Ham Network Collects Space Weather Data | 55

QST

DIGITAL EDITION

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DIGITAL FEATURE

44 | See our Video Review of the **BridgeCom Systems** SkyBridge Plus Dual-Band Digital Hotspot

The Best of the Best

A Superb All-around Wide-Coverage Transceiver

FT-991A 100W

HF/50/144/430MHz TRANSCEIVER

- Includes HF through UHF with one Radio
- Supports SSB/CW/AM/FM and C4FM digital
- IF Roofing Filters produce Excellent Shape Factor
- IF DSP enables Superb Interference Rejection
- Built in Real-Time Spectrum Scope Display
- 3.5-inch TFT Color Touch Panel Display
- 100 Watts (2 Meter & 70 Centimeter: 50 Watts) of Solid Performance

* External Speaker SP-10: Optional

The New Standard High Performance SDR Transceiver

FTDX10 100W

HF/50MHz TRANSCEIVER

* External Speaker SP-30: Optional

- Hybrid SDR Receiver (Narrow Band SDR & Direct Sampling SDR)
- 9MHz Down Conversion Receiver Configuration
- IF Roofing Filters produce Excellent Shape Factor
- IF DSP enables Superb Interference Rejection
- 5-inch TFT Color Touch Panel with 3DSS*1 Visual Display
- Superior Operating Performance by means of the MPVD*3

The World Leading HF Transceiver with Hybrid SDR

In Homage to the Founder of Yaesu – Sako Hasegawa JA1MP

FTDX101MP 200W

HF/50MHz TRANSCEIVER

The Ultimate

FTDX101D 100W

HF/50MHz TRANSCEIVER

- Dual Hybrid SDR Receivers (Narrow Band SDR & Direct Sampling SDR)
- 9MHz Down Conversion Receiver Configuration
- IF Roofing Filters produce Excellent Shape Factor
- VC-Tune (Variable Capacitor Tuning) Signal Peaking
- IF DSP enables Superb Interference Rejection
- 7-inch TFT Color Touch Panel with 3DSS*1 Visual Display
- Superior Operating Performance by means of ABI*2 & MPVD*3

* Microphone M-1: Optional

* Photo shows the FTDX101MP

*1 3DSS: 3-Dimensional Spectrum Stream *2 ABI: Active Band Indicator *3 MPVD: Multi-Purpose VFO Outer Dial

YAESU The radio

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Narrow Band SDR Transceiver

FTDX10

Unrivaled RF Performance
Narrow Band SDR Technology is the Revolution

Inheriting the performance of the FTDX101, which is validated to exceed HF transceivers in laboratories around the world.

The most advanced digital narrow band SDR technology is combined with the RF Front-End engineering, such as the low noise-figure RF amplifier and the very sharp shape factor roofing filter designs that Yaesu has incorporated over the years, resulting in unsurpassed HF receiver performance.

Equipped with the latest MPVD feature, and 3DSS visual display to deliver superior Operability and Visibility.

A New Legend in HF Transceivers debuts

HF/50MHz TRANSCEIVER

FTDX10 100W

- The image is shown with an optional third party external display that may be connected using a DVI-D digital cable.
- Shown with Optional External Speaker SP-30.

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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.

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, $599.95. 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.

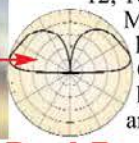
The 3-element A3S/A3WS and 4-element A4S are world-famous for powerhouse gain and super performance. **A-3WS, $569.95,** 12/17 M. **30/40 Meter** *add-on kits* available.

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*!

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



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

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.

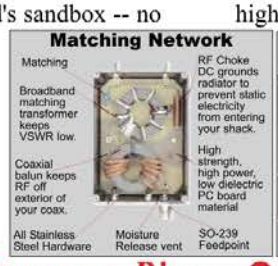
Rugged Construction: Thick fiberglass insulators, all-stainless steel hardware and 6063 aircraft-aluminum tubing is double or triple walled at key stress points to handle anything Mother Nature can dish out.

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

R8, $619.95. Like R9, less 75/80 M.

R-8TB, $109.95. Lets you tilt your antenna up/down easily by yourself to work.

R-8GK, $89.95. 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 compliment your FM base station with a dual-band Yagi? Not only will you eliminate a costly feed line, you'll realize extra gain for digital modes like high-speed packet and D-Star! Cushcraft's A270-6S provides three elements per band and the A270-10S provides five for solid point-to-point performance. They're both pre-tuned and assembly is a snap using the fully illustrated manual.

Cushcraft Famous *Ringo* Compact FM Verticals

W1BX's famous *Ringo* antenna has been around for a long time and remains unbeaten for solid reliability. The Ringo is broad-banded, lighting protected, extremely rugged, economical, 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!

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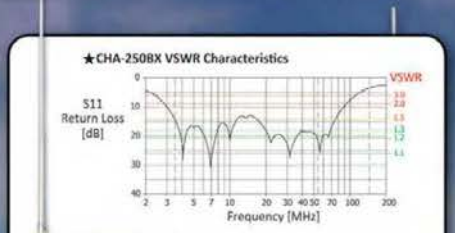


CHA-250B - *No Antenna Tuner Needed!*

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

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

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

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

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

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

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

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

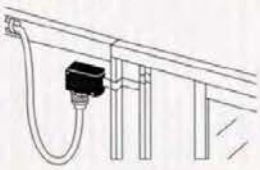
Wavelength: 146MHz 5/8 wave x 2 • 220MHz 5/8 wave x 3• 446MHz 5/8 wave x 5 • Max Pwr: 120W • Length: 10'2" • Weight: 3lbs. 1oz.• Conn: Gold-plated SO-239 • Construction: Fiberglass, 2 Sections

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

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

❼ COMET CTC-50M WINDOW GAP JUMPER

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



CAA-500MarkII

1.8-500MHz Antenna analyzer

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

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

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

CAA-5SC

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

Shoulder strap included.

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QST

Contents

August 2021 ♦ Volume 105 ♦ Number 8

Includes video
Includes audio
Additional content

Columns

Departments

Our Cover
Hiroki Kato's, AH6CY, coffee-can vertical antenna isn't the only example of ham ingenuity you'll find in this issue, though it might be the most inventive! In this month's technical section, Michael Foerster, WØIH, shows you how to use *WSJT-X* to check your frequency calibration, and James Forkin, WA3TFS, revisits his May 2020 *QST* receiver project to add an AGC circuit. [Hiroki Kato, AH6CY, photo]

Digital and Mobile Editions

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

Write for *QST*

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

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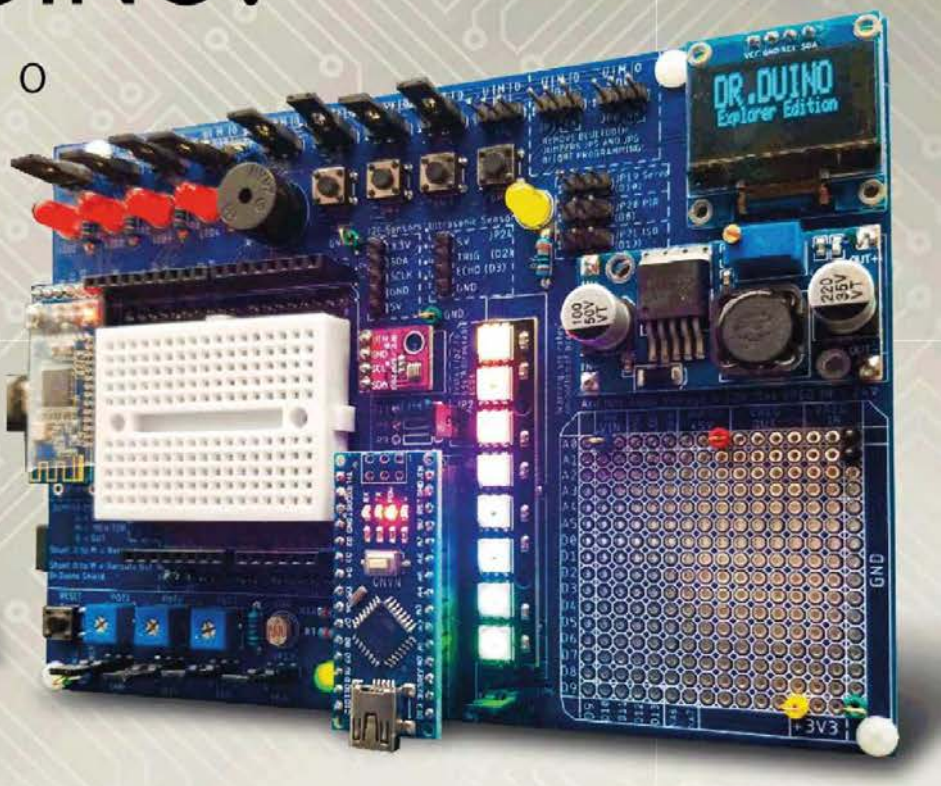

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As seen in QST Magazine January 2021

Page 48 Product Review Section

«The Dr.Duino Explorer Edition is a well-designed development, prototyping and troubleshooting platform»

Revied by Glen Popiel, KW5GP

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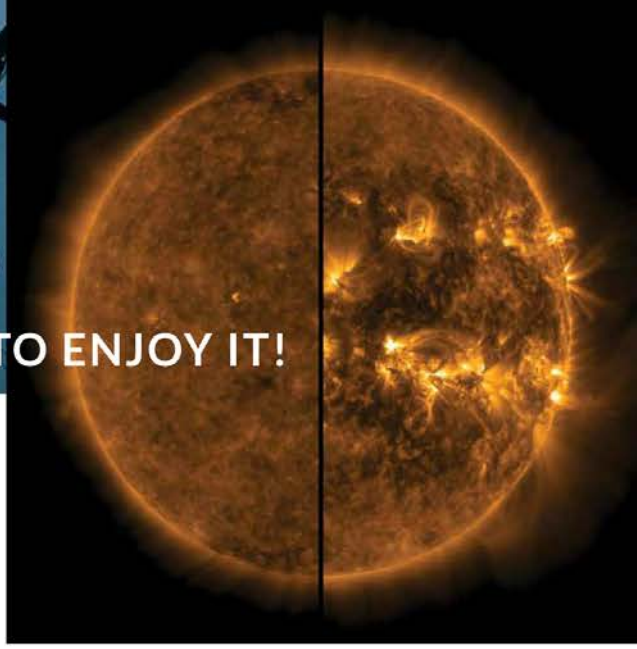
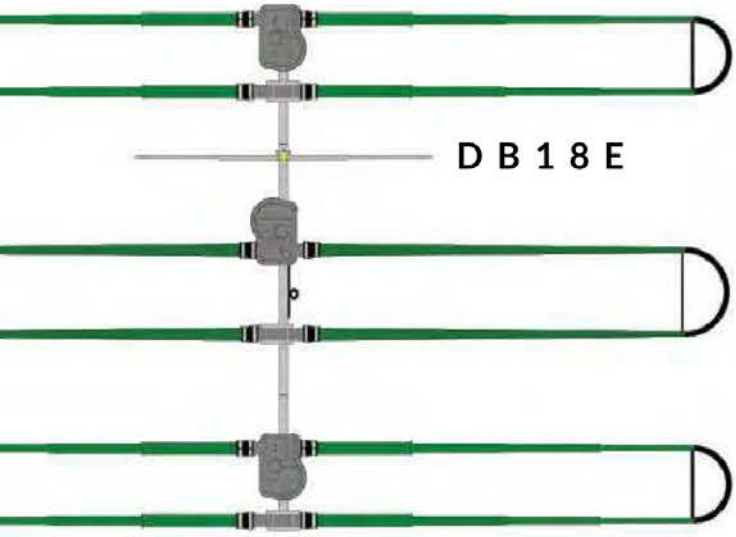
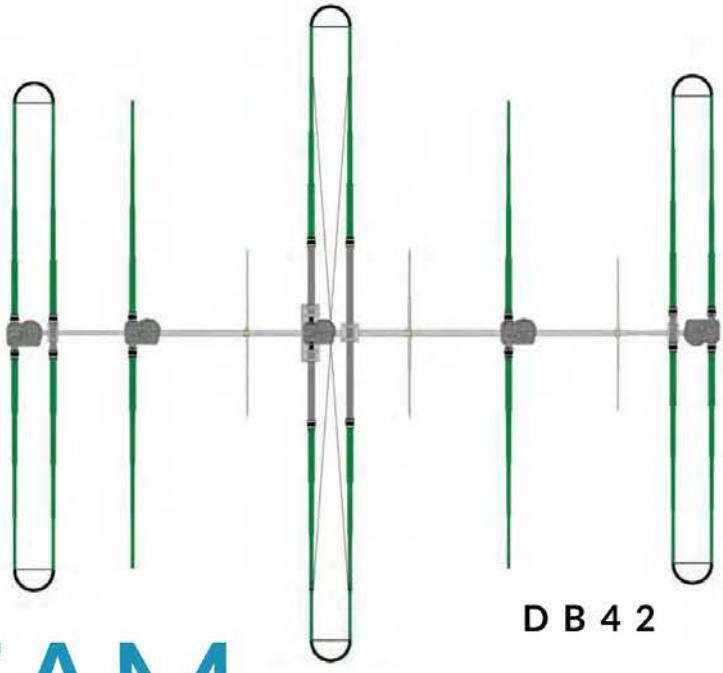
SOLAR CYCLE 25

IS HERE... AND WE HAVE THE GOODS TO ENJOY IT!



Sunspot Cycle 25 could have a magnitude that rivals the top few since records began. There is a 95% chance that Cycle 25 amplitude will fall between 153 and 305 spots, and with 68% confidence that the amplitude will be 233 spots. More sunspots during a cycle's solar maximum means better skip propagation, improved DXing, more log books filled with never-thought-possible QSOs, and happier Hams.





DREAM BEAM

The DB Series (DreamBeam) Yagi antennas are ideal for those looking for broadband, high-performance gain and exceptional front-to-rear. Each DreamBeam, with the exception of the ultra-stealth DB-11 (13.8-54 MHz), is an optimized Yagi antenna 6.8-54 MHz. The DB36 and DB42 Yagis have 3.5 -6.8 MHz dipole options available, which utilize the end elements as top-hats for excellent band coverage. All of the DB Series antennas employ our patented loop technology, resulting in a physical footprint that is 40% shorter than a full-size Yagi – with only 0.3 dB reduction in performance gain!

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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

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

Second Century

Out of the Darkness, Into the Light

In early June, I delivered the keynote address to the SEA-PAC Convention via Zoom. I hope this is the last time I have to do this virtually. The coast of Oregon is one of the most beautiful areas in the country, and the people are just wonderful. It wasn't possible to come together this year, and the team at SEA-PAC did a great job organizing the event and giving it purpose, right down to the event's theme: coming out of the darkness and into the light.

It has become cliché to revert attention to the past 18 months and reference the impact the pandemic has had on our lives. As we do come out of the shadows of the lockdowns and fears of getting sick, we cannot diminish the emotional toll many families have paid and the losses that our hobby has endured. Yet it is hard not to get excited about the fact that the country is opening up again. Many states have achieved significant vaccination rates, and the impact of COVID-19 is on a serious decline. People are able to return to a normalcy of life that we have missed for so long.

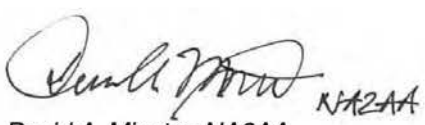
What does this mean for us? Everything! When you read this, ARRL Field Day will have passed, with many clubs around the country having enjoyed the ability to come together for the event, as they always have. Also, we will likely have announced the official re-opening of ARRL Headquarters and W1AW for visitors! We are so excited at the prospect of our member-volunteers returning to HQ to assist with tours, projects in the ARRL Lab, continued curating of our historical assets, and even operations at W1AW. Members will once again be able to plan their trips to Newington to visit this special place. And speaking of W1AW, visitors to the station can hardly contain their excitement as a pileup evolves while using our iconic and world-renowned call sign.

ARRL will also be taking to the road to meet with members, beginning this month! We'll kick off our return into the light with the Southeastern Division Convention at the Huntsville Hamfest. It is very exciting to think about how large this event is going to be in 2021 as a leading large-scale in-person event. In September, I'll be delivering the keynote address to the W9DXCC Convention, followed by attending the Great Lakes Division Convention at the Vette City Hamfest and the Pacific Division Convention at Pacificon, both in October. You'll see other ARRL staff members at in-person events, such as the New England Division Convention at the Northeast HamXposition in September. Please visit **www.arrl.org/hamfests** to see what events are scheduled in your area.

I want to end this month's column with a sincere thank you to our Section Managers. These elected member-volunteers have a huge job. They have to staff and manage a team, they have to nurture clubs, and they must serve as the enthusiastic leaders and cheerleaders of amateur radio to their members. And to that end, we have reorganized the HQ team that supports them in their mission. I called for a series of Zoom meetings with all the Section Managers, and they showed up. I asked for volunteers to take on a big project in their Section, and the rush to volunteer was inspiring.

We are focused on creating world-class collaboration among the Section Managers, and to extend that environment and culture to club leaders, to ensure the expansion, vitality, and fun of amateur radio. Reach out to your Section Manager with a quick note of thanks and support. They'll appreciate hearing from you.

I am looking forward to meeting many of you as we come back into the light! As always, get on the air! Be radio active. And be that connector, especially with your Section Manager and local clubs.



David A. Minster, NA2AA
Chief Executive Officer

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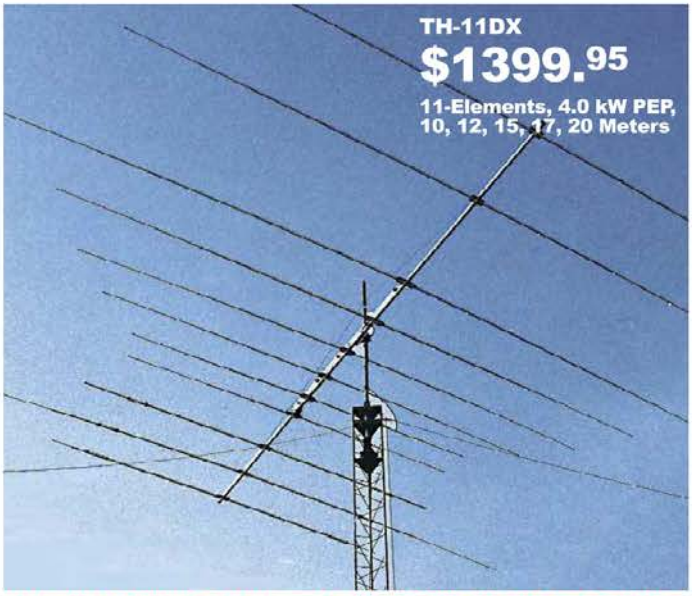

TH-11DX, $1399.95. 11-element, 4.0 kW PEP, 10, 12, 15, 17, 20M

The choice of top DXers.

With 11-elements, excellent gain and 5-bands, the super rugged TH-11DX is the "Big Daddy" of all HF beams!

Handles 2000 Watts continuous, 4000 Watts PEP.

Every part is selected for durability and ruggedness for years of trouble-free service.

Features a low loss logperiodic driven array on all bands with mono-band reflectors, BN-4000 high power balun, corrosion resistant wire boom support, hot dipped galvanized and stainless steel parts.

Stainless steel hardware and clamps are used on all electrical connections.

TH-7DX, $1199.95. 7-element, 1.5 kW PEP, 10, 15, 20 Meters

7-Elements gives you the highest average gain of any hy-gain tri-bander!

Dual driven for broadband operation without compromising gain. SWR less than 2:1 on all bands.

Uniquely combining monoband and trapped parasitic elements give you an excellent F/B ratio.

Includes hy-gain's diecast aluminum, rugged boom-to-mast clamp, heavy gauge element-to-boom brackets, BN-86 balun. For high power, upgrade to BN-4000.

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For limited space...Installs anywhere...14.75 ft turning radius... weighs 21 lbs...Rotate with CD-45II, HAM-IV

Fits on light tower, suitable guyed TV pole, roof tri-pod

TH-3JRS, $439.95. hy-gain's most popular 3-element 10, 15, 20 Meter tribander fits on most lots! Same top performance as the full power TH3MK4 in a compact 600 watt PEP design.

Excellent gain and F/B ratio let you compete with the "big guns".

Tooled manufacturing gives you hy-gain durability with 80 MPH wind survival.

TH-5MK2, $899.95. 5-element, 1.5 kW PEP, 10,15, 20 Meters

The broadband five element TH5-MK2 gives you outstanding gain.

Separate air dielectric Hy-Q™ traps let you adjust for maximum F/B ratio on each band.

Also standard is hy-gain's exclusive BetaMATCH™, stainless steel hardware and compression clamps and BN-86 balun.

TH-3MK4, $569.95. 3-element, 1.5 kW PEP, 10,15, 20 Meters

The super popular TH-3MK4 gives you the most gain for your money in a full-power, full-size durable hy-gain tri-bander!

You get an impressive average gain and a whopping average front-to-back ratio. Handles a full 1500 Watts PEP. 95 MPH wind survival.

Fits on average size lot with room to spare -- turning radius is just 15.3 feet.

Four piece boom is ideal for DXpeditions. Rotates with CD-45II or HAM-IV rotator.

Features hy-gain BetaMatch™ for DC ground, full power Hy-Q traps, rugged boom-to-mast bracket and mounts on standard 2"O.D. mast. Stainless steel hardware. BN-86 balun recommended.

TH-2MK3, $449.95. 2-element, 1.5 kW PEP, 10,15, 20 Meters

The 2-element TH-2MK3 is hy-gain's most economical full power (1.5kW PEP) full size tri-bander.

For just $339.95 you can greatly increase your effective radiated power and hear far better!

Ruggedly constructed, top-performing, compact 6 foot boom, tight 14.3 foot turning radius. Installs almost anywhere. Rotate with CD-45II or HAMIV. BN-86 balun recommened.

EXP-14, $719.95. 4-element, 1.5 kW PEP, 10,15, 20 Meters

Revolutionary 4-element compact tri-bander lets you add 40 or 30 Meters! Has 14 foot boom and tight 17.25 feet turning radius. Fits on roof tri-pod, mast or medium duty tower.

hy-gain's patented broadbanding Para Sleeve gives you less than 2:1 VSWR. 1.5kW PEP.

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Truly competitive against giant tri-banders at half the cost!

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Tooled Manufacturing... Highest Quality Materials

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2. **Tooled** Boom-to-Element Clamp
3. **Thick-wall** swaged aluminum tubing

Tooled manufacturing is the difference between hy-gain antennas and the others -- they just don't have it (it's expensive!).

Die-cast aluminum boom-to-mast bracket and element-to-boom compression clamps are made with specially tooled machinery.

hy-gain antennas feature tooled swaged tubing that is easily and securely clamped in place. All tubing is deburred and cleaned for smooth and easy assembly.

Durable precision injection molded parts.

hy-gain antennas are stronger, lighter, have less wind surface area, better wind survival, need no adjustments, look professional and last years longer.

Model No.	No. of elements	avg gain dBd	avg F/B dB	MaxPwr watts PEP	Bands Covered	Wind sq. ft. area	Wind (mph) Survival	Boom feet	Longest Elem. (ft)	Turning radius (ft)	Weight (lbs.)	Mast dia O. D. (in.)	Recom. Rotator	Sugg. Retail
TH-11DX	11	For Gain and F/B ratio–See... • www.hy-gain.com • hy-gain catalog • Call toll-free 800-973-6572		4000	10, 12, 15, 17, 20	12.5	100	24	37	22	88	1.9-2.5	T2X	$1399.95
TH-7DX	**7**			**1500**	**10, 15, 20**	**9.4**	**100**	**24**	**31**	**20**	**75**	**1.5-2.5**	**HAM-IV**	**$1199.95**
TH-5MK2	5			1500	10, 15, 20	7.4	100	19	31.5	18.42	57	1.5-2.5	HAM-IV	$899.95
TH-3MK4	**3**			**1500**	**10, 15, 20**	**4.6**	**95**	**14**	**27.42**	**15.33**	**35**	**1.9-2.5**	**CD-45II**	**$569.95**
TH-3JRS	3			600	10, 15, 20	3.35	80	12	27.25	14.75	21	1.25-2.0	CD-45II	$439.95
TH-2MK3	**2**			**1500**	**10, 15, 20**	**3.25**	**80**	**6**	**27.3**	**14.25**	**20**	**1.9-2.5**	**CD-45II**	**$449.95**
EXP-14	4			1500	10, 15, 20 opt.30/40	7.5	100	14	31.5	17.25	45	1.9-2.5	HAM-IV	$719.95

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Shown at left is the high Q vacuum capacitor with a 45,000-step resolution stepper motor. This delivers an unprecedented 511 Hz tuning resolution and allows the operator to set his/her band preferences. This is very helpful when making QSOs under non-ideal and crowded band conditions.

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It is completely redesigned. It controls both the HG3 PRO and HG3 QRO MLA models and the AR1 Rotator. It remotely tunes 7-30 MHz with stepper motor precision and resolution. *RapidTune*™ automatically scans each band for the lowest SWR and works with most HF radios.

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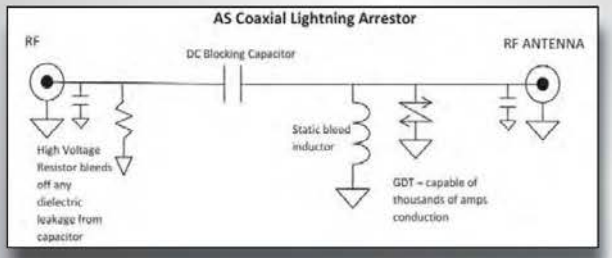
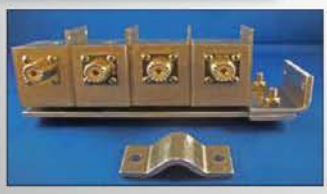
AS-303U

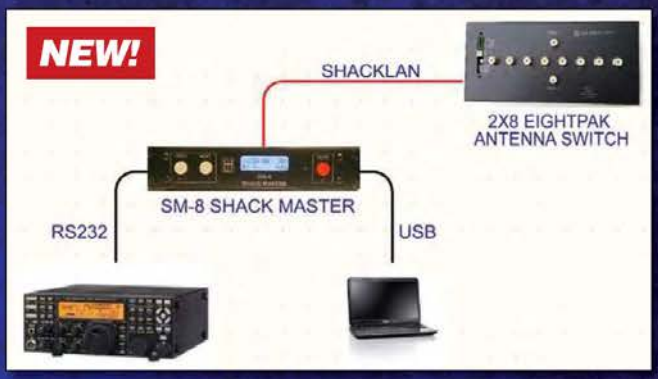




Hamation Station Automation

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

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



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

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

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

Three models to choose from:

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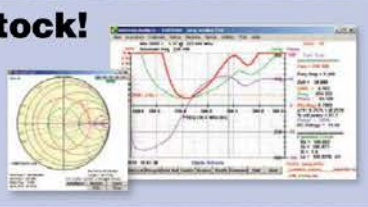

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Steve Ford, WB8IMY, wb8imy@arrl.net

Member Spotlight

Cedrick Johnson, WT2P

Although Cedrick Johnson, WT2P, was first licensed in 1994, he was drawn to the magic of radio well before then. "I remember being fascinated when I first saw the remnants of my grandfather's old station in Mississippi," he explained. "I never got to see the equipment powered up because he passed away before I was born, but my relatives would tell stories of him spending hours 'talking to people from all over.'"

Living in Illinois, Cedrick found himself spending considerable time at his local RadioShack store in the spring of 1994. He even purchased a handheld citizens band (CB) transceiver, but it soon become obvious that there was more to radio than CB. "One day, I was browsing the book section at the store," he said, "and I came across an ARRL Technician-class study guide titled *Now You're Talking! All You Need to Get Your Ham Radio Technician License*. I skimmed the pages and then asked the manager, Luis, 'So what is this ham radio?'"

Luis was happy to explain, showing him several VHF/UHF handheld transceivers and a 10-meter radio. According to Luis, there was a new world waiting for Cedrick if only he studied and obtained his FCC license. Before Cedrick left to spend the summer with family in Missouri, Luis presented him with a gift: a copy of *Now You're Talking!*

A few months later, Cedrick's uncle drove him to Raytown, Missouri, for a Volunteer Examiner test session. Cedrick said, "I was extremely anxious. The Raytown club was very friendly, but in the end, they had to give me some bad news: I had missed passing the Technician exam by two questions! They gave me some pointers on what I should study, and I left. It was a long, quiet ride back."

Cedrick sheepishly returned to the RadioShack store and Luis. "I told him the result and he had a look of sadness in his eyes. But he suddenly remembered that every second Tuesday or so he always saw a bunch of amateur radio call sign license plates in the parking lot, and he guessed that the cars belonged to members of a club that met at the bank a few doors down," he explained. "So, that Tuesday I rode my bicycle to the bank and, lo and behold, there was the parking lot full of cars with ham radio plates. I was nervous at first, walking slowly down the stairs to the basement where the meeting was being held. It must've been a shock to see a 12-year-old kid enter the room, but the folks at what turned out to be the Fox River Radio League were extremely welcoming."

At that club meeting, Cedrick met his mentor, Bill Hiltenbrand, N9JLP. After speaking with Cedrick for a while, Bill encouraged him to attend the test session the following Tuesday. "This time, the result was different," he said. "I passed!"

Before heading off to Northern Illinois University in 1999, Cedrick earned his Amateur Extra-class license. His post-college days found him living in Chicago, and then later New York City. Cedrick eventually returned to Illinois in 2014 and got back on the air in a major way.

Bitten by the DX and Contest Bug

"I absolutely love contesting," Cedrick declared. "I have my contest mentor, the late Bill Erickson, WA9TPQ, to thank for giving me the opportunity to use his station for the North American SSB QSO Party back then. That experience really set the hook."

Cedrick's radiosport activities also include DX hunting. "Living on a suburban lot with only wire antennas makes the pursuit a challenge at times, but the thrill of working a new DX Century Club entity never gets old!"

Variety is Key

Cedrick works as a software test engineer. "That's a fancy way of saying I break things," he said.

Overall, Cedrick believes that amateur radio is doing well. He points out that new digital modes, such as FT8, are making it possible for hams in restricted situations to get on the air and make contacts. "These are people who might not otherwise be able to enjoy the hobby."

His wish list includes more signals above 50 MHz. "I do wish there was more VHF activity, especially on CW/SSB. There is a lot of untapped potential there," he said. "But regardless of the frequency, I'd encourage more hams — especially younger hams — to get on the air and try as many activities as possible. The future of ham radio rests on its ability to be different things for different people. Variety is the key to growth."

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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**.

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Up Front

Practice and Pancakes

Dan Kostyk, KC1JTH, practices Morse code everywhere he can. Dan, a new ham, is taking a Morse code class from Rusty Moore, K1FVK, at New England Sci-Tech (**www.nescitech.org**). The nonprofit organization is run by Bob Phinney, K5TEC, who is a VE with over 1,000 exam sessions under his belt. Rusty says, "Use every opportunity to practice," and Dan took this adage to heart while enjoying a Morse-inspired breakfast.

Power to "73" and "88"

Winston Corbett, W4IXC, was getting ready to watch a football game and noticed the numbers on the labels of the available sports drinks. He chose the "73" to represent "best regards," as well as the added significance of representing his birthday, July 3. He also grabbed an "88," noting it was definitely a "game on" moment. (The 88 also signifies his August 8 anniversary with his wife.) For a little extra luck, he put the bottles in front of his radios and his autographed Frank Beamer and Marcus Vick Virginia Tech mini helmets.

Morse Coffee

Bill Maurer, WB6JJJ, found a new coffee shop during a walk in downtown Lake Oswego, Oregon. He was pleasantly surprised to find it even had the correct code under the letters.

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Correspondence

Letters from Our Members

Meeting an Old Friend

As a new Novice in 1970, my station on 15 meters consisted of a Knight T-50 transmitter, an Elmac PMR-6 receiver, and a modified citizens band (CB) ground-plane antenna. It certainly wasn't a powerhouse DX operation. My very first DX contact was Dan Flanagan, GM5ASI, in Scotland. When I received his QSL card, I discovered that he was a serviceman whose home station was just a few miles from my house. I still have that QSL card.

Imagine my surprise to see a photo and letter from Dan (now W3DF) in the February 2021 "Celebrating Our Legacy" column! Fifty-one years later and I'm just as excited as I was on October 26, 1970. It was like meeting an old friend.

Wes Clavey, W5WMC
Houston, Texas

Inspiration from an Aged Radio

In my early twenties, I attempted to learn Morse code, with a desire to earn my Novice-class license. An ex-girlfriend's dad was a ham and he encouraged me to read ARRL's *Now You're Talking! All You Need To Get Your First Amateur Radio License*. His call sign was KA1LBD (SK). While I was able to grasp all the radio-related concepts, I struggled with Morse code, and eventually gave up.

I recently found an old Realistic Pro-43 Hyperscan in my closet that I hadn't listened to in years, which made me think it was time to revisit ham radio. I passed my Technician-class license exam and brought the KA1LBD call sign back to the airwaves.

In March of this year, I earned my General-class license so I could participate in Parks on the Air. What an incredibly challenging and satisfying journey. I purchased the requisite equipment (radio, antenna, battery, etc.) and I plan to activate Niagara Falls, Mount Washington, and other parks in my area.

I'm grateful to KA1LBD for his encouragement nearly 20 years ago. Neither of us could have known then how much time would pass before I got licensed, but better late than never.

John Judge, KA1LBD
Malden, Massachusetts

Field Day RF Safety

I would like to suggest adding "RF safety" to next year's ARRL Field Day Safety checklist because of the attention this risk requires, and the modified FCC rules.

Many Field Day stations and antennas may have been previously analyzed with clearance results concluded, but others might need more attention. During this event, the general public (and perhaps some new hams) visit portable station areas with little to no awareness of RF safety and the steps we take to keep stations safe.

Perhaps a Field Day team could organize a handout or presentation explaining RF safety and the FCC's regulations. It could also work as a review or training tool for new hams.

Harry Jones, K9DXA
St. Charles, Illinois
Life Member

The Artists Among Us

I think the vast majority of hams have a background in electronics in some form, but I'm part of the group that doesn't. I love ham radio, but I don't have a background in electronics or any related field — I'm an artist. There must be artists, poets, sculptors, athletes, writers, dancers, performers, and so on throughout the hobby and ARRL membership. It would be great to find the hidden talents among us!

Phil Levine, K2JF
New York, New York

Calling Rhode Island on FT8

In the 2 or so years that I've operated using FT8, I've only ever heard one person calling "CQ TX." On the other hand, it's not rare to hear someone calling "CQ RI." I currently live in Texas, but I grew up in Rhode Island. In 1964, I took my Novice-class license code test and exam at the Blackstone Valley Amateur Radio Club.

Sometimes I still call my friends from the '60s to assist with calls. Typically, if I see someone calling for Rhode Island, I take a picture of the screen so the time stamp, call sign, and band are in the photo, and send it to my longtime friend and Rhode Island Section Manager, Bob Beaudet, W1YRC. After a few minutes, he'll call the station. We've been doing this for a while. I don't know how many people we've helped, but I know it's working.

If you're calling "CQ RI" on FT8, you may get some help making the contact. Keep on calling!

Bernie Krasowski, KD5QHV
El Paso, Texas

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

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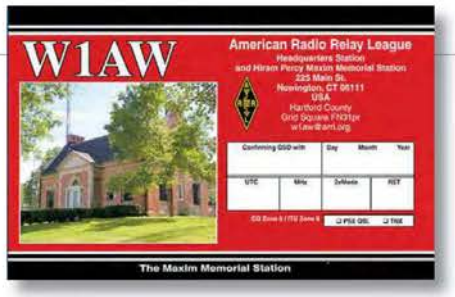
W1AW's QSL File

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 cards.



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Using *WSJT-X* to Graph Radio Frequency Stability

Discover the frequency drift characteristics of your radio with these easy measurements.

Michael Foerster, WØIH

The new digital modes, such as FT4 and FT8, can create a challenge to ensure that our radios are transmitting and receiving on the correct frequency. This is even more critical if you are using a transverter on your HF radio for the VHF bands to use MSK144 modes, where the frequency errors are multiplied. Calibrating the frequency of your radio needs to be done of course, but it's important to understand when to calibrate the radio. Temperature changes of the radio as it warms up and the frequency change characteristics could require calibration of your radio.

Many of the modern radios have a temperature compensated crystal oscillator (TCXO) that may minimize the frequency drift, but often, it may not completely eliminate it.

If you use the *WSJT-X* mode, you can check the calibration of your receiver and check the drift of the radio as it warms up. For this test, the actual frequency calibration is not important, because we will be looking at the frequency change over time. It is, however, easy to also verify the frequency calibration using the frequency difference readout of the Frequency Calibration mode. It is more accurate to use the highest possible frequency, such as WWV at 15 or 20 MHz.

This procedure isn't to calibrate your radio, but to find out when the frequency drift stabilizes.

WSJT-X Frequency Calibration Mode

When the *WSJT-X* application is correctly set up with your radio, you will find the *WSJT-X* "FreqCal" function at the bottom of the **MODE** menu. As indicated in the documentation, this can be used to run a calibration cycle to help correct some of the calibration errors of the radio.

Becoming familiar with the "Frequency Calibration" section in Chapter 13 of the *WSJT-X* documentation is very helpful. This will explain how the frequency calibration works within *WSJT-X* for your radio. However, keep in mind that the calibration procedure should be run after you have an understanding of the radio's temperature drift over time. If you run it before, you may want to zero out the slope and intercept values at the top of the Settings menu on the **FREQUENCY** tab.

Running the Stability Test

I suggest that you start your test by choosing a frequency standard (WWV, CHU, etc.) that has a reasonably strong signal in your area and for the time of day that you are testing. It's not important which you choose, as all of these radio signals have a very stable frequency output, but you might want to select one that is at a higher frequency.

Start up your radio from a cold start and open *WSJT-X*. Select **FREQCAL** from the **MODE** menu, and then select the station frequency from the dropdown list in the lower left side of the application window. The **MONITOR** button should be green, indicating that the application is collecting data from the radio. Make sure there are no, or few, asterisks (*) behind the data in the data output window. The asterisk indicates invalid data. If your radio frequency is off by quite a bit, you may need to change the "F Tol" setting from 10 to 20 or possibly even 30 to allow the **FREQCAL** function to recognize the frequency carrier.

Let the radio run for 1 – 2 hours to collect the data from *WSJT-X* as it records the frequency difference.

Preparing the Data

Once you have the data collected, press the **MONITOR** button to stop the data collection. Right-click inside the data window, and click **SELECT ALL** to highlight the visible data in the window. Right-click again in the data window, and select **COPY**. This copies all the data in the window to the buffer of your computer.

The raw data from the window must be modified slightly, so we can use it in a spreadsheet to allow generating a line graph that represents the radio's receive frequency over time. Change the data into a .csv format, which uses comma-separated values for each column that a spreadsheet can work with.

1 Open a text editor (Windows *Notepad* or a similar application), and paste the raw data into the editor.

2 Open the **EDIT** menu in your text editor, and find the **REPLACE** function. In the **FIND** box, enter a single-space character. In the **REPLACE** box, enter a single-comma character. Now, press the **REPLACE ALL** button. This should, with a single click, replace every instance of the space character with a comma.

3 Now replace all instances of multiple commas with a single comma. Using the same procedure in step 2, remove the space character from the **FIND** box, and enter two commas. In the **REPLACE** box, enter a single comma. Press the **REPLACE ALL** button several times, until the function no longer updates any of the lines.

4 You may want to scan through the file to look for any lines that end with an asterisk (*), which are lines of invalid data. Delete these lines completely.

5 Now save the data with a file name and location that you can readily find, but save the file using the .csv extension.

Generating the Graph

With the data in your .csv file, you can now generate a graph using a spreadsheet application (*Microsoft Excel*, *LibreOffice Calc*) or an online spreadsheet (Google Sheets, Apple Numbers).

Begin by opening the .csv file that you saved using the spreadsheet application. It should look something like Figure 1. Note that I have manually added the column names at the top. That helps recognize the columns by data type for the UTC and Difference in Frequency (DF) columns.

The columns are the UTC time, Frequency monitored, Calibration, and Frequency Offset used by the program. fMeas is the actual frequency measured, DF is the difference, Level is the signal level, and S/N is the measured signal-to-noise ratio. We use only the UTC and DF columns for our graph.

To create the graph, you hold the **CTRL** key down and select the "A" at the top to highlight Column A with the UTC time, and then select Column F the same way. Your spreadsheet application should have an Insert menu that you can use to select **LINE** to create a line chart.

	A	B	C	D	E	F	G	H
1	UTC	Freq	CAL	Offset	fMeas	DF	Level	S/N
2	13:20:23	7850	1	1500	1509.109	9.109	18.1	47.9
3	13:20:25	7850	1	1500	1509.064	9.064	15.8	47.5
4	13:20:27	7850	1	1500	1509.158	9.158	11.4	56.8
5	13:20:29	7850	1	1500	1509.193	9.193	13.3	52.8
6	13:20:34	7850	1	1500	1508.898	8.898	37.8	26.5
7	13:20:36	7850	1	1500	1508.422	8.422	25.6	42.2
8	13:20:39	7850	1	1500	1508.292	8.292	32	33.2

Figure 1 — A spreadsheet portion shows measured data.

Figure 2 shows the chart generated from my Elecraft K3S test using WWV 15 MHz with the stock ±5 ppm reference oscillator crystal. The radio's frequency crosses the 0 line at about 22:32:46. It appears to take over an hour for the frequency to stabilize.

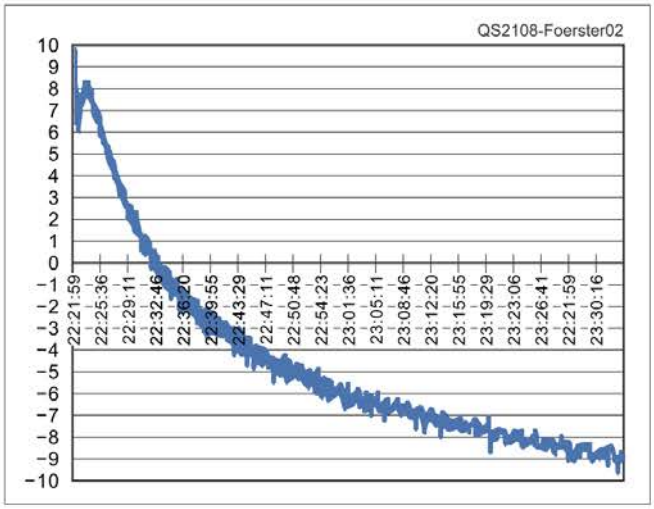


Figure 2 — Elecraft K3S frequency drift from a cold start using a ±5 ppm reference oscillator crystal.

Figure 3 was generated with the same K3S testing WWV 15 MHz, but using the ±1 ppm TXCO reference oscillator. The frequency begins to stabilize to ±1 Hz after about 25 minutes.

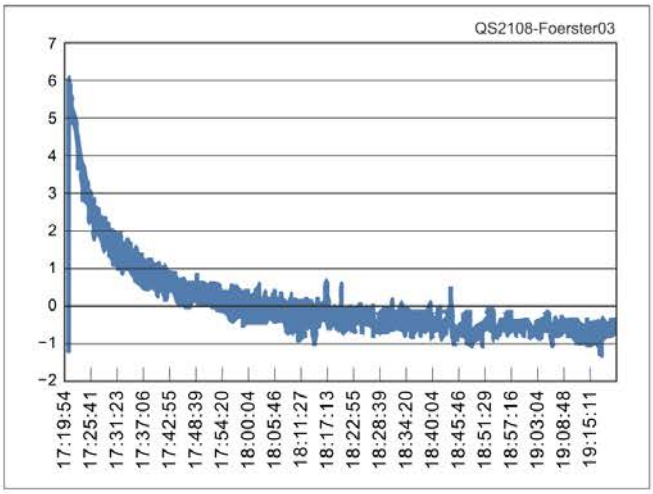


Figure 3 — Elecraft K3S frequency drift from a cold start using a ±1 ppm reference oscillator crystal.

Figure 4 shows the result of an Elecraft KX3 that had the Extended VFO Temperature Compensation Procedure completed. This was also run using WWV 15 MHz. Although the frequency change appears somewhat erratic, it is only a very small amount, slightly more than ±1 Hz.

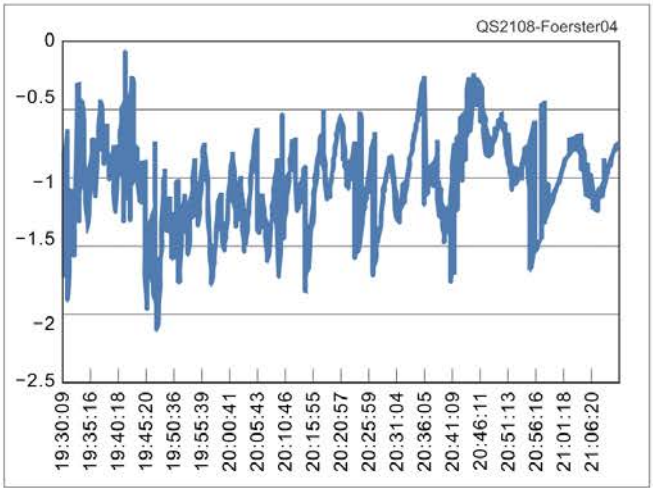


Figure 4 — Elecraft KX3 frequency drift after 45 minutes using a ±1 ppm reference oscillator crystal.

Figure 5 shows a plot from an Icom IC-7300 from cold start, running about 3.3 hours on 15 MHz. Although this radio appears to be off frequency by 3 Hz, there is less than a 0.5 Hz drift.

