been to Ducie before and knew the island very well. The characteristics of the reef that surrounds Ducie made it very difficult for the ship's inflatable boat to make safe beach landings. Instead, the boat went as close to the beach as possible, and the team hopped into the water to get to and from the beach.

Going Ashore

Because we planned two separate camps about 1 kilometer apart from each other, we needed two landing zones. Once people and equipment were shuttled to the island, the first order of business was to erect the operating and sleeping tents. We constructed a camp kitchen, toilet, shower, and covered eating area. Braveheart provided plenty

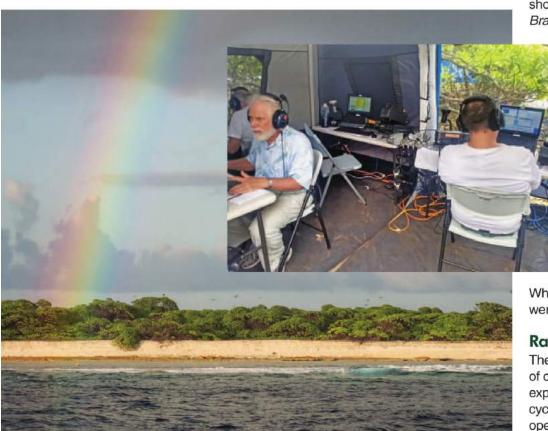
of drinking water for the team to stay hydrated.

Once we became familiar with the route between the camps, the walk was about 15 minutes, over terrain ranging from flat ground, to beach, to exposed coral during low tide, and then back into the bush to traverse the island. Throughout the DXpedition, the weather varied from hot and humid to varying levels of rain, but we did have some pleasant days.

While there was some wind, there were no significant antenna problems.

Radio Operations

The potential to make a large number of contacts drove the design of our expedition. At the bottom of the solar cycle, only a few bands would be open at any one time, so we set up one camp with a CW focus and the other primarily using SSB, although we operated digital modes from both.



Ducie Island (VP6/D) as seen from the *Braveheart*. [David Lloyd, K3EL, photo] Inset: VP6D Ducie Island team members (left to right) Gene, K5GS; Dr. Arnie, N6HC, and Ricardo, PY2PT. [Steve Dyer, W1SRD, photo]



The VP6D camp kitchen and meeting area. [Gene Spinelli, K5GS, photo]

The distance between camps allowed two stations to operate simultaneously on a band when it was open.

Elecraft provided eight K3S stations with KPA 500 amplifiers that we evenly divided between the camps. HF antennas were homemade vertical dipole arrays. Each camp had a 40-meter four-square. For CW, we had a 30-meter four-square and verticals for 80 and 160 meters. SteppIR provided two Yagi antennas and, later in the DXpedition, we added a 30-meter vertical to the SSB camp for FT8. The first contact was logged on October 20 at 0417, followed by all eight stations getting on the air the next day, as propagation allowed.

Even at the bottom of the sunspot cycle, most bands were busy during their expected open hours. We had 10 laptops connected by Ethernet cable and a Wi-Fi link between camps. Two computers in the headquarters tent were connected to separate Broadband Global Area Network (BGAN) satellite terminals.

We used the DXA logging site (www.cordell.org/DXA) to provide near real-time acknowledgement of contacts made, and contacts were also uploaded to the VP6D online log. These operations were not as smooth as we had hoped due to the chal-

lenges of building a robust network across the island (which was achieved after a couple of days of experimentation) and some incompatibilities between N1MM+ and WSJT-X, resulting in some contacts not making it to the N1MM+ log while on the island.

Project Attainment

Among the project's goals were to provide callers with an all-time new one (ATNO), provide band/mode fills, and make JT65 contacts on 6-meter Earth-Moon-Earth (EME) and FT8 contacts on HF — both a first from Ducie. At a solar cycle low, we estimated we would have between 60,000 – 80,000 contacts.

At the DXpedition's close, we logged over 112,000 total contacts with 189 DXCC entities. Of those contacts, 24,411 were with FT8, and 28 were through JT65 on 6-meter EME. The FT8 mode proved to be very popular. and it exceeded the 23,286 SSB contacts we made. This is because when SSB propagation faded away, we could still work FT8 on the seemingly dead bands. The final tally included 52.9% of total contacts with North America, 26.6% with Europe, and 15.8% with Asia. Considering our location in the southern Pacific, Europe was well represented in the numbers. Also of note were our 5,685 RTTY contacts, which made up 5.1% of our total.

Thanks to Our Sponsors and Friends

DXpeditions to uninhabited remote islands are expensive. We appreciate the support from DX clubs, foundations, and individual donors. Our major financial sponsors were the Northern California DX Foundation (NCDXF), the German DX Foundation (GDXF), and ARRL's Colvin Award. Equipment was donated, loaned, and/or deeply discounted by Elecraft, DX Engineering, SteppIR, Arlan Communications (RadioSport), Expert Linears America, RigExpert, and Spiderbeam.

We can't say enough about Matt Jolly and the *Braveheart* crew. Aside from getting us safely across the sea, they created and maintained a tent city and power grid for us in just a couple of days, prepared three meals a day, and even delivered clean laundry.

We also appreciate the cooperation we received from the Pitcairn Island Council. They guided us through the landing permit, radio licensing, and entry visa processes, and were welcoming with their remote paradise. Please visit www.vp6d.com for additional information.

The World Above 50 MHz

More Winter Surprises: North America-to-Australia 6-Meter Opening

Lightning struck again in January. After the unexpected and astonishing January 2 event, another widespread opening between North America and Australia took place on January 11 -12. Jay, W9RM, noted that a powerful opening from western Colorado to California set the stage. The XE2K/B was 40 dB over S9 for 4 hours. This set up potential links to transequatorial propagation to the Southern Hemisphere. From Australia, VK4CZ and others heard the FK8SIX/b via sporadic E. This established that sporadic E was present on both ends of the North America-to-Austrailia/New Zealand path.

Rod, ZL3NW, in New Zealand, had his radio parked on 50.313 MHz. He noted a few Australian decodes, and left WSJT-X running to grab some lunch. On returning, Rod's computer showed he'd decoded 11 US stations on 6 meters, one being Larry, NOLL (EM09).

Starting at 0020Z on January 12, VK4MA worked WB5HJV (EM20) then AC4TO (EM70) on FT8. NOLL (EM09) decoded many US stations working Australia, including W4TAA, VK3ZBQ, K9VSW, K0JY, WT0DX, W9RM, and several VKs calling CQ. VK4WTN logged Al5I (DM65) on JT65 at 0037Z and W9RM (DM58) worked VK4CZ (QG62) on FT8.

Jay, W9RM, said:

I worked eight VK station in call areas 4 and 5, the farthest being VK5PJ in PF95 at 8,800 miles.

Everyone else was a VK4. I was called by two other VK5s, but that final hop seemed to be unstable, with rapid and deep fading. Some of the VKs were loud enough that I asked them to change transmission to CW, and then I worked VK4WTN and VK4CZ on that mode with 559 signals. All the rest of the contacts were either FT8 or JT65. At times, some of the stations were certainly loud enough to work on SSB. The band was open to VK from DM58 for at least 90 minutes.

Stations worked were (in time order): VK4WTN, VK4MA, VK4CZ, VK4YH, VK5PJ, VK4CAG, VK4DDC, and VK4HJ. The last several stations answered my FT8 CQs.

Strangely enough, even though I've been active through several sunspot peaks, VK4WTN (and the rest) was a new DXCC contact, marking #141. I had worked many New Zealand stations in the past on F2, but I never did hear an Australian station until last night. That's why I was pleased to be able to work a few of them on old-school CW.

I (N0JK) decoded W4TAA (EL87), working VK4MA at 0008Z on January 12. W4TAA uses a sixelement SteppIR and 1,200 W.

At 0050Z, Tom, NH6Y, popped up for Robert, AA5AM (EM13). Robert said, "I saw one CQ from Tom, answered him and the contact was done a few seconds later. I never saw anyone else calling him, and he said I was the only station he'd decoded during the entire opening. That one wrapped up my 6-meter digital Worked All States achievement."

From Hawaii, Tom, NH6Y, noted signals were weak for his contact with AA5AM at -21/-24 on FT8. Tom observed that 10 meters had been open nearly every day in January from Hawaii to Australia across the geomagnetic equator, but not on 6 meters.

The amazing opening continued for over 2 hours. From Texas, AI, W5LUA (EM13), worked VK4MA at 0138Z, VK4CZ at 0145Z, and VK4HJ at 0159Z. AI runs a five-element Yagi at 85 feet with 1 kW. His best report from Australia was –3. AI had the last spot for an Australian station on 6 meters in North America at 0205Z.

This same 6-meter opening was also outstanding for stations in the midwest states. They worked strong stations in south Texas and northern Mexico. NOLL worked XE1H (DL80) at 0150Z. These same E_s clouds allowed stations, like W4UDH (EM52), to work VK4MA across them at the same time.

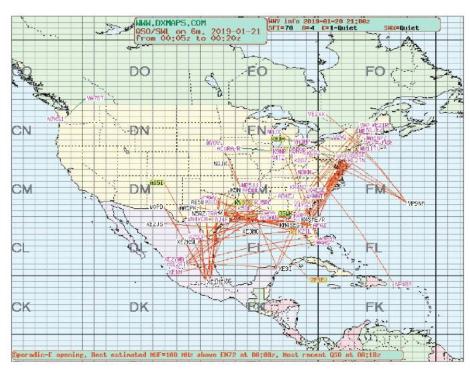
Legacy Radio on 6-Meter FT8 Update

Using the 10 W MFJ-9406 with a WSJT-X setup on FT8, described in the last column, and a three-element Yagi, I logged KZ5DP (EL06), XE2X (EL06), XE2AT (DL81), and XE2YWB (DL82) on FT8 during this opening.

Many wonder how two North America-to-Australia 6-meter openings happened with a solar flux of only 70. To investigate, I reviewed the proposed mechanism for the North America-to-New Zealand/Australia 6-meter openings previously, based on Carl Luetzelschwab's, K9LA, analysis in his WorldRadio articles. A problem Carl noted was with the trans-equatorial chordal F2 portion of the path. Carl studied this path with a solar flux of 77 in December 2009. The two 2019 openings had a flux of only 70. Even with a solar flux of 77, Carl noted the maximum useable frequency (MUF) of the TEP path would only be 33 MHz for 15 days out of the month and 44 MHz only one day.

Now, the question becomes how the 6-meter signals made it across the geomagnetic equator. Some clues may be found in the reports above. The majority of stations making contacts between North America and Australia on 6 meters were large Yagi, high-power stations. In addition, almost all of the contacts were made via FT8 and JT65, which can extend the weak-signal recovery of a path 10 – 20 more dB below the noise. Tom, NH6Y, noted many days of 10-meter signals on the TEP path between Hawaii and Australia, so the chordal F-layer MUF was rising to 28 MHz routinely.

With a solar flux of 70, the MUF probability of the chordal hop over the equator at 2300Z in January is 44 MHz one day a month, still below 50 MHz. A possibility is forward scatter (also known as over-the-MUF mode). At a MUF of 44 MHz, using established formulas,1 the additional scatter loss at 50 MHz would be 14 dB. The scatter path loss would be higher for lower MUF frequencies. My best guess, supported by K9LA's findings, suggests a multi-hop sporadic-E opening on both the Australian and North American ends of the path, with a chordal transequatorial F-layer hop with forward



Contacts made during the Sunday night of the January VHF Contest. [dxmaps.com]

scatter hopping across the geomagnetic equator.

On the Bands

50 MHz. Overall, January was better than December, with numerous sporadic-E openings reported. Most of these were along the Gulf Coast, desert southwest, and northern Mexico. Sporadic-E openings appeared on both days of the January VHF Contest. Larry, NOLL, made 22 contacts in Arizona and California on Saturday evening of the contest. On Sunday afternoon, I (N0JK) decoded K1TO (EL87), several XE2s, and XE3I. KF0M (EM17) worked XE2YWB (I saw his contact) at 0109Z. Quite a few DX stations were active in this contest. I reviewed spots for HH2AA, VP9NM, KP4, TG9, TI, ZF1EJ, and NH6Y. On January 23, WA2GFN heard VO1SIX/b (GN27). On January 25, Julian, XE2JS, operated portable from rare grid DL78. He was into EM28 for 2 hours, calling CQ a lot but there were few takers. I (NOJK) received a -21 signal report from W4TAA on the same evening.

144 MHz. KF0M (EM17) worked the remote-operated AA0F (EN04) station and WE7I (DM79) in the contest. He also logged KG9DUK/r (EM26) using FT8. He had no tones in his speaker, but he did have solid FT8 decodes. K7ULS had an interesting PSK report from W0LGQ (EN21), who copied him on 2-meter FT8 at 2158Z on January 19 in the contest.

