The Novices of 1970 — 50 Years Later Page 60

QST
DIGITAL EDITION
ARRL The national association for AMATEUR RADIO®
June 2020 www.arrl.org
DEVOTED ENTIRELY TO AMATEUR RADIO

Field Day 2020

Challenge Yourself!

QST Reviews

AnyTone AT-D578UVIIIPRO Triband DMR/FM Transceiver

RigExpert Stick 230 Antenna and Cable Analyzer

Elecraft AX1 Dual-Band Whip Antenna and Accessories

DIGITAL FEATURE

42| See our Video Review of the **AnyTone** AT-D578UVIIIPRO DMR/FM Transceiver

The radio... YAESU

Inherent Passion and Inspiration

Hybrid SDRs (Narrow Band SDR & Direct Sampling SDR)

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

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

2kHz Phase Noise −150dBc/Hz

VC-TUNE (Variable Capacitor Tune) signal peaking

Maximum Attenuation −70dB

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

TX Signal Purity

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

* Microphone M-1: Optional

In Homage to the Founder of Yaesu – Sako Hasegawa JA1MP

FTDX101MP 200W
HF/50MHz TRANSCEIVER

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

The Ultimate

FTDX101D 100W
HF/50MHz TRANSCEIVER

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

YAESU
The radio

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**

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

YAESU
The radio

C4FM/FM 144/430MHz Dual Band Mobile

High Visibility and Resolution QVGA Display with Exceptional Operability

Real Dual Band Operation V+V/U+U/V+U/U+V & Simultaneous C4FM Monitoring

FM Friendly Digital : AMS (Automatic Mode Select)

System Fusion II Compatible

WIRES-X Portable Digital Node Function

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

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

FTM-300DR

Bluetooth
AMS
Automatic Mode Select
microSD Card
66 ch DVS
C4FM
Clear and Crisp Voice Technology
WIRES-X

YAESU
The radio

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

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

Free Catalog/Dealers/Manuals Online – Visit: www.cushcraftamateur.com or call toll-free 662-323-9538

Cushcraft...Keeping You in Touch Around the Globe

MA-6B 6-Band Beam

Small Footprint – Big Signal

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

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

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

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

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

MA-5B, $579.95. Like MA-6B but five bands: 20/17/15/12/10 Meters. 12 and 17 Meters is a single element trapped dipole.
See cushcraftamateur.com *for gain figures.*

Cushcraft 10, 15 & 20 Meter Tribander Beams

Only the best tri-band antennas become DX classics, which is why the Cushcraft World-Ranger A4S, A3S, and A3WS go to the head of the class. For more than 30 years, these pace-setting performers have taken on the world's most demanding operating conditions and proven themselves every time. The key to success comes from attention to basics. For example, element length and spacing has been carefully refined over time, and high-power traps are still hand-made and individually tuned using laboratory-grade instruments. All this attention to detail means low SWR, wide bandwidth, optimum directivity, and high efficiency – important performance characteristics you rely on to maintain regular schedules, rack up impressive contest scores, and grow your collection of rare QSLs!

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

The 3-element A3S/A3WS and 4-element A4S are world-famous for powerhouse gain and super performance. **A-3WS, $529.95,** 12/17 M. **30/40 Meter** *add-on kits* available.

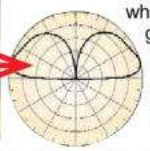
Cushcraft R9...80-6 Meters 80 Meters...No Radials...1500W

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

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

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

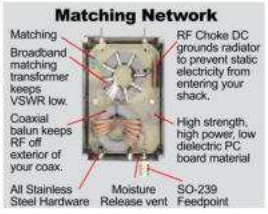
Use full 1500 Watts SSB/CW when the going gets tough to break through pileups/ poor band conditions.



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

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

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



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

R8, $569.95. Like R9 antenna but less 75/80 Meters.

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

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

Cushcraft Dual-Band Yagis

One Yagi for Dual-Band FM Radios

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

Cushcraft Famous Ringos Compact FM Verticals

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

Your New MFJ 2019 Ham Radio Catalog is HERE!

140 Pages of MFJ, Ameritron, Hygain, Cushcraft, Mirage and Vectronics Products! Visit **www.cushcraftamateur.com** to download your copy!

Cushcraft **Amateur Radio Antennas** 308 Industrial Pk Rd, Starkville, MS 39759 USA
Sales/Tech: (662) 323-9538 ■ **FAX:** (662) 323-5803 Open 8-4:30 CST, Mon.-Fri.

COMET®

Life is a JOURNEY. Enjoy the ride!

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

Base Antennas

❶ COMET CHA-250B 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 Maldol HVU-8 ULTRA-COMPACT 8 BAND HF/VHF/UHF VERTICAL ANTENNA
80/40/20/15/10/6/2M/70cm Only 1/2 the traditional size and weight of vertical HF antennas, and it includes 2M/70cm! Unique radial system rotates for balcony installations, the radials can all be rotated to one side. • Wavelength: HF and 6M: 1/4 wave • 2M: 1/2 wave • 70cm: Two 5/8waves in phase • Impedance: 50 Ohm • Max Power: HF 200W SSB • 6M–70cm: 150W FM• Conn: SO-239 • Height: Only 8'6" • Weight: 5lbs. 7ozs.

❸ 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

❹ 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

❺ 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

❻ 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

❼ 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

NEW
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®

QST

Contents

June 2020 ♦ Volume 104 ♦ Number 6

Includes video
Includes audio
Additional content

9 **Second Century**
What We Can Do

30 **Battery Sizing for Portable Operation**
Mike Bryce, WB8VGE

34 **Multistation Interference and Field Day**
Jim Danielson, AC9EZ

38 **Product Review**
Mark Wilson, K1RO
AnyTone AT-D578UVIIIPRO Triband DMR/FM Transceiver; RigExpert Stick 230 Antenna and Cable Analyzer; Elecraft AX1 Dual-Band Whip Antenna and Accessories

56 **Students Engineer Desert Rovers**
Heather Caton, W8GEM

60 **Where Are They Now? The Novices of 1970**
Steve Ford, WB8IMY

70 **2019 ARRL November Sweepstakes — Phone**
Bruce Draper, AA5B, and Scott Davis, K5TA

73 **2019 ARRL 160-Meter Contest Results**
Mark Beckwith, N5OT

75 **The 2020 IARU HF World Championships**

85 **A Look Back: September 1970**

Columns

At the Foundation 93
Celebrating Our Legacy 91
Classic Radio 92
Contest Corral 69
Correspondence 24
The Doctor is In 50
Eclectic Technology 54
Happenings 64
Hints & Hacks 52
How's DX? 76
Member Spotlight 13
Public Service 67
Up Front 20
The World Above 50 MHz 78
100, 50, and 25 Years Ago 94

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.

Departments

ARRL Section Managers 16
ARRL VEC Honor Roll 83
Certificate of Code Proficiency Recipients 82
Convention and Hamfest Calendar 84
Field Organization Reports 68
Guide to ARRL Member Benefits 14
Ham Ads 124
Index of Advertisers 126, 127
New Products 83
Officers, Division Directors, and Staff 15
QST Cover Plaque Award 75
Silent Keys 95
Special Event Stations 80
Strays 77
This Month in *QEX* 37
W1AW Qualifying Runs 82
W1AW's QSL File 28
W1AW Schedule 55

Write for *QST*

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

Our Cover

Nathan Charles, N3QKA, installed and maintained the solar power system at K4NN, the Signal Hill Amateur Radio Club's 2019 ARRL Field Day site, atop a mountain ridge on the West Virginia/Virginia border just west of Harrisonburg, Virginia. The batteries were sheltered in tents to keep them out of the rain. [Jonathan Charles, NB3I, photo]

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

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

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

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

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

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

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

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

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

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

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

*Payment arrangements available. Please write for details.

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

Reprints and permissions:
permission@arrl.org

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

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

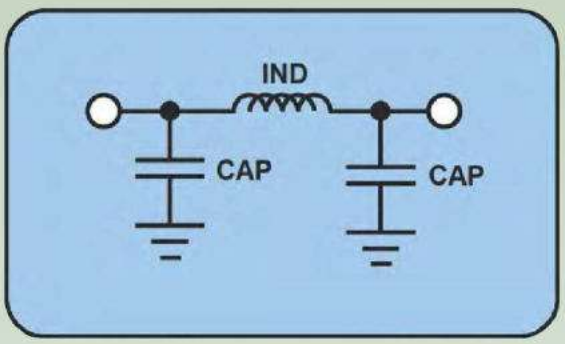
Engineers of LDG Mini-Notebook

Basic Tuners

Not sure which tuner design does what? It's confusing for everyone. Check out this handy chart of popular tuner configurations made with capacitors and variable or tapped inductors. Each one has its useful place in the Ham shack. LDG Tuners are Switched-L Networks for a balance of efficiency, size and tuning range. Visit www.ldgelectronics.com to learn more and see our full line of Ham Radio accessories.

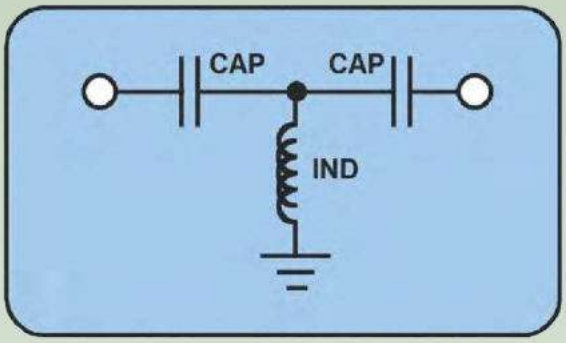
Pi Network

Widest Range. Used mainly for long wire and ladder line matching with its 100:1 SWR tuning range. Variable capacitors of 200pF and 470pF are obtainable through surplus, but large 20 μH variable inductor values increases size and cost



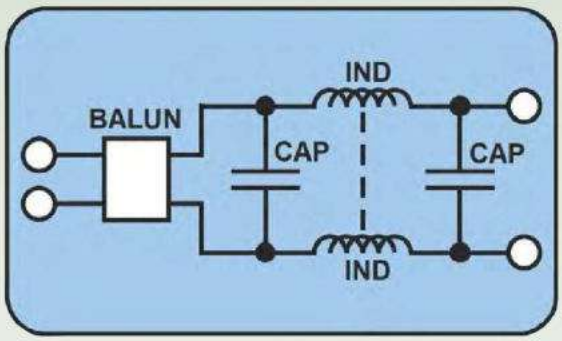
T-Match

Most versatile. Typically two variable 470 pF capacitors one 10 uH variable or tapped inductor. Popular for manual desktop matching due to its 60:1 SWR range. Prone to False tunes. The variable capacitors must be insulated from enclosure ground.



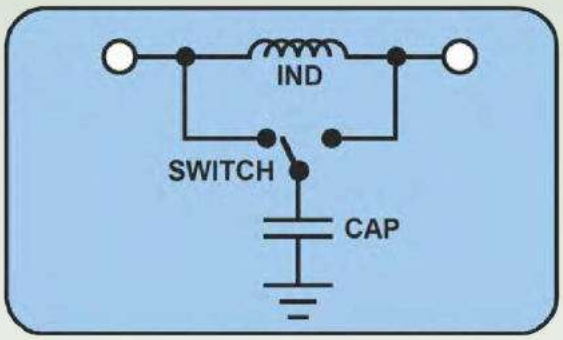
Balanced

Lowest loss, but it has the most parts and makes it the most expensive. The 20 uH inductors must be synchronized to turn at the same time and a 1:1 balun is used. Excellent for 450 ohm Ladder-Line and other balanced feedlines.



Switched-L

Most popular. Lowest parts count allows for smallest size and portable operation. One 10 uH inductor, one 4000 pF capacitor, and one Hi/Lo-Z switch. A medium 10:1 range limits tuning on antennas with very high SWR.



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

ANALYZER OPTIONS

Pocket sized SARK antenna analyzers!

$239

SARK-110-ULM

The SARK-110-ULM is the entry-level model of the SARK-110 antenna analyzer series. This is a truly pocket-size device, so you can take it anywhere. The built-in battery lasts up to eight hours on a single charge. It features a graphical display and an intuitive user interface that makes it easy to operate.

The native measurement frequency range is between 0.1 and 160 MHz, but it operates up to 700 MHz with reduced performances. It has full vector measurement capability and accurately resolves the resistive, capacitive and inductive components of a load.

The functionality is not restricted to antenna analysis, but it is a multipurpose instrument featuring a Time Domain Reflectometer (TDR) mode which is intended for fault location and length determination in coaxial cables; as well as an RF signal generator. The analyzer is designed for standalone operation, but it can be controlled from your desktop using SARK Plots for Windows and from your tablet or smartphone using SARK Plots for Android through USB or short-range Bluetooth LE.

Typical applications include checking and tuning antennas, impedance matching, components test, cable fault location, measuring coaxial cable parameters, and cutting coaxial cables to precise electrical lengths. As a signal generator, it is ideal for receiver calibration, sensitivity tests, and signal tracing.

The above pricing for both units includes a 2 year warranty and free technical support!

$389

SARK-110

The SARK-110 antenna analyzer is a pocket-sized instrument that provides fast and accurate measurement of the vector impedance, VSWR, vector reflection coefficient, return loss and R-L-C.

Typical applications include checking and tuning antennas, impedance matching, component test, cable fault location, measuring coaxial cable losses and cutting coaxial cables to precise electrical lengths. The SARK-110 has full vector measurement capability and accurately resolves the resistive, capacitive and inductive components of a load.

The SARK-110 is intuitive and easy to use, and utilizes four operating modes: sweep mode, smith chart mode, single frequency mode and frequency domain reflectometer (cable test).

- **Pocket size and lightweight**
- **Solid aluminum metal case**
- **Intuitive and easy to use**
- **Four operating modes: sweep mode (antenna test), Smith chart mode, single frequency, and frequency domain reflectometer (cable test)**
- **Excellent accuracy over a broad range of impedances**
- **Resolves the sign of the impedance**
- **Manual and automatic positioning tracking markers**
- **Internal 2MB USB disk for the storage of measurements, screenshots, configuration and firmware update**
- **Export data in ZPLOTS compatible format for further analysis on the PC**
- **Lifetime free firmware upgrades available, open to community requested features**
- **Open source SDK including a device simulator for user applications development**

steppIR COMMUNICATION SYSTEMS

FOR DETAILS & SPECS ON THESE PRODUCTS, AND TO ORDER:

www.steppir.com 425-453-1910

DIAMOND ANTENNA

diamondantenna.net

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

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

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

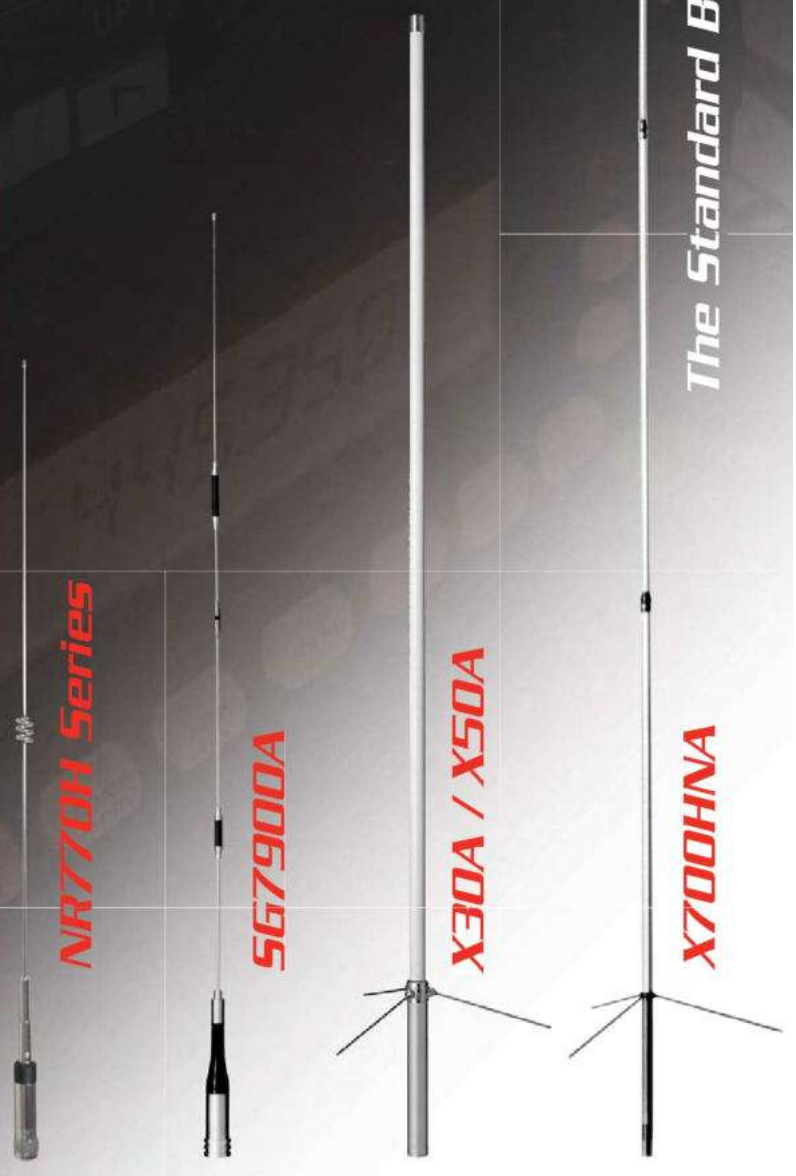
You've tried the rest, now own the best!

X700HNA Special Features:

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

Here is a small sample of our wide variety of antennas

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



The Standard By Which All Others Are Judged

RF PARTS™ COMPANY

Diamond Antenna is a division of RF Parts Company

Barry J. Shelley, N1VXY, n1vxy@arrl.org

Second Century

What We Can Do

Because of the lead time for sending QST to the printer, this is being written in early April. We've been told to stay in our homes, isolating and "social distancing." Hopefully, by the time you read this, we will be past the worst of the situation and seeing a light at the end of the tunnel. We're all facing many questions at this time, and among them is, how should amateur radio — and, specifically, ARRL — respond in the current health crisis and the limitations it has placed on all our lives?

Two months ago, as Interim CEO, I opened this column with the thought that you should hear from the management team at ARRL — the people who are working to shape the future of the organization. Now, looking back 2 months, I can't believe how much the world has changed. Just 2 months ago, we moved freely about the country, connected with friends and family in person, and engaged in all our professional and personal interests relatively unfettered. What an entirely different place we are in now; one we never could have imagined. As a result of all the changes, I thought it was important for you to hear from me regarding what is going on at ARRL Headquarters and across the amateur radio community.

First, and most importantly, amateur radio is in a unique position to serve not only our community of licensed operators, but the broader communities in which we all live and work. Opportunities exist to help keep people connected and provide support where and when we're needed. That's what amateur radio operators do. It's what they've always done, although certainly in different circumstances. Even something as simple as getting on the air and calling CQ can be uplifting for someone on the other end of the contact. Connecting with people is important in this time of isolation and social distancing, and this tried-and-true method is one of the best. Who knows? You might make a new friend.

There are even more opportunities to make contacts coming up on the calendar. ARRL Field Day is fast approaching and, although it will likely be very different this year, it still presents an opportunity to showcase our skills and make contacts. I recommend the article on the ARRL website, which talks about Field Day 2020 as being "A Time to Adapt" (**www.arrl.org/news/field-day-2020-a-time-to-adapt**). It provides suggestions on how to participate this year, and I encourage everyone to do so. If you're looking for opportunities to be active on the air, take a look at the Special Events search page on the ARRL website (**www.arrl.org/special-event-stations**) to find more localized events in which to participate.

As for ARRL, late on March 20, the Governor of the State of Connecticut ordered all non-essential and non-profit businesses to reduce their in-person workforce by 100% by the close of business on Monday, March 23, except for a very few specific functions. We scrambled during the weekend leading up to the 23rd, but with an amazing effort by the staff, by the morning of Tuesday, March 24, we had almost 80% of the staff working remotely. Our goal was to maintain as many of the member services as we could, while keeping within the spirit and the letter of the Governor's edict. In the end, our phones are being answered and your questions and concerns are being addressed as they always were. Our magazines are being produced, and are on schedule to be distributed as usual, and we are processing membership applications and publication orders. I would recommend that you use email to contact us (many addresses for the various departments are on pages 14 and 15 in *QST*) so we can process your request more efficiently. W1AW transmission schedules are mostly intact. Most other departments are working as normal, too. However, manual processing of award applications and awards is being delayed.

I'm especially proud of what the staff and membership of ARRL have been able to accomplish in this time of unbelievable turmoil. I've asked everyone to keep in mind two words in times like this: *patience* and *flexibility*. Everything we know is constantly changing, and we all need to be patient with all our interactions and be flexible to adapt to the ever-changing conditions.

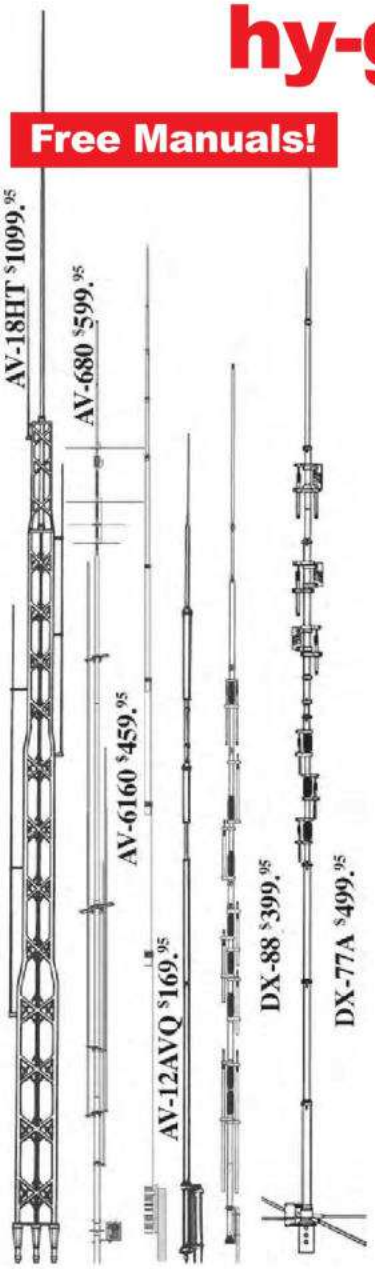
We at ARRL hope the entire amateur radio community is safe and healthy. As always, you can contact me at **ceo@arrl.org**.

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

The First Choice of Hams Around the World!

hy-gain® HF Verticals

Free Manuals!



hy-gain® Classics

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

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

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

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

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

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

Two-year limited warranty.

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

AV-18HT, $1099.95. (80,40,20,15,12,10 M, 160, 17 Meters optional). 53 ft., 114 lbs.
Standing 53 feet tall, the famous Hy-Gain HyTower is the world's best performing vertical!
Automatic band selection uses unique stub-decoupling which effectively isolates various sections of the antenna so an electrical 1/4 wavelength (or odd multiple) exists on all bands. 250 kHz 80 Meter bandwidth with 2:1 SWR. The addition of a base loading coil **(LC-160Q, $149.95)**, provides exceptional 160 Meter performance. **MK-17, $119.95**. Add-on 17 Meter kit. 24 foot tower is all rugged, hot-dip galvanized steel and all hardware is iridited for corrosion resistance. Special tiltover hinged base for easy raising & lowering.

AV-680, $599.95. (80, 40, 30, 20, 17, 15,12, 10, 6 Meters). 26 ft., 18.5 lbs.
No ground or radials needed.
Low 17 degree radiation angle and omni-directional gives world-wide coverage. 1500 Watts key down for two minutes. 1/4 wave stubs on 6, 10, 12, 17 Meters. Efficient end loading coil and capacity hats on 15, 20, 30, 40, 80 Meters. Wide low SWR bandwidth. End fed broadband matching unit wound with Teflon® wire. Auto band switching. Low 2.9 sq. ft. wind surface. Mounts on decks, roofs, patios. 65 mph wind survival. Aircraft aluminum tubing, stainless steel hardware.
AV-640, $499.95. 40/30/20/17/15/12/10/6M. 25.5 feet, 17.5 pounds.
AV-620, $399.95. 20/17/15/12/10/6M. 22.5 ft.

AV-6160, $459.95. (160, 80, 40, 30, 20, 17, 15, 12, 10, 6 Meters). 43 ft., 20 lbs.
Low profile, self-supporting 43 foot vertical assembles in less than an hour!
Blends in with sky and trees -- barely visible. Entire length radiates for exceptionally low angle radiation 160-20 Meters with very good performance on 17-6 Meters. A wide range automatic or manual antenna tuner at your rig easily matches this antenna for all bands. No physical adjustments. Includes ATB-65 base mount. Optimized balun design allows direct coax feed with negligible coax loss.
AV-6110, $349.95. 1.5 kW matching network improves efficiency on 160/80 Meters.

AV-12AVQ, $169.95. (20, 15, 10 Meters). 13 ft., 9 lbs.
Automatic bandswitching, omnidirectional, low angle DX antenna. self-supporting. 1500 Watts.
Hy-Q™ traps give full 1/4 wave performance with broad-banding top hat. SWR less than 2:1. Ground or roof mount. Requires radials.
AV-14RMQ, $119.95 roof mount.

DX-88, $399.95. (80, 40, 30, 20, 17, 15, 12, 10 Meters, 160 M optional). 25 ft., 18 lbs.
All bands are easily tuned with exclusive adjustable capacitors.
80/40 Meters tuneable from ground without lowering antenna. Super heavy-duty construction.
DX-88 OPTIONS:
KIT-160-88, $249.95.160 Meter add-on kit.
GRK-88, $129.95. Ground Radials System.
RRK-88, $119.95. Roof Radial System.

DX-77A, $499.95. (40, 30, 20, 17, 15, 12, 10 Meters). 29 ft., 25 lbs.
No ground radials required!
Off-center-fed Windom has 55% greater bandwidth than competitive verticals. Heavy-duty tiltable base. Each band independently tunable.

8 Bands

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

Operate eight HF bands for $119.95!

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

AV-18VS $149.95

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

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

Automatic Bandswitching

40/20/15/10 Meters

Quickly work DX instantly with automatic bandswitching!

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

AV-14AVQ $229.95

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

MK-80, $99.95.
80M add-on kit.

AV-14RMQ, $119.95.
Roof mount kit.

AV-12AVQ, $169.95.
3 band version, 13'.

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

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

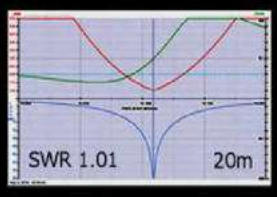
Step up to Unrivaled Performance with the New Stepper Tuned MLA!

The new HG3 stepper tuned Mag Loop Antenna (MLA) sets a new standard delivering unprecedented capability in remote tuning, performance and convenience for an MLA. It employs a proven, accurate and repeatable stepper motor design. Band selection, remote tuning, including optional loop rotation, is controlled via a microcontroller driving a high resolution stepper motor.

A built-in digital SWR bridge provides auto-tuning based on an SWR scan. This ensures compatibility with most radios. Manual tuning uses a convenient rotary encoder knob - no more finicky push buttons. The four-line LCD displays band selected, SWR, ERP, Cap value and more. The bottom line - count on top-notch RX and TX performance!

KEY FEATURES

- STEPPER MOTOR ACCURACY
- CONVENIENT REMOTE TUNING
- DISPLAYS BAND, SWR, ERP & MORE
- QUICK BAND SELECTION
- AUTO-TUNING BASED ON SWR
- 80m - 10m COVERAGE AVAILABLE
- NO COMPROMISE SPOT-ON TUNING



A precise LC match at the desired frequency ensures spot-on tuning (red SWR, blue RL, green Z) and minimizes mismatch losses within the MLA's specified frequency range.

preciseRf
www.preciserf.com

Patent pending

13690 Wisteria Dr. NE Aurora, OR 97002 • ph: 503-915-2490 • preciserf.com • Some items may be optional • © 2020 rev 8A

Array Solutions Your Source for Outstanding Radio Products

Professional Grade Equipment from Array Solutions

JK Antennas Are Now Sold by Array Solutions

NEW!

HIgh Quality HF Antennas for the Contester and DXER. We Focus on Quality and it Shows in Everything We Do. Call or email for antenna systems.

JK ANTENNAS

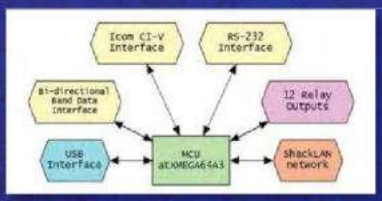
Announcing the new BM-5 BandMaster V

The next generation of the popular BM-3 with direct USB support for FLEX Radios

NEW!

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

The USB interface may be connected to your PC for radio control. **The USB interface may be connected directly to a Flex SDR with no additional cables or interfaces required.**



RatPack Remote Antenna Switch

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

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.

TwoPak

Two antenna switch, 12 V DC via wires or optional via coax cable. DC to 150 MHz. HF 5 kW rating. Metal box.

Off-Center Fed Dipole Antenna

AS-OCF-2K, AS-OCF-5K Seven bands antenna (80 to 6 m). Heavy duty materials. 4:1 balun included. Ratings: 2 or 5 kW or higher available.

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.

OM Power Amplifier Sales Program

Lower prices than the competition's equivalents, most modern design, and strongest warranty in the market!

OM4000HF	**Manual 160-10 m 4 kW**
OM4000A	**Automatic 160-10 m 4 kW**
OM2500HF	**Manual 160-10 m 2.5 kW**
OM2500A	**Automatic 160-10 m 2.5 kW**
OM2000+	**Manual 160-6 m 2 kW**
OM2000A+	**Automatic 160-6 m 2 kW**

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

OM Power was founded in 2004 as an initiative of two enthusiastic Slovak ham operators. Since that time OM Power has become a successful and well established company in the production of amplifiers. OM Power amplifiers can be found on all continents and in almost every country of the world. All of the amplifiers have state of the art design, and are solidly built.

OM4000A – OM4000HF
OM2500A – OM2500HF

The A-series are automatic band change amplifiers.
The HF-series are manual band change and tuning amplifiers.
OM4000: 4 kW SSB and CW, 3 kW RTTY, AM and FM
OM2500: 2.5 kW SSB and CW, 2 kW RTTY, AM and FM

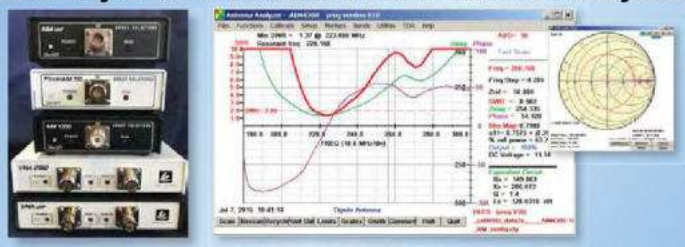
OM2000A+ – OM2000+

NEW!

The **OM2000A+** is the lightest and smallest 2000 W fully automatic HF/6 m power amplifier in the market. Its manual tuning version, the **OM2000+**, is our affordable unmatched best-seller.

Frequency coverage:
Amateur bands 1.8 – 29.7 MHz including WARC + 50 MHz
Power output: 2000+ W in SSB/CW on HF bands, 1500 W in RTTY
1500 W CW/SSB on 50 MHz

Laboratory Grade Antenna and Vector Network Analyzers



One Port Analyzers and Two Port Vector Network Analyzers ranging from 5 kHz up to 1 GHz

AIM 4300	**$495**
AIM UHF	**$695**
VNA 2180	**$995**
VNA UHF	**$1,295**
PowerAim 150 Broadcasting Engineers Choice. 150 V peak RF capable.	**$2,495**

Surge Arrestors

AS-302, AS-303 Coaxial cable arrestors. DC to 500 MHz. N-type or SO-239 connectors. **AS-300SB** Stacking fixture available. **AS-309H**, ladder line arrestor. All have static bleed function. **AS-8SP**, **AS-12SP** and **AS-16SP** control cable arrestors. Protect your rotator's and other control cables.

Baluns & RF Transformers

Ratios 1:1, 1:2, 2:1,4:1 and more. RF line isolators. Ratings 3, 5, 10 kW+. Get the most out of your antenna by stopping the coaxial cable from becoming part of it.

Check our Website for more new products!

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

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.

Jen Glifort, KC1KNL, jglifort@arrl.org

Member Spotlight

Heather Flewelling, AH7RF

Heather Flewelling, AH7RF, is a natural experimenter. "I loved taking things apart and fixing them as a kid," she said. This instinct to explore has led Heather to many projects in her life — from tinkering with her newfound radio hobby to discovering a comet in her work scouring the sky for asteroids.

Scientific Curiosity

Heather works for ATLAS — the Asteroid Terrestrial-impact Last Alert System — searching for near-Earth objects that could impact the Earth. The ATLAS Project is operated by the University of Hawaii's Institute for Astronomy and funded by NASA. Heather's work as a Planetary Defense Researcher involves software programming, hardware projects to assist ATLAS's robotic operations, and searching for new asteroids. Looking for asteroids sometimes means spotting a comet, as Heather did in 2019. The comet she discovered is now named after her.

Previously, Heather was a part of Pan-STARRS, where she helped build the world's largest astronomical database. It covers about three-quarters of the sky, including faint stars.

Heather's path to astronomy and physics wasn't always straightforward. "I had no idea what I wanted to major in when I was an undergraduate," she said. She settled on physics "because the class on waves was really cool." In graduate school, she still wasn't sure which area of physics to focus on. She studied gamma ray bursts because "they were quite mysterious" and little was known about them at the time. She said, "I became an experimental physicist not because I knew what one was, but because I liked building and tinkering with things."

[Todd Wilson, WH6DWF, photo]

Searching for Signals

Heather found her way to ham radio "somewhat by accident." She subscribes to AdaBox — a delivery of Adafruit products every 3 months. One month, Heather opened her AdaBox and found that it included a software-defined radio (SDR) receiver. "Next thing I knew, it was 1 AM," she said. "I'd been playing with that SDR for hours!"

She quickly discovered the local net on the ham bands and was intrigued by the lingo used by operators. She found herself listening to the bands every night she could, something that came naturally to her. "I loved searching for signals with whatever I could — and this was true when I was a kid too," she said. As a kid, Heather used to build antennas to pick up signals from FM and TV stations around her mom's house. Heather passed her Technician-class exam not long after finding the SDR in her subscription box. She has since upgraded to Amateur Extra class.

When it comes to experimenting with radio, Heather enjoys "trying to do as much with as little as possible." She uses a BaoFeng handheld to receive slow-scan TV (SSTV) transmissions from the International Space Station, or to connect to Winlink gateways with just her radio and a homebrew cable. "It's fun and goofy, and I like it," she said. She also activates summits on Oahu, for Summits on the Air (SOTA).

A Missing Piece

When she isn't working or fiddling with her radio, Heather spends time bike riding and hiking. She's also a fan of chess. In September of 2019, Heather gave a presentation about her various radio experiments at a meeting of the Hawaii Emergency Amateur Radio Club (EARC). The slides are available at **www.qsl.net/wh6ftq**.

"What I wasn't expecting was the social aspect of ham radio," Heather shared. "It was a missing piece of being able to connect with new people without much effort. You can do that with the internet and the phone, but it's just not the same. It's fun for me to make contacts when I don't know who I'll make contact with."

Guide to Member Benefits

Join or Renew
www.arrl.org/join

Benefits
www.arrl.org/benefits

Donate
www.arrl.org/donate

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 both *QST* and *On the Air* from a web browser and apps available for iOS, Android, and Kindle Fire devices. Members need a valid ARRL account to access the digital editions of *QST* and *On the Air*, 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: ham radio news, radio clubs, public service, contesting, and more!
- **Email Forwarding Service**
  Email sent to your **arrl.net** address will be forwarded to any email account you specify.

Technical Information Service | www.arrl.org/tis

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

Advocacy | www.arrl.org/regulatory-advocacy

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

Group Benefits* | www.arrl.org/benefits

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

*US only

Find...

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

Interested in Becoming a Ham?

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

Connect with ARRL

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

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

The American Radio Relay League, Inc.

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

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

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

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

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

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

Officers, Division Directors, and Staff

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

Officers

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

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

First Vice President
Michael N. Raisbeck, K1TWF*
85 High Street
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
Rodney J. Stafford, W6ROD
5155 Shadow Est.
San Jose, CA 95135
(408-238-4671); **w6rod@arrl.org**

Interim Chief Executive Officer and Secretary*
Barry J. Shelley, N1VXY
225 Main St.
Newington, CT 06111
(860-594-0212) **bshelley@arrl.org**

Treasurer
Rick Niswander, K7GM

Chief Financial Officer
Diane Middleton, W2DLM

Staff

Communications Manager
Vacant

Development Manager
Melissa Stemmer, KA7CLO

Director of Operations
Norm Fusaro, W3IZ

Laboratory Manager
Ed Hare, W1RFI

Assistant Laboratory Manager
Bob Allison, WB1GCM

Product Development Manager
Bob Inderbitzen, NQ1R

Marketing Communications Manager
Kathleen Callahan, KC1MBY

Marketing & Sales Manager
Yvette Vinci, KC1AIM

Membership Manager
Diane Petrilli, KB1RNF

Production & Editorial Manager
Steve Ford, WB8IMY

Advertising Sales Manager
Janet Rocco, W1JLR

Regulatory Information Manager
Dan Henderson, N1ND

VEC Manager
Maria Somma, AB1FM

Lifelong Learning Manager
Kris Bickell, K1BIC

Radiosport & Field Services Manager
Bart Jahnke, W9JJ

Business Staff
Controller
Thomas Bell, KC1MHQ

Information Technology Manager
Michael Keane, K1MK

*Executive Committee Member

Atlantic Division

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

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

Central Division

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

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

Dakota Division

www.arrldakota.org
Matt Holden, KØBBC
400 Marquette Ave., Apt. 3006
Minneapolis, MN 55401
(952-232-1984); **k0bbc@arrl.org**

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

Delta Division

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

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

Great Lakes Division

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

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

Hudson Division

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

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

Midwest Division

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

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

How to Contact ARRL Staff

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

New England Division

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

Vice Director: Vacant

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

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

Vice Director: **Kristen McIntyre, K6WX**
900 Golden Wheel Park Dr., #85, San Jose, CA 95112 (510-703-4942); **k6wx@arrl.org**

Roanoke Division

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

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

Rocky Mountain Division

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

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

Southeastern Division

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

Vice Director: **James Schilling, KG4JSZ**
44 Joel Massey Rd., Haines City, FL 33844
(407-504-2629); **kg4jsz@arrl.org**

Southwestern Division

www.kkn.net/n6aa
Richard J. Norton, N6AA
21290 West Hillside Dr., Topanga, CA 90290
(310-455-1138); **richardjnorton@yahoo.com**

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

West Gulf Division

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); **lcooper@arrl.org**

ARRL Section Managers

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

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

Delaware: Bill Duveneck, KB3KYH, 18682 Sunny Sky Blvd., Milton, DE 19968-2486 (302-537-4755); **kb3kyh@arrl.org**
Eastern Pennsylvania: George Miller, W3GWM, 293 Woods Rd., Wyalusing, PA 18853 (570-250-1007); **w3gwm@arrl.org**
Maryland-DC: Marty Pittinger, KB3MXM, 4 Pegram Rd., Owings Mills, MD 21117 (410-356-7899); **kb3mxm@arrl.org**
Northern New York: Thomas Dick, KF2GC, 11 Jenkins St., Saranac Lake, NY 12983 (518-891-0508); **kf2gc@arrl.org**
Southern New Jersey: Tom Preiser, N2XW, 177 Bowsprit Rd., Manahawkin, NJ, 08050-5001 (609-618-0224); **n2xw@arrl.org**
Western New York: Laura Mueller, N2LJM, 2011 E. Main St., Falconer, NY 14733 (716-338-3122); **n2ljm@arrl.org**
Western Pennsylvania: Joe Shupienis, W3BC, P.O. Box 73, Falls Creek, PA 15840-0322 (814-771-3804); **w3bc@arrl.org**

Central Division (IL, IN, WI)

Illinois: Ron Morgan, AD9I, 114 Herman St., East Peoria, IL 61611-4420 (309-397-9549); **ad9i@arrl.org**
Indiana: James Merry, Jr., KC9RPX, 7332 W. Mustang Dr., Ellettsville, IN 47429 (812-391-2661); **kc9rpx@arrl.org**
Wisconsin: Patrick Moretti, KA1RB, W349S3970 Waterville Rd., Dousman, WI 53118-9786 (262-354-2997); **ka1rb@arrl.org**

Dakota Division (MN, ND, SD)

Minnesota: Richard H. "Skip" Jackson, KSØJ, 1835-63rd St. E, Inver Grove Heights, MN 55077 (651-260-4330); **ks0j@arrl.org**
North Dakota: Nancy Yoshida, KØYL, 1079 Harvest Ln. NE, Thompson, ND 58278-9408 (218-779-6596); **k0yl@arrl.org**
South Dakota: Chris Stallkamp, KIØD, P.O. Box 271, Selby, SD 57472-0271 (605-870-1784); **ki0d@arrl.org**

Delta Division (AR, LA, MS, TN)

Arkansas: James D. Ferguson, Jr., N5LKE, 1500 Lauren Dr., Searcy, AR 72143-8477 (501-593-5695); **n5lke@arrl.org**
Louisiana: John Mark Robertson, K5JMR, 201 Madewood Ct., Bossier City, LA 71111-6325 (318-572-7917); **k5jmr@arrl.org**
Mississippi: Malcolm Keown, W5XX, 64 Lake Cir. Dr., Vicksburg, MS 39180 (601-636-0827); **w5xx@arrl.org**
Tennessee: David Thomas, KM4NYI, 205 Linford Rd., Knoxville, TN 37920 (865-654-5489); **km4nyi@arrl.org**

Great Lakes Division (KY, MI, OH)

Kentucky: Steve Morgan, W4NHO, 1124 W. 12th St., Owensboro, KY 42301-2975 (270-926-4451); **w4nho@arrl.org**
Michigan: Jim Kvochick, K8JK, 10366 Greystone Ct., Brighton, MI 48114-7650 (810-229-5085); **k8jk@arrl.org**
Ohio: Scott D. Yonally, N8SY, 258 Valley Hi Dr., Mansfield, OH 44904-9792 (419-512-4445); **n8sy@arrl.org**

Hudson Division (ENY, NLI, NNJ)

Eastern New York: John K. Fritze, Jr., K2QY, 4 Normanskill Blvd., Delmar, NY 12054-1335(401-261-4996); **k2qy@arrl.org**
NYC-Long Island: Jim Mezey, W2KFV, 38 Appletree Ln., Carle Place, NY 11514-1336 (516-315-8608); **w2kfv@arrl.org**
Northern New Jersey: Steve Ostrove, K2SO, 249 Keats Ave., Elizabeth, NJ 07208-1059 (908-403-8943); **k2so@arrl.org**

Midwest Division (IA, KS, MO, NE)

Iowa: Lelia Garner, WAØUIG, 145 Front St., Robins, IA 52328-9718 (319-213-3539); **wa0uig@arrl.org**
Kansas: Ronald D. Cowan, KBØDTI, P.O. Box 36, LaCygne, KS 66040 (913-757-3758); **kb0dti@arrl.org**
Missouri: Cecil Higgins, ACØHA, 27995 County Rd. 220, Hermitage, MO 65668-8493 (417-399-5027); **ac0ha@arrl.org**
Nebraska: Matthew N. Anderson, KAØBOJ, 14300 NW 98th St., Raymond, NE 68428-4254 (402-480-5515); **ka0boj@arrl.org**

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

Connecticut: Charles I. Motes, Jr., K1DFS, 22 Woodside Ln., Plainville, CT 06062 (860-747-6377); **k1dfs@arrl.org**
Eastern Massachusetts: Tom Walsh, K1TW, 9 Wildwood Dr., Bedford, MA 01730 (781-275-5882); **k1tw@arrl.org**
Maine: Bill Crowley, K1NIT, 150 Maple St., Farmingdale, ME 04344-4809 (207-512-0312); **k1nit@arrl.org**
New Hampshire: John Gotthardt, K1UAF, P.O. Box 2298, Wolfeboro, NH 03894-2298 (603-569-3633); **k1uaf@arrl.org**
Rhode Island: Bob Beaudet, W1YRC, 30 Rocky Crest Rd., Cumberland, RI 02864 (401-333-2129); **w1yrc@arrl.org**
Vermont: Paul N. Gayet, AA1SU, 11 Cherry St., Essex Junction, VT 05452 (802-878-2215); **aa1su@arrl.org**
Western Massachusetts: Raymond Lajoie, KB1LRL, 245 Leominster Rd., Lunenburg, MA 01462-2031 (978-549-5507); **kb1lrl@arrl.org**

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

Alaska: David Stevens, KL7EB, 8521 Golden St., Apt. 4, Anchorage, AK 99502 (907-242-6483); **kl7eb@arrl.org**
Eastern Washington: Jack Tiley, AD7FO, 1806 S. Fawn Dr., Spokane Valley, WA 99206-3318 (509-951-7214); **ad7fo@arrl.org**
Idaho: Dan Marler, K7REX, 6525 W. Fairfield Ave., Boise, ID 83709 (208-914-8939); **k7rex@arrl.org**
Montana: 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, SV, SF, SJV, SCV)

East Bay: Jim Siemons, W6LK, 2308 Lomond Ln., Walnut Creek, CA 94598-3705 (925-330-0049); **w6lk@arrl.org**
Nevada: John Bigley, N7UR, 2420 Palora Ave., Las Vegas, NV 89121-2157 (702-673-0904); **n7ur@arrl.org**
Pacific: Joe Speroni, AHØA, 278 Kapiolani Blvd. #502, Honolulu, HI 96826 (808-955-2496); **ah0a@arrl.org**
Sacramento Valley: Dr. Carol Milazzo, KP4MD, P.O. Box 665, Citrus Heights, CA 95611-0665 (916-259-3221); **kp4md@arrl.org**
San Francisco: Bill Hillendahl, KH6GJV, P.O. Box 4151, Santa Rosa, CA 95402-4151 (707-544-4944); **kh6gjv@arrl.org**
San Joaquin Valley: John Litz, NZ6Q, 1434 Douglas Rd., Stockton, CA 95207-3536 (209-331-3078); **nz6q@arrl.org**
Santa Clara Valley: Brandon Bianchi, NI6C, P.O. Box 60128, Palo Alto, CA 94306 (559-313-3373); **ni6c@arrl.org**

Roanoke Division (NC, SC, VA, WV)

North Carolina: 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 (803-327-4978); **n4ufp@arrl.org**
Virginia: Joseph Palsa, K3WRY, 9101 Arch Hill Ct., Richmond, VA 23236-2725 (804-350-2665); **k3wry@arrl.org**
West Virginia: Dan Ringer, K8WV, 18 W. Front St., Morgantown, WV 26501-4507 (304-292-1999); **k8wv@arrl.org**

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

Colorado: Jack Ciaccia, WMØG, P.O. Box 21362, Boulder, CO 80308-4362 (303-587-0993); **wm0g@arrl.org**
New Mexico: Bill Mader, K8TE, 4701 Sombrerete Rd. SE, Rio Rancho, NM 87124 (505-250-8570); **k8te@arrl.org**
Utah: Mel Parkes, NM7P, 2166 E. 2100 North, Layton, UT 84040 (801-547-1753) **nm7p@arrl.org**
Wyoming: Rick Breininger, N1TEK, 11 E. 2nd North St., Green River, WY 82935 (307-707-4010); **n1tek@arrl.org**

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

Alabama: JVann Martin, W4JVM, 16 Baron Dr., Chelsea, AL 35043-6607 (205-281-4728); **w4jvm@arrl.org**
Georgia: David Benoist, AG4ZR, 190 Fox Hall Crossing East, Senoia, GA 30276 (404-290-0470); **ag4zr@arrl.org**
Northern Florida: Kevin J. Bess, KK4BFN, 908 Flagler Ave., Edgewater, FL 32132-2124 (386-547-2838); **kk4bfn@arrl.org**
Puerto Rico: Oscar Resto, KP4RF, HC 77 Box 8743, Vega Alta, PR 00692-9660 (787-883-6878); **kp4rf@arrl.org**
Southern Florida: Barry M. Porter, KB1PA, 14555 Sims Rd., Apt. 251, 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: Darrell Davis, KT4WX, 6350 Mills Rd., Fort Meade, FL 33841 (863-245-9923); **kt4wx@arrl.org**

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

Arizona: Rick Paquette, W7RAP, 1600 W. Sunkist Rd., Tucson, AZ 85755-9561 (520-425-6877); **w7rap@arrl.org**
Los Angeles: Diana Feinberg, AI6DF, P.O. Box 4678, Palos Verdes Peninsula, CA 90274-9618 (310-544-2917); **ai6df@arrl.org**
Orange: Carl Gardenias, WU6D, 20902 Gardenias St., Perris, CA 92570 (951-490-2270); **wu6d@arrl.org**
San Diego: Dave Kaltenborn, N8KBC, 630 Alber St., Chula Vista, CA 91911 (619-616-8758); **n8kbc@arrl.org**
Santa Barbara: John Kitchens, NS6X, P.O. Box 178, Somis, CA 93066 (805-216-2569); **ns6x@arrl.org**

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

North Texas: Steven Lott Smith, KG5VK, 125 Contest Ln., Ben Franklin, TX 75415-3830 (318-470-9806); **kg5vk@arrl.org**
Oklahoma: Kevin O'Dell, NØIRW, 1718 South Fairgrounds, Stillwater, OK 74074 (580-220-9062); **n0irw@arrl.org**
South Texas: Paul Gilbert, KE5ZW, 1209 Doris Ln., Cedar Park, TX 78613-7067 (512-940-0441); **ke5zw@arrl.org**
West Texas: H. Dale Durham, W5WI, P.O. Box 375, Buffalo Gap, TX 79508 (830-719-9000); **w5wi@arrl.org**

Free Catalog/Dealers/Manuals Online – Visit: www.ameritron.com or call toll-free 800-647-1800

Ameritron...The World's High Power Leader!

AMERITRON...800 Watts... $1149!

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

Only the Ameritron AL-811H gives you four *fully neutralized* 811A transmitting tubes.

AL-811H
$1199
Suggested Retail
4-Tubes, 800 Watts

AL-811
$1099
Suggested Retail
3-Tubes, 600 Watts

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. 13 3/4W x 8H x 16D inches.

AL-811, $1099. Like AL-811H, but has three 811A tubes and 600 Watts output.

AMERITRON no tune Solid State Amplifiers

ALS-500M 500 Watt Mobile Amp

ALS-500M
$999
Suggested Retail

500 Watts PEP/400W 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. Extremely quiet fan. 13.8 VDC. 9W x 3 1/2H x 15D in., 7 lbs. **ALS-500RC, $64.95** Remote Head.

ALS-606S 600 Watt 160-6M Amp

ALS-606S
$2099
Suggested Retail

600 Watts PEP/500W CW output, 160-6 Meters with automatic instant bandswitching from your transceiver. Fits on your desktop. 9 3/4W x 7H x 14 1/2D in. and weighs 14.2 lbs., but is only 4 dB below 1500 Watts -- less than an S-unit! **ALS-606, $2299**, like ALS-606S but has transformer power supply.

New Lower price!

ALS-600S, $1899 with switching power supply.
ALS-600 $1999 with transformer power supply.

Desktop Kilowatt Amplifier

AL-80B
$1899
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. 14W x 8 1/2H x 15 1/2D in. **Two-year warranty**.

ALS-1306 1200W 1.5-5.4 MHz Amp

ALS-1306
$3499
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 10W x 6 1/2H x 18D in., just 22 lbs. **ALS-1300, $3099.** Like ALS-1306 but less automatic bandswitching and 6-M coverage.

Near Legal Limit™ Amplifier

AL-572
$2099
Suggested Retail

New class of *Near Legal Limit*™ amplifier gives you 1300 Watt PEP SSB power output for *60%* of price of a full legal limit amp! 4 rugged 572B tubes. Instant 3-second warmup, plugs into 120 VAC. Compact 14 1/2W x 8 1/2H x 15 1/2 D inches fits on desktop. 160-15 Meters. 1000 Watt CW output. Tuned input, instantaneous RF Bias, dynamic ALC, parasitic killer, inrush protection, two lighted cross-needle meters, multi-voltage transformer.

HF Amps with 3CX800A7 Tube

Suggested Retail

AL-800F
$2299
1 tube, 1250 W

AL-800HF
$3199
2 tubes, 1.5 kW *Plus*
AL-800, $2999
AL-800H, $4299
with *Eimac*® tubes

These *compact* desktop amplifiers with 3CX800A7 tubes cover 160-15 Meters including WARC bands. Adjustable slug tuned input circuit, grid protection, front panel ALC control, vernier reduction drives, heavy duty 32 lb. silicone steel core transformer, high capacitance computer grade filter capacitors. Multivoltage operation, dual lighted cross-needle meters. 14 1/4W x 8 1/2H x 16 1/2D in.

AMERITRON full legal limit amplifiers

AMERITRON legal limit amps use a super heavy duty Peter Dahl Hypersil® power transformer capable of 2.5 kW!

Most powerful – 3CX1500/8877

AL-1500F
$3999
3CX1500/8877 Tube
Suggested Retail

AL-1500
$4999
Eimac® Tube
Suggested Retail

Ameritron's *most powerful* amplifier uses the herculean 3CX1500/8877 ceramic tube. 65 watts drive gives you full legal output – it's just loafing with a 2500 Watts power supply.

Toughest – 3CX1200/Z7

AL-1200
$4899
Suggested Retail

Get ham radio's *toughest* tube with the Ameritron AL-1200 – the *Eimac*® 3CX1200Z7. It has a 50 Watt control grid dissipation. What makes the Ameritron AL-1200 stand out from other legal limit amplifiers? The answer: a super heavy duty power supply that loafs at full legal power – it can deliver the power of more than 2500 Watts PEP two tone output for a half hour.

