Build an Antenna for 2 Meters that Doubles as a Weathervane Page 38

QST

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Summer Adventures

QST Reviews

Butane-Powered Soldering Tools

Hy Power Antenna Company TRI1020 Triband Dipole

AlexLoop Premier 40 – 10 Meter Magnetic Loop Antenna with AlexTune

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High Visibility and Operation with a High-Resolution Full Color TFT & Touch Screen Display Superior Performance in a Compact C4FM Digital Transceiver

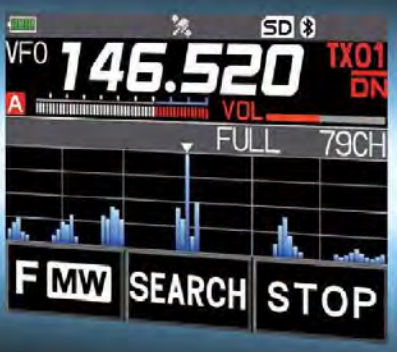
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- Dual band Simultaneous Receive
- High Visibility Full-Color TFT touch panel Display
- Built-in High Precision GPS Receiver
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- High-Resolution and High-Speed 79 channel Band scope
- CAM (Club channel Activity Monitor) Function
- FM Friendly Digital by AMS (Automatic Mode Select)
- WIRES-X Portable Digital Node Function



《Actual Size》







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MA-6B 6-Band Beam

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

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

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

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

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

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

Cushcraft 10, 15 & 20 Meter Tribander Beams

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





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

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

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

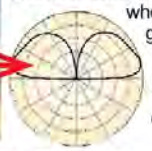


Cushcraft's world famous R8 now has a big brother!

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

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

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



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

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

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

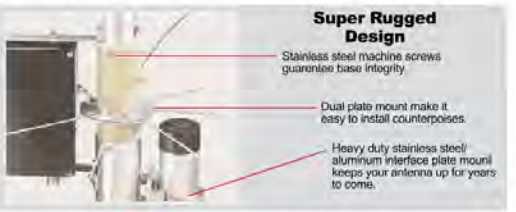


31.5 feet tall, 25 lbs. Mounting mast 1.25 to 2 inches. Wind surface area is 4 square feet.

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

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

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



Cushcraft Dual-Band Yagis





One Yagi for Dual-Band FM Radios

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

Cushcraft Famous Ringos Compact FM Verticals







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

Your New MFJ 2019 Ham Radio Catalog is HERE!

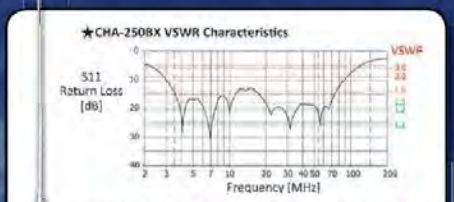
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CHA-250B - *No Antenna Tuner Needed!*

❶ ❷ ❸ ❹ ❺ ❻ ❼

Base Antennas

❶ COMET CHA-250B BROADBAND 80M THROUGH 6M VERTICAL ANTENNA
A newly designed broadband vertical with NO GROUND RADIALS. EXTREMELY easy to assemble, requires no tuning or adjustments and VSWR is under 1.5:1 from 3.5-57MHz! • TX: 3.5MHz – 57MHz • RX: 2.0– 90MHz • VSWR is 1.5:1 or less, continuous • Max Power: 250W SSB/125W FM• Impedance: 50 Ohm • Length: 23' 5" • Weight: 7 lbs. 1 oz. • Conn: SO-239 • Mast Req'd: 1" – 2" dia. • Max wind speed: 67MPH

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

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

❹ COMET GP-6 DUAL-BAND 146/446MHZ BASE REPEATER ANTENNA
Wavelength: 146MHz 5/8 wave x 2 • 446MHz 5/8 wave x 5 • Max Pwr: 200W • Length: 10'2"• Weight: 3lbs. 8ozs. • Conn: Gold-plated SO-239 • Construction: Fiberglass, 2 Sections

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

❻ COMET CX-333 TRI-BAND 146/220/446MHZ BASE REPEATER ANTENNA
Wavelength: 146MHz 5/8 wave x 2 • 220MHz 5/8 wave x 3• 446MHz 5/8 wave x 5 • Max Pwr: 120W • Length: 10'2" • Weight: 3lbs. 1oz.• Conn: Gold-plated SO-239 • Construction: Fiberglass, 2 Sections

❼ COMET GP-15 TRI-BAND 52/146/446MHZ BASE REPEATER ANTENNA
Wavelength: 52MHz 5/8 wave • 146MHz 5/8 wave x 2 • 446MHz 5/8 wave x 4 • Max Pwr: 150W • Length: 7'11" • Weight: 3lbs. 1oz. • Conn: Gold-plated SO-239• 2MHz band-width after tuning (6M) • Construction: Single-piece fiberglass



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Our Cover

Tillamook Rock is located in "the Graveyard of the Pacific," a few kilometers off the coast of Oregon. This rare IOTA location features a plethora of wildlife, including a large sea lion population. Read all about the K7TRI DXpedition to this stormy area in Cezar Trifu's, VE3LYC, article, "Operating from Tillamook Rock," on page 56 of this issue.

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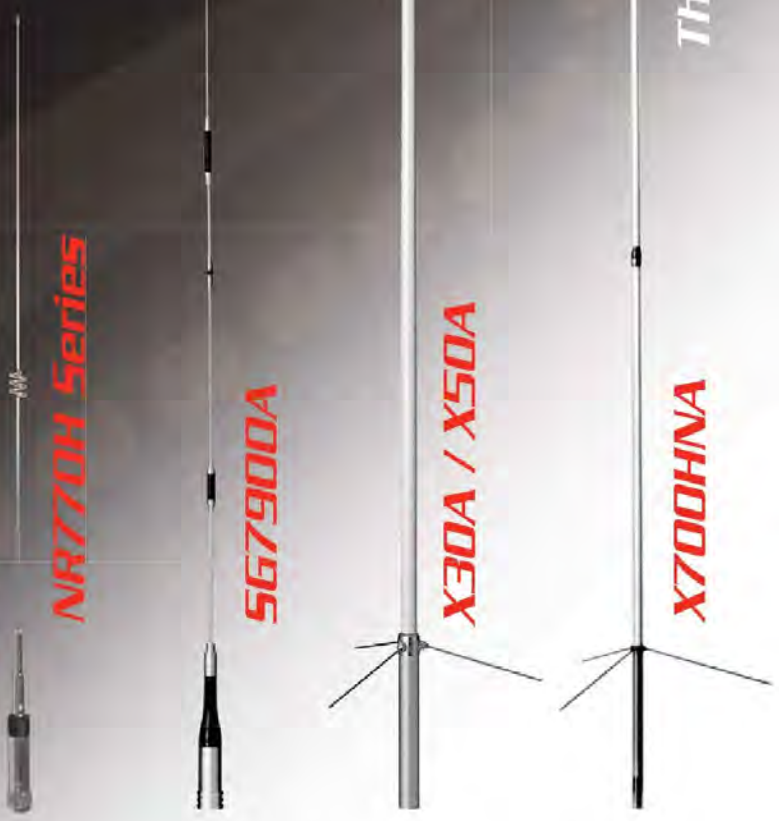
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X510HD (3 Section)	2m/70cm	17.2	330/250	UHF or N
X300A (2 Section)	2m/70cm	10	200	UHF or N
X200A (2 Section)	2m/70cm	8.3	200	UHF
X50A (1 Section)	2m/70cm	5.6	200	UHF or N
X30A (1 Section)	2m/70cm	4.5	150	UHF
Monoband Base Station/Repeater Antennas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



The Standard By Which All Others Are Judged

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Bob Inderbitzen, NQ1R, rinderbitzen@arrl.org

Second Century

Radio and the Ecosystem of Innovation

A fundamental purpose of amateur radio is the "Expansion of the existing reservoir…of trained operators, technicians, and electronics experts" [FCC Rules §97.1 (d)]. Amateur radio is an ideal breadboard for discovering how radio works. ARRL Product Development Manager Bob Inderbitzen, NQ1R, shares his perspective about using ham radio to find and prepare future radio technologists.