Here and There

A21EME will be active on EME from Botswana, Africa, on October 20 – 29, 2019, on EME on 6 and 2 meters, and 70, 23, 13, 9, 6, and 3 centimeters. They will be using CW and JT65. For more information, visit www.pa3cmc.nl.

Jim, NW7O, is now a Silent Key. He set a North American record for 2-meter sporadic E in the June 1987 VHF Contest by working KD4WF in Savannah, Georgia, at 3,182 kilometers. He went on many grid expeditions in Nevada, activating rare grids.

¹ITU (International Telecommunications Union) publication Report ITU-R P.2011.1.

Special Event Stations

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

Jan. 1 – Aug. 15, 0000Z – 2359Z, H31A, Panama City, Panama. HP1AVS. 500 Years of the Founding of Panama City, Panama. 21.074 14.074 10.136 7.074; 80 – 10 meters, SSB, RTTY, PSK31, and FT8. QSL. Victor Sierra, P.O. Box 0830-00338, Panama City 0830, Panama. QSL manager is HP1AVS. See website for more information. www.qrz.com/db/h31a

Mar. 23, 1400Z – 2100Z, N4H, Daviston, AL. Lake Martin Amateur Radio Club. 205th Anniversary of the Battle of Horseshoe Bend. 14.325 7.280 3.850. Certificate & QSL. John Philips, P.O. Box 938, Alexander City, AL 35011. wi4p@arrl.net or www.facebook.com/K4YWE

Apr. 1 – Apr. 30, 1600Z – 240000Z daily, W6RO, Long Beach, CA. Associated Radio Amateurs of Long Beach. 40th Anniversary of W6RO Aboard the *Queen Mary*. 14.340 14.040 7.240 7.040. QSL. W6RO/QSL, P.O. Box 7493, Long Beach, CA 90807. Other bands possible as conditions permit. www.qrz.com/db/w6ro or www.aralb.org

Apr. 8 – Apr. 14, 0000Z – 2300Z, W0W, Petal, MS. Hattiesburg Amateur Radio Club. Petal-Southern Miss Pow-Wow. 14.260 14.033 10.115 7.200 7.033 3.533-3.900. QSL. N5CW, P.O. Box 52, Petal, MS 39465. www.qrz.com/db/w0w or www.hattiesburgamateurradioclub.org

Apr. 13, 1500Z - 2000Z, W8PRC, Cleveland, OH. Parma Radio Club. 7th Annual Earth Day Celebration. 14.245 7.195. QSL. Parma Radio Club, 8111 Laumer Ave., Cleveland, OH 44105. Operating with solar power. parmaradioclub.com

Apr. 13, 1600Z – 2100Z, W5BMC, Franklin, LA. Bayouland Emergency Amateur Radio Service. 16th Annual Bayou Teche Black Bear Festival. 14.280 14.260 7.280 7.260. Certificate. Jackie Price, 708 Front St., Morgan City, LA 70380.

Apr. 13, 1600Z – 2300Z, NI6IW, San Diego, CA. USS *Midway* (CV-41) Museum Ship. Doolittle Raid. 14.320 7.250; PSK31 on 14.070. QSL. USS *Midway* (CV-41) COMEDTRA, 910 N. Harbor Dr., San Diego, CA 92101.

Apr. 13 – Apr. 14, 1500Z – 0300Z and Apr. 14, 1500Z – 2100Z, K5LRK, The Colony, TX. Lake Area Amateur Radio Klub. Activation of State Parks in the State of Texas. CW bottom of band +40 kHz; SSB general segment +25 kHz; VHF (SSB) 50.210 144.210; VHF (FM) 146.535 446.100. Certificate & QSL. Ken Rainy, AC5EZ, 529 Kenilworth Ave., Little Elm, TX 75068. www.k5lrk.com

Apr. 20 – Apr. 21, 1500Z – 2300Z, K5T, Nacogdoches, TX. Nacogdoches Amateur Radio Club. San Jacinto Day Special Event. 14.265 14.074 14.035 7.215. QSL. Nacogdoches Amateur Radio Club, 167 CR 2093, Nacogdoches, TX 75965. All contacts will be confirmed via LoTW. www.w5nac.com

Apr. 20 - May 4, 0100Z - 0100Z, W8S/WK8H, Vermontville, MI. Rev. Dr. Rodney L. Harmon. 78th Maple Syrup Festival. 446.200 MHz PL 74.4 HZ; 145.560 MHz; 147.080 MHz PL 100 HZ; IRLP Node 4868; 446.200 MHZ. Certificate. Rev. Dr. Rodney L. Harmon, WK8H, 172 E. Second St., Vermontville, MI 49096. srharmon1974@sbcglobal.net

Apr. 27, 1100Z – 2200Z, W4F, Powder Springs, GA. 5th District of Georgia, American Legion. Fishing for Freedom. 7.275. Certificate. W4F/Fishing for Freedom, American Legion Post 294, 3282 Florence Rd., Powder Springs, GA 30127. georgiafishingforfreedom@gmail.com Apr. 27, 1400Z – 2000Z, W1BSA, Fall River, MA. USTNR NE1PL. W1BSA. 14.259 7.259. QSL. USTNR, c/o Rick Emord, 135 Wareham St., Middleboro, MA 02346. ne1pl.org

Apr. 27, 1400Z – 2200Z, K5M, Paris, AR. Razorback Contest Club. Operation from the Highest Point in Arkansas. 14.250 14.040 7.200 7.040. QSL. Don Banta, 3407 Diana St., Springdale, AR 72764. k5db@cox.net

Apr. 27, 1700Z – 2300Z, W7VW, Klamath Falls, OR. Klamath Basin Amateur Radio Association. OC&E Woods Line Last Train Anniversary. 14.265; FT8 7.074. Certificate & QSL. KBARA, P.O. Box 8106, Klamath Falls, OR 97602. wo7v@arrl.net or www.facebook.com/pg/kfalls.radio

Apr. 27 – May 5, 0000Z – 2359Z, W5L, West Monroe, LA. NorthEast Louisiana Amateur Radio Club. Commemorating the Louisiana Purchase. 18.150 14.275 7.225 3.850. QSL. Jim Ragsdale, W5LA, 111 Eagle Lake Dr., West Monroe, LA 71291. www.nelarc.org/2019-W5L

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 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. Offline 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 **June** *QST* would have to be received by **April 1**. In addition to being listed in *QST*, your event will be listed on the ARRL Web Special Event page. Note: All received events are acknowledged. If you do not receive an acknowledgment within a few days, please contact us. ARRL reserves the right to exclude events of a commercial or political nature.

Special Events listed in this issue include current events received through February 10. You can view all received Special Events at www.arrl.org/special-event-stations.

April 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.

April Qualifying Runs will be transmitted by W1AW in Newington, Connecticut at 9 AM EDT on Thursday, April 4 (1300 UTC) and at 4 PM EDT on Thursday, April 18 (2000 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 K9JM on Wednesday, April 24 at 9 PM PDT (0400 UTC on April 25) on 3590 kHz. Unless indicated otherwise, sending speeds are from 10 to 40 WPM.

Convention and Hamfest Calendar

Abbreviations

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

Alabama (Headland) — Apr. 27 F H R T V

8 AM – noon. *Spr*: Wiregrass ARC. Headland Town Square, 8 Park St. Lunch BBQ for donation, door prizes, and ham radio tickets at gazebo. *Tl*: 145.430 (186.2 Hz). *Adm*: Free. www.w4dhn.org.

Alabama (Mobile) — Apr. 13 DFHRSV

8 AM – 2 PM. *Spr:* Mobile ARC. Abba Shrine Center, 7701 Hitt Rd. *TI:* 147.3 (203.5 Hz). *Adm:* \$5. **w4iax.net**.

Alabama (Northport) — May 4 D F H Q R S T V

8:30 AM – 4:30 PM. Spr: Black Warrior Hamfest Assn. Echols Middle School, 2701 Echols Ave. Tl: 147.06 (179.9 Hz). Adm: Advanced \$6, door \$8.

www.blackwarriorhamfest.org.

Arizona (Phoenix) — Apr. 20 D F H Q R T V

6 – 11 AM. *Spr:* Arizona ARC. DeVry University, 2149 West Dunlap Ave. *TI:* 147.06 (162.02 Hz). *Adm:* \$2. http://www.w7io.org.

Arizona (Sierra Vista) — May 4 F H R T 7 AM – noon. Spr. Cochise ARA. Green Acres, 2756 Moson Rd. Tl: 146.76 (162.2 Hz). Adm: Free. http://k7rdg.org/.

California (Sonoma) — Apr. 27 D F H R S T V

8 AM – noon. *Spr*: Valley of the Moon ARC. Sonoma Veterans' Memorial Building, 126 First St. W. Full breakfast, operating club station W6AJF. *Tl*: 145.35 (88.5 Hz). *Adm*: Free. **vomarc.org**.

70TH INTERNATIONAL DX CONVENTION

April 12 – 14, Visalia, CA D H Q R S

Friday and Saturday 6:30 AM – 11 PM, Sunday 7:30 AM – 11 AM. Spr. Northern California DX Club. The Visalia Convention Center, 303 E. Acequia Ave. TI: none. Adm: Full convention with meals \$130; convention only with no meals \$60.

www.dxconvention.com.

Connecticut (Gales Ferry) — Apr. 27 F H R

10 AM – 2 PM (or until last item is sold). Spr: Radio Amateur Society of Norwich. Gales Ferry Firehouse, 1772 Rte. 12. Tailgating allowed only for items impractical to be brought into firehouse hall. TI: 146.73 (156.7 Hz). Adm: \$5. www.rason.org.

Connecticut (Thompson) — Apr. 28

8 AM – noon. *Spr:* Eastern Connecticut ARA. Raceway Restaurant at Thompson

2019 ARRL NATIONAL CONVENTION AT DAYTON HAMVENTION®

May 17 - 19, Xenia, OH

DFHQRSV

Fri. 9 AM – 5 PM, Sat. 9 AM – 5 PM, Sun. 9 AM – 1 PM. Spr: Dayton ARA. Greene County Fairgrounds and Expo Center, 120 Fairgrounds Rd. TI: 146.940 (123 Hz). Adm: Advanced \$22, door \$27. www.hamvention.org and www.arrl.org/expo.

Speedway, 205 E. Thompson Rd. *TI*: 147.225 (156.7 Hz). *Adm*: \$3. www.ecara.net.

DELAWARE STATE CONVENTION

April 27, Georgetown, DE

DHQRSTV

8 AM – 3 PM. *Spr:* Sussex ARA. Cheer Community Center, 20520 Sand Hill Rd. Delmarva Radio and Electronics Expo. *Tl:* 147.09 (156.7 Hz). *Adm:* \$6. www.radioelectronicsexpo.com.

Florida (Daytona Beach) — Apr. 13 T 8 AM. Sprs: Daytona Beach ARA. First Presbyterian Church, 820 Grandview Ave. Tl: 147.15/75 (127.3 Hz). Adm: Free. www.dbara.org.

Florida (Waldo) — Apr. 20 D F H R T V 8 AM – 2 PM. Spr: Gainesville ARS. First Baptist Church of Waldo, 14370 Kennard St. (SR 24). Tl: 146.82. Adm: Advance \$5, door \$7. www.gars.club/hamfest/hamfest.pdf.

Georgia (Savannah) — Apr. 27 F H R T 8 AM – 1 PM. Spr: Coastal ARS. Savannah Hilton Head Regional Airport Recreation Building, 250 Crossroads Parkway. TI: 442.70. Adm: Free. coastalamateurradio society.net/wpW4LHSblog/?page_id=812.

Illinois (Sandwich) — May 5 D F H R T 8 AM – 1 PM. Spr: Kishwaukee ARC. Sandwich Fairgrounds, 1401 Suydam Rd. DeKalb Hamfest. Tl: 146.73 (100 Hz). Adm: Advance \$8, door \$10. www.karc-club.org.

Indiana (Peru) — Apr. 27 D H R S V 8 AM – 1 PM. Sprs: Cass County, Grant County, Miami County, and Kokomo ARCs. Miami County 4-H Fairgrounds, 1029 W. 200 N. TI: 147.345 (131.8 Hz). Adm: \$5. nci-hamfest.net.

lowa (Des Moines) — Apr. 27 D F H R S V

8 AM – 1 PM. Spr: Des Moines RA Association. Iowa State Fairgrounds, Elwell Family Center, 3000 E. Grand Ave. Tl: 146.94 (114.8 Hz). Adm: \$10, ages 12 and under are free. www.dmraa.com/hamfest.

Kentucky (Ashland) — Apr. 27 H R T V 8 AM – 1 PM. Spr: River Cities ARA. PNC Bank (rear parking lot), 1000 Carter Ave. Raffle and giveaways. Tl: 146.94 (107.2 Hz). Adm: Free. www.rcara.net.