Classic – Dual 3-500Gs

AL-82
$3499
Suggested Retail

This linear gives you 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.

Call your favorite dealer for your best price today!

Ameritron brings you the finest high power accessories!

ARB-704 amp-to-rig interface...$74.95

Protects rig from damage by keying line transients and makes hook-up to your rig easy!

ADL-1500 Dummy Load with oil... $89.95

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

ADL-2500 fan-cooled Dry Dummy Load, $249.95

Whisper quiet fan, 2.5kW/1 minute on, ten off. 300W continuous. SWR< 1.25 to 30 MHz.<1.4 to 60 MHz.

ATP-100 Tuning Pulser...$84.95

Safely tune up for full power, best linearity. Prevents overheating, tube damage, power supply stress, component failure.

AMERITRON® **The World's High Power Leader** 116 Willow Rd, Starkville, MS 39759
■ **Tech:** (662) 323-8211 ■ **FAX:** (662) 323-6551 8 a.m.-4:30 p.m. CST, Monday-Friday

WHEN IT'S MISSION CRITICAL TO ANALYZE THE HEALTH OF YOUR BATTERY

Graphically displays and charts voltage versus amp-hours.

CBA IV

- Easy-to-use software
- Test any type of battery
- Test Power Supplies
- Characterize Solar Panels
- Measures and displays voltage, current, amp-hours and watts

CBA SOFTWARE

Standard software is FREE for basic analysis.
Extended software is for more detailed tests and data analysis.

- Programmable duty cycles
- Multiple discharge tests
- Temperature graphing

CBA 500W AMPLIFIER

- Discharge up to 500W for each amp used in parallel
- Designed for commercial and industrial analysis under real world load conditions

ACCESSORIES

- Magnetic Temperature Probe detects and measures temperatures ranging from 150°F to -20°F
- Universal Battery Holder for testing 9V, AA, AAA, C, and D cell batteries 2.0mm & 2.5mm
- Universal Laptop Battery Test Cables with Powerpoles®

CBA CHARGE CONTROLLER

- Performs automated life cycle tests, automatically alternating between periods of charging the battery and discharging the battery
- Voltage/Current going from the charger into the battery is measured and logged by the software

West Mountain RADIO

262-522-6503 x 35
sales@westmountainradio.com
westmountainradio.com/QST620

KX Line: KX3/KX2

Elecraft® Full-Featured Ultra-portables 100W with Matching Amp

ELECRAFT **KX3**

SSB/CW/Data/AM/FM • 160-6 m • 15 W

NEW!
KX Line Packages
Visit Elecraft.com for details

The KX3 has become the compact, 160-6 meter, all-mode transceiver of choice for thousands of hams, for home, travel, and portable use. Its versatility has been demonstrated at countless Field Day and DXpedition operations.

- Matching PX3 panadapter with fast, full-color spectrum/waterfall*
- 7.4" x 3.5" x 1.7" (weight: 1.5 lbs.)
- Best-in-class performance
- 160-6 meters plus 2 or 4 m*
- SSB, CW, AM, FM, Data
- Up to 15 W TX
- Weighted, free-spinning VFO knob
- Precision roofing filter*
- Wide-range internal ATU*

ELECRAFT **KX2**

SSB/CW/Data/AM/FM • 80-10 m • 12 W

NEW!
AX1 20/17 Whip Antenna for the KX2!
Call for details

Our KX2 "stealth" transceiver can go wherever your imagination takes you. It's pocket sized, yet it transmits at up to 12 watts, covers 9 bands, and shares many features with the KX3. It also works with the KXPA100 amp.

- 5.8" x 2.8" x 1.5" (weight: 13 oz.)
- Ultralight grab-and-go station, perfect for SOTA and field operation
- 80-10 meters (9 bands)
- SSB / CW / Data/ AM / FM
- Up to 12 W TX
- Internal 2.6 Ah Li-ion battery*
- Built-in mic for HT-style operation
- Wide-range internal ATU*
- New KXPD2 compact keyer paddle*

* Option

Make Waves in Style with the New K-Line.

K4 Direct-Sampling SDR and KPA 1500 Legal-Limit Amp

K4 Features

Direct sampling SDR • Modular, hybrid architecture • Single or dual panadapter • High resolution tuning aid • Comprehensive I/O • Full remote control via Ethernet • 7" color screen with touch and mouse control • ATU with 10:1+ range • 3 antenna jacks • Up to 5 receive antenna sources

KPA1500 Features

1500 W • Very compact design • Fast, silent PIN diode T/R switching • Built-in ATU with dual antenna jacks • Compatible with nearly any transceiver – custom cables available • 160-6 meters • CE for Europe

ELECRAFT®

elecraft.com • 831-763-4211

Up Front

It's Never Too Late

Early this year, George "Buck" Miner, K6RFE, passed his Amateur Extra-class exam at age 94. Completely blind since age 26 from retinitis pigmentosa, he has never let his disability get in the way of anything he wanted to do. He is frequently found on 80 meters running multiple ragchewing groups that resemble coffee house chatter.

Buck has created multiple YouTube videos known as "Buck's Miracle Kitchen," in which he comically shows how he manages to cook without eyesight. In addition, he has published multiple books, most recently an autobiography titled *My Darkness Under the Sun*. Besides his involvement in amateur radio, Buck has a passion for country western music. Buck has composed hundreds of songs over the years and still performs regularly.

Ham Graffiti

While riding an Amtrak train between Schenectady, New York, and Philadelphia, Bob Saltzman,WB2ARK, spied some interesting graffiti as the train approached the Albany-Rensselaer station. He quickly snapped this photo through the rain-streaked window. Bob suspects that "Hams" may be the street name of a European graffiti artist, but has had difficulty confirming it.

Signal Hill

Adrian Stimpson, VE7NZ, spotted this fine fifth of Canadian whisky, complete with Morse code on the label. As it turns out, the company embraces its radio connection with gusto. See **www.signalhillwhisky.com/our-history** for more information.

T-Shirt Quilt

Bob Conley, WW5RC, has a talented sister. She gathered a bunch of Bob's amateur-radio-themed T-shirts and fashioned them into a quilt.

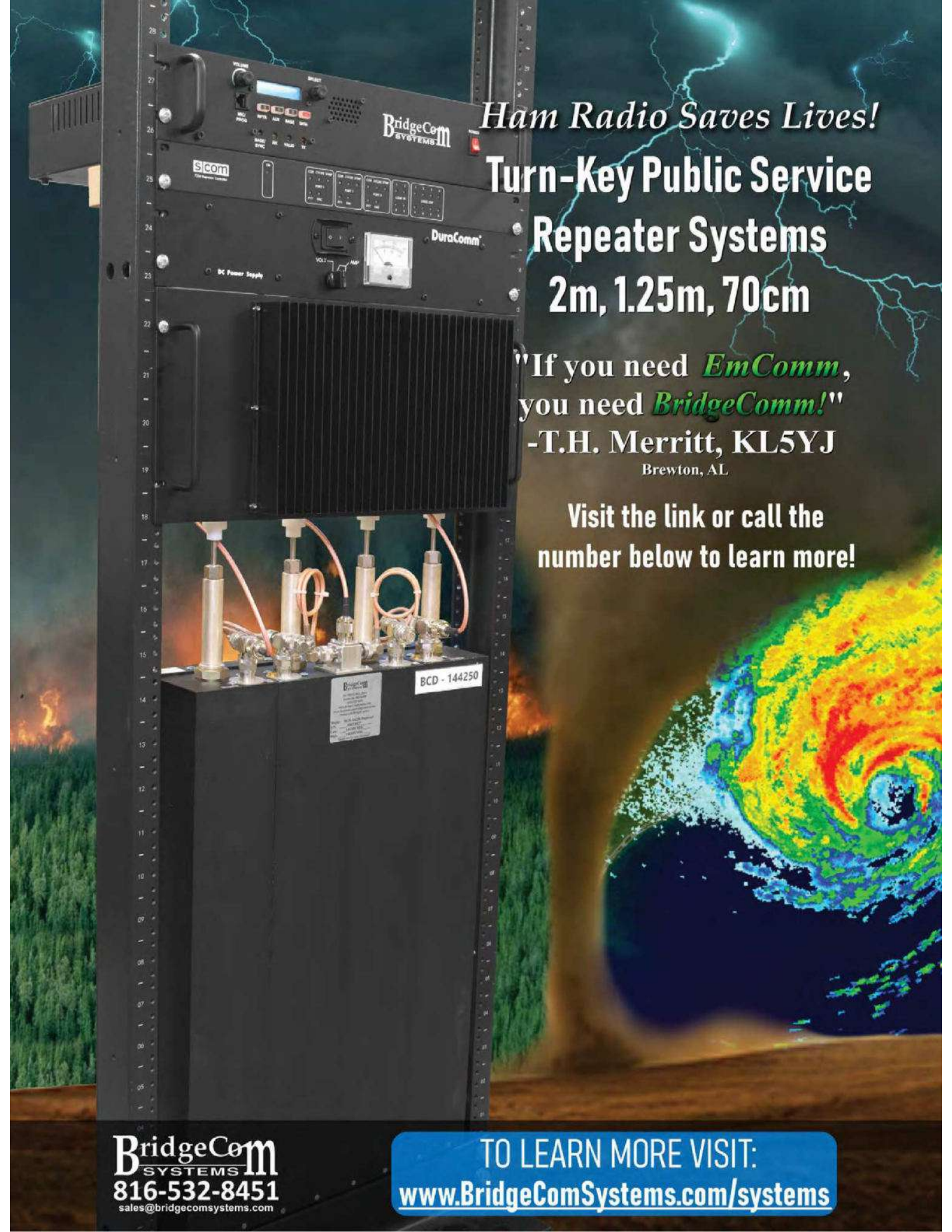
TURN YOUR RADIO INTO A LEGAL LIMIT BEAST.

Our Power Genius XL solid state, software defined amplifier is exceptionally clean and delivers full 1.5kW ICAS duty cycle on all bands and modes including RTTY & FT8. The only fully SO2R/Multi-Single capable amplifier on the market, it has 70dB nominal isolation between transceiver inputs, diplexed filters, and ultra-fast high SWR protection. Like our entire transceiver product line-up, the PGXL is Ethernet connected and fully integrated with SmartSDR for remote operation. Making all controls and meters available from anywhere. Just one more way to help you find everywhere. **flexradio.com/PowerGenius-XL**

FlexRadio

Find Everywhere

HERE'S AN IDEA: LET'S CREATE SOMETHING SO POWERFUL IT'S BARELY LEGAL.


Ham Radio Saves Lives!
Turn-Key Public Service
Repeater Systems
2m, 1.25m, 70cm
"If you need EmComm,
you need BridgeComm!"
-T.H. Merritt, KL5YJ
Brewton, AL
Visit the link or call the
number below to learn more!
BridgeCom SYSTEMS
816-532-8451
sales@bridgecomsystems.com
TO LEARN MORE VISIT:
www.BridgeComSystems.com/systems

Good Times Await

BridgeCom Makes DMR Easy

DMR Plug N' Play Package

Programmed with the most popular talk groups on Brandmeister and your state-wide talk group.

Visit the link or call the number below to learn more!

AnyTone AT-D878UV PLUS
(Bluetooth module included)

Bluetooth Push-to-talk Button

DVMEGA Hotspot

BridgeCom SYSTEMS
816-532-8451
sales@bridgecomsystems.com

TO LEARN MORE VISIT:
www.bridgecomsystems.com/goodtimes

Correspondence

Letters from Our Members

More Clipperton Island Excursions

I read Allison McLellan's March 2020 article, "The Saga of Clipperton Island," with great interest. Some time ago, I read about the island in *Clipperton: A History of the Island the World Forgot* by Jimmy Skaggs, published in 1989 (it's no longer being printed, but used copies are available on Amazon).

In addition to the incidents discussed in *QST*, the book documents recreational deep-sea fishing excursions to the island by Franklin D. Roosevelt that also included stops in XF4 (Revillagigedo Islands), TI9 (Cocos Island), and HC8 (Galapagos Island). This would have been an amazing DXpedition, but there's no mention of any hams being aboard.

Doug Grant, K1DG
Derry, New Hampshire
Life Member

Looking Back at a Classic Transmitter

The "Classic Radio" column from the March 2020 issue was a great look back at Collins Radio Company and its products. Not mentioned in the article was their broadcast transmitter line. When I was Chief Engineer of Columbia University's WKCR 89.9 FM in New York, I operated and maintained the station's 1,000 W Collins 830-series FM transmitter, which used a 4CX1000A tetrode power amplifier (PA) driven by a 10 W exciter and multiplex stereo generator. The PA used a tuned-cavity plate circuit with no direct connection to the output line — the power was capacitively transferred through the physical cavity by a foreshortened ¼-wave resonator. It's always nice to be reminded of radios we've known in the past.

Aldo Cugnini, W2AGC
Long Valley, New Jersey

A Low-Power Revelation

A few years ago, I bought a tiny Youkits HB-1B low-power transceiver for backpacking. Due to my transmitting into a bad antenna mismatch, I blew out the final amplifier and never fixed it. Lately, I've been using its receiver to check out the bands before I turn on the big rig.

Recently, I heard a strong signal from WB9DLC in Illinois. He was well over S-9. On a whim, I plugged in a key and called him. My wattmeter read less than 500 mW. He answered and gave me an S-5. South Florida is well over 1,200 miles from Illinois. For a rig putting out 1/14th the power of a nightlight bulb, that's impressive! Low-power operating still works at the very bottom of the sunspot cycle. Ham radio never ceases to yield new challenges and thrills.

Dennis Lazar, W4DNN
Port Charlotte, Florida

Morse Code Saves the Day

One night, around 3 AM, I heard a nearby car horn beeping "SOS." I quickly ran down several flights of stairs to discover a young lady in her car. She was sending a signal of distress because she was locked in a parking area without a remote to actuate the rolling gate. She assumed fewer people would respond to a long steady horn at that hour. It turned out she was studying to get her amateur radio license!

John Ruckert, WE4IAS
Los Angeles, California
Life Member

Ladder Line for Multiple HF Bands

The article, "Build Your Own Open-Wire Line" by Robert J. Zavrel, Jr., W7SX, featured in the March issue, touched on a subject in which I'm a firm believer.

I'm completely sold on the benefits of 600 Ω ladder line to feed a nonresonant dipole for effective and efficient operation on multiple HF bands. I currently have a homebrew Extended Double Zepp antenna (EDZ) cut for 3.5 MHz (360 feet, center fed) which provides a reasonable standing wave ratio (SWR) for easy matching with a tuner across all amateur bands from 160 – 6 meters.

Rather than going through the process of making my own ladder line, I found an excellent source that not only produces a top-notch product, but supports individuals with disabilities through their "sheltered workshop" program. The company is True Ladder Line (**www.trueladderline.com**), owned and operated by Brian Duerr, WB2JIX.

Lynton Norstad, WØLEN
St. Charles, Illinois

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

Get Ready for Field Day—June 27-28!

DX ENGINEERING

Field Day Triplexer Combo

We've made it easy to work the 20, 15 and 10 meter bands with three different radios, using just a single tri-band antenna! Our Field Day Triplexer Combo includes Low Band Systems' (LBS) innovative 200W Triplexer (LBS-PB-TP200), LBS 20/15/10M band-pass filters, and coaxial cable jumpers. Eliminate the need (and cost) for extra antennas while enjoying fast setup and worry-free operation without RF interference.

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

Headsets and Headphones

DX Engineering carries a great selection of hands-free headsets and state-of-the-art headphones from bhi, Heil, INRAD and other top brands. Don't accept anything less than clear, intelligible speech fidelity whether you're doing the speaking or listening. *Click on "Audio" at DXEngineering.com for our full lineup.*

bhi HEIL SOUND INRAD

NANUK RigExpert

RigExpert Analyzer and NANUK Case Combos

In the field, an antenna analyzer is especially at risk for weather and shock damage. We've paired select RigExpert Antenna Analyzers with perfectly sized NANUK equipment cases. Each case is filled with cubed, sectioned foam for custom configuration. Available separately or in combos. *Enter "Analyzer Combo" at DXEngineering.com.*

DX ENGINEERING

Coaxial Cable Tool Kits

Get everything you need to prep and install soldered or crimp-on connectors on your coax. Complete kits from DX Engineering include cable strippers, grippers, replacement blades, braid trimmers, cable shears and carrying case. Individual tools also sold separately.

Coaxial Cable Assemblies

These low-loss cable assemblies are available in standard lengths with DX Engineering's revolutionary patented PL-259 connector. Use the online Custom Cable Builder at DXEngineering.com to build assemblies made to your exact specs. DX Engineering's coaxial cable is also available by the foot or in bulk spools.

Multi-Band Dipole Antenna Kits

DX ENGINEERING

Ideal for easy setup on Field Day, these rugged yet lightweight 2,500W power rated antennas are usable to 30 MHz with a tuner balun (available separately). They feature strong and flexible 14 AWG stranded-copper, relaxed PVC-jacketed elements; 18 AWG 300-ohm ladder feedline; center-T support; and end mount brackets.

DXE-WA-070	Antenna, 70' Long for 40M and Up	**$64.99**
DXE-WA-135	Antenna, 135' Long for 80M and Up	**$73.99**
DXE-WA-260	Antenna, 260' Long for 160M and Up	**$89.99**

Free Standard Shipping for Orders Over $99*. If your order, before tax, is over 99 bucks, then you won't spend a dime on shipping. (Additional special handling fees may be incurred for Hazardous Materials, Truck Freight, International Orders, Next Day Air, Oversize Shipments, etc.).

FAST FREE SHIPPING over $99*

NANUK ICOM YAESU KENWOOD ALINCO AlexLoop MASTR ANT GATOR Cases iPortable

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

Ordering (via phone):
8:30 am to midnight ET, Monday-Friday
9 am to 5 pm ET, Weekends

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

800-777-0703 | DXEngineering.com

DX 20 YEARS ENGINEERING

CELEBRATING 20 YEARS 2000-20

We're All Elmers Here! Ask us at: Elmer@DXEngineering.com
Email Support 24/7/365 at DXEngineering@DXEngineering.com

YouTube

ENJOY WATCHING EVERYONE ELSE SUDDENLY SECOND-GUESS THEIR RADIOS.

EVERYWHERE MEANS EVERYWHERE.

We're for every corner of the earth. So much so, it's led to revolutionizing the ham radio industry as the leader in design of software defined radios (SDRs). Because when you're looking to connect with people and places that may or may not even be on the map, you better have the best partner in technology on the planet. To learn more about our boundary-pushing products, visit **flexradio.com/FindEverywhere**

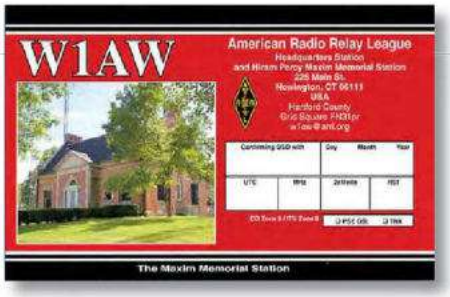
FlexRadio

Find Everywhere

6400 | 6400M | 6600 | 6600M |6700 | Maestro | Power Genius XL | SmartSDR

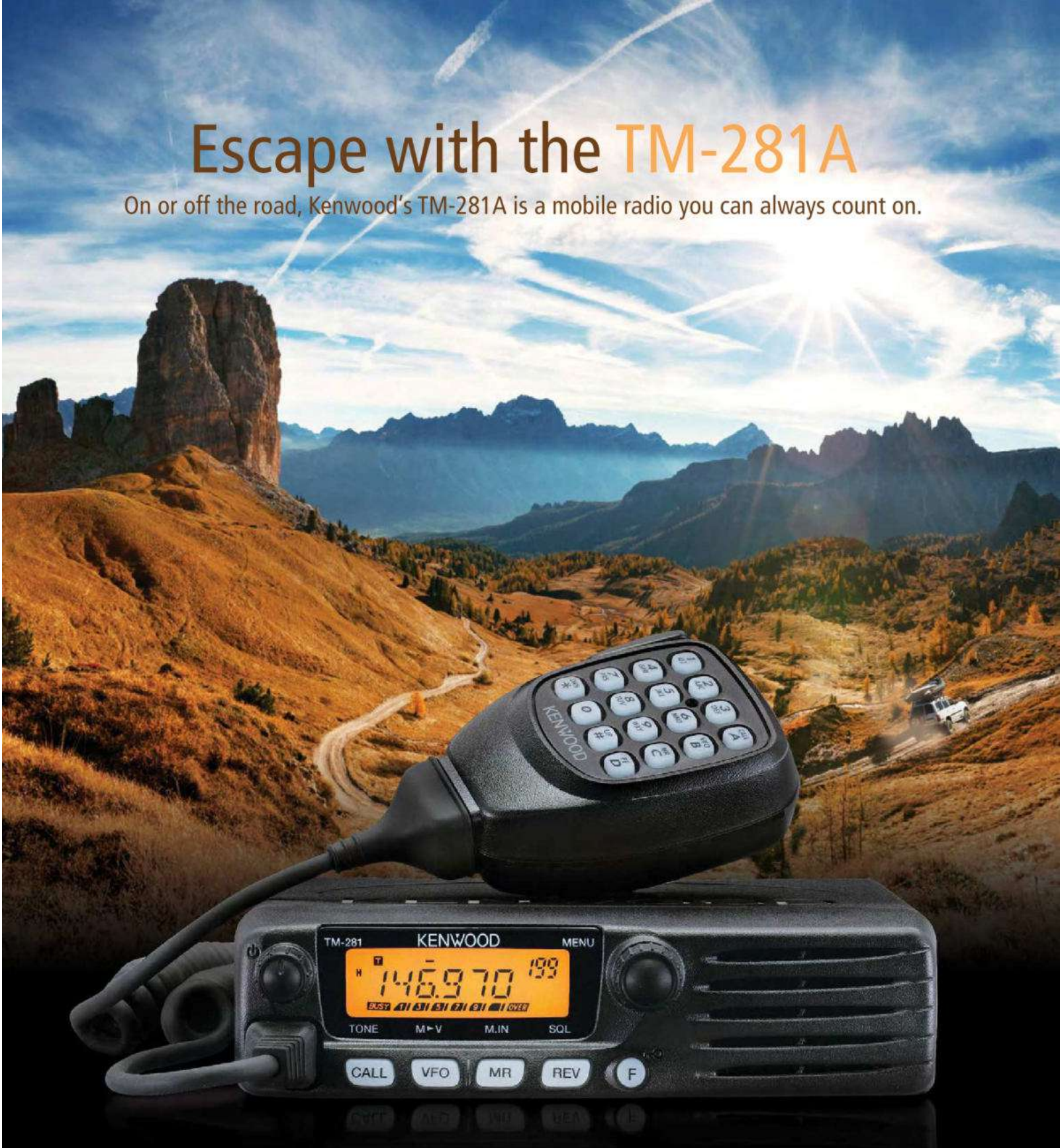
W1AW's QSL File

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



Escape with the TM-281A

On or off the road, Kenwood's TM-281A is a mobile radio you can always count on.



As tough as nails, this MIL-STD-compliant transceiver delivers powerful performance, excellent audio clarity, and a host of advanced features. It offers superb operating ease day or night thanks to the large backlit LCD and illuminated keys. So the next time you take off, take the TM-281A.

KENWOOD

Customer Support: (310) 639-4200
Fax: (310) 537-8235

www.kenwood.com/usa

ISO9001 Registered

ADS#01615

Scan with your phone to download TM-281A brochure.

Battery Sizing for Portable Operation

How to choose the right battery capacity for portable and ARRL Field Day operating.

Mike Bryce, WB8VGE

Portable HF operation is on fire right now. It seems like everyone is putting signals out from parks, lighthouses, and just about every hilltop or mountaintop in between. The lead photo shows my portable HF station set up along the Ohio Erie Canal. I carried this HF station via bicycle for a mile or so. A 7.5 Ah battery powers my Icom IC-703. Power is the fundamental requirement for all communications, and when you're operating portable, you need to bring your own. How much power you need depends on many factors.

Sizing by the Numbers

Determining how much battery capacity you need is a simple math problem. Let's use the popular Icom IC-7300 transceiver as an example. According to its specification sheet, the 7300 draws 0.9 to 1.25 A on receive. Let's call this 1 A for our normal listening volume. Transmit current could be as high as 21 A. That's our baseline.

How long you plan to operate, the duty factor and duty cycle of your transmitter, and the mode you'll be operating are all important information. You need all these factors to produce an accurate battery sizing profile. Of course, your mileage will vary.

Operation while just chatting (or "ragchewing") is normally a 50% duty cycle — half the time you're listening and the other half you're transmitting. Contest operation can drastically change the transmit-receive duty cycle.

Calculations

Let's crunch some numbers. Battery capacity is rated in ampere hours (Ah). We will consider a 4-hour scenario with a 50% transmit-receive duty cycle. The receiver draws 1 A for 50% of 4 hours, so you'll need 2 Ah for receiving. The transmitter at the 50% duty cycle will eat up the other 2 hours out of the 4. Icom specifies that the 7300 draws up to 21 A for the full 100 W RF power to the antenna. The only way to be confident of transmit current is to measure it. [For more details, see the *QST* Product Review for this transceiver, at **www.arrl.org/qst-product-review-and-short-takes-columns**. — *Ed.*] For this scenario, let's go with 15 A transmit current.

We would be transmitting 50% of the time, so our radio will be in transmit for 2 hours out of our 4 hours. When we run the numbers, we get 30 Ah for transmitting. Add in the receiver's demand for the remaining 50% of the time (2 Ah) and we need 32 Ah battery capacity.

Additional Factors

While we figured 50% transmit time, we might not be key-down full power for 2 hours. There's also the duty factor of the mode we'd be using to consider. Different modes have different duty factors. [Ed Hare's, W1RFI, book, *RF Exposure and You*, lists duty factors as low as 20% for SSB, 40% for CW, and 100% for RTTY and digital modes like FT8. — *Ed.*] To take care of additional wiring and system losses, add another 10 to 20% to the capacity.

There is also the issue of battery voltage. Remember how I said the transmitter would draw 15 A at 13.8 V? A fully charged lead-acid battery at rest is 2.1 V per cell, or 12.6 V for a 12 V battery (per Battery Council International).

Refining the guess, I'd say that out of the 4 hours you'd be operating, the total transmit time would be 1 hour (15 Ah) with 3 hours receiving (3 Ah). That lowers the demand to 18 Ah at full-power key-down operation, and means the battery must have at least 18 Ah total capacity. My example doesn't consider additional loads like a keyer or laptop computer.

Determining how much battery capacity you need is a simple math problem.

Hamspeak

Duty Cycle

The on-to-off ratio of the transmitter, expressed as a percentage. The average power consumption of a device is the power during the "on" time, times the duty cycle. Transmitters and linear amplifiers must be designed to operate at the duty cycle of the modulation type applied, to avoid overheating.

Duty Factor

The ratio between the average and peak power of the transmitting mode, expressed as a percentage.

Tweaks and Peaks

Most of my portable operations involve simple antennas. Running 100 W might not be practical, or compliant with RF safety standards. The popular small HF loop antennas are usually rated for 5 and 25 W input power. Obviously, running much lower RF to the antenna means less current drawn from the battery.

Of course, it is possible to recalculate the battery size requirement for different transmitter power levels. Remember, however, that the transmitter isn't as efficient at lower power settings as it is running the full 100 W.

If you intend to run low power (QRP), you should bring a radio designed for QRP. The popular Yaesu FT-817 — which uses an NiMH battery internally — or the Elecraft KX3 instantly come to mind. There are many radios to choose from that will produce power at QRP levels. Be aware that some radios can quickly discharge their internal battery.

Battery Types

It is beyond our scope to dig too deeply into the different types of batteries that might be used for portable operation. There are three, however, that should be mentioned: NiMH, lead-acid, and lithium-ion.

NiMH Batteries

NiMH (nickel metal hydride) battery cells are very similar to nickel-cadmium cells. They can be found with capacities of 1,000 to 4,000 mAh. A 9.6 V stack makes a suitable power source for the FT-817 or the Icom 703.

Lead-Acid Batteries

Lead-acid or lead-acid gel batteries might not make your lightweight hiking list. That said, the chemistry is

well understood and has been around since the 1800s. It is considered one of the safest battery chemistries. Its drawback is a rather low energy density of 80 to 90 Wh/L. That means it weighs a lot for the amount of energy it can store.

If you're sitting on a park bench, then the power density isn't going to be a factor. A common group 27 battery is easily carried for a short distance. Those batteries commonly come in at 105 Ah at a 20-hour rate.

The perfect lead-acid battery for park bench operation is hands-down the U1 31 Ah wheelchair/scooter battery (see Figure 1). It's a deep-cycle battery that can be drawn down by 50% or more. While it's possible to discharge a lead-acid battery by 80%, that's rough on the battery.

The U1 is an absorbed glass mat battery known as VRLA, or valve-regulated lead-acid battery. It weighs about 25 pounds, and can be purchased for about $60.

Figure 1 — A lead-acid U1 scooter battery is rated at 35 Ah capacity.

Lithium-Ion Batteries

We'll consider all lithium-ion batteries together, although there are many different chemistries that produce different voltages in the 18650 form factor — named for its 18-millimeter diameter and 65-millimeter length. It's important to explore all the different types of lithium battery chemistries. Some chemistries don't work well with our radios.

For example, one of the lithium-ion chemistries in the 18650 form factor is fully charged at 4.2 V. Three cells in series then produce 12.6 V. But the nominal voltage is 3.6 V, so three in series gives us a battery of 10.8 V — a bit too low for some of our needs. If you add another cell in series, then you end up with 16.8 V when fully charged. That's too high for any of the radios I own. You can discharge this cell to 2.5 V, so the three cells in series will drop to 7.5 V when discharged.

You'll hear "3S2P" or similar wording regarding 18650 cells. It simply means three cells in series, and two strings in parallel. Current technology limits 18650 lithium-ion cells at about 3,500 mAh. Some might be rated a bit higher, but don't be fooled by claims of 8,000 or 10,000 mAh in the 18650 form factor. The 3S2P example has a nominal voltage of 10.8 V at 7 Ah for the 3,500 mAh cells. The lithium-ion battery has an energy density of 250 Wh/L.

Lithium-ion batteries are becoming more and more mainstream, but large capacities remain expensive. A 12 V 100 Ah battery can cost up to $1,300.

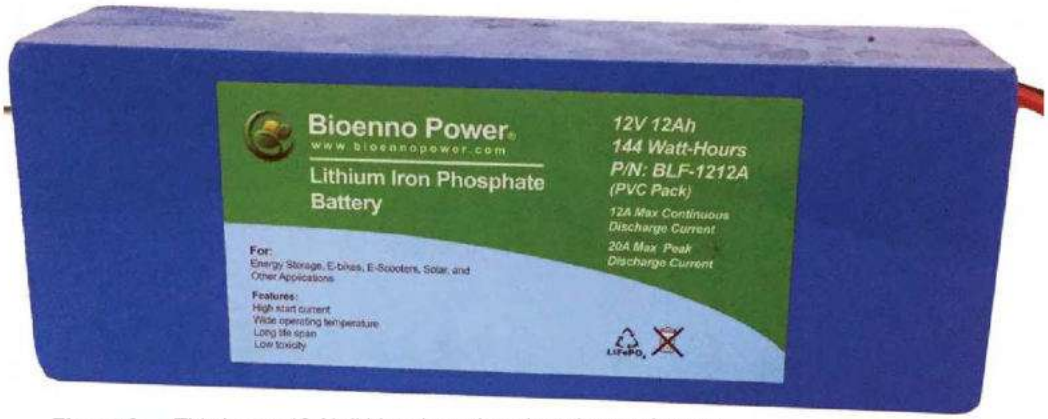


Figure 2 — This larger 12 Ah lithium iron phosphate battery has no trouble running my Yaesu FT-897 at 50 W RF power to the antenna.

The common lead-acid battery typically carries a 105 Ah rating at a discharge rate of 5 A in 20 hours.

Lithium iron phosphate (LFP) batteries (see Figure 2) have a ham-friendly voltage, much like lead-acid batteries. Fully charged, an LFP cell sits at 3.2 V, so four will make a battery of 12.8 V. The LFP has an energy density of 220 Wh/L.

Battery Management System

All lithium-ion chemistries require a battery management system (BMS). A BMS monitors the cells and keeps one or more from overcharging. Its function is to balance the cells within the battery. This battery balance is quite important to the lithium-ion cells. It will also limit the discharge current and, in some cases, shut the battery down to prevent damage to the cells due to deep discharge.

Battery Capacity

The common lead-acid battery typically carries a 105 Ah rating at a discharge rate of 5 A in 20 hours. The current and time are not linear. There is a derating curve for every battery that lists the discharge current over time. For example, while golf cart batteries are rated at a 20-hour discharge, they are also rated at 75 A for 90 minutes. Industrial lead-acid batteries used in forklifts are discharge rated at either 6 or 8 hours.

The Bottom Line

Sizing the energy requirements of a ham radio transceiver is usually based on an estimate derived from a use profile. A 105 Ah battery works great for Field Day operation. It's a bit heavy, but you can carry it for a short distance, and you can operate all weekend on one of them.

A 7.5 Ah gel cell or VRLA battery should be sitting in every ham shack. They cost about $15 and provide quite a bit of energy. You can't run your Icom IC-7300 on one, but a QRP rig will work just fine.

The 31 Ah U1 battery is my go-to power source if I want to run 100 W. It will provide more than enough energy to activate a state park.

I have a lithium iron phosphate battery that fits in my hand (see Figure 3), and has a 3 Ah capacity, which pairs well with a Yaesu FT-817 or an Elecraft KX3 transceiver. Bump the capacity to 12 Ah and the Icom IC-7300 would operate at reduced RF for a few hours.

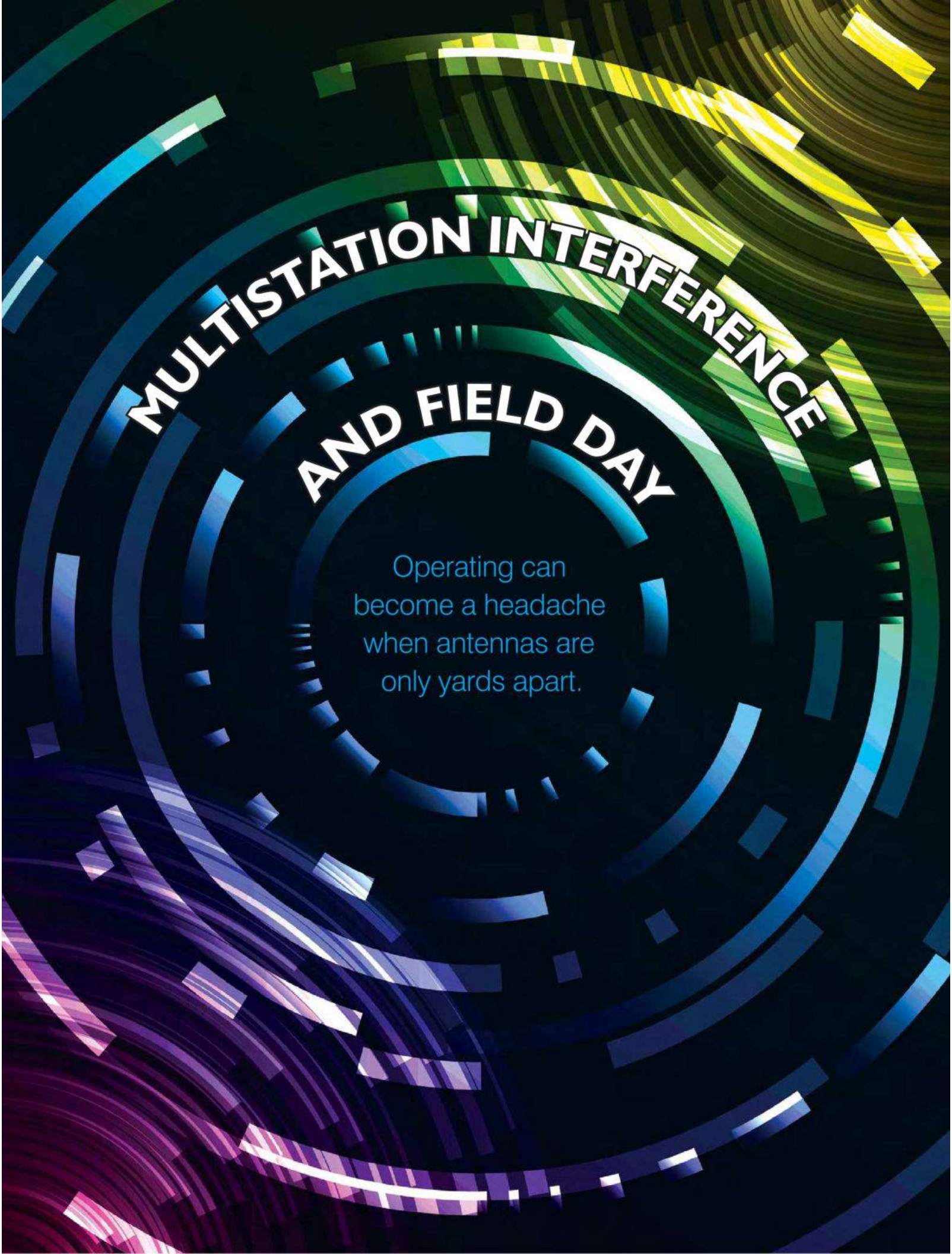
Know your equipment and remember that efficiency is the key to success when operating portable.

Figure 3 — This small 3 Ah lithium iron phosphate battery will provide energy for hours using any of the popular QRP radios.

All photos by the author.

Mike Bryce, WB8VGE, was licensed in 1975 and currently holds an Amateur Extra-class license. He retired after nearly 50 years at Republic Steel. You'll find him running QRP on the low end of 40 meters, or fixing broken radios. Mike was inducted into the QRP Hall of Fame in 2000. His spare time is divided by keeping the water levels topped up in the batteries for his solar power station and working in his greenhouse. Mike collects old radios, especially Heathkit, TEN-TEC, and Drake radios (see his website, **www.theheathkitshop.com**, for more information). Mike has written many ham radio and solar power articles over the years, including the ARRL book, *Emergency Power for Radio Communications*. You can contact Mike at **prosolar@sssnet.com**.

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


MULTISTATION INTERFERENCE
AND FIELD DAY
Operating can become a headache when antennas are only yards apart.

Jim Danielson, AC9EZ

Multistation transmitter sites are popular with ham clubs for ARRL Field Day operations. However, mitigating inter-station interference has always been a challenge. My local radio club, the Fort Wayne Radio Club, holds its Field Day event at a recreation frontier fort. The limited antenna space forces us to mount the antennas near one another, resulting in interference.

I decided to conduct some tests to see if it was possible to find a configuration and style of antenna that might reduce — or possibly eliminate — that inter-station interference. I especially wanted to investigate interference mitigation between 40-meter CW transmitters and 20-meter CW and SSB receivers, and two stations operating simultaneously on 20 meters (one operating CW and one SSB).

My test setup included a Yaesu FT-450D; an Icom IC-718; individual power supplies; a 40-meter folded dipole; two 20-meter dipoles resonant in the CW and SSB portions of the band; a 40-meter ground-mounted quarter-wave vertical; support poles for the antennas, and the necessary coax and dc cables and accessories. The antennas were mounted at low heights for the sake of convenience and safety, but I believe the results could help come to some conclusions regarding interference mitigation.

40-Meter Transmitter, 20-Meter Receiver

A 40-meter CW station interfering with a 20-meter CW or SSB station is the major problem my club experiences on Field Day. The 40-meter folded dipole was set up as an inverted **V**, with its apex at 16 feet and sloping down to 4½ feet above ground. The 20-meter dipole was mounted on a painter's pole with its apex 16 feet above ground, also set up as an inverted **V**. The 40-meter vertical was used to see if cross polarization would have much of an effect.

The 40- and 20-meter dipoles were placed end to end, and the adjacent dipole element spacing was varied from 6 to over 30 feet (as was the dipole end to the vertical antenna spacing). With just 5 W output on 7.003 MHz, unacceptable interference occurred from 14.023 MHz – 14.043 MHz. Placing the antennas over 30 feet apart actually increased the interference by several S-units. When transmitting on the 40-meter

Figure 1 — The author's radio test setup. [Jim Danielson, AC9EZ, photo]

vertical and receiving on the 20-meter dipole, the interference was again unacceptable.

Surprisingly, when I reduced the two dipole's end spacing to 2 feet, the results were much improved. The dipoles were 8 feet above ground at their feed points, and about 4½ feet above ground at the ends (see Table 1).

Table 1
40-Meter Transmitter (TX) Interference into a 20-Meter Receiver (RX)

TX Freq.	RX Freq.	TX Power	Interference Strength	Receive Pre-Amp On
7.003	14.013	50 W	Just under S-5	FT-450D
7.003	14.023	50 W	Under S-3	FT-450D
7.003	14.043	50 W	S-1 or less	FT-450D
14.023	7.003	50 W	None	IC-718
14.023	7.013	50 W	None	IC-718
7.003	14.013	80 W	About S-3	FT-450D

Three things are apparent from the results in the table. First, spacing the two dipole ends less than 3 feet apart and transmitting at power levels up to 80 W yielded interference levels on the other band/radio of S-5 or less. Next, the level of interference is a function of separation of the 20-meter receiver from the second harmonic of the interfering 40-meter signal — i.e., as you move away from the 40-meter second harmonic, the interference drops fairly quickly. And finally, the 20-meter transmitter did not interfere with the 40-meter receiver with this antenna configuration and power level.

Simultaneous 20-Meter CW/SSB

Next, I wanted to see if I could find an antenna orientation that would allow for operating 20-meter CW and 20-meter SSB simultaneously. For this test, I mounted two 20-meter dipoles about 8 feet above the ground at their apex. The dipoles were usually set up as inverted **V**s, but occasionally, I set them up as "droopy" flat-tops.

The power output was kept at 5 W, except as indicated in Table 2, where I raised it to 80 W. I was transmitting CW on 14.003 MHz with the FT-450D, and 14.243 MHz SSB with the IC-718.

This test showed that orienting the two antennas at right angles to each other did help somewhat, but the greatest drop in interference occurred when there was significant separation between the antennas — in this case, by over 70 feet.

Table 2
20-Meter Simultaneous CW and SSB Operation

IC-718 Noise Level	FT-450D Noise Level	Antenna Orientation	Antenna Separation
>S-5	>S-5	End to end	18½ inches
S-8	<S-5	Inverted **V**, end to end	5 ft., 4 in.
S-6	S-2	Inverted **V**, end to end	~16 ft.
S-7	<S-1	Inverted **V**, perpendicular	~16 ft.
S-7	>S-3	Inverted **V**, end to end	~25 ft.
S-1	>S-2	Inverted **V**, perpendicular	38 ft.
S-1 with spikes	< S-1	Inverted **V**, end to end	21 ft.
S-8	S-4	"Droopy" flat-top	16 ft.
None (80 W)	S-1/S-2, preamp on 80 W	Inverted **V**, end to end	74 ft.
<S-1 (80 W)	>S-1, preamp on 80 W	Inverted **V**, perpendicular	>74 ft.

Antenna Polarization Effects

I also wanted to investigate whether or not antenna polarization had an effect on increasing or diminishing noise level between two stations on the same band. For these tests, I varied the height and configuration of the antennas. The FT-450D was transmitting at 5 W on 14.003 MHz, and the IC-718 was transmitting at 5 W on 14.243 MHz. The attenuators were left on, and the preamplifiers were turned off (see Table 3).

I repeated these tests between 7.003 MHz CW and 14.243 SSB. I saw slightly under S-1 interference when the antennas were end to end, and no interference when the antennas were perpendicular to each other.

Conclusions

I want to point out that I did not use feed-line chokes in the 20-meter dipole antenna feed lines. This may have impacted the tests, as the coax shields could become part of the antennas without chokes. Also, as noted earlier, the antenna heights probably do not represent antenna heights typically encountered in portable and Field Day operations. However, these tests did provide indications of what may be achievable by experimen-

Table 3
Cross-Polarization Experiments

Dipole Orientation	CW Antenna/Height	SSB Antenna/Height	IC-718 Interference	FT-450D Interference
End to end (~7 ft.)	Inverted **v**/16 ft.	Flat-top/4 ft.	Almost S-8	S-4
Perpendicular (~16 ft.)	Inverted **v**/16 ft.	Flat-top/4 ft.	Under S-1	S-1

tally adjusting antenna orientation and spacing. That being said, my testing led to the following observations:

- If you have the space, nothing beats large antenna separation — especially when operating two stations on the same band.
- Keeping a 20-meter receiver greater than 20 kHz above the second harmonic of a 40-meter transmitter results in minimal interference to the 20-meter receiver.
- It is possible to reduce interference between 40- and 20-meter dipoles by placing them end to end at extremely close spacing.
- Dipole antennas for two stations on the same band should generally be at the same height.
- When running two stations simultaneously on one band, orient the antennas perpendicular to each other.
- A 20-meter transmitter usually won't interfere with a 40-meter receiver, even with antennas in close proximity.
- Interference between vertical antennas and low-height dipoles will probably result in unacceptable levels of interference.

Andrew "Jim" Danielson, AC9EZ, has been licensed since 2012, and earned his Amateur Extra-class license in 2013. His amateur radio interests include contesting, chasing DX, CW operating, antenna building, and experimenting with various digital modes. He is a member of ARRL, the Fort Wayne Radio Club, the Straight Key Century Club, the North American QRP CW Club, and is a life member of CWops.

Jim holds awards for Mixed WAS, WAC, and DXCC. He has activated grid DN97 in North Dakota numerous times, both on HF and 6 meters, and did a Parks on the Air activation of Muskallonge Lake State Park in Michigan. Jim was also the Youth/ATNO pilot station for the 2019 A35JT DXpedition to the Kingdom of Tonga.

Outside of amateur radio, Jim enjoys playing and composing music on the violin, piano, and pipe organ, reading, and learning new skills. You can reach Jim at **dfile13@hotmail.com**.

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

All ARRL members can now enjoy the online edition of *QEX* as a member benefit. Coming up in the May/June 2020 and future *QEX* issues are articles and technical notes on a range of amateur radio topics. These are at the top of the queue.

- Jacek Pawlowski, SP3L, describes more new broadband wire antennas in this Part 2 of a longer article.
- Steve Stearns, K6OIK, explores general uniform transmission lines having complex characteristic impedance and propagation constant.
- Bob DePierre, K8KI, extends the matching range of an 80-meter antenna.
- Andrew J. Anderson, VK3CV/WQ1S, gets on the 122 GHz band with a simple transverter.
- Gene Marcus, W3PM/GM4YRE, builds a project that includes a two-channel VFO, WSPR source, frequency counter, and a clock.
- Steve Franke, K9AN; Bill Somerville, G4WJS, and Joe Taylor, K1JT, describe the FT4 and FT8 digital modes implemented in *WSJT-X*.

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

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

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

Product Review

AnyTone AT-D578UVIIIPRO Triband DMR/FM Transceiver

Reviewed by Pascal Villeneuve, VA2PV
va2pv@arrl.net

The AnyTone AT-D578UVIIIPRO is a triband VHF/UHF mobile radio for North America that operates on DMR and analog FM. This transceiver covers 144 – 148, 222 – 225, and 430 – 450 MHz. The wideband receiver has additional coverage from 136 – 174 and 400 – 480 MHz. It can also receive the FM broadcast band between 87.5 and 108 MHz. RF output power is adjustable, with a specified maximum of 50 W on 2 meters, 5 W on 1.25 meters, and 45 W on 70 centimeters.

The AT-D578UVIIIPRO offers many features, including Bluetooth, a Global Positioning System (GPS) receiver, and support for Automatic Packet Reporting System (APRS) operation. The transceiver operates in full duplex, supports DMR roaming, and supports cross-mode operation with one VFO in analog and the other in DMR when the cross-band repeat function is activated.

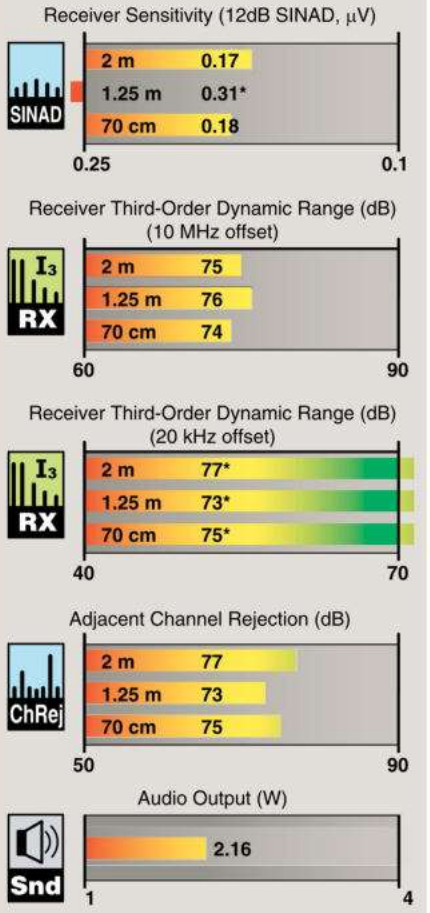
Overview

Included in the box with the AT-D578UVIIIPRO radio is a built-in Bluetooth module, an external Bluetooth

Bottom Line

The AnyTone AT-D578UVIIIPRO offers a wide range of features in a triband DMR/FM transceiver.

AnyTone AT-D578UVIIIPRO Key Measurements Summary



Notes: QS2006-PR145

Measurements shown for FM mode.

See Table 1 and expanded test results at **www.arrl.org/qst_in_depth** for additional measurements.

*Bars off the graph indicate values off scale.

Table 1
AnyTone AT-D578UVIIIPRO, serial number 1535193220002

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

Manufacturer's Specifications	Measured in ARRL Lab
Frequency coverage: Receive and transmit, 144 – 148, 222 – 225, 420 – 450 MHz.	Receive: 136 – 174, 220 – 225, 400 – 480 MHz. Transmit: as specified.
Modes: FM, digital voice (DMR), data, WFM (receive only).	As specified.
Power requirements: 15 A at 13.8 V dc.	At 13.8 V dc: Receive, no signal, max. audio and backlights, 536 mA; min. backlights, 524 mA; standby, 296 mA. Transmit (turbo/high/medium/low): 146 MHz, 7.75/5.0/3.3/1.52 A 223 MHz, 4.22/4.22/4.22/2.83 A 440 MHz, 8.75/6.05/4.09/1.59 A Power off, 6 mA.
Receiver	**Receiver Dynamic Testing**
Sensitivity: FM (12 dB SINAD), ≤0.25 µV.	FM (12 dB SINAD): 146 MHz, 0.17 µV; 223 MHz, 0.31 µV; 440 MHz, 0.18 µV. WFM 0.7 µV (100 MHz).
Adjacent-channel rejection: Not specified.	20 kHz offset: 146 MHz, 77 dB; 223 MHz, 73 dB; 440 MHz, 75 dB.
Squelch sensitivity: Not specified.	At threshold: 146 and 440 MHz, 0.31 to 0.77 µV; 223 MHz, 0.36 to 0.37 µV.
S-meter sensitivity: Not specified.	For full-scale signal (4 bars): 146 MHz, 46.2 µV; 223 MHz, 70.7 µV; 440 MHz, 74.1 µV.
Audio output power: 2 W into 8 Ω.	2.16 W into 8 Ω at 8% THD. THD at 1 V_{RMS}, 3%.
Transmitter	**Transmitter Dynamic Testing**
Power output (turbo/high/medium/low): 146 MHz, 55/25/10/1 W 223 MHz, 5/5/5/1 W 440 MHz, 40/25/10/1 W at 13.8 V dc.	Turbo/high/med/low at 13.8 V dc: 146 MHz, 50/21.2/9/1 W 223 MHz, 4.5/4.5/4.5/1 W 440 MHz, 35/18.8/8.8/0.9 W
Power output at minimum specified operating voltage: Not specified.	At 11.7 V dc, high power: 146 MHz, 43.4 W; 223 MHz, 4.4 W; 440 MHz, 32.9 W.
Spurious signal and harmonic suppression: ≥57 dB.	146 MHz, 68 dB; 223 MHz, 50 dB;* 440 MHz, >70 dB. Meets FCC requirements.

Size (height, width, depth): 1.5 × 5.5 × 7.4 inches (with protrusions); weight 2.35 pounds.

*52 dB required at 4.5 W RF output; considered borderline, but within measurement tolerances.

push-to-talk (PTT) key with an elastic bracelet, a handheld microphone, an external GPS antenna, a mobile bracket with assorted hardware, a fused dc power cable, a USB-to-microUSB programming cable, spare fuses, and a user manual. You can download the programming software (CPS) from AnyTone or from your dealer's website.

The AT-D578UVIIIPRO doesn't have a detachable remote head for mobile installations. However, the radio is very small, and it will probably fit in most vehicles somewhere under the dash.

The front panel with its 1.77-inch color display (see Figure 1) is attractive. The downside of a small package like this is that the screen and controls are small as well, but it's still highly functional. There are six programmable keys next to the display, plus a multifunction button that is also a programmable push-button. There are two separate volume knobs, one for each VFO. Volume levels are adjustable in steps, and I found it hard to adjust for low volume. It switches from nothing to a medium-low volume level, behavior that I have seen on other DMR transceivers.

Many important quick-access buttons are available on the hand

Figure 1 — The AT-D578UVIIIPRO front panel.