During months of working from home, I've taken closer notice of how much of my everyday life is interconnected by devices and networks that transmit and receive radio signals. The wireless router in my apartment is connected to laptop computers used by two working parents and a college student. This is also the hub for radio-connected "smart" devices including lightbulbs, thermostat, outdoor weather station, portable speakers, and streaming TV adapters. Smartphones and our wearable fitness trackers accompany us from room to room and anywhere we decide to venture.

Today, radio is a commodity. Invisible signals and tiny hidden antennas can mean the presence of a radio is altogether overlooked by the device's user. Yet radio technology plays a central role in our lives and across many fields: communications, transportation, energy, medicine, robotics, and artificial intelligence (AI). This ecosystem of innovation requires a regular supply of academics, technologists, and engineers — and students pursuing careers in the same fields. The world needs people who know how radio works, now more than ever.

We radio amateurs are uniquely positioned to be stewards of radio. ARRL's research finds that among the primary reasons for getting involved in amateur radio is expanding one's interest in electronics, communications, and related technologies. Our goal, then, should not be a rush to ham radio licensing as an end. Rather, we want to introduce new entrants to ham radio and its broad capability as a means for developing interest, knowledge, and skill in radio technology and radio communications. It's one of the reasons we recently added a digital edition of our technical journal, *QEX*, as a benefit for all members.

I've spent a lot of time at fairs and conventions working alongside ARRL member-volunteers in our endeavor to grow interest in amateur radio. Radio clubs often organize exhibits at air shows, Maker Faires, and for professional and educational science and technology conferences. I usually spend time in the aisle, catching attendees as they wander from booth to booth. "Do you know how radio works?" I'll ask the question hundreds of times during an event. What I've learned is that few people in the general public have any understanding of radio. The role of describing to someone the phenomena of creating, propagating, and receiving radio waves is like wearing the hats of both magician and professor. Hams can, and should, introduce radio to others with the same enthusiasm as an amateur astronomer who brings to life the night sky to an untrained observer.

College radio clubs are most directly contributing to the development of future radio technologists. These groups serve as both a student activity and, at some colleges, academic instruction in practical radio technology. Over the last months, volunteers for the ARRL Collegiate Amateur Radio Initiative (CARI) have held monthly online conferences, inviting students and campus club organizers to network with one another. Follow the CARI Facebook group at **https://www.facebook.com/groups/ARRLCARI** for details. A recurring theme in these meetings is how amateur radio opens doors for students. I know many hams who attribute their chosen career path or job to a connection they made within the amateur radio community.

Journalists often ask how amateur radio could remain relevant in a world dominated by smartphones and internet-connected devices. I respond that so long as there is radio, there will be radio amateurs. And so long as there are radio amateurs, there will be people who know how radio works. That should instill in us a great sense of purpose.

Bob Inderbitzen, NQ1R
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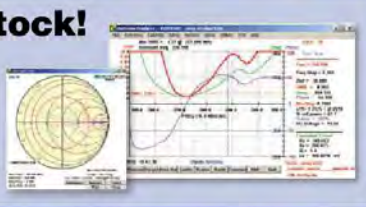


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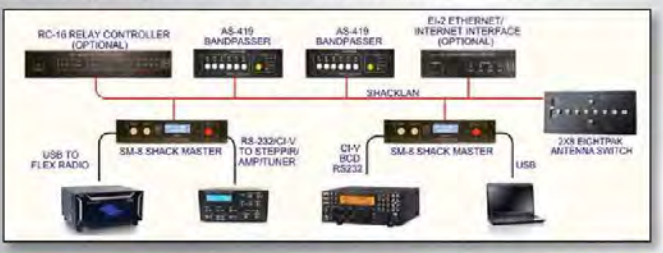
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Member Spotlight

George Burger, WØPHX



George Burger, WØPHX, has had over a decade of experience in public safety. He's been a police officer and emergency medical responder since 2007, later becoming a structural and wildland firefighter. Having to act under pressure is vital for his career, and he said his involvement in amateur radio is a huge asset.

Benefits of Amateur Radio

Since 2010, George's career path has been intertwined with his interest in amateur radio. He obtained his Technician-class license after learning of the ways amateur radio can be beneficial during emergencies. "In the event of a disaster or anything that is outside the normal response for first responders, communication is affected," George said. His respect for the amateur radio community only grew since then, as George began to understand how it can be a valuable resource.

After George was appointed as Emergency Management Director for the city of Ely, Minnesota, he planned a joint communications exercise to test the communications coordination among several agencies. The exercise incorporated a marathon where amateur radio operators were providing race communications support. Using a joint communications control station, amateur radio operators worked alongside municipal and federal agencies to relay messages and ensure that the event ran smoothly. "Having amateur radio operators available as a resource can help restore organized communication," George said, adding that the exercise "proved that amateur radio is still a viable asset to emergency management."

George also explained that his involvement with amateur radio has changed his mindset in regard to how he addresses emergencies. He said amateur radio — especially portable operating — has improved his communication, multitasking, quick-thinking, and problem-solving abilities. "Good communication and the ability to think outside the box keeps me calm when things get tough," he said.

Always Learning

Amateur radio has also given George a way to explore new passions. He was inspired by his ongoing interest in computers, electronics, and amateur radio to go to college, and he is currently pursuing a degree in information technology from Arizona State University.

Additionally, George used his interest in travel to sharpen his portable operating skills, challenging himself to make as many long-distance contacts as he can while on the go. He also became involved in ARRL's National Parks on the Air program, which motivated him to upgrade his license to General class, and Extra class soon after. After NPOTA, he became involved with Summits on the Air (SOTA) and the World Wide Flora and Fauna (WWFF) programs.

George has found so many different avenues to explore within ham radio, which has proved to him there's always more to learn. For instance, when he'd first become interested in amateur radio, he wanted to get into DXing, but the thought of learning Morse code was too daunting for him. "After much encouragement from an avid CW operator, Jess Guaderrama, W6LEN, I learned Morse code on my own and later enrolled in the CW Operators Club (CWOps) CW Academy to sharpen my skills." Now, CW is one of his favorite aspects of the hobby.

Giving Back

Leadership has always been an important quality for George, and amateur radio has only strengthened his sense of responsibility, especially because of the many mentors he's had within the amateur radio community. Motivated to also give back, George helped start the Vermilion Range Amateur Radio Club, KØVRC, became an advisor in the CW Academy, and became a Volunteer Examiner.

George is very active, always finding new ways to get involved. You can catch George on the air from Ely, Minnesota; Maricopa, Arizona, or mobile, "most likely up a mountain or in my Jeep running around," he added.

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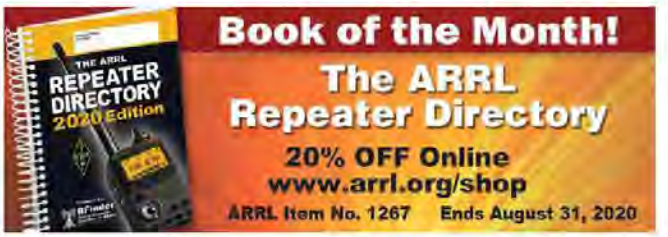
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To send an email to any ARRL Headquarters staff member, put his or her call sign (or first initial and last name) in front of **@arrl.org**. For example, to send to Hiram Maxim, First President of the ARRL, use **w1aw@arrl.org**, or **hmaxim@arrl.org**.