Kentucky (Whitesburg) — Apr. 13 F H T V

7 AM – 2 PM. Spr: Letcher County ARC. Mountain Shiren Club, 95 Maryland Dr. TI:

145.350 (186.2 Hz). Adm: \$5.

Maryland (Boonsboro) — May 4 D F H Q R S T V

6 AM – 2 PM. *Spr*: Antietam Radio Association. Washington County Agriculture Education Center, 7313 Sharpsburg Pike. The Great Hagerstown Hamfest. *TI*: 147.09, 146.940 (100 Hz). *Adm*: \$7. https://www.w3cwc.org/hamfest.

Michigan (Cadillac) — May 4 D F H Q R V

8 AM – noon. *Spr:* Wexaukee ARC. Cadillac Junior High School, 500 Chestnut St. *Tl:* 146.98. *Adm:* \$5. www.wexaukeearc.org.

Michigan (Chassell) — Apr. 27 F H R 9 AM – 1 PM. Sprs: Copper Country RAA, Keweenaw County Repeater Association, Baraga County Repeater Association. Chassell VFW, 42103 Wilson Memorial Dr. (US Rte. 41). TI: 146.88 (100 Hz). Adm: \$3. kcra-mi.net.

Minnesota (East Grand Forks) — May 4 F H Q R S V

8 AM – 1 PM. *Spr:* Forx ARC. Heritage Village, 219 20th Street NE. *TI:* 146.94 (123.0 Hz). *Adm:* \$7. www.wa0jxt.org.

AURORA '19 CONFERENCE

April 27, White Bear Lake, MN

HQST

9 AM – 4:30 PM. *Spr:* Northern Lights Radio Society. Community of Grace Lutheran Church, 4000 Linden St. Antenna Range (weather permitting). *Adm:* \$5. www.nlrs.org.

New Hampshire (Deerfield) — May 3 – 4 https://near-fest.com/.

New Hampshire (Hampton) — Apr. 13 D F H R T V

8 AM – noon. *Spr*: Port City ARC. St. James Hall, 77 Tide Mill Road. Seacoast Amateur Radio Flea Market. *Tl*: 145.15. *Adm*: \$5. **w1wqm.org/**.

A = AUCTION

D = DEALERS / VENDORS

F = FLEA MARKET

H = HANDICAP ACCESS

Q = FIELD CHECKING OF QSL CARDS

R = REFRESHMENTS

S = SEMINARS / PRESENTATIONS

T = TAILGATING

V = VE SESSIONS

New Jersey (Succasunna) — Apr. 27 DFHQRTV

8 AM – 12:30 PM. *Spr:* Splitrock ARA. Roxbury Senior Center, 72 Eyland Ave. *Tl:* 146.985 (131.8 Hz). *Adm:* \$7. www.splitrockara.org.

New Jersey (Toms River) — Apr. 14 D H R T V

Vendors 7 AM, buyers 8 AM – noon. *Spr:* Jersey Shore ARS. Riverwood Park Building #2, 100 Riverwood Dr. *TI:* 146.91. *Adm:* \$5 donation. **jsars.org**.

New Mexico (Roswell) — Apr. 13 T V 8 AM – noon. Spr: Pecos Valley ARC. PVARC Clubhouse, 403 N. Richardson Ave. Tl: 147.32, 444.425, 444.950, 146.64 (146.2 Hz). Adm: \$5, \$20 for 5. https://www.pecosvalleyarc.com/.

New York (Middletown) — Apr. 28 D H Q R T V

9 AM – noon. *Spr:* Orange County ARC. Town of Wallkill Community Center, 7 Wes Warren Dr. *Tl:* 146.76 (100 Hz). *Adm:* \$6. www.ocarcny.org.

New York (Palmyra) — Apr. 27 D F H R T V

8 AM – 1 PM. *Spr:* Drumlins ARC. VFW Post 6778, 4306 Rte. 31. *TI:* 146.745 (71.9 Hz). *Adm:* \$5. **drumlinsarc.us**.

RV RADIO NETWORK RALLY

April 24 - 27, Linwood, NC

FS

All day. Spr: RV Radio Network. Cross Winds Family Campground, 160 Campground Lane. RV camping, daily net, tours, seminars. TI: 146.55. Adm: Free with required check-in, \$35 for food and prizes (registration on website). https://rvradionetwork.com.

North Carolina (Morganton) — Apr. 27 DFHRSTV

8 AM – 1 PM. *Spr:* McDowell ARA. Burke County Fairgrounds, 145 Bost Rd. Catawba Valley Hamfest. *Tl:* 147.15. *Adm:* Advance \$4, door \$5. **cvhamfest.com**.

ARRL NORTH CAROLINA STATE CONVENTION

April 20, Raleigh, NC

DFHQRSV

8 AM – 3 PM. *Spr:* Raleigh ARS. NC State Fairgrounds Jim Graham Building, 1025 Blue Ridge Road. Raleigh Hamfest. *TI:* 146.640. *Adm:* Advance \$8, door \$10. https://www.rarsfest.org/.

Ohio (Athens) — Apr. 28 D F H R T V 8 AM – 1 PM. Spr: Athens County ARA. Athens Community Center, 701 E. State St. TI: 145.15. Adm: \$5. www.ac-ara.org.

Ohio (Cuyahoga Falls) — Apr. 13 D F H Q R V

Vendors 6 AM, shoppers 8 AM. *Spr:* Cuyahoga Falls ARC, Inc. Emidio & Sons Party Center, 48 E. Bath Rd. 65th Annual Hamfest. *Tl:* 147.27 (110.9 Hz). *Adm:* Advance \$5, door \$6. www.cfarc.org.

Ohio (Portsmouth) — Apr. 20 D H R S T V

8 AM – 1 PM. *Spr:* Portsmouth RC. Former National Guard Armory, 2313 17th St. *TI:* 147.36 (136.5 Hz). *Adm:* \$2. www.facebook.com/groups/portsmouth radioclub.

OKLAHOMA SECTION CONVENTION

April 12 - 13, Claremore, OK

DFHSV

Friday 4 – 9 PM, Saturday 8 AM – 3 PM. Spr: Green Country Hamfest, Inc. Claremore Expo Center, 400 Veterans Pkwy. TI: 147.09 (88.5 Hz). Adm: Advance \$8, door \$10. greencountryhamfest.org.

EASTERN PENNSYLVANIA SECTION CONVENTION

May 5, Bristol, PA

DFHQRSTV

7 AM – 1 PM. *Spr:* Warminster ARC. Bucks County Community College, Lower Bucks Campus, 1304 Veterans Hwy. (Rte. 413). *Tl:* 147.09 (131.8 Hz). *Adm:* \$7. www.k3dn.org/hamfest/.

Pennsylvania (Spring Grove) — Apr. 27 D F H Q R S T V

8 AM – 1 PM. *Spr:* York Hamfest Foundation. Elicker's Grove Park, 511 Roth Church Rd. *Tl:* 147.33 (123 Hz). *Adm:* \$5. www.yorkhamfest.org.

ARRL TENNESSEE STATE CONVENTION

April 13, Bartlett, TN

DFHRSTV

9 AM – 3 PM. Spr: Mid-South ARA. Bartlett Station Municipal Center Auditorium, 5868 Stage Rd. Memphis FreeFest. TI: 147.03,147.63 (107.2 Hz). Adm: Free. maraonline.org.

Texas (Garland) — Apr. 27 H S V 9 AM – 4 PM. Spr: ARRL North Texas Section, Hella Hams. Hella Shrine Temple, 2121 Rowlett Rd. ARRL NTX Mentorfest 2019. Mentoring new operators. Tl: 146.66, 147.39 (110.9, 85.4 Hz). Adm: Free. www.arrIntx.org/mentorfest.

VHF SUPER CONFERENCE

April 26 - 28, Sterling, VA

DFHRS

All day Friday and Saturday. Sprs: Southeastern VHF Society, North East Weak Signal Group, Mt. Airy VHF RC. Holiday Inn Washington-Dulles Intl. Airport, 45425 Holiday Drive. Tl: none. Adm: Advance \$99, door \$110 depending on availability. https:// vhfsuperconference.com/.

COMMUNICATIONS ACADEMY 2019

April 13 - 14, Seattle, WA

DHRS

8 AM – 5 PM. *Sprs:* Seattle ACS, WWA Medical Services, King County ARES, Bellevue ACS. South Seattle College,

6000 16th Ave. SW. Communications vehicle display. *TI*: 147.08 (103.5 Hz). *Adm*: Advance \$40 (1 day), \$70 (2 days), door \$45 (1 day), \$75 (2 days); includes lunch. www.commacademy.org.

Washington (Yakima) — Apr. 13 D F H R V

9 AM – 3 PM. Spr: Yakima ARC. State Fair Park Modern Living Building, 1301 S. Fair Ave. Tl: 146.66 (123 Hz). Adm: \$7. yakimaamateurradioclub.com/yakimahamfest/

Wisconsin (Cedarburg) — May 3 – 4

Friday: noon – 4 PM, Saturday: set up 6 AM, doors 8 AM – 1 PM. *Spr:* Ozaukee RC. Columbia St. Mary's Center, W67 N866 Washington Ave. 41st Annual Spring Swapfest. *Tl:* 146.97 (127.3 Hz). *Adm:* \$5. www.ozaukeeradioclub.org/.

Wisconsin (Stoughton) — Apr. 13 DFHRSV

8 AM – noon. *Spr*: Madison Area Repeater Association. Mandt Community Center, 400 Mandt Parkway. *Tl*: 147.15 (123 Hz). *Adm*: \$7. https://w9hsy.org/.

Wisconsin (Superior) — May 4 F H Q R V

9 AM – 1 PM. *Spr:* Arrowhead RAC. Head of the Lakes Fairgrounds, 4700 S. Tower Ave. *TI*: 146.94 (103.5 Hz). *Adm:* \$7. **thearac.org**.

Wyoming (Dayton) — Apr. 27 F V 9 AM – 3 PM. Spr: Cloud Peak Radio & Electronics Group. Dayton Community Center, 1100 US-14. TI: 147.255 (100 Hz). Adm: Free. cloudpeakradio.org/.

To All Event Sponsors

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

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 April 1 to be listed in the June 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.

101

75, 50, and 25 Years Ago

April 1944

- The cover photo shows W1JLK and his lightbeam transmitter-receiver, described in this
- The editorial delivers both kudos and cautions "To Our Gang Overseas" (our fellow hams serving in the military), noting many are still able to receive and read QST.
- In "The Alaska Communication System," T/4 Gail Fowler describes the radio system that supported the building of the Alaska Highway.
- A. D. Mayo, W4CBD, reports on "A Ham-Built Communications-Type Receiver," despite the increasing trend of using manufactured equip-
- Harold Mitchell, W4IBZ, tells us about "WKXM-8 A Novel WERS Transmitter" that fulfills WERS needs for battery-powered equipment made from priority-free, salvaged materials.
- "Hams in Combat" presents tales from the combat experiences of A. C. Jones, W9NE, receiving SOS calls for the US Navy, and Tech. Sgt. Howard Sullivan, W9QGS, who helped organize a search party in the Sahara.



- The cover photo shows W1DBM's triband beam covered by a flock of birds across all three elements
- The editorial addresses the emerging problem of the obscenities we too often hear on the air.
- Lewis McCoy, W1ICP, scales down a popular beam used on the HF bands to build "The Delta-Loop Beam on 144 MHz.
- R. H. Turrin, W2IMU, tutors us on the "Application of Broad-Band Balun Transformers," using newly available low-loss ferrite materials.
- J. Wayne Waller, W4TZB, describes "A Hidden Mobile Antenna" that uses the car body itself as the antenna.
- In "A Requiem for Radio Row," Gerald Samkofsky, W2YSF, reports that Manhattan's neighborhood of electronic retailers is being cleared out for the construction of the World Trade Center.

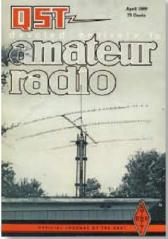
Note: In last month's column, we incorrectly identified the principal amateur station involved in

making the record-breaking 2300 MHz contact reported in the February 1969 issue of QST. The organizer of the contact was John Zimmer, W2BVU.

April 1994

- The cover photo declares, "This Issue Is Packed with Projects," featuring photos of three homebrewed devices.
- The editorial, "Wake-Up Call for 13 cm," discusses FCC proposals to transfer 200 MHz of spectrum to nongovernmental use, which could affect our 2400 MHz band.
- "Build Your Own Lowfer Transceiver," by David Curry, WD4PLI, tells us how even non-licensed operators could explore the low 1750-meter band with a high-performance CW transceiver.
- Ben Spencer, G4YNM, gives us "A Function Generator with a Frequency-Counter Digital
- "The RingMaster Ring Detector," by Robin Rumbolt, WA4TEM, provides increased security for repeaters that are controlled via telephone landlines and at risk due to Caller ID.
- Dennis Drudge, W0XD, tells us how to build a decoder to receive "The Elkhart County Tone Alert" that is used for group call-ups of SKYWARN operators.