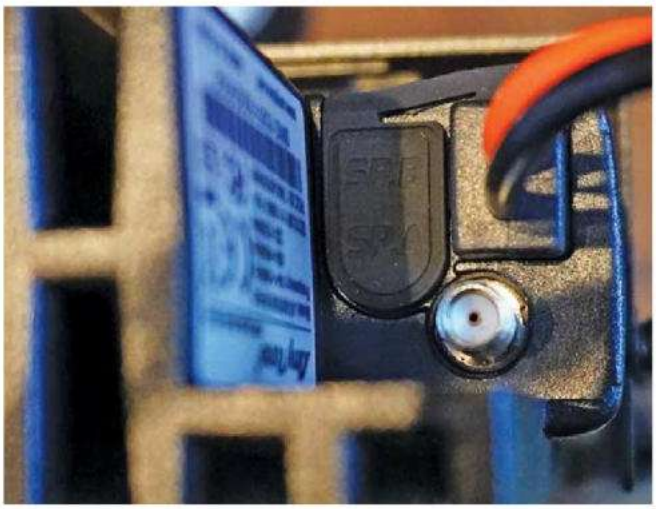
microphone. Functions include toggling between the main and sub VFOs, DTMF tones, and up/down buttons on top for frequency or memory changes. On the mic, there are also dedicated buttons for menu navigation (menu, zone up, zone down, and exit).

The radio supports up to 4,000 memory channels, 10,000 DMR talk groups (TG), 200,000 digital contacts, and up to 250 radio IDs. It is compatible with DMR Tier I and Tier II.

On the rear panel, you will find two antenna ports. One is for the external GPS using an SMA female connector (see Figure 2). The other is a standard UHF female connector (SO-239) with an integrated triplexer for triband operation with a single feed line. Next to the GPS antenna port is a removable rubber cap with two ⅛-inch speaker output jacks that can be configured with separate output for each receiver (VFO A and B). You can also pair the radio with your car stereo for listening to received audio via Bluetooth (if your car has that capability) and still use the external PTT at the same time.

Customizing the Transceiver Using the CPS

The CPS programming software for the AT-D578UVIIIPRO is identical to the software used for AnyTone's DMR handheld radios. With a new DMR radio, there is always a learning curve before you become familiar with its functions. Some features are not available until you check a box or enable a setting in the software. For example, by default, you won't find the setup menu for APRS if you do not



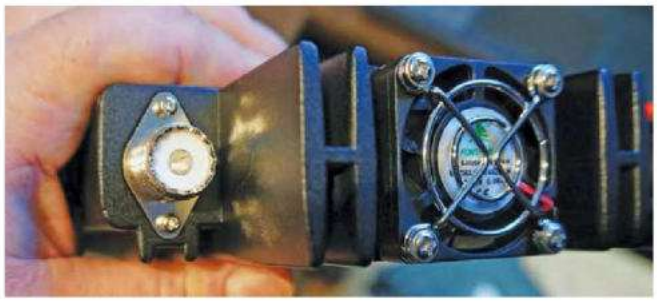


Figure 2 — (Left) On the rear panel, the GPS antenna connects to the SMA connector and two ⅛-inch external speaker jacks are under a rubber cap. (Above) The AT-D578UVIIIPRO uses a single SO-239 antenna jack. The radio has a triplexer built in, and the user will need to supply a suitable multiband antenna.

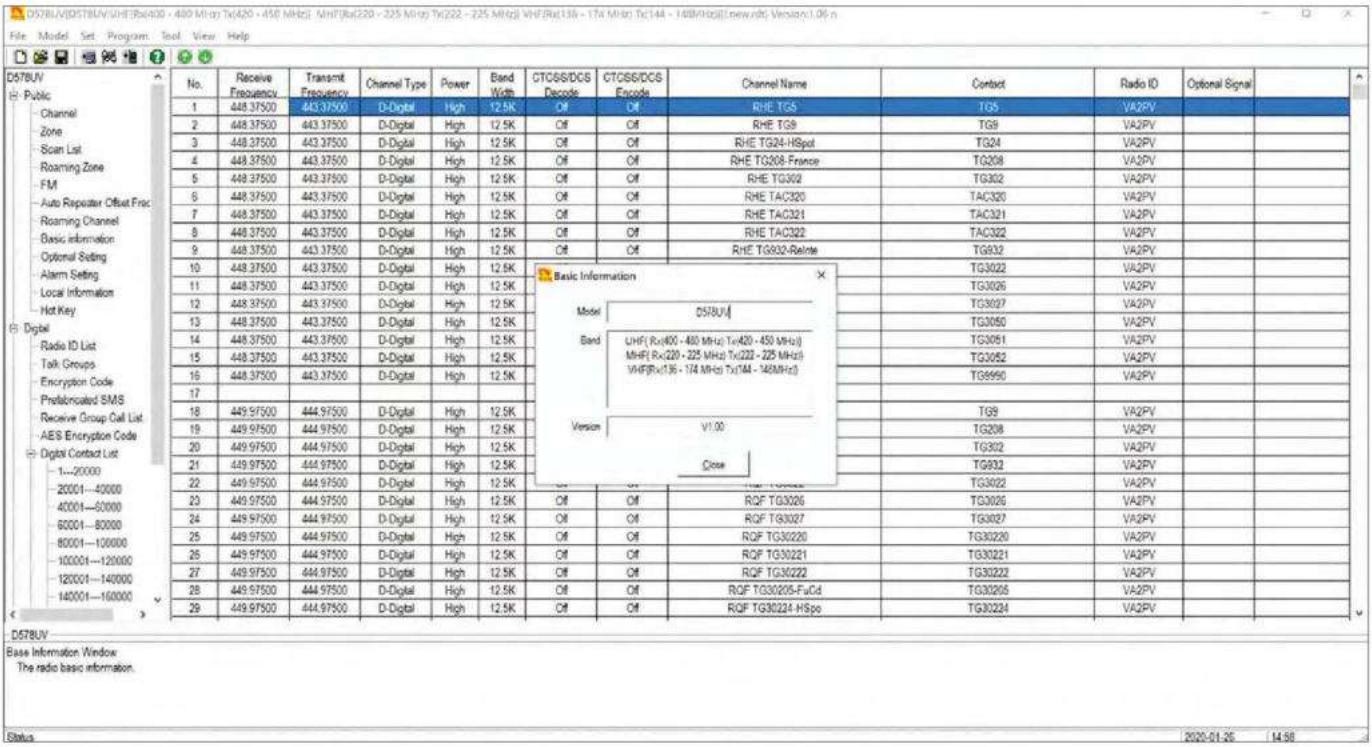


Figure 3 — The CPS software programming screen.

activate the feature first. The same holds for Bluetooth and GPS. To enable these features, go into the CPS **TOOL** tab, and choose the options you want. A typical CPS programming screen is shown in Figure 3.

After I installed the CPS, I wondered if the code plug from my AnyTone AT-D878UV handheld would be compatible. It's not as simple as opening the handheld's code plug into the mobile radio's CPS software, but you won't have to start from scratch. You can import a code plug for the AT-D878UV handheld and edit it for the mobile transceiver. The AT-D578UVIIIPRO can be configured manually from the front panel, and you can build a code plug from the keypad if you are patient. However, I strongly recommend taking the time to build a comprehensive code plug using the CPS software.

Operation on the Air

I tested the radio using analog and digital modes in simplex and on repeaters and received very good feedback about the audio quality. If you're already familiar with the AnyTone AT-D868UV or the AT-D878UV, operating this unit will be easy. All the submenus are the same, but with more features.

This radio has two independent receivers, and it can receive both at the same time. Both VFOs can be set to analog, or one can be set to analog and the other to DMR. When both VFOs are set to DMR, you can only receive one digital signal at a time.

Keep in mind that the analog APRS support is for transmit only. You can send your position manually or as a timed beacon, but you won't be receiving any APRS beacons or displaying them on the screen.

The AnyTone AT-D578UVIIIPRO is a full-duplex transceiver, and it supports the repeater mode (also known as cross-band repeat). You can operate cross-band between the 2-meter and 70-centimeter bands, and you can also operate cross-band between the 1.25-meter and 70-centimeter bands. You cannot operate cross-band between 2 meters and 1.25 meters. (For more information on requirements for cross-band repeat or auxiliary operation in the US, see **www.arrl.org/auxiliary-station-faq**. In Canada, an Advanced-class licence is required.)

I wondered if the radio supports cross-band repeat in DMR as well as analog FM. I started my test in analog (both VFO A and B in FM), and it worked. Then I tried DMR (on both VFOs), and it worked. Then I tried one VFO set for DMR operation and one for analog FM, and I was very surprised to see that it did cross-mode between the two VFOs. Yes, you can use an analog radio to talk to a DMR radio using this feature.

Keep in mind that the DMR color code (analogous to an access tone in analog FM), time slot (TS), and talk group (TG) have to be set correctly if you want to do this. I tried it with my DMR hotspot, and it worked fine. When using a DMR handheld to communicate cross-mode to analog FM, the mobile radio needs to have the same DMR configuration as the handheld for the audio to be decoded.

When operating cross-band repeat with both VFOs set to DMR, I noticed that it will work with any incoming signals on either time slot (TS1 or TS2). For the test, my first handheld was set to TS1 using TG9 on 2 meters, and the second handheld was set to TS2 using TG9 on 70 centimeters, and they were able to communicate.

For the test, I made sure that neither radio was in dual-TS monitor mode. It was a bit confusing, but if the handheld configuration didn't match the mobile radio's TG or the color code, I couldn't hear anything. If you're considering this unit specifically for its cross-mode capabilities, you should confirm with your local dealer that it will work specifically for the intended application.

When you transmit, the fans start as soon as you push the PTT button. I thought the fans were a bit loud, particularly in my quiet home station. That may or may not be the case in a mobile installation, depending on the normal road and wind noise in your vehicle. I guess this is a compromise with a high-power transmitter in a small form factor. I recommend keeping both VFOs set to low power if you operate using the cross-band repeat function, as it gets pretty hot. Keep in mind that in cross-band repeat mode, the radio will transmit as soon as it receives a signal or the squelch opens.

Conclusion

This triband radio adds the 1.25-meter band and offers quite a few features that hams expect in a VHF/UHF transceiver. AnyTone has announced a forthcoming Bluetooth microphone with integrated display that would be a great addition for mobile operation. I also like that you can use any analog handheld to talk to DMR radios via the cross-mode feature. The ARRL Lab did note that receiver sensitivity is lower on 1.25 meters than on the other two bands.

ARRL purchased the review radio from BridgeCom Systems. Their website's Support section has a page with downloadable firmware updates and videos showing how to update the firmware and get started with the CPS software. The purchase price also includes a coupon for free access to BridgeCom University, a series of online lessons on various aspects of installing and using the AT-D578UVIIIPRO.

Additional test data and photos are available from **www.arrl.org/qst_in_depth**.

Manufacturer: Qixiang Electron Science and Technology Co. Ltd., Fujian, China; **www.anytone.net**. Available from several US dealers. Price: $399.99 with GPS, Bluetooth, and programming cable.

Visit https://youtu.be/JIHvvUY26QE to see our review of the AnyTone AT-D578UVIIIPRO Triband DMR/FM Transceiver on YouTube.

RigExpert Stick 230 Antenna and Cable Analyzer

Reviewed by Phil Salas, AD5X
ad5x@arrl.net

The lightweight and compact RigExpert Stick 230 antenna and cable vector analyzer is intended for portable applications in the field or on a tower, although it can be used indoors as well. It is less expensive than the RigExpert AA-230 ZOOM, which covers the same 0.1 – 230 MHz frequency range, but there are some significant differences between these two analyzers. It's a good idea to read the AA-230 ZOOM review in the March 2016 issue of *QST* before deciding which to buy.

Overview

The Stick 230 is a single-port vector network analyzer (VNA) that provides signed, complex impedance measurements of RF loads from 100 kHz to 230 MHz with a frequency resolution of 1 kHz. A user manual is not provided with the instrument, but is available for download from the RigExpert website. Supplied accessories include a USB cable, carrying strap, and connector cover.

The measurement port is an SO-239 jack. A USB cable is provided for computer interfacing using *Antscope2* software for Windows or macOS, and for charging the internal 3.7 V, 2,800 mAh type 18650 Li-ion battery. A battery indicator on the main menu shows the battery status. When a computer is connected, power is provided through the USB connection. The Stick 230 has a Bluetooth interface that permits display and control from an Android smart phone using the *AntScope for Android* app from Google Play.

All information is displayed on a 1 × 1 inch (200 × 200 pixel) monochrome screen. You can select single-frequency or a swept-frequency displays. The single-frequency mode displays SWR, return loss, impedance (Z, R, and X), or the equivalent series and parallel representation of an impedance. The swept-frequency mode displays SWR. When using the *Antscope2* software, you can display SWR, phase, impedance, return loss, Smith chart, and TDR (time domain reflectrometer) plots. Table 2 summarizes the Stick 230's specified performance and features.

Stick 230 Testing

I began my tests by checking the Stick 230 output against WWV at 10 MHz. The frequency was within 20 Hz of WWV, and I did not detect any noticeable frequency drift over a 5-minute test period. I also found the fundamental frequency output level to be –8.5 dBm over the full-frequency range.

Table 2
RigExpert Stick 230 Manufacturer's Specifications

Measurement frequency range: 0.1 to 230 MHz, for 25, 50, 75, 100, 150, 200, 300, 450, and 600 Ω systems.
Frequency resolution: 1 kHz.
SWR measurement range: 1 to 100 in numerical modes, 1 to 10 in graphical modes.
Impedance ranges: R = 0 to 10,000 Ω, X = –10,000 to 10,000.
RF output: Square wave, 0.1 to 230 MHz, at –10 dBm (into 50 Ω resistive).
Operating temperature: 32 – 104 °F.
Dimensions: 7.3 × 1.6 × 1.3 inches. Weight: 6.5 ounces with battery.

Bottom Line

The Stick 230 antenna and cable analyzer is compact, lightweight, and rugged. It's a useful tool for antenna system measurements in the field or at home.

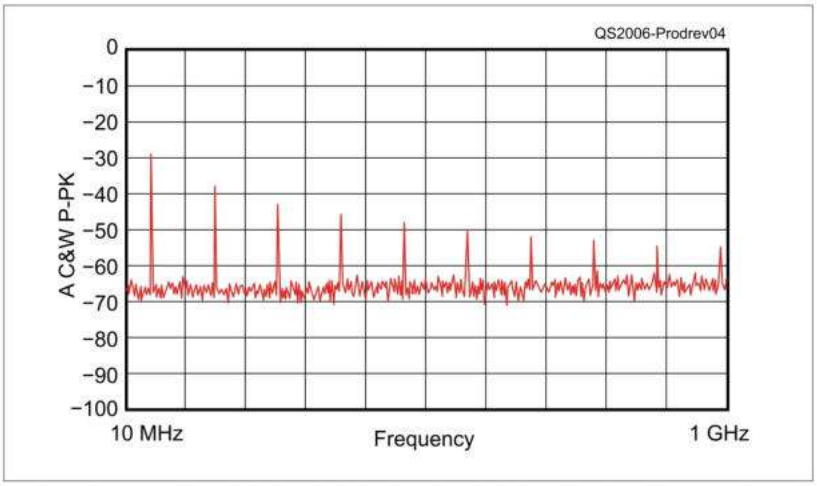


Figure 4 — The output of the Stick 230 viewed on a spectrum analyzer. The fundamental frequency is 50 MHz, and odd harmonics are visible every 100 MHz.

Table 3
Stick 230 Measured Open Circuit Impedance

Frequency (Ω)	Output (Z) (MHz)
1.8	~4,200
3.5	~3,200
7	~2,100
14	~1,200
28	~700
50	~400
146	~150
222	~90

When used as a signal source, keep in mind that the output waveform is almost a perfect square wave, as you can see in the 50 MHz (fundamental) spectrum output of Figure 4. This relative spectrum is constant over the full frequency range of the instrument. The odd harmonic amplitudes almost exactly follow $A = 2/(\pi N)$, the equation for the amplitude of odd harmonics of a perfect square wave.

Next, I recorded the open-circuit output impedance as measured by the Stick 230. This gives an indication of the impedance magnitude you can accurately measure as a function of frequency. The results, tabulated in Table 3, indicate that accuracy will drop off as you go higher in frequency, especially for higher-impedance loads.

For the all-important SWR testing, I checked the Stick 230 against a precision 50 Ω load, and then shorted microwave attenuators of 5 dB (1.92:1 SWR), 3 dB (3.01:1 SWR), 2 dB (4.42:1 SWR), and 1 dB (8.7:1 SWR). Because the pads are not perfect, I also measured them on my Array Solutions VNAuhf for comparison, as shown in Table 4. As you can see, the Stick 230 SWR readings compare quite favorably to the VNAuhf readings.

For my final tests, I used complex loads with an SWR of approximately 2:1 at 50, 146, and 222 MHz. Table 5 displays the Stick 230 versus the VNAuhf measurements. As you can see, the Stick 230 provides almost identical SWR measurements to the VNAuhf. The series R and C measurements compared favorably to the VNAuhf as well.

Using the Stick 230

I found it interesting that the Stick 230 screen is not blank when off. It displays **ANTENNA ANALYZER 230 MHZ**, the serial number, and the firmware version. Prior to using the Stick 230, check the RigExpert website for firmware updates. If a newer version of firmware is available, the RigExpert firmware update tool will download and install the new firmware for you with minimal effort.

I found that the Stick 230 operation is not as intuitive as other RigExpert analyzers because few keys are available. After using it for a while, it does become easier to use. However, if you use the Stick 230 infrequently, you'll probably need to keep the manual on hand for quick reference.

A quick press of the lower right key powers on the unit (press and hold this same key to turn off the unit). Figure 5 shows the Main Menu displayed on power up. A tap of the lower left key brings up screens with descriptions of the four measurement options, and it also provides access to user-adjustable settings. At this time, there is no capability for open/short/load calibration on the Stick 230 menus.

When you select the **SINGLE** mode, you can then sequentially display fixed frequency values of SWR and return loss (screen 1); [Z], R and X (screen 2); Ls and Cs (screen 3); Rp and Xp (screen 4); and Lp and Cp (screen 5). I used this mode to record the data shown in Tables 3, 4, and 5.

Table 4
Stick 230 Resistive Load Measurements

Stick 230 compared to Array Solutions VNAuhf (see text)

Load (SWR)	*1.0:1*	*1.9:1*	*3:1*	*4.4:1*	*8.7:1*
Frequency (MHz)	*Stick*	*Stick/uhf*	*Stick/uhf*	*Stick/uhf*	*Stick/uhf*
	Measurement with NanoVNA/VNAuhf				
1.8	1.02	1.95/2.00	3.1/3.17	4.5/4.45	10/10.93
3.5	1.02	1.95/2.00	3.1/3.17	4.4/4.43	10/10.87
7	1.02	1.95/2.00	3.1/3.17	4.4/4.41	10/10.85
14	1.02	1.95/1.99	3.1/3.17	4.4/4.38	10/10.80
28	1.02	1.94/1.98	3.1/3.16	4.4/4.33	10/10.49
50	1.02	1.94/1.98	3.1/3.16	4.4/4.30	10/10.52
146	1.0	1.92/1.96	3.1/3.17	4.5/4.51	10/10.35
222	1.01	1.92/1.93	3.1/3.18	4.6/4.66	9.9/10.10

Table 5
Stick 230 Complex Load Measurements

Stick 230 compared to Array Solutions VNAuhf measurements of SWR and series resistance/capacitance (see text)

Frequency	**------- Stick 230 -------**		**-------- VNAuhf --------**	
(MHz)	**SWR**	**Rs + Cs**	**SWR**	**Rs + Cs**
50	1.97	47 Ω + 98 pF	1.97	48 Ω + 95 pF
146	1.80	44 Ω + 43 pF	1.83	46 Ω + 37 pF
222	1.70	41 Ω + 36 pF	1.77	43 Ω + 28 pF

Figure 5 — The Stick 230 power-up screen and controls.

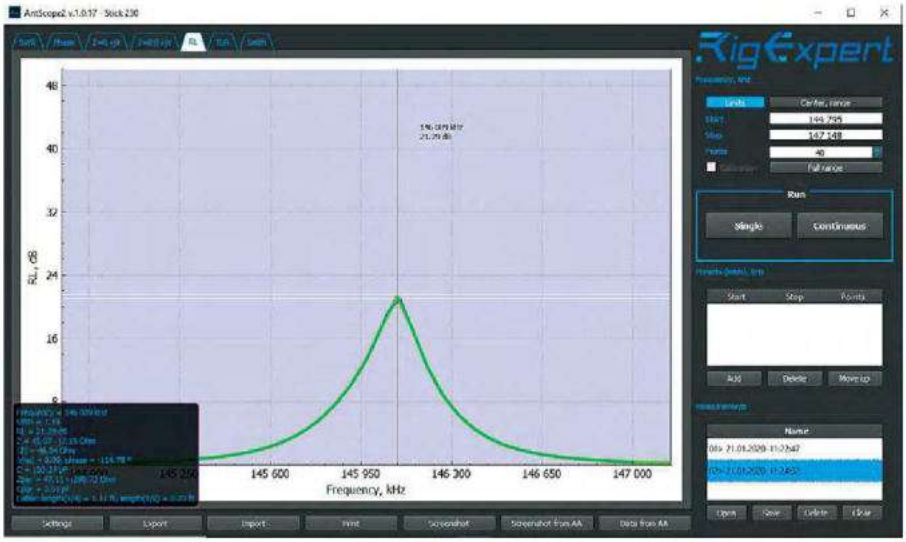
The **Multé** mode scans the amateur bands in the 100 kHz – 230 MHz frequency range and displays all frequencies where the SWR is less than 3:1. You step through the found frequencies using the left and right arrow keys.

The **HAM** mode graphically displays SWR on all ham bands. You step through the ham bands (plus 11 meters) with the left and right arrow keys. Once a band is selected, you can adjust the swept bandwidth with the – and + keys and change the center frequency with the left and right arrow keys. Figure 6 is an SWR scan of a 2-meter band-pass filter.

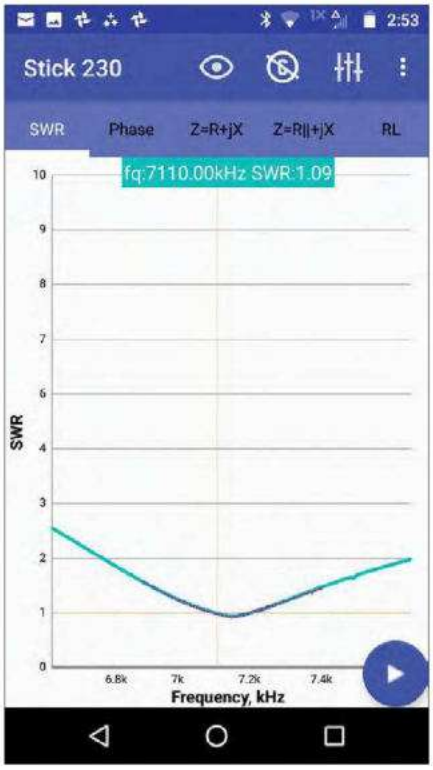
The **FREE** mode lets you set up a user-defined swept frequency range. This is useful for looking at multiple resonances as you might find in a multiband antenna.

In all cases, you can change frequency in two ways. First, tapping the left or right arrow key will decrement or increment the frequency in small steps. Pressing and holding one of these keys will change frequency in an accelerating manner. The second way to change frequency is to press the lower left key for 2 seconds. This will bring up a screen where you can change the individual frequency digits using the – and + keys.

Figure 6 — SWR scan of 2-meter band-pass filter on the Stick 230 screen.



▲ **Figure 7** — Return loss sweep of the 2-meter band-pass filter viewed in *AntScope2* software.



▶ **Figure 8** — SWR scan of a 40-meter antenna viewed with the *AntScope for Android* app on a smartphone.

Computer Interface

The *AntScope2* software, available for download from RigExpert's website provides real-time control of the instrument. Upon installation, *AntScope2* creates a desktop icon. Figure 7 shows the *AntScope2* return loss display of the 2-meter band-pass filter tested in Figure 6. It is interesting that the return loss is displayed inverted from what I've typically seen in other VNA software.

AntScope for Android

As mentioned earlier, the Stick 230 has a built-in Bluetooth interface that allows you to control the device from a paired smartphone or tablet using the *AntScope for Android* app. I downloaded the app to my Google Pixel phone and the app instantly recognized the Stick 230. I did not find operating *AntScope* from my phone to be very intuitive, but with a little playing around, I figured it out. Figure 8 is an SWR scan of a 40-meter inverted-V dipole viewed on a smartphone.

It is interesting that *AntScope for Android* shows an open/short/load (OSL) calibration routine, but this feature did not appear to be enabled yet. When I started the OSL function from my phone, the first calibration process seemed to continue far too long. I terminated it after waiting 10 minutes.

Finally, I did have two cases where the Stick 230 completely froze up on me. The only way I could resolve this was to remove the lithium battery (this required removing two screws) and then re-inserting it. RigExpert indicates that this has been fixed in firmware version 1.4 and the Stick 230 no longer freezes.

Conclusion

The Stick 230 is another option for those who want an antenna analyzer, particularly for field applications. It is more compact and less expensive than the RigExpert AA-230 ZOOM analyzer, making it more convenient for carrying around in a toolbox or simply putting it in your pocket. The monochrome E ink display offers excellent visibility, even in direct sunlight. You can investigate the Stick 230 further by viewing the manual on the RigExpert website.

Additional illustrations showing the Stick 230 in operation are available from **www.arrl.org/qst_in_depth**.

Manufacturer: Rig Expert Ukraine Ltd., Kyiv, Ukraine; **www.rigexpert.com**. Available from several US dealers. Price: $290.

Elecraft AX1 Dual-Band Whip Antenna and Accessories

Reviewed by Bob Allison, WB1GCM
ARRL Assistant Laboratory Manager
wb1gcm@arrl.org

In my youth, portable operation typically happened only at ARRL Field Day, using gasoline-powered generators, temporary antennas, and heavy home-station equipment. Today, we can choose from a selection of HF transceivers that are very small, lightweight, and powered by internal batteries. These are ideal for operating from a remote mountain summit or a local park.

Portable HF transceivers still require an antenna, though. A half-wave dipole antenna cut for the operating frequency is efficient, but may be too large to easily move or put up. A compromise between antenna efficiency and portability must be made.

The Elecraft KX2 and KX3 transceivers are very popular with portable operators, and Elecraft recently

Bottom Line

The Elecraft AX1 and accessories make a highly portable antenna system that integrates well with an Elecraft KX2 or KX3 transceiver. While a short, base-loaded whip antenna is by definition a compromise, the combination works well enough to be heard, even at the very bottom of the solar cycle.

introduced the companion AX1 Multi-Band Whip Antenna. We ordered an AX1 and accessories for use with my Elecraft KX2.

Overview

The AX1 is designed for use on the 20-, 17-, and 15-meter bands. It's resonant on 20 meters and works on 17 and 15 meters, with help from the transceiver's automatic antenna tuner (ATU). There's a switch to select 20-meter or 17/15-meter operation. The Elecraft AXE1 Extender permits operation on 40 and 30 meters with the ATU. Maximum power rating is 30 W, which is more than enough to handle the RF power output of the KX2 or KX3 transceivers. The ARRL Laboratory performed an RF safety evaluation for the AX1 at various frequencies at 10 W and 30 W in controlled and uncontrolled environments. For the most part, the operator and others nearby should be safe using this antenna with the KX2 or KX3. The operator may need to pay attention if the antenna is used with other transmitters operating at the 30 W power limit of the antenna. See **www.arrl.org/files/file/Technology/RFsafetyCommittee/RF%20safety%20sidebar.pdf** for the full report.

The AX1 Whip Antenna consists of two pieces: a 6-inch-long loading coil base with BNC male connection, and a 45-inch-long, 10-section telescopic whip (collapsed length is 6 inches). There are two loading coils mounted one above the other, wound around a pair of slender circuit boards that provide electrical connections and mechanical support. A transparent Lexan cylinder covers the coils and has a small opening above the BNC connector for access to the band switch (20 or 17/15 meters).

The manual recommends the use of at least one radial wire, attached to chassis ground. Elecraft offers a 13-foot radial wire accessory to use with the AX1 for 20-, 17-, and 15-meter operation. A 33-foot radial wire is available from Elecraft for 40/30 meters with the AXE1 Extender. We used the radials for on-air operating for this review.

My measurements showed that the review antenna is resonant at approximately 15.350 MHz in the 20-meter position and 19.280 MHz in the 17/15-meter position, with the 13-foot radial wire connected. With the AX1/AXE1 combination for 40/30 meters and the 33-foot radial wire, the antenna was resonant at about 7.440 MHz. The internal antenna tuner in my KX2 had no difficulty finding a match of 2:1 or less across 20 and 17 meters, and across 40 meters with the AXE1 Extender. I achieved reasonable SWR on 30 meters with the AX1/AXE1 using the 17-meter switch position and 33-foot radial. In the 17-meter position, I was able to find a match on 12 meters as well as 15. Overall operation is smooth using the KX2/AX1 combination, as the transceiver's ATU memorizes tuning settings for previously used operating frequencies.

Although the AX1 uses a sturdy, collapsible whip element, it can be damaged if you accidentally step or sit on it. Give it the same level of care as your transceiver, and it should hold up well. The antenna coil assembly is not submersible or water resistant, though I give it a fair mark on its ability to handle moisture. The coil assembly can be disassembled and dried after use in moist environments. Placing a small piece of tape over the band switch access hole can also help keep out moisture.

The AXE1 40-Meter Extender coil and solder connections are sealed in a thick, transparent cover. As shipped, the AXE1 did not fit the top of the AX1 coil assembly. I removed ¼ inch of the plastic covering from the bottom of the AXE1 body, and then the two pieces fit properly.

Figure 9 — The AX1 mounted on a KX2 transceiver with the optional AXB1 Whip Bipod.

Figure 10 — The AXT1 Tripod Adapter is handy for mounting the antenna on a tripod, away from the operator, but it required a tripod without an integrated head.

Accessories

The AXB1 Whip Bipod consists of two metal supports, hinged in the middle (see Figure 9). The hinge point has a small plastic clamp that fits over the shell of the AX1 male BNC connector. A small, knurled plastic knob adjusts the friction of the bipod, permitting firm placement of the bipod and antenna on a variety of level and irregular surfaces (such as a boulder on a mountaintop).

The AX1 can also be mounted on a camera tripod, away from the transceiver (and operator), using the Elecraft AXT1 Tripod Adapter. The AXT1 is designed to work with any camera tripod that uses a standard ¼-20 threaded mount. Make sure the tripod head is small enough to allow access to the antenna connection. Some tripods have an integrated tilt/pan head with a flat camera platform that's too large to use with the adapter (see Figure 10). The AXT1 bracket has several holes that can be used to guy the tripod and/or attach one or more counterpoise wires.

On the Air with the AX1

The antenna can be connected directly to the BNC antenna jack on the side of a KX2/KX3 transceiver, with the radio held like a small VHF transceiver. For tabletop use, Elecraft includes a right-angle BNC adapter. With an overall antenna length of 51½ inches (add 6 inches if using the AXE1), the antenna tends to flop around a bit, but can be easily braced to remain in a vertical position by using the Elecraft AXB1 Whip Bipod.

I've operated HF using QRP (low power, 5 W or less) and compromised antennas, and had reasonable expectations for what I could do with this short base-loaded whip antenna. To get the most out of your outdoor operating excursions, study radio propagation carefully. Know the times when signal levels are likely to peak from a given location on a given frequency. This will increase your likelihood of making contacts.

While on a hilltop in central Connecticut, I set up the KX2/AX1 combination on the hood of my truck. I didn't expect much, because the bands were reported to be dead, but the weather was sunny and mild for mid-February. Yes, 20 meters was dead, but not completely. There were enough weak signals to try the AX1 with and without the radial wire attached. As expected, the radial wire drastically improved signal strengths, up to about 30 dB by my observation.

On 40 meters, I added the AXE1 extender coil and 33-foot radial wire, leaving the loading coil switch set to 20 meters. That just took a couple minutes. I managed to snag a quick CW contact, with a 459 report from Virginia; otherwise, my CQ calls went unanswered.

On another sunny afternoon in March, I participated in the ARRL International DX Phone Contest. Propagation conditions were fair, but I managed to contact 12 stations, mostly located in Europe, with half the contacts in the clear. As noted in the AX1 manual, "QRP operation with a short whip can be both rewarding and challenging."

I could not resist trying 40-meter operation with the KX2, AX1, and AXE1 extender while walking, with no trailing radial (although the manual recommends using the radial for best results). The KX2 is well suited for this type of pedestrian mobile operating with its built-in microphone and push-to-talk button. For this test, my wife Kathy, KA1RWY, operated from our home station and volunteered reports as I went to various scenic places around our hometown. I comfortably talked over distances up to about 5 miles on SSB on the high end of 40 meters. Transmit audio quality is very good with the KX2 and its built-in microphone. Once sunspots increase, there will be a lot more opportunities to enjoy using the AX1 on 17, 15, and 12 meters.

Manufacturer: Elecraft, 125 Westridge Dr., Watsonville, CA 95076; tel. 831-763-4211, **www.elecraft.com**. Price: AX1 Multi-Band Whip Antenna, $99.95; AXE1 40-Meter Extender, $49.99; AXB1 Whip Bipod Support, $31.95; AXT1 Tripod Adapter, $24.95; AXW1 Replacement Whip, $9.95; E770091 33-Foot Ground Radial, $8.95; E770064 13-Foot Ground Radial, $6.95.

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

The Doctor is In

Most Antenna Design Dimensions Can Be Scaled With Frequency

Q Jeff, KB7QAG, asks: I want to build a 2-meter dipole for single sideband (SSB). I have information on a dipole for 2-meter FM, but should I change the length for SSB? Can I just connect my coax feed to the center, or should I have some kind of balun or choke between the coax and the dipole?

A The length of a dipole is a function of a number of parameters, including frequency, element diameter, and height above ground, to mention a few. For VHF antennas mounted well above ground, it's mostly a function of the first two. There's a big difference between the length of wire antennas and those made from tubing, so I would need to know the details of the design you're looking at in order to give a specific answer to your lengths question, but I can describe the amount of change needed.

Most SSB communication on 2 meters is in the range of 144.15 – 144.3 MHz, but of course SSB is legally usable anywhere from 144.1 – 148 MHz. Note that to keep the components of your upper sideband (USB) signal inside the band, the indicated (suppressed carrier) transmit frequency should be no higher than 147.996 kHz. FM communication is usually between 146 – 148 MHz. Again, stay below 147.98 kHz. If we pick 147 MHz and 144.2 MHz as the center of the two subbands, the SSB antenna should be 147/144.2, or about 2% longer than the FM antenna, to have similar performance. In most parts of the country, SSB (and CW) antennas are horizontally polarized rather than vertically polarized, as for FM. This is beneficial for a dipole because a horizontal antenna can more easily have the coax leave the antenna perpendicular to the dipole, which is needed to avoid the coax shield being in the antenna's near field and distorting the pattern (see Figure 1).

In my experience, a 2-meter horizontal SSB antenna in a reasonable location can also be used to access nearby FM repeaters, even though it's not optimal for the application. There's typically a 20 – 30 dB loss between antennas of opposite polarization, but for a close line-of-site path, very little power is actually needed, so it will often work fine.

It's always good to have some form of common-mode choke between the feed point of a balanced antenna (such as a dipole) and the unbalanced coax. Otherwise, some of the current you intend to have radiating from the dipole will instead run down the outside of the coax. That will radiate as well, but perhaps not in the directions you desire, and possibly into household systems. A direct connection can also result in a higher

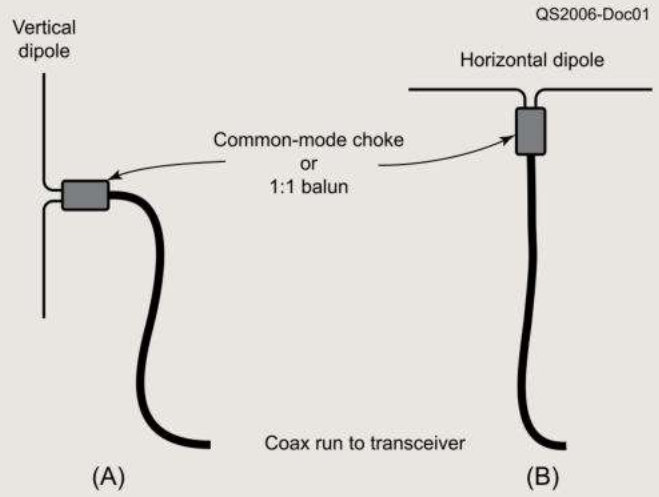


Figure 1 — At (A), coaxial cable is shown being fed into a vertical dipole. Note that to avoid the coax shield coupling to the antenna, the transmission line should be close to being perpendicular to the antenna for a distance of at least ¼ wavelength. There are a number of ways to achieve this. Perhaps the easiest is to mount the vertical antenna on a boom that extends past the mast and supports an antenna for another band on the other side of the mast, with both transmission lines routed along the boom to the common mast. At (B), a horizontal dipole is shown with the transmission line perpendicular to the antenna. In this case, the perpendicular orientation requires no special attention in most cases.

standing-wave ratio (SWR) than the antenna itself has, increasing loss in the coax. To read more about the topic, see my article, "For Best Results, Consider a Balun in Your Antenna System," in the January 2013 issue of *QST*.

To reduce common-mode current, the impedance seen going down the outside of the coax, which would be in parallel with the shield-connected side of the dipole, should be at least 10 times as high as half the dipole impedance (300 Ω minimum, but 500 – 1,000 Ω would be better — or 0.5 to 1 μH). You could get that from an air-wound coil, or ferrite beads on the coax, which would be less bulky but more expensive. Two or three Fair-Rite snap-on mix 61 beads should do the trick. Select beads with an inside diameter (ID) large enough to go around the diameter of your coax (**www.fair-rite.com/product-category/suppression-components/round-cable-snap-its**).

To make a coil to provide the inductance requires knowing the cable type, which will determine the minimum number of turns per inch (TPI). The formula in section 4.3.2 of the 2020 edition of *The ARRL Handbook* should provide a starting point for winding the inductors.

Q David, K1KA, asks: For many years, all my antennas have used coaxial feed lines, however, based on some of your comments about the lower loss of balanced line, I would like to try for better SWR across 80 meters, as well as potential multiband capabilities. I also have an unused antenna tuner, which has balanced line capability. I'm concerned, however, about the physical and electrical constraints of routing the balanced cable inside my house.

I have an 80-meter dipole at about 50 feet, currently fed with RG-213 coax cable. I use a metal cable entry box with lightning arrestors for the dipole as well as four other coax cables. There is about 25 feet of additional coax cable routed through a basement area. All coaxes are in close proximity and pass near metallic objects. I have read that balanced line should be routed away from other cables and metallic objects, but I don't see a way to avoid it.

A friend is using the center conductors of two coaxial cables, each connected to one side of the window line with the shields soldered together at both ends. He has a short run of his double coax to the balanced input on his tuner. Is this transition to coax a valid way of maintaining system balance?

A Window line is a good choice, although on 80 meters the loss in mismatched coax may not be worth the effort. Still, your questions are good ones.

The usual dipole cut for the center of 80 meters will have an SWR of about 5:1 at the ends of the band. With 100 feet of RG-213, the additional loss due to mismatch will be about 0.6 dB, with a total loss of about 1 dB. Using 100 feet of #14 AWG window line with the same load will have a loss of about 0.3 dB. After taking into account tuner losses, I'm not sure you will quite break even. On the other hand, if you want to use the same antenna on all bands, it's a very different story and makes sense to use window or open-wire line and a wide-range tuner.

Window or open-wire line needs to be spaced two and a half to three times the wire spacing from lossy or metallic objects to avoid undesired effects. I usually use TV-type standoffs designed for 300 Ω TV twinlead, and put one of the window-line wires through the insulator.

Using two coax cables as a shielded balanced line can work (I used it going through a sill above my foundation), but the loss is as high as that of mismatched coax (and costs twice as much), so make it short. Mine was just a few feet long with connections to window line on each side. You are correct to solder the shields together at both ends, otherwise it won't work as you expect, and the signal will also be on the outside of the shields and still couple to the lossy material. As to the breakdown, you need to calculate the maximum voltage of the cables. Keep in mind that the cables won't be matched, so the line voltage somewhere on the line will be as high as the square root of the SWR, multiplied by the matched voltage. If all is balanced, the voltage on each will be half of the total. This makes a balanced line section that can be close to, or run through, lossy material. Note that the cables can be run together or separately, if that makes it easier, but they each need to be the same length.

Paul Mondok, AA2PM, and others wrote in with comments about my answer to AG7FF about downward pattern repeater antennas. Paul noted:

I saw the question in "The Doctor is In" from the January 2020 issue from AG7FF regarding antennas with downward radiation patterns. This is a fairly common need in mountainous terrain.

*Sinclair Technologies (***www.sinctech.com/base-station-antennas***) offers several antennas with downward elevation patterns. A friend has owned several repeater sites over the years, and had very good experiences with their products.*

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

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

Hints & Hacks

Soldering Surface-Mount Components, Turning a Cordless Phone into a Wireless Mic/Headset, and More

The Machinist Approach to Surface-Mount Soldering

I combined a couple of my hobbies (or at least the tools from them) to simplify the task of soldering surface-mount components. I use machinist double-sided tape (it holds tight, but doesn't leave any residue when removed) and a small machinist surface gauge (see Figure 1) to hold the circuit board and surface-mount components in place for soldering.

The double-sided tape holds the project board in place while the gauge gives very precise adjustment and just the right amount of force to hold the components to the board while the solder is applied.

I position the tool over the part using the gross adjustment (side screw) and then use the fine adjustment (rear screw) to contact the part and just barely lift the front of the tool. The weight of the tool holds the part in place without bending any leads. The fine tip allows the soldering iron to get to all the leads on the part.
— 73, Dave Penrose, K1DHP, **k1dhp@arrl.net**

Figure 1 — A small machinist's surface gauge is great for holding down surface-mount devices while soldering. [Dave Penrose, K1DHP, photo]

Caution with Homebrew Inductors

Like many who enjoy building their own equipment, I often need to wind various inductors. I usually wind coils with enameled wire from surplus stores or hamfests.

On one occasion, I had just completed winding a coil for a project and securing the windings with cyanoacrylate cement. But upon measuring the coil's inductance, I discovered that it was not at the value I had expected — not even close.

As I was removing the wire, I noticed the insulation was coming off in several places. I put some cement on a cotton swab and rubbed the swab on the wire. Turns out, the cement was dissolving the insulation on the wire. By using this particular cement, I was creating a coil with shorted turns.

If you're planning on using cement to hold coil windings, be sure to test it first with your chosen wire and make sure it will not dissolve the insulation.
— 73, Chris Maukonen, WA4CM, **wa4cm@arrl.net**.

A Cordless Headset and Microphone

If you have a cordless phone and a phone patch in your station, you are closer than you realize to having a voice-operated cordless headset and microphone.

I had a Panasonic 900 MHz cordless telephone with headset and Kenwood phone patch. All I needed to complete this installation was a two-line A/B switch and assorted telephone cables.

To use this telephone interface with a half-duplex radio requires the separation of transmit and receive audio into two separate paths. Combined with some switching and level adjustments, this is the major function of a phone patch. A variety of phone patch units can be purchased on eBay and from other used equipment sources in the $25 to $50 range.

Two wires (red and green for line 1) from the cordless telephone are connected to **LINE IN** of the phone patch and to the swinger of the A/B switch (see Figure 2). The A/B switch simply connects or disconnects the incoming phone line from the system. When in the A position, the wireless phone can be used as a normal telephone (with patch **OFF**), or as an actual phone patch (with patch **ON**).

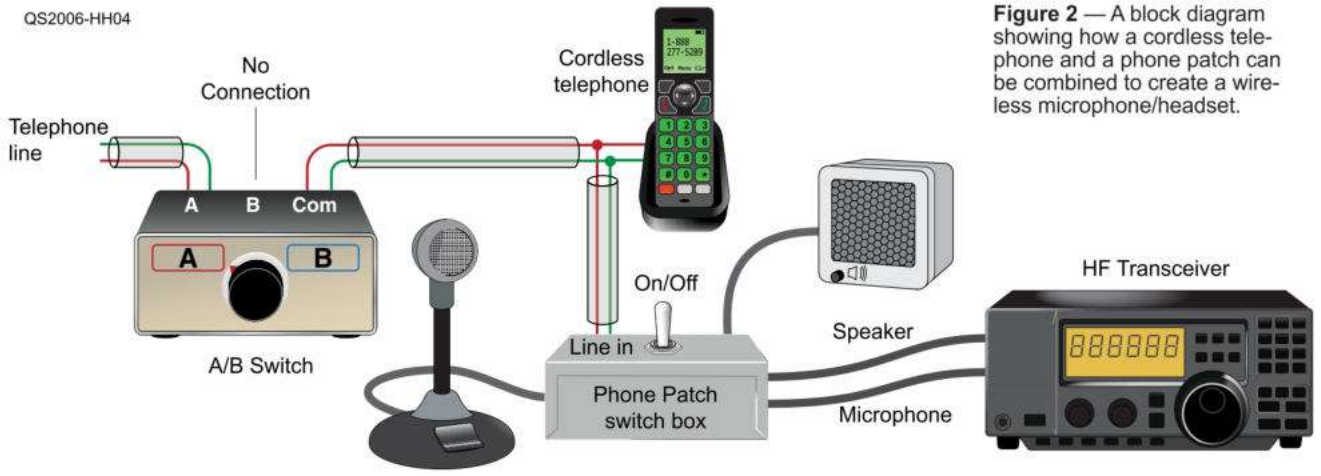


Figure 2 — A block diagram showing how a cordless telephone and a phone patch can be combined to create a wireless microphone/headset.

In position B, the local telephone instrument, patch, and HF radio are isolated from the incoming telephone line and (with patch switch **ON**) become your cordless headset and microphone.

There is no provision for push-to-talk on the cordless handset, so the HF transceiver is set for VOX mode and the **MUTE** button on the handset serves as the VOX on and off functions. All phone patch level and balance controls on the phone patch still perform normally. — *73, David Byrd, KD7VA,* **kd7va@arrl.net**

Photo Paper for Front Panels

I used my computer to create lettering for the front panel of my latest homebrew project. Since my panel was already drilled (see Figure 3), I measured carefully and made several lettering sheets. Each lettering sheet was the size of the entire front panel, with the lettering correctly positioned on the paper according to my measurements. I used Microsoft *Visio* software to create the layout on the paper, but there is nearly identical, free software called *Draw* available in OpenOffice.

I sprayed the panel with a thick layer of lacquer and let it set. While it was setting, I printed the front panel lettering on glossy photo paper. Glossy photo paper doesn't soak through like regular printer paper (I tried regular paper first and it looked awful).

When the lacquer was sticky, I set the paper on the lacquered panel and tweaked it just a bit until it was properly aligned. I then let it set and trimmed it with an X-ACTO™ knife.

The glossy photo paper makes for a nice front panel (see Figure 4). I've struggled with press-on lettering in the past, so this was much better. — *73, Roy Hansen, KL7GQ,* **wizard@cvinternet.net**

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

QST invites you to share your hints with fellow hams. Send them to "Attn: Hints and Hacks" at ARRL Headquarters, 225 Main St., Newington, CT 06111, or via email to **hh@arrl.org**. Please include your name, call sign, complete mailing address, daytime telephone number, and email address on all correspondence. Whether you are praising or criticizing an item, please send the author(s) a copy of your comments.

Figure 3 — The author's project before applying the lettering sheet. [Roy Hansen, KL7GQ, photo]

Figure 4 — The project with the lettering sheet applied. [Roy Hansen, KL7GQ, photo]

Steve Ford, WB8IMY, wb8imy@arrl.org

Eclectic Technology

LimeSDR Mini

Every so often, I stumble across cool devices that just beg for hams to scoop them up and start playing. The latest discovery is the LimeSDR Mini (see Figure 1). This tiny, affordable, software-defined transceiver operates on any frequency between 10 MHz and 3.5 GHz, with about 20 mW output. Being software defined, the operating modes are essentially up to you and whatever software you're using to run it.

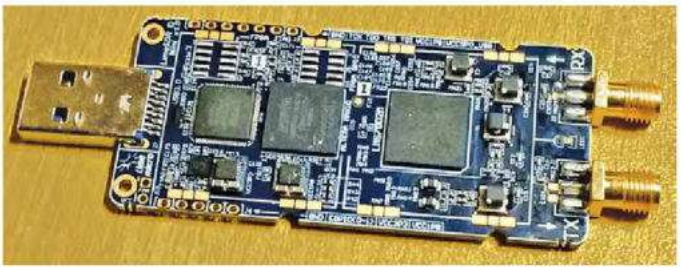


Figure 1 — The tiny LimeSDR Mini is a complete software-defined transceiver that operates from 10 MHz to 3.5 GHz.

Its big brother, the LimeSDR, has been around for several years, but the Mini is smaller in size *and* price. Don't let the diminutive form factor fool you — the LimeSDR Mini uses the same LMS7002M radio transceiver as its predecessor. The Mini has two channels instead of the four found in the LimeSDR, SMA connectors instead of micro U.FL connectors, and it features Intel's MAX 10 FPGA.

The entire transceiver comes on a 2¾ × 1 inch board with a USB connector on one end that plugs into your computer.

The LimeSDR Mini was selling at $159 when this column was written. Of course, if you opt for the starter kit or various enclosures, you'll pay more. It is available at **www.crowdsupply.com/lime-micro/limesdr-mini**.

WSJT-X for the Visually Impaired

Rich Zwirko, K1HTV, passed along a tip about a free logging program that offers support for the visually impaired without having to resort to screen-reading software such as *JAWS*. The application is known as *QLog* and has been around for a while. There are versions for Windows, MacOS, and Linux (see Figure 2).

The most interesting development, however, is the introduction of a new version of *QLog* that supports the *WSJT-X* software suite for operating FT8, FT4, and other digital modes.

When working with *WSJT-X*, operators can use the *QLog* voice commands to search for a vacant area in the waterfall display, call CQ, call a specific station, and more. The hassle of setting up the assistive features is the only drawback. There is a considerable learning curve and, according to Rich, it requires the help of a sighted amateur.

Rich has been working on improvements to the documentation and he said that *QLog* version 1.0.2.190 is working well, with no known bugs. In fact, *QLog* now supports the Fox/Hound mode used by many DXpeditions as well as a number of special operating events such as Field Day. At the end of each contact, the data can be automatically uploaded if the user has accounts at eQSL, QRZ, Club Log, or Logbook of The World.

The software documentation is available in the **FILES** section of the *QLog* Users Group at **groups.io/g/QLogusers**. You'll need to join the group, but access is free. You will also find *QLog* on GitHub at **github.com/7h0ma5/QLog**.

Figure 2 — *QLog* offers support for the visually impaired and will now work with the popular *WSJT-X* software suite.

W1AW Schedule

PAC	MTN	CENT	EAST	UTC	MON	TUE	WED	THU	FRI
6 AM	7 AM	8 AM	9 AM	1300		FAST CODE	SLOW CODE	FAST CODE	SLOW CODE
7 AM-1 PM	8 AM-2 PM	9 AM-3 PM	10 AM-4 PM	1400-1600 1700-1945	VISITING OPERATOR TIME (12 PM-1 PM CLOSED FOR LUNCH)				
1 PM	2 PM	3 PM	4 PM	2000	FAST CODE	SLOW CODE	FAST CODE	SLOW CODE	FAST CODE
2 PM	3 PM	4 PM	5 PM	2100	CODE BULLETIN				
3 PM	4 PM	5 PM	6 PM	2200	DIGITAL BULLETIN				
4 PM	5 PM	6 PM	7 PM	2300	SLOW CODE	FAST CODE	SLOW CODE	FAST CODE	SLOW CODE
5 PM	6 PM	7 PM	8 PM	0000	CODE BULLETIN				
6 PM	7 PM	8 PM	9 PM	0100	DIGITAL BULLETIN				
6:45 PM	7:45 PM	8:45 PM	9:45 PM	0145	VOICE BULLETIN				
7 PM	8 PM	9 PM	10 PM	0200	FAST CODE	SLOW CODE	FAST CODE	SLOW CODE	FAST CODE
8 PM	9 PM	10 PM	11 PM	0300	CODE BULLETIN				

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

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

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

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

Code bulletins are sent at 18 WPM.

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

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

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

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

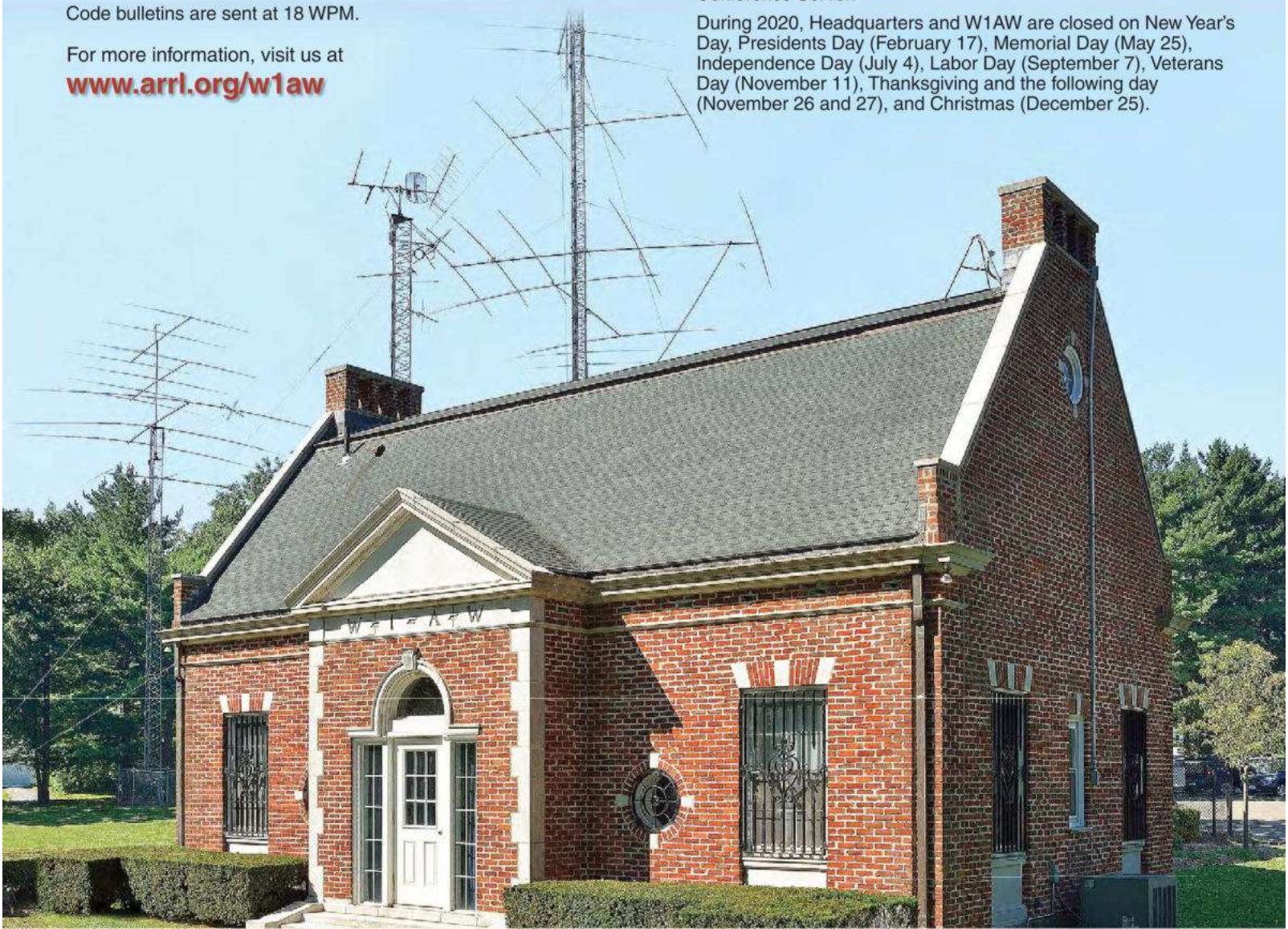
Keplerian elements for many amateur satellites will be sent on the regular digital frequencies on Tuesdays and Fridays at 6:30 PM Eastern time using Baudot and PSK31.