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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

Special Delivery





Natalie Lyle, N8TLE, of Shakopee, Minnesota, is shown visiting Shawn Williams, ZS1SBW, in Fish Hoek, Cape Town, South Africa, to personally receive a QSL card for her father, Jay Lyle, KØMU.

Natalie serves in the United States Peace Corps in Ghana, where she teaches mathematics, as well as develops the literacy and computer skills of her students, with an emphasis on empowering young women.

QST Ski Boot

Tony Manna, WA1ENO, and Anne Manna, WB1ARU, spotted this somewhat familiar footwear in a shop in North Conway, New Hampshire. QST is a brand of rugged ski boots made by Salomon International.



Getting On Your Father-In-Law's Good Side

Joe Pollet, W5ABC, has a son-in-law who knows how to stay in Joe's good graces. He presented Joe with a handcrafted call letter sign made from an 11 × 24 inch pine board. The call sign is routed and burned into the wood along the top. Below it is a three-dimensional wood carving of an RF waveform. The waveform is a depiction taken from an oscilloscope while Joe was saying, "Whisky 5 Alpha Bravo Charlie."



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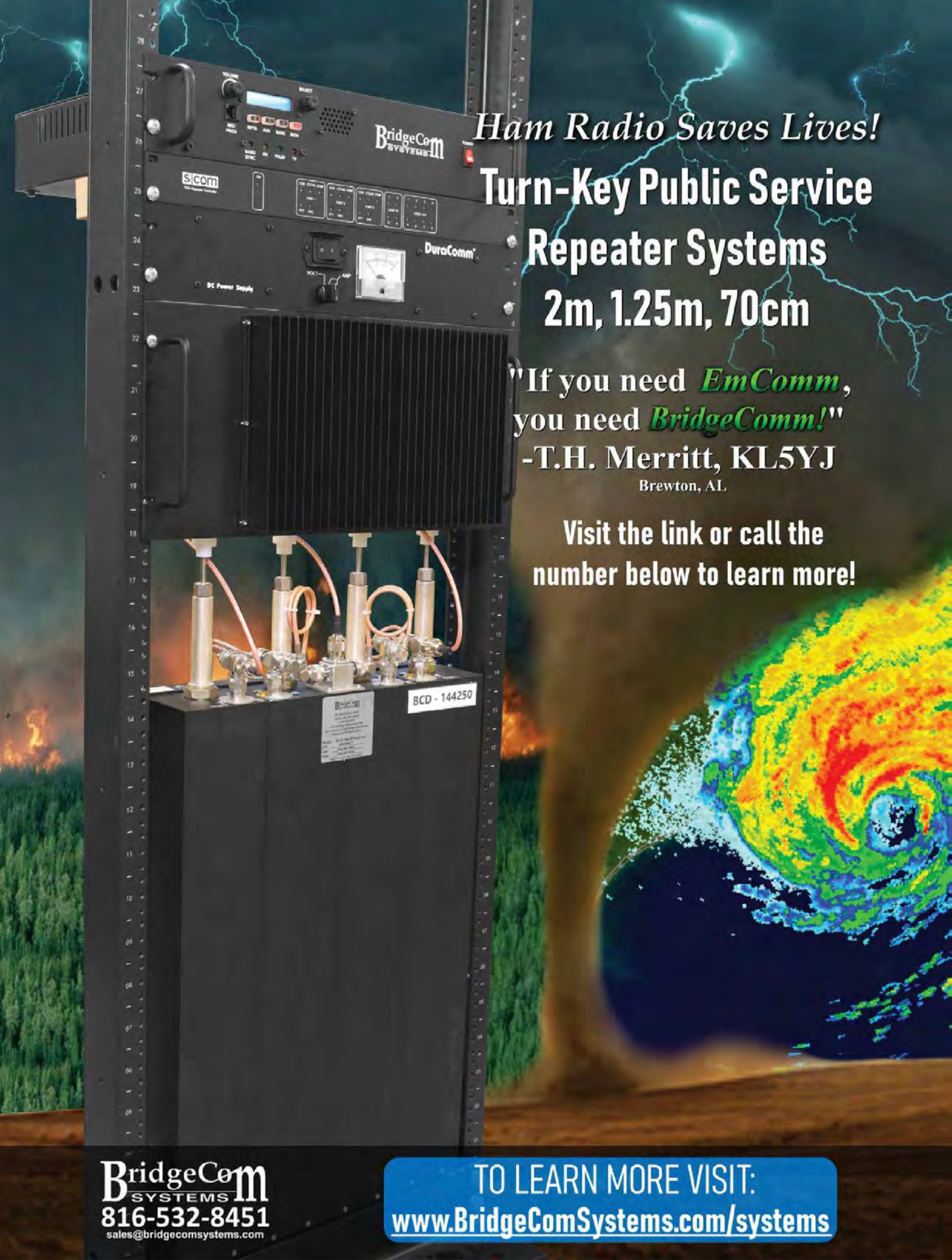
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Letters from Our Members

30 Years of Ham Radio

I recently celebrated 30 years in ham radio. I have enjoyed many facets of this hobby, from editorship of a ham radio club newsletter to passing a fair amount of traffic to serving as a Volunteer Examiner (VE).

I've been a member of ARRL for many years. Thank you all for helping me be a part of ham radio! I also owe a debt of gratitude to the FCC for issuing a license to me. I appreciate the privilege of being an amateur radio operator.

Paul L. Marcum, AC4QZ
Kingsport, Tennessee

More Storm-Spotter Resources

Rick Palm's, K1CE, "Public Service" column in the May 2020 issue about becoming a National Weather Service (NWS) spotter interested me. As he stated, amateur radio operators are in a unique position to assist the NWS, and many of us have already connected weather stations that can be accessed by the NWS, should the need arise. I would like to add two more resources that can be used.

The Community Collaborative Rain, Hail & Snow Network (**www.cocorahs.org**) uses manual readings to report precipitation at the user's location via their website. Interested hams will have to purchase a rain gauge that meets their requirements.

Another resource is mPING (**https://mping.nssl.noaa.gov**), which assists the National Oceanic and Atmospheric Administration (NOAA) and the NWS in reporting precipitation where their radars can't reach. This is a downloadable app that works on Android and Apple devices.

Also, don't forget the SKYWARN® Recognition Day event in December (**www.weather.gov/SKYWARN**) to celebrate the contributions that volunteer SKYWARN radio operators make to the NWS.

George M. Badger, W3AB
Soquel, California

An Unexpected Benefit of FT8

Recently, I was feeling guilty operating on FT8. Some of my old-fashioned friends feel that FT8 is "too automated," or "just not ham radio."

But something occurred to me: you don't even have to speak English to enjoy this mode. All of the stations around the world that are shy about coming up against a language barrier aren't inhibited in any way on FT8. I'm contacting so many places that I'm certain I never would have had a contact with had they not been on FT8. Sure, they might have been on CW or PSK31 and struggled through a contact, but on FT8 they can just enjoy making contacts. I suspect for non-English-speaking hams this must be very liberating.

I've had Asiatic Russia, Japan, little islands I've never heard of, and more calling me on FT8, when I didn't even have to call CQ. And none of us had to worry about a language barrier.

I'm not arguing that we should abandon all other modes, but I often hear folks demean FT8 without considering its benefits, especially those that may apply to hams around the world.

Dennis R. Blanchard, K1YPP
Sarasota, Florida
Life Member

QSL Card Conundrum

With the current stay-at-home orders due to the pandemic, I thought more people would be on the air and I figured I could try to finish earning my DXCC and Worked All States (WAS) awards on 6 through 160 meters. Logbook of The World (LoTW) certainly makes award-chasing easier (no trips to the post office for stamps or mailing cards overseas!). However, I was dismayed to find that a lot of DX stations don't use LoTW.

