QST

DIGITAL EDITION

ARRL The National Association for Amateur Radio®

May 2023 www.arrl.org

DEVOTED ENTIRELY TO AMATEUR RADIO

Getting Started with Surface Mount

QST Reviews

Xiegu G106 5 W QRP Transceiver

Lynovation CTR2-Mini+ Radio Controller

TinyGS — An Application of LoRa Technology

Birth of the New Flagship Mobile

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

BIGHEAD

Actual Size

PMG(Primary Memory Group)Display

Dual Receive Display

Scope Display

FTM-500DR

As of March 2023, this device has not been approved by the FCC. It may not be offered for sale or lease until FCC approval has been obtained. The information shown is preliminary and may be subject to change without notice or obligation.

YAESU
Radio for Professionals

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

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

Smart New Operating Features

Touch & Go

Simply Touch the displayed Channel Bar to Quickly Start Communications

High-resolution Full-color LCD touch panel, and Ultra-High-Speed PLL Real-time Scope

PMG (Primary Memory Group) Activity Monitor

- Register the current display frequency into PMG with one press of the "PMG" key.
- Simply press the "PMG" key to instantly display the receive status of the registered frequencies in a Bar Graph (Activity Monitor).
- Touch & Go Operation allows quickly starting communication by touching the displayed target channel bar.

79 channel Band Scope

- Displays a bar graph of up to 79 channels, in high-speed real time, centered on the current VFO frequency.
- Select the number of channels from 79ch/39ch/19ch by touching the displayed channel number.
- Touch & Go Operation allows immediately moving to the frequency and starting communication by touching a displayed channel bar.

C4FM/FM 144/430MHz DUAL BAND
5W DIGITAL TRANSCEIVER

FT5DR

C4FM Digital Clear Voice Mode
Clear and Crisp Voice Technology

AMS Automatic Mode Select

66 ch GPS

WIRES-X

Touch & Go Operation

microSD Card

Bluetooth®

Comfortable Grip with Full Flat-Back and Quick Release Holster (Supplied)

- Comfortable size and form with no protrusions provides excellent grasp, even when wearing gloves for outdoor activities.
- Quick Release Holster that easily attaches and releases the FT5DR and allows operation with an excellent hold and feel.

YAESU
Radio for Professionals

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

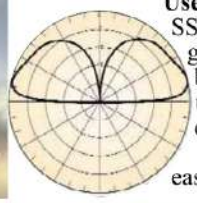
For the latest Yaesu news, visit us on the Internet: **http://www.yaesu.com**

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

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

Big Brother R9 now includes 75/80M for ragchewing and world-wide low band DX *without radials*!

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



Use full *1500 Watts* SSB/CW when the going gets tough to break through pile-ups/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 sand-box -- no ground radials to bury with all RF-energized surfaces safely out of reach.

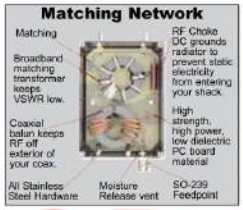
Rugged Construction: Thick fiberglass insulators, all-stainless steel hardware and 6063 air-craft-aluminum tubing is double or triple walled at key stress points to handle anything Mother Nature can dish out.

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

R8, $699.95. Like R9 antenna but less 75/80 Meters.

R-8TB, $119.95. Tilt-base lets you tilt your antenna up/down easily by yourself to work on.

R-8GK, $99.95. Three-point guy kit for high winds.



MA-6B 6-Band Beam

Small Footprint -- Big Signal

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

Cushcraft's latest MA-6B gives you *2-elements on 6 bands!* Solid *signal-boosting directivity* in bantam size/ 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. 7' 3" boom has less than 9' of turning radius. Contest tough -- handles 1500 Watts.

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

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

MA-5B, $759.95. Like MA-6B but 5 bands: 20/17/15/12/10 Meters. 12/17M is a single element trapped dipole. ***See cushcraftamateur.com*** for gain figures.

Cushcraft 10, 15 & 20 Meter Tribander Beams

Only the best tri-band antennas become DX classics, which is why the Cushcraft World-Ranger A4S, A3S, and A3WS go to the head of the class. For more than 30 years, these pace-setting per-formers have taken on the world's most demanding operating condi-tions and proven themselves every time. The key to success comes from attention to basics. For example, ele-ment 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 charac-teristics you rely on to maintain regular schedules, rack up impressive contest scores, and grow your collection of rare QSLs!

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

The 3-element A3S/A3WS and 4-element A4S are world-famous for powerhouse gain and super performance. **A-3WS, $569.95,** 12/17 M. **30/40 Meter** *add-on kits* available.

Cushcraft Dual Band Yagis

One Yagi for Dual-Band FM Radios

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

Cushcraft Famous *Ringos* Compact FM Verticals

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

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

Cushcraft
Amateur Radio Antennas
308 Industrial Park Road, Starkville, MS 39759 USA
Open: 8-4:30 CST, Mon.-Fri. ***Add Shipping.***
• **Sales/Tech:** 662-323-5803 • **FAX:** 662-323-6551
http://www.cushcraftamateur.com

Cushcraft . . . Keeping you in touch around the globe!

Visit www.cushcraftamateur.com

Forward Power
Reflected Power
SWR
All At Once!

DAIWA

Testing, Tuning, Matching, Monitoring - Made Easy!

	CN-501H	CN-501H2	CN-501V/N
Frequency	1.8~150MHz	1.8~150MHz	140~525MHz
Power Range: Forward	15/150/1.5KW	20/200/2KW	20W/200W
Power Rating	1.5KW (1.8~60MHz) 1KW (144MHz)	2KW (1.8~60MHz) 1KW (144MHz)	200W (140~525MHz)
Tolerance	±10% at Full Scale	±10% at Full Scale	±10% at Full Scale
SWR Measurement	1:1~1:∞	1:1~1:∞	1:1~1:∞
SWR Detection Sensitivity	4W MIN	4W MIN	4W MIN
Input/Output Impedance	50 ohms	50 ohms	50 ohms
Input/Output Connectors	SO-239	SO-239	SO-239 or N-Type

CN-501
Economy Series

Compact HF/VHF AVG reading SWR/Power Meter Cross needle technology displays:
• FORWARD POWER • REFLECTED POWER • SWR - Simultaneously!

	CN-901HP	CN-901HP3	CN-901V/N	CN-901G
Frequency	1.8~200MHz	1.8~200MHz	140~525MHz	900~1300MHz
Power Range: Forward	20/200/2KW	30/300/3KW	20/200W	2/20W
Tolerance	±10% at Full Scale	±10% at Full Scale	±10% at Full Scale	±10% at Full Scale
SWR Measurement	1:1~1:∞	1:1~1:∞	1:1~1:∞	1:1~1:∞
SWR Detection Sensitivity	5W MIN	5W MIN	5W MIN	0.4W
Input/Output Impedance	50 ohms	50 ohms	50 ohms	50 ohms
Input/Output Connectors	SO-239	SO-239	SO-239 or N-Type	N-Type

CN-901
Professional Series

AVG & True PEP power meter .5 second PEP delay to dampen the needle movement with on/off switch:
• FORWARD POWER • REFLECTED POWER • SWR - Simultaneously!

CS-201

Frequency Range (up to): 600MHz
Power Rating: 2.5 kW PEP1 kW CW
VSWR: Below 1.2:1
Insertion Loss: Less than 0.2 dB
Isolation: 60 dB 600 MHz
Connector: SO 239
Output Port: 2

CS-201GII

Frequency Range (up to): 2 GHz
Power Rating:
1.5 kW CW (up to 30 MHz)
250 W CW (up to 1 GHz)
150 W CW (up to 2 GHz)
VSWR: Below 1:1.3 at 1.3 GHz
Insertion Loss: Less than 1.2 dB at 1.2 GHz
Isolation: 50 dB 1 GHz
Connector: Gold Plated N-Type
Output Port: 2

NCG company

Call, visit, or click on your favorite dealer today!
www.natcommgroup.com | 800-962-2611

QST

Contents

May 2023 ♦ Volume 107 ♦ Number 5

Columns

Departments

Our Cover
If you're still designing and building circuits using through-hole components and are interested in making the change to surface-mount devices, Scott Lentz, AG7FF, has provided a wealth of information in "Surface-Mount Design and Assembly for the Everyday Amateur." The article steps you through the process, from design software to board fabricators, to stenciling and soldering. [Scott Lentz, AG7FF, photo]

Digital and Mobile Editions

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

Write for *QST*

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

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

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

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

International
To compensate for additional postage for mailing outside the US, the following rates apply: Membership in ARRL, including a 1-year subscription to *QST*, $76, payable in US funds. Life Membership, including a subscription to *QST*, is available at $1,900.* Libraries and institutions, $76 per year.

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

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

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

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

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

*Payment arrangements available. Please write for details.

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

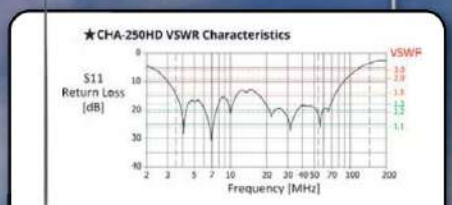
Reprints and permissions:
permission@arrl.org

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

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

COMET®

Life is a JOURNEY. Enjoy the ride!



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

The Comet CHA-250HD is the updated version CHA-250B. The top aluminum section has been replaced with a solid whip for greater flexibility and less strain on the lower 4 aluminum sections in high winds.

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

Base Antennas

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

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

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

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

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

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

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

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

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

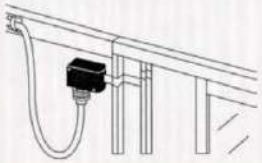
Wavelength: 146MHz 5/8 wave x 2 • 220MHz 5/8 wave x 3• 446MHz 5/8 wave x 5 • Max Pwr: 120W • Length: 10'2" • Weight: 3lbs. 1oz.• Conn: Gold-plated SO-239 • Construction: Fiberglass, 2 Sections

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

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

❼ COMET CTC-50M WINDOW GAP JUMPER

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



CAA-500MarkII

1.8-500MHz Antenna analyzer

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

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

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

CAA-5SC

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

Shoulder strap included.

Call or visit your local dealer today!

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

COMET®

DIAMOND ANTENNA

diamondantenna.net

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

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

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

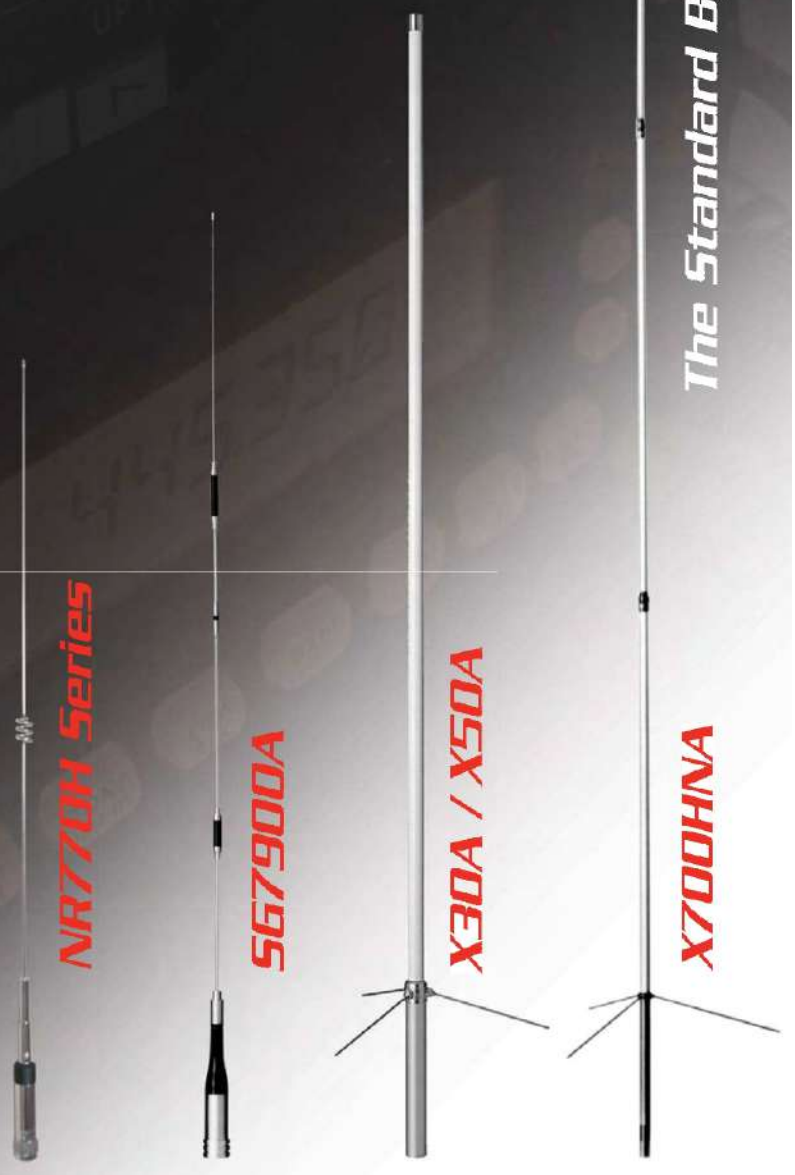
You've tried the rest, now own the best!

X700HNA Special Features:

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

Here is a small sample of our wide variety of antennas

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



The Standard By Which All Others Are Judged

RF PARTS™ COMPANY

Diamond Antenna is a division of RF Parts Company

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

Second Century

YEAR of the VOLUNTEERS

Bouvet — A Very Tough Teacher

DXpeditions are a part of amateur radio and its history. ARRL's annual Colvin Award, funded by an endowment established by Lloyd D. Colvin, W6KG (SK), commemorates the legacy of Lloyd, W6KG, and Iris, W6QL, Colvin in celebration of their achievement of operating from more than 200 DXCC entities. These grants help underwrite some of the costs — often extraordinary costs — of running a DXpedition. I am a casual — yet committed — DXer, with 300 countries confirmed, but I focus more on the chase to fill my DXCC Challenge total! These expeditions catch my attention with the hope that I'll work them from my modest station. Just look at the post-COVID flurry of activity, from Benin, to Andaman, to Crozet, and the excitement it has generated. But the subject of the most attention, excitement, anticipation, and investment has to be the recent expeditions to Bouvet.

ARRL is proud to have backed this group of daring risk-takers as they took on likely the most formidable place on Earth, just so that we could add one more to our DXCC totals. Was the operation successful? If getting there, operating, and getting back safely is a measure of success, then yes. Did it achieve for all of us the ability to be one of the more than 100,000 contacts they planned and hoped to make? Then regrettably, no, it was not a success. But we need to look beyond that by taking in the lessons learned and benefiting from them.

The three major lessons for me are:

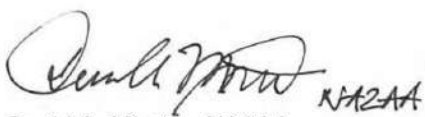
First, deliberate QRMers and pirate imitators are despicable at best and troubled at worst. We need to use our technological skills to root them out and get them out of the hobby. If that is not realistic, then we may need to completely rethink how the fox jumps about and how the hunters can be spread across the entire band so that jamming is no longer practical. I spoke with a very active ham located in the Caribbean who heard the DQRM from both the US and Europe. His comments were not flattering. It is so easy to follow the simple recommendations put forth in the DX Code of Conduct. If you're not familiar with them, you can find them at **www.dx-code.com**.

Second, in the future we need to recalibrate the measures *of* success and align the requirements *for* success according to the difficulty of each DXpedition. Bouvet represented the toughest conditions on Earth. At a cost of hundreds of thousands of dollars, two Bouvet expeditions in 4 years led to only 20,000 contacts. It is the DX community, through its clubs and organizations, who will ultimately need to decide what level of scrutiny they will use to measure the risks and the likelihood of success. This will require each DXpedition team to build out a robust plan, with potentially extensive contingencies, and the addition of sufficient non-ham resources, as a prerequisite for funding. The detail and rigor, after what has happened trying to tackle Bouvet, should be more aggressive not as a punitive act, but as a collaborative act to help reduce the risks and elevate the possibility of a level of success that we can all agree on.

Third, and the most provocative of all, are we taking ourselves just a little too seriously with how we view where a DXpedition must be in order to work it? Think about this: you take a boat to a tiny island that is a rare DXCC entity. If you're on the island, your expedition counts. If you're tied to a dock on the island, it doesn't count. If you're 300 feet off shore but within the territorial waters of the island, it definitely does not count. Why not? The reason is, the DXCC rules say so. But aren't these man-made rules? Can they not be reviewed and changed? Is it so unreasonable to think that an antenna hanging from a mast on a sailboat is the same as that same antenna, 300 feet away, hanging from a palm tree? The challenges of working that expedition from around the world do not change. But the safety factor is improved, as is the likelihood of success. If it were up to me — *and it isn't* — that's a DXCC rule I'd want to see changed for the betterment of amateur radio and radiosport, despite the inevitable cries that it goes against what has "always been done this way."

There have been those who have questioned the validity of the Bouvet operation. Rest assured that the DXCC Desk received documentation before and after the expedition, confirming that all aspects of the operation meet the regulations and policies of Norway and their Polar Institute. All evidence points to a dangerous, yet successful, undertaking — and it counts for DXCC!

There are many resources online that allow you to see which DXpeditions will be coming up for you to chase. Consider supporting them with a donation, definitely try to make contact with them, and, as we do each year with the legacy of the Colvins in mind, celebrate their interest and effort in giving all of us the chance to work them! Be radio active, be a connector and help a new ham learn to chase DX, and see you in the pileups!



David A. Minster, NA2AA
Chief Executive Officer

hy-gain Antennas and Rotators

HF Verticals

Work amazing DX with these extremely low radiation angle omnidirectional antennas. All self supporting, 1500 Watts PEP SSB, low SWR. Heavy duty, slotted, tapered, swaged, aircraft quality aluminum tubing. Stainless steel hardware. Two year limited warranty.

AV-680, $739.95. 9 Bands: (6, 10, 12, 15, 17, 20, 30, 40, 80 Meters). 26 ft., 18.5 lbs. *Our most popular vertical now has 75/80 Meters! Lets you work exciting DX with a low 17 degree radiation angle!* Easily mount on decks, roofs, patios. *No ground or radials needed.* Extra wide 2:1 SWR bandwidths. *Each* band tunable. Auto band-switching, handle 1.5kW, 80 MPH wind survival, low 2.5 sq. ft. wind surface. Aircraft aluminum tubing, stainless steel hardware.

AV-640, $659.95. Like AV-680 less 80M. 25'1/2', 17'1/2 lbs.

AV-620, $599.95. Like AV-640 less 40M. 22'1/2'/10'1/2 lbs.

AV-14AVQ, $299.95. (10, 15, 20, 40 Meters). 18 ft., 9 lbs. *Classic* AV-14AVQ uses same trap design as famous Hy-Gain 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, $219.95. (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.

AV-18VS, $199.95. (10,12,15,17,20,30,40,80M). 18 ft., 4 lbs. hy-gain's lowest priced vertical gives you 8 bands. Easily tuned to any band by adjusting base loading coil.

See our website for even more hy-gain vertical antennas!

HF Beams

Hy-gain beams are *stronger, light-er, have less wind surface and last years longer.* Why? *Hy-gain* uses durable *tooled* components -- massive boom-to-mast bracket, heavy gauge element-to-boom clamps, thick-wall swaged tubing -- no failures!

TH-11DX, $1799.95.
11-element, 4.0 kW PEP, 10,12,15,17,20 Meters. *The choice of top DXers.* With 11-elements, excellent gain and 5-bands, the super rugged TH-11DX is the *"Big Daddy"* of all HF beams! Features low loss log-periodic driven array on all bands with mono- band reflectors, BN-4000 high power balun, corrosion resistant wire boom support, hot dipped galvanized and stainless steel parts.

TH-7DX, $1599.95. 7-Element, 1.5 kW PEP, 10, 15, 20 Meters. 7-Elements gives you *the highest average gain of any Hy-gain* tri-bander! 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.

TH-3MK4, $769.95. 3-Element, 1.5 kW PEP, 10, 15, 20 Meters. Gives most gain for your money in full-power, full-size *hy-gain* tri-bander! Impressive gain and a *whopping* average front-to-back ratio and still fits on an average size lot. 95 MPH wind survival.

TH-3JRS, $529.95. Compact 3-Element, 600 W PEP, 10, 15, 20 Meters. *Hy-gain's most popular and lowest-priced tri-bander fits smallest lot,* 14.75 ft turning radius, 21 lbs. Excellent gain and front-to-back let you compete with the "big guns"! 80 MPH wind survival.

hy-gain Rotators . . . the first choice of hams around the world!

HAM-IV . . . $799.95

The most popular rotator in the world! For medium communications arrays up to 15 sq. feet wind load area. 5-second brake delay! Test/Calibrate function. Low temperature grease permits normal operation down to -30° F. Alloy ring gear gives extra strength up to 100,000 PSI for maximum reliability. Indicator potentiometer. Ferrite beads reduce RF susceptibility. Cinch plug plus 8-pin plug at control box. Dual 98 ball bearing race for load bearing strength and electric locking steel wedge brake prevents wind induced antenna movement. North or South center of rotation scale on meter, low voltage control, max mast size of 2'/16".

HAM-VI, $1299.95. 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, $1399.95. Like HAM VI but with ***DCU-3*** digital controller with *six programmable memories*.

Tailtwister T-2X . . . $1099.95

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* weather-proof 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, 2'/16" max. mast.

T-2XD2, $1299.95. Tailtwister with ***DCU-2*** *digital* controller.

T-2XD3, $1249.95. Tailtwister with ***DCU-3*** digital controller with *six programmable memories*.

AR-40, $499.95. For compact antenna arrays and FM/TV up to 3.0 sq. ft. wind load. Dual 12 ball-bearing race. Fully automatic.

CD-45II, $599.95. 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

DCU-3
$639.95

DCU-3 Digital Controller lets you program 6 beam headings! Gives fully automatic or manual control of 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. Antenna automatically rotates precisely, safely to desired direction.

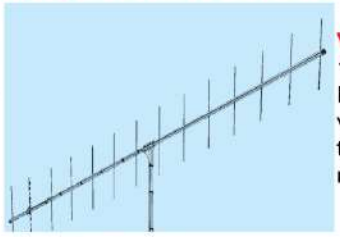
DCU-2, $519.95. Like DCU-3 but less six programmable beam headings.

Replace Your Yaesu Rotator Controller

YRC-1
$429.95

Replace your Yaesu rotator controller. More features and a much more robust controller that is far less prone to lighning damage. YRC-1 costs less than repairing your original controller!

hy-gain VHF/UHF Antennas



VB-214FM, $219.95. 14-element 2-Meter FM beam antenna provides exceptional front-to-back ratio and maximum obtainable gains.

VB-23FM, $99.95. 3-element.
VB-25FM, $119.95. 5-element.
VB-28FM, $179.95. 8-element. Threaded stub for feedpoints. Accepts up to 2 inch mast.
DB-2345, $159.95.
Dual band 144 (3-elements) 440 (5-elements) MHz.

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

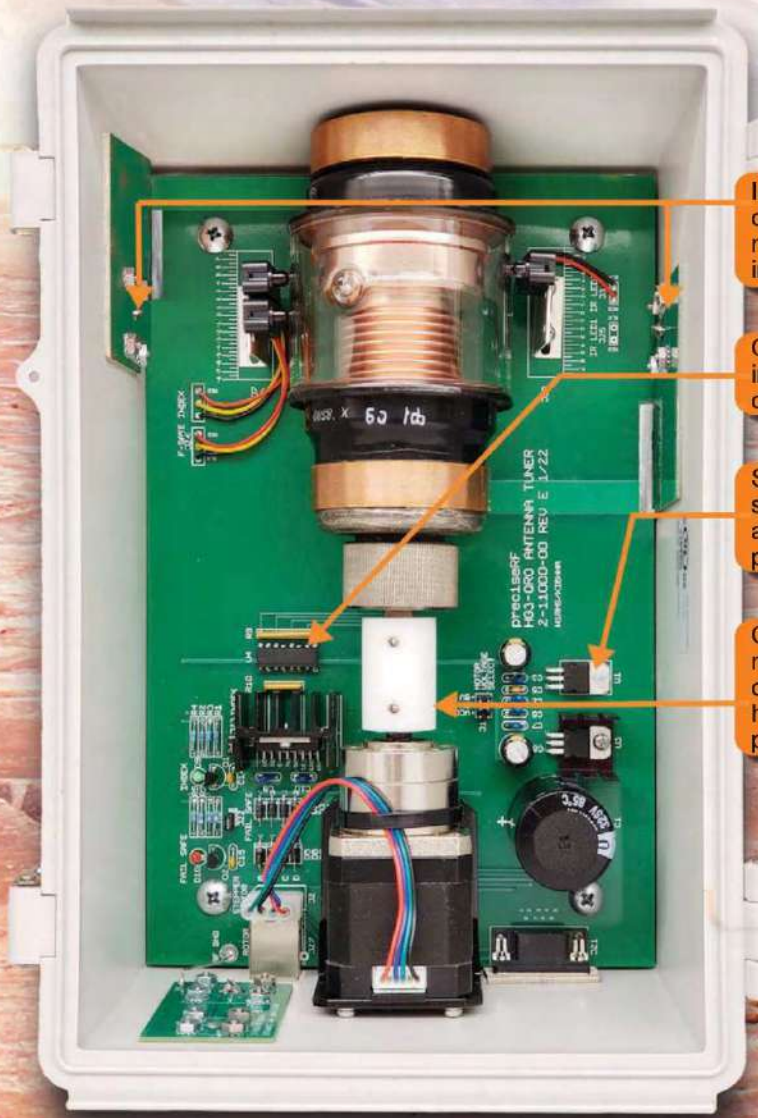
COMPROMISE WAS NOT AN OPTION FOR THE NEW HG3 QRO-A!

No Compromises Mag Loop

The new HG3 QRO-A raised the bar again for Magnetic Loop Antennas (MLA). MLAs are well known for their superior performance. The remotely tuned HG3 QRO-A MLA covers 80*-10 meters with stepper motor precision and resolution. The high Q vacuum capacitor allows for 1.5 KW PEP*. The 45,000-step resolution delivers an unprecedented 511 Hz resolution bandwidth allowing you to set your band preferences spot on. Rapid-Tune automatically scans each band for the lowest SWR and works with most HF radios.

It Pays to Pay Attention

How do you make a great product even better? You listen to your customers.The heart of an MLA is the tuner. We made so many improvements to it that we now call it the HG3 QRO-A. The HG3 Plus Controller also received new firmware and an improved SWR function. *Some limitations may apply or are optional.



HG3 QRO-A Improvements:

- Integrated capacitor to radiator connections with six times more copper surface area for improved efficiency
- Optical isolated driver interface allows for a longer control cable and RFI rejection
- Separate logic circuit and stepper motor power supplies allow for smoother and more precise tuning
- Custom high voltage Delrin motor to capacitor shaft coupler provides for greater high power and high voltage protection

Check Preciserf.com for all our high performance Magnetic Loop Antennas

preciseRf™

PRECISERF.COM

13690 Wisteria Dr. NE Aurora, OR 97002
• ph: 503-915-2490 • preciserf.com • © 2022

Array Solutions

Your Source for Outstanding Radio Products

Professional Grade Equipment from Array Solutions

OM Power Amplifier

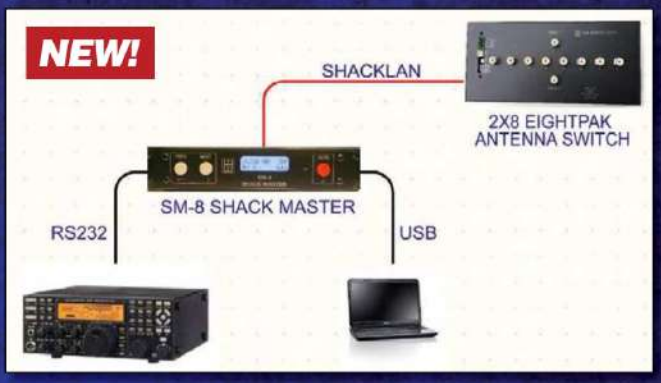
OM4001A

OM Power Amplifiers, The New RF Power Benchmark!

Hamation Station Automation

Hamation remote and Local Station Control products allow you to automatically or manually select antennas, bandpass filters, and control accessories. Accessories can be StackMatches, Antenna switches, antenna phasing systems, SteppIR controller, turning radios on and off, etc. All of this can be done directly from the Ethernet as well!

Wiring are simple phone cables that daisy chain to all the devices. Wireless control is also available to your tower-located switches. Call us to learn how to set up simple or complex systems. Below is a simple basic system that can switch antennas as you change bands. We can interface to any radio CAT port, not just RS232.



A more complex system could be a SO2R contest station as shown.

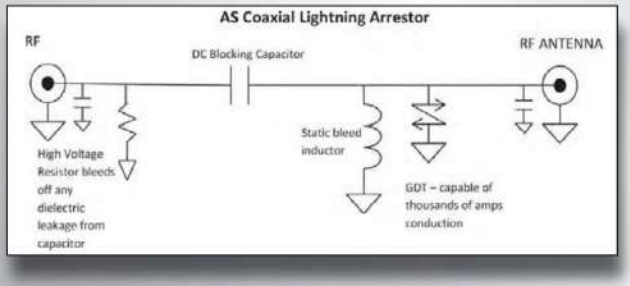
Array Solutions Lightning Arrestors

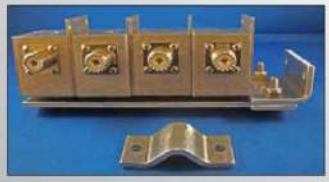
Coaxial , Ladder Line, Single wire, Control Line protection for Rotators, Switches, and Antenna Motors

AS-300 Series arrestors are known for their reliability and performance. They feature easy mounting to plates, ground rods with our stacking bracket and also a convenient screw lug. The stacking bracket can be used on plates as well to save precious room in arrestor enclosures.

- Available in SO-239, Type-N, and 7/16 DIN
- connectors
- DC blocked, DC pass is available as a custom option
- Unique static bleed system with a UL approved Gas Discharge Tube, also ITU K 12 tested. This system usually prevents the GDT from ever firing unless a direct hit is taken. Saves your radio from static build up on large antennas.
- Models available for 3 kW, 5 kW, 10 kW and higher, details on website. Lower power available.
- FM low power broadcast model AS-303D FM
- Model AS-309H high-power single wire or ladder line arrestor, also DC block with static bleed
- Control line Arrestors for 8, 12, and 16 wires – 65V sparkover.
- Models for HF, VHF to UHF – Extremely low loss and Low VSWR

AS-303U





The Shared Apex Loop Array™!

Capture the whole band or the whole HF spectrum at once with the Shared Apex Loop Array 2nd Generation. Can be remote controlled over the internet or in your station. 8 directions of directivity.

The Shared Apex Loop Array™ is a revolutionary receiving antenna that will change the way that you listen to the radio! The patented design provides performance in a size and over a wide range of frequencies that will please both the rag-chewer and DXer alike.

Three models to choose from:

- AS-SAL-30 - optimized for VLF, BCB, 1.8-10 MHz
- AS-SAL-20 - optimized for BCB, and 1.8-30 MHz
- AS-SAL-12 - optimized for 3-30 MHz

StackMatch

The original, not the imitations. For phasing 2, 3, 4 and even 6 antennas. Also it can be used to combine vertical and horizontal polarized antennas to diminish fading.

PowerMaster II

RF Power and SWR meter. Couplers for 3 kW, 10 kW or higher available for HF/6 m. VHF and UHF couplers for 1.5 kW. You can connect up to 5 couplers to the display to monitor RF power on different TX lines.

Switches for Six Antennas

New RatPak Remote Switch now operates from DC to 225 MHz! Finally a switch that can work on HF, 2m, and 1.25m bands!

www.arraysolutions.com

2611 North Beltline Rd., Suite 109
Sunnyvale, Texas 75182 USA
sales@arraysolutions.com
Phone 214-954-7140 Fax 214-954-7142

Check our Website for more new products!

Array Solutions' products are in use at top DX and Contest stations worldwide as well as commercial and governmental installations. We provide RF solutions to the DoD, FEMA, Emcomm, UN, WFO, FAA and the State Dept. for products and installation of antennas systems, antenna selection, filtering, switching and grounding. We also offer RF engineering and PE consulting services.

Sam Shaner, sshaner@arrl.org

Member Spotlight

In 2023, this page will highlight amateurs who have achieved recognition in areas outside of, or related to, amateur radio.

YEAR of the VOLUNTEERS

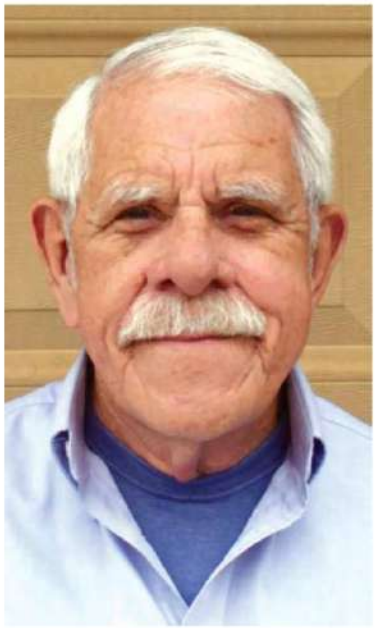
Keith Cambron, KC1ATT

Like many hams, becoming established as an amateur radio operator came long after Keith Cambron, KC1ATT, passed his first licensing test. "I earned my Novice-class license around 1980, and my call sign was WA2YJL. I got a transmitter and a receiver, but I just didn't make time for the hobby until after I retired," he said. It's no surprise that the former President and CEO of AT&T Labs had little opportunity to get on the air over the course of his career.

An Engineer in His Element

Keith earned a bachelor's degree in electrical engineering from the University of Missouri with a US Navy scholarship. He spent 4 years with the Naval Construction Battalion, also known as the Seabees, before moving on to the Reserves for the next 20 years, where he eventually became a Commander.

In 1977, Keith joined Bell Laboratories. He recalled, "It was a unique place to work — halfway between an industrial site and a university." Indeed, Bell Laboratories, the former research and testing hub for AT&T, was a hotbed of innovation. Telecommunication essentials, such as coaxial cable and the transistor, were invented by its researchers. Some of the biggest names in communications engineering, including Harry Nyquist and Claude Shannon, were Bell Labs staff. "Those engineers came on long before I did, but it was the culture of Bell Labs to share information. It was collegial in that there was not much in the way of rank or title. I was a new engineer, but the fellow who wrote my textbook was literally two floors below me," Keith said.



Change and Growth

When the Bell System broke up in 1982, Keith moved on to work for Pacific Bell as the chief engineer for a then-developing hybrid fiber coaxial system. During this time, he also worked on digital subscriber line technology, which enhanced his RF expertise. This enabled him to develop several patents, including technology for detecting crosstalk and interference. Keith eventually left Pacific Bell to do consulting and engineering for various Silicon Valley startups. He accepted an invitation to become President and CEO of Southwestern Bell Laboratories in 2003. After Southwestern Bell acquired AT&T in 2006, Keith became the President and CEO of AT&T Labs. He said, "I've always enjoyed the tactical side of engineering. But when you're President and CEO, your real job is to steer the entire enterprise."

Shifting to Radio

Keith remained in this role for 5 years before retiring. However, he feels that his true interests have always laid in the hands-on aspects of technology, like writing software. He developed his own SDR website, **www.radiocheck.us**, that reflects his ongoing desire to test his programming skills — now in the context of ham radio. In addition to shortwave listening services, the website provides a way for hams to test their transmission audio, free of charge. Keith's motivation for doing so was to help fellow operators, but also "just to see if I could do it." His latest passion project, **www.icuspeeder.com**, utilizes a 24 GHz phased-array transceiver to detect speeders on his quiet Georgetown, Texas street.

Nowadays, Keith is dedicating more time to getting on the air with the help of the Williamson County Amateur Radio Club (WCARC). He considers WCARC members to be his mentors. Though his background helped him catch on fast, Keith emphasizes the importance of exchanging information across all experience levels. "A lot of people need a bit more work before they can effectively use their stations. The elmers are there to help you." This sentiment echoes the culture Keith experienced at Bell Labs, as he believes the ham radio community functions in the same way. He continued, "We have a Monday-night beginner's net on our repeater because it's hard to learn just from the books." Whether a newcomer, a mentor, or the leader of an expert team, the ability to cooperate as equals has been integral to Keith's success every step of the way.

Guide to Member Benefits

Join or Renew
www.arrl.org/join

Donate
www.arrl.org/donate

Benefits
www.arrl.org/benefits

Shop
www.arrl.org/shop

ARRL Online | www.arrl.org/myarrl

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

- **Magazines | www.arrl.org/qst** and **www.arrl.org/ota**
  Members in the US receive a choice of print magazine: *QST*, ARRL's membership journal (12 monthly issues), or *On the Air*, our new magazine for new and beginner-to-intermediate-level radio amateurs (6 bimonthly issues). All members can access the digital editions of *QST*, *On the Air*, *QEX*, and *NCJ* from a web browser and apps available for iOS, Android, and Kindle Fire devices. Members need a valid ARRL account to access ARRL's digital magazines, the Archives and Periodicals Search, and the Product Review Archive.
- **E-Newsletters | www.arrl.org/myarrl**
  Subscribe to the weekly **ARRL Letter** and a variety of other ARRL e-newsletters and announcements.
- **The ARRL Current Email Newsletter**
  Members can elect to receive this monthly email within their online profile. Each issue provides a reminder of the available digital magazine issues and highlights articles from all four digital publications, along with podcast overviews, benefit updates, product and publication specials, and more.
- **ARRL Learning Network**
  www.arrl.org/arrl-learning-network
  This 30-minute webinar series features member-volunteers covering a variety of topics: technology, operating, and public service. Live presentations are recorded for viewing later.
- **Email Forwarding Service**
  Email sent to your **arrl.net** address will be forwarded to any email account you specify.

Technical Information Service | www.arrl.org/tis

Call or email our expert ARRL Technical Information Service specialists for answers to all of your technical and operating questions.

Advocacy | www.arrl.org/regulatory-advocacy

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

Group Benefits* | www.arrl.org/benefits

- **ARRL Ham Radio Equipment Insurance Plan**
  *US only

Find...

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

Interested in Becoming a Ham?

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

Connect with ARRL

ARRL The National Association for Amateur Radio®
225 Main Street, Newington, CT 06111-1400 USA
1-860-594-0200, Mon. – Thurs. 8 AM to 7 PM EST, and Fri. 8 AM to 5 PM EST.
except holidays

FAX 1-860-594-0259, email **hq@arrl.org**
Contact ARRL: **www.arrl.org/contact-arrl**

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

The American Radio Relay League, Inc.

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

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

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

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

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

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

Officers, Division Directors, and Staff

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

Officers

Founding President 1914-1936
Hiram Percy Maxim, W1AW

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

First Vice President
Michael N. Raisbeck, K1TWF*
85 High St.
Chelmsford, MA 01824
978-250-1235; **k1twf@arrl.org**

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

International Affairs Vice President
Rod Stafford, W6ROD
5155 Shadow Est.
San Jose, CA 95135
408-238-4671; **w6rod@arrl.org**

Chief Executive Officer and Secretary
David A. Minster, NA2AA*
225 Main St.
Newington, CT 06111
860-594-0404; **dminster@arrl.org**

Treasurer
John Sager, WJ7S

Chief Financial Officer
Diane Middleton, W2DLM

Staff

Director of Operations
Bob Naumann, W5OV

VEC Manager
Maria Somma, AB1FM

Field Services Manager
Mike Walters, W8ZY

Radiosport & Regulatory Information Manager
Bart Jahnke, W9JJ

Laboratory Manager
Ed Hare, W1RFI

Director of Emergency Management
Josh Johnston, KE5MHV

Membership Manager
Yvette Vinci, KC1AIM

Director of Marketing & Innovation
Bob Inderbitzen, NQ1R

Advertising Sales Manager
Janet Rocco, W1JLR

Public Relations & Outreach Manager
Sierra Harrop, W5DX

Director of Publications & Editorial
Becky R. Schoenfeld, W1BXY

Education & Learning Manager
Steve Goodgame, K5ATA

Director of Development
Kevin Beal, K8EAL

Controller
Thomas Bell, KC1MHQ

Human Resources Manager
Luci Goodwin

*Executive Committee Member

Atlantic Division

www.atldiv.org
Robert B. Famiglio, K3RF
P.O. Box 9, Media, PA 19063
610-359-7300; **k3rf@arrl.org**

Vice Director: **Marty Pittinger, KB3MXM**
4 Pegram Rd., Owings Mills, MD 21117
410-356-7899; **kb3mxm@arrl.org**

Central Division

www.central.arrl.org
Carl Luetzelschwab, K9LA
1227 Pion Rd., Fort Wayne, IN 46845
260-637-6988; **k9la@arrl.org**

Vice Director: **Brent Walls, N9BA**
2151 E. Bomar Ln., Greenfield, IN 46140
317-557-7224; **n9ba@arrl.org**

Dakota Division

www.arrldakota.org
Bill Lippert, ACØW
2013 6th Ave. SE, Austin, MN 55912
507-993-9181; **ac0w@arrl.org**

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

Delta Division

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

Vice Director: **Ed B. Hudgens, WB4RHQ**
1441 Wexford Downs Ln., Nashville, TN 37211
615-630-2753; **wb4rhq@arrl.org**

Great Lakes Division

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

Vice Director: **Scott Yonally, N8SY**
258 Valley Hi Dr., Lexington, OH 44904
419-512-4445; **n8sy@arrl.org**

Hudson Division

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

Vice Director: **Nomar Vizcarrondo, NP4H**
P.O. Box 245, Tenafly, NJ 07670
917-443-2664; **np4h@arrl.org**

Midwest Division

www.arrlmidwest.org
Art Zygielbaum, KØAIZ*
6601 Pinecrest Dr., Lincoln, NE 68516
402-421-0840; **k0aiz@arrl.org**

Vice Director: **Dave Propper, K2DP**
747 Old Bonhomme Rd., University City, MO 63132, 314-225-5167; **k2dp@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 ARRL, use **w1aw@arrl.org** or **hmaxim@arrl.org**.

New England Division

https://nediv.arrl.org
Fred Kemmerer, AB1OC*
39 Baldwin Ln., Hollis, NH 03049
603-413-5400; **ab1oc@arrl.org**

Vice Director: **Phillip E. Temples, K9HI**
125 Coolidge Ave. #803
Watertown, MA 02472-2875
617-331-0183; **k9hi@arrl.org**

Northwestern Division

www.arrlnwdiv.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.pacific.arrl.org
Kristen McIntyre, K6WX*
900 Golden Wheel Park Dr., #85, San Jose, CA 95112, 510-703-4942; **k6wx@arrl.org**

Vice Director: **Anthony Marcin, W7XM**
6836 Boulder Canyon St., North Las Vegas, NV 89084, 702-984-9589; **w7xm@arrl.org**

Roanoke Division

www.arrl-roanoke.com
Dr. James Boehner, N2ZZ*
525 Barnwell Ave. NW, Aiken, SC 29801-3939
803-641-9140; **n2zz@arrl.org**

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

Rocky Mountain Division

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

Vice Director: **Dan Grady, N2SRK**
8706 S. Buchanan Way, Aurora, CO 80016
720-236-7397; **n2srk@arrl.org**

Southeastern Division

www.facebook.com/ARRLSoutheasternDivision
Mickey Baker, N4MB
14764 Black Bear Rd., West Palm Beach, FL 33418, 561-320-2775; **n4mb@arrl.org**

Vice Director: **Jeff Beals, WA4AW**
P.O. Box 1584, Loxahatchee, FL 33470
561-252-6707; **wa4aw@arrl.org**

Southwestern Division

www.kkn.net/n6aa
Richard J. Norton, N6AA
21290 West Hillside Dr., Topanga, CA 90290
310-455-1138; **n6aa@arrl.org**

Vice Director: **Edward Stearns, AA7A**
7038 E. Aster Dr., Scottsdale, AZ 85254
480-332-8255; **aa7a@arrl.org**

West Gulf Division

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

Vice Director: **Lee H. Cooper, W5LHC**
2507 Autrey Dr., Leander, TX 78641
512-658-3910; **w5lhc@arrl.org**

ARRL Section Managers

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

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

Delaware: John Ferguson, K3PFW, 20116 Donovans Rd., Georgetown, DE 19947-3005 302-245-5469; **k3pfw@arrl.org**
Eastern Pennsylvania: Bob Wilson, W3BIG, 2223 West Helms Manor, Upper Chichester, PA 19061-3325 484-836-9367; **w3big@arrl.org**
Maryland-DC: Chris Van Winkle, AB3WG, 24 Tattersaul Ct., Reisterstown, MD 21136-2431 240-755-4257; **ab3wg@arrl.org**
Northern New York: Rocco Conte, WU2M, 152 W. Bush Rd., Gloversville, NY 12078-6405 518-848-9028; **wu2m@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: Thomas Beebe, W9RY, 3540 Market Rd., Marion, IL 62959-8940 618-534-6282; **w9ry@arrl.org**
Indiana: Bob Burns, AK9R, P.O. Box 808, Brownsburg, IN 46112 317-520-1188; **ak9r@arrl.org**
Wisconsin: Jason Spetz, KC9FXE, E5910 490th Ave., Menomonie, WI 54751-5644 715-231-7722; **kc9fxe@arrl.org**

Dakota Division MN, ND, SD

Minnesota: Bill Mitchell, AEØEE, 7412 Colfax Ave. S., Richfield, MN 55423 510-529-5658; **ae0ee@arrl.org**
North Dakota: Ralph Fettig, NØRDF, 6650 County Rd. 12 W., Minot, ND 58701-3003 701-822-3467; **n0rdf@arrl.org**
South Dakota: Chris Stallkamp, KIØD, P.O. Box 271, Selby, SD 57472-0271 605-848-3929; **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 Circle Dr., Vicksburg, MS 39180 601-636-0827; **w5xx@arrl.org**
Tennessee: David Thomas, KM4NYI, 205 Linford Rd., Knoxville, TN 37920 865-654-5489; **km4nyi@arrl.org**

Great Lakes Division KY, MI, OH

Kentucky: Charles O'Neal, KE4AIE, 301 Autumn Ridge Rd., Glasgow, KY 42141-9699 502-680-0539; **ke4aie@arrl.org**
Michigan: Larry Camp, WB8R, 71 Oakdale Ln., Coldwater, MI 49036-1200 517-617-4883; **wb8r@arrl.org**
Ohio: Tom Sly, WB8LCD, 1480 Lake Martin Dr., Kent, OH 44240-6260 330-554-4650; **wb8lcd@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: Bob Buus, W2OD, 8 Donner St., Holmdel, NJ 07733-2004 732-946-8615; **w2od@arrl.org**

Midwest Division IA, KS, MO, NE

Iowa: Lelia Garner, WAØUIG, 145 Front St., Robins, IA 52328-9718 319-213-3539; **wa0uig@arrl.org**
Kansas: Ronald D. Cowan, KBØDTI, P.O. Box 36, La Cygne, KS 66040 913-757-4456; **kb0dti@arrl.org**
Missouri: Cecil Higgins, ACØHA, 27995 County Rd. 220, Hermitage, MO 65668-8493 417-493-8208; **ac0ha@arrl.org**
Nebraska: Matthew N. Anderson, KAØBOJ, 14300 NW 98th St., Raymond, NE 68428-4254 402-480-5515; **ka0boj@arrl.org**

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

Connecticut: Bud Kozloff, W1NSK, 223 Gallows Hill Rd., Redding, CT 06896-1413 203-939-3708; **w1nsk@arrl.org**
Eastern Massachusetts: Jon McCombie, N1ILZ, 75 Northwest St., Eastham, MA 02642 508-246-4982; **n1ilz@arrl.org**
Maine: Philip Duggan, N1EP, 195 Kansas Rd., Milbridge, ME 04658-3120 207-598-5397; **n1ep@arrl.org**
New Hampshire: Peter Stohrer, W1FEA, 9 Gladstone St., Concord, NH 03301-3130 603-345-1470; **w1fea@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, AA1SE, 245 Leominster Rd., Lunenburg, MA 01462-2031 978-549-5507; **aa1se@arrl.org**

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

Alaska: David Stevens, KL7EB, 8521 Golden St., Apt. 4, Anchorage, AK 99502 907-242-6483; **kl7eb@arrl.org**
Eastern Washington: Jo Whitney, KA7LJQ, P.O. Box 2222, Yakima, WA 98907 509-952-5765; **ka7ljq@arrl.org**
Idaho: Dan Marler, K7REX, 6525 W. Fairfield Ave., Boise, ID 83709 208-914-8939; **k7rex@arrl.org**
Montana: Paul Stiles, KF7SOJ, 5427 Deadwood Dr., Billings, MT 59105 406-671-7092; **kf7soj@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, W7FF, P.O. Box 3008, Silverdale, WA 98383 360-633-7665; **w7ff@arrl.org**

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

East Bay: Mike Patterson, N6JGA, P.O. Box 30627, Walnut Creek, CA 94598 925-200-8300; **n6jga@arrl.org**
Nevada: John Bigley, N7UR, 2420 Palora Ave., Las Vegas, NV 89121-2157 702-498-5829; **n7ur@arrl.org**
Pacific: Joe Speroni, AHØA, 278 Kapiolani Blvd. #502, Honolulu, HI 96826 808-955-2496; **ah0a@arrl.org**
Sacramento Valley: Dr. Carol Milazzo, KP4MD, P.O. Box 665, Citrus Heights, CA 95611-0665 916-259-3221; **kp4md@arrl.org**
San Francisco: Bill Hillendahl, KH6GJV, P.O. Box 4151, Santa Rosa, CA 95402-4151 707-538-0331; **kh6gjv@arrl.org**
San Joaquin Valley: John Litz, NZ6Q, 1434 Douglas Rd., Stockton, CA 95207-3536 209-331-3078; **nz6q@arrl.org**
Santa Clara Valley: James Armstrong, NV6W, 2048 Paseo Del Sol, San Jose, CA 95124-2048 408-679-1680; **nv6w@arrl.org**

Roanoke Division NC, SC, VA, WV

North Carolina: Marvin K. Hoffman, WA4NC, P.O. Box 2208, Boone, NC 28607 828-964-6626; **wa4nc@arrl.org**
South Carolina: Marc Tarplee, N4UFP, 4406 Deer Run, Rock Hill, SC 29732-9258 803-487-1115; **n4ufp@arrl.org**
Virginia: Jack Smith, KE4LWT, 515 New Life Dr., Ruckersville, VA 22968-3045 662-523-0000; **ke4lwt@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: Amanda Alden, K1DDN, 230 Glenmoor Rd., Canon City, CO 81212-7705 719-315-0434; **k1ddn@arrl.org**
New Mexico: Bill Mader, K8TE, 4701 Sombrerete Rd. SE, Rio Rancho, NM 87124 505-250-8570; **k8te@arrl.org**
Utah: Pat Malan, N7PAT, 10102 S. Redwood Rd. #95401, South Jordan, UT 84095 801-413-7438; **n7pat@arrl.org**
Wyoming: Garth Crowe, Sr., WY7GC, 2342 Sagewood Ave., Casper, WY 82601-5018 307-689-1340; **wy7gc@arrl.org**

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

Alabama: Roger Parsons, KK4UDU, 5791 Birmingport Rd., Mulga, AL 35118-9670 206-641-9063; **kk4udu@arrl.org**
Georgia: David Benoist, AG4ZR, 190 Fox Hall Crossing E., Senoia, GA 30276-3481 404-290-0470; **ag4zr@arrl.org**
Northern Florida: Scott Roberts, KK4ECR, 2361 Oak Hammock Ln., Orange Park, FL 32065 904-759-7812; **kk4ecr@arrl.org**
Puerto Rico: Rene Fonseca, NP3O, Urb Santa Isidra 4 G8 Calle 6, Fajardo, PR 00738-4145 939-579-4134; **np3o@arrl.org**
Southern Florida: Barry M. Porter, KB1PA, 14555 Sims Rd., Apt. 258, Delray Beach, FL 33484 561-499-8424; **kb1pa@arrl.org**
Virgin Islands: Fred Kleber, K9VV, P.O. Box 24275, Christiansted, VI 00824-0275 **k9vv@arrl.org**
West Central Florida: Michael Douglas, W4MDD, 2527 Apple Blossom Ln., Wauchula, FL 33873 863-585-1648; **w4mdd@arrl.org**

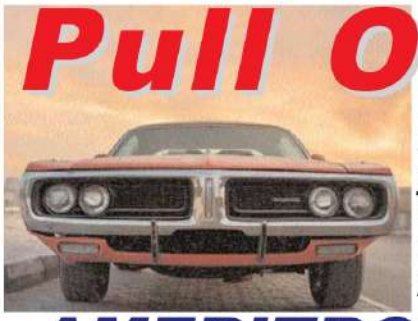
Southwestern Division AZ, LAX, ORG, SB, SDG

Arizona: Rick Paquette, W7RAP, 1600 W. Sunkist Rd., Tucson, AZ 85755-9561 520-425-6877; **w7rap@arrl.org**
Los Angeles: Diana Feinberg, AI6DF, P.O. Box 4678, Palos Verdes Peninsula, CA 90274-9618 310-544-2917; **ai6df@arrl.org**
Orange: Bob Turner, W6RHK, P.O. Box 973, Perris, CA 92572 951-236-8975; **w6rhk@arrl.org**
San Diego: Dave Kaltenborn, N8KBC, 630 Alber St., Chula Vista, CA 91911 619-616-8758; **n8kbc@arrl.org**
Santa Barbara: John Kitchens, NS6X, P.O. Box 178, Somis, CA 93066 805-216-2569; **ns6x@arrl.org**

West Gulf Division NTX, OK, STX, WTX

North Texas: Steven Lott Smith, KG5VK, 125 Contest Ln., Ben Franklin, TX 75415-3830 318-470-9806; **kg5vk@arrl.org**
Oklahoma: Mark Kleine, N5HZR, 2651 84th Ave. SE, Norman, OK 73026 405-410-6756; **n5hzr@arrl.org**
South Texas: Stuart Wolfe, KF5NIX, 408 Cedar Grove Rd., Rockdale, TX 76567 512-660-9954; **kf5nix@arrl.org**
West Texas: H. Dale Durham, W5WI, P.O. Box 375, Buffalo Gap, TX 79508 830-719-9000; **w5wi@arrl.org**

Pull Out the Muscle!



Hear the roar and feel the POWER! Get that POWER you need to really bust through the pileups, win a few contests, work the world!!! Ameritron amplifiers will go a long way towards making those dreams a reality. We've got an amplifier for every budget!

AMERITRON . . . 800 Watts . . . $1499!

More hams use Ameritron AL-811/H amplifiers than any other amplifier in the world!

AL-811H
$1499
Suggested Retail
4-Tubes, 800 Watts

AL-811
$1399
Suggested Retail
3-Tubes, 600 Watts

Only the Ameritron AL-811H gives you four *fully neutralized* 811A transmitting tubes. You get absolute stability and superb performance on higher bands that can't be matched by un-neutralized tubes.

You get a quiet desktop linear that's so compact it'll slide right into your operating position -- you'll hardly know it's there . . . until QRM sets in. And you can conveniently plug it into your nearest 120 VAC outlet -- no special wiring needed.

You get all HF band coverage (with license) -- including WARC and most MARS bands at 100% rated output. Ameritron's *Adapt-A-Volt*™ hi-silicon core power transformer has a special buck-boost winding that lets you compensate for high/low power line voltages.

You also get efficient full size heavy duty tank coils, slug tuned input coils, operate/standby switch, transmit LED, ALC, dual illuminated meters, QSK with optional QSK-5, pressurized cooling that you can hardly hear, full height computer grade filter capacitors and more. 13¾Wx8Hx16D inches.

AL-811, $1399.
Like AL-811H, but has three 811A tubes, 600 Watts output.

AMERITRON *no tune* Solid State Amplifiers

ALS-500M 500 Watt Mobile Amp

ALS-500M
$1199
Suggested Retail

500 Watts PEP/ 400 W CW output, 1.5-22 MHz, instant bandswitching, no tuning, no warm-up. SWR, load fault, thermal overload protected. On/Off/Bypass switch. Remote on/off control. DC current meter. qquiet fan. 13.8 VDC. 9Wx3½Hx15D in., 7 lbs. **ALS-500RC, $84,** Remote Head.

ALS-606S 600 Watt 160-6M Amp

ALS-606S
$2399
Suggested Retail

600 Watts PEP/ 500W CW output, 160-6M with automatic instant bandswitching. Desktop. 9¾Wx7Hx14½D".14.2 lbs. Only 4 dB below 1500W -- less than an S-unit! **ALS-606, $2599,** like ALS-606S above, but has transformer power supply.

Desktop Kilowatt Amplifier

AL-80B
$2399
Suggested Retail

Whisper quiet *desktop* amp plugs into 120 VAC to give *full* kilowatt SSB PEP output. Ameritron's exclusive *DynamicALC*™ doubles average SSB power out and *Instantaneous RF Bias*™ gives cooler operation. All HF bands. 850 Watts CW out, 500 Watts RTTY out, extra heavy duty power supply, 3-500G tube, 70% efficiency, tuned input, Pi/Pi-L output, inrush current protection, dual Cross-Needle meters, QSK compatible, 48 lbs. 14Wx8½Hx15½D". **2-year Ameritron warranty.**

ALS-1306 1200W 1.5-54 MHz Amp

ALS-1306
$3999
Suggested Retail

Ameritron's *highest power* solid state FET amplifier gives you automatic bandswitching! Get 1200W PEP output on all bands, including 6-Meters. No tuning, no warm-up, no tubes to baby and no fuss! Eight rugged MRF-150 power FET's give outstanding reliability. Just 100 Watts drive gives full rated power MHz. Compact 10Wx6½Hx18D in., just 22 lbs. **ALS-1300, $3499.** Like ALS-1306 but less automatic bandswitching and 6-M coverage.