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

♦ Notes: On Fridays, UTC, a DX bulletin replaces the regular bulletins. W1AW is open to visitors 10 AM to noon and 1 PM to 3:45 PM Monday through Friday. FCC-licensed amateurs may operate the station during that time. Be sure to bring your current FCC amateur license or a photocopy. In a communication emergency, monitor W1AW for special bulletins as follows: voice on the hour, teleprinter at 15 minutes past the hour, and CW on the half hour.

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

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



Students Engineer Desert Rovers

AZARA, a youth-led amateur radio program in Arizona, holds an annual robotics and radio science competition.

Heather Caton, W8GEM

Two years after a radio contact with the International Space Station, student members of the youth-led Arizona Amateur Radio Association (AZARA) are still chasing their fascination with the combination of radio science and space research. On March 6, 2019, 28 students from communities along both sides of the Colorado River in Arizona and California gathered for their second annual Desert Rover Robotics and Radio Science competition at the Desert Preparatory Academy in Blythe, California.

Sparking Their Own Imaginations

Founded about 4 years ago as part of the World Genesis Foundation (**www.worldgenesis.org**), AZARA's membership includes 100 young ham radio operators from La Paz County, Arizona, and Riverside County, California. The youth lead the organization, decide its future, and participate in many types of amateur radio and space science projects. After earning their Technician-class license, the youth in each community vote on the next semester's project in their local school and community. The only requirement is that any project they choose must include some aspect of amateur radio science. Projects can involve electronics, digital radio, robotics, computer science, or HF radio.

For the 2019 school year, the students voted to build and operate a mini Mars rover. So, for 6 months, students in schools across the region started learning, planning, building, testing, and developing their own desert rovers, not from a kit, but from a blank piece of paper and their own imaginations.

Building Community Support

Their rovers — named Integrity and Echo — used amateur radio and the students' own circuit board design for remote control of navigation and to activate onboard systems like headlights, speed control, and payload power. The rover control systems operated in the experimental portion of the 2-meter band, managed call sign identification, and used 5.8 GHz modules for video monitoring. Only limited by the transceivers used, their design supported a maximum range of 1-mile explorations.

During development stages, student scientists built community support through technical presentations of the systems, software, and rover payloads they developed for the event. In the 2 months leading up to competition, the youth leaders field tested and demoed the rovers, and taught hundreds of ham radio operators how to drive and operate their rovers at the 2019 Quartzfest ARRL Convention in January and at the La Paz County Family Preparedness Expo in February.

Nicolas, KM6HFZ, and David, KI7CUN, working on Mission Control software.

Competition Day

On competition day, students had to explore an artificial planet built for the event. The simulated planet was assembled by the local Desert Waves Amateur Radio Club and included art dioramas made by students, mazes, navigation challenges, special missions, alien life forms, a 400-cubic-foot cave filled with fluorescent life, and other surprises.

Teachers, parents, news media, and special guests watched as our young scientists completed tasks with their desert rovers. They worked from two separate remote mission control centers, using only the amateur radio and remote video capabilities they built into their rovers. The students used a third mission control center, for their rover named Explorer, to challenge their rover piloting skills and speed to navigate an indoor obstacle and racecourse.

Something to Inspire Every Student

Because the program is youth led, participants decide what their group will learn about and in what capacity they will contribute to the project. While 28 students traveled for the competition, more than 50 students were active in the hands-on design, development, and programming of the desert rovers and their systems, all based upon their individual interests and skills.

Throughout the 6-month program, students migrated to specialize and participate in different parts of the project. The combination of amateur radio and robotics offered youth the opportunity to engage in mechanical design, electronics, mathematics, radio science, computer programming, art, and more.

Mechanical Design

Students working on the mechanical design elements learned about options for their robot chassis and assembly of the final designs. They chose a tracked vehicle with a chassis that would easily accept the electronics, batteries, and other equipment they needed for their desert rovers. The mechanical assembly and preparation of the chassis required almost four classes to complete.

Electronics

Every student designed their own modular payload to be attached, powered, and remotely controlled on the rovers. This was the event's first year with a payload, but it allowed for all students to become actively involved. At a minimum, every student's payload had to include multicolor LEDS, a motor, an associated schematic circuit, and presentation of their design. Mounting components, soldering, and wiring the rovers' different switches and modules was a significant task, taking 10 to 12 classes to complete the final wiring.

Seth, KM6YQZ, teaching how to drive the rovers at a local Expo.

Art

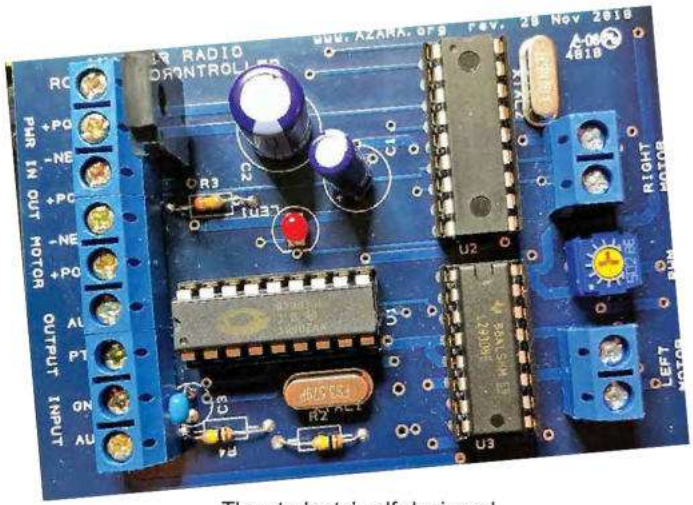
Artistic expression became a growing part of the project as students prepared presentations and exhibits, labelled and decorated rovers, designed payloads, and built dioramas for the artificial planet. Student participation became so significant that art became a competitive part of the competition.

Joe Lewellen, K7JEL, and students show off the finished Integrity rover.

Breadboarding and Printed Circuit Board (PCB) Design

Taking the electronics aspect farther than we anticipated, the students developed and tested breadboard designs of their own circuit, which they called an Amateur Radio Robotics Controller (ARRC). Students were so invested, they chose to take their breadboard to a production circuit board using the free software tool *PCB Artist*. Two weeks later, the students' commercially produced boards arrived, were assembled, and worked perfectly.

Their ARRC is now the heart of all the Desert Rovers. It can receive audio from any radio transceiver with dual-tone multifrequency (DTMF) capability, processes the tones into commands for navigation or control of the rover, and tells the chassis motors how to operate, using command signals and pulse-width modulation. The controller also includes a built-in 5 V, 2 A supply for powering payloads and can also manage call sign identification.



The students' self-designed amateur radio robotics control module.

Science and Math

Throughout the design process, the students were challenged to apply science and math in practical ways. They learned about battery technology, calculating battery life, electronic modules, microcontrollers, preparing parts for machining, pulse-width modulation, and Ohm's law, all to determine the best way for them to power and control their rovers. The students used what they learned to conserve battery power, doubling the operating time up to 65 minutes for Integrity and Echo (using a 2,200 mAh LiPo battery) and over 2.5 hours for Explorer (using a 5,500 mAh LiPo battery).

MCU Programming

For the first time, we integrated microcontroller (MCU) programming and windows software programming into the project. Several students learned programming MCUs using MeLabs PicBasic Pro. The three main chips on the students' robotic controller board included a DTMF Decoder, a Pic MCU, and a motor driver. The students got the robotic controller operating and fine-tuned, and the result was a 32-line program that would interpret DTMF signals from any radio and change them to rover control signals for direction and pulse-width modulation.

A.C. Fulcher, N4SVD, assisting students with chassis assembly.

Partnerships with Local Schools

With students spread across thousands of square miles of the Sonoran Desert, teaming up with local schools was essential for the program to succeed. Offering the project as part of the in-school curriculum or as an after-school activity, the students have a better opportunity to participate. Additionally, the inspiration and motivation from the teachers is essential, offering a safe, secure, and supervised environment for students. The schools also benefit because amateur radio addresses dozens of common-core requirements, supports enrichment programs, and incorporates concepts from many subjects.

Keeping the Spark Alive

Programs like the Desert Rovers bring our communities closer. The projects would not be possible without the cooperative effort and support of Cactus Intertie Inc., the Desert Waves Amateur Radio Club, the Quartzsite Amateur Radio Association, and the Industrial Development Authority of La Paz County. A.C. Fulcher, N4SVD; Joe Lewellen, K7JEL, Dave Anderson, K1AN, all technical mentors for the program, were also critical to our success. They used their technical knowledge to guide the students, but even more, they positively challenged the students to learn and help themselves and each other.

Our program provides social and learning connection for our youth that might otherwise be unavailable. This is a wonderful opportunity for the students to take an idea from design to development, creation, and implementation. We hope that it will spark lifelong learners and interest in science and radio technology.

Windows Programming

Nicolas Lindbergh, KM6HFZ, and David Poole, KI7CUN, used Microsoft Visual Studio to build a Windows computer program to control and observe their rovers from a single computer screen. The computer program generated the audio of a call sign and duplicated the sounds from the DTMF radio keypad. The students then fed the audio into a handheld radio in VOX mode, and the rovers responded. Nicolas and David used mathematical slope and combinations of tones to precisely and smoothly navigate the rovers with the computer mouse. All of the students in the competition used the software from Mission Control.

All photos by the author.

Heather Caton, W8GEM, is the president and CEO of World Genesis Foundation. She has a Bachelor's degree in art education and psychology, and a Master's in social work, with an extensive background in local and international educational settings. She can be reached at **Heather.Caton@WorldGenesis.org**.

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

Where Are They Now?
The Novices of 1970

Fifty years ago, the faces of nine young amateurs appeared on the cover of *QST*. We decided to track them down and see what they've been up to.

Steve Ford, WB8IMY

The June 1970 cover of *QST* celebrated the Novice Roundup Contest by featuring photographs submitted by nine participants. In the April 2020 issue of the magazine, we reproduced this cover as part of our "A Look Back" section.

As we were preparing the half-century-old cover image, we wondered if any of those young Novices still had their amateur radio licenses today. We decided to find out.

We knew our detective work wouldn't be easy. Assuming they had upgraded their Novice licenses, their call signs would have changed. And as they aged into adulthood, there was a strong probability that they would've relocated and changed their call signs again — perhaps multiple times.

Of course, all of this assumes that they had remained in the hobby in the first place. We spent considerable time paging through old editions of the *Radio Amateur's Callbook* and searching online call sign databases. We also sifted through public records when call sign histories failed to provide the necessary clues.

Reaching Out

To our astonishment, we were eventually able to dig up contact information for each of the Novices shown on the cover. What was even more astonishing is the fact that they had *all* retained their amateur radio licenses.

Most of the former Novices had access to email, so we reached out and asked if they could provide current photographs and brief stories. In a few cases, we had to resort to postal mail to make contact.

The results were gratifying. Of the nine amateurs we attempted to contact, seven responded and said they would be happy to participate in a retrospective article for this issue. In numerical order, clockwise from upper right corner of the cover, here are their stories.

1 Larkin Crutcher, WN5WOW — Now WA5WOW

Larkin has remained an active amateur continuously since 1969. He credits amateur radio for introducing him to a love of electronics that eventually turned into a career.

"After high school, I went on to get a degree in electrical engineering," he said. "I've spent my career designing and building RF/microwave and fiber optics circuits and systems. In fact, my first job out of college was working at Rockwell Collins, where I was involved in 6 and 12 GHz waveguide component design. I also did work on quadrature amplitude modulation (QAM) radio systems."

Today, Larkin is retired and spends time restoring vintage tube equipment. He is currently restoring two Collins R-390As and a Collins R-388. He also does repair work on test equipment.

When he isn't enjoying international travel with his wife or working in his repair shop, Larkin gets on the air with various activities, primarily on the HF bands.

2 John Fore, WN2HID — Now W6LD

John is active in amateur radio today, although it hasn't always been that way. His current pursuits include building and maintaining the club station at Stanford University, W6YX, as well as a small contest station in Aruba (P4ØL/P49Y; previously P49V), which he has co-owned with Andrew Faber, AE6Y, since 2003.

John says that once he turned 16, he began spending all his free time working at a local electronics/stereo store, which greatly reduced the time available for amateur radio. As a result, he became inactive.

After a long hiatus, John finally returned to the hobby. He said, "I got restarted in amateur radio when I stumbled across the club station at Stanford University while living on campus as a Resident Fellow in the 1980s. I started testing the waters in various contests and eventually connected with the terrific community at the Northern California Contest Club."

John spent his career in Silicon Valley, primarily with technology start-ups and other growth companies as an outside lawyer in finance (including IPOs), mergers and acquisitions, strategic and other business transactions. Today, he is preparing to retire and looks forward to traveling, contesting from Aruba, and sailing (his other hobby).

3 Greg Carter, WN4OPG — Now KX4R

Greg was first licensed in October 1969 at age 15 and has been on the air ever since. He has also been an ARRL member continuously since then.

Greg became a General-class licensee as WB4OPG in 1971. He earned his Advanced-class license the following year and clinched his Amateur Extra in 1978. In 1980, his call sign changed to KX4R.

Upon graduating high school in 1971, Greg attended Georgia Tech University in the hope of earning an engineering degree. However, life had other plans. Greg said, "To help with my expenses at college, I got a job at UPS in 1973 and ended up staying there until my retirement 37 years later in 2010!"

Greg operates, as he explained, "on all bands, 160 meters through 23 centimeters, mainly DXing and contesting. I also collect and restore old tube gear."

CW is Greg's mode of choice, but lately he has been trying some digital modes. "I'm still as fascinated with radio communication today as I was when I was a Novice. Through the years, I have accomplished DXCC #1 Honor Roll (2002), 10-band DXCC, DXCC Challenge Award (2,826 worked), DXCC Phone (only BS7 needed), DXCC CW (only P5 needed), and have accumulated a pretty good collection of vintage equipment from the 1930s to the '60s, which will provide me with enough projects to keep me busy for another 50 years."

4 Richard Davis, WN9ZAZ — Now N3FDR

Rick is still an active amateur, "but not nearly as much as I would like. My work schedule has only gotten more intense over the last 5 years or so." When time permits, Rick enjoys participating in traffic nets, occasional public service communications support, as well as casual contesting and DXing.

His career has been in the arts, primarily theater, and in higher education. He said, "I got into theater at a very young age through stage lighting, because of my ham radio and electronics interests."

Rick retains his love of the hobby and has many fond memories of his Novice days. "Being a ham has been a nice slice of my life since those early days — off and on, to be sure — but I still 'speak' Morse code fluently, and the early education in electronics still helps me understand things about the world today," he shared. "My older brother, Scott, K5TA, who got me into radio back in the late '60s, is a serious contest operator and I've worked him once or twice in Sweepstakes, but I get nervous that I'll slow him down!"

5 Richard Masak, Jr., WN8EIZ — Now WB8EIZ

Although Richard has been continuously licensed since 1969, holding five different call signs in the process, he has been off the air since about 1990.

"Circumstances and other interests took priority over ham radio through the years," he explained. "When my wife, Brenda, and I moved to San Diego in 1987, our backyard was extremely small, but I did strap a Hy-Gain vertical antenna to a chain-link fence along a canyon rim. After a while, I lost interest and finally took it down and put it away. Desert camping, mountain biking, hiking, and Baja, Mexico exploration took a front seat to staying home in front of a radio."

Richard found work in the electronics industry for nearly 20 years. He said, "I have been employed by small companies and large corporations alike. My initial involvement was with Intel 8080 microprocessor diagnostics support for wall-mounted energy management systems." He also spent 4 years in the US Navy in the 1970s, and was more recently employed in retail for a number of years.

Today, Richard is retired and enjoys making and flying kites. "I have yet to use a kite as a sky hook for an HF long-wire antenna, but the thought does cross my mind every now and then," he said. He keeps his amateur radio license current in the hope that someday the bug will bite once again.

6 Craig Saunders, WN3NPS — Now WA3NPS

After 50 years, Craig is no longer active in amateur radio, but he still owns a small handheld transceiver. In addition to keeping his license current, Craig considers owning a handheld as his way of maintaining a small stake in the hobby. He said, "I still turn the radio on occasionally, just to listen."

At the time his photo was taken for the June 1970 *QST* cover, Craig was an active Novice and involved in his high school amateur radio club. "I made a friend in the club and we've remained lifelong pals."

7 Tim Kresky, WNØYMK — Now ABØS

Tim Kresky has been off the air for only 3 years during the last 5 decades. "The longest time away was in my late teens, when amateur radio was replaced by school, work, girls, and partying," he said.

Today, Tim is involved in contesting, mainly on the HF bands with CW and RTTY. He also enjoys casual FT8 and FT4. He explained, "I go hard with Sweepstakes, both SSB and CW, as part of the longstanding WØNO, KØWA, and ABØS multioperator team. I also love the CW North American QSO Parties and Sprints." Tim is a proud member of CWops and the Deep Dixie Contest Club.

He didn't pursue a career in electronics, but instead earned his undergraduate degree in accounting and acquired his Master's in business administration. Today, he is the financial controller for one of many factories owned by an international farm equipment manufacturer.

"I've been a ham since 1969 and married since 1975, with two grown children," Tim said. "While they all appreciate and support my hobby, none have an interest in it. I live in a small town with a 30-foot limit on antenna heights, so my home station is limited to a multiband vertical antenna."

Thanks to QST *Production Coordinator Maty Weinberg, KB1EIB, for providing the inspiration for this article, and to* QST *Production Designer, Jodi Morin, KA1JPA, for her work in bringing the 50-year-old cover back to life.*

Steve Ford, WB8IMY, is the *QST* Editor. You can contact him at **sford@arrl.org**.

Where Are *You* Now? Tell Us!

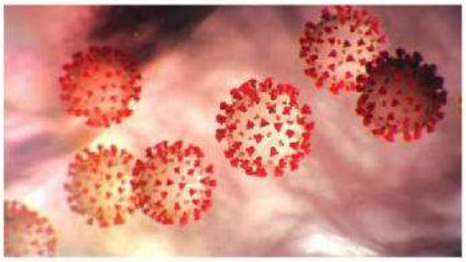
Maybe you're the same age as these hams, with similar "before" and "after" photos. Take a minute to write to us about what you were doing in ham radio 50 years ago, and send it, along with a photo of your "good old radio days," to **celebrate@arrl.org**. Selected stories may appear in *QST*'s monthly "Celebrating Our Legacy" column.

Rick Lindquist, WW1ME, ww1me@arrl.org

Happenings

Most Ham Radio Gatherings Fall Victim to COVID-19

The COVID-19 pandemic has devastated the amateur radio convention, show, and hamfest schedule, along with many other events on the calendar that would have placed participants in proximity to one another. Dayton Hamvention® was canceled for the first time in its 68-year history. The news was not entirely unexpected, given widespread cancellations of public gatherings and a national state of emergency. Concern over COVID-19 also led to the cancellation of the 2020 International DX Convention (Visalia), held in late April. Others included SEA-PAC in Oregon, which was to host the ARRL Northwestern Division Convention this year. HamXposition in Massachusetts, home to the New England Division Convention, was postponed until November.



Europe's premiere show, HAM RADIO in Friedrichshafen, Germany, canceled in mid-April. Ham-Com, set for June 12 – 13 in Plano, Texas, was holding firm as of mid-April, but closely monitoring the situation.

Some ham radio events were quickly reworked as virtual events. That list included the HamSCI Workshop on March 20 – 21. "We actually got many more participants than had we just held it in person," organizer and University of Scranton Professor Nathaniel Frissell, W2NAF, said.

After suspending tours and guest visits, ARRL Headquarters closed after a stay-home order was issued. Most Headquarters staffers successfully transitioned to a work-at-home protocol. The May issue of *QST* went out to subscribers on schedule. Stay-home decrees also severely impacted the administration of amateur radio exams by Volunteer Examiners (see "Remotely Administered Amateur Exam Systems Showing Promise.")

The International Amateur Radio Union (IARU) advised those taking part in the IARU HF World Championship on July 11 – 12, to take the global COVID-19 pandemic into account. The IARU called on multioperator and IARU member-society HQ station operations to adhere strictly to regulations and physical-distancing guidelines issued by the responsible health authorities and the World Health Organization (WHO) in effect at the time of the event — even if observing those guidelines is not legally required at their locations. This requirement also applies to single-operator stations, and especially to those hosting guest operators.

The annual Armed Forces Day Crossband Test was postponed, due to the coronavirus pandemic. Test planners were considering rescheduling the event to November.

A COVID-19 news and information clearinghouse is available on the ARRL website at **www.arrl.org/arrl-news-coronavirus-covid-19**.

Remotely Administered Amateur Exam Systems Showing Promise

Facing a growing demand for amateur radio exam sessions in a time of social distancing and stay-at-home orders, sponsors of some Volunteer Examiner (VE) teams are developing systems to remotely proctor test sessions.

"Many of our VEs and VE teams have been working on remotely proctored exam session ideas, employing both video and in-person components — following social distancing protocols," ARRL Volunteer Examiner Coordinator (VEC) Manager Maria Somma, AB1FM, said. "We have been receiving interesting and innovative suggestions, and we appreciate the dedication and ingenuity our examiners have shown."

The Spalding County Amateur Radio Club in Georgia is among those that have come up with plans to remotely administer amateur exams while complying with ARRL VEC testing standards during COVID-19 stay-home mandates and social distancing guidelines. Current systems leverage Zoom video-teleconferencing technology, the "Fill & Sign" feature of Adobe PDFs, reliable email,

appropriate computer equipment and internet connection, and no volunteer examiners (VEs) present at individual remote test sites. The Georgia club collaborated and shared ideas with the Emergency Amateur Radio Club (EARC) in Hawaii, which has successfully conducted sessions since 2011 with its own remote testing system, initially with paper exams and an on-site proctor, and now with fillable PDFs, and no on-site proctor.

"We started with testing just one candidate at a time but are planning to ramp up to multiple candidates — probably two or three — simultaneously," club member David Robinson, K4WVZ, told ARRL in mid-April.

The club's procedures entail a pre-exam video interview with candidates to ensure they understand all the requirements and procedures.

New England Amateur Radio Inc (NE1AR), an affiliate of New England Sci-Tech, (NESciTech), has taken it one step further, Somma said, employing "completely online testing with strict rules and protocols for maintaining the integrity of the testing environment." NE1AR is limiting candidates to one exam per session, due to the backlog and the "difficulty of administering exams online." Candidates must agree to a list of protocols, which includes a cell-phone camera scan of the entire room and exam area.

NE1AR President Bob Phinney, K5TEC, told ARRL, "We have now tested 12 applicants and are still working on streamlining the process. We are working with the software developer of the exam delivery system to help them adapt the system for video-supervised testing."

With pressure continuing to build to provide testing compatible with COVID-19 guidelines and stay-home orders, ARRL VEC Manager Maria Somma, AB1FM, has asked the amateur radio community to be patient. "Please remember that with the introduction of significant new processes such as these, that there should be proof of concept, establishment of protocols and procedures, and beta testing before expanding to a larger audience," she said, allowing that video-supervised exam sessions require a different skillset than in-person exam administration.

"ARRL is pleased to be one of the leaders in providing an opportunity, although limited initially, for video-supervised exams in this time of social distancing and isolation required by the current health situation," Somma said.

ARRL Calls for Continued Coexistence in 3.4 and 5.9 GHz Bands

In comments filed on March 9, ARRL said that while the FCC has not proposed to alter the secondary amateur allocation at 5.850 – 5.925 GHz, changes the FCC has proposed for other users "will constrain current and future amateur operations" in that band, if the proposals are adopted. Amateur radio shares the 5.850 – 5.925 GHz band on a secondary basis with Dedicated Short-Range Communications (DSRC) systems and the 5.850 – 5.875 GHz segment with industrial, scientific, and medical (ISM) applications. ARRL's comments were in response to a *Notice of Proposed Rule Making* (*NPRM*) in WT Docket 19-138, in which the FCC said it would "take a fresh and comprehensive look" at the rules for the 5.9 GHz band and proposed to make the lower 45 MHz of the band available for unlicensed operations and to permit vehicle safety systems in the upper 30 MHz of the band. "This proceeding is of concern to radio amateurs across the country, because many of the operations carried out in this band are similar to those conducted in the 3.4 GHz band, from which the Commission, in a companion proceeding, is proposing to evict radio amateur operations," ARRL said.

FCC Grants Temporary Emergency Authority to WISPs Operating in 5.8 GHz Band

In March, the FCC granted temporary permission to wireless internet service providers (WISPs) in rural portions of 29 states and the US Virgin Islands to operate in the 5.8 GHz band (5.850 – 5.895 GHz). The authorizations were aimed at meeting temporary surge in demand for residential fixed broadband services during the COVID-19 pandemic. Amateur radio shares this spectrum on a secondary basis.

The FCC advised applicants of their obligation to protect incumbent users of the 5.8 GHz band from interference. According to the request, each WISP provides fixed wireless broadband service in rural areas, primarily relying on unlicensed spectrum for last-mile connections.

New Volunteer Monitor Program Is Up and Running

After kicking off on January 1, the new Volunteer Monitor Program (**www.arrl.org/volunteer-monitor-program**) has ramped up to operational status. A "soft rollout" began on February 1, designed to familiarize Volunteer Monitors (VMs) with issues on the bands and to put into practice what to report (and what to ignore), based on their training. The VMs will not only be looking for operating discrepancies, but for examples of good operating. The VM program has, at least for the moment, put Riley Hollingsworth, K4ZDH, back in the center of amateur radio enforcement as the Volunteer Monitor Coordinator (VMC). He was brought aboard to get the program up and running; ARRL will eventually take over the VMC function.

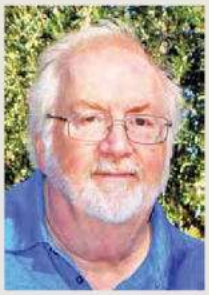
Hollingsworth is using a system called *VMTRAC* — developed by a VM — to measure the work of VMs and determine instances that qualify for good operator or discrepancy notices, referral to the FCC, or follow-up with FCC requests to the VM program. Hollingsworth reported that during March, the 165 active VMs logged upward of 2,300 hours of monitoring on HF, and nearly 2,000 hours on VHF-UHF and other frequencies.

Two VMs constantly monitor FT8 watering holes and have developed programs that alert them if a licensee is operating outside of license privileges or with an expired license. "We have 30 open cases, five of which are good operator cases," Hollingsworth said. "Regarding open cases relating to rule violations, none have yet had to be referred to the FCC." He said he's experimented with letters, telephone calls, or emails to the subjects of discrepancy reports where they could be identified. One case "being groomed for FCC referral," he said, involves long-standing interference to a repeater in the Philadelphia area by someone using an unauthorized call sign. Hollingsworth said he worked with net control operators of nets on 75 and 40 meters that had been suffering serious interference, and so far the solutions are working.

"It is becoming apparent that if informal contact can be made by the VMC with a known offender, the problem can sometimes be stopped," Hollingsworth said. "We do not want to call upon the FCC unless absolutely necessary."

In Brief...

- **ARRL President Rick Roderick, K5UR, has appointed Edward J. "Ned" Stearns, AA7A, of Scottsdale, Arizona, as ARRL Southwestern Division Vice Director.** He succeeds Mark Weiss, K6FG, who resigned. Stearns has held the post previously. He served as Southwestern Division Vice Director for 2005 – 2006 and again for 2017 – 2019.



- **The FCC has levied an $18,000 fine on a Louisiana licensee.** In an enforcement case prompted by complaints filed in 2017, the FCC has imposed an $18,000 forfeiture on Jerry W. Materne, KC5CSG, of Lake Charles, Louisiana, for intentional interference and failure to identify. The FCC had proposed the fine in a *Notice of Apparent Liability* (NAL) in July 2018 and affirmed the fine in a March 12 *Forfeiture Order* (FO). As the FCC recounted in the *FO*, an FCC agent "observed Materne causing intentional interference to a local repeater by generating digital noise into an analog radio." The agent further reported that Materne failed to transmit his call sign, as required.

- **Past ARRL Atlantic Division Director Bernard E. "Bernie" Fuller, N3EFN, of Saegertown, Pennsylvania, died on April 2.** He was 86. Fuller moved into the Atlantic Division Director's position in 2000, after the ARRL Board elected then-Atlantic Division Director Kay Craigie, WT3P (now N3KN), as a Vice President. Fuller served as an ARRL Director until 2006.

- **Past ARRL Treasurer James E. "Jim" McCobb, Jr., K1LU (ex-K1LLU, W1LLU), died on April 1.** An ARRL Life Member, he was 77. McCobb served as ARRL Treasurer, a volunteer post, for nearly 32 years, from 1980 until 2012. A US Air Force veteran, McCobb was first licensed at age 16 and very active on HF.

Rick Palm, K1CE, k1ce@arrl.net

Public Service

Pandemic Response and Morale Considerations

In the April column, when I wrote about a simulated emergency exercise involving an epidemic caused by a virus, I didn't imagine I'd be writing about a real virus just a few months later. In this month's column, I'll share some actions we can take against elevated risk and morale deficits in the context of a pandemic, such as COVID-19.

A mechanical ventilator control head, designed by medical professionals with the assistance of radio amateurs. [Photo courtesy of Dr. Gordon Gibby, KX4Z]

Social Distancing Doesn't Have to Mean Isolation

Social distancing is part of being a radio amateur: we can talk by radio instead of in person. ARRL Northern New Jersey Section Public Information Coordinator Ed Efchak, WX2R, reported that the Fair Lawn Amateur Radio Club (FLARC), a 60-year-old public service-oriented club, is holding a nightly health and welfare net for the duration of the COVID-19 outbreak. The net is self-directed and all amateurs are welcome to check in, stay in touch, and pass along information. John Bloodgood, KDØSFY, Emergency Coordinator and Public Information Officer for Pikes Peak ARES® (Amateur Radio Emergency Service) in Colorado, said that prior to the state's governor issuing a statewide stay-at-home order, Pikes Peak ARES began hosting a similar daily health and welfare net with the same mission.

Evan Esaki, WH6ECG, the Windward Oahu ARES® District Emergency Coordinator in Hawaii, wrote, "Since normal communications infrastructure is working fine, we saw as our current role the provision of accurate information and comfort/social contact via radio to the ham community."

International Amateur Radio Union (IARU) Region 2 President Ramón Santoyo, XE1KK, affirmed that, "amateur radio offers a unique way for us to maintain our social contacts while remaining physically separate from each other." He indicated that many clubs and national societies are activating nets to be prepared to supplement communications should regular telecommunications become less able to meet demand. Santoyo recommended that Region 2 (the Americas) radio amateurs get on the air to check equipment, update skills, learn something new by trying a new band or mode, and expand their circle of friends.

In response to international emergencies such as the COVID-19 pandemic, leaders of ARES and other amateur radio emergency communication support groups must consider safety above all else when contemplating any response. Much of the load can be handled by home stations and Community Emergency Response Teams (CERTs) with neighbors using personal radio services, while maintaining social distancing or even complying with stay-at-home orders.

Check with your ARRL Section Manager or Section Emergency Coordinator for more information.

Emergency Communications Planning During a Pandemic

While telecommunications infrastructure may remain physically intact and the internet may continue to handle the load, a communications emergency during a pandemic can quickly develop when the critical personnel available to operate it become ill and unavailable to work. The ensuing emergency presents the need for alternative communication services, including the Amateur Radio Service. This situation presents special challenges. For example, there are potential critical personnel shortages that may last months; ARES, Radio Amateur Civil Emergency Service (RACES), Auxiliary Communications Service (ACS), and other groups may face their own personnel shortages; mutual assistance such as ARES Mutual Assistance Teams (ARESMAT) may not be available because of the geographic scope of the pandemic; demand for communications for food and medicine delivery and medical emergency support functions may require more resources than the alternative communications services can provide, and the pandemic situation may present psychological stressors.

During a pandemic, the focus of radio amateurs should be on wellness checks and other needs assessments of neighbors (conducted at safe distances or even while quarantined at home), which can be done via personal radio services. Amateurs support connectivity with what the Federal Emergency Management Agency (FEMA) calls the whole community (not just traditional agencies) and safely try to meet its expectations for an extended period of time until normal communications can resume.

Health Monitoring

Self-observation, self-monitoring, and monitoring others for evidence of physical and mental health issues are essential in a pandemic — fatigue and stress can lead to immunosuppression. A healthy radio amateur (and asset to the community response) can't assist with these efforts if they become sick.

Amateurs Assist with Solutions

Erik Westgard, NY9D, the Medical Communications Coordinator for the Medtronic Twin Cities Marathon in Minnesota, said, "The most compelling photo I've seen on the current status of COVID-19 was from a New Jersey hospital's parking lot of a telemedicine kiosk (with a video camera and screen on a cart) in a tent. The patient sits in front the camera and is evaluated for symptoms, keeping the facility and provider remote and safe, with the patient getting to see a real doctor." Westgard's amateur radio team has high-speed data capabilities that could help support a dozen or more similar triage stations with high-definition video.

It's not just communications acumen, it's also technological ingenuity that amateur radio operators bring to the table. A team of hams are assisting an engineering team at the University of Florida in the quest to rapidly develop an open-source, low-cost human patient ventilator that can be built anywhere in the world from PVC pipe and common lawn sprinkler valves. The radio amateurs are teaming up to create the Arduino-based control software that will set the respiratory rate and other key parameters to adjust the ventilation of critically ill patients during this public health crisis.

Field Organization Reports

March 2020

Public Service Honor Roll

This listing recognizes radio amateurs whose public service performance during the month indicated 70 or more points in six categories. Details on the program can be found at **www.arrl.org/public-service-honor-roll**.

522
WA7PTM

457
W7PAT

440
N9VC

431
WS6P

415
KD8TTE

335
WA3EZN

319
KE8BYC

260
KW9EMG
ND8W

255
N5MKY

227
AD8CM

226
WA2CCN

220
KK4PUX

195
KD8UUB
KØIBS

180
N8SY

173
KT4WX

165
N2WGF

160
W2PH
WC4FSU

157
KD2LPM

155
KC8WH

150
W4DNA
WD8USA

143
WØPZD

141
K3FAZ

140
W8DJG
KØRCJ
K4IWW
KK3F
KB8RCR

135
WB9WKO
W3YVQ

134
ALØY

132
N2LJM

131
KB3YRU

130
WØLAW
KW1U
NA7G
AC0KQ
KA9QWC
N1LL

128
KY2MMM

125
W4CMH
AG9G
W9GRG
KD8ZCM

120
W4NWT
WA4VGZ
AD4DO
K9LGU
N3KRX
K3JL
KY2D

N7IE
W7EES
WA4VGZ
N4NWT
WK4WC
W4TTO

118
KA8ZGY

115
W2PAX
KØPTK

112
K8AMH

110
W1KX
K6HTN
KO4OL
WB8YLO
N2DW
N1RVY
N1IQI
KD2JKV
KA5AZK
KF5IOU
AA7BM
K3IN
WA3QLW
WB8TQZ
K2RMF
KA2ZNZ
KD2IWN

106
N8CJS
WV5Q
W9EEU

105
KE8ANW
KJ7BHO

104
W9BGJ

103
KB3KYH

100
WB4RJW
KZ8Q
NN7H
NX9K
KN9P
AD3J

K3RC
AC8RV
WB8SIQ
AC8NP
KA2GQQ
KB2QO
N1LAH
KE5YTA
KG5NNA
AA3SB
WB3FTQ
KB2YAA
AB9ZA

99
KC1HHO
KI7TIG

96
K9DUR

95
N3SW
KE1ML

94
K2TV
KB1NMO

91
WB8YYS
KBØDTI

90
KM4WHO
WD8DHC
KC9FXE
K8KRA
KB8HJJ
KA1G
K8MDA
KD4EAQ
K3MIY
KA2HZP
W8IM
N1TF
WA1LPM
AA3N
KN4AAG
K8ED
WDØBFO

89
N6IET

88
KV8Z
KØFBS

87
W4INK
W7PHX
K8RDN

86
N3RB
KF7GC
KA0DBK

85
KL7RF
AB3WG

84
KD2MEN
K6JT
K1HEJ

83
K1XFC

82
WB6NCT
KC8YVF

81
K1STM
N3JET
WB8R

80
KA2JFU
W2JPS

76
W5XX

75
W2CTG
AF4NC
KC7ASA

74
K6RAU

73
WB7OSC

72
WB2VUF

71
NBØZ

70
N8MRS

The following stations qualified for PSHR in previous months but were not reported in this column: (Feb.) N1LL 130, KA9QWC 120, KØPTK 115, WS4P 101, W9BGJ 100, W9EEU 96, K9DUR 94, WB7OSC 90, WDØBFO 90, AB9ZA 89, KA0DBK 82.

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

Section Emergency Coordinator Reports

The following Section Emergency Coordinators reported: AR, AZ, CT, DE, ENY, EPA, GA, IA, ID, IN, KY, LA, MDC, ME, MI, MN, MO, MS, MT, ND, NLI, NNJ, NNY, NM, NV, OH, OR, PAC, SFL, SJV, SNJ, STX, SV, UT, VI, VT, WPA, WTX, WV, WY.

Brass Pounders League

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

NX9K 1208, KK3F 1193, KY2D 952, K6HTN 844, WB9WKO 817, N1IQI 672, KW1U 613, N1LL 519.

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

Contest Corral

June 2020

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

Start - Finish Date-Time		Date-Time		Bands	Contest Name	Mode	Exchange	Sponsor's Website
1	1900	1	2030	3.5	RSGB 80-Meter Club Championship, Data	Dig	RST, serial	www.rsgbcc.org/hf
2	0100	2	0300	3.5-28	ARS Spartan Sprint	CW	RST, SPC, power	arsqrp.blogspot.com
4	1700	4	2100	28	NRAU 10-Meter Activity Contest	CW Ph Dig	RS(T), 6-char grid square	nrau.net/activity-contests
4	1900	4	2100	1.8-50	SKCC Sprint Europe	CW	RST, SPC, name, mbr or power	www.skccgroup.com
5	1900	5	1959	3.5, 7	HA3NS Sprint Memorial Contest	CW	RST, mbr or "NM"	radioamator.honlapepites.hu
6	0000	7	0200	1.8-28	PVRC Reunion	CW Ph	1st year of membership (for members), name, SPC, call sign when joined PVRC (for members)	pvrc.org/reunion/reunion.htm
6	0000	7	2359	28	10-10 International Open Season PSK Contest	Dig	Name, SPC, mbr	www.ten-ten.org
6	0400	7	2000	3.5-28	DigiFest	Dig	RST, 4-char grid square	rigexpert.com/digifest/rules
6	0600	6	0800	7, 14	Wake-Up! QRP Sprint	CW	RST, serial, suffix of previous QSO	qrp.ru/contest/wakeup
6	0600	7	0600	3.5-28	VK Shires Contest	CW Ph	RS(T), VK Shire or CQ zone	wia.org.au/members/contests/wavks
6	1300	7	1300	50	UKSMG Summer Contest	CW Ph Dig	RST, serial, 6-char grid square	uksmg.org/summer-contest-rules.php
6	1400	7	0200	1.8-144	Kentucky QSO Party	CW Ph Dig	RS(T), county or SPC	www.kyqsoparty.org
6	1500	7	1500	7-50	Dutch Kingdom Contest	CW Ph	RS(T), serial	dkars.nl/index.php?page=rules
6	1500	7	1500	1.8-28	RSGB National Field Day	CW	RST, serial	www.rsgbcc.org/hf
7	1700	7	2200	All (no WARC)	Cookie Crumble QRP Contest	CW Ph Dig	RS(T), SPC, cookie #, name	w3atb.com/cookie-crumble
10	0030	10	0230	3.5-14	NAQCC CW Sprint	CW	RST, SPC, mbr or power	naqcc.info
10	1900	10	2030	3.5	RSGB 80-Meter Club Championship, CW	CW	RST, serial	www.rsgbcc.org/hf
13	0000	14	1559	3.5-28	DRCG WW RTTY Contest	Dig	RST, CQ zone	www.drcg.de/drcgww
13	0000	14	2359	50	SMIRK Contest	CW Ph	4-char grid, mbr (optional)	smirk.org/contest.html
13	1100	13	1300	14, 21	Asia-Pacific Sprint, SSB	Ph	RS, serial	jsfc.org/apsprint/aprule.txt
13	1200	14	1200	3.5-28	Portugal Day Contest	CW Ph	RS(T), CT district or serial	portugaldaycontest.rep.pt
13	1200	14	2359	1.8-50	SKCC Weekend Sprintathon	CW	RST, SPC, name, mbr or "none"	www.skccgroup.com
13	1400	13	1800	144, 432	AGCW VHF/UHF Contest	CW	RST, serial, power class, 6-char grid	agcw.org/index.php/en
13	1500	14	1500	3.5-28	GACW WWSA CW DX Contest	CW	RST, CQ zone	contest.com.ar/gacw-wwsa
13	1600	14	1600	50	REF DDFM 6 Meter Contest	CW Ph	RS(T), serial, 4-char grid	concours.r-e-f.org
13	1800	15	0259	50 and up	ARRL June VHF Contest	CW Ph Dig	4-character grid square	www.arrl.org/june-vhf
15	0000	15	0200	1.8-28	4 States QRP Group Second Sunday Sprint	CW Ph	RS(T), SPC, mbr or power	www.4sqrp.com
15	1900	15	2030	3.5	RSGB FT4 Contest Series	Dig	4-char grid square	www.rsgbcc.org/hf
16	1200	16	1400	7	SARL Youth Sprint	Ph	RS, age	www.sarl.org.za
17	0030	17	0230	3.5-14	NAQCC CW Sprint	CW	RST, SPC, mbr or power	naqcc.info
20	0000	20	2359	3.5-28	Battle of Carabobo International Contest	Ph	RS(T), YV state or serial	www.qrz.com/db/YV4VV
20	0000	21	2359	1.8-28	All Asian DX Contest, CW	CW	RST, 2-digit age	www.jarl.org/English
20	1200	21	1159	3.5-28	Ukrainian DX Classic RTTY Contest	Dig	RST, 2-letter oblast or serial	urdxc.org/rtty/eng.htm
20	1400	21	1400	50, 70	IARU Region 1 50/70 MHz Contest	CW Ph Dig	RS(T), serial, 6-char grid	www.iaru-r1.org
20	1500	21	1500	1.8	Stew Perry Topband Challenge	CW	4-char grid square	www.kkn.net/stew
20	1600	21	0400	3.5-28	West Virginia QSO Party	CW Ph Dig	RS(T), county or SPC	qsl.net/wvsarc/wvqp/wvqp.html
20	1800	20	1959	1.8-50	Feld Hell Sprint	Dig	RST, mbr, QTH, grid, power	sites.google.com/site/feldhellclub
20	1800	20	2359	3.5,7,14,18, 21,24,28, 144 repeaters	ARRL Kids Day	Ph	Name, age, QTH, favorite color	www.arrl.org/kids-day
21	0800	21	1400	50	WAB 50 MHz Phone	Ph	RS, serial, WAB square or country	wab.intermip.net
21	1900	21	2359	1.8-28	Run for the Bacon QRP Contest	CW	RST, SPC, mbr or power	qrpcontest.com/pigrun
24	0000	24	0200	1.8-28	SKCC Sprint	CW	RST, SPC, name, mbr or power	www.skccgroup.com
25	1900	25	2030	3.5	RSGB 80-Meter Club Championship, SSB	Ph	RS, serial	www.rsgbcc.org/hf
27	0600	27	1700	3.5-28	UFT QRP Contest	CW	RST, QRP/QRO, mbr or "NM"	uft.net/reglement/eng.pdf
27	1200	28	1200	3.5-28	Ukrainian DX DIGI Contest	Dig	RST, 2-letter oblast or serial	www.izmail-dx.com
27	1200	28	1200	1.8-28	His Majesty King of Spain Contest, SSB	Ph	RS, EA province or serial	concursos.ure.es/en
27	1800	28	2100	All (no WARC)	ARRL Field Day	CW Ph Dig	Number of transmitters, operating class, ARRL/RAC section or "DX"	www.arrl.org/field-day
29	0001	5	2359	28	10-10 International Spirit of 76 QSO Party	CW Ph Dig	Name, mbr or "0," SPC	www.ten-ten.org
29	1300	30	0400	1.8-28	QCX Challenge	CW	RST, name, SPC, rig	qrp-labs.com/party.html

All dates refer to UTC and may be different from calendar dates in North America. Contests are not conducted on the 60-, 30-, 17-, or 12-meter bands. Mbr = Membership number. Serial = Sequential number of the contact. SPC = State, Province, DXCC Entity. XE = Mexican state. Listings in blue indicate contests sponsored by ARRL or *NCJ*. The latest time to make a valid contest QSO is the minute listed in the "Finish Time" column. *Data for Contest Corral is maintained on the WA7BNM Contest Calendar at* **www.contestcalendar.com** *and is extracted for publication in* QST *2 months prior to the month of the contest. ARRL gratefully acknowledges the support of Bruce Horn, WA7BNM, in providing this service.*

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

2019 ARRL November Sweepstakes — Phone

Last year's ARRL November Sweepstakes phone weekend was held November 16 – 18, 2019.

You don't need an elaborate setup to participate in the ARRL November Sweepstakes phone weekend. Adam Bartlett, N5YHF, operated from Choke Canyon State Park in Texas using his Yaesu FT-450D fed into an end-fed wire antenna. He made 134 contacts in 63 sections. [Adam Bartlett, N5YHF, photo]

Top Ten

Single Operator, High Power

K5TR	333,660
W7WA	323,202
K5TA	255,640
W2RQ	250,162
WC6H	246,328
WH7Z (W0CN, op @KH6YY)	240,408
N4OX	219,120
KL7SB	203,520
WD0T	202,520
K9BGL	202,354

Single Operator, Low Power

K2PO	186,584
W0EWD	185,422
W4AAA (KK9A, op)	180,774
N4OO	174,466
K6JO	159,246
VE5SF	150,562
N8II	127,008
WR3R	124,476
K9WZB	122,450
KU2M	120,184
AC0W	120,184

Single Operator, QRP

WZ8P	61,304
NK8Q	34,350
VE6EX	29,040
NA1ME	25,254
WK4P	22,440
N9LQ	20,636
K7MM	17,810
K2GMY	17,472
K0TEA	16,800
N7JI	15,080

Single Operator Unlimited, High Power

KH7XS (K4XS, op)	300,128
VY2TT	274,564
W7RN (WX5S, op)	256,968
K7RL	246,178
K3MM	231,238
W1SJ	220,946
W3IDT	218,124
ND8DX	212,314
W9KKN	203,848
WB0TEV	203,184

Single Operator Unlimited, Low Power

W4LT	176,300
WB2P	138,278
NT5V	126,160
K0UK	120,376
KK7AC	109,388
WZ8T	89,586
K8BZ	88,232
N0IRM	78,080
K2SDS	77,080
K0AD	75,604

Multioperator, Single Transmitter, High Power

W0NO	262,612
K4OV	258,960
W3NX	240,700
N6WM	234,890
W5WZ	234,226
NX6T	234,226
W5RRR	225,262
W1XX	224,100
KR0P	217,294
N3OC	206,670

Multioperator, Single Transmitter, Low Power

K5KU	161,186
K7RU	116,154
K9KE	107,402
WX4W	87,980
VA2CZ	79,520
K9DA	69,554
WR5O	63,504
W9ET	62,694
W1FM	55,902
N8YXR	55,404

School Club

W6YX	252,154
K0HC	207,832
W4AQL	148,570
K9IU	76,360
W9JWC	42,042
KD8NOM	30,528
W8EDU	27,202
W4UAL	21,060
W1YK	18,810
W0EEE	15,480

The 2020 ARRL November Sweepstakes phone weekend will be held November 21 – 23, 2020.