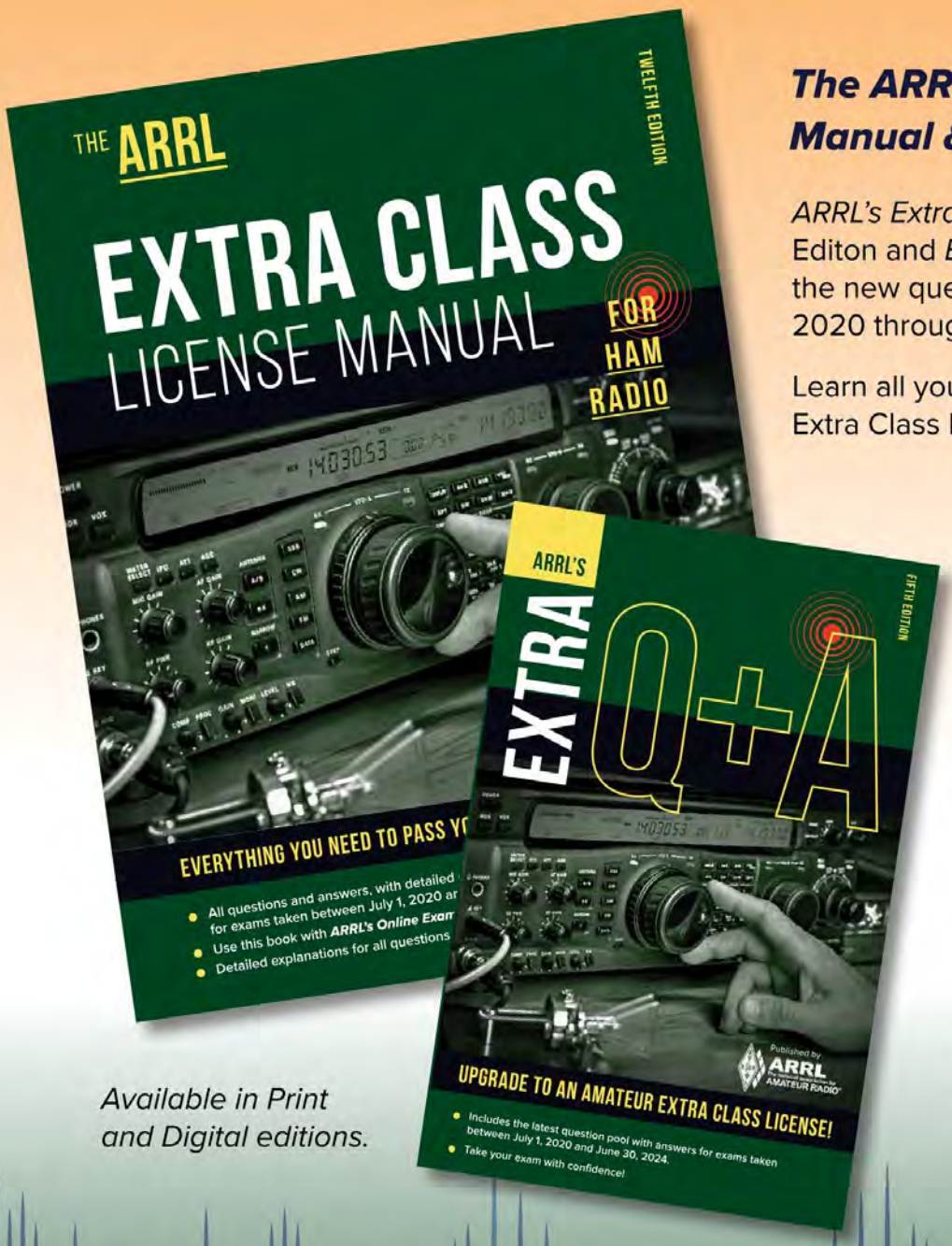
Because my confirmed totals were only slowly rising, I decided to start mailing QSL cards when needed, using **QRZ.com** to determine addresses. I was surprised to see that many hams wanted $3 – $5 sent by PayPal for confirmed contacts in LoTW or mailed QSL cards. I miss the time when the QSL card was a courtesy.

Sandy B. Walker, WB4EVH
McRae-Helena, Georgia
Life Member

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W1AW Schedule

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

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

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

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

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

Code bulletins are sent at 18 WPM.

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

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

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

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

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

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

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

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

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



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A microcontroller project to strengthen builders' programming skills.

Program an Arduino to Transmit WSPR

Anthony Le Cren, F4GOH/KB1GOH

This article is intended for those who know how to program an Arduino and can wire components on a breadboard, such as the Fritzing diagram in Figure 1.

The idea here is to generate a WSPR signal with an AD9850 DDS controlled by an Arduino ATmega328P, using a DS3231 real-time clock for perfect synchronization of the transmission. A simple for-loop code transmits the WSPR signal. By building this project, you will learn how to program a DDS, how to create HF filters, and how to adjust the transmission frequency.

The Basic WSPR Transmitter

The basic architecture includes the Arduino ATmega328P nano microcontroller, Arduino IDE 1.0+ support for OSX, Windows, or Linux. It is powered via a USB port or an external source +5 V supply. Two I/O pins are provided for a possible addition of GPS. The transmitter includes a removable HF filter, a DDS AD9850 programmable oscillator, an RTC DS3231 real-time clock, and a BS170 100 mW amplifier. It is housed in a 100 × 66 × 43 millimeter aluminum housing.

WSPR

Weak-Signal Propagation Reporter (WSPR) implements a protocol designed for probing potential propagation paths. See the *WSPR User Guide* at **physics.princeton.edu/pulsar/K1JT/doc/wspr/wspr-main.html**. Periodic WSPR transmissions are received by many stations around the world, and are then posted to an internet server. This makes it possible to rapidly generate a map of the different listening points for the transmitting station and to test propagation. Figure 2 shows a propagation map for transmissions on the 30-meter band from F4GOH, with spots in a 10-minute interval. Andy Talbot, G4JNT, describes the WSPR encoding in detail at **www.g4jnt.com/wspr_coding_process.pdf**.

Description of the Circuitry

The circuit, seen in Figure 3, is built around an Arduino nano. The DS3231 real-time clock is synchronized to transmit every even minute. DDS (direct digital synthesis) generates an RF signal via an SPI link. A pair of BS170 transistors is used as a class-C amplifier, which requires a low-pass filter.

I opted for an I2C DS3231 clock because, when I transmit WSPR, the box is usually inside a house where GPS reception is difficult.

HF Amplifier

DDS U2 has two HF output modes via J2. One is sinusoidal (SINA or SINB), the other is a square wave