Near Legal Limit ™ Amplifier

AL-572
$2399
Suggested Retail

Near Legal Limit™ amp gives you 1300W PEP SSB power output for *60%* of the price of a full legal limit amp! Four rugged 572B tubes. Instant 3-second warm-up, 120 VAC. Desktop 14½Wx8½Hx15½D". 160-15M. 1000 Watt CW output. Tuned input, instantaneous RF Bias, dynamic ALC, parasitic killer, inrush protection, cross-needle meters, multi-voltage transformer.

HF Amps with 3CX800A7 tube

AL-800
$4199
1 tube, 1250 W Suggested Retail

AL-800H
$5399
2 tubes, 1.5 kW *Plus Eimac*(R) *tubes*

Desktop 3CX-800A7 tubes cover 160-15M, WARC bands. Adjustable slug tuned input, grid protection, ALC control, vernier reduction drives, hefty 32 lb. transformer, high capacitance computer grade filter capacitors. Multi-voltage, dual cross-needle meters. 14¼Wx8½Hx16½D".

AMERITRON *full legal limit* amplifiers

AMERITRON legal limit amps use a super heavy duty power transformers capable of 2.5 kW!

Most powerful -- *3CX1500/8877*

AL-1500F
$5999
3CX1500/8877 Tube

AL-1500
$6999
Eimac(R) tube

Ameritron's *most powerful* amplifier uses the herculean 3CX1500/8877 ceramic tube. 65 watts gives full legal output -- loafing with a 2500W power supply.

Toughest -- *3CX1200Z7*

AL-1200
$5999
Suggested Retail

Ham radio's *toughest* tube -- the *Eimac*(R) 3CX1200Z7. 50-Watt control grid dissipation. Super heavy duty power supply loafs at legal power -- delivers more than 2500 Watts PEP two tone output for a 1/2 hour.

Classic -- *Dual 3-500Gs*

AL-82
$3999
Suggested Retail

Gives full legal output using a *pair* of *genuine* 3-500Gs. Competing linears using 3-500Gs *can't* give you 1500 Watts because their lightweight power supplies *can't* use these tubes to their full potential.

Ameritron brings you the finest high power accessories!

ARB-704 amp-to-rig interface . . . $89

Protects rig from keying line transients. Easy rig hookup.

ADL-1500 Dummy Load with oil . . . $119

Oil-cooled, 50 Ohms. 1500W/5 minutes. SWR< 1.2, 30 MHz. Low to 400 MHz.

ADL-2500 fan-cooled Dry Dummy Load, $299

Whisper quiet, 2.5 kW/1 min. on, 10 off. 300W continuous. Low SWR.

ATP-100 Tuning Pulser . . . $99

Safely tune up.Full power, best linearity. Prevent over-heating, tube and power supply stress.

AMERITRON®
. . . the world's high power leader!
116 Willow Road, Starkville, MS 39759
TECH (662) 323-8211 • **FAX** (662) 323-6551
8 a.m. - 4:30 p.m. CST Monday - Friday
For power amplifier components call (662) 323-8211
http://www.ameritron.com

Shack Spring Cleaning

Anderson Powerpoles® make DC power safe and easy for your station!

Choose ready-made cables or make your own - your choice!

RIGrunner 4008 is a 8-way fused Distribution Panel
Sku: 58307-1035

30A Desktop PSU with Anderson Powerpoles®
Sku: 58561-1258

4 Pin HF Radio Power (fits most modern HF base radios)
Sku: 58257-1111

6 Pin HF Radio Power (fits most older HF base radios)
Sku: 58257-1075

T-style Radio Power (fits most VHF mobile radios)
Sku: 58257-1078

Over 80 off-the-shelf cables
Create a Custom cable online!
View a complete list of Powerpole® cables and accessories:
www.westmountainradio.com/powerpole

WEST MOUNTAIN RADIO

262-522-6503 ext 35
sales@westmountainradio.com
westmountainradio.com/QST0523

ELECRAFT K4

High-Performance Direct-Sampling SDR

A direct-sampling SDR you'll love to use

Our new K4 transceiver harnesses advanced signal processing while retaining the best aspects of the K3S and P3. It features a 7" touch display, plus a rich set of dedicated controls. Per-VFO transmit metering makes split mode foolproof. Band-stacking registers and per-receiver settings are versatile and intuitive. Control usage information is just one tap away thanks to a built-in help system.

Modular, hybrid architecture adapts to your needs

The basic K4 covers 160-6 m, with dual receive on the same or different bands. The K4D adds diversity receive, with a full set of band-pass filters for the second receiver. (Thanks to direct RF sampling, there's no need for crystal filters in either the K4 or K4D.) The K4HD adds a dual superhet module for extreme-signal environments. Any K4 model can be upgraded to the next level, and future enhancements–such as a planned internal VHF/UHF module–can be added as needed.

Single or dual panadapter, plus a high-resolution tuning aid

The main panadapter can be set up as single or dual. Separate from the main panadapter is our per-receiver *mini-pan* tuning aid, with a resampled bandwidth as narrow as +/- 1 kHz. You can turn it on by tapping either receiver's S-meter or by tapping on a signal of interest, then easily auto-spot or fine tune to the signal.

Comprehensive I/O, plus full remote control

The K4's rear panel includes all the analog and digital I/O you'll ever need. All K-line accessories are supported, including amps, ATUs, and our K-Pod controller. The Video display output supports its own user-specified format. Via Ethernet, the K4 can be 100% remote controlled from a PC, notebook, tablet, or even another K4, with panadapter data included in all remote displays. Work the world from anywhere–in style!

K4 KEY FEATURES

- Optimized for ease of use
- Modular, upgradeable design
- 7" color screen with touch and mouse control
- ATU with 10:1+ range, 3 antenna jacks
- Up to 5 receive antenna sources
- Full remote control via Ethernet

The K4 interfaces seamlessly with the KPA500 and KPA1500 amplifiers

"The performance of their products is only eclipsed by their service and support. Truly amazing!" **Joe - W1GO**

ELECRAFT®

For complete features and specifications visit elecraft.com · 831-763-4211

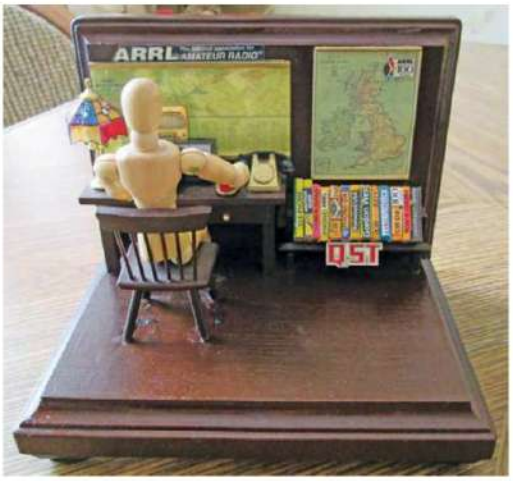
Up Front

Studying Pays Off

Proud grandpa Jim Torrey, WW7Z, credits *The ARRL Ham Radio License Manual* for the success of his grandson, Morgan Emmons, KK7IVR, age 7, passing his Technician-class license exam. (Mom, Dad, and Grandpa helped, too.)

Mini Ham Shack

Bruce Gordon, WB8FMA, likes to make things. He shared this photo of a mini ARRL ham shack he constructed several years ago. We hope you enjoy it as much as we did.



Morse Academy On Board the SS *Rotterdam*

Morse Academy began a long-awaited Morse code course aboard the SS *Rotterdam* in November 2022. The objective was to familiarize students with Morse code characters and provide material that would be of interest to radio amateurs. Six former radio officers were asked to share their Morse code experiences with students. Subjects included Morse history, straight keys, operating practice, techniques, Morse training, as well as CW contesting.

Morse Academy is grateful to WestCord Hotels, the owners of the SS *Rotterdam*, for allowing them to hold classes aboard their ship. The SS *Rotterdam* is currently moored in Rotterdam, Netherlands, and is operated as a hotel offering many amenities. — *Thanks to Harm de Haan, PG2GF, for sharing this story.*

Cozy Dog Drive In Is Cozy for Hams, Too

Folks enjoy traveling US Route 66, and many stop by the original Cozy Dog Drive In when passing through Springfield, Illinois. Every Wednesday morning, a group of local hams enjoy their breakfast and coffee there, too. Upon entering, you see a small collection of ham radio license plates. That's ARRL Charter Life Member Ben Kiningham, K9IDQ, at right, pointing them out.

Ben is one of the many amateurs who helped save the Illinois amateur radio license plates when the Secretary of State wanted to cancel the program. The issue was that "Amateur Radio" had too many letters to fit on the tag. Ben joined other amateurs in suggesting the use of "Ham Radio," thus saving the plates.

20 YEARS OF INNOVATION

HERE'S TO 20 MORE YEARS OF ACCELERATING INNOVATION.

WE'RE JUST GETTING STARTED.

As the pioneers of software-defined radio in the amateur market, we didn't set out to change the course of the entire amateur radio industry, but it kind of turned out that way. And we couldn't have done it alone. So this is a shout out to our customers and partners to say "Thank You" for being with us over the years and here's to the next 20 years of creating solutions even we can't see yet.

Together, we will **Find Everywhere.**

FlexRadio.com

FlexRadio

"The products sold by BridgeCom Systems in the Plug & Play Package have exceeded all of my expectations.. Now that I have my 878UVII Plus and the SkyBridge Plus, my ham hobby has gotten much more enjoyable. I highly recommend you get yours too."

-Marshall K4P0E

"I was ready to give up, then I discovered Bridgcom Systems. This package is exactly as advertised! The customer support is the best I have experienced in my 71 years! Can't say THANK YOU enough!"

-Stephen K04NSU

"The AnyTone AT-D878UVII Plus in my opinion is the best DMR/Analog HT on the market. It's made strong with lots of features, looks great, easy to program, sound is excellent, great reception."

-Michael K7FLA

"Buying from Bridgecom was seamless and fast. The radio is very high quality and while I'm new to DMR, the vast amount of customer support content makes programming and getting my new radio up and running very doable. Overall very happy with this radio and I'd highly recommend"

-Tony KJ7RNV

Correspondence

Letters from Our Members

An Unusual Source for Radials

My neighbor's well pump failed, and he wasn't available when the replacement was installed. To help him out, I met with the service crew and shut off the pump breaker. When they started hauling the old pump out of the ground, along for the ride was a 220 V power cable line that consisted of three-strand twisted insulated 10-gauge solid copper wire. They were cutting it off in 100-foot sections.

I asked if they would make a deal for the pile of wire. A batch of my wife's chocolate-walnut brownies, fresh from the oven, and 20 dollars were all it took.

After untwisting and separating the wire, I gained more than 1,000 feet of heavy-gauge insulated wire, ready to add to the radials on my vertical. Given the price of copper wire today, that was a bargain!

It may be worth checking with your local drilling company to see if they, too, might be willing to skip the recycling yard.

Rob Becker, N1EEK
Cheshire, Massachusetts

Message Wholeheartedly Received

In August, I attended the Northeast HamXposition. ARRL CEO David Minster, NA2AA, gave the keynote address, and I found it inspiring and informative.

He asked us to do three things: become a Diamond Club member, get just one person active on the air over the next year, and as 2023 is the Year of the Volunteers, he asked that all members "move up one rung" in their responsibilities as an active ham.

At the beginning of this year, I became a Diamond Club member. I got an inactive ham, Rick, KB1ASM, to be more active, and we both "moved up one rung." He was elected President of our club, the York County Amateur Radio Club, W1YCA, and I was elected Secretary.

I'm also more active with the York County Emergency Communications Team, helping to develop scenarios for our emergency communications exercises. Additionally, I became an authorized SHAred RESources alternate radio operator.

David's words didn't go unnoticed. I enjoyed his transparency and truthfulness, and I will try to steer our club toward becoming ARRL affiliated.

Tony Baker, AA3HD
Wells, Maine
Life Member

There's Always Something New to Learn

I've been a ham since 1964. I'm a homebrewer, retired engineer, and what some would call a "techie." I read all of ARRL's magazines because I believe there is always something new to learn. It is said that *On the Air* is for beginners, but in the latest issue I learned something new. *QEX* is quite technical, but I try to learn something from each article. There's always something to learn, whether it's a new technique, technology, mode, or service ham radio provides. We're all beginners, just at different things. I encourage all members to read every ARRL magazine from cover to cover because I'm sure you will learn something like I did!

Jim Kocsis, WA9PYH
South Bend, Indiana

Helping Blind Hams

There are many hams who are blind and still have a great time on the air. I had a good friend, Summer Hartzfeld, VE5SDH, who was blind from birth and still got into ham radio. She took to CW and became a highly skilled operator. She was a member of CWops and the First Class CW Operators' Club (FOC).

In 2018, I designed and built a few special semiautomatic Morse keys, called Woodbugs, that were made entirely of wood. I gave one to Summer with her call sign on it in braille, and she used it regularly. She passed away in 2018, and the key was returned to me. I quickly found another worthy recipient: Dave Hillebrandt, W4CI, another FOC member who had actually met Summer. Dave is also a blind, very skilled bug driver.

I had a spare radio, a Kenwood TS-590S, which, thanks to its voice guide function (VGS-1), is rated one of the most accessible radios on the market. With that module installed, the rig can announce key presses, frequency, S-meter readings, and all sorts of information.

Because I no longer needed the radio, I asked Dave if he knew of someone I might donate the rig to. He suggested Tom Moore, KF4YEY, who is fully blind and a good CW operator. I shipped the radio to Dave, who helped Tom set it up, and he was on the air right away!

I plan to stay involved as an advocate for blind hams everywhere, and I've even started learning braille! There are many hams who can benefit from your extra equipment, help, and encouragement.

Gary Johnson, NA6O
Livermore, California

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

Upgrade Your Station with New Gear from DX Engineering!

PicoAPRS and VHF Transceiver with GPS Receiver

WIMO

Version 4 of the world's smallest APRS transceiver (1.30" x 2.60" x 1", 2.10 ounces) comes with a TNC and GPS receiver but now includes a VHF 2-meter handheld transceiver with PTT button, microphone, speaker, stored memories, color display, and more. Also new is the KISS data protocol for packet radio via a side-mounted USB-C socket, Bluetooth, or WiFi, making it easy to set up an APRS IGate. Transmit power is approximately 1 watt, switchable to 0.5 watts. Users will enjoy improved functionality from the new joystick-style front buttons. Depending on configuration, the device boasts a run time of up to 10 hours with its included 850 mAh Li-Ion battery.

Enter "PicoAPRS" at DXEngineering.com. WMO-PICOAPRS-VHF $399.99

DX ENGINEERING

Receive Four-Square and Eight Circle V3 Complete Array Systems

Enjoy dramatically improved weak-signal reception with unparalleled rejection of extraneous signals and noise. Systems come with four or eight Receive Short Element Active Vertical Antennas, featuring upgraded AVA-3 Active Matching Units; 8.5-foot, three-piece aluminum whip; directional control console; array controller; 1,000 feet of RG6U cable; connectors; hardware; and tools. They're the ultimate high-performance, directional receive antenna systems for HF, SWL, or AM DXing.

Enter "DXE V3 System" at DXEngineering.com. From $1,754.89

ACOM

2020S Automatic HF+50 MHz Linear Amplifier

The announcement of the latest amplifier from the amateur radio giants at ACOM is always big news—and the company's new 2020S model is no exception. This operator-friendly 1500W solid-state amp delivers maximum legal power in all modes. It includes a remote control unit with high-resolution, color touchscreen; built-in switching mode power supply and continuous monitoring of system health; and the ability for the operator to monitor 11 operation parameters. Users benefit from intermodulation distortion better than 30 dB below rated PEP.

Enter "2020S" at DXEngineering.com. From $7,859.99

350W VHF RF Power Amplifier

JM TAIWAN

The single-stage wideband PA-350V 135-165 MHz RF Power Amplifier—the latest addition to Toptek's stellar lineup of linear amps—delivers over 350W RF output typically from 8W of drive power, low-noise reception with bandpass filter to prevent blocking by HF signals, Automatic Level Control for output power regulation and high SWR protection, individual DC current sensing and limiting of each sub-amplifier, output power (FM) selectable between three user-programmable levels (20W to 360W), and two temperature-enabled fans.

Enter "PA-350V" at DXEngineering.com. TEK-PA-350V $879.99

eton

Shortwave Radios, Weather Radios, and Home Emergency Products

DX Engineering is pleased to now carry products from Eton Corporation—an American company that has gained a strong worldwide reputation since 1986. Choose from six models of high-performance, feature-rich, and stylish Elite Series shortwave radios, including the Elite Satellite model, which combines HD quality AM, FM, SW, LW, and Air coverage;1,700 memory channels; and high dynamic range for detection of weak signals. Also available are rugged weather radios featuring hand-crank, solar, and battery power; the dependable Blackout Buddy flashlight/nightlight; the Aqualite solar-charged lantern that doubles as a basic emergency kit; and family first aid and survival packages.

Enter "Eton" at DXEngineering.com.

DX ENGINEERING

Aluminum Radio RF Ground Plane Kits

A less expensive alternative to DX Engineering's Copper Radio RF Ground Plane Kits, these aluminum versions are also effective in reducing stray RF pickup by indoor radio equipment and interconnecting cables. The kits include a pre-drilled 1/16-inch-thick aluminum sheet (13" x 10", 16" x 16", or 20" x 20") that is placed under your HF radios, microphones, and other devices, and connected to your existing grounding bus. The large surface area of metal improves upon the single-conductor grounding bus by equalizing the RF electric field around equipment and attached cables. This reduces voltage differences between pieces of equipment and the associated currents that cause RF interference to transceivers, microphones, tuners, amplifiers, computers, and other electronic equipment. Kits are available with or without an MDF mounting board.

Enter "DXE Aluminum Plane" at DXEngineering.com. From $49.99

CSN Technologies

Self-Contained Antenna Tracker

Looking for an easier way to enjoy making QSOs via amateur radio satellites? The Self-Contained Antenna Tracker (S.A.T.) from CSN Technologies helps Yaesu Az-El rotator and Icom satellite transceiver owners get more out of satellite operating without the need to purchase a computer interface or configure satellite tracking software to work with a cable/rotator combo. Just attach the S.A.T. to a rotator and a transceiver. The device works with any modern web browser. From its main menu, choose from "Pass Predictions" or view the entire list of satellites, with all relevant information about each pass displayed in real-time. While tracking, the Track Panel displays essential satellite information and current antenna position information. Includes built-in WiFi and GPS, custom TLE list, manual and automatic TLE updates, and much more.

Enter "CSN" at DXEngineering.com. ATN-SAT-TRACKER $275.00

YAESU ICOM KENWOOD ALINCO AnyTone InnoAntennas microHAM MONITOR SENSORS

See you at Dayton Hamvention® Building One Booths 1207-1210, 1307-1311, 1407-1411, 1508-1511

DX® ENGINEERING

Ordering (via phone) Country Code: +1
9 am to midnight ET, Monday-Friday
9 am to 5 pm ET, Weekends
Phone or e-mail Tech Support: 330-572-3200
9 am to 7 pm ET, Monday-Friday
9 am to 5 pm ET, Saturday
Email: DXEngineering@DXEngineering.com

Ohio Showroom Hours:
9 am to 5 pm ET, Monday-Saturday
Ohio Curbside Pickup:
9 am to 8 pm ET, Monday-Saturday
9 am to 7 pm ET, Sunday
Nevada Curbside Pickup:
9 am to 7 pm PT, Monday-Sunday

800-777-0703 | DXEngineering.com

ON ALL BANDS

YouTube

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

Prices subject to change without notice. Please check DXEngineering.com for current pricing.

MFJ QRP!

MFJ-9232
$79.95

QRPocket™ Loop Antenna Tuner

Drape a wire around a bookcase, window, tree or other object and attach both ends to this *MFJ QRPocket™ Loop Antenna Tuner. It instantly turns into a small, high efficiency multi-band transmitting loop antenna!*

Operate 40-10 Meters with included flexible wire loop (80/60 Meters with your bigger loop). No ground, radials or counterpoises needed. 25 Watts.

It's a very quiet receiving antenna. Its hi-Q reduces QRM, overload, harmonics.

Perfect for apartments, antenna restricted areas and portable operation. Tune *any* shape loop -- circle, square, rectangle, *etc.*

Adjust tuning and matching capacitors for minimum SWR and operate.

BNC for transmitter, wing nut posts for loop wire. Tiny 2¼Wx4Hx2¼D inches.

MFJ-9234, $84.95. Like MFJ-9232 but connects directly to your transceiver SO-239 antenna connector.

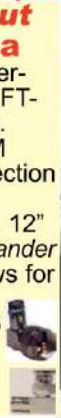
VIDEOS: https://m.youtube.com/results?search_query=MFJ-9232

QRP Antenna Tuner

MFJ-9201, $74.95. *Tunes any antenna* 80-10 Meters, 25 W. 12-position hi-Q inductor, tune/bypass, variable antenna and transmitting matching capacitors, BNC connectors. Tiny 4Wx2⅝Hx1½D inches -- MFJ-9201, rig and antennas easily fit into a backpack or briefcase for vacation, SOTA, hikes, etc.

MFJ *Walk-About* 80-6M Antenna

MFJ-1899T, $119.95. Perfect for QRP radios like FT-817, KX3, Xiegu, others. Covers *all* bands 80-6 M including WARC. Ten section telescoping whip (52" extended, 7" collapsed). 12" base loading coil with *Wander Lead*. Whip/coil unscrews for easy storage. 25Watts. BNC. **MFJ-7703, $10.95** BNC/PL-259 elbow. **MFJ-7760, $9.95.** BNC/BNC elbow.



MFJ Single Band *Walk-Abouts*

Each is 51 inches extended and collapses to 5.5 inches. Handles 25 Watts. BNC.

MFJ-1806T (6M) $44.95
MFJ-1810T (10M) $44.95
MFJ-1812T (12M) $44.95
MFJ-1815T (15M) $44.95
MFJ-1817T (17M) $44.95
MFJ-1820T (20M) $44.95
MFJ-1830T (30M) $54.95
MFJ-1840T (40M) $54.95
MFJ-1880T (80M) $89.95

QRP Tuner/Dummy Load/Wattmeter *New!*

MFJ-9219, $129.95. This new MFJ-9219 is everything you need for your QRP rig and antenna. Great for backpacking QRP adventures! The SWR/Wattmeter, Dry dummy load and QRP antenna tuner are all in one small 3x3x1.5 inch cabinet!

80-10M End-Fed Half Wave Antenna

MFJ-1982LP, $79.95. Get on the air quick! 30W, 132' wire. No tuner needed.

33' Telescopic Portable Mast

MFJ-1910, $119.95. Fiberglass. 3¾ ft collapse, 3.3 lbs. Twist and lock into place.

17' Telescopic Whip

MFJ-1979, $79.95. Stainless steel, collapses to 27".
MFJ-1977, $69.95. 12 ft. stainless steel, 26" collapsed.
MFJ-1976, $59.95. 10 ft. stainless steel, 20" collapsed.

MFJ *Mini* Switching QRP Power Supply

MFJ-4103, $79.95. Delivers reliable regulated 13.8 VDC at 2.89 Amps (40 Watts) to anywhere in the world (100-240 VAC/47-63Hz input). Overvoltage, over-current, over-temperature protected. Tiny 4½x2⅝x1⅜", 10 oz; 2.1 mm ID, 5.5mm OD coaxial DC connector. FT-817 adapter included. **MFJ-5513M, $17.95.** 2.1 mm to *PowerPoles*™.

MFJ 500 MHz Dummy Load

MFJ-261, $44.95. Finned aluminum, air-cooled heatsink 50 Ohm dummy load. 100W peak, 15W average. DC to 500 MHz, 1.15:1 SWR. 1⅝" dia. by 3" long.

CW Straight Key

MFJ-550, $34.95. Morse Code straight key. Adjustable spacing and spring tension. Durable plastic base with mounting holes.

SWR/Wattmeter Dummy Load

MFJ-9218, $74.95. Resistive SWR Meter protects output transistors with 3:1 maximum SWR when tuning your antenna. 5/10/20 Watt power ranges. Tune/Bypass switch, BNC input and output connectors. Covers 1.8 to 60 MHz. Rugged tiny case fits any where 4½Wx2¼Hx2¾D".

QRP WattMeter/ Dummy load

MFJ-9214, $54.95. Check *true* QRP output power with this sensitive QRP Wattmeter with *built-in* 50 Ohm dummy load. Also tests battery condition. Reads 5W full scale 1.8-150 MHz. BNC male connects directly to your rig. 2Wx2¼Hx1½D". **MFJ-7737, $8.95.** BNC female to PL-259 adaptor.

QRP SWR/Wattmeter

MFJ-9213, $69.95. Read SWR, forward, reflected power in three ranges: 5, 30, 100 Watts on calibrated meter scale. *Bruene* bridge insures uniform accuracy over 1.8-50 MHz and allows you to leave in-line for continuous monitoring without insertion loss. BNC for transmitter/antenna. 4½Wx2¼Hx2¾D inches.

MFJ *QRPocket* ™ 4:1 Balun

MFJ-9211, $44.95. **4:1** current balun for feeding balanced dipole/antenna to 50 Ohm coax. Binding post, BNC.

Artificial Ground

MFJ-9231, $89.95. **Tune** your counterpoise and ground to greatly increase your radiated power.

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

Enjoy a "noise free" listening with..
..a bhi DSP noise canceling product!

bhi

ParaPro EQ20 Audio range with parametric equalisation

- 20W audio and parametric equalisation on all units
- Greatly improved audio for those with hearing loss
- Simple control of all DSP functions
- Two separate mono inputs or one stereo input
- Basic 20W EQ units: EQ20, EQ20B* (use with your Dual In-Line or Compact In-Line unit)
- 20W DSP noise canceling EQ versions: EQ20-DSP and EQ20B*-DSP * Denotes Bluetooth on input

EQ20B-DSP *QST Dec 2019* review *"easy-to-use device that improves the audio clarity of amateur signals"*

New In-Line Module

8 filter levels 8 to 40dB - Tone reduction up to 65dB
- 5W audio with latest bhi DSP noise cancelation
- Audio bypass feature - 3.5mm mono inputs and outputs
- Headphone socket - Audio input overload feature
- DC power 10 to 16V DC - Dims 135mm x 65mm x 46mm
- Replacement for bhi ANEM MKII and NEIM1031MKII

Dual In-Line

Fully featured flexible dual channel DSP noise canceling unit
- 8 Filter levels 9 to 40dB
- 3.5mm mono or stereo inputs
- Line level input/output
- 7 watts mono speaker output
- Separate headphone socket
- Easy to use controls

Enjoy clear "noise-free"speech

Compact In-Line

- Powerful audio processor
- Unique DSP noise canceling technology
- Low latency of 32mS
- Remove noise and interference
- Hear weak signals clearly
- Rotary encoders perform all functions
- Easy to use with "real time" adjustment
- Use with headphones or a loudspeaker
- 3.5mm line level and speaker level inputs

NES10-2MK4

5W Compact rugged amplified DSP noise canceling speaker
- 8 filter levels 8 to 40dB
- Three position switch for off/audio bypass mode, power on and DSP filter on
- LEDs for power on, filter on and audio overload
- 3.5mm Headphone socket - Supplied with integrated 2M audio lead, fused DC power lead and user manual

DESKTOP MKII

Latest bhi DSP noise canceling technology for even better receive audio
- 10W Amplified DSP noise canceling base station speaker
- "Real-time" control of all functions
- 8 filter levels 9-40dB
- Speaker level and line level input sockets
- Suitable for all radios incl' SDR, Elecraft and FlexRadio products

New NEDSP1962-KBD 5W amplified DSP noise canceling pcb install module available!

DX ENGINEERING
1-800-777-0703

www.bhi-ltd.com

GigaParts
1-256-428-4644

EA&O

VISA PayPal MasterCard

W1AW Schedule

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

W1AW's schedule is at the same local time throughout the year. From the second Sunday in March to the first Sunday in November, UTC = Eastern US time + 4 hours. For the rest of the year, UTC = Eastern US time + 5 hours.

♦ Morse code transmissions: Frequencies are 1.8025, 3.5815, 7.0475, 14.0475, 18.0975, 21.0675, 28.0675, 50.350, and 147.555 MHz.

Slow Code = practice sent at 5, 7½, 10, 13, and 15 WPM.

Fast Code = practice sent at 35, 30, 25, 20, 15, 13, and 10 WPM.

Code bulletins are sent at 18 WPM.

For more information, visit us at
www.arrl.org/w1aw

♦ W1AW Qualifying Runs are sent on the same frequencies as the Morse code transmissions. West Coast qualifying runs are transmitted by various West Coast stations on CW frequencies that are normally used by W1AW, in addition to 3590 kHz, at various times. Underline 1 minute of the highest speed you copied, certify that your copy was made without aid, and send it to ARRL for grading. Please include your name, call sign (if any), and complete mailing address. Fees: $10 for a certificate, $7.50 for endorsements.

♦ Digital transmissions: Frequencies are 3.5975, 7.095, 14.095, 18.1025, 21.095, 28.095, 50.350, and 147.555 MHz.

Bulletins are sent using 45.45-baud Baudot, PSK31 in BPSK mode, and MFSK16 on a daily revolving schedule.

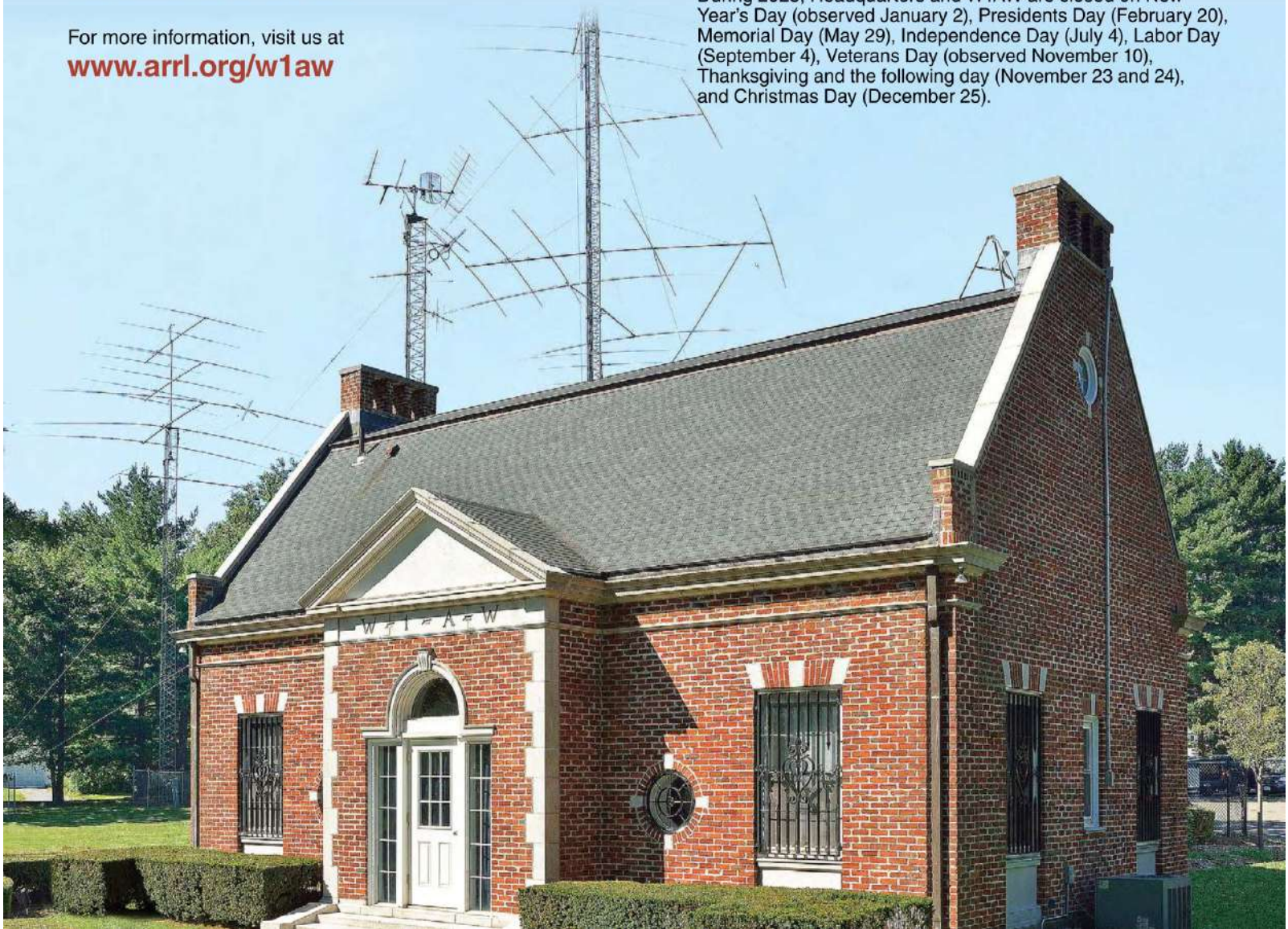
Keplerian elements for many amateur satellites will be sent on the regular digital frequencies on Tuesdays and Fridays at 6:30 PM Eastern time using Baudot and PSK31.

♦ Voice transmissions: Frequencies are 1.855, 3.99, 7.29, 14.29, 18.16, 21.39, 28.59, 50.350, and 147.555 MHz. Voice transmissions on 7.290 MHz are in AM double sideband, full carrier.

♦ Notes: On Fridays, UTC, a DX bulletin replaces the regular bulletins. W1AW is open to visitors 10 AM to 3:45 PM Monday through Friday. FCC-licensed amateurs may operate the station during that time. Be sure to bring a reference copy of your current FCC amateur license. In a communication emergency, monitor W1AW for special bulletins as follows: voice on the hour, teleprinter at 15 minutes past the hour, and CW on the half hour.

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

During 2023, Headquarters and W1AW are closed on New Year's Day (observed January 2), Presidents Day (February 20), Memorial Day (May 29), Independence Day (July 4), Labor Day (September 4), Veterans Day (observed November 10), Thanksgiving and the following day (November 23 and 24), and Christmas Day (December 25).



KENWOOD

3rd IMDR 110 dB*

RMDR 122 dB*

BDR 150 dB*

Performance Exceeding Expectations.

The most happy and sublime encounters happen in the worst circumstances and under the harshest conditions.

There are enthusiasts who know this all too well because of their love of HF radio.

Results born of certainty and not circumstance. Delivered through impeccable performance. This is our offering to you.

"The Kenwood TS-890S has the highest RMDR of any radio I have ever measured."
- Rob Sherwood - NC0B - December 2018

HF/50MHz TRANSCEIVER
TS-890S

Top-class receiving performance

3 kinds of dynamic range make for top-class performance.

- Third order intermodulation Dynamic Range (3rd IMDR) 110dB*
- Reciprocal Mixing Dynamic Range (RMDR) 122dB*
- Blocking Dynamic Range (BDR) 150dB*

*Values are measured examples. (2kHz spacing:14.1 MHz, CW, BW 500 Hz, Pre Amp OFF)

- Full Down Conversion RX
- High Carrier to Noise Ratio 1st LO
- H-mode mixer

4 kinds of built-in roofing filters

500Hz / 2.7kHz / 6kHz / 15kHz (270Hz Option)

7 inch Color TFT Display

- Roofing frequency sampling band scope
- Band scope auto-scroll mode
- Multi-information display including filter scope

Clean and tough 100W output

Built-in high-speed automatic antenna tuner

32-bit floating-point DSP for RX / TX and Bandscope

*: 2 kHz spacing measurement standard - Receiver frequency 14.2 MHz, MODE CW, BW 500 Hz, PRE AMP OFF

Customer Support: (310) 639-4200

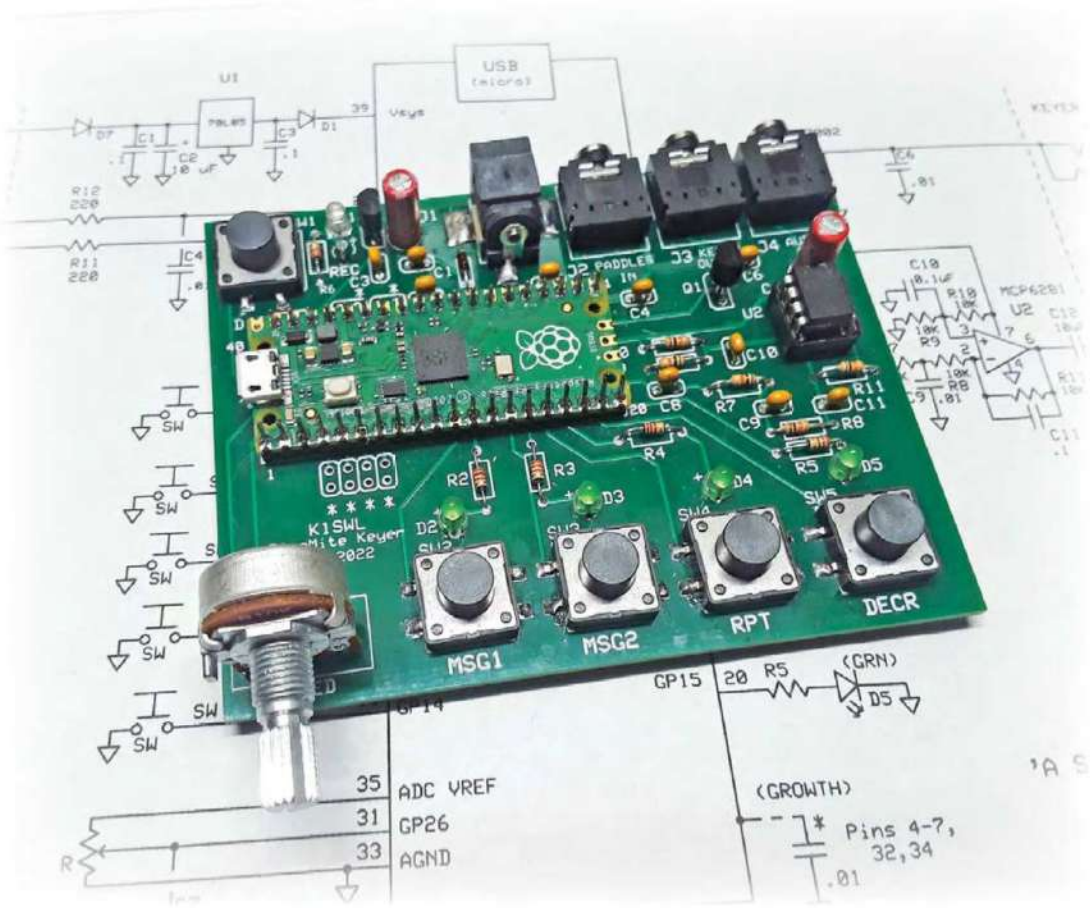
www.kenwood.com/usa

ISO9001 Registered
JVCKENWOOD Corporation

ADS#16221

A Simple Morse Memory Keyer

Build this standalone, customized keyer for use during your contest operations.



Dave Benson, K1SWL

My modern radio includes a built-in keyer, but it requires an inconvenient number of button pushes to operate. I needed a standalone memory keyer that was dedicated to my contest operations. I based the design on the Raspberry Pi Pico, a tiny single-board computer with interesting features. Software for this device includes an *MMBasic* interpreter with plenty of memory space. With the interpreter loaded, it's referred to as the PicoMite. Some testing in *MMBasic* convinced me that it can generate CW characters at 40 WPM, which was indeed fast enough.

A Simple Design

I made a small printed circuit board (see the lead image) with tactile pushbuttons, LED indicators, and input/output provisions. I opted for four function buttons, which is a practical minimum for memory keyers.

The Pico Memory Keyer (PMK) schematic is shown in Figure 1. Five tactile switches control its operation — four initiate the message functions, and one starts the recording process in standalone mode. Each of the five inputs has a corresponding LED indicator.

The PMK tactile switches each have a dedicated purpose: (one) send call sign, (two) send contest exchange, (three) repeat contest exchange, (four) decrement exchange serial number, and (five) record.

Most of the good stuff is in function two. It's programmable by several methods. For many different contests, operators send a sequential serial number, and my design includes that feature. Function three repeats the exchange you just sent. This is needed when a CQing station sends "?" or "AGN" (again). If they never get the complete exchange and send "SRI" (sorry) or go back to CQing, it's a busted contact.

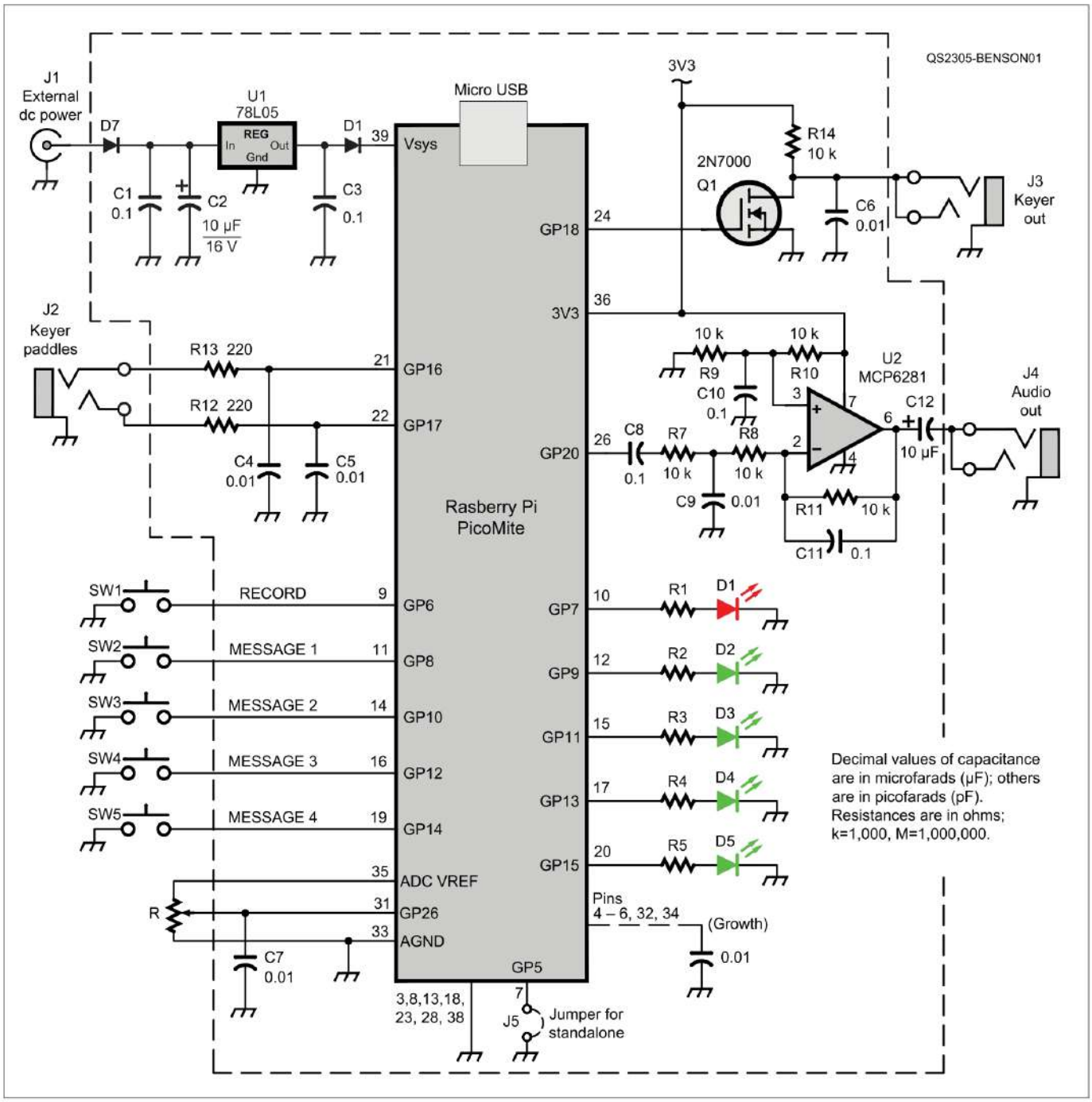


Figure 1 — Schematic diagram of the Pico Memory Keyer.

Function four rolls back the contact number. Function five enables you to record keyer paddle input for filling the message buffers. This function is useful in standalone mode.

There is some analog circuitry around operational amplifier U2 that takes a pulse-width modulation tone from the PicoMite and buffers and filters it into a nice-sounding sine wave for listening with earbuds. This is most useful during software development and usually isn't needed for on-the-air use, as your radio typically provides its own sidetone. The audio output also doubles as an off-air code practice oscillator. The PMK also has five spare breakout pins. Two of these can be used as analog inputs read by the PicoMite's analog-to-digital conversion feature. This could allow it to be used in monitoring battery voltage and SWR, for instance. These breakout signal paths can be taken off the board by plugging Adafruit jumpers onto the PicoMite header pins. There's room on the PMK board to add bypass capacitors to ground, if needed, to minimize RF pickup issues.

PicoMite Features at a Glance

- ✓ Comprehensive BASIC interpreter: floating point, 64-bit integer, strings, multidimensional arrays
- ✓ 133 MHz clock frequency
- ✓ Compiled C can be embedded
- ✓ Fast Fourier Transform and inverse Fast Fourier Transform included
- ✓ Memory: 7 blocks 124 K flash, 156 K RAM
- ✓ Extensive serial and parallel LCD support, including resistive-touch SPI/I2C/RS-232 support
- ✓ XMODEM protocol for program transfers and archiving
- ✓ 26 lines of general-purpose input/output (I/O)
- ✓ Three I/Os provide fast 12-bit A/D conversions
- ✓ Raspberry Pi Pico cost: $5

R12 and R13 were added in series with the paddle inputs to reduce the slew rate and eliminate the overshoot behavior, which could cause the Pico to crash. If your application includes bringing remote high-speed signals to the Pico, those resistors need to be included.

I developed software (available on the **www.arrl.org/qst-in-depth** web page) using the PicoMite's resident BASIC interpreter and a micro USB adapter cable. At the other end of the cable is a computer and a readily available (and free) terminal emulator program called *Tera Term* (**www.teraterm.org**). That environment allows editing and execution of programs without the need to compile code after each minor change. Details of the software installation process for the PMK can be found on the *QST* in Depth web page.

Two Operating Modes

The PMK has two distinct operating modes: terminal and standalone. In terminal mode, you rely on the virtual terminal running on your computer for setup and message entry. Upon connecting the USB cable, the PMK software comes alive with a user dialog. It prompts you to enter two messages and select three other features: reset serial number, paddle reversal, or iambic mode A/B. You can return to it at any time to make changes to the operational settings or customize the program for your own needs.

In standalone mode, only the keyer paddles are needed to initialize the PMK functions. Pressing the record button arms the programming mode for entering a new message. At the end of the message, press one of the two message pushbuttons to store it in your desired location, and the record LED will turn off. Your newly stored message will then be played back to you. This sequence is shorter because you won't be changing the keyer settings often, if at all. The program automatically starts in standalone mode upon application of power if a jumper has been installed at J5.

The last serial number is retained if the PMK is not reset. This allows the keyer to recover gracefully in the event of a power interruption. The other operational settings — paddle reverse and iambic A/B — are stored in non-volatile memory and are restored upon application of power. In both operating modes, a quick tap of either keyer paddle aborts an outgoing message if you've pressed the wrong message button. The keyer functions are available at all times.

Final Comments

This keyer satisfies my need for hunt-and-pounce operation in a contest. I'm also using it on a weekly basis for several sprint activities. If your Morse skills are rusty, or if you're new to operating CW, a memory keyer is a great option. You're able to put your best foot forward on the air, without the jitters that can arise from being relatively unfamiliar with Morse operation.

I'm grateful to George Heron, N2APB, for suggesting the PicoMite and for his steadfast support of this project. He's working on his own ham applications using this board, and we should expect to hear more about them in the future.

A printed circuit board for this project is available at minimal cost. Visit **https://midnightdesignsolutions.com** for details.

See *QST* in Depth for More!

Visit www.arrl.org/qst-in-depth for the following supplementary materials and updates:

- ✓ Software program and installation
- ✓ Bill of materials
- ✓ Additional images
- ✓ Assembly and driver installation

Lead photo by the author.

Dave Benson, K1SWL, is a retired electrical engineer. He contributed to a number of displays programs in the airborne military environment in Honeywell's Phoenix and Albuquerque divisions. This work included graphics overlay on sensor videos, as well as MIL-STD-1553B terminal design. He also holds several US patents. Dave left the corporate world to pursue amateur radio full-time as proprietor of Small Wonder Labs. He has frequently contributed to *QST* and is now undertaking a variety of homebrew projects. Dave designed and built his home in New Hampshire, where he enjoys gardening and woodworking. He can be reached at **k1swl@arrl.net**.

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

Surface-Mount Design and Assembly for the Everyday Amateur

An easy, inexpensive way to design and build circuits with surface-mount components.

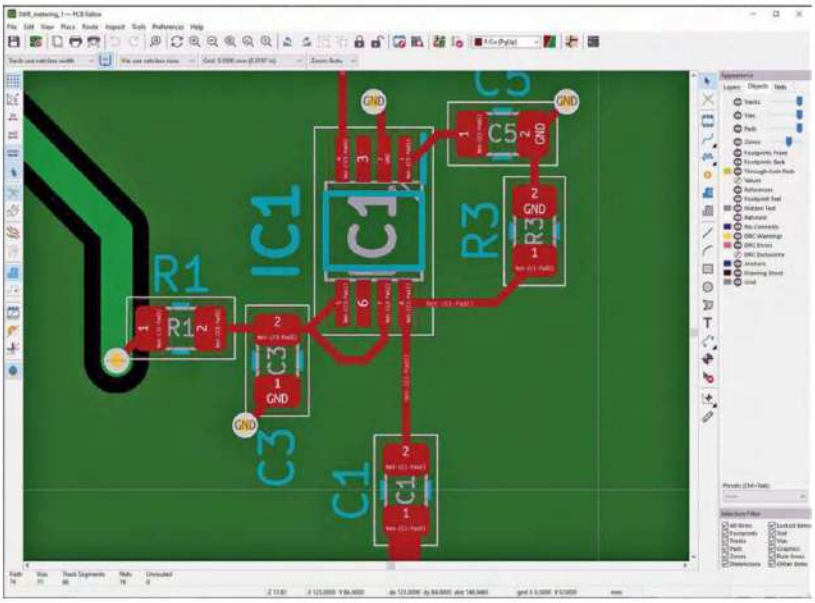


Figure 1 — A screenshot of the *KiCad* PCB design editor. Red traces are on the top layer, and green traces and ground plane fill are on the bottom layer.

Scott Lentz, AG7FF

For the past 20 years or so, most integrated circuits (ICs) have been available only as surface-mount devices (SMDs). While many through-hole components are still available, they are typically more expensive and much larger than their SMD equivalents. I recently developed an HF CW rig with SMD components, which helped me better understand the SMD design and assembly process.

Basics

I recommend using the free *KiCad* design suite at **www.kicad.org** to arrange your SMD. There are many online *KiCad* tutorials, and with practice, you should be able to develop a complex schematic and printed circuit board (PCB) layout within a few hours. Many components are already in the *KiCad* library, but component distributors (Mouser Electronics, Digi-Key, etc.) can provide additional symbols and footprints compatible with *KiCad*.

In the *KiCad* schematic capture, you can associate symbols with footprints and connect the pins. Footprints include the precise size and shape of the components, solder pads, and stencil openings. Most of your design phase will be spent in the schematic capture. If you arrange your schematic in roughly the same way you plan to lay out your PCB, then footprint placement and trace routing in the PCB design editor will be brief. The PCB design editor allows you to make only connections defined in the schematic. It aids you by highlighting which connections need to be made, so make sure your schematic is correct before moving on to this stage (see Figure 1).

Next, plot the Gerber files to be uploaded to your selected fabricator; each fabricator will have specific upload instructions on their web page. You can compare prices from different fabricators based on board size and quantity at **www.pcbshopper.com**. The two fabricators I use are JLCPCB (**www.jlcpcb.com**), located in China, and US-based OSH Park (**www.oshpark.com**). Chinese fabricators can be quite inexpensive — sometimes less than $10, including shipping, for five copies of a two-layer PCB sized less than 100 × 100 millimeters. A US fabricator might ship faster, but it also might charge $5 or more per square inch. Of course, prices vary with the PCB area and number of layers.

You may want to order a stencil, especially if you are using ICs with finely spaced leads. The stencil is automatically generated from the Gerber files generated for the fabricator, so no extra design effort is required. Choosing the thinnest possible stencil will help minimize solder bridges (i.e., shorts) that can occur due to excess solder paste. I use OSH Park's sister site, **www.oshstencils.com**, for inexpensive plastic sten-

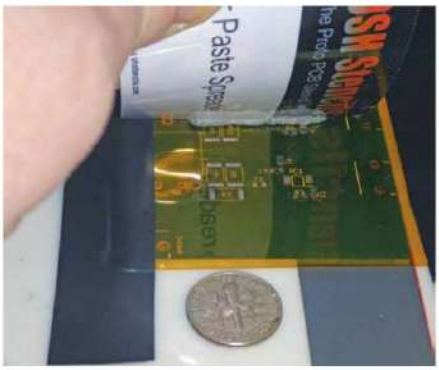


Figure 2 — Applying solder paste through a stencil.

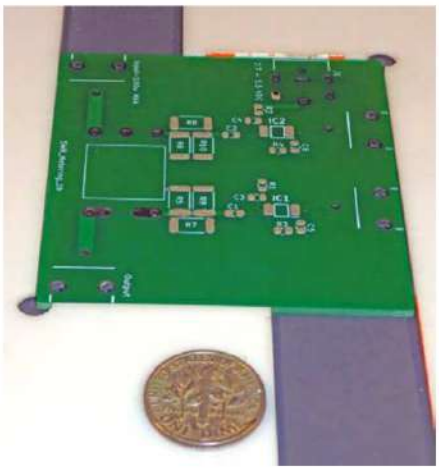


Figure 3 — The stencil-applied solder paste.

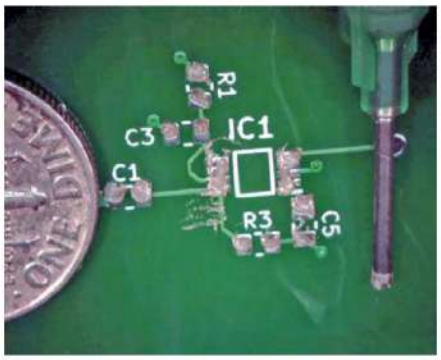


Figure 4 — Syringe-applied solder paste.

cils. These typically take less than a week to arrive and cost about $10 each, including shipping.

Assembly

First, apply solder paste to your PCB. I have found that the tin/bismuth/silver-based solder paste manufactured by Chip Quik (part number TS391LT) is easy to use. It requires less heat than other lead-free solder pastes, so it is less stressful on the components and makes rework easier.

If you are using a stencil, tape it down over your PCB on a plastic frame. Then, smear solder paste through the holes and onto the part footprints (see Figure 2). Don't press down too hard, or the paste will get under the stencil and between the holes. If that happens, scrape it off and try again. Figure 3 shows the result of using a stencil. If you don't use a stencil, you can apply a thin layer of solder paste to each pad with the tip that comes with the paste syringe. Place the tip straight up on the board, slightly tilt it to one side, and squeeze the plunger while slowly moving it over the pad (see Figure 4). The *resist*, or surface film, between PCB pads minimizes solder bridges, but it may not prevent them. You are more likely to have solder bridges without a stencil, as it is harder to apply the correct amount of solder paste.

SMD components come in plastic or paper strips with a thin plastic film. Peel off the film a little at a time and dump the components out onto your electrostatic discharge (ESD)-safe work mat. Use ESD-safe tweezers to place the components onto the paste. This may be the most difficult part of the process, especially if you don't have steady hands. However, even if the parts are not perfectly placed, they tend to align with the PCB pads while you solder.

Soldering the SMD Components

To solder larger components, you can buy a hot-air rework station from Amazon for less than $50. But on small boards with many small, crowded components, the hot air often blows the components out of place. I've found that a toaster oven capable of heating to at least 450 °F works great for all board sizes with Chip Quik TS391LT or equivalent low-temperature solder paste. I paid $35 for a 1150 W toaster oven, and another $5 for a digital timer (see Figure 5). You may still want a hot-air rework station so you can experiment with different components later.

Figure 5 — The toaster oven soldering station.