Full Results Online

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

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

Winner	Division	Category	Sponsor
K5TR	Overall	Single Operator High Power	Icom America
K2PO	Overall	Single Operator Low Power	Icom America
WZ8P	Overall	Single Operator QRP	Icom America
KH7XS (K4XS, op)	Overall	Single Operator Unlimited High Power	Icom America
W4LT	Overall	Single Operator Unlimited Low Power	Icom America
W0NO	Overall	Multioperator High Power	Icom America
K5KU	Overall	Multioperator Low Power	Icom America
W6YX	Overall	School Club	Robert Tuttle, N8YXR, and Jennie Tuttle, KC0RBV
K3ZO	Atlantic	Single Operator High Power	Icom America
WR3R	Atlantic	Single Operator Low Power	Potomac Valley Radio Club
NK8Q	Atlantic	Single Operator QRP	Icom America
K3MM	Atlantic	Single Operator Unlimited High Power	Icom America
WB2P	Atlantic	Single Operator Unlimited Low Power	Icom America
W3NX	Atlantic	Multioperator High Power	Icom America
K2APD	Atlantic	Multioperator Low Power	Icom America
K9BGL	Central	Single Operator High Power	Society of Midwest Contesters
AJ9C	Central	Single Operator Low Power	Society of Midwest Contesters
N9LQ	Central	Single Operator QRP	Icom America
WT9U	Central	Single Operator Unlimited High Power	Society of Midwest Contesters
W9QL	Central	Single Operator Unlimited Low Power	Society of Midwest Contesters
N9SJ	Central	Multioperator High Power	Icom America
K9KE	Central	Multioperator Low Power	Icom America
K9IU	Central	School Club	Icom America
WD0T	Dakota	Single Operator High Power	Minnesota Wireless Assoc. – in memory of Tod Olson, K0TO
AC0W	Dakota	Single Operator Low Power	Minnesota Wireless Assoc.
K1KD	Dakota	Single Operator Unlimited High Power	Minnesota Wireless Assoc.
K0AD	Dakota	Single Operator Unlimited Low Power	Minnesota Wireless Assoc.
NR0T	Dakota	Multioperator High Power	Icom America
K0AJW	Dakota	Multioperator Low Power	Icom America
K0EJ	Delta	Single Operator High Power	Icom America
N5RN	Delta	Single Operator Low Power	Icom America
KC4NX	Delta	Single Operator Unlimited High Power	Icom America
N4ZZ	Delta	Single Operator Unlimited Low Power	Icom America
W5WZ	Delta	Multioperator High Power	Icom America
K5KU	Delta	Multioperator Low Power	Icom America
W5YM	Delta	School Club	Icom America
ND4Y	Great Lakes	Single Operator High Power	Icom America
WB8WKQ	Great Lakes	Single Operator Low Power	Icom America
WZ8P	Great Lakes	Single Operator QRP	Icom America
ND8DX	Great Lakes	Single Operator Unlimited High Power	Icom America
K8BZ	Great Lakes	Single Operator Unlimited Low Power	Icom America
W8BI	Great Lakes	Multioperator High Power	Icom America
WX4W	Great Lakes	Multioperator Low Power	Icom America
KD8NOM	Great Lakes	School Club	Robert Tuttle, N8YXR, and Jennie Tuttle, KC0RBV
W2RQ	Hudson	Single Operator High Power	Icom America
KU2M	Hudson	Single Operator Low Power	Icom America
K2YG	Hudson	Single Operator QRP	Icom America
W2GDJ	Hudson	Single Operator Unlimited High Power	Icom America
NY6DX	Hudson	Single Operator Unlimited Low Power	Icom America
N2NC	Hudson	Multioperator High Power	Icom America
AD2P	Hudson	Multioperator Low Power	Icom America
K0VXU	Midwest	Single Operator High Power	Icom America
W0EWD	Midwest	Single Operator Low Power	Icom America
W8MZ	Midwest	Single Operator QRP	Icom America
W0TT	Midwest	Single Operator Unlimited High Power	Icom America
N0IRM	Midwest	Single Operator Unlimited Low Power	Icom America
W0NO	Midwest	Multioperator High Power	Icom America
K0TSA	Midwest	Multioperator Low Power	Icom America
K0HC (W0BH, op)	Midwest	School Club	Icom America
KK1L	New England	Single Operator High Power	Icom America
K1EP	New England	Single Operator Low Power	Icom America
NA1ME	New England	Single Operator QRP	Icom America
W1SJ	New England	Single Operator Unlimited High Power	Icom America
K1ECU	New England	Single Operator Unlimited Low Power	Icom America
W1XX	New England	Multioperator High Power	Icom America
W1FM	New England	Multioperator Low Power	Icom America
W1YK	New England	School Club	Icom America
W7WA	Northwestern	Single Operator High Power	Icom America
K2PO	Northwestern	Single Operator Low Power	Icom America
K7MM	Northwestern	Single Operator QRP	Icom America
K7RL	Northwestern	Single Operator Unlimited High Power	Icom America
WZ8T	Northwestern	Single Operator Unlimited Low Power	Icom America
K7RI	Northwestern	Multioperator High Power	Icom America
K7RU	Northwestern	Multioperator Low Power	Icom America
WC6H	Pacific	Single Operator High Power	Icom America
KH6CJJ	Pacific	Single Operator Low Power	Icom America
K2GMY	Pacific	Single Operator QRP	Icom America
KH7XS (K4XS, op)	Pacific	Single Operator Unlimited High Power	Icom America
K6GHA	Pacific	Single Operator Unlimited Low Power	Icom America
N6WM	Pacific	Multioperator High Power	Icom America
N6TCE	Pacific	Multioperator Low Power	Icom America
W6YX	Pacific	School Club	Icom America
W6SFG	Roanoke	Single Operator High Power	Icom America
W4AAA (KK9A, op)	Roanoke	Single Operator Low Power	Icom America
WK4P	Roanoke	Single Operator QRP	Icom America
K3DNE	Roanoke	Single Operator Unlimited High Power	Icom America
N1WR	Roanoke	Single Operator Unlimited Low Power	Icom America
K4OV	Roanoke	Multioperator High Power	Icom America
W4YK	Roanoke	Multioperator Low Power	Icom America
K5TA	Rocky Mountain	Single Operator High Power	Icom America
K0KR	Rocky Mountain	Single Operator Low Power	Icom America
K7DLX	Rocky Mountain	Single Operator QRP	Icom America
WD4IXD	Rocky Mountain	Single Operator Unlimited High Power	Icom America
K0UK	Rocky Mountain	Single Operator Unlimited Low Power	Icom America
K2KR	Rocky Mountain	Multioperator High Power	Icom America
K5LRW	Rocky Mountain	Multioperator Low Power	Icom America
N4OX	Southeastern	Single Operator High Power	Icom America
N4OO	Southeastern	Single Operator Low Power	Icom America
K3TW	Southeastern	Single Operator Unlimited High Power	Icom America
W4LT	Southeastern	Single Operator Unlimited Low Power	Icom America
K2ADA	Southeastern	Multioperator High Power	Icom America
WA1F	Southeastern	Multioperator Low Power	Icom America
W4AQL	Southeastern	School Club	Icom America
W6AFA	Southwestern	Single Operator High Power	Icom America
K6JO	Southwestern	Single Operator Low Power	Icom America
WB6NJA	Southwestern	Single Operator QRP	Icom America
W6TK	Southwestern	Single Operator Unlimited High Power	Icom America
KK7AC	Southwestern	Single Operator Unlimited Low Power	Icom America
NX6T	Southwestern	Multioperator High Power	Icom America
KC7KFF	Southwestern	Multioperator Low Power	Icom America
K5TR	West Gulf	Single Operator High Power	Icom America
WD5K	West Gulf	Single Operator Low Power	Icom America
WB0TEV	West Gulf	Single Operator Unlimited High Power	Icom America
NT5V	West Gulf	Single Operator Unlimited Low Power	Icom America
W5RRR	West Gulf	Multioperator High Power	Icom America
WR5O	West Gulf	Multioperator Low Power	Icom America
KF5CRF	West Gulf	School Club	Icom America
VE4VT	Canada	Single Operator High Power	Icom America
VE5SF	Canada	Single Operator Low Power	Icom America
VE6EX	Canada	Single Operator QRP	Icom America
VY2TT	Canada	Single Operator Unlimited High Power	Icom America
VE3PJ	Canada	Single Operator Unlimited Low Power	Icom America
VE6AO	Canada	Multioperator High Power	Icom America
VA2CZ	Canada	Multioperator Low Power	Icom America

Affiliated Club Competition

Club	Score	Entries
Unlimited		
Potomac Valley Radio Club	14,079,340	280
Frankford Radio Club	6,041,690	108
Society of Midwest Contesters	4,643,038	107
Yankee Clipper Contest Club	4,464,474	75
Minnesota Wireless Assn.	3,676,284	92
Medium		
Mother Lode DX/Contest Club	3,874,762	46
Southern California Contest Club	2,955,914	44
Florida Contest Group	2,675,750	42
Contest Club Ontario	2,130,752	48
Western Washington DX Club	2,095,486	29
Mad River Radio Club	2,069,890	37
Arizona Outlaws Contest Club	1,861,352	32
Tennessee Contest Group	1,801,124	38
DFW Contest Group	1,731,496	26
Northern California Contest Club	1,530,270	42
Central Texas DX and Contest Club	1,337,288	21
Alabama Contest Group	1,111,060	13
Grand Mesa Contesters of Colorado	1,079,538	17
Willamette Valley DX Club	1,053,356	13
South East Contest Club	989,404	17
Big Sky Contesters	938,172	14
Kentucky Contest Group	935,952	20
Kansas City Contest Club	732,906	9
North Texas Contest Club	729,892	10
Great Places Contest Club	722,820	9
CTRI Contest Group	629,230	15
Hudson Valley Contesters and DXers	593,712	16
Sussex County ARC	553,294	4
North Coast Contesters	472,742	10
Georgia Contest Group	455,762	6
Niagara Frontier Radiosport	407,988	14
Northeast Maryland Amateur Radio Contest Society	342,230	15
Mississippi Valley DX/Contest Club	230,222	7
Order of Boiled Owls of New York	221,836	6
Swamp Fox Contest Group	216,348	5
West Park Radiops	182,146	3
Bay Area DXers	179,982	4
Maritime Contest Club	177,738	4
Rochester (NY) DX Assn.	143,428	5
Alberta Clippers	122,606	3
New Providence ARC	116,294	7
Driftless Zone Contesters	114,168	6
Texas DX Society	106,044	3
Portage County Amateur Radio Service	104,930	5
South Jersey Radio Assn.	104,884	7
Badger Contesters	100,370	3
Providence Radio Assn.	92,252	3
Silver Comet Amateur Radio Society	88,694	9
Skyview Radio Society	85,010	4
Orca DX and Contest Club	75,758	5
Sierra Foothills ARC	72,286	5
Granite State ARA	60,920	8
Motor City Radio Club	52,552	4
Pacific Northwest VHF Society	47,220	4
Sierra Nevada ARS	45,360	4
Southern Berkshire ARC	8,182	3
Local		
Pizza Lovers 259	1,367,848	10
Redwood Empire DX Assn.	562,076	9
Iowa DX and Contest Club	561,570	6
New Mexico Big River Contesters	356,010	3
Metro DX Club	167,530	9
Bristol (TN) ARC	94,470	5
Sunday Creek Amateur Radio Federation	47,940	3
North Fulton ARL	29,028	3
Alexandria Radio Club	22,776	3

Division Winners

Single Operator, High Power

Atlantic	K3ZO	187,780
Central	K9BGL	202,354
Dakota	WDØT	202,520
Delta	KØEJ	100,962
Great Lakes	ND4Y	177,122
Hudson	W2RQ	250,162
Midwest	KØVXU	157,440
New England	KK1L	159,732
Northwestern	W7WA	323,202
Pacific	WC6H	246,328
Roanoke	W6SFG	126,608
Rocky Mountain	K5TA	255,640
Southeastern	N4OX	219,120
Southwestern	W6AFA	105,944
West Gulf	K5TR	333,660
Canada	VE4VT	140,320

Single Operator, Low Power

Atlantic	WR3R	124,476
Central	AJ9C	82,164
Dakota	ACØW	120,184
Delta	N5RN	35,926
Great Lakes	WB8WKQ	117,126
Hudson	KU2M	120,184
Midwest	WØEWD	185,422
New England	K1EP	111,618
Northwestern	K2PO	186,584
Pacific	KH6CJJ	52,852
Roanoke	W4AAA (KK9A, op)	180,774
Rocky Mountain	KØKR	34,560
Southeastern	N4OO	174,466
Southwestern	K6JO	159,246
West Gulf	WD5K	61,600
Canada	VE5SF	150,562

Single Operator, QRP

Atlantic	NK8Q	34,350
Central	N9LQ	20,636
Great Lakes	WZ8P	61,304
Hudson	K2YG	13,750
Midwest	W8MZ	6,160
New England	NA1ME	25,254
Northwestern	K7MM	17,810
Pacific	K2GMY	17,472
Roanoke	WK4P	22,440
Rocky Mountain	K7DLX	7,998
Southwestern	WB6NJA	6,844
Canada	VE6EX	29,040

Single Operator Unlimited, High Power

Atlantic	K3MM	231,238
Central	WT9U	160,356
Dakota	K1KD	200,694
Delta	KC4NX	157,760
Great Lakes	ND8DX	212,314
Hudson	W2GDJ	179,280
Midwest	WØTT	63,246
New England	W1SJ	220,946
Northwestern	K7RL	246,178
Pacific	KH7XS (K4XS, op)	300,128
Roanoke	K3DNE	164,838
Rocky Mountain	WD4IXD	163,800
Southeastern	K3TW	56,440
Southwestern	W6TK	148,570
West Gulf	WBØTEV	203,184
Canada	VY2TT	274,564

Single Operator Unlimited, Low Power

Atlantic	WB2P	138,278
Central	W9QL	63,990
Dakota	KØAD	75,604
Delta	N4ZZ	63,840
Great Lakes	K8BZ	88,232
Hudson	NY6DX	63,200
Midwest	NØIRM	78,080
New England	K1ECU	26,268
Northwestern	WZ8T	89,586
Pacific	K6GHA	53,628
Roanoke	N1WR	51,376
Rocky Mountain	KØUK	120,376
Southeastern	W4LT	176,300
Southwestern	KK7AC	109,388
West Gulf	NT5V	126,160
Canada	VE3PJ	75,492

Multioperator, Single Transmitter, High Power

Atlantic	W3NX	240,700
Central	N9SJ	120,848
Dakota	NRØT	50,244
Delta	W5WZ	234,226
Great Lakes	W8BI	139,728
Hudson	N2NC	195,382
Midwest	WØNO	262,612
New England	W1XX	224,100
Northwestern	K7RI	154,880
Pacific	N6WM	234,890
Roanoke	K4OV	258,960
Rocky Mountain	K2KR	134,958
Southeastern	K2ADA	201,192
Southwestern	NX6T	234,226
West Gulf	W5RRR	225,262

Multioperator, Single Transmitter, Low Power

Atlantic	K2APD	54,264
Central	K9KE	107,402
Dakota	KØAJW	28,842
Delta	K5KU	161,186
Great Lakes	WX4W	87,980
Hudson	AD2P	38,016
Midwest	KØTSA	22,244
New England	W1FM	55,902
Northwestern	K7RU	116,154
Pacific	N6TCE	6,384
Roanoke	W4YK	33,280
Rocky Mountain	K5LRW	41,952
Southeastern	WA1F	16,506
Southwestern	KC7KFF	24,426
West Gulf	WR5O	63,504
Canada	VA2CZ	79,520

School Club

Central	K9IU	76,360
Delta	W5YM	3,016
Great Lakes	KD8NOM	30,528
Midwest	KØHC	207,832
New England	W1YK	18,810
Pacific	W6YX	252,154
Southeastern	W4AQL	148,570
West Gulf	KF5CRF	13,064

Mark Beckwith, N5OT, n5ot@arrl.net

2019 ARRL 160-Meter Contest Results

Last year's contest was held December 6 – 8, 2019.

Top Ten — DX

Single Operator, High Power

ZF9CW	208,662
XE2X	185,484
PJ2T (K8ND, op)	94,950
TM6M (F1AKK, op)	51,350
RT0F	38,064
S59A	33,930
YL2SM	29,312
CT1ILT	28,202
J35X	22,048
F6AGM (FM5CD, op)	19,376

Single Operator, Low Power

K7BX/VP9	90,374
CO2AN	37,296
CO2RQ	34,038
HI3AA	29,000
HI3Y	4,392
ON7EH	4,288
HC2AO	4,218
R7NW	3,648
JA7KPI	2,150
JE1SPY	2,058

Single Operator, QRP

LY5G	16
JH7UJU	4

Single Operator Unlimited, High Power

XE2S	68,526
EA7KW	54,528
OM2VL	47,232
GW3YDX	44,288
EM2Q (US8ICM, op)	41,904
D4C (IK2NCJ, op)	41,674
UW2M (UR0MC, op)	35,604
EA5FR	34,188
OK7Z (OK2ZI, op)	31,752
G4AMT	25,220

Single Operator Unlimited, Low Power

IK2CLB	3,876
PC3T	2,106
EA4AOC	1,800
OZ0B (OZ1ISY, op)	1,680
LY4ZZ (LY2BMX, op)	1,518
MI5I (GI0RQK, op)	1,200
SF1Z (SM0HEV, op)	1,120
G3ZRJ	1,092
OK2BFN	850
RV6ASU	588

Single Operator Unlimited, QRP

JG1LFR	60
YO8WW	30
SD6F (SM6JWR, op)	8

Multioperator, Single Transmitter, High Power

C6AGU	227,918
TO9W	59,496
RL3A	51,392
LU8DPM	33,726
OT6M	31,200
OL1A	21,450
JA3YBK	20,580
HB7X	14,688
EA5DY	11,856
OK6O	6,888

Multioperator, Single Transmitter, Low Power

V31MA	54,470
DJ5LA	108

Top Ten — US and Canada

Single Operator, High Power

K1LZ	674,500
K1DG	639,880
K1KI	559,845
W1UE	540,408
AA1K	506,112
W1/WP3C	452,718
NA8V	450,210
NP2J (K8RF, op)	435,837
VE3DZ	408,460
W0SD (W0DB, op)	391,556

Single Operator, Low Power

K9PG	219,800
WB8JUI	206,300
K1BX	203,910
K8FH	199,008
K8NVR	187,880
AC0W	153,032
N8II	137,970
K1DC	130,254
N9JF	129,021
N8LJ	119,016

Single Operator, QRP

N9SE	119,718
W3TS	64,944
NK8Q	61,655
W8GP	58,938
N7IR	51,436
N5OE	26,944
NA5NN (K2FF, op)	26,532
WB2CPU	21,855
N4IY	20,539
N5EE	19,893

Single Operator Unlimited, High Power

K1A (KO7SS, op)	649,700
N8OO	642,597
VA2WA	599,760
VE3EJ	541,940
WB9Z	527,340
VA2EW	473,144
KV0Q	470,968
K0RF	426,224
VE6WZ	418,734
W0AIH (K0TG, op)	412,050

Single Operator Unlimited, Low Power

K1EP	265,995
VE3MGY	249,828
KG9X	182,061
N0UR	158,166
N2ZX	152,168
K0RC	134,830
W9XT	126,825
VA3DF	123,660
AI1TT (W1WBB, op)	116,776
N4IJ	115,974

Single Operator Unlimited, QRP

N2WK	53,067
K5LG	49,700
WE9R	49,700
N3HEE	45,646
N3CZ	30,208
W3UL	29,300
W1IE	25,800
K8ZT	21,010
W3RGA	5,910
K2AL	2,376

Multioperator, Single Transmitter, High Power

W2GD	617,045
N0NI	561,060
W3NX	448,335
WW2R	423,776
W5MX	418,340
KC4D	360,553
K5CM	355,680
W1VE	337,250
N4RV	320,670
W4PM	314,216

Multioperator, Single Transmitter, Low Power

NC1CC	88,218
KA4J	62,832
WQ4RP	59,228
W3KWH	32,700
N1SOH	24,592
W5WTM	21,634
NT6H	1,216

Jim Peterson, K6EI, operated from his cabin in Washington state for the 2019 ARRL 160-Meter Contest. Jim made 149 contacts with stations in 45 multipliers, garnering him the top spot in the Northwestern Division QRP category. [Jim Peterson, K6EI, photo]

Full Results Online

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

Affiliated Club Competition

Club	Score	Entries
Unlimited		
Frankford Radio Club	9,012,473	86
Potomac Valley Radio Club	7,432,079	98
Yankee Clipper Contest Club	6,971,929	65
Society of Midwest Contesters	4,942,089	52
Minnesota Wireless Assn.	4,368,887	72
Medium		
Contest Club Ontario	3,291,474	31
Mad River Radio Club	1,816,557	16
Florida Contest Group	1,589,387	22
Tennessee Contest Group	1,539,790	18
Southern California Contest Club	1,379,252	18
Arizona Outlaws Contest Club	1,364,315	25
Alabama Contest Group	1,286,573	13
Grand Mesa Contesters of Colorado	1,163,664	8
Kansas City Contest Club	1,132,728	7
North Coast Contesters	1,078,171	10
Central Texas DX and Contest Club	921,964	11
Hudson Valley Contesters and DXers	913,561	13
Kentucky Contest Group	868,906	9
Niagara Frontier Radiosport	780,467	11
Rochester (NY) DX Assn.	571,449	8
South East Contest Club	494,302	9
Western Washington DX Club	470,253	8
Willamette Valley DX Club	451,601	8
Big Sky Contesters	442,465	4
Northern California Contest Club	434,130	18
DFW Contest Group	386,300	8
North Texas Contest Club	380,800	3
599 DX Assn.	343,321	6
Mother Lode DX/Contest Club	320,437	6
Maritime Contest Club	287,302	4
Not Quite Workable Contest Club	226,280	4
Northeast Wisconsin DX Assn.	201,477	3
Carolina DX Assn.	179,665	4
Granite State ARA	160,034	3
West Park Radiops	129,865	3
Orca DX and Contest Club	35,704	4
New Providence ARC	29,308	3
Local		
Central Virginia Contest Club	755,151	6
CTRI Contest Group	656,603	7

Continental Winners

Africa		
Single Operator, Low Power	3V8SF (KF5EYY, op)	154
Single Operator Unlimited, High Power	D4C (IK2NCJ, op)	41,674
Asia		
Single Operator, High Power	RT0F	38,064
Single Operator, Low Power	JA7KPI	2,150
Single Operator, QRP	JH7UJU	4
Single Operator Unlimited, High Power	JE1CKA	12,768
Single Operator Unlimited, Low Power	RD8D (RX9CAZ, op)	168
Single Operator Unlimited, QRP	JG1LFR	60
Multioperator, Single Transmitter, High Power	JA3YBK	20,580
Europe		
Single Operator, High Power	TM6M (F1AKK, op)	51,350
Single Operator, Low Power	ON7EH	4,288
Single Operator, QRP	LY5G	16
Single Operator Unlimited, High Power	EA7KW	54,528
Single Operator Unlimited, Low Power	IK2CLB	3,876
Single Operator Unlimited, QRP	YO8WW	30
Multioperator, Single Transmitter, High Power	RL3A	51,392
Multioperator, Single Transmitter, Low Power	DJ5LA	108
North America		
Single Operator, High Power	ZF9CW	208,662
Single Operator, Low Power	K7BX/VP9	90,374
Single Operator Unlimited, High Power	XE2S	68,526
Multioperator, Single Transmitter, High Power	C6AGU	227,918
Multioperator, Single Transmitter, Low Power	V31MA	54,470
Oceania		
Single Operator, High Power	5W1SA	570
South America		
Single Operator, High Power	PJ2T (K8ND, op)	94,950
Single Operator, Low Power	HC2AO	4,218
Single Operator Unlimited, High Power	CX6VM	5,332
Multioperator, Single Transmitter, High Power	LU8DPM	33,726

Daniel Dembrowski, W2NO; John Crovelli, W2GD, and Steven Strauss, NY3B, working hard at W2GD to gain the top spot in the Multioperator, Single Transmitter, High Power category for the US and Canada. [Peter Barletto, KU2C, photo]

Division Winners

Single Operator, High Power

Atlantic	AA1K	506,112
Central	K9ZO	293,480
Dakota	W0SD (W0DB, op)	391,556
Delta	WD5R	372,922
Great Lakes	NA8V	450,210
Hudson	W2XL	235,180
Midwest	N0TT	344,640
New England	K1LZ	674,500
Northwestern	K7RAT (N6TR, op)	238,818
Pacific	N6RK	167,616
Roanoke	W4CB (W2RU, op)	316,224
Rocky Mountain	N2IC	204,129
Southeastern	NP2J (K8RF, op)	435,837
Southwestern	K6AM	292,444
West Gulf	K5BG	218,268
Canada	VE3DZ	408,460

Single Operator, Low Power

Atlantic	NJ3K	106,020
Central	K9PG	219,800
Dakota	AC0W	153,032
Delta	K4OAQ	76,860
Great Lakes	WB8JUI	206,300
Hudson	N2HMM	39,848
Midwest	K0FLY	74,775
New England	K1BX	203,910
Northwestern	AK6A	31,169
Pacific	KE6QR	13,545
Roanoke	N8II	137,970
Rocky Mountain	W0ETT	44,400
Southeastern	K1DC	130,254
Southwestern	WA7NB	44,676
West Gulf	NZ5A	105,924
Canada	VE3VSM	111,419

Single Operator, QRP

Atlantic	W3TS	64,944
Central	N9SE	119,718
Dakota	KE0TT	7,844
Delta	NA5NN (K2FF, op)	26,532
Great Lakes	W8GP	58,938
Hudson	K2MIJ	10,257
Midwest	W0MB	19,800
New England	WB2CPU	21,855
Northwestern	K6EI	13,635
Pacific	K6MI	697
Roanoke	K2PI	8,172
Rocky Mountain	KR0U	10,896
Southeastern	K3TW	18,668
Southwestern	N7IR	51,436
West Gulf	N5OE	26,944
Canada	VE7VV	6,264

Single Operator Unlimited, High Power

Atlantic	K3WW	367,510
Central	WB9Z	527,340
Dakota	K0KX	224,640
Delta	N8OO	642,597
Great Lakes	W8MJ	328,202
Hudson	N2NT	322,250
Midwest	K3PA	403,522
New England	K1A (KO7SS, op)	649,700
Northwestern	KL7SB	235,653
Pacific	WD6T (@N6RO)	238,446
Roanoke	K2AV	372,810
Rocky Mountain	KV0Q	470,968
Southeastern	NP2P (N2TTA, op)	372,118
Southwestern	W0RIC (W4IX, op)	181,486
West Gulf	K5NA	377,612
Canada	VA2WA	599,760

Single Operator Unlimited, Low Power

Atlantic	W3KB	82,720
Central	KG9X	182,061
Dakota	N0UR	158,166
Delta	KV8S	55,872
Great Lakes	K8BL	94,968
Hudson	N2ZX	152,168
Midwest	K0LAF	17,873
New England	K1EP	265,995
Northwestern	W7MEM	23,506
Pacific	K7XC	22,646
Roanoke	N4IJ	115,974
Rocky Mountain	K0UK	44,622
Southeastern	KC4HW	24,360
Southwestern	K0XP	39,216
West Gulf	K5LJ	19,454
Canada	VE3MGY	249,828

Single Operator Unlimited, QRP

Atlantic	N2WK	53,067
Central	WE9R	49,700
Delta	K5LG	49,700
Great Lakes	K8ZT	21,010
Hudson	K2AL	2,376
Pacific	K2GMY	1,224
Roanoke	N3CZ	30,208

Multioperator, Single Transmitter, High Power

Atlantic	W2GD	617,045
Great Lakes	W5MX	418,340
Hudson	NJ1F	20,748
Midwest	N0NI	561,060
New England	W1VE	337,250
Pacific	KH6/KU1CW	156,464
Roanoke	KC4D	360,553
Rocky Mountain	N0KE	111,060
Southeastern	WW2R	423,776
Southwestern	NI6W	214,390
West Gulf	K5CM	355,680
Canada	VE2OJ	305,738

Multioperator, Single Transmitter, Low Power

Atlantic	W3KWH	32,700
Delta	KA4J	62,832
New England	NC1CC	88,218
Pacific	NT6H	1,216
Roanoke	WQ4RP	59,228
West Gulf	W5WTM	21,634

The 2020 ARRL 160-Meter Contest will be held December 4 – 6.

The 2020 IARU HF World Championships

1200 UTC Saturday, July 11 – 1159 UTC Sunday, July 12

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

♦ The exchange is a signal report and your ITU Zone.

♦ Single-Operator entrants choose from High, Low, or QRP Power and Mixed Mode, CW Only, or Phone Only.

♦ Stations from IARU member-societies all around the world will be active. Get on the air to find out how many HQ stations you can work.

♦ Five-day log submission deadline: Upload Cabrillo-formatted logs to the web app at **contest-log-submission.arrl.org** no later than 1200 UTC, July 17. Or mail paper logs (postmarked by July 17) to IARU HF Championships c/o ARRL Contests, 225 Main St., Newington, CT 06111 USA.

Carol Milazzo, KP4MD, operated portable on the beach in Puerto Rico for the 2019 event. She made 353 contacts, totaling 110,000 points, for her best score in the event. [Carol Milazzo, KP4MD, photo]

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

Congratulations

March 2020
QST Cover Plaque Award Winner

Ellwood (Woody) Brem, K3YV

Woody's article emphasized the need to be wary of RF isolation when working with antenna switches. Woody also showed how one can measure the amount of port-to-port isolation a switch provides. Woody will receive a plaque featuring the cover of the March 2020 issue.

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 pick your favorite article in this issue!

"Leaky" Antenna Switches

When switching between equipment and antennas, it is important to consider the RF isolation your switch provides.

Ellwood (Woody) Brem, K3YV

Any ham who has two or more antennas has probably considered using an antenna switch, which allows you to switch your radio from one antenna to another without having to connect and reconnect antenna cables each time you change antennas. Some modern radios have built-in antenna switches, and quite a few antenna tuners do as well. And then there are basic standalone switches and even remote outdoor switches.

Besides switching multiple antennas to one radio, antenna switches can also be used to switch multiple radios to one antenna. The problem with switching radios is keeping the RF output signal of the transmitting radio from causing damage to the off-line radio or other equipment (such as a receive preamplifier), which can be damaged if too much power leaks through the switch. Every switch has some degree of leakage between the selected port and the unselected port(s). So, RF from a radio transmitting through one port will leak through to the switched-off port. To safeguard your gear from inadvertent damage, the antenna switch must provide a high degree of isolation between its switched-on port and its switched-off ports.

How Much Leakage is Too Much?

How much power can a receiver accept without damage? Unfortunately, many manufacturers don't specify a maximum input signal level. Radio manufacturers who do specify a safe input power level generally limit the maximum to between +10 and +20 dBm. I have always used +10 dBm, to be on the conservative side. That translates into 0.01 W or 1.0 V peak RF voltage in a 50 Ω system. So, considering +10 dBm as our limit of maximum input power, how much isolation is required in our antenna switch?

The maximum output power allowed by the FCC for amateur stations is 1,500 W, which is +61.76 dBm. If we are to limit the input power of our offline radio to +10 dBm, then we need at least 51.76 dB of isolation. That's a lot of isolation.

The MFJ-2703 switch.

Generally, a switch will have higher port-to-port isolation at HF than VHF, with the isolation getting progressively less as the frequency increases. Unfortunately, not all antenna switch manufacturers specify their isolation. Among those that do, some manufacturers specify their switch isolation to be greater than 50 dB at HF, while others specify greater than 70 dB isolation. We have shown that nearly 52 dB of isolation is necessary when running 1,500 W. Therefore, switches with 50 dB of isolation are extremely marginal. Switches with 70 dB of

Table 1
Measured Isolation in dB Between Switch Ports

Frequency (MHz)	Isolation (dB)					
	Pos 1		Pos 2		Pos 3	
	Port 2	Port 3	Port 1	Port 3	Port 1	Port 2
3.0	129	122	129	129	121	128
4.0	129	116	127	125	115	127
5.0	129	111	125	117	110	124
7.5	122	102	117	111	103	116
10.0	117	97	109	104	97	110
12.5	112	93	105	99	93	106
15.0	112	91	107	96	90	105
17.5	114	88	105	93	87	103
20.0	113	86	102	91	85	101
22.5	109	84	100	92	84	99
25.0	107	82	96	90	82	98
27.5	109	81	94	88	80	96
30.0	108	80	92	86	79	92

Bernie McClenny, W3UR, w3ur@arrl.org

How's DX?

A Tribute to Donald B. Search, W3AZD

In 1939, Donald B. Search, W3AZD (SK), was born in Washington, DC, before he moved to Silver Spring, Maryland, when he was 9 years old. When Don was 16, he earned his Novice-class license and was issued the call WN3AZD in January 1955. His first station was a Heathkit AT-1 and Hallicrafters S-38B. The following year, Don upgraded to his General-class license and earned the new call sign W3AZD.

He became interested in DX with his low-power station, and within 2 years achieved DXCC. His lifetime achievement was 338 out of 340 countries on the current DXCC list. If you include the 62 deleted countries, his total achievement was 378 out of 402 countries.

During the Dayton DX Dinner, attendees are asked to stand if they have reached a certain number of countries. As the number of countries increases, those with fewer than the number called sit down. After reaching 340, the deleted countries are added until the last DXer is standing with the most number of countries worked. Many will remember Don as one of the last DX chasers standing during the DXCC stand down at the Dayton DX Dinner.

In 1959, after finishing high school, Don joined the United States Air Force and quickly became specialized in automatic weapons control systems for complex aircraft such as the McDonnell F-101B Voodoo. Around the same time, he began a lifelong relationship with Hope Smith, who eventually earned the call sign WB3ANE. After 4 years as an Airman First Class, Don left the Air Force and worked as an electronics technician for manufacturers such as Burrows Communications Limited in Washington, DC.

Contesting

Between 1968 and 1978, Don was involved in multioperator contesting, operating in the Bahamas and Curacao. He conducted some record-breaking operations. He was a member of the Potomac Valley Radio Club (PVRC) and was a regular operator at W3MSK/W3AU, usually on 40 meters single sideband (SSB). After moving to Newington, Connecticut, Don also operated from the Yankee Clipper Contest Club station, W2PV. He was a Charter member of the National Capitol DX Association (NCDXA) and never missed a meeting (even when he lived out of state). In 1974, Don was on both the ARRL and CQ DX Honor Rolls.

Don Search, W3AZD, checking cards at the infamous DXCC Desk at ARRL Headquarters in 1977. [Photo courtesy of *QST*]

Hope Smith, WB3ANE, and Don Search, W3AZD, at the Crowne Plaza Hotel during the 1997 Hamvention. [Thomas Roscoe, K8CX, photo]

Working for ARRL

In 1977, Don and Hope moved to Newington, Connecticut, to join the ARRL Headquarters staff, where Don administered the DXCC monthly listings. He was later put in charge of the DXCC Desk. Don worked at HQ for about 15 years. My dad Tony, KC3AJ (later N3ME), and I first met Don around 1979 at an NCDXA meeting. Don made an impression on me, a 15-year-old Novice-class

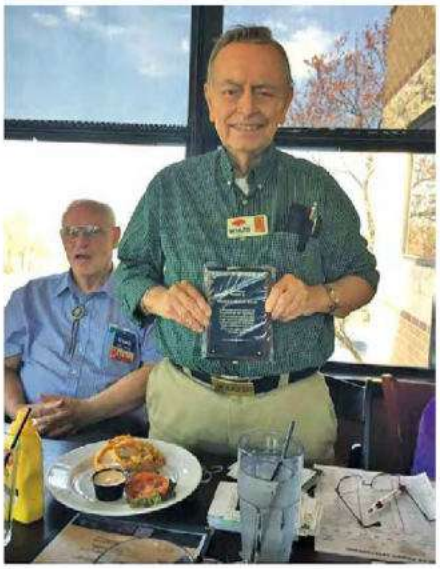
Don Search, W3AZD, was a proud "True Blue DXer." [Photo courtesy of *QST*]

Outside the 2018 Hamvention DX Forum, from left to right: Bernie McClenny, W3UR; Mike Fulcher, KC7V; Don Search, W3AZD, and Bill Marx, W2CQ. [Thomas Roscoe, K8CX, photo]

ham. A year or so later, we drove to Newington to see him, "Mr. DXCC."

Retirement

After retiring from HQ, Don and Hope moved to Davie, Florida, where he quickly became involved with the South Florida DX Association (SFDXA), continuing to act as an ambassador to DXing and giving back to the hobby as a DXCC Field Checker and QSL Bureau Letter Sorter. Long after leaving HQ, Don would help check cards at the ARRL DXCC booth at the Dayton Hamvention®.



In April 2018, Don Search, W3AZD, received a perfect attendance award for attending every National Capitol DX Association (NCDXA) meeting since 1972. [Alfred Laun, K3ZO, photo]

At the 1997 Hamvention, just 2 months after I started *The Daily DX*, Don and Hope attended the DX forum and were kind enough to help me pass out fliers about my new adventure. Don was a longtime friend and supporter of my DXing, and it was always a pleasure seeing him at NCDXA and PVRC meetings. Anytime the SFDXA asked for help, Don was ready, willing, and able.

In December 2019, Don was sent to a rehabilitation center after a fall. He passed away on the morning of March 26, 2020. I'll always remember Don as a tough guy with a heart of gold, as he was always willing to help anyone who loved DXing. I hope we can all continue that legacy of support and passion for this hobby.

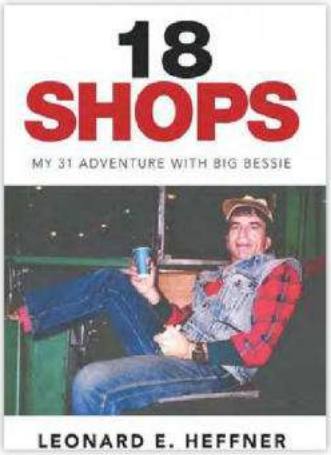
Wrap-Up

Thanks to K3ZO, K8CX (The Ham Gallery), KJ4VCT, and W2CQ for helping to make this month's column possible. If you have any DX or IOTA news, photos, or club newsletters please send them to **bernie@dailydx.com**. Until next month, see you in the pileups!
— Bernie, W3UR

Strays

QST Congratulates...

Lenny Heffner, KR3J, on the publication of his book *18 Shops*. The book recounts his 31 years as a steelworker at the various departments, or "shops," at Bethlehem Steel Corporation. *18 Shops* is available on Xlibris (**www.xlibris.com**) and Amazon.



Jon Jones, NØJK, n0jk@arrl.org

The World Above 50 MHz

Sporadic E and the Seasons

When you begin operating on 6 meters, you learn that the occurrence of sporadic E is related to the seasons. Sporadic E occurs frequently during the early summer months, with a minor season peaking around the winter solstice, and very rare occurrences around the equinoxes. Scientists still do not fully understand the reason for this, but Pat Dyer, WA5IYX (SK), collected many years' worth of meticulous data of reception of FM broadcast stations via sporadic E at his home in San Antonio, Texas.

The data shows the occurrence of sporadic E is very low in October and March. In fact, March has the lowest occurrence of sporadic E of any month in North America, with most documented years in 1990 showing no sporadic E at all during March.

Rare March Activity

According to a study published in *GPS Solutions*, one possible explanation for the lack of sporadic E in March is related to the Russell-McPherron effect, which is based on the hypothesis that around the equinoxes, solar wind can pour through cracks in the Earth's geomagnetic field. The cracks are opened by the solar wind itself. South-pointing magnetic fields inside the solar wind oppose Earth's north-pointing magnetic field. The two magnetic fields partially cancel one another out, weakening our planet's magnetic defenses. This cancellation can happen at any time of year, but it happens with greatest effect around the equinoxes. Indeed, a 75-year study shows that March is the most geomagnetically active month of the year, followed closely by September and October — a direct result of equinox cracks. So, aurora tends to take place more often around the equinoxes.

And the converse — mid-latitude sporadic E — has the lowest occurrence at the equinoxes. But it does occur, such as in March 2020, when there was an unusually high amount of sporadic E. When it does occur, some interesting contacts can be made, particularly when sporadic E forms a link to trans-equatorial propagation (TEP) across the geomagnetic equator. An example is when sporadic-E clouds occurred during the late afternoon over the Gulf of Mexico. A signal can reflect off the E_s clouds, then onto South America via TEP. The links can form on both sides of the path, extending the range.

On the Bands

50 MHz. Larry, NØLL, conducted another grid expedition to EN00 on March 14 (see Figure 1). Despite 3 inches of sloppy snow, Larry made a number of MSK144 contacts. Starting at 1128Z, he made over 10 contacts, and decoded several more. He had great results on random meteors with only 70 W and a three-element Yagi.

Sporadic E made some surprising appearances during March. I caught one of the rare openings March 28,

Figure 1 — Larry's, NØLL, portable 6-meter setup from his March 14 operation from grid square EN00. [Larry Lambert, NØLL, photo]

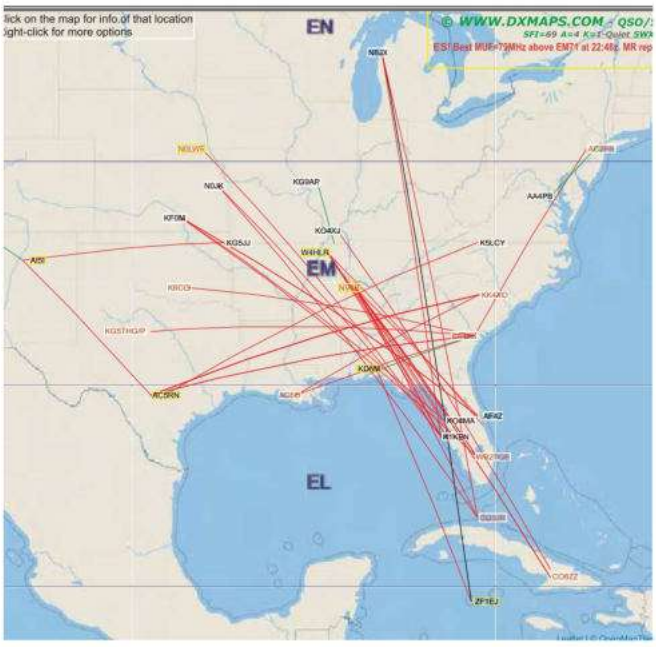


Figure 2 — DX Maps for the rare sporadic-E opening on March 28 on 50 MHz. [**dxmaps.com**]

and logged NØRW (EL87) at 2242Z (see Figure 2). From Wichita, Kansas, John, KFØM (EM17), made contacts with a number of stations in Florida, including K3VN and KO4MA. Larry, NØLL (EM09), made contacts with NJ2F (EL96) and W2PKY (EL88). N8JX spotted ZF1EJ. W5LDA (EM15) worked CO3VR (EL83) at 0055Z on March 29. There weren't any links during this opening to South America.

On March 31, extensive sporadic E covered the eastern states, the southern US border, Mexico, and the Gulf Coast. Around 2315Z, Peter, WA2GFN (FN20), made seven contacts, including those with KB5WNU (EM40), KD4CIF (EM63), KA1GHF (EM63), W3NH (EM63), K5DSB (EM51), K4TK (EM62), and K5MVP (EM50). The extensive E_s set up some links to TEP on to South America for those stations in the right location.

Chip Margelli, K7JA (DM03), who runs 180 W from a Kenwood TS-990 to a seven-element LFA Yagi, shared his account:

> The late afternoon of March 31 brought a 6-meter opening to the southern half of California, as well as states to the east. Here, in DM03, south of Los Angeles, I worked Dale, CE2SV, on FT8 at 2325 UTC, followed by CE3BN, XQ3MCC, and XQ3SK/4. CE2SV was worked on CW at 0002 UTC (April 1), and several other CE and LU stations were heard but not worked, along with HC2DR in Ecuador. Flags from PSKReporter indicated that I was heard by a total of seven CE stations, plus LU9FVS. Because I am so far north (geomagnetically), I suspect this may well have been an E-to-TEP path.

144 MHz. On March 7, Mike, K7ULS (DN41), worked Franco, I2FAK, via EME on JT65 (see Figure 3). Mike was running only 50 W and a single Yagi with –23 dB signals. Franco speculated they could have completed the contact with Mike running only 25 W.

Tropospheric propagation appeared several times. On March 23, Sam, K5SW (EM25), made contacts with stations in Texas as far as KB5WB (EM02) on SSB. On March 25, KFØM (EM17) logged W5FH (EM21) and KX5S (EM14) on SSB. I noted strong tropo on FM broadcast stations from Oklahoma to Kansas. On March 27, KFØM worked KV5W (EM22) on FT8. From EM93, Joe, WA4LDU, worked K5TR (EM00) at 1,653 kilometers and N5WS (EL09) at 1,693 kilometers on FT8. Joe uses 25 W to a 14-element Yagi up 60 feet.

On March 30, Steve, K2IL (EL97), worked WP4G, NP4BM, WP3DN (FK68), and HI3DL (FK58) on FT8. He suspected there was tropospheric propagation. Steve runs 200 W to a 10-element Yagi.

222 MHz. On March 22, Jay, N1AV, contacted K7MAC on MSK144. Keith, W9RM (DM58), worked W5EME (EM32) on MSK144 on March 29 on random meteors. On March 29, Jay, N1AV, also worked AA5C (EM13) and K5DOG on MSK144.

432 MHz. On March 17, AB9QH had 15 stations check in to the Monday evening SSB net from the Chicago area. KFØM (EM17) worked K5IM (EM20) on March 26.

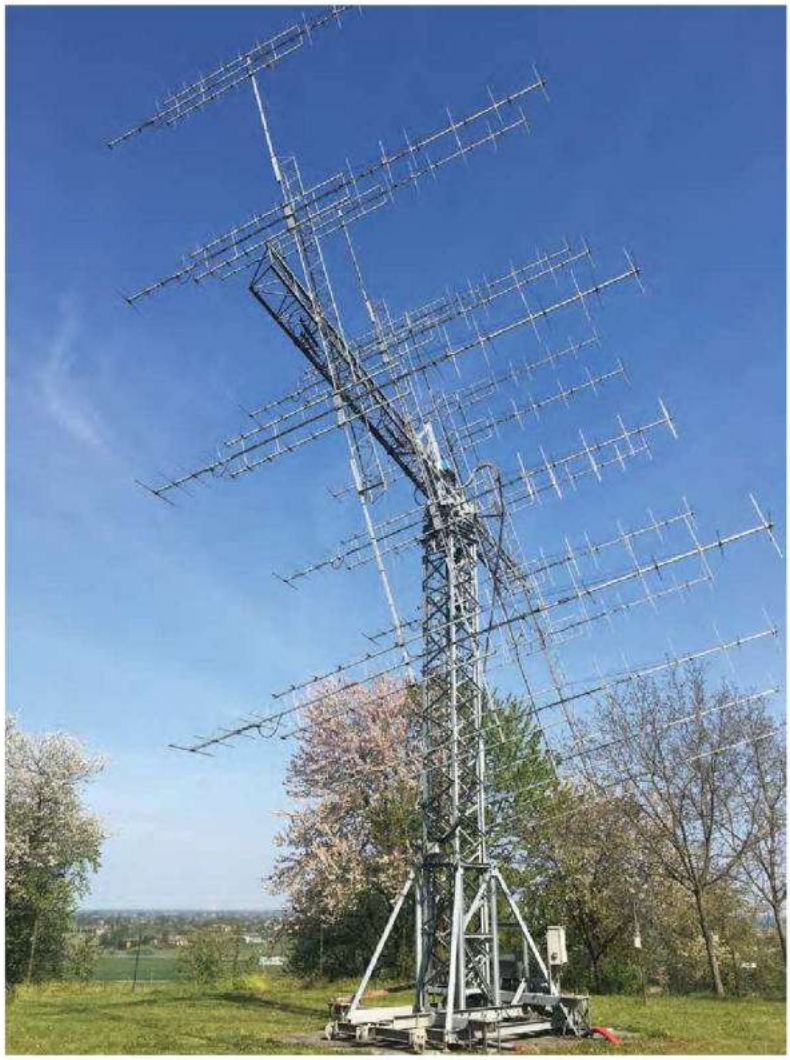


Figure 3 — Franco's, I2FAK, big 144 MHz EME array. [Franco Giorgi, I2FAK, photo]

Here and There

Wyatt, ACØRA, is planning a trip to rare grid CM93 to activate it on 6 meters in June, possibly during the ARRL June VHF Contest.

Monster sporadic-E openings took place April 14 and 15. More on this to come in the July issue.

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

Special Event Stations

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

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

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

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

May 4 – May 31, 1400Z – 2359Z, GB2ØØFN, Romsey, United Kingdom. RSGB. **Florence Nightingale Bicentenary**. 14.190 3.650. QSL. John Wakefield, Oakhurst, Lower Common Rd., Romsey SO51 6BT, United Kingdom. **www.qrz.com/db/gb200fn**

May 16, 1530Z – 2000Z, KSØKS, Strong City, KS. Santa Fe Trail Amateur Radio Club. **Amateur Radio Day on the Prairie**. 18.145 14.280 10.115 7.245. QSL. SFTARC, P.O. Box 3144, Olathe, KS 66063. *Operating from Tallgrass Prairie National Preserve.* **www.sftarc.org**

May 18 – May 25, 0000Z – 0000Z, K1A, Cleburne, TX. Club KC5NX. **Memorial Day**. 14.250 14.045 7.233 7.045. QSL. Club KC5NX, 9200 Summit Ct. W., Cleburne, TX 76033-8212. **club.kc5nx@gmail.com** *or* **www.qrz.com/db/kc5nx**

May 20, 1330Z – 2030Z, K2CAM, Garden City, NY. Long Island Mobile Amateur Radio Club. **Apollo 11**. 21.340 14.240 7240. QSL. LIMARC, P.O. Box 392, Levittown, NY 11756. *The aerospace industry on Long Island was a significant part of the moon landing project. Much of that history is displayed at the Cradle of Aviation.* **www.cradleofaviation.org** *or* **www.limarc.org**

May 22 – May 25, 2000Z – 2000Z, W3M, Boalsburg, PA. Nittany Amateur Radio Club. **Birthplace of Memorial Day, Boalsburg, PA**. 14.245 7.185 3.845 146.85. QSL. W3M c/o, Nittany Amateur Radio Club, P.O. Box 614, State College, PA 16801. **www.qrz.com/db/w3m**

May 23, 1300Z – 1900Z, W4OT, Fort Pierce, FL. Vero Beach Amateur Radio Club. **National Military Month**. 14.330 +/-; D-STAR Ref 078C. Certificate. Vero Beach Amateur Radio Club, c/o IRC EOC, 4225 43rd Ave., Vero Beach, FL 32967. *4th Annual Special Event at the Fort Pierce Navy Seal Museum.* **https://w4ot.webs.com**

May 31, 1500Z – 1900Z, WØOEL, Dundee, IA. Rural Iowa and Buchanan County Amateur Radio Clubs. **Iowa State Parks On-the-Air Centennial — Backbone**. 14.240 7.240. Certificate & QSL. Great River ARC, P.O. Box 1384, Dubuque, IA 52004. *QSL for contact; certificate for five parks. See website for details.* **www.w0dbq.org/rules** *or* **www.w0oel.com**

June 1 – June 7, 0001Z – 2359Z, N6M, Monterey, CA. West Coast DX Group. **Monterey, CA 250th Anniversary**. 1770-2020. 14.250 7.250. QSL. G. Costello, WC6DX, P.O. Box 1332, Monterey, CA 93942-1332.

June 1 – June 11, 0059Z – 2359Z, K4D, Carrabelle, FL. K5TEN. **Dog Island IOTA DXpedition to NA-085/EL79**. 14.074 7.074 14.235 7.190. QSL. Bruce Brady, 208 Mt. Tabor Rd., Hot Springs National Park, AR 71913. *Rare grid EL79. Rare IOTA NA-085. Paper QSL preferred, also LoTW and eQSL. See website for QSL details.* **rockradio1@aol.com** *or* **www.qrz.com/db/k4d**

June 3 – June 10, 1300Z – 2200Z, W2W, Baltimore, MD. Amateur Radio Club of the National Electronics Museum. **D-Day Commemoration**. 14.244 14.044 7.244 7.044; 80 meters (3.544, 3.844) and digital modes possible during event. Certificate & QSL. W2W D-Day, P.O. Box 1693, MS 4015, Baltimore, MD 21203. *Additional operation possible during between June 3 – 5 and 8 – 10, as operator availability permits.* **ww-2.us**

June 5, 1400Z – 2200Z, KØSAL, Lincoln, NE. Lincoln SATERN. **Salvation Army National Donut Day**. 14.318. Certificate & QSL. Charles Bennett, P.O. Box 67181, Lincoln, NE 68506. **kd0ptk@gmail.com**

June 6 – June 7, 0000Z – 2359Z, N1S, Groton, CT. Generations Amateur Radio Club. **Nuclear Submarine USS *Nautilus* SSN 571**. 28.400 14.280 7.250 3.870. QSL. Bureau via K3LBD, or direct to Generations Amateur Radio Club, 110 Vinegar Hill Rd., Gales Ferry, CT 06335-1713. **www.ussnautilus.org**, **www.qrz.com/db/k3lbd** *or* **www.qrz.com/db/n1s**

June 6 – June 7, 0800Z – 1800Z, N8S, Harrison Township, MI. Utica Shelby Emergency Communication Association. **Selfridge Air National Guard Base Open House & Air Show**. 14.230 7.180. QSL. USECA c/o N8S, P.O. Box 46331, Mount Clemens, MI 48046.

June 6 – June 7, 1300Z – 2100Z, K8E, Toledo, OH. Toledo Mobile Radio Association. **Museum Ships Weekend**. 14.260 14.039 7.260 7.039. Certificate. K8E Col. James M. Schoonmaker Team, P.O. Box 9673, Toledo, OH 43697. **www.tmrahamradio.org**

June 6 – June 7, 1400Z – 2100Z, NB9QV, Manitowoc, WI. USS *Cobia* Amateur Radio Club. **World War II Sub USS *Cobia* on the Air**. 14.240 7.240. QSL. Fred Neuenfeldt, 4932 S. 10th St., Manitowoc, WI 54220-9121. **www.qrz.com/db/nb9qv**

June 6 – June 7, 1630Z – 2130Z, W5KID, Baton Rouge, LA. Baton Rouge Amateur Radio Club. **Museum Ships Weekend**. 14.250 14.035 7.225 7.035. QSL. USS *Kidd* Amateur Radio Club, 305 S. River Rd., Baton Rouge, LA 70802. *Operation onboard the* USS Kidd *(DD-661), World War II Fletcher class destroyer.* **qrz.com/db/w5kid**

June 12 – June 14, 1300Z – 2359Z, W3W, Cumberland, MD. Mountain Amateur Radio Club. **Whiskey Rebellion/ Cumberland Heritage Days**. 14.322 7.222 3.855. QSL. MARC, P.O. Box 234, Cumberland, MD 21501. **www.hamtalk.org**

June 13, 1300Z – 1900Z, W1M, Russell, MA. Western Mass Council — BSA. **WHOA/Scout Camps On the Air**. 14.250 10.115 7.060 7.190. QSL. Thomas Barker, 329 Faraway Rd., Whitefield, NH 03598.

June 14, 1500Z – 1900Z, KCØRMS, Quasqueton, IA. Buchanan County Amateur Radio Club. **Iowa State Parks On-the-Air Centennial — Cedar Rock**. 14.240 7.240. Certificate & QSL. Great River ARC, P.O. Box 1384, Dubuque, IA 52004. *QSL for contact; certificate for five parks. See website for details.* **www.w0dbq.org/rules** *or* **www.bcarc.net**

June 19 – June 22, 1300Z – 0100Z, W9C, Crescent City, IL. Metro DX Club. **Crescent City Fireball Anniversary**. 14.280 14.050 7.280 7.050. Certificate & QSL. Jim Mornar, N9TK, 8607 W. Kendall Ln., Orland Park, IL 60462. *E-certificate available:* **n9tk@comcast.net**. **www.metrodxclub.com**

June 20, 1200 – 2300, K5E, Bonham, TX. Fannin County Amateur Radio Club K5FRC. **Treasure Island**. 28.415 14.265 7.265 3.815. QSL. Fannin County ARC, P.O. Box 553, Bonham, TX 75418. *We will experiment with FT4 digital.* **www.k5frc.org**

June 20, 1800Z – 2359Z, K1D, Lawton, OK. Frank Phillips Memorial Repeater Association, AB5J. **Kids Day Lawton, OK**. 21.250 14.250 14.045 7.250. QSL. Ronald Grossman, 1308 SW Washington Ave., Lawton, OK 73501. *We plan to be on FT8, CW, SSB, DMR, etc.*

June 22 – Aug. 9, 1600Z – 1600Z, K2BSA/3, Rising Sun, MD. Chester County Council BSA Camp Horseshoe Scout Reservation. **BSA Camp Horseshoe Scout Reservation**. 14.325; primarily 20 and 40 meters, camp station is capable of operating from 80 meters and up; modes will be SSB, digital PSK/RTTY, and CW when possible. QSL. Walt Beattie, 2315 Bradley Way, Pottstown, PA 19464-2684. *QSL cards welcomed. If possible, please ID the operator with whom you spoke.* **https://k2bsa.net/2020/02/camp-horseshoe-2019-summer-camp-k2bsa-3**

June 24 – June 30, 0000Z – 2359Z, N6R, Simi Valley, CA. Ventura County Amateur Radio Society, Simi Settlers Amateur Radio Club and other area amateur radio operators**. Field Day 2020, Commemorating the Lives of President Ronald and Mrs. Nancy Reagan**. 21.320 14.255 7.260 3.810. QSL. Peter S. Heins, 1559 Norwich Ave., Thousand Oaks, CA 91360. **www.qrz.com/db/n6r**

June 25 – July 6, 0900Z – 0900Z, W8S, Vermontville, MI. Fire/ EMS Dance Committee. **Vermontville TWP Fire & EMS 100th Annual Dance**. 446.200 MHz PL 74.4; 147.080 MHz PL 103.5; 145.560 MHz; IRLP Node 4868. QSL. Rodney L. Harmon, WK8H, 172 E. Second St., Vermontville, MI 49096-9455. **wk8h_michigan@att.net**

June 27 – June 28, 0730Z – 1700Z, AG4BV, Jupiter, FL. Jupiter Tequesta Repeater Group. **38th Anniversary Jupiter Tequesta Repeater Group/Field Day**. 14.214 14.174 14.164 14.184. QSL. Albert Moreschi, II, 11826 154 Rd. N., Jupiter, FL 33478. **www.jtrg.org**

June 28 – July 3, 1300Z – 0500Z, K2BSA/8, Metamora, MI. Garden City Amateur Radio Club. **Boy Scouts of America Trail to Eagle XXVI**. 14.330 7.270 3.840. QSL. Richard Zarczynski, AC8FJ, 7371 N. Farmington Rd., Westland, MI 48185-6900. *K2BSA/8 will operate at the D-Bar-A Scout Ranch during the week as time permits. We will also be teaching the radio merit badge to our scouts.* **michiganscouting.org/event/trail-to-eagle-xxvi-2019-trail-to-eagle**

Certificates and QSL cards: To obtain a certificate from any of the special event stations offering them, send your QSO information along with a 9 × 12-inch self-addressed, stamped envelope (three units of postage) to the address listed in the announcement. To receive a special event QSL card (when offered), be sure to include a self-addressed, stamped business envelope along with your QSL card and QSO information. *Note: Some clubs may ask for a nominal fee to cover the cost of the certificate or QSL. Request will be made on air during the event or on the club's website.