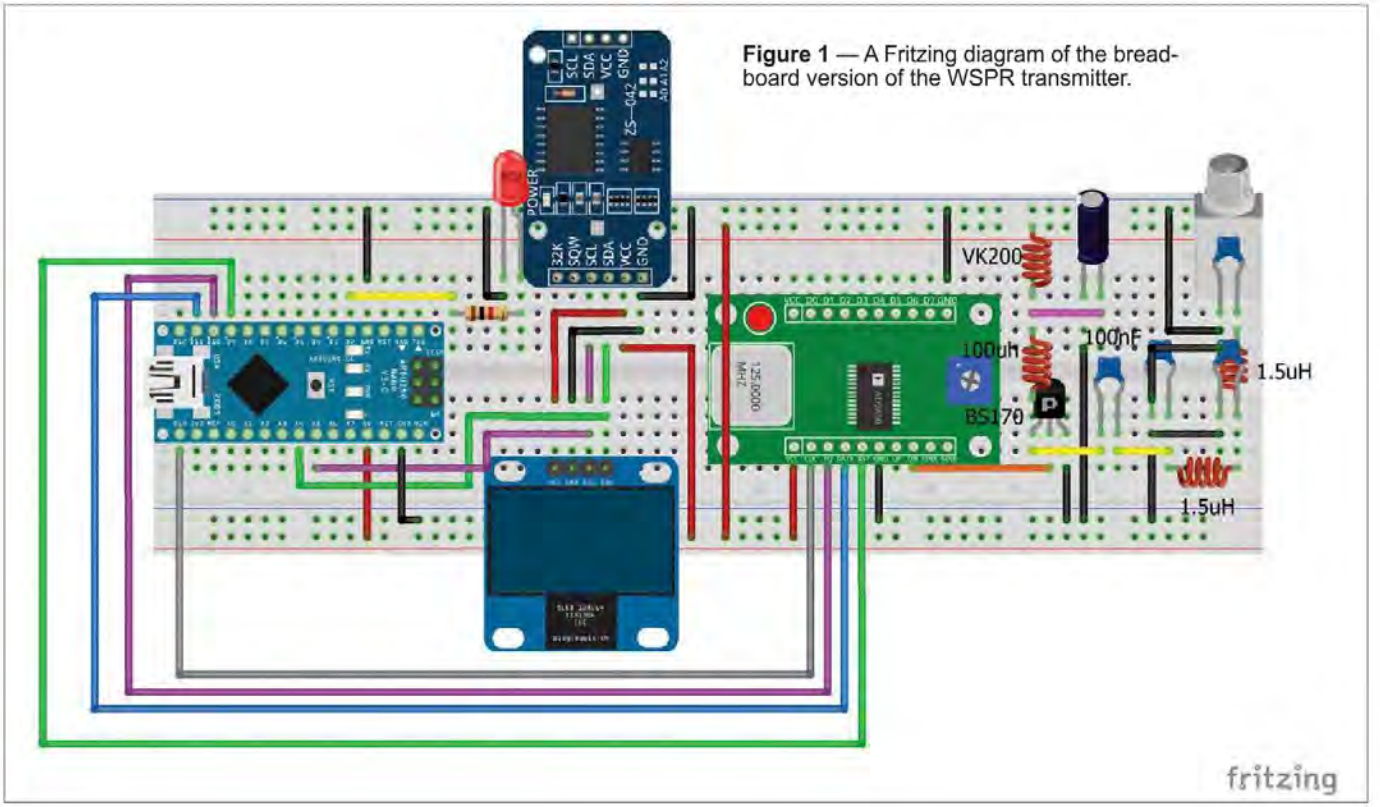


Figure 1 — A Fritzing diagram of the breadboard version of the WSPR transmitter.



Figure 2 — A propagation map for transmissions. (1) Shows the transmission is on the 30-meter band. (2) Shows that it's coming from F4GOH. (3) Indicates spots in a 10-minute interval. At (4) **UPDATE** refreshes the map.

(QP or QN). If you use the DDS QN output, replace capacitor C7 with a bridge strap. Do not use R3, C6, R4, L1, and leave J8 open — this is the configuration I use with a pair of BS170 transistors in parallel. If you use SINB, you will need to apply a bias voltage to the transistor. Solder in the low-pass filter R3, C6, R4, L1, and bridge jumper J8.

The HF Filter

A fifth-order HF filter is absolutely necessary for harmonic suppression. I used the *SVC Filter Designer* software, which can be found at **tonnesoftware.com/svcdownload.html**, to design the output low-pass filter. Set the cutoff frequency (7.2 MHz), and select the filter type. The software automatically calculates the values of capacitors and inductances. I chose the closest 5% tolerance components; those schematic values are: C11 + C12, and C15 + C16 add up to 390 pF each; C13 + C14 add up to 750 pF, and the inductors L4 and L5 are each 1.5 μH. The inductors L4 and L5 are 18 turns on a T30-2 toroid, and L3 in the drain of Q1 is 18 turns on an FT37-43 toroid. Use the mini Ring Core Calculator by DL5SWB to find the inductor turns.

The Software

As a safety measure for the power transistor, first remove jumper J2. The software is available on my **github.com** site. There, in folder *src*, you will find the program *wsprSimple.ino* to be implemented in the Arduino nano. The libraries and drivers are also provided.

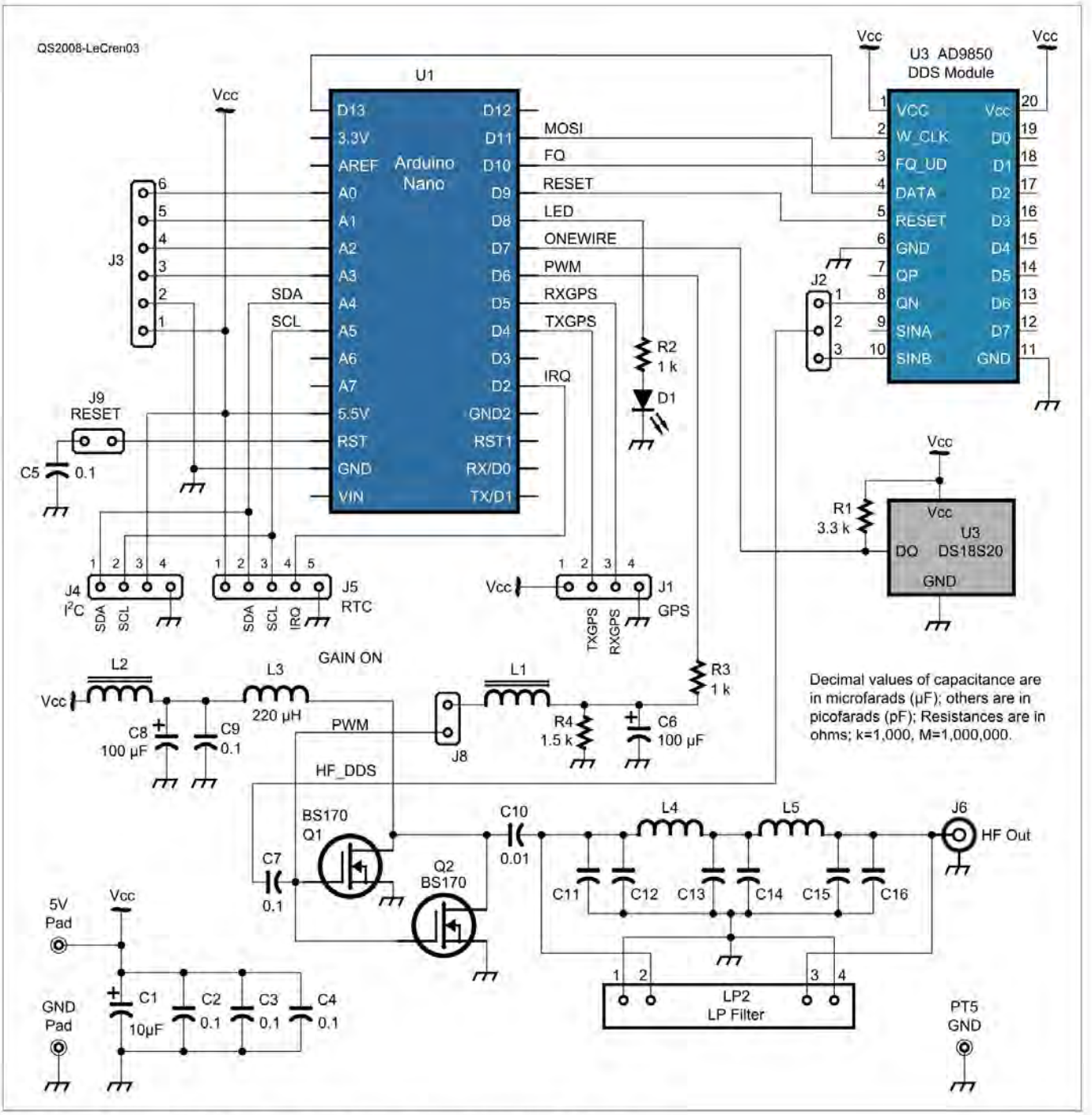


Figure 3 — A schematic of the printed circuit board version of the WSPR transmitter.