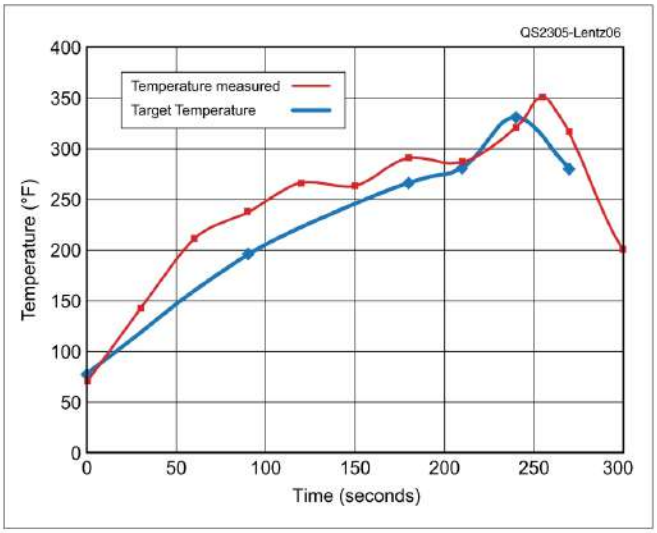


Figure 6 — A graph of the Chip Quik TS391LT recommended soldering temperature profile (blue) versus the measured temperature profile (red). This depicts the PCB surface temperature, not the oven air temperature.

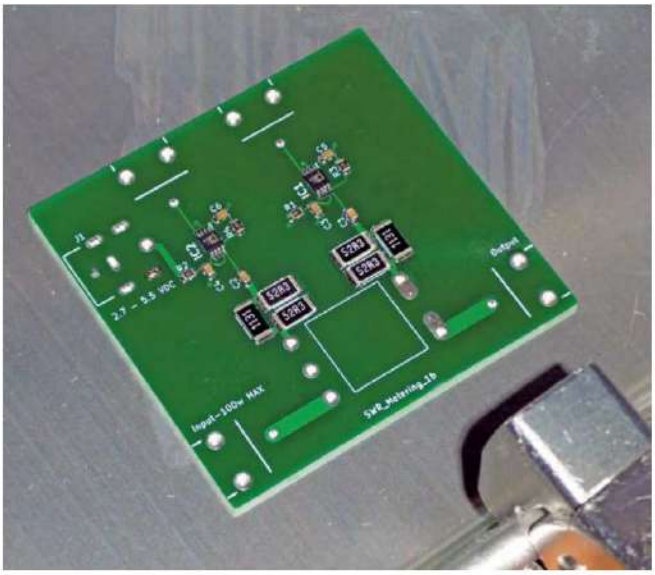


Figure 7 — The final soldered SMD assembly.

Though your results can vary depending on your oven's wattage, the following process closely follows the temperature profile provided by Chip Quik, based on the readout of a thermistor taped to a PCB (see Figure 6).

Begin by preheating the oven and an aluminum baking pan to 350 °F. Remove the pan from the oven and let it cool for a minute so that you can safely handle it. Then, carefully place the PCB on the pan without moving the parts. Place the pan back into the oven and bake for 3.5 minutes for the ramp and soak phases. After this, increase the temperature to maximum — 450 °F in my case — and bake for 45 seconds for the reflow phase. Shut off the oven and gently remove the pan to let it cool down. Figure 7 shows the final soldered SMD assembly.

If you use a toaster oven with a different wattage, you may need to test the thermal profile, particularly for the reflow phase. To test PCB temperature, use an unpopulated PCB and a multimeter that has a thermistor and temperature readout. With tape, attach the thermistor to the PCB and measure the temperature every 30 seconds. The ramp and soak phase of 3.5 minutes at 350 °F should yield fairly consistent results among various ovens. For the reflow phase described earlier, carefully watch the temperature and record the time it takes for the PCB temperature to reach 350 °F. Once you know the reflow stage time, you will need a timer for any future board soldering.

Results

That's it for the soldering process. Before applying power to your circuit, use a 10× magnifying glass, a USB microscope, and/or an ohmmeter to confirm that there are no solder bridges, especially between IC pins. If you find any, drag a lightly tinned soldering iron tip (one that is wide enough to cover the adjacent pins) over and away from the pins. This should wick the solder away from the pins. If the solder bridge is substantial, use a desoldering braid to wick away the excess.

Depending on circuit complexity, schematic design and PCB layout normally take me 2 – 4 hours. The boards typically arrive after 3 weeks, and it takes me less than an hour to apply solder paste, pick and place parts, and bake the board. Up-front costs can total slightly more than $100 for a hot-air rework station, a toaster oven, solder paste, tweezers, and a magnifying glass. Constructing circuits with SMD components does not have to be difficult.

All photos by the author.

Scott Lentz, AG7FF, retired from the US Forest Service, where he worked as a fisheries biologist and a communications technician during major fire incidents. He holds a bachelor's degree in aquatic wildlife biology, and a master's degree in organismal biology and ecology, both from the University of Montana. Scott was first licensed in 2003, and his ham radio interests shift every few years. Lately, he has been designing a CW transceiver. You can contact Scott at **scott.ag7ff@gmail.com**.

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

Certificate of Code Proficiency Recipients

Sponsored by

www.i2rtf.com

This month, ARRL recognizes merit and progress in Morse code proficiency on the part of the following individuals, who have achieved proficiency at the following rates, in words per minute.

November 2022

Ryan M. Ernest, KFØGVX	10
Donald A. Cutshaw, KO4KYN	15
John S. Hickman, WW3B	15
Thomas J. McGuire	15
David A. Rose, N8GZ	15
Jack W. Bumgarner, WS5D	20
Keith A. Marang, W4AFB	20
Paul W. Peterson, K1HIS	20
Niece Haynes, KA1ULN	35
Dennis A. Mills, NT4U	40

December 2022

Timothy W. Freeze, KO4ELL	10
Ronald W. Melcher, W3RFX	10
Ron Kinney, KCØZPS	15
John W. Wilson, K5BOI	15
Lawrence Obrowski, WØLRF	20
R. Charles Rippel, K8HU	20
Gary C. Tartanian, K3WK	20
John W. Wilson, K5BOI	20
Jack W. Bumgarner, WS5D	25
Steven H. Saef, AA2BB/4	25
John W. Wilson, K5BOI	25
R. Charles Rippel, K8HU	30
John W. Wilson, K5BOI	30
John W. Wilson, K5BOI	35

January 2023

Scott F. Avery, AD4SA	10
Moses Bennett, KN6TXF	10
Erich C. Fitschen, KQ4BBC	10
Justin A. McKeever, KQ6BZ	10
Justin A. McKeever, KQ6BZ	15
George A. Stickney, W7BXW	15
Donald A. Cutshaw, KO4KYN	20
John H. Kelly, WA2CHV	20
Justin A. McKeever, KQ6BZ	20
Brian D. Smith, W9IND	25
Jack W. Bumgarner, WS5D	30

February 2023

Richard H. Mark, WZ8N	10
Jeremy D. Sadler, K5NCO	10
Richard H. Mark, WZ8N	15
Reiner R. Dieg, N2PEZ	20
Ron Kinney, KCØZPS	20
Russel J. Megargle, K8AF	40

Congratulations to all of the recipients.

May 2023 W1AW Qualifying Runs

W1AW, the Hiram Percy Maxim Memorial Station at ARRL Headquarters in Newington, Connecticut, transmits Morse code Qualifying Runs to assist ham radio operators in increasing and perfecting their proficiency in Morse code. Amateur radio operators can earn a Certificate of Code Proficiency or endorsements by listening to W1AW Qualifying Runs.

May Qualifying Runs will be transmitted by W1AW in Newington, Connecticut, at the times shown on 1.802.5, 3.581.5, 7.047.5, 14.047.5, 18.097.5, 21.067.5, 28.067.5, 50.350, and 147.555 MHz. The West Coast Qualifying Runs will be transmitted by K9JM on Wednesday, May 24, at 9 PM PDT (0400 UTC on May 25) on 3590 and 7047.5 kHz. Unless indicated otherwise, sending speeds are from 10 to 35 WPM.

Amateur radio operators who participate in Qualifying Runs may submit proof of 1 minute of the highest speed they have copied in the hope of qualifying for the Certificate of Code Proficiency, or an endorsement to their existing certificate. Legibly copy at least 1 minute of text by hand, and mail the sheet to: W1AW Qualifying Runs, 225 Main St., Newington, CT USA 06111. Include $10 (check or money order) if this is a submission for your initial Code Proficiency certificate; $7.50 if you are applying for an endorsement (available for speeds up to 40 WPM). Your test will be checked against the actual transmissions to determine if you have qualified.

Members of the North Fulton (Georgia) Amateur Radio League (**https://nfarl.org**) are offering to subsidize the total cost of a Code Proficiency certificate or endorsement submission for any individual age 21 years and younger, and who reside in either the US or Canada. Participants who wish to make use of this offer should indicate on their Qualifying Run submissions they are age 21 or younger, and certify as such via their signature. Eligible participants are not required to send any fee with their Code Proficiency submissions.

For more information about Qualifying Runs, please visit **www.arrl.org/qualifying-run-schedule**.

For information about how to qualify for the Certificate of Code Proficiency, please visit **www.arrl.org/code-proficiency-certificate**.

W1AW Qualifying Runs — May 2023
(All times are in Eastern Daylight Time.)

Monday	Tuesday	Wednesday	Thursday	Friday
5/1 4 PM – 2000Z 10 – 35 WPM	**5/2** 7 PM – 2300Z 35 – 10 WPM		**5/4** 9 AM – 1300Z 10 – 35 WPM	
	5/9 4 PM – 2000Z 10 – 35 WPM	**5/10** 7 PM – 2300Z 10 – 40 WPM	**5/11** 9 AM – 1300Z 35 – 10 WPM	**5/12** 10 PM – 0200Z **(5/13 – UTC)** 10 – 35 WPM
5/15 4 PM – 2000Z 10 – 40 WPM	**5/16** 9 AM – 1300Z 10 – 35 WPM	**5/17** 10 PM – 0200Z **(5/18 – UTC)** 35 – 10 WPM	**5/18** 7 PM – 2300Z 10 – 35 WPM	
	5/23 9 AM – 1300Z 35 – 10 WPM		**5/25** 4 PM – 2000Z 35 – 10 WPM	**5/26** 7 PM – 2300Z 10 – 35 WPM

Pascal Villeneuve, VA2PV, va2pv@arrl.org

Product Review

Xiegu G106 5 W QRP Transceiver

Reviewed by Phil Salas, AD5X
ad5x@arrl.net

I have had the opportunity to review the Xiegu X5105, X6100, and G90 transceivers. So I was pleased to be able to review the G106, the latest QRP radio from Xiegu.

The Xiegu G106 is a compact transceiver covering the 80- through 10-meter ham bands, along with a general-coverage receiver that tunes continuously from 550 kHz to 29.7 MHz (see Table 1). It also covers the 88 – 108 MHz FM broadcast band (receive only). The cast aluminum metal case has a solid feel to it. Operating modes are CW, SSB, and AM. Included with the G106 is the speaker/microphone, a power cord, and the manual. If you wish to operate digital modes, and/or provide a computer interface for computer control and firmware updates, you must purchase the optional DE-19 interface unit. The G106 has a built-in speaker. An external speaker or headphones must be plugged into a 3.5-millimeter mono jack on the speaker/microphone. All normal operating parameters, including a spectrum display, are displayed on a 1.7-inch diagonal black-and-white screen. The spectrum display is 48 kHz wide and is centered on your tuned frequency. There is no waterfall display.

The G106 includes split-frequency operation (both within a band and on separate bands) and has a receiver preamplifier. While it has fixed bandwidth filters for AM and SSB, it has 50 Hz, 250 Hz, and 500 Hz selectable filters for CW. There are 50 memory channels available. There is no RIT, receiver attenuator, noise blanker, or digital noise reduction. The G106 does not display SWR, nor does it have VOX for SSB or AM. And it does not include an internal auto-tuner.

Interfaces and Controls

All operating controls are on the front and top of the G106, as you can see in the lead photo and Figure 1. An RJ11 (four-pin) speaker/microphone jack is on the front panel, along with the volume control, main tuning knob, and four multi-function buttons. On the top of the G106 are the power, mode, and band-switch buttons. Figure 2 shows the rear of the G106, where you will find the BNC RF connector, a 3.5-millimeter key interface, a 3.5-millimeter COM port, a mini-DIN8 accessory port, and a 2.5 × 5.5-millimeter dc power interface.

The volume and tuning controls are multi-function. A metal rim around these two controls provides some protection for the controls and the front panel. When

Figure 1 — Topside controls.

Bottom Line

The Xiegu G106 is a rugged, compact, 5 W portable transceiver. While it has fewer features than other QRP transceivers, it is also priced below much of the competition.

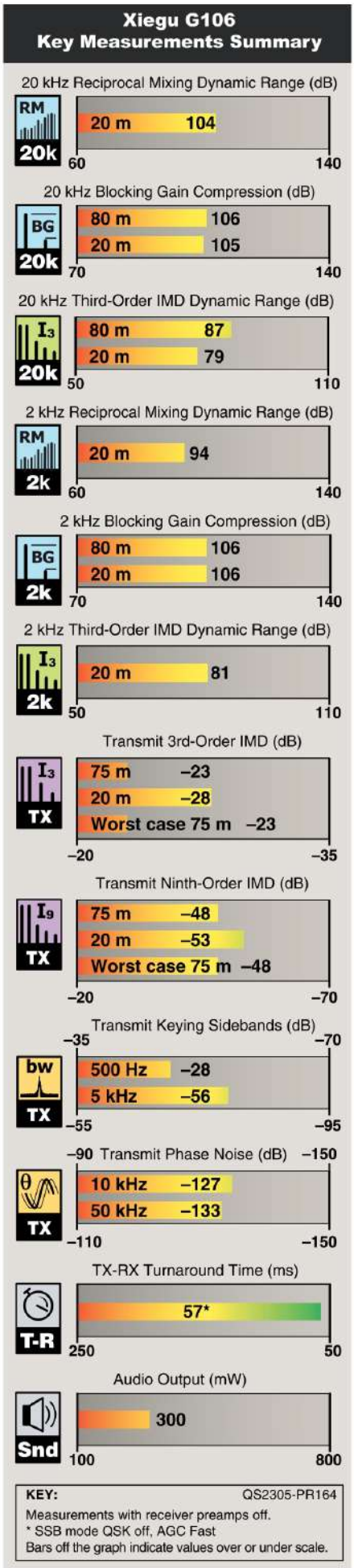


Table 1
Xiegu Communication G106, serial no. V8W#Q81055
Firmware: V1.2 Sept 20, 2022

FCC ID# 2ANLH-G106

Manufacturer's Specifications	Measured in the ARRL Lab
Frequency coverage: Receive: 0.5 – 30 MHz; 88 – 108 MHz (WFM). Transmit: 3.5 – 4.0 MHz; 7 – 7.3 MHz; 10.1 – 10.15 MHz; 14 – 14.35 MHz; 18.068 – 18.168 MHz; 21 – 21.45 MHz; 24.89 – 24.99 MHz; 28 – 29.7 MHz.	As specified. Transmit: As specified, plus 5.331 – 5.405 MHz.
Power requirement: 9 – 15 V dc. Transmit: 2.8 A max. Receive: 370 mA max.	At 13.8 V dc: Transmit: 2 A (max). Receive: 320 mA, (no signal, max. volume, max. lights) 314 mA (backlight off).
Modes of operation: SSB, CW, AM, FM.	As specified.
Receiver	**Receiver Dynamic Testing**
CW sensitivity:	Noise floor (MDS), 500 Hz BW:
Noise floor (MDS): Not specified; 3.5 – 30 MHz (CW): 0.25 µV (–119 dBm).	3.52 MHz: *Preamp Off* –115 dBm / 0.39 µV; *Preamp On* –132 dBm / 0.06 µV 14.020 MHz: –112 dBm / 0.54 µV; –130 dBm / 0.07 µV
AM sensitivity: 3.5 – 30 MHz (AM): 10 µV (–87 dBm).	For 10 dB (S+N)/N, 1 kHz tone, 30% mod. 3.885 MHz: *Preamp Off* –86 dBm / 11.9 µV; *Preamp On* –102 dBm / 1.70 µV
Blocking gain compression dynamic range: Not specified.	Blocking gain compression dynamic range, 500 Hz BW: 20 kHz offset *Preamp off/on*: 3.5 MHz 106 / 105 dB; 14 MHz 105 / 105 dB 5/2 kHz offset *Preamp off*: 3.5 MHz 106 / 106 dB; 14 MHz 106 / 106 dB
Reciprocal mixing dynamic range: Not specified.	14 MHz, 20/5/2 kHz offset: 104 / 100 / 94 dB

Lab Notes: Xiegu G106 5 W QRP Transceiver

The ARRL Lab encountered a few quirky issues while testing this radio. It is standard procedure for the Lab to update the firmware to the latest version on any radio we purchase for Product Review testing. We strongly recommend that hams do the same when they get their new rig home, to benefit from any improvements that the manufacturer included in the update. A new firmware update came out just after we started testing, so I updated from V1.0 to V1.2 (the latest version available at the time of testing).

I noticed that the power output had changed! Although it was still within Xiegu's specifications, the power was reduced by about 1 W on all bands and modes of operation. Another issue I observed was that by adjusting the mic gain to more than 20, the IMD products drastically increased, which would cause splatter on the air. I would be cautious setting the gain significantly higher, keeping the output below the rated power of 5 W PEP.

I also observed during the blocking gain compression dynamic range test several receiver spurious responses (birdies). Most were weak, but a few were strong enough that they could interfere with actual received signals, especially at closer spacings. These birdies did not prevent proper measurements from being made, but they were there.

Manufacturer's Specifications — Measured in the ARRL Lab

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

Band/Preamp	*Spacing*	*Measured IMD Level*	*Measured Input Level*	*IMD DR*
3.5 MHz/off	20 kHz	–115 dBm –97 dBm	–28 dBm –22 dBm	87 dB
14 MHz/off	20 kHz	–112 dBm –97 dBm	–33 dBm –27 dBm	79 dB
14 MHz/on	20 kHz	–130 dBm –97 dBm	–43 dBm –30 dBm	87 dB
14 MHz/off	5 kHz	–112 dBm –97 dBm	–31 dBm –20 dBm	81 dB
14 MHz/off	2 kHz	–112 dBm –97 dBm	–31 dBm –20 dBm	81 dB

Second-order intercept point: Not specified.*	Preamp off/on: 14 MHz, +53/+51 dBm.
S-meter sensitivity: Not specified.	For S-9 signal, preamp off/on: 14 MHz, 86.0/43.6 µV.
Receiver processing delay time: Not specified.	25 ms.
Audio output: 0.3 W into 8 Ω @10% T.H.D.	0.1 W into 8 Ω at <1% T.H.D.
IF/audio response: Not specified.	CW: 515 – 1105 Hz, SSB: 59 – 2200 Hz, AM: 38 – 3900 Hz.

Transmitter — Transmitter Dynamic Testing

Power output: >5 W @ 13.8 V dc.	At 13.8 Vdc 5.2 to 10.4 W. At 9 Vdc: 14 MHz, 0.07 W.
Spurious and harmonic suppression: HF: >50 dB.	>–57 dBc Meets the FCC limits for spurious emissions.
Third-order intermodulation distortion (IMD) products: Not specified.	3rd/5th/7th/9th order, 5 W PEP: –28/–41/–55/–53 dB PEP 20 m –23/–42/–41/–48 dB PEP (worst case, 75 m).
CW keyer range: Not specified.	5 to 50 WPM, default = 20 WPM iambic modes A and B.
CW keying characteristics: Not specified.	See Figures A and B.
Transmit-receive turnaround time (PTT release to 50% audio output): Not specified.	57 ms.
Receive-transmit turnaround time (TX delay): Not specified.	SSB, 10 ms.
Transmit phase noise: Not specified.	See Figure C.

Size (height, width, depth): 1.6 × 4.7 × 5.3 inches, not including protrusions.

Weight: 1.6 pounds.

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

During testing, the frequency and mode get changed quite a bit depending on the test being performed. To save some time, I saved the commonly used frequency/mode pairs in memory locations. While switching from VFO to memory channel modes, the operating mode frequently did not change to the mode that was stored in the memory channel. Changing to a different memory channel and then back to the desired channel seemed to fix this problem most of the time, though the behavior was somewhat inconsistent.

This rig is far from stellar on CW transmit. Most modern rigs use internal DSP to shape the CW keying to obtain a reasonable waveform that does not generate key clicks. This transmitter does not, and as you can see in Figure A, the RF envelope rises very quickly at the beginning of each keying element. Figure B shows the resultant keying sidebands of this poorly shaped waveform. This rig has keying sidebands that are 20 – 40 dB worse than some of the better rigs we have tested lately. Fortunately, this is a QRP rig, so most of the time, the key clicks won't cause interference to other users, but when conditions are right, QRP can be loud. In that case, you may get some reports of key clicks from other users, or from an ARRL Official Observer! This would be especially likely if an external amplifier is used with this radio. The transmit third-order IMD on 75 meters is also poor, which will generate splatter on adjacent channels. — *George Spatta, W1GKS, ARRL Assistant Lab Manager*

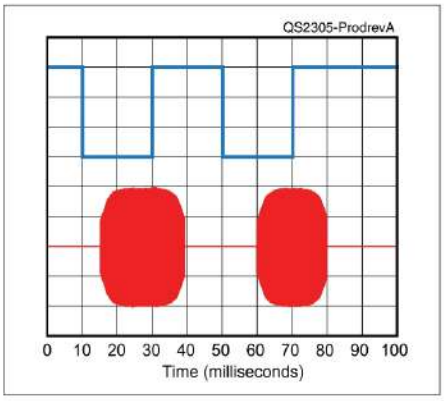


Figure A — CW keying waveform for the G106 showing the first two dits using external keying. Equivalent keying speed is 60 WPM. The upper trace is the key closure; the lower trace is the RF envelope. Horizontal divisions are 10 ms. The transceiver was being operated at 5 W output on the 14 MHz band, using QSK set to **ON**. The first-dit rise time is 3.7 ms; the fall time is 3.5 ms. The second-dit rise time is 3.9 ms; the fall time is 3.5 ms. The first-dit on delay is 5.7 ms; the off delay is 8.8 ms. The second-dit on delay is 10.4 ms; the off delay is 9.5 ms.

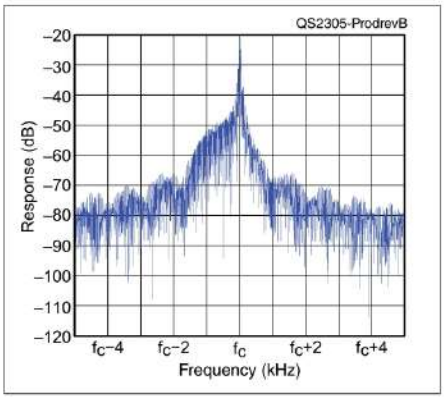


Figure B — Spectral display of the Xiegu G106 transmitter during keying sideband testing. Equivalent keying speed is 60 WPM using external keying and the default rise time setting. Spectrum analyzer resolution bandwidth is 10 Hz, and the sweep time is 200 ms. The transmitter was being operated at 5 W 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.

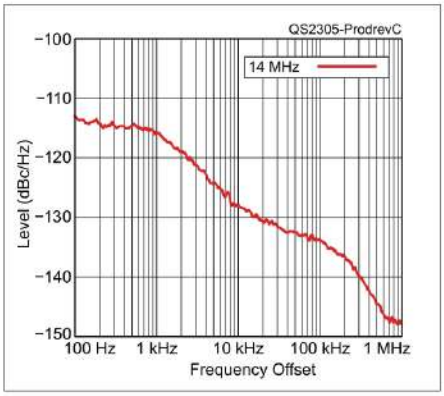


Figure C — The spectral display of the Xiegu G106 transmitter output during phase-noise testing. Power output is 5 W on the 14 MHz band. The carrier, off the left edge of the plot, is not shown. This plot shows phase noise 100 Hz to 1 MHz from the carrier. The reference level is –100 dBc/Hz, and the vertical scale is 10 dB per division.

Figure 2 — Rear panel connectors.

tapped, the volume control selects between the internal speaker and the speaker in the speaker/microphone. Besides tuning, the main tuning control is also used to select any one of the five menu pages, and to adjust menu parameters. On the top side of the radio, tapping the **MODE** button cycles through the **AM**, **LSB**, **USB**, and **CW** modes. Pressing and holding the **MODE** button turns the preamplifier on and off. Tapping the **BAND** buttons cycles the radio through the different ham bands, and pressing and holding the **BAND** buttons changes the tuning step. All of the buttons have an excellent tactile feel, and the two controls feel solid and are wobble-free.

Firmware Update

The latest firmware is available from **https://xiegu.eu**. At the time of this writing, the latest update was labeled "V1.2B03." This added three transmit power settings (low, medium, and high). As this review unit had an earlier firmware version, I went through the G106 firmware update procedure. This procedure is included with the firmware update download and requires that you download and install the *Tera Term* terminal emulator software. While not as simple as my Elecraft KX3 update procedure, it is not difficult. As mentioned earlier, Xiegu states that the DE-19 is required to interface the G106 with your computer. However, I found that an FTDI 3.3 V TTL USB-to-serial 3.5-millimeter adapter works fine. You can find this adapter for less than $20 at **www.amazon.com**.

A Bit More Testing

You will find my test results in Tables 3 – 6 at **www.arrl.org/qst-in-depth**. As the G106 now has three power settings, I first checked the actual power on several of the bands (see Table 3). Because the specified voltage range is 9 – 15 V dc, I also checked

Solid-State Keying Interface for Xiegu Transceivers

The Xiegu DE-19 accessory provides a keying interface that will work with most external amplifiers. However, unless you are using the Xiegu XPA125B amplifier, the DE-19 is overkill, as the ALC and band data interface is not compatible with non-Xiegu amplifiers. Therefore, I decided to build my own interface, which is applicable for keying any device with an open-circuit keying input up to 80 V dc, and a maximum enable current of 0.5 A. I have verified that this interface works with the G106, the G90, and the X5105.

The Xiegu ACC connector is a miniDIN8 female with the pinouts shown in Figure 3. I found that the PTT output measured 8 V dc on receive, and 0 V dc when transmitting. Figure 4 shows the schematic of the keying interface. The LED is not necessary, but I like visual indication when the PTT output is active, and Figure 5 shows the Xiegu amplifier-keying interface schematic.

Construction

The parts list is shown in Table 2. The keying interface uses a miniDIN8 cable with one connector cut off. While the circuit is easily built on a small piece of perf board, I implemented the circuit on a small printed circuit board (PCB). The connection points and component locations for my PCB are shown in Figure 5, and the completed unit is shown in Figure 6. The #4 hole provides for a PCB mount if desired.

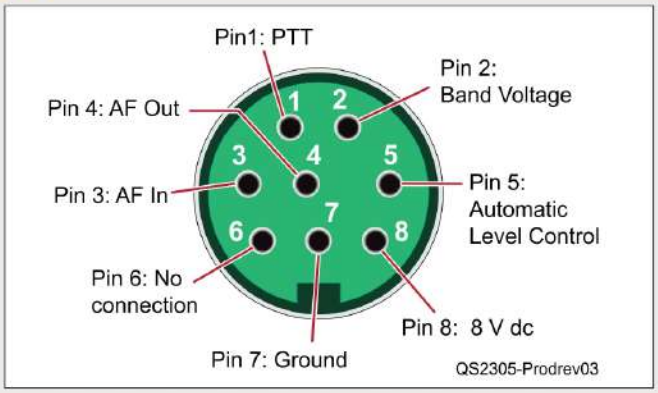


Figure 3 — Xiegu accessory port pinouts and descriptions.

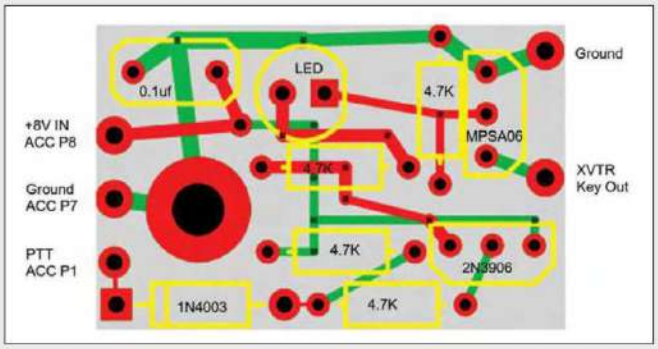


Figure 4 — Keying interface PCB layout.

the maximum output power at 9, 13.8, and 15 V dc. Table 4 shows the test results.

Because the G106 does not have an internal auto-tuner, I wanted to see how it would do with some reasonable mismatches. Table 5 shows the output power when transmitting at high power into high-impedance and low-impedance 2:1 and 3:1 SWR resistive loads. It is interesting that the G106 seems to have no problem with low-impedance loads — at least up to a 3:1 SWR.

Finally, I checked the S-meter reading against my Elecraft XG3 signal generator and a precision step attenuator on 40, 20, and 10 meters. The Elecraft XG3 level of accuracy specification is ± 1 dB. The results are shown in Table 6. Note that the G106 does a nice job of tracking signals at the rate of 6 dB per S-unit.

General Operation

When adding your power connector of choice (a Powerpole® in my case) to the supplied dc cable, keep in mind that the G106 does not have reverse polarity protection.

I found the G106 easy to operate. You will need to get into the menu for some settings, such as memory save and recall, transmit power, CW filters, CW speed, break-in delay, and some other less-used settings. Once you go through the menu a time or two, it will become second nature. Tapping any of the four multi-function buttons below the display brings up the menu, and the tuning control is then used to select between the five menu screens. There is no internal antenna tuner; however, the menu permits cycling from a paddle to a straight key, so you can use your paddle to put out a carrier for tuning an external antenna tuner if needed. Or you can use the AM mode.

CW Operation

The G106 internal keyer speed range is 5 to 50 WPM, and the CW pitch is adjustable from 500 to 1000 Hz (800 Hz default). You cannot select the opposite CW sideband; however, I have rarely used this feature on other transceivers. I could not hear ringing on even the narrow 50 Hz CW filter. T/R switching uses an internal relay, and you can hear the relay click. The break-in delay is settable from 0 to 1000 ms; however, the T/R delay is no shorter than about 50 ms. I wound up preferring about a 500 ms break-in delay to minimize relay clicking.

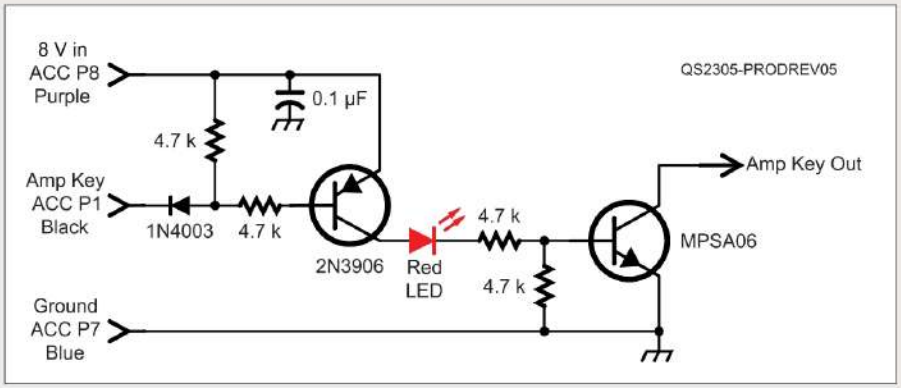


Figure 5 — Xiegu amplifier-keying interface schematic.

Table 2
The DIY Parts List:
Flexible Amp-Key Interface

QTY	Description	Mouser/ Part Number
1	0.1 µf 100 V capacitor	81-SR211C104KAR
1	MPSA06 transistor	512-MPSA06
1	1N4003 diode	63-1N4003G
1	2N3906 PNP transistor	512-2N3906TA
4	4.7 K resistor	660-MF1/4LCT52R472J
1	Red LED (3000 mcd)	755-SLI-570UT3F
1	Plastic box 1.97 × 1.38 × 0.79 inches	546-1551GBK
1	Phono jack	534-580
1	MiniDIN8 cable	**www.amazon.com**

Figure 6 — The DIY Xiegu keying interface.

SSB Operation

The microphone gain can be adjusted in the menu, though the default setting is fine for the supplied speaker/microphone. You may need to change this setting if you change microphones. There are no receive and transmit audio equalization filters or transmit speech processing. The receive filter bandwidth is fixed at about 2400 Hz.

Digital Modes

The G106 can be operated with a computer for RTTY, PSK, JT65, or any of the other popular digital modes. However, you must purchase the optional DE-19 interface unit. Use the **L-D** or **U-D** modes for lower or upper sideband data transmission. The **L-D** and **U-D** modes disable the microphone, and permit external audio input only through the ACC interface.

On the Air

I did not test the G106 on digital modes, as I am primarily a CW and SSB QRP operator. I operated on 40, 30, 20, and 17 meters using my 43-foot vertical. At the maximum power level (~5 W), I had no problems making CW contacts on any of the bands. I like to use headphones, especially when operating CW, so I did not like having to use the speaker/microphone for the headphone interface. A headphone jack on the radio would have been nice.

SSB operation was a bit more of a challenge at the 5 W level. However, by focusing on calling strong stations, I could normally make contacts, especially on 20 and 17 meters. The audio reports were all quite good. I noticed one interesting little glitch. When operating either SSB or AM, pressing the PTT button produces a momentary full-output power spike. This is a very short-duration spike. Receiving stations heard it as a click.

Conclusion

The G106 is a minimally featured SDR 5 W radio. However, this makes operation easier than more complex radios. For more information, you can download the G106 user manual from **www.radioddity.com**.

Manufacturer: Xiegu. Distributed and supported in the US by select US distributors. Price: G106 HF transceiver, $320; DE-19 keying interface, $70.

Lynovation CTR2-Mini+ Radio Controller

Reviewed by Sean Klechak, W9FFF
sean.klechak@gmail.com

In the September 2022 issue of *QST*, an article featured the CTR2-Mini, a radio controller designed by Lynn Hansen, KU7Q. To briefly summarize the CTR2-Mini, it's a convenient way to control an HF transceiver via CAT control. Controlling a radio via the Mini has many benefits, including a colorful screen and easy-to-access menus. The CTR2 project piqued my interest, as I believe that some of the items used in this project will continue to evolve and be developed for amateur radio use. The use of Wi-Fi and an application programming interface (API) allows for multiple systems to communicate with each other and provide control, such as is the case with FlexRadio systems, which utilize an API to get and send commands and get information about the current status of the radio.

Subsequently, I was provided an opportunity to test the CTR2-Mini+, their latest of the CTR2 series. I

Bottom Line

The CTR2-Mini+ is everything you want it to be. It can be used to control your radio locally or remotely, and you can use it for its programmable keys or even to practice Morse code.

found multiple ways to effectively incorporate this radio controller into my daily amateur radio use. Compared to *SmartSDR*, the CTR2-Mini+ is easier to utilize as a radio controller for several reasons. The most noticeable upgrade to the CTR2-Mini is the controller's front panel, which now includes a six-button keypad. These buttons provide programmable shortcuts to rapidly access an operator's most used or favorite features.

On my desktop computer, I utilize a keyboard and a mouse to remotely control my FLEX-6400. This approach works fine, as long as I am sitting at my desktop, which is the problem; I'm increasingly less at my desktop, and more often than not working on a tablet with *SmartSDR* to access my Flex radio. A tablet does the job. Yes, there is a touchscreen on the tablet. Still, a touchscreen with no keyboard becomes a lesson in patience when navigating *SmartSDR*, FlexRadio's graphical software for controlling a radio. There are also several other options that make it possible to control a Flex radio remotely, including the utilization of a Stream Deck and *FRStack* software, or the utilization of Node-RED-based flows to control the Flex radio.

Description

I received the Mini+ as an assembled unit. At approximately 5 × 5.5 × 3.5 inches, the Mini+ is small enough to be carried around and utilized while traveling, easily fitting in a camera bag, a convenient way to carry my various electronics. A 2.4-inch LCD screen (the Wio Terminal) is attached to a black plastic case that has several control options. On the top portion of the case, there are six buttons labeled **1** through **5** and **PTT**, a power **OFF** and volume (**VOL**) knob, an encoder knob, a sidetone speaker, and a sidetone headphone jack. The rear panel (see Figure 7) includes many ports, a 12 V dc input (**12VDC**), **CAT I/O**, a PTT key output (**PTT/K OUT**), **RADIO I/O**, a paddle input (**PDDL IN**), and a PTT key input (**PTT/K IN**).

The Mini+ is just over 13 ounces in weight without the power supply. The pushbuttons on the Mini+ are placed in rows of two, spring-loaded, color coded, and labeled **1**, **2**, **3**, **4**, **5**, and **PTT**. On the bottom portion of the black plastic case are two brass hex spacers that help to provide an angle for the Mini+ to rest, and still allow for the operator to clearly see and utilize all buttons and the LCD screen. The hex spacers are removable, as they just unscrew from the case. Before turning on the Mini+, I made sure it was going to fit in my bag, which it did. So far, the Mini+ seemed to be well built.

Figure 7 — The CTR2-Mini+ back panel has connections for footswitches, paddles, 12 V dc input, CAT cables, and multi-radio links.

My first step in getting the Flex set up for use with the CTR2-Mini+ was to download and print the 69-page user manual (see **https://ctr2.lynovation.com/ctr2-mini-operation-manual**). I initially felt overwhelmed by the sheer size of the user manual, but most of it is used as a reference, as opposed to step-by-step instructions to operate the device.

Firmware Update

One of the things I noticed in the manual and on the website was the potential firmware update. The Wio Terminal included in this device is the brains of the operation. Inside the Wio is a programming code, which is in charge of everything the CTR2-Mini+ does — listening for input from each of the buttons, connecting to Wi-Fi, telling the radio to adjust the squelch, and activating the PTT. The firmware update was my first step in the exploration of the unit, as I wanted to ensure I had the latest features and bug fixes, if any. Updating the firmware was easy (see **https://ctr2.lynovation.com**). On the download page, I quickly found the latest firmware, dated December 31, 2022 (CTR-Mini_v113000), and downloaded it to my computer. I then found the instructions on the website:

> Connect the Wio Terminal to your PC. This can be done on Windows, Linux, or Mac.
> 1. Quickly double-click the power button (pushing it down past the "On" position twice) on the Wio to put it into programming mode.
> 2. Your PC's file browser should open with the Arduino folder selected. If not, navigate to it. It will be with your removable drives.
> 3. Copy and paste the CURRENT.UF2 file in the CTR2-Mini_v10xxxx.zip link below into the Arduino folder, replacing the original CURRENT.UF2 file.

That's how easy it is to upgrade the firmware. At the bottom of the page I was able to see the revisions included in this firmware; this addressed fixes to not

only the firmware of the device, but also the instructions in the user manual. During the time I tested the product, I saved personal settings multiple times and then upgraded the firmware. I can confirm that a firmware upgrade does not remove user-created personal profiles/settings.

Setting Up the Radio Connection

With the firmware update complete, I browsed through the Quick Start Guide on page 9 of the manual. Step 3b explained how to connect a Flex radio with the CTR2 Mini+. This involves connecting the Wio portion of the Mini+ to the local Wi-Fi, entering the radio IP address information in the Wio, and directing the CAT control to TCP port 4992. I was doing this remotely (from outside of my personal network) by connecting the CTR2-Mini+ to my Flex radio. To connect my Flex to the CTR2 remotely, you must open port 4992 on your home router (or the router where your Flex radio is located). It's mentioned in the manual that there is potential to expose the Flex radio to be controlled by anyone on the internet at this point, as it doesn't require authentication to access and control. I found this information to be incredibly valuable and accurate.

In the future, I may choose to configure some sort of VPN to prevent bad actors from taking control of my radio. Additionally, when testing the Wi-Fi connectivity with the CTR2-Mini+, I tried both 2.4 GHz and 5 GHz networks. After double-checking case sensitivity in my network name and password, I did not have any issues connecting. Inputting the network name and password requires the use of the encoder/VFO knob and the blue button on the face of the Wio Terminal.

Now the Mini+ was connected to my Flex radio. There were about eight different directions in which I wanted to go. Keeping things as simple as possible, I started turning knobs and pressing buttons to check out their functionality and my abilities. I realized the game plan I was formulating was to customize the pushbuttons, get a feel for the navigation through the menus, use the Mini+ to operate CW with one of my iambic paddles, and use the PTT button alongside my Bluetooth headphones, which will be synced to my tablet. The Mini+ doesn't currently have the ability to send and receive audio, so I leverage the Mini+ with my Bluetooth headphones to give me the ability to listen and communicate through *SmartSDR*, while still controlling through the Mini+. The advantage of using my Bluetooth headphones is that they're 100% portable, and *SmartSDR* has great transmit equalization options. Additionally, I can activate the PTT button in *SmartSDR* through the Mini+ controller, without accessing *SmartSDR*. I am aware that I could use VOX, but I am not comfortable with VOX going off at any audio level — especially if I am somewhere busy, like a coffee shop.

Programming the CTR2-Mini+

With the aforementioned ideas in mind, I decided to program each of the five pushbuttons that were available first (refer to page 17 of the user manual). Programming the buttons is easy. On the main screen, tap the encoder. Once the encoder is pressed, a menu displays different options. Utilize the encoder to scroll to **CONFIGURATION**, and tap the encoder again. Once inside the configuration menu, there are several options that could be set: programming function buttons, programming (**C**) buttons (buttons located on the Wio Terminal), changing the theme/color sequence of the graphical user interface (GUI) presented on the Wio screen, and many other options. Within the configuration menu, certain sub-settings may be configured by using the encoder and blue button on the Wio or by using a key. I used my paddle to type my call sign, W9FFF. I enjoy the ability to configure my Mini+ with a key, as it allows me to practice Morse code.

Additional options for configuring the text data include using terminal mode. Terminal mode is used by connecting a USB cable to the Wio Terminal and to a computer, setting the baud rate in Windows, opening the *Tera Term* software, and utilizing a command prompt-style screen to configure the settings. Although this option won't always be practical, it became straightforward to leverage the initial setup feature of the Mini+.

As for configuring the buttons, there are two different banks for programming buttons, so really, the five buttons you can program may be utilized twice. The bank used will depend on the time the button is pressed. I programmed each of the pushbuttons within both banks to my liking, having a combination of the ability to change modes and bands, tune the radio, as well as other various features that I'd utilize most.

During this time, I learned about C-button programming. The C button is located on the top of the Wio device. When selecting the programming, I was able to choose between most of the same options as I could program with the standard pushbuttons. I opted to program my C button to open the **MODE** menu, which will help me rapidly change between the different modes.

Practicing CW with the CTR2-Mini+

Feeling confident that the buttons were programmed to my liking, I now wanted to utilize my CW key through the Mini+. I've wanted to improve my Morse code skills, and I've made use of many tools and techniques to continue to learn. The Mini+ has come in handy, as it has a practice mode under the keyer menu. In this menu, I was able to choose a variety of practice techniques, focusing on fixed- or random-length letters, call signs, numbers, custom uploaded practice files, and more.

For the sake of practice and familiarity, I chose to listen to Q codes to learn them. The Mini+ allows for adjustment of both speed and spacing of letters, and utilizes the Koch training method to help teach Morse code. However, I was unable to set these below 15 WPM. The speed may be increased faster than 15 WPM, but 15 WPM is actually a feature. This forced me to learn the characters and code by ear, not by mentally processing the combination of dits and dahs. I can attest that I am not good with code. I can send it with relative ease, but I am unable to process it by ear. I have been spending about 10 – 15 minutes a day picking an option within the menu and listening. When I think I understand a Q code, for example, I look at the on-screen trainer to see how well I did. The trainer tool is useful as a way to keep me learning, but it is not the primary purpose of my Mini+.

Using the CTR2-Mini+ as an Operation Tool

In order to utilize the Mini+ with my tablet and a set of Bluetooth headphones, I tested both of my Bose Avantree headphones. They both have Bluetooth capability, so I can sync them to my tablet (see Figure 8). This configuration allows me to not only listen to my Flex radio, but utilize the headphones' built-in microphone to transmit to my Flex radio.

The Mini+ activates the PTT button in the event that I am utilizing SSB mode. As mentioned earlier, I've never been comfortable with VOX as a PTT activation method, especially in public settings. Utilizing FlexRadio's *SmartSDR* software to activate the PTT is possible, but I must be inside the *SmartSDR* software to utilize that feature. If I am working within another application, pressing an external PTT button makes things very simple. I sometimes utilize the Mini+ in public places; by plugging in an audio cable to the headphone (**HP**) port on the top portion of the Mini+, I can also use CW mode with an external keyer. Plugging into the **HP** port allows me to hear the tones I am generating from my key, while also utilizing the tablet and headphones to continue to hear the airwaves.

Figure 8 — A simple solution that utilizes the CTR2-Mini+, a tablet, and an iambic paddle for remote CW use. Not pictured are headphones that plug into the HP port.

This setup works well for me. Being able to operate and change bands, frequencies, filter widths, and even slices with the Flex radio is a convenient option to have. While operating remotely, I can easily access all of the possibilities by tapping the VFO encoder a few times or leveraging my user-defined buttons. An easily accessible remote meter panel has an excellent user interface that allows me to view a combination of my S-meter, power meter, ALC meter, and compressor meter all at the same time. Additionally, while operating remotely and with specific ports open at the Flex radio's location, I can place the Mini+ into GUI mode, which gives me a graphical panadapter. This allows me to see where signals may be on the spectrum for the band in which I am operating.

Support

I previously mentioned that I upgraded the firmware to this device. While utilizing some features of the Mini+, I observed what may have been a bug in the current firmware. I believe it had to do with an array being called for the numerical Morse code characters.

I reached out to Mr. Hansen and informed him of my findings, and was surprised to receive a prompt response and an updated firmware emailed to me that evening. The support provided in this experience was great and personable. From browsing articles online, it appears that Mr. Hansen is open to hearing ideas regarding the Mini+ features, and I am convinced that this will help the future popularity of the Mini+ and other CTR2 devices.

In Summary

The Mini+ has the capability to control multiple radios via one device. It really can be what you want it to be, and if you have questions regarding the Mini+, I encourage you to browse through the manual to determine if this product is a solution for something you are working on now or may be working on in the future.

Although this article was written while using my Flex radio, the CTR2-Mini+ is supported for CAT control by a variety of different radios. It has great potential to conveniently access features to your current radio, as well as train with Morse code. This product has many features, with the potential for more to come in the future.

Taking into consideration the current features offered, the quick response to support, and the overall build quality, I consider (for the price tag) a fully assembled CTR2-Mini+ to be a good value. I am excited to watch for the future development of this product.

Manufacturer: Lynovation, **www.lynovation.com**. Price: $140 for the assembled unit. For more details on the kit version, please visit the manufacturer's website.

TinyGS – An Application of LoRa Technology

Reviewed by
Ivan Shulman, WC2S
wc2s@arrl.net

Some of the exciting aspects of amateur radio are the introduction of new technology, the repurposing of an existing device, and the exploration of an area in radio that is unfamiliar. Now-retired *QST* Editor Steve Ford, WB8IMY, in the ARRL Eclectic Tech podcast (**http://www.arrl.org/eclectic**) discussed amateur radio applications of long-range (LoRa) boards, which are tiny 70-centimeter data transceivers, readily available at **www.ebay.com** or **www.amazon.com** for about $27 each. LoRa technology can be used to create small area networks, and is ubiquitous in cities with modern parking meters, connecting credit cards with your bank at street level. In the April 2021 column, guest author Anthony Le Cren, F4GOH/KF4GOH, described the tracking of radiosondes with the use of these devices and a smartphone app called MySondy GO. Amateurs living in large cities may be challenged to locate weather balloons in their areas, but those living elsewhere are likely to have more success with this.

TTGO LoRA ESP32 board.

While many hams make contacts via satellite, the number of active amateur satellites will soon be dwarfed by the number of pico-satellites that carry LoRa modules into orbit, and these are readily accessible to amateurs with simple equipment. As described at **www.tinygs.com**, "TinyGS is an open network of

Bottom Line

The TinyGS board is a low-cost 70-centimeter transceiver. At this reasonable price, it would be consistent with the amateur spirit to explore the world of LoRa and see what else can be done.

ground stations distributed around the world to receive and operate LoRa satellites, weather probes and other flying objects, using cheap and versatile modules." Many of the satellites are designed by students at universities worldwide and are launched by commercial rockets from many countries. The power output of these satellites is often less than 1 W, with 500 mW being common. The Norby satellite usually runs at 2000 mW, but on occasion will be cranked up to 7000 mW. Because these picosatellites are in low Earth orbit, their operative lifetime is limited, and they are expected to self-destruct, to avoid adding to the problem of orbital debris. While downloads currently consist of only telemetry data, one pair of amateurs managed to exchange messages via an older satellite using TinyGS. The future offers hams an opportunity to try to expand on these capabilities, as LoRa technology becomes more common.

The website **https://github.com/G4lile0/TinyGS** shows complete details about TinyGS. A number of suitable devices are available on the internet, such as the TTGO LoRa32 V2.1 ESP32 Bluetooth Wi-Fi Wireless Module (433Mhz), but see the more specific list on GitHub. There are units that work at 915 MHz and other frequencies (see the lead photo), but as there are no satellites currently using those frequencies, 433 MHz units are recommended. While "Meshtastic" boards are available, they are more specialized than what is needed for TinyGS. Most boards come with a 4-centimeter-long stubby antenna, but reception with them is limited. The system can easily be improved with the use of a simple 440 MHz ground plane or even a mobile collinear antenna placed on a metal baking pan. While a low-noise amplifier will also enhance reception, this would be a good opportunity to try out more complex antennas, such as a quadrifilar helix antenna, an eggbeater, or a parasitic Lindenblad.

Getting Started

Connect the board to a USB port on a desktop computer, and identify the COM port assigned for the specific board. Be sure to use the CP210x drivers. From the GitHub site, download the TinyGS uploader, which is available in Windows, macOS, and Linux versions. Using the proper COM port, execute the program and install the firmware. The *Telegram* app (desktop or smartphone version) is required to obtain a login to the TinyGS dashboard on your board. The TinyGS community site on *Telegram* will direct you to the TinyGS Personal Bot, which will give you a login link. An MQTT username and password will be assigned. Save these, as they will be needed later.

Figure 9 — TinyGS IP address.

Figure 10 — TinyGS map.

From the TinyGS website, open the dashboard and configure the needed parameters. Name your station, assign a password for future access to the dashboard, and provide the local Wi-Fi network name and password, the latitude and longitude coordinates, the time zone, and the MQTT username and password. Only licensed amateur radio operators can transmit; otherwise, accept the default settings. If there are problems communicating with the board, be certain that you are connecting to the board's network (TinyGS) and not your local network. After configuring the board, reconnect to it via your local network.

Using an antenna with a wide view of the sky, power the board with a small USB power bank or a solar panel. This is a good opportunity to experiment with alternative power sources, to allow the antenna to be placed where power may not be readily available. The board will automatically link to the web via Wi-Fi. The screen will show the IP address assigned to the device, as well as a map with the satellite nearest to your QTH (see Figures 9 – 11). The system will automatically keep the board tuned to the appropriate frequency, which changes with each satellite. The screen will display specific satellite information, while the downloaded packets, as well as the transmission points, are posted to the TinyGS web page. Depending on your location and antenna, it is possible to receive as many as 10 – 12 packets or more each day

Figure 11 — TinyGS satellite data.

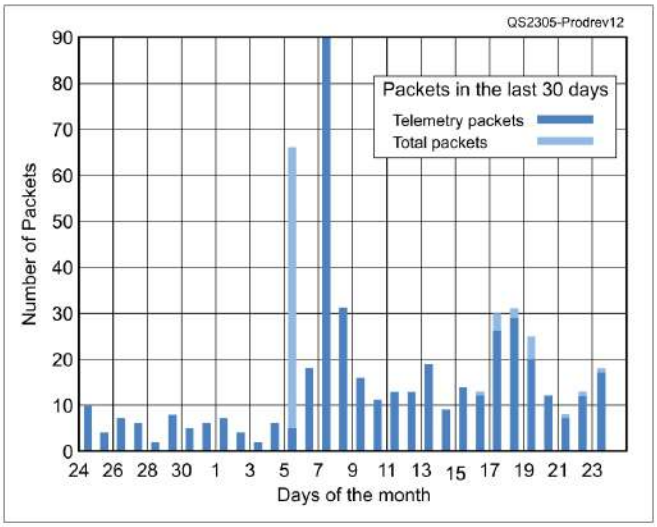


Figure 12 — Packets received.

(see Figure 12), but this can vary by the number of orbit paths of the satellites over a given QTH (see Figure 13). The sudden increase in packets received on the fifth day of this particular month (February 2023) represents the launch of several additional satellites simultaneously. The data received is aggregated, and the status of each satellite is closely monitored by satellite designers and their faculty (see Figures 12 and 13).

Conclusion

While there are an increasing number of users in the US and Canada, there are many others in Europe who are on the TinyGS network. TinyGS is more than just an introduction to satellite radio reception; it can be used as an educational tool, to encourage learning about coding on non-standard boards, antenna development, and consideration of alternative power

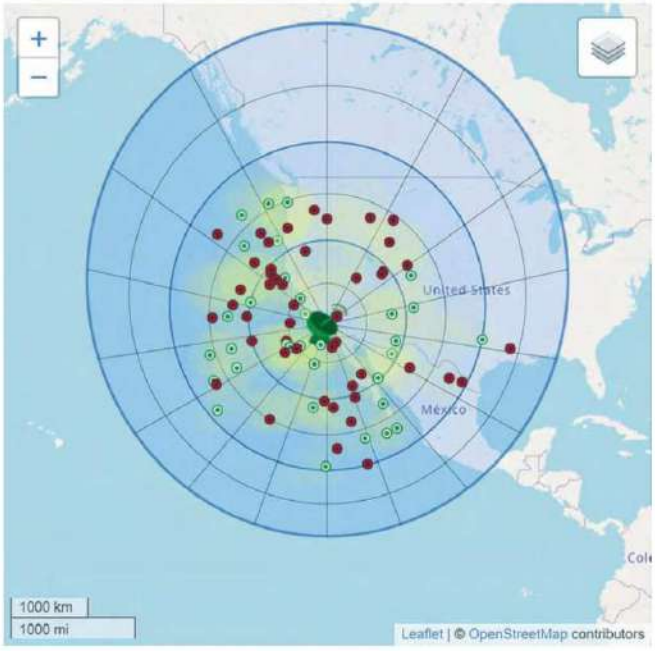


Figure 13 — Packets sent.

sources. Alternatively, students might be interested in connecting with others in the construction of a pico-satellite. LoRa is a relatively new technology, and both MySondy GO and TinyGS seem to be just the beginning of the application of these devices. As Steve Ford, WB8IMY, said, at such a reasonable price, it would be consistent with the amateur spirit to explore the world of LoRa and see what else can be done.

Manufacturer: LILYGO, **www.lilygo.cc**. Price: Between $20 and $30. Available from different online sources.

See *QST* in Depth for More!

Visit www.arrl.org/qst-in-depth for the following supplementary materials and updates:

- ✓ Table 3: The Xiegu G106 Power Levels Measured at 13.8 V dc
- ✓ Table 4: The Xiegu G106 Output Power and Current Draw vs Input Voltage
- ✓ Table 5: SWR Impact on the Xiegu G106 Transmit Power
- ✓ Table 6: The Xiegu G106 S-Meter Accuracy

Dave Casler, KEØOG, askdave@arrl.org

Ask Dave

Get more information from the "*QST:* Ask Dave" YouTube playlist at **https://bit.ly/3z2MBMI**.

Antennas and Backup Power

Put the Unun High on the Mast

Q Rick Nalisnick, W3AMT, asks: Should I put my 49:1 unbalanced-to-unbalanced impedance transformer (unun) above or below the roof when moving my station to a metal-roofed shed? My mast is 30 feet tall and made of heavy-duty high-pressure water pipe. I have a Johnson Viking Valiant.

A A 49:1 unun implies that you plan to use an end-fed half-wave (EFHW) dipole. I would put the unun as high on your mast as you safely can. Let's assume you're building the antenna for 40 meters and above. Connect 66 feet of wire from the unun positive-output terminal, and pull it up and away from the unun. You can make this into an inverted **V**, or a long sloper, to a tree or another mast. You should be able to use this antenna on 40, 20, 17, 15, 12, 10, and maybe 6 meters, but perhaps not on 30 meters.

Run your coax from the unun to a lightning arrester, such as the Alpha Delta ATT3G50U, mounted on a ground rod. From there the coax goes into your shed and to the radio.

This antenna system requires a counterpoise (something connected to the ground side of the windings). This can be the coax shield that runs to ground, the mast (if metal), or a 10- or 20-foot-long wire dangling from the unun common ground.

There are only two adjustments on an EFHW. Adjust the length for a low SWR on 40 meters. This should give you reasonable SWR for higher bands. If the SWR is much greater than 1.5:1, you can tweak the counterpoise configuration to see what works best.

Your Johnson Viking Valiant uses a pi network output. This is a matching circuit between the output tubes and the antenna. Under normal conditions, you will not need an additional tuner because the pi network has a circuit configuration equivalent to the modern T-network tuner.

The Johnson Viking Valiant is vintage tube equipment. Any modern transceiver (for example, Yaesu, Kenwood, Icom) will acquit itself better in every measure of transmitter performance than even the best vintage tube radios.

Extending the ARRL Antenna Kit

Q Joe Barcelo, KB2JSB, asks: What can I do to fix the high antenna SWR for my rig's internal tuner when attempting to work the 75-meter New Jersey Office of Emergency Management net held at 3.993 MHz? I purchased the ARRL End-Fed Half-Wave Antenna Kit and extended it from its original 66 feet to 132 feet. I found it works well on the low end of 80 meters and performs on the higher bands. As you can see in the SWR chart (created by a RigExpert AA-600) in Figure 1, it's great at the low end of 80 meters.