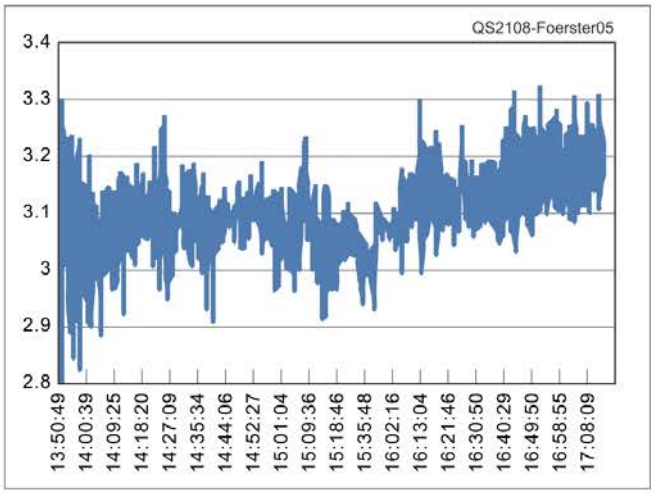


Figure 5 — Icom IC-7300 from cold start, running about 3.3 hours on 15 MHz.

Calibration

You can use the Frequency Calibration function to calibrate your radio, once you have determined at which point in the warm-up cycle the calibration would average out the best. With the FreqCal function running, refer to the documentation for your radio, and adjust the calibration so that the DF reading is about 0, or where you would like to try it. When you adjust the calibration of your radio, make the adjustments in small increments, and watch the values that are generated every few seconds by the changes to the radio calibration.

Once you complete this calibration, I suggest you recheck the calibration using the calibration procedure recommended by your radio manufacturer.

If you choose, you can re-run the *WSJT-X* FreqCal function from cold startup again with your new calibration value in the radio to verify the changes are as you expected. You might also want to run a long-term test, generating a graph using a different frequency source: WWV 5 MHz, 10 MHz, 15 MHz, CHU 7.85 MHz, etc., to get an average for each frequency using your radio. Depending on the radio's design, it may vary between bands; this may be true for some of the older radio designs.

ARRL member Michael Foerster, W0IH, holds an Amateur Extra-class license and has been licensed since 1968. He has worked as an electronics technician, and then moved into software testing. Michael retired in 2015 and enjoys experimenting with ham radio. You can contact Michael at **w0ih@arrl.net**.

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

A Simple, Adaptable AGC Circuit for the Simple High-Frequency Communications Receiver

This circuit is also useful with other home-built receivers.

James Forkin, WA3TFS

My simple high-frequency communications receiver (see the lead photo), which was featured in the May 2020 issue of *QST*, has manual gain controls that must be adjusted when the signal levels are of varying signal strength. An automatic gain control (AGC) circuit would keep the audio output at a more consistent level on weak signals and attenuate the audio when the incoming signal is at a much higher level, thereby eliminating the need to readjust gain manually. This simple AGC circuit meets that need.

The circuit retains the manual gain control function, and also provides an output to drive an S-meter. Two different AGC outputs are provided. One increases level when a loud signal is received, and a second one decreases level on a loud signal. The second output is used with my simple high-frequency communications receiver.

The Circuit

The design (see Figure 1) uses a handful of readily available and inexpensive through-hole parts. A 1.35 × 2.45 inch PCB is available at **www.wa3tfs.com**. You could also wire it on perf board; my board layout is on the *QST* in Depth web page at **arrl.org/qst-in-depth**. Provide a good ground plane for best performance.

Three potentiometers allow full adjustment of AGC action. One is used to set the point at which AGC action is desired. A second provides adjustment to calibrate an optional S-meter, and a third sets the level of attenuation when a strong signal is present.

The input to the AGC circuit connects to the top of the existing receiver volume control, which is the output from the audio pre-amp. Potentiometer R8 sets the threshold point where AGC action begins. The signal is amplified by Q1 and rectified by D1 and D2. The rectified signal charges C6. The dc voltage level stored on C6 varies with the incoming audio level. It is then amplified by Q2 and, if desired, optionally drives the positive input of a 1 mA full-scale S-meter. The negative S-meter lead connects to ground. Potentiometer R9 adjusts the level to calibrate the meter.

The amplified signal also passes to Q3, which is connected to the receiver board at R8 of Figure 2. As signal level increases, Q3 begins to turn on. As input signal level increases, the AGC board draws more current. Less current flows through D2 of Figure 2 on the

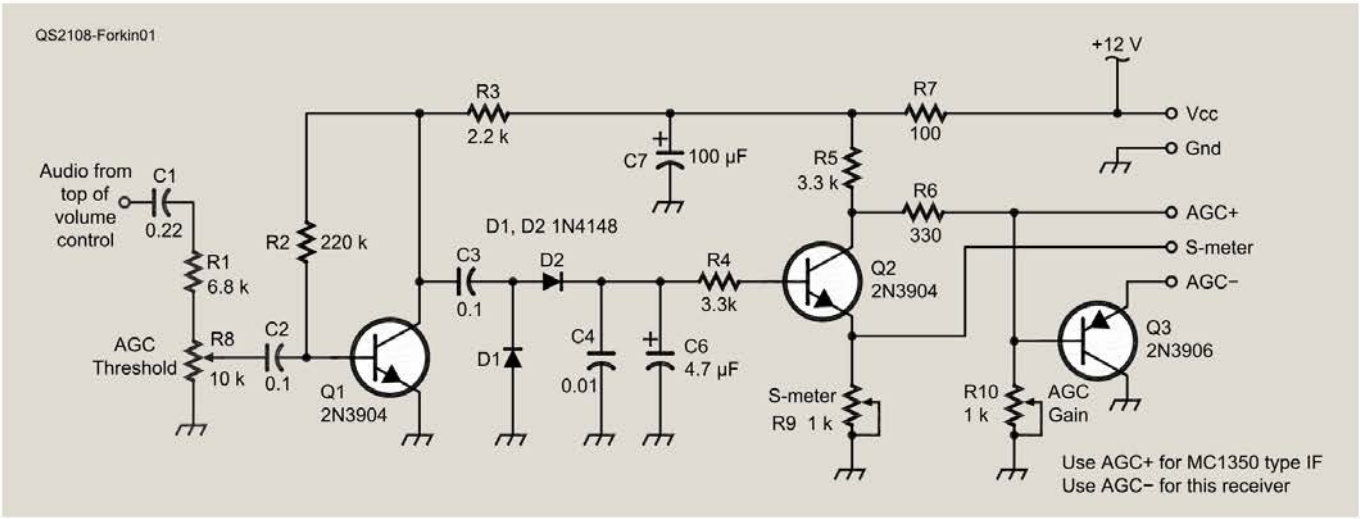


Figure 1 — Schematic diagram of the AGC circuit. Digi-Key part numbers are shown below:

C1 — 0.22 µF, ceramic capacitor, 50 V, 399-13990-2-ND
C2, C3 — 0.1 µF, ceramic capacitor, 50 V, 20%, 478-12590-ND
C4 — 0.01 µF, ceramic capacitor, 50 V, 10%, 399-9865-1-ND
C6 — 4.7 µF, electrolytic capacitor, 50 V, 20%, 493-11017-1-ND
C7 — 100 µF, electrolytic capacitor, 35V, 35YXJ100M6.3X11
D1, D2 — 1N4148, switching diode, 1N4148FS-ND
Q1, Q2 — 2N3904, NPN general-purpose transistor, 2368-2N3904-ND
Q3 — 2N3906, PNP general-purpose transistor, 2368-2N3906-ND
R1 — 6.8 kΩ, ¼ W resistor, 5% axial, CF14JT6K80CT-ND
R2 — 220 kΩ, ¼ W resistor, 5% axial, CFM14JT220K
R3 — 2.2 kΩ, ¼ W resistor, 5% axial, CF14JT2K20CT-ND
R4, R5 — 3.3 kΩ, ¼ W resistor, 5% axial, CF14JT3K30CT-ND
R6 — 330, ¼ W resistor, 5% axial, CF14JT330RCT-ND
R7 — 100, ¼ W resistor, 5% axial, CF14JT100RCT-ND
R8 — 10 kΩ, miniature trimmer resistor, CT6EP103-ND
R9, R10 — 1 kΩ, miniature trimmer resistor, CT6EP102-ND
PCB — Printed circuit board, available at **www.wa3tfs.com**

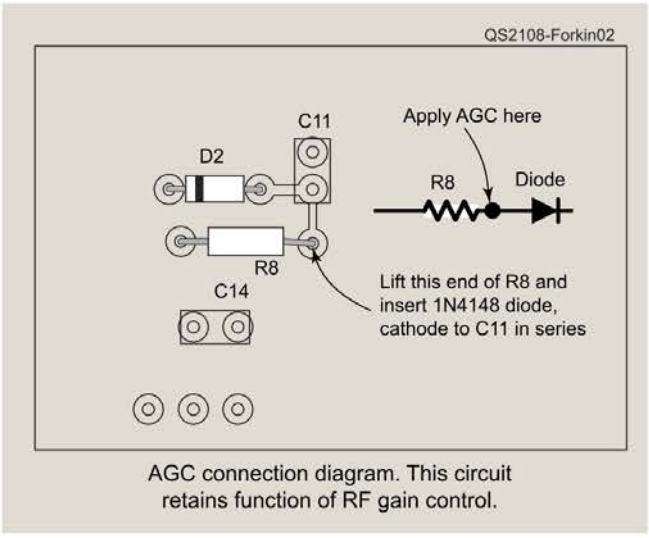


Figure 2 — High-frequency communications receiver modifications to accommodate the AGC.

receiver board, so gain decreases in the second IF amplifier stage and that, in turn, lessens the detected audio level. You must modify the receiver, as shown in Figure 2. Lift one end of the R8 resistor and insert a 1N4148 diode in series to provide a connection point (see Figure 2). AGC output level to the receiver is also adjustable by R10, so you can set the attenuation required.

The Circuit Board

The circuit board is configured to closely match the layout of the schematic diagram. See the board layout and details at **arrl.org/qst-in-depth**.

Setup

Start with the receiver RF gain control set to maximum, and the AF gain control to a comfortable level. Then, on the AGC board:

1 Set R8, R9, and R10 potentiometers approximately to mid-point.

2 If you have connected an S-meter, tune in a strong signal that you would consider S-9 level, and adjust R9 to show S-9 on the meter. If the meter will not reach that high, adjust R8 until the level is reached.

3 Adjust the AGC (R10) for a comfortable audio level from the receiver.

4 Now, tune in a weak signal of about S-5, and adjust the threshold to the point where the audio level from the receiver just starts to lower. There will be no AGC applied at or below this point, but AGC begins on signals above this level. No AGC is necessary on signals of this level.

5 Initially, adjust settings as necessary to meet your own requirements. There is interaction between the R8, R9, and R10.

6 Once you set the controls to your preferences, no further adjustments are necessary.

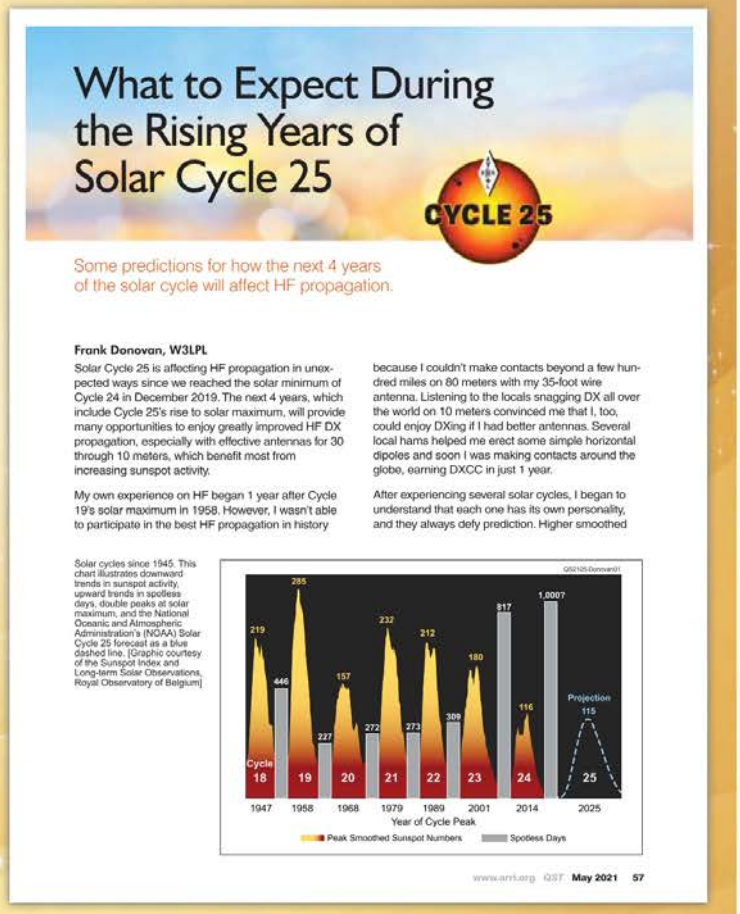
If no S-meter is attached, leave the connection open. Also, leave open the unused AGC output. AGC hold time is controlled by the value of C6. I designed it for fast AGC, but you can change this by increasing C6 up to 10 μF or so. As designed, the AGC action works well on CW, SSB, and AM signals. If you increase C6, and you hear a popping sound when a strong signal is detected, the value of C6 is too high; it is slowing initial AGC response, as well as increasing hold time. Decrease the value of C6.

Conclusion

You will find that listening becomes more comfortable. You can now set the RF gain on the receiver to maximum and the audio to a comfortable level. However, the RF gain still functions normally and may be decreased for extremely strong signals if necessary. The circuit works well with several receivers I've built, and the small size allows inclusion into small enclosures. Although simple in design, it enhances listening pleasure under varying signal conditions.

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

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



What to Expect During the Rising Years of Solar Cycle 25

CYCLE 25

Some predictions for how the next 4 years of the solar cycle will affect HF propagation.

Frank Donovan, W3LPL

Solar Cycle 25 is affecting HF propagation in unexpected ways since we reached the solar minimum of Cycle 24 in December 2019. The next 4 years, which include Cycle 25's rise to solar maximum, will provide many opportunities to enjoy greatly improved HF DX propagation, especially with effective antennas for 30 through 10 meters, which benefit most from increasing sunspot activity.

My own experience on HF began 1 year after Cycle 19's solar maximum in 1958. However, I wasn't able to participate in the best HF propagation in history because I couldn't make contacts beyond a few hundred miles on 80 meters with my 35-foot wire antenna. Listening to the locals snagging DX all over the world on 10 meters convinced me that I, too, could enjoy DXing if I had better antennas. Several local hams helped me erect some simple horizontal dipoles and soon I was making contacts around the globe, earning DXCC in just 1 year.

After experiencing several solar cycles, I began to understand that each one has its own personality, and they always defy prediction. Higher smoothed

Solar cycles since 1945. This chart illustrates downward trends in sunspot activity, upward trends in spotless days, double peaks at solar maximum, and the National Oceanic and Atmospheric Administration's (NOAA) Solar Cycle 25 forecast as a blue dashed line. [Graphic courtesy of the Sunspot Index and Long-term Solar Observations, Royal Observatory of Belgium]

The Tin-Can Tower Vertical

An effective 15-meter portable antenna made from coffee cans.

Hiroki Kato, AH6CY

I drink a lot of Italian Illy coffee, and wanted to use the abundant amount of coffee cans on a radio-connected project. Remembering an old article about a vertical antenna made from beer cans soldered together, I wanted to reproduce that with the coffee cans, which are 3.5-inch-diameter steel cans and could be easily soldered together with a 100 W soldering iron. Further, the larger the diameter of an antenna, the broader the frequency coverage, and the more efficient it is due to the increased radiating surface.

Figure 1 — The two-piece vertical section.

Assembly

A stack of 17 Illy coffee cans with their covers makes a perfect 8-foot vertical antenna for the 15-meter band (see Figure 1). To make it portable, I built it in three pieces, consisting of two antenna sections and a supporting platform. The two top sections are connected with an HVAC metal hose clamp, which can be found in any hardware store. The base is an acrylic disk, about ⅜ inches thick and 6 inches in diameter. I used six L brackets to attach the antenna to the acrylic disk. The supporting platform is made from the legs of an old camera tripod, and a repurposed three-leg camping stool component. The tripod legs are connected with a plastic piece taken from the camping stool, and three notches on the acrylic disk snugly fit the tripod legs. The radial wires are constructed of three 15-wire computer ribbon cables, cut to 11-foot, 15-foot, and 30-foot lengths (see Figures 2 and 3).

Results

The final antenna covers the entire 15-meter band with an SWR under 2:1. Using the internal KX2 autotuner or the LDG autotuner with my Yaesu FT-817, I achieved an SWR close to 1:1 on all ham bands from 40 through 10 meters.

I used this antenna on outings to the beach, hilltops, and parks. Not only has it been an effective antenna, but it also never fails to attract attention from non-hams.

Figure 2 — The tripod leg detail.

Figure 3 — The supporting platform.

All photos by the author.

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

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

Product Review

Lab599 Discovery TX-500 160 – 6 Meter Portable Transceiver

Reviewed by Phil Salas, AD5X
ad5x@arrl.net

Several low-power, portable transceivers have taken advantage of the continual development of DSP hardware, including Elecraft's KX2 and KX3, and the Xiegu G90 and X5105. A recent entry is the Discovery TX-500 transceiver from Lab599, a relatively new Russian company. The radio is distributed in the US by Ham Radio Outlet and is supported by a US service center in Nevada.

Overview

The Lab599 Discovery TX-500 is an attractive and very rugged transceiver that covers the ham bands from 160 to 6 meters, along with a general-coverage receiver that tunes continuously from 500 kHz to 56 MHz. It's hard to find any online comments about the TX-500 that don't describe it as being built like a tank. The housing is a heavy machined aluminum chassis. Left- and right-side front-panel extensions protect the display and all controls from being damaged if dropped. The transceiver is also water resistant because of its liquid-protected housing, encoders with sealing rings, and water-resistant connectors.

This radio has a flat profile compared to typical transceivers. Two feet on the back fold out to orient the radio at about 30 degrees for operating and ease of viewing the display and controls. A 3.6-inch, high-contrast monochrome LCD shows everything necessary during operation (see Figure 1).

Transmit power is adjustable from 1 to 10 W, and operating modes include SSB, CW, FM, AM, and digital modes using an external computer. The TX-500 includes many useful features, such as two VFOs, split-frequency operation, transmit and receive offset tuning (RIT/XIT), an SWR bridge, a receiver preamp and attenuator, a noise blanker, digital noise reduction, a notch filter, a speech processor, and variable bandwidth DSP filters. There is also a built-in 48 kHz high-speed panadapter for easy signal search and evaluation of band conditions. Finally, the TX-500 has two 20-second voice memories, four CW memories, and 100 general-purpose memories that store VFO frequency, mode, and other settings.

There is no internal automatic antenna tuner, and no built-in speaker. However, the speaker in the provided speaker/microphone offers plenty of audio for any environment and it sounds fine.

Interfaces and Controls

The water-resistant I/O connectors, located on the left and right sides of the TX-500, seem to be what determines the 1.1-inch thickness of the radio

Bottom Line

The Lab599 Discovery TX-500 is a rugged, compact, feature-loaded 10 W portable transceiver that should satisfy any QRP portable operator.

Figure 1 — The Lab599 TX-500 display conveys quite a bit of operating information at a glance, and even includes a spectrum scope. The wide vertical bar near the center of the scope shows the received bandwidth. Labels for the rows of soft keys above and below the display change depending on settings.

(see Figure 2). Other than the BNC RF connector, the interface connectors are different from those typically found on QRP transceivers. They are GX12 series multipin connectors that are readily available online from **www.w2eny.com** and other sources. You probably won't need to worry about that because adapter cables for the CW key, the USB computer interface, the dc power, and the external mic/headphone/speaker (with PTT switch) are included. All of the connectors use a different number of pins, so you won't mix them up.

The one cable that's shown in the manual but not included is an audio interface cable for digital-mode operation. A connector is included, so you can make your own, and wiring diagrams for all interfaces are available for download from the Lab599 website.

Three variable controls on the front panel provide AF gain, RIT/XIT offset, and frequency tuning. Buttons to the left of the large tuning knob provide for band, mode, filter, and menu selection. To the right of the tuning knob are buttons for RIT/XIT, VFO/memory, VFO lock/unlock, and VFO step size. There are four soft keys above the LCD screen, and four more soft keys below the LCD. These buttons change functions for different operations, and they are also used for menu selections. All of the buttons have excellent tactile feel, and the three controls feel solid and are wobble free.

More Testing

Table 1 lists the TX-500 specifications and the ARRL Lab measurement results. Because the TX-500 doesn't have an internal autotuner, I wanted to see how the radio would do with some reasonable mismatches, like you might encounter with a temporary portable antenna. Table 2 shows the output power when transmitting into high-impedance and low-impedance 2:1 and 3:1 SWR loads.

The TX-500 manual states that the radio's SWR protection reduces transmitter output power as the SWR increases. This does appear to be the case if the higher SWR is due to a high-impedance load. However, it is interesting to note that the TX-500 output increases with high SWR with a low-impedance load. (Of course, it's best to observe the rated RF power output at all times.)

General Operation

The TX-500 is powered from an external 9 – 15 V dc battery or power supply capable of sourcing up to 2.5 A. The TX-500 does have overvoltage and reverse-polarity protection, but the manual cautions that

Figure 2 — The connectors on either side of the radio case are for antenna, CAT (computer-aided transceiver), and CW key on one side, and dc power, data/remote, and speaker/mic on the other. The GX12 series I/O connectors offer weather protection.

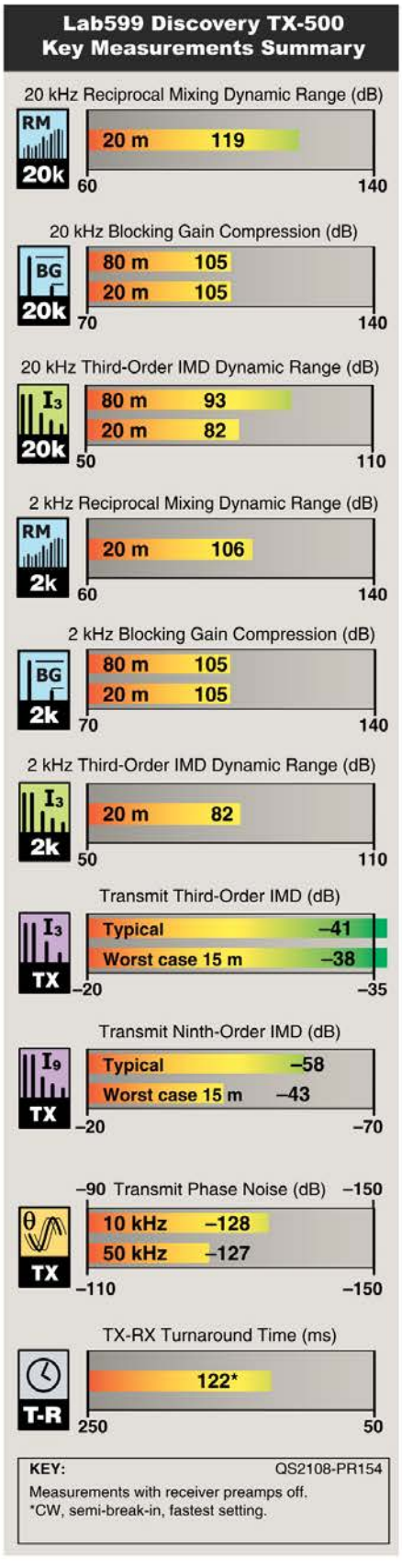

Table 1
Lab599 Discovery TX-500, S/N N/A

Manufacturer's Specifications

Frequency coverage: Receive, 0.5 – 56 MHz; transmit, 1.8 – 54 MHz (amateur bands only).

Power requirements: 9 – 15 V dc. Receive, 100 mA (backlight on, preamp off, no signal). Transmit, 1 – 3 A typical.

Modes of operation: SSB, CW, Digital AM, FM.

Measured in the ARRL Lab

Receive and transmit, as specified. 60-meter segment transmit, 5.3515 – 5.3665 MHz.

At 13.8 V dc: Receive, 104 mA (max brightness, max volume, no signal). Transmit, 2.0 A at max RF output; 930 mA at minimum RF output.

As specified.

Receiver

Sensitivity: –136 dBm typical with preamp on.

Noise figure: Not specified.

AM sensitivity: Not specified.

FM sensitivity: Not specified.

Blocking gain compression dynamic range: Not specified.

Reciprocal mixing dynamic range: Not specified.

Receiver Dynamic Testing

Noise floor (MDS), 500 Hz bandwidth:

Preamp	*Off*	*On*
1.0 MHz	–123 dBm	–138 dBm
3.5 MHz	–125 dBm	–141 dBm
14 MHz	–125 dBm	–141 dBm
50 MHz	–109 dBm	–129 dBm

Preamp off/on: 14 MHz, 22/6 dB; 50 MHz; 38/18 dB.

10 dB (S+N)/N, 1 kHz tone, 30% modulation, 10 kHz bandwidth:

Preamp	*Off*	*On*
1.02 MHz	8.31 µV	1.80 µV
3.88 MHz	5.37 µV	1.16 µV
29.0 MHz	8.12 µV	1.43 µV
50.4 MHz	17.6 µV	2.24 µV

For 12 dB SINAD, 3 kHz deviation, 12 kHz bandwidth:

Preamp	*Off*	*On*
29 MHz	2.54 µV	0.40 µV
52 MHz	5.68 µV	0.68 µV

Blocking gain compression dynamic range, 500 Hz bandwidth:†

	20/5/2 kHz offset
	Preamp off
3.5 MHz	105/105/105 dB
14 MHz	105/105/105 dB
50 MHz	140/140/140 dB

14 MHz, 20/5/2 kHz offset: 119/108/106 dB

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

Band/Preamp	*Spacing*	*Measured IMD Level*	*Measured Input Level*	*IMD DR*
3.5 MHz/Off	20 kHz	–125 dBm –97 dBm	–32 dBm –23 dBm	93 dB
14 MHz/Off	20 kHz	–125 dBm –97 dBm	–43 dBm –28 dBm	82 dB
14 MHz/On	20 kHz	–141 dBm –97 dBm	–50 dBm –27 dBm	91 dB
14 MHz/Off	5 kHz	–125 dBm –97 dBm	–43 dBm –27 dBm	82 dB
14 MHz/Off	2 kHz	–125 dBm –97 dBm	–43 dBm –27 dBm	82 dB
50 MHz/Off	20 kHz	–109 dBm –97 dBm	–18 dBm –31 dBm	91 dB
50 MHz/On	20 kHz	–129 dBm –97 dBm	–40 dBm –29 dBm	89 dB

Manufacturer's Specifications	Measured in the ARRL Lab
Second-order intercept point: Not specified.	Preamp off/on, 14 MHz, +47/+43 dBm; 21 MHz, +47/+39 dBm; 50 MHz, +45/+35 dBm.
FM adjacent channel rejection: Not specified.	Preamp on: 29 MHz, 63 dB; 52 MHz, 78 dB.
FM two-tone, third-order IMD dynamic range: Not specified.	Preamp on, 20 kHz offset: 29 MHz, 63 dB;* 52 MHz, 78 dB.* 10 MHz offset: 29 MHz, 91 dB; 52 MHz, 78 dB.
S-meter sensitivity: Not specified.	For S-9 signal, preamp off/on: 14 MHz, 58.8 µV; 50 MHz, 64.5 µV. Scaling: 6 dB/S-unit.
Squelch sensitivity: Not specified.	14 MHz SSB, minimum to maximum squelch: 1.78 µV to 158 mV.
Receive signal processing delay time: Not specified.	29 ms.
IF/audio response: Not specified.	Range at –6 dB points:‡ CW (500 Hz BW): 507 – 925 Hz; Equivalent Rectangular BW: 457 Hz; SSB (2.7 kHz BW): 400 – 2937 Hz; AM (10 kHz BW): 400 – 2937.
Transmitter	**Transmitter Dynamic Testing**
Power output: HF, 1 to 10 W PEP; 50 MHz, 1 to 7 W.	As specified.
Spurious signal and harmonic suppression: >50 dB.	Harmonic suppression: HF, typically >70 dB (62 dB worst case, 15 m). 50 MHz: 68 dB. Spurious suppression: 48 dB (see Lab Notes). Meets FCC requirements.
Third-order intermodulation distortion (IMD) products: Not specified.	3rd/5th/7th/9th-order IMD products 10 W PEP RF output: –41/–52/–54/–58 dB (HF typical) –38/–57/–42/–43 dB (worst case, 15 m) –32/–44/–52/–54 dB (50 MHz)
CW keyer speed range: Not specified.	1.8 to 51 WPM, iambic mode B.
CW keying characteristics: Not specified.	See Figures A and B.
Transmit-receive turnaround time (PTT release to 50% audio output): Not specified.	S-9 signal, AGC fast, 28 ms. CW semi-break-in, 122 ms.
Receive-transmit turnaround time (tx delay): Not specified.	SSB, 41 ms; FM, 30 ms (29 MHz), 33 ms (52 MHz).
Transmitted phase noise: Not specified.	See Figure C.

Size (height, width, depth, incl. protrusions): 1.1.× 9.1 × 3.5 inches; weight, 1.2 pounds.

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

†The AGC cannot be turned off (AGC is normally disabled during dynamic range testing). The TX-500 blocked adjacent signals with no effects on the desired signal, up to the point of ADC overload at +4 dBm with the preamp off and –15 dBm with preamp on.
*Measurement was noise limited at the value indicated.
‡Bandwidth is adjustable via DSP.

Table 2
SWR Impact on TX-500 Transmit Power

SWR	Forward Power (W)
1:1	10.8
2:1 (high impedance)	7.7
3:1 (high impedance)	6.3
2:1 (low impedance)	13.1
3:1 (low impedance)	13.8

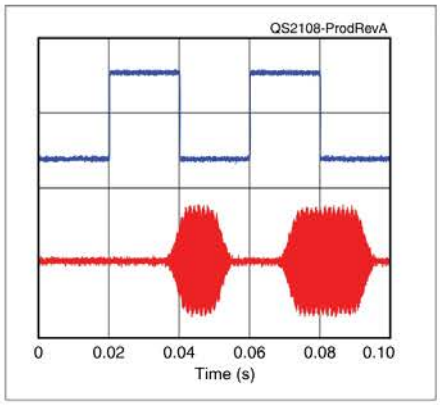

Figure A — CW keying waveform for the LAB599 Discovery TX-500 showing the first two dits using external keying. Equivalent keying speed is 60 WPM. The upper trace is the actual key closure; the lower trace is the RF envelope. (Note that the first key closure starts at the left edge of the figure.) Horizontal divisions are 10 ms. The transceiver was being operated at 10 W output on the 14 MHz band.

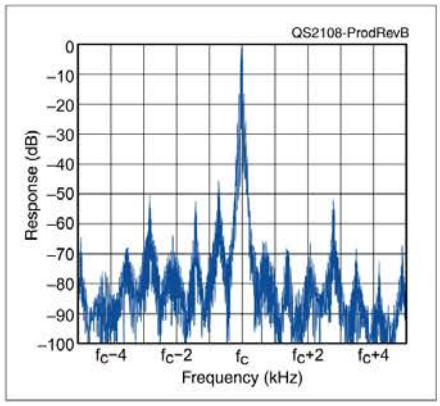

Figure B — Spectral display of the LAB599 Discovery TX-500 transmitter during keying sideband testing. Equivalent keying speed is 60 WPM using external keying. Spectrum analyzer resolution bandwidth is 10 Hz, and the sweep time is 30 seconds. The transmitter was being operated at 10 W PEP output on the 14 MHz band, and this plot shows the transmitter output ±5 kHz from the carrier. The reference level is 0 dBc, and the vertical scale is in dB.

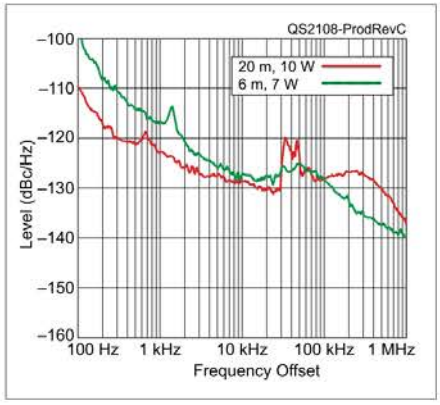

Figure C — Spectral display of the LAB599 Discovery TX-500 transmitter output during phase-noise testing. Power output is 10 W on the 14 MHz band (red trace) and 7 W on the 50 MHz band (green trace). The carrier, off the left edge of the plot, is not shown. This plot shows phase noise 100 Hz to 1 MHz from the carrier. The reference level is –100 dBc/Hz, and the vertical scale is 5 dB per division.

Lab Notes: Lab599 Discovery TX-500

Bob Allison, WB1GCM

The TX-500 receiver is well suited for field use. Its lowest dynamic range is third-order IMD dynamic range, which is 82 dB at 2 kHz spacing at 14 MHz. Though the AGC cannot be turned off, the TX-500 blocked adjacent signals with no effects on the desired signal, up to the point of ADC overload. On some frequencies, internally generated spurious signals are heard in the receiver. These tones were quite noticeable around 14.044 MHz in the review radio, even with an antenna connected and typical band noise. According to the manual, this results from the way the internal signal conversion is performed. Enabling the DIF (virtual intermediate frequency) feature moves the tones to a different frequency.

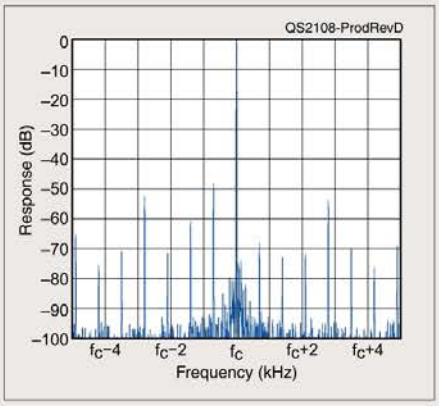

Figure D — A spectral sweep ±5 kHz from the carrier while a constant CW tone is transmitted reveals several additional low-level signals at least 48 dB below the carrier level.

On the transmit side, the TX-500 exceeds the FCC's requirement for harmonic and spurious suppression, which is 43 dB for HF and 60 dB above 50 MHz. However, I observed multiple low-level signals transmitted along with the intended signal. For example, in CW mode, a spectrum analyzer typically displays a single carrier, which turns on and off as CW characters are transmitted. As shown in Figure D, a spectral sweep ± 5 kHz from the carrier, there are numerous low-level signals also transmitted. These signals are at least 48 dB below the carrier (a fraction of a milliwatt). The added spurious signals explain the unusual plot of the CW sidebands in this review, despite the TX-500's nice CW waveshaping (see Figures A and B with Table 1).

In SSB mode, two tones into the microphone jack produce the expected transmit IMD odd-order products, but also present were other low-level distortion products.

All of the low-level spurious emissions observed during this test are suppressed more than the FCC-required 43 dB below the carrier and are unlikely to be heard on the air because they will be below the receiver's noise floor. However, I do not recommend using an RF amplifier with this transceiver because that could raise the level of these signals enough to be heard by other stations operating nearby.

Finally, I observed the carrier suppression on 6 meters of only 42 dB. This is okay for QRP, but more carrier suppression is desirable for higher transmitted power. Also, sensitivity could be improved on 6 meters.

Additional spectral plots from the TX-500 transmitter are available from **www.arrl.org/qst-in-depth**.

exceeding 16 V dc can damage the transceiver. The receive current drain is just over 100 mA, which is important to help conserve battery power because typically a high percentage of operating time is spent listening.

The TX-500 comes with a fold-out *Quick Start Guide*. A detailed user manual can be downloaded from **lab599.com**, but I found that the accompanying guide was really all I needed to operate the radio because the TX-500's controls and buttons are mostly self-explanatory, and the menu system is well thought out. The more commonly used functions are available through the soft keys above and below the display. Tap the **MENU** button, and you can change many less-often-needed settings, such as microphone gain, compression level, type of CW key, break-in delay, and other set-and-forget items.

I particularly liked the **INTEL** tuning setting. This feature increases the tuning rate based on how fast you turn the tuning knob, which makes moving around in the bands very easy. There are also four default receive bandwidths per mode, all of which can be easily changed by the user. An internal CR2032 battery powers internal memory to save user settings and keep the real-time clock operating.

As mentioned earlier, there is no internal antenna tuner, but the **TONE** soft key transmits a 4 W constant carrier to enable you to adjust an external antenna tuner if needed. It is interesting that the **TONE** control can be changed to output two tones instead of the single tone. I'm not sure what the purpose of this is though, as the tones are 1 kHz and 2 kHz. Because the two tones are harmonically related, they are not suitable for two-tone intermodulation distortion (IMD) testing. Perhaps a future firmware update will change these to the more traditional 700 Hz/1900 Hz tones used for IMD testing.

Finally, the TX-500 can drive an external speaker or external headphones via a 3.5-millimeter monaural jack on the speaker/mic with up to 3 W of audio power. The supplied mic/headphone cable does produce dual outputs for stereo headphones.

CW Operation

The TX-500 internal keyer speed range is 2 – 51 WPM as measured in the ARRL Lab. Sending speed is dis-

Computer Interface and Digital Modes

Mark Wilson, K1RO

The included USB cable can be used for interfacing the TX-500 with a computer for computer-aided transceiver (CAT) operation and for firmware upgrades. As with other radios, the first step is to install a driver to create a virtual COM port when the radio is plugged in. According to the manual, Lab599 ships the radio with either FTDI (blue) or Prolific (black) USB adapters. Ours came with a Prolific adapter.

Windows 10 automatically installed a driver when I connected the TX-500 to my computer, but I got an error message, and it didn't work. I downloaded the recommended driver from the Lab599 website. With that driver, the radio showed up as COM7 in Windows Device Manager, but the Lab599 firmware update utility software wouldn't recognize it. After uninstalling the driver, restarting the computer, and reinstalling the Lab599 driver, everything worked as expected. Other TX-500 users have reported similar behavior with the Prolific USB adapter and driver. A few days after my initial installation, I had to uninstall/reinstall the driver again to get the software to recognize the radio. Based on my experience with other devices, if you are lucky enough to get the FTDI version, installation should be automatic and seamless.

Firmware upgrades are easily performed as new features and bug fixes become available. A TX-500 firmware update utility for Windows or Linux is available from the Lab599 "Downloads" page, along with the latest firmware files. With the USB driver issue sorted, it was just a matter of pressing two buttons on the TX-500 at power-on to put it into the update mode, starting the firmware update utility, and selecting the appropriate COM port and firmware version. The update took only a minute or two, with progress and successful completion clearly indicated.

Digital Modes

As noted in the text, the TX-500 can be operated with a computer and sound card for any of the popular audio-based digital modes. Following the well-illustrated diagram available for download from the Lab599 website, I made an interface cable using the provided seven-pin GX12 connector for the **REM/DATA** jack. The connector is small and tightly packed, so it took a steady hand, and in my case magnifying glasses, to solder the pins. The cable uses just three of the pins for connection to your computer's sound device — input and output signal lines and a ground. You'll also need a 10 µF capacitor for the **AUDIO IN** line. Given the popularity of FT8 and other digital modes, it is surprising that this cable is not part of the package.

Transmit-receive switching for digital modes can be implemented using either the VOX function or the CAT cable. For CAT operation, the TX-500 emulates the Kenwood command set available in most ham radio applications.

With the audio and CAT cables in place, I quickly configured *WSJT-X* using the Kenwood TS-2000 settings and appropriate computer sound devices. Everything worked, and soon I was making contacts using FT4 and FT8 on 15, 17, 20, and 40 meters with the TX-500. I'm always impressed by how effective these modes can be while running just 5 to 10 W.

Audio level settings for the data modes are independent of settings for the voice modes. I found that I had to increase the default audio level setting in the TX-500 quite a bit using the **GAIN>DIG** menu to fully drive the transmitter. I also tried the CAT interface with N3FJP's *Amateur Contact Log*, and it correctly followed the TX-500's frequency and mode changes using the **KENWOOD2** settings.

played as characters per minute (CPM), and the TX-500 user manual states that you can divide CPM by five to get the more common speed in WPM. CW speed is one of the top soft key options. Tap **CW SPEED**, adjust it using the tuning control, and then tap **RETURN** on the bottom left soft key.

The four CW memories are also accessible through top soft keys. Memories are programmed by pressing and holding the appropriate soft key, then sending the desired message.

CW pitch is adjustable from 400 to 1200 Hz (700 Hz default), and the center of the receive bandwidth filter adjusts itself to track the pitch frequency. The default CW filter bandwidths are 300 Hz, 200 Hz, 100 Hz, and 50 Hz. As I like to tune around with wider bandwidths, I reprogrammed these to 1 kHz, 500 Hz, 300 Hz, and 100 Hz. You can select either CW or CW-R (reverse), depending on interference conditions.

The TX-500 is not capable of full-break-in operation because the minimum break-in delay time is 100 milliseconds (primarily due to the digital processing time). The TX-500 uses a relay for transmit-receive switching, and you can definitely hear the relay click. I found that the default 100-millisecond break-in delay resulted in too much clicking for me. Changing the break-in delay to 500 milliseconds kept the clicking to a minimum.

Voice Operation

Speech compression is turned on and off via a soft key on the top row. Compression level and microphone gain are set up in the menu, and should be a one-time

adjustment unless you change microphones. The four default SSB filter bandwidths are 3 kHz, 2.7 kHz, 2.4 kHz, and 2.05 kHz.

The TX-500 has receive and transmit audio equalization filters (three bands), but I found that the default responses were fine. The radio offers two voice memories of up to 20 seconds each. Voice-operated transmit (VOX) and push-to-talk (PTT) operation may be selected.

Digital Modes

The TX-500 can be operated with a computer and sound card for FT8, FT4, RTTY, PSK, or any of the other popular audio-based digital modes. See the sidebar, "Computer Interface and Digital Modes," for more information.

On the Air

I am primarily a CW and SSB QRP portable operator. During the review period, band conditions limited my portable operations to 40, 30, and 20 meters. The 10 W output from the TX-500 is only 10 dB down from the typical 100 W desktop transceiver output — about 1½ S-units — so I had no problems making CW contacts as long as I kept this in mind. There is no internal speaker, so to hear anything when operating CW, you must have the speaker/mic connected, or else use the included audio breakout cable with mono or stereo headphones.

Take a look at the "Lab Notes" sidebar if you think you might use an amplifier with the TX-500. As you can see from the spectrum plot, spurious tones range from 48 to 70 dB below the carrier. To put this into real world terms, if a station is receiving you at an S-9 level, the strongest spurious signal will be about S-1. I can hear these signals on my lab receiver with no external band noise present. However, in the real world, the spurious signals will normally be below the noise floor. I asked a few contacts to listen off to the side while I sent a string of dits, and they could not hear any spurious signals. However, they could easily become apparent if an amplifier is used. Add 10 dB or more to the CW signal with a 100 W amp, and some of these tones can exceed the noise floor, especially on quiet bands.

SSB operation was a bit more of a challenge than CW at the 10 W level. However, by focusing on calling strong stations, I could normally make contacts with minimal problems. The audio reports were all quite good. Again, review the "Lab Notes" comments should you think about using the TX-500 with an amplifier.

Conclusion

The Lab599 Discovery TX-500 is a rugged, easy-to-use transceiver that you will feel comfortable using even in the least hospitable portable operating environments. An integrated battery pack would be a big plus for simplifying operation in the field. Lab599 has announced an attachable battery pack that will be fully compatible with the form factor of the TX-500, but pricing and availability were not available when this was written. An autotuner for compromise portable antennas would be useful as well.

For more information, you can download the TX-500 user manual and other documentation from the Lab599 website or from **pileupdx.com/downloads/**. There is also an active TX-500 user group at **groups.io/g/Lab599** and another group on Facebook.

Manufacturer: Lab599, Rubtsovsk, Altari region, Russia; **lab599.com**. Distributed in the US by Ham Radio Outlet. US service center: Box 165, 3983 S. McCarran Blvd., Reno, NV 89502; **usa.service@lab599.com**. Price: $899.95.

BridgeCom Systems SkyBridge Plus Dual-Band Digital Hotspot

Reviewed by Pascal Villeneuve, VA2PV
va2pv@arrl.net

The open-source *Pi-Star* software package running on the Raspberry Pi with a multimode digital voice modem (MMDVM) add-on board is probably the most popular type of multimode digital hotspot these days. A hotspot is a digital radio internet gateway that uses an integrated low-power VHF or UHF transceiver to com-

Bottom Line

The BridgeCom SkyBridge Plus hotspot is a plug-and-play solution for adding a VHF/UHF digital voice internet gateway to your home or portable station. It can be used with a variety of popular modes, including DMR, D-STAR, and System Fusion.

municate with an amateur radio digital-mode transceiver. It's a great way to get the most out of your VHF/UHF digital radios, especially if you don't have a compatible repeater nearby.

BridgeCom has used this platform to create their own device, the SkyBridge Plus Dual-Band Digital Hotspot, which is sold separately or as part of a package with one of their DMR-capable transceivers.

Open-Source Solution

The Raspberry Pi is a miniature Linux PC with several different hardware versions (Raspberry Pi 2, 3, 4, and Zero). The available add-on boards used to create a hotspot are based on open-source MMDVM hardware and the open-source *Pi-Star* software package.

Because this platform is open-source and many people can contribute, development and improvements are not dependent on a single manufacturer. *Pi-Star* has proven its stability over the past few years. You can build your own kit, but you need to choose the right software image with the right hardware. One of the most critical parts is the quality of the microSD card used for storage. I had many problems in the past with inexpensive microSD cards used with a Raspberry Pi. If I didn't shut down the device properly, the software package got corrupted, and I had to re-flash the card. That's not very good if you want to use it for portable or mobile operations.

For those willing to learn, Linux can be fun, because you can build and customize your own hotspot. If you just want a good hotspot without dealing with the complexity, or you think you will need technical assistance, the SkyBridge Plus is a good option.

The SkyBridge Plus hardware consists of a Raspberry Pi 3 Model B, with a dual-band (2-meter/70-centimeter) MMDVM board, along with a microSD card slot for the *Pi-Star* image. The hotspot hardware is well built — a solid 10-ounce brick. The integrated 2.4-inch, color LCD screen is helpful to monitor the hotspot status or just to remember its IP address if you need to connect to it for any change in configuration. The unit uses passive cooling with convection airflow (no fan). The antenna connector is SMA female.