Generation of Symbols

Edit the *wspr.bat* file; it must be in the same directory as *WSPRcode.exe*. Enter your call sign, grid locator, and transmitter power. For 100 mW, enter 20 dBm. Edit the *Symbols.txt* file and select channel symbols. Replace spaces with commas using the find and replace menu.

Now paste the 162 symbols (see Figure 4) in place of the existing symbols in the *wsprSimple.ino* program (see Figure 5).

After programming, you must update the clock manually. Launch the serial terminal integrated into the Arduino *IDE* (see Figure 6). At (1) select 115200 baud, at (2) press the **h** key, then at (3) press **ENTER**, at (4) type in the date and time, including the commas. Synchronize with the clock on your computer at (5) when you press **ENTER**. This will save the current time in the *RTC*.

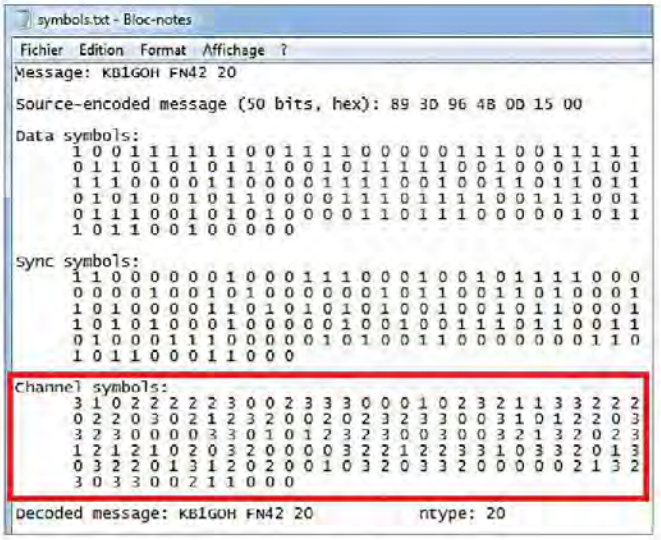


Figure 4 — The channel symbols are copied from the *symbols.txt* file.

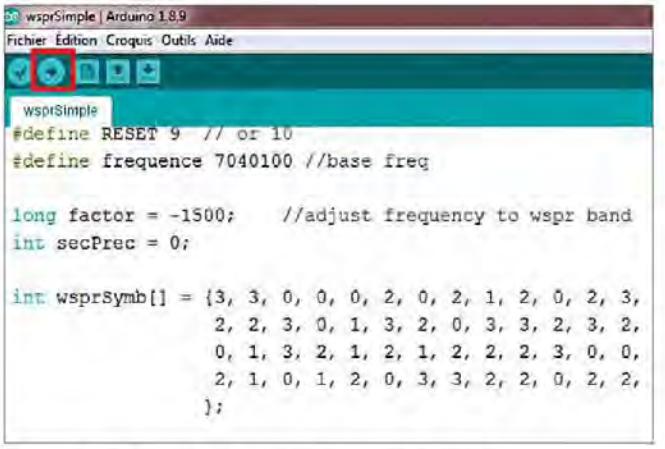


Figure 5 — The channel symbols are pasted into the *wsprSimple* program.

Adjusting the DDS

Adjust the potentiometer of DDS 9850 to produce a square-wave signal at the QN output. When the transmission stops after 1 minute and 50 seconds, the QN voltage must be 0 V. A GND connection point is available on PT5. Reminder that the transmissions take place every even minute. Now replace jumper J2.

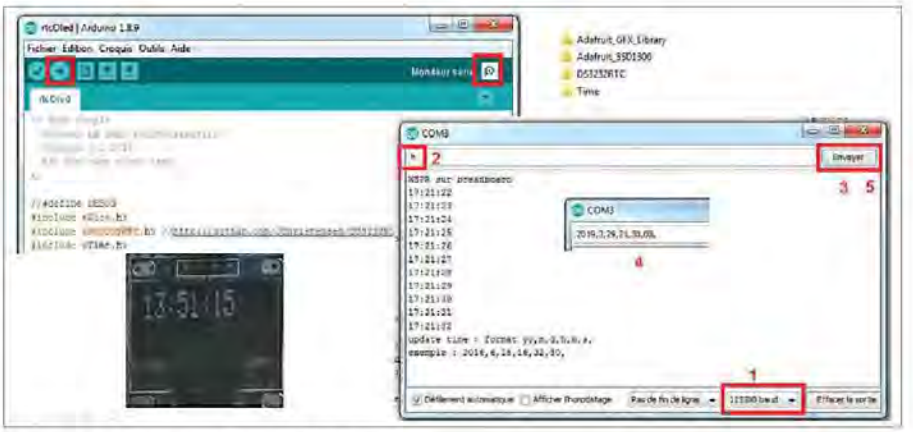


Figure 6 — Setting up the *rtcOled* program.

Receiving Verification

Install *WSJT-X* and configure it with your HF receiver. Select WSPR mode to decode the signals. Check that the transmit frequency is located in the decoding area of the *WSJT-X* software. If not, adjust the variable **LONG FACTOR = -1,500** in the *wsprSimple.ino* program (see Figure 5) by increasing or decreasing by 200 at a time.

There are several web pages for WSPR web reports: **wsprnet.org/drupal/wsprnet/map**, **wspr.aprsinfo.com/**, **https://wspr.fggs.de/**, and **wspr.vk7jj.com/**.

Conclusion

It is a pleasure to study the WSPR modulation while using a programmable oscillator. I was amazed at the performance of the transmitter, even in the breadboard form. This project was designed primarily for builders, without having a complicated software program. This can serve as a basis for a number of projects. A version based on ESP8266 is being developed. The transmitter will be controlled with a smartphone and a web browser.

Anthony Le Cren, F4GOH, has been licensed since 2010, and earned his General-class license in 2019 as KB1GOH. Anthony loves to experiment with Arduino applied to radio. He is a professor of computer science at Lycée Gabriel-Touchard High School in Le Mans, France. Anthony has written numerous articles and maintains a web page of amateur radio projects at **https://hamprojects.wordpress.com/**. You can reach Anthony at **kb1goh@yahoo.com** or **f4goh@orange.fr**.

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Antenna Performance in a Forest of Trees

Trees can be the crown jewel or the bane of an amateur radio station. One or two trees in the right locations can be better than a tower for antenna installation, but if the station is in the middle of a forest, things can get complicated.



Steve Stearns, K6OIK

Jim Brown, K9YC, is a noted 160-meter band operator. His station is in the Santa Cruz Mountains of northern California, in the middle of a forest of tall redwood trees. He wanted to know how the trees affect his antennas.

Jim Peterson, K6EI, is a 160-meter DXer and contester. His station at Loon Lake, Washington, is in the middle of a pine tree forest. The trees are 80 – 100 feet tall and are spaced 20 – 25 feet apart. Jim's antennas are located in a small meadow. The closest trees are about 25 feet away. He wanted to know what impact the forest has on his antenna performance at low elevation angles.

Analyzing Trees

There are several methods for modeling and analyzing antennas near trees. One way is to model individual trees as dielectric columns. The forest is then treated as an array of dielectric columns. I presented this approach in 2008 at Pacificon, and gave a live software demonstration in the 2018 Pacificon Antenna Seminar.[1] See slides 99 – 106 of my revised presentation at **www.fars.k6ya.org/docs/k6oik**. In the demo, I put four redwood trees modeled as dielectric columns surrounding a vertical antenna on a spherical dielectric planet.