Special Events Announcements: For items to be listed in this column, use the ARRL Special Events Listing Form at **www.arrl.org/special-events-application**. A plain-text version of the form is available at that site. You may also request a copy by mail or email. Off-line completed forms can be mailed, faxed (Attn: Special Events), or emailed.

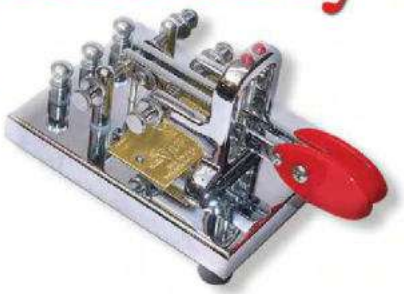
Submissions must be received by ARRL HQ no later than the 1st of the second month preceding the publication date; a special event listing for **September** *QST* would have to be received by **July 1**. In addition to being listed in *QST*, your event will be listed on the ARRL Web Special Events page. Note: All received events are acknowledged. If you do not receive an acknowledgement within a few days, please contact us. ARRL reserves the right to exclude events of a commercial or political nature.

You can view all received Special Events at **www.arrl.org/special-event-stations**.

Certificate of Code Proficiency

Recipients

Sponsored by VIBROPLEX
www.vibroplex.com



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

January 2020

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

February 2020

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

March 2020

Paul A. Gierow, KN4NVU	10
Richard J. Guerrera, KB1FGC	10
Michael S. Lundy, W4MSL	10
Richard J. Guerrera, KB1FGC	15
Robert B. Brown, K6AAQ	20
Cesidio DiBenedetto, Jr., KD8OOB	20
Robert S. Zarges, Jr., K2MZ	20

Congratulations to all the recipients.

June 2020 W1AW Qualifying Runs

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

June Qualifying Runs will be transmitted by W1AW in Newington, Connecticut at the times shown at 1.802.5, 3.581.5, 7.047.5, 14.047.5, 18.097.5, 21.067.5, 28.067.5, 50.350, and 147.555 MHz. The West Coast Qualifying Runs will be transmitted by K6KPH on Saturday, June 20 at 2 PM PDT (2100 UTC) on 3581.5, 7047.5, 14047.5, and 18097.5 kHz. Unless indicated otherwise, sending speeds are from 10 to 35 WPM.

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

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

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

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

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

W1AW Code Proficiency Schedule — June 2020
(All times in Eastern Daylight Time)

Monday	Tuesday	Wednesday	Thursday	Friday
6/1 4 PM – 2000Z 10 – 35 WPM	**6/2** 7 PM – 2300Z 35 – 10 WPM		**6/4** 10 PM – 0200Z **(6/5 – UTC)** 10 – 40 WPM	**6/5** 9 AM – 1300Z 10 – 35 WPM
	6/9 4 PM – 2000Z 10 – 35 WPM	**6/10** 7 PM – 2300Z 10 – 40 WPM	**6/11** 9 AM – 1300Z 35 – 10 WPM	**6/12** 10 PM – 0200Z **(6/13 – UTC)** 10 – 35 WPM
	6/16 9 AM – 1300Z 10 – 35 WPM	**6/17** 10 PM – 0200Z **(6/18 – UTC)** 35 – 10 WPM	**6/18** 7 PM – 2300Z 10 – 35 WPM	**6/19** 4 PM – 2000Z 10 – 40 WPM
6/22 10 PM – 0200Z **(6/23 – UTC)** 10 – 40 WPM		**6/24** 9 AM – 1300Z 35 – 10 WPM	**6/25** 4 PM – 2000Z 35 – 10 WPM	**6/26** 7 PM – 2300Z 10 – 35 WPM

ARRL VEC Volunteer Examiner Honor Roll

The ARRL VEC Honor Roll recognizes the top five Volunteer Examiners in each ARRL Division according to the total number of ARRL exam sessions in which they have participated since their accreditations. Considering each session requires an average time commitment of 2 to 4 hours or more, the thousands of hours these VEs have invested represent extraordinary dedication! Whether you are one of our VE Teams that tests once a week, once a month, or once a year, we want to express our warmest appreciation to all volunteers for your generous contribution to the ARRL VEC program.

If you are an ARRL VE, you can view your session stats online at **www.arrl.org/ve-session-counts**.
If you are not a VE, become one today! See **www.arrl.org/become-an-arrl-ve**.

Examiner	Sessions	Accreditation Date
Atlantic		
Jobst Vandrey, AC0LP	324	23-Jun-08
James McCloskey, NS3K	320	14-Nov-94
Edward Genoino, WA2NDA	298	10-Jul-85
George Brechmann, N3HBT	280	01-Apr-91
William Klepser, Jr., WB2AIV	215	09-Jun-99
Central		
Ed Wagner, AB9FN	338	01-Jul-02
Eldon Boehm, NK9U	316	21-Nov-86
Allan Bukowski, N9ZD	313	01-Jun-92
Donald Hlinsky, N9IZU	302	01-Mar-91
Timothy Pechtold, AA9BV	277	01-Nov-92
Dakota		
John Schwarz, Jr., AE0AL	309	26-Oct-94
Jeffrey Goodnuff, W0KF	304	17-Jun-03
Shep Shepardson, N0NMZ	249	12-Mar-01
Daniel Royer, KE0OR	237	01-Jul-91
Dennis Ackerman, KB0OQQ	221	15-Jul-96
Delta		
Arthur Parry, Jr., WB4BGX	268	01-May-91
Glenn King, N5GK	245	05-Jun-86
Joe Lowenthal, WA4OVO	243	25-May-06
Roger Gray, N5QS	226	01-Mar-93
Bobbie Williams, W1BEW	215	01-Jun-92
Great Lakes		
Charles Hall, W8HF	285	01-Jun-92
Archie Mack, Sr., AF4EB	224	19-Aug-97
Dale Pritchett, KC8HJL	223	26-Mar-98
Christian Anderson, K8VJ	220	09-Feb-90
Stanley Arnett, II, AC8W	211	06-Sep-84

Examiner	Sessions	Accreditation Date
Hudson		
Paul Maytan, AC2T	661	06-Sep-84
Stanley Rothman, WA2NRV	454	01-Mar-85
E. Drew Moore, W2OU	441	01-Aug-90
Fritz Boigris, KB2O	418	26-Oct-84
Gerald Miller, Jr., AA2ZJ	399	05-Dec-95
Midwest		
David Bartholomew, AB0TO	720	22-Mar-02
Kevin Naumann, N0WDG	633	17-Nov-02
Harry Steger, Jr., W0HMS	557	26-Aug-08
Roland Kramer, W0RL	526	21-Jun-01
Jeanette Nordman, AB0YX	460	21-Aug-03
New England		
Robert Beaudet, W1YRC	383	01-Aug-90
Paul Lux, K1PL	350	25-Jan-85
Bruce Anderson, W1LUS	338	11-Feb-88
Lawrence Polowy, KU1L	338	02-Jan-85
Stefan Rodowicz, N1SR	335	20-Nov-84
James Mullen, KK1W	335	01-Mar-91
W. Ben Fleck, K2LYE	277	07-Jun-88
Northwestern		
Richard Morgan, KD7GIE	450	11-Aug-00
Loren Hole, KK7M	381	06-Sep-84
George Ftikas, N7TQZ	299	01-Dec-92
David Brooks, N7HT	296	10-Jun-87
S. Riley McLean, W7RIL	293	02-Sep-99
Pacific		
Morris Jones, AD6ZH	481	27-Nov-01
Dieter Stussy, KD6LVW	417	27-Jan-94
Gordon Fuller, WB6OVH	351	06-Sep-84
Bill Nichols, NN7K	329	01-Sep-93
Jim Brunk, N6BHX	284	13-Jul-95

Examiner	Sessions	Accreditation Date
Roanoke		
Judy Friel, AC4RG	285	01-Feb-91
Alan Ronald Moeck, WA2RPX	264	27-Sep-94
David Snyder, W4SAR	249	01-May-93
Sheila Frank, KT4YW	221	30-Oct-96
Terry Sanner, WV8V	216	06-Sep-84
Rocky Mountain		
Robert Hamilton, N0RN	382	19-May-87
David Avery, N0HEQ	301	13-Jan-88
Jeffrey Weinberg, W0QO	292	01-Apr-93
Donald Baune, AC0EX	259	19-Sep-06
David Sharpe, KI0HG	257	02-Feb-98
Southeastern		
Victor Madera, KP4PQ	465	01-Mar-92
Val Jacyno, AK4MM	388	08-Nov-11
Pablo Soto, KP4SJ	374	01-May-92
Robert Cumming, Sr., W2BZY	354	29-Jan-97
Joseph Patti, N4UMB	321	01-Sep-90
Southwestern		
Bill Martin, AI0D	1,045	01-Nov-84
Fred Bollinger, AB7JF	535	17-Apr-95
David Morrill, N7TWT	429	20-Jul-00
Steve Gurley, KY7W	409	19-Apr-96
Joseph Cutitta, W0SLL	406	09-Nov-99
West Gulf		
Franz Laugermann, K3FL	1,044	01-Dec-91
Wilbert Cannonier, KK5JJ	469	03-Nov-95
Adolph Chris Koehler, K5VCR	466	29-Sep-95
Gerald Grant, WB5R	466	04-Jan-85
David Fanelli, KB5PGY	437	01-Oct-91
Michael Nault, W5OFT	389	06-Sep-01

New Products

The HybridDX Antenna

The new HybridDX antenna offers 160- through 6-meter coverage in a unique wire dipole design that occupies just 79 feet. The HybridDX combines horizontal, vertical, and efficient linear loading for performance superior to a G5RV design within a much smaller footprint. The antenna is center fed with 450 Ω ladder line — 75 feet of line is provided — and includes UV-stabilized polymer spreaders. For more information, see **www.hybriddx.com**. Price: $99.95. Available from Quicksilver Radio at **www.qsradio.com**.

Convention and Hamfest Calendar

Abbreviations

Spr = Sponsor
TI = Talk-in frequency
Adm = Admission

Due to the COVID-19 pandemic, many hamfests and amateur radio conventions have been canceled. Please note that as this column was being composed, the events listed here were still scheduled. Be sure to check **www.arrl.org/canceledHamfests.php** to see if an event has been canceled. Thank you to all our members for your support during this challenging time.

Florida (Dade City) — June 13 F H R T
8 AM – noon. *Spr:* Dade City Masonic Lodge. Dade City Masonic Lodge, 13642 21st St. S. *TI:* 147.135 (146.2 Hz). *Adm:* $5. **www.dadecitymasoniclodge.com**

Florida (Orlando) — June 20 F H R T
6 AM – noon. *Spr:* South Conway Road Baptist Church. South Conway Road Baptist Church, 6099 S. Conway Rd. *TI:* 146.52. *Adm:* Free.

Illinois (Granite City) — June 14 D F H R T V
7 AM – noon. *Spr:* Egyptian Radio Club. Holy Family Church, 2600 Washington Ave. (back of the building). *TI:* 146.79 (141.3, 127.3 Hz). *Adm:* Advance $5, door $8. **www.w9aiu.org**

Illinois (Wheaton) — June 21 D F H R
7 AM – 1 PM. *Spr:* Six Meter Club of Chicago. DuPage Fairgrounds, 2015 Manchester Rd. *TI:* 146.97. *Adm:* Advance $6, door $10. **www.k9ona.com**

Indiana (Winchester) — June 20 D F H Q R S T V
8 AM – 3 PM. *Spr:* Randolph County Amateur Club. Randolph County Fairgrounds, 1885 US 27. *TI:* 147.3 (110.9 Hz). *Adm:* Free.

Iowa (Creston) — June 13 D F H R T V
8 AM – noon. *Spr:* South West Iowa ARA. Union County Emergency Management, 705 E. Taylor St. *TI:* 146.79 (136.5 Hz). *Adm:* Free. **www.facebook.com/groups/327085807349791**

Maryland (Upperco) — June 21 D F H Q R T
7 AM – 2 PM. *Spr:* Baltimore ARC. Arcadia Fairgrounds, 16920 Carnival Ave. TI: 146.67 (107.2 Hz). *Adm:* $5. **www.w3ft.com**

Michigan (Monroe) — June 21 D F H Q R T
7:30 AM – 1 PM. *Spr:* Monroe County Radio Communications Assn. Monroe County Fairgrounds, 3775 S. Custer Rd. *TI:* 146.72/12 (100 Hz). *Adm:* $6. **www.mcrca.org**

New Jersey (Piscataway) — June 20 D F Q R T V
8 AM – noon. *Spr:* Raritan Valley RC. Piscataway High School, 110 Behmer Ave. (Lots 11 – 12). *TI:* 146.652 (103.5 Hz). *Adm:* $7.

New York (Cortland) — June 13 F R T V
7 AM – noon. *Spr:* Skyline ARC. Courtland County Fairgrounds, 4301 Fairgrounds Dr. *TI:* 147.18 (71.9 Hz). *Adm:* $5. **www.skylineradioclub.org**

Ohio (Owensville) — June 20 D F H Q R T V
8 AM – 1 PM. *Spr:* Milford ARC. Clermont County Fairgrounds, 1000 Locust St. *TI:* 147.345 (123 Hz). *Adm:* $5. **www.w8mrc.com**

PENNSYLVANIA STATE CONVENTION

July 4, Harrisburg, PA
D F H Q R S T
8 AM. *Spr:* Harrisburg RAC. Shumaker Public Service Building, N. Hall Dr. (Industrial Rd.) Firecracker Hamfest. *TI:* 146.76 (100 Hz). *Adm:* $5. **www.w3uu.org**

Pennsylvania (Lime Ridge) — June 13 D F H R T V
7 AM – 1 PM. *Spr:* Columbia-Montour ARC. Lime Ridge Community Center, 6405 4th St. *TI:* 147.225 (85.4 Hz). *Adm:* $5. **www.qsl.net/cm-arc/hamfest.htm**

Pennsylvania (Plains) — June 5 D F H R T V
8 AM – noon. *Spr:* Murgas ARC. Polish American Veterans Club, 2 S. Oak St. *TI:* 146.61 (82.5 Hz). *Adm:* $7. **www.hamfest.murgasarc.org**

DELTA DIVISION CONVENTION

June 20, Knoxville, TN
D F H Q R S T V
8:30 AM – 3 PM. *Spr:* Radio Amateur Club of Knoxville. Kerbela Temple, 315 Mimosa Ave. *TI:* 147.3 (100 Hz). *Adm:* Advance $8, door $10. **www.w4bbb.org**

Texas (Plano) — June 12 – 13 D F H Q R S T V
Fri noon – 5 PM, Sat 8 AM – 5 PM. *Sprs:* Ham-Com Event Organizers and Supporting Area Clubs. Plano Event Center, 2000 E. Spring Creek Pkwy. *TI:* 147.10. *Adm:* Advance $8, door $10. **www.hamcom.org**

Wisconsin (Kaukauna) — June 13 D F H R T
7 AM. *Spr:* Fox Cities ARC. Starlite Club, W2091 County Rd. *TI:* 146.76 (100 Hz). *Adm:* $6. **www.fcarc.club/sunshineswap.php**

Washington (Peshastin) — June 12 – 14 D R V
All day. *Spr:* Apple City ARC. Dryden Gen Club, 7649 Saunders Rd. *TI:* 146.68 (156.7 Hz). *Adm:* $7. **www.applecityarc.com**

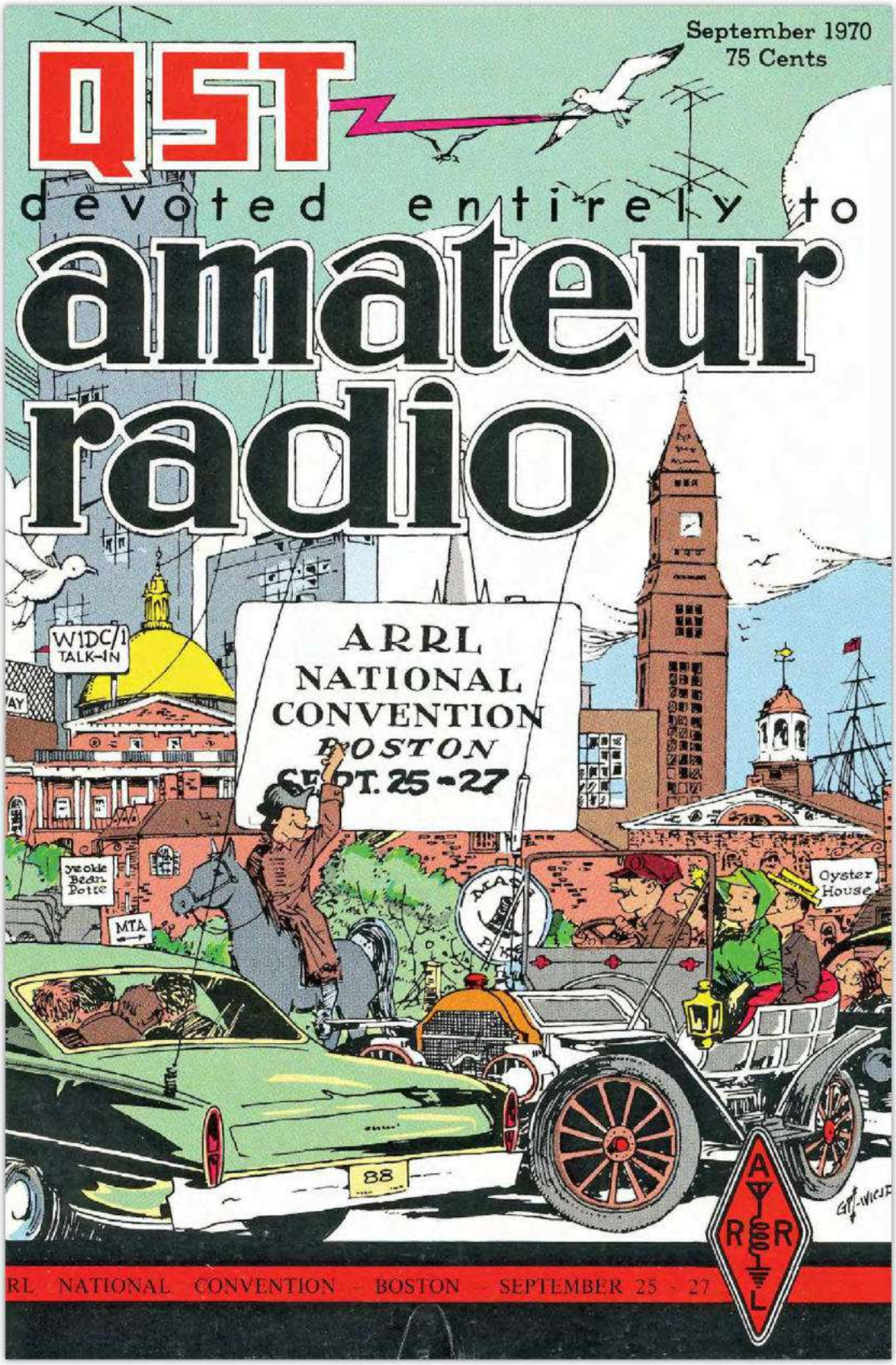
A = AUCTION
D = DEALERS / VENDORS
F = FLEA MARKET
H = HANDICAP ACCESS
Q = FIELD CHECKING OF QSL CARDS
R = REFRESHMENTS
S = SEMINARS / PRESENTATIONS
T = TAILGATING
V = VE SESSIONS

To All Event Sponsors

Before making a final decision on a date for your event, you are encouraged to check the Hamfest and Convention Database (**www.arrl.org/hamfests-and-conventions-calendar**) for events that may already be scheduled in your area on that date. You are also encouraged to register your event with HQ as far in advance as your planning permits. See **www.arrl.org/hamfest-convention-application** for an online registration form. Dates may be recorded up to 2 years in advance.

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.

A Look Back


September 1970
75 Cents
QST
devoted entirely to
amateur
radio
ARRL
NATIONAL
CONVENTION
BOSTON
SEPT. 25-27
W1DC/1
TALK-IN
ye olde
Bean Pote
MTA
Oyster
House
88
RL NATIONAL CONVENTION - BOSTON - SEPTEMBER 25 - 27

A QRP Console

BY DOUG DEMAW,* W1CER

Here is a mate for the 80- and 40-meter QRP transceiver that appeared in last month's QST. *It combines a low-power SWR meter with a universal pi-section antenna coupler. The speaker for the transceiver is contained in this accessory box.*

The QRP console is shown atop the QRP transceiver described in August *QST*. These electrically compatible units have look-alike decor with green panels, white labels, and lye-bath finished aluminum covers. Kurz-Kasch 700 Series knobs are used on both pieces of gear (Catalog No. 112, Kurz-Kasch, Inc., Dayton, Ohio 45401).

IT'S HANDY to keep the station equipment neat and orderly, especially during portable or emergency operation. This QRP console is a fitting mate for the August *QST* cw box, and permits matching the transceiver output to almost any load, reactive or resistive in nature. The tuner portion will look into end-fed random or resonant wires, coax-fed antennas, or into antennas that use balanced feeders. Ideally, the antenna would be cut to a resonant length, but even with nonresonant antennas this tuner will disguise whatever SWR is present to give the transceiver the 50-ohm load it is designed to look into.

The Circuit

Referring to Fig. 1, the transceiver connects to J1 at low impedance (50 ohms). An SWR bridge[1] is permanently in the low-impedance part of the line, and permits the operator to adjust the antenna tuner for zero reflected power, which will correspond to a 50-ohm termination at the output port of the bridge (junction of C6 and L1). The forward-power reading can be used when tuning up the transmitter portion of the transceiver.

The tuner consists of a pi-section tuned circuit whose inductor is tapped at 10 places to permit a variety of matching conditions on 80 and 40 meters. By using both C6 and C7 as a part of the matching network the pi-network configuration exists. By adjusting either C6 or C7 to minimum capacitance (approximately 15 pF with the plates completely unmeshed) an L-network tuner can be realized. By switching L2 in parallel with L1 the inductance is reduced. This will permit a vernier effect when working at the low-inductance end of the adjustments. Ideally, a rotary inductor would be used in place of the tapped coil, but sufficient flexibility exists with the circuit of Fig. 1 to match almost any impedance the operator will encounter.

Switch S4 permits the operator to select either a balanced or unbalanced output. In the balanced position S4 places T2, a 1:1 balun transformer, in the circuit to allow the use of balanced feeders (300-ohm folded dipole or similar). When S4 is thrown to the opposite position one can use a single-wire or coax-fed antenna by connecting the wire or feed line to J2.

This accessory box is designed to handle up to 10 watts of rf power. If greater power levels are anticipated, the variable capacitors should be replaced by units with more spacing between plates. Also, the primary winding of T1 will require modification, as will the bridge constants. The toroidal inductors will handle up to 25 or 30 watts safely.

Construction Information

The components are housed in a homemade aluminum box which is 7 inches wide, 5 1/2 inches deep, and 5 inches high. The same construction technique used for the August *QST* transceiver cabinet is employed here – two U-shaped channels which are held together by means of L brackets and No. 6 sheet-metal screws. Most of the parts are assembled on a circuit board, whose pattern is given in Fig. 2. The circuit board is spaced away from the bottom surface of the box a distance of 3/8 inch. Rubber grommets serve as spacers.

*Technical Editor, *QST*.

[1] Information on homemade SWR meters is given in December 1969 *QST*, p. 11.

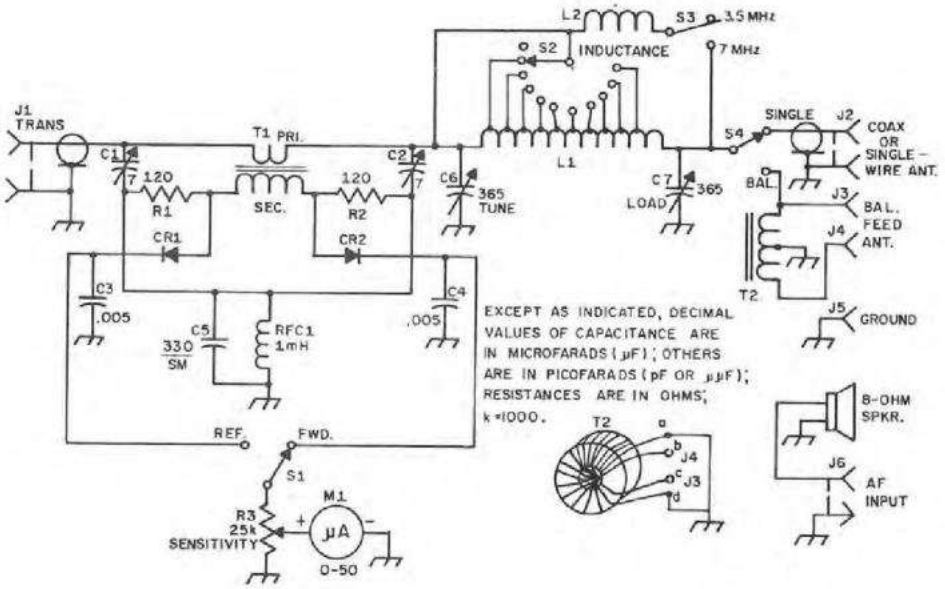


Fig. 1 — Schematic diagram of the QRP Console.

C1, C2 — 1.5 to 7-pF ceramic trimmer.
C3, C4 — Disk ceramic, 50-volt type.
C5 — Silver mica.
C6, C7 — Single-section variable (J. W. Miller Co. No. 2111 or equivalent. Address is 19070 Reyes Ave., Compton, CA 90221. Catalog available).
CR1, CR2 — IN34A germanium diode.
J1, J2 — Coaxial connector, chassis-mount type.
J3, J4, J5 — Insulated binding post (E. F. Johnson type 111-101).
J6 — Phono connector, single-hole mount.
L1 — 38 turns No. 20 enameled wire on Amidon T-130-2 toroidal core. Space turns equally around entire core. Make first tap 4 turns in from C6, then tap at 7, 10, 13, 16, 19, 22, 26, 30 and 34 turns. Unloaded Q is 300. Inductance is 17 μH. (Amidon Associates, 12033 Otsego St., N. Hollywood, CA 91607.)
L2 — 44 turns No. 24 enam. wire, close-wound on Amidon T-68-2 toroidal core. Inductance is 15 μH, unloaded Q is 220.
M1 — Zero to 50-μA dc meter (Calectro No. D1-910 used here).
R1, R2 — 120-ohm, 1/2-watt carbon resistor.
R3 — 25,000-ohm linear-taper carbon control.
RFC1 — Miniature 1-mH rf choke (James Millen J300-1000 or similar).
S1, S3, S4 — Spdt slide switch.
S2 — Single-section, phenolic-wafer, single-pole 11-pos. rotary.
T1 — 60 turns No. 30 enam. wire, close-wound on Amidon T-68-2 toroidal core. Primary is two turns No. 24 enam. or insulated hookup wire over center portion of secondary.
T2 — See drawing and text.

Toroidal transformer T1 uses 60 turns of No. 30 enamel wire for its secondary. The primary winding consists of 2 turns of insulated hookup wire over the center area of the secondary winding, thus assuring symmetry. The 2-turn primary is necessary to assure adequate sensitivity at very low power levels. Full-scale meter deflection can be obtained with somewhat less than 1/2 watt output at zero reflected power.

Inductor L1 uses a toroid core which is considerably larger than those used at L2, T1 and T2. The larger core is not needed as far as power-handling capability or Q is concerned, but the writer found that it was much less difficult to make the tap connections by using the larger core. The stout of heart may use the same core type specified for L2, but from a practical point of view it is not recommended.

Balun transformer T2 consists of 22 bifilar turns of No. 24 enameled wire. Wiring details are given in the pictorial inset of Fig. 1. One winding has its ends labeled "a." The ends of the remaining winding are marked "b."

Using the Console

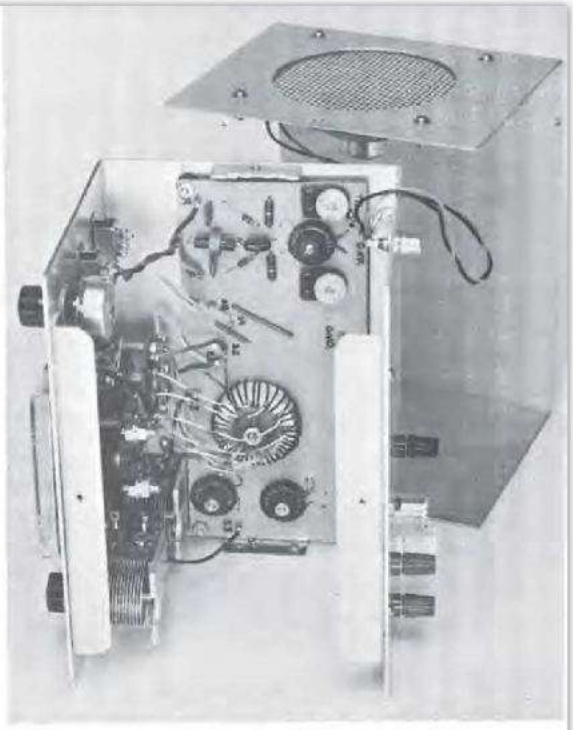
Attach an antenna to the appropriate terminals on the rear of the tuner — single wire or coax-fed antenna to J2, or balanced-feeder antenna to J3 and J4. An earth ground should be attached to J5. Set C6 and C7 at maximum capacitance, and adjust S2 (S3 open) for maximum inductance (no turns shorted out). Attach the transceiver antenna lead to J1 by means of 50-ohm coaxial line. Set S1 to read REF power. Adjust C6, C7, and S2, alternately, for a peak in received signal. This will get the tuner fairly close to resonance. Next, turn the

transmitter on and adjust C6, C7, and S2 for a zero reading in reflected power. Now, switch S1 to read forward (FWD) power. Set R3 for a full-scale reading on M1. Then switch back to REF and tweak the tuner controls for minimum meter reading. Retune the transmitter for maximum power output. Be sure to readjust the tuner when changing frequency within the band. If S2 will not provide sufficient range for obtaining an SWR of 1, switch L2 into the circuit and repeat the tuning procedure. The adjustments are the same whether balanced feeders, coaxial line, or single-wire antennas are used.

Final Comments

The SWR bridge should be nulled before the remainder of the console is built. This can be done by placing a 2-watt, 51-ohm resistor between the top connection of C2 (Fig. 1) and chassis ground. Apply transmitter power, set S1 to REF, and adjust R3 to give maximum meter sensitivity. Adjust C1 for minimum meter reading. Next, connect the transmitter to the output side of the bridge, and connect the 51-ohm resistor across J1. Apply transmitter power and tune C2 for a null. Repeat the process once more, then finish assembling the console.

Those wishing to have a measure of safety for the output transistor of the transceiver can use the calibrating resistor as part of the tuner. It can be switched in parallel with C6 during initial adjustments of the tuner. This will provide the transmitter with a constant load until the tuner matches the antenna system to the transmitter output. The resistor can then be switched out of the circuit, and the tuner touched up again for zero reflected power. There is plenty of panel space for adding a switch for this function. QST



Looking into the console the SWR bridge is at the top end of the circuit board. The large toroid core, which has been wrapped with 3M Co. No. 27 glass tape (masking tape will suffice), is shown at the lower center of the board. The small toroid at the lower right is the balun transformer, and the small core to its left is the inductor which is used in parallel with the large core for 40-meter operation. The circuit board is spaced away from the bottom of the box by means of rubber grommets.

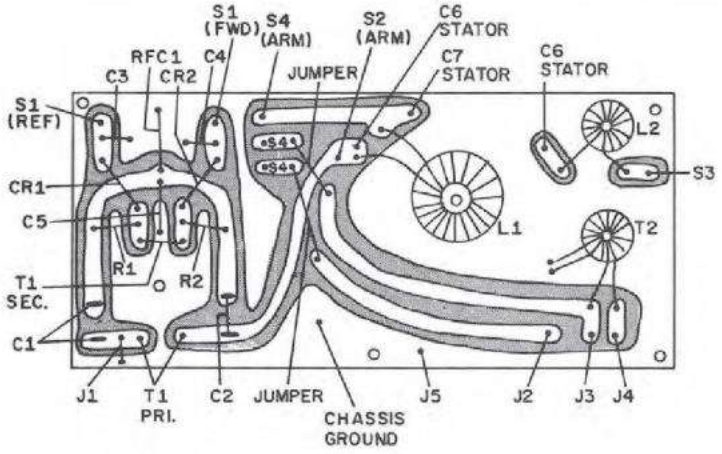


Fig. 2 — Half-scale drawing and parts layout of the circuit board. Ready-made circuit boards for this and other *QST* projects are available from Stafford Electronics, Inc., 427 S. Benbow Rd., Greensboro, NC 24701.

Celebrating Our Legacy

Radio Connections

When I was 15 years old, an astonishing connection was revealed while I was practicing CW on a code practice oscillator. Concentrating on my sending, I was startled when my father asked me when I was going to learn some numbers. My father, who had done everything to discourage me from ham radio, sat down beside me and showed me how to send Morse code. He grasped the key with his right hand in a way I had never seen. His thumb and index finger seemed to fit my J-38 like old friends.

He sent CW with the most perfect "fist" I have ever heard, then or since. I had no idea that my father was not only a ham but had sailed on the German-American lines in the early 1920s as a Spark Operator. He received two US Navy commendations for his phone patch work between KC4USV, McMurdo Sound, Antarctica, and the US. He received his first ham radio license in 1920 as 3AWF, and a year later held two commercial telegraph licenses, all before his 18th birthday. He also participated in the 1BCG transatlantic experiments in 1923.

He was against my earning an amateur radio license because his consuming interest in wireless contributed to his unsatisfactory secondary education. As a result, he never had the opportunity to attend college. After that evening, he never mentioned it again and remained uninterested in my radio pursuits. Several years later, I followed in his footsteps and spent 4 years at sea in the Navy during the Vietnam War as a shipboard CW operator.

My father did eventually give in to his love of radio, and re-tested for his license in late 1965. He went on to get his Amateur Extra-class license and build a contest-level station, which he operated from Bryn Mawr, Pennsylvania, and Vero Beach, Florida, until he passed away in 1999. He held the calls 3AWF, W3AWF, WA3DDT, W3ABI, and K4QM.

Lloyd Bankson Roach, K3QNT
Bedford, Pennsylvania
Life Member

K4TO's recreated Walter Ashe Novice station.

Recreating My Rig

Twenty-six years had passed since the Christmas of 1956, when I got my first shortwave receiver. I put the rig into storage when we moved to the Marshall Islands, where I operated as KX6DS. Five years later, the rig and some assorted electronics were missing from storage. Since then, I've searched the internet looking for a Walter Ashe Novice station. Who knows what I might have paid for one, had I found it.

I decided to build a replica of the rig. I contacted someone in a discussion group who graciously sent me a PDF file of the original article from the September 1953 issue of *Radio and Television News* describing the rig. The circuit used was based on designs published in ARRL's *How To Become A Radio Amateur*.

I had the original instructions and the article, so I collected parts and finished building it in June 2019. I couldn't find the original coil forms and their sockets, so I designed and built my own from acrylic sheet, Molex pins, and pill bottles.

For whatever reason, I had a far harder time getting it working this time around. One would think with over 60 years of experience and an electrical engineering degree, it wouldn't have been this hard. Eventually, I got it to work.

I joined the Novice Rig Roundup Group on Facebook (**www.facebook.com/groups/novicerigroundup**) and we get on the air every week to use our rigs. I even put up a duplicate of the antenna I used as a Novice. It's a 100-foot end-fed wire at 30 feet, sloping to 18 feet at the far end. It's a real source of joy to make a contact with the J-38 key, regenerative receiver, and the transmitter, which puts out *maybe* 10 W.

The group also has a website (**www.novicerigroundup.org**) and they welcome folks who share their interest in the Novice rigs of yesteryear.

Dave Sublette, K4TO
Winchester, Kentucky
Life Member

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.

George J. Misic, KE8RN, ke8rn@comcast.com

Classic Radio

The Hallicrafters SX-101

One of the heaviest amateur radio receivers made by Hallicrafters was the last of its type: the 70-pound SX-101, which appeared on the market in 1956. It was built to operate with the HT-32 SSB/CW transmitter and the HT-33 linear amplifier. Hallicrafters promoted it as having the heaviest chassis in the industry.

The SX-101 was 20 inches wide, 16 inches deep, and 10.5 inches high, which was about the same size as its matching transmitter. A speaker was not included, but a 100 kHz crystal calibrator was built in, as well as automatic gain control (AGC) that worked with the beat frequency oscillator (BFO) in operation. The next high-end Hallicrafters amateur band receiver was the far more technically advanced SX-115. This was a smaller, lighter receiver with more modern engineering.

Hallicrafters, Collins, and Drake

The SX-101 came out before Collins introduced the S-Line with the concept of transceiving, with one dial controlling both receiver and transmitter frequencies. The SX-101 didn't transceive with the HT-32. In 1946, Collins introduced the concept of a crystal-controlled first conversion and a tunable second intermediate frequency (IF), which was eventually replicated by most manufacturers in the amateur radio business.

For the SX-101, this idea was not copied and the first conversion used a switched local oscillator, similar to most products on the market at that time. It wasn't until the Drake 1A SSB/CW/AM receiver entered the market using this excellent idea, which was widely copied in the 1960s by Heathkit, Drake, Galaxy, and Japanese manufacturers. The SX-101 used a 12BY7 vacuum tube in the switched local oscillator, which was often used as a driver tube in transmitters.

The Hallicrafters SX-101 Mark 2. [Norman Johnson, KK6IYM, photo]

Intermediate Frequencies

The SX-101 family was sold from 1956 to 1963. The receiver used dual conversion with a first IF of 1650 kHz and a second IF of 50 kHz. Hallicrafters used this concept on many of their receivers, starting with the S-76, introduced in 1951 as the first receiver to use a very low-frequency last IF to improve selectivity.

Like many other Hallicrafters receivers, two crystals were used to allow easy switching between lower sideband (LSB) and upper sideband (USB) by changing which frequency was used to convert from the first to the second IF. To go from 1650 kHz to 50 kHz, either a 1600 kHz or 1700 kHz crystal was used, inverting the sideband in one case and not in the other.

Product Detectors for SSB and CW

The SX-101 didn't have a product detector for reception of CW or SSB, but the AGC claimed to work on those modes. This is an unusual design, because most receivers without product detectors didn't have AGC that worked on CW and SSB. The SX-101 used a 6BJ7 triple-signal diode tube to act as a diode. This created the AGC voltage independent of the BFO and allowed it to serve as a detector, including the BFO signal for CW and SSB reception, while the third diode acted as the noise limiter. The lack of a product detector was unfortunate, as the matching transmitter was primarily designed for SSB and CW and not AM operation. However, in 1959, the SX-101A gained a conventional product detector using a 6BY6 tube.

Many of the competitive receivers had product detectors and AGC for SSB and CW. The Hammarlund HQ-170 and HQ-180 both had product detectors, but the HQ-110, HQ-145, and HQ-160 did not. The National NC-300 and NC-303 had a heterodyne detector that the company referred to as a product detector. Collins gained a product detector in 1955 with the 75A-4 receiver, and Drake had them from their start in receivers in 1957. Hallicrafters went to considerable efforts to get AGC to work for CW and SSB reception without using a product detector.

The Evolution of Transceiving

As the design of the SX-101 aged, Hallicrafters worked on a more modern design that was somewhat smaller and lighter, but still didn't transceive with anything. The

Hallicrafters SX-115 was designed to compete with the Collins 75A-4 and 75S-1 S-Line receivers. The S-Line was the first line of ham equipment that had the ability to transceive — the receiver could control the frequency of the companion 32S-1 transmitter, a new capability for amateur radio equipment.

The Hallicrafters HT-32 transmitter and the SX-101 had no signal inputs or outputs to enable transceiving. The SX-115 was introduced in 1961, 2 years before the SX-101A was taken off the market in 1963. It weighed 44 pounds and was 16 inches wide (quite a bit lighter and narrower than the 70-pound SX-101). Both receivers were 10.5 inches high and 16 inches deep.

A 1950s advertisement for the Hallicrafters SX-101. [Photo courtesy of **www.ominous-valve.com**]

The SX-117 was the first Hallicrafters receiver that would transceive with a companion transmitter: the HT-44. It was released for sale in 1962. In 1965, Hallicrafters made one more equipment set that could transceive: the SX-146, joining the HT-46 companion transmitter. The SX-146 only weighed 18 pounds and was 13.125 inches wide, making it smaller than the Collins S-Line and about the size of the Drake 4-Line. The SX-146 was available until 1968 and was the last new receiver design aimed at the amateur radio market. Hallicrafters sold shortwave receivers until about 1973, when the last of their shortwave listening (SWL) receivers ceased to be marketed.

Hallicrafters was acquired by Northrop Corporation in 1966. Northrop sold Hallicrafters in 1975 and they soon disappeared completely.

Melissa Stemmer, KA7CLO, mstemmer@arrl.org

At the Foundation

ARRL Foundation and ARDC Partner for Scholarship Grant

On March 3, 2020, ARRL Foundation President Dr. David Woolweaver, K5RAV, announced that the nonprofit Amateur Radio Digital Communications (ARDC) has generously agreed to award a grant to the ARRL Foundation to match the Foundation's 2019 – 2020 scholarships on a dollar-for-dollar basis, up to a total of $200,000.

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

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

The ARRL Foundation and ARDC are negotiating the terms for ARDC's 2020 – 2021 academic year scholarship awards, which will consist of scholarships separate from those the ARRL Foundation already administers.

The winners of the ARRL Foundation and matching ARDC scholarship awards will be announced in the September 2020 issue of *QST*.

Al Brogdon, W1AB

100, 50, and 25 Years Ago

June 1920

- The cover art shows a young woman with headphones on.
- The editorial, "Summer Construction," reminds readers of the station and antenna upgrades they can work on during the season of unbearable static.
- "The A.R.R.L. QSS Tests" outlines the tests ARRL initiated, with the help of members' stations, to try and make sense of signal fading.
- Walter S. Lemmon examines the "Recent Development of Radio Telephones," with both theory and an overview of equipment that's commercially available.
- R.H.G. Mathews offers Part I of an essay on "The Underground Antenna Adapted to Amateur Waves."
- Robert Muns, operator of 2ACQ, reports on his "Construction of a 500-Volt Rectifier Transformer for C.W. Work."
- The "Amateur Radio Stations" column reports on 6ZA, of Salt Lake City, Utah.

June 1970

- The cover photo montage shows a few of the young operators who got on the air during the 1970 Novice Roundup.
- The editorial explains why "A.R.R.L. Opposes Repeater Rules."
- Terry Hall, K1PLP, shows how to build "A Digital Morse-Code Message Generator" that can send CQ and sign your call.
- Doug DeMaw, W1CER, describes "Building a Simple Two-Band VFO."
- Lew McCoy, W1ICP, gives advice on "How to Handle Hi-Fi Interference," a common ham problem.
- Douglas Blakeslee, W1KLK, discusses "The Portable/Mobile Microphone."
- In Part 8 of "Let's Talk Transistors," Robert Stoffels covers an assortment of "odds and ends."
- Charles Rankin, WA2HMM, shares how he built "A 10-6 Mobile Whip," using a simple homemade trap.
- Bill Briles, W7ABW, and Robert Gervenack, W7FEN, report on building a "Slow-Scan TV Viewing Adapter for Oscilloscopes."
- In "A Bonus to the Public," Bill Tynan, W3KMV, points out the value of amateur satellites to non-hams.

June 1995

- The cover photo shows the crew of KL7JGS/7 erecting their mast-mounted Yagi for ARRL Field Day.
- The editorial, "New and Wider Bands?," discusses future spectrum possibilities for hams.
- Steve Bible, N7HPR, and Greg Pool, WH6DT, provide Part 1 of "Amateur Radio on the World Wide Web."
- In Part 1 of "Voice-Track — a Multifunctional, Talking Repeater Controller," Alexander Bonello, LW2EET, shares how to substantially upgrade repeater operation.
- Denton Bramwell, K7OWJ, explains how to build "An RF Step Attenuator" inexpensively.
- Nigel Thompson, KG7SQ, writes about how he designed and built "A DTMF to RS-232-C Converter and HF-Link Controller."
- Jay Craswell, WBØVNE, details how to "Build the Stealth Antenna Tuning Indicator," so hams can tune their rigs at low power settings and reduce the well-known tuner-upper interference.
- Patty Smith, WB6DRG, illustrates how she and others have been running "Patches from Palmer Station" for the past 10 years, keeping the residents of Antarctic bases in touch with their families and friends back home.
- In "A Trip Through the Teaching Universe," Connie Dunn, KB5LES, reports on how Sheila Perry, NØUOP, used a $155,000 grant to give her students the experience of space simulations.

Silent Keys

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

N1CCB **Hobbs**, David B., Center Conway, NH
♦W1CKV **Heffner**, Frederick G., Granby, CT
N1HUI **Raiola**, Thomas M., Branford, CT
KB1JVB **Schunk**, David A., Bristol, CT
KC1LGT **Windley**, David A., Newport, RI
N1LT **Christopher**, Richard P., Laconia, NH
♦KB1MNO **Ebersold**, John E., Holyoke, MA
W1SV **Rossetti**, George A., Granby, CT
KA1TAC **Ayer**, Bryant M., Mercer, ME
W1TEF **Francis**, Thomas E., Columbia, SC
•W1VRT **Rogers**, Alton T., Jr., Uncasville, CT
K1YI **Furmanick**, Francis J., Princeton, MA
K1YZB **Toohey**, Daniel J., Lowell, MA
W2BWQ **Shustack**, Eugene J., Congers, NY
•KB2CWJ **Benzian**, Rolf R., Chesterfield, MA
•KB2DOT **Musella**, Josephine, Elmont, NY
K2ESE **Scally**, Thomas J., Dover, DE
WA2IKC **Kreutter**, Richard H., Rochester, NY
KD2IQO **Roeten**, Daniel J., Colby, KS
K2IWE **Hawe**, Ronald L., Oswego, NY
N2MUN **Lewis**, Philip R., Lindenhurst, NY
WB2NRG **Nastawa**, Raymond P., Monroe Township, NJ
♦KA2RGI **Wenzel**, Walter M., Garner, NC
KD2SSB **Gore**, Henry P., Holland Township, NJ
KI2Z **Holmes**, Earl J., Clinton, NY
•WI2Z **Bennett**, Theodore D. "Ted," West Hempstead, NY
W3AHM **Meitzler**, Allen H., Ann Arbor, MI
♦W3AZD **Search**, Donald B., Davie, FL
K3BRE **Niven**, James W., Columbiana, AL
♦K3BS **Ray**, Robert E., Drums, PA
WJ3D **Moffett**, Carl L., Arnold, MD
N3ESE **Fisher**, Robin D. "Rob," Coal Township, PA
KC3FRE **Hermann**, Ronald W., Warwick Township, PA
♦W3HXF **Scholtz**, William E., Jr., Falls Church, VA
KC3PR **Strausbaugh**, Joseph E., York, PA
W3PTW **Van Vranken**, Thomas C., Severna Park, MD
♦• NX3S **Garland**, Robert E., Perkasie, PA
W3WTJ **Coleman**, Howard T., Delmont, PA
KG4AFP **Metcalf**, Daniel E., Crestwood, KY
N4AG **Maddux**, Paul L. "Lanier," Chattanooga, TN
NC4CM **Morton**, Christopher A., Graham, NC
KJ4D **Canup**, Thomas, San Jose, CA
KE4DRI **Bloodworth**, Ruth S., Wendell, NC
KK4DW **Ballentine**, George David, Orlando, FL
NN4G **Everman**, Randall D., Grayson, KY
KY4H **Sedenquist**, John C., Sr., Valley, AL
K4HCA **Hairston**, Norman H., Clarkesville, GA
K4HTV **Hartley**, Gary W., Boone, NC
N4ICN **Taylor**, Neil E., Clanton, AL
K4IUM **Finkel**, Alan G., Oxford, NC
K4JBW **Woolfolk**, John "Byron," Dahlonega, GA
W4JMA **Lieberman**, Lionel M., Wyncote, PA
KN4JVK **Kilby**, Keith A., Norfolk, VA
KF4LAR **Davis**, Garlie C. "Cal," Jr., Lyman, WY
NG4M **Gouge**, Ralph L., Sr., Independence, KY
AB4NM **Cooley**, Donald L., Dayton, TN
♦K4PB **Harp**, Hugh A. "Alan," Jupiter, FL
K4RKI **Furr**, Glynn R., Jr., Cary, NC
KJ4SFT **Wagner**, Ronald L., Woodstock, GA
AE4TF **Meeker**, Robert A., Charlotte, NC
W4TJN **Overacker**, William E., San Antonio, TX
W4UDJ **Brown**, Martha A., Grand Junction, CO
WA4VGA **Massey**, Raymond D., Jr., Big Canoe, GA
KR4VU **Sartelle**, Donald W., Roanoke, VA
K4WWS **Moore**, Douglas L., Vinton, VA
•KC4YA **Williamson**, Andrew H., Jr., Dunwoody, GA
♦N4YE **Ramsay**, Christopher B., Annandale, VA
KD4ZBP **Haycock**, Clifford P., Tucson, AZ
KK4ZIU **Thompson**, William U., Jr., Thomasville, NC
♦WA4ZLJ **Patterson**, Hubert A. "Hap," Boca Raton, FL
N5CRT **Crabtree**, Arthur L., Sr., Beaumont, TX
W5GNF **Nelson**, Paul C., Ames, IA
WK5K **Anderson**, Miles E., Denton, TX
•W5KZ **Kautz**, Rose Mary, Booneville, AR
KE5LSY **Waddups**, Delores E., Harlingen, TX
N5MFI **Bartholomew**, Raymond L., Texarkana, AR
W5OEC **Duclos**, Edward H., Oklahoma City, OK
K5OMD **Karpienski**, Zymunt E. "Ed," Fords Corner, TX
WA5RQV **Scott**, Arthur M. "Red," San Angelo, TX
WA5RSU **Sanders**, Margaret R., Pearland, TX
KE5S **Clingan**, Patrick A., Bartlesville, OK
N5SOE **Tircuit**, Jeffrey J. "Jeff," Addis, LA
WA5UWI **Holt**, Sam H., III, Austin, TX
W5UYF **Killion**, Laverne T., Palmyra, MO
N5VHK **Vose**, Burton G. "BG," Jr., Albuquerque, NM
WH6BDR **Johnson**, David L., Wilsonville, AL
AG6CS **Seeley**, Richard C., Santa Barbara, CA
KI6DYC **Bjornstedt**, Erik M., Ojai, CA
♦W6FWX **Alfaro**, Ricardo J., II, San Francisco, CA
W6GAM **Mancebo**, Charles E., Atwater, CA
W6LRS **Haley**, Thomas, Clovis, CA
K6MQO **Vernoy**, Robert L. "Bob," Victorville, CA
KE6NQA **Rubinstein**, Karl L., Corpus Christi, TX
N6OLT **Gordon**, Bruce E., Santa Barbara, CA
W6PS **Bermann**, David A., Paradise, CA
WB6SOI **Hughes**, Jack M., California, MD
W7DAT **Shepherd**, Sandra V., Springfield, OR
W7DCZ **Stoler**, John E., III, Billings, MT
KD7DYW **Young**, Wendy G., Livingston, MT
KJ7GUU **Macnab**, John E., Grants Pass, OR
W7JEF **Jeffery**, Richard D. "Jeff," Fernley, CA
KI7JZ **Schiltneck**, Carol E. "Erika," Prescott, AZ
KT7KEN **Tuning**, Kenneth J., Kamiah, ID
KB7MKF **Fisher**, Sharon D., Yakima, WA
KD7MR **Axness**, Paul B., Boise, ID
K7PWW **Brod**, Philip, Jr., Great Falls, MT
W7RIY **Pringle**, John, Seattle, WA
WA7RZW **Howe**, Jonathan, Gray, GA
AA7UE **Sayrs**, Larry L., Spokane, WA
WA7UZG **Dickeson**, Robert, Lewiston, ID
W8AOL **Baird**, Ronald R., Jackson, MI
W8AUU **Antos**, John, Shelby Township, MI
K8BJP **Barnhart**, Robert H. "Barney," Sr., Dade City, FL
K8CYN **Gillogly**, Bronson R. "Zippo," Zanesville, OH
KW8E **Konopinski**, Louis G. "Jerry," Niles, MI
•KC8EAF **Reid**, Thomas E., Sr., Dayton, OH
♦WD8EIL **Rice**, Carolyn W., Ormond Beach, FL
•WB8HDC **Docter**, William, Byron Center, MI
WA8HGF **Ludwick**, Danny D., Hillsboro, OH
♦W8ILC **Moorefield**, Ronald L., Dayton, OH
•WD8JBX **Sturm**, Henry H., Englewood, OH
WA8JLT **Fisher**, Raymond D., Arcanum, OH
WD8KGR **Mason**, Sewell J., Lawrence, MI
WE8M **Sharp**, Earl D., Beavercreek, OH
KB8QJK **Houchins**, Herman D., Toledo, OH
WB8OWI **Steele**, Robert C., Piqua, OH
W8RAC **Conely**, Richard A., Byron, MI
♦AB8RW **Wiltshire**, Raymond S., Loveland, OH
K8YLZ **Potter**, William M. "Mac," Englewood, OH
N8ZBH **Taunt**, Russell G., Swartz Creek, MI
WB8ZZY **Schmitt**, John K., Waverly, OH
WA9ACI **Forster**, Charles G., Oregon, WI
WI9COX **Cox**, Randall E. "Randy," Janesville, WI
KA9DTZ **Watson**, Gregory H., Huntington, IN
K9EBY **Yelch**, Jerry M., Princeton, IN
W9EXJ **Nagel**, David, Quincy, IL
W9GOB **Busta**, Daniel N., Palos Park, IL
♦K9HMB **Miller**, Frank D., Harvard, IL
W9MIM **Mullen**, Marcus I., Clinton, MO
W9RCK **Klein**, Robert C., Dyckesville, WI
K9SLQ **Grove**, Darrell W. "Wayne," Bluffton, IN
•K9UGF **Rulien**, Craig W., Las Vegas, NV
AB0DP **Clark**, Guy K., Wichita, KS
•W0EJL **Loeffler**, Edward J., Burwell, NE
N0EKB **Fay**, Gary T., Charlotte, NC
N0ENM **Quintana**, Joseph R., Colorado Springs, CO
W0FDP **Petrus**, Forest D., Ames, IA
W0FXL **Weidman**, Earl F., Hutchinson, KS
N0GEX **Smith**, Paul F., Jr., Herculaneum, MO
K0GHT **Lechelt**, David M., Port Washington, WI
N0HZE **Roe**, Carol A. "Kim," North Richland Hills, TX
•KA0ICB **Schmidt**, Ernest W. "Wheeler," Saint Joseph, MO
KC0IKP **Ewing**, Gale F., Phillipsburg, KS
♦NW0J **McElravy**, Richard A. "Mac," Aurora, CO
♦NN0L **Borkgren**, Ronald C., Anamosa, IA
♦W0LE **Lee**, James A., Saint Paul, MN
KC0LLB **Miller**, Roxian M., Natchez, MS
•KA0LTJ **Nordwall**, Thor H., Ely, MN
•WA0PUF **Kramer**, Billy M., Cedar Rapids, IA
AA0QV **Swearingen**, Donald R. "Ridge," Pueblo West, CO
W0RY **Vogel**, Robert J., Rochester, MN
KT0T **Schwartz**, Robert C. "Bob," Bloomington, MN
W0WUG **Williams**, Roger L., Merrifield, MN
KY0X **Neiman**, David C., Clear Lake, MN
KB0ZSG **Ballantyne**, Connie L., Porter, TX
•VE3SQ **Endenburg**, Frank W., St. Catharines, ON, Canada
♦DJ2MM **Friedrich**, Franz J., Jülich, Germany

♦ Life Member, ARRL
• Former call sign

For information on how to list a Silent Key in *QST*, please visit **www.arrl.org/silent-key-submission-guidelines**.