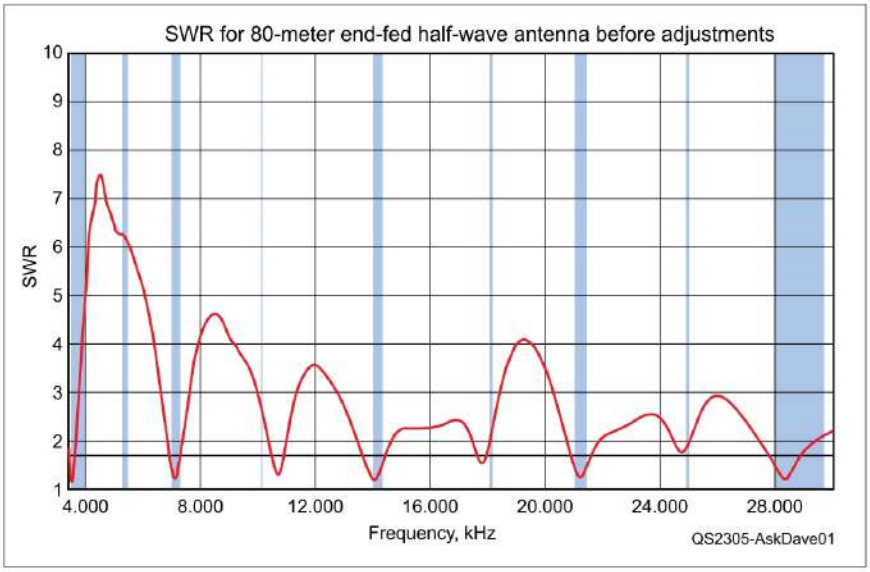


Figure 1 — Joe Barcelo, KB2JSB, measured the SWR across the entire range of the ARRL EFHW antenna kit after he had extended it by 66 feet. He used his RigExpert AA-600 and the included *AntScope2* software. The measurements show excellent results of the extended antenna, including on the bottom of 80 meters.

A The ARRL EFHW antenna kit can be extended to include the bottom of the 80-meter band, handy for CW, FT8, and other digital modes. In researching your question, I came across a blog post by Steve Ellington, N4LQ, who gave me permission to use his ideas. The answer is to electrically shorten the wire you added to make it work on 75-meter phone (the top of the 80-meter band). It's known that a short antenna can be electrically lengthened by adding "loading," meaning adding inductance near the feed point. Many antennas do this; however, the opposite is also true. An antenna can be artificially shortened by adding capacitance at the feed point. So, because we care only about electrically shortening the antenna on 80 meters, add the capacitance where the wire you added is connected.

Take your antenna down, and fold the wire in half. Cut the wire at the folded point, and attach each end to an insulator. Place a high-voltage capacitor across the insulator. About 500 pF will push up the resonance of only the 80-meter band by a few hundred kilohertz without affecting the other bands. Less capacitance will push it up more. Experiment with a few capacitance values until you get what you want. Note that the antenna will no longer cover the low end of 80 meters. You can easily get inexpensive high-voltage capacitors at Amazon.

I have the ARRL EFHW antenna kit, but have not built it yet. I will do so and create a video about it. You can find the video through the link at the top of this article.

Backup Power for Computers and Radios

Q James King, KK1NGJ, asks: I need to replace the battery in my computer-type uninterruptible power supply (UPS). Is the UPS the best answer for ham radio situations? If not, what is? The UPS backs up my computer and radios. The radios themselves are powered by a power supply plugged into the UPS.

A A consumer-grade UPS is designed to keep your computer system going long enough for you to do an orderly shutdown and not lose any data. It will also bridge momentary power anomalies. The UPS is not designed to keep you at your computer for a significant length of time. Similarly, your radio operation will continue for a few minutes.

Commercial installations, such as data centers, also have backup systems. The batteries are designed to last long enough for the diesel generators to start. The generators can go a week or more before needing fuel.

Figure 2 — Dave's, KEØOG, solar panel. The charge controller reduces to the correct voltage to charge several AGM batteries that provide indefinite backup power to his radios.

My computer has a companion UPS. However, my backup power for my ham station is solar. Figure 2 shows my 270 W 24 V panel that I purchased from a local solar supplier. My charge controller tracks the maximum power point and feeds a large 12 V absorbed glass mat (AGM) lead-acid battery bank. It's enough to power my station indefinitely without the amplifier.

You may want to address your computer needs with a simple backup system such as those sold by Office Depot or Amazon. You may want to look to another source, such as solar, to keep your radio powered indefinitely during an emergency.

Send your questions to **askdave@arrl.org**. I answer some questions here, and some via videos on my YouTube channel (**www.youtube.com/davecasler**), or during my weekly livestream on Thursdays at 6:45 to 8:15 PM Mountain Time on my channel.

Hints & Hacks

Hy-Gain AV-680 Tips; Gathering Backup Fuses; a Movable Amp; Crafting a Mobile Mic Mount

Making a Great Antenna Better

The Hy-Gain AV-680 is a great antenna. After assembling three of these, I'd like to pass on a few helpful tips.

The 30- through 80-meter loading coils are near the top of the antenna, which makes it top-heavy and prone to wind damage. One solution is to reinforce the connections between tubes BB and BC, and tubes BC and BD. The manual states that only stainless-steel hose clamps are needed at those junctions. But they are weak points, and if repeatedly subjected to high winds, they tend to fail. To make these connections secure, I first installed the clamps as directed. Then, I drilled holes all the way through the junctions above and below the clamps. Through these holes, I installed #10-32 × 1¼-inch stainless-steel bolts, nuts, and lock washers.

Figure 1 — A close-up of one of the tube joints. Notice the stainless-steel bolts above and below the hose clamp.

Now the two joints are extremely rigid (see Figure 1).

I live in an area that is often hit by hurricanes, so I also followed Hy-Gain's advice by installing three guy lines at a height of 14 feet. I purchased three thimbles and three guy clamps from Cushcraft, and mounted and secured them with stainless-steel clamps. I attached the lines with ¼ × 6-inch plastic wire ties.

The screws and nuts for the radial mounting brackets are exceedingly small and easily lost. My solution was to put a cloth under the work area to catch anything that drops.

Lastly, I found that it is easier to mount the antenna and install the counterpoise at the bottom *after* installation. — *73, Al Wasielewski, WA2VJL,* **wa2vjl@yahoo.com**

Spare Fuse Storage

How many unique fuses are in your shack? Do you have spares for all of them? By asking myself these questions, I realized that my shack lacked spares of critically important fuses.

To make sure your station is fully prepared, take inventory of all of the fuses used in your equipment. Fuses may be found in radios, battery chargers, power supplies, go-kits, and battery boxes.

Radios may come with spare fuses, but other devices usually don't. My inventory consisted of mini and standard low-voltage blade fuses, as well as older glass fuses.

Figure 2 — Two versions of a small storage box — one with space for both mini and regular blade fuses, and the other for only standard-size blade fuses.

Once you've identified the fuses you need, I recommend storing them in labeled boxes for quick retrieval. If you have access to a 3D printer, you can easily make your own containers. There are several free designs to download. To find the latest 3D designs, visit **www.thingiverse.com** and search for fuse storage.

Figure 2 shows two versions of a small storage box. One version has

Figure 3 — This is a larger container for bulk storage of standard blade fuses. The 3D-printed part is the insert for the Altoids® tin.

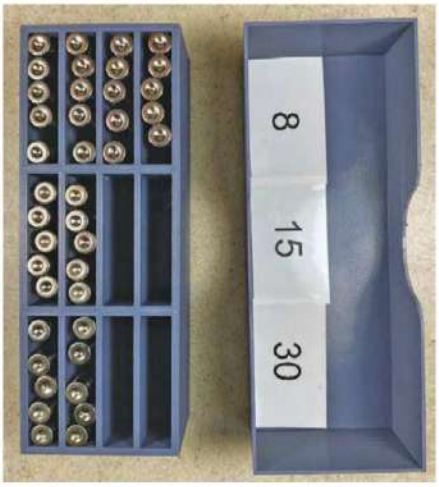


Figure 4 — This storage container was originally designed for storing metal tins, but it works well for loose glass fuses.

space for both mini and standard blade fuses, and the other has space for only standard blade fuses. You can attach these fuse storage boxes to the inside of a go-kit or battery box with hook-and-loop fasteners. Figure 3 shows a larger container for bulk storage of standard blade fuses. The 3D-printed part is the insert for the Altoids® tin. At present, there aren't any storage designs on Thingiverse meant exclusively for mini blade fuses.

If you have older-style glass fuses, Figure 4 shows a storage container that will keep them organized and safe. It was designed for storing metal tins, but it works well for loose glass fuses. You can label the box for convenience; if labeling the top of the box, you may want to label the bottom, too, so that they are correctly oriented.

Currently, there are no downloadable storage boxes for a mixture of mini blade, regular blade, and glass fuses. Perhaps that's something a reader can design for the future. — *73, Warner Phelps, KN4POG,* **kn4pog@arrl.net**

Adding Wheels to an Amplifier

My ham station is located on a desk in a cramped closet. Space is extremely limited, so to be able to access the back of my amplifier and the rest of my gear, I mounted my amplifier on wheels (see Figure 5). This simple addition made it much easier to service my equipment. — *73, Bill Kerber, WA2ILY,* **wa2ily@arrl.net**

Microphone Hanger

I was having a tough time finding places to hang the transceiver microphone in my truck, so I produced an easy solution. I took a surplus car adapter (see Figure 6) and removed the interior wiring to prevent the screws from causing a short circuit. Then I attached a microphone connector to the top of the adapter (see Figure 7). After this, I was able to plug the adapter into a power outlet and hang my mic (see Figure 8). — *73, Dave Lane, KBØRFY,* **kb0rfy@q.com**

Figure 5 — Adding a set of small wheels (circled in yellow) to my amplifier cabinet made it easy to maneuver in tight spaces.

Figure 6 — Start with a surplus car adapter. It is likely that you have one in your junk box.

Figure 7 — Using small screws, attach the microphone connector to the top of the adapter.

Figure 8 — With the adapter inserted into a convenient outlet, my microphone will always have a place to reside.

"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.

Technical Correspondence

Front-End Amplification and Filtering for the tinySA

Enhancing the tinySA

The March 2021 *QST* Product Review featured Phil Salas', AD5X, review of the tinySA spectrum analyzer, which prompted me to get one and investigate its capabilities. While this instrument has its limitations, for $50 it brings remarkable power into the hands of its owner.

The tinySA's input is easily overdriven, causing the display to fill up with so much clutter that I can't see the weaker signals. I planned on using the tinySA as a field strength meter on the AM and shortwave broadcast bands, and to measure weak signals and noise levels. Simply connecting a loop antenna tuned to those bands brought little satisfaction. However, I made two simple additions to enhance this instrument.

One problem was that the minimum discernible signal was only –102 dBm for a 30 kHz bandwidth when used with the tinySA's low-frequency input. This corresponds to a minimum discernible signal of –112 dBm for the narrowest 3 kHz resolution bandwidth. It also indicates that the equivalent noise figure of the instrument is about 27 dB. Adding up to 30 dB of front-end gain with a low-noise amplifier could greatly increase its ability to measure weak signals. I tried adding a 32 dB wideband amplifier, but the front-end overload problem was worse than ever.

Before connecting the amplifier, I verified that its maximum output was less than +10 dBm — this ensured that it couldn't damage the input of the tinySA. For added insurance and convenience, I operated the amplifier from a 9 V battery instead of the normal 12 V and found that it still had about 26 dB of gain.

When I looked at the output of the loop antenna with and without the amplifier, I saw that between 0.5 and 350 MHz, the strongest signals were FM broadcasts, even though I live at least 10 miles away from the nearest FM station. This suggested that my loop was not well shielded, which I already knew. Because the FM signals were stronger than the AM signals from the loop, the whole spectrum was filled with distortion products. While using the 100 kHz to 350 MHz input — even with the sweep set to a maximum frequency of 2 MHz — the 88 to 108 MHz signals seemed to be overloading the front-end circuits.

I built a quick low-pass filter that cut everything above 2 MHz. This breadboard filter didn't help much until I

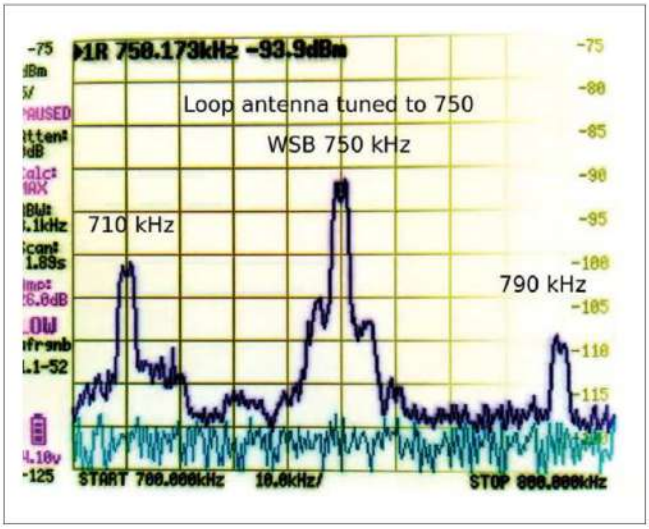


Figure 1 — The addition of a front-end filter made it possible to accurately measure AM broadcast signals.

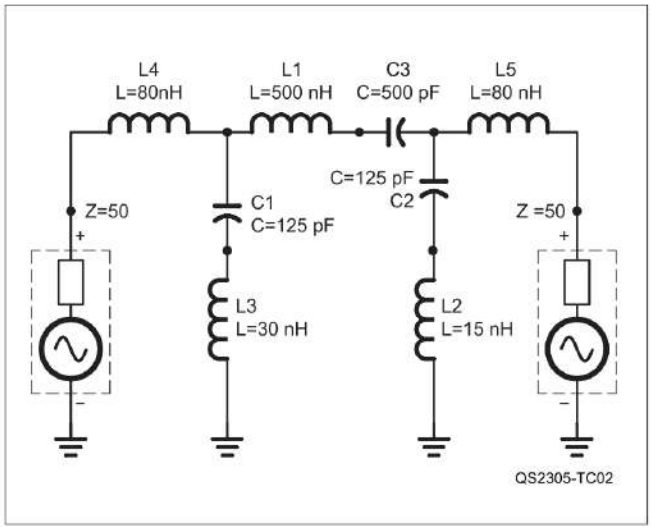


Figure 2 — For use on the HF bands, I simulated and built this 30 MHz low-pass filter.

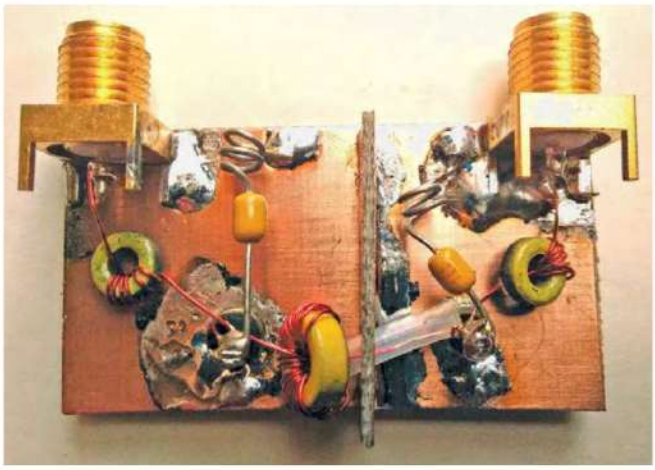


Figure 3 — My homebrew MF/HF filter prior to adding shielding.

shielded it. Then I saw the AM band come to life. With the added 26 dB low-noise amplifier and a way to attenuate the FM signals, the screen began to display the weak signals.

I plan to calibrate my loop antenna to measure the absolute field strength of AM/SW broadcast signals and noise with a small, inexpensive portable setup. Figure 1 shows a plot of some of the AM stations I was able to see and measure. WSB in Atlanta, Georgia is 100 miles away from my home and just strong enough to be heard at 750 kHz with a car radio. Driving past a noisy location, like an intersection with traffic lights, wipes the station out. But with the loop, the noise floor was –118 dBm at my house, which was 16 dB lower than what the tinySA could have displayed alone.

For use on the HF bands, I simulated and built a 30 MHz low-pass filter (see Figure 2). The SPICE simulation showed a 65 dB rejection of the FM broadcast band while passing signals up to 30 MHz. Deep notches require particularly good shielding between stages, and as built, the notch depth measured only –55 dB. This was enough to prevent overloading by the FM stations. Some users may also have strong AM stations nearby. Adding C3 will knock down AM broadcast signals by about 6 to 12 dB, and changing it to 250 pF will give you 12 to 24 dB of AM band rejection. Without C3, the filter passes dc to 30 MHz, where response is down by 2 dB.

L4 and L5 are optional; they add additional attenuation above 150 MHz. The inductors in series with C1 and C2 are used to provide deep notches at 88 and 108 MHz. For the 15 nH inductor, I simply wound two turns around a 3/16-inch drill bit to form a small coil with one of the leads of the capacitor. I then wound three turns for the 30 nH coil. These can be adjusted to give notches near 88 and 108 MHz. The result, before I added the shielding, is shown in Figure 3.

Figure 4 depicts the setup with the shielded filter, amplifier, and tinySA. The antenna connects to the leftmost SMA connector. The tinySA itself is well shielded. If the preamp and input filters are also well shielded, then you will notice its ability to display and analyze weak MF/HF signals.

Of course, the minimum resolution bandwidth of 3 kHz will still limit your ability to observe narrow modes. Even a CW tone will show up as 3 kHz wide, but you will be able to record the amplitudes of weak signals and noise sources. Work on the 600-, 160-, and 80-meter bands is especially noise-limited. Man-made noise signals are often broad, but they can have narrow peaks. Unless you can see all the way to your receiver's noise floor, you may not be able to observe noise sources getting into your loops, or other lossy receive-only antennas common on the low bands. With this setup, you should see the noise sources, and once they are eliminated, you will see the weak signals beneath them. — *John Stanley, K4ERO,* **k4ero@arrl.net**

Figure 4 — The completed setup with the shielded filter, amplifier, and tinySA.

Technical Correspondence items have not been tested by *QST* or ARRL unless otherwise stated. Although we can't guarantee that a given idea will work for your situation, we make every effort to screen out harmful information.

Materials for this column may be sent to ARRL, 225 Main St., Newington, CT 06111; or via email to **tc@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 a work, please send the author(s) a copy of your comments. The publishers of *QST* assume no responsibility for statements made herein by correspondents.

Beginner Foxhunting

Everything hams should know about this exciting radio direction-finding sport.

Rob Zielfelder, N1NUG

Within amateur radio, *foxhunting* is the search for hidden transmitters with the help of radio equipment and direction-finding techniques. Many hams — and non-hams — of all backgrounds and skill levels find foxhunting enjoyable. Foxhunts can be carried out individually or as a club activity, and they are a great way to introduce unlicensed family and friends to amateur radio.

Foxhunting Equipment and Logistics

The hidden transmitter, or *fox*, can be something as simple as a fellow ham hiding in the bushes with a handheld, or as intricate as an automated transmitter disguised as a tree stump. Most foxhunts are conducted on the 2-meter or 70-centimeter bands. Therefore, a popular choice is to build a *fox box* that consists of an inexpensive handheld paired with an automated controller, a battery, and a small antenna built into a weatherproof container, such as a military surplus ammo box.

The most popular fox box controllers are pre-assembled units that use a pre-made cable, which plugs into the external speaker and microphone jacks of a handheld. This type of controller can be programmed by connecting it to a PC with a standard USB cable, then running programming software supplied by the manufacturer. For long-duration foxhunts, the controller can be configured to let hunters trigger the fox box by transmitting DTMF and/or CTCSS tones on a predetermined frequency. For timed hunts, the controller is commonly programmed to activate the transmitter and play tones or a short Morse code message at predetermined intervals.

Hunters can use various radios, antennas, and other equipment to search for a fox. A simple and effective foxhunting setup is a handheld, a directional antenna (such as a Yagi), and an in-line attenuator. A handheld used for foxhunting must have a signal strength meter that shows received signal strength with a bar graph display. Signal strength meters with the most segments offer the most usable measurement range between weak and strong signals, and are the best for foxhunting. Some handhelds lack signal strength

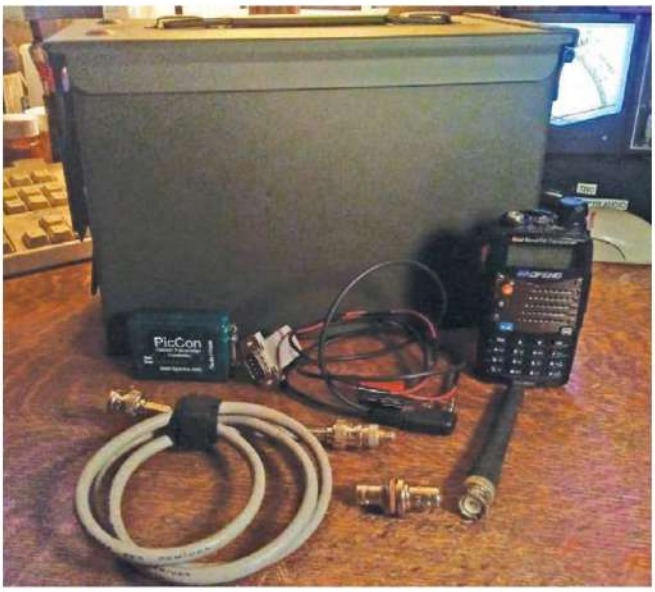
Foxhunts can be enjoyed by hams and non-hams of all ages. [Melinda Zielfelder, photo]

meters with enough range, so it is important to check for this feature before selecting a radio.

There are many directional antennas that work well for foxhunting. One of the most popular and inexpensive options is a homebrew tape measure Yagi. In one afternoon, a ham can construct this type of antenna for $20 to $30 with materials from a home improvement store. Other popular choices include commercially available collapsible Yagis, homebrew coat hanger Yagis, and loop antennas. Many hunters opt for a heavier, more rugged antenna to mount on a vehicle at the start of a hunt. Then they switch to a smaller handheld antenna when they're close enough to find the fox on foot.

An *attenuator* is a device inserted between the radio and antenna to reduce the strength of received signals, and is necessary when hunting near the fox. Step attenuators are popular among new foxhunters; they use a series of switches to turn on the resistor networks that weaken the signal picked up by the hunter's radio. This allows hunters to adjust the received signal strength of the fox by turning the switches on or off as needed. A more complicated — but possibly more effective — choice is an offset attenuator. Like a step attenuator, this device installs between the radio and antenna. It differs by using active circuitry to generate a carrier signal that mixes with the received signal from the fox. This creates a weaker secondary signal on another frequency, to which the hunter can tune their radio. The hunter can then use the weaker signal on the offset frequency to get a better reading on the radio's signal strength meter when close to the fox. Both options are available as fully assembled products or project kits. There are also homebrewing instructions for both attenuator types online.

Along with radio gear, hunters need equipment to navigate unfamiliar areas and determine which initial direction to travel. The direction of travel, or *heading*, is usually decided by orienting the hunting antenna with magnetic or true north on a map, and turning the antenna for maximum signal strength. For more information about magnetic north and true north, see the sidebar, "Magnetic North Versus True North." After this, the hunter can determine the heading by using a compass to measure the difference in degrees between magnetic or true north, and the direction in which the antenna is pointing. Once a hunter determines a heading, they can use a ruler to draw lines on a map toward areas of interest, such as a public park or recreation area.



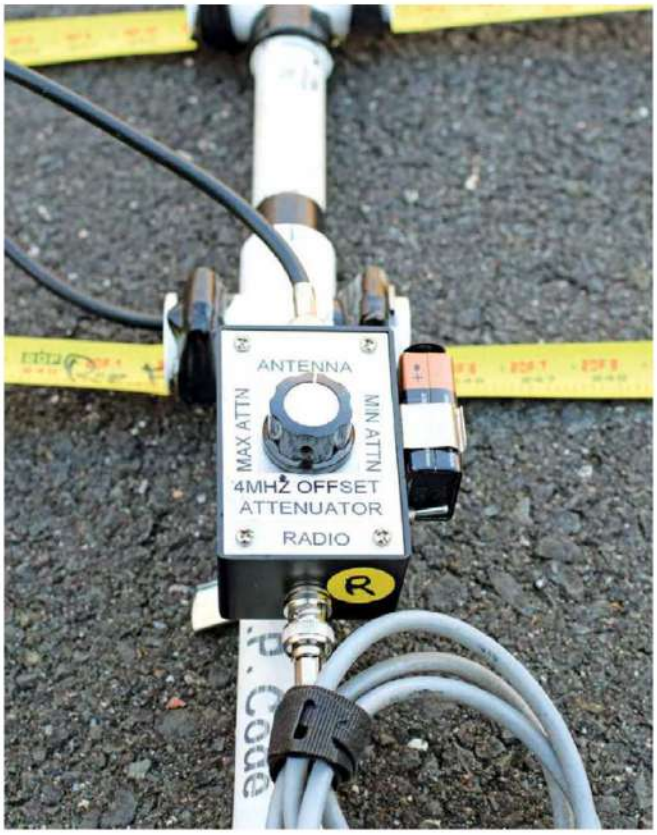
A typical fox box with accessories. [Bill Curlew, KC1JTS, photo]

The Hunt Begins

A typical hunt for an automated fox box begins with someone hiding a box out in the field, then notifying hunters that the fox is "loose." The fox owner will usually offer some basic information, such as the fox's transmit and receive frequencies, access codes for activating the fox box (if applicable), a general starting location, and a general search area. Most automated foxhunts don't have a strict time limit, but it's good practice for fox box owners to tell hunters how long the fox's battery should last. They should also mention any plans to move or retrieve the box after a period of time. For this type of hunt, the first person to find the fox box earns some bragging rights, but a winner isn't usually declared otherwise.

Magnetic North Versus True North

Modern maps are created with north referenced as the Earth's true north pole. However, compass needles always point toward the Earth's magnetic north pole, which is not in the same place as the true north pole. This difference is called *declination*, and it is important to know in order to establish accurate direction measurements during a foxhunt. The declination varies depending on where the hunter is on Earth, so hunters need to determine declination in their area by using a smartphone app or an online resource. Some maps will show the local declination in their legends. Once they know the declination, hunters must add or subtract this number from their compass readings to establish accurate headings.



An offset attenuator attached to a homebrew tape measure Yagi, courtesy of Bill Curlew, KC1JTS. [Melinda Zielfelder, photo]

When the fox is a live person operating a transmitter, a starting time and location for the hunt are given well in advance. Hunters will gather at the starting location, and the person acting as the fox will initiate the hunt at the specified time. They will begin transmitting on a designated frequency that can be heard at the starting location. Once the fox starts transmitting, the hunters can take signal strength readings, establish a heading, and begin hunting. At the first transmission, the fox will often give hunters a search radius and a time limit before transmitting at set intervals for the rest of the hunt. The fox may choose to vary power levels and antennas to throw hunters off the trail, or they may give helpful clues. The clues can be straightforward, like references to nearby landmarks, or they can be riddles. For example, the fox may state, "I can see a water tower from my location" or "The airport looks busy today." Or, to add more of a challenge, a fox might ask, "What can run but never walk, has a mouth but never talks, has a head but never weeps, and has a bed but never sleeps?" instead of simply saying, "I can see a river from where I'm located." Hunters may work alone or share their findings with the others as the hunt progresses. Generally, the first hunter to find the fox wins, but some hunts will factor in each hunter's mileage when determining a winner or settling a tie.

For either type of hunt, the first step is to establish a heading by finding the direction that the fox's signal is coming from. Hunters do this by tuning their radios to the frequency the fox is transmitting on. Then, they turn their directional antenna while watching the radio's signal strength meter for a maximum reading. Once they find the maximum signal strength, they note the direction toward which their antenna is pointing and use a compass and a map — or a smartphone app — to decide on a heading. For more information about smartphone mapping apps, see the "Smartphone Mapping Apps: Boon or Bane?" sidebar. It may also be possible to estimate how far away the fox is by the strength of the signal reading.

After choosing a heading, two strategies can be used to narrow the search area. One option is to follow the heading for some distance and take another signal strength reading later to verify that the heading was accurate. This method can be repeated with course corrections along the way until the hunter is close to the fox. The other strategy is triangulating the fox by moving to a new location perpendicular to the starting point. This allows the hunter to take another reading and plot a new heading on their map; the new and original headings should intersect at some point. Taking another reading from an equally distant location will yield a third heading, which should cross close to the intersection of the first two headings. The area around the three intersecting lines should be close to where the fox is hiding. This method, although potentially more accurate, can result in a longer search time.

As a hunter approaches the fox, the signal strength will continue to grow until it is no longer possible to see dips and peaks on the meter when turning the antenna. At that point, it will be necessary to cut the signal strength with an attenuator so that a heading can be determined. If using a step attenuator, stages can be turned on and off to achieve a usable signal at the receiver. If using an offset attenuator, the hunter will first need to tune the radio's receiver to the offset frequency, then adjust the attenuator for optimal signal strength.

The last leg of the hunt is usually carried out on foot with a handheld. But at this stage, the fox's signal may be too strong for attenuators and directional antennas to be effective. One technique for cutting

Smartphone Mapping Apps: Boon or Bane?

Smartphone mapping apps can be useful, but they can come with a learning curve and fail to work properly if cell phone service is interrupted. When using an app to plot headings over a large area, detail can also be hard to see, due to the small screen size. However, when the search area is small or when the hunter is close to the fox, a mapping app will often be more detailed than a paper map. Most apps can also help with plotting routes and alerting hunters to potential road hazards that may hinder progress during a hunt.

signal strength, known as *body fading*, is to remove the traditional antenna from the handheld and use something like a paper clip or bobby pin as an antenna instead. The hunter can then hold the handheld close to their chest while walking in a tight circle and looking for peaks and nulls on the signal strength meter. The makeshift antenna functions as an attenuator, and the hunter's body acts as a reflector on a directional antenna, which helps them find a heading. Another technique that is especially helpful for camouflaged foxes is tuning the receiver to the third harmonic frequency of the fox box. For example, if the fox is transmitting at 146.550 MHz, the hunter can tune their dual-band handheld to 439.650 MHz. If the hunter is close enough, they should be able to receive a weak signal from the transmitter, determine a final heading, and zero in on the fox.

Get Involved

Foxhunting is an enjoyable activity that helps build technical prowess and operating skill. Some hams even participate in competitive foxhunting and other amateur radio direction finding (ARDF) contests to earn awards and recognition. There are many ARDF organizations that promote this activity and sponsor sanctioned foxhunting events throughout the year.

Rob Zielfelder, N1NUG, has been a licensed amateur since 1992. In addition to foxhunting, he enjoys portable operating, collecting and preserving classic ham radio gear, and ragchewing with local hams. He is the secretary of the Natchaug Amateur Radio Club, based in Mansfield, Connecticut, and an active member of the BEARS of Manchester Amateur Radio Club. Rob works as a product validation engineer at Cadence Design Systems in Burlington, Massachusetts. When not working or operating, he enjoys outdoor activities like camping, biking, and kayaking with his wife and son.

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

Check Out *On the Air* Magazine for More About Finding Foxes

If foxhunting sounds appealing and you want more information, read "Radio Orienteering: Using Sound to Find Your Way," by Charles E. Scharlau, NZØI, in the March/April 2023 issue of *On the Air*, ARRL's magazine for hams at beginner and intermediate skill levels.

The March/April 2023 issue of *On the Air*, featuring "Radio Orienteering: Using Sound to Find Your Way" by Charles Scharlau, NZØI.

Radio orienteering (aka, amateur radio direction finding, or ARDF) involves radios, maps, compasses, and navigating on foot outdoors — think of it as foxhunting's more competitive, athletic cousin. Participants use direction-finding receivers to seek out transmitters located within a forest or park, and winners are determined by the number of transmitters they find, and the time spent completing the course.

Gheorghe Fala and Norbert Linke wait for their 80-meter classic start times with receivers, maps, and compasses at the ready. [Photo courtesy of Imre Polik, KX4SO]

As is the case with foxhunting, no amateur radio license is required to participate in radio orienteering (because you're only receiving, and not transmitting), so this is an ideal activity for involving the non-hams in your life.

Radio orienteering brings together science, technology, nature, and sport. Its pace and level of challenge can be adapted to match the skills of the participants, regardless of age, physical fitness, or experience level. Read the article at **www.arrl.org/ota** and find out more at **www.arrl.org/radio-orienteering**.

Frank Donovan, W3LPL

The last solar minimum occurred in December 2019, marking the beginning of the end of the longest period of spotless days (days without sunspots) since the beginning of the radio age. While most solar minima have 200 to 500 spot-free days, the recent solar minimum produced nearly 1,000.

DXers have long hoped for a return of the seemingly endless days of 10- and 6-meter worldwide propagation that delighted them during the solar maxima of five of the six solar cycles from 1946 to 2003.

DXers' dreams came true starting in January 2023, thanks to a sudden onset of 12- and 10-meter DX propagation nearly every day through at least March. A major upsurge in 6-meter DX propagation is likely to begin just a few weeks after this article appears in print, and is forecast to recur during May and June (and possibly from November through February) for about the next 4 years. While the highest monthly sunspot number will likely occur in mid-2024, improved HF and 6-meter propagation will likely continue through about 2027.

This article focuses on significantly improved HF and 6-meter propagation for the next 4 years and offers practical guidance to help HF and 6-meter DXers make the most of their solar-maximum experience.

Steadily Improving Propagation

The most important beneficial effect of solar maxima is the much more intensely ionized high-altitude (about 250 to 400 kilometers) F region. Increased ionization greatly increases high-altitude F-region electron density, improving the reliability of long-distance 20- through 10-meter propagation during the day, and 40- through 10-meter propagation at night.

From May through early August in the Northern Hemisphere, thin highly reflective and very efficient (but relatively short-lived) sporadic-E ionization patches develop in the ionosphere at an altitude of about 100 to 120 kilometers. Unlike F-region ionization, sporadic-E ionization is believed to be caused by the massive daily influx of high-velocity, dust-like micrometeoroids from May to early August as they shed long-lived ions into the ionosphere as they burn up at high temperatures in the ionosphere's denser lower altitudes. Wind shears in high-altitude tidal neutral winds are believed to compact the ions into dense sporadic-E patches with distinct morning and afternoon peak occurrence rates.

While sporadic-E propagation does not improve significantly during solar maxima, it plays a crucial role during the 4 years near solar maxima by providing additional ionospheric hops coupling into F-region propagation, especially on 6 meters.

Sporadic-E patches begin developing shortly after sunrise and continue to develop into the evening, mostly during May through early August in North America, less frequently during December through mid-January, and much less frequently during the rest of the year. Sporadic E is crucial for 12-, 10-, and 6-meter DX propagation during the spring and summer because its high-efficiency reflections often support multi-hop propagation, extending to distances of 4,000 to 10,000 kilometers, and occasionally beyond. Sporadic-E patches are crucial for 6-meter DXers because they extend the range of F-region propagation by coupling sporadic-E

propagation at mid-latitudes into frequent F-region propagation in the equatorial region.

The F region is the most important region for DX communications below 30 MHz throughout the solar cycle, especially at 50 MHz during the 4 years near solar maxima. This is due to its high electron density at high altitudes, and its ability to persist throughout every night of the year. Nighttime persistence results from slow electron recombination through infrequent collisions with atoms in the very thin high-altitude ionosphere.

Low-Power Worldwide 12- and 10-Meter DXing

Twelve- and 10-meter DX propagation improved dramatically starting in January 2023, especially for low-power and QRP stations. Simple 12- and 10-meter antennas are much more effective during solar maxima because of very low ionospheric absorption on these bands.

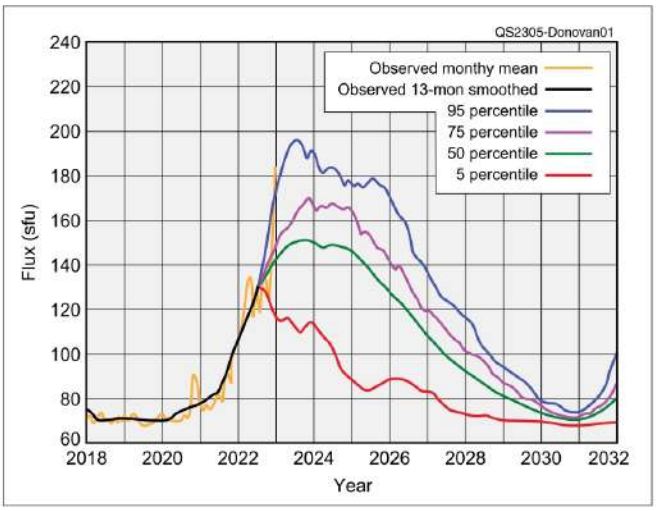
Long-path propagation traverses more than half of Earth's circumference, usually occurring at an azimuth nearly opposite to the short-path azimuth to the distant location. For example, long path from the US east coast to Japan is usually at an azimuth of approximately 130 to 150 degrees toward South Africa and Brazil. Long-path propagation is very frequent during the 4 years near solar maxima from sunrise through mid-morning in North America, but it is only occasionally strong enough for QRP stations with simple antennas to take advantage of. Long-path contacts are workable with a 100 W transmitter and a horizontal dipole at least 25 feet high during many days throughout the year.

Twelve- and 10-meter short-path propagation to Europe, the Middle East, and North Africa during the 4 years near solar maxima usually produces strong signals for many hours during most days from October through April. Strong-signal short-path propagation provides many opportunities for low-power and QRP stations using simple antennas to enjoy frequent DX contacts over the next 4 years.

In North America, 12- and 10-meter short-path propagation to the Pacific, New Zealand, Australia, Japan, and East Asia begins in the late afternoon during most days between October and April. Propagation from North America to Asia is particularly sensitive to solar storms that can dramatically reduce the strength of signals reflecting from the disturbed F region near the auroral oval over Alaska and northern Canada.

Worldwide Winter Nighttime DX

Thirty- through 10-meter propagation usually fails during winter nights during the 4 years near solar minima.



This graph shows solar radio flux forecasts up until 2032, as of March 2, 2023. On or before the 10th of every month, the NASA Marshall Space Flight Center updates its solar cycle forecasts. Visit **www.nasa.gov/msfcsolar** for more information.

Seventeen- through 10-meter DX propagation extends well into nighttime hours during the 4 years near solar maxima, and 30- and 20-meter DX propagation often extends throughout the night during the 4 years near solar maxima.

Forty-meter nighttime propagation from North America to Europe and Asia often fails during the 4 years near solar minima. This is caused by a trough of depleted ionization that often develops from November through early March shortly after local sunset in the ionosphere in a narrow band bordering the south wall of the Northern Hemisphere auroral oval. This band of depleted ionization is known as the *mid-latitude ionization trough*. Increased residual nighttime ionization greatly improves 40-meter propagation from North America to Europe and Asia during the 4 years near solar maxima, by significantly reducing the severity, frequency, and duration of winter nighttime depleted ionization affecting the 40-meter band.

Unfortunately, 80-meter (and especially 160-meter) DX propagation will be degraded by increased solar ionizing radiation and more frequent solar storms for at least the next 4 years.

Year-Round Excitement for 6-Meter DXers

During May 2022, North American 6-meter DXers experienced many days of enhanced F-region trans-equatorial propagation (TEP) to the southern cone of South America. Frequent enhanced 6-meter TEP is highly likely to recur during many days from late April to early June through at least 2027. Much of the following description of enhanced 6-meter propagation also applies to 12 and 10 meters.

A Reliable Radio Propagation Resource

The comprehensively updated propagation section in the 100th edition of *The ARRL Handbook for Radio Communications* — "Radio Propagation and Antenna Systems" — provides detailed explanations of the solar cycle, propagation on each ham band, the effects of solar disturbances on propagation, propagation forecasting methods, and many other related topics. More detailed discussions of the underlying physics and mathematics of radio propagation can be found in the section's references. Visit **https://handbook.arrl.org** for more information on this special edition of *The ARRL Handbook*.

Earth's magnetic field plays an important role in enhancing high-altitude TEP by contributing to the creation of two bands of significantly enhanced electron density in the F region, known as the *equatorial ionization crests*, about 1,500 kilometers north and south of the geomagnetic equator. The increased ionization follows magnetic field lines, producing a few degrees of upward tilt in the equatorward sides of both equatorial ionization crests. The equatorial ionization crests begin to develop several hours after local sunrise at the crests and persist until several hours after local sunset at the crests. In the Northern Hemisphere, the northern equatorial ionization crest is located over Venezuela and Colombia, about 500 kilometers north of the geographic equator. In the Southern Hemisphere, the southern equatorial ionization crest is located over Brazil and Bolivia, about 3,000 kilometers south of the northern ionization crest. TEP greatly enhances 6-meter propagation at distances of up to about 8,000 kilometers via a chordal hop directly between the two tilted equatorial ionization crests, avoiding a lossy intermediate ground reflection.

TEP in North America usually reaches only as far north as Haiti and the Dominican Republic, because the northern equatorial crest over Venezuela and Colombia is usually too far south for propagation directly into the US. The two equatorial ionization crests reach their maximum electron density in May when the geomagnetic equator is oriented toward the sun, just as sporadic-E propagation begins to occur almost every day in the US. From mid-afternoon through evening during most days in May, sporadic E couples to TEP from much of the US to the southern cone of South America. Sporadic E coupled to TEP occurs much less often during the fall, due to infrequent sporadic E in the Northern Hemisphere.

The northern equatorial ionization crest over West Africa sometimes supports enhanced propagation into the equatorial region of Central Africa and the Indian Ocean. Stations in the US can occasionally couple into this propagation via long-distance sporadic-E propagation across the Atlantic Ocean during morning hours from May through July, and less frequently at other times of the year.

The northern equatorial ionization crest over Colombia and Venezuela frequently supports enhanced propagation from North America into the equatorial region of South America. US stations frequently couple into this propagation via sporadic-E from May through July.

Long-distance sporadic-E propagation throughout the solar cycle also supports frequent, but not daily, propagation from North America to Europe, the Middle East, and North Africa from shortly after sunrise through early evening hours in North America from early June through early August, without the need for F-region propagation. Long-distance sporadic-E propagation from North America to Japan and its nearby Asian countries often begins shortly after sunrise in Asia from early June to mid-July.

A few isolated occurrences of F-region propagation from the US to Europe occurred in January 2023. If this solar cycle continues to increase in intensity over the next 6 months, there's a chance that 6-meter F-region propagation to Europe and other worldwide locations may occur during isolated days from November 2023 through early February 2024, and possibly for the next 2 years.

Your Solar Maximum Adventure

Now is the time to prepare for many memorable solar maximum experiences by improving your station and antennas to allow you to make the most of your operations. During the 4 years near solar maxima, 100 W and a simple dipole antenna only about 25 feet high will allow you to easily work the world. See the sidebar, "A Reliable Radio Propagation Resource," for where to find more information on how to prepare for Solar Cycle 25's solar maximum.

Frank Donovan, W3LPL, began his ham radio adventures as a 12-year-old during the W1OP/1 Providence Radio Association 1959 Field Day. His multioperator, multitransmitter DX contest teams have made more than 1 million DX contacts in CQWW and ARRL DX contests. Frank was a contributor to the updated propagation section in the 100th edition of *The ARRL Handbook*. He's enjoying retirement after a 45-year career in electronics and systems engineering. Frank can be reached at **donovanf@erols.com**.

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

Two Girls Take on YOTA Camp

Marissa Collier, KE8SSG, and Veronica Romanek, KD2UHN

Last year, 21 campers met during the third week of June at the National Voice of America Museum of Broadcasting (VOA Museum) in West Chester, Ohio, to attend the second annual Region 2 Youth on the Air (YOTA) Camp. We were campers and wish to share our experiences.

YOTA Camp Director Neil Rapp, WB9VPG (in the blue shirt), and some staff members gathered together with the campers in the entrance of the VOA Museum during the last day of camp.

Discovering the Different Facets of Ham Radio

Throughout the week, we operated under the special event call sign W8Y. Young hams between the ages of 13 and 25 traveled from New Jersey, Ohio, Wisconsin, Arizona, California, Idaho, and many other states around the country to attend the camp. Because neither of us attended YOTA Camp last year, we weren't sure what to expect. The experience proved to be more meaningful to us than we could've ever imagined!

Campers engaged in many educational ham activities that involved mid- and high-altitude ballooning, operating digital VHF and UHF modes, kit building, direction finding, ham satellites, and much more. Campers were introduced to multiple aspects of amateur radio to show that the hobby offers something for everyone.

Some campers discovered their interests for the first time, while others dug deeper into their already-established passions, using equipment donated by Amateur Radio Digital Communications, Icom America, DX Engineering, World Wide Radio Operators Foundation, Heil Sound, R&L Electronics, and many other generous sponsors. The campers' interests varied widely. Many liked using SSB to communicate with others on the radio, while others enjoyed contesting. Some preferred not to speak on the air and leaned more toward operating digital modes, such as FT8. Whatever aspect of the hobby we preferred, we were able to pursue it in the amazing and resourceful shack within the VOA Museum.

Veronica Romanek, KD2UHN (left), and Marissa Collier, KE8SSG (right), operated using the camp's special event station, W8Y, with Assistant YOTA Camp Director Adam Johnson, KD9KIS (middle), making lots of contacts around the world!

Making Unforgettable Connections

When we weren't operating or participating in another fun ham radio activity, we spent time getting to know our fellow campers. We had time to go bowling, play laser tag and arcade games, and make a lot of connections. Later in the week, we took a bus to Kings Island and enjoyed the theme park and water park, while taking a break here and there to practice contesting. We could also operate the special event station set up in a temporary shack in the hotel, as well as play UNO in the hotel lobby. This bonding time led to the forming of many lifelong friendships. For many

Katie Campbell, KE8LQR (middle), and Abby Kimi Matsuyoshi, KK7CFJ (right), learned about satellite contacts from Ruth Willet, KM4LAO (left). The campers made many satellite contacts throughout the week.

Dylan Romero, KN6IVW, was cheered on by camp parents and staff while he tracked down a beacon in the YOTA Camp foxhunt.

of the campers, this was the first time they had gathered with a large group of ham radio operators, especially other youth operators. Both of us have always been the youngest operators in the room at almost every event, so being able to meet and interact with other operators our age was incredibly exciting, even life-changing.

An Education to Last a Lifetime

Both of us are new to ham radio, so YOTA Camp was our first time getting so much hands-on experience with a radio. We had a lot of thoughts to share about our experieces:

Marissa: It wasn't until I left camp that I was encouraged to figure out what interested me about amateur radio. Hearing about my peers' fascination with the hobby and listening to their passionate conversations intrigued me more than anything else. I read multiple books and watched multiple videos, but nothing really piqued my interest until I attended YOTA Camp. Now, I find myself operating FT8 frequently and researching amateur radio astronomy. Thanks to camp, I got a grasp on basic topics that I could never quite understand previously. It helped me gain a strong basic understanding of amateur radio, which I had been struggling to build on my own.

Veronica: I came into YOTA Camp having some experience with ham radio. I'm the President of the University of Scranton Amateur Radio Club, W3USR, but the club is still in the early stages. We're currently in the process of getting a new antenna, so I haven't really had a lot of chances to transmit yet. I appreciated being able to do so much at camp. One thing I really enjoyed learning about was satellite contacts. Before YOTA Camp, I never even knew it was possible to bounce radio waves off a little satellite moving so quickly so far away from us. I loved learning about it, and I even got to make a satellite contact of my own!

Attending YOTA Camp was such a unique experience because it was camper-led. If there was something we wanted to learn, we had the freedom to learn more about it, either on our own or with others. Campers and staff were incredibly understanding about each camper having their own level of amateur radio knowledge. Everyone was more than willing, thrilled even, to answer any question a camper had. It was clear that what really mattered was getting young ham operators together to share the passion of the hobby and keep it alive. This shared goal created a supportive and fun environment for everyone.

We are both looking forward to the 2023 YOTA Camp. Ham operators aged 15 to 25 who are interested in attending this year's YOTA Camp can submit their applications online at **https://youthontheair.org**. The application deadline is May 31, 2023.

All photos provided by the authors.

Veronica Romanek, KD2UHN, has been a ham since 2019 and has her Amateur Extra-class license. She's currently in her senior year at The University of Scranton, double majoring in physics and Spanish. Veronica is also President of the University of Scranton Amateur Radio Club, W3USR. As a research assistant to her physics professor, she uses ham radio technology often, studying the sun's effects on Earth's ionosphere.

Marissa Collier, KE8SSG, has been an amateur radio operator for 1 year. Her dad has been very involved in amateur radio her entire life and has constantly encouraged her to get a license and get involved in the community. It wasn't until recently that Marissa became interested in the hobby and began engaging in it often.

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

FCC Exposure Rules Soon to Affect Every US Radio Amateur

As the 2-year transition period comes to an end, the ARRL RF Safety Committee Chair discusses the rules and how to evaluate your station's RF exposure to ensure compliance.

Gregory Lapin, PhD, PE, N9GL

On May 3, 2021, new FCC rules governing RF exposure went into effect. A 2-year transition period was implemented to allow existing stations to make any necessary changes. On May 3, 2023, the transition period ends, and all transmitters operating in the US are expected to comply with the exposure rules.

A Brief History

FCC RF exposure rules aren't new to radio amateurs. In 1996, the FCC enacted the first exposure regulations that affected the Amateur Radio Service, and all amateur radio stations were expected to comply by 1998. In addition to rules governing Maximum Permissible Exposure (MPE) for amateur radio stations, some procedural rules were applied. For the FCC to be assured that radio amateurs understood the important aspects of RF exposure to humans, they required that every amateur radio examination contain at least one question related to exposure. In order to correctly answer that question, the entire question pool had to be studied and, in doing so, every licensed amateur radio operator would be assumed to have knowledge about the subject.

The FCC also added a certification statement to Form 605 and Form 610 that had to be affirmed by every radio amateur who was issued an FCC license, renewed their license, or changed their station address. Due to the 10-year license period, by 2008, every licensed radio amateur in the US had certified that they would comply with the FCC's rules for RF safety.

Many radio amateurs determined that their stations complied with the FCC exposure regulations by 1998. However, a provision of the rules at that time — Categorical Exemptions in FCC Part §97.13(c)(1) — made it possible for some to avoid evaluating their stations.

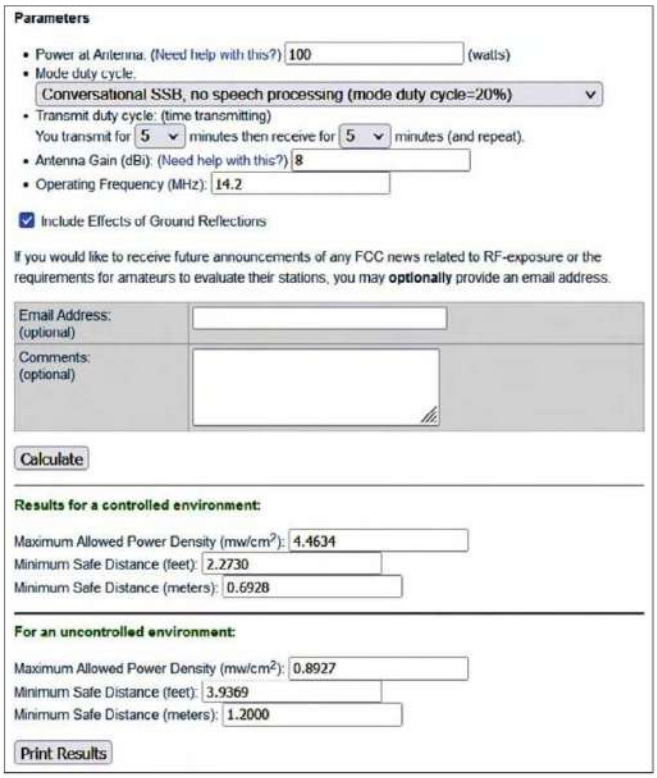


Figure 1 — The ARRL RF Exposure Calculator, showing a sample analysis for a 100 W transmitter with no feed-line loss and normal (non-compressed) SSB modulation into a 20-meter Yagi. The closest that any part of a person can be to any part of the antenna is 0.7 meter (2.3 feet) for the occupational population, or 1.2 meters (3.9 feet) for the general population. Note that this calculator is not valid for exposure distances less than 20 centimeters (8 inches) from a person.

To simplify the determination of human exposure compliance for many radio amateurs, the FCC set up some operating conditions that would preclude amateurs who operated under those limits from being required to assess their stations. For instance, if a transmitter produced less than 225 W on 20 meters, no further assessment would be required for that band. The conditions for categorical exemption were based on power and frequency. In addition, all mobile

and handheld radios were categorically exempted from performing exposure assessments, as were repeaters that transmitted less than 500 W effective radiated power.

Recent Rule Adjustments

In April 2020, the FCC proposed a major reorganization of their exposure rules for all services. Even though they were not proposing changes to the MPE limits, they strove to harmonize exposure rules for all services. Unlike previously, where some services had special rules to follow, under the newly proposed changes, the same rules would apply to all licensed transmitters in the US. This affected the Amateur Radio Service in several ways. The categorical exemptions that applied only to radio amateurs were eliminated. A different method of exposure analysis, called *specific absorption rate*, became required for all radios with antennas that were less than 20 centimeters from a person.

Another change was what the FCC calls *positive access control* (PAC), which becomes the responsibility of all affected radio amateurs under the new rules. If a location is identified as causing excessive exposure to people within it, the FCC expects every station, including amateur stations, to prevent access by unauthorized persons to that location and to post warning signs about potential high RF exposure.

The FCC delayed implementation of their new rules until May 3, 2021, and allowed all stations that operated under the previous rules to have a 2-year transition period before being required to comply. The FCC was clear that only stations that had complied with the previous rules as of May 3, 2021, could avail themselves of the transition period. After the implementation date, if a station was changed in such a way as to affect exposure, such as changing antennas or power, the exposure assessment had to be performed immediately. As of May 3, 2023, every station must be assessed for exposure before it is operated.

Simple Exposure Assessment Methods

The new rules still include distinctions for people who know about their exposure and are trained on how to control it, and those who do not. The *occupational exposure* (also referred to as *controlled exposure*) designation applies to amateurs and members of their households, with the expectation that they be trained about RF exposure. A separate *general population exposure* designation applies to everyone else. Their exposure is deemed *uncontrolled*, and they have more restrictive MPE limits.

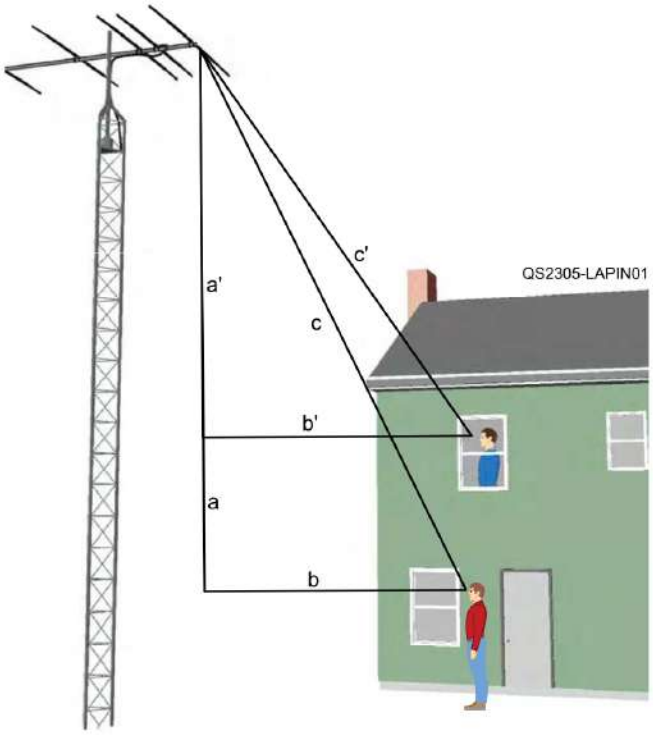


Figure 2 — In determining the compliance distances between the antenna and the location of people, consider the antenna height, the nearest point of the person being exposed, and the horizontal distance between the antenna and the exposure point. This drawing, originally published in *RF Exposure and You* by Ed Hare, W1RFI, illustrates the exposures of a person standing on the ground and on the second-story level of a nearby house. The formula $c = \text{sqrt}(a^2 + b^2)$ is used to determine if the person meets the compliance distance.

Most stations can be assessed with little effort. In place of the categorical exemptions, the FCC developed a table of exemption formulas based on power to the antenna, antenna gain, and minimum distance between a person and the antenna. With a simple calculation, this could exempt an amateur from having to perform further analysis of a station to help ensure compliance with the FCC MPEs. The FCC exemption treats every exposed person as if they were in the general population, and thus applies more restrictive MPE limits.

ARRL provides an RF Exposure Calculator at **http://arrl.org/rf-exposure-calculator** (see Figure 1). The calculator requires values to be entered for the power transmitted minus the feed-line loss, the antenna gain, the type of modulation used, the approximate transmit and receive times, and the frequency of operation. There is a checkbox to enable calculations with ground effects, and in the interest of conserva-

tism, this should be selected. From these values, the calculator generates the minimum distance from any part of the antenna that a person in the occupational and general populations may be located. See Figure 2 for how to calculate direct distances to the antenna. This evaluation must be repeated for every frequency band, antenna, and the maximum power level that's used to obtain a complete environmental analysis of a station.