In their February 2018 *QST* article — "Live Trees Affect Antenna Gain" — Kai Siwiak, KE4PT, and Rich Quick, W4RQ, approximated a tree trunk as a dielectric column modeled by wires and loads in *4nec2*, as well as by a rigorous electromagnetic lossy cylinder analysis. They estimated losses and pattern distortion by the two methods for a vertical antenna near an isolated tree trunk.

HOBBIES (*Higher Order Basis Based Integral Equation Solver*), which I demonstrated again at Pacificon 2019, is my preferred software for computational electromagnetics. It permits trees to be modeled directly as circular cylinders having complex dielectric constant. However, neither approach is suitable to model a forest. There are just too many trees.

In his March/April 2006 *NCJ* article, "Low Band Antennas and Trees," Carl Luetzelschwab, K9LA, cited a 1967 analytical study by Theodor Tamir to





Figure 1 — A vertical antenna embedded in a dielectric "forest."

model a forest of uniform trees whose spacing is small compared to a wavelength as a "homogenized" medium. I studied the research literature and decided a forest can indeed be treated as a meta-material having effective parameters. The theory of effective parameters for random, homogenized meta-materials was explained to me by Professor Rudy Diaz of Arizona State University.[2]

The Dielectric "Puck" Model

Using *HOBBIES*, I modeled a 160-meter-band vertical antenna in a forest at 1.9 MHz. The antenna is a quarter-wave monopole fed against 16 elevated quarter-wave radials. The radials are 10 feet above ground. The forest is 90 feet high and extends out two wavelengths (1,036 feet) in all directions from the antenna. The bottom of the vertical antenna and radials are in the forest. The top at 139.5 feet, extends 49.5 feet above the top of the forest. I modeled the forest at 1.9 MHz as a uniform dielectric "puck," with parameters set by effective media theory to correspond to a dense softwood forest[3] with medium moisture content. The relative permittivity of my "puck" was $\varepsilon_r = 1.06 - j\,0.002$.

There are several methods for modeling and analyzing antennas near trees.

There is a very large circular ground plane of typical "average" ground ($\varepsilon_r = 13$, $\sigma = 0.005$ S/m) under everything. This method is rigorous and eliminates the need for messy Sommerfeld integrals. The radius of the forest is sufficiently large that ray paths above 5° exit through the top of the forest, just as they would if the forest were of infinite radius. Thus, the computed patterns are free of artifacts caused by the finite radius of the forest, at least for elevation angles greater than 5°. Figure 1 shows the model. The top 49.5 feet of the vertical antenna sticks out above the forest.

It is worth mentioning that neither *NEC-2*, *NEC-4*, *MININEC*, *EZNEC*, *4nec2*, or *MMANA-GAL* are capable of analyzing this model. The calculation can be made using *HOBBIES* as I did, or with *WIPL-D*, *FEKO*, or any other program that can handle electrically large structures involving dielectric materials. There are inexpensive or free programs for modern computational electromagnetics that radio amateurs should consider using (see **www.fars.k6ya.org/others#Software** for more information).

Results

Figure 2 shows an overlay of elevation patterns with and without the forest (the green curve is with forest; the black curve is without forest). The graph is scaled linearly in dBi, over a 30 dB range from center (–25 dBi) to the outer ring (+5 dBi). Computer run time with the forest was about a minute on my Windows 10 based desktop computer; without the forest it took less than a second. The effect of the forest is to make the antenna appear electrically longer, shift the pattern skyward, and reduce the maximum gain by 0.9 dB. With the forest present, maximum gain is 2.4 dBi at 38° elevation, and the feed-point impedance is $18.1 - j1.5\ \Omega$. Without the forest, maximum gain is 3.3 dBi at 21.5° and the impedance is $18.5 - j12.7\ \Omega$.

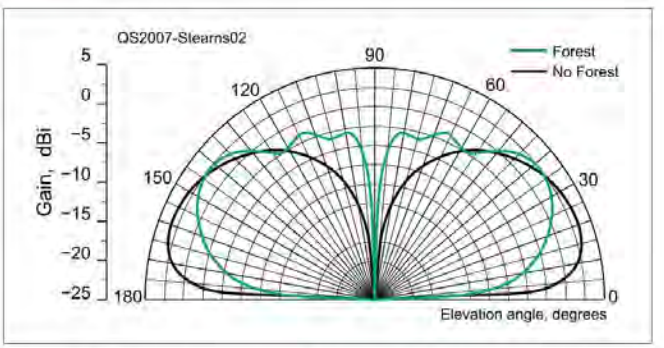


Figure 2 — Elevation patterns of a vertical antenna in the forest (green), and without the forest (black). Note the equal-increment radial dBi gain scale.

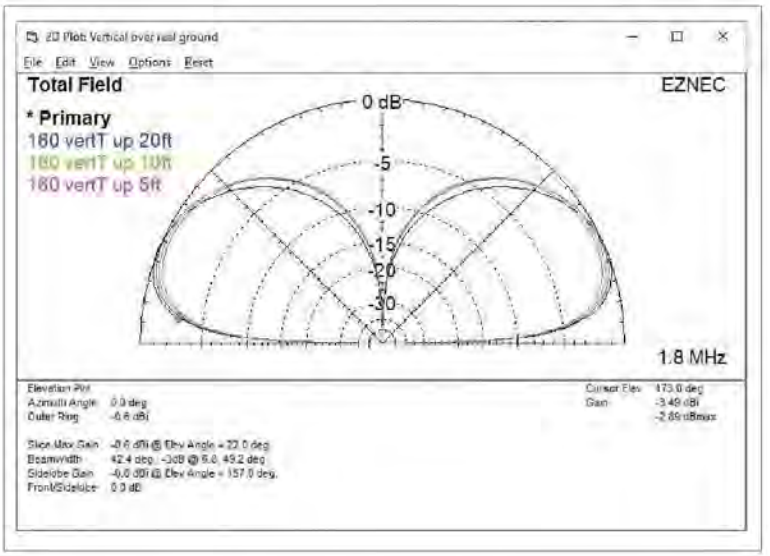


Figure 3 — An *EZNEC* plot of a short 160-meter vertical with elevated radials without a forest. Higher radials slightly improve the performance.

Table 1
Attenuation Due to the Forest

Elevation Angle, Deg.	Forest-Induced Attenuation, dB
35	0.0
30	1.2
25	2.5
20	4.2
15	6.0
10	7.5

For comparison, Jim Peterson modeled a short 160-meter vertical antenna with a capacity hat fed against two elevated radials at four heights (5, 10, 20, and 40 feet) above average ground. Figure 3 shows Jim's *EZNEC* (**www.eznec.com**) results. The black curve labeled **PRIMARY** corresponds to a 40-foot radial height.

Not surprisingly, higher radials work better. The shapes of the *EZNEC* patterns match the shape of the "no forest" curve in Figure 2. The gain is less because the antenna is a short vertical having two radials, whereas Figure 2 is for a quarter-wave vertical antenna and 16 elevated quarter-wave radials.

Table 1 shows the reduction in antenna gain in the forest as compared to open air, as found in Figure 2. This data is specific to the vertical antenna and forest under study. The data does not apply to antennas generally, although similar results are expected for other vertical antennas.

Final Comments

The forest in this study is a 90-foot tall, dense pine forest with medium moisture content. In a future study, I plan to examine what happens if the forest is taller (redwood trees) or shorter (oaks and poplars). The effect of forests on other kinds of antennas will be studied as well. It seems I have discovered yet another way to make an NVIS antenna system — plant trees around a vertical antenna and wait 30 years! The real conclusion is that one can model a forest, not as a collection of individual trees, but as a dielectric medium, provided the forest is of uniform composition and trees are closely spaced compared to a wavelength.