Note: Silent Key reports must confirm the death by one of the following means: a copy of a newspaper obituary notice, a copy of the death certificate, or a letter from the family lawyer or the executor. Please be sure to include the amateur's name, address, and call sign. Allow several months for the listing to appear in this column.

Many hams remember a Silent Key with a memorial contribution to the ARRL Foundation or to ARRL. If you wish to make a contribution in a friend or relative's memory, you can designate it for an existing youth scholarship, the Jesse A. Bieberman Meritorious Membership Fund, the Victor C. Clark Youth Incentive Program Fund, or the General Fund. Contributions to the Foundation are tax deductible to the extent permitted under current tax law. Our address is: The ARRL Foundation Inc., 225 Main St., Newington, CT 06111.

HAM RADIO OUTLET

WWW.HAMRADIO.COM

NOBODY BEATS AN HRO DEAL!

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

FTDX3000 | *100W HF + 6M Transceiver*

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

FT-991A | *HF/VHF/UHF All ModeTransceiver*

Real-time Spectrum Scope with Automatic Scope Control • Multi-color waterfall display • State of the art 32-bit Digital Signal Processing System • 3kHz Roofing Filter for enhanced performance • 3.5 Inch Full Color TFT USB Capable • Internal Automatic Antenna Tuner • High Accuracy TCXO

FTDX101D | *HF + 6M Transceiver*

• Narrow Band SDR & Direct Sampling SDR • Crystal Roofing Filters Phenomenal Multi-Signal Receiving Characteristics • Unparalleled - 70dB Maximum Attenuation VC-Tune • 15 Separate (HAM 10 + GEN 5) Powerful Band Pass Filters • New Generation Scope Displays 3-Dimensional Spectrum Stream

FT-891 | *HF+50 MHz All Mode Mobile Transceiver*

Rugged Construction in an Ultra Compact Body • Stable 100 Watt Output with Efficient Dual Internal Fans • 32-Bit IF DSP Provides Effective and Optimized QRM Rejection • Large Dot Matrix LCD Display with Quick Spectrum Scope • USB Port Allows Connection to a PC with a Single Cable • CAT Control, PTT/RTTY Control

FTM-300DR | *C4FM/FM 144/430MHz Dual Band*

• 50W Reliable Output Power • Real Dual Band Operation (V+V, U+U, V+U, U+V) • 2-inch High-Res Full Color TFT Display • Band Scope • Built-in Bluetooth • WiRES-X Portable Digital Node/Fixed Node with HRI-200

FT-2980R | *Heavy-Duty 80W 2M FM Transceiver*

• Massive heatsink guarantees 80 watts of solid RF power • Loud 3 watts of audio output for noisy environments • Large 6 digit backlit LCD display for excellent visibility • 200 memory channels for serious users

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

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

FTM-400XD | *2M/440 Mobile*

• Color display-green, blue, orange, purple, gray • GPS/APRS • Packet 1200/9600 bd ready • Spectrum scope • Bluetooth • MicroSD slot • 500 memory per band

FT-70DR *C4FM/FM 144/430MHz Xcvr*

• System Fusion Compatible • Large Front Speaker delivers 700 mW of Loud Audio Output • Automatic Mode Select detects C4FM or Fm Analog and Switches Accordingly • Huge 1,105 Channel Memory Capacity • External DC Jack for DC Supply and Battery Charging

FT-3DR *C4FM/FM 144/430 MHz Xcvr*

• High Res Full-Color Touch Screen TFT LCD Display • Easy Hands-Free Operation w/Built-In Bluetooth Unit • Built-In High Precision GPS Antenna • 1200/9600bps APRS Data Communications • Simultaneous C4FM/C4FM Standby • Micro SD Card Slot

FT-65R | *144/430 MHz Transceiver*

Compact Commercial Grade Rugged Design • Large Front Speaker Delivers 1W of Powerful Clear Audio • 5 Watts of Reliable RF Power Within a compact Body • 3.5-Hour Rapid Charger Included • Large White LED Flashlight, Alarm and Quick Home Channel Access

FT-60R | *2M/440 5W HT*

• Wide receiver coverage • AM air band receive • 1000 memory channels w/alpha labels • Huge LCD display • Rugged die-cast, water resistant case • NOAA severe weather alert with alert scan

- 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	OAKLAND, CA (877) 892-1745	PORTLAND, OR (800) 765-4267	PHOENIX, AZ (800) 559-7388	MILWAUKEE, WI (800) 558-0411	WOODBRIDGE, VA (800) 444-4799
PLANO, TX (877) 455-8750	SAN DIEGO, CA (877) 520-9623	DENVER, CO (800) 444-9476	ATLANTA, GA (800) 444-7927	NEW CASTLE, DE (800) 644-4476	SALEM, NH (800) 444-0047

Shop Anytime From Anywhere with Our Online Superstore
WWW.HAMRADIO.COM

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.

HAM RADIO OUTLET

WWW.HAMRADIO.COM

ENJOY SUMMERTIME SAVINGS!

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-7700 | *HF/50MHz Transceiver*

The Contester's Rig • HF + 6m operation • +40dBm ultra high intercept point • IF DSP, user defined filters • 200W output power full duty cycle • Digital voice recorder

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

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

IC-7300 | *HF/50MHz Transceiver*

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

IC-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

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

ID-5100A Deluxe

VHF/UHF Dual Band Digital Transceiver

• Analog FM/D-Star DV Mode • SD Card Slot for Voice & Data Storage • 50W Output on VHF/UHF Bands • Integrated GPS Receiver • AM Airband Dualwatch

ID-4100A | *VHF/UHF Dual Band Digital Xcvr*

• Compact, Detachable Controller for Flexible Installation • DV/FM Near Repeater Search Function • Apps for iOS™ and Android™ devices • Wireless Operation with VS-3 & UT-137 Bluetooth® Headset & Module • MicroSD Card Slot

IC-V86 | *VHF 7W HT*

• 7W OutputPower Plus New Antenna Provides 1.5 Times More Coverage • More Audio, 1500 mW Audio Output • IP54 & MIL-STD 810G–Rugged Design Against Dust & Water • 19 Hours of Long Lasting Battery Life • 200 Memory Channels, 1 Call Channel & 6 Scan Edges

IC-R30 | *Digital/Analog Wideband Xcvr*

• 100 kHz to 3.3 GHz Super Wideband Coverage • P25 (Phase 1), NXDNTM, dPMRTM, D-STAR Mode • 2.3" Large LCD Display & Intuitive User Interface • MicroSD Card Slot for Voice & Data Storage • USB Charging & PC Connection

ID-51A PLUS2

VHF/UHF D-STAR Portable

• RS-MS1A, free download Android™ application • New modes for extended D-STAR coverage • Terminal Mode & Access Point Mode allow D-STAR operation through Internet • DV & FM repeater search function • Dplus reflector link commands

New Ham Radio Outlet Coming Soon!

ICOM

Tell Us Where To Build The Next Ham Radio Outlet Superstore!

For everyone who wanted an HRO store close to them... now is your ultimate chance. Let us know now at: **www.hamradio.com/newstore**

**Except 60M Band. ***Frequency coverage may vary. Refer to owner's manual for exact specs. QST JUNE 2020. 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.

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

bhi

ParaPro EQ20 Audio DSP range with parametric equalisation

- 20W audio and parametric equalisation on all units
- Precise adjustment to compensate for hearing loss
- DSP noise cancelling and Bluetooth versions
- Easy to use with simple control of all DSP functions
- Use with passive speakers or headphones
- Greatly improves the clarity of you receive audio
- Four models: EQ20, EQ20B, EQ20-DSP, *EQ20B-DSP

Read the excellent EQ20B-DSP review in December 2019 QST!

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

Dual In-Line

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

Compact In-Line

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

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

New NES10-2MK4

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

DESKTOP

10W Amplified DSP noise cancelling base station speaker
- "Real-time" control of all functions
- 8 filter levels 9 - 40dB
- Suitable for all radios incl' SDR, Elecraft and FlexRadio products
- Headphone socket
- Speaker level and line level input sockets

Check out our range of extension speakers, headphones and accessories

DX ENGINEERING
1-800-777-0703

www.bhi-ltd.com

GigaParts
1-256-428-4644

EA&O

VISA PayPal MasterCard

ICOM

FIRST IN TECHNOLOGY

Be Active: IC-705

Your New Partner for Field Operations

- HF/50/144/430 MHz All Mode, with D-Star DV
- RF Direct Sampling System
- Real-Time Spectrum Scope and Waterfall Display
- Large Touch Screen Color Display
- Compact and Lightweight Design
- BP-272 Battery Pack or 13.8 V DC External Power Supply
- Maximum Output Power 10 W (13.8 V DC), 5 W (BP-272)
- Bluetooth® and Wireless LAN Capabilities
- Full Equipped D-STAR Functions
- Optional Backpack, LC-192, Ideal for Field Operations

HF/50/144/430 MHz <SSB/CW/RTTY/AM/FM/DV> 10 W TRANSCEIVER

New IC-705 *Coming Soon*

WWW.ICOMAMERICA.COM

For the love of **ham radio.**

TIMEWAVE TECHNOLOGY INC.

Available at:
- HRO
- Universal Radio
- R&L Electronics

See us at Dayton! Booth 5007

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!

ANC-4 Antenna Noise Canceller

See & hear a demo on YouTube!

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

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
Fax 651-489-5066

The First Choice of Hams Around the World!

hy-gain® HF Rotators

HAM-IV – $709.95

The Most Popular Rotator in the World!

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

HAM-VI – $809.95 with DCU-2
HAM-VII – $959.95 with DCU-3

HAM IV and HAM V Rotator Specifications	
Wind Load Capacity (inside tower)	15 square feet
Wind Load (w/mast adapter)	**7.5 square feet**
Turning Power	800 in.-lbs.
Brake Power	**5000 in.-lbs.**
Brake Construction	Electric Wedge
Bearing Assembly	**Dual race/96 ball bearings**
Mounting Hardware	Clamp plate/steel U-bolts
Control Cable Conductors	**8**
Shipping Weight	26 lbs.
Effective Moment (in tower)	**2800 ft.-lbs**

TAILTWISTER SERIES II – $869.95

For Large Medium Antenna Arrays up to 20 sq. ft. wind load.

Has 5-second brake delay, Test/Calibrate functions. Low temp grease, tough alloy ring gear, indicator potentiometer, ferrite beads on potentiometer wires, weatherproof AMP connectors plus 8-pin plug at control box, triple bearing race with 138 ball bearings for large load bearing, electric locking steel wedge brake, North/South center of rotation scale meter, low voltage control, $2^{1}/_{16}$" max mast. **MSHD, $139.95**. Above tower heavy duty mast support. T2X, HAM-IV, HAM-V, HAM-VI. Accepts $1^{7}/_{8}$-$2^{5}/_{8}$" OD.

T-2XD2 – $979.95 with DCU-2
T-2XD3 – $1039.95 with DCU-3

TAILTWISTER Rotator Specifications	
Wind Load Capacity (inside tower)	20 square feet
Wind Load (w/mast adapter)	**10 square feet**
Turning Power	1000 in.-lbs.
Brake Power	**9000 in.-lbs.**
Brake Construction	Electric Wedge
Bearing Assembly	**Triple race/138 ball bearings**
Mounting Hardware	Clamp plate/steel U-bolts
Control Cable Conductors	**8**
Shipping Weight	31 lbs.
Effective Moment (in tower)	**3400 ft.-lbs**

CD-45II – $499.95

For antenna arrays up to 8.5 sq. feet mounted inside tower or 5 sq. ft. with mast adapter.

Low temperature grease good to -30 F degrees. New Test/Calibrate function. Bell rotator design gives total weather protection, dual 58 ball bearing race gives proven support. Die-cast ring gear, stamped steel gear drive, heavy duty, trouble free gear train, North center scale, lighted directional indicator, 8-pin plug/socket on control unit, snap-action control switches, low voltage control, safe operation, takes maximum mast size to $2^{1}/_{16}$ inches. MSLD light duty lower mast support included.

CD-45D2 – $599.95 with DCU-2
CD-45D3 – $659.95 with DCU-3

CD-45II Rotator Specifications	
Wind Load Capacity (inside tower)	8.5 square feet
Wind Load (w/mast adapter)	**5.0 square feet**
Turning Power	600 in.-lbs.
Brake Power	**800 in.-lbs.**
Brake Construction	Disc Brake
Bearing Assembly	**Dual race/48 ball bearings**
Mounting Hardware	Clamp plate/steel U-bolts
Control Cable Conductors	**8**
Shipping Weight	22 lbs.
Effective Moment (in tower)	**1200 ft.-lbs**

New!

Hy-Gain Programmable DCU-3 Digital Rotator Controller

DCU-3 – $499.95

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

Press a memory button or dial in your beam heading or let *Ham Radio Deluxe* (or other) take control. Your antenna auto rotates precisely and safely to your DX.

DCU-3 automatically jogs your antenna free and safely unlocks it before rotating begins (*great for older rotators with "sticky" brakes*) then turns off your motor before reaching its final heading. Your antenna gently coasts to a stop before the brake re-locks -- greatly reducing damaging overshoots and extending rotator life.

Simply press *Left* and *Right* buttons for full manual control and fine tuning.

Bright blue LCD shows current, dialed in and computer controlled beam headings in one degree increments and your call.

Calibrate lets you accurately match your display to your true beam heading. Has USB/RS-232 ports for computer control. Adjustable LCD sleep time. Field upgradeable firmware. 8.5Wx4.3H x9D".

110 VAC. Order DCU-3X for 220 VAC.

DCU-2 Digital Rotator Controller – $459.95
Like DCU-3, but less programmable memories. 110 VAC. Order **DCU-2X**, for 220 VAC.

AR-40 – $399.95

For compact antenna arrays and large FM/TV up to 3.0 square feet wind load area.

Dual 12 ball bearing race. Automatic position sensor never needs resetting. Fully automatic control -- just dial and touch for any desired location. Solid state, low voltage control, safe and silent operation. $2^{1}/_{16}$ inch maximum mast size. MSLD light duty lower mast support included.

AR-40 Rotator Specifications	
Wind Load Capacity (inside tower)	3.0 square feet
Wind Load (w/mast adapter)	**1.5 square feet**
Turning Power	350 in.-lbs.
Brake Power	**450 in.-lbs.**
Brake Construction	Disc Brake
Bearing Assembly	**Dual race/12 ball bearings**
Mounting Hardware	Clamp plate/steel U-bolts
Control Cable Conductors	**5**
Shipping Weight	14 lbs.
Effective Moment (in tower)	**300 ft.-lbs**

Replace your Yaesu Rotator Controller

YRC-1 – $369.95

Hy-gain YRC-1 -- more features, more robust, far less prone to lightning damage. Costs less than repairing!

Easy-to-use -- dial in your beam heading and tap GOTO button. Exclusive 180 degree *AutoReversal*™ for fast longpath operation. All DCU-2 features. Bright blue LCD shows current, dialed-in, computer controlled beam headings, call. USB port for computer control. Extra heavy-duty AC power supply. Fast variable DC motor minimizes overshoot. Intuitive menu. Field upgradeable. For Yaesu G-800/1000/2800/G450/650. AC or DC motors.

YRC-3, $449.95. Like YRC-1 and adds 6 memories.

AR-500 Rotator/Controller – $169.95

UHF/VHF/6-Meter, MFJ-1886 Rotator/Controller and Remote. For use of small VHF/UHF, 6M, TV, FM, the MFJ-1886 wide band receiving loop and other light-weight ham antennas. Rotator is built in a weather-proof one piece cast aluminum housing with precision all metal gears, steel thrust bearings and automatic braking. Includes rotator, controller, remote, clamps, and all hardware.AR-500 remembers up to 12 directions even after a power outage! Use remote control or direct console. Displays location and relative position.

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

MFJ Portable Antennas!

Cover HF bands with one single EFHW, no tuner needed!

MFJ-1982MP, $79.95

• **Get on the air** 80-10 Meters with a single wire *EFHW* and one center or end support. Fast, easy set-up/take-down for portable use.

• **End-Fed Half-Waves** (EFHW) resonate on halfwave fundamental frequency and even harmonics. 80-10 Meters -- no traps, stubs, resonators. Broad-band matching transformer gives you low SWR! No tuner usually needed.

• **No long counterpoise**, radials or feedline required

• **Nearly invisible,** no-tangle black *Teflon* insulated radiator wire.

• **Weather** and U/V resistant. Easy storage and transport.

MFJ-1982MP, $79.95. *300 Watts* Restricted space, 80-10M. 132 ft.
MFJ-1984MP, $69.95. *300 Watts* Restricted space, 40-10M. 66 feet.

MFJ-1982HP, $109.95. *800 Watts*, high power, 80-10 Meters. 132 feet.
MFJ-1984HP, $89.95. *800 Watts*, high power, 40-10 Meters. 66 feet.

MFJ-1982LP, $59.95. *30 Watts* QRP, 80-10 Meters. 132 feet.
MFJ-1984LP, $49.95. *30 Watts* QRP, 40-10 Meters. 66 feet.

17' Stainless Steel Telescopic Whip

MFJ-1979, $69.95. Premium stainless steel, 17 feet ext., 27" collapsed. Adjust length for full 1/4 wave antenna on 20-2M. Use MFJ-67 loading coil for 30/40/60/80M. For 3/8-24 standard mounts.

33' Telescopic Portable Mast

MFJ-1910, $99.95. Fiberglass. 3¾ ft collapse, 3.3 lbs.

Single-band Rotatable mini Dipoles

MFJ-22XX, $69.95. Lightweight *true balanced* mini-dipoles for portable and space limited use. Choose: 75/60/40/30/20/17/15/12/10/6 Meters. Includes two HF sticks of your choice and dipole mount.

MFJ-347, $24.95. *True isolated balanced* dipole mount only. 1.25" mast size.

MFJ Walk-About 80-6M Antenna

MFJ-1899T, $99.95. Operate 80-6 Meters/WARC bands. BNC attaches directly to your Yaesu FT-817, Elecraft KX1/2/3, Icom IC-705, Xiegu G-90, X5105. 12" loading coil with wander lead. 10-section telescopic whip, 52" ext., 7" collapsed. Whip unscrews for easy carry and storage. 25 Watts.

MFJ-7703, $8.95. BNC/PL-259 right angle adapter.

10-band 80-2M Mobile/Portable

MFJ-1699T/S, $79.95 HF: 80-10 Meters, VHF: 6 and 2 Meters. Low SWR, 200 Watts. Wander lead changes bands. Maximum height is 49.5 inches. 3/8-24 or PL-259. Whip unscrews at base for quick storage.

Hamsticks! Choose: 75/40/30/20/17/15/12/10/6 Meters. **$19.95-$29.95 each.**

BigEAR™ Dipole

MFJ-2289, $209.95. 7-55 MHz portable, 34' ext., 28" collapsed, balun, 1kW, 30/40M coil.

BigStick™ Vertical

MFJ-2286, $119.95. 7-55 MHz 17' ext., 28" collapsed, mount, counterpoise, 30/40M coil, 1kW.

BigEar™ Combo

MFJ-2289PKG, $339.95. BigEAR, tripod/mast. Canvas carry bag, padding, pockets, handle.

4-Band Octopus Antenna Hub

MFJ-2100, $109.95. *Turns pairs of hamsticks into four fully balanced dipole antennas in minutes!* Any bands: 80-2M, 440 MHz. Balun, single coax feed, no antenna tuner needed. Perfect for fiberglass pole on tripod at any height. Eight 3/8-24 connectors for antennas.

MFJ QuickStik™ Mount/Ground

MFJ-1936T, $44.95. Push into ground up to 4 ft., attach any HF/VHF/UHF antenna with 3/8-24 connector like a hamstick or whip, attach coax to SO-239, operate! Use *QuickStik™* as *ground* and/or use included 25 ft. counterpoise wire.

20W Transceiver Xiegu G-90, $449.95

20-W SDR Xcvr, .5-30 MHz, Auto-tuner, SSB/CW/AM/FM/Digital, detachable front panel, IQ out.

5W 160-6M Transceiver

Xiegu 5105, $599.95. All modes, DSP, ATU, 3800 mAH battery, microphone.

MFJ 10-40 Meters Portable Antenna

MFJ-1621, $119.95. 40-10M, telescoping whip: 54" extended, 22" collapsed. Tuner, field strength meter, 50' coax. 200W SSB/CW.

Box Fan Mag Loop

MFJ-1780, $369.95. Portable 2x2 ft. Carry handle. 14-30 MHz *continuous*. 150W SSB/CW. High efficiency *true mag loop,* no rotating contact *butterfly capacitor*, all welded. Fast/slow tune remote control.

Portable MFJ Tripods and Tripod/Masts

Black *steel* base forms strong braced equilateral triangles on a side. Non-skid feet, strong, mast locks.

MFJ-1919, $109.95. 9¾ lbs. Holds 100 lbs. 1.4" dia. mast extends 7.8 ft. Base spreads to 4.8 ft. 54"x6" dia. collapsed.
MFJ-1919EX, $179.95. Tripod *plus* 18' fiberglass mast. 5' collapsed. 1/8" wall, 3/4" dia. top, 1½" dia. bottom. 15 lbs.
MFJ-1918, $69.95. Tripod: 6' ext. 38" collapsed, 6¾ lbs.
MFJ-1918EX, $109.95. Smaller tripod with 9½' fiberglass mast. 3.8 ft. collapsed. ¾"top, 1" bottom. 6.5 lbs.

MFJ QRPocket™ Loop Tuner

MFJ-9232, $69.95. Drape a wire around a bookcase, window, tree or other and attach to this MFJ QRP Loop Antenna Tuner. It becomes a 25 Watt multi-band transmitting magnetic loop! 40-10 Meters with included flexible wire loop. No ground, radials or needed.

QRP Antenna Tuner

MFJ-9201, $59.95. *Tunes any antenna* 80-10 Meters, 25 W. 12-position hi-Q inductor, tune/bypass, antenna and transmitting matching variable capacitors, BNC connectors. Tiny 4Wx2⅝Hx 1½D inches -- MFJ-9201, rig and antennas easily fit into a backpack or briefcase for vacation, SOTA, hikes, etc.

MFJ Manual Tuner

MFJ-945E, $159.95. 1.8- 60 MHz, 300 Watts PEP. Tunes coax-fed antennas and random wires. Lighted cross-needle SWR/forward and reflected Wattmeter. Bypass switch bypasses tuner. SO-239, wing nut post for ground. Efficient, low loss airwound inductor. Small, 8Wx2Hx6D inches.

200W Auto Tuner

MFJ-939, $159.95. Plug and play auto tuner for Icom, Yaesu, Kenwood and others. Automatically tunes any antenna ultra-fast! 20,000 Virtual antenna memories, matches 6-1600 Ohms, 1.8-30 MHz, 2 to 200 Watts SSB/CW. Radio interface cable included, 2-year MFJ warranty. 6½Wx1⅝Hx7½D".

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 *Telescopic* Fiberglass Masts

Portable, telescoping high-strength fiberglass masts extend way up into the sky! Just pull out sections and lock.

Choose Lightweight-Light-Duty or Super-Strong Thick-Wall models -- 10 to 50 feet long. Each collapses to an easy-to-carry size for true portability.

For quick put-up and take-down, light-duty models have Twist & Lock sections and heavy-duty thick wall models use military style *QuickClamps*™ or stainless steel hose clamps.

Use them for traveling, camping, at hotels, hamfests, field day, DX-peditions. Put up full size full performance inverted Vee, dipole or vertical antenna in minutes at heights that will snag you real DX.

Use multiple telescoping masts to make loops, quads, rotatable dipoles even beams.

← *Light Duty Lightweight Fiberglass Masts*

So lightweight you can take them anywhere!

MFJ's most popular MFJ-1910 is 33 feet long, 3.3 lbs.

MFJ-1910, $99.95. 33 ft., light duty w/top tie ring.
MFJ-1911, $109.95. 20 ft., light duty w/top tie ring.
MFJ-1913, $109.95. 28 ft., lightweight w/top tie ring.
MFJ-1915, $159.95. 25 ft., for heavier duty use.
MFJ-1916, $179.95. 34 ft., for heavier duty use.
MFJ-1917, $189.95. 43 ft., heavier duty w/top tie ring.

Super-strong .125" Thick-Wall Fiberglass Masts

Use for temporary or permanent wire antennas, small beams or verticals. **Best seller** is 50 ft. long, just 26 lbs.

Heavy Duty Models: All have QuickClamps™ →

MFJ-1908HD, $289.95 is 48 ext., 7.75-ft. collapsed, has $2^1/_2$" OD bottom, 1" OD top, seven 7.75-ft. sections, 24 lbs.
MFJ-1906HD, $249.95 is 38' extended, 6 feet collapsed, has $2^1/_2$" OD bottom, 1" OD top, seven 6-foot sections, 24 lbs.
MFJ-1904HD, $179.95 is 25' extended, 4 feet collapsed, has $2^1/_2$" OD bottom, 1" OD top, seven 4-foot sections, 14 lbs.
MFJ-1904H, $159.95. 22' ext., 5' collapsed, 9 lbs. $2^1/_2$" OD.
MFJ-1902H, $139.95, 10' ext., 38" collapsed, 5 lbs. $2^1/_2$" OD

Standard Models: H models have QuickClamps™

MFJ-1906, $159.95/MFJ-1906H, $219.95, 33 feet, ext., 6 ft. collapsed, six 6-ft. sections, 13 lbs. 2" bottom, $^3/_4$" top OD.
MFJ-1908, $199.95/MFJ-1908H, $259.95, 41' ext., 7.75 ft. collapsed, six 7.75-ft. sect., 16 lbs. 2" bottom, $^3/_4$" top OD.

Mast Accessories

MFJ-1900, $79.95. Mount clamps mast to mounting pipe.
MFJ-13S, $69.95. 5 Military *QuickClamps*™. Fit $^3/_4$" to 2" OD.
MFJ-13HD, $69.95. Extra set clamps, 1- $2^1/_2$" masts.

Mast Guy Ring Sets

Fits masts $^3/_4$" to $1^1/_4$" dia OD. **MFJ-2830X, $9.95,** *fiberglass*; **MFJ-2840X, $12.95**, *aluminum*.

Left: *Stainless Steel Hose Clamps* recommended for permanent installations. Fiberglass is slotted.

Right: UV protected Military grade *QuickClamps*.Guy 2 levels when fully extended.

18' Telescopic Mast & Tripod

MFJ-1919EX, $179.95.
Put your antennas up high anywhere with this super-strong* 18 foot telescoping fiberglass mast and MFJ-1919 heavy duty steel tripod.** ***QuickClamps™ lower mast to 5 feet. Mast has thick 1/8 in. wall, .75" top, 1.5" bottom dia. 15 lbs. Steel tripod has braced triangle base, non-skid feet, mast lock.

MFJ-1918EX, $109.95.
MFJ-1918 tripod has super strong 9.5 foot telescoping fiberglass mast. 3.8 feet collapsed. *QuickClamps*™. Thick 1/8 inch wall, .75" top, 1" bottom diameters. 6.5 lbs.

Tripods Only

MFJ-1921, $199.95, Giant tripod base spreads to 8 feet! Supports massive antennas. Adjustable length non-skid legs accommodates uneven ground surfaces. Optional foot anchors **MFJ-1905, $34.95**, see **Tripod Anchors** bottom right. 5.75Hx7D feet collapsed. 14 lbs.
MFJ-1919, $109.95, *Large tripod* base spreads to 4.8 feet. Supports 100 pounds. 7.8 feet, 1.4 inch diameter mast. 4.5H x .5D feet collapsed. 9.75 lbs.
MFJ-1918, $69.95, Smaller tripod base spreads to 2.75 ft. Support 66 lbs. 6 foot, 1" dia. mast. 3.2H x .3D ft. collapsed. 6.75 lbs.

80-6 Meter Antenna

3.8 foot fiberglass mast telescopes to a 31 foot self-supporting high performance 80-6 Meter vertical antenna in minutes!

MFJ-2980
$115.95
40-6 Meters

MFJ-2982
$169.95
80-6 Meters

Quarter wave performance on 40 Meters, halfwave on 20M. High-Q air wound loading coil. Use antenna tuner for 30, 20, 15, 12, 10, 6 Meters. 600 Watts SSB/CW.

Use as temporary, portable or permanent antenna for home, RVs, camping, field day, hamfest, DX-pedition.

Includes four 12 foot radials. Current balun reduces feedline radiation and pattern distortion.

MFJ "HamStick" Isolated Dipole

Build your own 80-6 Meter *mini*-dipole using two HF mobile whips! Only MFJ-347 mount *isolates* dipole elements and lets you use a balun to give a true *balanced dipole*. Prevents pattern distortion, noise pickup and RFI radiation from RF on coax shield. Solid aluminum. Use mast up to $1^1/_4$" OD.

MFJ-347
$24.95

3/8-24 Hamstick

MFJ-342T
$15.95
Mount 3/8-24 HF/VHF hamsticks vertically or horizontally on masts up to 1 inch. Built-in SO239 connector.

MFJ Balcony Mount

MFJ-1907
$49.95

Mount *multiple* HF/VHF hamsticks, verticals, dipoles vertically and/or horizontally on your apartment/condo balcony. High-strength aircraft aluminum extends out 14". Two U-bolts mount up to $1^1/_2$" diameter.

Tripod Anchors

Securely anchor tripod to ground with these 3 stainless steel foot braces and your stakes. For high winds, unlevel ground, tall antennas. Fits legs to $1^1/_2$"OD.

MFJ-1905
$34.95

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.

ARRL FIELD DAY 2020

Get on the air in style with 2020 ARRL Field Day gear!

Order online at www.arrl.org/shop/FieldDay

2020 Field Day Shirt - ***Ham Radio on Tour***

Our kiwi-green t-shirt features our popular retro-inspired logo on the front and an easy, fun way to keep track of your Field Day contacts on the back.

Available in adult sizes Small – 6XL.

ARRL Item No. 2020K / Only $17.95

Supplies are limited, order yours today!

JUNE 27-28

MFJ SDR T/R Protection Switch

Turn your SDR into a panadapter to see entire bands on frequency/waterfall displays...

New!

An inexpensive wide-band SDR dongle receiver lets you see entire bands on frequency/waterfall computer displays!

MFJ-1708B-SDR
$119.95

If you want to know where the activity is, who's generating splatter, what's in the DX window, how wide your audio is or what frequencies are clear, it's all right there! While receiving on your transceiver, MFJ-1708B-SDR switches your SDR to your antenna showing the entire band. On transmit your SDR is switched out and grounded to protect your SDR. PTT and a failsafe RF sense switches MFJ-1708B-SDR. For HF/VHF/UHF. Monitor multiple bands with multiple SDRs and a multi-coupler.

MFJ-1708B-SDR-S, $129.95. SMA connector for your SDR.

MFJ-1708SDR, $99.95. Original model for HF/VHF.

New B series improvements...
The original MFJ-1708 series used one relay and wires to connect the SO-239s. The new B-series uses four relays and connectors on a *single* pc board. This gives you > 50 dB isolation at 300 MHz and > 68 dB at 50 MHz. SWR < 1.16:1 at 50 MHz and < 1.75:1 at 450 MHz at the transmit port. Mute output is a selectable short or open to ground. Use "boat anchors" or modern receivers or key a linear amplifier. Receiver input protection prevents overload from nearby high power signals and from receive to transmit. A hybrid splitter on SDR models reduces loading effect and gives > 15 dB isolation between the SDR REC and XCVR ports to reduce interference. The original MFJ-1708 series is still available.

MFJ Low Noise VLF/HF Receiving Loop

Pull weak signals out of static crashes, atmospheric, man-made and power line noise!

Hear signals 500 KHz to 30 MHz cleaner, quieter than ever before! Power line noise disappears. Rotate its figure 8 pattern and its extremely deep null to completely eliminate an interfering signal or greatly peak a desired one. Fully protected state of-the-art Gali MMICs in push-pull gives you a preamp with extremely high dynamic range, low IMD and 25 dB of low noise gain. Excellent performance on strong and weak signals without overload. 36-inch dia. loop. 1-in. OD 6061 aluminum.

MFJ *wideband* SDR *Discone* Antenna

Receives 25-1300 MHz

MFJ ultra wide-band *Discone* Antenna receives 25-1300 MHz. Perfect for all band SDR reception. Covers 10, 6, 2 Meters, 220 and 440 MHz and 33/23 CM ham bands and everything in between. It is excellent for monitoring multiple bands simultaneously using multiple SDRs and a multi-coupler. Also test any transmitter 50-1300 MHz using a single discone and single coax. Handles 200W. Includes 50 feet coax, stainless steel elements and mounting hardware.

MFJ-1866, $59.95. Like MFJ-1868 but transmits 144-1290 MHz. Coax and mounting hardware not included.

Tuned Indoor SDR Active Antenna

MFJ-1020C
$119.95

Make your SDR receiver come alive with HF signals, .3-40 MHz, while rejecting interference with MFJ-1020C *tuneable* indoor active antenna! Gain control, telescoping whip.

Untuned Indoor SDR Active Antenna

MFJ-1022, $79.95. Hear weak, noisy VLF to UHF signals. Noise-less feedback gives excellent low noise reception. Handles strong signals.

Active Outdoor Antenna

MFJ-1024 $179.95 *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/pre-amp gives maximum signal and minimum noise. Covers .05-30 MHz. **Indoor** unit: 20 dB attenuator, gain control, 2 receiver and 2 antenna switches.

HF SDR Preselector

MFJ-1040C
$139.95

Tuneable MFJ-1040C lets you copy weak, noisy SDR signals from 1.8 to 54 MHz. Greatly tunes out and reject out-of-band interference. Up to 20 dB gain. Has gain control. Cascode FET/bipolar transistor gives low noise, high gain without overloading. Switches for 2 antennas and 2 receivers. SO-239s. Has 20 dB attenuator. Automatically bypasses when transmitting or use PTT. 6 1/2W x 2 1/2H x 4D inches.

MFJ LW/MW/SW SDR Preselector/Tuner

MFJ-956
$79.95

Highly rated series-tuned MFJ-956 boosts your desired signals while greatly rejecting interference and preventing serious overload. **Greatly** improves reception 0.15 to 30 MHz. Incredibly effective below 2 MHz. **Super** easy to operate, select band and tune! **Bypass** tuner and ground receiver switch positions. **Compact** 2 x 3 x 4 inches. SO-239 connectors.

MFJ-1708B, $119.95.

MFJ RF Sense Transmit/Receive Switch

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.

MFJ-1707B, $119.95.

Auto switch XCVR between 2 antennas

Switches switches separate transmit and receive antennas on transceivers with only one antenna port. *Example*: Efficient 75M dipole for XMIT and MFJ-1708B low noise MFJ loop for receive -- *no static crashes*!

MFJ 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-1234 . . . Remotely operate your transceiver from anywhere in the world!

https://www.mfjenterprises.com/Product.php?productid=MFJ-1234

Apple iPhone connected to RigPi Station Server from anywhere via the Internet

RigPi trademarked, Howard Nurse, W6HN. Raspberry Pi is a trademark of the Raspberry Pi Foundation.

Remotely operate your station! Use any web browser on your mobile phone, iPad, tablet, laptop, desk-top even a Kindle!

MFJ-1234

$319.95

Use nearly any transceiver with CAT control, old or new.

Operate all modes SSB, CW, FM, digital. WSJT-X, Fldigi are installed.

Control from anywhere via the internet using any browser -- radio, rotor, CW keying, VoIP, digital modes, logging, spot monitoring, callbook lookups, more.

Look-up calls using included FCC database or optional QRZ subscription.

Monitor DX spots for unworked or unconfirmed calls.

Design, maintain multiple logs. Upload ADIF logs to ARRL LoTW server.

Send CW from a mobile device, keyboard or paddle.

32 programmable macros.

Two or more hams from different locations can operate different radios at the same time using one MFJ-1234.

Single-click updating, I/Q Input for SDR radios, onboard VoIP server gives outstanding 2-way audio.

Includes email, word processing, spreadsheet programs, 1000's of Linux programs, including many for ham radio. Modify, program RigPi Station Server features using a text editor.

HARDWARE

RSS is a Raspberry PiTM computer running Linux and RigPi Keyer and Audio boards. RigPi Keyer uses K1EL WinKeyer3 integrated circuit for keyboard/paddle input. RigPi Audio is used for VoIP for remote, digital modes and I/Q spectral display (Panadaptor).

RADIO/ROTOR SOFTWARE

RSS radio/rotor control uses Hamlib, a library of over 200 radios, 30 rotors. **MFJ-1305RP, $24.95**. 5V, 3A Pwr Supl. **MFJ-1234SD, $49.95**. RigPi operating system on SD card.

TECH HELP

- RigPi forum is *https://rigpi.groups.io*
- RigPi website is *https://rigpi.net*

MFJ CW *Reader and Keyer* Combination

Plug MFJ's CW Reader with Keyer into your transceiver's phone jack and key jack.

Now you're ready to compete with the world's best hi-speed CW operators – *and they won't even know you're still learning the code!* Sends and reads 5-99 WPM.

Automatic speed tracking. Large 2-line LCD shows send/receive messages. Use paddle or computer keyboard.

Easy menu operation. Front panel speed, volume controls. 4 message memories, type ahead buffer, read again buffer, adjustable weight/sidetone, speaker. RFI proof.

MFJ-551, $29.95. RFI suppressed keyboard, a must to avoid RFI problems.

MFJ-464
$239.95
(Keyboard, Paddle Not Included.)

MFJ Pocket-Size *CW Reader*™ and *Code Tutor*

MFJ-461, $109.95. Place this tiny pocket size MFJ Morse Code Reader near your receiver's speaker and watch CW turn into solid text messages as they scroll across an easy-to-read LCD. No cables to hook-up, no computer, no interface, nothing else needed! Practice by copying along with the MFJ-461. Learn the code and increase your speed as you instantly see if you're right or wrong. Eavesdrop on interesting Morse QSOs from hams all over the world MFJ's *AutoTrak*™ automatically locks on, tracks and displays CW to 99 WPM. Serial port lets you display full screen CW text on your computer monitor with your computer and terminal program. Tiny 21/4x31/4x1", 51/2 oz. Fits in your shirt pocket, take it anywhere. Use 9 Volt battery.

MFJ-418, $109.95. Morse Code Tutor. Learn Morse code anywhere! Copy letters, numbers, prosigns or any combina tion or words or QSOs. ARRL/VEC format. Go from zero code speed to a high speed *CW Pro*! High contrast LCD, built-in speaker.

Plug & Play FT-8 and all Digital Modes!

MFJ-1204, $119.95. *Plug&Play* all digital modes! Specify your radio when ordering and just plug USB cable into your computer. Download free software from internet and operate: FT-8, JT4, JT-65, JT6M, FSK441, WSPR, PSK-31, EchoLink, APRS, CW, RTTY, packet, Amtor, more. Easy-to-set transmit/receive levels. Transformer isolated audio, PTT sensing eliminates adjustments. Universal, never obsolete.

MFJ-407E Deluxe CW Keyer $119.95

MFJ Curtis-Keyer has all keyer modes, dot-dash memories, jam-proof spacing, weight, sidetone, built-in speaker. Speed, weight and tone controls and tune, semi-auto and on/off switches are on the front panel.

MFJ-557 Code Oscillator/Key $49.95

Practice sending Morse code. Telegraph key, code oscillator, speaker on heavy non-skid steel base. Volume/tone controls. Use 9V battery. **MFJ-550, $19.95.** Key only.

MFJ-561 Tiny Iambic paddle $34.95

Tiny *Iambic paddle* is just 1 3/4W x 3/4H x 1 3/4D", just 2 1/2 oz. Precision paddle formed from phosphorous bronze, rugged metal base, non-skid rubber feet, wired.

MFJ-401E *Econo* CW Keyer $94.95

Front-panel volume/speed controls (8-50 wpm), tune switch. Internally adjust weight/tone. Solid state keying. Tiny 4 x 2 x 3 1/2 inches.

MFJ-564 Iambic Paddles $109.95

Deluxe Iambic paddles. Tension/contact spacing adjustments, steel bearings, precision frame, non-skid feet. Chrome (MFJ-564) or Black (MFJ-564B).

MFJ-422E Keyer/Paddle $229.95

MFJ *CW keyer and Iambic Paddle combo* lets you send smooth, easy CW. Front panel volume/speed (8-50 WPM), built-in dot-dash memories, speaker, sidetone.

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 – 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!

Eliminate severe power line noise from arcing transformers and insulators, fluorescent lamps, light dimmers, touch controlled lamps, computers, TV birdies, lightning crashes from distant thunderstorms, electric drills, motors, industrial processes -- before it gets into your receiver.

It's more effective than a noise blanker! Interference much stronger than your desired signal can be completely removed without affecting your signal. Works on all modes -- SSB, AM, CW, FM, digital -- and from BCB to lower VHF.

MFJ-281, $15.95. Clearest speech you ever heard! 3" speaker, 8W, 8 Ohms, 6' cord, 3.5 mm plug.

Null out strong QRM on top of weak rare DX and work him! Null out strong local ham or AM broadcast station to prevent receiver overload.

The MFJ-1026 is an adjustable phasing network that combines two antenna signals to give you various directional patterns. Null out a strong interfering signal or peak a weak signal at a push of a button.

Use external or built-in active noise antenna. RF sense T/R switch bypasses your transceiver. Plugs between antenna and transceiver. 12 VDC, 110 VAC with **MFJ-1312D, $19.95.** 6 1/2 x 1 1/2 x 6 1/4".

MFJ-1026
$239.95

MFJ-1025, $209.95. Like MFJ-1026 less active antenna, use external noise antenna.

MFJ Morse Code Reader and Keyer Combo

Plug in this MFJ Morse Code Reader with built-in keyer and watch CW turn into solid text messages as they scroll across an easy-to-read LCD

MFJ-464
$239.95
(Keyboard, paddles not included)

Built-in keyer makes working high speed CW a breeze. Type-ahead buffer, message memories and adjustable speed lets you compete with the best high speed CW operators – they won't even know you never passed a code test!

Everything you need for ultimate CW: sends/reads 5-99 WPM, automatic speed tracking, large 2-line LCD shows send/receive messages, use single, iambic paddle or computer keyboard, front panel speed, volume controls, 4 message memories, type ahead buffer, read again buffer, adjustable weight & sidetone, RFI proof, easy menu operation, more!

MFJ-551, $29.95. RFI suppressed keyboard.

MFJ-564/B, $109.95. MFJ Iambic paddles, chrome/black.

MFJ Contest Voice Keyer

Makes contesting easy -- Calls CQ, sends your call, does contest exchanges -- in your own natural voice

MFJ-434B
$239.95

MFJ Contest Voice Keyer™ makes contesting easy! Calls CQ, sends your call and does contest exchanges for you in your own natural voice!

Save your voice! Record and play back frequently used phrases like "CQ Contest this is KF5C", "You're 59", "Qth is Mississippi".

Repeat messages continuously. Vary repeat delay 3-500 seconds. Makes a great voice beacon and calling CQ easy.

Record and play back off-the-air signals -- great help if you didn't get it right the first time!

A playing message can be halted by the Stop Button, your microphone's PTT/VOX, remote control or computer.

All audio lines are RF filtered to eliminate RFI, audio feedback and distortion. Audio isolation transformer totally eliminates hum and distortion caused by ground loops.

Five messages, 75 seconds total. Use your mic or built-in mic for recording. Can be remote or computer controlled.

Works with 8 pin round or modular mics. Built-in Speaker amplifier.

External speaker, phone jack. 9V battery, 12 VDC or 110 VAC with **MFJ-1312D, $19.95**. 6 1/2W x 2 1/2H x 6 1/2D".

MFJ-73, $44.95. MFJ-434B Remote Control with cable.

MFJ SDR T/R Protection Switch

New!

MFJ-1708SDR, $89.95. An inexpensive wide-band SDR dongle receiver lets you see an entire band on a frequency/waterfall computer display! 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-1708SDR switches your SDR to your antenna showing the entire band. On transmit your SDR is switched out and grounded to protect your SDR. PTT and a failsafe RF sense circuit switches MFJ-1708SDR. For HF/VHF.

MFJ-1270X TNC for VHF Packet/APRS

MFJ-1270X, $149.95. A universal self-contained KISS mode TNC that works with every Packet software program that supports KISS mode -- just connect your FM transceiver and plug into your computer USB port. Natural for emergency communications. Perfect for APRS. Fully compatible with WinLink 2000. Works with Windows, Mac OS X and Linux. Active audio filter cleans up analog signals. Uses less than 25 mA.

MFJ-1270DG, $39.95. X-digi board converts MFJ-1270X into a remotely configureable digipeater.

MFJ Giant SWR/WattMeter

MFJ-868B, $169.95. World's largest 1.8-54 MHz SWR/Wattmeter has giant 6 1/2 inch meter! True active peak/average forward/reflected power. 20/200/2000 Watt ranges.

MFJ Desk Microphones

MFJ-299, $119.95. Tailored for SSB. Adjustable 11" boom. Silibant sound shield, graphic equalizer, compressor, VU meter, on-air indicator, PTT/lock switch.

MFJ-297, $79.95. SSB Boom Mic, PTT switch.

MFJ-1702C Antenna Switch

MFJ-1702C, $49.95. 2-position coax switch has a new center ground protection!

MFJ-1164B AC Line RFI Filter

MFJ-1164B, $99.95. Multiple Outlet, 119VAC

MFJ 24/12 Desk Clock

MFJ-108B, $27.95. **Read** both UTC and local time simultaneously. BIG 5/8 inch digits! Solid brushed aluminum frame. 4 1/4W x 2H x 1D

Mic Control Center

MFJ-1263, $139.95. Instantly switch ragchewing to DX mic to any two transceivers. Use PTT foot switch, boom mic/headset, phones, speaker, audio-in jack.

MFJ Dry Dummy Load

MFJ-260C, $49.95. 300 Watts. SWR below 1.1:1 to 30 MHz. 1.5:1 from 30-650 MHz. **MFJ-264, $89.95.** 1.5kW load.

MFJ AC Line Filter

MFJ-1164B, $89.95. Filters AC line RFI, surges, noise, transients, hash 30 dB, 60-80 dB with ground. Four 15A/120 VAC outlets.

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.

LISTEN & SUBSCRIBE

On your favorite podcast platform

ARRL's Podcasts have something for every ham!

On the Air Podcast

This free podcast geared toward beginner to intermediate hams is companion to the *On the Air* magazine (an ARRL membership benefit) and takes a deeper dive into select features and projects. Each month, host and *On the Air* Editorial Director Becky Schoenfeld, W1BXY, offers resources, techniques, and hints to get your on the air!

Eclectic Tech Podcast

ARRL's every other week, *Eclectic Tech* podcast hosted by *QST* Editor and ARRL Publications Manager Steve Ford, WB8IMY, brings you news, interviews, and commentary about technology and science -- all with an amateur radio twist!

LISTEN TO ARRL PODCASTS online at **www.arrl.org, iTunes (iOS), Stitcher (Android)** and **Blubrry.**

The *On the Air* and *Eclectic Tech* podcasts are sponsored by ICOM -- for the love of amateur radio.

ARRL Audio News Podcast

A summary of the week's top news stories in the world of amateur radio, along with interviews and other features.

Enjoy ARRL Audio News anywhere: on your smart phone or tablet, your local repeater, or stream it on the go!

You can also listen to ARRL Audio News on repeaters, listen for the letter "K" sent in Morse code every three minutes or so; that signals a four second pause in the audio. We provide these breaks to give you a moment to prevent your repeater from timing out or insert a repeater ID.

MFJ Analyzers

MFJ-269D...280 KHz - 230 MHz plus 415-470 MHz plus 2200 Meters

New and improved. Now covers 280 KHz to 230 MHz and 415 to 470 MHz plus 2200 Meters!

Instantly gives you a complete picture of your antenna.

Read SWR, return loss, reflection coefficient, match efficiency at any frequency simultaneously.

Read Complex Impedance (280 KHz to 230 MHz plus 2200 Meters) 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 and velocity factor.

Measure SWR and loss of coax with *any* characteristic impedance (280 KHz to 230 MHz plus 2200 Meters) from 10 to over 600 Ohms.

Measures inductance in uH and capacitance in pF at RF frequencies, 280 KHz to 230 MHz plus 2200 Meters.

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-bit A/D converters – *MFJ-269D exclusive!*

Built-in frequency counter, battery saver, low battery warning, Ni-Mh/NiCd charge circuit. 4W x 2D x 6¾ inches, 2 lbs. Use ten double A batteries or 110 VAC with **MFJ-1312D, $19.95**.

New!

MFJ-269D
$419.95

MFJ-269DPRO™ Analyzer

MFJ-269DPro, $459.95. Like MFJ- 269D, but UHF range covers **430 to 520 MHz** to include commercial industrial frequencies. Rugged protective shell protects knobs, switches, meters, LCD for industrial/lab work.

MFJ No Matter What™ Warranty

Every MFJ Analyzer is protected by MFJ's famous one year **No Matter What**™ limited warranty. We will repair or replace your MFJ analyzer (at our option) for a full year.

More hams use MFJ analyzers than all others in the world!

MFJ-259D

Now Covers 280 KHz-230 MHz plus 2200 Meters, World's most popular and improved analyzers

MFJ-259D
$319.95

New!

Super easy-to-use – Read antenna SWR, complex impedance, return loss, reflection coefficient. Determine velocity factor, coax cable loss in dB, length of coax and distance to short or open in feet. Read inductance in uH, capacitance in pF at RF frequencies. Large easy-to-see two line LCD screen and side-by-side meters clearly display your information. Built-in frequency counter, signal generator, Ni-Cad charger circuit, battery saver, low battery warning and smooth reduction drive tuning. More!

MFJ-223

1-60 MHz Color Graphic VNA Analyzer

MFJ-223
$319.95

This *pocket-sized* wonder breaks the mold for analyzer design with user-friendly convenience, top notch accuracy, and a vivid TFT multi-color display. Don't let the size fool you, MFJ-223 is packed with all the VNA features and performance you need!

- **Single-frequency** and *swept-frequency* operating modes
- **Truly accurate** SWR, R, X, and Z measurements
- **Seamless DDS** coverage with 280-Hz resolution from 1-60 MHz
- **Smooth "skip-free"** encoder tunes fast or slow without missing a step
- **Powerful +5-dBm** stimulus generator overrides local interference
- **Field-strength meter** measures local signals, detects potential interference
- **DDS generator** precision signal source
- **Vivid 1600-pixel/inch** color graphics on a 2x2 inch non-glare TFT screen

MFJ-225

1.5-180MHz continuous Two-Port Graphic Analyzer

Out in the field, MFJ-225 is a compact completely self-contained handheld graphing analyzer. On the bench it becomes a full-fledged two-port (S21) desktop machine when teamed up with your PC. Using powerful IG-miniVNA freeware, you'll run detailed data analysis and print out stunning color-graphic plots to document your work! Built-in back-lighted 3-inch LCD graphic display. Make fine adjustments using full-screen easy-to-view SWR bargraph, capture vivid swept displays for SWR, impedance, return loss, phase angle, more. DDS generator.