What's Included

The SkyBridge Plus is fully assembled and is almost a plug-and-play device. BridgeCom is a well-known ham radio vendor with great support and service. For example, their website offers many tutorials to help you learn about VHF/UHF digital voice setup and operation. The SkyBridge Plus package includes all the necessary accessories and free access to a video training program on the BridgeCom Systems University website.

Here's what's included:

- VHF/UHF SMA antenna
- Pre-imaged 16 GB microSD card with *Pi-Star* software
- 3-foot ethernet cable, 3-foot USB-to-Micro USB power cable, wall transformer, and car power adapter
- 3,000 mAh external battery (although the review unit came with a 5,000 mAh, two-output battery — 5 V/1 A and 5 V/2.1 A)

Overview

The SkyBridge Plus supports multiple popular digital modes, including DMR, D-STAR, Fusion (Yaesu System Fusion), P25, and NXDN. The hotspot has a Wi-Fi interface, but keep in mind that because it's based on the Raspberry Pi 3 Model B (not the B+), it only supports 2.4 GHz. There's also a wired ethernet port that you can use for the initial configuration or during operation for better internet stability. The RF portion is a low-power (10-milliwatt) 2-meter/70-centimeter transceiver. Note that this unit does not convert analog FM signals to any digital mode, and you need at least one digital radio to use it.

Prerequisites

As with all hotspots, the SkyBridge Plus requires some preparation, depending on your intended mode of

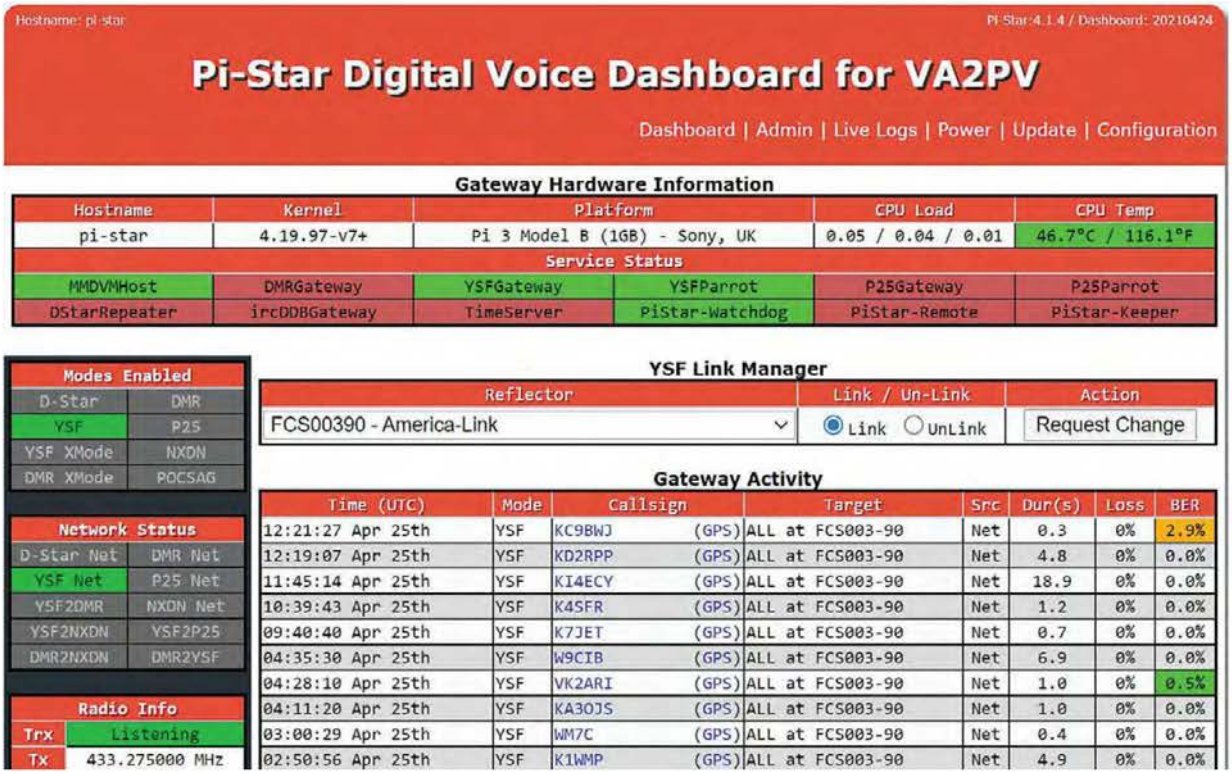

Figure 3 — A portion of the *Pi-Star* web interface dashboard.

operation. For example, some reflector systems require a DMR ID, which is coordinated worldwide, even if your intention is to operate exclusively in a mode other than DMR. This registration process is free. For details, see **www.radioid.net/account/register**.

You also need to make sure you are registered to the D-STAR trust server in order to use this mode. For more information, please contact your local D-STAR repeater club, or visit **www.dstargateway.org**.

Pi-Star

Pi-Star is a preconfigured SD card image for Raspberry Pi specially developed by hams for hams and based on the Raspbian version of Linux. According to the official Pi-Star website, it's the sum of many open-source packages. (For details, see **www.pistar.uk/info_what.php**.) With *Pi-Star*, you also get a very nice web interface to configure and monitor your hotspot, making operation a lot easier for most of us (see Figure 3). Depending on the hardware version, some features shown in the *Pi-Star* interface may not be available.

SkyBridge Plus Technical Support

A significant advantage of the SkyBridge Plus hotspot is the support offered by BridgeCom. Although I'm able to program it myself, I wanted to test their services, so I joined the BridgeCom Systems Facebook Group and also created an account on their website. With the SkyBridge Plus, they included a coupon code for their BridgeCom Systems University.

I went to their training website and used the coupon provided with the hotspot for free access to their video. I was impressed by their quality step-by-step instructions. If you're new to digital voice mode, you will find this training very useful.

Setting Up the Hotspot

After the unboxing, I immediately connected the USB cable to the power source and the ethernet cable to my router. It obtains and displays a dynamic IP address. Using my computer browser, I entered the IP address shown on the hotspot LCD screen and connected immediately to the *Pi-Star* web interface.

Before I could activate a digital mode and connect to a reflector, I needed to click on **CONFIGURATION** at the top of the web interface screen (see Figure 3). It asked for a username and password. You will find that information in the documentation (it uses the *Pi-Star* default credentials).

I activated the Fusion echo reflector (FCS003/99, channel 99 on the FCS003 reflector for Canada), and I did a quick echo test on both VHF and UHF. It worked like a charm. Although this hotspot is dual band, it can only use one band at a time. Keep in mind that some MMDVM boards are full duplex, but those boards have two antenna ports rather than the single antenna port on the SkyBridge Plus. For me, this is not a problem, and it's just great to be able to select between VHF and UHF. That's a good feature if you have other hotspots in your station, as most of them are UHF-only.

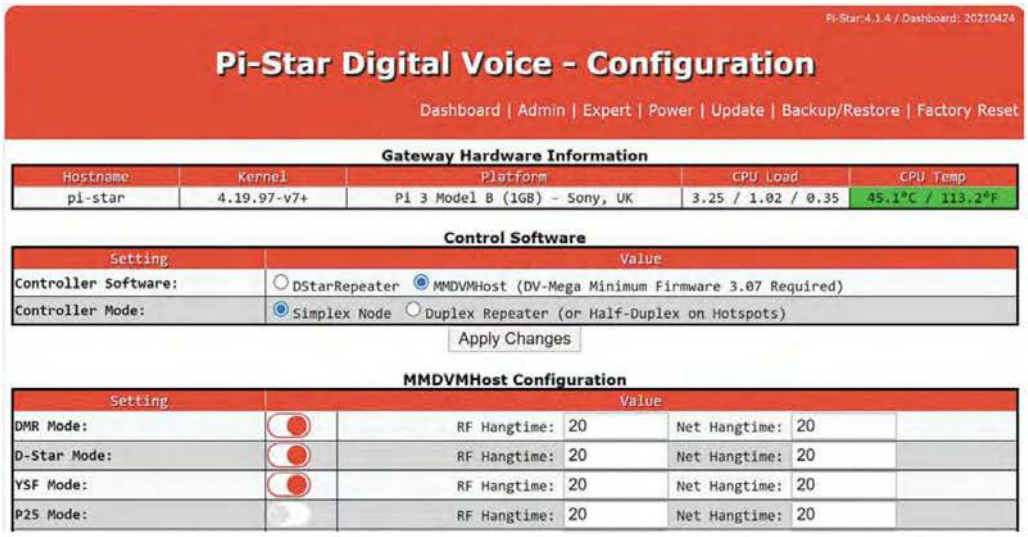

Figure 4 — A portion of the *Pi-Star* configuration screen, with DMR, D-STAR, and Fusion modes activated.

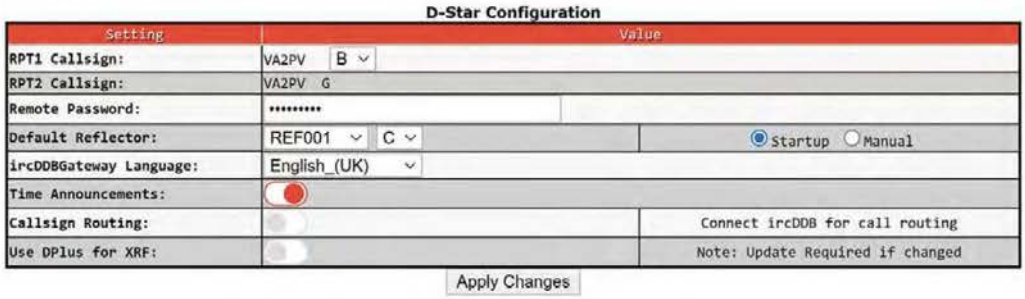

Figure 5 — Scrolling further down the configuration screen, you will find sections for setting up each mode. This section is for D-STAR, and I also configured DMR and Fusion settings in other sections (not shown).

The best feature of the *Pi-Star* hotspots is that you can activate multiple digital modes and monitor a reflector on each mode. Figure 4 shows how I activated DMR, D-STAR, and Fusion, but you can activate all the modes at the same time. It receives only one mode at a time, but it's like scanning among reflectors. The hang time setting lets you stop on a reflector to make a contact, and after a period of inactivity, it starts scanning again among the modes.

When you're on the configuration page, you can scroll down to set up your call sign, DMR ID, and other information. It's also where you select your reflectors for the activated modes. Figure 5 shows my reflector setup for D-STAR on REF001 C. There are similar sections for Fusion and DMR reflectors, which I have also activated. With *Pi-Star*, every time you make a change — modes, reflectors, or anything else — you have to click **APPLY CHANGES**, and it will take about 15 seconds before it's effective.

The **UPDATE** button at the top of the "Configuration" page, shown in Figure 4, is for updating the software package with one click. It's also recommended that you do a backup right away, using the **BACKUP/RESTORE** button to save your configuration.

Operation

Once your digital mode is selected, you're connected to a reflector, and your radio is configured correctly, you're all set. I own a few DMR, D-STAR, and Fusion radios, so I was able to test three digital modes.

The frequencies I use are 433.275 MHz or 144.930 MHz, both in simplex, and it's the same frequency for all the modes. (Please follow your regional band plan when selecting frequencies.) With all three radios for different modes using the same frequency, only one radio at a time will decode the received signal. If it's DMR, only the DMR radio will be receiving; if it's Fusion, only the Fusion radio will be receiving, and so on. All the other radios will be muted if they can't decode the received digital mode, but they will show a received signal on their S-meter. You will hear only a data stream if your radio is set to FM.

The SkyBridge Plus performs very well, and the audio quality is also very good, as it only manages the digital data. Keep in mind that you still need to know how to program your radio and how to switch reflectors for each mode in order to use this hotspot.

The screen is very useful, and the small power bank provided with the unit is also nice for portable operation. The fully charged power bank lasted 4 to 6 hours. There are four LEDs on top of it to indicate the status of the battery, and while using the hotspot continuously, I lost approximately one LED per hour. If longer portable operating time is needed, the SkyBridge Plus could be powered from the provided car power adapter or from a higher-capacity power bank.

Conclusion

If you're new to digital and have no one to help you get started, the BridgeCom Systems step-by-step videos will guide you through the process. With the videos, you can progress at your own pace or watch a segment again if needed. The SkyBridge Plus is a great product for those who want something that works right out of the box but still want to learn the details.

I used the review unit for several weeks with no issues. To test the stability, I unplugged and plugged in the USB power without going through the shutdown procedure, and it didn't crash on me. BridgeCom Systems did a great job of putting this product together, and their video training is a huge bonus to help hams progress in the digital world. Larger versions of the screenshots in Figures 3, 4, and 5 are available from **www.arrl.org/qst-in-depth**.

Manufacturer: BridgeCom Systems, 113 South Bridge St., Smithville, MO 64089; **www.bridgecomsystems.com**. Price: $350.

Visit https://youtu.be/mWwohdN0kBE to see our review of the BridgeCom Systems SkyBridge Plus Dual-Band Digital Hotspot on YouTube.

Intuitive Circuits DTMF-8 Decoder Board

Reviewed by Steve Ford, WB8IMY
wb8imy@arrl.net

This compact circuit board makes it as easy as possible to turn any transceiver into a remote-control link. The Intuitive Circuits DTMF-8 takes the audio directly from an external speaker or headphone jack and decodes any dual-tone multiple frequency (DTMF) tones received. Upon decoding the proper tone sequence, the DTMF-8 will activate one of eight relays, allowing you to turn devices on or off remotely.

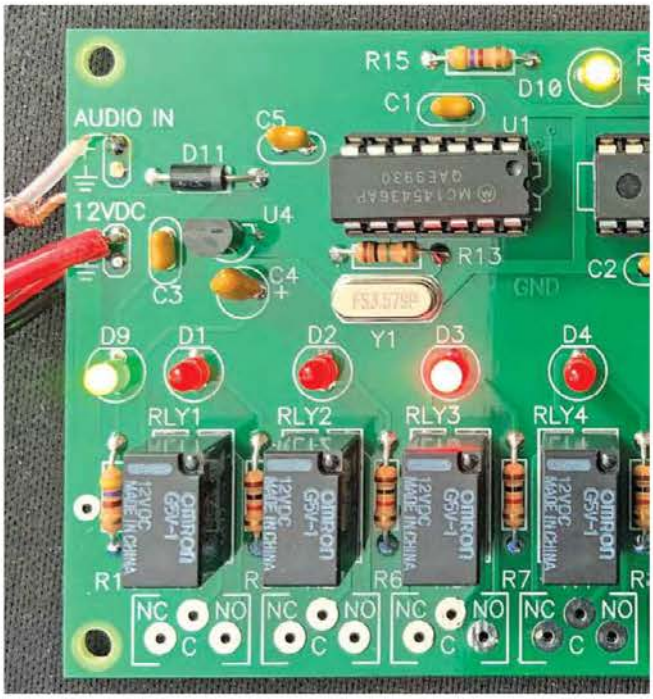

Figure 6 — In this example, sending a "3," followed by an asterisk activated Relay 3 and lit the red LED (D3). The green LED, D9, indicates that the board has power, and the yellow LED (D10) indicates that a valid DTMF digit is being decoded.

The decoder board is only 4½ × 2½ × 9/16 inches, with a Motorola MC145436AP DTMF receiver and a PIC16F84-04I/P microprocessor. The eight individual relays are rated for 1 A at 12 V dc (0.5 A at 120 V ac). Each relay provides a common connection on the board, along with normally open and normally closed connections. The DTMF-8 itself requires 12 V dc at 250 mA.

Using the DTMF-8

For this review, I connected the DTMF-8 to a 12 V battery and ran a small audio cable to the external speaker jack of a 2-meter FM handheld transceiver that was set to a simplex frequency. It became my remote-control receiver.

Bottom Line

The Intuitive Circuits DTMF-8 offers remote control of up to eight relays using DTMF tones.

I adjusted the audio output to a low level to avoid overdriving the decoder input, although it appears that the DTMF-8 is tolerant of much higher levels.

My first test was to latch Relay 3, which I did by transmitting "3," followed by an asterisk from the keypad of another radio. The yellow LED glowed to indicate that tones were being decoded. A fraction of a second later, Relay 3 clicked, and its accompanying red LED glowed (see Figure 6). I had the DTMF-8 in the latched mode, so I had to send "3," followed by the pound sign to turn the relay off.

The DTMF-8 offers a momentary mode that keys relays only while a tone is received. It even includes a mode that allows you to designate some relays as latching while others are momentary. For example, you could latch Relay 4 to enable power to a transmitter and keep it on, and then use Relay 7 to momentarily key the transmitter.

There is also a password function. When it is active, the DTMF-8 will permit relay control only when you send the code you've established. Let's say you've programmed the password to be 12345. To activate Relay 6, you'd need to send "12345" followed by "6" and the asterisk.

The DTMF-8 comes with a well-written manual that includes instructions for those who want to install the board into RF-shielded enclosures, which is always a good idea.

Manufacturer: Intuitive Circuits LLC, 3928 Wardlow Ct., Troy, MI 48083; **www.icircuits.com**. Price: $119.

Dave Casler, KEØOG, askdave@arrl.org

Ask Dave

Quick Menu Item Fixes Frequency Access Problems

QST's new question-and-answer column is here. Submit your questions to *askdave@arrl.org*.

How to Punch in the Desired Frequency

Q Bruce, KJ6WYV, asks: I decided to buy a backup radio and purchased a Baofeng UV-5R. When I try to enter a frequency in VHF, the radio will take all of the numbers except the last digit. When I enter the last digit, the radio reverts to the previous frequency and announces, "cancel." I've searched the internet and can find several instances in which people have had a similar problem, but there is no solution available. Have you encountered this problem?

A Indeed I have. Like many others, I have the same radio. The problem you are encountering is that the radio's default frequency step size is too large to accommodate your desired frequency. You can solve this problem quickly by changing the step size. It's Menu #1, STEP. With the radio on, press **MENU**, then press the number **1** (which is the shortcut key to STEP). Press **MENU** again, then use the **UP/DOWN** arrow keys to select "5.0K" (not "50.0K"). Lastly, press **MENU** again, then press **EXIT**. This should allow your radio to use any commonly used ham frequency. If you still have trouble, select "2.5K" instead of "5.0K." This answer is accompanied by a video on ARRL's YouTube channel (**youtube.com/arrlhq**), showing the step-setting process.

Distance Between Multiple HF Antennas

Q Bob, KC1MOF, asks: I have a Hustler 4 BTV and am finishing an MFJ-1846 Hex Beam. How close can I place these antennas in my backyard?

A I assume that you have one HF radio and use either the Hustler or the MFJ antenna. I have a situation similar to yours. I have an MFJ-1846 Hex Beam antenna up 22 feet, and the mast is 80 feet horizontally away from my SteppIR BigIR ground-mounted vertical. I note here that the MFJ-1846 is heavier than you would think looking at it, and if it is at the end of a mast, it will be impossible to hold it upright by yourself. Be sure to have two or three other people to help you push up the mast. A 20-pound antenna at the end of a 20-foot mast gives you a 400-pound bending moment — not something you can push up by yourself.

Rule number 1 of antennas is that everything affects everything. Yes, having an inactive antenna near another antenna will affect the active antenna's radiation pattern. Your MFJ antenna is horizontally polarized, and the Hustler is vertically polarized. That helps. The bottom line is that the vertical did not affect the Hex Beam's pattern in any perceptible way (see Figure 1).

I used *EZNEC+* v.6 and the G3TXQ model of the Hex Beam and looked at the difference between the vanilla model and one modified to include a 40-meter vertical 50 feet away (see Figure 2).

My poor backyard looks like a pincushion with all the masts and wires I use to test antennas for my YouTube videos (**www.youtube.com/davecasler**), and I have

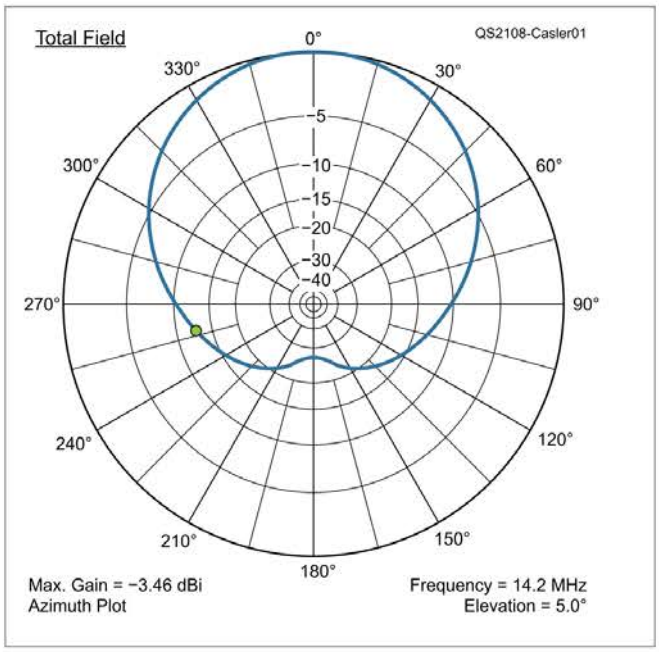

Figure 1 — The Hex Beam's pattern is not affected by the 33-foot vertical directly in front of it.

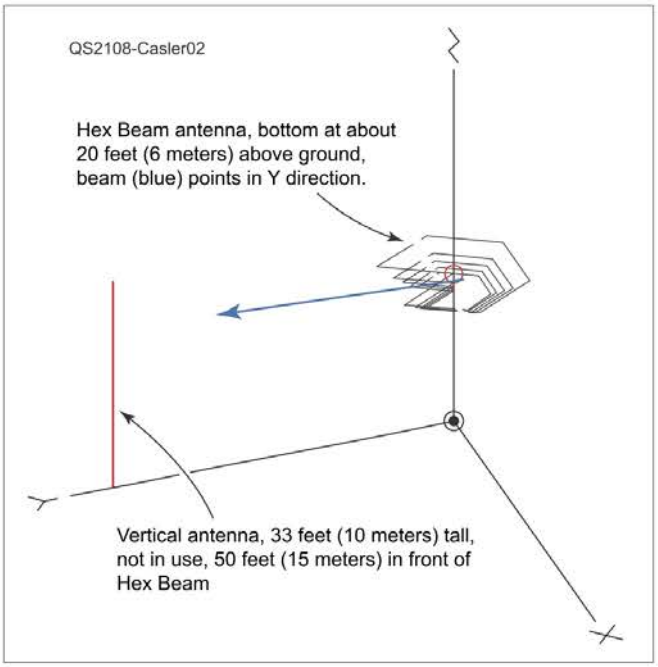

Figure 2 — The Hex Beam in *EZNEC+* v6, with a 33-foot vertical directly in front of it.

not found any interference between the antennas. I think you're good to go with the two antennas.

Putting an Amateur Antenna on a Salt-Water Ship

Q Shawn, KO4IDY, asks: I am a ship's captain and would like to set up my station on board while at sea. My problem is figuring out what type of antenna would be good on a steel ship with a steel mast. From the top of the mast to the water line is about 114 feet. I was thinking I could use the ship as the ground plane and maybe dispense with the need for radials. I want to experiment a bit with different configurations from an end-fed half-wave to maybe just a Wolf River coil with a 17-foot whip. What do you think?

A As the ship's captain, you are aware of the ship's many electronic systems, what they do, and where the key components are located. Usually the ship's owner/operator manages the installation and removal of these systems. These systems are highly hardened against a salt-water environment.

The ship itself is an excellent ground for antennas, though the ship's shape makes its RF behavior unpredictable. You can certainly put up an amateur antenna. The ship's mast makes an excellent point for mounting an inverted V or a sloper. One possibility, depending on the size of the ship, is an end-fed half-wave antenna, such as the MyAntennas EFHW (end-fed half-wave) 8010, which covers many bands between 80 and 10 meters, although the usable bandwidth on 80 meters is limited. You can place the balun that comes with the antenna near your station location, and the other end can be up the ship's mast. The balun offers a connection for ground or a counterpoise. Simply connect that to the metal of the ship itself. Given that the ship's mast is a lightning target, be sure to put in a lightning arrestor where the cable penetrates to the interior. Standard ship's anti-corrosion policies must be followed.

You can try just about any antenna you have room for. You can put up a vertical and just attach the coax shield to the ship itself to serve as radials. The attachment point to the ship should be within a few inches of where the coax center line attaches to the vertical.

Multiple Inverted-V Antennas on the Same Pole

Q Bob, KBØXT, asks: How close can I put a 20-meter dipole to a 6-meter dipole without having problems? It would be nice to mount them on the same pole.

A If you hang them as inverted-V antennas, you can simply pull the 6-meter dipole elements away from the 20-meter elements. But you can go a step further by feeding both dipoles from the same feed line. In doing so, you create a fan dipole. You may need to go back and forth on trimming the 20- and 6-meter elements to get the SWR down as low as you can on both bands. Be sure to keep both 20-meter elements the same length and similarly the 6-meter elements.

Note that while the 20-meter dipole will likely cover the entire band, the 6-meter dipole likely will not. You will want to trim it to cover from 50 MHz at the low end, with the high end as high as you go without creating problems covering the lowest part of the band. By tuning to cover the bottom of the band, you'll cover most of the non-FM activity, such as SSB, CW, FT8, etc.

As an aside, if you are wanting to cover 6-meter FM activity, you'll want to use a vertical, as FM activity is generally vertically polarized. You'll want to feed the vertical antenna with a separate coaxial cable.

Send your questions to **askdave@arrl.org**, or fill out the form at **www.ke0og.net/ask-dave**. I answer some questions here, and some via videos on my YouTube channel (**www.youtube.com/davecasler**), or during my weekly livestream on Thursdays at 6:45 to 8:15 PM Mountain Time on my channel.

Hints & Hacks

Improved Desoldering; a Temporary Heatsink, and Sliding Antenna Insulators

Upgrading a Simple Desoldering Tool

Most inexpensive desoldering tools that use squeeze bulb suction are rather anemic, not to mention a bit awkward to use. The old, larger solder pumps are usually too big for modern printed circuit board work, and professional desoldering stations cost hundreds of dollars.

Figure 1 — A 12 V vacuum pump available online for $25. [Jeff Whalin, KC9JOB, photo]

Figure 2 — A $10 solder trap. [Jeff Whalin, KC9JOB, photo]

Figure 3 — The finished desoldering tool (shown without the solder trap). [Jeff Whalin, KC9JOB, photo]

Here's a simple $35 modification you can make to an inexpensive combination tool or bulb-type solder sucker to remove solder like a pro. It's as easy as replacing the bulb with a small but powerful 12 V vacuum pump operated by a footswitch. The pump is available from sources like Amazon for about $25 (see Figure 1). You'll also want a solder trap, which can be purchased on Amazon for about $10 (see Figure 2).

To make this modification, wire the pump's 12 V dc line to a footswitch (used models can be found for less than $20), or any type of switch that you prefer (see Figure 3). Remove the bulb and attach tubing between its attachment point and the solder trap. Then use another short tube between the solder trap and the pump, and you're done. — *73, Jeff Whalin, KC9JOB (submitted by Fred Glenn, K9SO,* ***wa9mvz@yahoo.com****)*

A Helping Hand

My wire antennas are installed in trees that are in or on the edge of a forest. Inevitably, when putting a wire antenna into a tree, the pull string used to haul up the rope becomes tangled in leaves and sticks. I have to stop, walk to the other side of the tree, free the string, then walk back and resume pulling the rope into the tree. Of course, the string gets tangled again, so I walk to the other side and repeat.

The best way to put an antenna into a tree is to enlist another ham or a friend. During the many times I've performed this exercise solo, however, frustration was too often the result. I created a solution with some scrap wood, a saw, a wooden dowel, and about 30 minutes of assembly time (see Figure 4).

The result is a spooling jig that maintains the rope at the proper upward angle and away from the soil. It also

Figure 4 — You can use a dowel and some scraps of wood to create a "helping hand" to smooth the process of getting ropes and strings aloft.

helps keep tension on the line to avoid tangles. I've used this "helping hand" on many occasions and have put several antennas into trees with minimal time and frustration. — *73, Lionel Booth, N5LB,* **n5lb@outlook.com**

An Ad-Hoc Heatsink

I was trying to test parts for an analog adjustable-voltage 5 A power supply using an LM338 voltage regulator. Unfortunately, I discovered that the two different types of LM338 packages — TO-3 and TO-220 — did not work as they should. The TO-3 case-type adjusted voltage just fine, but wouldn't deliver more than 100 mA of current, even when using a proper heatsink. The TO-220 package would run at 7 A, but the voltage could not be adjusted.

I needed to quickly test both components without the laborious process of attaching and removing them from sizeable heatsinks. The solution was as simple as clamping a pair of locking pliers onto the regulators. The pliers have enough surface area to safely dissipate heat for brief tests.

Figure 5 shows two LM338 TO-220 regulators, one in the locking pliers, connected for testing. The other LM338 is there to show how the leads were bent to make it easy and safer for clip-on connections. Bending the pins in this way makes it less likely for any clip-on connection to short out with another. — *73, Phil Karras, KE3FL,* **ke3fl@arrl.net**

Sliding Insulators

I recently had to add extra insulators to my 144-foot wire loop antenna. It was impractical to take down the entire antenna, disconnect the wire, and add the necessary insulators, so I found an easier way.

I started with a 5½-inch piece of PVC. In one end, I drilled the hole for the rope. On the other end, I drilled a hole for the antenna wire. I then cut two slots 180 degrees apart, connecting the antenna hole to the end of the pipe.

To install this insulator, I fed the antenna wire through the slots and into the antenna wire hole. I then used PVC pipe cement to attach the cap. Next, I cemented a cap on the guy rope end of the insulator and ran the guy rope through that hole. Using this movable insulator allows you to slide it along the antenna wire until you reach the desired connection point and then the tie off the rope.
— *73, Jeff Rahmel, KA8ZAW,* **jrahmel@roadrunner.com**

"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 5 — A pair of locking pliers can be pressed into service as a heatsink. [Phil Karras, KE3FL, photo]

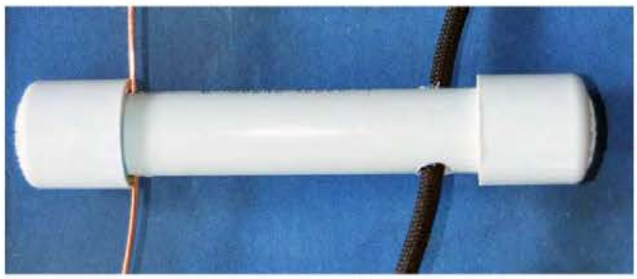

Figure 6 — A movable insulator. The antenna wire is at the top and the guy rope appears at the bottom. [Jeff Rahmel, KA8ZAW, photo]

Steve Ford, WB8IMY, wb8imy@arrl.net

Eclectic Technology

Super-Sharp RF Filtering — With Light

The latest advance in photonics brings light into the RF realm. Researchers at the University of Twente in the Netherlands have applied photonics to the task of filtering RF signals, creating flexible programmable filters with almost unbelievably sharp contours. According to reports, these filters function at frequencies well into the microwave range.

A Programmable Photonic Chip

At the heart of their breakthrough is a silicon chip that is capable of processing light itself (see Figure 1).

First, you use the RF signal to modulate the output of a laser. The RF-modulated light is fed to the photonic chip, where it is essentially disassembled according to the frequency of the light. The separate parts, like the radio side bands around the optical frequency, can then be processed separately. When all photonic processing is done and the desired spectral shape is created, the light is recombined and converted back into a radio frequency signal. The conversion back to RF takes place through a special high-speed detector.

If this technology makes it into transceivers, the result would be RF filters capable of enhancing reception to a level that would be difficult to imagine today.

"Don't Cross the Streams!"

As Dr. Peter Venkman warned in the movie *Ghostbusters*, crossing the streams generated by their proton packs could have unfortunate consequences. Researchers at the University of California, Berkeley, are defying this famous admonition by twisting streams of laser light using optical "antennas" made of concentric rings roughly equal to the diameter of a human hair. Through this technique, they have tremendously increased the amount of information that can be multiplexed, or simultaneously transmitted, by a coherent light source.

One technique for increasing the information a light source can transmit is to use polarization, where light waves are separated into horizontal or vertical orientations. This effectively doubles the amount of information transmitted.

The Berkeley scientists have taken the next step by using *orbital angular momentum*, or OAM, instead. To achieve this with light, however, they needed to create a special optical antenna — a *topological* antenna.

To make the topological antenna, the researchers used electron-beam lithography to etch a grid pattern onto indium gallium arsenide phosphide, and then bonded the structure onto a surface made of yttrium iron garnet. The researchers designed the grid to form quantum wells in a pattern of three concentric circles — the largest about 50 microns in diameter — to trap photons.

By applying a magnetic field perpendicular to their two-dimensional microstructure, the researchers successfully generated three OAM laser beams traveling in circular orbits above the surface. The amount of information such a system could carry would be phenomenal.

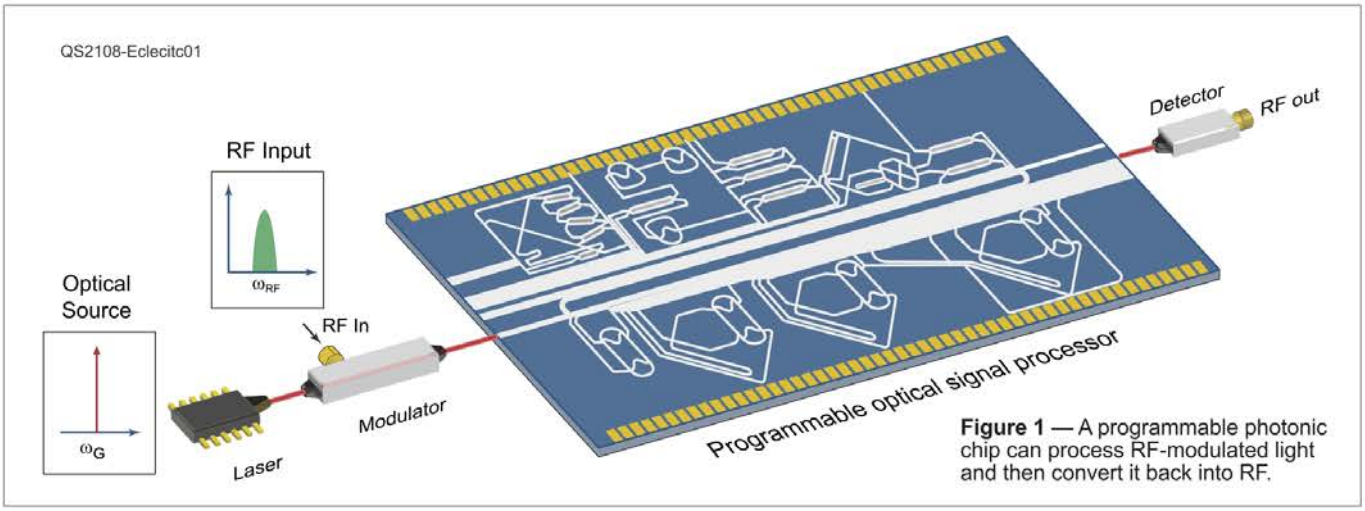

Figure 1 — A programmable photonic chip can process RF-modulated light and then convert it back into RF.

Ham Radio Creates a Planet-Sized Space Weather Sensor Network

For researchers who monitor the effects of solar activity on Earth's atmosphere, telecommunications, and electrical utilities, amateur radio is a valuable resource for crowdsourced science.

Kristina Collins, KD8OXT; David Kazdan, AD8Y, and Nathaniel A. Frissell, W2NAF

Space weather events, triggered by solar emissions and their interactions with Earth's atmosphere, can have significant effects on communications and navigation technology, as well as electric power systems. As with terrestrial weather events, the economic impacts of space weather-related disruptions can be substantial, affecting satellite systems, as well as systems on the ground. A severe geomagnetic storm (such as the Carrington Event of 1859) could have a catastrophic effect on modern infrastructure. Even solar storms of more ordinary size can induce currents in the power grid that increase energy prices, affecting manufacturing and commerce.

There's considerable interest in developing space weather forecasting technologies that use the Earth's ionosphere as a sensor for events in its neighboring atmospheric layers. The ionosphere occupies a privileged niche in the geospace system, as it's coupled into both the terrestrial weather of the neutral atmosphere below and the space weather of the magnetosphere above.

To fully understand ionospheric variability on small spatial scales and short timescales, the scientific community will require vastly larger and denser sensing networks. Although we have a good understanding of ionospheric climate — daily and seasonal variations are well known, as are the rhythms of the sunspot cycle — there are new and vital areas of research to be explored. For example, it's known that the ionosphere (and near-Earth space) experiences variability (e.g., radio signals can fade in and out over periods of seconds, minutes, or hours due to changes in ionospheric electron densities along signal propagation paths), but this variability hasn't been sampled or studied adequately on regional and global scales. With open-source instrumentation being cheaper and more plentiful than ever before, the time is ripe for amateur scientists to take distributed measurements of the ionosphere, and the amateur radio community is up for the challenge.

Radio Signals and the Changing Ionosphere

Just outside Fort Collins, Colorado, lies the heartbeat of the electromagnetic spectrum — and one key to precision measurements of the interactions between ham radio and solar weather. Shortwave listeners are familiar with the sound of radio station WWV, the time and frequency standard of the National Institute of Standards and Technology (NIST). It's the oldest continuously operating radio station in the US, having been on the air since 1919. Today, WWV and its sister station WWVH in Hawaii, broadcast, "At the tone, the time will be…" on 2.5, 5, 10, 15, and 20 MHz, with the frequencies calibrated to at least nine significant digits.

These stations provide listeners with standardized time information, high seas weather forecasts, and other programming. Station WWVB, located at the same Colorado site, transmits on 0.060 MHz and provides timing information to radio-controlled "atomic" clocks. Recently,

WWV's cesium-controlled carrier found another use as a beacon for ionospheric measurements — radio signals.

Radio signals provide a window into the changing ionosphere. The various signals from WWV, reflecting off the ionosphere, undergo changes in path length as the ionospheric electron density profile changes. This results in changes to the observed frequency of radio signals at receiving points, similar to the rise and fall in pitch of a passing train whistle.

Comparing the received radio signal with a precision local frequency standard, such as a GPS-disciplined oscillator, allows a user to measure these ionospherically induced frequency shifts (see Figure 1). This measurement is prepared and recorded with open-source software (visit **www.w1hkj.com** for more information). Numerous data sets recorded simultaneously from multiple locations offer information (when examined individually and collectively) about the ionosphere at the time the data is taken. This information includes the movements of traveling ionospheric disturbances and other important phenomena at various scales.

The Festival of Frequency Measurement

On October 1, 2019, the Ham Radio Science Citizen Investigation (HamSCI) celebrated the centennial of WWV with a Festival of Frequency Measurement.

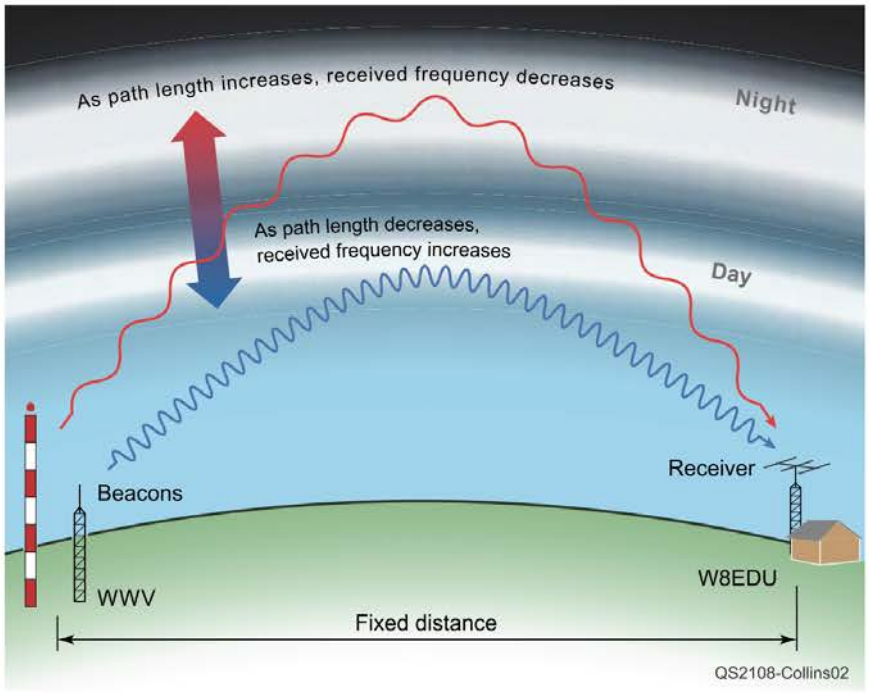

Figure 1 — Signals from radio station WWV reflecting off the ionosphere. Space weather affects how far a signal travels before it's received, and the receiving station detects this as a change in signal frequency. [Kristina Collins, KD8OXT, graphic]

HamSCI issued an open call to amateur radio operators and shortwave listeners to gather Doppler shift data, and about 50 stations responded (see Figure 2). The data is rich with signatures of ionospheric dynamics, including coherent wave-like disturbances with periodicities at night of about an hour. The observations are less active during the day. The data from the experiment is available at **https://zenodo.org/record/3707210#.YL5Tt0wpBdh** and the results are summarized in *IEEE Geoscience and Remote Sensing Letters* (**https://ieeexplore.ieee.org/document/9377452**).

WWV was never intended to provide this data, but the station's exceptional precision, high power, and guaranteed continuous availability make it a perfect beacon. Thanks to the advent of inexpensive GPS-disciplined oscillators and single-board computers, amateur scientists can assemble complete prototype systems to collect such data for less than $200, or they can build systems from existing equipment. Thus, the amateur community, mobilized on a national scale, can generate a large-scale, novel data set for ionospheric study.

Following the success of the WWV Centennial Festival of Frequency Measurement, data collection campaigns during the solar eclipses of 2020 were conducted, and further demonstrated the potential for scientists to engage with the amateur community. Dubbed the Eclipse Festivals, these events followed the template of the WWV centennial event on a global scale, using additional 10 MHz time-standard stations. The June 2020 Eclipse Festival, built around the annular solar eclipse across eastern Africa and Asia on June 21, ran for 3 days and included volunteer participation from 50 stations in 19 countries. The December 2020 Eclipse Festival, a 7-day campaign built around the total solar eclipse across South America on December 14, drew data submissions from over 80 stations. Both were advertised through the same channels used for radiosport contests and other events. The strong participation in these events demonstrates the community's interest in community science and the potential for deployment in science campaigns.

Figure 2 — The Festival of Frequency Measurement events drew participation from stations worldwide. The first event was held in 2019, to commemorate the WWV centennial (participating stations are shown in blue), and two more were held in 2020 — once in June (participating stations are shown in red) and then again in December (participating stations are shown in green) — to gather data during solar eclipses. [Kristina Collins, KD8OXT, graphic]

Making Space Weather Personal

The personal weather station has become a familiar fixture for meteorologists. Stations belonging to hobbyists, networked through sites like Weather Underground (**www.wunderground.com**), provide a dense constellation of sensors reporting air temperature and pressure, as well as precipitation. We have better knowledge of terrestrial weather because of these networks, but no such system exists yet for ionospheric weather.

Through HamSCI, ham radio operators and researchers are bridging this gap by designing hardware for a distributed network of personal space weather stations (PSWSs), accessible to professional and amateur scientists. These stations come in two varieties (see Figure 3): a low-cost model designed only for observations like those performed during the Festival of Frequency Measurement, and a more powerful software-defined radio, called TangerineSDR — a wide-

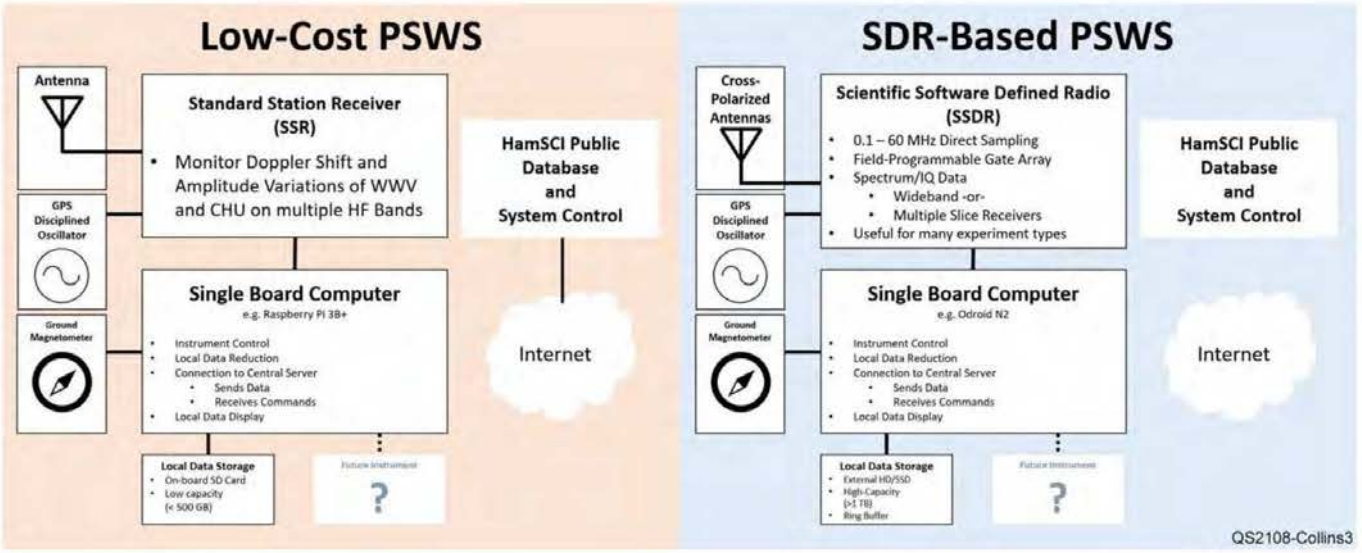

Figure 3 — Low-cost personal space weather stations (PSWS) are designed primarily for measurements of time-standard stations, such as WWV and the Canadian station CHU. More powerful software-defined radio (SDR) PSWS systems can be reconfigured for a range of experiments. [Nathaniel A. Frissell, W2NAF, graphic]

Equipment belonging to the Case Amateur Radio Club, W8EDU. [David Kazdan, AD8Y, photo]

band receiver that can be reconfigured for a range of experiments. At the core of both is a single-board computer, which interfaces with a set of modular instruments (such as a magnetometer) and uploads data to a central database.