The disadvantages of the simple methods of performing exposure assessments are that they can be overly conservative. The FCC exemption applies a perfect ground reflection factor, which makes it seem like people are being exposed to higher fields than they usually are. The FCC exemption and the online calculator assume that the fields produced by directionality of an antenna are present at all locations around the antenna, rather than only in the main beam. This often overestimates the exposure of people located out of the main beam of a directional antenna mounted on a tower or rooftop.

More complex analysis methods are available for stations that need them. If the simple assessment methods show that PAC will be needed to prevent excessive exposure, a more exact method of analysis may show that this is not the case. Computer modeling or calibrated measurement can be used to give more exact determinations of exposure.

Most radio amateurs will want to avoid applying the PAC principles. Permanent high fences and warning signs are not what most amateurs want. It's generally more desirable to modify a station's operation or antenna positions so that no publicly accessible locations could cause overexposure. This can be done in many ways, which include lowering transmitter power, raising antennas, and operating with lower operational and modulation duty cycles.

Moving Forward

The FCC plans to publish updates to *OET Bulletin 65* and *OET Bulletin 65 Supplement B*, but the current versions can still be found online. Those documents provide more details about performing exposure assessments and ways to mitigate when locations are determined to cause excessive exposure. Sections in the 2023 revisions of *The ARRL Handbook for Radio Communications* and *The ARRL Antenna Book for Radio Communications* also provide up-to-date information about exposure assessment. More information can be found on the ARRL RF Exposure web page, at **http://arrl.org/rf-exposure**.

As before, the FCC does not require that the results of a station's exposure analysis be submitted. However, it is advisable to keep a record of the analysis so that if there's ever an exposure complaint about that station, the calculations can be shown to the FCC.

Under the updated FCC rules, every radio amateur is responsible for determining that their station does not cause exposure that exceeds the FCC MPE limits to any person, either within their homes or outside of them. This is also required for portable and mobile operations.

Help show the FCC and the public that we're responsible users of RF energy by carefully considering exposure from your station and performing any required evaluations.

Gregory Lapin, N9GL, has been a radio amateur for 53 years, earning his license at a young age. He received his PhD in electrical engineering, specializing in biomedical imaging techniques, from Northwestern University. Greg studied drug delivery methods for brain tumors before becoming involved with RF exposure effects. He is a Life Senior Member of IEEE, serves on the IEEE Committee on Man and Radiation, and co-chairs the subcommittee that develops the C95.1 EMF safety standard for the IEEE International Committee on Electromagnetic Safety. Greg has been the Chairman of the ARRL RF Safety Committee since 1998 and represents ARRL on the FCC Technological Advisory Council. His other radio interests include propagation effects, software-defined radio, and hiking through parks to operate POTA and SOTA. Greg can be reached at **n9gl@comcast.net**.

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

Feedback

In the March 2023 issue of *QST*, an error was made that has since been corrected in the digital edition. In "W9BSP: Remembering a Historic CW Mentor, 100 Years Later" by Leanna Figlewski, KC1RMP, Don Mix's call sign was incorrectly listed as W1TC. His correct call sign was W1TS. *QST* regrets this error.

The ARRL Ham Radio Equipment Insurance Plan

This policy covers radios and related equipment, with a lower deductible than most homeowners policies.

There are all kinds of ways to lose valuable gear in an instant. ARRL offers a ham radio equipment insurance plan as a benefit to members. Through this insurance, members can cover all of their equipment at a low price and ease their fears.

Tom McDonough, Senior Vice President of Risk Strategies Insurance, Inc., is the broker and administrator for this program with ARRL. He said, "The equipment insurance plan covers your radio equipment and all related equipment — whether you include computers, portable gear, miscellaneous cables and accessories, handhelds, etc."

The insurance covers mobile and home station equipment from damage by fire, lightning, wind, collisions, theft, and other accidents or natural hazards. It also covers loss or damage to antennas, towers, and rotators.

The insurance coverage available to ARRL members can help safeguard your equipment in the event of theft or damage. [Larry Schroeder, K9VOA, photo]

ARRL Insurance Plan vs. Homeowners Policies

McDonough explained how the ARRL insurance plan compares to homeowners policies:

> The premium is based on a rate well below typical homeowners policy rates, and the deductible of $50 to replace and $25 to repair is far below the deductible on most homeowners policies. Your homeowners policy is protecting you from a major economic loss — such as a fire — to your home. That is why most homeowners policies have minimum deductibles of $500 per claim. You can reduce premiums by having a $1,000 deductible on your homeowners policy, and even more if you raise it to $2,500 or higher. This will save you on premium costs while still protecting you from the catastrophic loss due to a fire or damage from a fallen tree. The downside of that is your radio transceiver or other station equipment can be worth less than the homeowners deductible, and if lightning strikes, burning out the equipment, you could be faced with a significant expense to replace the equipment and get back on the air. Insuring the equipment in the ARRL program may help you reduce your premium on your homeowners policy and give you coverage that would not be available under the homeowners policy, because the deductible alone would prevent a covered claim.

The annual premium for this plan is just $1.40 per $100 of replacement cost value (with a minimum premium of $20), whereas other coverage available typically runs from $5 – $8 per $100 of replacement cost value. The plan doesn't cover normal wear and tear on the equipment, dishonest acts by the policyholder, and other similar situations that are excluded in the policy.

How to Enroll

The ARRL Ham Radio Equipment Insurance Plan is available to all ARRL members who live in the United States. To enroll, visit **www.arrlinsurance.com**, where you can sign up, schedule your equipment, and pay your premium using a credit card or check. Make sure you list all radio equipment in use and its replacement value.

You must notify the plan administrator (Risk Strategies) of new equipment within 60 days of acquisition. With no additional premium, coverage for up to $2,000 of new equipment is included until your next renewal date. For assistance, please call Risk Strategies' toll-free number, 866-819-0209.

Protection begins as soon as the premium is processed. For more information, visit **www.arrlinsurance.com**.

John Ross, KD8IDJ, kd8idj@arrl.net

Happenings

IARU Held First 2023 Meeting

The 56th meeting of the Administrative Council of the International Amateur Radio Union (IARU) was held via Zoom on January 16, with President Tim Ellam, VE6SH, presiding.

The council received reports from the officers of each of the three regions. The meeting's focus was on the International Telecommunication Union's (ITU) upcoming World Radiocommunication Conference (WRC-23) later this year in Dubai, United Arab Emirates. The IARU effort for WRC-23 is being led by IARU Vice President Ole Garpestad, LA2RR.

Here is a summary of the meeting submitted by IARU Secretary Joel Harrison, W5ZN:

Of particular interest to the amateur radio and amateur satellite services for WRC-23 is agenda item 9.1b concerning the amateur allocation in the 23-centimeter band at 1240–1300 MHz. The Radio Navigation Satellite Service (RNSS) is seeking protection from secondary users in addition to an expanded allocation. Preparatory work for this item is being conducted within the ITU's Working Party 5A. IARU's global WRC-23 9.1b team, led by Barry Lewis, G4SJH, has been consulting with the amateur community, resulting in a contribution to the draft guidance recommendation in support of coexistence with RNSS. Details on this work can be found at ***www.iaru.org****.*

The council reviewed a comprehensive written report from IARU [Electromagnetic Compatibility] Coordinator Dr. Martin Sach, G8KDF, on his work with the International Special Committee on Radio Interference (CISPR). CISPR was formed in 1934 to set standards for controlling electromagnetic interference in electrical and electronic devices. CISPR's specific areas include radio interference measurements and statical methods, and limits for the protection of radio frequencies.

An ongoing strategic planning review of the current IARU structure is being conducted within several Working Groups (WGs). The Administrative Council received reports from the Futures WG Steering Committee, Relationship WG, Governance WG, and the Legal WG. This work is scheduled for completion no later than July to allow discussion at the Region 1 [General] Conference in Serbia in October, with additional opportunities provided to the other two regions.

Region 1 has received several inquiries regarding the status of [John Devoldere's,] ON4UN, and [Mark Demeuleneere's,] ON4WW, book, Ethics and Operating Procedures for the Radio Amateur *and is considering how this document [can] be updated.*

The Summary Record from this meeting, in addition to previous meetings, is available at ***www.iaru.org/reference/ac-summary-records****.*

The next virtual meeting of the Administrative Council is scheduled for March 20, and an in-person meeting is scheduled for June 25 at the conclusion of Ham Radio in Friedrichshafen, Germany.

Amateur Radio Digital Communications Awards $420,000 to the FreeDV Project

Amateur Radio Digital Communications (ARDC) has awarded a $420,486 grant, one of the first for 2023, to develop and document FreeDV, an open-source amateur radio technology. The grant will be used to help advance the state of the art in HF digital voice and promote its use.

FreeDV is a graphical user interface application for Windows, Linux, and macOS that allows any SSB radio to be used for low-bit-rate digital voice. Speech is compressed to 1600 bps and modulated onto a 1.25 kHz-wide 16 QPSK signal, which is sent to the microphone input of an SSB radio. The technology was initially developed by David Rowe, VK5DGR. Now, an international team of radio amateurs are working together on the project.

Among the many opportunities for FreeDV, the ARDC grant will allow experienced digital signal processing developers to work with volunteer staff to improve speech quality and low signal-to-noise ratio operation, thereby making FreeDV performance superior to SSB over poor HF channels. Commercial HF radio companies will also be able to embed FreeDV into at least two commercial radios and greatly reduce setup effort and latency. In addition, ARDC hopes the grant will facilitate widespread adoption of a truly open-source, next-generation digital voice system for HF radio as well as a mature, open-source low-bit-rate codec useful for a variety of amateur radio and commercial applications. Lastly, the grant will contribute to a suite of high-performance, HF data modems for open-source data applications, usable by any radio amateur.

To learn more about the technical specifications of FreeDV, go to **www.freedv.org**.

2023 Hamvention Awards Announced

The 2023 Hamvention Awards Committee for Dayton Hamvention® has announced this year's award winners.

The Special Achievement Award recipient is Jason McDonald, MD, N2TPA. Dr. McDonald began his career as a radio frequency engineer before becoming a trauma surgeon. He brings amateur radio to the world through youth projects and Scouting, and particularly through Radio Scouting. He has helped form Scouting clubs all around the world. To date, more than 500 youths in these clubs have become licensed and are on the air.

The Amateur Radio Club of the Year is the Delaware Valley Radio Association (DVRA). This ARRL Affiliated Club was formed in 1930 and serves the Trenton, New Jersey area. DVRA has tripled in size over the last 6 years due to the wide range of amateur radio activities and events they offer.

The Technical Achievement Award recipient is Dr. James Breakall, WA3FET. As a Professor of Electrical Engineering at Penn State University from 1989 to 2022, Dr. Breakall developed cutting-edge antenna technology and mentored his students in amateur radio. Through his mentorship, he inspired 700 of his students to become new licensees. Now a retired Professor Emeritus, he serves as a consultant to the US Army, Air Force, and Navy on many antenna-related projects.

The Amateur of the Year is Carsten Dauer, DM9EE. For 30 years, Dauer has been active in European amateur radio through the World Radiosport Team Championship and Youth on the Air. Recently, he spearheaded a movement that provides amateur radio equipment to Ukraine by collecting donations and personally delivering them.

You can read more about the 2023 Hamvention Awards at **www.hamvention.org**. Dayton Hamvention is May 19 through 21, 2023, at the Greene County Fairgrounds and Expo Center.

Special Achievement Award recipient Jason McDonald, MD, N2TPA. **[www.hamvention.org/event-details/awards**, photo]

Technical Achievement Award recipient Dr. James Breakall, WA3FET. [**www.hamvention.org/event-details/awards**, photo]

AMSAT Recruiting Engineering Volunteers

AMSAT is looking for an electrical engineer with RF experience to join its Fox Plus team. The team will be a collaboration of up to 10 electrical, mechanical, software, and systems engineer volunteers. There will also be an opportunity to design and build the RF communications subsystems for a series of low-Earth orbit 1U-3U CubeSats to support AMSAT's educational and engineering objectives.

Candidates should have working knowledge of analog and digital communications protocols (e.g., FM, PSK, and FSK) to provide digitally synthesized audio for FM modulated VHF/UHF/SHF voice and telemetry channels. Development opportunities can begin with modification of previous Fox designs and/or by starting with an original design.

Mechanical engineers are also needed to join AMSAT's Fox and GOLF CubeSat teams. There will be collaboration with an all-volunteer team of up to 12 electrical, mechanical, software, and systems engineers. The positions entail an opportunity to use structural design and analysis skills to develop a series of low-Earth orbit and highly elliptical orbit 1U-3U CubeSats. Contributions may include developing the spaceframe and deployable solar panel subsystem, analyzing thermal characteristics of the CubeSat and the design of the thermal management system, preparation and oversight of the environmental testing procedure, and managing documentation of the CubeSat's adherence to the launch provider and space vehicle owner's specifications.

AMSAT volunteers typically spend 5 hours per week on their project and attend a weekly online update meeting. An amateur radio license and CubeSat experience are helpful, but not necessary. US citizenship or proof of permanent residency is required. Interested applicants can send an email with their resume/curriculum vitae to **volunteer@amsat.org**.

Jack Ference, W3KX, Appointed ARRL Third Call Area (W3) Incoming QSL Bureau Manager

The National Capitol DX Association (NCDXA) Board of Directors has appointed Jack Ference, W3KX, as the new ARRL Third Call Area (W3) Incoming QSL Bureau Manager. He fills the position of the late Fred Laun, K3ZO (SK), who passed away on January 3, 2023.

There were some delays in the transition, and contact confirmations that were forwarded to the old P.O. box were not able to be collected. Incoming confirmations that were sent between December 2022 and March 2023 were returned to the senders by the US Postal Service.

Please send any returned QSLs and new shipments to the following new address:

W3 QSL Bureau
NCDXA
P.O. Box 190
Glenelg, MD 21737-0190

Amateurs who have contact with active foreign QSL bureaus or international QSL managers are asked to pass this information along to them.

Foreign bureau managers and international QSL managers are asked to contact Ference by email, so their mailing address and contact information can be updated for future business. All questions and inquiries sent to the new P.O. box will be answered. Ference can be contacted directly at **w3kx@arrl.net**.

Section Manager Nomination Notice

To all ARRL members in Colorado, Georgia, Los Angeles, Sacramento Valley, San Francisco, South Texas, Eastern Washington, West Virginia, and Western Washington. 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. It is acceptable to submit signatures that have been sent via email or mail under the following guidelines: The petition copies must be made from the original form supplied by ARRL or downloaded from the ARRL website. The form must be exactly the same on both sides (i.e., autobiographical information should appear exactly the same on all copies). All forms/copies must be submitted together.

Candidates may use any of the available electronic signature platforms such as DocuSign, HelloSign, and Signed PDF. Candidates who use an electronic signature platform to be nominated, as described above, do not have to send in original paper copies of the nominating documents. The packet that is sent to ARRL Headquarters must be complete. Multiple files or emails for a single petition will not be accepted.

We suggest the following format:

(Place and Date)

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

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

(Signature _____ Call Sign _____ City _____ ZIP _____)

Any candidate for the office of Section Manager must be a resident of the Section, an amateur radio licensee of Technician class or higher, and a full member of 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 9, 2023. If more than one member is nominated in a single Section, ballots will be mailed from Headquarters no later than July 3, 2023, to full members of record as of June 9, 2023, which is the closing date for nominations. Returns will be counted August 22, 2023. Section Managers elected as a result of the above procedure will take office October 1, 2023.

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, 2023. If no petitions are received from a Section by the specified closing date, such Section will be resolicited in the October issue of *QST*. A Section Manager elected through the resolicitation will serve a term of 18 months. A Section Manager vacancy occurring between elections is filled through appointment by the Field Services Manager.
— *Mike Walters, W8ZY, Field Services Manager*

SM Nomination Resolicitation:

Because no nomination petitions were received for the Montana Section Manager election by the nomination deadline of December 9, 2022, nominations are hereby resolicited. See the above for details.

Rick Palm, K1CE, k1ce@arrl.org

Public Service

The Benefits of Using an External Speaker

External speakers are often overlooked for use in an emergency response or public event operations tent station. This piece of equipment is used to provide additional audio from a radio, and is typically connected to the external speaker jack on the back of a transceiver. There are times when an external speaker is helpful, such as at a busy Incident Command Post (the primary location for on-scene incident command and management) in a major disaster area with a high ambient noise level due to military vehicles and large PA systems blaring loud notifications, warnings, etc. In this scenario, an external speaker can help officials and other people hear radio transmissions more clearly for copying error-free messages that may contain critical information.

Headphones can be a part of the solution, but the operator may miss an emergency alert issued over the PA system. It's good to be able to hear both the radio and the PA system.

Some indications that an external speaker may be beneficial might include an operator's hearing deficit, or a situation in a large room where a group of officials, commanders, Amateur Radio Emergency Service® leaders, etc., need to listen firsthand to radio message traffic.

There are also scenarios where an external speaker may not be appropriate, such as inside the Emergency Operations Center's (EOC)

My Behringer B105D external speaker. I usually place it on the floor during operations, but for display purposes, it's shown on the desktop at my station. [Rick Palm, K1CE, photo]

main conference room where the Emergency Manager and the Emergency Support Function Managers gather. They can also be unnecessary in a smaller radio room that adjoins the EOC main conference room. Be sure to use good judgment.

External Speaker Options

I decided to look for external speaker options for my Icom IC-7300 HF transceiver and Yaesu FTM-3100R VHF FM transceiver. Icom makes two external speakers for the IC-7300: the SP-33 for base station operations, and the SP-35 for mobile operations. I also found a basic model with a 4-inch speaker and an output of 20 W of audio, made by a manufacturer that I trust and selling for less than $100. I considered purchasing it, but then wondered if I could find a small PA stage or studio monitor like the type used by performing and studio recording artists. It would certainly offer more audio output and better sound quality.

I decided to purchase the Behringer B105D from Sweetwater Sound (**www.sweetwater.com**), a large musical instrument retailer based in Fort Wayne, Indiana. This piece of equipment is an ultra-compact 50 W PA/monitor speaker with two line inputs (¼-inch plugs and a ⅛-inch mini plug) that accept both of my radios. It features a 5-inch speaker; is only 11 inches high, 8 inches wide, and 7 inches deep, and weighs 2.2 pounds. There are equalizer pots for high, mid, and low audio frequencies, as well as separate volume controls for each channel. There are also an MP3 player and Bluetooth circuit, which could be useful if a briefing is recorded on a thumb drive as an MP3 file. The thumb drive would then be inserted in the USB port, and the file could be played at an EOC staff meeting.

On-the-Air Experience

My experience with the B105D speaker has been excellent. Its versatility allows me to adjust the volume of my HF and VHF radios separately while they're plugged into the speaker. I can turn the volume down on one while listening to the other, but still have an ear on the first for an emergency traffic alert, etc. I can also adjust the tonality of both outputs separately — I can turn the high frequencies down and the mid and low ranges up, as personal preferences.

The unit is rugged with a heavy-duty injection-molded Cycolac plastic case for protection, and a built-in, non-dynamic carrying handle. The Bluetooth circuit connection works fine, and so does the USB MP3 player. The output tone quality and volume of the unit are excellent; it blows my two radios' audio outputs away.

At a price point of less than $100, it works great for my purposes, which almost always involve consideration of emergency communications demands. It would easily fill a large EOC or American Red Cross briefing room with loud, clear, and intelligible audio.

Field Organization Reports

February 2023

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**.

545
N9VC

525
WA3EZN

465
W7PAT

449
W9GRG

344
W7EES

290
WØPZD

250
KT2D

248
AD8CM

240
WO2H

235
WM5N
ND8W

215
KK4PUX
KK6GXG

200
KC8WH
N5MKY

195
KV8Z

185
KC9FXE
AC8NP

182
KB5PGY

181
W4CAC

180
N2LC

172
W9RY

165
AG9G
W4DNA

153
KB3YRU

148
WD8USA
K2VTT

145
N4CNX
N8SY

140
WB9QPM
KF5OMH
KØRCJ

138
WM2C

136
AI9F
KD2LPM

135
WA3QLW
W2PAX
WB9WKO
KF5IOU
W3YVQ

134
WB8R

130
K4IWW
KC8PBU
N2JBA
KW1U
N1UMJ

128
KO4KUS
KC8T

127
AC0KQ

125
K7OED
KE8RS
NI2W
KD8ZCM
W2OOD

123
KE5YTA

121
KC3MAL

120
WA4VGZ

WC4FSU
K9LGU
KY2D
WA1URS
W2AH

119
N2DW

116
K3JL
WV5Q

111
K8AMH
KB8RCR
K1XFC

110
AD4DO
KA9MZJ
K8MDA
WB8TQZ
KB1TCE
W1KX
KB2QO
K1UAF
N1IQI
W1RVY
N1ILZ
W2ZXN

109
W8IM
KD2QAR

106
KR4PI

105
W4EDN
KG5NNA
KC8YVF
K3FAZ
N2EWC

101
W4CMH

100
KZ8Q
WB4RJW
KM4WHO
NX9K
KA5AZK
WB8SIQ
AC8RV
KB8GUN
W8MAL
AA3SB
KB8PGW
K3YAK

KA2GQQ
KA2HZP
NW3X
N1PZP
WZ0C
N1LAH
WA2U
AK2Z
KB2YAA

96
AA7BM

95
KDØHHN
W8GSR
KB1NMO
KD2PQP

94
NØDMP
KF7GC

93
WB2VUF

90
KB9GO
KC9UC
WA3QPX
W4KX
KL7RF
K8KRA
N8MRS
KB8HJJ
KA1G
K8ED
N3GE
WX2DX
KC1KVY
N3ARB

89
W7PHX

88
W5WMC
W4TTO
KD2TDG

87
KE8DON

86
KT5EM
KF5IVJ
K8RDN
KD2VZA

84
KB1NAL
K1HEJ

KD2GXL

83
KØAVU
N3KRX

82
WB4ZDU

81
N2TSO
KC1OIP

80
AE2EY
KT4WX
KR4ST
N8OD

79
KK7FYW
K6JT
K2MTG
K2EAG

78
K1CFI
KC1HHO

77
W7IMN
WB8RGE
AB1AV

76
W1INC

75
KE8ANW
KD8UUB
KB3MXK

74
W3ZR
WW3S

73
K3RAU
WB3FTQ
KBØDTI

72
KN4AAG
W5XX
KR2HWK

71
K5OB
NØET
AA3N

The following stations qualified for PSHR in previous months, but were not acknowledged in this column last month: (Jan. 2023) KK4PUX 225, W4CAC 164, W2ZXN 110, K2VTT 108, KB2YAA, KD2PQP, WA2U 100, KT5EM 99, N3ARB 90, KR2HWK 86, K2EAG 85, N2EWC 79. (Dec. 2022) W7PAT 391, KK4GXG 340, W7EES 259. (Aug 2022) WA3QLW 155, AC0KQ 129, KF0BPN 124.

Section Traffic Manager Reports

The following Section Traffic Managers reported: AR, AZ, CO, CT, DE, EMA, ENY, EPA, GA, IL, KS, KY, LA, MDC, ME, MI, MO, MS, NC, ND, NFL, NH, NLI, NNY, NV, OH, OR, SFL, SJV, STX, TN, VA, WCF, WI, WMA, WNY, WPA, WV, WY.

Section Emergency Coordinator Reports

The following Section Emergency Coordinators reported: AL, AR, CT, ENY, EWA, GA, ID, IN, MDC, ME, MI, MO, NFL, NLI, NNJ, NNY, NV, PAC, SCV, SNJ, STX, TN, VA, VI, WCF, WMA, WPA, WTX.

Brass Pounders League

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

NX9K 1,766, WB9WKO 853, WA3QLW 564, KW1U 538, N9CK 525.

WA3QLW qualified for Brass Pounders League in these previous months, but was not acknowledged in this column: (Jan. 2023) 633, (Dec. 2022) 696, (Nov.) 751, (Oct.) 662, (Sept.) 532, (Aug.) 508.

Contest Corral

May 2023

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

Start - Finish				Bands	Contest Name	Mode	Exchange	Sponsor's Website
Date	Time	Date	Time					
1	0000	1	0100	1.8-28	K1USN Slow Speed Test	CW	Name, SPC; Max 20 WPM	www.k1usn.com/sst.html
1	1300	1	1900	3.5-28	AGCW QRP/QRP Party	CW	RST, serial, class (A/B)	www.agcw.de/contest/qrp-qrp
1	1630	1	1729	3.5,7	OK1WC Memorial (MWC)	CW	RST, serial	memorial-ok1wc.cz
2	0100	2	0159	1.8-28,50	Worldwide Sideband Activity Contest	Ph	RS, age (OM/YL/Youth)	wwsac.com/rules.html
2	0100	2	0300	3.5-28	ARS Spartan Sprint	CW	RST, SPC, pwr	arsqrp.blogspot.com
3	1300	3	1400	1.8-28	CWops Test (CWT)	CW	Name, mbr or SPC	cwops.org/cwops-tests
3	1700	3	2100	144	VHF-UHF FT8 Activity Contest	Dig	4-char grid	www.ft8activity.eu/index.php/en
4	0000	5	0300	7	Walk for the Bacon QRP Contest	CW	RST, SPC, name, mbr or pwr; max 13 WPM	qrpcontest.com/pigwalk40
4	1700	4	2100	28	NRAU 10m Activity Contest	CW Ph Dig	RS(T), 6-char grid	nrau.net/nrau-contests-in-general
4	2000	4	2200	1.8-28,50	SKCC Sprint Europe	CW	RST, SPC, name, mbr or "none"	www.skccgroup.com
4	2300	5	0300	All, no WARC	MIE 33 Contest	CW Ph	RS(T), age	www.ztv.ne.jp/isoda/33
5	0145	5	0215	1.8-21	NCCC RTTY Sprint	Dig	Serial, name, QTH	ncccsprint.com/rules.html
5	0230	5	0300	1.8-21	NCCC Sprint	CW	Serial, name, QTH	ncccsprint.com/rules.html
5	2000	5	2100	1.8-28	K1USN Slow Speed Test	CW	Name, SPC; max 20 WPM	www.k1usn.com/sst.html
6	0001	7	2359	28	10-10 Int'l Spring Contest, CW	CW	Name, mbr or "none," SPC	www.ten-ten.org
6	0300	6	0859	3.5-28	RCC Cup	CW Ph	RS(T), mbr or ITU zone	rcccup.ru
6	0800	6	1400	All above 902	Microwave Spring Sprint	All	6-char grid	sites.google.com/site/springvhfupsprints
6	1200	7	1159	3.5-28	ARI International DX Contest	CW Ph Dig	RS(T), 2-letter province or serial	www.ari.it
6	1200	7	1200	3.5-28, 144	F9AA Cup, Digi	Dig	RST, serial	www.site.urc.asso.fr
6	1300	7	0700	1.8-28	7th Call Area QSO Party	CW Ph Dig	RS(T), 5-ltr state/county code or SPC	7qp.org
6	1500	7	0300	1.8-28	Indiana QSO Party	CW Ph	RS(T), IN county or SPC	www.hdxcc.org/inqp
6	1700	7	2359	1.8-28, VHF	Delaware QSO Party	Ph Dig	RS(T), DE county or SPC	www.fsarc.org
6	2000	7	2359	3.5-28	New England QSO Party	CW Ph Dig	RS(T), New England county/state or SPC	neqp.org/rules
7	1000	7	1400	7	WAB 7 MHz Phone	Ph	RS, serial, WAB square or SPC	wab.intermip.net/Contests.php
8	1900	8	2030	3.5	RSGB 80m Club Champ, SSB	Ph	RS, serial	www.rsgbcc.org/hf
10	1700	10	2100	432	VHF-UHF FT8 Activity Contest	Dig	4-char grid	www.ft8activity.eu/index.php/en
11	1900	11	2000	3.5,7	EACW Meeting	CW	RST, mbr, name, EA province or country	www.eacwspain.es/eacwmeeting
13	1200	14	1159	1.8-28	CQ-M International DX Contest	CW Ph	RS(T), serial	cqm.srr.ru/en/rules
13	1200	14	1200	3.5-28	VOLTA WW RTTY Contest	Dig	RST, serial, CQ zone	www.contestvolta.com/rules.pdf
13	1200	14	2359	1.8-28,50	SKCC Weekend Sprintathon	CW	RST, SPC, name, mbr or "none"	www.skccgroup.com
13	1700	14	0300	7-28	Canadian Prairies QSO Party	CW Ph	RS(T), VE4/5/6 district code or SPC	cpqp.ve6hams.ca
13	2300	14	0300	50	50 MHz Spring Sprint	All	4-char grid	sites.google.com/site/springvhfupsprints
15	0000	15	0200	1.8-28	4 States QRP Group 2nd Sun Sprint	CW Ph	RS(T), SPC, mbr or pwr	www.4sqrp.com/SSS/sss_rules.pdf
17	1700	17	2100	1.2G	VHF-UHF FT8 Activity Contest	Dig	4-char grid	www.ft8activity.eu/index.php/en
17	1900	17	2030	3.5	RSGB 80m Club Champ, Data	Dig	RST, serial	www.rsgbcc.org/hf
18	0000	19	0300	14	Walk for the Bacon QRP Contest	CW	RST, SPC, name, mbr or pwr; max 13 WPM	qrpcontest.com/pigwalk20
18	0030	18	0230	3.5-14	NAQCC CW Sprint	CW	RST, SPC, mbr or pwr	naqcc.info
18	1900	18	2000	3.5-14	NTC QSO Party	CW	RST, mbr or "NM"; max 25 WPM	pi4ntc.nl/ntcqp
20	0300	21	0900	50-1296	SARL VHF/UHF Digital Contest	Dig	RST, 6-char grid	www.sarl.org.za
20	0600	20	2100	3.5-28	UN DX Contest	CW Ph	RS(T), Kazakhstan district code or serial	undxc.kz/rules-eng
20	0800	21	1100	3.5	NZART Sangster Shield Contest	CW	RST, serial, branch no. or serial	www.nzart.org.nz/activities
20	1200	21	1200	1.8-28	His Maj. King of Spain Contest, CW	CW	RST, EA province or serial	concursos.ure.es/en
20	1200	21	1200	3.5-28	EU PSK DX Contest	Dig	RST, EU area or serial	eupsk.club
20	1400	21	0200	1.8-144	Arkansas QSO Party	CW Ph Dig	RS(T), AR county or SPC	www.arkqp.com
20	1600	20	2159	1.8-28,50	Feld Hell Sprint	Dig	See rules	sites.google.com/site/feldhellclub
21	2300	22	0100	1.8-28	Run for the Bacon QRP Contest	CW	RST, SPC, mbr or pwr	qrpcontest.com/pigrun
22	0800	22	1959	3.5-28	YOTA Contest	CW Ph	RS(T), age	www.ham-yota.com/contest
22	1900	22	2030	3.5-14	RSGB FT4 Contest	Dig	4-char grid	www.rsgbcc.org/hf
24	0000	24	0200	1.8-28,50	SKCC Sprint	CW	RST, SPC, name, mbr or "none"	www.skccgroup.com
25	1900	25	2030	3.5	RSGB 80m Club Champ, CW	CW	RST, serial	www.rsgbcc.org/hf
27	0000	28	2359	1.8-28	CQ WW WPX Contest, CW	CW	RST, serial	www.cqwpx.com/rules.htm

There are a number of weekly contests not included in the table above. For more info, visit: **www.qrpfoxhunt.org**, **www.ncccsprint.com**, and **www.cwops.org**. All dates and times 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.*

Kelly Taylor, VE4XT, ve4xt@mymts.net

2022 ARRL November Sweepstakes — CW

Last year's ARRL November Sweepstakes (CW weekend) was held November 5 – 7, 2022.

Plaque Sponsors

ARRL is pleased to award a Sweepstakes Plaque to the Overall and Division Leaders in each category, thanks to Icom America, clubs, and individuals who sponsor these awards. For more information on plaque sponsorship or to order a duplicate plaque, contact the ARRL Contest Program at 860-594-0232 or **contests@arrl.org**. Plaques cost $80, which includes all shipping charges.

Winner	Division	Category	Sponsor
N2IC	Overall	Single Operator High Power	Trey Garlough, N5KO
WJ9B	Overall	Single Operator Low Power	Radiosport Manitoba – VE4VV Memorial
VE3VN	Overall	Single Operator QRP	Icom America
KØEU	Overall	Single Operator Unlimited High Power	Icom America
N4ZZ	Overall	Single Operator Unlimited Low Power	Icom America
W2GD	Overall	Single Operator Unlimited QRP	Icom America
ND7K	Overall	Multioperator High Power	Icom America
WP3TT	Overall	Multioperator Low Power	Icom America
KØHC	Overall	School Club	Icom America
AA3B	Atlantic	Single Operator High Power	Icom America
K3WU	Atlantic	Single Operator Low Power	John Thompson, K3MD
WR3R	Atlantic	Single Operator QRP	Icom America
K3MM	Atlantic	Single Operator Unlimited High Power	Icom America
NY3A	Atlantic	Single Operator Unlimited Low Power	Icom America
WA3EKL	Atlantic	Multioperator High Power	Icom America
W2GD	Atlantic	Single Operator Unlimited QRP	Icom America
K2AA	Atlantic	Multioperator Low Power	Icom America
W9RE	Central	Single Operator High Power	Society of Midwest Contesters
KG9X	Central	Single Operator Low Power	Society of Midwest Contesters
K9ZO	Central	Single Operator QRP	Icom America
K9CT	Central	Single Operator Unlimited High Power	Society of Midwest Contesters
N9CO	Central	Single Operator Unlimited Low Power	Society of Midwest Contesters
N9NE	Central	Single Operator Unlimited QRP	Icom America
KV3T	Central	Multioperator High Power	Icom America
KA9VVQ	Central	Multioperator Low Power	Icom America
N7IV	Dakota	Single Operator High Power	Minnesota Wireless Association — In memory of Tod Olson, KØTO
NAØN (@WØZT)	Dakota	Single Operator Low Power	Minnesota Wireless Association
WDØT	Dakota	Single Operator QRP	Icom America
NØAT (NØKK, OP)	Dakota	Single Operator Unlimited High Power	Minnesota Wireless Association — In memory of Jim Dokmo,KØFVF
K7BG	Dakota	Single Operator Unlimited Low Power	Minnesota Wireless Association
KEØOR	Dakota	Multioperator Low Power	Icom America
K4RO	Delta	Single Operator High Power	Icom America
N5EE	Delta	Single Operator Low Power	Icom America
KØEJ	Delta	Single Operator QRP	Icom America
AD4EB	Delta	Single Operator Unlimited High Power	Icom America
N4ZZ	Delta	Single Operator Unlimited Low Power	Icom America
W5GAD	Delta	Multioperator Low Power	Icom America
KE4KY	Great Lakes	Single Operator High Power	Icom America
W8CAR	Great Lakes	Single Operator Low Power	Icom America
N8AA	Great Lakes	Single Operator QRP	Icom America
N4QS	Great Lakes	Single Operator Unlimited High Power	Icom America
K4FN	Great Lakes	Single Operator Unlimited Low Power	Icom America
N4ROA (W6LX, op)	Great Lakes	Single Operator Unlimited QRP	Icom America
K8LX	Great Lakes	Multioperator High Power	Icom America
W8EDU	Great Lakes	School Club	Icom America
N2NT (N2NC, op)	Hudson	Single Operator High Power	Icom America
KU2M	Hudson	Single Operator Low Power	Icom America
AC2YD	Hudson	Single Operator QRP	Icom America
N2NI	Hudson	Single Operator Unlimited High Power	Icom America
N2BA	Hudson	Single Operator Unlimited Low Power	John Thompson, K3MD
N2GC	Hudson	Single Operator Unlimited QRP	Icom America
NJ1F	Hudson	Multioperator Low Power	Icom America
NØNI (AG9A, op)	Midwest	Single Operator High Power	Icom America
KVØI	Midwest	Single Operator Low Power	Icom America
NØUJT	Midwest	Single Operator QRP	Icom America
NØXR	Midwest	Single Operator Unlimited High Power	Icom America
NUØQ	Midwest	Single Operator Unlimited Low Power	Icom America
KKØU	Midwest	Single Operator Unlimited QRP	Icom America
KØWA	Midwest	Multioperator High Power	Icom America
KØHC	Midwest	School Club	Icom America
K5ZD	New England	Single Operator High Power	Icom America
K1XM	New England	Single Operator Low Power	Icom America
K8CN	New England	Single Operator QRP	Icom America
W1SJ	New England	Single Operator Unlimited High Power	Icom America
KI1G	New England	Single Operator Unlimited Low Power	Icom America
N1QD (@K1KP)	New England	Single Operator Unlimited QRP	Icom America
K1LZ	New England	Multioperator High Power	Icom America
W1FM	New England	Multioperator Low Power	Icom America
W7RM (N6TR, op)	Northwestern	Single Operator High Power	Icom America
WJ9B	Northwestern	Single Operator Low Power	Icom America
W7YAQ	Northwestern	Single Operator QRP	Icom America
KG7CW	Northwestern	Single Operator Unlimited High Power	Icom America
K7QA	Northwestern	Single Operator Unlimited Low Power	Icom America
K7SS	Northwestern	Single Operator Unlimited QRP	Icom America
W7VJ	Northwestern	Multioperator High Power	Icom America
W7RN (N6TV, op)	Pacific	Single Operator High Power	Icom America
AH6KO	Pacific	Single Operator Low Power	Icom America
W6JTI	Pacific	Single Operator QRP	Icom America
W1SRD	Pacific	Single Operator Unlimited High Power	Icom America
K9JM	Pacific	Single Operator Unlimited Low Power	Icom America
K6JS	Pacific	Single Operator Unlimited QRP	Icom America
N6RO	Pacific	Multioperator High Power	Icom America
K4ZW	Roanoke	Single Operator High Power	Potomac Valley Radio Club
N8II	Roanoke	Single Operator Low Power	Icom America
K4WY	Roanoke	Single Operator QRP	Icom America
W4NF	Roanoke	Single Operator Unlimited High Power	Icom America
W4AAA	Roanoke	Single Operator Unlimited Low Power	Icom America
AD8J	Roanoke	Single Operator Unlimited QRP	Icom America
K8LF	Roanoke	Multioperator High Power	Icom America
W4TG	Roanoke	Multioperator Low Power	Icom America
W4ODU	Roanoke	School Club	Icom America
N2IC	Rocky Mountain	Single Operator High Power	Icom America
WA7LNW	Rocky Mountain	Single Operator Low Power	Icom America
WC7S	Rocky Mountain	Single Operator QRP	Icom America
KØEU	Rocky Mountain	Single Operator Unlimited High Power	Icom America
W7YM	Rocky Mountain	Single Operator Unlimited Low Power	Icom America
K5AM	Rocky Mountain	Single Operator Unlimited QRP	Icom America
KK5OV	Rocky Mountain	Multioperator Low Power	Icom America
NX4N	Southeastern	Single Operator High Power	Icom America
WW4XX (LZ4AX, op)	Southeastern	Single Operator Low Power	Icom America
K3TW	Southeastern	Single Operator QRP	Icom America
K4AB	Southeastern	Single Operator Unlimited High Power	Icom America
N4KH	Southeastern	Single Operator Unlimited Low Power	Icom America
K4PQC	Southeastern	Single Operator Unlimited QRP	Icom America
N4EEB	Southeastern	Multioperator High Power	Icom America
WP3TT	Southeastern	Multioperator Low Power	Icom America
W4UAL	Southeastern	School Club	Icom America
KH7X (KH6ND, op)	Southwestern	Single Operator High Power	Icom America
NC6K	Southwestern	Single Operator Low Power	Icom America
N7IR	Southwestern	Single Operator QRP	Icom America
AA6PW	Southwestern	Single Operator Unlimited High Power	Icom America
K6WSC	Southwestern	Single Operator Unlimited Low Power	Icom America
W6GL	Southwestern	Single Operator Unlimited QRP	Icom America
ND7K	Southwestern	Multioperator High Power	Icom America
NX6T	Southwestern	Multioperator Low Power	Icom America
N6RA	Southwestern	School Club	Icom America
WXØB (AD5Q, op)	West Gulf	Single Operator High Power	Icom America
K5CM/KG5U (Tie)	West Gulf	Single Operator Low Power	Icom America
WK8V	West Gulf	Single Operator QRP	Icom America
K5PI	West Gulf	Single Operator Unlimited High Power	Icom America
WA8ZBT	West Gulf	Single Operator Unlimited Low Power	Icom America
KG5VK	West Gulf	Multioperator High Power	Icom America
WDØGTY	West Gulf	Multioperator Low Power	Icom America
VY2TT (K6LA, op)	Canada	Single Operator High Power	Icom America
VE5SF	Canada	Single Operator Low Power	Icom America
VE3VN	Canada	Single Operator QRP	Icom America
VE4GV	Canada	Single Operator Unlimited High Power	Icom America
VE3YT	Canada	Single Operator Unlimited Low Power	Icom America
VE7KW	Canada	Single Operator Unlimited QRP	Icom America
VY1CO	Canada	Multioperator High Power	Icom America

Top Ten

Single Operator, High Power

N2IC	236,040
W7RN (N6TV, op)	217,224
W7RM (N6TR, op)	215,544
VY2TT (K6LA, op)	215,302
WØUA	206,808
AA3B	201,936
K4RO	201,096
WXØB (AD5Q, op)	200,694
W9RE	200,256
N2NT (N2NC, op)	200,088

Single Operator, Low Power

WJ9B	167,328
N7XU (K4XU, op)	165,144
NAØN (@WØZT)	163,128
N5EE	159,432
WW4XX (LZ4AX, op)	158,592
K1XM	156,240
WA7LNW	147,504
W8CAR	141,960
VE5SF	141,792
AH6KO	140,602

Single Operator, QRP

VE3VN	117,362
N7IR	111,054
KØEJ	108,360
W6AYC	106,572
WDØT	106,512
W6JTI	90,888
K3TW	86,688
NØUR	80,352
N8AA	77,572
K9ZO	75,768

Single Operator Unlimited, High Power

KØEU	219,576
K9CT	194,208
K3MM	187,152
K4AB	182,112
AD4EB	180,264
NØAT (NØKK, op)	176,400
W4NF	176,400
W1SJ	175,728
W1SRD	175,560
KD4D	173,880

Single Operator Unlimited, Low Power

N4ZZ	178,248
NY3A	169,680
W4AAA	162,624
K7QA	158,592
N2YO	155,400
N9CO	152,376
KI1G	149,016
NE9U	145,152
WY7M	143,136
VE3YT	140,616

Single Operator Unlimited, QRP

W2GD	128,016
KKØU	99,288
AD8J	88,200
N9NE	66,068
K7SS	65,736
N1QD (@K1KP)	62,250
N4ROA (W6LX, op)	60,092
K6JS	59,926
ND4Y	58,930
VE7KW	57,760

Multioperator, Single Transmitter, High Power

ND7K	234,360
K1LZ	218,736
KY7M	191,688
N6RO	188,328
KØWA	187,656
NØAX	185,976
N4EEB	180,096
N4WW	176,568
K8LX	159,096
W7VJ	146,910

Multioperator, Single Transmitter, Low Power

WP3TT	177,576
NX6T	142,096
KT4XA	103,992
W5GAD	103,656
W1FM	80,304
W4TG	72,160
KA9VVQ	67,336
WDØGTY	58,800
W5AFV	53,120
NJ1F	38,544

School Club

KØHC	176,232
N6RA	175,392
W4UAL	25,920
K7UAZ	21,248
W4ODU	14,112
W8EDU	11,322

Division Winners

Single Operator, High Power

Atlantic	AA3B	201,936
Central	W9RE	200,256
Dakota	N7IV	157,768
Delta	K4RO	201,096
Great Lakes	KE4KY	142,560
Hudson	N2NT (N2NC, op)	200,088
Midwest	NØNI (AG9A, op)	200,030
New England	K5ZD	183,624
Northwestern	W7RM (N6TR, op)	215,544
Pacific	W7RN (N6TV, op)	217,224
Roanoke	K4ZW	184,464
Rocky Mountain	N2IC	236,040
Southeastern	NX4N	191,896
Southwestern	KH7X (KH6ND, op)	187,152
West Gulf	WXØB (AD5Q, op)	200,694
Canada	VY2TT (K6LA, op)	215,302

Single Operator, Low Power

Atlantic	K3WU	122,508
Central	KG9X	128,016
Dakota	NAØN (@WØZT)	163,128
Delta	N5EE	159,432
Great Lakes	W8CAR	141,960
Hudson	KU2M	62,400
Midwest	KVØI	112,548
New England	K1XM	156,240
Northwestern	WJ9B	167,328
Pacific	AH6KO	140,602
Roanoke	N8II	115,702
Rocky Mountain	WA7LNW	147,504
Southeastern	WW4XX (LZ4AX, op)	158,592
Southwestern	NC6K	124,148
West Gulf	KG5U	118,944
West Gulf	K5CM	118,944
Canada	VE5SF	141,792

Single Operator, QRP

Atlantic	WR3R	62,156
Central	K9ZO	75,768
Dakota	WDØT	106,512
Delta	KØEJ	108,360
Great Lakes	N8AA	77,572
Hudson	AC2YD	46,400
Midwest	NØUJT	31,780
New England	K8CN	44,148
Northwestern	W7YAQ	70,728
Pacific	W6JTI	90,888
Roanoke	K4WY	37,120
Rocky Mountain	WC7S	22,892
Southeastern	K3TW	86,688
Southwestern	N7IR	111,054
West Gulf	WK8V	10,560
Canada	VE3VN	117,362

Single Operator Unlimited, High Power

Atlantic	K3MM	187,152
Central	K9CT	194,208
Dakota	NØAT (NØKK, op)	176,400
Delta	AD4EB	180,264
Great Lakes	N4QS	161,112
Hudson	N2NI	100,928
Midwest	NØXR	171,024
New England	W1SJ	175,728
Northwestern	KG7CW	135,744
Pacific	W1SRD	175,560
Roanoke	W4NF	176,400
Rocky Mountain	KØEU	219,576
Southeastern	K4AB	182,112
Southwestern	AA6PW	158,760
West Gulf	K5PI	129,696
Canada	VE4GV	104,814

Single Operator Unlimited, Low Power

Atlantic	NY3A	169,680
Central	N9CO	152,376
Dakota	K7BG	133,392
Delta	N4ZZ	178,248
Great Lakes	K4FN	133,728
Hudson	N2BA	112,056
Midwest	NUØQ	105,000
New England	KI1G	149,016
Northwestern	K7QA	158,592
Pacific	K9JM	84,336
Roanoke	W4AAA	162,624
Rocky Mountain	WY7M	143,136
Southeastern	N4KH	107,184
Southwestern	K6WSC	115,248
West Gulf	WA8ZBT	91,676
Canada	VE3YT	140,616

Single Operator Unlimited, QRP

Atlantic	W2GD	128,016
Central	N9NE	66,068
Great Lakes	N4ROA (W6LX, op)	60,092
Hudson	N2GC	36,080
Midwest	KKØU	99,288
New England	N1QD (@K1KP)	62,250
Northwestern	K7SS	65,736
Pacific	K6JS	59,926
Roanoke	AD8J	88,200
Rocky Mountain	K5AM	40,672
Southeastern	K4PQC	21,128
Southwestern	W6GL	22,952
Canada	VE7KW	57,760

Multioperator, Single Transmitter, High Power

Atlantic	WA3EKL	56,252
Central	KV3T	111,356
Great Lakes	K8LX	159,096
Midwest	KØWA	187,656
New England	K1LZ	218,736
Northwestern	W7VJ	146,910
Pacific	N6RO	188,328
Roanoke	K8LF	41,760
Southeastern	N4EEB	180,096
Southwestern	ND7K	234,360
West Gulf	KG5VK	93,120
Canada	VY1CO	137,088

Multioperator, Single Transmitter, Low Power

Atlantic	K2AA	8,190
Central	KA9VVQ	67,336
Dakota	KEØOR	21,838
Delta	W5GAD	103,656
Hudson	NJ1F	38,544
New England	W1FM	80,304
Roanoke	W4TG	72,160
Rocky Mountain	KK5OV	13,356
Southeastern	WP3TT	177,576
Southwestern	NX6T	142,096
West Gulf	WDØGTY	58,800

School Club

Great Lakes	W8EDU	11,322
Midwest	KØHC	176,232
Roanoke	W4ODU	14,112
Southeastern	W4UAL	25,920
Southwestern	N6RA	175,392

Ron Schwartz, VE3VN, installed a new three-element 40-meter Yagi at 150 feet on his tower, in preparation for ARRL November CW Sweepstakes. Ron took first place in Canada in the Single Operator, QRP category. [Ron Schwartz, VE3VN, photo]

Full Results Online

You can read the full results of the contest online at **http://contests.arrl.org**. You'll find detailed analysis and more play-by-play, along with the full line scores. Improve your results by studying your log-checking report, too.

The 2023 ARRL November Sweepstakes (CW weekend) will be held November 4 – 6, 2023.

C. R. "Skip" Paulsen, W1PV, flathood@rcn.com

2022 ARRL International EME Contest

Last year, the 2.3 GHz and up weekends of the ARRL International EME Contest were held August 27 – 28 and September 17 – 18. The 50 – 1296 MHz weekends took place October 15 – 16 and November 12 – 13.

Multioperator Scores by Category

Call Sign	Score	QSOs	Mults
Multioperator, CW/Phone Only, All Band			
SQ6OPG	1,600	4	4
Multioperator, All Mode, All Band			
UA5Y	6,313,500	345	183
K5QE	5,088,700	337	151
K2UYH	4,524,100	281	161
LU8ENU	372,400	76	49
NØAKC	345,000	75	46
OZ9KY	315,000	70	45
KØPRT	281,400	67	42
LU1CGB	266,600	62	43
NC1I	172,800	48	36
W4ZST	117,000	39	30
Multioperator, All Mode, 144 MHz			
S51ZO	921,100	151	61
ZC4RH	513,600	107	48
W9VW	218,300	59	37
F6HEO	117,000	39	30
KK4MA	91,200	38	24
SK6EI	77,000	35	22
JA1DYB	54,600	26	21
Multioperator, All Mode, 1.2 GHz			
DF3RU	836,000	152	55
IQ2DB	768,500	145	53
W2ZQ	673,100	127	53
VA7MM	494,900	101	49
SP3YDE	469,200	102	46
SKØCT	462,000	105	44
WR8AA	372,000	93	40
IK5VLS	250,800	76	33
W3HZU	237,600	72	33
Multioperator, All Mode, 10 GHz			
W3SZ	74,800	34	22
GB2FRA	73,500	35	21

Single Operator Scores by Category

Call Sign	Score	QSOs	Mults
Single Operator, CW/Phone Only, All Band			
G3LTF	544,500	99	55
KL6M	468,000	90	52
WA6PY	400,000	80	50
SP3XBO	96,000	40	24
Single Operator, CW/Phone Only, 1.2 GHz			
DG5CST	479,600	109	44
G4CCH	472,500	105	45
OZ4MM	276,500	79	35
SP9VFD	178,200	66	27
IK1FJI	163,800	63	26
DU3T	152,500	61	25
LZ2US	120,000	50	24
F5KUG	86,100	41	21
DL1AT	63,000	35	18
N8CQ	57,600	32	18
WK9P	44,200	26	17
NQ7B	34,500	23	15
OK2PE	33,600	24	14
F6ETI	16,000	16	10
N4PZ	12,000	12	10
DJ3JJ	4,900	7	7
SP6GWN	4,200	7	6
Single Operator, All Mode, All Band			
OK1CA	2,352,000	210	112
N1AV	1,562,400	168	93
PA3DZL	1,368,000	152	90
VE6TA	1,264,900	139	91
ON4AOI	1,096,000	137	80
K3WM	963,600	146	66
OH1LRY	805,600	106	76
KNØWS	777,200	116	67
OK1KKD	702,100	119	59
LZ1DX	678,000	113	60
WA3RGQ	648,900	103	63
CX2SC	644,800	104	62
IK3COJ	588,300	111	53
VE4MA	298,900	61	49
YL2GD	298,900	61	49
DL1SUZ	295,200	72	41
K4EME	206,700	53	39
W5LUA	201,600	48	42
LZ4OC	185,000	50	37
W3CJK	168,000	48	35
R1NW	133,300	43	31
DL4DTU	110,400	46	24
W6TCP	69,000	30	23
KC2HFQ	64,400	28	23
K7ULS	52,500	25	21
W1PV	43,200	24	18
DJ3AK	22,400	16	14
K1WHS	18,200	14	13
JE1TNL	16,800	14	12
W8TN	12,000	12	10
4X1AJ	8,000	10	8
JH3AZC	6,300	9	7
K1DS	4,200	7	6
NY2NY	400	2	2
Single Operator, All Mode, 50 MHz			
KJ9I	402,900	79	51
AG6EE	4,900	7	7
JA1QJI	100	1	1
OZ1DJJ	100	1	1
Single Operator, All Mode, 144 MHz			
PA5Y	2,133,600	254	84
SM2BYC	672,800	116	58
OK1DIX	632,200	109	58
W9IP	624,000	120	52
WB9UWA	577,700	109	53
K1DG	577,200	111	52
KA1EME	414,000	92	45
G8RWG	400,200	87	46
OG3Z	355,500	79	45
UA9YJM	294,000	70	42
SM5CUI	235,200	56	42
AI1K	207,400	61	34
KØTPP	184,800	56	33
WQ5S	177,600	48	37
DF2ZC	171,600	52	33
UC1I	167,200	44	38
JP3EXR	132,000	44	30
YB2MDU	122,200	47	26
KG6NK	121,500	45	27
AG4W	108,000	40	27
UA6LQZ	100,800	42	24
VE7PS	88,400	34	26
YO5TP	80,000	32	25
OH1MA	64,400	28	23
4Z5CP	63,000	30	21
F4HBY	58,000	29	20
JHØWJF	49,400	26	19
UA4AQL	36,800	23	16
UA9CCL	27,200	17	16
OK2AB	22,400	16	14
UA9HO	22,400	16	14
W2LPL	16,800	14	12
YO2NAA	15,000	15	10
IW4ARD	13,200	12	11
LY1G	10,000	10	10
WA3DRC	7,200	9	8
E27EK	4,800	8	6
YO6XK	4,800	8	6
VE3WY	4,200	7	6
SP9TTG	4,000	8	5
EW7T	3,600	6	6
SQ1GU	1,600	4	4
ON4EC	900	3	3
JG2TSL	400	2	2
R7LP	200	2	1
EI2FG	100	1	1
EI8KN	100	1	1
N2AMC	100	1	1
WO9Z	100	1	1
Single Operator, All Mode, 222 MHz			
WA4NJP	8,100	9	9
Single Operator, All Mode, 432 MHz			
KU4XO	214,500	55	39
KD2LGX	197,200	58	34
VK2CMP	174,900	53	33
VK4EME	105,300	39	27
DL1VPL	83,200	32	26
RD3FD	58,800	28	21
SM4GGC	58,000	29	20
YO8RHI	43,200	24	18
7M2PDT	36,800	23	16
HG5BMU	34,500	23	15
NN3Y	32,300	19	17
OK1TEH	26,600	19	14
S51LF	23,800	17	14
DL5DAW	16,500	15	11
BV3CE	12,000	12	10
K7ATN	1,600	4	4
JRØWFY	900	3	3
JG2XWH	100	1	1
JM2FCJ	100	1	1
N1BUG	100	1	1
N9ZL	100	1	1
Single Operator, All Mode, 1.2 GHz			
OK1DFC	1,104,100	181	61
OK2DL	1,060,200	171	62
OM4XA	625,000	125	50
IK2DDR	597,800	122	49
UA9FAD	580,800	121	48
ES3RF	575,000	115	50
DL7UDA	531,100	113	47
SP5GDM	528,000	110	48
PA3FXB	504,000	112	45
N5BF	475,200	99	48
GØLBK	469,200	102	46
RA4HL	464,600	101	46
KB2SA	440,000	100	44
OK2ULQ	324,000	81	40
KB7Q	280,000	80	35
AA6I	225,700	61	37
CE3VRT	204,600	62	33
G7TZZ	179,800	58	31
KA1GT	169,600	53	32
RX6AIA	168,000	56	30
W5GLD	145,700	47	31
OK1USW	143,100	53	27
AA4MD	132,000	44	30
PE1LWT	130,200	42	31
VE3KRP	110,000	44	25
SV1CAL	84,000	40	21
N9JIM	81,400	37	22
VE4SA	78,200	34	23
VK3VJP	70,300	37	19
UA6AH	56,100	33	17
DKØTE	49,600	31	16
DL7AIG	45,900	27	17
WA3GFZ	44,200	26	17
K8ZR	32,000	20	16
OK1IL	28,600	22	13
DK1KW	26,400	22	12
NX9O	24,700	19	13
W3HMS	23,800	17	14
KN2K	20,400	17	12
LY3DE	7,000	10	7
G4BRK	400	2	2
Single Operator, All Mode, 2.3 GHz			
DL1EMA	5,600	8	7
Single Operator, All Mode, 10 GHz			
OZ1LPR	126,900	47	27
OK2AQ	95,000	38	25
UR3VKE	42,500	25	17
ON5TA	29,400	21	14
IW2FZR	17,600	16	11
VK7ZBX	2,000	5	4

Full Results Online

You can read the full results of the contest online at **http://contests.arrl.org**. You'll find detailed analysis and more play-by-play, along with the full line scores. Improve your results by studying your log-checking report, too.