MFJ-225
$339.95

MFJ-249D Analyzer

MFJ-249D, $279.95

If digital display is all you need MFJ-249D does everything MFJ-259D does without analog meters.

Visit: www.mfjenterprises.com or call toll-free 800-647-1800

MFJ VNA Antenna Analyzer

MFJ VNA Antenna Analyzer covers 1 to 230 MHz, 1Hz resolution.

- ***Frequency sweep plots:*** *SWR, Impedance, Resistance, Reactance, Phase Angle, Complex Return Loss, Smith Chart*
- ***Sign of reactance*** positively identifies inductive or capacitive reactance
- ***Amazing accuracy with OSL (Open-Short-Load) calibration*** – calibrate through feedline/test cable at different frequencies and store in memory. Measure directly or through feedline with exceptional accuracy, correcting for line loss/phase angle. ***Smith Chart*** plots S11 magnitude/phase over any frequency span. ***Capture screens*** in 32 memories to download to PC via USB.

MFJ-226
$379.95

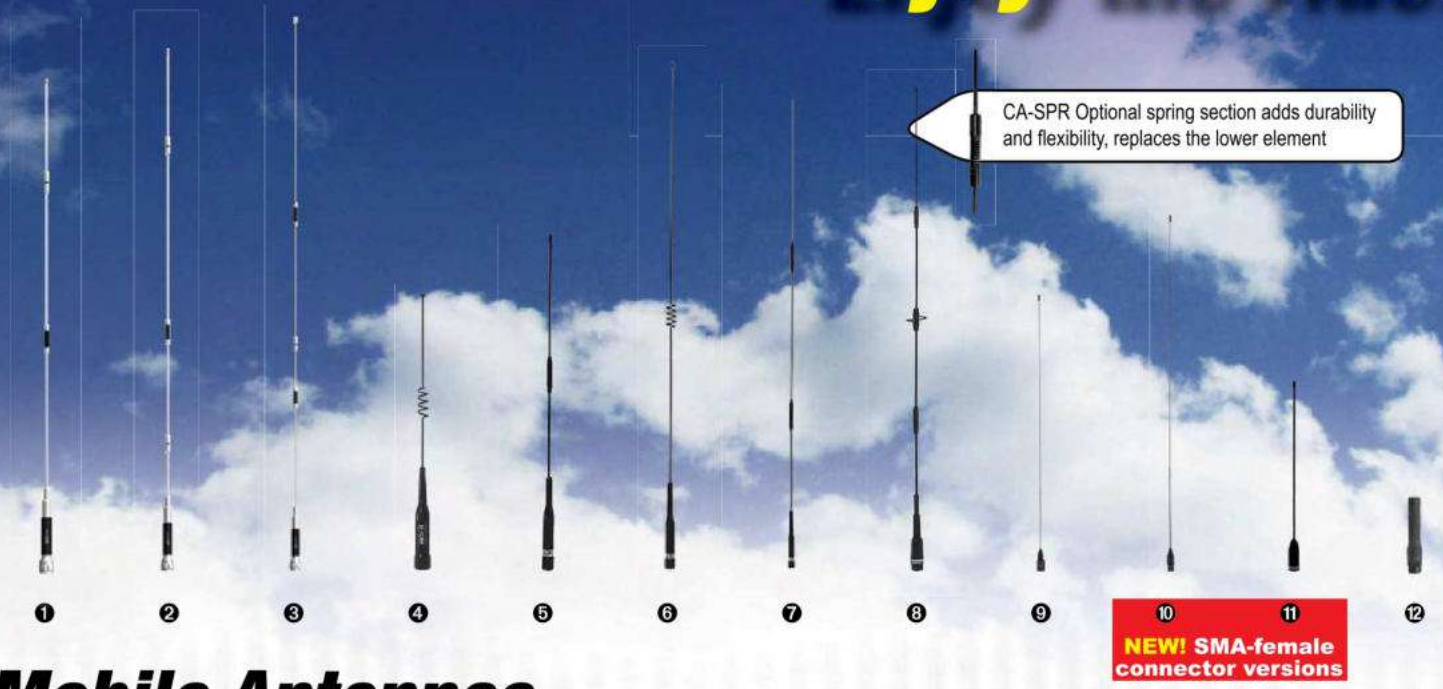
MFJ SWR Analyzer Accessories

- **A. MFJ-29D/MFJ-39D, $39.95.** Carrying Pouch for MFJ-259D/269D.
- **B. MFJ-92AA10, $39.95.** 10-Pack 2500 mAh Ni-MH Supercells.
- **C. MFJ-66D, $39.95.** Dip coils, set of two covers 1.8-230 MHz.
- **D. MFJ-731, $109.95.** Tunable Analyzer Filter, 1.8-30 MHz, for strong RF fields.
- **E. MFJ-917, $39.95.** 1:1 Current balun for SWR Analyzers to test balanced line antennas, other loads.
- **F. MFJ-5510D, $15.95.** 12VDC cigarette lighter adapter.
- **G. MFJ-7737, $9.95.** PL-259 to BNC Female.
- **H. MFJ-7727, $9.95.** PL-259 to SMA Female.

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®

Life is a JOURNEY. Enjoy the ride!



Mobile Antennas

❶ COMET **CSB-750A** DUAL-BAND 2M/440MHz w/FOLD-OVER
2M: 1/2 wave • 440MHz: 5/8 wave x 2 • VSWR: 1.5:1 or less • Length: 42" • Conn: PL-259 • Max. Pwr: 150W

❷ COMET **CSB-770A** DUAL-BAND 2M/440MHz w/FOLD-OVER
2M: 5/8 wave center load • 440MHz: 5/8 wave x 2 center load • VSWR: 1.5:1 or less • Length: 51" • Conn: PL-259 • Max Pwr: 150W

❸ COMET **CSB-790A** DUAL-BAND 2M/440MHz w/FOLD-OVER
2M: 7/8 wave center load • 440MHz: 5/8 wave x 3 center load • VSWR: 1.5:1 or less • Length: 62" • Conn: PL-259 • Max Pwr: 150W

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

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

❻ COMET **SBB-5/SBB-5NMO** DUAL-BAND 2M/440MHz w/FOLD-OVER
2M: 1/2 wave • 440MHz: 5/8 wave x 2 • Length: 39" • Conn: SBB-5 PL-259, SBB-5NMO - NMO style • Max Pwr: 120W

❼ COMET **SBB-7/SBB-7NMO** DUAL-BAND 2M/440MHz w/FOLD-OVER
2M: 6/8 wave • 440MHz: 5/8 wave x 3 • Length: 58" • Conn: SBB-7 PL-259, SBB-7NMO - NMO style • Max Pwr: 70W

❽ COMET **CA-2X4SR/CA-2X4SRNMO** WIDE-BAND 140-160MHz 435-465MHz w/FOLD-OVER
2M: 5/8 wave • 440MHz: 5/8 wave x 3 • Length: 40" • Conn: CA-2x4S PL-259, CA-2x4SRNMO NMO style • Max Power: 150W

❾ COMET **BNC-24** DUAL BAND 2M/440MHz HT ANTENNA
RX range: 100-1200MHz • Length: 17" • SuperFlex featherweight whip • Conn: BNC

❿ COMET **SMA-24** NEW! **SMA-24J** DUAL BAND 2M/440MHz HT ANTENNA
RX range: 100-1200MHz • Length: 17" • SuperFlex featherweight whip • Conn: SMA-24: SMA-male / SMA-24J: SMA-female

⓫ COMET **SMA-503** NEW! **SMA-503J** DUAL BAND 2M/440MHz HT ANTENNA
RX range: 100-1200MHz • Length: 8.75" • Conn SMA-503: SMA-male, SMA-503J: SMA-female

⓬ Maldol **MH-209, MH-209SMA** DUAL BAND 2M/440MHz HT ANTENNA
Length: 3" • Conn: MH-209 BNC, MH-209SMA: SMA-male • Soft rubber cover, good performance in a small package!

Call or visit your local dealer today!
www.natcommgroup.com | 800-962-2611

COMET®

APRS® / D-STAR®

TH-D74A 144/220/430 MHz Tribander

The TH-D74A represents the ultimate in APRS and D-STAR performance. KENWOOD has already garnered an enviable reputation with the TH-D72A handheld APRS amateur radio transceiver. Now it has raised the bar even further with the TH-D74A, adding support for D-STAR, the digital voice & data protocol developed by the JARL, and enabling simultaneous APRS and D-STAR operation – an industry first.

- APRS compliance using packet communication to exchange real-time GPS position information and messages
- Compliant with digital/voice mode D-STAR digital amateur radio networks
- Built-in high performance GPS unit with Auto Clock Setting
- Wide-band and multi-mode reception
- 1.74" (240 x 180 pixel) Transflective color TFT display
- IF Filtering for improved SSB/CW/AM reception
- High performance DSP-based audio processing & voice recording
- Compliant with Bluetooth, microSD & Micro-USB standards
- External Decode function (PC Decode 12kHz IF Output, BW:15 kHz)
- Free software for Memory and Frequency Control Program
- Data Import / Export (Digital Repeater List, Call sign, Memory Channel)
- Four TX Power selections (5/2/0.5/0.05 W)
- Dust and Water resistant IP54/55 standards

APRS (The Automatic Packet Reporting System) is a registered American trademark of WB4APR (Mr. Bob Bruninga).
D-Star is a digital radio protocol developed by JARL (Japan Amateur Radio League).

KENWOOD

Customer Support/Distribution Customer Support:
(310) 639-4200 Fax: (310) 537-8235

www.kenwood.com/usa

ISO9001 Registered

ADS#38419

MFJ Tuners

New, Improved MFJ-989D 1500 Watt legal limit Antenna Tuner

World's most popular 1500 Watt Legal Limit Tuner just got better -- much better -- gives you more for your money!

New, improved MFJ-989D legal limit antenna tuner gives you better 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 and 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.

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. $12^{7}/_{8}$W x 6H x $11^{5}/_{8}$D inches.

MFJ-989D **$469.95**

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.

More hams use MFJ tuners than all other tuners in the world!

MFJ-986 Two knob Differential-T™

MFJ-986 **$419.95**

Two knob tuning (differential capacitor and AirCore™ roller inductor) makes tuning foolproof and easier than ever. Gives minimum SWR at only one setting. Handles 3 kW PEP SSB amplifier input power (1.5 KW output). Gear-driven turns counter, lighted peak/average Cross- Needle SWR/Wattmeter, antenna switch, balun. 1.8 to 30 MHz. 15W x $4^{1}/_{2}$H x $10^{3}/_{4}$D in.

MFJ-962D compact kW Tuner

MFJ-962D **$359.95**

A few more dollars steps you up to a KW tuner for an amp later. Handles 1.5 kW PEP SSB amplifier input power (800W output). Ideal for Ameritron's AL-811H! AirCore™ roller inductor, gear-driven turns counter, pk/avg lighted Cross-Needle SWR/Wattmeter, antenna switch, balun, Lexan front, 1.8-30MHz. $10^{7}/_{8}$W x $10^{3}/_{4}$H x $4^{1}/_{2}$D in.

MFJ-969 300W Roller Inductor Tuner

Superb, AirCore™ Roller Inductor tuning. Covers 6 Meters thru 160 Meters! 300 Watts PEP SSB. Active true peak reading lighted Cross-Needle SWR Wattmeter, QRM-Free PreTune™, antenna switch, dummy load, 4:1 balun, Lexan front panel. $10^{1}/_{2}$W x $3^{1}/_{2}$H x $9^{1}/_{2}$D inches.

MFJ-969 **$259.95**

MFJ-949E deluxe 300 Watt Tuner

More hams use MFJ-949s than any other antenna tuner in the world! Handles 300 Watts Full 1.8 to 30 MHz coverage, custom inductor switch, 1000 Volt 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. $10^{5}/_{8}$W x $3^{1}/_{2}$H x 7D inches. **MFJ-948, $179.95**. Economy version of MFJ-949E, less dummy load, Lexan front panel.

MFJ-949E **$219.95**

MFJ-941E Super Value Tuner

Most for your money! 300 Watts PEP, 1.8-30 MHZ, lighted Cross-Needle SWR/Wattmeter, 8 position antenna switch, 4:1 balun, 1000 volt capacitors, Lexan front panel. $10^{1}/_{2}$W x $2^{1}/_{2}$H x 7D in. **MFJ-941EK, $139.95.** Tuner Kit -- Build your own!

MFJ-941E **$169.95**

MFJ-945E HF/6M mobile Tuner

Extends your mobile antenna bandwidth so you don't have to stop, go outside and adjust your antenna. Tiny 8W x 2H x 6D in. Lighted Cross-Needle SWR/Wattmeter. Lamp and bypass switches. Covers 1.8-30 MHz and 6 Meters. 300 Watts PEP. **MFJ-20, $9.95**, mobile mount.

MFJ-945E **$159.95**

MFJ-971 portable/QRP Tuner

Tunes coax, balanced lines, random wire 1.8-30 MHz. Cross-Needle Meter. SWR, 30/300 or 6 Watt QRP ranges. Matches popular MFJ transceivers. Tiny $6^{1}/_{2}$W x $2^{1}/_{2}$H x 6D in.

MFJ-971 **$149.95**

MFJ-901B smallest Versa Tuner

MFJ's smallest (5W x 2H x 6D in.) and most affordable wide range 200 Watt PEP Versa tuner. Covers 1.8 to 30 MHz. Great for matching solid state rigs to linear amps.

MFJ-901B **$119.95**

MFJ-902B Tiny Travel Tuner

Tiny $4^{1}/_{2}$W x $2^{1}/_{4}$H x 3D inches, full 150 Watts, 80-6 Meters, has tuner bypass switch, for coax/random wire. **MFJ-904H, $169.95**. Same but adds Cross-needle SWR/Wattmeter and 4:1 balun for balanced lines. $7^{1}/_{4}$W x $2^{3}/_{4}$H x $2^{3}/_{4}$D inches.

MFJ-902B **$129.95**

MFJ-16010 random wire Tuner

Operate all bands anywhere with MFJ's reversible L-network. Turns random wire into powerful transmitting antenna. 1.8-30 MHz. 200 Watts PEP. Tiny 4W x 2H x 3D in.

MFJ-16010 **$79.95**

MFJ-9201 QRPocket™ Tuner

80-10 Meters, 25 Watts. 12 position inductor, tune/bypass switch, wide-range T-network, BNCs. 4W x $2^{5}/_{8}$H x $1^{1}/_{2}$D inches. **MFJ-9201, $49.95**

MFJ-9201 **$54.95**

MFJ-921/924 VHF/UHF Tuners

MFJ-921 covers 2 Meters/220 MHz. **MFJ-924** covers 440 MHz. SWR/Wattmeter. 8W x $2^{1}/_{2}$H x 3D in.

MFJ-921/924 **$109.95**

MFJ-931 Artificial RF Ground

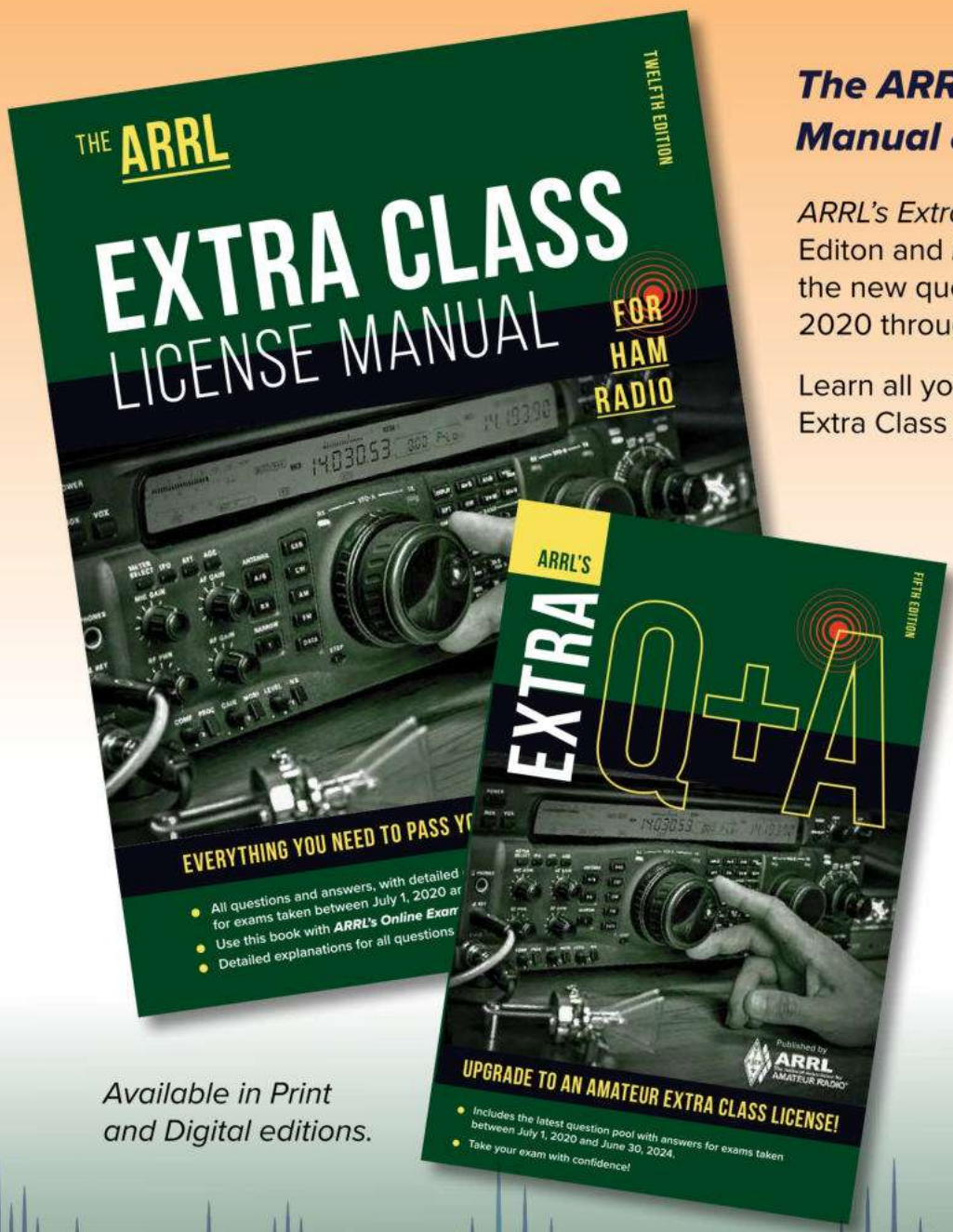
Eliminates RF hot spots, RF feedback, TVI/RFI, weak signals caused by poor RF grounding. Creates artificial RF ground or electrically places far away RF ground directly at rig. **MFJ-934, $249.95**, Artificial ground/300 Watt Tuner/Cross-Needle SWR/Wattmeter.

MFJ-931 **$129.95**

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.

Earn every privilege granted to amateur radio operators.

Pass the Amateur Extra Class License Exam with Confidence!



Available in Print and Digital editions.

The ARRL Extra Class License Manual & ARRL's Extra Q&A

ARRL's Extra Class License Manual, 12th Editon and *Extra Q & A*, 5th Edition feature the new question pool effective from July 1, 2020 through June 30, 2024.

Learn all you need to know to pass the Extra Class License Exam after July 1, 2020.

TESTIMONIALS

"...you can't go wrong with these books. They are well-written and designed to teach you the material, not merely prep you for the exams."

"I used this manual to study for the Extra Class exam and passed it the first time!"

"The books are organized in a way that makes learning the material easy. ARRL has online test-taking that you can use free, so review is simple. "

PRE-ORDERS AVAILABLE NOW – WILL SHIP IN EARLY JUNE 2020

ARRL The national association for AMATEUR RADIO®

www.arrl.org/shop

MFJ Dummy Loads & SWR/Wattmeters

Dummy Loads

World's most popular Dry 300 Watt HF/VHF Dummy Load

Air-cooled, non-inductive resistor in a perforated metal housing; Has SO-239 connector. Full 300W for 30 seconds. Derating curve to 5 minutes. SWR below 1.1:1 to 30 MHz, 1.5:1 30 to 650 MHz. Compact 2 1/4 x 2 1/4 x 7 inches. **MFJ-260CN, $59.95.** With type "N" connector.

MFJ-260C $49.95

Dry 1.5 kW HF/VHF/UHF Dummy Load

Ham radio's most versatile 1.5 kW 50 ohm *dry* dummy load covers DC through 650 MHz. SWR 1.1:1 to 30 MHz and 1.3:1 to 650 MHz. Handles 1500 Watts for ten seconds, 100 Watts for 10 minutes. 3W x 3H x 9D in. SO-239 connector. **MFJ-264N, $109.95.** With type "N" connector.

MFJ-264 $89.95

Oil-Cooled 1 kW CW, 2 kW SSB 50-Ohm VersaLoad™

Run 1kW CW or 2 kW PEP for 10 minutes. Run *continuous duty* with 200 Watts CW or 400W PEP. Transformer oil included. SWR 1.2:1 to 30 MHz. Low SWR to 400 MHz. SO-239 connector. Safety vent with cap, carrying handle. 7 1/2H x 6 5/8D in. **MFJ-250X, $69.95.** No transformer oil.

MFJ-250 $79.95

500 MHz, 100 Watt Dummy Load

Connects directly with built-in PL-259. Finned aluminum air-cooled heatsink. 15 Watts continuous, 100W peak. SWR <1.5:1, DC-500 MHz. 15/8 inch round by 3 inches long. **MFJ-262B, $69.95.** PL-259. 35 Watts continuous, 200W for 5-seconds. SWR< 1.2;1 DC-1 GHz.

MFJ-261 $34.95 *with PL-259* DC to 500 MHz

MFJ 2500W *fan-cooled* Dry Load

MFJ's 2500 Watt *fan cooled* load handles legal limit amps, 2500W average one minute on, ten minutes off, 300W continuous. DC- 6 Meters. SWR <1.25, 30 MHz; <1.4, 30-60 MHz. Detailed power curve. 12 VDC or 110 VAC. 8 1/4W x 4H x 9 1/2D in. SO-239s. 5 pounds.

MFJ-265 $249.95

Switchable RF Dummy Load

Select 16.6, 25, 50, 100, 150 Ohm dummy loads. Test/calibrate your wattmeters, SWR accuracy. At 50 Ohms it handles 300 Watts for 30 seconds with SWR < 1.1, 60 MHz. SO-239. 4 1/2W x 2 1/4H x 6 1/2D in. Optional 12 VDC/110 VAC adaptor, **MFJ-1312D, $19.95**.

MFJ-251 $169.95

3 GHz, 300 Watts Dry Dummy Load

New high-tech metal film resistor on large heavy-duty air-cooled heatsink. 300 Watts for ten seconds and 125W continuously. SWR < 1.1, 1 GHz; <1.2, 1.5 GHz; <1.5, 3 GHz. N-connector. 10 3/4W x 2 1/4H x 5 1/4D inches.

MFJ-263 $139.95

1.5kW Dry DummyLoad/SWR/Wattmeter

Tune up your transceiver, linear amplifier or antenna tuner into a safe 50 Ohm dummy load at *full power*. Then instantly switch to your antenna and monitor SWR, forward and reflected power on lighted cross-needle meter. 300/3000 Watt ranges. DC-60 MHz.Test/tune Xceivers, amps, tuners, baluns, filters, coax, stubs.

MFJ-267 $179.95

SWR/Wattmeters

Compact Cross-Needle SWR/Wattmeters

Large 3-inch lighted Cross-Needle meter covers 1.8-200 MHz in 30/300W power ranges. Read forward, reflected power, SWR *simultaneously*. 3 1/4W x 3 1/4H x 3 1/4D in. SO-239 connectors. **MFJ-842, $69.95.** 140-525 MHz, 15/150W.

MFJ-822 $69.95

High-accuracy 1.8-60 MHz Digital SWR/Wattmeter

Highly accurate! Auto-ranging select 25W, 250W, 1500W ranges with *full 10-bit* resolution. Frequency compensated data insures highest accuracy. *True peak*/average forward/reflected power, SWR and frequency are *simultaneously* displayed on backlit LCD and large 3-inch lighted cross needle meter. Peak hold. LED, buzzer, amplifier-by-pass alerts and protects your amplifier when SWR is high and toggles extra relay. 6 1/2W x 2 5/8H x 6D". **MFJ-826B, $199.95.** No meter, ampr bypass, control relay.

MFJ-828 $269.95

MFJ GrandMaster™ SWR/Wattmeters

GrandMaster™ SWR/Power Meters are the *Cadillacs of ham radio!* Large 3 1/4 x 1 1/4 inch precision illuminated meter gives easy wide-angle viewing of SWR, forward or reflected power. 7 1/2W x 3 1/8H x 4 1/4D in. SO-239s. **MFJ-870, $89.95.** 1.6-60 MHz. 30/300/3000 Watt ranges. **MFJ-874, $129.95.** 1.8-525 MHz. 5/20/200 Watt ranges.

MFJ-870 $89.95

MFJ *giant* 6.5 inch SWR/Wattmeter

World's *largest* HF+6M SWR/Wattmeter has giant 6½ inch meter! Extra-long scales gives highly accurate SWR/power 1.8-54 MHz. Huge numbers make reading easy. *True* peak or average forward and reflected power. 20/200/2000 Watt ranges. 9 Volt battery, 12 VDC or 110 VAC with **MFJ-1312D, $19.95.** 7W x 5 1/2H x 5D in. SO-239s.

MFJ-868B $179.95

VHF SWR/Wattmeter plus Field Strength

World's most popular – and most affordable – VHF SWR/Wattmeter. Read SWR, forward and reflected power over 144-220 MHz in two ranges, 30/300W. Built-in field strength meter for 1-220 MHz. 4 1/2W x 2 1/4H x 3D".

MFJ-812B $49.95

Compact Digital SWR/Wattmeters

Displays forward, refelected power, SWR (1.6-60 MHz) and battery *all in a single glance!* Large 1/2" forward power digits and 5/8" reflected/SWR digits! 0-200W. Power/backlight on/off. SO-239s. **MFJ-847, $114.95.** 125-525 MHz, 0-120W. **MFJ-849, $189.95.** Large 3.5" bright orange LCD displays SWR, forward/reflected power. 1.5-525 MHz, 200W, HF/VHF-UHF switch.

MFJ-845 $114.95

MFJ-849 $189.95

MFJ HF *QRP* SWR/Wattmeter

Read forward, reflected power 1.8- 50 MHz, 0-5W. Also reads SWR, relative power 100 mW to 50W. SO-239s. 4 1/2W x 2 1/4 H x 3D in.

MFJ-813 $49.95

VHF/UHF SWR/Wattmeter

Lighted Cross-Needle,SWR/Watts,144/220/440 MHz, 30/300W Forward power, 6/60W Reflected power.

MFJ-862 $79.95

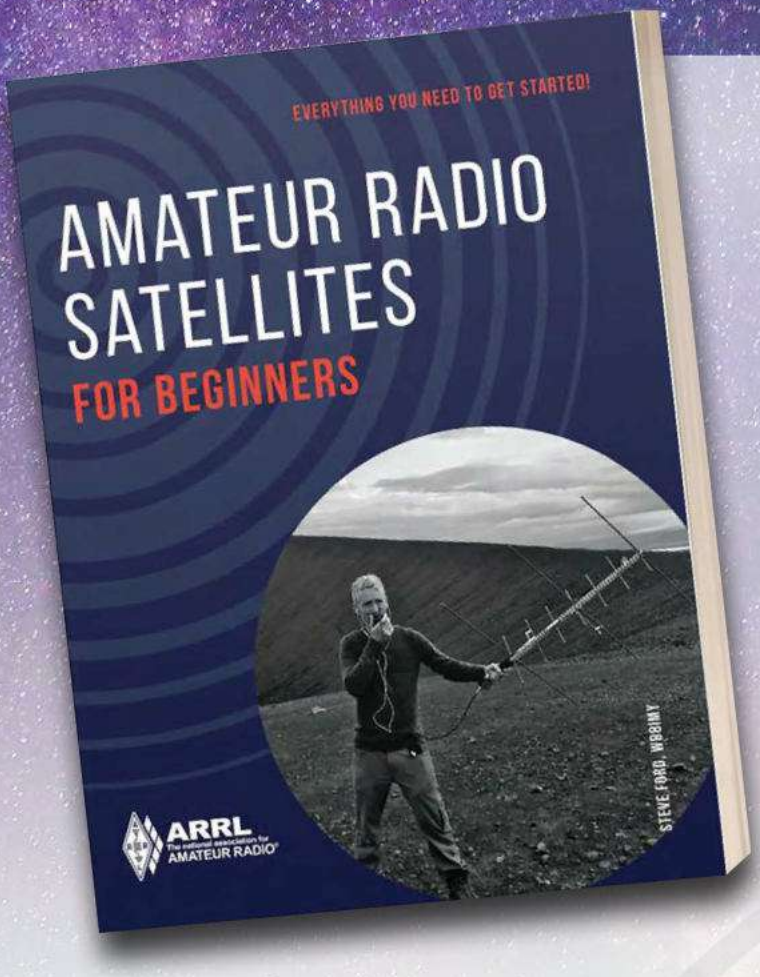
MFJ Enterprises, Inc. 300 Industrial Pk Rd, Starkville, MS 39759
Phone: (662) 323-5869 ■ **Tech Help:** (662) 323-0549 ■ **FAX:** (662) 323-6551 8-4:30 CST, Mon.-Fri.

MFJ_260C_MFJ_868B_110618_QST_090619DS

OUTER SPACE IS YOUR NEXT RADIO FRONTIER!

NEW Amateur Radio Satellites for Beginners

"Even with just a dual-band FM transceiver and a mobile antenna, you can make contacts through an amateur satellite!" - Author and *QST* Editor Steve Ford, WB8IMY



You can make contacts through amateur radio satellites, and even with the International Space Station, using equipment you probably own right now!

There are dozens of spacecraft in orbit just waiting for your signals, and more are being launched every year. This book is your guide to a whole new world of operating enjoyment.

Inside you will:

- Be able to locate satellites and determine when they will be available.
- Gain tips for building your own "satellite station".
- Find a simple step-by-step guide to making your first contacts.
- Discover satellite antenna projects you can build at home.

ARRL The national association for AMATEUR RADIO®

Amateur Radio Satellites for Beginners
ARRL Item No. 1304 / ISBN: 978-1-62595-130-4

Member Price! Only $19.95 (retail $22.95)
Order Now - www.arrl.org/shop

ARRL Eclectic Tech

Check out the new ARRL science and technology podcast. Produced every two weeks, the ***Eclectic Tech*** is hosted by author Steve Ford.

MFJ Mobile Antennas!

Dual Band Mag Mount Antennas

MFJ-1724B

2-Meter/440 MHz

MFJ-1724B **$34.95**

This antenna is perfect for your dual band mobile or HT. Powerful 3 1/2 inch magnet holds firm at highway speeds, rubber guard, 19" black stainless steel whip, low SWR, excellent gain, 300 Watts PEP, 12 feet coax with PL-259. Free BNC adapter.

MFJ-281 **$15.95**

MFJ-281

Clearest speech you ever heard!
3" speaker, 8W, 8 Ohms, 6' cord, 3.5 mm plug.

MFJ-1729

Power*Gain™

MFJ-1729 **$49.95**

Ham Radio's most powerful dual band antenna gives whopping gain on 440 MHz and 2-Meters! Low SWR. 27 1/2" stainless steel Slimline™ radiator minimizes wind vibration for less SWR flutter for longer range, better readability. 12' coax, PL-259, Heavy duty magnet mount.

MFJ-1728B

5/8 Wave 2/6 Meter Mobile

MFJ-1728B **$34.95**

Full 50-inch 5/8 Wave gives you maximum possible gain of any single element antenna on 2-Meters. On 6-Meter "magic band" you get a powerful signal with its high-performance low SWR full 1/4 Wave. 300 Watts PEP, heavy duty magnet, 12 feet coax, stainless steel radiator.

MFJ Super-Strong Magnet Mounts with Coax/PL-259

MFJ 5-inch Magnet

Best Seller!

These jetblack 5-inch super strong magnet mounts have 17' coaxial line terminated with PL-259 connectors. SO-239 (BS) or NMO (BM) for your VHF/UHF antennas or 3/8-24 threaded (BT) for your HF hamstick antennas with a 3/8-24 threaded connector.

$19.95 Each

MFJ-335BS – SO-239
MFJ-335BM – NMO
MFJ-335BT – 3/8 - 24 For HF sticks

MFJ 3-inch Magnet

3-inch Black Magnet Antenna Mounts

17-foot coax is terminated with PL-259 connector. Choose SO-239 (BS) or NMO (BM). For VHF/UHF light-weight antennas.
MFJ-333BS Pictured

$15.95 Each

MFJ SMA/BNC Cables

Release strain on your HT's antenna connector! 3 ft. flexible, mini coax with SO-239 connector.

$19.95 Each

A. **MFJ-5612S** SMA Male.
B. **MFJ-5612SF** SMA Female Wouxun/Baofeng.
C. **MFJ-5612B** BNC Male.

MFJ Triple 5-inch Magnets

Goliath™ – Ultimate Strength Magnet

Three super-strong 5-Inch Magnets make up this MFJ Goliath™ Tri-Magnet Mount. 1/4" thick steel triangle base. 17' coax. Select SO-239, NMO, 3/8-24 antennas.

Caution: once on, it's difficult to get off!

$44.95 Each

MFJ-336S – SO-239
MFJ-336M – NMO
MFJ-336T – 3/8 x 24

HF/VHF/UHF 200 Watt Duplexers

MFJ-916B **$34.95**

Use separate HF/VHF and 440 MHz UHF antennas with single transceiver OR use two separate HF/VHF and 440 MHz UHF transceivers with a single HF/VHF/UHF antenna. Heavy-duty diecast enclosure houses low/high pass networks that separate/combine HF/VHF/UHF signals. Low loss SO-239s. 50 Ohm ports. **MFJ-916BC, $59.95** 3 ft. coax pigtails on 2-port side.

1.8-200 MHz SWR/Wattmeter

Compact 1.8-200 MHz SWR/Wattmeter has HUGE 3" Cross-Needle meter. Read forward/reflected power and SWR simultaneously. Perfect for mobile/portable. 30/300 Watt ranges. Built-in meter light. SO-239s. 3 1/4W x 3 1/4H x 3 1/4D". **MFJ-842, $69.95** covers 140-525 MHz, 15/150 Watts.

MFJ-822 **1.8-200 MHz $69.95**
MFJ-842 140-525

VHF/UHF Hi-Gain Antennas

A. MFJ-1402, $39.95.
VHF/UHF RuffRiderJunior™. Premium, short 16 1/2" antenna fits in any garage on any auto. 1/4 Wave on 2 Meters, 1/2 Wave, gain on 440 MHz. 100W. No foldover. B or C.

B. MFJ-1412, $39.95.
VHF/UHF RuffRider High Power™. Just 40" long handles full 200 Watts. Great for high power mobile amp. 1/2 Wave, gain on 2 Meters, 5/8 Wave, great gain on 440 MHz. Black or chrome.

C. MFJ-1422, $44.95.
VHF/UHF RuffRider High Gain™. 41 1/2 inch long antenna gives extra gain with little height increase. Handles 150 Watts. 1/2 wave with good gain on 2 Meters, 5/8 wave, excellent gain on 440 MHz. Black or chrome.

D. MFJ-1432, $64.95.
VHF/UHF RuffRider Hyper Gain™. 62 1/2" brute gives whopping gain on 7/8 Wave 2-Meters, 5/8 Wave and a MONSTER gain on 440 MHz. MFJ will rock your ham radio world! 150 Watts. Use tri-magnet. Black or Chrome.

MFJ Mobile HF Ham Sticks

Each is ruggedly constructed. A heavy duty 4 foot, 3/8 inch diameter fiberglass rod; a nearly indestructible .125 inch diameter PH-17-7 stainless steel whip and chrome plated brass fittings will give you years of service. It's sleek, low profile construction has low wind loading and its semi-rigid fiberglass eliminates the need for springs or guys.

Black anti-static jacket protects loading coil, blends with any vehicle. Stainless steel whip is adjustable for lowest SWR. Push it down to park in the garage or fully extend it for maximum efficiency during mobile operation.

Includes allen wrench and complete tuning and matching instructions. Handle 250 Watts PEP. Whips are 7 feet fully extended, and collapse to about 4 feet for easy storage.

Simply screws into any 3/8 x 24 female mount for quick bandchanging. Get them all for great band coverage!

MFJ-1675T - 75 Meters
MFJ-1660T - 60 Meters
MFJ-1640T - 40 Meters
MFJ-1630T - 30 Meters
MFJ-1620T - 20 Meters
MFJ-1617T - 17 Meters
MFJ-1615T - 15 Meters
MFJ-1612T - 12 Meters
MFJ-1610T - 10 Meters
MFJ-1606T - 6 Meters

$19.95-$21.95 Each

60-75 Meters $29.95 each

— 3/8-24 Ham Stick Mounts —

MFJ-343, $15.95. Tough 3/8-24 hard mount for permanent installation.

MFJ-342T, $15.95. 3/8-24 HF horizontal or vertical 1/4 or 1/2 inch pipe or mirror mount.

MFJ-344, $15.95. Like MFJ-342T, but horizontal pipe mount.

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_1724B_101008_QST_040819DS

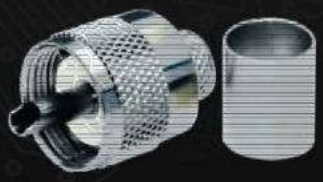
Quicksilver Radio

WHY CRIMP?

- ✓ Solid mechanical & electrical connection
- ✓ No melted dielectric
- ✓ Connect all the braid, not just a few strands
- ✓ High reliability
- ✓ More info on our website

Crimp-On Connectors

Excellent quality, no bargain basement stuff here. Adapters & connectors for most types of connections.



US Made Coax Jumpers

Premium Bury Flex, USA-400 & USA-240 coax jumpers with your choice of UHF, Type N, BNC, SMA, TNC & Mini-UHF Connectors.

Quickstick™

"Hamstick" style mobile antennas. Available in 6, 10, 12, 15, 17, 20, 30, 40, 60, & 75M. Made in the USA!

WATER-SHED™

Coax connector sealing tape. No adhesive, bonds to itself. UV, oil, salt, and chemical resistant silicone tape. Made in the USA **Only $6 ea. or $15 for a 3 pk.**

PaneRelief™ Window Feed-through

Mobile Antennas & Mounts

Marine Grade Pulleys

Absolutely the best pulleys you can get for your antenna installation.

New Item!! HybridDX™ HF antenna. Get on 80M in less than 80 ft.

Play-Series™ System

Check out our new Play-Series™ USB modules. New body & LED colors & styles. Aluminum body available. Spruce up your Ham shack, car, etc.

www.qsradio.com

Quicksilver Radio

In these tough times, we're here to help you with Quality, Service & Value!

HAMMO-CAN™ Go Box

Ready to go, a complete VHF-UHF station in a box. Get them with or without radios installed. Fits most FM mobiles & several HF radios, too.

Building your own? Check our large selection of parts and accessories.

FREE SHIPPING on all orders over $73.00 to any United States address.

Soldering Supplies

Ultimate Crimp Kit™

Testing Equipment

DC Power Cables

Connectors & Adapters

Power Supplies & Batteries

Audio

Powerpoles and DC Connectors

Antenna Supplies

www.qsradio.com

Ham Ads

Please contact the Advertising Department at 860-594-0255 or hamads@arrl.org for further information or to submit your ad.

For information on placing a Classified Ad:
www.arrl.org/ham-ads-classified-rules-and-rates

Before considering a ham ad please read.

1. Advertising must pertain to products and services which are related to Amateur Radio.

2. The Ham-Ad rate for commercial firms offering products or services for sale is $2.25 per word. Individuals selling or buying personal equipment: ARRL member 1.00 per word. Non-ARRL member $1.50 per word. **Bolding** is available for $2.50 a word. Prices subject to change without notice. You may pay by check payable to the ARRL and sent to: Ham-Ads, ARRL, 225 Main St., Newington, CT 06111. Or, you may pay by credit card sending the information by fax to 860-594-4285 or via e-mail to hamads@arrl.org. The credit card information we need is: the type of credit card, the exact name that appears on the credit card, the credit card number, the expiration date and the credit card billing address.

3. Remittance in full must accompany copy since Ham-Ads are not carried on our books. Each word, abbreviation, model number and group of numbers counts as one word. Entire telephone numbers count as one word. No charge for postal Zip code. No cash or contract discounts or agency commission will be allowed. Tear sheets or proofs of Ham-Ads cannot be supplied. Ads submitted in writing should be typed or printed clearly on an 8 1/2" X 11" sheet of paper.

4. Closing date for Ham-Ads is the 15th of the second month preceding publication date. No cancellations or changes will be accepted after this closing date. Example: Ads received December 16th through January 15th will appear in March *QST*. If the 15th falls on a weekend or holiday, the Ham-Ad deadline is the previous working day. Please contact the Advertising Department at 860-594-0255 or hamads@arrl.org for further information or to submit your ad.

5. No Ham-Ad may use more than 200 words. No advertiser may use more than three ads in one issue. Mention of lotteries, prize drawings, games of chance etc is not permitted in *QST* advertising.

6. New firms or individuals offering products or services for sale must check with us to determine if a production sample (which will be returned) should be submitted for examination. Dealers are exempted, unless the product is unknown to us. Check with us if you are in doubt. You must stand by and support all claims and specifications mentioned in your advertising.

The publisher of *QST* will vouch for the integrity of advertisers who are obviously commercial in character and for the grade or character of their products and services. Individual advertisers are not subject to scrutiny.

The American Radio Relay League does not discriminate in its advertising on the basis of race, color, religion, age, sex, sexual orientation, marital status or national origin. The League reserves the right to decline or discontinue advertising for any other reason.

7. AN IMPORTANT NOTICE TO ALL HAM AD POSTERS AND RESPONDERS, FROM THE ARRL ADVERTISING DEPARTMENT Greetings from ARRL HQ! Please note that we have received reports from many ARRL members who have placed classified ads in these listings, and have received responses from individuals proposing "creative" payment schemes. These particular instances involved offers of overpayments for goods by bank check, followed by instructions to deduct the cost of your item from the overpayment, and to transfer the overage back or to another individual. This is a well-known scam. Unfortunately, we have no control over this and other scams of this type. Once your email address is posted, you are vulnerable to those individuals seeking to provide you with questionable information.

QST Ham Ads on the Web
Updated Monthly!

www.arrl.org/ham-ad-listing

Club/Hamfests/Nets

CW INSTRUCTION via internet video conference classes. VISIT longislandcwclub.org

FRIEND OF BILL W?? http://www.qsl.net/haam HF Net 12:30 Eastern Sat 14.290, Sun 14.340 Mon-Fri 14.316 QSO Net 11:30 Eastern 21:350

MARCO Medical Amateur Radio Council. Professionals enjoying ham radio. Free newsletter & info: secretary@marco-ltd.org

Texas Ham Radio Net - Forums, Discussions, Resources, Public/Private Groups and Classifieds for Texas Hams. https://texashamradio.net

Property/Vacation/Rentals

A DX Apartment available in VP9 with rigs and antennas. Email: ed@vp9ge.com for details.

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

IDAHO! is awesome! Thinking of buying or selling? Contact Ron Bishop, W7IM. Keller Williams Realty Boise. 208-870-6075.

KD7UIZ Helps sell/buy radio friendly properties anywhere in AZ. Pima Canyon Realty. Email: **donsellsazhomes@gmail.com** Direct line: **520-907-2682**

MAINE year round Ham Station. www.CottagebytheDam.com

Need a NEW QTH on Florida's east coast? Contact Greg Bowman, N4EN, Realtor Associate, Pioneer Properties USA, Melbourne FL. 321-305-9142

Operate N4USA in Virginia's high Blue Ridge Mountains www.n4usa.com

SAINT KITTS "V4" CARIBBEAN DX RENTAL See v47ja on qrz.com and/or email: w5jon@sbcglobal.net for full information. John W5JON/V47JA

W1EJM's home in **The Villages, Florida** is **For Sale** A very unique setting, visit at **www.hamqth4you.com** 17 years operating at this QTH 160-3/4Meters Let's QSO 75M or 40M SSB. **THIS STATION GET'S OUT!** Buy/occupy now or rent to me or the rental market

www.peidxlodge.com

Antique/Vintage/Classic

6 Meter legacy by K6EDX K6MIO. www.bobcoopertv.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

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

QSLCards/Call Sign Novelties

CALLSIGN NAME CARDS Deputypatch.com

CALLSIGN PLAQUES www.HamPlaques.com

CallSign Stuff www.HamQRU.com KTØMMY

Engraving, **QSL's,** Memo's, Stamps, Plaques since 1962, Full-Service Printing. Samples. WA2WAO@CornerPress.com www.CornerPress.com 425 286-5952

Get Top Quality Full Color UV Coated QSL Cards direct from the printer. Chester QSL Cards by Chester Press. Call 800-748-7089 for samples, email QSLinfo@chesterpressinc.com or visit the chesterpressinc.com/QSL website.

WWW.THESIGNMAN.COM
RICK@THESIGNMAN.COM/225.757.1545

General

#1 AMATEUR CALLSIGN DVD! HamCall contains over 2,400,000 world-wide callsigns, 10,400,000 archive callsigns. Supported by most logging programs. Six FREE monthly internet updates and HamCall.net Gold online access included. Visa/MC/Discover 800-282-5628 http://hamcall.net

AMSAT - WHO DECIDES THE FUTURE OF AMATEUR RADIO IN SPACE? YOU DO! Since 1969 AMSAT has pioneered dozens of spacecraft that have brought operating enjoyment to thousands. Your membership in AMSAT will support exciting projects planned for launch in the years to come. In addition, you'll receive the bimonthly AMSAT Journal and substantial discounts on software distributed by AMSAT. Join now! From the US call toll free at (888) 322-6728. From all other locations call 1-301-822-4376. Or visit the AMSAT Web site at www.amsat.org AMSAT®, 10605 Concord St, #304 Kensington MD 20895, USA.

ATTENTION YAESU-FT 10218,000hrs, 25yrs, 800+ FT-102's Repaired. Have all parts. AM and Roofing Filters available. 25/hr, parts at cost. 954-961-2034 NC4L www.w8kvk.com/nc4l

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

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! Fast, inexpensive home study course. Command Productions. **www.LicenseTraining.com** Free info: (800) 932-4268

Glen Martin Hazer Tower Trams & Roof Top Towers. Same Day Shipping. www.antennapartsoutlet.com

HAM KITS for sale at www.HecKits.com L/C Meter, SWR Bridge, ESR Meter, 2-Tone Gen, FET DIP Meter.

Help with International Goodwill www.n4usa.org

ISOTRON ANTENNAS FOR 160 - 6 METERS! Efficient, rugged and resonant. Please visit **WWW.ISOTRONANTENNAS.COM**. wd0eja@isotronantennas.com 719/687-0650.

KB6NU'S "NO NONSENSE" LICENSE STUDY GUIDES have helped 1000's get their first license and upgrade to General or Extra. They can help you, too. KB6NU.COM/STUDY-GUIDES/

LEARN CODE by Hypnosis, www.success-is-easy.com 561-302-7731

LED DESK SIGN - www.Gifts4Hams.com

MicroLog-By-WA0H .. Easy to use logging program .. Free download .. **www.wa0h.com**

NW9ALLIANCE LLC - Adapters, coax, connectors, and Passive microwave components. **WWW.NW9ALLIANCE.NET**

PRINTED CIRCUIT BOARDS for projects shown in QST, QEX, HR, ARRL HB, 73 and more. Custom boards available. FAR Circuits, 18N640 Field Ct, Dundee, IL 60118; fax/phone 847-836-9148; www.farcircuits.net; mail@farcircuits.net

RF CONNECTORS & GADGETS - Parts - Products and More! www.W5SWL.com

RF SUPERSTORE
Connectors, Adapters, Antennas, Coaxial Cable and more!
High Quality, Low Cost, Ham Friendly - center
WWW.RFSUPERSTORE.COM

Rohn Tower, telescoping poles, tripods and antenna parts delivered to your door. **www.antennaparts outlet.com**

ROTARY FUNCTION SWITCH REPAIRS and rebuilding. Small and large, late model and vintage types. Free estimates. **Joe, KC3JDL 215-801-4362**

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 817ND, 857D, 897D, 891, 991A, ICOM 7300, 7200, 7000, 706/703 and 9700. W0MSN www.portablezero.com

Xcellent **Amateur** and **Monitor Logging** from **DX-treme!** Click **www.dxtreme.com**

Advertising Department Staff:

Janet Rocco, W1JLR, Advertising Sales Manager
Lisa Tardette, KB1MOI, Account Executive

QST Index of

Advanced Specialties – www.advancedspecialties.net 102
Air Boss Antenna Launcher– www.kr4loairboss.com 124
Alpha Delta Radio Communications, LLC – www.alphadeltaradio.com 108
Ameritron – www.ameritron.com 17
Arcom Communications – www.arcomcontrollers.com 102
Array Solutions – www.arraysolutions.com 12
ARRL – www.arrl.org 104, 106, 108, 112, 118, 120
bhi Ltd – www.bhi-ltd.com 98
BridgeCom Systems – www.BridgeComSystems.com ..... Cover III, 22, 23
Clear Signal Products, Inc. – www.coaxman.com 102
Communication Concepts, Inc. – www.communication-concepts.com 104
Cushcraft – www.cushcraftamateur.com 2
Debco Electronics, Inc. – www.Debcoelectronics.com 110
Diamond Antenna – www.diamondantenna.net 8
DX Engineering – www.DXEngineering.com 25
Elecraft – www.elecraft.com 19
Elk Antennas – www.ElkAntennas.com 126
Expert Linears America, LLC – www.ExpertLinears.com 104
EZ Hang – www.ezhang.com 102
FlexRadio Systems – www.flex-radio.com 21, 26, 27
Global TSCM Group, Inc. – www.kn2c.us 102
Ham Ads – www.arrl.org/ham-ad-listing 124
Ham Radio Outlet – www.hamradio.com 96, 97
Hammond Mfg. Co. – www.hammondmfg.com 110
Hy-Gain – www.hy-gain.com 10, 101
ICOM America – www.icomamerica.com 99

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

Intuitive Circuits, LLC – www.icircuits.com 126
Kenwood Communications – www.kenwood.com/usa/ ....Cover IV, 29, 116, 125
LDG Electronics – www.ldgelectronics.com 6
MFJ Enterprises – www.mfjenterprises.com 103, 105, 107, 109, 111, 113, 115, 117, 119, 121
Mosley Electronics – www.mosley-electronics.com 125
Motosports of Ukiah – www.hondashop.com 125
NCG Company – www.natcommgroup.com 3, 114
OCI-Olds Communications Inc. – www.ocicom.com 127
Pacific Antenna – www.qrpkits.com 126
Palomar Engineers – www.Palomar-Engineers.com 126
PreciseRF – http://preciserf.com 11
Quicksilver Radio Products – www.qsradio.com 122, 123
Radio Club of JHS 22 NYC – www.wb2jkj.org 110
RF Parts Company – www.rfparts.com 127
RT Systems – www.rtsystems.com 102
RW Antenna Store – www.rwantennastore.com 110
SteppIR Communications Systems – www.steppir.com 7
Tac-Comm – www.tac-comm.com 126
Ten-Ten International Net, Inc. – www.ten-ten.org 102
Tigertronics – www.tigertronics.com 102
Timewave Technology, Inc. – www.timewave.com 100
W5SWL Electronics – www.w5swl.com 125
Warren Gregoire & Associates – www.superbheadsets.com 126
West Mountain Radio – www.westmountainradio.com 18
Yaesu USA – www.yaesu.com ..... Cover II, 1

Leave a Lasting Impression

The ARRL Diamond Terrace at our Headquarters in Newington, Connecticut provides a place of permanent recognition for annual Diamond Club donors.

Individuals who contribute $250 or more to the ARRL Diamond Club can purchase an inscribed brick in the Diamond Terrace.

Clubs and other amateur radio organizations may also participate with a one-time gift to recognize their organization or a long-time club member.

Inscribe your call sign or honor someone special to you

Uniquely inscribed bricks

Forever be a part of ARRL history

*For more information on the Diamond Club and Diamond Terrace Commemorative Bricks call Maryann McDonald at **1-860-594-0228**.*

Good times await you with the Tri-Band AnyTone 578!

See the official QST review on page 38!

The DMR mobile you have been dreaming about is finally here! Up to 50W of Tri-Band power.

Visit the link or call the number below to learn more!

AnyTone AT-D578UVIIIPRO

- TRI-BAND
- 50W 2m, 5W 220, 40W 70cm
- Bluetooth
- GPS
- APRS

Free 578 Course ($97 Value) At BridgeCom University

BridgeCom SYSTEMS
816-532-8451
sales@bridgecomsystems.com

TO LEARN MORE VISIT:
www.bridgecomsystems.com/578

Escape with the TM-281A

On or off the road, Kenwood's TM-281A is a mobile radio you can always count on.

As tough as nails, this MIL-STD-compliant transceiver delivers powerful performance, excellent audio clarity, and a host of advanced features. It offers superb operating ease day or night thanks to the large backlit LCD and illuminated keys. So the next time you take off, take the TM-281A.

KENWOOD

Customer Support: (310) 639-4200
Fax: (310) 537-8235

www.kenwood.com/usa

ISO9001 Registered

ADS#01615

Scan with your phone to download TM-281A brochure.