These stations are in the prototyping and testing stage, with plans to deploy a network of PSWSs in the next 3 years, just in time to record the 2024 solar eclipse across North America. As the moon's shadow travels across Earth's surface, it will shield the radio stations from solar extreme ultraviolet radiation, providing an excellent opportunity to collect baseline radio data. We hope to have the network running in time for Festival of Frequency Measurement 2024, and we invite hams to join in as volunteer scientists to help improve our understanding of Earth's space environment.

Acknowledgments

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Kristina Collins, KD8OXT, is a PhD candidate in electrical engineering at Case Western Reserve University, focusing on distributed remote sensing. She is a longtime member of the Case Amateur Radio Club, W8EDU, and organizer of the Eclipse Festivals. She can be reached at **kd8oxt@case.edu**.

David Kazdan, AD8Y, earned his MD at the University of Cincinnati and his PhD in biomedical engineering at Case Western Reserve University (CWRU). In 2017, the university awarded him with the Carl F. Wittke Award for Excellence in Undergraduate Teaching. As a retired anesthesiologist, David has leveraged his passion for amateur radio in his Seminar Approach to General Education and Scholarship (SAGES) course at CWRU, where all students are required to earn their ham radio license. He can be reached at **ad8y@arrl.net**.

Nathaniel A. Frissell, W2NAF, is an Assistant Professor at The University of Scranton Department of Physics and Engineering. He earned his PhD in electrical engineering at the SuperDARN HF radar laboratory at Virginia Tech. Nathaniel was also involved in the Virginia Tech Amateur Radio Association (VTARA), where he coordinated the Volunteer Examiner (VE) team. He can be reached at **w2naf@arrl.net**.

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

Tips for Earning Nine-Band DXCC

Learn how to make the most DX contacts by taking advantage of propagation, contests, and online resources.

Christian Bravo, W4ALF

Immediately after earning my license in 2014, I worked toward earning the Mixed DXCC and Worked All States (WAS) awards. Seeing pictures of well-equipped stations with large, high-gain antennas, I wondered what was possible with a smaller station. It turns out just about anything is achievable, even from a small property lot.

As I accumulated DX entities across the bands, I became interested in the Five-Band DXCC (5BDXCC) certificate. Most, if not all, of my ham endeavors have been during periods of low solar cycle activity. I'm still amazed at what's achievable by getting on the air and experimenting with antennas, while utilizing different weak-signal modes like CW and FT8.

I've completed 5BDXCC (on 10, 15, 20, 40, and 80 meters), including endorsements for 30, 17, and 160 meters, for eight bands total. My ninth DXCC band will be 12 meters, and I've confirmed 62 DX entities on this band. I don't have a huge station or 1,500 W of power at my disposal, but it isn't necessary for 9BDXCC. Most surprising was my success with DXCC on the lower bands. I thought I would need height or lengthy antennas that wouldn't fit on my small property, but it was possible without them.

Chasing 9BDXCC has helped me learn a lot about the hobby. I now have a better understanding of propagation characteristics on different bands, antennas, related software, and a multitude of modes.

Antennas, Equipment, and Modes

Hustler 5BTV

My main antenna is a Hustler 5BTV with additions for 12 and 17 meters. This was my only antenna on 30 through 80 meters, with an added 17-foot wire connected above the 80-meter resonator and the other strung to a tree in an inverted L. With this setup, I was able to operate on 160 meters with 100 kHz of 3:1 bandwidth centered on the FT8 frequency. My choice of center frequency allowed for opportunities to operate CW on either side of 1.840 MHz. It's worth

A closeup look at Christian Bravo's, W4ALF, vertical antenna set up in the trees in his backyard.

noting that this 160-meter "hack" didn't allow the use of 80 meters with the wire in place in the 80-meter resonator versus the standard whip antenna. This was an acceptable compromise because I'd just finished 80-meter DXCC and was ready for 160 meters. My vertical antenna is on a tilt mount, which made it easy to replace the added 160-meter wire with the stock 80-meter whip antenna when desired.

To provide my vertical antenna with better performance, I have 32 20-foot-long antenna radials. I placed the antenna 23 feet away from my house among some trees in my backyard. My choice of a vertical antenna allows for a low takeoff angle for DX and an easy fit on a small property. I attempted other wire antenna configurations, trying to configure it to my property or get it up high enough, but kept coming back to the vertical. Although vertical antennas can add some noise, it wasn't enough to keep me from making DX contacts all over the world and achieving my award goals.

Cushcraft MA5B Mini Beam

The Cushcraft MA5B is a 6- to 20-meter two-element beam and dipole on 12 and 17 meters. This is an extremely compact mini beam with a 7-foot boom and elements no longer than 17 feet. The small size is achieved using traps and cap hats.

The mini beam was a directional antenna using a Yaesu rotor, placed on a 4½-foot tower atop my second-story roof. The setup gave me a little height and some gain on 6 through 20 meters. While working toward the QRP DXCC and WAS awards, the beam antenna wasn't necessarily a requirement for my pursuits. The MA5B played its role of getting me 5BDXCC a little faster than I could without it.

Elecraft K3 Transceiver

The Elecraft K3 is an excellent choice for DXing and CW operations. I added an Elecraft 500 W amplifier for when I needed the extra boost. It rarely sees action past 300 W.

Christian Bravo's, W4ALF, home station.

I concentrated on CW and weak propagation digital modes such as JT65 and FT8. Both CW and FT8 worked equally well and made up the bulk of my contacts.

The amount of contacts you make will reflect what band you're working on, your preferences, and equipment. According to my 2021 Club Log results, I worked 56.75% CW, 27.25% phone, and 15.99% data.

Choosing a Band

I learned a lot about propagation, antennas, and what I could do to increase my chances of landing DX contacts.

I operated the higher HF bands first, making sure I was working the grayline mode. As sunspots began to wane, I moved my focus to the low bands (40, 80, and 160 meters). I spent a lot of time operating the predominantly nighttime bands, 80 and 160 meters. The last of the low bands I tackled was 160 meters, which has an operating season of roughly November through April in the Northern Hemisphere.

I made sure to be on the radio during any DX contests, to help increase my chances of working more people.

The Right Tools

It's crucial to have logging software keeping track of your status with awards, as well as spotting data. This allows you to quickly decipher what stations you need

to focus on. I used *Ham Radio Deluxe* (*HRD*) for logging and found it to be an indispensable tool. Not only does it track my awards, but it also indicates whether a contact is needed on a specific band. These features aren't unique to *HRD*, so it's likely your logger does the same. I also regularly had **www.dxwatch.com** open on a separate computer monitor to watch spots across the bands.

To figure out propagation, I used **www.voacap.com**, which allows you to get propagation predictions between two locations. Their propagation prediction wheel indicates what band might be open between locations and at what times, with an associated probability percentage of success by hour.

Another site I monitored is **www.dxmaps.com**. These live data sites provide consolidated data from various sources to indicate what bands are open and where. Their map interface makes identifying specific geographical openings easy.

Operating DX on Lower Frequencies

John Stanley, K4ERO

While waiting for higher solar activity to open up on 17 through 10 meters, don't neglect 160 and 80 meters. How more sunspots affect DX on these lower frequencies is controversial, but they're useful even when the sun is spotless. Radio waves passing through thinner D and E layers allow them to go further and longer during the daylight hours.

With higher sunspot numbers (SSNs) post-sunset signals will be weaker, as some D- and E-layer absorption continues into the darkness, while pre-sunrise signals may benefit from a stronger F layer. These factors affect the popular grayline mode, which uses paths along the daylight/darkness terminator.

Below 4 MHz, noise limits reception. Worldwide thunderstorms make static, which follow any dark path to your receiver, and close storms are the worst offenders. Longer skip zones on 80 and 160 meters during the low sunspot years decrease nighttime static so weaker DX signals can be heard.

Operators seeking nine-band DXCC should build their 160- and 80-meter country totals now. When the SSN goes high, it may be harder to add countries on 160 and 80 meters, as many rare DX stations migrate to the higher bands.

The Reverse Beacon Network (**www.reversebeacon.net**) is another helpful site that not only provides DX spots, but signal strength reports from listening stations worldwide allow you to see if you're being heard after calling "CQ" in CW mode. This helped me figure out if I needed to focus on a specific geographic region based on my signal reports from those areas.

A Few Tips

Below are a few operating tips to remember when trying to reach your DX operating goals:

✔ Be open to different modes. Operating CW or FT8 can help significantly with chasing DX.

✔ Learn about the propagation and band you're operating on. Your time on the air should be focused around the DX spots you need according to your logger, propagation openings, and contests to maximize productivity.

✔ Embrace opportunity. If a 160-meter contest is happening over the weekend, then take advantage of the increased on-air activity that can land you a log full of DX.

✔ Utilize tools and websites (such as the ones listed in this article) that'll help you understand when to be on the bands you need when making DX contacts is likely.

Conclusion

It's predicted that the bands may open for a strong propagation cycle, and I've already seen some good openings on the HF bands lately. I believe now is a good time to get on the air. Operate on the low bands when propagation isn't great and the higher HF bands when there are openings.

There are always opportunities to earn awards or get on the air!

All photos by the author.

Christian Bravo, W4ALF, earned his Amateur Extra-class license in 2014. He has achieved ARRL DXCC on eight bands, ARRL WAS on five bands, and most recently VUCC satellite and WAS satellite. He's a CW instructor with CWops CW Academy and is active participating in Summits on the Air (SOTA) and Parks on the Air (POTA). Portable QRP operations and CW are his favorite styles of operating. Christian currently works as a Java developer for Kroger Technology. He can be reached at **w4alf@arrl.net**.

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

Anatomy of a Special Event Station

Chris Brady, N3CB

There are few activities in our hobby as rewarding as operating a special event station. Operating these stations requires planning, publicity, and technical skills. A well-organized approach ensures the activity will be successful and fulfilling to the participating hams and event hosts.

Making Connections

I'm the News Operations Supervisor for KYW-TV, the CBS television station in Philadelphia, Pennsylvania. One of the locations we went to film in 2019 was the Elmwood Park Zoo in Norristown. This small community zoo was celebrating their 95th anniversary.

When TV planning began, I had already contacted the zoo's directors of marketing and guest services, the manager of special events, and a marketing associate. I immediately began thinking about how I could create an opportunity for a special event station during the zoo's 95th anniversary.

One of the most difficult parts of planning a special event is being able to successfully "sell" amateur radio. Most people have no idea what the hobby is, what it involves, or why they should be interested in connecting with hams for an event. However, events like the annual Route 66 On the Air Special Event are exceptions. The Route 66 celebration is an example of established ham relationships that can help pave the way for new events.

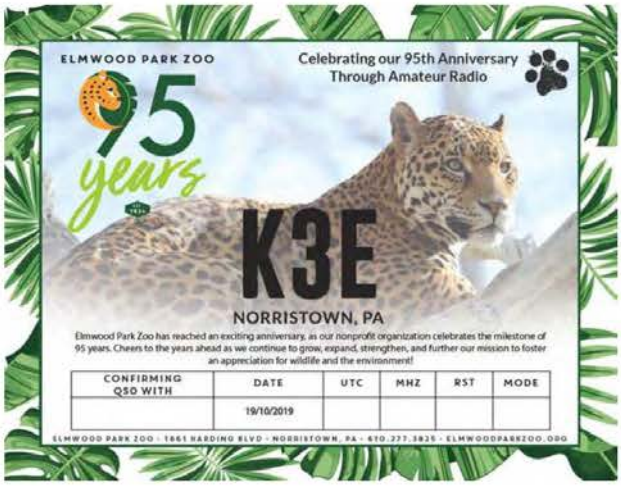
> Special event stations are a great opportunity to connect with community leaders and spread knowledge of amateur radio.

I had an opportunity to create a professional relationship with the zoo's management team prior to involving ham radio through an

The K3E Special Event Station at the Elmwood Park Zoo in Norristown, Pennsylvania. From left to right: Greg Malone, WA3GM; Kurt Magni, NN3C; Ken O'Connor, KB3DFR, and Sal Marandola, NC3U.

on-site meeting and subsequent phone calls. Generally, businesses understand that news coverage provides publicity, but they don't always understand what amateur radio can provide.

I explained that there was an opportunity to promote the zoo with little to no effort from them. I pointed out that many hams look for special event stations, hoping to make a unique contact. In return, they typically expect a commemorative card or certificate, which is another way to promote an event. These often include a logo or photograph, and background information of what's being celebrated.



The K3E special event station QSL certificate.

Planning the Special Event

It's important to consider your operating location and its impact on the surrounding area. Safety from wires, power cords, antennas, and RF exposure should be your main concern. Also, although COVID-19 restrictions are slowly being lifted, please follow any restrictions in place for your area to ensure you're keeping yourself and the people around you safe.

Zoo management and I agreed on a picnic pavilion close to ac power, which also allowed amateur radio to be displayed to the public. This location was covered, was located at the crossroads of several busy walkways, and had plenty of power and Wi-Fi. It also sat beneath dozens of tall trees for wire antennas.

A special event often involves a special call sign. There are hundreds of combinations of 1 × 1 call signs. These are valid for a period of about 2 weeks, so we had to plan our call request and special event carefully. The zoo and I settled on K3E, with the "E" signifying Elmwood and the "3" for our Pennsylvania operating location.

When explaining call signs to non-hams, they're best compared to local broadcast station identities. These are good examples, particularly if a radio station in your area has a clever jingle attached to that call. This becomes something non-hams can relate to. It's important to explain this call sign selection step with your hosts, as it will become the identity of your ham radio event station. Be prepared to explain the difference between amateur radio and broadcasting to your hosts.

With five special event 1 × 1 call sign coordinators, I used **www.1x1callsigns.org**, but the ARRL Volunteer Examiner Coordinator (VEC) system is also a helpful resource (**vec@arrl.org**). The application process is straightforward, with easy-to-follow instructions.

If you want to publicize your event in *QST*, be mindful of the deadlines. After deciding on a date, apply for a special call sign. *QST* requires a 2-month lead time for inclusion in the "Special Event Stations" column. This is an important step in conveying all the pertinent information for obtaining a card or certificate from your operation.

Certificate and Signage

Because the Elmwood Park Zoo special event wasn't sponsored by a radio club, I approached four operators that had personalities and talents to complement this project: Kurt Magni, NN3C; Greg Malone, WA3GM; Sal Marandola, NC3U, and Ken O'Connor, KB3DFR.

We decided that 40 and 75 meters were the best bands to operate. I recommend investing in a selection of band-pass filters. They're invaluable for reducing interference between stations.

For amateurs contacting the special event station, the "face" of the event is the design of the certificate. A clever design adds some professionalism to the endeavor. The zoo's marketing associate created the design based on my examples of a basic QSL card layout. Be sure to print these out prior to the event. I guessed about 10 – 15% respondents and was right on target.

We created a .png file of an adapted version of the zoo's anniversary graphics, the event call sign, and one of the zoo's animal graphics. A local sign shop used the file to create two vinyl signs with grommets for around $75. Signage helps identify where your station is located and what the event is. Information regarding the date and time was left off the signs to make them reusable if we were invited back.

Not everyone has access to marketing associates or design directors, but there are other ways to get help. Don't be afraid to ask one of your children, a neighbor, or even a local school for assistance. Designing a certificate looks great on an aspiring artist's resume.

A young guest at the zoo stopped by to operate K3E with Sal Marandola, NC3U.

Setup and Operation

Our special event was held on Saturday, October 19, 2019, with the call sign K3E. This coincided with the Elmwood Park Zoo Harvest Fest, which is essentially a Halloween costume day for visitors. Sal, Kurt, and I set up antennas on Friday evening after the zoo closed for the day. The zoo programming manager monitored us as we tested our compressed air tennis ball launcher. We wanted to make sure that the noise wouldn't bother the animals. Next, with two runs of coax safely pulled from the dangling ladder-line sections, our transmission lines were corralled and tied to one of the pavilion support posts.

The morning of the event, we set up a pair of tables, ran power, unboxed radios, and got computers running with *N3FJP's Amateur Radio Software* for logging.

Operations began promptly at 10 AM. The five of us even wore Halloween animal masks to fit in with the other zoo festivities. The event finished around 4:30 PM, as the sun began to set. I was pleased with the turnout. I anticipated about 200 contacts, and we ended up logging around 230 CW/SSB contacts.

QSL Certificate Submission

Of the 30 contacts who requested the certificate, only about 10 followed the printed QSL directions published in *QST*. The printed instructions for a certificate are different than those for a card. While many hams sent along a self-addressed stamped envelope (SASE), the certificate was printed on heavy card stock. It would have been destroyed if it was folded to fit inside the envelope.

This was my fault, as I had the financial responsibility for postage and the correct envelope size. The cost to mail a certificate-sized envelope is three times that of a business envelope. Many hams provided no postage support, while a select few sent more than what was needed.

You may want to consider offering a link from which a QSL certificate can be downloaded. This requires no printing costs or postage fees.

Final Thoughts

Special event stations are a lot of fun to plan for and operate. I hope you'll be able to identify a local activity or event and make a pitch for it to involve amateur radio. The hardest part is just getting started!

All photos by the author.

Chris Brady, N3CB, was first licensed in 1989. He's active on many repeaters in the Philadelphia, Pennsylvania, area and is an avid HF contester. He also enjoys temporary HF station operation by assembling a small group of friends annually to operate Field Day, or organizing special event stations.

His career in broadcast television news began 35 years ago at WNEP in Scranton, Pennsylvania. For the past 33 years, he's been the News Operations Supervisor for KYW-TV in Philadelphia. Chris has won five Regional Emmy Awards and is a member of the National Academy of Television Arts & Sciences (NATAS) Silver Circle. Chris can be reached at **brady@kyw.com**.

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

Rick Lindquist, WW1ME, ww1me@arrl.org

Happenings

Revitalization of Field Services with New Organization

The Field Services that ARRL Headquarters (HQ) provides to its member-volunteers are now in the spotlight with a reorganization and a fresh start to Section Manager and Affiliated Club engagement.

The backbone of ARRL, and the Amateur Radio Service, is the expansive field organization of volunteers. This is especially true of our Board members, our "first among peers," who provide leadership to this vast network of engaged volunteers. During a marathon series of Zoom calls on June 9 with ARRL Section Managers and most ARRL Board members in attendance, the restructuring of the Field Services organization at HQ was announced.

Bob Naumann, W5OV, who has a lifetime of experience as a radio amateur — ranging from contesting, to public service, to working with a number of well-known industry retailers — is now serving as the Director of Operations following the retirement of Norm Fusaro, W3IZ.

Mike Walters, W8ZY, who has been involved with field volunteers for many years and is currently the Section Emergency Coordinator (SEC) for Connecticut, is now serving as the Field Services Manager.

Bart Jahnke, W9JJ, who was managing Field Services, remains responsible for Radiosport and is also taking on the role of Regulatory and Advocacy Manager following the retirement of Dan Henderson, N1ND.

The meetings went on to discuss the focus the ARRL Board has placed on Field Services, working to create a new standing committee to oversee its revitalization and growth. Also discussed were the initiatives being undertaken with Section Managers to foster collaboration, share content, undertake projects, and set expectations.

The first project will be a focused census that a dozen Section Managers across the country will be driving with local clubs to understand the disparity between the ever-growing number of licensed hams versus the unchanging number of active hams.

We are very excited to turn the page and begin this new chapter for Field Services, and to continue forward with our digital transformation of ARRL.

ARRL Section Manager Election Results Announced

In the only contested election in the spring Section Manager election cycle, Utah ARRL members elected Pat Malan, N7PAT, as their new Section Manager (SM) for a 2-year term commencing July 1. Malan, of South Jordan, received 419 votes, while incumbent Mel Parkes, NM7P, garnered 339 votes. Parkes had served as Utah Section Manager for 22 years. ARRL Headquarters counted and verified the ballots on May 18.

In New Hampshire, Pete Stohrer, K1PJS, of Concord, was the only nominee for Section Manager when nominations closed on March 4. Stohrer, who served as SM from 2013 until 2019, succeeds John Gotthardt, K1UAF, who decided not to seek a new term.

Six incumbent Section Managers faced no opposition and were declared re-elected: Marty Pittinger, KB3MXM (Maryland-DC); John Bigley, N7UR (Nevada); Bob Buus, W2OD (Northern New Jersey); Bob Beaudet, W1YRC (Rhode Island); John Litz, NZ6Q (San Joaquin Valley), and Dale Durham, W5WI (West Texas).

All new terms began on July 1.

Woodsat, LightCube to Offer Satellite Enthusiasts Something Offbeat

The interactive LightCube and the novel Woodsat satellite projects are both are somewhat outside the box in terms of amateur satellites.

NASA has selected LightCube, along with 13 other small research satellites, to fly as auxiliary payloads aboard rockets launching between 2022 and 2025, as part of the agency's CubeSat Launch Initiative. Designed, built, and tested by an interdisciplinary team of students, advisors, and engineers across multiple organizations, LightCube is a microsatellite educational mission that aims to produce a light visible to the naked eye of observers on Earth. The spacecraft's two xenon flashtubes will be triggered via amateur radio.

When the light beacon is activated, the 1U CubeSat will be visible momentarily (each flash will take 8 microseconds) from the ground, with a brightness similar to the International Space Station (ISS).

The LightCube mission is a collaborative project between Arizona State University's (ASU) Interplanetary Initiative, the ASU Ira A. Fulton Schools of Engineering, Vega Space Systems, and CETYS (Centro de Enseñanza Técnica y Superior) Universidad. ASU designed and built the satellite.

An artist's rendering of Woodsat, showing its extended selfie stick.

The WISA Woodsat project, sponsored by plywood supplier WISA in an unconventional PR initiative, is poised to place a wooden satellite into orbit by the end of the year. The idea is to test the suitability of treated wood as a low-cost and widely available material for space applications. The IARU posting for Woodsat indicates that several amateur radio experiments will be on board, as well as photo downlinking, including selfies.

The satellite will be a 10-centimeter cube weighing 1 kilogram, covered on all sides by coated birch plywood from WISA Plywood.

The satellite would downlink its telemetry and images from two cameras using amateur radio frequencies.

Woodsat will be able to extend a selfie stick to capture photographs of the wooden box as it hurtles through space at 40,000 kilometers (24,800 miles) per hour. This will allow the mission leaders to monitor the impact of the environment on the plywood. The satellite would downlink its telemetry and images from two cameras using amateur radio frequencies.
— *Thanks to* AMSAT News Service *via JoAnne Maenpaa, K9JKM*; E&T Magazine, *and the IARU*

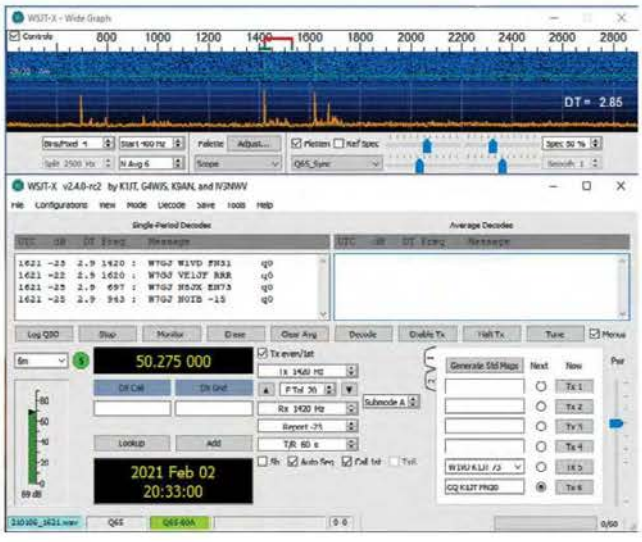
WSJT-X Version 2.4.0 in General Release, Version 2.5.0 on the Horizon

As of June, *WSJT-X* version 2.4.0 was available in general release, with version 2.5.0 ready to follow. According to co-developer Joe Taylor, K1JT, *WSJT-X* version 2.4.0 includes the new digital mode Q65. This protocol is designed for two-way contacts over especially difficult propagation paths, including ionospheric scatter, troposcatter, rain scatter, TEP, EME, and other types of fast-fading signals.

"On paths with Doppler spread more than a few Hertz, the weak-signal performance of Q65 is the best among all *WSJT-X* modes," the *Quick Start Guide* asserts.

Q65 uses 65-tone frequency-shift keying and builds on the demonstrated weak-signal strengths of QRA64, a mode introduced to *WSJT-X* in 2016. Q65 offers user message and sequencing identical to that in FST4, FT4, FT8, and MSK144. It includes a unique tone for time and frequency synchronization.

Testing showed that Q65 will enable stations with a modest Yagi and 100 W or more to work one another on 6 meters at distances up to around 2,000 kilometers on most days of the year, in dead band conditions.



The updated *WSJT-X* version 2.4.0 in action.

East Bay SM Jim Siemons, W6LK, Steps Down; Mike Patterson, N6JGA, Appointed

Mike Patterson, N6JGA

After serving as East Bay Section Manager (SM) since July 2018, Jim Siemons, W6LK, stepped down earlier this year because he has relocated to Wyoming. ARRL Life Member Mike Patterson, N6JGA, was appointed to succeed him, effective June 1.

Siemons said, "There really is not a greater honor for a ham like me than to watch so many people get their licenses, learn the code, program a radio for the first time, win some 'wallpaper,' or just enjoy each other's company over a cup of coffee. I get to constantly witness this as SM. ARRL afforded me the opportunity to have experiences and gain memories that will last me forever!"

Patterson is serving the balance of Siemons' term, which extends to the end of this year. Patterson's amateur radio background is strong in mentoring, emergency communications, public service, and club leadership. He is a Volunteer Examiner and the Treasurer of the Northern Amateur Relay Council of California — the repeater coordination body for the area that covers about two thirds of California. Patterson is also on the Board of the Pacific Division annual convention (Pacificon), active in the local Community Emergency Response Team (CERT), including serving as trustee of the group's repeater, past president of the Mount Diablo Amateur Radio Club (MDARC), and a member of several clubs within and outside the Section.

Patterson has been very active in MDARC's education and training programs, and has helped many people prepare for their first license and to upgrade.

Bart Jahnke, W9JJ, who was at the time functioning in his capacity as ARRL Radiosport and Field Services Manager, made the appointment based on the recommendations of Siemons and ARRL Pacific Division Director Kristen McIntyre, K6WX.

Section Manager Nomination Notice

To all ARRL members in Alabama, Alaska, Delaware, East Bay, Kansas, Michigan, New Mexico, Santa Barbara, Tennessee, and Western Massachusetts. You are hereby solicited for nominating petitions pursuant to an election for Section Manager (SM). Incumbents are listed on page 16 of this issue.

To be valid, a petition must contain the signatures of five or more full ARRL members residing in the Sections concerned. It is advisable to have a few more than five signatures on each petition. A sample nomination form is available on the ARRL website at **www.arrl.org/section-terms-nomination-information**. Nominating petitions may be made by facsimile or electronic transmission of images, provided that upon request by the Field Services Manager, the original documents are received by the manager within 7 days of the request. It is acceptable to submit signatures that have been sent via email or mail under the following guidelines: The petition copies must be made from the original form supplied by ARRL or downloaded from the ARRL website. The form must be exactly the same on both sides (i.e., autobiographical information should appear exactly the same on all copies). All forms/copies must be submitted together.

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

We suggest the following format:

(Place and Date)

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

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

(Signature _____ Call Sign _____ City _____ ZIP _____)

Any candidate for the office of Section Manager must be a resident of the Section, an amateur radio licensee of Technician class or higher, and a full member of the League for a continuous term of at least 2 years immediately preceding receipt of a nominating petition. Petitions must be received at Headquarters by 4 PM Eastern Time on September 10, 2021. If more than one member is nominated in a single Section, ballots will be mailed from Headquarters no later than October 1, 2021, to full members of record as of September 10, 2021, which is the closing date for nominations. Returns will be counted November 23, 2021. Section Managers elected as a result of the above procedure will take office January 1, 2022.

If only one valid petition is received from a Section, that nominee shall be declared elected without opposition for a 2-year term beginning on January 1, 2022. If no petitions are received from a Section by the specified closing date, such Section will be resolicited in the January *QST*. A Section Manager elected through the resolicitation will serve a term of 18 months. A Section Manager vacancy occurring between elections is filled through appointment by the Field Services Manager. — *Mike Walters, W8ZY, Field Services Manager*

Call for Nominations for ARRL Director and Vice Director

Attention to full ARRL members in the Central, Hudson, New England, Northwestern, and Roanoke Divisions. You have the opportunity to choose a Director and Vice Director to represent you for 3-year terms beginning January 1, 2022.

ARRL is governed by its Board of Directors. A voting Director is chosen by ballot by the full (licensed) ARRL members in each of its 15 Divisions. Vice Directors, who serve in the absence of the Director at a Board meeting and succeed to the position of Director should a vacancy occur, are chosen at the same time. Elections are held in five Divisions per year. It only takes 10 full members in a Division to nominate a candidate for either office.

Qualifications

The eligibility of nominees for the positions of ARRL Director and Vice Director will be reviewed by the Ethics & Elections Committee, composed of three Directors not subject to election this year: Mickey Baker, N4MB; Tom Abernethy, W3TOM, and Jeff Ryan, KØRM. A nominee must be at least 21 years old and must have been licensed and a full member of ARRL for a continuous term of at least 4 years immediately preceding nomination. Each nominee must provide information concerning their employment, ownership, and investment interests, and other financial arrangements to ensure compliance with the Conflict of Interest Policy (see Article 12 of the ARRL *Articles of Association and Bylaw 45*, available at **www.arrl.org/general-information**). The qualifications for Director and Vice Director are identical. All the powers of the Director are transferred to the Vice Director in the event of the Director's death, resignation, recall, removal outside the Division, or inability to serve.

Nomination Procedure

Step 1: Obtain official nominating petition forms. Starting July 1, any full member residing in a Division where there is an election may request an official nominating petition package in writing, either by letter or via email, to **cpereira@arrl.org**. The request must reach the ARRL Secretary no later than noon EDT on Friday, August 13, 2021. If you are seriously considering running or nominating someone to run, please don't wait until the last minute to request the forms. The deadline for submitting a completed petition form is just 1 week later.

Step 2: Obtain signatures and complete questionnaire. Only the official form may be used. The petition form has two sides. To be valid, a nominating petition must name the candidate and must bear the signatures of 10 full members of the Division. The candidate must complete the other side, providing the information required to determine eligibility, certifying its accuracy, and agreeing to assume the office if elected.

Step 3: Submit petition form. The completed form must reach the Secretary no later than noon EDT on Friday, August 20, 2021. The submission may be made by electronic transmission of images (i.e., a PDF or JPEG attachment to an email) or facsimile provided that upon request, the original documents are received by the Secretary within 7 days of the request. A person who is nominated for both Director and Vice Director may choose to decline the nomination for Director; otherwise the nomination for Director will stand and that for Vice Director will be void.

On Monday, August 23, 2021, the Secretary will notify each candidate of the name and call sign of each other candidate for the same office. Candidates will then have until Friday, September 3, 2021 to submit a 300-word statement and a photograph if they desire these to accompany the ballot, in accordance with instructions that will be supplied.

Balloting

If there is only one eligible candidate for an office, they will be declared elected by the Ethics & Elections Committee. If there is more than one eligible candidate for an office, the full members in that Division who are in good standing as of September 10, 2021 will have the opportunity to cast ballots. Official paper ballots and candidates' statements will be mailed to members who are eligible to vote no later than October 1, 2021. Completed ballots must be received at the designated PO Box in the envelope provided by noon Eastern Time on Friday, November 19, 2021. The candidate receiving the most votes will be declared the winner that day.

Absentee Ballots

A full member who is residing temporarily outside their home Division, including overseas, may arrange to vote in the home Division by notifying the Secretary prior to September 10, 2021, giving their current mailing address as reflected in the ARRL membership records (i.e. *QST* mailing address) and the reason why another Division is considered home. Members with overseas military addresses should take special note of this provision; in the absence of information received to the contrary, ballots will be sent to them based on their postal addresses.

The Incumbents

The incumbent Directors and Vice Directors, respectively, in the five Divisions in which elections will be held this year are:

Central: Kermit Carlson, W9XA, Director, and Carl Luetzelschwab, K9LA, Vice Director

Hudson: Ria Jairam, N2RJ, Director, and Bill Hudzik, W2UDT, Vice Director

New England: Fred Hopengarten, K1VR, Director, and Phil Temples, K9HI, Vice Director

Northwestern: Mike Ritz, W7VO, Director, and Mark Tharp, KB7HDX, Vice Director

Roanoke: Bud Hippisley, W2RU, Director, and Bill Morine, N2COP, Vice Director

For the Board of Directors
May 18, 2021

David Minster, NA2AA,
Secretary/Chief Executive Officer

Rick Palm, K1CE, k1ce@arrl.net

Public Service

Keys to a Successful
Emergency Management and EOC Partnership

Many emergency communicators wonder how to get radio operators connected to their local emergency management department and emergency operations center (EOC). This is done by understanding and embracing our true role — to serve and support the professionals in the agency and EOC in the way they see fit. We're there to respond to their orders, even if sometimes we may be assigned non-amateur radio tasks. We help them with their profound and often complicated mission of public safety during an emergency.

Tips for Success

The inspiration for this editorial comes from a Florida county group that truly understands how the relationship works and why they've garnered the respect and appreciation of the emergency manager and their department. Here are a few things they've done:

1 What's asked of them by the emergency management department or EOC. Once, this entailed moving an entire radio room, which was done within a week, and with a positive attitude.

2 Purchased and installed their own shelving for the radio room (this cost a few hundred dollars).

3 Held serial license courses until most of their members earned their Amateur Extra-class licenses, gaining knowledge and expertise that the emergency manager could count on.

4 Conferenced on the Incident Command System (ICS) and conducted Homeland Security Exercise and Evaluation Program (HSEEP) exercises of professional quality, and wrote full after-action reports and improvement plans. Going forward, they tracked their progress on the improvement plan action items.

5 Recruited the emergency management staff to evaluate their exercises. Suggested improvements were promptly adopted.

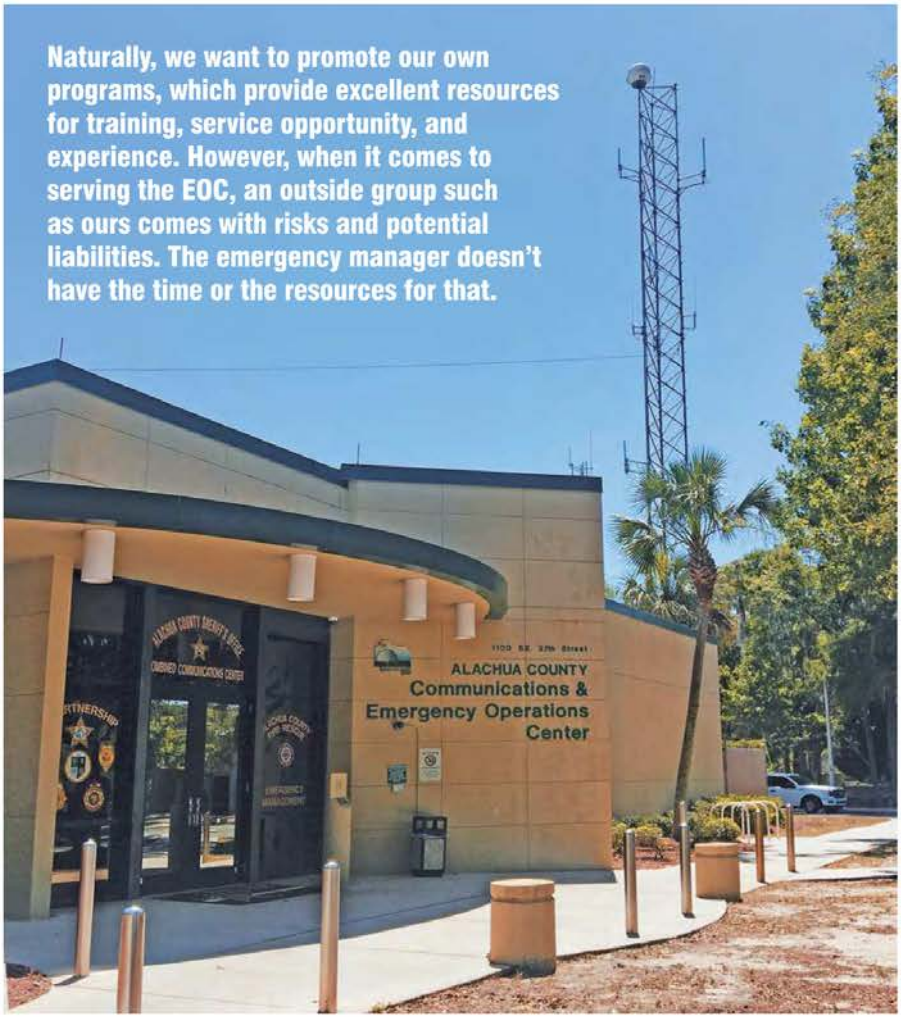
6 Explored outside systems and became licensed for the SHAred RESources (SHARES) HF Radio program administered by the Department of Homeland Security's (DHS) National Coordinating Center for Communications (NCC) for interoperability.

7 Offered to help with anything. For example, they diagnosed the EOC's HF noise problem and implemented solutions.

8 Their license class netted an influential member of law enforcement, creating a connection that opened doors.

9 They knew when to stay out of the way.

Naturally, we want to promote our own programs, which provide excellent resources for training, service opportunity, and experience. However, when it comes to serving the EOC, an outside group such as ours comes with risks and potential liabilities. The emergency manager doesn't have the time or the resources for that.



The Alachua County Emergency Operations Center in Gainsville, Florida. [Rick Palm, K1CE, photo]

10 Brought in their own equipment. This allowed them to operate at no cost to the county, but the county decided to purchase better equipment for them after seeing what they could do.

11 Implemented the full ICS for managing their Field Day.

12 Members joined diverse outside groups to gain more knowledge to benefit their county.

Serving Your Local EOC

Some things to do when looking to serve at your EOC include trading your group's badges, logo hats, and polo shirts for an EOC-provided "Communications Volunteer" or "RADO" (Radio Operator) badge, cap, or shirt, and knowing and observing the ICS as it's implemented in the EOC. Sometimes you're part of the Communications Unit (COM Unit or COMU) under the logistics section and report to the COMU Leader (COML), or whoever is designated by the emergency manager. (The COMU is not always activated; we have to recognize that the ICS is flexible, expandable, and contractible to include only those elements that are needed. For example, a logistics section function, such as communications, might fall under the planning section because there's no logistics section chief.)

There are many other radio operators/communicators involved at the EOC, such as professional sheriff's department dispatchers and other emergency support function (ESF) radio operators. All operators need to be prepared to report to the COML or designee for tasking and coordination. We cannot bring our own group's organization, rules, and ways of doing things and try to make the staff deal with them. That would be a subversion of the ICS.

Our groups' roles involve training our members to serve within the ICS, no matter what that looks like during any given disaster. We write everything up with ICS-approved forms, send messages with the ICS message form, and otherwise use ICS for everything we do. The Red Cross has followed the ICS model, too — their ARC-213 message form was patterned after the ICS version.

A Final Word

In my local county ARES® program, the emergency manager is now convinced that the operators will work well within the emergency management department and EOC under the ICS. The emergency manager is open to engaging with others who will present themselves as volunteers for the department, and not trying to run the show.

The emergency management staff is comfortable enough with Alachua County ARES that they ended up listing ARES as a component of the ESF for Communications (ESF #2). The professional staff looks at the group here and sees an opportunity for service and support.

We need to solve the EOC's problems and meet their needs — serving them by responding to their orders and tasks for us. We're not trying to sell them on ARES. We're trying to sell them on our individual volunteers, who have completed the training requested, gained the experience needed, and will serve confidently, competently, and appropriately.

Thanks to Gordon Gibby, KX4Z, for subject matter expertise and source material.

Field Organization Reports

May 2021

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**.

542
W7PAT

512
WA7PTM

510
KK6GXG

505
N9VC

465
WA3EZN

363
W7EES

336
KE8BYC

288
KD2LPM

281
WA2CCN

268
KE8KOC

250
KW9EMG

230
W3GWM

220
KD2GRS

210
AC0KQ

209
N2WGF

205
ND8W

200
N2LC

195
KC8T
KM8V

190
N2RQ

170
KB1TCE

166
KB8RCR

165
K0RCJ

160
W2PH
N5MKY

155
W4CMH
N4CNX

154
K9ILJ

145
KT5SR
WB9WKO
W4DNA
AC8NP
KW1U

144
N3KRX

142
KD2GXL
N3XMB

140
K9LGU
K4IWW
KK3F
KD8ZCM

139
AD9CM

135
K1XFC
W3YVQ

134
KV8Z

131
K7OED

132
WD8USA

130
KB5PGY
WM5N
KC9FXE
WK4WC
W8DJG

125
AG9G
W8MAL
K2MZ

122
N8SY

120
WA4VGZ
WC4FSU
KD0HHN
K3JL
KY2D
KB8PGW
KC8YVF

118
KY2MMM

117
K2TV

115
K0FBS
AD3J
AB8MW
KD8KBX
N1TF

113
AB3WG

110
WA1URS
AD4DO
WA3QLW
N3SW
KC8WH
KI7TIG
N1IQI
KD2JKV
W1RVY
K3IN
WB8TQZ
K8BKM

106
K8MDA

105
W2PAX

104
K1HEJ

100
W1KX
WB4FSU
WB4RJW
KZ8Q

KA9IKK
KN9P
NX9K
AA3N
AC8RV
WB8SI
K2EAG
KB2YAA
W2ZXN
W2AH
N1LAH
KB1NMO
AA3SB
K8ED

99
KU1U

98
WB2ZEX

96
WB8YYS
KD2IWN
K8RDN

95
NI2W

92
W4TTO

91
KC1HHO

90
K6HTN
K0WAV
KB9GO
KL7RF
K8KRA
N8MRS
KD8UUB
KB8HJJ
KA1G
KA2JFU
KA2HZP
KB2QO
W3CJD
KC1KVY
WA1LPM
KC1MSN

89
N6IET

87
WV5Q

84
KE4DRF
N8CJS

83
K2KNB

82
KC1OIP

81
N3ARB

80
KR4ST
W4EDN
KG7QWR
KJ7BHO
K1STM

79
KB3MXK
KB0DTI

78
WB8R

77
KA2GQQ
N3JET

76
W7PHX
KC1NBI
W5XX

75
K4FHR
KN4AAG
AF4NC
NV1N

74
W2ARP
W3ZR

73
KF0BPN

72
K6RAU

70
K5OB
WJ3P

The following station qualified for PSHR in March, but was not reported in this column yet: KU1U 94.

Section Traffic Manager Reports

The following Section Traffic Managers reported: AR, AZ, CO, CT, DE, EPA, IN, KS, LA, LAX, MDC, ME, MI, MN, MO, MS, ND, NFL, NLI, NM, NNJ, NV, OH, OR, SD, SJV, SNJ, STX, TN, WCF, WI, WNY, WPA, WV, WWA, WY.

Section Emergency Coordinator Reports

The following Section Emergency Coordinators reported: ENY, EPA, IN, KY, MI, MO, MS, ND, NLI, NM, NNJ, NNY, NV, OH, OK, PAC, SCV, SFL, SJV, STX, UT, WCF, WPA, 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.

KK3F 1,605, NX9K 1,361, K6HTN 964, WB8WKO 848, N9CK 806.