Field Organization Reports January 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.

				00
720 WA7PTM	WD8MWD 163	120 KI0JO	103 AD5CQ	88 N1LAH
524 WB7OSC	KT5SR 160	AG9G KA9QWC KD2MEN	W8IM 102	87 K4VWK
460 KD8TTE	WB9QPM 156	AA7BM KY2D	KA8ZGY 101	KE5HYW 85
435 WA2CCN	WB8RCR	KO4OL WK4WC	W8CPG	WD8DHC 82
330 KK4PUX	153 KB5PGY WA2BSS	116 KI4UDZ	W4NWT WB4RJW	N2PQJ KD8ZCM
325 KB2RTZ	145 W5DY	115 N9VC NX9K	KZ8Q NN7H KN9P	81 W9EEU WA1LPM
318 WM2C	KC1CIC 140	KC8WH KB8MAF	K9DUR AB9ZA	KG5NNA 80
285 KW9EMG	W0LAW AC8RV WB4FDT	112 NI2W	KD2MDV N8CJS K3RC	W2PAX AA4XZ W9NXM
272 KE8BYC	KK3F 139	110 WC4FSU	K0VTT KB2YAA AA3SB	WB8QLT KF7GC
255 AL0Y	W3CB 136	W1KX WA3QLW K3JL	KE5YTA WB6UZX	KB2QO KB1NAL
250 KI6LNB	WS6P 135	WB8YYS WB8YLO	98 W9BGJ	N3SW 79
248 KV4LY	W2PH WB9WKO	WB6OTS N1PZP	97 KT4WX	KB3KYH 78
246 KF4DVF	N2LJM W3YVQ	KA2ZNZ N1TF W1RVY	N3JET 96	ND0CW W2CTG
245 KT2D	134 WM3G	KD2JKV N1IQI	N2WGF KA1G KA2GQQ	K6JT 76 WB8SIQ
WA3EZN 240	133 KC7ZGG	K4GK K1HEJ K3IN	KB1NMO	K8AMH
N8SY 238	132 KD8UUB	AF4NC WB8TQZ	95 KB3YRU KW4GU	75 KL7RF W4INK
WD8USA 221	130 K9LGU N1LL	KC5OZT KA5AZK KF5IOU	K1XFC 92	KA2HZP 74
KB1TCE 220	ACOKQ N2JBA	108 KD2IWN	K3FAZ 91	KA0DBK KN4AAG
W0PZD 188 KD2LPM	KW1U K4IWW	W4TTO KA5DON	N3RB 90	73 WA0UIG WB3FTQ
186 N3KRX	126 KC8YVF 125	107 N2DW	KM4VTK KM4WHO N2TSO	72 KC7ASA
180 WC9CW	W4CMH K8RDN	105 W7PHX KC4BQK	K8KRA WD8Q WB0B	K3YAK 71
175 KOIBS	124 K2TV	K8ED 104	WD0BFO KD4EAQ	KC1HHO W5XX
170 W4DNA	123 WA4VGZ	AD3J KE4AHC	AA3N WB8WKQ	70 K6RAU K0CY
165 KBLPC	122 K2RMF		W3BC	КЗМІУ

The following stations qualified for PSHR in previous months but The following stations qualified for PSHR in previous months but were not reported in this column: (Dec. 2018) WB9FHP 188, AB9ZA 145, KA9GWC 137, N1LL 130, K4GK 120, W9EEU 99, W9BGJ 98, K9DUR 95, W0DBFO 90. (Nov.) W8IM 141, N1LL 140, KA9GWC 120, N2DW 106, K9DUR, W9EEU 104, W9BGJ 98, AB9ZA 94, KT4WX 80. (Oct.) W8IM 127, N2DW 88, KT4WX 80. (Sept.) W8IM 118, N2DW 86, KT4WX 80. (Aug.) N1LL 175, KA9GWC 120, AB9ZA 110, K9DUP 98, W9BGJ 90, W9EEU 86, W9EE 85, UJul.) WB9FHP 250, N1LL 175, KA9GWC 120, AB9ZA 110, K9DUR 93, W9BGJ 90, N9SE 86, W9EEU 74. (May) W9BGJ 92.

Section Traffic Manager Reports

The following Section Traffic Managers reported: AL, AR, AZ, CO, CT, EB, EMA, ENY, EPA, GA, IA, IL, IN, KY, LA, MDC, ME, MI, MN, MS, NC, NE, ND, NFL, NLI, NM, NNJ, NTX, OH, SFL, SNJ, SJV, STX, TN, VA, WCF, WI, WMA, WNY, WPA, WV, WY.

Section Emergency Coordinator Reports

The following Section Emergency Coordinators reported: CT, DE, EPA, GA, IA, ID, IN, KY, LA, MDC, MI, MN, MS, NLI, NNJ, NV, OH, OR, PAC, SFL, SJV, SNJ, STX, WPA, WV.

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.

KK3F 1734, NX9K 963, WB9WKO 793, KW1U 550.

The following stations qualified for BPL in previous months, but were not reported in this column: (Dec. 2018) WB9FHP 4793. (Oct.) WB9FHP 452. (Aug.) N1LL 528. (Jul) WB9FHP 5630, N1LL 589. (May) WB9FHP 4398, N1LL 589.

Silent Keys

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

it is with	i deep regret that we record the
NN1A	Cook, Alfred W., Beverly, MA
KA1AS	Bolduc, Albert S., Reading, MA
♦W1BH	Hicks, Robert G., Sanford, FL
•WB1EEE	Gavagan, Vincent J., Jr., Inverness, FL.
WIGRG	Curtis, Robert H., Elsworth, ME
KB1KHA	Cooper, Michel C., Groton, CT
♦K1KU	Daley, Darrel L., Putney, VT
N1OFC	Bumpus, Bruce R, Plainville, MA
WIRWC	Carter, Richard W., Torrington, CT
• WIRXH WITGY	Parsons, Ernest L., Bowdoin, ME Young, Dorothy, Hiram, ME
KB1WFM	Morin, Henry L., Jr., Fremont, NH
WA1WWG	Tyler, Thomas R., Mystic, CT
KD2GGD	Love, Gregory M., Ocean City, NJ
W2GQC	Marino, James A., Helena, MT
WZIQB	Huey, George E., West Chester, PA
♦WA2K00	Stauder, Victor M., Dayton, OH
W2MOW	Erb, Ludwig C., Jr., Scotch Plains, NJ
WA2NCF	Wilson, Howard R., Poughkeepsie, NY
WA2SRW	Zwinge, Walter, Inverness, FL. Zillioux, Thomas J., Rochester, NY
NETOC NEUWI	Himelfarb, Jack, Lake Worth, FL
AB2YP	Bevilacqua, Anthony L., Hamilton, NJ
WZ2Z	Dally, Bruce J., West Bloomfield, M
WBAEG	Holdridge, Milton E., Jr., Highland, MD
W3FIP	Pannebaker, Frank I. "Skip," Jr.,
	Millsboro, DE
WB3FWE	Aldridge, David E., Solomons, MD
N3GH	Murray, Bruce A, Pittsburg, PA
K3LNV	Allen, Emer L., Jr., Perkasie, PA
W3MPN	Asaki, Goro "George," Pasadena, MD
NBNGA	Ashlin, Poy A, Jr., Beltsville, MD
KY3Q N3QBV	Leftridge, Gary L., Shawnee, KS Fouse, Stephen E., Altoona, PA
• KA3TIQ	Guy, William P., Claysville, PA
•W3TMO	Jones, Joseph, Justus, PA
♦K3VT	Trotnick, Vincent W., Jr., McMurray, PA
WSWER	Hadley, Herbert A., Monocacy, PA
NBZQY	Fornwalt, Brian W., Altoona, PA
WA4AIW	Caudill, James "David," Glade Valley, NC
KIVAARY	Emmons, Michael R., Jamestown, TN
NABB ACACI I	Baker, Thomas G., Montross, VA
AC4OH	Arnett, Frank W., Greenbrier, TN Hayes, Robert D., Scottsboro, AL
WD4CZV WD4DES	Riner, Joseph S., Cleveland, TN
KD4DZE	Eldridge, William F., Grayson, KY
KP4EP	Harrel, Hiddin A., Jr., Midlothian, VA
KF4EZE	Grissett, Sevell H., Waynesboro, GA
AE4FB	Adams, Mchael D, Mdland City, AL
KI4FKR	Cole, Floyd N., Gainesville, GA
WD4GCD	Garbee, Shirley T., Centreville, VA
K4GLO	White, Aubrey H., Jr., Chipley, FL.
AC4GO	Hampton, James A, Decatur, AL
AG4HR	Grady, Rajah E., Deep Run, NC
♦WW4I W4ITX	Henry, Philip C., Greenwood, SC Freeman, Larry D., Taylors, SC
• KA4J	Ledford, Larry G., Cleveland, TN
K4JEA	Kicklighter, Ottis C., II, Jacksonville, FL
NAJJM	Mount, Jerry, Hull, GA
KD4JSB	Wallace, Thomas L., Wilmington, NC
♦AK4JW	Weigand, James M., Groveland, FL.
KB4JZ	Gregory, Curtis "Phil," Moultrie, GA
AF4LG	Randall, Gary D., Vero Beach, FL.
WALWZ	Zimmer, Lawrence W, Cape Coral, FL
KK4MBP	Ware, Genn T., McLean, VA
NAMZNANBM	Redding, Howard E., Melbourne, FL. Best, Alan T., Largo, FL.
K4OOE	Glazner, Frederick E., Huntsville, AL
• AA4OU	Alexander, James B.,
	Winston-Salem, NC
KF4QVT	Eary, Martha E., Ashland, KY
WA4RHT	Cooke, Dewey Wilson, Tigerville, SC

passing	of these radio amateurs.
♦WA4WIP	Tesar, Richard G., Sarasota, FL.
KIV4WLV	Michael, Daniel W, Rockwell, NC
W4XS	Hayes, James H.,
VH20	Thompson's Station, TN
N4ZX	Lambert, John M., Charlotte, NC
AC5A	Richardson, Walter S.,
7	Port Saint Lucie, FL
K5BIS	Grab, Donald J., Albuquerque, NM
KG5CCB	Snyder, Norman D., Granbury, TX
KB5ON	Baker, Charles V., Dripping Springs, TX
KX5F	Burns, Patrick C., Oklahoma City, OK
KC5FRS	Reynolds, Donald, Conway, AR
W5GAK	Hyatt, Joe, Kingfisher, OK
KF5IBW	Baker, Albert E., Tickfaw, LA
K5JZT	Bearden, William C., Bartlesville, OK
♦KF5KHZ	Ramsey, John W., Bells, TX
W5NX	Tillotson, Charles C., Fayetteville, AR
AB5PX	Mayberry, Greg L., Caddo Mills, TX
KF5SJ	Gowens, Truman G., Graham, TX
WB5SWW	Phillips, Charles C., Laurel, MS
NEUNI	Roper, Reagan D., Midland, TX
WA5UNO	Moore, Larry L., Alamogordo, NM
NOUTI	Weeks, Denise "Shalanna Collins,"
	Richardson, TX
W5VBD	Fenn, George L., Jr., Tulsa, OK
KB5VEW	Whitworth, Richard L., Blackwell, TX
AA5VU	Kriss, Richard M., Austin, TX
KE5WQU	Bennett, Donna M., Wichita Falls, TX
♦W5ZH	Lambert, Richard E., Albuquerque, NV
WA6AD	Epps, Clyde, McAlester, OK
K6BNS	Smith, Bruce N., Walnut Creek, CA
AG6C	Bravin, Betty, Santa Rosa, CA
WECLC	Christian, Charles L., Fairfield, CA
W6EO	Nelson, Thomas L., Jr., Lakewood, CO
W6ETS	Senser, Ernest T., Laguna Woods, CA
• KD6FGQ	Christenson, Tosca A, Greenville, CA
• KE6HUU ♦W6LSW	Stasio, Terry D., Fresno, CA Ozment, William L., Pollock Pines, CA
• K60T	Vickers, Thomas E, Grand Island, NY
•WB6QMD	Sumida, Linda H., Sacramento, CA
• N6SEZ	Rosenberg, Leah, Phoenix, AZ
• K6TAV	Varin, Tom, Fountain Valley, CA
NETOR	Hargrove, Hardd E. "Hal," Salem, OR
K6UXP	Wagner, William R, Los Angeles, CA
WEWAA	Jones, Bevan J., Payson, UT
WEWCF	Fertig, William C., Hesperia, CA
N6YR	Canaday, James H, Lawrence, KS
KL7AG	Weber, Albert F., Fairbanks, AK
• KL7AZ	Weber, Florence R., Fairbanks, AK
KF7GNM	Bach, Alan R., North Plains, OR
N7JBJ	Sabel, Gerald J., Welches, OR
W/LB	Brown, Larry, Tucson, AZ
N7OYG	Weed, Jane M, Kingman, AZ
K7RFT	Nichols, Lynn L, Ava, MO
KE7TOC	Griffith, Greg D., San Antonio, TX
W7YWP	Baker, William, Olympia, WA
K7ZME	Harger, Armand John, Surprise, AZ
KH8AF	Dufficy, Daniel C., San Rafael, CA
KC8DSC	Decker, Ronald C., Dayton, OH
WBICB	Corbin, Lovell D., Cadillac, M
WA8LUK	Cumbow, James B., Jr.,
A POA AO I	Lynn Township, MI
N8MNI	Crosbie, Mark "Andy," London, OH
• K8NMG	Klesch, Charles J., Oregon, OH
	Mark, Howard N., Willard, OH
K8OOK WBOWN	Esborn, John E., Wokliffe, OH Rouman, George I. Big Basids M.
WD8SAY	Rouman, George L., Big Papids, M McNabb, William G., Yellow Springs, Or
WASSCR	Lober, Robert F., Perrysburg, OH
WB8SIO	Dean, James F., Vermilion, OH
K8SMC	Osborn, William "Teny," Jackson, M
WB8TGP	Cole, Clifford, Allendale, MI
VILLOIG	Solo, Ciliota, Alca Late, IVI