Total Reported QSOs by Mode

Digital	9,698
CW/Phone	2,094
Total	11,792

Total Reported QSOs by Band

50 MHz	96	2.3 GHz	190
144 MHz	3,302	3.4 GHz	27
222 MHz	43	5.7 GHz	77
432 MHz	1,032	10 GHz	440
1.2 GHz	6,585	Total	11,792

The 2023 International EME Contest weekends are scheduled for August 12 – 13 and September 9 – 10 (2.3 GHz and up weekends), as well as October 28 – 29 and November 25 – 26 (50 – 1296 MHz weekends).

The largest on-air amateur radio event in the world returns June 24 – 25, 2023. It will run from 1800 UTC Saturday, June 24 to 1759 UTC Sunday, June 25.

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

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

Reporting Your Score: All entries must be received at ARRL HQ no later than Tuesday, July 25, 2023. Participants are strongly encouraged to use the online ARRL Field Day score reporting system at **www.field-day.arrl.org**. Online entrants will receive an email confirmation that their entry was accepted, as well as 50 bonus points for submitting their score electronically.

New Rules for 2023: There is a new 500 W peak envelope power (PEP) transmitter output category only for Class A, B, and C stations. Changes to scoring the Get on the Air (GOTA) station have also been made this year. Contacts made from the GOTA station are worth 5 points, regardless of mode, with no limit to the number of contacts that can be made. Stations can earn 100 GOTA Coach bonus points for having a coach supervise at least 10 of the contacts made and logged at the GOTA station.

Changes have been made to the Radio Amateurs of Canada (RAC) Section list. The Maritime (MAR) Section has been eliminated, making New Brunswick (NB) and Nova Scotia (NS) their own Sections. The Greater Toronto Area Section has been renamed Golden Horseshoe (GH), and the Northern Territories Section has been renamed Territories (TER). Participants should make sure their logging software has been updated to reflect these changes. For a complete list of ARRL/RAC Sections, visit **https://contests.arrl.org/contestmultipliers.php?a=wve**.

Let everyone know where you will be operating for Field Day by using the Field Day Locator at **www.arrl.org/field-day-locator**. It can also be used to find a nearby Field Day site, or an operation to join if you're traveling out of town.

Groups that actively promote their Field Day event on Facebook, Instagram, or Twitter can earn 100 bonus points. Use the hashtag **#ARRLFD** to share your plans, tips, and tricks for a successful Field Day. See the full ARRL Field Day packet for more information on all of the bonus points available.

Participants should download and review the material found in the 2023 Field Day packet available at **www.arrl.org/field-day**. Email any questions to **fdinfo@arrl.org**.

Bob Wick, N2HM, and George Robinson, WA3LVR, operate CW late into the night as part of the Spark to Space Amateur Radio Group's 2022 ARRL Field Day operation in Chester County, Pennsylvania. [Joseph Fell, W3GMS, photo]

2023 ARRL International Digital Contest

1800 UTC Saturday, June 3 – 2359 UTC Sunday, June 4

The view of Jerry Slama's, HSØZOY, operating position during the 2022 ARRL International Digital Contest. Jerry placed fourth overall in Asia in the Single Operator, One Radio, Low Power category. [Jerry Slama, HSØZOY, photo]

The ARRL International Digital Contest is a digital competition on the 160-, 80-, 20-, 15-, 10-, and 6-meter bands, with Single Operator and Multioperator, Single Transmitter categories. With the exception of RTTY, all digital modes that can support the contest exchange are permitted.

Single-operator categories include Single Operator, One Radio (SO1R) and Single Operator, Two Radio (SO2R). SO1R and SO2R stations may operate 24 hours out of the 30-hour contest period. Multioperator stations may operate the entire 30 hours. There's also a Limited Operating Time category for single-operator stations, where a maximum 8 hours of operating time is allowed.

Power categories are QRP (5 W PEP transmitter output or less) and low power (100 W PEP transmitter output). There is no high-power category for this event.

The contest exchange is the station's four-character grid square. For more information about grid squares, visit **www.arrl.org/grid-squares**.

Participants earn one point per contact, plus one point for every 500-kilometer distance between stations. The total score is the sum of all contact points. See **http://arrl.org/arrl-digital-contest** for scoring examples.

Stations may work each other once per band, regardless of digital mode (excluding RTTY).

Participants may contribute their scores to the ARRL Affiliated Club Competition, as well as form a team with fellow participants. Teams must consist of two to five single-operator stations that are operating within a 175-mile radius, and whose individual scores can be combined to produce a team score. Teams must be registered at **http://contests.arrl.org/teamreg.php?eid=31** prior to the start of the contest.

Logs must be submitted via the contest web app at **http://contest-log-submission.arrl.org** no later than 2359 UTC on June 11, 2023. Only Cabrillo-formatted electronic logs will be accepted for this event.

Visit **http://arrl.org/arrl-digital-contest** for full rules and details.

The 2023 ARRL June VHF Contest

1800 UTC Saturday, June 10 – 0259 UTC Monday, June 12

The June VHF Contest is right around the corner! The late-spring weather brings enhanced tropospheric ducting and meteor scatter. Plus, it's the peak of the sporadic-E season. Take advantage of these propagation enhancements and have some fun on the VHF and UHF bands. With several different categories to participate in, there's something to match your favorite style of operating. Single-operator participants can enter in either all mode or analog-only (CW/phone) categories.

Here are some things to remember for this contest:

- The exchange is simple: Just the Maidenhead grid square you're operating from. For more information on grid squares, visit **www.arrl.org/grid-squares**.
- All authorized modes on 50 MHz bands and higher are permitted to be used in the contest.
- Assistance is permitted in all ARRL VHF contests — you can make announcements or chat with others about your contest activity (as long as the contact is completed over the air).
- Log submissions: Upload your Cabrillo log file to the contest web app at **http://contest-log-submission.arrl.org**. Paper logs can be mailed to ARRL — June VHF Contest, 225 Main St., Newington, CT 06111.
- Ten-day deadline: All logs must be uploaded or postmarked no later than 0259 UTC, June 22, 2023.
- Share your photos and VHF contest stories to the ARRL Contest Soapbox at **http://contests.arrl.org/contestsoapbox.php**.

Jason Patterson, K3GD, operated in the Single Operator, Portable category in the 2022 ARRL June VHF Contest. He took first place in the Atlantic Division, and third place overall in the US and Canada. [Photo courtesy of Jason Patterson, K3GD]

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

The June 2023 Kids Day

1800 UTC – 2359 UTC Saturday, June 17, 2023

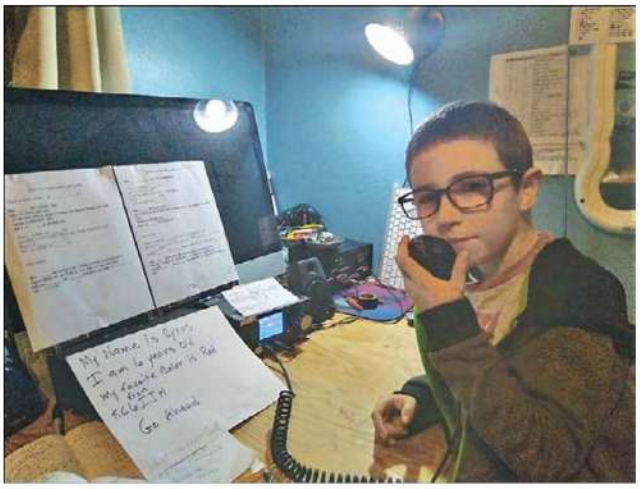
The third Saturday in June is a great time to encourage youngsters to get on the air and share in the excitement and fun that amateur radio can provide!

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

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

Share your photos and stories of Kids Day via the ARRL soapbox at **http://arrl.org/contests/soapbox**.

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



Six-year-old Cyrus Bell participated in the 2022 ARRL Kids Day with his grandfather, Bill Bickham, KC6IJH. Bill made cue cards with contact information for Cyrus to read from while on the air. [Bill Bickham, KC6IJH, photo]

Mike Walters, W8ZY, mwalters@arrl.org

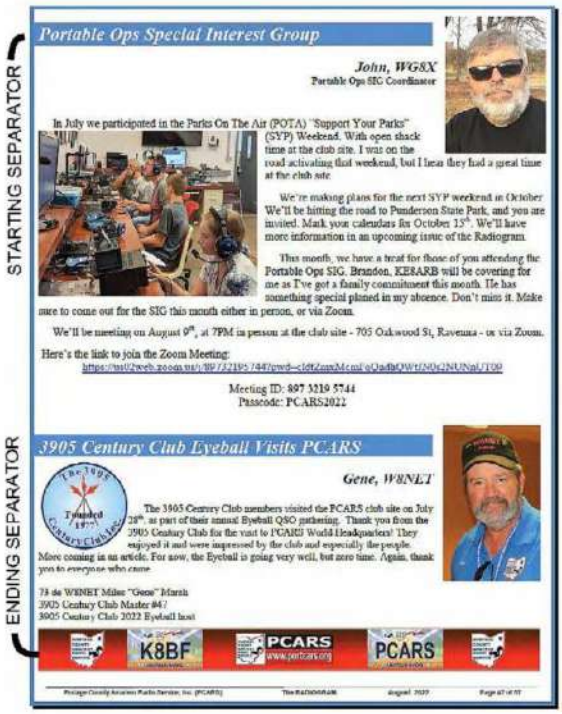
Club Station

Creating and Maintaining a Club Newsletter

For nearly 20 years, the Portage County Amateur Radio Service (PCARS) has been providing its members with a monthly newsletter. In this month's column, PCARS Newsletter Editor Tom Parkinson, KB8UUZ, shares how he puts the club's award-winning newsletter together, what it includes, and how it benefits the club.

A club newsletter can attract prospective members, as well as keep current members informed of club events and activities. You can't rely solely on monthly meetings to keep members informed, as not all club members will attend.

PCARS's newsletter, "The Radiogram," has won various awards, including recognition by the ARRL Ohio Section and ARRL Great Lakes Division. I've been working on "The Radiogram" since its inception in 2005. It presently averages about 50 pages and is published monthly. It takes me about 10 – 20 hours a month to gather the articles, format the layout, and publish the newsletter.



This page from the August 2022 issue of "The Radiogram" shows how I format and style newsletter articles. Each title is formatted in a larger point size, followed by the author's name and call sign, as well as a photo, if available. I also format the article's text to wrap around the images, so there's no wasted space. [Tom Parkinson, KB8UUZ, photo]

Easy-to-Use Programs

Putting a newsletter together every month is simpler than one may think, and the programs I use are commonly available and user-friendly.

Formatting the Newsletter

I format the newsletter in Microsoft *Word*. When laying it out, I choose easy-to-read fonts, such as Times New Roman, Arial, and Arial Narrow, and make sure to keep the articles together, as opposed to telling readers to jump to a faraway page to finish reading. It's also important to number the pages. This will be helpful later when you're making the table of contents. I insert photos (formatted as JPG files) within the article where needed, and format them as tight wrap text (once the photo is inserted, go to **PICTURE FORMAT** or **FORMAT**, then **WRAP TEXT**, then **TIGHT**), so the words automatically wrap around the photo. I format article titles and author names and call signs in larger point sizes than the regular text, so they stand out and act as separators for each article (see the lead photo for examples). This is a good place to add a photo of the author if you have one. If the article has any sources, I include them at the end.

Working with Photos

I use a few different programs for photos. One is *ScreenHunter*, free software for capturing your computer's screen and recording videos of the active programs. I use it for gathering photos from the web. First, I save the photo as a BMP file to allow for editing. Then, I make it as large as I can on the screen and use *ScreenHunter* to capture it. You can download an image from a website, but it might be too small. Windows offers the Snipping Tool, but I've found *ScreenHunter* to be easier and faster to use.

You'll need a photo-editing program that allows you to crop and format photos, as well as adjust their brightness, contrast, and size. I've tried programs such as Adobe *Photoshop*, but prefer the free program *PaintShop Pro*, for its ease of use. When requesting photos from contributors, always ask for them to be sent in a large format and make sure that they're in focus. You can always make them smaller if necessary. I like to use the free software *PIXresizer*, to resize images that I've edited. Keeping photos around 500 KB in size and formatted as JPG files keeps the overall size of the *Word* document smaller, making it

easier to convert the file to a PDF before posting the newsletter online.

General Layout

I start each newsletter with a cover page that includes a photo, the name of the newsletter, the volume number, the issue number, and the date. The next page is the table of contents, which includes page numbers for each item. If you have space, this page is a nice spot to add some photos of what's in that month's issue. The table of contents in "The Radiogram" is broken down into four sections: Featured Articles, Mark Your Calendar, Regular Departments, and Finals.

"The Radiogram" always begins with articles from PCARS's President and Vice President, followed by an event schedule that informs readers of what's coming up in the next month or two, including meeting information for PCARS's Special Interest Groups (SIGs).

In addition to club leadership writing articles for our newsletter, our ARRL Division Director and Vice Director, as well as our ARRL Section Manager, contribute content. Their monthly articles keep our members aware of what's going on in our state and Division.

Other material I include regularly is: information about VE testing at the PCARS club location, as well as the latest information on license testing; upcoming local hamfests; PCARS's net information; monthly meeting information and photos from the last meeting; PCARS products for sale (patches, coffee cups, etc.); a list of club officers, appointments, and committee members; a Swap-N-Shop section of for-sale and wanted items; SIG reports; upcoming DXpeditions; member birthdays, and a thank you to the hams that contributed to the issue.

Finding Content

"The Radiogram" is a mix of content from repeat authors as well as new contributors. When you're expecting content from contributors, it's important to maintain deadlines. I email contributors about 1 week before the next issue's deadline. This helps me maintain a regular publication date of the first of each month.

For the rest of the content, I search the internet and ask people to send me photos they took during PCARS activities. I also check other club newsletters and many amateur radio-related blogs, because they may offer things of interest to PCARS members. It's important to note that if you're republishing information from another source, you must get permission first and credit them in the article. When asking for permission, include a link to your published newsletters.

Publishing the Newsletter

Once the newsletter is laid out in *Word*, I have one or two members review it to ensure everything looks good. Then I save the final draft and convert it to a PDF file, which gets published on the club website. Publishing the newsletter on your club's website is easy. You just need to dedicate a web page on your site for current and past newsletters. Having an online archive also allows members to use the newsletter as a resource.

I save a copy of each published issue, along with the raw photos and contributions that were submitted. Then, instead of starting from scratch the next month with a new *Word* file, I work in the previous month's file and just rename it and save it as a new document.

In Conclusion

Over the years, we have improved "The Radiogram" by incorporating changes requested by readers. We send surveys to members asking what they want to see more of, and they're encouraged to submit articles.

"The Radiogram" issues are posted online at **www.portcars.org/wp/newsletter**. Let everyone know what your club is doing and planning by publishing an online newsletter. Get people excited about ham radio, and the fun will follow! If you would like more information about how to create a newsletter for your club, you can email me at **kb8uuz@gmail.com**.

Write for "Club Station"

QST's "Club Station" column is a designated space for clubs to share specific and practical ideas about what has contributed to their success, in the hope that the information will help other clubs grow and thrive. Visit **www.arrl.org/qst-club-station-guidelines-and-profile-form** for more information, including author guidelines and a Club Profile Form (this form is required in order for "Club Station" submissions to be considered complete).

ARRL Special Service Clubs

ARRL offers the Special Service Club (SSC) program for clubs that demonstrate that they're working to improve the amateur radio community by completing special projects, holding license classes, and working with local groups on events, among other activities. Visit **www.arrl.org/ssc-application** for more information about this program. Below is a list of new and renewing SSCs as of February 21, 2023.

New SSCs

Rocky Mountain Ham Radio, NØSZ	Evergreen, CO

Renewing SSCs

Maine Ham Radio Society, KB1CEJ	Milbridge, ME
Rappahannock Valley ARC, K4TS	Fredericksburg, VA
Stillwater ARA, WØJH	Stillwater, MN
Nixa ARC, KØNXA	Nixa, MO
Voice of Idaho ARC, W7VOI	Boise, ID
South Bay ARS, K6QM	Chula Vista, CA
Ascension ARC, K5ARC	Gonzales, LA
Newport County Radio Club, W1SYE	Newport, RI
Saint Paul Radio Club, KØAGF	Saint Paul, MN
Cape Ann ARA, W1GLO	Gloucester, MA
Boulder ARC, WØDK	Boulder, CO
Delaware ARA, K8ES	Centerburg, OH
Northern Ohio ARS, K8KRG	Avon Lake, OH
Ozaukee Radio Club, W9CQO	Cedarburg, WI

Steve Goodgame, K5ATA, sgoodgame@arrl.org

Ham Media Playlist

Ham Radio DX — Inspiring and Educating Hams

One of the best ways to engage youth in amateur radio is to make meaningful connections to learning opportunities and hobbies. Hayden Honeywood, VK7HH, of Australia, is evidence of this.

Hayden's Early Years

At the age of five, Hayden became interested in computers. As he grew older, he began to build Funway kits by Dick Smith, and learned about breadboarding, circuits, resistors, etc. Eventually, Hayden found a 27 MHz receiver circuit, which sparked his interest in radio. He built the kit, but became frustrated when all he heard was static. Knowing nothing about band conditions and radio, he assumed the kit didn't work. But his curiosity was piqued.

When visiting an uncle who was a licensed ham, Hayden had his first opportunity to meaningfully engage with radio, tuning around on his uncle's Kenwood TS-120V. Being able to spin the dial proved to be the hook for this youngster. Hayden vividly remembers hearing stations in the United Kingdom talking to each other. He wanted to learn more.

In 2004, on his 13th birthday, Hayden earned his first ticket as VK7HAY. Both of his uncles were hams, and even though they lived far away, they sent him materials and antenna designs to try out. They encouraged him to find and join a local club, which was crucial to keeping this young ham engaged in amateur radio. The club members helped him set up his station and install antennas, and donated equipment, such as coax, to help him get started. Hayden didn't have just one mentor — he had a community of them.

The Start of "Ham Radio DX"

As Hayden advanced in amateur radio, he became fascinated with VHF and above. He wanted to experiment with microwaves. At the time, he was running a blog, but he found that writing and publishing were becoming too time-consuming, so he decided to try something new. Hayden felt that if he made a video of what he was doing, he could include more details in less time. Thus, his YouTube channel, Ham Radio DX, was born. You can find his channel at **www.youtube.com/HamRadioDX**.

With approximately 28,000 subscribers, Hayden's channel is popular with amateur radio enthusiasts. Currently about one-third of his subscribers are under the age of 45, and 16% of his viewers are under the age of 34.

An ardent supporter and international member of ARRL, Hayden regularly encourages hams around the world to become members. In his videos he spreads the word about ARRL education and youth programs, contests, and the benefits of membership.

Making Contacts and Having Fun

In his video titled "Pushing the Limits of 2.4 GHz Radio (WiFi Frequency)" (**https://tinyurl.com/vk7hh-testinglimits**), Hayden and a friend, Richard, VK7ZBX, attempt to make contact from Tasmania, Australia, to northern New Zealand. This video docu-

Hayden Honeywood, VK7HH, attempts to make a contact on 2.4 GHz from Tasmania, Australia, to Nick, ZL1IU, in New Zealand.

Hayden Honeywood, VK7HH, walks viewers through the setup and operation of FT8.

Hayden created a video titled "Get Started with FT8 – An Introduction for Beginners | WSJT-X Ham Radio" (**https://tinyurl.com/vk7hh-ft8**). Rather than just explaining how to set up a radio and software, Hayden takes the time to explain the elements of an FT8 contact. He then proceeds to step viewers through some of the preliminary setup. Hayden keeps to the basics in this video, providing just enough information for viewers to start and find success. He references other videos on his channel in case viewers want to get more into the nitty-gritty details.

ments the antennas and other equipment they use. They find success on 2 meters and 70 centimeters, though the signal strength was rather low on 70 centimeters. One of the benefits of this video, and all of Hayden's other videos, is that viewers get to witness his struggles as he experiments. In this video, Hayden drops his power to 1 W and still makes contact about 1,500 miles away.

The primary focus of Hayden's channel is to show people how much fun they can have with ham radio. Whether it is experimenting, tinkering with antennas, or just chatting with friends, the purpose is to inspire, promote, and educate anyone who is interested in amateur radio. Hayden also makes a concerted effort to reach out to and engage youth. He does this through not only his YouTube channel, but TikTok as well. Hayden creates content to help people learn different modes of operating. With so many hams taking an interest in digital modes, specifically FT8,

Reaching Far and Wide

Hams around the world enjoy making contacts using various modes. As Hayden learned at an early age, making contacts with people in faraway places can be exhilarating. In his video titled "We Bounced Radio Signals off the MOON!!!" (**https://tinyurl.com/vk7hh-eme**), Hayden and his friend Richard, VK7ZBX, set up a station to bounce a signal off the moon. Hayden and Richard explain what is needed for an Earth-moon-Earth station and how to get on the air. Again, Hayden allows viewers to see the struggles they face trying to make contact with OK2AQ.

Ham Radio DX not only teaches others about various aspects of amateur radio, but it does so with a level of transparency that is refreshing. All too often hams try something new after watching other videos and get discouraged because the people in those videos didn't appear to struggle. This element of Ham Radio DX is part of what makes Hayden's channel such a gem.

Bernie McClenny, W3UR, w3ur@arrl.org

How's DX?

3Y0J DXpedition 2023: A Recap

In this month's column, guest author Ken Opskar, LA7GIA, provides a sequel to the February 2023 "How's DX?" column written by Mike Crownover, AB5EB, by summarizing 3Y0J's experience on Bouvet Island.

On January 17, we set sail for Port Stanley in the Falkland Islands. We had to adjust our route as we approached the icebergs of South Georgia island, but the trip went well, thanks to our captain's expert navigation. As part of the trip, all 3Y0J team members were given the chance to steer the ship under the captain's supervision.

The 3Y0J camp, with accompanying supplies and antennas. The team members operated, slept, and ate in this single tent.

Arrival

We arrived on January 30, at dusk. In front of us was Bouvet — wild, mysterious, and shrouded in mist. It was an emotional experience to finally see the island that we have studied so closely for years. The water was calm, and we anchored close to Cape Fie, ready to operate the following day. Our first objectives were to survey the waters, set up a climbing route, and access the camp. We had two ways of getting equipment and people ashore. One option was to land by inflatable dinghy directly on the beach. The other option was to take the dinghy to a buoy, and from the buoy, pull it ashore with a rope system. We knew the waves would pose a challenge, and we had practiced both methods in Norway. During the planning stage, we performed a risk analysis and identified 37 potential hazards, which allowed us to settle on the unmanned rope system as the safest method.

The first group, consisting of myself; Peter Madej; Mike Crownover, AB5EB, and Dave Jorgensen, WD5COV, went ashore with equipment and provisions by early afternoon the next day. The glacier surrounding Cape Fie has retreated in recent years, so it was easily accessible from the beach without climbing. The surf increased shortly after, meaning there was no way to get any more gear on the island that day. We had to spend the first night in our emergency backup shelter.

The strong waves continued well into the next day, which prevented us from building the camp on schedule. A storm, with wind speeds of up to 65 mph, was also forecasted to arrive in a few days. We were not equipped for the storm, so we focused instead on getting more supplies ashore via the unmanned rope system. The surf was getting rougher, with 10- to 15-foot waves hitting the shore and making it too risky to stay on the beach for much longer. The dinghy was punctured in the process, but we managed to repair it later. Our tents and provisions were continuously taken back by the waves and washed out to sea; it amounted to hours of hard work, but we were able to get many of the supplies ashore.

Evacuation and Floating Back

On the fourth day, we evacuated the island successfully. We left all of the equipment at Cape Fie and returned to the vessel one by one. The events of the last few days required us to reset the DXpedition. We had been studying the swell during those 4 days and knew that we could only go ashore when conditions allowed.

Inside the tent, it was rather tight with all of the equipment.

With the upcoming storm in mind, there would only be a small window of opportunity to get the rest of the equipment on land. If we didn't accomplish this before the storm, the alternative would be to wait another week before the next attempt, which would have compromised the entire DXpedition. Due to these limitations, we were forced to scale back the operation and limit the amount of equipment brought to shore. In total, we packed 620 kilograms of gear, consisting of the following: two K3 radios, three antenna masts, five antennas, 60 meters of coaxial cable, one 1800 W Honda generator, 50 liters of gas, one tent, food, and drinking water.

We did not pack an amplifier, nor any comforts like chairs or tables. There was no heating for the tent, so we had to dry all of our wet clothing on the cold rocks of Bouvet. Our unmanned dinghy system was slightly modified, in that each operator had to don their survival suit and climbing harness. We hooked the climbing harnesses onto the rope between the buoy and shore, and then we floated about 400 feet from the boat to shore.

We similarly floated all of our equipment. The generator was protected inside a 500-liter hypalon bag, the jerry cans of fuel were taped to prevent water ingression, and the antenna bags were packed with bubble wrap; everything was tested beforehand to ensure proper flotation. We then transported our goods to the buoy and hooked the package to the rope. The team members who were already on land pulled the rope and, thus, the equipment ashore. The task was physically demanding, but we finally brought everything and everyone into the camp within 6 hours. The wind was strong by this point, up to 45 mph with rain, so it was also challenging to set up the camp. Thanks to shared effort from the team, we succeeded in reaching our goal for the day.

3YØJ On the Air

We wanted to give as many all-time new ones as possible, so we decided to focus only on CW and SSB. We chose 30 meters as our primary band, as well as 17 and 15 meters — we expected all three bands to provide the longest and most stable openings over the course of the day, in addition to minimal station interference. The team refrained from 20 meters because of poor propagation during the day. We immediately became aware that our 100 W signals were weak, and we also received information about deliberate QRM (DQRM). There were good receive conditions and no noise. As expected, the signals from Asia were extremely strong, and the same generally applied to Europe and the US west coast. But due to the DQRM, we often had to repeat the call signs three to five times before being able to log the contacts. It was still satisfying to log stations that were struggling under the difficult conditions, though if not for the DQRM, it is no exaggeration to say that we could have doubled our contacts and unique call signs. Regardless, all of our antennas and the tent survived the storm, which reinforced our choice of equipment.

Concluding the Activation

We initially planned to expand the station during the next clear weather window. However, the subsequent conditions on Bouvet and the associated risks prevented us from doing so. Some DXers may be disappointed by how we conducted the operation. Whether traveling there by helicopter or inflatable dinghy, or whether there is thick fog or strong waves, Bouvet Island has proven time and again to be a difficult place to activate. We left with mixed feelings, even though we managed to log about 9,000 unique call signs (50%). We did not experience any injuries during the trip, thanks to our risk assessment-based approach. At the same time, we are glad that we were able to adapt to hardships with the tools at our disposal. It took an extreme amount of effort from everyone on the team to make this possible. We would like to thank all of the clubs, organizations, and individual sponsors for their support throughout this project.

Jon Jones, NØJK, n0jk@arrl.org

Long-Path F-Region Propagation on 50 MHz

With the rising solar flux in February from Solar Cycle 25, as well as seasonal changes in the ionosphere, some amazing long-distance F-region propagation began to appear on 6 meters. Long-path contacts, such as VU2NKS and YBØAZ to HC2FG, were made on February 18, 2023, at 1350 UTC. Additionally, VU3WEW answered a call from HC1MD/2 on February 20. HC1MD/2 also copied YBØAZ, who logged 9Z4Y. These contacts occurred in the morning on the west end, with the 6-meter propagation going east from South America.

Long path categorizes contacts occurring more than 20,000 kilometers by the radio path. As noted by propagation expert Jim Kennedy, KH6/K6MIO, in his "50 MHz Long-Path Propagation" presentation at the 37th Conference of the Central States VHF Society, there are three types of very long-distance terrestrial F-region propagation modes on 50 MHz: transpolar long path (TPL), transequatorial long path (TEL), and "short path transequatorial via the geomagnetic equator." The 50 MHz contacts, like YBØAZ to the Caribbean and Ecuador, are via TEL. Similar 6-meter contacts were reported during Solar Cycle 23, between FY/W7XU in French Guiana and Australia, and KH8/NØJK in American Samoa and Jordan. The K index is typically 3 to 4, with a solar flux greater than 165. The best time of year for long-path propagation is around the equinoxes in March and October.

3B9FR: Rodrigues Island

On February 18, Robert Felicite, 3B9FR, on Rodrigues Island, made contacts with stations in North America around 1600 UTC. He logged WW1L, KF8MY, NØTB, and Greg Clausen, WØLGQ (EN21), among others. Greg noted that Robert confirmed his contact in OQRS and LoTW, and Robert told Greg that he was his first 6-meter contact with North America. In fact, these may be the first contacts between Rodrigues Island and mainland US on the 6-meter band per ARRL's "6 Meter Firsts" list.

Tim, NØTB, also copied 3B8FA calling 5B4AIF. Though not true long path, the distances from North American stations to 3B8FA and 3B9FR are more than 17,000 kilometers — this propagation mode can thus be described as "long-throw transequatorial short path" by KH6/K6MIO. Also regarding this mode, Frank Donovan, W3LPL, observed it as "enhanced-MUF transequatorial propagation nearly parallel to the geomagnetic equator." Larry Lambert, NØLL (EM09), reported that he had sporadic E to W8 and W9 stations while others were copying Robert. Perhaps there was an E_s link to F-region propagation toward Rodrigues. While Robert was working North America, Phil, TI5/N5BEK, copied YBØAZ at 1620 UTC via transequatorial long path.

On the Bands

50 MHz. A major F2 opening took place for North American stations on February 16 (see Figure 1), and some remarkable contacts were made. Connie Marshall, K5CM (EM25), worked KH6CJJ (BL10) in Maui, Hawaii. Many stations in the mainland US worked South America during this time. From Kansas, I, NØJK (EM28), logged Rick, HC1MD/2 (EI97), at 1916 UTC. Figure 2 depicts Rick's operating station in Ecuador. Greg, WQØP (EM19), and John Lock, KFØM (EM17), worked stations in Ecuador and farther south to Chile, as they logged CE6TK. K7SMA picked

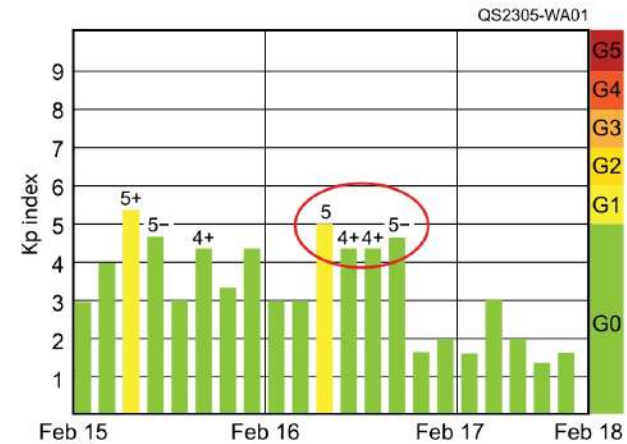


Figure 1 — A graph of the elevated K index on February 16, which sparked F2 propagation on 50 MHz.

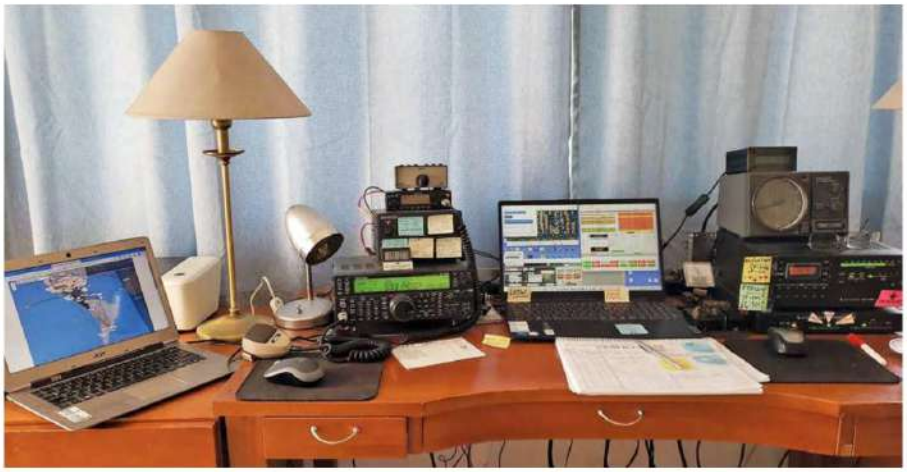


Figure 2 — Rick Dorsch's, HC1MD/2, 6-meter station on February 16, 2023. The *WSJT-X* screen is red with callers. [Rick Dorsch, HC1MD/2, photo]

up CX, LU, and TI in addition to copying VP8NO up to –3 dB. But two contacts stood out that day:

192600 –7 0.3 1778 ~
KL7HBK CE6TK RR73

231900 –19 0.0 832 ~
AC4TO LU1ZV 73

That's right — John, KL7HBK, in Alaska, worked CE6TK in Chile at 1926 UTC. Then, just a few hours later, Ken, AC4TO (EM70), worked LU1ZV (GC16) in Antarctica!

Other stations in south Florida, such as N2NL and W4AS, were also successful in working the Argentinian Antarctic station. K5RK, in Texas, logged LU1ZV at 2327 UTC. LU1ZV reported using a rhombic antenna on 50 MHz.

Another F2 opening occurred on February 21. Rich Zwirko, K1HTV, worked PZ5RA, one station in Spain, three in the Canary Islands, and another in Ecuador. He notes that WW1L, K2KA, K2ZD, N1NG, N4SIX, K4XD, and W3IP all heard FR4OO. K9RX (EM84) worked FR4OO, and WW1L copied 3B9FR again.

Jim, K5ND (EM13), "heard lots of Caribbean stations and picked up V26K for a new country." From Kansas, NØLL (EM09) worked PJ4 while WQØP logged 9Z4Y. On February 23, Chuck, NA6XX, copied 7X2KF via long path at 2041 UTC.

There appeared to be two coronal mass ejection impacts the morning of February 27, as the Kp index went to 7. At first, there was not much of a bump for 6-meter propagation. Gary, NØKQY (DM98), worked HC1MD/2 (EI97) at 1600 UTC. But later, at 1930 UTC, 6 meters broke open with widespread F2 south of North America, to the Caribbean, Central America, South America, and the South Pacific. NØKQY worked TG9AJR, 4BØT, PV8DX, V31MA, HC2AO, and HC2DR. Additionally, NØLL (EM09) worked 4BØT, ZL1RQ, CO2XN (on SSB), and HC2TE. From my fixed mobile station, I copied KH6HI (BL01), OA1F (FI03), and PV8DX (FJ92), and I noted W4TAA and AC4TO exchanging reports with KH7Z/mm. The strongest F2 seemed to occur south and west of the Gulf Coast states, with heavy interference from stateside stations on F2 backscatter. From FM18, Rich Zwirko logged ZL1AKW at 2020 UTC and mentioned that *QST*'s "How's DX?" columnist Bernie McClenny, W3UR, worked New Zealand. Rich copied many west coast stations on backscatter while beaming southwest. Steve Sacco, NN4X, also worked KH6HI, KH6/NA2U, WH6GPU, and stations in New Zealand. Steve copied FK8CP for an extended period, and Mike, K7ULS (DN41), worked LU9AEA, YS1RS, TG9AJR, and KH7Z/mm. WBØBBC (EL96) copied a KH6 station, but was unable to make the contact; he used a squalo antenna.

The K index was still elevated by February 28. Mike King, KMØT (EN13), worked VK4WTN at 2315 UTC and VK4MA at 2351 UTC. He also saw decodes on FK8CP and FK8HA before finally working FK8CP at 0009 UTC on March 1.

432 MHz. BV3CE is back on 432 MHz EME with four 20-element Yagis, and he is currently building a 1500 W amplifier. Also, according to *432 and Above EME News* Vol. 52 #1, W5AFY achieved WAS #31 on 432 MHz.

1296 MHz. The PJ2T DXpedition made 52 contacts on 1296 MHz EME — this was the first 1296 MHz EME from Curaçao. The operator, Gene Shea, KB7Q, used a 1.8-meter dish antenna with 350 W. He may operate from Bonaire next year. In addition, IK3COJ achieved DXCC on 1296 MHz, thanks to a February 21, 2023, contact with ZL1NJR. This information is also courtesy of *432 and Above EME News* Vol. 52 #1.

Here and There

The DM02 grid is one of the rarest needed for the FFMA award. San Clemente Island is in the grid, but it is owned and operated by the US Navy. They have been reluctant to grant permission to operate from DM02 due to safety concerns. One possibility, advanced by Al Bailey, K8SIX, is to work with naval personnel to set up a station on the island's highest peak. He is seeking donations for this effort. Another option is a maritime mobile operation; in 2015, K6ZH, N7CW, and NØKE operated from a boat in DM02 (see "A Grid Expedition to DM02" in the February 2016 issue of *QST*). However, there is now a no-anchor zone surrounding San Clemente. WL7T/P has been previously successful with maritime mobile grid activations, and reportedly has operated from DM02.

Special Event Stations

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

Through Dec. 31, 0000Z – 2359Z, 858ØAA, Västerås, Sweden. Västerås Radioklubb. **80th Anniversary.** All bands, all modes; 2 – 160 meters. Certificate. See website for QSL information. *This is an operating event.* **www.sk5aa.se**

Through Dec 31, 0000Z – 2359Z, K5PRK/5Ø, Plano, TX. Plano Amateur Radio Klub. **50th Anniversary Special Activation**. 14.160. QSL. Plano Amateur Radio Klub, P.O. Box 860435, Plano, TX 75086. *Club members will be activating K5PRK with a /5Ø suffix throughout the year.* **www.k5prk.net**

Through Feb. 26 (2024), 1600Z – 0400Z, W7EK, Bothell, WA. Cascade Radio Club. **75th Anniversary of ARRL Affiliation**. 3.925 7.250 14.250 21.250. QSL. Cascade Radio Club, 5505 189th St. SE, Bothell, WA 98012. **www.cascaderadioclub.org**

Apr. 17 – Apr. 18, 1700Z – 2300Z, W2W, Rochester, NY. Roc-Ham Radio Network. **World Amateur Radio Day 2023**. EchoLink Roc-Ham conference/531091; EchoLink FreeSTAR conference; EchoLink Wales conference; 20 meters, 14.313. Certificate & QSL. John Derycke, W2JLD, 85 Amherst St., Apt. 2, Rochester, NY 14607. **www.roc-ham.net**

Apr. 22 – Apr. 23, 1500Z – 2000Z, W8PRC, Cleveland, OH. Parma Radio Club. **Earth Day Celebration**. 7.195 14.245 145.410 2-meter repeater PL 110.9. QSL. Parma Radio Club, 7811 Dogwood Ln., Cleveland, OH 44130. **www.parmaradioclub.com**

Apr. 29, 1400Z – 1900Z, N4P, Altamonte Springs, FL. Lake Monroe Amateur Radio Society. **Hams for PanCAN**. 40 20 15 10 meters. Certificate & QSL. Lake Monroe ARS, 7747 Danu Dr., Orlando, FL 32822. *Multiple N#P stations participating. QSL available from participating station; a Clean Sweep certificate will be awarded for contacting all section stations.* **rybar1949@gmail.com** or **www.lmars.org**

Apr. 29 – May 1, 1400Z – 2000Z, N3P, New Kensington, PA. WQ3Q. **HAMS for PanCAN**. 3.960 7.172. Certificate & QSL. Skyview Radio Society N3P, 2335 Turkey Ridge Rd., Upper Burrell, PA 15068. *Multiple N#P stations participating. QSL available from participating station; a Clean Sweep certificate will be awarded for contacting all section stations.* **rybar1949@gmail.com** or **www.qrz.com/db/n3p**

May 1 – May 14, 0001Z – 2359Z, WØT, Dickson, TN. Dickson County Amateur Radio Club. **Dickson County Old Timers Day**. 7.235 14.280 21.400 28.450. Certificate. Suzanne Bennett, 1203 Old Highway 48 N., Cumberland Furnace, TN 37051. **www.wc4dc.org**

May 5 – May 6, 1200Z – 2000Z, K4C, Concord, NC. Cabarrus Amateur Radio Society. **Jiggy with the Piggy Barbeque Cook Off**. 7.230 14.310 28.430. Certificate. Cabarrus Amateur Radio Society, P.O. Box 785, Concord, NC 28026. **www.cabarrusars.org** or **www.facebook.com/cabarrusars**

May 5 – May 20, 0000Z – 2359Z, KØC, Bridgeton, NJ. New Jersey Knights of Columbus. **127th State Convention**. 18.121 21.21 24.941 28.31. Certificate & QSL. Thomas M. Perrotti, 785 Vineland Ave., Bridgeton, NJ 08302-4822. **n2jie@arrl.net** or **www.qrz.com/db/k0c**

May 7 – May 13, 0000Z – 2359Z, W9IMS, Indianapolis, IN. The Indianapolis Motor Speedway Amateur Radio Club. **The INDYCAR Grand Prix — Race One**. 3.840 7.245 14.245 18.140. Certificate & QSL. Indianapolis Motor Speedway ARC, P.O. Box 30954, Indianapolis, IN 46230. **www.w9ims.org**

May 10, 1500Z – 2300Z, W7G, Corinne, UT. Ogden Amateur Radio Club. **Golden Spike Special Event Station**. 7.235 14.255. QSL. Ogden Amateur Radio Club, P.O. Box 3353, Ogden, UT 84409. **www.ogdenarc.org**, **www.qrz.com/db/w7g**, or **www.w7g.org**

May 13, 0200Z – 1100Z, W2YRC, Yonkers, NY. Yonkers Amateur Radio Club. **75th Anniversary**. 7.275 14.275 21.375 28.375. QSL. Gil Lugo, WC2Y, 33 Tyndale Pl., Yonkers, NY 10701. **info@yarc.org** or **www.yarc.org**

May 13, 1400Z – 1900Z, NØF, Anoka, MN. Anoka County Radio Club, WØYFZ. **Minnesota Fishing Opener**. 7.255 14.255. QSL. Anoka County Radio Club, P.O. Box 982, Anoka, MN 55303. **www.anokaradio.org**

May 13, 1400Z – 2000Z, K4RC, Williamsburg, VA. Williamsburg Area Amateur Radio Club. **Jamestown Landing Day Event**. 7.265 14.265. Certificate & QSL. See website for information on receiving a QSL and/or certificate. **www.k4rc.net/events/special-event-stations**

May 13, 1500Z – 2100Z, W2M, Hamburg, NY. South Towns Amateur Radio Society. **WNY Regional Maker Faire**. 3.85 7.180 14.230 28.550. QSL. Joseph Claus, 6313 Kast Pl., Hamburg, NY 14075. **www.wb2elw.net**

May 13, 1600Z – 2300Z, NI6IW, San Diego, CA. USS *Midway* Museum Ship. **Commemorating Armed Forces Day and the First US Aircraft Carrier Angle Deck Tests in 1952**. 7.250 14.320; 14.071 PSK31 D-STAR on PAPA System repeaters. QSL. USS *Midway* Museum Ship COMEDTRA, 910 N. Harbor Dr., San Diego, CA 92101. **www.qrz.com/db/ni6iw**

May 20 – May 21, 0001Z – 2359Z, WQ4CWA/75, Virginia Beach, VA. QCWA Chapter 119, Tidewater Virginia. **75th Anniversary of the Quarter Century Wireless Association**. 7.210 14.245 21.300 28.493; other modes on all bands as propagation allows. QSL. Jim Geisinger, 252 Rocky Mount Rd., Virginia Beach, VA 23452. *Operating from members' home stations. QSL arrangements to be announced soon.* **www.qcwa.org/chapter119.htm**

May 20 – May 22, 0000Z – 0000Z, W6SFM, Sacramento, CA. Samuel F. Morse Amateur Radio Club. **W6SFM On-Air Bug Roundup**. 3.533 7.033 14.033 21.033. QSL. Bob Kehr, 13989 Sutter Highland Dr., Sutter Creek, CA 95685. **www.w6sfm.org**

May 21 – May 27, 0000Z – 359Z, N4E, Gainesville, FL. W.T. Loften High School Amateur Radio Club. **National EMS Week**. 7.030 14.200 21.340 28.300. QSL. W.T. Loften High School, 3000 E. University Ave., Gainesville, FL 32641. **bobw4gj@gmail.com**

May 22 – May 28, 0000Z – 2359Z, W9IMS, Indianapolis, IN. The Indianapolis Motor Speedway Amateur Radio Club. **The Indianapolis 500 — Race Two**. 3.840 7.245 14.245 18.140. Certificate & QSL. Indianapolis Motor Speedway ARC, P.O. Box 30954, Indianapolis, IN 46230. **www.w9ims.org**

May 26 – May 27, 2200Z – 2200Z, K9V, Columbia City, IN. Whitley County Amateur Radio Club. **Vietnam Veterans Memorial Special Event Station**. 14.270. QSL. Vietnam Veterans Memorial Special Event Station, P.O. Box 652, Columbia City, IN 46725. **wc9ar@arrl.net**

May 27, 1200Z – 2000Z, KC3TKC, Loysville, PA. Perry County Amateur Radio Club. **Celebrating Marie Doro's Birthday**. 7.240 14.274 21.280 146.550. Certificate. Send QSO information and email address to **events@perrycountyarc.org**. *No paper QSL cards; printable certificates available.* **www.qrz.com/db/kc3tkc**

May 29, 1500Z – 2030Z, W5KID, Baton Rouge, LA. Baton Rouge Amateur Radio Club. **Memorial Day Remembrance**. 7.040 7.250 14.040 14.250; CW SSB FT8. QSL. USS *Kidd* Amateur Radio Club, 305 S. River Rd., Baton Rouge, LA 70802. **www.qrz.com/db/w5kid**

May 29, 1800Z – 2100Z, N3TAL, Glenarden, MD. American Legion Post 275. **Memorial Day Special Event**. 7.275 LSB. QSL. American Legion Post 275 ART, 8201 Martin Luther King Jr. Hwy., Glenarden, MD 20706. **n3tal.275@gmail.com** or **www.qrz.com/db/n3tal**

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 (3 units of postage) to the address listed in the announcement. To receive a special event QSL card (when offered), be sure to include a self-addressed, stamped business envelope along with your QSL card and QSO information.

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**, or email information to **events@arrl.org**.

Submissions must be received by ARRL HQ no later than the 1st of the second month preceding the publication date; a special event listing for **August** *QST* would have to be received by **June 1.** In addition to being listed in *QST*, your event will be listed on the ARRL Web Special Event page. **Note**: All received events are acknowledged. If you do not receive an acknowledgment within a few days, please contact us. ARRL reserves the right to exclude events of a commercial or political nature.

You can view all received Special Events at **www.arrl.org/special-event-stations**.

Volunteers On the Air Update

Have you worked all the VOTA W1AW portable state activations?

There will be two opportunities to work all the W1AW portable state activations. See our VOTA web page at **https://vota.arrl.org** and click the W1AW activations link (or visit **https://contests.arrl.org/docs/2023-VOTA-State-Activations-Schedule.pdf**) to see when states are scheduled.

Listed below are initial QSO tallies from recent W1AW portable activations, as of March 14, which were not reported previously:

- W1AW/7 Utah (January 8 – 14) = 3,812 QSOs
- W1AW/Ø Kansas (January 18 – 22) = 6,651 QSOs
- W1AW/5 Oklahoma (January 25 – 31) = 3,395 QSOs
- W1AW/4 South Carolina (February 1 – 7) = 17,337 QSOs
- W1AW/Ø South Dakota (February 1 – 7) = 4,611 QSOs
- W1AW/4 Georgia (February 8 – 14) = 1,632 QSOs
- W1AW/KH6 Hawaii (February 8 – 14) = 10,393 QSOs
- W1AW/9 Wisconsin (February 15 – 21) = 4,863 QSOs
- W1AW/4 Florida (February 22 – 28) = 7,377 QSOs
- W1AW/8 Michigan (February 22 – 28) = 3,733 QSOs

Frequently Asked Questions

Q How can I see what value my QSOs are worth based on the persons I contact?

A See our point value lookup page, and search by call sign at **https://vota.arrl.org/callPoints.php**.

Q Is there a way to see when specific states will be active on a certain band or mode?

A Yes, in the scheduling PDF file referenced earlier, the sixth row, with the header "State Scheduling Page (if any)," supplies a link to the band, mode, date, and time that is scheduled to be used by that state for activating certain bands or modes. Not all states have these links, but we expect more will be added, so check back often. Check out **https://vota.arrl.org** for the latest updates of ongoing, future, and completed W1AW portable activations.

Q Where can I see how many points my call sign has accumulated?

A We have enabled the leaderboard at **https://vota.arrl.org/leaderboard.php**. On this page, there will be additional enhancements as the event progresses, so check back often.

To follow state activation dates, the leaderboard, and related activities of VOTA, visit **https://vota.arrl.org**.

Convention and Hamfest Calendar

A = AUCTION
D = DEALERS / VENDORS
F = FLEA MARKET
H = HANDICAP ACCESS
Q = FIELD CHECKING OF QSL CARDS
R = REFRESHMENTS
S = SEMINARS / PRESENTATIONS
T = TAILGATING
V = VE SESSIONS

Abbreviations

Spr = Sponsor
TI = Talk-in frequency
Adm = Admission

Arizona (Prescott Valley) — May 13 D F H Q R T
8 AM – noon. *Spr:* Yavapai ARC and Amateur Radio Council of Arizona. Granville Elementary School, 5250 Stover Dr. *TI:* none. *Adm:* $5. **www.prescotthamfest.org**

Arizona (Sierra Vista) — May 6 F H R T V
6:30 AM – 11 AM. *Spr:* Cochise ARA. Green Acres, 2756 S. Moson Rd. *TI:* 146.76 (162.2 Hz). *Adm:* Free. **www.k7rdg.org**

Colorado (Delta) — June 3 T
6:30 AM – 11 AM. *Spr:* Montrose ARC. Delta Lions Club Pavilion, Gunnison River Dr. *TI:* 147.195 (107.2 Hz). *Adm:* Free. Email: **ki0ky@arrl.net**

Connecticut (Goshen) — May 20 D F H R T V
8 AM – noon. *Spr:* Southern Berkshire ARC. Goshen Fair Grounds, 116 Old Middle St. (Rte. 63). *TI:* 147.285 (77.0 Hz). *Adm:* $5. **www.sberk.org**

Florida (Daytona Beach) — Apr. 29 F T V
8 AM – 2 PM. *Spr:* Daytona Beach ARA. First Presbyterian Church North Building, 620 S. Grandview Ave. *TI:* 147.150 (127.3 Hz). *Adm:* Donation appreciated. **www.dbara.org**

Florida (Pinellas Park) — May 27 F H T
8 AM – noon. *Spr:* The Glorious Society of the Wormhole. Freedom Lake Park, 9990 46th Street N. *TI:* 146.850 (146.2 Hz). *Adm:* Free. **www.w4orm.org**

Georgia (Forsyth) — May 13 R T
8 AM – 2 PM. *Spr:* Barnesville GA Repeater Net. Monroe Co. Recreation Department, 100 Dan Pitts Dr. *TI:* 147.225 (no tone). *Adm:* Free. **www.barnesvillega.net**

ARRL GEORGIA SECTION CONVENTION

June 3, Marietta, Georgia
D F H Q R S T V
9 AM – 3 PM. *Spr:* Atlanta Radio Club, Kennehoochee ARC. Jim R. Miller Park & Event Center, 2245 Callaway Rd. SW. *TI:* 146.820 (146.2 Hz). *Adm:* $6 Advance, $8 door. **www.atlantahamfest.org**

Illinois (Mendota) — June 4 D F H R T V
8 AM – 1 PM. *Spr:* Starved Rock Radio Club. Mendota Tri-Co. Fair, 405 1st St. *TI:* 147.120 (103.5 Hz), 146.520 simplex. *Adm:* $8 Advance, $10 door. Email: **starvedrockhamfest@gmail.com**

Indiana (Peru) — Apr. 29 D H R T V
9 AM – 2 PM. *Spr:* Cass Co., Grant Co., Miami Co., Howard Co. ARCs. Miami Co. 4H Fairgrounds, 1029 W. 200 N. *TI:* 147.345 (131.8 Hz). *Adm:* $5. **www.ncihamfest.com**

Iowa (Creston) — June 10 D F R T V
8 AM – noon. *Spr:* South West Iowa ARA. Union Co. Emergency Management, 705 E. Taylor St. *TI:* 146.790 (136.5 Hz). *Adm:* Free. **www.facebook.com/groups/327085807349791**

Louisiana (Monroe) — May 13 D F H Q R S T V
8 AM – 1 PM. *Spr:* Louisiana Delta Radio Club. Barak Shrine Temple, 6620 Frontage Rd. *TI:* 147.135 (127.3 Hz). *Adm:* $5. Email: **kb5vjy@gmail.com**

Maryland (West Friendship) — May 28 D F H R T V
8 AM – 1 PM. *Spr:* Maryland FM Association. Howard Co. Fairgrounds, 2210 Fairgrounds Rd. *TI:* 146.76, 224.76, 444.0 (107.2 Hz). *Adm:* $10. Email: **marylandfm@verizon.net**

Michigan (Chelsea) — June 4 D F H Q R S T V
8 AM – 4 PM. *Spr:* Chelsea ARC. Chelsea Community Fair, 20501 W. Old US Hwy. 12. *TI:* 145.450 (100 Hz). *Adm:* $5. **www.wd8iel.com**

Michigan (Hudsonville) — June 3 F H Q R T V
8 AM – noon. *Spr:* Independent Repeater Association. Hudsonville Community Fair, 5235 Park Ave. *TI:* 147.16 (94.8 Hz). *Adm:* $8. **www.w8ira.org**

Michigan (Newberry) — June 10 D F H R V
8 AM – noon. *Spr:* Luce ARS. Luce-West Mackinac Co. Fairgrounds, 11555 Co. Rd. 399. *TI:* 146.61 (114.8 Hz). *Adm:* $5. **www.w8nby.org**

AURORA '23

June 3, Plymouth, Minnesota
F H Q S T
9 AM – 5 PM. *Spr:* Northern Lights Radio Society. West Medicine Lake Community Club, 1705 Forestview Ln. N. *TI:* none. *Adm:* $5. **www.nlrs.club**

Missouri (Braymer) — May 20 D F R
8 AM – 2 PM. *Spr:* Missouri Five Co. ARC. Braymer American Legion Hall Post 117, 9th St. *TI:* 147.225 (94.8 Hz). *Adm: $5.* Email: **preamp62@yahoo.com**

Missouri (Springfield) — June 3 D F H R S T V
8 AM – 1 PM. *Spr:* Southwest Missouri ARC. Salvation Army, 1707 W. Chestnut Expy. *TI:* 146.910 (162.2 Hz). *Adm:* $7 Advance, $10 door. **www.smarc.org/smarc-pre-field-day-hamfest-june-3rd**

New Jersey (Fair Lawn) — June 10 D F H Q R S T
6 AM. *Spr:* Fair Lawn ARC. Memorial Pool parking lot, Essex Pl. *TI:* 145.470 (167.9 Hz). *Adm:* $5. **hamfest.fairlawnarc.org**

New Jersey (Spring Lake) — June 3 D F H R T V
7 AM – 1 PM. *Spr:* Ocean Monmouth ARC. Spring Lake Heights Independent Fire Company #1, 700 6th Ave. *TI:* 145.110 (127.3 Hz). *Adm:* $5. **www.n2mo.org**

New Jersey (Wall Township) — June 10 D F H T
8 AM – 2 PM. *Spr:* CDL Radio Group/W2CDL. Info Age-Camp Evans Historic District parking lot, Monmouth Blvd. *TI:* 147.045 (67 Hz). *Adm:* $5. **www.vcfed.org/vcf-swap-meet**

New Mexico (Clovis) — May 27 D F H R S T V
8:30 AM – 4 PM. *Spr:* Eastern New Mexico ARC. McDaniels Flooring America, 1013 Mitchell St. *TI:* 443.45 (131.8 Hz). *Adm:* Free. **www.ka5b.org**

New York (Depauville) — May 20 F H R T V
8 AM – noon. *Spr:* Thousand Islands Repeater Club. Depauville Fire Dept. Historical Society, 15191 School St. *TI:* 147.030 (151.4 Hz). *Adm:* $2. Email: **kc2ztg@gmail.com**

FOUR DAYS IN MAY

May 18 – 21, Fairborn, Ohio
D R S
9 AM – 10 PM. *Spr:* QRP ARCI. Holiday Inn, 2800 Presidential Dr. *TI:* none. *Adm:* $35. **www.qrparci.org/fdim**

New York (Hilton) — June 3 D F H Q R T V
7 AM – 2 PM. *Spr:* Rochester ARA. Hilton Exempt Club, 137 S. Ave. *TI:* 146.61 (110.9 Hz). *Adm:* $10, free to students and RARA members. **www.rochesterham.org/hamfest.htm**

RV RADIO NETWORK

May 13 – 17, Millersburg, Ohio

S

All week. *Spr:* RV Radio Network. Berlin RV Park & Campground, 5898 State Rte. 39. *Tl:* 146.55 (simplex). *Adm:* Free. Email: **shrine94@aol.com**

Ohio (Piketon) – May 27 F H R T V

8 AM – noon. *Spr:* Scioto Valley ARC. Pike Co. Fair and Fairgrounds, US Rte. 23. *Tl:* 146.850 (74.4 Hz). *Adm:* $5. Email: **kd8chp@cqohio.com**

Ohio (Wauseon) — June 3 D F H R T V

8 AM – noon. *Spr:* Fulton Co. ARC. Roth Family Woodlot Park, 105 Hill Ave. *Tl:* 147.195 (103.5 Hz). *Adm:* $5. **www.k8bxq.org/hamfest**

ARRL GREAT LAKES DIVISION CONVENTION

May 19 – 21, Xenia, Ohio

D F H Q R S V

Fri. and Sat. 9 AM – 5 PM, Sun. 9 AM – 1 PM. *Spr:* Dayton ARA. Greene Co. Expo Center, 120 Fairground Rd. *Tl:* 146.94 (123.0 Hz), 146.985 (123.9 Hz). *Adm:* $26 Advance, $30 door. **www.hamvention.org**

ARRL NORTHWESTERN DIVISION CONVENTION

June 2 – 4, Seaside, Oregon

D F H Q R S V

Fri. and Sat. 9 AM – evening, Sun. 9 AM – 4 PM. *Spr:* Oregon Tualatin Valley ARC, Clark Co. ARC. Seaside Civic & Convention Center, 415 1st Ave. *Tl:* 145.49 (118.8 Hz). *Adm:* $15 Advance, $20 door. **www.seapac.org**

ARRL WESTERN PENNSYLVANIA SECTION CONVENTION

June 4, Prospect, Pennsylvania

D F H Q R S T V

8 AM – 3 PM. *Spr:* BreezeShooters ARC. Big Butler Fair Grounds, 1127 New Castle Rd. (Rt 422). *Tl:* 147.300 (131.8 Hz). *Adm:* $7 Advance, $10 door. **www.breezeshooters.org**

UTAH DIGITAL COMMUNICATIONS CONFERENCE

April 29, Sandy, Utah

H S

9 AM – 5 PM. *Spr:* Utah Digital Communications Committee. The Conference Center at Miller Campus, 9750 S. 300 W. *Tl:* 146.620 (no tone). *Adm:* $15 Advance, $20 door. **www.utah-dcc.org**

Virginia (Manassas Park) — June 3 F T

8 AM – 2 PM. *Spr:* W4OVH Ole Virginia Hams. The field across from Signal Hill Park, 9300 Signal View Dr. *Tl:* 146.970 (100 Hz). *Adm:* $5. **www.w4ovh.net/tailgate**

Washington (Dryden) — June 9 – 11 F H R V

9 AM – 1 PM. *Spr:* Apple City ARC. Dryden Gun Club, 7649 Saunders Rd. *Tl:* 146.680 (156.7 Hz). *Adm:* $8. **www.applecityarc.com**

Washington (Stanwood) — May 13 F H R V

9 AM – 1 PM. *Spr:* Stanwood-Camano ARC. Stanwood Middle School, 9405 271st St. NW. *Tl:* none. *Adm:* $5. **www.scarcwa.org**

Washington (Union Gap) — May 20 F H R T

9 AM – 2 PM. *Spr:* N7YRC Group. Yakima Co. Emergency Management, 2403 S. 18th St. *Tl:* 444.7500 (131.8 Hz). *Adm:* Free. Email: **kc7vqr@arrl.net**

Wisconsin (Green Bay) — June 3 D F H R T V

8 AM – noon. *Spr:* Green Bay Mike & Key Club. Our Saviour Lutheran Church, 120 S. Henry St. *Tl:* 147.120 (107.2 Hz). *Adm:* $5. **www.k9eam.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 **June 1** to be listed in the **August** issue. Information in this column is accurate as of our deadline; contact the sponsor or check the sponsor's website for possible late changes, driving directions, and other event details. Please note that postal regulations prohibit mention in *QST* of games of chance, such as raffles or bingo.