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

Contest Corral

August 2021

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	1400	1	1700	3.5-14	SARL HF Phone Contest	Ph	RS, serial	www.sarl.org.za
2	0000	2	0100	1.8-14	K1USN Slow Speed Test	CW	Max 20 WPM. Name, SPC	k1usn.com/sst.html
3	0100	3	0159	1.8-50	Worldwide Sideband Activity Contest	Ph	RS, age group (OM, YL, or Youth)	wwsac.com/rules.html
3	0100	3	0300	3.5-28	ARS Spartan Sprint	CW	RST, SPC, power	arsqrp.blogspot.com
3	1700	3	1900	3.5-14	RTTYops Weeksprint	Dig	Other's call, your call, serial, name	rttyops.com
4	0230	4	0300	1.8-21	Phone Weekly Test — Fray	Ph	Name, SPC	perluma.com/Phone_Fray_Contest_Rules.pdf
4	1300	4	1400	1.8-28	CWops Mini-CWT Test	CW	Name, mbr or SPC	cwops.org/cwops-tests
4	1700	4	2000	144	VHF-UHF FT8 Activity Contest	Dig	4-char grid square	ft8activity.eu/index.php/en
4	1900	4	2000	1.8-28	CWops Mini-CWT Test	CW	Name, mbr or SPC	cwops.org/cwops-tests
5	0300	5	0400	1.8-28	CWops Mini-CWT Test	CW	Name, mbr or SPC	cwops.org/cwops-tests
5	1700	5	1900	3.5-14	RTTYops Weeksprint	Dig	Other's call, your call, serial, name	rttyops.com
5	1700	5	2100	28	NRAU 10-Meter Activity Contest	CW Ph Dig	RS(T), 6-character grid square	nrrlcontest.no/index.php
5	1900	5	2000	3.5, 7	EACW Meeting	CW	RST, name, mbr or EA province or country	www.eacwspain.es
5	1900	5	2100	1.8-50	SKCC Sprint Europe	CW	RST, SPC, name, mbr or "none"	www.skccgroup.com
6	0100	6	0230	14	QRP Fox Hunt	CW	RST, SPC, name, power	www.qrpfoxhunt.org
6	0145	6	0215	1.8-21	NCCC RTTY Sprint	Dig	Serial, name, QTH	www.ncccsprint.com
6	0230	6	0300	1.8-21	NCCC Sprint	CW	Serial, name, QTH	www.ncccsprint.com
6	2000	6	2100	1.8-14	K1USN Slow Speed Test	CW	Max 20 WPM. Name, SPC	k1usn.com/sst.html
7	0000	8	2359	3.5-28	Batavia FT8 Contest	Dig	4-char grid square	batavia-ft8.com
7	0001	8	2359	28	10-10 International Summer Contest, SSB	Ph	Name, mbr or "0," SPC	www.ten-ten.org
7	1200	7	2359	1.8-28	European HF Championship	CW Ph	RS(T), 2-digit year first licensed	lea.hamradio.si/~scc/euhf
7	1200	8	2359	1.8-50	SKCC Weekend Sprintathon	CW	RST, SPC, name, mbr or "none"	www.skccgroup.com
7	1300	7	1330	144	Two-Meter Classic Sprint	CW Ph	Serial, 4-char grid square	fwrc.info
7	1600	7	1800	3.5-28	FISTS Saturday Sprint	CW	RST, SPC, name, mbr or "0"	fistsna.org
7	1800	8	0559	1.8-28	North American QSO Party, CW	CW	Name, state/DC/province/country	www.ncjweb.com
7	1800	8	1800	222 and up	ARRL 222 MHz and Up Distance Contest	CW Ph Dig	6-char grid square	arrl.org/222-mhz-and-up-distance-contest
9	0000	9	0200	1.8-28	4 States QRP Group Second Sunday Sprint	CW Ph	RS(T), SPC, mbr or power	www.4sqrp.com
11	0030	11	0230	3.5-14	NAQCC CW Sprint	CW	RST, SPC, mbr or power	naqcc.info
11	1500	13	1459	144	MMMonVHF 144 MHz Meteorscatter Sprint	CW Ph Dig	Signal report	mmmonvhf.de/ctestinfo.php
11	1700	11	2000	432	VHF-UHF FT8 Activity Contest	Dig	4-char grid square	ft8activity.eu/index.php/en
14	0000	15	2359	3.5-28	WAE DX Contest, CW	CW	RST, serial	darc.de/der-club/referate/referat-conteste/worked-all-europe-dx-contest/en
14	0800	14	1100	1.8-28	QRP ARCI European Sprint	CW	RST, SPC, mbr or power	qrparci.org/contest
14	1200	14	1300	7	SARL Youth Sprint	Ph	RS, age	www.sarl.org.za
14	1400	14	2200	3.5-28	Kentucky State Parks on the Air	CW Ph Dig	KY park abbreviation or SPC	k4msu.com/kypota
14	1400	15	0400	1.8-432	Maryland-DC QSO Party	CW Ph Dig	Entry class, county or SPC	w3vpr.org/mdcqsop
14	2300	15	0300	50	50 MHz Fall Sprint	CW Ph Dig	4-char grid square	svhfs.org
15	1400	15	1700	3.5-14	SARL HF Digital Contest	Dig	RST, serial	www.sarl.org.za
15	1700	15	2100	3.5-28	NJQRP Skeeter Hunt	CW Ph	RS(T), SPC, skeeeter # or power	www.qsl.net/w2lj
15	2100	15	2300	3.5-28	FISTS Sunday Sprint	CW	RST, SPC, name, mbr or "0"	fistsna.org
15	2300	16	0100	1.8-28	Run for the Bacon QRP Contest	CW	RST, SPC, mbr or power	qrpcontest.com/pigrun
21	0000	22	1600	3.5-28	SARTG WW RTTY Contest	Dig	RST, serial	www.sartg.com
21	0600	22	2359	10 GHz to light	ARRL 10 GHz and Up Contest	CW Ph Dig	6-char grid locator	www.arrl.org/10-ghz-up
21	0800	22	0800	1.8-28	Russian District Award Contest	CW Ph	RS(T), RU district code or serial	rdaward.org/rdac1.htm
21	1200	22	1200	1.8-50	Keyman's Club of Japan Contest	CW	RST, JA prefecture code or CQ zone	kcj-cw.com/e_index.htm
21	1600	21	1759	1.8-50	Feld Hell Sprint	Dig	RST, mbr, SPC, grid	sites.google.com/site/feldhellclub
21	1800	22	0559	1.8-28	North American QSO Party, SSB	Ph	Name, state/DC/province/country	www.ncjweb.com
22	1800	22	2359	3.5-28	ARRL Rookie Roundup, RTTY	Dig	Name, 2-digit year first licensed, SPC or XE province	arrl.org/rookie-roundup
25	0000	25	0200	1.8-50	SKCC Sprint	CW	RST, SPC, name, mbr or "none"	www.skccgroup.com
28	0400	30	0400	1.8-28	Hawaii QSO Party	CW Ph Dig	RS(T) HI district or SPC	hawaiiqsoparty.org
28	0600	29	0559	3.5-28	ALARA Contest	CW Ph	RS(T), serial, mbr, name, YL or OM	alara.org.au/contests
28	1200	29	0300	1.8-50	W/VE Islands QSO Party	CW Ph Dig	RS(T), USI/CISA Island Designation or SPC	usislands.org/qso-party-rules
28	1200	29	1200	1.8-28	YO DX HF Contest	CW Ph	RS(T), YO county or serial	www.yodx.ro/en
28	1200	29	1200	1.8-28	World Wide Digi DX Contest	Dig	4-char grid square	ww-digi.com
28	1400	29	2000	3.5-50	Kansas QSO Party	CW Ph Dig	RS(T), KS county or SPC	ksqsoparty.org
28	1600	29	0400	1.8-28	Ohio QSO Party	CW Ph	RS(T), OH county or SPC	www.ohqp.org
29	1400	29	1700	3.5-14	SARL HF CW Contest	CW	RST, serial	www.sarl.org.za

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

Mark Beckwith, N5OT, n5ot@arrl.net

2021 ARRL International DX CW Contest Results

This year's ARRL DX CW Contest was held February 20 – 21, 2021.

Martin Huml, OL5Y, operated during the 2021 ARRL International DX CW Contest from his station in the Czech Republic. He placed first in the Single Operator, Unlimited, Low Power category in the Czech Republic, and ninth overall worldwide. [Martin Huml, OL5Y, photo]

Full Results Online

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

The next ARRL International DX CW Contest will be held February 19 – 20, 2022.

Continental Winners

Africa

Single Operator, High Power	ZD7BG	302,706
Single Operator, Low Power	EA8BQM	407,217
Single Operator Unlimited, High Power	EA8RM	2,805,495
Single Operator Unlimited, Low Power	EA8OM	245,220
Single Operator, 40 Meters	D4Z (IK2NCJ, op)	298,245
Single Operator, 20 Meters	ED8W	358,602
Single Operator, 15 Meters	5Z4VJ	20,412

Asia

Single Operator, High Power	JN2AMD	313,938
Single Operator, Low Power	JH1EAQ	298,224
Single Operator, QRP	HZ1TT	119,475
Single Operator Unlimited, High Power	P3X (5B4AMM, op)	1,215,687
Single Operator Unlimited, Low Power	P3AA (RN3QO, op)	267,330
Single Operator Unlimited, QRP	JK1TCV	29,415
Single Operator, 160 Meters	JA0QNJ	2,262
Single Operator, 80 Meters	JR0BQD	1,920
Single Operator, 40 Meters	JH7XMO	44,226
Single Operator, 20 Meters	RT0F	162,030
Single Operator, 15 Meters	JH7XGN	14,256
Multioperator, Single Transmitter, High Power	JH4UYB	937,512
Multioperator, Single Transmitter, Low Power	JK2VOC	48,888
Multioperator, Two Transmitter	JH8YOH	851,472
Multioperator, Multitransmitter	JF1NHD	771,756

Europe

Single Operator, High Power	CR6K (CT1ILT, op)	4,034,016
Single Operator, Low Power	S52NR	667,080
Single Operator, QRP	M7DX (M0UNN, op)	62,832
Single Operator Unlimited, High Power	EA7X	2,588,832
Single Operator Unlimited, Low Power	EB7A	1,299,480
Single Operator Unlimited, QRP	EF3O (EA3O, op)	116,235
Single Operator, 160 Meters	S50C (S53RM, op)	44,226
Single Operator, 80 Meters	HB9FAP	117,012
Single Operator, 40 Meters	9A5W	286,425
Single Operator, 20 Meters	EI7M (EI6KX, op)	305,502
Single Operator, 15 Meters	ZB2TT	65,736
Single Operator, 10 Meters	LZ4TX	27
Multioperator, Single Transmitter, High Power	EA5RS	2,978,250
Multioperator, Single Transmitter, Low Power	TM6M	2,062,830
Multioperator, Two Transmitter	9A7A	2,574,684
Multioperator, Multitransmitter	II9P	3,218,292

North America

Single Operator, High Power	ZF1A (N6MJ, op)	8,257,080
Single Operator, Low Power	NP3X (N2TTA, op)	3,627,900
Single Operator, QRP	HI3T	92,907
Single Operator Unlimited, High Power	WP3R	173,160
Single Operator Unlimited, Low Power	HI0LT (KC1XX, op)	4,099,200
Single Operator, 160 Meters	NP2J (K8RF, op)	119,955
Single Operator, 80 Meters	XE2X	213,846
Single Operator, 40 Meters	CO6RD	160,710
Single Operator, 20 Meters	HI3Y	265,002
Single Operator, 15 Meters	NP3YL	31,350
Multioperator, Single Transmitter, High Power	KP4AA	5,801,634
Multioperator, Single Transmitter, Low Power	ZF5T	5,439,360

Oceania

Single Operator, High Power	WH7T	1,507,332
Single Operator, Low Power	KH6CJJ	1,172,934
Single Operator, QRP	N7ET/DU7	6,786
Single Operator Unlimited, High Power	KH7M (NA2U, op)	2,790,606
Single Operator Unlimited, Low Power	AH6KO	118,773
Single Operator Unlimited, QRP	YC2VOC	540
Single Operator, 160 Meters	ZL3CW	2,340
Single Operator, 80 Meters	VK2CCC	17,316
Single Operator, 40 Meters	ZM1A (ZL3CW, op)	262,218
Single Operator, 20 Meters	ZM1M	58,650
Single Operator, 15 Meters	VK1FOC	71,346
Multioperator, Single Transmitter, Low Power	VK3GK	64,548
Multioperator, Two Transmitter	ZL3X	1,477,020
Multioperator, Multitransmitter	KH6LC	5,708,064

South America

Single Operator, High Power	LU2FE	1,624,662
Single Operator, Low Power	PY2EX	688,788
Single Operator Unlimited, High Power	P44W (W2GD, op)	6,584,409
Single Operator Unlimited, Low Power	ZW8T (PS8HF, op)	1,319,835
Single Operator, 160 Meters	PP5JR	75
Single Operator, 80 Meters	CW5W (CX6VM, op)	26,445
Single Operator, 40 Meters	PS2T (PY2ZEA, op)	270,918
Single Operator, 20 Meters	PJ4A	441,969
Single Operator, 15 Meters	LU5FC	338,424
Single Operator, 10 Meters	CE3CT	100,521
Multioperator, Single Transmitter, High Power	PJ2T	4,585,722
Multioperator, Single Transmitter, Low Power	FY5KE	4,744,224
Multioperator, Two Transmitter	PY1DX	190,281

Top Ten — US and Canada

Single Operator, High Power

N2NT	4,212,306
K1ZZ	3,876,147
AA1K	3,149,916
N4AF	3,028,410
N1UR	2,847,516
NN7CW	2,782,380
VE3DZ	2,646,222
KØEJ	2,528,640
K5GN	2,501,724
W9RE	2,484,540

Single Operator, Low Power

N4TZ	1,154,010
VO1HP	875,160
K7SV	851,694
K1VUT	843,759
WØUO	774,900
N8II	761,589
WJ9B	588,138
AC4G	352,512
K1HT	338,844
WB8JUI	313,605

Single Operator, QRP

K2DM	364,332
W6JTI	158,340
KM6Z	147,936
N7IR	140,844
NA1ME	108,288
N7RCS	96,375
W7YAQ	67,848
W6QU (W8QZA, op)	64,989
K2YAZ	61,401
KH6KG/W5	56,286

Single Operator Unlimited, High Power

K5ZD (AK1W, op)	5,048,604
KI1G	5,030,316
AA3B	4,494,528
K3WW	4,029,600
N3RS	3,791,781
VE3EJ	3,646,377
VA2WA	3,495,312
VE3JM	3,434,970
N3RD	3,120,891
NY3A	3,103,245

Single Operator Unlimited, Low Power

K9OM	1,329,627
W1QK	1,203,048
N2BA	1,093,476
K3AU (K2YWE, op)	1,039,830
W3KB	1,007,307
N9CO	935,640
WO1N	883,740
K1OA	804,261
K1TR	752,760
KM4SII	687,375

Single Operator Unlimited, QRP

N4IJ	220,248
VE3CV	69,540
K8ZT	35,640
W4QO	30,660
VA3AMX	28,914
WB4OMM	26,280
VE3NZ	20,580
K1DJ	18,000
KZ3I	17,934
K2GMY	12,300

Single Operator, 160 Meters

VY2ZM	84,816
K1WHS	29,256
KØDI	21,465
KM1R	19,650
W8RT (W8UVZ, op)	17,424
N1PGA	13,542
N2GC	12,600
W8WTS	9,240
W2VO	8,436
NIØG	7,242

Single Operator, 80 Meters

W1UE	207,207
W3BGN	139,035
K3SV	68,208
K1EP	66,744
W1HI	22,185
K8GU	13,770
KØPJ	12,402
KC4WQ	9,486
KY9KYO	7,980
AC8CE	7,437

Single Operator, 40 Meters

K3UA	409,728
N2MF	351,624
K5TR	227,520
K2LE	173,055
KØEU	128,982
W4NZ	112,632
N2YO	106,260
KU8E	102,024
W3EF	100,872
NU4Y	32,670

Single Operator, 20 Meters

K3LR (N2NC, op)	650,754
K2SSS	431,424
N2IC	344,250
N7TU	271,272
W6YA	201,240
K1JB	171,258
W2UP	166,518
W9ILY	161,352
VE7UF (VE7JH, op)	152,958
N5JJ	119,574

Single Operator, 15 Meters

N5AW	127,680
WB4TDH	42,456
KX7M	37,668
KU2M	30,369
W4VQ	9,030
N6RM	6,864
K4TRH	4,608
VE5KS	2,829
AB4SF	2,448
WØBF	2,394

Single Operator, 10 Meters

W4DD	7,380
K4WI	6,552
WB2AMU	540
NØJK	297
KN4JN	216
N2JNR	84

Multioperator, Single Transmitter, High Power

K3JO	3,813,732
K1RX	3,404,397
N1MM	2,442,744
K3PH	2,295,804
K3AJ	2,237,880
W6YX	2,024,445
KY7M	2,007,048
W4IZT	1,760,058
K8LX	1,401,585
W2IRT	1,176,981

Multioperator, Single Transmitter, Low Power

K1XM	1,704,192
N1SOH	353,628
W4TG	304,140
K1RQ	59,364
KA9VVQ	4,800

Multioperator, Two Transmitter

W3LPL	7,633,944
W2FU	5,224,104
K1IR	4,826,412
K2AX	3,918,474
W9VW	2,826,600
N2AA	2,167,785
N7DX	1,563,540
NR4L	1,443,000
K3CCR	1,304,262
VE9BK	1,155,198

Multioperator, Multitransmitter

N4WW	5,600,439
K1TTT	5,263,803
K2QMF	4,136,616
K1KI	3,944,517
KØRF	3,051,765
WD6T	2,500,956
K3TEJ	2,113,020
NJ3I	2,101,323
N1RR	1,442,016
NE3F	1,038,429

Top Ten — DX

Single Operator, High Power

ZF1A (N6MJ, op)	8,257,080
KP2M (KT3Y, op)	6,128,640
FM5BH	5,054,994
NP4Z	4,836,000
CR6K (CT1ILT, op)	4,034,016
NP2X (K9VV, op)	2,925,384
IR2Q (IK2PFL, op)	2,874,564
G6XX (G4FAL, op)	1,930,932
LU2FE	1,624,662
WH7T	1,507,332

Single Operator, Low Power

NP3X (N2TTA, op)	3,627,900
TG9AOR	1,290,912
KH6CJJ	1,172,934
TI2OY	792,276
XE1CT	696,897
PY2EX	688,788
CO2RQ	682,479
S52NR	667,080
LW3DG	553,554
OA4DX	468,468

Single Operator, QRP

HZ1TT	119,475
HI3T	92,907
CO2CW	91,260
JH1OGC	69,336
M7DX (MØUNN, op)	62,832
JH7UJU	49,593
CM3EFM	41,535
LZ2RS	39,798
EA7AAW	34,485
JQ1NGT	32,292

Single Operator Unlimited, High Power

P44W (W2GD, op)	6,584,409
EA8RM	2,805,495
KH7M (NA2U, op)	2,790,606
EA7X	2,588,832
ZM4T (ZL3IO, op)	2,269,164
HG3R	2,230,200
OM2VL	2,091,390
G5W (G3BJ, op)	2,011,023
9A3XV	1,794,651
TM2Y (F6BEE, op)	1,591,200

Single Operator Unlimited, Low Power

HIØLT (KC1XX, op)	4,099,200
HH2AA (KO7SS, op)	3,520,809
VP5M	2,969,280
XE2B	1,390,158
ZW8T (PS8HF, op)	1,319,835
EB7A	1,299,480
LU8MHL	962,991
EC4TA	674,730
OL5Y	433,719
XQ3WD	307,500

Single Operator Unlimited, QRP

EF3O (EA3O, op)	116,235
F8AOF	72,312
EA5ICL	50,796
DL1EFW	32,757
JK1TCV	29,415
PA3CWN	24,252
JK7DWD	18,576
IW3ILM	16,875
YU1LM	10,608
PE2K	4,209

Single Operator, 160 Meters

NP2J (K8RF, op)	119,955
S5ØC (S53RM, op)	44,226
DR5X (DL8LAS, op)	32,058
OK6W (OK1MU, op)	31,635
HGØR (HAØNAR, op)	25,812
OL1A	23,976
LY7Z	19,998
GU4YOX	17,760
OZ1LO	16,218
SN1W	13,692

Single Operator, 80 Meters

XE2X	213,846
CO2AN	165,648
CO2JD	132,165
HB9FAP	117,012
9A1P	105,018
S51J	67,584
M5O (G3LET, op)	64,008
R7NW	49,536
DH8BQA	49,491
TM6X	48,216

Single Operator, 40 Meters

D4Z (IK2NCJ, op)	298,245
9A5W	286,425
PS2T (PY2ZEA, op)	270,918
ZM1A (ZL3CW, op)	262,218
VK2IA	258,774
II2S (IK2QEI, op)	218,709
S51YI	208,395
CT1GFK	206,226
DK9PY	201,690
4O4T	187,245

Single Operator, 20 Meters

PJ4A	441,969
ED8W	358,602
EI7M (EI6KX, op)	305,502
LX7I (DK9IP, op)	281,961
IR6T (IK1HJS, op)	281,076
PY2NY	274,173
S5ØK	267,801
HI3Y	265,002
IR4K (IZ4ZZB, op)	257,712
DMØA (DK3DM, op)	240,939

Single Operator, 15 Meters

LU5FC	338,424
PX2A (PY2BK, op)	303,909
XQ1KZ	280,722
LW8DQ	250,455
HK3TU	208,329
LU8QT	204,966
LU1ICX	123,090
PY5ZHP	121,464
LU6UO	113,736
PT9DX	91,206

Single Operator, 10 Meters

CE3CT	100,521
CE2ML (CX1EK, op)	67,824
LT7D	55,476
PY2RSA	35,178
YV1JGT	16,008
LU8DZJ	14,280
PU1NAF	1,134
LZ4TX	27

Multioperator, Single Transmitter, High Power

KP4AA	5,801,634
PJ2T	4,585,722
HP3SS	4,035,900
EA5RS	2,978,250
4A7S	2,879,904
OL3Z	2,041,788
OM7M	1,953,450
OK5Z	1,592,640
HG6N	1,450,836
YU5R	1,215,552

Multioperator, Single Transmitter, Low Power

ZF5T	5,439,360
NP4DX	4,761,804
FY5KE	4,744,224
KP2B	2,894,304
V31MA	2,523,360
TM6M	2,062,830
ED1R	827,070
E7CW	711,048
HB9ON	311,040
3Z1K	155,742

Multioperator, Two Transmitter

9A7A	2,574,684
LZ9W	2,516,850
DR4A	1,911,888
ZL3X	1,477,020
UA7K	1,386,630
HG7T	1,349,640
SK3W	916,674
RL3A	892,206
JH8YOH	851,472
PY1DX	190,281

Multioperator, Multitransmitter

KH6LC	5,708,064
II9P	3,218,292
LN8W	1,245,990
JF1NHD	771,756
G4IIY	409,920
IQ2BZ	127,395
PA6X	50,310
RT4F	5,952
YO3GNF	1,881

Jeff Stai, WK6I, wk6i.jeff@gmail.com

2021 ARRL RTTY Roundup Results

This year's ARRL RTTY Roundup was held January 2 – 3, 2021.

Top Ten — US and Canada

Single Operator, RTTY Only, High Power

AA3B	271,370
AC0C	251,538
W7RN (WK6I, op)	232,848
AI9T	179,087
K6MR	172,480
N1IXF	156,456
K5ZD	135,753
WB4YDL	127,008
N5HC	126,582
WØYK	119,616

Single Operator, RTTY Only, Low Power

W4AAA (KK9A, op)	207,900
KØTI	117,990
K9WX	112,792
K3AJ	106,428
NØAT	104,013
AA2MF	102,178
W1QK	95,060
K3RWN	87,032
KØAD	86,504
WA1FCN	85,446

Single Operator, RTTY Only, QRP

VE3KI	35,700
NØNI	32,163
K2YG	24,882
W4DWS	17,152
N7RCS	15,455
K6EI	11,542
WE6EZ	5,676
NE3R	5,074
KH6KG/W5	4,998
KO3T	4,312

Single Operator Unlimited, Mixed Mode, High Power

N8OO	255,996
VE5MX	163,449
KK6P	155,136
N7NM	103,872
NA3M	103,230
AG4W	99,400
KA6BIM	98,475
NF3R	89,424
WQ5L	82,709
K6OK	77,714

Single Operator Unlimited, Mixed Mode, Low Power

W9SN	158,662
K9OM	143,910
AK6A	78,958
AA4DD	77,353
WA3AAN	60,630
W3KB	59,813
KT4Q	57,362
KK8MM	53,680
VE2NMB	49,734
K6GHA	47,212

Single Operator Unlimited, Mixed Mode, QRP

NØUR	50,760
W7YAQ	31,084
AA5KD	9,000

Single Operator Unlimited, Digital Only, High Power

W1UE	141,504
AG2J	55,752
N4BP	55,404
N1EK	47,476
KQ4AV	46,065
NT6X	40,940
VE6WQ	35,446
K1BZ	29,082
N7PHY	27,880
NE9U	27,145

Single Operator Unlimited, Digital Only, Low Power

WA2BOT	66,833
KE8M	49,217
KB1IKC	44,880
KM4RL	42,658
WBØTEV	38,090
W3PAX	36,018
N3AAA	34,632
NR3M	34,279
N7ZZ	33,152
KØBAK	31,122

Single Operator Unlimited, Digital Only, QRP

WM5L	10,945
KK4BZ	10,476
N8ME	7,992
VA1MM	4,712
K4PQC	3,640
WØKI (KJ4ZMQ, op)	3,640
WY7BG	3,115
WD9EKA	3,024
KEØJMK	2,013
WA9QXY	836

Single Operator Unlimited, RTTY Only, High Power

KI1G	316,416
K9CT	222,902
N6WM	201,214
W6YX (N7MH, op)	200,016
K6LL	199,808
W9KKN	194,021
KO7SS	189,175
WØLSD	185,934
N3QE	175,044
N4ZZ	173,340

Single Operator Unlimited, RTTY Only, Low Power

AA5AU	209,645
AD4EB	165,025
WW3S	139,040
NA4DA	99,746
KA2K	95,824
W3RGA	91,278
WW5M	83,072
KØCN	76,194
N7US	71,200
KB3AAY	65,600

Single Operator Unlimited, RTTY Only, QRP

K7XC	14,640
VE6EX	6,400
W4ER	5,280
K6MI	2,144
K8ZT	840

Multioperator, Single Transmitter, High Power

K5RZA	225,459
N7AT	212,628
N7TY	178,825
AB5EB	139,849
N6EE	105,525
VE3NZ	105,152
KM4OQO	102,500
W4MLB	100,260
KT1I	91,600
W6DR	81,035

Multioperator, Single Transmitter, Low Power

K9NR	125,248
NTØK	114,688
N8LRG	111,644
WTØDX	87,032
WD4LBR	73,055
NØHJZ	55,130
K4MM	49,820
W4DAN	15,246
WSØZ	14,094
NJ1F	8,533

Multioperator, Two Transmitter

ND2T	272,976
WV4P	254,640
NW8S	227,808
KT7E	162,162
NA5NN	149,657
K3CCR	118,932
KB3VQC	73,950
W5NN	31,734
W9CF	36

Multioperator, Multitransmitter

W3GH	240,218
WW4LL	174,615
K5LRW	10,506

Top Ten — DX

Single Operator, ingle Operator, RTTY Only, High Power

OK7W	186,340
UW1M	173,884
IK2QPR	141,804
EMØI (UT2IZ, op)	127,317
D4Z (IK2NCJ, op)	89,688
OK2ZA	89,095
DL3BQA	72,540
KH6ZM	66,600
EA8DO	61,425
PZ5RA	58,656

Single Operator, RTTY Only, Low Power

CT7AUP	80,649
UX1VT	56,689
TG9ADQ	41,200
IK2BUF	39,063
KH6CJJ	36,180
MW9W (GWØKRL, op)	32,674
UT5EPP	32,192
PY2NY	30,498
CO2AME	30,388
HA8WY	29,273

Single Operator, RTTY Only, QRP

F5BEG	37,101
OK6AB	8,820
MØHMO	8,500
ON3CQ	5,311
F4GKY	4,840
CO2GL	4,180
SP4LVK	3,840
JA6WFM	3,030
JH7UJU	2,520
G8VVY	1,960

Single Operator Unlimited, Mixed Mode, High Power

YO9HP	99,327
MM9I (GMØOPS, op)	95,778
LU5VV	72,474
PB7Z	36,195
IK4UOA	33,998
IK4MTK	24,140
IZ2RLO	16,060
YO3GNF	13,988
PA4O	6,084
RU6YJ	4,592

Single Operator Unlimited, Mixed Mode, Low Power

EW7B	50,310
S56A	33,761
M3ECT	29,970
OL6D	20,661
G1P (MØIEP, op)	20,605
JH7RTQ	20,448
PD1RP	18,970
UT5EOX	16,756
JH4UTP	15,552
UX7QV	15,087

Single Operator Unlimited, Mixed Mode, QRP

PC2F	7,956
RV3DBK	2,660
7L4IOU	345
JH3DMQ	72

Single Operator Unlimited, Digital Only, High Power

ON6NL	42,971
IK2TDM	23,280
DG9BEO	20,368
XE1FJM	20,100
UA6CE	14,219
JO7KMB	13,969
SP7IIT	10,452
I3FIY	10,207
IZ2FOS	6,670
DU3TW	6,360

Single Operator Unlimited, Digital Only, Low Power

SV2AEL	30,178
OQ4U	28,700
OZ1ADL	22,648
DG5LP	22,100
OH3MA	21,609
CO7HNS	21,420
LY2PAD	21,252
RN3OG	19,929
HI8JSG	19,032
LZ2INP	18,639

Single Operator Unlimited, Digital Only, QRP

PA3EOU	10,584
EA3FHP	9,593
IZ3NVR	7,304
IK4UXA	5,265
YL3FW	4,260
TA3OWL	931
TA1BM	304
TA3OER	300
JA1KPF	105
TA3ONK	42

Single Operator Unlimited, RTTY Only, High Power

SN7Q (SP7GIQ, op)	218,375
EA4GOY	142,044
TK5MH	115,188
IV3SKB	112,454
UR7GO	105,163
P3X (5B4AMM, op)	95,034
G3ORY	83,538
PY2KNK	79,285
LZ8E (LZ2BE, op)	74,195
IK3ORD	70,956

Single Operator Unlimited, RTTY Only, Low Power

WP3C	106,488
DF2SD	77,367
EC1A	75,735
ON5GQ	69,498
UZ1WW	63,226
UT4LW	56,420
SP9H	41,280
F4EGA	39,840
SE4E (SM4DQE, op)	38,269
F4DSK	38,010

Single Operator Unlimited, RTTY Only, QRP

HA3OU	4,600
YU1LM	4,212
PE2K	3,597

Multioperator, Single Transmitter, High Power

DP7D	183,138
OK7O	126,672
MW2I	112,140
UZ2I	74,582
DJ1XT	52,440
9A1CBM	41,225
F8KCF	34,188
RK3DXW	26,112
VR2CC	18,444
SP9ZHR	7,296

Multioperator, Single Transmitter, Low Power

LY5W	45,227
4U1A	44,368
S57ZT	15,264
9A7B	14,600
DX3H	5,040
SN65KDU	4,275
BH3DHE	3,584
JK2VOC	1,375

Full Results Online

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

Affiliated Club Competition

Club	Score	Entries
Unlimited		
Northern California Contest Club	3,286,060	75
Potomac Valley Radio Club	2,146,246	66
Society of Midwest Contesters	1,931,858	51
Minnesota Wireless Assn.	1,748,109	55
Medium		
Frankford Radio Club	2,550,431	48
Contest Club Ontario	1,048,630	25
Yankee Clipper Contest Club	1,027,140	25
Arizona Outlaws Contest Club	983,519	20
Tennessee Contest Group	954,828	20
Florida Contest Group	656,230	22
Grand Mesa Contesters of Colorado	538,662	14
Central Texas DX and Contest Club	470,502	8
Willamette Valley DX Club	435,876	14
Niagara Frontier Radiosport	421,533	13
Western Washington DX Club	408,616	15
Alabama Contest Group	339,719	8
Kentucky Contest Group	338,155	13
North Coast Contesters	301,280	6
Carolina DX Assn.	298,432	10
Southern California Contest Club	282,033	17
Northeast Maryland Amateur Radio Contest Soc.	280,730	14
Spokane DX Assn.	268,714	9
Swamp Fox Contest Group	267,266	6
Louisiana Contest Club	238,365	3
DFW Contest Group	225,044	7
South East Contest Club	202,588	4
Saskatchewan Contest Club	195,438	4
Order of Boiled Owls of New York	176,846	6
Orca DX and Contest Club	158,327	5
New Providence ARC	119,404	6
Rochester (NY) DX Assn.	111,589	4
North Carolina DX and Contest Club	97,743	3
Valley ARA	93,837	3
Mad River Radio Club	93,177	7
Portage County Amateur Radio Service	72,164	5
Hudson Valley Contesters and DXers	38,909	5
Skyview Radio Soc.	14,312	3
Silver Comet Amateur Radio Soc.	8,673	3
Local		
Orleans County Amateur Radio Club	609,977	10
CTRI Contest Group	447,480	5
New Mexico Big River Contesters	224,908	6
Central Virginia Contest Club	188,536	5
Midland ARC	106,305	3
Metro DX Club	91,522	3

Sponsored Plaque Winners

Thanks to the generous support of numerous clubs and individuals, we are pleased to list the winners of the Sponsored RTTY Roundup plagues below. For more information on plaque sponsorship or to order a duplicate plaque, contact the ARRL Contest Manager at 860-594-0232 or **contests@arrl.org**. Plaques cost $80, which includes all shipping charges.

Winner	Plaque Category	Plaque Sponsor
AA3B	W/VE Single Operator High Power	Preston Radio Club, K7RU
KI1G	W/VE Single Operator Unlimited High Power	Steve Dyer, W1SRD, and Doris Wong, KØBEE
AA5AU	W/VE Single Operator Unlimited Low Power	Kevin der Kinderen, N4TT
K7XC	W/VE Single Operator Unlimited, RTTY Only, QRP	Jeff Stai, WK6I
K5RZA	W/VE Multioperator High Power	John Lockhart, WØDC
K9NR	W/VE Multioperator Low Power	Dan Karg, KØTI
OK7W	DX Single Operator High Power	Yankee Clipper Contest Club
CT7AUP	DX Single Operator Low Power	Rich Cady, N1IXF
WP3C	DX Single Operator Unlimited Low Power	Kevin der Kinderen, N4TT
DP7D	DX Multioperator High Power	Paolo Cortese, I2UIY, memorial by WØYK
AA3B	Atlantic Division Single Operator High Power	Mike Jacoby, N3MA
K3AJ	Atlantic Division Single Operator Low Power	Mike Jacoby, N3MA
AI9T	Central Division Single Operator High Power	Soc. of Midwest Contesters
K9WX	Central Division Single Operator Low Power	Soc. of Midwest Contesters
K9CT	Central Division Single Operator Unlimited High Power	Soc. of Midwest Contesters
N7US	Central Division Single Operator Unlimited Low Power	Soc. of Midwest Contesters
KIØF	Dakota Division Single Operator High Power	Minnesota Wireless Assn.
KØTI	Dakota Division Single Operator Low Power	Minnesota Wireless Assn.
KØMD	Dakota Division Single Operator Unlimited High Power	Minnesota Wireless Assn.
KØCN	Dakota Division Single Operator Unlimited Low Power	Minnesota Wireless Assn.
W7QDM	Northwestern Division Single Operator High Power	Hank, KR7X
N7UVH	Northwestern Division Single Operator Low Power	Brian Moran, N9ADG
W6OAT	Northwestern Division Single Operator Unlimited High Power	Brian Moran, N9ADG
AK6A	Northwestern Division Single Operator Unlimited Low Power	Brian Moran, N9ADG
WB3JFS	Pacific Division Single Operator Low Power	Dick Wilson, K6LRN, and Carolyn Wilson, K6TKD
N6WM	Pacific Division Single Operator Unlimited High Power	Northern California Contest Club
W4AAA	Roanoke Division Single Operator Low Power	Kevin der Kinderen, N4TT
NTØK	Roanoke Division Multioperator Low Power	Sheila Blackley, K4WNW
OK7W	Europe Single Operator High Power	Kresimir Kovarik, 9A5K, memorial by K6MR

The next ARRL RTTY Roundup will be held January 8 – 9, 2022.

Continental Winners

Africa

Single Operator, RTTY Only, High Power	D4Z (IK2NCJ, op)	89,688
Single Operator, RTTY Only, Low Power	EA8OM	17,064

Asia

Single Operator, RTTY Only, High Power	JA7IC	17,424
Single Operator, RTTY Only, Low Power	JA6GCE	26,791
Single Operator, RTTY Only, QRP	JA6WFM	3,030
Single Operator Unlimited, Mixed Mode, High Power	JR3RIY	4,181
Single Operator Unlimited, Mixed Mode, Low Power	JH7RTQ	20,448
Single Operator Unlimited, Mixed Mode, QRP	7L4IOU	345
Single Operator Unlimited, Digital Only, High Power	JO7KMB	13,969
Single Operator Unlimited, Digital Only, Low Power	BG8GAM	12,152
Single Operator Unlimited, Digital Only, QRP	TA3OWL	931
Single Operator Unlimited, RTTY Only, High Power	P3X (5B4AMM, op)	95,034
Single Operator Unlimited, RTTY Only, Low Power	JF1RYU	4,107
Multioperator, Single Transmitter, High Power	VR2CC	18,444
Multioperator, Single Transmitter, Low Power	BH3DHE	3,584

Europe

Single Operator, RTTY Only, High Power	OK7W	186,340
Single Operator, RTTY Only, Low Power	CT7AUP	80,649
Single Operator, RTTY Only, QRP	F5BEG	37,101
Single Operator Unlimited, Mixed Mode, High Power	YO9HP	99,327
Single Operator Unlimited, Mixed Mode, Low Power	EW7B	50,310
Single Operator Unlimited, Mixed Mode, QRP	PC2F	7,956
Single Operator Unlimited, Digital Only, High Power	ON6NL	42,971
Single Operator Unlimited, Digital Only, Low Power	SV2AEL	30,178
Single Operator Unlimited, Digital Only, QRP	PA3EOU	10,584
Single Operator Unlimited, RTTY Only, High Power	SN7Q (SP7GIQ, op)	218,375
Single Operator Unlimited, RTTY Only, Low Power	DF2SD	77,367
Single Operator Unlimited, RTTY Only, QRP	HA3OU	4,600
Multioperator, Single Transmitter, High Power	DP7D	183,138
Multioperator, Single Transmitter, Low Power	LY5W	45,227

North America

Single Operator, RTTY Only, High Power	KL2R (N1TX, op)	8,007
Single Operator, RTTY Only, Low Power	TG9ADQ	41,200
Single Operator, RTTY Only, QRP	CO2GL	4,180
Single Operator Unlimited, Digital Only, High Power	XE1FJM	20,100
Single Operator Unlimited, Digital Only, Low Power	CO7HNS	21,420
Single Operator Unlimited, RTTY Only, High Power	KL7SB	66,123
Single Operator Unlimited, RTTY Only, Low Power	WP3C	106,488

Oceania

Single Operator, RTTY Only, High Power	KH6ZM	66,600
Single Operator, RTTY Only, Low Power	KH6CJJ	36,180
Single Operator, RTTY Only, QRP	YC8FXI	88
Single Operator Unlimited, Mixed Mode, Low Power	VK3YV	550
Single Operator Unlimited, Digital Only, High Power	DU3TW	6,360
Single Operator Unlimited, Digital Only, Low Power	YB2HAF	2,370
Single Operator Unlimited, RTTY Only, High Power	ZL3P	5,074
Single Operator Unlimited, RTTY Only, Low Power	YB8RW	2,568
Multioperator, Single Transmitter, Low Power	DX3H	5,040

South America

Single Operator, RTTY Only, High Power	PZ5RA	58,656
Single Operator, RTTY Only, Low Power	PY2NY	30,498
Single Operator, RTTY Only, QRP	PU2RTO	1,161
Single Operator Unlimited, Mixed Mode, High Power	LU5VV	72,474
Single Operator Unlimited, Mixed Mode, Low Power	YV6BXN	2,940
Single Operator Unlimited, Digital Only, Low Power	YV5KAJ	14,904
Single Operator Unlimited, RTTY Only, High Power	PY2KNK	79,285
Single Operator Unlimited, RTTY Only, Low Power	PY4XX	8,085
Multioperator, Single Transmitter, High Power	CE4WT	1,170

The 2021 ARRL September VHF Contest

1800 UTC Saturday, September 11 – 0259 UTC Monday, September 13

The ARRL September VHF Contest is an opportunity to take advantage of some of the enhanced propagation on the VHF and UHF bands that late summer can offer. With good conditions, stations hundreds of miles away can be worked via tropospheric ducting and sporadic E. All amateur bands 50 MHz and higher can be used in this event. The exchange is your four-digit Maidenhead grid square. To figure out your grid square, visit **www.arrl.org/grid-squares**.

All legal modes are allowed in the contest. While CW and SSB/phone are the more traditional modes, some of the newer digital modes, such as FT4 and FT8, are gaining popularity. Be sure to check the *WSJT-X* website for the latest software updates at **https://physics.princeton.edu/pulsar/k1jt/wsjtx.html**.

Amateurs of all experience levels can enjoy this event. If you have an HF radio that includes 6 meters or VHF/UHF capability, or even an FM-only handheld or mobile radio, you have the tools you need to get on the air.

Use our web app to submit your Cabrillo-formatted log at **http://contest-log-submission.arrl.org**. Paper logs can be submitted to ARRL September VHF Contest, 225 Main St., Newington, CT 06111.

10-day deadline: All logs must be submitted or postmarked no later than 0259 UTC September 23, 2021.

Jon Fox, KF7KTC, operated 2-meter FM from McClellan Peak in Nevada during the 2020 ARRL September VHF Contest. [Jon Fox, KF7KTC, photo]

Complete rules and entry forms can be found at **www.arrl.org/september-vhf**

The 2021 ARRL 10 GHz and Up Contest

Held each year on the third full weekend of August and September.

Joel Wilhite, KD6W, braved the winds and heat of the San Joaquin Valley in California, during the first weekend of the 2020 ARRL 10 GHz and Up Contest. He reported that the conditions were some of the best he's ever seen. [Joel Wilhite, KD6W, photo]

Complete rules and entry forms can be found at **www.arrl.org/10-ghz-up**

Weekend 1: August 21 – 22, 2021
Weekend 2: September 18 – 19, 2021

Each weekend begins 6 AM Saturday and runs through midnight Sunday, local time.

The microwave bands 10 GHz and above will be active again this year during the 2021 ARRL 10 GHz and Up Contest. The objective is to work as many stations as possible from different locations, using frequencies from 10 GHz to light. Because contest scores increase over greater distances, taking your station portable will give you an advantage — the greater the distance, the higher your score.

Scheduling contacts is not only permitted but encouraged in this contest. Consider getting in touch with one of the many VHF+ or microwave clubs to arrange contacts with them. To locate a club, enter the term "VHF" on the ARRL club search page at **www.arrl.org/find-a-club**.

When the event is over, be sure to upload your Cabrillo log to our web app at **http://contests.arrl.org/arrl10gscoresubmission.php**, or send paper logs to ARRL 10 GHz Contest, 225 Main St., Newington, CT 06111. All logs must be received or postmarked by 2359 UTC on October 19, 2021.

Bernie McClenny, W3UR, w3ur@arrl.org

How's DX?

The Season of DX Gatherings

As we begin August, the DX convention season is gearing up. It's been so long since many of us have ventured out of our stations, and now we are able to gather safely with other like-minded friends. One positive result of the lockdown has been the use of online platforms for meetings and conventions, making them more accessible.

Tim Duffy, K3LR, his crew at DX Engineering, and the Contest University (CTU) professors hosted the 2020 and 2021 CTU as well as the 2021 Propagation Summit. The entire presentations are available on the DX Engineering website at **www.contestuniversity.com/videos**. In fact, if you missed it, I would highly recommend the presentation, "There Is Nothing Magic About Propagation," by Jose Nunes, CT1BOH.

This year's International DX Convention (Visalia) was held virtually by the Northern California DX Club. All the forums were recorded and can be viewed at **https://ncdxc.org/idxc-2021**. Over 1,600 people from more than 60 countries attended this virtual conference.

Pacific Northwest DX Convention

The 2021 Pacific Northwest DX (PNWDX) Convention event will take place online. This one rotates locations and hosts each year, bouncing between four different locations in the Pacific Northwest and hosted or cohosted by seven clubs. The 2021 host is the Willamette Valley DX Club from Portland, Oregon, and will be done on Zoom on August 7, 2021. The program is as follows:

- Carl Luetzelschwab, K9LA — Cycle 25: A New Hope
- Al Rovner, K7AR — The Raspberry Pi and Arduino for Dummies
- Scott Wright, KØMD — Operating from the B1Z Contest Station
- Randy Foltz, K7TQ — *N1MM+* Setup From Beginner to Intermediate
- Mike Ritz, W7VO — ARRL Forum
- Vince Van Der Hyde, K7VV — How to Work DX: The First One Hundred

For complete details on this year's PNWDX Convention, check out their website at **https://pacificnwdxconvention.com**.

W8DXCC Convention

This year will be the second W8DXCC Convention, and it will be merging with the Greater Cincinnati Hamfest (**https://cincinnatihamfest.org**), which is sponsored by the Milford Amateur Radio Club. It will be held on Saturday, August 28, 2021, from 1 to 6 PM. Attendees will need to purchase both a hamfest ticket and separate W8DXCC ticket, both $8. The official times for W8DXCC are 1 – 5 PM, however, there will be a DXpedition Roundtable starting at noon and lasting about 50 minutes.

I will be attending, and others expected to be present include Hal Turley, W8HC; Joe Pater, W8GEX; Jay Slough, K4ZLE; Gregg Marco, W6IZT, and Carl Luetzelschwab, K9LA. Jay will be the emcee for the event. Carl will give a propagation report. Joe will be giving a talk on Swains Island, and the upcoming W8S DXpedition. Hal will be presenting on the "Rig in a Box," which could revolutionize some of the rarer DXpedition locations. I will give the keynote speech.

An IC-7300 will be given away, thanks to the support of Icom and DX Engineering. More details about W8DXCC can be found on the SouthWest Ohio DX Association (SWODXA) website at **https://www.swodxa.org/w8dxcc**.

W9DXCC Convention

The W9DXCC Convention, an ARRL-sanctioned event, will be held September 10 and 11, 2021 at the Chicago Marriott in Naperville, Illinois. The Northern Illinois DX Association (NIDXA) will be hosting this event, starting off with Contest University (CTU) and DX University (DXU). I'll be one of the professors giving a talk at DXU. ARRL CEO David Minster, NA2AA, will be the Banquet Keynote Speaker. For updates, check out the W9DXCC website at **https://w9dxcc.com**.

W4DXCC Convention

The 2021 W4DXCC Convention, sponsored by the South Eastern DX and Contesting Organization (SEDCO), will take place at the MainStay Hotel and

Conference Center in Pigeon Forge, Tennessee on September 24 and 25, 2021. As has been the case for the past few years, they will once again have "Ham Radio Bootcamp" on Friday and the DX convention on Saturday. As the writing of this column, the agenda for bootcamp has been posted, but not the DX program. W4DXCC is an approved Operating Specialty Convention. I plan to attend this year's event. For up-to-date details on this year's event, visit their website at **http://www.w4dxcc.com**.

Around The Globe

5N — Nigeria

In early May 2021, Jean Louis Haye, ZS6AAG (aka F5MAW), began his next assignment with Doctors Without Borders in Abuja, Nigeria. Jean Luis' license as 5N9JLH has been forwarded and approved by the DXCC Desk for Accreditation. Haye expects to remain in 5N until September. He can often be found on the air on 14.122 MHz from 1600 to 1700Z. It is out of the US phone band. Bart Tichelaar, KE5GUR, has been in Port Harcourt since February 2020 and has been trying to get a license. He is now dealing directly the NCC.