K8TSJ Pitchford, Delma E., Saranac, M. WBWNA Sanderson, James K., Perrysburg, OH Bohannan, William, Columbus, OH · KE8YA WBYGW Neal, Gordon K., Hamersville, OH KA8ZYZ Sandbrink, William, Lugoff, SC NO9A Carr, Lawrence J., Elk Grove Village, IL Charles, Edward B., Goshen, IN KB9BBI Norris, William F., Evansville, IN · N9BOY ♦AA9CN Lepouce, Joel E., Pleasant Prairie, W. McMichael, Herman L, Jr., N9FXI Posewille, IN WA9GXZ Shulz, Warren G., Griffith, IN Gizzi, Joseph, Hahwood, IL W9HLA N9HZD Wescoat, James C., Sr., Mascoutah, IL K9MJR Rauen, Matt J., Palatine, IL. KB9MMS Hawkes, Roland K., Concord, MA NONAM Everson, William A., Green Bay, Wi · W9QNR Scarborough, William B., Centralia, IL. KD9UQ Trenshaw, George C., Goshen, IN Mayfield, Elbert "Clyde," Columbus, IN NT9W W9WPV Butcher, Bradley A., Pensacola, FL. N9YDL Gray, John L., Jr., Chillicothe, IL WOACP Saint, Gary A, Idaho Springs, CO KOADI Kittleman, Rod A, Nixa, MO KE0AY Tissot, Frank G., Florissant, MO **WD0FYJ** Chivers, Walter J., Jr., Urbandale, IA WOGPF Vollmar, Lewis C., Sainte Genevieve, MO WA0GUD Krauel, Amold L., Audubon, IA WOUCF Hyland, Ronald I., Minneapolis, MN Seibold, Duane L, La Plata, MO AAOJT NOLGU Bauer, David C., Fremont, NE Callen, Delbert, Tribune, KS ♦KB0MH ♦KB0MWG Coby, William A, Saint Louis, MO Stitt, Nancy, Sun City, AZ KONNC · WONGB Pehkonen, Robert R., Cedar Rapids, IA NONW Cummings, Betty M., Saint Marys, KS Lufcy, Stephen C., Raytown, MO · KOOU KCOSTQ DeGuire, Thomas D., Saint Louis, MO NOTIMIN Komarek, Lillian P., Boulder, CO KBOWWZ Chamberlain, Ronald W, Lamar, CO NOXDW Gerst, Jeff M., Akron, CO VE3HBB Gillingham, Herbert A, Moose Creek, ON, Canada VE6UX Elsinger, Robert, Whitecourt, AB, Canada VUZBL Bhanumathy, M., Hyderabad, India.

- ♦ Life Member, ARRL
- Former call sign

For information on how to list a Silent Key in QST, please visit www.arrl.org/silent-keysubmission-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.

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NOBODY BEATS AN HRO DEAL!



FTDX5000MP Limited | 200W HF + 6M Xcvr

• Internal Power Supply • Two Totally Independent Receivers · Super Sharp "Roofing" Filters · High Performance Yaesu Custom- designed 32-bit Floating Point DSP • True Analog Meter Precision



FTDX3000 | 100W HF + 6M Transceiver

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



FT-991A | HF/VHF/UHF All ModeTransceiver

Real-time Spectrum Scope with Automatic Scope Control . Multi-color waterfall display • State of the art 32-bit Digital Signal Processing System • 3kHz Roofing Filter for enhanced performance • 3.5 Inch Full Color TFT USB Capable • Internal Automatic Antenna Tuner • High Accuracy TCXO



FTDX1200 | 100W HF + 6M Transceiver

. Triple Conversion Receiver With 32-bit Floating Point DSP • 40 MHz 1st IF with selectable 3 kHz, 6kHz & 15 kHz Roofing Filters . Optional FFT-1 Supports AF-FFT Scope, RTTY/PSK31 Encode/Decode, CW Decode/Auto Zero-In . Full Color 4.3" TFT Display



FT-891 | HF+50 MHz All Mode Mobile Transceiver

Rugged Construction in an Ultra Compact Body • Stable 100 Watt Output with Efficient Dual Internal Fans • 32-Bit IF DSP Provides Effective and Optimized QRM Rejection • Large Dot Matrix LCD Display with Quick Spectrum Scope . USB Port Allows Connection to a PC with a Single Cable . CAT Control, PTT/RTTY Control



FT-857D | Ultra Compact HF/VHF/UHF

• 100w HF/6M, 50W 2M, 20W UHF • DSP included • 32 color display • 200 mems • Detachable front panel (YSK-857 required)



FT-2980R | Heavy-Duty 80W 2M FM Transceiver

· Massive heatsink guarantees 80 watts of solid RF power · Loud 3 watts of audio output for noisy environments . Large 6 digit backlit LCD display for excellent visibility • 200 memory channels for serious users



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

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



FTM-400XD | 2M/440 Mobile

- · Color display-green, blue, orange, purple, gray · GPS/APRS
- Packet 1200/9600 bd ready Spectrum scope Bluetooth MicroSD slot • 500 memory per band



FT-70DR C4FM/FM 144/430MHz Xcvr

- · System Fusion Compatible · Large Front Speaker delivers 700 mW of Loud Audio Output · Automatic Mode Select detects C4FM or Fm
- Analog and Switches Accordingly . Huge 1,105 Channel Memory Capacity • External DC Jack for DC Supply and Battery Charging

FT-2DR C4FM/FM 144/430 MHz Xcvr

 Analog/C4FM Dual Monitor (V+V/U+U/V+U) System Fusion compatible • 1200/9600 APRS Data Communications • Integrated 66ch High Sensitivity GPS . Wide Band Receiver . Snapshot Picture Taking Capability With Optional MH-85A11U



with alert scan

FT-65R | 144/430 MHz Transceiver

Compact Commercial Grade Rugged Design . Large Front Speaker Delivers 1W of Powerful Clear Audio • 5 Watts of Reliable RF Power Within a compact Body . 3.5-Hour Rapid Charger Included . Large White LED Flashlight, Alarm and Quick Home Channel Access

FT-60R | 2M/440 5W HT

· Wide receiver coverage · AM air band receive · 1000 memory channels w/alpha labels · Huge LCD display . Rugged die-cast, water resistant case . NOAA severe weather alert





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IC-9100 | The All-Round Transceiver

- HF/50MHz 144/43vvv0 (440) MHz and 1200MHz*1 coverage
 100W on HF/50/144MHz, 75W on 430 (440) MHz, 10W on 1200MHz*1 Double superheterodyne with image rejection mixer

IC-7851 | HF/50MHz Transceiver

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



IC-7700 | HF/50MHz Transceiver

The Contester's Rig • HF + 6m operation • +40dBm ultra high intercept point • IF DSP, user defined filters • 200W output power full duty cycle • Digital voice recorder



IC-7610 | HF/50 MHz All Mode Transceiver

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



IC-7300 | HF/50MHz Transceiver

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



IC-9700 | All Mode Tri-Band Transceiver

VHF/UHF/1.2GHz
 Direct Sampling Now Enters the VHF/UHF
Arena • 4.3"Touch Screen ColorTFT LCD • Real-Time, High-Speed
Spectrum Scope & Waterfall Display • Smooth Satellite Operation



IC-7100 | All Mode Transceiver

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



IC-718 | HF Transceiver

• 160-10M** • 100W • 12V operation • Simple to use • CW Keyer Built-in • One touch band switching • Direct frequency input • VOX Built-in • Band stacking register • IF shift • 101 memories



IC-2300H | VHF FM Transceiver

65W RF Output Power • 4.5W Audio Output • MIL-STD 810 G
 Specifications • 207 alphanumeric Memory Channels • Built-in
 CTCSS/DTCS Encode/Decode • DMS



IC-2730A | VHF/UHF Dual Band Transceiver

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



IC-R8600 | Wideband Software Defined Receiver

• 10 kHz to 3 GHz Super Wideband Coverage • P25, NXDN™, dPMR™, D-STAR Mode • Large Dot Matrix LCD Display w/ Quick Spectrum Scope • SD Card Slot • Remote Control Function



ID-5100A Deluxe

VHF/UHF Dual Band Digital Transceiver

 Analog FM/D-Star DV Mode • SD Card Slot for Voice & Data Storage • 50W Output on VHF/UHF Bands • Integrated GPS Receiver • AM Airband Dualwatch



ID-4100A | VHF/UHF Dual Band Digital Xcvr

Compact, Detachable Controller for Flexible Installation •
 DV/FM Near Repeater Search Function • Apps for iOS™ and
 Android™ devices • Wireless Operation with VS-3 & UT-137
 Bluetooth® Headset & Module • MicroSD Card Slot



IC-R30 | Digital/Analog Wideband Xcvr

- 100 kHz to 3.3 GHz Super Wideband Coverage
 P25 (Phase 1), NXDNTM, dPMRTM, D-STAR Mode
 2.3" Large LCD Display & Intuitive User Interface
- MicroSD Card Slot for Voice & Data Storage
 USB Charging
 PC Connection

ID-51A PLUS2

VHF/UHF D-STAR Portable

- RS-MS1A, free download Android™ application
- New modes for extended D-STAR coverage Terminal Mode & Access Point Mode allow D-STAR operation through Internet • DV & FM repeater search function • Dplus reflector link commands





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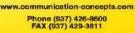




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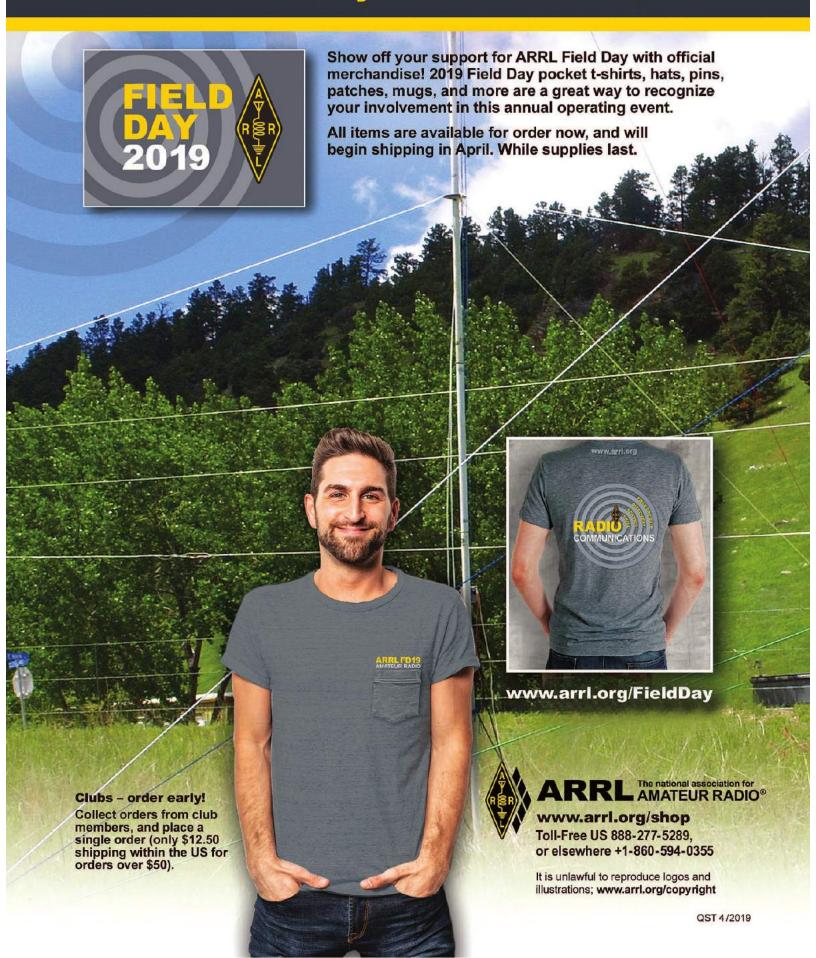
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As of Jan. 2019 this device has not been approved by the Federal Communications Commission.