Promoting your event is guaranteed to increase attendance. As an approved 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**.

Volunteer Monitor Program Report

The Volunteer Monitor (VM) Program is a joint initiative between ARRL and the FCC to enhance compliance in the Amateur Radio Service. This is the February 2023 activity report of the VM Program.

♦A warning was issued to an Extra-class licensee in eastern Virginia for deliberate interference and obscenities on 3.933 MHz. The licensee was informed that this information was being referred to the FCC for consideration in his 2025 license renewal.

♦An advisory notice was issued to a California repeater operator for constant identification of transmissions on a cross-band repeater operating on 146.595 and 446.500 MHz. Such identification with no traffic constitutes broadcasting, which is contrary to FCC rules.

♦An advisory notice was issued to a Technician-Plus operator in Indiana for operation on 3.630 MHz, and for operating with an expired license. The matter was referred to the FCC.

♦A commendation was issued to an amateur in Florida for his efforts in resolving a deliberate interference issue in December 2022 on a net operating on 7.153 MHz.

♦An advisory notice was issued to a cross-band repeater operator in Wisconsin for operating with an expired license on 147.225 and 447.4815 MHz.

♦A second notice of unlicensed operation was issued to a high-altitude balloon operator in Colorado for operation on 144.390 MHz. The matter was referred to the FCC.

♦An advisory notice was issued to an operator in Indiana for excessive bandwidth, 10 kHz, on 3.620 MHz.

The totals for VM monitoring during January 2023 were 2,209 hours on HF frequencies, and 3,773 hours on VHF frequencies and above, for a total of 5,982 hours. — *Thanks to Volunteer Monitor Program Administrator Riley Hollingsworth, K4ZDH*

At the Foundation

Happy 50th Anniversary, ARRL Foundation!

On September 21, 1973, in Hartford, Connecticut, the ARRL Foundation was formed to support the mission of ARRL, in the words of the Foundation's Articles of Incorporation: "To advance the art, science, and societal benefits of the amateur radio service by awarding financial grants and scholarships to individuals and organizations in support of their charitable, educational, and scientific efforts."

As many as 100 scholarships, in amounts ranging from $500 to $25,000, are awarded annually to amateur radio operators.

Thank you to our many donors, directors, and volunteers for making this work possible, and congratulations to the numerous scholarship recipients who have benefited from their generosity.

Congratulations

February 2023
QST Cover Plaque Award Winners

Sean Kutzko, KX9X, and Nancy Livingston, N9NCY

In the article, "Wild West Rove," Sean describes lessons learned on how to negotiate a vacation with ham radio, including tips on planning, expectations, and compromise. Nancy's photos of the trip illustrate the piece.

QST Cover Plaque Awards are given to the author or authors of the most popular article in each issue. *You* choose the winners by casting your vote online at

www.arrl.org/cover-plaque-poll

Log in now and choose your favorite article in this issue!

Sean Kutzko, KX9X

I've operated portable hundreds of times, and being able to transmit from a new location is one of the primary factors I think of when planning vacations. My partner, Nancy, N9NCY, earned her Technician-class license in January 2021, and she dove into portable operating because it couples with her love of driving and traveling.

Though she enjoys ham radio, her interest is not as intense as mine. I can become downright obsessive when a portable operation is being planned. "When Sean suggested we combine our vacation to Glacier National Park [Montana] this year with a rove, I was all in," Nancy said. "We spent a ton of time planning the vacation, with me handling the actual vacation part and Sean handling the roving part… Sean gets immersed in how much radio time he can pack into any opportunity that presents itself."

Forming the Plan

We planned to leave directly from our home in Urbana, Illinois. This trip would be taking us through eight states and nearly 40 grid squares; in the parlance of satellite and VHF operators, this would be a rove of epic proportions.

We agreed that the first part of the trip, driving to and spending 6 days in Glacier National Park, would mainly be a vacation. Leaving Glacier and driving home would be more radio focused.

But it would take 3 10-hour days to get to Glacier from Illinois. I knew I couldn't pass through so many grids without operating, so I decided to operate 6-meter FT8 and do linear satellite passes while mobile on the trip out. It was not an ideal circumstance; after hours of grounding and bonding, my gear was still picking up a significant amount of noise from Nancy's SUV. FM satellites proved impossible to use in pre-trip testing while mobile, so I focused on the linear (SSB) satellites instead. FT8 tests on 6 meters also proved modestly successful despite an S6 noise level.

For satellites, I used my standard rover kit: two Yaesu FT-817s and a 10 Ah battery. I also added two 19-inch, dual-band mobile whips spaced as far apart as possible. On 6 meters, I used a four-magnet mount base with a 6-meter hamstick. In the end, I had a storage tub full of gear in the back seat along with a 13-foot, collapsible painter's pole to use as a mast for a two-element, 6-meter beam. I also packed two Arrow Antenna dual-band Yagis for satellite work when we weren't in motion. It was a lot of gear for a 2-week trip, despite the initial emphasis on traveling light.

The Rove Begins

At 6:00 AM on July 13, 2022, Nancy and I began our "Wild West Rove." The drive out to Glacier was full of excitement. We had 3 days to get to our campsite, and we had plans to meet up with a few ham friends along the way, including Minnesota satellite rover Randy

A Look Back


QST
June 1973
75 Cents
CLEARLY
amateur radio
HEY, GEORGE... IT'S YOUR TRICK ON EIGHTY
I DISTINCTLY HEARD YOU SAY
ELECTRIC FENCES... YES...BUT NOW THEY'RE
SECRET QTH, OM...
CQ FD
CRASH!
BUMP BUMP
Propagation Chart
ZING, really hot
WOW!
HUM, NOT BAD
GETTING BETTER
EH!
LOUSY
N.G.
PUTRID
NIL
Field Day
SWISH
2 days b4 FD
day b4 F.
the BIG day
day after
2 days after FD
LOOKED LIKE A PURTY VINE
WHAT YOU DOIN', MISTER
. . . have a good Field Day!
OFFICIAL JOURNAL OF THE ARRL
ARRL

A Simple Az-El Antenna System for Oscar

BY KATASHI NOSE,* KH6IJ

THIS ARTICLE describes an antenna system which was assembled in three hours using store-bought items in an attempt to meet the Oscar-AOC launch date advance. Other literature points out the necessity for a circularly polarized system and the methods used to produce that polarization.[1] The basic considerations in the design of this system were low cost and ease of assembly. In the matter of choice between a crossed-Yagi system and a helical antenna, the main factor was that Yagi antennas can be bought off the dealers shelf, but most helical antennas can not.

The Crossed Yagi

To obtain circular polarization, one has to feed two Yagis in proper phase quadrature, which means that one antenna must be fed with coaxial cable that is one-quarter wavelength longer than the feed line to the other. The preferred method is to use a grid-dip meter to check the sections of coax for correct length.

Fig. 1 shows the overall assembly of the array. The antennas used are Hy-Gain Model 341 eight-element Yagis. Fig. 2 is a head-on view of the array, showing the antennas mounted at 90 degrees with respect to each other and 45 degrees with respect to the cross arm.

Coupling between the two Yagis is minimal at 90 degrees and is somewhat greater at 45 degrees, following the greatly simplified formula:

$$E = E_o \cos \theta$$

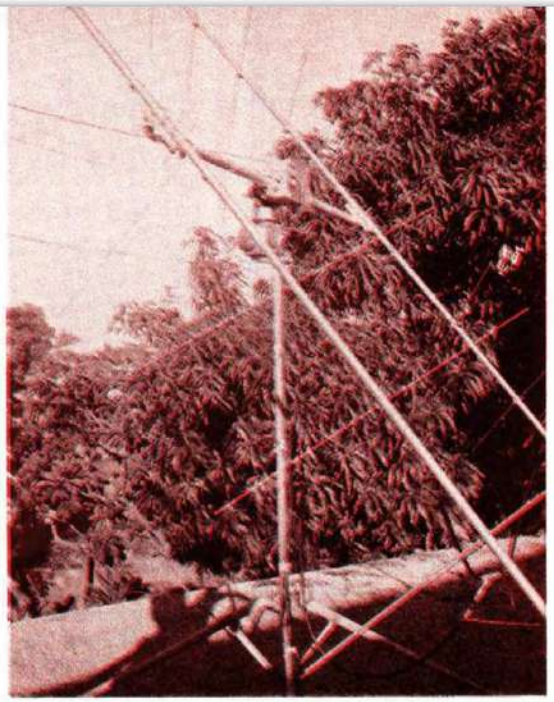
Where E = induced voltage

E_o = inducing voltage

θ = axial angle between the two Yagis.

* Dept. of Physics and Astronomy, 2565 The Mall, Univ. of Hawaii, Honolulu, HI 96822.

[1] Nose, "Crossed Yagi Antennas for Circular Polarization," *QST*, January, 1973.



By setting the angle at 45 degrees with respect to the cross arm, coupling is minimized but not eliminated.

Length "D" in Fig. 2 should be the minimum necessary for the elements to clear the tripod base when the array is pointed straight up and rotated. In my case a five-foot section of TV mast served the purpose.

The Phasing Section

Phasing problems are covered in another article (see footnote 1). The method of phasing and

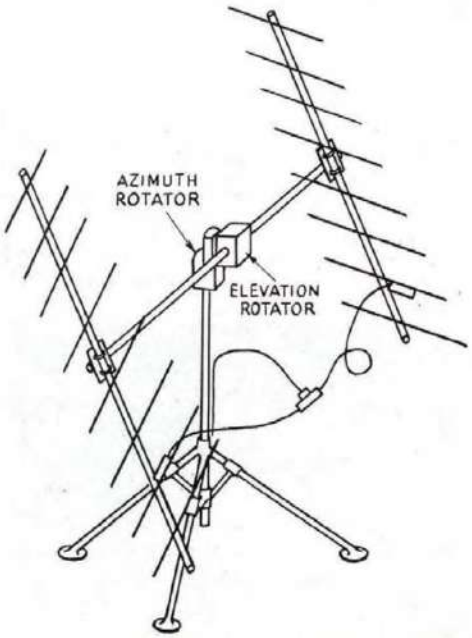


Fig. 1 — The antenna system can be assembled using off-the-shelf components such as Hy-Gain Yagis, Cornell-Dubilier or Blonder-Tongue rotators, and a commercially made tripod.

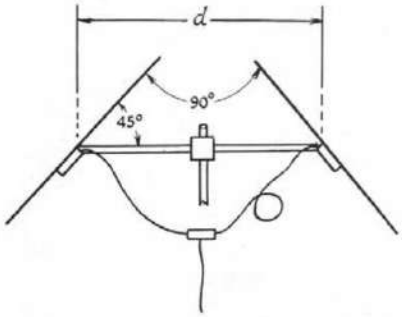


Fig. 2 — An end-on view of the antennas show that they are mounted at 90 degrees to each other, and at 45 degrees to the cross boom.

cutting cables to length is described briefly, using paralleled lengths of coax cable to match the feed impedance. Alternatively, one can bring two separate feed lines to the shack, one a quarter wave length longer than the other, then selecting the polarization that gives the best response. The latter method is not too good with circular polarization, or if the linearly polarized signals are undergoing rapid Faraday rotation.

The Mounting Tripod

A mounting tripod could be made by using aluminum railing, called "NuRail," which comes with all manner of swivels, crosses, and T fittings. However, the cheapest method is to purchase a TV tower such as Lafayette No. 18-56233W, which is a collapsible tripod. It is made by the South River Metal Products Company, South River, NJ 08820. Their model number is HDT-5. This tower sells for such a low price that there is little point in constructing your own. Spread the legs of the tripod more than usual to assure greater support, but be sure that the elements of the antenna will clear the base in the straight-up position.

Elevation-Azimuth Rotators

The azimuth rotator is a Cornell-Dubilier AR-20, which sells for approximately $25. The elevation rotator is a Blonder-Tongue Prism-matic PM-2, which sells for about $35. The latter is one of the few on the market which allows the boom of the Yagi to rotate on its axis when supported at the center.

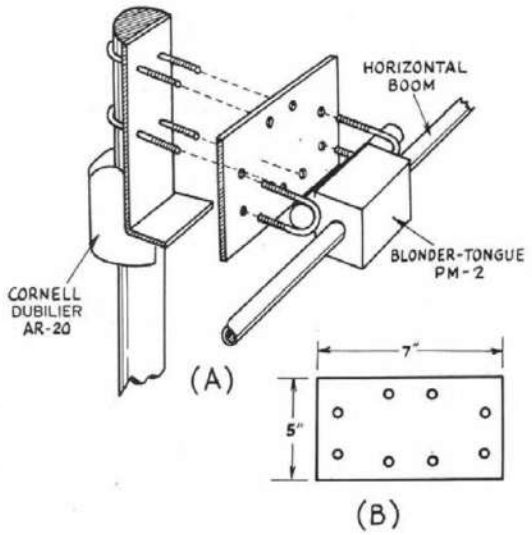
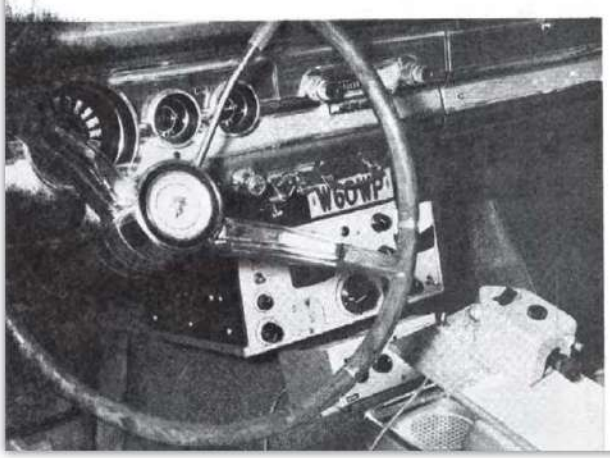


Fig. 3 — The method of mounting two rotators together. A pair of PM-2 rotators may also be used. The adapter plate (B) may be fabricated from 1/4-inch-thick aluminum stock, or a ready-made plate is available from Blonder-Tongue.

Fig. 3 shows the detail of the method of mounting the two rotators together. Notice that the flat portion of the AR-20 makes an ideal mounting surface for the PM-2. If you want to utilize commercially fabricated components throughout, a mounting plate similar to that shown in Fig. 3B can be purchased. Blonder-Tongue makes an adapter plate for their heavy-duty CATV antennas. It is called a YSB Stacking Block and costs $13.75. The PM-2 rotator fits horizontally on this plate even though this was not the intended application. The adapter plate may be used to fasten two PM-2 rotators together. QST

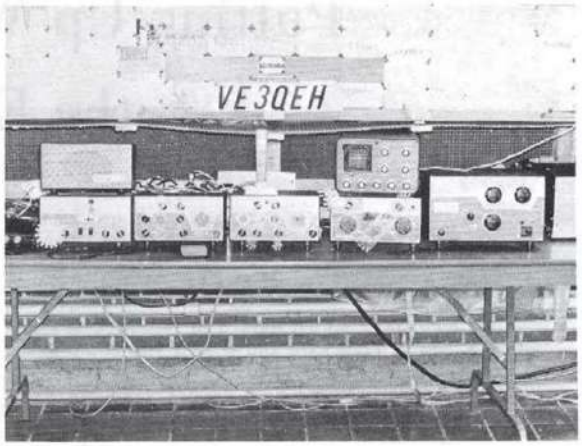
Strays



How's this for a nifty mobile set-up? Strictly cw, of course, as befits our longtime West Coast code practice stalwart W6OWP. Bart tells us that it is only for 40 meters and although no real effort has been made DX-wise, two JAs and a UA were worked one weekend while driving through the Nevada desert.

QST for

VE3Queen Elisabeth Hospital Calling . . .



A BLUE SIGNAL comes down the mast and there's a bit of red on it. We make a yellow signal in the receiver and send it up to meet the red. All we want out of the mix is the red, and that red is the human voice.

Not the usual way, perhaps, of talking about oscillators and manageable i-fs, but this kind of teaching has been the key to creating one of Canada's most unusual and worthwhile ham shacks – VE3QEH at Toronto's Queen Elisabeth Hospital for the permanently handicapped.

Len Sumner, VE3DOR, has recently guided six new operators – Dot, Bessie, Lear, Jimmie, Ken and Ted – through to their first tickets, and the hardest job was persuading them that they had the ability to cope with the complexities involved.

In the hospital between 20 and 45 years, these severely handicapped patients had learned such skills as painting with brushes between teeth, and typing with a mouth-held stick – but it was a big step to going on the air as full-fledged operators, especially when, as in Dorothy's case, you've never taken a test on anything in your life.

They did it, though, thanks to Len's simplified teaching and fund-raising efforts and to the equipment modifications by Ray Hunter, VE3UR, the Drake agent in Toronto.

The shack is a beauty – with a fine layout in the hospital's sixth floor solarium. The station equipment includes a complete Drake-line and the antenna farm is a Hy-gain TH6DXX beam, Ham-m rotor, and dipoles for 80 and 40 meters 160 feet above ground level.

But the secret is in the series of plexiglass disks fitted to the dials so that fine tuning can be done with a stick held in the mouth or by other adaptive devices. VE3UR cut the disks as the training program went along so they fitted everyone's needs exactly.

James Jarvie, the Federal Department of Communications Inspector who administered the license tests, was really impressed. "It was quite an operation," he said afterwards. Regulations were bent a little so that the six could go on voice straightaway, though they have passed the Morse code requirements. All the other tests were oral.

"We completely re-wrote all the usual ideas about training," Sumner said. "The usual two sessions a week with a lot of private study and delving into manuals was obviously of no use at all. We did everything orally with six one-hour sessions a week, about as much as the patients could handle without getting overtired."

The therapeutic effects have been startling in some cases. Bessie, 66 years old and 23 years in a wheel chair with multiple sclerosis, has started throwing her voice in a way she never managed before without the incentive of being on the air.

Lear Warner, a youngster from Barbados, paralized with a viral disease, could hardly make himself heard at first because of a throat operation for insertion of sustenance tubes during 14 months he spent in a coma. "Now he operates like a pro," Mr. Jarvie said.

VE3DOR was himself a late starter. He took up ham radio as a hobby after retiring from the insurance and computer software business. Just recently (long after the patients he trained) he passed his Advanced Amateur exam and can finally go home and talk to VE3QEH – over the airwaves. – *Norman Hartley*

With stick in mouth and a little practice, the operator can manipulate the slotted-disk tuning controls of the station.

June 1973

Celebrating Our Legacy

Honoring Easy Ocean Wave

When I was a kid in the early 1960s, I listened to my dad, WØEOW, operate the radio equipment that he built: "CQ, CQ, calling CQ 40, this is W Zero Easy Ocean Wave." He made a contact with someone on an island off the coast of Alaska, and I got to talk to him. I had no idea that a radio could do that!

My dad made an oscillator and attached a key to it. I would listen and copy the Morse code he sent me. Soon, my interest faded, and the oscillator started gathering dust.

My dad passed away in 1977, and that's when I became interested in his ancestry. His parents emigrated from Sweden, so my wife and I traveled there in 1981. My dad's uncle, WØWTZ, also emigrated from Sweden, and he used his ham license to keep in touch with friends there. I was starting to see how hams connected all around the world! I was hooked.

Once I got home, I studied hard and got my Novice license in 1982. My son unknowingly helped me work toward the General license. I carried him around trying to get him to fall asleep while listening to W1AW code broadcasts.

Passing the General-class license test was truly one of the most special moments of my life. I remember saying, "Dad, I did it!"

Easy Ocean Wave didn't get to see that moment. For all he knew, the dots and dashes of my childhood ended in grade school. Perhaps other hams have tried to excite their kids and didn't see it stick. Well, maybe it did!

Don J. Pearson, KE5GJ
Gig Harbor, Washington

Source of My Success

As a retired electronics engineer, I am sure that ham radio is the secret to my success.

I got my license in 1952, and 6 months later I enlisted in the US Navy. Because of my ham license, I was sent to electronics technician school, which led to my job as Communications Technician in the Naval Security Group. It was my responsibility to repair broken transmitters and receivers, and I was in ham heaven. In my free time, I operated several Navy club stations, and ran phone patches from American service members in Japan to their families back home.

I thank this wonderful hobby not only for my fulfilling career, but for the many long friendships I have made over the years.

Sumner Weisman, W1VIV, operating CW at a US Navy ham radio club station. [Photo courtesy of Sumner Weisman, W1VIV]

Sumner Weisman, W1VIV
Framingham, Massachusetts

A Piece of History

For more than 50 years, I have been a ham radio operator and have collected unknown pieces of electronic equipment.

I was searching for a variable capacitor when I found a strange-looking piece of thin wood that formed a hollow box with a removable cover. One end had two brass terminals. Upon removing the cover, I found two copper or bronze discs that were about 3 inches in diameter. These discs were pressed against a copper strap that connected to the terminals.

A piece of paper was pressed between the upper copper strap and the lid of the box. It was a letter dated 1912, addressed to Rawson Stark in Andersons Bay, New Zealand. Online newspaper articles revealed that he and two young friends accomplished the first land-based public wireless communication using home-built spark transmitters and receivers on September 10, 1908.

The device that James Forkin, WA3FTS, found. [James Forkin, WA3FTS, photo]

I found an old picture of what appears to be the device, which is atop a large coil on a transmitter they had constructed. Because the device is a capacitor of some sort (it measures 151 pF), and was located on the large inductor, it may have been used to resonate the inductor.

There was much praise for the boys, though they were not given official credit for their accomplishment (as it was potentially illegal). Instead, a transmission on November 17, 1921, was determined as the first official broadcast from the University of Otago.

Another article mentioned that one of the boys moved to the US, which explains how the device ended up here.

James Forkin, WA3TFS
Pittsburgh, Pennsylvania

Send reminiscences of your early days in radio to "Celebrating Our Legacy," ARRL, 225 Main St., Newington, CT 06111 or **celebrate@arrl.org**. Submissions selected for publication will be edited for space and clarity. Material published in "Celebrating Our Legacy" may also appear in other ARRL media. The publishers of *QST* assume no responsibility for statements made in this column.

Scott Freeberg, WA9WFA, wa9wfa@gmail.com

Classic Radio

A Brief History of E.F. Johnson Company

One of the great old American ham radio manufacturers was E.F. Johnson Company. Founded in 1923 by Edgar F. Johnson, and located in Waseca, Minnesota, the company began by selling purchased radio parts to hams and AM radio broadcasters and builders.

In 1925, Johnson started manufacturing and selling its own line of transmitter parts. The company quickly became well respected for offering quality components. It even received a citation by American naval officer and explorer Admiral Richard E. Byrd, following his Antarctic expedition from 1928 to 1930. During World War II, Johnson supplied quality parts for the war and received an Army-Navy "E" Award for outstanding production efficiency.

Over the years, the company added more parts, delved into amateur radio, went wild with the CB radio craze, became a powerhouse in commercial land and mobile communications, and provided some of the first tower transmitters for cell phones.

Entering the Amateur Radio Market

After World War II, in 1949, E.F. Johnson Company (like many other electronics companies) needed to find a new market, as military spending slowed to a crawl. The company started manufacturing amateur radio transmitters and amplifiers using many of their own parts.

Johnson manufactured the Viking series of transmitters and amplifiers from 1949 to 1965, starting with the Viking I. It was a powerful AM-CW transmitter that covered all of the ham bands from 160 through 10 meters. It was incredibly well built, weighed around 70 pounds, and was 11.25 × 21 × 15 inches.

The company sold transmitters in kit and wired forms. The Viking I trans-

Edgar F. Johnson, circa 1944. [Photo courtesy of the Waseca County Historical Society]

The inside cover of the Viking I manual. [Photo courtesy of Pete Markavage, WA2CWA]

mitter kit cost $209.50 in 1949, which is equivalent to $2,576 in 2023 (**www.usinflationcalculator.com**). The wired version cost $259.50, equivalent to $3,190 today. Many of the wired versions were built in the homes of Waseca housewives, and Johnson workers got paid extra to assemble kits on nights and weekends. These units would often have the builder's name, handwritten by them, on the serial number label on the top of the chassis.

The Viking series included the Viking I, Viking II, Viking Adventurer, Viking Challenger, Viking Navigator, Viking Mobile, Viking Ranger, Viking Valiant, Viking Five Hundred, Viking Desk Kilowatt, Viking Pacemaker, Viking Invader, Viking Courier, and Viking Thunderbolt.

My Viking Ranger transmitter, which I still operate today. [Scott Freeberg, WA9WFA, photo]

The styling of the Viking series was quite striking. The logo consisted of a typical bearded Viking warrior with horns on their hat. The gray and maroon units featured the name on the front panel in mint green. They remain beautiful to look at.

Over the years, E.F. Johnson Company offered a wide range of small to large transmitters and amplifiers, Morse code keys, and various amateur accessories.

A Dramatic Market Shift

In the early to mid 1960s, manufacturers like Heathkit, R. L. Drake Company, Swan Electronics, Eico, Sideband Engineers, and Collins Radio started offering a new generation of radios that were small and lightweight, and had a lot of features in a small package. The market for heavyweight radios dried up almost overnight. Big names like E.F. Johnson, National, Hammarlund, and Hallicrafters all started going downhill when they couldn't come up with their own small-package radios. Johnson tried to build a smaller, more modern solid-state radio called the Avenger, but only a few prototypes were made. The last of the fabled E.F. Johnson Company transmitters rolled off the assembly line in 1965.

In spite of the demise of E.F. Johnson Company's amateur radio line they continued to thrive. The company still manufactured parts, became a CB radio powerhouse, provided early cellular phone tower transmitters, and had a huge presence in the commercial land and mobile transceiver market. The company is still in business today, and is now owned by JVC-KENWOOD.

The Johnson Magic Continues

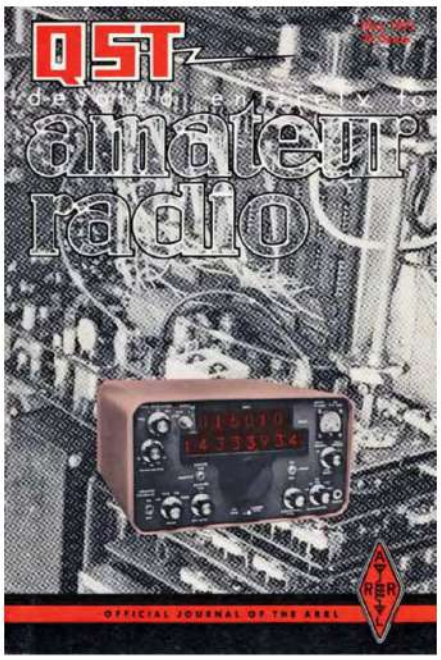
I use a Viking Ranger transmitter in my vintage station, and it's a joy to operate and own. Half the fun is having that beautiful transmitter on my shack table, while the other half is having the ability to make contacts with it. Look for me on 80- and 40-meter CW. My vintage station can be seen at **www.qrz.com/db/wa9wfa**.

E.F. Johnson Company manufactured ham radio transmitters for a brief 16 years, and it was a glorious time. The magic that Edgar Johnson started in 1949 continues today, with an extraordinary number of hams restoring Johnson transmitters, amplifiers, and tuners and putting them on the air.

100, 50, and 25 Years Ago

May 1923

- The cover, titled "The Main 'Guy,'" shows a ham leaning against the guy wire holding up a mast that is being planted in the ground.
- K. B. Warner, 1BHW, shares a brief summary of the outcome of the "The Second National Radio Conference" held in Washington, March 20 – 24, 1923.
- You can't determine power output or transmitter efficiency unless you know the total antenna resistance. Albert F. Murray explains "How to Measure Antenna Resistance and Capacity."
- M. Adaire Garmhausen, 3BCK, shares some humor in "The Perfect Aerial."
- Because no one seemed to know which insulators were good for C.W. work, L. C. Young; John Reinartz, 1QP; H. F. Mason, 1ID, and S. Kruse, 1OA, conducted some tests. A compilation of their findings is in "Some Tests of Amateur Antenna Insulators."
- With C.W. being more available and efficient, spark must (eventually) go. The lead editorial debates this topic.
- H. F. Mason, 1ID, discusses the features necessary in the design of a good antenna in "The Junior Operator: Your First Transmitting Antenna."



May 1973

- The state-of-the-art, homemade, solid-state SSB/CW transmitter on the cover can be built by reading "A Medium-Power HF SSB CW Transmitter," by Timothy P. Hulick, W9MIJ/4.
- "It Seems to Us…: Volunteer Leaders…And Newcomers" thanks our volunteers who operate in the public interest and keep our machinery running, and reminds us to lend a helping hand and guide those who are new to amateur radio.
- The construction of two simple-to-make devices is described in "Beginner and Novice: An Antenna Changeover System and Power-Output Indicator" by Ki Negoro, WN6QJP.
- Karl Meinzer, DJ4ZC, describes using slow-scan TV equipment to determine orbital parameters in "Range Measurements with Oscar 6."
- In "The Case for Minimal Regulation," ARRL President Dannals, W2TUK, relates how restrictive rules inhibit growth and stifle public service.
- "The World Above 50 Mc." reports a "Doppler Anomaly on Oscar 6 435-MHz Beacon" that has been observed by John Fox, WØLER, and Ron Dunbar, WØMJS. The findings have interested scientific and space officials, though they have no satisfactory explanation.

May 1998

- The cover shows a map centered on the North Pole, with a photo of a restored Russian Antonov AN2 biplane. The story of how amateur packet satellites support an unusual aeronautical expedition is in "North Pole PACSAT Triumph" by James Enterline, KV2Z, and Scott Hamilton, N1VFW.
- In "It Seems to Us: Volunteers," David Sumner, K1ZZ, tells of the important contributions volunteers make in doing the League's work.
- Nathan A. Miller, NW3Z, and James K. Breakall, WA3FET, show how to get big signals on 40 meters without the hassle and expense of a large tower and rotator in "The V-Yagi: A Lightweight Rotatable Antenna for 40 Meters."
- In "Clean Up Your Signals with Band-Pass Filters," Ed Wetherhold, W3NQN, explains that inexpensive, easily built filters can be the buffer you need between the signals you want to hear and send, and those you don't!
- Pack your handheld and take your next vacation on the rails in "Ham Radio on the High Iron" by Steve Ford, WB8IMY.

Silent Keys

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

N1BPC **Box**, William H., Bethlehem, CT
K1CL **Ludinsky**, Charles J., Chelmsford, MA
vW1DAL **Lawrence**, David A., Waldoboro, ME
vW1DQO **Hall**, Robert A., Shelburne, VT
•WA1EHK **Blakley**, May E., Ansonia, CT
vK1FAL **Larson**, Frederick A., Cambridge, ME
v♦K1FRD **Spencer**, Dean W., Cheshire, CT
WA1FYB **Eslinger**, Peter J., Enfield, CT
N1IRL **Fiorey**, Ricardo P., Budd Lake, NJ
vAB1JZ **Dwelley**, Kenneth G., Whiting, ME
vKD1KK **Sabin**, Alton F., Jr., Bangor, ME
KA1KRP **Andrew**, Leslie S., Jr., West Hartford, CT
vK1LF **Fasolino**, Ludwig G., Wellesley, MA
N1MAT **Lombard**, Dennis W., Suffield, CT
N1SZW **Taylor**, Lawrence E., Concord, NH
vW1UDQ **Davies**, William T., Jr., Acton, MA
vWA1VDV **Bancroft**, Frederick S., Fairport, NY
vN1WGX **Wilks**, William M., Southampton, MA
vW1ZFV **Pascal**, David, Cumberland, RI
•KC1ZI **Worrell**, James E., Sr., Dorchester, MA
KE2FV **Ferguson**, Harold D., Minoa, NY
W2GKE **Zawacki**, Ronald, Bayonne, NJ
vKA2HJC **Blackmon**, Bruce O., Olean, NY
•N2IXD **DiTucci**, James C., Rochester, NY
K2JHK **Karger**, Jeffrey H., Nanuet, NY
♦KD2JQ **Brummer**, Patricia A., Queensbury, NY
•N2KOD **Strothmann**, Jeffrey S., Middleport, NY
v♦W2SAH **Wexler**, Howard R., Palm Beach Gardens, FL
NA2T **Sauers**, Robert G., Jr., Madison Township, PA
vK2UM **Buhyoff**, Gregory J., Round Pond, ME
v♦K2VPR **Tyburski**, John A., Springfield, VA
WA2WPD **Reno**, Francis E., Harborcreek, PA
vW3CRG **Peck**, Donald L., Annapolis, MD
KC3EKZ **Kief**, Randy W., Houston, PA
K3EVB **Dempsey**, James C., Brookline, NH
W3HT **Dimmick**, Don E., Mahaffey, PA
N3LCO **Mastrov**, Lance K., Allentown, PA
•N3LPW **Crane**, Chester L., Salisbury, MD
K3OTS **Snowberger**, Willard C., Murrells Inlet, SC
KB3PFK **Hartman**, William H., Jr., Greensburg, PA
vN3PMC **Parmerlee**, David A., Keymar, MD
vK3POW **Kepchia**, John B., Greensburg, PA
K4ACT **Singleton**, Billy J., Jr., Dyersburg, TN
vK4BSL **Fletcher**, Benton L., LaFayette, GA
KE4BVP **Bird**, Tama M. "Tim," Deerfield, VA
vWA4CPA **Suter**, John L., Sr., Jacksonville, FL
vK4DYU **Nuckoles**, William O., Stuarts Draft, VA
KI4EMT **Calhoun**, John C., Greenville, NC
vKI4FPC **Grindstaff**, Roger, Arden, NC
N4GTQ **Lindsey**, William H., DeFuniak Springs, FL
W4GWI **Kidd**, Garvis O., Louisville, KY
vKI4JOJ **Workman**, Larry L., Tallahassee, FL
♦KM4KF **Simpson**, Jeffery L., Dyersburg, TN
•N4LKU **Plunkett**, Jane C., Pulaski, TN
vWA4OBC **Shook**, Clyde E., Jr., Connelly Springs, NC
vWD4PFN **Bryner**, Robert W., Jacksonville, FL
♦WA4PRR **Byzet**, Ronald K., Huntingtown, MD
KE4PTC **Clark**, Donald G., Lynchburg, TN
K4QIO **Schafer**, Patricia C., Louisville, KY
W4RMG **Gant**, Robert M., Jr., Huntersville, NC
vKJ4RVK **Cox**, James L., Howard Creek, FL
♦W4SPJ **Rohr**, Dwight M., Covington, VA
KO4TV **Bloodworth**, Glenn M., Wendell, NC

vN4UPX **Statzer**, Robert D., Gulfport, MS
•NB4V **Abraham**, Dennis G., Concord, NC
vKE4VIS **De Rhone**, John H., Knoxville, TN
K4WWY **Wright**, Barry W., Calhoun, GA
v•N4YET **Bowman**, Zane R., Jr., Harrisonburg, VA
vW4YKY **Thomas**, Carl W., Warm Springs, GA
vWV4Z **French**, Bill F., Lumberton, NC
KK4ZIV **Trexler**, William B. "Bruce," Lexington, NC
vN4ZRE **Meachum**, Joseph B., Lexington, NC
•W4ZRZ **Long**, James N., Springville, AL
KO5B **De Witt**, John R., Jr., Monroe, LA
vW5CZI **McLaughlin**, W. R., Olmito, TX
KA5CZY **Garrett**, Benny M., Lubbock, TX
KA5DDV **Goldsberry**, Brenda A., Nacogdoches, TX
vWA5ET **Oakley**, Willis A., Burnet, TX
KG5JMB **Fluth**, John A., Lufkin, TX
KD5JXF **Ashcraft**, Sean P., Panama, OK
N5LXP **Fondren**, Calvin R. "Reese," Port Lavaca, TX
vW5MWW **Winston**, Marvin W., Little Rock, AR
♦W5NDS **Moag**, Rodney F., Austin, TX
KG5OIL **Schwark**, James R., Oklahoma City, OK
vW5RHL **Barnett**, Charles R. "Bob," Cabot, AR
K5RIS **Meinecke**, Bill, San Angelo, TX
KB5TL **Mills**, David F., Baton Rouge, LA
KC5UNS **Davis**, Jimmy D., Austin, TX
vKC5VSG **Dick**, George R., Bangs, TX
KF5WL **Ecker**, Jacob E., Covington, LA
•N5XXO **Norris**, Rodney M., Odessa, TX
♦KC5YC **Colligan**, Charles B., Hackberry, LA
WA6BDE **Erbe**, Nora D., Fresno, CA
W6BIS **Rogers**, Ronald A., Napa, CA
v•KD6DGV **Gordon**, Norman S., Calabasas, CA
v•K6LDH **Hanks**, Larry D., Salem, UT
v•KK6SW **Lord**, James J., Spring Hill, FL
•KB6TBW **Kaufman**, Allan H., Riverside, CA
vWA6VDC **Taylor**, Norman J., Jr., Lompoc, CA
vW6YCV **Evans**, Donald C., Chesterfield, MO
WA6ZFL **Petter**, John D., Jamestown, CA
WA7AAX **Treat**, Bernie F., Selah, WA
NH7AR **Schneider**, Donald A., II, Salem, SC
vK7BMS **Hufsmith**, Robert A., Mesa, AZ
vW7CIH **Keyes**, Robert E., Portland, OR
vW7CPG **Yoes**, Maurice E. "Earl," Walla Walla, WA
vKA7DWX **Hale**, Robert W., Central Point, OR
K7DX/DJ0QN **Wolfson**, Mitchell B., Naples, FL
•KB7KOA **Morton**, Gary E., Thayne, WY
KB7NKP **Arko**, Gary P., Auburn, WA
W7OOK **Howard**, Keith C., Salt Lake City, UT
vW7SMR **Bass**, Richard K., Milwaukie, OR
K7SMY **Ellner**, Harold J., Seattle, WA
WA7SOK **Griffis**, Joan E., Portland, OR
KA7UND **Haveron**, James A., Sr., Phoenix, AZ
KD7UYN **Oakman**, Deborah L., Tacoma, WA
NV8A **Beagley**, Alan J., Zeeland, MI
KA8CPS **Jaikins**, Virginia, Carthage, TN
vWB8CTC **McCready**, Joe T., Wheeling, WV
KF8HA **Bowles**, Steven E., Charlotte, MI
N8HBZ **Mott**, James L., Mancelona, MI
AA8JJ **Eimers**, Leroy E., Jamestown, OH
vKB8JOP **Opperman**, Eugene G., Akron, OH
K8NLD **Zabkowski**, Larry, Chesterfield, MI
v♦W8PN **Braschwitz**, Harold J., Cleveland, OH

K8QFH **Inman**, Robert E., Grand Rapids, MI
vKI8S **Magnusson**, Niels M., Jr., Sun City West, AZ
N8UDT **Krist**, Betty Lou, Marion, OH
vKB8XO **Fryling**, Howard B., San Antonio, TX
KA9BAC **Pedersen**, Beryl D., Juneau, WI
vWA9CCT **Swanson**, Roger O., Cherry Valley, IL
vWD9CVX **Shaffer**, Leonard, Auburn, IN
WB9DZS **Williams**, Thomas K., Chesterfield, VA
W9GDK **Keneipp**, Glenn D., Carbondale, IL
vW9HLQ **Davis**, Brian M., Tinley Park, IL
K9IHM **Johnson**, Jerrold L., New Market, TN
W9JBE **Wood**, Richard M., Waukesha, WI
WB9JSR **Wehmer**, John P., Port Sheldon, MI
vAB9LQ **Grim**, Daniel R., Stoughton, WI
v♦W9ML **Thompson**, Francis A., New Castle, IN
vKX9N **Meyer**, Duane J., Milwaukee, WI
vWA9NBE **McDonald**, Lyle C., Oshkosh, WI
KA9OKH **Doty**, Stephen P., Evansville, IN
KA9PWK **Slagal**, Robert P., Richmond, IN
KB9TNZ **Kujawa**, John A., Morton, IL
N9TRY **Yager**, Thomas R., Portage, WI
vWA9TZE **Akre**, James L., South Milwaukee, WI
vWA9UCZ **Besch**, David F., Bloomingdale, IL
v♦K9UE **Fansler**, Roy L., Fairfield, IL
v•KB9UY **Platt**, Harold L., Winchester, IN
vNØCHN **McClure**, Earl A., Riverside, IA
WØECM **Bowers**, Dennis J. "Jess," Owasso, OK
♦KØFP **Pfeiffer**, Fred M., Red Wing, MN
v♦KØGYK **Hoog**, John F., Saint Louis, MO
vKØIVM **Johnson**, Lawrence M., Minneapolis, MN
v♦WØJC **Logan**, James B., Kansas City, MO
v♦WØJDB **Bruning**, Jere D., Hiawatha, KS
NØKBD **Johnson**, David E., Champlin, MN
KØPV **Zielinski**, Donald P., Goodland, KS
NØRFL **Caster**, Doug E., Kidder, MO
KAØRGI **De Coursey**, William P., Jr., Saint Louis, MO
NØSTX **Demoret**, Howard L., Mendota, IL
WØUZR **Lassila**, Steve R., Hibbing, MN
vKEØV **Anthony**, George A., Clinton, MO
KAØVAD **Becker**, Albert D., Scottsbluff, NE
NØXOO **Krogstad**, Doris V., Winger, MN
KMØY **Zdan**, Brian R., Omaha, NE
vWØYWP **Bailey**, James B., Mount Hamill, IA
v♦KØZA **Hizer**, John N., Loveland, CO
vNØZH **Dolson**, Michael R., New Bloomfield, MO
VE2VY **Kofsky**, Harvey I., Hampstead, QC, Canada
VA3HP **Chase**, Gary A., St. Thomas, ON, Canada

♦ Life Member, ARRL
♦ Maxim Society
v Veteran
• Former call sign

For information on how to list a Silent Key in *QST*, please visit **www.arrl.org/silent-key-submission-guidelines**.

Note: Silent Key reports must confirm the death by one of the following means: a copy of a newspaper obituary notice, a copy of the death certificate, or a letter from the family lawyer or the executor. Please be sure to include the amateur's name, address, and call sign. Allow several months for the listing to appear in this column.

HAM RADIO OUTLET®

WWW.HAMRADIO.COM

May is Hamvention Month at HRO!

IC-9700 | *All Mode Tri-Band Transceiver*

• VHF/UHF/1.2GHz • Direct Sampling Now Enters the VHF/UHF Arena • 4.3" Touch Screen Color TFT LCD • Real-Time, High-Speed Spectrum Scope & Waterfall Display • Smooth Satellite Operation

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-7300 | *HF/50MHz Transceiver*

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

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

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

IC-R8600 | *Wideband SDR Receiver*

10 kHz to 3 GHz Super Wideband Coverage • Real-time Spectrum Scope w/Waterfall Function • Remote Control Function through IP Network or USB Cable • Decodes Digital Incl P25, NXDN™, D-STAR • SD Card Slot for Receiver Recorder

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

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

IC-7100 | *All Mode Transceiver*

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

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

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

ID-5100A Deluxe

VHF/UHF Dual Band Digital Transceiver

• Analog FM/D-Star DV Mode • SD Card Slot for Voice & Data Storage • 50W Output on VHF/UHF Bands • Integrated GPS Receiver • AM Airband Dualwatch

IC-V3500 | *144MHz FM Mobile*

• 65W of Power for Long Range Communications • 4.5 Watts Loud & Clear Audio • Modern White Display & Simple Operation • Weather Channel Receive & Alert Function

IC-2300H | *VHF FM Transceiver*

• 65W RF Output Power • 4.5W Audio Output • MIL-STD 810 G Specifications • 207 alphanumeric Memory Channels • Built-in CTCSS/DTCS Encode/Decode • DMS

IC-V86 | *VHF 7W HT*

• 7W OutputPower Plus New Antenna Provides 1.5 Times More Coverage • More Audio, 1500 mW Audio Output • IP54 & MIL-STD 810G–Rugged Design Against Dust & Water • 19 Hours of Long Lasting Battery Life • 200 Memory Channels, 1 Call Channel & 6 Scan Edges

IC-T10 | *Rugged 144/430 MHz Dual Band*

• Disaster Ready - Excellent Fit for Your Emergency Bag • Loud Audio - New Speaker Design • Long Bettery Life - Up to 11 Hours • FM Broadcast & Weather Channels

ID-52A | *VHF/UHF D-STAR Portable*

• Bluetooth® Communication • Simultaneous Reception in V/V, U/U, V/U and DV/DV • Enriched D-STAR® Features Including the Terminal Mode/Access Point Mode • UHF (225~374.995MHz) Air Band Reception

5 Ways to Shop!

- **RETAIL LOCATIONS – Store hours 10:00AM - 5:30PM - Closed Sunday**
- **PHONE – Toll-free phone hours 9:30AM - 5:30PM**
- **FAX – All store locations**
- **ONLINE – WWW.HAMRADIO.COM**
- **MAIL – All store locations**

ICOM®

FOLLOW HRO ON SOCIAL MEDIA

twitter.com/HamRadioOutlet
facebook.com/HROHamRadioOutlet
instagram.com/HamRadioOutlet
youtube.com/HamRadioOutlet

*On most orders over $100 in the continental US. (Rural locations excluded.) **Except 60M Band. The Icom logo is a registered trademark of Icom Inc. Toll-free including Hawaii, Alaska and Canada. All HRO 800-lines can assist you if the first line you call is busy, you may call another. Prices, specifications and descriptions subject to change without notice.

HAM RADIO OUTLET®

WWW.HAMRADIO.COM

Family owned and operated since 1971

FTDX101MP | *200W HF/50MHz Transceiver*

• Hybrid SDR Configuration • Unparalleled 70 dB Max. Attenuation VC-Tune • New Generation Scope Display 3DSS • ABI (Active Band Indicator) & MPVD (Multi-Purpose VFO Outer Dial) • PC Remote Control Software to Expand the Operating Range • Includes External Power With Matching Front Speaker

FTDX10 | *HF/50MHz 100 W SDR Transceiver*

• Narrow Band and Direct Sampling SDR • Down Conversion, 9MHz IF Roofing Filters Produce Excellent Shape Factor • 5" Full-Color Touch Panel w/3D Spectrum Stream • High Speed Auto Antenna Tuner • Microphone Amplifier w/3-Stage Parametric Equalizer • Remote Operation w/optional LAN Unit (SCU-LAN10)

FT-991A | *HF/VHF/UHF All ModeTransceiver*

Real-time Spectrum Scope with Automatic Scope Control • Multi-color waterfall display • State of the art 32-bit Digital Signal Processing System • 3kHz Roofing Filter for enhanced performance • 3.5 Inch Full Color TFT USB Capable • Internal Automatic Antenna Tuner • High Accuracy TCXO

FTDX101D | *HF + 6M Transceiver*

• Narrow Band SDR & Direct Sampling SDR • Crystal Roofing Filters Phenomenal Multi-Signal Receiving Characteristics • Unparalleled - 70dB Maximum Attenuation VC-Tune • 15 Separate (HAM 10 + GEN 5) Powerful Band Pass Filters • New Generation Scope Displays 3-Dimensional Spectrum Stream

NEW

FT-710 Aess | *HF/50MHz 100W SDR Transceiver*

• Unmatched SDR Receiving Performance • Band Pass Filters Dedicated for the Amateur Bands • High Res 4.3-inch TFT Color Touch Display • AESS: Acoustic Enhanced Speaker System with SP-40 For High-Fidelity Audio • Built-in High Speed Auto Antenna Tuner

FT-891 | *HF+50 MHz All Mode Mobile Transceiver*

Stable 100 Watt Output • 32-Bit IF DSP • Large Dot Matrix LCD Display with Quick Spectrum Scope • USB Port Allows Connection to a PC with a Single Cable • CAT Control, PTT/RTTY Control

FTM-300DR | *C4FM/FM 144/430MHz Dual Band*

• 50W Output Power • Real Dual Band Operation • Full Color TFT Display • Band Scope • Built-in Bluetooth • WiRES-X Portable Digital Node/Fixed Node with HRI-200

FT-2980R | *Heavy-Duty 80W 2M FM Transceiver*

• 80 watts of RF power • Large 6 digit backlit LCD display for excellent visibility • 200 memory channels for serious users

FTM-200DR | *C4FM/FM 144/430MHz Dual Band*

• 1200/9600bps APRS® Data Communications • 2" High-Res Full-Color TFT Display • High-Speed Band Scope • Advanced C4FM Digital Mode • Voice Recording Function for TX/RX

FTM-3100R | *Rugged 65W 2M FM Transceiver*

• Rugged & Compact • Crystal Clear Front Panel Audio • 220 Memory Channels • Weather Broadcast Reception • Severe Weather Alert Feature

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-5DR *C4FM/FM 144/430 MHz Dual Band*

• High-Res Full-Color Touch Screen TFT LCD Display • Easy Hands-Free Operation w/Built-In Bluetooth® Unit • Built-In High Precision GPS Antenna • 1200/9600bps APRS Data Communications • Supports Simultaneous C4FM Digital • Micro SD Card Slot

FT-65R | *144/430 MHz Transceiver*

Compact Commercial Grade Rugged Design • Large Front Speaker Delivers 1W of Powerful Clear Audio • 5 Watts of Reliable RF Power Within a compact Body • 3.5-Hour Rapid Charger Included • Large White LED Flashlight, Alarm and Quick Home Channel Access

FTM-6000R | *50W VHF/UHF Mobile Transceiver*

• All New User Operating Interface-E2O-III (Easy to Operate-III) • Robust Speaker Delivers 3W of Clear, Crisp Receive Audio • Detachable Front Panel Can Be Mounted in Multiple Positions • Supports Optional Bluetooth® Wireless Operation Using the SSM-BT10 or a Commercially Available Bluetooth® Headset

5 Ways to Shop!

- RETAIL LOCATIONS – Store hours 10:00AM - 5:30PM - Closed Sunday
- PHONE – Toll-free phone hours 9:30AM - 5:30PM
- FAX – All store locations
- ONLINE – WWW.HAMRADIO.COM
- MAIL – All store locations

YAESU The radio

ANAHEIM, CA (800) 854-6046	PORTLAND, OR (800) 765-4267	PHOENIX, AZ (800) 559-7388	MILWAUKEE, WI (800) 558-0411	WOODBRIDGE, VA (800) 444-4799	WINTER SPRINGS, FL (800) 327-1917
SACRAMENTO, CA (877) 892-1745	DENVER, CO (800) 444-9476	PLANO, TX (877) 455-8750	NEW CASTLE, DE (800) 644-4476	SALEM, NH (800) 444-0047	ATLANTA, GA (800) 444-7927

Contact HRO for promotion details. Toll-free including Hawaii, Alaska and Canada. All HRO 800-lines can assist you. If the first line you call is busy, you may call another. Prices, specifications and descriptions subject to change without notice.

Aim Higher

Enter the world of SHF

IC-905

VHF/UHF/SHF All-Mode Transceiver

*Optional
CX-10G
10GHz Transverter

The IC-905 is an industry-first all-mode transceiver with 144/440/1200/2400/5600/10000* MHz coverage.

Optional Antennas

AH-24 – 2.4GHz Antenna
AH-56 – 5.6GHz Antenna
AH-100 – 10GHz Antenna
AH-109PB – 10GHz Parabolic Antenna

For the love of **ham radio.**

www.icomamerica.com/amateur
Insidesales@icomamerica.com

ICOM®

MFJ G5RV Antennas

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

MFJ-1778 **$89.95** ***The famous G5RV antenna is the most popular ham radio antenna in the world!***

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

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

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

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

MFJ-1778M, $79.95. *Half-size, 52 foot G5RV JUNIOR for limited space.* 40-10 Meters with tuner. Full 1500 Watts.

MFJ All Band Classic Doublet

MFJ-1777 **$99.95**

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

RF Isolator

MFJ-915 **$59.95**

MFJ-915 *RF Isolator* prevents unwanted RF from traveling on the outside of your coax shield into your transceiver. This unwanted RF can cause painful RF "bites" when you touch your microphone or volume control, cause your display or settings to go crazy, lock up your transceiver or turn off your power supply. In mobile installations, stray RF could cause your car to do funny things even blow your car computer. Clear up these problems, plug an MFJ-915 between your antenna and transceiver. 1.8-30 MHz, 1500 Watts. 5x2 inches.

MFJ-919, $74.95. 4:1 current balun,1.5 kW.

MFJ-913, $49.95. 4:1 balun, 300 Watts.

True 1:1 Current Balun & Center Insulator

MFJ-918 **$59.95**

True *1:1 Current Balun/ Center Insulator* forces equal radiator currents in dipoles for true dipole radiation pattern. Reduces coax radiation and field pattern distortion -- your signal goes where *you* want it. Reduces TVI, RFI and RF hot spots. *Don't build a dipole without one!* 50 hi-permeability ferrite beads on high quality RG-303 *Teflon®* coax and *Teflon®* SO-239. 1.5kW 1.8-30 MHz. Stainless steel hardware. 14 gauge stranded copper wire is *directly* connected to your antenna. 5x2 inches. Heavy duty weather housing.

2-Position Antenna Switch

MFJ-1702C, $79.95. 2-position antenna switch, lightning surge protection, center ground. SO-239s.

Lightning surge protectors. MFJ-270,

$34.95. 400W. **MFJ-272, $49.95.** 1500 W. Gas discharge tube shunts 5000 amps peak.< 0.1 dB loss. 1 GHz. SO-239s.

MFJ-16C06, $9.95. 6-pack *glazed ceramic* end/center ant. insulators.

MFJ-16B01, $31.95. Molded high-strength center insulator. SO-239.

MFJ-16D01, $15.95. 450 Ohm fiberglass end/center insulator with ladder line stress relief and SO-239 mount.

MFJ-18H100, $69.95. 100 feet, 450 Ohm ladder line, 18 gauge copper clad.

80-10 Meter End-Fed Half Wave antenna

Cover all HF bands with one single wire and no tuner!