A3 — Tonga

As of the writing of this column, Masato Tamura, JA0RQV, was stuck in Fiji, waiting to move on to Nuku'alofa, Tongatapu Island (OC-049). Once he makes it to Tonga, he plans to be active again as A35JP, until October 2021. He plans to be active with his 100 W IC-7300 and a vertical on 80 through 5 meters on CW, SSB, and FT8. He also has plans to make trips to Niuatoputapu (OC-191), Niuafo'ou (OC-123), Vava'u (OC-064), and Ha'apai (OC-169). Watch your favorite DX outlet for updates. Please do not send for your QSL request until after Masato has returned home.

Wrap-Up

That's all for this month. Special thanks to AJ8B, 5N9JLH, KE5GUR, and K9KE for helping to make this month's column possible. Don't forget to send any news, photos, and club newsletters to your editor at **bernie@dailydx.com**. Until next month, see you in the pileups!
— *Bernie, W3UR*

The 2021 ARRL International EME Competition

0000 UTC Saturday – 2359 UTC Sunday for each of the event's three weekends.

There are three weekends of activity for this year's contest:
October 23 – 24: 2.3+ GHz
November 20 – 21: 50 – 1296 MHz
December 18 – 19: 50 – 1296 MHz

Look to the moon for assistance during the ARRL International EME Competition! Long-distance DX contacts can be made on VHF, UHF, and above with 100 – 200 W and a medium- to long-boom Yagi. Using CW, phone, or digital modes, you too can bounce your signal off the lunar surface and work DX.

Spotting assistance is allowed in all categories, including but not limited to DX-alerting nets, reflectors, email, or even telephone.

Logs must be submitted or postmarked no later than 2359 UTC, January 18, 2022. Send electronic log submissions via our web app at **http://contests.arrl.org/arrlemescoresubmission.php**, or send paper logs to ARRL EME Contest, 225 Main St., Newington, CT 06111 USA.

Complete rules can be found at www.arrl.org/eme-contest

During the 2020 ARRL International EME Competition, Oleg Lartsyn, R9WL, used this two-Yagi array fed with a 2-meter transceiver driving a 500 W amplifier to contact stations in Europe and the US via the moon. [Oleg Lartsyn, R9WL, photo]

Jon Jones, NØJK, n0jk@arrl.org

The Fred Fish Memorial Award

One of the most prestigious VHF operating awards is the Fred Fish Memorial Award (FFMA). The FFMA was created in honor of Fred Fish, W5FF (SK), who was the first amateur to have worked and confirmed all 488 Maidenhead grid squares in the 48 contiguous United States on 6 meters. The award will be given to any amateur who can duplicate W5FF's accomplishment. The list of those achieving this award is an honor roll of some of the best and most dedicated 50 MHz operators, including W5FF, W5OZI, K5UR (ARRL President), KM0A, WD5K, NØLL, W7GJ, AA5AM, W4UDH, ND0B, WØFY, and K9CT. Achieving this award may take a lifetime, as some of the grids needed appear only rarely.

On May 31, 2021, Paul Kiesel, K7CW (see Figure 1), joined this elite list by working WØW (EN48) for his last grid to earn the FFMA (see the sidebar, "Earning the FFMA").

Paul Kiesel, K7CW, at his home station after achieving the FFMA. [Paul Kiesel, K7CW, photo]

Earning the FFMA

Paul Kiesel, K7CW

Wyatt, ACØRA; Vince, KØSIX, and Brad, KBØHNN, activated EN48 using the special call WØW, and because of them, on May 31, 2021, I was able to get my last needed grid for completing the requirements for FFMA (see Figure A).

Propagation conditions on Saturday and a good part of Sunday were poor in the western states, making it very unlikely a contact between us could occur. Yet, we kept in contact and tried various things to take advantage of whatever propagation modes existed, if any. Finally, Sunday afternoon gave us a decent multi-hop 6-meter opening to the East Coast. We tried the different digital modes and finally found each other using *WSJT-X* FT8. But, due to rapid signal fading, we couldn't decode one another. We ultimately decided to try *WSJT-X* Q65 mode, and we had immediate results. We had to work at it for a while to complete the contact, but we got it done.

Due to their inaccessible locations or lack of activity in them, the most difficult grids for me to work were DL88, DM71, EL58, EL84, FM13, and, as it turns out, EN48. I was able to work all 488 grids needed for completion of the FFMA requirements only because of the generosity of many grid Activators, many of whom spent large amounts of their own money and time to travel with the needed gear and antennas, arrange for places to stay and eat, arrange for permissions to enter properties, etc. DL88 was excessively hot. EL84 took working a station on a boat via EME to get it done. Activators go through a lot to help Chasers like me cross rare grids off our lists. I thank all of them for helping me get all 488 grids.

There has always been some doubt about whether it was possible for someone on either coast to work all 488 grids needed for FFMA. I am the first to complete FFMA from either coast, and I hope my success encourages others to take on the challenge.

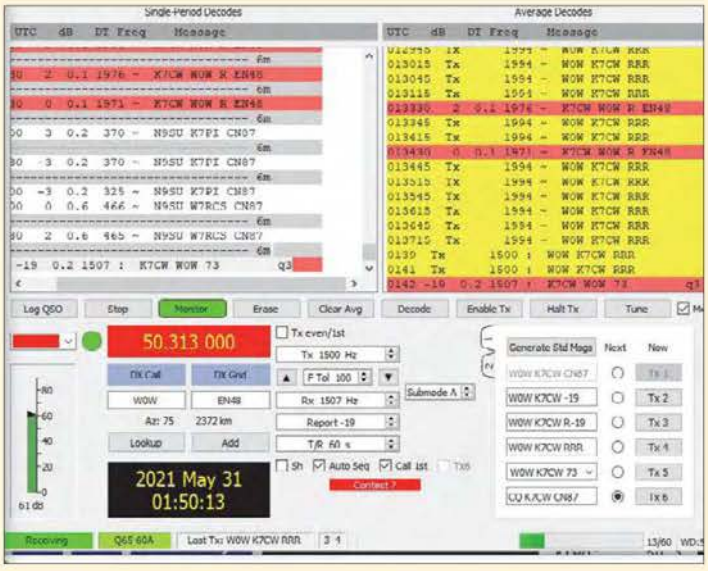


Figure A — K7CW's *WSJT-X* interface showing the completed contact between K7CW and WØW.

On the Bands

50 MHz. May was an outstanding month for sporadic E, with early openings from North America to Europe and Japan. Roger, VE1SKY (FN74), had great conditions to South America, making contacts in Argentina, Brazil, and Uruguay (CX6DRA) on May 2, and contacts with Chile on May 3, using FT8. ZF1EJ (EK99) and S57RR completed a transatlantic contact using Q65-30A on May 8. During the Eta Aquariid meteor shower, NØLL operated from rare grid DN91. Li, BA4SI, was received by N1KWF (FN32) on May 12 on FT8 at 1054Z. On May 13, Jack, KOØT (EM28), worked XE2OR (DL98) on SSB with 12 W to a dipole. On May 14, Dale, KZ5DP (EL06), worked DK8NE (JO50) on FT8. On May 17, VE1SKY worked G4IFX on Q65. Ken, KG7GD (DM33), made his first 6-meter contact with AL7RT (DN28) on SSB using a SteppIR vertical.

N4II (EM70) reported making contacts with 34 Japanese stations. Europe reached into Texas on May 18. Greg, WQØP (EM19), worked EC4C at 1912Z and stations in France. From California (DM04), K6TAR decoded HA7TM on FT8. On May 19, NØJK (EM28) had DK1MAX (JN58) in at –3 dB at 1529Z on 50.313 MHz FT8 (see Figure 2).

Figure 2 — Jon Jones', NØJK, portable setup that he used on May 19, 2021.

KD2CYU worked over 100 European stations. WA9M (EM79) reported making contacts with stations in Germany, Italy, and England. NP2J (FK77) logged 97 European stations, all CW. KY7M (DM52) had an opening to Europe and worked EI, GD, and GI. That afternoon, WQØP worked several stations in Japan and found BV6CC in Taiwan on FT8 at 0134Z on May 20 for his "best 6-meter DX ever." Larry, NØLL (EM09), also worked BV6CC at 0100z with only 150 W. On May 20, Ken, WB2AMU (FN30), worked eight European stations on CW.

Tom, N4TL (FM05), worked YT9A for his DXCC #112 on 6-meter FT8. AJ6T (EM66) worked S57RR and MMØAMW. On May 22, Bruce, KØBJ (DM99), had a strong opening to Japan. Bruce worked 13 JA stations and decoded VR2. Larry, W5LDA (EM15), made six JA contacts. Jay, KØGU (DN70), ran Japan and worked BV3UF, VR2XYL, BH4TVU, BH4SPN, and BA4SI. On May 23, Fred, K6IJ/KH7Y (CM98), worked EA8DBM and SØ1WS. On May 24, Jim, K5ND (EM12), worked PJ2BR and PJ4DX for new countries.

On May 26, KFØM (EM17) made several contacts with KH6 stations. NØYO (EM18) worked KH6U (BL11), KH6CJJ (BL10), and KH6TU (BL10) for his 49th state. WA2GFN (FN20) noted double-hop stations on SSB.

Memorial Day weekend was outstanding. The WØW team put EN48 in many logs. On May 30, Mario, K2ZD (FN21), worked A45XR at –13 dB. Lance, W7GJ, activated rare grids, and I (NØJK) logged him in DN64 and DN65 on May 31. NØND (DN96) made SSB contacts to the Midwest. TZ4AM worked K5EJ (EM45) and K1USA (EM37) on 50.107 MHz CW. Gregg, KE2SX (FM05), worked rare VE2ZOS (FN48) on CW with 25 W.

On the evening of May 31, there was a strong opening from the East Coast and Midwest to the Caribbean, Japan, and the Pacific Northwest. N1AV (DM43) worked a double-hop opening coast to coast. K1HTV worked PJ2, PJ4, FG, 9Y, and J7.

144 MHz. On May 3, WZ1V (FN31) noted coastal tropo to KC8KSK (FM03) on SSB. SM6VTZ copied EA8CXN at 3,908 kilometers on May 19, during an intense sporadic-E opening but lost the signal in fading variations on FT8.

There was strong tropo from EA8CXN on the island of Tenerife to the northwest coast of Spain, which is about 1,400 kilometers apart. SM6VTZ had sporadic-E to Spain. So, it is possible sporadic E from Sweden to Spain coupled into tropo from Spain to the Canary Islands. Thanks to Steve, NN4X, and John, EI7GL, for information on this report. Larry, NØLL, and I have speculated about the potential for 2-meter sporadic E or meteor scatter to link to the California–Hawaii tropospheric path from the Midwest. On May 26, W3BFC (FM28) worked N4TUT (EL98) on tropo.

Here and There

The Perseid meteor shower will peak on August 12. The best times/paths are NE-SW 0900 – 1100 and SE-NW 0100 – 0300 local time mid-path.

Special Event Stations

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

Through Dec. 31, 0000Z – 2359Z, all calls, all areas. VE2GT and VE2NCG. **Quebec Parks on the Air (QCPOTA)**. Certificate. *This is an operating event; see website for details.* **qcpota.ca**

Mar. 15 – Nov. 30, 0000Z – 2300Z, II3VE, Venezia, Italy. ARI Venezia. **1,600 Years of the Foundation of Venice**. All bands. Certificate & QSL. Sezione ARI Venezia, S. Croce 1776/B, Venezia 30135, Italy. *Detailed rules on ARI Venezia website and on* **QRZ.com** *for II3VE call. Both II3VE and club call IQ3VE are valid. QSL via eQSL or bureau.* **www.arivenezia.it**

July 16, 1400Z – 1800Z, K5S, Aberdeen, MS. Shiloh Amateur Radio Club. **Eugene O. Sykes, the First Chairman of the FCC, 125th Birthday**. 14.270 7.170. QSL. Jim Buffington, K5JIM, P.O. Box 52, Aberdeen, MS 39730-0052. **jim@jimbuffington.com**

July 31 – Aug. 1, 1400Z – 1900Z, N3P, Susquehanna, PA. Binghamton Amateur Radio Association. **66th Season at Penn Can Speedway**. 28.350 14.260 7.260 146.865 repeater (146.2 tone). Certificate. Robert Mess, 2505 Oak Hill Rd., Susquehanna, PA 18847. **ws2u.bob@gmail.com** *or* **www.w2ow.org**

Aug. 1 – Aug. 31, 0000Z – 2359Z, 4A2MAX, Diamond, Mexico. Asociacion de Radioexperimentadores de Nuevo Leon. **San Max Special Event**. 28.420 21.220 14.180 7.160. Certificate & QSL. Jose de Jesus Lopez V., 5914 San Bernardo Ave., Suite 4-135, Laredo, TX 78041-2506. **4a2max@xe2n.org** *or* **www.qrz.com/db/4a2max**

Aug. 4, 1400Z – 2300Z, K1CG, Port Angeles, WA. CG CW Operators Association. **US Coast Guard 231st Birthday**. 21.052 14.052 7.052 3.552. QSL. Fred Goodwin, 424 N. Bagley Creek Rd., Port Angeles, WA 98362. **www.qrz.com/db/k1cg**

Aug. 6 – Aug. 8, 0000Z – 2359Z, W7P and W7P/Ø, Flagstaff, AZ. Northern Arizona DX Association. **Pluto: Countdown to the 100th Anniversary of the Discovery of Pluto**. 14.290 14.090 21.290 7.290. Certificate & QSL. Bob Wertz, NF7E, 6315 Townsend/Winona Rd., Flagstaff, AZ 86004. *See website for certificate and QSL information.* **www.nadxa.com**

Aug. 6 – Aug. 8, 1900Z – 2359Z, W8AL, Canton, OH. Canton Amateur Radio Club. **Pro Football Hall of Fame Enshrinement Festival**. 14.280 7.280 3.980. Certificate & QSL*. Canton ARC/W8AL, P.O. Box 8673, Canton, OH 44711-8673. *Watch for FT8 or other digital modes. On-air times subject to operator availability, watch spots/social media.* **www.w8al.org**

Aug. 7, 1500Z – 2259Z, W9B, Sheboygan, WI. Sheboygan County Amateur Radio Club. **Johnsonville Brat Days**. 14.240 7.240. Certificate*. W9VCL Sheboygan County Amateur Radio Club, 4235 N. 29th St., Sheboygan, WI 53083. *See website for instructions on how to receive certificates.* **www.w9vcl.com**

Aug. 7, 1700Z – 2100Z, K9UXZ, Montrose, IL. National Trail Amateur Radio Club. **Montrose Sesquicentennial**. 14.250 7.250. QSL. National Trail Amateur Radio Club, P.O. Box 903, Attn: Montrose Sesquicentennial, Effingham, IL 62401. **www.nationaltrailarc.org**

Aug. 7 – Aug. 15, 0001Z – 2359Z, KØB, Saint Charles, MO. Saint Charles Amateur Radio Club. **Missouri Bicentennial 1821 – 2021, First State Capitol**. 14.215 7.215 7.105; all bands, all modes as conditions permit. Certificate & QSL. Special Event Station KØB/SCARC, P.O. Box 658, Saint Charles, MO 63302. *Club members will be operating as many modes and bands as possible from home stations.* **www.wb0hsi.org**

Aug. 8 – Aug. 14, 1400Z – 0000Z, W8J, Jackson, MI. Cascades Amateur Radio Society. **Jackson County Fair**. 14.235 14.045 7.180 7.045. QSL. Cascades Amateur Radio Society, P.O. Box 512, Jackson, MI 49204. **k8ts@arrl.net** *or* **www.w8jxn.org**

Aug. 8 – Aug. 15, 0000Z – 2359Z, W3KWH, Carnegie, PA. Steel City Amateur Radio Club. **80th Year Anniversary**. 28.495 3.985 146.550. QSL. Steel City ARC, P.O. Box 281, Carnegie, PA 15106. **w3kwh.com/steel-city-arc-80th-year**

Aug. 9 – Aug. 14, 1800Z – 2359Z, NU5DE, McDade, TX. Naturist Amateur Radio Club. **American Association for Nude Recreation National Convention**. 21.365 14.265 7.260. Certificate. Naturist Amateur Radio Club, 166 Eely Rd., #G1, McDade, TX 78650. *Celebrating 90 years.* **www.nu5de.org**

Aug. 9 – Aug. 15, 0000Z – 2359Z, W9IMS, Indianapolis, IN. The Indianapolis Motor Speedway Amateur Radio Club. **The Brickyard 400 — Race Three**. 18.140 14.245 7.245 3.840. Certificate. W9IMS, P.O. Box 30954, Indianapolis, IN 46230. *See the website for complete information!* **www.w9ims.org**

Aug. 10 – Aug. 14, 0000Z – 0000Z, N7C, Chinle, AZ. N7HG. **Navajo Code Talkers**. 21.265 18.133 14.265 7.265. Certificate & QSL. Herbert Goodluck, P.O. Box 06, Lukachukai, AZ 86507. **n7hgster@gmail.com**

Aug. 12 – Aug. 21, 0500Z – 0500Z, K9Y, Rochester, IL. K9ZXO. **Celebrating the Return of the 2021 Illinois State Fair**. 14.070; all modes, all bands. QSL. K9Y/J. Mitch Hopper, 536 E. Mill St., Rochester, IL 62563. **id@brainmist.com** *or* **www.qrz.com/db/k9y**

Aug. 13 – Aug. 27, 1400Z – 1400Z, K4H, Dallas, GA. W4IBM Amateur Radio Club. **Hedy Lamarr, the Inventor**.10, 20, 40, and 80 meters; 28.345 14.245 7.245 3.945; FT8 as conditions permit. Certificate & QSL. Ruth Leber, 598 Trace Rd., Dallas, GA 30157. **w4ibm.club/joomla30/index.php/club-activities/18-special-event-hedy-lamarr-inventor**

Aug. 14, 1600Z – 2200Z, W9UP, La Crosse, WI. Riverland Amateur Radio Club. **Irishfest La Crosse Special Event**. 14.265 14.260. Certificate. Riverland Amateur Radio Club, P.O. Box 621, Onalaska, WI 54650. *Additional operation, Yaesu Fusion WIRES-X, Room 63956 via Riverland Amateur Radio Club's Repeater.* **www.rarc.qth.com**

Aug. 19 – Aug. 22, 2000Z – 0400Z, W8D, Conneaut, OH. D-Day Ohio Radio Amateur Club. **D-Day Ohio D-Day Reenactment and World War II Living History Special Event Station**. 7.290 3.885 1.885; AM and CW. QSL. Garret Scott/W8D, 10236 Birch Hill Ln., Knoxville, TN 37932. **www.w8d.us**

Aug. 21 – Aug. 22, 1200Z – 2359Z, WB2DHY, Amelia Court House, VA. Amiable Amelia County Radio Club. **Discover Amelia County — Finally!** 14.280 7.280 14.074 7.074. QSL. Phil Lorito, 12371 Deaton Ln., Amelia Court House, VA 23002. *Operating CW, SSB, and FT8. Additional frequencies and times will be posted.* **www.qrz.com/db/wb2dhy**

Aug. 21 – Aug. 22, 1400Z – 0200Z, K2T, Cornwall, NY. Orange County Amateur Radio Club. **First Rail Road Train Dispatch by Telegraph 1851**. 14.250 14.074 14.040 7.255 7.074 7.040 3.920 3.573 3.540. Certificate. OCARC, P.O. Box 624, Cornwall, NY 12518. *Certificate downloadable from website.* **w2ho@ocarcny.org** *or* **www.ocarcny.org**

Aug. 27 – Sep. 5, 0500Z – 0459Z, K2A/K2R/K2S, Ames, IA. Amateur Radio Software Award. **Amateur Radio Software Awards**. 14.250 7.185 3.950 7.078. QSL. Amateur Radio Software Awards, Special Event Station, P.O. Box 126, Ames, IA 50010-0126. **www.arsaward.com**

Aug. 28 – Aug. 29, 1400Z – 2350Z, WØJH, White Rock, SD. Stillwater Amateur Radio Association. **Tri-States Portable Special Event: ND, MN, and SD**. 21.360 14.260 7.260 3.860. Certificate. By email only to Shel Mann, NØDRX, **WhiteRock2021@radioham.org**. *Certificates will* only *be sent via email in PDF.* **www.radioham.org**

Aug. 28 – Sep. 7, 0800Z – 2200Z, W3B, Sharon, PA. Mercer County Amateur Radio Club. **Buhl Day Celebration**. 7.185 14.240 145.350. QSL. Mercer County Amateur Radio Club, P.O. Box 996, Sharon, PA 16146. **www.w3lif.org**

Aug. 28 – Sep 8, 0000Z – 2359Z, K9A, Auburn, IN. Northeastern Indiana Amateur Radio Association (W9OU). **65th Annual Auburn, Cord, Duesenberg Festival**. 14.074 7.225 7.074 7.030. Certificate & QSL. K9A c/o Northeastern Indiana ARA, P.O. Box 145, Auburn, IN 46706. **www.w9ou.org**

Certificates and QSL cards: To obtain a certificate from any of the special event stations offering them, send your QSO information along with a 9 × 12 inch self-addressed, stamped envelope (three units of postage) to the address listed in the announcement. To receive a special event QSL card (when offered), be sure to include a self-addressed, stamped business envelope along with your QSL card and QSO information. *Note: Some clubs may ask for a nominal fee to cover the cost of the certificate or QSL. Request will be made on air during the event or on the club's website.

Special Events Announcements: For items to be listed in this column, use the ARRL Special Events Listing Form at **www.arrl.org/special-events-application**. A plain-text version of the form is available at that site. You may also request a copy by mail or email. Off-line completed forms can be mailed, faxed (Attn: Special Events), or emailed.

Submissions must be received by ARRL HQ no later than the 1st of the second month preceding the publication date; a special event listing for **November** *QST* would have to be received by **September 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**.

All ARRL members can now enjoy the online edition of *QEX* as a member benefit. Coming up in the July/August 2021 and future *QEX* issues are articles and technical notes on a range of amateur radio topics. These are at the top of the queue.

- Alan Victor, W4AMV, applies a systematic design flow for Class C RF power amplifiers.
- Ric Tell, K5UJU, considers new FCC rules that may now require RF exposure compliance using specific absorption rate (SAR).
- Jacek Pawlowski, SP3L, investigates the design of antennas considering common-mode currents on the transmission line.
- Tony Brock-Fisher, K1KP, describes a fixture for measuring Q of inductors.
- John Stanley, K4ERO, matches twinlead or ladder line feeders with a sleeve implementation of a series-section transformer.
- Dan Koellen, AI6XG, uses *Telegram* to remotely command and monitor his ham station.

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.

The printed edition annual subscription rate (six issues per year) for members and non-members in the US 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.

Certificate of Code Proficiency

Recipients

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www.vibroplex.com

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

March 2021	
David A. Hewitt, WA9AVZ	10
Richard J. Berezanich, WB3HUS	10
Ben Bowers, KE3KQ	10
Thomas L. Hardy, K6TLH	10
David O. Krovetz, K4KXA	10
Thomas W. Porter, W8KYZ	10
Brett H. Sharpton, KD2SZW	10
Remell A. Spencer, Jr., KA6DOY	10
Thomas P. Stelmach, NØQBX	10
Rene M. Beland, KE8NPD	15
Mark Anthony Isom, KI5JH	15
Michael S. Lundy, W4MSL	15
Thomas W. Porter, W8KYZ	15
Paul A. Miller, W5RES	20
Thomas W. Porter, W8KYZ	20
Brian K. Moore, KM6ZX	25

April 2021	
William T. Cronenwett, W5TPJ	10
Dane E. Groszek, KD2SSS	10
Christopher J. Porter, AA7KL	10
Donald L. Steinbach, AE6PM	10
Bill H. Stephens, NUØY	10
Joel F. Wagner, III, ND5V	10
Richard J. Berezanich, WB3HUS	15
Victor Denisov, N6DVS	15
Edward H. Linch, III, N4LS	15
Richard B. Peglowski, KE4SAV	15
Warren T. Seeley, W4FLL	15
John H. Summers, Jr., WØDY	15
Robert T. Marston, AA6XE	20
Arvid W. Weflen, KL7YC	25
James Carson, WT8P	30
Christopher G. Pearson, G5VZ	30
Edward J. Picha, N9EP	35

May 2021	
Angelica T. Brewer, KN4SGS	10
James W. Carter, K7IOL	10
Federico Grau, KC3MWD	10
Roger L. Burkhart, N3GE	15
Daniel Lasorso, KD8OFT	15
Bill H. Stephens, NUØY	15
Joel F. Wagner, III, ND5V	15
Roger L. Burkhart, N3GE	20
William N. Massie, AA8KY	20
Dennis J. Niles, WV7S	20
Paul D. Manoli, KB1NCD	35

Congratulations to all the recipients.

August 2021 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.

August 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 are scheduled to be transmitted by K9JM on Wednesday, August 25 at 9 PM PDT (0400 UTC on Thursday, August 26) on 3590 and 7047.5 kHz. Unless indicated otherwise, sending speeds are from 10 to 40 WPM.

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

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

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

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

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

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

W1AW Code Proficiency Schedule — August 2021
(All times are in Eastern Daylight Time)

Monday	Tuesday	Wednesday	Thursday	Friday
8/2 4 PM – 2000Z 10 – 35 WPM	**8/3** 7 PM – 2300Z 35 – 10 WPM		**8/5** 10 PM – 0200Z **(8/6 – UTC)** 10 – 40 WPM	**8/6** 9 AM – 1300Z 10 – 35 WPM
	8/10 4 PM – 2000Z 10 – 35 WPM	**8/11** 7 PM – 2300Z 10 – 40 WPM	**8/12** 9 AM – 1300Z 35 – 10 WPM	**8/13** 10 PM – 0200Z **(8/14 – UTC)** 10 – 35 WPM
	8/17 9 AM – 1300Z 10 – 35 WPM	**8/18** 10 PM – 0200Z **(8/19 – UTC)** 35 – 10 WPM	**8/19** 7 PM – 2300Z 10 – 35 WPM	**8/20** 4 PM – 2000Z 10 – 40 WPM
8/23 10 PM – 0200Z **(8/24 – UTC)** 10 – 40 WPM		**8/25** 9 AM – 1300Z 35 – 10 WPM	**8/26** 4 PM – 2000Z 35 – 10 WPM	**8/27** 7 PM – 2300Z 10 – 35 WPM

Convention and Hamfest Calendar

A = AUCTION
D = DEALERS / VENDORS
F = FLEA MARKET
H = HANDICAP ACCESS
Q = FIELD CHECKING OF QSL CARDS
R = REFRESHMENTS
S = SEMINARS / PRESENTATIONS
T = TAILGATING
V = VE SESSIONS

Abbreviations

Spr = Sponsor
TI = Talk-in frequency
Adm = Admission

ARRL SOUTHEASTERN DIVISION CONVENTION

August 21 – 22, Huntsville, Alabama

D F H Q R S V

Sat. 9 AM – 4:30 PM, Sun. 9 AM – 3 PM. *Spr:* Huntsville Hamfest, Inc. Von Braun Center, 700 Monroe St. SW. *TI:* 146.94 (100 Hz). *Adm:* $10; children aged 12 and under, free. **www.hamfest.org**

Connecticut (Newtown) — Aug. 29 D F H R S T V

8 AM – 1 PM. *Spr:* Candlewood Radio Association. Edmond Town Hall, 45 Main St. *TI:* 147.300 (100 Hz). *Adm:* $7, $1 discount with flyer. **www.cararadioclub.org**

Florida (Fort Pierce) — Aug. 14 D F H Q R S V

8 AM – 2 PM. *Spr:* Fort Pierce ARC. Indian River State College, 3209 Virginia Ave. *TI:* 147.345 (107.2 Hz). *Adm:* $5 advance, $7 at-door. **www.fparc.org**

Florida (Tampa) — Aug. 21 F H Q R T V

8 AM – 1 PM. *Spr:* Tampa ARC. Tampa ARC Clubhouse, 7801 N. 22nd St. *TI:* 147.105 (146.2 Hz). *Adm:* $5. **www.hamclub.org**

ARRL GEORGIA STATE ARES MEETING & CONVENTION

August 14, Forsyth, Georgia

H S

7:30 AM – 4:30 PM. *Spr:* Georgia ARES. Georgia Public Safety Training Center, 1000 Indian Springs Dr. *TI:* none. *Adm:* none. Email: **kn4yz@arrl.net**

ARRL ILLINOIS SECTION CONVENTION

September 10 – 11, Naperville, Illinois

D H Q R S

8 AM – 5 PM. *Spr:* Northern Illinois DX Association. Chicago Marriott Naperville, 1801 Naper Blvd. *TI:* none. *Adm:* $55 advance, $60 at-door. **www.w9dxcc.com**

Indiana (Avon) — Aug. 14 T

9 AM – 1 PM. *Spr:* Ham Emergency Radio Operations. Avon United Methodist Church, 6850 E. Hwy. 36. *TI:* 147.015 (88.5 Hz). *Adm:* $5. Email: **kc9sqd425@gmail.com**

Indiana (Peru) — Aug. 28 D H R S V

9 AM – 2 PM. *Sprs:* Cass Co., Grant Co., Kokomo, and Miami Co. ARCs. Miami Co. 4-H Fairgrounds, 1029 W. 200 N. *TI:* 147.345 (131.8 Hz). *Adm:* $5. **www.nci-hamfest.net**

Kansas (Hutchinson) — Aug. 14 F H R V

8 AM – 2 PM. *Spr:* Reno County Kansas ARA. Kansas National Guard Armory, 1111 N. Severance. *TI:* 147.120 (103.5 Hz). *Adm:* donations requested. **www.rckara.org**

Louisiana (Shreveport) — Aug. 14 D F H Q R S V

8 AM – 2 PM. *Spr:* Shreveport ARA. Louisiana State Fair Agriculture Bldg, 3206 Pershing Ave. *TI:* 146.820 (186.2 Hz). *Adm:* $5. **www.shreveporthamfest.com**

Massachusetts (Adams) — Aug. 22 D F H R T V

7 AM – noon. *Spr:* Northern Berkshire ARC. Bowe Field (Adams Agricultural Fairgrounds), 371 Old Columbia St. *TI:* 146.91 (162.2 Hz). *Adm:* $5. **www.nobarc.org**

ARRL NEW ENGLAND DIVISION CONVENTION

September 10 – 12, Marlborough, Massachusetts

D F H Q R S T V

8 AM – 10 PM. *Spr:* Federation of Eastern Massachusetts ARA. Best Western Royal Plaza, 181 Boston Post Rd. *TI:* 147.270 (146.2 Hz), 449.925 (88.5 Hz). *Adm:* $18. **www.hamxposition.org**

Michigan (Port Huron) — Aug. 29 F H Q R T

8 AM – noon. *Spr:* Eastern Michigan ARC. Great Lakes Maritime Center at Vantage Point, 5 Water St. *TI:* 146.800 (100 Hz). *Adm:* free. Email: **ac8w@arrl.net**

Michigan (Shelby Township) — Aug. 21 D F

8 AM – noon. *Spr:* General Motors ARC. Packard Proving Grounds, 49965 Van Dyke Ave. *TI:* 443.075 (123 Hz). *Adm:* $5 per carload buying or selling. **www.gmarc.org**

Minnesota (Brewster) — Aug. 28 F H R S V

9 AM – 1 PM. *Spr:* Northern Plains Regional Radio Council. Brewster American Legion Post, 825 3rd Ave. *TI:* 146.67 (141.3 Hz). *Adm:* $5. **www.facebook.com/groups/NPRRC**

New York (Avoca) — Aug. 21 F H R T V

8 AM. *Spr:* Keuka Lake ARA. Howard Community Center, 7481 Hopkins Rd. *TI:* 145.190 (110.9). *Adm:* $5. **www.klara.us**

New York (Rensselaer) — Aug. 21 D F R T

8 AM – 1 PM. *Spr:* East Greenbush ARA. East Greenbush Volunteer Fire Department Pavilion, 68 Phillips Rd. *TI:* 147.270 (94.8 Hz). *Adm:* $6. **www.egara.club**

New York (Macedon) — Aug. 28 D F H R T V

7 AM – 2 PM. *Spr:* ROC City Net. The Log Cabin Family Restaurant, 2445 W. Walworth Rd. *TI:* 145.110 (110.9). *Adm:* none. **www.facebook.com/groups/roccitynet**

North Carolina (Fayetteville) — Aug. 14 D F H R T V

8 AM – noon. *Spr:* Cape Fear ARS. Cumberland County Shrine Club, 7040 Ramsey St. *TI:* 146.910 (100 Hz). *Adm:* none. **www.cfarsnc.org**

ARRL NORTH CAROLINA SECTION CONVENTION

September 3 – 5, Shelby, North Carolina

D F H Q R S T V

7 AM – 5 PM. *Spr:* Shelby ARC. Cleveland Co. Fairgrounds, 1751 E. Marion St. *TI:* 146.880. *Adm:* $8 advance, $10 at-door. **www.shelbyhamfest.org**

Ohio (Owensville) — Aug. 28 D F H Q R T V

8 AM – 1:30 PM. *Spr:* Milford ARC. Clermont County Fairgrounds, 1000 Locust St. *TI:* 147.345 (123.0 Hz). *Adm:* $5. **www.cincinnatihamfest.org**

Pennsylvania (New Kensington) — Aug. 29 F Q R T

8 AM – 2 PM. *Spr:* Skyview Radio Society. Skyview Radio Society Clubhouse, 2335 Turkey Ridge Rd. *TI:* 146.640 (131.8). *Adm:* $5. **www.skyviewradio.net**

Pennsylvania (Uniontown) — Aug. 14 D F H R T V

7 AM, tailgaters; 8 AM, attendees. *Spr:* Uniontown ARC. Uniontown ARC Clubhouse, 433 Old Pittsburgh Rd. *TI:* 147.045 MHz (131.8 Hz). *Adm:* free. **www.w3pie.org**

Tennessee (Lebanon) — Aug. 28 D H R S T
8 AM. *Spr:* Short Mountain Repeater Club. Cedars of Lebanon State Park, 328 Cedar Forest Rd. *Tl:* 146.910 (114.8 Hz). *Adm:* $5. Email: **portercw@bellsouth.net**

Virginia (Berryville) — Aug. 1 D F H Q R T V
8 AM – 4 PM. *Spr:* The Shenandoah Valley ARC. Clarke County Ruritan Fairgrounds, 890 W. Main St. *Tl:* 146.820 (146.2 Hz). *Adm:* $10. **www.svarc.us/hamfest**

West Virginia (Huntington) — Aug. 14 D F H R V
8:30 AM – 1:30 PM. *Spr:* Tri-State ARA, Inc. New Baptist Church 610 28th St. *Tl:* 146.76. *Adm:* $6. **www.qsl.net/w8va**

ARRL WEST VIRGINIA STATE CONVENTION

August 27 – 29, Sutton, West Virginia
D F H R S T V
8 AM – 5:30 PM. *Spr:* West Virgina State Amateur Radio Council. Flatwoods Days Inn and Suites and the Flatwoods Conference Center, 350 Days Dr. *Tl:* 145.290 (91.5 Hz). *Adm:* $10. **www.qsl.net/wvsarc**

Wisconsin (Baraboo) — Aug. 28 D F H R S T V
8 AM – noon. *Spr:* Yellow Thunder ARC. Badger Steam and Gas Engine Club, E3347 Sand Rd. *Tl:* 147.315 (123.0 Hz). *Adm:* $5. **www.yellowthunder.org**

Wisconsin (Milwaukee) — Aug. 28 D F H R
8 AM – 12 PM. *Sprs:* Milwaukee Radio Amateurs' Club and Milwaukee Area ARS. Elks Lodge #46, 5555 W. Good Hope Rd. *Tl:* 145.390 (127.3 Hz), 145.130 (127.3 Hz). *Adm:* $4 advance, $5 at-door. **www.w9rh.org/club-events/swapfest**

Wisconsin (Tomahawk) — Aug. 21 D H R
9 AM – 3 PM. *Sprs:* Tomahawk Repeater Association and Rhinelander Repeater Association. SARA Park Center, 900 W. Somo Ave. *Tl:* 145.430 (114.8 Hz). *Adm:* $5. Email: **trapper330@gmail.com**

To All Event Sponsors

Before making a final decision on a date for your event, you are encouraged to check the Hamfest and Convention Database (**www.arrl.org/hamfests-and-conventions-calendar**) for events that may already be scheduled in your area on that date. You are also encouraged to register your event with HQ as far in advance as your planning permits. See **www.arrl.org/hamfest-convention-application** for an online registration form. Dates may be recorded up to 2 years in advance.

Events that are sanctioned by ARRL receive special benefits, including an announcement in these listings and online. Sanctioned conventions are also listed in *The ARRL Letter.* In addition, events receive donated ARRL prize certificates and handouts. Once the form has been submitted, your ARRL Director will decide whether to approve the date and provide ARRL sanction.

The deadline for receipt of items for this column is the **1st of the second month preceding publication date**. For example, your information must arrive at HQ by **September 1** to be listed in the **November** 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.

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Volunteer Monitor Program Report

The Volunteer Monitor (VM) Program is a joint initiative between ARRL and the FCC to enhance compliance in the Amateur Radio Service. This is the May 2021 Volunteer Monitor Program Report.

♦Technician-class operators in Palm Bay and Hollywood, Florida, received advisories after making more than a dozen FT8 contacts on 40 and 20 meters. Technicians are not permitted to operate on 20 meters and have no data privileges on 40 meters.

♦A licensee in El Cerrito, California, received an advisory concerning use of his 444.700 MHz repeater for deliberate interference and unidentified transmissions.

♦A General-class licensee in Guanica, Puerto Rico, received an advisory after operating on 14.187 MHz during a DX contest in May. General-class licensees have no privileges below 14.225 MHz on 20 meters.

♦A General-class licensee in Texas received a warning concerning deliberate interference, broadcasting, and failure to identify on 3.919 MHz and 3.922 MHz. The operator was informed that if such operation continued, the FCC would be requested to remove voice privileges from his license.

♦A General-class licensee in Slippery Rock, Pennsylvania, received an advisory for operation on 7.163 MHz. General-class licensees are not permitted to operate below 7.175 MHz.

♦A repeater station in Mission Viejo, California, was shut down after the operator received a notice that the repeater was being used for deliberate interference.

♦A warning was issued to a licensee in Erie, Pennsylvania, for operation on 146.61 MHz and 146.682 MHz after the repeater licensee had requested in writing that the individual refrain from using the repeaters.

♦VM monitoring totals in April were 1,784 hours on HF frequencies and 2,214 hours on VHF frequencies and above.

The Volunteer Monitor Program Administrator had one meeting with the FCC, and one case was referred to the FCC for further action. — *Thanks to Riley Hollingsworth, K4ZDH, Volunteer Monitor Program Administrator*

Life Members

Elected May 3, 2021

Alvin A. Alcaide, NA6V
Walter William Carter, KD8LWC
Norman Chasse, AC3GD
Donald D. Coker, KM6TRZ
Stewart F. Cooke, N9OGI
Leonard S. Cowles, K1PYU
RheaAnn Crowe, KD5HTJ
Jacob J. Feltz, K9TVG
Frank B. Giorgianni, K2PF
Christopher Hammond, KO4PCJ
Bruce A. Littlefield, WA1HGJ
Bruce A. Manning, NJ3K
Gregory A. Mitchell, KB1AWM
Gary E. Norman, W1PG
Brian Nuss, WH6ETE
Stephen M. Russ, NI4SR
George A. Smith, WD8INW
Joseph A. Valinotti, III, N3WSO
Kevin A. White, KG7LSD

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.

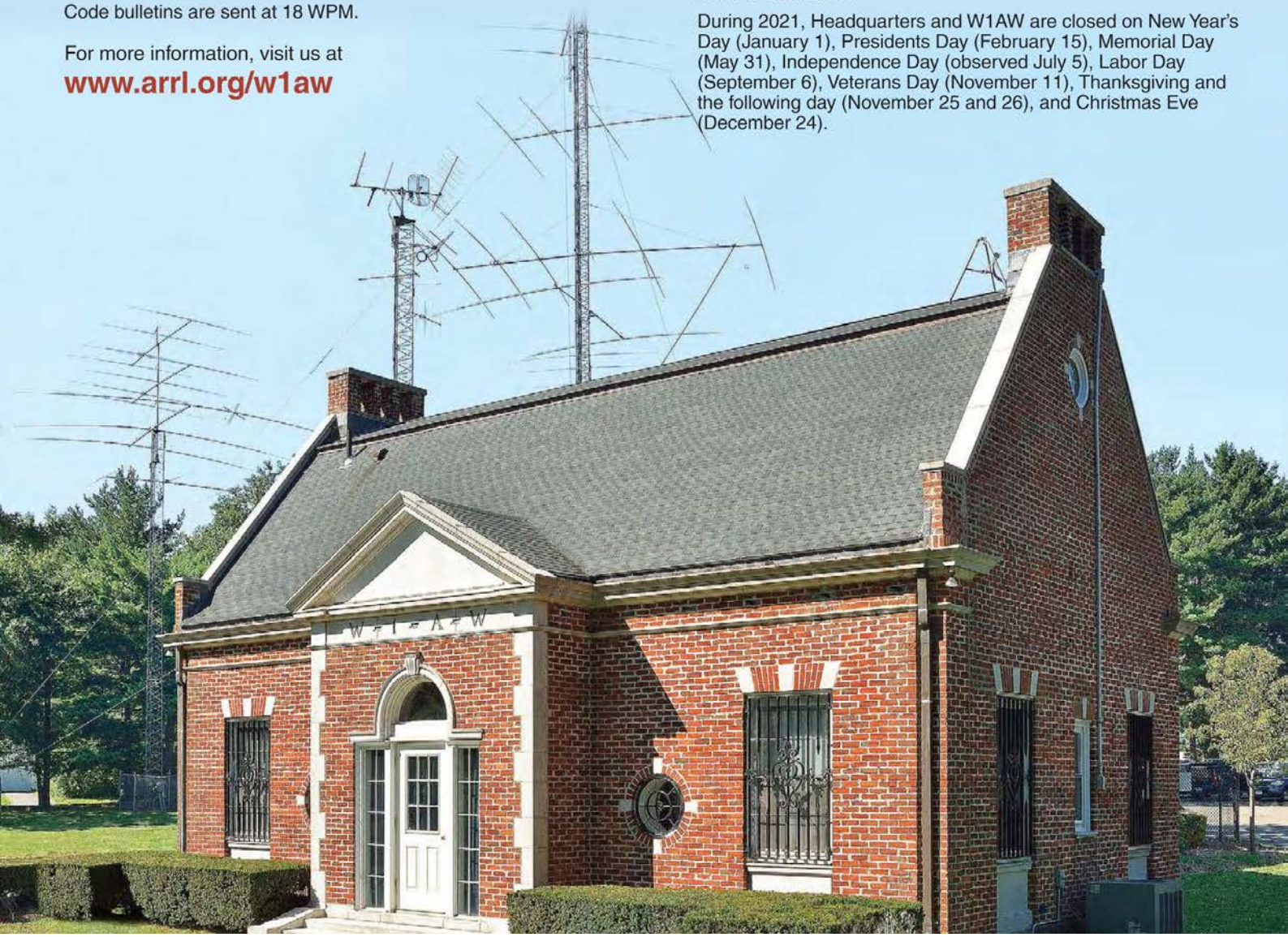
Keplerian elements for many amateur satellites will be sent on the regular digital frequencies on Tuesdays and Fridays at 6:30 PM Eastern time using Baudot and PSK31.

♦ 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.

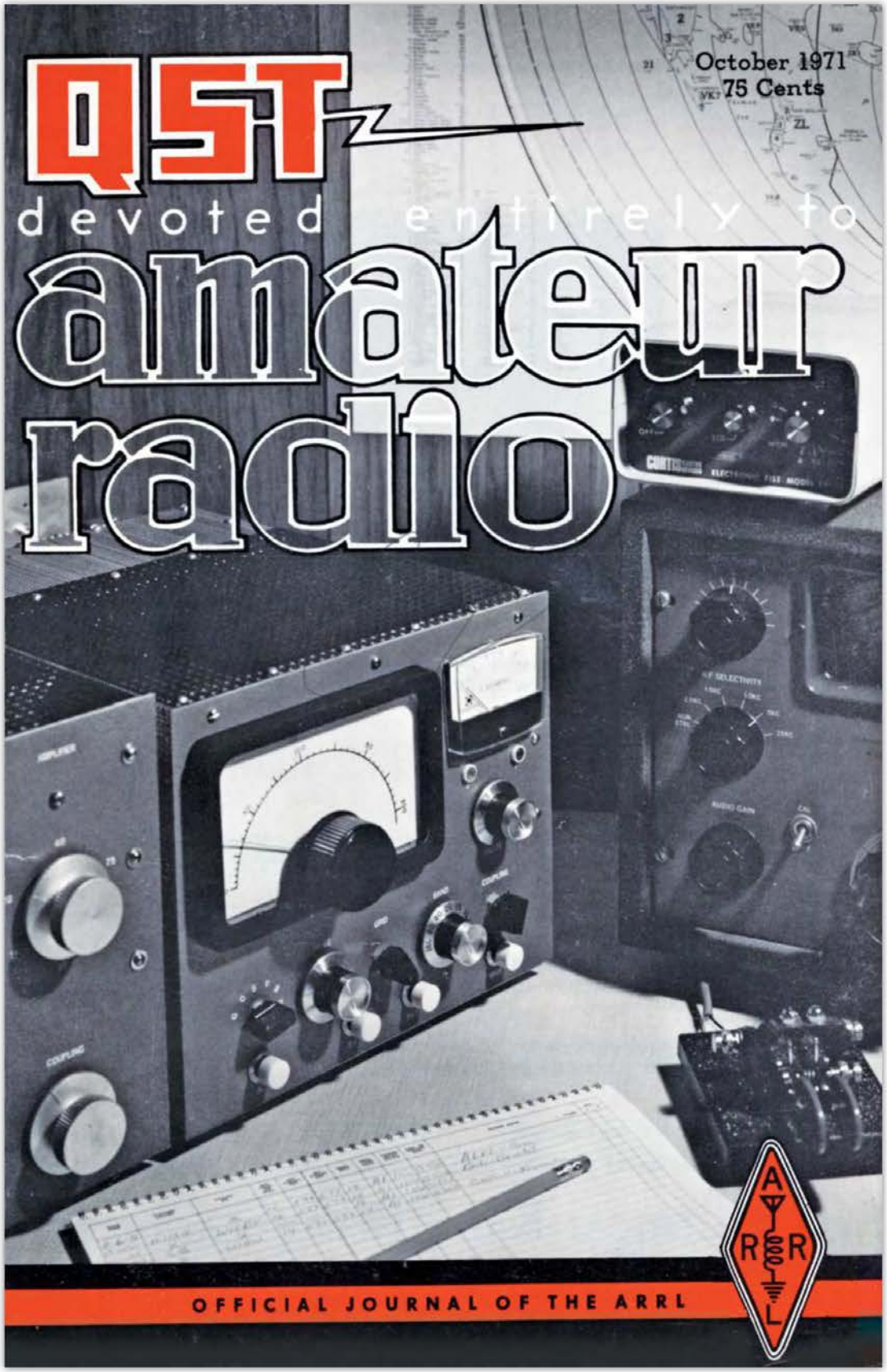
♦ Notes: On Fridays, UTC, a DX bulletin replaces the regular bulletins. W1AW is open to visitors 10 AM to noon and 1 PM to 3:45 PM Monday through Friday. FCC-licensed amateurs may operate the station during that time. Be sure to bring a reference copy of your current FCC amateur license. In a communication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

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

During 2021, Headquarters and W1AW are closed on New Year's Day (January 1), Presidents Day (February 15), Memorial Day (May 31), Independence Day (observed July 5), Labor Day (September 6), Veterans Day (November 11), Thanksgiving and the following day (November 25 and 26), and Christmas Eve (December 24).