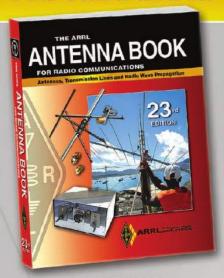
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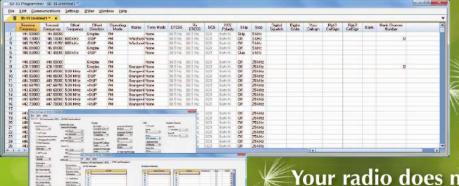
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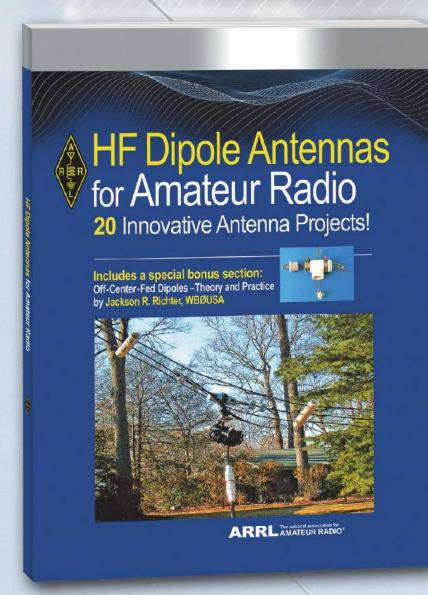
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HAM-VI - \$749.95 with DCU-2 HAM-VII - \$799.95 with DCU-3

M V Rotat	or Specification	
Wind Load Capacity (inside tower)	15 square feet	
Wind Load (w/mast adapter)	7.5 square feet	
Turning Power	800 inlbs.	
Brake Power	5000 inlbs.	
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 ftlbs	

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Turning Power	1000 in,-lbs.
Brake Power	9000 inlbs.
Brake Construction	Electric Wedge
Bearing Assembly	Triple race/138 ball bearings
Mounting Hardware	Clamp plate/steel U-bolts
Control Cable Conductors	8
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II Rotator Special	
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Brake Construction	Disc Brake
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Wind Load (w/mast adapter)	1.5 square feet
Turning Power	350 inlbs.
Brake Power	450 inlbs.
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 ftlbs

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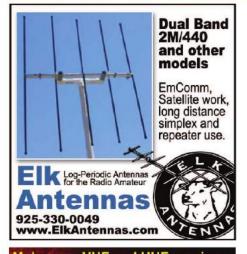
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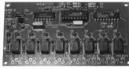
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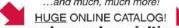
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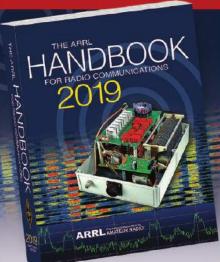


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6-Bands: 20/17/15/12/10/6 M...Outstanding Performance!



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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, \$119.95. 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

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.

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New MFJ HexBeams deliver solid gain and directivity on 20/17/15/12/10/6 Meters with two elements on each band.

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MFJ-1846, \$499.95. 6 Bands: 20/17/15/12/10/ 6M, 2-elements per band, full 1500W. 25 lbs. 11 ft.turning radius.

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3-Element Hexbeam



MFJ-1856 is six individually stacked monoband yagis!

6 Bands: 20/17/15/12/10/6M. Full 1500 Watts.

Three full-size elements on each band gives high gain, high front-to-back ratio and wide bandwidth. Works great at 20 feet. 30lbs. 17 feet turning radius. Ideal for a small rotator like hy-gain's CD-45II, \$449.95.

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rated metal housing. SO-239 connector. Full load 30 seconds. Silkscreened derating curve to 5 minforces equal antenna currents utes. SWR below 1.1:1 to 30 MHz, 1.5:1 from 30 to 650 MHz.

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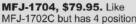
MFJ-1702C, \$39.95. 2-position antenna switch has center ground, auto grounding of unused position. handles 2.5 kW PEP and works to over 500 MHz. Lightning surge protection. Quality SO-239 connectors, heavy duty diecast.

MFJ-1702C but has 4 positions.

MFJ G5RV Antenna

MFJ-1778, \$49.95. G5RV antenna covers 160-10 Meters with antenna tuner. 102 ft. long. Inverted vee or sloper. Use on 160 Meters as Marconi. 1500 Watts.

Super-strong fiberglass center/feedpoint insulators. Glazed ceramic end insulators. Hand-soldered. Add coax, some rope and you're on the air!













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Choose any 4 bands: HF/VHF/UHF

Octopus antenna hub turns your hamsticks into four fully balanced dipoles in minutes!

Mix and match any four HF/VHF/UHF bands.

Example: screw-in 80, 40, 20 Meter hamsticks and a dual band 2M/440 MHz whip (two on each band) on opposite sides. Now you have an automatic bandswitching 5-band dipole! Rotate it for maximum signal and minimum QRM and noise with a small rotator like Hy-Gain AR-500, \$149.95.

Works at any height, low for local NVIS and high for DX. At a fixed height, (say 20-30 feet) use 80-Meters for NVIS and 20-Meters for low-angle DX.

Mounts on any mast up to 1-inch diameter. Use a fiberglass pole on a tripod and you're on the air!

Perfect for casual portable operation, limited space, HOAs, field day, camping, ARES during disasters.

Single coax feed, built-in balun.

Interaction between bands is minimized because the ends are spaced apart at a large angle.

You don't need an antenna tuner if you carefully tune each dipole. An easier way is to just set each dipole approximately on frequency and use an antenna tuner to operate and widen the bandwidth.

Hamsticks break down to about four feet for easy storage.

MFJ 250W & 600W HamSticks

MFJ HamSticks are ruggedly constructed. They have a sleek, low profile construction with low wind loading. Semi-rigid fiberglass eliminates the need for springs or guys while mobile.

> Black anti-static jacket protects loading coil and blends with any vehicle. Nearly indestructible 4 foot, 0.125 inch diameter PH-17-7 stainless steel whips are adjustable for lowest SWR. Chrome plated brass fittings will give you years of reliable service.

Screws into any 3/8 x 24 female mount.

Includes allen wrench, tuning/matching instructions.

MFJ-16XXT HamSticks handle 250 Watts PEP. About 7 feet fully extended, 4 feet collapsed.

MFJ-26XXT Hi-Q HamSticks handle 600 Watts PEP. Much larger diameter loading coil and wire gauge gives you higher-Q. Lower losses let you dramatically talk further and hear better. 101 inches fully extended. 53 inches collapsed.

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30-M	N/A	N/A	MFJ-1630T	\$18.95
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Eight 3/8 x 24 threaded connectors for hamsticks. Super strong fiberglass filled ABS base insulator. Your Octopus hub will give you years of trouble-free service!

Based on Geoff Haines, N1GY, award-winning December 2007 QST article.

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MFJ-2104, \$249.95 Octopus hub with your choice of four (2 each) 250W HamSticks™. Saves \$20!

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Antenna Rotator

AR-500 \$149.95

Rotate your Octopus dipoles for maximum gain and minimum QRM/noise!

Weatherproof 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.

110/220VAC switchable.

Portable Tripod with 18-foot mast

MFJ-1919EX \$159.⁹⁵ w/18' ext. mast

Black steel base forms strong braced equilateral triangles on a side. Non-skid feet and strong base and mast locks.

Stays in place! Telescopic fiberglass mast with *QuickClamps™* for instant *no-tool* set-up. 18 feet extended. 5 feet collapsed. Strong 1/8" wall fiberglass, ³/₄" diameter top section, 1¹/₂" diameter bottom section. 15 lbs. MFJ-1905, \$24.95. Tripod anchor foot braces. 3-pack stainless hardware set.



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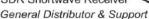
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A book focused entirely on active and passive receiving antennas and their associated circuits. There are few a separate, well-designed receiving antenna or antenna system. On the





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IFJ Antennas

MFJ Super High-Q Loop™ Antennas



MFJ 36-inch diameter loop antenna lets you operate 10 through 30 MHz continuously - including the WARC bands!

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

Work exciting DX with low angle radiation and local close-in contacts with high angle radiation when mounted vertically. 150 watts.

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

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

loss and polished to prevent high voltage arcing.

Nylon bearing, antibacklash mechanism, limit switches, continuous no-step DC motor gives smooth precision tuning. Heavy-duty ABS plastic housing has ultraviolet inhibitor protection.

Cover 40-15 Meters. MFJ-1788, \$499.95. Like MFJ-1786 but covers 40-15 Meters continuous. Includes remote control.



MFJ-1780, \$329.95. Portable 24 x 24 x 5 ³/₄" box fan loop with carrying handle. 20-10 Meters continuous Fast/slow tune remote control. Highly efficient all-welded contstruction

MFJ no radial Multiband Antennas...

...highly efficient end-loading gives full size performance

40/20/15/10/6/2M Vertical

Only 12 feet high with a tiny 24 inch footprint!

MFJ-1796

Covers 40/20/15/10/6/2 Meters Mount anywhere - ground level, tower top, roofs, patios, apartments and small

Small and lightweight - perfect for DXpeditions, field day, camping, vacations.

Efficient end-loading, no lossy traps. Entire length radiates. Full halfwave on 2/6 Meters.

High power air-wound choke balun eliminates feedline radiation. Adjusting one band has minimum effect on others.

Automatic bandswitching, low radiation angle, omni-directional,

handles 1500 watts PEP. Goes together in an

MFJ-1796W, \$299.95. WARC band version for 12, 17, 30, 60 Meters.

40/30/20/17/15/12/10M Vertical



MFJ-1797

40, 30, 20, 17, 15, 12, 10 Meters. Extra-long 40 Meter radiator gives super 40M

Super low profile makes it perfect for roof mounting, ground mounting, on patio tower top or to blend into the trees

23.5 feet tall including extra-long 40 Meter radiator. Weighs just 7.5 lbs.

No ground or radials needed. 1000 Watts PEP. High strength 6063 aircraft aluminum. Use mast up to

13/4 inches. MFJ-1797LP, \$299.95. Like MFJ-1797 but without

extra-long 40 Meter radiator. Less efficient with narrower bandwidth on 40M. 9 feet tall, weighs just 6 lbs.

80/40/30/20/17/15/12/10/6/2M Vertical



MFJ-1799 ΔII \$399_{.95} Bands HF through VHF!

Highly efficient endloaded 1/2 Wave vertical requires no radials, no lossy traps.

Only 20 feet high with a seven foot footprint so it mounts easily in a small area or patio.

High power air-wound choke balun eliminates feedline radiation. Automatic bandswitching, low radiation angle, omnidirectional, 1500W PEP.

Built-to-last. Incredibly strong solid fiberglass rod and aircraft strength aluminum tubing are in the main structure.

MFJ-1799X, \$349.95. Like MFJ-1799, but covers 40-2 Meters.

40/30/20/17/15/12/10 Meter ground mounted Vertical



High performance, low cost, low profile, ground mounted. 7 bands: 40, 30, 20, 17, 15, 12, 10 Meters, full 1500 Watts PEP.

MFJ-1794 249₋95

Permanent or temporary in antenna restricted spaces

Full 11 feet collapses to 7 feet to hide behind fences, etc.

Automatic bandswitching, low radiation angle for DX, omni-directional. Highly efficient end-loading. Entire length radiates. Low SWR.

Ground or roof mount with radials, ground rod. Portable or permanent operation with MFJ-1901, \$109.95 (left) 2 x 2 foot ground-coupled stainless antenna base. Hard-ware, U-bolts included.

MFJ-1795, \$199.95, Like MFJ-1794 but covers 40/20/15/10M. MFJ-1795W, \$199.95

Like MFJ-1795 but for 12, 17, 30, 60 Meters.

MFJ-1901 \$109.⁹⁵

9-Band Rotatable Mini-Dipole covers 40-2M

Low profile 14 feet...7 ft. turning radius...40, 30, 20, 17, 15, 12, 10, 6, 2 Meters... 1500 W



Directivity reduces QRM/noise and focus your signal to work real DX. Operate 40, 30, 20, 17, 15, 12, 10 plus 6 and 2 Meters. Run full 1500 Watts SSB/CW on HF!