MFJ-1982HP, $129.95

No tuner needed!

All band 80-10M EFHW antenna

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

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

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

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

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

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

More 80-10 Meter Models

MFJ-1982MP, $99.95. Like MFJ-1982HP but handles 300 Watts.

MFJ-1982LP, $79.95. Like MFJ-1982MP but handles 30 Watts.

EFHW 40-Meter Models

MFJ-1984HP, $109.95. Like MFJ-1982HP but 40-10M. 66 feet jacketed wire.

MFJ-1984MP, $89.95. Like MFJ-1982HP, but handles 300 Watts.

MFJ-1984LP, $69.95. Like MFJ-1982MP, but handles 30 Watts.

Dual Band Dipoles

MFJ-17758 **$129.95** 80/40 Meters

MFJ-17758, $129.95. Operate 80/40 Meters with a short 85 foot dipole. *Full-size* on 40 Meters with ultra-efficient end-loading on 80 Meters. 1500 Watts. Super-strong custom molded center insulator with SO-239 connector and hang hole. Ceramic end insulators. 7-strand, 14 gauge hard copper wire. *No tuner needed!*

MFJ-17754, $89.95. Like MFJ-17758 but is only 42 feet. Operate 40/20 Meters. *Full-size* on 20 Meters, ultra-efficient end-loading on 40 Meters. 1500 Watts.

Single Band Dipoles

MFJ-1779A **$99.95** 160M, 265 ft.

MFJ-1779B **$79.95** 80-40M, 135 ft.

MFJ-1779C **$59.95** 20-6M, 35 ft.

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

OCFD Dipoles

MFJ-2012 **$109.95** 1500 Watts

MFJ-2010 **$89.95** 300Watts

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

MFJ Enterprises, Inc. 300 Industrial Pk Rd, Starkville, MS 39759

Phone: (662) 323-5869 • Tech Help: (662) 323-0549 • FAX: (662) 323-6551 8-4:30 CST, Mon.-Fri.

MFJ Cobweb Antenna

6-Bands: 20/17/15/12/10/6 M . . . Outstanding Performance!

Restricted space spoiling your operating fun? MFJ Cobweb puts your call back on the map!

This six-band (20, 17, 15, 12, 10, 6 Meters) full half-wave *Cobweb Antenna* is perfect for restricted space or portable operation. Sky-gray fiberglass spreaders and *nearly invisible* wire elements (flat 9x9x1/2 feet square. 8 pounds), blend in with your surroundings while standing tough against nasty weather.

Outstanding performance! Horizontally polarized for less local noise pickup plus solid gain over verticals will allow you to work DX easily -- even on QRP. Omni-directional. No radials needed! Works great at low heights. Low SWR is due to MFJ's exclusive *Spider-Match*™ broadband network. Use lightweight TV hardware to mount on your chimney, balcony, mast.

Low in cost, but big on performance. MFJ *Cobweb Antenna* turns your space problem into a stack of QSL cards from far away places.

MFJ-1836HK34, $169.95. Add-on kit adds 40/30 Meters to MFJ-1836/1836H cobwebs.

MFJ-1838
$489.95

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. 12 feet, 23 lbs.

MFJ 20/17/15/12/10/6 Meter Hexbeam

***New* MFJ HexBeams** deliver solid gain and directivity on 20/17/15/12/10/6 Meters with two elements on each band.

MFJ uses an updated G3TXQ element configuration for excellent gain, improved bandwidth, superior front-to-back ratio and low SWR!

MFJ takes the HexBeam's unique balanced-tension framework to a new level with rugged mounting hardware, exceptionally durable spreaders and sliding antenna wire guides -- designed to ensure years of reliable service.

MFJ-1846, $599.95. 6 Bands: 20/17/15/12/10/6M, 2-elements per band, full 1500W. 25 lbs. 11 ft. turning radius.

MFJ-1848, $809.95. 8 Bands: 20/17/15/12/10/6M, 2-elements per band; 40/30M, single elements, full 1500W. 28 lbs. 14 ft. turning radius.

3-Element Hexbeam

MFJ-1856 is ***six*** individually stacked monband 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. 30 lbs. 17 feet turning radius. Ideal for a small rotator like hy-gain's CD45 II, $449.95.

MFJ Isolator and 1:1 Balun

MFJ-915, $59.95. Stop *RF* traveling down coax line, painful RF "bites" and erratic operation. 1.5 kW 1.8-60 MHz. 2Wx5H". SO-239s.

MFJ-918, $59.95. True 1:1 Current balun & center insulator forces equal antenna currents in dipole elements.

MFJ Dry Dummy Load

MFJ-260C, $59.95. Air-cooled, 300 Watt dry dummy load with a non-inductive resistor in a perforated metal housing. SO-239 connector. Full load 30 seconds. Silk-screened derating curve to 5 minutes. SWR below 1.1:1 to 30 MHz, 1.5:1 from 30 to 650 MHz.

MFJ 2-Pos. Antenna Switch

MFJ-1702C, $74.95. 2-Position antenna switch has center ground, auto grounding of unused positions, handles 2.5 kW PEP and works to over 500 MHz. Lightning surge protection. Quality SO-239 connectors, heavy duty diecast.

MFJ-1704, $129.95. Like MFJ-1702C but has 4 positions.

MFJ G5RV Antenna

MFJ-1778, $89.95. 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!*

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

MFJ Low-Noise Receiving Loops

Work DX and ragchew even through horrendous noise!

Pull weak signals out of static crashes, atmospheric, man-made and power line noise!

Clearly hear signals 50 KHz to 30 MHz you never knew existed. Power line noise and static just disappears.

MFJ-1886 drastically reduces noise and interference by receiving the magnetic field and rejecting the electric field. Rotate MFJ-1886 receiving loop to totally eliminate interfering signals or greatly peak desired signal.

Excellent antenna and preamplifier balance gives deep null.

State-of-the-art push-pull Gali MMICs preamp gives you high dynamic range, low IMD and 25 dB of low noise gain.

Gives excellent strong and weak signal performance without overload.

Fully protected preamplifier -- magnetically coupled voltages up to 40V and capacitively coupled voltages up to 20V will not damage preamplifier.

Output is protected from transmission line surges induced by distant lightning.

Use anywhere, inside or outside. RF signal and power goes through your 50 Ohm coax.

Ruggedly built to withstand extreme weather. 1-inch OD diameter 6061 aluminum tubing. 36-inch diameter. 2½lbs. SO-239. Use masts up to 1¾ inches.

MFJ-1886, $319.95. Includes receive loop and MFJ-4116 bias-tee to power MFJ-1886 through coax.

MFJ-1886TR, $369.95. Includes MFJ-1886 and MFJ-4113TR Bias-Tee/Transmit/Receive switch. MFJ-4113TR powers MFJ-1886 through coax and switches between transmitting antenna and receiving loop. For radios with only one antenna connector.

MFJ-4116, $54.95. Bias-Tee provides RF signal and power through coax transmission line. Send up to 1A DC up to 50 Volts.

MFJ-4113TR, $129.95. Bias-Tee with built-in Transmit/Receive switch. Switches between transmitting and receiving antenna. For radios with only one antenna connector. Provides RF signal and power through coax.

Multi-coupler/Bias-Tee

New! **MFJ-1888MC, $299.95.** Connect four receivers to one antenna. Receivers are fully isolated. Each receiver port has 1-12 dB adjustable gain. IP3 is +15 dB. 2dB noise figure. Built-in Bias-Tee powers receiving loop through coax. SO-239s. Use 12 VDC or 110 VAC with MFJ-1312D, $29.95. RF tight, 7¼Wx1¾Hx5D inches.

Super High Dynamic Range High Gain Receiving Loop

New! **MFJ-1888, $499.95.** 32 dB gain from 50 KHz to 30 MHz. 20 dB gain at 80 MHz. IP3 is + 30 dB, 1 dB compression point is 23 dB, noise figure is 1.7 dB. Built-in BCB input filters to reduce overloading. Includes MFJ-1888MC remote multi-coupler. Can be used with MFJ-4113TR Bias-Tee/T/R switch and/or MFJ-4116 bias tee. 36-inch diameter. 2½ lbs. SO-239. Use masts up to 1¾ inches.

Antenna Rotator

Perfect for MFJ-1886/1786/1788 loop, VHF/UHF, small HF beams, TV, FM antennas.

AR-500 **$199.95**

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. Memories for 12 directions! Digitally displays position. 110/220 VAC.

Wipe out RFI

Wipe out RFI, noise, interference from any direction at any frequency with a 60 dB notch before it gets into your receiver!

MFJ-1026 **$269.95**

Eliminate power line noise, fluorescent lamps, light dimmers, computers, TVs, lightning, motors, industrial processes.

Null out QRM on rare DX and work him! Null out local ham or AM station to prevent receiver overload. Works on SSB, AM, CW, FM, digital BCB to lower VHF. Plugs between antenna and transceiver. 12VDC, 110VAC with MFJ-1312D, $19.95.

MFJ Super High-Q™ Transmitting Loop Antennas

MFJ 36-inch diameter transmitting loop antenna lets you operate 10-30 MHz continuously including WARC bands!

Ideal for limited space, HOA.

Work DX with low angle radiation and local close-in contacts with high angle radiation when mounted vertically. 150 watts.

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

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

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

Cover 40-15 Meters. MFJ-1788, $719.95. Like MFJ-1786 but covers 40-15 Meters continuous. Includes remote control.

Portable Loop

MFJ-1780, $419.95. *Box fan loop with carrying handle, 24x24x 5¾". 20-10 Meters continuous, 150 Watts. Fast/slow tune remote control. Highly efficient all-welded construction.*

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

MFJ Weather-Proof Window Feedthrough Panels

Weather-proof window feedthrough panels bring HF/VHF/UHF antennas, balanced lines, random wire antennas, ground, DC/AC power and Rotator/Antenna Switch Cables into your hamshack without drilling through walls!

made in USA

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

Simply place in window sill and close window. One cut customizes it for any window up to 48 inches. Use horizontal or vertical. Connectors are mounted on inside/outside stainless steel plates and attached to a 4 ft. long, 3½" high, 3/4" thick pressure-treated wood panel.

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

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

MFJ-4603
$129.95

MFJ-4603 Universal Window Feedthrough Panel

Four 50 Ohm *Teflon*(R) SO-239 coax connectors let you feed HF/VHF/UHF antennas at full legal power limit.

A 50 Ohm *Teflon*(R) 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 telvision, satellite, HFD cable TV and FM radio signals.

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

Has random/longwire antenna ceramic feedthrough insulator.

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

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

MFJ's exclusive *Adaptive Cable Feedthru*™ lets you bring in rotator/antenna switch cable, etc. without removing connectors (up to 1¼ x 1⅝ in.) Adapts to virtually any cable size. Seals out rain, snow, adverse weather.

3 Coax, Balanced Line, Random Wire

Best Seller! 3 *Teflon*(R) coax connectors for HF/VHF/UHF antennas. Separate high voltage ceramic feed-thru insulators for balanced lines and long wire/random wire. Stainless steel ground post.

MFJ-4601
$89.95

6 Coax

6 high quality *Teflon*(R) coax connectors for HF/VHF/UHF antennas. Stainless steel ground post. Full 1500 Watts.

MFJ-4602
$99.95

4 Balanced Line, 2 Coax

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

MFJ-4600
$109.95

5 Cables, any-size

5 Adaptive Cable Feedthrus™. Pass any cable with connector: 2 cables with large connectors up to 1¼x1⅝ inches and 3 cables with UHF/N size coax connectors. Seals out weather.

MFJ-4604
$134.95

All-Purpose FeedThru/CableThru™

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

MFJ-4605
$249.95

Bring cables thru eave of your house

MFJ-4616 shown with vent (not included) it replaces. *Six Holes*
$49.95

made in USA

MFJ-4613 shown with vent (not included) it replaces. *Three Holes*
$34.95

Replace standard house eave/sofitt air vents with these *MFJ AdaptiveCable™ Plates*.

Bring in coax, rotator, antenna switch, power cables, etc. of nearly any size up to 1¼x1⅝".

Sliding plates, 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.

MFJ *AdaptiveCable*™ Wall Plates

MFJ-4614 (*Four Holes*)
$69.95

MFJ's exclusive weather-sealed *AdaptiveCable*™ *Wall Plates* let you bring nearly any cable -- rotator, antenna switch, coax, etc. -- through walls without removing connectors. Pass cable connectors up to 1¼x1⅝". Slide plates adjust hole size to weather-seal virtually any cable. Rubber grommet seals out rain, snow, adverse weather. Kit includes 18 gauge *stainless steel* plates for wall side, sliding plates, rubber grommets, weather stripping and hardware. Models for one, two and four cables.

MFJ-4612 (*Two Holes*)
$49.95

MFJ-4611 (*Single Hole*)
$34.95

made in USA

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

made in USA

New!

MFJ SDR T/R Protection Switch

Turn your SDR into a panadapter to see entire bands on frequency/waterfall displays . . .

An inexpensive wide-band SDR dongle receiver lets you see entire bands on frequency/waterfall computer displays!

MFJ-1708B-SDR **$139.95**

If you want to know where the activity is, who's generating splatter, what's in the DX window, how wide your audio is or what frequencies are clear, it's all right there! While receiving on your transceiver, MFJ-1708B-SDR switches your SDR to your antenna showing the entire band. On transmit your SDR is switched out and grounded to protect your SDR. PTT and a fail-safe RF sense switches MFJ-1708B-SDR. For HF/VHF/UHF. Monitor multiple bands with multiple SDRs and a multi-coupler.

MFJ-1708B-SDR-S, $149.95. SMA connector for your SDR.

New B series improvements . . .

The original MFJ-1708 series used one relay and wires to connect the SO-239s. The *new B-series* uses *four* relays and connectors on a *single* pc board. This gives you > 50 dB isolation at 300 MHz and > 68 dB at 50 MHz. SWR < 1.16:1 at 50 MHz and < 1.75:1 at 450 MHz at the transmit port. Mute output is a selectable short or open to ground. Use "boat anchors" or modern receivers or key a linear amplifier. Receiver input protection prevents overload from nearby high power signals and from receive to transmit. A hybrid splitter on SDR models reduces loading effect and gives > 15 dB isolation between the SDR REC and XCVR ports to reduce interference. The original MFJ-1708 series is still available.

MFJ Low Noise VLF/HF Receiving Loop

Pull weak signals out of static crashes, atmospheric, man-made and power line noise!

Hear signals 50 KHz to 30 MHz cleaner, quieter than ever before! Power line noise disappears. Rotate its figure 8 pattern and its extremely deep null to completely eliminate an interfering signal or greatly peak a desired one. Fully protected state-of-the-art Gali MMICs in push-pull gives you a preamp with extremely high dynamic range, low IMD and 25 dB of low noise gain. Excellent performance on strong and weak signals without overload. 36-inch dia. loop. 1-in. OD 6061 aluminum.

MFJ *wideband* SDR *Discone* Antenna

Receives 25-1300 MHz

MFJ ultra wide-band *Discone* Antenna receives 25-1300 MHz. Perfect for all band SDR reception. Covers 10, 6, 2 Meters, 220 and 440 MHz and 33/23 CM ham bands and everything in between. It is excellent for monitoring multiple bands simultaneously using multiple SDRs and a multi-coupler. Also test any transmitter 50-1300 MHz using a single discone and single coax. Handles 200W. Includes 50 feet coax, stainless steel elements and mounting hardware.

MFJ-1866, $64.95. Like MFJ-1868 but transmits 144-1290 MHz. Coax and mounting hardware not included.

Tuned Indoor SDR Active Antenna

Make your SDR receiver come alive with HF signals, .3-40 MHz, while rejecting interference with MFJ-1020C *tuneable* indoor active antenna! Gain control, telescoping whip.

MFJ-1020C **$139.95**

Untuned Indoor SDR Active Antenna

MFJ-1022, $99.95. Hear weak, noisy VLF to UHF signals. Noise-less feedback gives excellent low noise reception. Handles strong signals.

Active OutdoorAntenna

MFJ-1024 **$209.95**

World Radio TV Handbook says "MFJ-1024 is a *first rate, easy-to-operate active antenna, quiet, excellent dynamic range, good gain, very low noise factor, broad frequency coverage, excellent choice . . .*"

Outdoor mounted 54-inch whip/preamp gives maximum signal and minimum noise. Covers .05-30 MHz.

Indoor unit: 20 dB attenuator, gain control, 2 receiver and 2 antenna switches.

HF SDR Preselector

Tuneable MFJ-1040C lets you copy **w**eak, noisy SDR signals from 1.8 to 54 MHz. Greatly tunes out and reject out-of-band interference. Up to 20 dB gain. Has gain control. Cascode FET/bipolar transistor gives low noise, high gain without overloading. Switches for 2 antennas and 2 receivers. SO-239s. Has 20 dB attenuator. Automatically bypasses when transmitting or use PTT. 6½Wx2½Hx4D inches.

MFJ-1040C **$159.95**

MFJ LW/MW/SW SDR Preselector/Tuner

Highly rated series-tuned MFJ boosts your desired signals while greatly rejecting interference and preventing serious overload.

MFJ-956 **$109.95**

Greatly improves reception 0.15 to 30 MHz. Incredibly effective below 2 MHz.

Super easy to operate, select band and tune!

Bypass tuner and ground receiver switch positions.

Compact 2x3x4 inches. SO-239 connectors.

MFJ RF Sense Transmit/Receive Switch

MFJ-1708B $139.95.

Switches your antenna from receiver to transmitter using a relay. Shorts your receiver to ground during transmit. Use RF sensing with adjustable delay or PTT line. Has selectable open/short mute.

Auto switch XCVR between 2 antennas

MFJ-1707B $139.95.

Automatically switches separate transmit and receive antennas on transceivers with only one antenna port. *Example:* Efficient 75M dipole for XMIT and low noise MFJ loop for receive -- *no static crashes!*

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

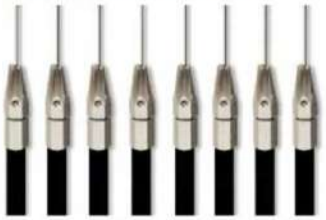
Quicksilver Radio

HAMMO-CAN™ Go Box

A complete VHF-UHF station in a can. Get them with or without radios. Check out our large assortment of parts if you want to build your own!

Ultimate Crimp Kit™

Quickstick™



"Hamstick" style mobile antenna. Available from **6M to 75M.** Made in the USA

DC Power Cables

Test Equipment

Powerpoles & DC Connectors

FREE SHIPPING

on all orders over $73.00 to any United States address.

HybridDX™ HF antenna. Get on 6M to 160M in less than 80 ft.

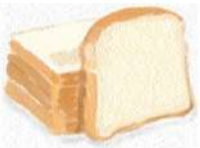
Connectors & Adapters

Play-Series™ System

Modular system with meters, usb, powerpoles, switches and more.

In these tough times, we're here to help you with Quality, Service & Value!

www.qsradio.com



"Best thing since sliced bread!"

More hams use MFJ analyzers than all others in the world!

MFJ-269D . . . 280 KHz - 230 MHz plus 415-470 MHz, 12-bit A/D

New and improved. Now covers 280 KHz to 230 MHz and 415 to 470 MHz and 2200 Meter band!

Instantly gives you a complete picture of your antenna.

Read SWR, return loss, reflect-ion coefficient, match efficiency at any frequency simultaneously.

Read Complex Impedance (100 KHz to 230 MHz) as series equivalent resistance and reactance (Rs+jXs) or as magnitude (Z) and phase (degrees). Also reads parallel equivalent resistance and reactance (Rp+jXp).

Determine velocity factor, coax loss in dB, length of coax and *distance to short or open in feet (it's like a built-in TDR).*

Coax Calculator™ calculates coax line length in feet given degrees and vice versa for any frequency, velocity factor.

New! MFJ-269D **$449.95**

Measure SWR and loss of coax with *any* characteristic impedance (280 KHz to 230 MHz) from 10 to over 600 Ohms.

Measures inductance in uH and capacitance in pF at RF frequencies, 100 KHz to 230 MHz.

High contrast LCD gives precision readings and two side-by-side analog meters make antenna adjustments smooth and easy.

12-bit A/D converter gives much better accuracy and resolution than common 8-bits -- *MFJ-269D exclusive!*

Built-in frequency counter, battery saver, low battery warning, Ni-Mh/NiCd charge circuit. 4Wx2Dx6¾", 2 lbs. Use ten aA batteries or 110 VAC with MFJ-1312D, $26.95.

MFJ-269DPRO™ SWR Analyzer

MFJ-269DPro, $519.95. Like MFJ-269D, but UHF range covers ***430 to 520 MHz***. For commercial work.

MFJ-259D . . . World's Most Popular Antenna Analyzer!

New!

MFJ-259D **$349.95** ***New and improved, now covers 280 KHz-230 MHz!***

***World** famous* MFJ-259D gives you a complete picture of your antenna's SWR and Complex Impedance.

MFJ-259D is a complete ham radio test station including frequency counter, RF signal generator, *SWR Analyzer™*, RF Resistance/ Reactance Analyzer, Coax Analyzer, Capacitance/ Inductance Meter and more!

Read Complex Impedance as series resistance and reactance (R+jX) or as magnitude (Z) and phase (degrees).

Determine velocity factor, coax cable loss in dB, length of coax and distance to short/open.

Read SWR, return loss and reflection coefficient at any frequency simultaneously.

Read inductance (uH) and capacitance (pF) at RF frequencies.

Large easy-to-read two line LCD screen and side-by-side meters clearly display your information.

Built-in frequency counter, Ni-MH/Ni-CD charger circuit, battery saver, low battery warning, smooth reduction drive tuning.

Super easy-to-use! Just set the bandswitch and tune the dial -- just like your transceiver. SWR, Complex impedance displayed instantly!

Fully portable, take it anywhere -- remote sites, up towers, on DX-peditions. Use 10 AA or Ni-Cad or Ni-MH batteries (not included) or 110 VAC with MFJ-1312D, $26.95. Rugged metal cabinet, 4x2x6¾". **MFJ-249D, $329.95.**

MFJ-249D does everything MFJ-259D does with digital display only.

1500 Watt *Legal Limit*

for Ameritron AL-1500/1200/82 amps

Roam the entire HF spectrum 1.8- 30 MHz *hands-free* with full *1500 Watt* legal limit on SSB/CW/ Digital and near-perfect SWR! Ultra-fast automatic antenna tuning, back-lighted LCD and Cross-Needle SWR/Wattmeter. Highly efficient L-network, 12-1600 Ohms impedance matching, 20,000 *VirtualAntenna™* memories, audio SWR, multiple antenna connections. Made in USA!

MFJ-998 **$769.95**

MFJ-225 1.5-180 MHz *continuous* Two-Port Graphic Analyzer

Out in the field, the MFJ-225 is a compact completely *self-contained handheld graphing analyzer*. On the bench it becomes a full-fledged two-port (S21) desktop machine when teamed up with your PC. Using powerful IG-miniVNA freeware, you'll run de-tailed data analysis and print out stunning color-graphic plots to document your work! Built-in back-lighted *3-inch LCD graphic* display. Make fine adjustments using full-screen easy-to-view SWR bar-graph, capture vivid swept displays for SWR, impedance, re-turn loss, phase angle, more. DDS generator.

MFJ-225 **$429.95**

SWR Analyzer Accessories

A. **MFJ-29D/MFJ-39D, $49.95.** Carrying Pouch for MFJ-259D/269D.

B. **MFJ-92AA10, $44.95.** 10-Pk 2500 mAh Ni-MH Supercells.

C. **MFJ-66C, $59.95.** Dip coils, set of two covers 1.8-230 MHz.

D. **MFJ-731, $139.95.** Tunable Analyzer Filter, 1.8-30 MHz, for strong RF fields.

E. **MFJ-917, $54.95.** 1:1 Current balun for SWR Analyzers to test balanced line antennas, other loads.

F. **MFJ-7737, $8.95.** PL-259 to BNC Female.

G. **MFJ-7727, $9.95.** PL-259 to SMA Female.

H. **MFJ-5510C, $24.95.**12VDC cigarette lighter adapter.

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

Comet's primary tool for any antenna adjustment or diagnostic project...

CAA-500MarkII Antenna Analyzer

1.8-500MHz

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

Functions:
In addition to the display of antenna properties, SWR curves are plotted quickly, easily and accurately!

Auto band-sweep function:
Switch to the amateur band of choice and press "Sweep Center". The chosen band is swept and the SWR graphed in seconds!

Manual band-sweep function:
Select the band, select the center frequency, and select the bandwidth. Manually sweep the chosen frequency range and display the SWR graph.

Multiple Manual Band-Sweeps
Manually graph the user defined bandwidth multiple times and see the results overlaid in 5 selectable colors! Make antenna length, position, height above ground, gamma match adjustments, etc...and graph each adjustment in seconds, in a new color, without losing the previous graph!

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

Features:
Operates on 8-16VDC external power, 6 AA Alkaline or NiMH rechargeable cells • Trickle charger built in (only when using NiMH batteries) • Typical battery life: 9 hours of continuous operation • Battery level indicator • Selectable auto power-off time limit preserves battery capacity • SO-239 connector for 1.8-300MHz range • N-female connector for 300-500MHz range • Optional soft carry case sold separately: CAA-5SC

Call or visit your local dealer today!
www.natcommgroup.com | 800-962-2611

COMET®

MFJ...the World Leader in Ham Radio Accessories!

MFJ 1500 Watt Remote Auto Tuner

Place this MFJ-998RT remote tuner at your antenna to match high SWR antennas/long coaxes -- greatly reduce losses for high efficiency

. . . Match 12-1600 Ohms, 1.5 kW, SSB/CW/Digital, 1.8-30 MHz . . . Match coax/wire antennas . . . Weather-sealed . . . Remotely powered thru coax . . . Amplifier, radio, tuner protection . . . Output static/lightning protection . . . StickyTune™ always tunes when power folds back . . . DC power jack . . .

MFJ-998RT
$919.95

Bottom Chassis

Inside View

Tune your antenna at your antenna

Get greatly reduced losses and high efficiencies with long coax runs and high SWR antennas with this new MFJ-998RT 1.5 kW Remote Antenna Tuner.

Weather-Sealed

A tough, durable weather-sealed ABS cabinet with over-lapping lips, sealing gasket and stainless steel chassis protects the MFJ-998RT from all kinds of weather.

No Power Cable Needed!

No power cable needed -- remotely powered through coax. Includes MFJ-4117 Bias-Tee with on/off switch for station end of coax. Has 12 VDC jack for power cable, if desired.

Fully Protected

MFJ exclusive algorithms protect your tuner, radio and RF power amplifier from damage.

Automatic inductor and capacitor limiting prevents tuning extreme loads which can destroy your tuner.

Your tuner will not tune if more than 75 Watts with SWR greater than 3:1 is applied or if more than 125 Watts is applied.

Tuner output is static electricity and lightning induced surge protected.

MFJ exclusive StickyTune™

Very high SWR can fold back transmitter power and prevent tuning caused by extreme differences in loads (example: changing bands and other conditions).

But MFJ exclusive StickyTune™ always tunes with a simple on/off power cycle and re-transmit.

Tunes Coax fed and Wire Antennas

Tunes both coax fed and wire antennas. Has ceramic feed-through insulator for wire antennas. 2 kV Teflon® insulated SO-239 – prevents arcing from high SWR.

High Power, Highly Efficient

A highly efficient L-network matches 6-1600 Ohms at full 1500 Watts legal limit SSB/CW and Digital, 1.8 to 30 MHz with Hi-Q Ls, Cs.

MFJ-998RT Learns as you Operate

As you operate, the MFJ-998RT automatically tunes for minimum SWR and remembers your frequency and tuner settings. The next time you operate on that frequency and antenna, its tuner solution is restored in milliseconds and you're ready to operate!

Highly Intelligent, Ultra-fast Tuning

MFJ InstantRecall™ recalls stored tuning solutions from 10,000 memories. For new frequencies, MFJ Intelli-Tune™ measures your antenna impedance and instantly determines the correct matching components. If antenna impedances cannot be measured, MFJ AdaptiveSearch™ searches only the relevant components that can match your antenna giving you ultra-fast tuning.

Field upgradeable firmware. Requires 12-15 VDC at 1.4 Amps maximum or 110 VAC with optional **MFJ-1316, $39.95**. Weighs 9.5 lbs. 13 1/4W x 6 3/4H x 17 1/2D inches.

600W Remote IntelliTuner™

MFJ-994BRT – perfect for 600 Watt SSB/CW amplifiers like Ameritron's AL-811/ ALS-600/ALS-500M. Matches 12-800 Ohms. Coax/wire antennas, 1.8-30 MHz. Fully weather-sealed for outdoor use. Remotely powered through coax. Tough, durable, built-to-last cabinet, 9 1/4W x 3H x 14 1/4D inches, 4 lbs. Includes MFJ-4117 BiasTee Power Injector.

MFJ-994BRT
$509.95

300W Remote IntelliTuner™

MFJ-993BRT handles 300 Watts SSB/CW and digital.Has extra-wide 6-1600 Ohm impedances. Coax/ wire antennas, 1.8-30 MHz. Fully weather-sealed for remote outdoor or marine use. Remotely powered through coax. Tough, durable, built-to-last cabinet measures 9 1/4W x 3H x 14 1/4D inches. Weighs just 4 pounds. Includes MFJ-4117 BiasTee Power Injector.

MFJ-993BRT
$389.95

200W Remote IntelliTuner™

MFJ-926B, 200 Watts SSB/CW/Digital, 6-1600 Ohms, Coax/wire antennas, 1.8-30 MHz. Includes BiasTee.

MFJ-926B $379.95

MFJ No Matter What™ Warranty

One year **No Matter What**™ Warranty
30 Day Money Back Guarentee
(less s/h) on orders direct from MFJ.

160-6 Meters 43 foot Vertical Antenna

Operate all bands 160-6 Meters at full 1500 Watts with this self-supporting, 43 foot high performance vertical! Assembles in less than an hour. Low profile blends in with sky and trees -- barely see it. Entire length radiates. Exceptional low angle DX performance on 160-20 Meters and very good performance on 17-6 Meters. Telescope it shorter for more effective low angle radiation on 17-6 M if desired. One of these wide range MFJ automatic tuners at the antenna easily matches all bands 160-6 Meters. There's no physical tuning adjustments on the antenna -- you simply put it up! Requires ground system, at least one radial, more the better. Includes balun and base mount. **MFJ-1932, $44.95**. All band ground radial system.

MFJ-2990
$399.95

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

LDG Electronics

The Innovators of Hiqh Quality Automatic Tuners, Baluns & Ununs

LDG has a complete line of autotuners, baluns, ununs and accessories that have been relied upon by countless operators. Trust the innovators. Trust LDG!

Best Value
Best Service
Best Warranty
Nobody Beats LDG!

HAM RADIO OUTLET
WORLDWIDE DISTRIBUTION

SALES & SERVICE SINCE 1971 EXCELLENCE

ANAHEIM, CA: 800-854-6046 | ATLANTA, GA: 800-444-7927 | DENVER, CO: 800-444-9476
MILWAUKEE, WI: 800-558-0411 | NEW CASTLE, DE: 800-644-4476 | PHOENIX, AZ: 800-559-7388
PLANO, TX: 877-455-8750 | PORTLAND, OR: 800-765-4267 | SACRAMENTO, CA: 877-892-1745
SALEM, NH: 800-444-0047 | WINTER SPRINGS, FL: 800-327-1917 | WOODBRIDGE, VA: 800-444-4799

HAMRADIO.COM

Find us on facebook | FOLLOW US ON twitter | YouTube

MFJ Antenna Tuners

New, Improved MFJ-989D 1500 Watt Legal Limit Antenna Tuner

World's most popular 1500W Legal Limit Tuner just got better -- *much better* -- gives you more for your money!

New, Improved MFJ-989D legal limit antenna tuner gives you beter efficiency, lower losses and a new true peak reading meter. It easily handles full 1500 Watts SSB/CW, 1.8 to 30 MHz, including MARS/WARC bands.

New, dual 500 pF air variable capacitors give you twice the capacitance for more efficient operation on 160/80 Meters.

New, improved *AirCore*™ Roller Inductor gives you lower losses, higher Q and handles more power more efficiently.

New, *TrueActive*™ peak reading Cross-Needle SWR/Wattmeter lets you read true peak power on all modes.

MFJ-989D, $499.95

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.

12⅞Wx6Hx11⅝D inches.

Includes six position ceramic antenna switch, 50 Ohm dummy load, indestructible multi-color Lexan front panel with detailed logging scales and legends.

The MFJ-989D uses the superb time-tested T-Network. It has the widest matching range and is the easiest to use of all matching networks. Now with MFJ's new 500 pF air variable capacitors and new low loss roller inductor, it easily handles higher power much more efficiently.

***No Matter What*™ Warranty**

Every MFJ tuner is protected by MFJ's famous one year *No Matter What*™ limited warranty. We will repair or replace your MFJ tuner (at our option) for a full year.

MFJ-986 Two Knob *Differential-T*™

MFJ-986, $449.95

Two knob tuning (differential capacitor and *AirCore*™ roller inductor) makes tuning fooolproof 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. 15Wx4½Hx10¾D".

MFJ-962D compact kW Tuner

MFJ-962D, $399.95

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, peak/avg lighted Cross-needle SWR/Wattmeter, antenna switch, balun, Lexan front, 1.8 to 30 MHz. 10⅞Wx14½Hx10¾D".

MFJ-969 300W Roller Inductor Tuner

MFJ-969, $299.95

Superb, *AirCore*™ roller inductor. Covers 6 Meters through 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. 10½Wx3½Hx9½D".

MFJ-949E deluxe 300 Watt Tuner

More hams use MFJ-949s than any other antenna tuner in the world! Handles 300 Watts, full 1.8-30 MHz coverage, custom inductor switch, 1000V tuning capacitors, full size peak/average lighted Cross-Needle SWR/Wattmeter, 8 position antenna switch, dummy load, *QRM-Free PreTune*™, scratch proof Lexan front panel. 10⅝Wx3½Hx7D". **MFJ-948, $219.95.** Econ-omy version of MFJ-949E, less dummy load.

MFJ-949E, $249.95

MFJ-941E Super Value Tuner

Most for your money! 300 Watts PEP, 1.8-30 MHz, lighted Cross-Needle SWR/Wattmeter, 8-position antenna switch, 4:1 balun, 1000 Volt capacitors, Lexan front panel. 10½Wx2½Hx7D". **MFJ-941EK, $179.95.** Tuner Kit -- *Build your own!*

MFJ-941E, $199.95

MFJ-945E HF/6M mobile Tuner

Extends your mobile antenna bandwidth so you don't have to stop, go outside and adjust your antenna. Tiny 8Wx2Hx6D". Lighted Cross-Needle SWR/Wattmeter, Lamp and Bypass switches. Covers 1.8-30 MHz and 6-Meters. 300 Watts PEP. **MFJ-20, $13.95**, mobile mount.

MFJ-945E, $189.95

MFJ-971 portable/QRP Tuner

Tunes coax, balanced lines, random wire, 1.8-30 MHz. Cross-Needle Meter, SWR, 30/300 or 6 Watt QRP ranges. Matches popular MFJ rigs. Tiny 6½Wx2½Hx6D".

MFJ-971, $179.95

MFJ-901B smallest Versa Tuner

MFJ's smallest (5Wx2Hx6D") and most affordable wide range 200 Watt PEP Versa Tuner. Covers 1.8 to 30 MHz. Great for matching solid state rigs to linear amps.

MFJ-901B, $149.95

MFJ-902B Tiny Travel Tuner

Tiny 4½Wx2¼Hx3D", full 150 Watts, 80-6 Meters, has tuner bypass switch for coax/random wire. **MFJ-904H, $199.95.** Same but adds Cross-needle SWR/Wattmeter and 4:1 balun for balanced lines. 7¼Wx2¾Hx2¾D".

MFJ-902B, $149.95

MFJ-16010 random wire Tuner

Operate all bands anywhere with MFJ's reversible L-network. Turns random wire into powerful transmitting antennas. 1.8-30 MHz. 200 Watts PEP. Tiny 4Wx2Hx3D".

MFJ-16010, $104.95

MFJ-9201 *QRPocket*™ Tuner

80-10 Meters, 25 Watts. 12 position inductor, tune/bypass switch, wide-range T-network. BNCs. 4Wx2⅝Hx1½D".

MFJ-9201, $74.95

MFJ-921/924 VHF/UHF Tuners

MFJ-921 covers 2 Meters/220 MHz. **MFJ-924** covers 440 MHz. SWR/Wattmeter. 8Wx2½Hx3D".

MFJ-921/924, $139.95

MFJ-931 Artificial RF Ground

Eliminates RF hot spots, RF feedback, TVI/RFI, weak signals caused by poor RF grounding. Creates artificial RF ground or electrically places far away RF ground directly at rig. **MFJ-934, $259.95.** Artificial ground/300 Watt Tuner/Cross-Needle SWR/Wattmeter.

MFJ-931, $149.95

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

TIMEWAVE TECHNOLOGY INC.

ANC-4+ Now Shipping!

- Ham Radio Outlet www.hamradio.com
- R&L Electronics www.randl.com
- Japan Communication www.jacom.com
- Radio Parts Japan www.radio-part.com

*NEW! ANC-4+

The familiar, rugged ANC-4 now with:

- External TX/RX control - great for QRP operation
- Continously Adjustable TX hang time
- Noise amp front end protection
- TX LED indicator
- SMT construction w/ gold-plated PCB
- Heavy steel laser-cut housing for precise tuning and mechanical stability

ANC-4+ Antenna Noise Canceller

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

Navigator

The Premier Sound Card Modem!

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

- Quiet - hear what others miss!
- Proven USB Sound Card built-in
- Precise FSK
- Genuine K1EL Winkeyer CW IC
- Complete - Six FTDI COM ports
- Universal Rig Control for every radio
- Works well with HRD, M110A, Fldigi, FT8 & many more software programs
- Front-Panel Audio & CW controls
- USB connected and powered
- Convenient - No annoying jumpers!

PK-232SC+

Multimode Data Controller*

- RTTY
- Packet
- Pactor
- CW
- PSK31 & all the Sound Card modes!

Upgrade any PK-232 to the PK-232SC with New Lower Combo Pricing for SC & DSP Upgrade!

Customize your PK-232 installation with our complete line of upgrades, accessories and cables.

100,000 sold - All-time top selling data controller!

- Single USB connection to computer
- USB Sound Card built-in
- 3-Way Rig Control built-in - logic level, RS-232 & USB!
- Computer isolated from radio
- Real FSK & AFSK
- keyboard CW - send and receive
- Dual Port - two radios at same time!

■ PK-96/100 USB Packet TNC

1200/9600 bps AX.25 Packet

Available with USB or RS-232 connection

■ HamLinkUSB™ USB-to-RS-232 Adapter

Proven FTDI Chip. 9 and 25 pins for all radios, TNCs, Rotor Controllers & more!

■ HamLinkUSB™ Rig Control+

C-IV, CAT, RTS (PTT, FSK or CW) for sound card software

Perfect for HRD owners with simple sound card adapters

Timewave Technology Inc.
360 Larpenteur Ave. W., Suite 100
St. Paul, MN 55113 USA

www.timewave.com
sales@timewave.com

651-489-5080

Free Dealer/Catalog/Manuals/Instructions -- Visit: www.mfjenterprises.com or call toll-free 800-647-1800

MFJ . . .the World Leader in Ham Radio Accessories!

MFJ-4416C *Super* Battery Booster

Boost battery voltage as low as 9 Volts back up to 13.8 VDC! Keeps your transceiver at full power output, compensates for run down battery, wiring voltage drop, car off . . .

MFJ-4416C **$229.95** **Keeps** your transceiver at full power output, provides full performance, high efficiency, prevents output signal distortion and transceiver shutdown. Compensates for run-down battery, wiring voltage drop or when car is off. Provides up to 25 Amps peak with 90% efficiency. Selectable 9/10/11 Volts minimum input voltage prevents battery damage from over-discharging. RF sense turns MFJ-4416C off during receive to save power, increases efficiency and reduces noise. Adjustable 12 to 13.8 VDC output pass-through improves efficiency and lets transceiver run cooler. Has output over-voltage crowbar protection. *Anderson PowerPoles*(R) and high-current 5-way binding posts for DC input, regulated output. 7¾Wx4Hx2⅛D inches. **MFJ-4416BRC, $119.95.** Booster Remote Control.

Super Heavy Duty Battery Booster

MFJ-4418 **$279.95** **Super** robust with heavy duty transistors, rectifier, improved switch-mode transformer, larger heatsink. Input and output EMI filters reduce noise to minimum. Rugged construction. *Power-Poles*™ and 5-way binding posts. MFJ software adjusts output voltage, measure load current, set minimum voltage level, over-current trip level, ignition control, more. External boost enable, remote input/output voltage sampling, remote controllable with MFJ-4416BRC.

RFI Filter for DC power

MFJ-1142 **$89.95** **Connects** between rig and 12/ 24/50 VDC power supply/battery. Reduces RFI, hash, transients, motor noises, alternators, fuel pump whine, power windows, more! Binding posts/*PowerPoles*(R).

Digital Volt/Amp Meter

MFJ-4422 **$69.95** **Connect** in-line. Displays 4.5-30 VDC and up to 30A simultaneously. .01-.1V resolution. Dual .28" red/blue LED digits. *Anderson PowerPoles*™. Reverse polarity protection. 3x2x1 inches.

RFI Ferrite Chokes

MFJ-700A4 **$19.95** **Suppress** RFI. Snap and locks on DC power line, coax, wires. Effectively removes RFI and noise. Install end-to-end or loop multiple turns for more suppression. .275" hole dia. 4 in package.

PowerPole™ DC Outlet Box

MFJ-1104 **$69.95** **One** fused 30 Amp input and 25, 10, 5 Amp fused outputs *with Anderson PowerPoles*™. Has open fuse indicator. Sturdy metal construction, 2¾Wx3¼Hx1½D inches.

MFJ Low Pass Filter

MFJ-704 **$124.95** **High** attenuation above 40 MHz. 1.5kW, 1.8-30 MHz. SWR<1.3. Nine Chebyshev poles, *Teflon*(R) dielectric capacitors, high-Q inductors, ground plane shielding, RF tight.

Lightning Surge Protector

MFJ-270 **$34.95** **Protect** your expensive equipment from lightning induced surges on 50 Ohm coax. Use for transceivers up to 400 Watts, 1000 MHz. **MFJ-272, $49.95.** 1.5 kW.

MFJ 30-Amp Power Supply

MFJ-4230MVP **$169.95** **World's** most compact 30 Amp switching power supply. Switchable Volt/Amp meter. Adjust 4-16 VDC output. 120/240 VAC. *PowerPoles*™, binding posts. 5Wx2½Hx6D" 3lbs.

High-efficiency Loop Tuner

New! MFJ-935C **$289.95** **Instantly** turn wire or coax into a small, high-efficiency multi-banded loop antenna. 150W, 5.3-30 MHz. Tripod/mast mount included. **MFJ-936C, $379.95.** Relative RF antenna current and Cross-needle SWR/Wattmeter. **MFJ-933C, $269.95.** Like MFJ-935C, no meter.

MFJ Field Strength Meter

MFJ-801 **$54.95** **Relative** field-strength readings .1-500 MHz. Sensitivity control, 1¾ inch meter. 20-inch telescoping whip. Finger contact increases sensitivity.

Tuned Indoor Active Antenna

MFJ-1020C **$139.95** **Rival** outside wire antennas hundreds of feet long and pick up signals loud and clear all over the world. 0.3-40 MHz.

25-1300 MHz Discone Ant

MFJ-1868 **$89.95** **Receives** 25-1300 MHz. Transmits 50-1300 MHz up to 200 Watts. Test various X-mitters on one coax. 50 ft. coax, stainless steel elements.

17-foot Telescopic Whip

MFJ-1979 **$79.95** **17-foot** stainless steel whip collapses to 27". Full 1/4 Wave on 20/17 Meters, 30-160 Meter operation with loading coil. Fits any standard 3/8-24 threaded mount.

Telescopic Fiberglass Mast

MFJ-1906HD **$269.95** **Super-strong** heavy-duty mast with *QuickClamps*™. 38 ft. ext., 6 ft. collapsed. 2½" OD bottom, 1" OD top. .125" thick wall. Supports "*real*" weight.

Giant 2½ inch LED Clock

MFJ-117 **$19.95** New Low Price! **Giant** 2½ inch super bright LEDs -- see from across the street day or night. 12/24 switch, 110VAC, 9V battery backup.

MFJ 2-Position *Remote* Antenna Switch

MFJ-4712 **$109.95** **MFJ** 2-position *remote* antenna switch uses a *single* coaxial feedline to feed two antennas, DC power and control signals. Remotely switch HF and/or VHF antennas. Covers 1.8 MHz to 150 MHz. Handles 1500W. Impedance is 50-75 Ohms. Compact 4Wx2⅝Hx1½D". *Outside Switch Box* is fully enclosed and weather protected. Three quality *Teflon*(R) SO-239 connectors for transmitter, antenna one and antenna two. Stainless steel 1½" tall bracket with a U-bolt for masts up to 1½ in. O.D. *Inside biastee* control is 2¼Wx2½Hx1¼ in. Use 12 VDC or 110 VAC with MFJ-1312D, $26.95.

MFJ Artificial RF Ground

MFJ-931 **$149.95** **By** tuning out ground wire reactance RF hot spots disappear and your rig is at actual earth ground. Improve signals by resonating a wire into a tuned counterpoise.

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

Ham Ads

Please contact the Advertising Department at 860-594-0255 or hamads@arrl.org for further information or to submit your ad.

QST Ham Ads on the Web
Updated Monthly!

www.arrl.org/ham-ad-listing

Club/Hamfests/Nets

159 Counties That's how many Georgia has. Work them all and get the free "Worked All Georgia" award. https://atlantaradioclub.org/worked-all-georgia-award.html. Get missing counties during the Georgia QSO Party in April: https://gaqsoparty.com/

CW INSTRUCTION via internet video conference classes. VISIT longislandcwclub.org

Emergency Ham Net. Forming a new group, free membership. Have fun and push the frontiers of digital radio. www.emergencyham.net

Friend of BILL W meets Thur on 14.316 @ 12:30 ET. Daily Meeting on QSO NET on 21.350 @ 11:30 Eastern Time. More info please visit HAAM Group website www.qsl.net/haam.

SOCIETY OF WIRELESS PIONEERS - Professional brass pounders "on land, sea, and air from the time of spark to solid state preserved photos, stories, schematics, letters, cartoons, catalogs, books, and manuals to keep radio history alive. Website showcases **early ham stations**, naval communications history, SOS events, and more, all free. www.sowp.org

Property/Vacation/Rentals

A CARIBBEAN SAINT KITTS "V4" DX RENTAL. See V47JA on QRZ.com and email: W5JON@sbcglobal.net for Ham Discount information. John W5JON/V47JA

A DX Apartment available in VP9 with rigs and antennas. Email: ed@vp9ge.com for details.

Beautiful outdoor Idaho! Spacious low populated areas. Abundant recreation opportunities. Moderate four season climate. Thinking of buying or selling? Contact Ron Bishop, W7IM, Keller Williams Realty Boise. 208-870-6075. Ron@BoiseBargains.com

CAPE COD real estate for hams, buy or sell, John Strome, KC1MLR, ColdwellBanker associate, john.strome@nemoves.com, 508-527-0499

COLORADO CHALET with ham gear for weekly rental, www.lostcreekcabin.com. WØLSD, Buena Vista, CO.

Hams Looking to purchase or sell real estate in Connecticut? Please contact Licensed Ham and Realtor, Claude Cousins, Sr. N1QAE, Berkshire Hathaway Home Services, claudecous@gmail.com, 860-989-2113

KD7UIZ Helps buy/sell radio friendly properties anywhere in AZ. Pima Canyon Realty. Email - **DON@DONERNLE.COM**

MAINE year-round Ham Station. www.CottagebytheDam.com

SC HOUSE FOR SALE Myrtle Beach SC. Tower and complete ham shack included. 3BR 2BA, dock on river. maryfav@aol.com AE4BX

www.peidxlodge.com

Antique/Vintage/Classic

6 Meter legacy by K6EDX K6MIO. www.bobcooper.tv

ANTIQUE WIRELESS ASSOCIATION - the largest international organization for historic radio enthusiasts. Publishes the quarterly AWA Journal and annual AWA Review on all aspects of collecting and history of communications. AWA produces the famous annual AWA Convention and sponsors the world renowned Antique Wireless Museum. Only $35/year USA, $40/year elsewhere. Antique Wireless Association, PO Box 421, Bloomfield, NY 14469. Website: http://www.antiquewireless.org

AR88 Excellent condition with LM7 Frequency Meter. Spare tubes available. ericbforsyth@gmail.com

Awesome Technology & Stem Museum - www.cyberengineer.info

Six Decades of Amateur Radio www.kk4ww.com

Vintage Radio, Ham Radio and Military Radio Repair. www.mcveyelectronics.com 845-561-8383

WANTED PRE-1980 MICROCOMPUTERS for historical Museum www.kk4ww.com

QSLCards/Call Sign Novelties

Engraving, **QSL's,** etc. WA2WAO@CornerPress.com Retiring after over 60 Years as a printer. I'm referring people to Randy KB3IFH, 410-440-0282. THANK YOU to all my Ham Customers. It's time for me to relax. See you on the air! Barry

Flaunt your call! www.**HAMFLAGS**.com

Get Top Quality Full Color UV Coated QSL Cards direct from the printer. Chester QSL Cards by Chester Press. Call 800-748-7089 for samples, email info@chesterpressinc.com or visit the chesterpressinc.com/QSL website.

General

RF CONNECTORS & GADGETS
Parts - Products - More
www.W5SWL.com.

#1 Amateur website for useful links and downloadable information: www.kb9at.com

Amateur and High-End Audio Equipment Repair/. www.chfeletronics.com, seecumulus@gmail.com

Antenna Masts for ECOM - Only $99.95!! Excellent 31 ft. Telescopic Fiberglass Poles for wire antennas. **Plus** - Starlink RV Pole Kits, ladder mounts, and more. **https://www.hitched4fun.com/antenna-masts/**

ATTENTION YAESU-FT 10218,000hrs, 30yrs, 800+ FT-102's Repaired. Have every part. AM-FM/board. $25/hr. Parts@cost. Relays lifetime warranty. 954-961-2034 NC4L www.w8kvk.com/nc4l

CALL SIGN T-SHIRTS, COFFEE MUGS AND CAPS! See my store KA7UNW at www.etsy.com/shop/KA7UNW or just Google KA7UNW

Custom LED Call Signs. www.ledboothsign.com 408-315-4573 Phone

ENTIRE INVENTORY OF TELETYPE MACHINES, Assemblies, and parts available. Mostly model 28. Enough to build up numerous machines; ASR, KSR, RO & Tape. Paper and tape also. Moving and can't take it with me. Southeast Michigan area. 810-305-1513, K8JOF

FOR SALE: 250 Antenna Design Books, many of which are "Out of Print" classics. 860-652-9234, cjm@ix.netcom.com W1LYQ

FOR SALE: Kenwood Hybrid Radios - 520, 520S etc... Plus, other equipment. Email nlamanteer@comcast.net for pictures.

GAIN the EDGE with NARTE Certification – NARTE gives you the competitive edge with individual certification in Electromagnetic Compatibility, Electromagnetic Discharge Control and Telecommunications. Industry-recognized certification required or desired by more than 400 corporations nationwide. Call 1-800-89-NARTE or visit www.inarte.org. NARTE offers the premier EMC/EMI, ESD, Telecommunications and Wireless certification to professional technicians and engineers.

Get the F.C.C. "Commercial" Radiotelephone License: The highest-class Telecommunications Certification! Fast, inexpensive, Guaranteed Home-Study. Command Productions. Please visit: **www.LicenseTraining.com** (800) 932-4268

Ham in declining health. ICOM station for sale: IC-7800; IC-PW1; IC-R 7000 (cellular not blocked); IC-2300H (factory mod done for MARS); Samlex SEC-1235 P-M; IC-SP-41 speaker. All like new. All manuals. Total sale only. Pick up only - Winston-Salem, NC. $8900. N4QEC: d7metcalf@aol.com

HAM KITS for sale at www.HecKits.com L/C Meter, SWR Bridge, ESR Meter, 2-Tone Gen, FET DIP Meter.

ISOTRON ANTENNAS FOR 160 - 6 METERS! Efficient, rugged and resonant. Please visit **WWW.ISOTRONANTENNAS.COM**. wd0eja@isotronantennas.com 719/687-0650.

KB6NU'S "NO NONSENSE" LICENSE STUDY GUIDES have helped 1000's get their first license and upgrade to General or Extra. They can help you, too. KB6NU.COM/STUDY-GUIDES/

LEARN CODE by Hypnosis, www.success-is-easy.com 561-302-7731

MicroLog-By-WA0H .. Easy to use logging program .. Free download .. www.wa0h.com~

Personalized amateur radio Coffee mugs at myfunnycoffeemug.com

PRINTED CIRCUIT BOARDS for projects shown in QST, QEX, HR, ARRL HB, 73 and more. Custom boards available. FAR Circuits, 18N640 Field Ct, Dundee, IL 60118; fax/phone 847-347-2432; www.farcircuits.net; mail@farcircuits.net

RF SUPERSTORE
Connectors, Adapters, Antennas, Coaxial Cable and more!
High Quality, Low Cost, Ham Friendly
WWW.RFSUPERSTORE.COM

Rohn Tower, telescoping poles, tripods and antenna parts delivered to your door. **www.antennapartsoutlet.com**

Soldering-desoldering-hand tools-ESD how can we help? **www.technimark-inc.com** and E-Bay store-ebay.com/str/technimarkinc

Start to read fast CW in your head! Begin to hear whole words sent in fast CW! Soon reading is easy! **https://www.hearcwwords.com**

Tactical Portable Accessories for Yaesu 450D, DX-10, 817ND, 857D, 897D, 891, 991A, ICOM 7300, 7200, 7000, 706/703 and 9700. W0MSN www.portablezero.com

Universal Aluminum push up towers. Same day shipping. www.antennapartsoutlet.com

Want to make monthly income without much work? Champion Radio Products is for sale. More information at sales@championradio.com

WANTED: Kenwood DK-520 Digital Adapter Kit. b52ewo54@gmail.com or 484.474.2167

WANTED: Large General Electric Clock 2915_ or 2939_ 24 Hour. W0EVC 573.248.2043

Xcellent **Amateur** and **Monitor Logging** from **DXtreme!** Click **www.dxtreme.com**

Advertising Department Staff:
Janet Rocco, W1JLR, |
Advertising Sales Manager

QST Index of

Contact Information:

Toll Free: 800-243-7768
Fax: 860-594-4285
E-mail: ads@arrl.org
Web: www.arrl.org/ads

Additional advertising information is available on the web at:
www.arrl.org/ads

Advertisers

The **ARRL** Diamond Club

2023 is the **ARRL Year of the Volunteers** –
and Diamond Club is one way you can reach one rung higher.

Life Members ▶ You can support ARRL with an unrestricted gift to Diamond Club and keep all the benefits of your Life Membership while ensuring ARRL can continue steadfast in promoting and protecting amateur radio.

Annual Members ▶ When you join Diamond Club you receive all the benefits of your annual ARRL membership, including a choice of print magazine, *QST* or *On the Air*, all while knowing that your additional support provides financial resources where they're needed most to support our mission.

JOIN TODAY or Renew your gift to **Diamond Club**

Get Your Challenge Coin

With your gift of $125 or more you can receive this limited-edition challenge coin, specially minted for Diamond Club supporters in this **Year of the Volunteers** as a thank you.

*While supplies last

Individuals and radio clubs contributing $250 or more to the **ARRL Diamond Club** may choose to inscribe a brick placed in the Diamond Terrace with their own call sign, or as a tribute to a friend or family member, mentor, or Silent Key.

ACT NOW

www.arrl.org/the-arrl-diamond-club | development@arrl.org

ARRL, 225 Main Street, Newington CT 06111-1400 USA

From Zero to Hero!

Digital Radio made easy.

BridgeCom SYSTEMS

Get Your FREE Bluetooth Earpiece

with purchase of $50 or more

*Call Now!

Digital Radio Doesn't Have To Be Scary.

Industry Leading Training (BridgeCom University)
with the purchase of **every** radio.
+Live Training & American-based 5-star Customer Service.

www.BridgeComSystems.com 816-532-8451 ***Use Code 3XAYQM**

The Legend Continues

The TS-590SG

Back in 1973, Kenwood introduced the first affordable HF radio to the world, the legendary TS-520... 27 years later, the TS-570D and the TS-570S with 6 meters were by far the most popular HF and HF+6 transceivers on the market.

Be witness to the evolution of KENWOOD's pride and joy - the TS-590S HF transceiver - pushing performance and technology to its utmost limit, with the receiver configured to capitalize on roofing filter performance and IF AGC controlled through advanced DSP technology. Enter the TS-590SG. A new generation of high performance transceiver, with the type of high level response to meet DX'ers needs.

Don't be fooled by big boxes, high price tags, complex operation and broken promises. As Kenwood continues to build outstanding products with unparalleled performance and great value, it's no surprise Kenwood is rated as one of the leading choices for HF radios.

It's not too late to own an HF legend because we still build them today.

KENWOOD

Customer Support: (310) 639-4200
Fax: (310) 537-8235

www.kenwood.com/usa

ISO9001 Registered

ADS#36419