A Look Back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October 1971
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High-Frequency Atmospheric Noise

Part I — Whither Comest Thou?

BY MARVIN R. CLINCH,* K2BYM, and CALVIN R. GRAF,** W5LFM.

RADIO AMATEURS, like all other communicators, want to have the best possible communications quality when they are operating. A predominant factor in conventional communications quality is the signal-to-noise ratio, or S/N. The usual practice of most communicators, professional and amateur alike, when faced with an objectionably low S/N, is to increase the transmitter power, all other things being equal. However, doubling the power, for example, will only increase it by 3 dB, and doubling it again will only increase it by a total of 6 dB. This means that a ham with 150-watts output to his antenna will have to raise his power to 600 watts to increase the S/N by a mere 6 dB, approximately one S unit on some receivers.

A less obvious way to improve the S/N, but perhaps more appropriate in these days of highly crowded frequencies, is to decrease the noise received. Until recently, amateurs have been concerned with the level of internal receiver noise. W7IV has presented an interesting thesis concerning atmospheric noise.[1] However, there is evidence that the atmospheric-noise picture is not as black as he presented (or should we say white, since noise is involved[2]). In fact, there have been studies which show that atmospheric noise is both directional and predictable. One way of understanding this is to look at a world map which shows the distribution of thunderstorms to be concentrated in certain parts of the world. Since the noise is propagated just like a coherent radio signal in an approximately great circle path, one might paraphrase the DXers bible and say, "Where the thunderstorm is located, there ye shall find the noise also." It is known that the greatest noise sources, in terms of both time and intensity, are along the equator, with very large concentrations at well-known spots along the Amazon, in Java, and in central Africa.

* 4500 Skenandoah Dr., R.D. 2, Oneida, NY 13421.
** 207 Zornia, San Antonio, TX 78213.

1 Hyder, "Atmospheric Noise and Receiver Sensitivity," *QST*, November, 1969.

2 There is a class of noise called "white noise," which has a broad band of frequencies present, just as white light has a continuous broadband spectrum.

Geographic Considerations

Now, since these concentrations are distributed geographically, each will have a different azimuthal bearing from a given receiving location. In addition, the farther one gets away from these great noise concentrations, the more dependent the received sferics will be on propagation and the less the received strength will be. This is also observed from the noise maps shown in the W7IV article. The intensity of the sferics can therefore vary in two ways, being dependent on the bearing angle of the receiving antenna and the distance from the source.

To the ham who has spent all his amateur career operating from the midwest (Iowa) or the far north (Canada), it is not at all uncommon to operate in the 75- and 80-meter bands as if it were 40 meters to the ham from the southern part of the U.S. (southern Texas to Florida). The ham in Iowa easily receives the W5 on 80-meter cw from Texas, but the poor chap in Texas with a simple dipole who is close to the Gulf of Mexico and its thunderstorm areas has a hard time making sense out of the WØ's dits and dahs among the sferics crashes.

However, if the W5 were to string some antennas with directive gain from his oil-well towers in his back yard, he would be able to look away from his nearby noise sources. He would easily receive the WØ chap who is happy for the years of success he has had with his dipole antenna stretched between two tall corn stalks. Perhaps it was a Louisiana 160-meter cw man, who, after using a broadside array to make WAS, wrote the well-known antisferics song, "Look Away, Dixieland."

THE WØ WITH YEARS OF SUCCESS.'

Determination of the directional properties of atmospheric noise to a degree for fully acceptable prediction requires the use of a fairly directive and expensive antenna system (i.e., antenna gain of 10 to 15 dB with all side lobes 15 to 20 dB down) either capable of being scanned 360 degrees in azimuth or having multiple fixed beams over the full circle. The multiple beams are by far the more desirable. It is also desirable to determine the vertical angle of arrival of the signal as well as its polarization. Such an antenna system could then be used with the same ARN-2 type of receiving set used by ESSA (Environmental Sciences Service Administration) in their collection of the data for the CCIR Report 322.[3]

The general conclusions reached in the CCIR Report 322 are based upon the early excellent work of W. Crichlow *et al* at ESSA. These data were taken in certain parts of the world using the ARN-2 with an electrically short, vertical, omnidirectional whip antenna. The output of this antenna is fed to the ARN-2 receiver which integrates the noise over a 90-second or more integration period. Thus, no strong conclusions can be reached concerning the directivity of atmospheric noise based upon the data taken. The short whip receives lightning-crash noise from all directions and can't "look away" from the sferics source as can the lucky W5.

Local Thunderstorm Activity

It is well known that thunderstorm activity is localized (as discussed above) and somewhat predictable (spring showers, summer thunderstorms), although only on a short-term probability basis. Since a greater part of the received atmospheric noise is the integration product of the lightning strokes throughout the viewing angle of the receiving antenna, it can be seen that a directional antenna looking away from the storm centers will reduce the noise received. It is also true that most (if not all) of the noise, for any given day, is a function of the propagation conditions and frequency. A single storm might be in the skip zone and not be heard. Therefore, to a somewhat lesser extent, the received noise might be predicted by using the new *Ionospheric Predictions Handbook*.[4] It should be realized that the maximum usable frequency (MUF) is calculated from an estimated sunspot number and predicts what the MUF might be 50 percent of the days of the month. Because of this uncertainty, when sitting

down at the rig and being unable to work the WØ in Iowa, the W5 from oiltown was heard to mutter the definition of median MUF – "Fifty percent of the time I can't hear them when I should, and fifty percent of the time I hear them when I shouldn't!"

Because of the above sage observations it might be more useful to look at the weather map in the evening paper to see where the rain showers might be, before turning on the rig. In the meantime, the VE8 to the far north chuckles as he makes WAC on 160 meters (low power) with his dipole stretched between push-pull igloos.

There has been some professional communicator interest generated in the determination of the directional characteristics of atmospheric radio noise. One paper in particular, by P.A. Bradley and C. Clarke in the British journal, *Proceedings of the IEE*, Vol. III, No. 9, Sept., 1964, describes an observational program. Simultaneously using both omnidirectional and directional antennas in a tropical environment, the data were taken to determine the relative noise and signal-to-noise relationships. The results of the data are presented in a statistical form as amplitude-probability-distribution charts. In the paper, Bradley and Clarke state, "Noise values observed from the present series of measurements on the rhombic aerials have been as much as 12 dB greater than would be expected from the assumption of uniformly distributed incident noise." That is, they saw more noise when they looked at the storm center with a very directional antenna, as compared to the omnidirectional whip antenna. This difference of 12 dB is equivalent to a power difference in a transmitter of almost 16 times, for the same signal-to-noise ratio. Elsewhere in the paper they state that their results "may be regarded as representative of conditions at tropical receiving sites. At temperate- and high-latitude locations where the azimuthal distribution of long-distance thunderstorms is less uniform, the influence of directional-aerial heading on relative noise power pickup will be greater." The last sentence says that the more antenna directive gain you have, the more you can "look away" from the noise sources. So, even the VE8 with phased rhombics would see more noise when he tried to work toward one of the noise concentrations described earlier.

[3] [EDITOR'S NOTE: The International Radio Consultive Committee (CCIR) Report No. 322, published in 1964 by the International Telecommunications Union, Geneva, is the "bible" on atmospheric noise. This report is discussed in some detail by Hyder. See footnote 1.]

[4] [EDITOR'S NOTE: The Institute for Telecommunications Sciences, formerly a branch of ESSA, publishes a handbook of ionospheric predictions consisting of four volumes. These volumes replace the former monthly publication, *Ionospheric Predictions*. Three volumes contain world maps for various degrees of solar activity, and the fourth describes the maps and illustrates their usage. The set is available through the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402, for $9.30. Volumes may also be obtained individually.]

Man–Made Noise

Another factor which must be taken into account in the receiving case is the localization of man-made noise. It is well known that heavily industrialized/populated areas are sources of radio noise. (neon signs, arc welders, electric blankets, and so on). These sources may be treated somewhat as thunderstorms except that their locations are fixed and their signal levels perhaps more predictable (arc welder off, electric blanket on).

Since the atmospheric noise is not isotropic, that is, not radiated equally in all directions, a directional antenna should show an increase in S/N ratio when its beam is pointed away from the high-noise areas. This however, depends heavily upon the beam characteristics, both the side-lobe structure and the elevation take-off angle.

No great store of information exists on all the directive characteristics of atmospheric radio noise. While atmospherics, in general, propagate the same as radio waves, little is known about many of their properties. These are azimuthal distribution, backscatter influence, predominant polarization, elevation angle of arrival, symmetry of radiation of a lightning flash, fading characteristics, and others. Perhaps the future will allow research work in these areas to be conducted.

In years past, the amateur fraternity has done a terrific job in conducting tests and gathering data which point out to the scientific groups that certain phenomena do, indeed, exist. Some examples of these are: radio astronomy, moon-bounce, meteor reflection, transequatorial vhf propagation, long-delay echoes, and communication by backscatter. It appears that, once again, perhaps the skilled radio amateur can advance his hobby and develop a keen technical insight by listening *to* sferics rather than *through* them. Part II of this article will describe some simple hf-atmospheric-noise experiments. QST

Strays

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– . . . –

Please advise us direct of any change of address. As our address labels are prepared in advance, please allow six weeks notice. When notifying, please give old as well as new address and Zip codes. Your promptness will help you, the postal service and us. Thanks.

The National Bureau of Standards, with the cooperation of the National Aeronautics and Space Administration, is now relaying a frequency and time format similar to that of WWV and WWVH (the NBS standard and frequency stations) from the ATS-3 geostationary satellite. These broadcasts are strictly experimental, operating under NASA's "User Experiment Program," and will not be continued indefinitely. The satellite relays voice announcements of the time of day, ticks every second, audio frequency tones, and a digital time code.

The broadcasts occur at 1700 to 1715 and 2145 to 2200 GMT. The broadcast occurs Monday through Friday, excluding holidays. Being an experimental program, some interruptions to the schedule are expected. August 1, 1972, is the expected termination date for these experiments.

The broadcasts from ATS-3 are centered at 135.625 MHz with a 30 kHz bandwidth. The signals are frequency modulated. An fm receiver with a noise figure of approximately 5 dB fed by an antenna with 12 dB gain above isotropic will provide good reception. The signals are linearly polarized; thus, if a linearly polarized antenna is used it may require rotation for maximum received signal.

The satellite is located approximately 22,300 miles above the equator at 70 degrees west longitude. Complete information regarding its operation and equipment requirements may be obtained by contacting the Time and Frequency Dissemination Research Section, 273.01, National Bureau of Standards, Boulder, CO 80302.

Three generations of hams are represented as proud father, W1SVQ, and grandfather, W1DTW, watch WN1ODD make a contact. When not hamming or keeping up with his fifth grade studies, Gordon indulges his interests in trains and adventure stories.

QST for

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SPECIFICATIONS • **Frequency Range:** 10 kHz to 30.0 MHz. • **Modes of Operation:** USB, LSB, CW, RTTY, AM, ISB. • **Frequency Readout:** Complete to 100 Hz on six NIXIE tubes. • **Frequency Selection:** 10 MHz, 1 MHz, 0.1 MHz switch selected; 0 to 0.1 MHz continuously variable. • **Frequency Stability:** Drift does not exceed 150 Hz in any 15 minute period with a temperature change of 7° C per hour over a range of 0° to 40° C. • **Sensitivity:** Less than 0.5 microvolt for 10 dB SINAD at 2.4 kHz SSB mode; Less than 1.0 microvolt for 10 dB SINAD at 6 kHz AM mode. • **Image Rejection:** Greater than 70 dB relative to 1 microvolt. • **Blocking:** Greater than 100 dB relative to 1 microvolt. • **Cross Modulation:** Greater than 90 dB relative to 1 microvolt. • **Intermodulation:** Greater than 80 dB relative to 1 microvolt. • **Opposite Sideband Suppression:** Greater than 60 db at 500 Hz into the opposite sideband. • **I.F. Bandwidth:** 6 kHz, 2.4 kHz, 1.2 kHz, 0.4 kHz; Selectivity @ −6 dB: 6 kHz, 2.4 kHz, 1.2 kHz, 0.4 kHz; @ −60 dB: 11.5 kHz, 4.3 kHz, 2.4 kHz, 0.8 kHz; Optional filters available for other bandwidths. • **I.F. Outputs:** 50 millivolts into 50 ohms at 1st I.F.; 5.05 MHz and 2nd I.F. 50 kHz. • **Automatic Gain Control:** Audio Output rises less than 3 dB for RF input change of 1 microvolt to 100 millivolts; Attack time 100 microseconds; Release time 750 milliseconds (Slow AGC), 25 milliseconds (Fast AGC). • **Antenna Input Impedance:** 10 kHz to 500 kHz, 1000 ohms; 500 kHz to 30 MHz, 50 ohms. • **Audio Output:** 3 watts at 5% maximum distortion into 3.2 ohm load; 1 volt into 600 ohm output line; 3.2 ohm unbalanced and two 600 ohm balanced outputs; ISB output is one of the two 600 ohm balanced outputs. • **Audio Hum and Noise:** Greater than 60 dB below rated output. • **BFO:** Derived from standard clock or variable over a ± 3 kHz range from front panel. • **Power Requirements:** 115/230 volts ± 10% single phase 50-420 Hz 15 watts; 12 or 24 VDC supply optional. • **Dimensions:** 5.25 in. H x 19 in. W x 15 in. D, (13.3 cm H x 48 cm W x 38 cm D). • **Weight:** 17 lbs (7.7 kg).

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Mark Persons, WØMH, teki@mwpersons.com

Classic Radio

Restoring an Heirloom:
The Gonset Twins

The Gonset G-66B and G-77A Twins.

The Gonset G-66B receiver and G-77A transmitter make up the famed "Gonset Twins" that came from Burbank, California in the 1950s. They run CW and AM. My father, Charles B. Persons, WØLOJ (SK), built WELY Radio in Ely, Minnesota, in 1954. The Gonset Twins are family heirlooms from this era. The radio station was sold in 1959, but the Twins came with us to a suburb of Minneapolis, Minnesota.

Gonset Twins for Remote Broadcasting

I was only seven at the time my family ran the radio broadcast station, so it was an adventure. A radio trend back then was to do live remote broadcasts from civic events via radio relay to a studio, so they could be put on the broadcast station live. The FCC authorized 26.47 MHz for that use. To make it work, my father purchased the Gonset Twins in 1958.

Touted as ham radio equipment for mobile or home, the Twins were designed with Hammertone gray paint and chrome steel front panels. They were built small enough to fit under car dashboards of the time.

Because the receiver and transmitter are separate, they were divided so the transmitter was in a remote broadcast car while the receiver was at the broadcast studio. The transmitter is VFO or crystal controlled. In this case, a crystal was used to put the transmitter exactly on frequency.

Gonset Twins Operation

The Twins are dedicated to operating over the 80-, 40-, 20-, 15-, and 10-meter bands with slide rule tuning. The conversion from 28 MHz to 26.47 MHz involved re-tapping one coil in each unit, and some minor retuning.

The G-66B receiver is a 10-tube superheterodyne. There is an RF amplifier with two 265 kHz intermediate frequency (IF) stages. The BFO knob is calibrated to tune upper or lower single sidebands. There is a speaker in the power supply module, attached to the rear of the receiver.

The receiver with the front panel removed.

The transmitter and power supply uncased.

The transmitter vibrator was cleaned.


The transmitter power supply and modulator chassis.

The G-77A transmitter is AM and CW, but no sideband. It has only three tubes in the RF chain, using a 6146 final tube amplifier handling 50 to 60 W input with 30 to 40 W of output power on AM. The trunk-mounted power supply and modulator has five tubes, including a 6DQ6 pair.

A simple 9-foot steel whip on a car's rear bumper made a great antenna for the range of 15 miles or fewer that was necessary to get the signal to the studio. The transmitter has output tuning and loading controls, so it can tune into a reasonable load without the need for an antenna tuner.

Gonset's Quality Design

Preparing to restore the Twins brought back so many memories of my childhood experience with them. I kept remembering using the pair as a 15-year-old Novice, taking the Gonset Twins, a 12 V storage battery, and a wire antenna in a wagon behind my bicycle during the summer.

Gonset provided a detailed instruction manual with photos. Written in pencil are modifications my father made to broaden the audio frequency response to make it closer to broadcast quality. He used a broadcast microphone too. Gonset was progressive by utilizing silicon solid-state rectifiers that plugged in like fuses. The originals still work.

Restoring the Gonset Twins

I'm a retired radio engineer, so I put my skills to use with this restoration. Blowing dust out was just the beginning of the project. Paint fell off the meter pointers. I had to carefully disassemble the meters and apply a drop of paint on each with a cotton swab. I cleaned and lubricated the switch contacts with CAIG Labs DeoxIT D100L solution.

The front-panel knobs were aluminum, and they were not in good shape after so many years. I put each one on a drill press to gently remove tarnish with a Scotch-Brite Hand Pad. Then a coat of polyurethane went on to keep them looking good.

I replaced the twist-lock aluminum-canned electrolytic capacitors. Because the Twins were designed for mobile use, they were very compact, and there was no extra room for me to do the work myself. Instead, I hired Hayseed Hamfest in Cedar Rapids, Iowa. They put new radial-lead capacitors in new twist-lock cans that fit exactly where the original, now failed, capacitors were. The capacitors were not cheap, but they solved the problem while keeping to the original Gonset factory design.

The receiver and transmitter each have power supplies capable of operating from 6 and 12 V dc, and 115 V ac. Vibrators are used to chop dc, so it can be fed into the power transformers. Neither vibrator worked at first. I found a "Hints & Kinks" item in the March 1957 issue of *QST* that was helpful. It showed a way to connect a 40 W incandescent lightbulb in series with a vibrator attached to 115 V ac, for up to 15 minutes, to clean the vibrator switch contacts. That got the receiver's vibrator working. This wasn't the case with the larger vibrator in the transmitter power supply. I had to carefully pry the vibrator's can open at its base to gain access to the switch contacts. A burnishing tool and some DeoxIT restored normal operation.

Results

I spent 40 hours cleaning, replacing components, and tuning. That included troubleshooting and replacing carbon resistors and capacitors that went out of tolerance. The Twins are beautifully hand-wired, and the original receiver book was very helpful in the receiver tune-up.

Testing the rig, with the required interconnect wiring, worked out great. I made contacts around Minnesota on 80-meter AM with good signal reports during the day.

All photos by the author.

Celebrating Our Legacy

The Radio Boys, 100 Years Later

I recently rediscovered *The Radio Boys* series of books, published in the early 1920s. My father introduced me to these books in the 1950s, and they're among the first I remember reading as a boy. Curious about how well these stories held up 100 years after their first publication, I started rereading the series. *The Radio Boys* books are wholesome action-adventure stories for young adults. The early books detail the history and excitement of amateur radio at that time.

Each book in the series has a foreword by Jack Binns. In 1922, every amateur in the nation knew him as the radioman on the steamship *Republic*, who sent the distress call "CQD" from the partially destroyed radio room aboard the ship after a collision. Using a 10-inch spark coil transmitter, a magnetic detector, and operating on emergency battery power, he worked the key for 15 straight hours before being rescued.

The first in the series, titled *The Radio Boys' First Wireless*, is a how-to manual for constructing a crystal radio set. It includes a chapter devoted to winding coils and making condensers from metal foil and paraffin. In another book, the radio boys discuss the intricacies and nuances in tuning a regenerative receiver.

Reading *The Radio Boys* is a glimpse into a more innocent time of unlimited possibilities, when radio was poised to change the world and generations of young people in the process. Now, 100 years later, the optimism seems to have faded somewhat, but radio is still as important as ever.

William Luyster, W8BL
La Plata, Maryland

Radio Reminiscences

I earned my Novice-class license at age 14 in 1965. My first HF receiver was a Heathkit HR-10 with a transmitter like the Ameco AC-1 that my cousin, Evan Liechty, W8LSQ, built. He introduced me to the hobby. My first contacts were made on 2-meter AM with an army surplus transceiver, and 6-meter AM with a Knight Kit TR-106 and a six-element Hy-Gain Long John beam. As a teenager, I worked 38 states with 15 W! Instead of playing sports, I came home from school to work DX on VHF openings.

Wayne F. Steury, N9EGT, at 17 years old with his radio station.

I fell out of the hobby during college, but earned my Technician-class license after I got married. I built a Heathkit HW-8 to start operating CW. From there, I earned my General-, Advanced-, and Amateur Extra-class licenses. I'm now retired and enjoy operating QRP with many home-brewed kits, my Kenwood TS-2000, and digital mobile radio (DMR). I also enjoy my Heathkit HR-10 and DX-60B. It has been a wonderful journey with many interesting acquaintances along the way.

Wayne F. Steury, N9EGT
Clifton, Colorado

Self-Taught During the Great Depression

I've been a ham for about 79 years. When I was a boy during the Great Depression, we lived in northern Arizona, where there was little in the way of interests available, until I came across an old copy of *The ARRL Handbook*.

By the time I turned 15, I had taught myself Morse code and a lot of theory. When we moved to Riverside, California, just before World War II began, I passed my General-class license exam (I still hold my original call sign). With the war months away, the bands were very active.

I fear young people today don't have the same opportunity that I had to learn ham radio by trial and error. I built my own 6L6 oscillator and a power supply with an 83 rectifier. I made my antenna out of bell wire — a ¼ wavelength on 40 meters with a ladder-line feed made with sticks, and two condensers built out of old radios. They were seldom the right capacity or ohmage, and certainly not rated for the voltage I was using. But figuring out what went wrong and fixing it was a wonderful way to learn.

On December 7, 1941, I was in my shack operating CW on 40 meters during a contact with another teenager — W6UOR in Encino, Los Angeles, California — when my mother called me to come listen to KFI radio announcing the bombing of Pearl Harbor. Throughout the war and the rest of my life, I've enjoyed ham radio.

James R. Helms, Jr., W6UOI
Arcadia, California

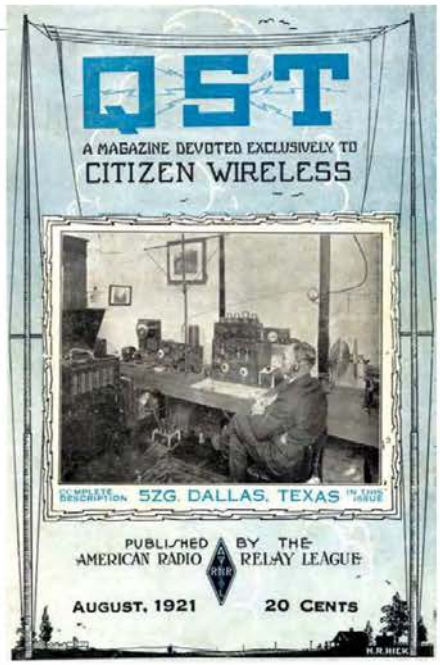
Send reminiscences of your early days in radio to "Celebrating Our Legacy," ARRL, 225 Main St., Newington, CT 06111 or **celebrate@arrl.org**. Submissions selected for publication will be edited for space and clarity. Material published in "Celebrating Our Legacy" may also appear in other ARRL media. The publishers of *QST* assume no responsibility for statements made in this column.

Al Brogdon, W1AB

100, 50, and 25 Years Ago

August 1921

- The cover photo shows 5ZG at his station.
- The editorials cover a variety of topics, including "Summer Radio," "The Transition" from spark to C.W., and "Radio Amplification."
- R. A. Heising presents Part II of "Modulation in Radio Telephony."
- H. J. Tyzzer discusses "Amateur Quenched Gap Problems."
- Leroy M. E. Clausing reports on the "Reception of 200-meter Signals by Means of a Loop and an Armstrong Super-Heterodyne."
- Henry L. Ley describes "The C.W. Transmitter at 8ZV," complete with a schematic diagram and photos.
- The "Amateur Radio Stations" column looks at 1BDC in Southbridge, Massachusetts; 7YS in Lacey, Washington, and 2XX in Ossining, New York.



August 1971

- The cover photo shows K6YNB's "Cabover Kilowatt," described in this issue.
- The editorial discusses the World Administrative Radio Conference for Space Telecommunications, which opened in Geneva, Switzerland, on June 7.
- Doug DeMaw, W1CER, discusses "FM Pip-Squawk MK-II," an improved version of the original, which was described in the previous issue.
- Bob Buus, WA2HVA, describes "A Technique for Burst Two-Tone Testing of Linear Amplifiers."
- A. K. Weis, WA5VQC, shares "How to Make a Low-Cost Keying Mechanism" for an electronic keyer, using parts from an old semi-automatic bug key.
- Ralph P. Ulrich, K7UVK, presents Part I of "A Semiconductor Curve Tracer for the Amateur."
- Robert V. McGraw, W2LYH, shares how to build "A 3 to 4-MHz Franklin VFO."
- "The Cabover Kilowatt" photo essay describes the portable station put together by Wayne Overbeck, K6YNB. The station is built into a cabover camper on a pickup truck and includes a tower and beam.
- Franklin D. Moore, WB9GCC, discusses "Homebrew DX Prediction."
- "Two Hams Receive High Honor" reports that twin brothers Richard, KØULQ, and Robert, KØVTD, Santin were awarded the President's Trophy, the nation's highest tribute to the courage and determination of handicapped citizens.

August 1996

- The cover photo shows the sternwheel steamboat *Spirit of Peoria*, as the caption urges readers to come to Peoria, Illinois, for the ARRL National Convention.
- The editorial, by 1996 ARRL President Rod Stafford, KB6ZV, asks readers to go "Back to Basics," and remember the importance of amateur radio's public service work.
- "Reflections on a Repeater in Paradise," by Michael Homsany, AH8E, tells the tale of building a repeater on top of a mountain in American Samoa.
- Eugene F. Ruperto, W3KH, describes his omnidirectional VHF antenna, "The W3KH Quadrifilar Helix Antenna."
- Tony Brock-Fisher, K1KP, and Bill Shaheen, N1CQ, explain how to "Install a House-Bracketed Tower — the Right Way!"
- Ed Hare, KA1CV, discusses "'Intermod' — A Modern Urban Problem," and shares some solutions.
- World traveler George Pataki, WB2AQC, talks about visiting "The Radio Amateurs of Ceuta and Melilla, and Gibraltar," sharing photos of those hams and their stations.
- Mike Bedford, G4AEE, shares how he used ham radio with fellow cave-explorer hams, in "Underground Radio."
- Rick Lindquist, KX4V, reviews "The BayGen Freeplay Windup Radio," which uses a built-in hand-cranked generator as its power source.
- Delta Airlines Captain Terry J. Taylor, WB5JFM, describes "An Aeronautical Antenna Farm" that exists on the MD-88 aircraft he pilots, covering everything from VLF to microwave frequencies.

Silent Keys

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

KA1AKZ **Ramsey**, Kathleen D., Marshfield, MA
N1CIU **Williams**, John J., Winchester, MA
WA1FJ **Jarvis**, Frederick S., Estero, FL
•KB1FJW **Gendron**, Joseph E., Jr., Saint Agatha, ME
N1FWC **Coop**, Frederick W., Burtchville, MI
•N1GOH **Tepper**, Howard F. "Howy," Greenville, NC
W1GSL **Finberg**, Stephen, Cambridge, MA
WA1IGA **Gervais**, Alexander W. "Jigger," Chelmsford, MA
KA1JHG **De Costa**, John, Jr., West Bridgewater, MA
KA1JRL **Silva**, Eduino N., Providence, RI
W1OUN **Pettengill**, Gordon H., Concord, MA
♦W1PM **Medeiros**, Anthony J., Jr., Seekonk, MA
K1QEX **Mushin**, Allen E., Orange, CT
K1VQS **Voss**, Thomas E., Barrington, NH
WA1WM **May**, William H., Coventry, RI
WA1ZCC **Berube**, Joseph, Swansea, MA
W2AKS **Castor**, Donald E., Galway, NY
K2AKV **Schlagel**, Eugene "Gene," Delray Beach, FL
WA2COP **Lebron**, Louis, Venice, FL
N2FZI **Mulvey**, Edward J., Poughkeepsie, NY
WB2GZR **Totten**, Thomas F., Saratoga Springs, NY
W2IBM **Engelke**, Harold A., Longboat Key, FL
♦W2KJ **Trombino**, Joseph, Jr., Hampstead, NC
KC2KU **Westerdahl**, Marvin L., Lakeland, FL
KB2NZF **Krizek**, James E., Lake Ariel, PA
N2OHD **Hartley**, Kenneth A., Pennsville, NJ
•WA2PIK **Grieder**, Franklin J., Ho-Ho-Kus, NJ
KC2PSF **Elliott**, Priscilla C., North Tonawanda, NY
K2QAI **Phillips**, John J., Winsted, CT
WB2RMB **Scherer**, Mark, Willow Street, PA
N2XTM **Richards**, James C., Bridgewater, NJ
KB3ANO **Burstein**, Denise R., Royersford, PA
WB3CEZ **Yoder**, Paul L., Royersford, PA
N3EFC **Gates**, Ronald J., Fairfield, PA
WA3MVF **Nissel**, Patricia A., New Cumberland, PA
W3MVX **Young**, William L., Mount Airy, MD
N3NEJ **Chaffier**, Michael, Roseto, PA
W3PLJ **Daday**, Bernard J. "Bernie," II, Allentown, PA
N3QZO **Feeney**, Charles M. "Michael," II, York, PA
KE3TH **Brewer**, Ronald W., Cocoa, FL
KB3WQF **Emberg**, Ruth B., Mars, PA
♦•WA3YOH **Whetstone**, Cameron R., Pikesville, MD
N4ARQ **Hedrick**, Mary Arlene K., Tyro, NC
KI4BBJ **Parrish**, Eddie L., Sonora, KY
WA4BKW **Svee**, William J., Jr., Roanoke, VA
♦W4CIH **Jolkovski**, Jean, Phoenix, AZ
♦K4DHT **Herman**, Daniel L., Mountain City, TN
KM4DUJ **Southern**, Martha C., Hazel Green, AL
KB4EI **Wilkes**, Jewell M., Quinton, AL
WA4EMU **Dahmke**, William B. "Bill," Satellite Beach, FL
N4GJD **Prince**, Harry R., Jr., Savannah, GA
NM4H **Harrell**, Michael W., Harrogate, TN
N4HQT **Miller**, David R., Kimball, TN
W4ISE **Carson**, Joseph E., III, Vero Beach, FL
KN4JCQ **Tiller**, John A., Suwanee, GA
WD4JOJ **Doby**, William P., Raleigh, NC
WD4JZG **Giangrosso**, Joseph P., Niceville, FL
WD4KPX **Stotesbury**, Hiram A. "Skip," Jr., Rocky Mount, NC
KF4KQE **Davis**, Travis E., Bonifay, FL
KK4MJ **Justice**, Michael H., Louisville, KY
♦W4NL **Lamb**, Layfield L. "Lynn," Maryville, TN
♦W4OLS **Behrends**, Paul O., Annapolis, MD
KM4ORD **Barhite**, Dennis L., Blowing Rock, NC
W4RGN **Hearn**, Jarvis M., Jr., Smithfield, VA
K4TWS **Largen**, Loman L., Melbourne, FL
KE4VPO **Campbell**, Edgar R., Mount Holly, NC
KU4WD **Jones**, Quentin D., Cookeville, TN
N4WWX **Frost**, Ronald A., Sr., Mocksville, NC
KE4WXV **Smart**, Troy D., Sr., Lenoir, NC
WA5BDR **Singleton**, James E., Livingston, TX
♦W5BXJ **Cothren**, William D., Malvern, AR
N5CC **Huffman**, John W. "Bill," Oklahoma City, OK
•WD5CDM **McMillan**, Bonnie C., Lucedale, MS
*W5CGU **Adamson**, John D., Sr., Leander, TX
WA5COX **Cox**, Clay H., Dallas, TX
AC5EI **Measels**, Carlton W., Desha, AR
•N5ESP **Kessinger**, Billye N., Trinity, TX
K5FJP **Perteet**, Jerrold W., McAlester, OK
K5HW **Walton**, Harry R. "Bud," Richardson, TX
KW5I **Myers**, Charles E., Tulsa, OK
K5JUP **Higgins**, Darmon C., Trenton, TX
K5KK **Garon**, Henry A., New Orleans, LA
NZ5L **Sullivan**, Norman N., Beach Lake, PA
WB5NXD **Blankenship**, Charles, Lake Charles, LA
KE5OAZ **Langston**, William H., II, Lubbock, TX
W5PFQ **Barry**, Edward G., Jr., Little Rock, AR
W5SOH **Adams**, Thomas M., San Antonio, TX
N5SOI **Holland**, Robert B., III, Edmond, OK
•WB5STJ **Robles**, Gilberto, San Antonio, TX
N5TVB **Connally**, Wesley R., Richardson, TX
KI5UQ **Harmon**, Harold E. "Gene," Grapevine, TX
KA5VOA **Fincher**, Frankie D. "Frank," Greenfield, MO
WA5YCL **Loudermilk**, Donald L., Paxton, IL
K5YH **Dixon**, William P., Springdale, AR
N6CMB **Brown**, Christopher M., Walnut Creek, CA
KK6DBT **Harper**, Jack M., Pleasant Hill, CA
*W6EIG **Kincaid**, Nilan L., Hawthorne, CA
KH6GDE **Jimenez**, Carlos J., Bowling Green, VA
KE6IQF **Goad**, Royce A., Atwater, CA
WB6JFZ **Prouty**, Kenneth B., Santa Rosa, CA
•WA6JTI **Meehan**, Richard D., Elmwood, CA
♦WA6MDJ **Walker**, Edward L., Los Angeles, CA
WB6OLI **Hedlund**, Richard C., San Bernardino, CA
K6VHP **Fortenberry**, David S., Meadow Vista, CA
•N6VRH **Ansley**, Clara M., Olivehurst, CA
KC6VYZ **Lombaer**, Thomas D., San Jose, CA
KC6WDK **Rosenberg**, George B., Tucson, AZ
WA7DKF **Bixler**, Richard M., Portland, OR
KC7FDV **Kotter**, Linda S., Ogden, UT
W7HFI **Lemon**, Robert M., Colfax, WA
♦WA7HRA **Hart**, Robert A., Hoodsport, WA
•KA7IXO **Thurmond**, Anne C. "Nancy," Butte, MT
W7JHJ **Smith**, Blaine M., Wilsonville, OR
W7JKL **Albert**, Joseph L., Idaho Falls, ID
KB7LX **Leach**, William R., Blackfoot, ID
W7MMI **Grey**, Herbert J., Medford, OR
•W7MMW **DeVey**, William J. "Bill," Jr., Cannon Beach, OR
K7PVV **Frause**, Norman L. "Norm," Sammamish, WA
W7SZR **Fronek**, Donald K., Blairsville, GA
♦AF7TL **Scott**, Craig T., Cheney, WA
W7TQU **Vogt**, Darrel D., Cheyenne, WY
KB7VOX **Painter**, Patricia J., Orofino, ID
♦WA7YKV **Hebert**, David P., Kennewick, WA
K8AUS **Smith**, James H., Short Gap, WV
WD8CBC **Morgan**, John S., Sr., Shadyside, OH
KC8CCL **Lompis**, Anthony J., Northwood, OH
K8CLV **Yoakam**, Ronald E., Lima, OH
KA8CXS **Williams**, Beverly J., Marshall, MI
KC8EI **Loving**, James E., Sr., Northwood, OH
♦K8EIO **Sheneman**, Robert L., Grand Rapids, MI
KA8ERS **Shepherd**, Rick, Westerville, OH
KD8IHO **Earl**, Gordon R., Kincheloe, MI
K8IIU **Shott**, John S. "Jack," Brecksville, OH
N8INQ **Hooper**, James J., Fort Myers, FL
KB8JHD **Crincic**, David J., Youngstown, OH
WD8KPR **Dittenber**, William A., Saint Louis, MI
WB8KPS **Hosfelt**, Terry A., Steubenville, OH
♦N8LEF **Zsenyuk**, Paul M., Waterford, MI
N8MCT **Heaton**, Robert E., Toronto, OH
N8MVV **Sheldon**, James L., Battle Creek, MI
K8MXC **Sikkila**, Robert L., Reed City, MI
N8OZN **Howard**, Ruth E., Middletown, OH
♦•W8PBO **Ellis**, Arthur A., Sterling Heights, MI
WA8QCA **Jackson**, John R., Gladstone, MI
KD8QLB **Perry**, William I. "Bill," Litchfield, MI
KX8R **Shaw**, William A., Coldwater, MI
K8REB **Billow**, Ralph E., Fremont, OH
W8SIC **Messner**, Ronald B., Norton, OH
K8TFD **Sands**, Kenneth S., Plymouth, MI
KD8TQ **Seibenick**, Michael L., Defiance, OH
W8WGP **Lemons**, Carlton E. "Lem," Wauseon, OH
WB8ZQL **Lehman**, Mary E., Lexington, OH
AB9AY **Oberg**, Charles M. "Mike," Rockford, IL
KD9CRU **Dickson**, Raymond J., Jr., Shelburn, IN
W9DOD **Nagler**, John E., Fox Lake, WI
•N9DUZ **Kehr**, James M., Goshen, IN
WD9DVA **Woods**, Edward J., Greenwood, IN
KD9EFH **Moore**, Michael R., Greencastle, IN
N9FEL **Naylor**, Dennis W., Frankton, IN
W9GVW **Juhre**, Eric C., San Antonio, TX
KB9HJW **Prunty**, Dennis D., Spencer, IN
•W9JRC **Craddock**, John R., Muncie, IN
N9MHL **Mitchell**, John M., Glenview, IL
N9MOX **Chaney**, Gregory A., Greenfield, IN
W9OSH **Moran**, Ken R., Oshkosh, WI
KB9RZC **Kincannon**, Ervin L. "Larry," Dakota, IL
KB9TUI **Gruesbeck**, Gary L., Fort Wayne, IN
•K9VEN **Hays**, John A., Jacksonville, IL
K9ZBV **Koleto**, Kenneth M., Monroe Township, NJ
KDØAKT **Stirn**, Warren A., Marysville, KS
WTØD **Johnson**, Lee A., Cedar Rapids, IA
WØEK **Bruner**, Robert J., Albany, MN
KØELE **Graf**, Karl Heinz G., Denver, CO
WØGHM **Moberg**, Guy H., Newton, NC
NØGRV **Robison**, Jeffery D., Sr., El Dorado Springs, MO
KØHMO **Drew**, Richard F., Springfield, IL
NAØI **Weiss**, William J., Jr., Ames, IA
WDØMFL **Lepore**, Michael F., Estes Park, CO
WAØMUG **Fitz**, Edwin R. "Bob," Ames, IA
WAØNSH **Helland**, Paul E., Sr., Slater, IA
NØNUC **Pokorny**, Roger W., Des Moines, IA
♦WØTLE **Philstrom**, Richard K. "Dick," Scandia, MN
•KVØW **Nordmann**, Bernie, Webster Groves, MO
KØWPC **Tschetter**, Wesley J., Sioux Falls, SD
NFØY **Moreshead**, Jon A., Saint Charles, MO
VA3GP **Podnar**, George J., Thunder Bay, ON, Canada
VE3VBG **Duquet**, Andre, Windsor, ON, Canada
VE4OL **Bell**, John A., Winnipeg, MB, Canada
G2HKU **Trowell**, Edward H. "Ted," Minster, Sheerness, United Kingdom
SMØFLY **Bottema**, Abraham "Bram," Sorunda, Sweden

♦ Life Member, ARRL
♦ Maxim Society
♦ Current Diamond Club
• 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.

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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

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• 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

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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

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DX70, 77
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IC-105 Optional

LDG Z-100A Specifications

Frequency Range: 1.8 to 54 MHz
Power: 125W SSB, 50W FT-8, 30W AM/FM
Input Impedance: 50 ohms
Tuning Range: 10:1 SWR, 3:1 on 6M
Memories: 2000
Retune Time: Less than 1.0 second
Voltage: 13.8 VDC +/-15%
Current Draw: 500 mA tuning, 20 mA idle
Size: 6.3"x6.3"x1.5", 160x160x40mm
Weight: 1.5 pounds, 680 grams

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HAM-IV

HAM-IV **$729.95**

The most popular rotator in the world! For medium communications arrays up to 15 sq. ft. wind load area. 5-second brake delay, Test/Calibrate function. Low temperature grease permits normal operation down to -30 degrees F. Alloy ring gear for 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 **$909.95** with DCU-2

HAM-VII **$999.95** *with DCU-3*

TAILTWISTER SERIES II

T-2X **$969.95**

T-2XD2 **$1079.95** with DCU-2

T-2XD3 **$1139.95** with DCU-3

For large medium antenna arrays up to 20 sq. ft. wind load. 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, triple bearing race (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" mast.

MSHD, $149.95. Above tower heavy duty mast support. Accepts 1 7/8-2 5/8" OD.

CD-45II

CD-45II **$519.95**

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.

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 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 brngs**
Mounting Hardware	Clamp plate/steel U-bolts
Control Cable Conductors	**8**
Shipping Weight	31 lbs.
Effective Moment (in tower)	**3400 ft.-lbs.**

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 brings**
Mounting Hardware	Clamp plate/steel U-bolts
Control Cable Conductors	**8**
Shipping Weight	22 lbs.
Effective Moment (in tower)	**1200 ft.-lbs.**

hy-gain Programmable DCU-3 Digital Rotator Controller

New!

DCU-3 **$519.95**

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

$479.95. Like DCU-3, but less programmable memories. 110 VAC. Order **DCU-2X**, for 220 VAC.

AR-40

AR-40 **$419.95**

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 bolts
Control Cable Conductors	**5**
Shipping Weight	14 lbs.
Effective Moment (in tower)	**300 ft.-lbs.**

Replace your *YAESU* Rotator Controller

New!

YRC-1 **$399.95**

Hy-gain YRC-1 gives you more features and a much more robust controller that is far less prone to lightning damage. Costs less than repairing your original Yaesu controller!

Easy-to-use -- dial in your beam heading and tap *GOTO* button. *Exclusive* 180 degree *AutoReversal*™ for fast longpath operation.

Has all features of DCU-2. Bright blue LCD shows current, dialed-in and computer controlled beam headings and your call. USB port for computer control. Extra heavy-duty AC power supply.

Variable DC motor speed for minimizing damaging antenna overshoot and fast operation. Intuitive menu for calibrating, offsetting, or changing parameters. Field upgradeable firmware. Use with Yaesu G-800/1000/2800/G450/650. For AC or DC motors.

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Got Noise?!

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Noise-Cancellers Wipe Out Interference

Null out all types of noise!!! Severe power line noise from arcing transformers and insulators, fluorescent lamps, dimmers, touch controlled lamps, computers, TV birdies, lightning, garage door openers, electric drills, motors, industrial processes. It's much more effective than a noise blanker because interference much stronger than a desired signal can be completely removed without affecting the desired signal. All modes -- SSB, AM, CW, FM, frequences from BCB to lower VHF.

Null out strong QRM on top of weak rare DX ! Null out a strong local ham or AM broadcast station to prevent your expensive receiver from overloading.

Use as an adjustable phasing network. Combine two antennas to give you a powerful receive station and have a variety of directional patterns.

MFJ-1026 **$249.95**

MFJ-1026 simply plugs between your transmitting antenna and your transceiver. To null, you adjust the amplitude and phase potentiometer controls for a minimum S-meter reading or low noise. To peak, push reverse.

Use built-in active or external antenna. *Constant Amplitude Phase Control*™ makes nulling super easy -- snag that rare DX you have missed.

RF-sense T/R switch auto bypasses your rig when you transmit. Adjustable T/R delay time. Use 12 VDC or 110 VAC with **MFJ-1312D, $24.95**. 6½X1½X6¼ inches.

MFJ-1025, $219.95. Like MFJ-1026, less the built-in active antenna. Use external antenna connection.

MFJ *Ultrasonic* Receiver with parabolic reflector *pinpoints* power line noise

HF and VHF operation can be affected by noise, makes it hard to hear weak stations, adds to fatigue. Often, noise comes from power lines. Power companies are willing to help with issues, but don't have equipment or trained personnel to locate it. MFJ aids in finding noise generated by corona discharge and arcing components. Acoustic receiver is tuned to 40 KHz. 18" diameter plastic dish gives a narrow beamwidth to pinpoint noise sources less than 12" at 50 feet. Also listen to nature: bats, birds, and insects!