End-loading inductors and capacitive hats insures highest efficiency. Entire length radiates. 6 and 2 meters are full length halfwave dipoles.

Low profile at fourteen feet - size of TV antenna - easily rotated by inexpensive

rotators like Hy-Gain's AR-500, \$129.95.

Built-to-last - incredibly strong solid rod fiberglass center insulator and 6063 T6 aircraft strength aluminum tubing radiator. Assembles in an afternoon.

MFJ-1775, \$319.95. Like MFJ-1789 but covers 40, 20, 15, 10, 6 and 2 Meters.

MFJ-1775W, \$319.95. WARC band version for 12, 17, 30, 60 Meters only. MFJ-1785, \$399.95. 80/40/ 20M. Endloaded rotatable dipole 33

feet. 1500W PEP. 6063 T6 al. tubing, solid center fiberglass.

MFJ-4603 Universal Window Feedthrough \$89.95. 4 SO-239, 1 N, 1 F, 3 ceramic feedthru for random/balanced lines, binding posts, more!

MFJ G5RV Antenna MFJ-1778

Meters with antenna tuner. 102 feet long. Can use as

inverted vee or sloper. Use on 160 Meters as Marconi

1500 Watts. Super-strong fiberglass center/feedpoint insulators. Glazed ceramic end insulators. All hand-soldered connections. Add coax, some rope and you're on the air! MFJ-1778M, \$44.95. G5RV Junior. Half-size, 52 ft. 40-10M with tuner, 1500 Watts.



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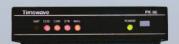
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MFJ G5RV Antennas

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



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

It's an efficient, all band 102 foot long antenna - shorter than an 80 Meter dipole. Has 32.5 foot ladder line

matching section ending in SO-239 connector for your coax \$49.95 feedline.

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

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

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

MFJ-1778M, \$44.95. Half-size, 52 foot G5RV JUNIOR for limited space. 40-10 Meters with tuner. Full 1500 Watts.

MFJ All Band Classic Doublet

MFJ 102 foot all band doublet covers 160-6 Meters with balanced line tuner Super strong custom fiberglass center insulator relieves stress on 100 foot

Glazed ceramic end insulators. 1500 Watts.

RF Isolator

MFJ-915 RF isolator prevents unwanted RF from traveling on the outside of your coax shield into your transceiver. This unwanted RF can cause painful RF "bites" when you touch your microphone or volume control, cause your display or settings to go crazy, lock up your transceiver or turn off your power supply. In mobile installations, stray RF could cause your car to do funny things even blow your car computer. Clear up these

problems, plug an MFJ-915 between your antenna and transceiver, 1.8-30 MHz. 1500 Watts, 5 x 2 inches.

MFJ-919, \$59.95. 4:1 current balun,1.5 kW. MFJ-913, \$29.95. 4:1 balun, 300 Watts.

True 1:1 Current

Balun & Center Insulator

True 1:1 Current Balun/Center Insulator forces equal radiator currents in dipoles for true dipole radiation pattern. Reduces coax radiation and field pattern distortion - your signal goes where you want it. Reduces TVI, RFI and RF hot spots. Don't build a dipole without one! 50 hi-permeability ferrite beads \$29.⁹⁵ on high quality RG-303 Teflon® coax and Teflon® SO-239.

1.5kW 1.8-30 MHz. Stainless steel hardware. 14 gauge stranded copper wire is directly connected to your antenna. 5 x 2 inches. Heavy duty weather housing

2-Position Antenna Switch



ladder line.

MFJ-1702C, \$39.95. 2-position antenna switch, lightning surge protection, center ground.

Lightning surge protectors

MFJ-270, \$29.95. 400W. MFJ-272, \$39.95. 1500 W. Gas discharge tube shunts 5000 amps peak.< 0.1 dB loss. 1 GHz. SO-239s.

MFJ-16C06, \$4.99. 6-pack glazed ceramic end/center ant insulators

MFJ-16B01, \$19.95. Molded high strength center insulator, SO-239.

MFJ-16D01, \$6.95. 450 Ohm fiberglass end/center insulator with ladder line stress relief and SO-239 mount.

▼ MFJ-18H100, \$34.95. 100 feet, 450 Ohm ladder line, 18 gauge copper clad.

80-10 Meter End-Fed Half Wave antenna Cover all bands with one single wire and no tuner!

MFJ-1982HP \$89.95

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

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

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

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

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

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

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

MFJ-1984HP, \$79.95. Like MFJ-1982HP but 40-10M, 66 feet jacketed wire.

See www.mfjenterprises.com

for 30 Watt QRP and 300 Watt models.

Dual Band Dipoles

MFJ-17758, **\$89.95.** Operate 80/40 Meters with a short 85 foot dipole. Full-size on 40 Meters with ultra-efficient



end-loading on 80 Meters. 1500 Watts. Superstrong custom molded center insulator with SO-239 connector and hang hole. Ceramic end insulators. 7-strand, 14 gauge hard copper wire. No tuner needed!

MFJ-17754, \$59.95. Like MFJ-17758 but is only 42 feet. Operate 40/20 Meters. Full-size on 20 Meters, ultra-efficient endloading on 40 Meters. 1500 Watts.

Single Band Dipoles



MFJ-1779A injection-molded UV resistant \$69.⁹⁵

160M, 265 ft. MFJ-1779B \$49.⁹⁵ 80-40M, 135 ft MFJ-1779C \$29.⁹⁵

20-6M, 35 ft.

Ultra high quality center fed dipoles give years of troublefree service. Custom

MFJ-918

center insulator has built-in SO-239 and hanging hole. Glazed ceramic end insulators. 7-strand, 14-gauge hard copper antenna wire. 1500 Watts. Use horizontally or as sloper or inverted vee. Simply cut to length with provided cutting chart.

OCFD Dipoles



MFJ-2012 \$79.95

MFJ-2010 \$59.95

No tuner needed!



bandwidth on 40/20/10/6 Meters. A Guanella current balun kills feedline radiation, pattern distortion, SWR shifts, RFI and noise pickup. Install anywhere and get the same predictable performance regardless of feedline length. You get ground reinforced gain over verticals. Use horizontally, inverted vee, sloper. 98% efficient, 14 gauge, 7-strand copper wire, ceramic end insulators.



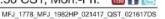
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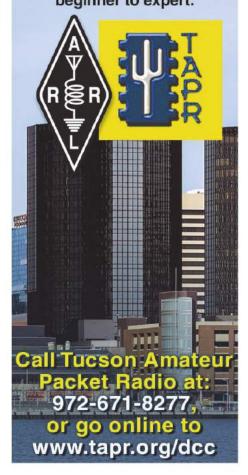


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124

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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

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



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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.

\$89.95 **5-way** binding posts lets you supply 50 Volts/15 Amps DC/AC power to your outside antenna tuners/relays/switches.

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MFJ's exclusive Adaptive Cable Feedthru™ lets you bring in rotator/antenna switch cable, etc. without removing connectors (up to 11/4 X 15/8 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 MFJ-4602 voltage ceramic feed-thru insulators \$69.⁹⁵ for balanced lines and longwire/random wire, Stainless steel ground post.

6 high quality Teflon® coax

connectors for HF/VHF/UHF antennas. Stainless steel ground post. Full 1500 Watt legal limit.

MFJ-4601 \$**59.**95

4 Balanced Line, 2 Coax

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



5 Adaptive Cable Feedthrus™. Pass any cable with connector: 2 cables with large connectors up to 11/4 x 15/8 inches and 3 cables with UHF/N size coax connectors. Seals out weather.

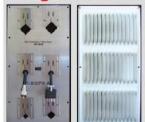
Stacks MFJ-4603 E C C F OF and MFJ-4604!

Gives you every possible cable connection you'll ever need through your window without drilling holes in wall - including

MFJ-4605 **\$159.**95

UHF, N and F coax connectors, balanced lines, random wire, ground, DC/AC power and cables of any size for rotators, antenna switches, etc.

Bring cables through the eave of your house



MFJ-4616 shown with standard full size vent (not included) it replaces For 6 Cables **\$26.**95

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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 $1^1/4 \times 1^{5/8}$ 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

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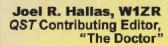
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Instantly gives you a complete picture of your antenna.

Read SWR, return loss, reflection coefficient, match efficiency at any frequency simultaneously.

Read Complex Impedance (530 KHz to 230 MHz) as series equivalent resistance and reactance (Rs+iXs) or as magnitude (Z) and phase (degrees). Also reads parallel equivalent resistance and reactance (Rp+jXp).

Determine velocity factor, coax loss in dB, length of coax and distance to short or open in feet (it's like a built-in TDR).

Coax Calculator™ calculates coax line length in

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Measure SWR and loss of coax with any characteristic impedance (530 KHz to 230 MHz) from 10 to over 600 Ohms.

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All-in-one ham radio test set ...

Includes frequency counter, RF Generator, SWR Analyzer™, RF Resistance and Reactance Analyzer, Coax Analyzer, Capacitance and Inductance Meter and more!

Large easy-to-read two line LCD screen and side-by-side meters clearly display your information. MFJ-259C ters clearly display your information.

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Out in the field, MFJ-225 is a compact completely self-con-

MFJ-223



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MFJ-249C Analyzer

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MFJ-226 **\$339.**95

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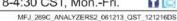


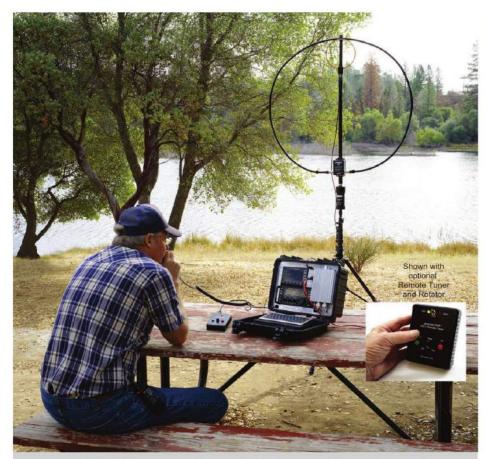












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- 15-45 W (10W for 80m)
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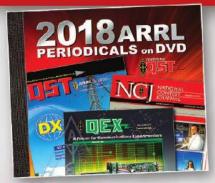


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Built-in radio interface controls most transceivers

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Use balanced line antennas with external MFJ-912, \$59.95, 1.5 kW 4:1 balun.

Small 13W x 4H x 15D inches easily fits into your ham station. 8 pounds. Requires 12-15VDC at 4 amps maximum or 110 VAC with MFJ-1316, \$21.95

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Digital Meter, Ant Switch, Balun



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Halfsize, 52 ft. 40-10M with tuner, 1500 Watts.

200W Weather-sealed

For Remote/Outdoor/Marine

Fully weather-sealed for remote Outdoor/Marine use! Tough, durable, built to last the elements for

MFJ-926B \$279.95

200 Watt Remote

Coax/Wire Ant, No power cable needed

Weather protected fully automatic remote auto tuner for wire and coax antennas - an MFJ exclusive. Powers through coax - No separate power cable needed.

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New, dual 500 pF air variable capacitors give you twice the capacitance for more efficient operation on 160 and 80 Meters

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New, TrueActive™ peak reading Cross-Needle SWR/Wattmeter lets you read true peak power on all modes.



New, high voltage current balun lets you tune balanced lines at high power with no worries

New, crank knob lets you reset your roller inductor quickly, smoothly and accurately.

New, larger 2-inch diameter capacitor knobs with easy-to-see dials make tuning much easier

New, cabinet maintains components' high-Q. Generous air vents keep components cool. 127/8W x 6H x 115/8D inches.

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Includes six position ceramic antenna switch, 50 Ohm dummy load, indestructible multi-color Lexan front panel with detailed logging scales and leg-

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More hams use MFJ tuners than all other tuners in the world!

MFJ-986 Two knob Differential-T™



MFJ-986 \$369.95

Two knob tuning (differential capacitor and AirCore™ roller inductor) makes tuning foolproof and easier than ever. Gives minimum SWR at only one setting. Handles 3 kW PEP SSB amplifier input power (1.5 KW output). Gear-driven turns counter, lighted peak/ average Cross- Needle SWR/Wattmeter, antenna switch, balun. 1.8 to 30 MHz. 15W x 41/2H x 103/4D in.