MFJ-5008 **$219.95**

MFJ Power Line Noise Finder

MFJ-852 **$149.95**

Walk or drive around with these *handheld* power line noise meters to search out leaky insulators, loose hardware and corroded ground lines quickly. Track noise right down to the pole,transformer or insulator, or other source. Operates in 135 MHz region where activity is minimum and radiation from corona/arcing is more localized. 0.3 uV sensitivity and wide-range AGC for noise level meter -- *over 70 dB!*

MFJ-1767, $109.95. Adds 3-element beam to MFJ-852.

MFJ-856, $189.95. Combination of MFJ-852 noise finder and MFJ-1767 three-element beam antenna.

MFJ Low-Noise Receiving Mag Loop

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

Reduce Harmonics, Avoid TVI with MFJ Low Pass Filters

Suppress TVI, RFI, telephone, other interference by reducing unwanted harmonics to your antenna. Your HF signal still passes through with low loss so you snag that rare DX! *Keep the wife and neighbors happy!*

MFJ-702B, $49.95. 200W. SWR below 1.5 to 30 MHz.

MFJ-704, $114.95. 1500W. SWR below 1.3 to 30 MHz.

MFJ-705, $169.95. 2500W. SWR below 1.3 to 30 MHz.

MFJ Clamp-on RF Ammeters

MFJ-854 **$149.95**

Clamp-On RF Ammeters quickly snap over wires and cables to measure RF currents flowing in antenna elements, radials, ground wires and on outside of coax. Tune counterpoises, radials, ground systems. Study/optimize antennas for peak performance. Find peaks/nulls. MFJ-854 has five calibrated ranges to 3 Amperes, including sensitive 30 mA range.

MFJ-853, $89.95. Like MFJ-854, Ranges: 0.3, 1, 3 A. Mini size.

MFJ-853H, $89.95. 3/10/30 A ranges.

MFJ-805, $129.95. Check RFI on cables up to 1/4" dia. VLF to VHF.

MFJ AC Line Filter/Protector

MFJ-1164B **$104.95**

Filters and reduces AC power line RFI, hash, noise, transients, surges generated by computers, motors, RF transmitters, static/lightning by 30 db and up to 60-80 dB with ground. Fast, *nano-second* overvoltage protection. Provides inductive isolation, capacitive decoupling, RFI rejection, overvoltage protection of common mode, differential signals. Rejects/shunts undesired signals to ground. 12Wx3½Hx2D".

Ferrite RFI Suppression Chokes

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MFJ-700C4, $29.95. .528" diameter 4-Pack
MFJ-700D4, $34.95. .750" diameter 4-Pack

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New!

MFJ SDR T/R Protection Switch

Turn your SDR into a panadapter to see entire bands on frequency/waterfall displays . . .

An inexpensive wide-band SDR dongle receiver lets you see entire bands on frequency/waterfall computer displays!

MFJ-1708B-SDR **$129.95**

If you want to know where the activity is, who's generating splatter, what's in the DX window, how wide your audio is or what frequencies are clear, it's all right there! While receiving on your transceiver, MFJ-1708B-SDR switches your SDR to your antenna showing the entire band. On transmit your SDR is switched out and grounded to protect your SDR. PTT and a fail-safe RF sense switches MFJ-1708B-SDR. For HF/VHF/UHF. Monitor multiple bands with multiple SDRs and a multi-coupler.

MFJ-1708B-SDR-S, $139.95. SMA connector for your SDR.

New B series improvements . . .

The original MFJ-1708 series used one relay and wires to connect the SO-239s. The *new B-series* uses *four* relays and connectors on a *single* pc board. This gives you > 50 dB isolation at 300 MHz and > 68 dB at 50 MHz. SWR < 1.16:1 at 50 MHz and < 1.75:1 at 450 MHz at the transmit port. Mute output is a selectable short or open to ground. Use "boat anchors" or modern receivers or key a linear amplifier. Receiver input protection prevents overload from nearby high power signals and from receive to transmit. A hybrid splitter on SDR models reduces loading effect and gives > 15 dB isolation between the SDR REC and XCVR ports to reduce interference. The original MFJ-1708 series is still available.

MFJ Low Noise VLF/HF Receiving Loop

Pull weak signals out of static crashes, atmospheric, man-made and power line noise!

Hear signals 50 KHz to 30 MHz cleaner, quieter than ever before! Power line noise disappears. Rotate its figure 8 pattern and its extremely deep null to completely eliminate an interfering signal or greatly peak a desired one. Fully protected state-of-the-art Gali MMICs in push-pull gives you a preamp with extremely high dynamic range, low IMD and 25 dB of low noise gain. Excellent performance on strong and weak signals without overload. 36-inch dia. loop. 1-in. OD 6061 aluminum.

MFJ *wideband* SDR *Discone* Antenna

Receives 25-1300 MHz

MFJ ultra wide-band *Discone* Antenna receives 25-1300 MHz. Perfect for all band SDR reception. Covers 10, 6, 2 Meters, 220 and 440 MHz and 33/23 CM ham bands and everything in between. It is excellent for monitoring multiple bands simultaneously using multiple SDRs and a multi-coupler. Also test any transmitter 50-1300 MHz using a single discone and single coax. Handles 200W. Includes 50 feet coax, stainless steel elements and mounting hardware.

MFJ-1866, $64.95. Like MFJ-1868 but transmits 144-1290 MHz. Coax and mounting hardware not included.

Tuned Indoor SDR Active Antenna

Make your SDR receiver come alive with HF signals, .3-40 MHz, while rejecting interference with MFJ-1020C *tuneable* indoor active antenna! Gain control, telescoping whip.

MFJ-1020C **$129.95**

Untuned Indoor SDR Active Antenna

MFJ-1022, $89.95.

Hear weak, noisy VLF to UHF signals. Noise-less feedback gives excellent low noise reception. Handles strong signals.

Active OutdoorAntenna

MFJ-1024 **$189.95**

World Radio TV Handbook says "MFJ-1024 is a *first rate, easy-to-operate active antenna, quiet, excellent dynamic range, good gain, very low noise factor, broad frequency coverage, excellent choice . . .*"

Outdoor mounted 54-inch whip/preamp gives maximum signal and minimum noise. Covers .05-30 MHz.

Indoor unit: 20 dB attenuator, gain control, 2 receiver and 2 antenna switches.

HF SDR Preselector

Tuneable MFJ-1040C lets you copy **w**eak, noisy SDR signals from 1.8 to 54 MHz. Greatly tunes out and reject out-of-band interference. Up to 20 dB gain. Has gain control. Cascode FET/bipolar transistor gives low noise, high gain without overloading. Switches for 2 antennas and 2 receivers. SO-239s. Has 20 dB attenuator. Automatically bypasses when transmitting or use PTT. 6½Wx2½Hx4D inches.

MFJ-1040C **$149.95**

MFJ LW/MW/SW SDR Preselector/Tuner

Highly rated series-tuned MFJ-956 boosts your desired signals while greatly rejecting interference and preventing serious overload.

MFJ-956 **$89.95**

Greatly improves reception 0.15 to 30 MHz. Incredibly effective below 2 MHz.

Super easy to operate, select band and tune!

Bypass tuner and ground receiver switch positions.

Compact 2x3x4 inches. SO-239 connectors.

MFJ RF Sense Transmit/Receive Switch

MFJ-1708B $129.95.

Switches your antenna from receiver to transmitter using a relay. Shorts your receiver to ground during transmit. Use RF sensing with adjustable delay or PTT line. Has selectable open/short mute.

Auto switch XCVR between 2 antennas

MFJ-1707B $129.95.

Automatically switches separate transmit and receive antennas on transceivers with only one antenna port. *Example:* Efficient 75M dipole for XMIT and low noise MFJ loop for receive -- *no static crashes!*

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MFJ-4416C *Super* Battery Booster

Boost battery voltage as low as 9 Volts back up to 13.8 VDC! Keeps your transceiver at full power output, compensates for run down battery, wiring voltage drop, car off . . .

MFJ-4416C **$209.95** **Keeps** your transceiver at full power output, provides full performance, high efficiency, prevents output signal distortion and transceiver shutdown. Compensates for run-down battery, wiring voltage drop or when car is off. Provides up to 25 Amps peak with 90% efficiency. Selectable 9/10/11 Volts minimum input voltage prevents battery damage from over-discharging. RF sense turns MFJ-4416C off during receive to save power, increases efficiency and reduces noise. Adjustable 12 to 13.8 VDC output pass-through improves efficiency and lets transceiver run cooler. Has output over-voltage crowbar protection. *Anderson PowerPoles*(R) and high-current 5-way binding posts for DC input, regulated output. 7¾Wx4Hx2⅛D inches. **MFJ-4416BRC, $99.95.** Booster Remote Control.

Super Heavy Duty Battery Booster

MFJ-4418 **$259.95** **Super** robust with heavy duty transistors, rectifier, improved switch-mode transformer, larger heatsink. Input and output EMI filters reduce noise to minimum. Rugged construction. *Power-Poles*™ and 5-way binding posts. MFJ software adjusts output voltage, measure load current, set minimum voltage level, over-current trip level, ignition control, more. External boost enable, remote input/output voltage sampling, remote controllable with MFJ-4416BRC.

RFI Filter for DC power

MFJ-1142 **$79.95** **Connects** between rig and 12/ 24/50 VDC power supply/battery. Reduces RFI, hash, transients, motor noises, alternators, fuel pump whine, power windows, more! Binding posts/*PowerPoles*(R).

Digital Volt/Amp Meter

MFJ-4422 **$59.95** **Connect** in-line. Displays 4.5-30 VDC and up to 30A simultaneously. .01-.1V resolution. Dual .28" red/blue LED digits. *Anderson PowerPoles*™. Reverse polarity protection. 3x2x1 inches.

RFI Ferrite Chokes

MFJ-700A4 **$16.95** **Suppress** RFI. Snap and locks on DC power line, coax, wires. Effectively removes RFI and noise. Install end-to-end or loop multiple turns for more suppression. .275" hole dia. 4 in package.

PowerPole™ DC Outlet Box

MFJ-1104 **$54.95** **One** fused 30 Amp input and 25, 10, 5 Amp fused outputs *with Anderson PowerPoles*™. Has open fuse indicator. Sturdy metal construction, 2¾Wx3¼Hx1½D inches.

MFJ Low Pass Filter

MFJ-704 **$114.95** **High** attenuation above 40 MHz. 1.5kW, 1.8-30 MHz. SWR<1.3. Nine Chebyshev poles, *Teflon*(R) dielectric capacitors, high-Q inductors, ground plane shielding, RF tight.

Lightning Surge Protector

MFJ-270 **$29.95** **Protect** your expensive equipment from lightning induced surges on 50 Ohm coax. Use for transceivers up to 400 Watts, 1000 MHz. **MFJ-272, $44.95.** 1.5 kW.

MFJ 30-Amp Power Supply

MFJ-4230MV **$124.95** **World's** most compact 30 Amp switching power supply. Switchable Volt/Amp meter. Adjustable 4 to 16 VDC output. Select 120/240 VAC input. 5Wx2½Hx6D in., 3 lbs.

High-efficiency Loop Tuner

New! MFJ-935C **$299.95** **Instantly** turn wire or coax into a small, high-efficiency multi-banded loop antenna. 150W, 5.3-30 MHz. Tripod/mast mount included. **MFJ-936C, $349.95.** Relative RF antenna current and Cross-needle SWR/Wattmeter. **MFJ-933C, $249.95.** Like MFJ-935C, no meter.

MFJ Field Strength Meter

MFJ-801 **$44.95** **Relative** field-strength readings .1-500 MHz. Sensitivity control, 1¾ inch meter. 20-inch telescoping whip. Finger contact increases sensitivity.

Tuned Indoor Active Antenna

MFJ-1020C **$129.95** **Rival** outside wire antennas hundreds of feet long and pick up signals loud and clear all over the world. 0.3-40 MHz.

25-1300 MHz Discone Ant

MFJ-1868 **$84.95** **Receives** 25-1300 MHz. Transmits 50-1300 MHz up to 200 Watts.Test various X-mitters on one coax. 50 ft. coax, stainless steel elements.

17-foot Telescopic Whip

MFJ-1979 **$74.95** **17-foot** stainless steel whip collapses to 27". Full 1/4 Wave on 20/17 Meters, 30-160 Meter operation with loading coil. Fits any standard 3/8-24 threaded mount.

Telescopic Fiberglass Mast

MFJ-1906HD **$259.95** **Super-strong** heavy-duty mast with *QuickClamps*™. 38 ft. ext., 6 ft. collapsed. 2½" OD bottom, 1" OD top. .125" thick wall. Supports "*real*" weight.

Giant 2½ inch LED Clock

MFJ-117 **$27.96** New Low Price! **Giant** 2½ inch super bright LEDs -- see from across the street day or night. 12/24 switch, 110VAC, 9V battery backup.

MFJ 2-Position *Remote* Antenna Switch

MFJ-4712 **$99.95** **MFJ** 2-position *remote* antenna switch uses a *single* coaxial feedline to feed two antennas, DC power and control signals. Remotely switch HF and/or VHF antennas. Covers 1.8 MHz to 150 MHz and handles 1500 Watts. Impedance is 50-75 Ohms. Compact 4Wx2⅝Hx1½D". *Outside Switch Box* is fully enclosed and weather protected. Three quality *Teflon*(R) SO-239 connectors for transmitter, antenna one and antenna two. Stainless steel 1½" tall bracket with a U-bolt for masts up to 1½ in. O.D. *Inside biastee* control is 2¼Wx2½Hx1¼ in. Use 12 VDC or 110 VAC with MFJ-1312D, $24.95.

MFJ Artificial RF Ground

MFJ-931 **$139.95** **By** tuning out ground wire reactance RF hot spots disappear and your rig is at actual earth ground. Improve signals by resonating a wire into a tuned counterpoise.

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MFJ Wire Antennas

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

Operate 80-10 or 40-10M with tuner. 14 gauge, 7-strand copper antenna wire. 1.5kW. 32.5' ladder line matching section with SO-239 for coax.
MFJ-1778, $79.95. 80-10M. 102 feet long.
MFJ-1778M, $69.95. 40-10M. 52 feet long.

End Fed Half Waves

Operate 80-10 or 40-10M with one support/no tuner.
80-10 Meters, 132 feet:
MFJ-1982HP, $119.95. 800 Watts.
MFJ-1982MP, $89.95. 300 Watts.
MFJ-1982LP, $69.95. 30 Watts.
40-10 Meters, 66 feet:
MFJ-1984HP, $99.95. 800 Watts.
MFJ-1984MP, $79.95. 300 Watts.
MFJ-1984LP, $59.95. 30 Watts.

Off Center Fed Dipoles

Lightweight, virtually invisible. Gives you directivity and gain (*see MFJ website*).
MFJ-2012, $99.95, 40/20/10/6 Meters, 1500 Watts. 67 ft.
MFJ-2010, $79.95. 40/20/10/6 Meters, 300 Watts. 67 ft.
MFJ-2014, $129.95. 75/40 Meters, 1500 Watts. 122 ft.
MFJ-2016, $159.95. 160/75/40 Meters, 1500 Watts. 240 ft.
MFJ-2013, $99.95. 60/30 Meters, 300 Watts. 86 ft.

Dual Band 80/40 or 40/20 Dipoles, 1.5 kW

MFJ-17758, $119.95. 80/40 Meters, 95 feet long, ultra-efficient end-loading on 80 Meters. No tuner needed. Super-strong center insulator, built-in SO239, hanghole.
MFJ-17754, $79.95. 40/20M, 42 ft.

MFJ All Band Doublet

MFJ-1777, $89.95.102 foot, 160-6 Meters with tuner/balun. *Extremely low feedline loss.* Super strong fiberglass center insulator provides stress relief for included 100 feet ladder line. *Ceramic* end insulators. 1500 Watts SSB/CW/Digital.

MFJ 1.5 kW Dipoles

7-strand, 14-ga. copper wire.*Ceramic* insulators. Center insulator with SO-239
MFJ-1779C, $49.95. 20-6M, 35 feet.
MFJ-1779B, $69.95. 80-40M,135 feet.
MFJ-1779A, $89.95. 160M, 265 feet.

20M Extended Double Zepp

MFJ-1742, $104.95. See web for gain. 90 ft. long, 100 ft. ladder line. 7-strand, 14-ga. wire. 80-10M with tuner/balun. 1500 Watts SSB/CW/Digital.

80M End-Fed Zepp

MFJ-1748, $104.95. 125 feet long, 100 foot ladder line included. 7-strand, 14-ga. wire. Use tuner/balun. 1500 Watts SSB/CW/Digital.

MFJ Vertical Mounted Antennas

MFJ 6-Band Cobweb Antenna

MFJ-1836H, $309.95. Six-bands: 20/17/15/12/10/6 Meters, 1.5 kW. *Perfect for restricted space*. Nearly invisible. 9x9x1/2 feet, 8 lbs. Outstand-ing performance! Horizontally polarized gives less noise, more gain over verticals. Omni-directional. No radials needed! Works great at low heights. Low SWR.
MFJ-1836, $279.95. Like MFJ-1836H, but 300 Watts.

MFJ *4-Band* Dipole Octopus Antenna

Octopus *antenna hub turns hamsticks into four balanced* HF/VHF/UHF *dipoles!* Rotate for maximum signal, minimum QRM/noise. Mount low for local NVIS, high for DX. Perfect for portable, limited space, HOAs, camping, ARES. Balun. No tuner needed.
MFJ-2104, $299.95. Includes 8 hamsticks for 75/40/20/15 M.
MFJ-2100, $129.95. Hub only. Use eight hamsticks.

MFJ Multi-Band Verticals, no radials needed!

Low angle radiation lets you easily work far-away, rare DX!
Efficient end loading gives maximum radiated power.
1500 Watts SSB/CW/Digital. Low SWR. Omni-directional. No radials or antenna tuner needed.
Low profiles blend into any surroundings. Mount them anywhere ground level, roof tops, apartments, houses, small lots.
Efficient high-Q coils. High power air-wound choke balun.
Built-to-last. Solid fiberglass rod, aircraft aluminum tubing.
5 models: Choose your bands 80-2 Meters
MFJ-1796, $349.95. 6 bands: 40/20/15/10/6/2M, 12 feet.
MFJ-1797, $379.95. 7 bands:40/30/20/17/15/12/10M. 23 ft.
MFJ-1797LP, $359.95. Like MFJ-1797, but only 9 feet tall. Narrower bandwidth on 40 Meters.
MFJ-1799, $469.95.10 bands: 80/40/30/20/17/15/12/10/6/2M. 20 ft.
MFJ-1799X, $419.95. Like MFJ-1799, but less 80M.

MFJ 43-foot Vertical, 160-6 Meter

MFJ-2990,$419.95. High performance 43 foot vertical operates 160-6 Meters, 1500 Watts SSB/CW/Digital. 2 square feet wind load. Self-supporting, no guy wires needed. 6063 aircraft aluminum tubing, bottom section 2" OD, .120" wall thickness. 20 lbs. Requires antenna tuner, ground/counterpoise.

BigStick ™ Vertical

MFJ-2286, $129.95. 7-55 MHz, *full 1/4 wave* 20-6M, 40M coil. 17 ft. extended, 28" collapsed. 2 lbs. 1 KW. Mount, radial kit included.

BigEAR ™ Dipole

MFJ-2289, $219.95. 7-55 MHz. *Full-size* 20-6 Meter dipole, 40M air loading coil. Two 17 ft. telescopic whips, 28" collapsed.

MFJ-915, $49.95 RFI Isolator

Prevents unwanted RF from traveling on your coax shield into your expensive transceiver. Prevents painful RF "bites" and erratic operation. 1.5 kW. 1.8-30 MHz.

MFJ-918, $49.95 4:1 Balun

True 1:1 current balun/center insulator. High-permeability ferrite beads on RG-303 *Teflon*(R) coax. 2" dia.x6" long. 14 gauge 7-strand copper wire. 1.5 kW 1.8-30 MHz.

MFJ-913, $49.95, 300W MFJ-919, $74.95, 1.5 kW

True 4:1 current baluns/antenna center insulators transform 200 ohms to 50 ohms, 1.8-30 MHz. Transmission line transformer, low permeability ferrite cores, SO-239, stainless steel hardware with direct 14 gauge stranded copper wire to antenna.

Lightning surge protectors

MFJ-270, $29.95. 400W.
MFJ-272, $44.95. 1500W. Gas discharge tube shunts 5000 amps peak.< 0.1 dB loss. 1 GHz. SO-239s.

2-Position Antenna Switch

MFJ-1702C, $54.95. 2-position antenna switch, lightning surge protection, center ground.

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More hams use MFJ analyzers than all others in the world!

MFJ-259D . . . World's Most Popular Antenna Analyzer!

New!

MFJ-259D **$329.95** *New and improved, now covers 280 KHz-230 MHz!*

***World** famous* MFJ-259D gives you a complete picture of your antenna's SWR and Complex Impedance.

MFJ-259D is a complete ham radio test station including frequency counter, RF signal generator, *SWR Analyzer*™, RF Resistance/Reactance Analyzer, Coax Analyzer, Capacitance/Inductance Meter and more!

Read Complex Impedance as series resistance and reactance (R+jX) or as magnitude (Z) and phase (degrees).

Determine velocity factor, coax cable loss in dB, length of coax and distance to short/open.

Read SWR, return loss and reflection coefficient at any frequency simultaneously.

Read inductance (uH) and capacitance (pF) at RF frequencies.

Large easy-to-read two line LCD screen and side-by-side meters clearly display your information.

Built-in frequency counter, Ni-MH/Ni-CD charger circuit, battery saver, low battery warning, smooth reduction drive tuning.

Super easy-to-use! Just set the bandswitch and tune the dial -- just like your transceiver. SWR, Complex impedance displayed instantly!

Fully portable, take it anywhere -- remote sites, up towers, on DX-peditions. Use 10 AA or Ni-Cad or Ni-MH batteries (not included) or 110 VAC with MFJ-1312D, $19.95. Rugged metal cabinet, 4x2x6¾". **MFJ-249D, $309.95.**

MFJ-249D does everything MFJ-259D does with digital display only.

MFJ-269D . . . 280 KHz - 230 MHz plus 415-470 MHz, 12-bit A/D

New and improved. Now covers 280 KHz to 230 MHz and 415 to 470 MHz and 2200 Meter band!

Instantly gives you a complete picture of your antenna.

Read SWR, return loss, reflect-ion coefficient, match efficiency at any frequency simultaneously.

Read Complex Impedance (100 KHz to 230 MHz) as series equivalent resistance and reactance (Rs+jXs) or as magnitude (Z) and phase (degrees). Also reads parallel equivalent resistance and reactance (Rp+jXp).

Determine velocity factor, coax loss in dB, length of coax and *distance to short or open in feet (it's like a built-in TDR).*

Coax Calculator™ calculates coax line length in feet given degrees and vice versa for any frequency, velocity factor.

New! MFJ-269D **$429.95**

Measure SWR and loss of coax with *any* characteristic impedance (280 KHz to 230 MHz) from 10 to over 600 Ohms.

Measures inductance in uH and capacitance in pF at RF frequencies, 100 KHz to 230 MHz.

High contrast LCD gives precision readings and two side-by-side analog meters make antenna adjustments smooth and easy.

12-bit A/D converter gives much better accuracy and resolution than common 8-bits -- *MFJ-269D exclusive!*

Built-in frequency counter, battery saver, low battery warning, Ni-Mh/NiCd charge circuit. 4Wx2Dx6¾", 2 lbs. Use ten aA batteries or 110 VAC with MFJ-1312D, $19.95.

MFJ-269DPRO™ SWR Analyzer

MFJ-269DPro, $469.95. Like MFJ-269D, but UHF range covers ***430 to 520 MHz***. For commercial work.

MFJ-223 1-60 MHz Color Graphic VNA Analyzer

MFJ-223 **$349.95**

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, it's packed with VNA features and performance you need!

- **Single-frequency** and *swept-frequency* operation
- **Truly accurate** SWR, R, X, and Z measurements
- **Seamless DDS** coverage, 100-Hz resolution from 1-60 MHz
- **Smooth "skip-free"** encoder tunes fast or slow without missing a step
- **Powerful +5-dBm** stimulus generator
- **Field-strength meter**
- **DDS generator** precision signal source
- **Vivid 1600-pixel/inch** color graphics on a 2x2 inch non-glare TFT screen

MFJ-225 1.5-180 MHz *continuous* Two-Port Graphic Analyzer

MFJ-225 **$349.95**

Out in the field, the MFJ-225 is a compact completely *self-contained handheld graphing analyzer.* On the bench it becomes a full-fledged two-port (S21) desktop machine when teamed up with your PC. Using powerful IG-miniVNA freeware, you'll run de-tailed data analysis and print out stunning color-graphic plots to document your work! Built-in back-lighted *3-inch LCD graphic* display. Make fine adjustments using full-screen easy-to-view SWR bargraph, capture vivid swept displays for SWR, impedance, re-turn loss, phase angle, more. DDS generator.

SWR Analyzer Accessories

A. **MFJ-29D/MFJ-39D, $44.95.** Carrying Pouch for MFJ-259D/269D.

B. **MFJ-92AA10, $44.95.** 10-Pk 2500 mAh Ni-MH Supercells.

C. **MFJ-66, $44.95.** Dip coils, set of two covers 1.8-230 MHz.

D. **MFJ-731, $124.95.** Tunable Analyzer Filter, 1.8-30 MHz, for strong RF fields.

E. **MFJ-917, $44.95.** 1:1 Current balun for SWR Analyzers to test balanced line antennas, other loads.

F. **MFJ-7737, $7.95.** PL-259 to BNC Female.

G. **MFJ-7727, $7.95.** PL-259 to SMA Female.

H. **MFJ-5510C, $19.95.** 12VDC cigarette lighter adapter.

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The familiar, rugged ANC-4 now with:
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Kill Noise before it reaches your receiver!
Great for supressing power line noise, plasma TV noise & many other local electrical noises.

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- Single USB connection to computer
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Available with USB or RS-232 connection

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Proven FTDI Chip. 9 and 25 pins for all radios, TNCs, Rotor Controllers & more!

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MFJ 1500 Watt Remote Auto Tuner

Place this MFJ-998RT remote tuner at your antenna to match high SWR antennas/long coaxes -- greatly reduce losses for high efficiency

. . . Match 12-1600 Ohms, 1.5 kW, SSB/CW/Digital, 1.8-30 MHz . . . Match coax/wire antennas . . . Weather-sealed . . . Remotely powered thru coax . . . Amplifier, radio, tuner protection . . . Output static/lightning protection . . . StickyTune™ always tunes when power folds back . . . DC power jack . . .

MFJ-998RT
$879.95

Bottom Chassis

Inside View

Tune your antenna at your antenna

Get greatly reduced losses and high efficiencies with long coax runs and high SWR antennas with this new MFJ-998RT 1.5 kW Remote Antenna Tuner.

Weather-Sealed

A tough, durable weather-sealed ABS cabinet with over-lapping lips, sealing gasket and stainless steel chassis protects the MFJ-998RT from all kinds of weather.

No Power Cable Needed!

No power cable needed -- remotely powered through coax. Includes MFJ-4117 Bias-Tee with on/off switch for station end of coax. Has 12 VDC jack for power cable, if desired.

Fully Protected

MFJ exclusive algorithms protect your tuner, radio and RF power amplifier from damage.

Automatic inductor and capacitor limiting prevents tuning extreme loads which can destroy your tuner.

Your tuner will not tune if more than 75 Watts with SWR greater than 3:1 is applied or if more than 125 Watts is applied.

Tuner output is static electricity and lightning induced surge protected.

MFJ exclusive StickyTune™

Very high SWR can fold back transmitter power and prevent tuning caused by extreme differences in loads (example: changing bands and other conditions).

But MFJ exclusive StickyTune™ always tunes with a simple on/off power cycle and re-transmit.

Tunes Coax fed and Wire Antennas

Tunes both coax fed and wire antennas. Has ceramic feed-through insulator for wire antennas. 2 kV Teflon® insulated SO-239 – prevents arcing from high SWR.

High Power, Highly Efficient

A highly efficient L-network matches 6-1600 Ohms at full 1500 Watts legal limit SSB/CW and Digital, 1.8 to 30 MHz with Hi-Q Ls, Cs.

MFJ-998RT Learns as you Operate

As you operate, the MFJ-998RT automatically tunes for minimum SWR and remembers your frequency and tuner settings. The next time you operate on that frequency and antenna, its tuner solution is restored in milliseconds and you're ready to operate!

Highly Intelligent, Ultra-fast Tuning

MFJ InstantRecall™ recalls stored tuning solutions from 10,000 memories. For new frequencies, MFJ Intelli-Tune™ measures your antenna impedance and instantly determines the correct matching components. If antenna impedances cannot be measured, MFJ AdaptiveSearch™ searches only the relevant components that can match your antenna giving you ultra-fast tuning.

Field upgradeable firmware. Requires 12-15 VDC at 1.4 Amps maximum or 110 VAC with optional **MFJ-1316, $34.95**. Weighs 9.5 lbs. $13\frac{1}{4}$W x $6\frac{3}{4}$H x $17\frac{1}{2}$D inches.

600W Remote IntelliTuner™

MFJ-994BRT – perfect for 600 Watt SSB/CW amplifiers like Ameritron's AL-811/ ALS-600/ALS-500M. Matches 12-800 Ohms. Coax/wire antennas, 1.8-30 MHz. Fully weather-sealed for outdoor use. Remotely powered through coax. Tough, durable, built-to-last cabinet, $9\frac{1}{4}$W x 3H x $14\frac{1}{4}$D inches, 4 lbs. Includes MFJ-4117 BiasTee Power Injector.

MFJ-994BRT
$469.95

200W Remote IntelliTuner™

MFJ-926B, 200 Watts SSB/CW/Digital, 6-1600 Ohms, Coax/wire antennas, 1.8-30 MHz. Includes BiasTee.

MFJ-926B $339.95

300W Remote IntelliTuner™

MFJ-993BRT handles 300 Watts SSB/CW and digital.Has extra-wide 6-1600 Ohm impedances. Coax/ wire antennas, 1.8-30 MHz. Fully weather-sealed for remote outdoor or marine use. Remotely powered through coax. Tough, durable, built-to-last cabinet measures $9\frac{1}{4}$W x 3H x $14\frac{1}{4}$D inches. Weighs just 4 pounds. Includes MFJ-4117 BiasTee Power Injector.

MFJ-993BRT
$349.95

MFJ No Matter What™ Warranty

One year **No Matter What**™ Warranty
30 Day Money Back Guarentee
(less s/h) on orders direct from MFJ.

160-6 Meters 43 foot Vertical Antenna

Operate all bands 160-6 Meters at full 1500 Watts with this self-supporting, 43 foot high performance vertical! Assembles in less than an hour. Low profile blends in with sky and trees -- barely see it. Entire length radiates. Exceptional low angle DX performance on 160-20 Meters and very good performance on 17-6 Meters. Telescope it shorter for more effective low angle radiation on 17-6 M if desired. One of these wide range MFJ automatic tuners at the antenna easily matches all bands 160-6 Meters. There's no physical tuning adjustments on the antenna -- you simply put it up! Requires ground system, at least one radial, more the better. Includes balun and base mount. **MFJ-1932, $44.95**. All band ground radial system.

MFJ-2990
$399.95

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MFJ Tuners

Ham Radio's Most Popular 300 Watt Antenna Tuner

MFJ-949E $229.95

More hams use MFJ-949s than any other antenna tuner in the world!

Why? Because the world's leading tuner has earned a worldwide reputation for being able to match just about anything.

Full 1.8-30 MHz Operation

Tune your antenna for minimum SWR! Works 1.8-30 MHz on dipoles, verticals, inverted vees, random wires, beams, mobile whips, shortwave receiving antennas...Use coax, random wire, balanced lines. Has heavy-duty 4:1 balun for balanced lines.

Custom inductor switch

Custom designed inductor switch, 1000 volt tuning capacitors, Teflon® insulating washers and proper L/C ratio gives you arc-free no worries operation up to 300 Watts PEP transceiver input power.

The MFJ-949E inductor switch was custom designed to withstand the extremely high RF voltages and currents that are developed in your tuner.

8-Position Antenna switch

Antenna switch lets you select two coax fed antennas, random wire/balanced line or dummy load through your MFJ-949E or direct to your transceiver.

Lighted Cross-Needle Meter

Full size 3-inch lighted Cross-Needle Meter. Lets you easily read SWR, peak or average forward and reflected power simultaneously. Has 300 Watt or 30 Watt ranges.

QRM-Free PreTune™

MFJ's QRM-Free PreTune™ lets you pre-tune your MFJ-949E off-the-air into its built-in dummy load! Makes tuning your actual antenna faster and easier.

Plus Much More!

Full size built-in non-inductive 50 Ohm dummy load, scratch-proof Lexan multi-colored front panel, $10^5/_8$ x $3^1/_2$ x 7 inches. Superior cabinet construction and more!

MFJ-948, $199.95. Econo version MFJ-949E. Has all features except for dummy load.

No Matter What™ Warranty

Every MFJ tuner is protected by MFJ's famous one year **No Matter What™** limited warranty. We will repair or replace your MFJ tuner (at our option) for a full year.

More hams use MFJ tuners than all other tuners in the world!

MFJ-989D Legal Limit Tuner

MFJ-989D $479.95

New, improved MFJ- 989D legal limit antenna tuner gives you better efficiency, lower losses and a new true peak reading meter. Easily handles full 1500 Watts SSB/CW, 1.8-30 MHz, including MARS/WARC bands. Six position antenna switch, dummy load. New 500 pF air variable capacitors. New improved AirCore™ Roller Inductor. New high voltage current balun. New crank knob. $12^7/_8$W x 6H x $11^5/_8$D inches.

MFJ-986 Two knob Differential-T™

MFJ-986 $429.95

Two knob tuning (differential capacitor and AirCore™ roller inductor) makes tuning foolproof and easier than ever. Gives minimum SWR at only one setting. Handles 3 KW PEP SSB amplifier input power (1.5 KW output). Gear-driven turns counter, lighted peak/average Cross- Needle SWR/Wattmeter, antenna switch, balun. 1.8 to 30 MHz. $10^3/_4$W x $4^1/_2$H x 15 in.

MFJ-962D Compact kW Tuner

MFJ-962D $369.95

A few more dollars steps you up to a KW tuner for an amp later. Handles 1.5 KW PEP SSB amplifier input power (800W output). Ideal for Ameritron's AL-811H! AirCore™ roller inductor, gear-driven turns counter, pk/avg lighted Cross-Needle SWR/Wattmeter, antenna switch, balun, Lexan front, 1.8-30MHz. $10^3/_4$ x $4^1/_2$ x $10^7/_8$ in.

MFJ-969 300W Roller Inductor Tuner

Superb, AirCore™ Roller Inductor tuning. Covers 6 Meters thru 160 Meters! 300 Watts PEP SSB. Active true peak reading lighted Cross-Needle SWR Wattmeter, QRM-Free PreTune™, antenna switch, dummy load, 4:1 balun, Lexan front panel. $10^1/_2$W x $3^1/_2$H x $9^1/_2$D inches.

MFJ-969 $269.95

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, $159.95.** Tuner Kit -- Build your own!

MFJ-941E $179.95

MFJ-945E HF/6M Mobile Tuner

Extends your mobile antenna bandwidth so you don't have to stop, go outside and adjust your antenna. Tiny 8 x 2 x 6 in. Lighted Cross-Needle SWR/Wattmeter. Lamp and bypass switches. Covers 1.8-30 MHz and 6 Meters. 300 Watts PEP. **MFJ-20, $11.95**, mobile mount.

MFJ-945E $169.95

MFJ-971 Portable/QRP Tuner

Tunes coax, balanced lines, random wire 1.8-30 MHz. Cross-Needle Meter. SWR, 30/300 or 6 Watt QRP ranges. Matches popular MFJ transceivers. Tiny 6 x $6^1/_2$ x $2^1/_2$ in.

MFJ-971 $159.95

MFJ-901B Smallest Versa Tuner

MFJ's smallest (5 x 2 x 6 in.) and most affordable wide range 200 Watt PEP Versa tuner. Covers 1.8 to 30 MHz. Great for matching solid state rigs to linear amps.

MFJ-901B $129.95

MFJ-902B Tiny Travel Tuner

Tiny $4^1/_2$ x $2^1/_4$ x 3 inches, full 150 Watts, 80-6 Meters, has tuner bypass switch, for coax/random wire. **MFJ-904H, $179.95**. Same but adds Cross-needle SWR/Wattmeter and 4:1 balun for balanced lines. $7^1/_4$ x $2^1/_4$ x $2^3/_4$ inches.

MFJ-902B $139.95

MFJ-16010 Random Wire Tuner

Operate all bands anywhere with MFJ's reversible L-network. Turns random wire into powerful transmitting antenna. 1.8-30 MHz. 200 Watts PEP. Tiny 2 x 3 x 4 in.

MFJ-16010 $89.95

MFJ-9201 QRPocket™ Tuner

80-10 Meters, 25 Watts. 12 position inductor, tune/bypass switch, wide-range T-network, BNCs. 4W x $2^5/_8$H x $1^1/_2$D inches. **MFJ-9201, $59.95**

MFJ-9201 $64.95

MFJ-921/924 VHF/UHF Tuners

MFJ-921 covers 2 Meters/220 MHz. **MFJ-924** covers 440 MHz. SWR/Wattmeter. 8 x $2^1/_2$ x 3 in.

MFJ-921/924 $114.95

MFJ-931 Artificial RF Ground

Eliminates RF hot spots, RF feedback, TVI/RFI, weak signals caused by poor RF grounding. Creates artificial RF ground or electrically places far away RF ground directly at rig. **MFJ-934, $259.95**, Artificial ground/300 Watt Tuner/Cross-Needle SWR/Wattmeter.

MFJ-931 $139.95

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"Hamstick" style mobile antenna. Available from **6M to 75M**. Made in the USA

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HybridDX™ HF antenna. Get on 6M to 160M in less than 80 ft.

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Modular system with meters, usb, powerpoles, switches and more.

In these tough times, we're here to help you with Quality, Service & Value!

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MFJ *4-Band Octopus* Antenna

Choose any 4 bands: HF/VHF/UHF

Octopus antenna hub turns your ham-sticks into four fully balanced dipoles in minutes!

Mix and match *any* four HF/VHF/UHF bands.

Example: screw-in 80, 40, 20 Meter hamsticks and a dual band 2M/440 MHz whip (two on each band) on opposite sides. Now you have an automatic bandswitching 5-band dipole! Rotate it for maximum signal and minimum QRM and noise with a small rotator like Hy-Gain ARI-500, $189.95.

Works at any height, low for local NVIS and high for DX. At a fixed height, (say 20-30 feet) use 80-Meters for NVIS and 20-Meters for low-angle DX.

Mounts on any mast up to 1-inch diameter. Use a fiberglass pole on a tripod and you're on the air!

Perfect for casual portable operation, limited space, HOAs, field day, camping, ARES during disasters. **Single** coax feed, built-in balun.

Interaction between bands is minimized because the ends are spaced apart at a large angle.

You don't need an antenna tuner if you carefully tune each dipole. An easier way is to just set each dipole approximately on frequency and use an antenna tuner to operate and to widen the bandwidth.

Lightweight, 14-foot diameter. Hamsticks break down to about four feet for easy storage.

Tough Octopus Hub

Eight 3/8-24 threaded connectors for hamsticks. Super strong fiberglass filled ABS base insulator. Your Octopus hub will give you years of trouble-free service!

Super Octopus Deals

MFJ-2104, $299.95. Octopus hub with your choice of four (2 each) 250W *HamSticks*™. *Saves $20!*

MFJ-2104H, $579.95. Octopus hub with your choice of four (2 each) 600W *HamSticks*™. *Saves $20!*

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MFJ *HamSticks* are ruggedly constructed. They have a sleek, low profile construction with low wind loading. Semi-rigid fiberglass eliminates the need for springs or guys while mobile.

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40-M	MFJ-2640T	$64.95	MFJ-1640T	$24.95
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20-M	MFJ-2620T	$64.95	MFJ-1620T	$24.95
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10-M	MFJ-2610T	$54.95	MFJ-1610T	$21.95
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2M/440MHz	N/A	N/A	MFJ-1414	$39.95

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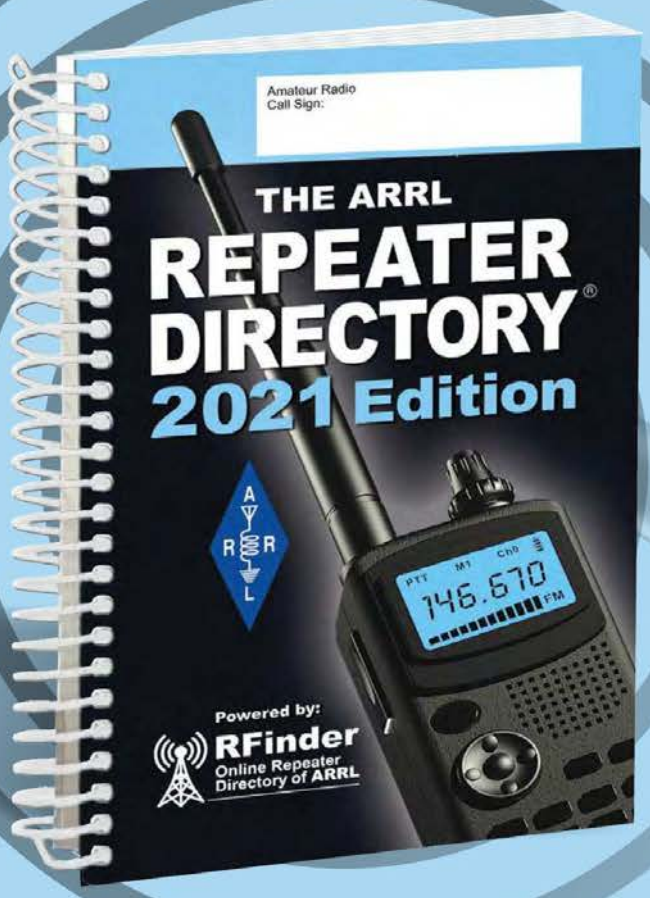

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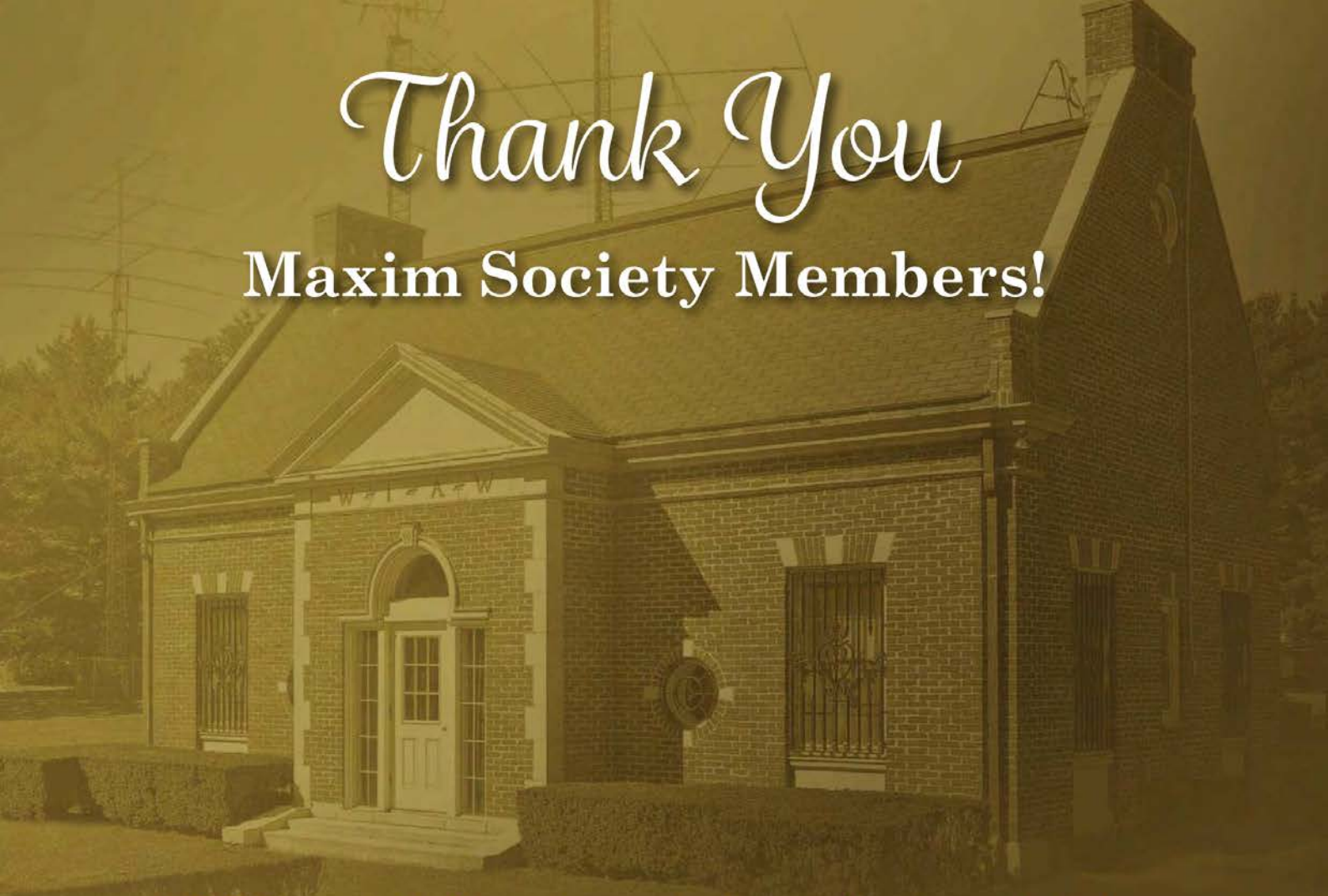

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