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MFJ-962D \$319.95

A few more dollars steps you up to a KW tuner for an amp later. Handles 1.5 kW PEP SSB amplifier input power (800W output). Ideal for Ameritron's AL-811H! AirCore™ roller inductor, gear-driven turns counter, pk/avg lighted Cross-Needle SWR/Wattmeter, antenna switch, balun, Lexan front, 1.8-30MHz. 107/eW x 103/aH x 41/oD in

MFJ-969 300W Roller Inductor Tuner



Superb, AirCore Roller Inductor

MFJ-969 **\$229.**95

Covers 6 Meters thru 160 Meters! 300 Watts PEP SSB. Active true peak reading lighted Cross-Needle SWR Wattmeter, QRM-Free PreTune™. antenna switch, dummy load, 4:1 balun, Lexan front panel. 101/2W x 31/2H x 91/2D inches.

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Most for your money! 300 Watts PEP, 1.8-30 MHZ, lighted Cross-Needle



SWR/Wattmeter, MFJ-941E \$149_95 8 position antenna switch, 4:1 balun, 1000 volt capacitors, Lexan front panel. 101/2W x 21/2H x 7D in. MFJ-941EK, \$129.95. Tuner Kit -- Build your own!

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Extends your mobile antenna bandwidth so you don't have to stop, go outside and adjust your antenna. Tiny 8W x 2H x 6D in.



Lighted Cross-Needle SWR/Wattmeter. Lamp and bypass switches. Covers 1.8-30 MHz and 6 Meters. 300 Watts PEP. MFJ-20, \$6.95, mobile mount.

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Tunes coax, balanced lines, random wire 1.8-30 MHz. Cross-Needle Meter. SWR, 30/300 or 6 Watt QRP ranges. Matches popular MFJ transceivers. Tiny 61/2W x 21/2H x 6D in. MFJ-971 \$129.95



MFJ-901B smallest Versa Tuner



MFJ's smallest (5W x 2H x 6D in.) and most affordable wide range 200 Watt PEP Versa tuner. Covers 1.8

MFJ-901B **\$99.**95

to 30 MHz. Great for matching solid state rigs to linear amps.

MFJ-902B Tiny Travel Tuner

Tiny 41/2W x 21/4H x 3D inches, full 150 Watts, 80-6 Meters, has tuner bypass switch, for coax/random wire. MFJ-904H, \$149.95. Same but adds Cross-needle SWR/ Wattmeter and 4:1 balun for balanced lines.

71/4W x 23/4H x 23/4D inches.



\$109.⁹⁵

MFJ-16010 random wire Tuner



Operate all bands anywhere with MFJ's reversible L-network Turns random wire into powerful transmitting antenna. 1.8-30 MHz. 200 Watts PEP. Tiny 4W x 2H x 3D in.

MFJ-16010 \$69.95

MFJ-9201 QRPocket™ Tuner

80-10 Meters, 25 Watts. 12 position inductor, tune/bypass switch, wide-range T-network, BNCs. 4W x 25/8H x 11/2D inches. MFJ-9201, \$49.95



MFJ-9201 \$49_95

MFJ-921/924 VHF/UHF Tuners

MFJ-921 covers 2 Meters/220 MHz MFJ-924 covers 440 MHz. SWR/Wattmeter. 8W x 21/2H x 3D in.



MFJ-921/924 \$89.95

MFJ-931 Artificial RF Ground

Eliminates RF hot spots. signals caused by poor RF grounding. RF feedback, TVI/RFI, weak RF grounding. Creates artificial RF ground or electrically places far away RF ground



MFJ-931 **\$109.**95

directly at rig. MFJ-934, \$209.95, Artificial ground/300 Watt Tuner/Cross-Needle SWR/Wattmeter.



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MFJ *Telescopic* Fiberglass Mast<u>s</u>

Portable, telescoping high-strength fiberglass masts extend way up into the sky! Just pull out sections and lock.

Choose Lightweight-Light-Duty or Super-Strong Thick-Wall models -- 10 to 50 feet long. Each collapses to an easy-to-carry size for true portability.

For quick put-up and take-down, light-duty models have Twist & Lock sections and heavy-duty thick wall models use military style QuickClamps™ or stainless steel hose clamps.

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Use multiple telescoping masts to make loops, quads, rotatable dipoles even beams

Light Duty Lightweight Fiberglass Masts

So lightweight you can take them anywhere!

MFJ's most popular MFJ-1910 is 33 feet long, 3.3 lbs.

MFJ-1910, \$79.95. 33 ft., light duty w/top tie ring. MFJ-1911, \$89.95. 20 ft., light duty w/top tie ring. MFJ-1913, \$89.95. 28 ft., lightweight w/top tie ring. MFJ-1915, \$139.95. 25 ft., for heavier duty use. MFJ-1916, \$159.95. 34 ft., for heavier duty use.

MFJ-1917, \$169.95. 43 ft., heavier duty w/top tie ring.

Super-strong .125" Thick-Wall Fiberglass Masts Use for temporary or permanent wire antennas, small beams or verticals. Best seller is 50 ft. long, just 26 lbs.

Heavy Duty Models: All have QuickClamps

MFJ-1908HD, \$259.95 is 48 ext., 7.75-ft. collapsed, has 2¹/₂" OD bottom, 1" OD top, seven 7.75-ft. sections, 24 lbs. MFJ-1906HD, \$219.95 is 38' extended, 6 feet collapsed, has 21/2" OD bottom, 1" OD top, seven 6-foot sections, 24 lbs. MFJ-1904HD, \$159.95 is 25' extended, 4 feet collapsed, has 21/2" OD bottom, 1" OD top, seven 4-foot sections, 14 lbs. MFJ-1904H, \$139.95. 22' ext., 5' collapsed, 9 lbs. 2¹/₂" OD. MFJ-1902H, \$119.95, 10' ext., 38" collapsed, 5 lbs. 2¹/₂" OD

Standard Models: H models have QuickClamps™

MFJ-1906, \$139.95/MFJ-1906H, \$189.95, 33 feet, ext., 6 ft. collapsed, six 6-ft. sections, 13 lbs. 2" bottom, $^{3}/_{4}$ " top OD. MFJ-1908, \$179.95/MFJ-1908H, \$229.95, 41' ext., 7.75 ft. collapsed, six 7.75-ft. sect., 16 lbs. 2" bottom, 3/4" top OD.

Mast Accessories

MFJ-1900, \$69.95. Mount clamps mast to mounting pipe. MFJ-14, \$59.95. 5 Military *QuickClamps*™. Fit ³/₄" to 2" OD. MFJ-14HD, \$69.95. Extra set clamps, 1- 2¹/₂" masts.

Mast Guy Ring Sets Fits masts 3/4" to

11/4" dia OD. MFJ-2830X, \$6.95, fiberglass; MFJ-2840X, \$8.25, aluminum.



Left: Stainless Steel Hose Clamps recom-mended for perma-Fiberglass is slotted.

Right: UV protected Military grade Quick-Clamps.Guy 2 levels when fully extended.



MF-J-347

18' Telescopic **Mast & Tripod**

MFJ-1919EX, \$159.95.

Put your antennas up high anywhere with this super-strong 18 foot telescoping fiberglass mast and MFJ-1919 heavy duty steel tripod. QuickClamps™ lower mast to 5 feet. Mast has thick 1/8 in. wall, .75" top, 1.5" bottom dia. 15 lbs. Steel tripod has braced triangle base, non-skid feet, mast lock.

MFJ-1918EX, \$89.95.

MFJ-1918 tripod has super strong 9.5 foot telescoping fiberglass mast. 3.8 feet collapsed. QuickClamps™ Thick 1/8 inch wall, .75" top, 1" bottom diameters, 6.5 lbs.

Tripods Only

MFJ-1921, \$169.95, Giant tripod base spreads to 8 feet! Supports massive antennas. Adjustable length non-skid legs accommodates uneven ground surfaces. Optional foot anchors MFJ-1905, \$24.95, see Tripod Anchors bottom right. 5Hx7D feet collapsed, 14 lbs MFJ-1919, \$89.95, Large tripod base spreads to 4.8 feet. Supports 100 pounds. 7.8 feet, 1.4 inch diameter mast 4.5H x .5D feet collapsed.

MFJ-1918, \$49.95, Smaller tripod base spreads to 75 ft. Support 66 lbs. 6 foot, dia. mast. 3.2H x .3D ft. collapsed, 6.75 lbs.

80-6 Meter Antenna

MFJ-2980

3.8 foot fiberglass mast telescopes to a 31 foot

\$99.95 40-6 Meters MFJ-2982 self-supporting high perfor-

\$149.95 80-6 Meters mance 80-6 Meter vertical antenna in minutes!

Quarter wave performance on 40 Meters, halfwave on 20M.

High-Q air wound loading coil. Use antenna tuner for 30, 20, 15, 12, 10, 6 Meters. 600 Watts SSB/CW.

Use as temporary, portable or permanent antenna for home, RVs, camping, field day, hamfest, DX-pedition.

Includes four 12 foot radials. Current balun reduces feedline radiation and pattern

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Build your own 80-6 Meter mini-dipole using two HF mobile whips! Only MFJ-347 mount isolates dipole elements and lets you use a balun to give a true balanced dipole. Prevents pattern distortion,

noise pickup and RFI radiation \$19.⁹⁵ from RF on coax shield. Solid aluminum. Use mast up to 11/4" OD.

3/8-24 Hamstick

Mount 3/8-24 HF/VHF hamsticks MFJ-342T vertically or horizon-**\$9.95** tally on masts up to 1 inch. Built-in SO239 connector.

MFJ Balcony Mount



Mount multiple HF/VHF hamsticks, verticals, dipoles vertically and/or horizontally on your apartment/condo balcony. High-strength aircraft aluminum extends out 14". Two U-bolts mount up to 11/2" diameter.

Tripod Anchors

Securely anchor tripod to ground with these 3 stainless steel foot braces and your stakes. For high winds, unlevel ground, tall antennas. Fits legs to 11/2"OD.





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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.

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Ruggedly built to withstand extreme weather. 1-inch OD diameter 6061 aluminum tubing. 36-inch loop diameter. 21/2 pounds. SO-239 connector. Use masts up to 13/4 inches. MFJ-1886TR has built-in T/R switch, Bias-Tee.



Antenna Rotator AR-500/X Perfect for MFJ1886/1786/1788 129.95 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.

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MFJ-1786 \$449.95

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Portable Loop

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Q5T QuickStats

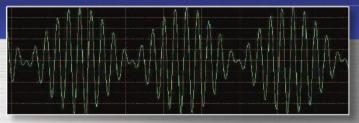
Online QuickStats Poll Results for January 1 through February 1, 2019.

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What is your favorite analog voice mode?

SSB **77**%

AM 2%

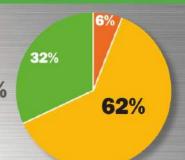


I don't operate analog voice modes. 7%



Will you be participating in the phone version of the Rookie Roundup on April 14th?

Yes. 6%
No. 62%
Not sure at this time. 32%



When operating SSB, do you use your transceiver's speech compression function?

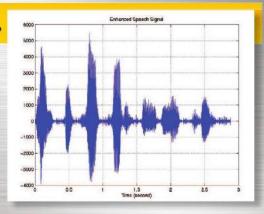
Yes, all the time. 30%

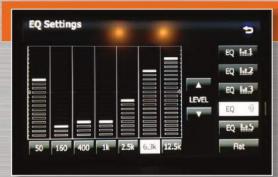
Yes, but only when I need the extra "punch" to be heard. 33%

No. 26%

My transceiver doesn't have a speech compression function. 4%

I don't operate SSB. 7%





Have you adjusted your transmit audio equalization for operating AM or SSB?

Yes. 46%

No. 30%

My transceiver doesn't have a transmit audio equalization adjustment. 17%

I don't operate AM or SSB. 7%

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*: 2 kHz spacing measurement standard - Receiver frequency 14.2 MHz, MODE CW, BW 500 Hz, PRE AMP OFF





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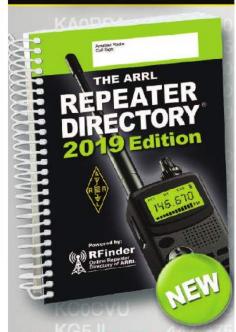
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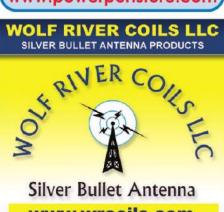
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OTHER FEASON.

7. AN IMPORTANT NOTICE TO ALL HAM AD POSTERS AND RESPONDERS, FROM THE ARRL ADVERTISING DEPARTMENT Greetings from ARRL HO! 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 defluct the cost of your ifem from the overpayment and to to deduct the cost of your item from the overpayment, and to transfer the overage back or to another individual. This is a well-known scam. Unfortunately, we have no control over this and other scams of this type. Once your email address is posted, you are vulnerable to those individuals seeking to provide you with questionable information.

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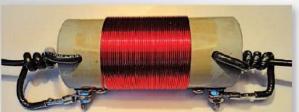


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