Acknowledgments

I am grateful to many individuals for discussions and ideas that contributed to this article. In particular, I wish to thank Jim Peterson, K6EI, for stimulating my interest in the forest problem, and Tom Schiller, N6BT, for discussions on verticals, pattern measurements, and the effects of irregular terrain shape (bumpy ground like hills, valleys, slopes).

Notes

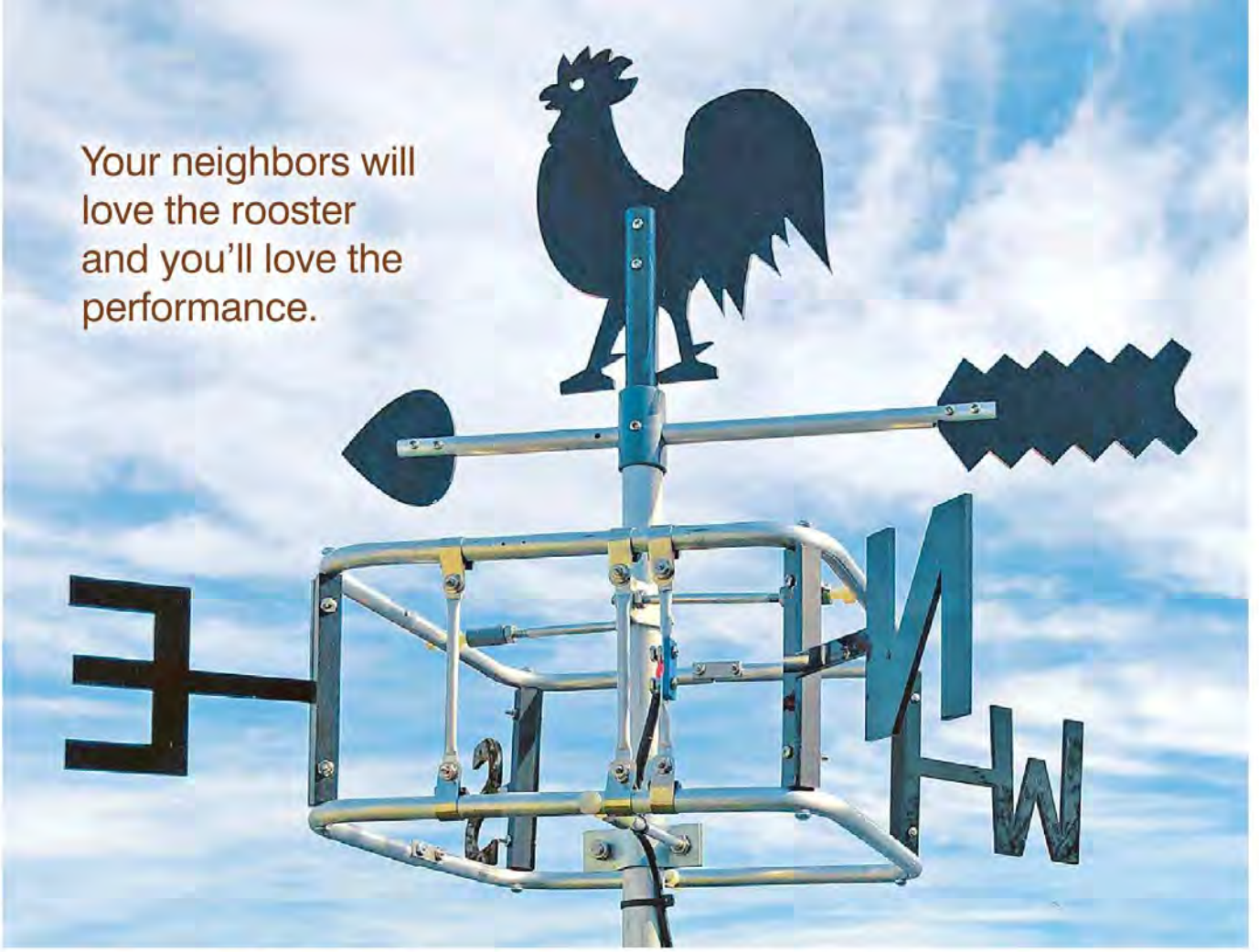
[1]S. Stearns, K6OIK, "Antennas: The Story from Physics to Computational Electromagnetics," presented at *Pacificon Antenna Seminar*, Oct. 19 – 21, 2018, slides 72 – 81.
[2]R. E. Diaz; W. M. Merrill, and N. G. Alexopoulos, "Analytic Framework for the Modeling of Effective Media," *Journal of Applied Physics*, vol. 84, no. 12, Dec. 1998, pp. 6815 – 6826.
[3]D. Tomasanis, "Effective Dielectric Constants of Foliage Media," *RADC* TR-90-157, ADA226296, Arcon Corp., July 1990, Figures 42 and 43.

Steve Stearns, K6OIK, got started in ham radio at the height of the Heathkit era, while he was in high school. Steve holds an Amateur Extra-class license and a commercial General Radio Operator License (previously, the First Class Radiotelephone License) with radar endorsement. Steve studied electrical engineering at California State University, Fullerton; the University of Southern California, and Stanford, specializing in electromagnetics, communication engineering, and signal processing.

Steve was a Technical Fellow of Northrop Grumman Corporation before his retirement. He worked at Northrop Grumman's Electromagnetic Systems Laboratory in San Jose, California, where he led the development of advanced communication signal processing systems, circuits, antennas, and electromagnetic devices. Steve is Vice President of the Foothills Amateur Radio Society, and served previously as Assistant Director of ARRL's Pacific Division under Jim Maxwell, W6CF (SK). He has over 80 professional publications and 10 patents. Steve has received numerous awards for professional and community volunteer activities. You can contact Steve at **k6oik@arrl.net**.

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The Rooster-Tenna – A 2-Meter Weathervane Antenna

John Portune, W6NBC

Weathervanes are great for making an antenna look like it belongs on a rooftop to avoid receiving complaints. For instance, my weathervane just happens to also be a high-performance 2-meter antenna (see the lead photo). A Rooster-Tenna is a great disguise.

In the August 2005 issue of *QST*, I presented an earlier rooster-vane antenna. This new version is much improved. The antenna is now a wide-spaced, parallel-fed horizontal folded dipole bent into a flattened cube. Technically, it is a skeleton slot. It's built around two horizontal square aluminum tubing rings, 11½ inches on a side, separated by 5½ inches (center-to-center), and electrically connected by three vertical interconnect sections.

The rings are bent from rigid ½-inch OD aluminum tubing. Hardware-store soft copper or aluminum tubing is not as durable. Local metals dealers, **DXengineering.com**, **metalsdepot.com**, and **onlinemetals.com** all stock it. At the corners, the rings are held apart by four ½ × 5 inch square acrylic posts, which also mount the vane's N-S-E-W letters. The posts are tapped lengthwise for 10-24 screws through the rings. The mast is 1-inch thin-wall (.063-inch) aluminum tubing. Only the size and spacing of the rings need to be what is shown in Figure 1. The other dimensions are just suggestions. Table 1 shows the list of materials.

The vertical sections that connect the rings are made from ¼-inch soft aluminum tubing. The plain ones, left and center in Figure 2, are the ends of the folded dipole. You adjust the antenna-matching SWR by moving the vertical section on the right, the one that contains the feed point. Adjust the operating frequency by moving the section on the left.

Performance

Figure 3 shows that the antenna SWR is less than 2.5:1 across the entire 2-meter band. Figure 4 shows the free-space *EZNEC* elevation, azimuth, and 3D radiation patterns with gains in dBi. For a comparison, a half-wavelength vertical dipole or J-pole has an azimuth gain of roughly 2.1 dBi. The Rooster-Tenna is more nearly isotropic, so it has only a little less horizontal gain but higher overhead gain, which can be useful for satellite work. The antenna is omnidirectional in azimuth, and as a horizontal slot, it is vertically polarized — best for accessing repeaters and mobile stations.

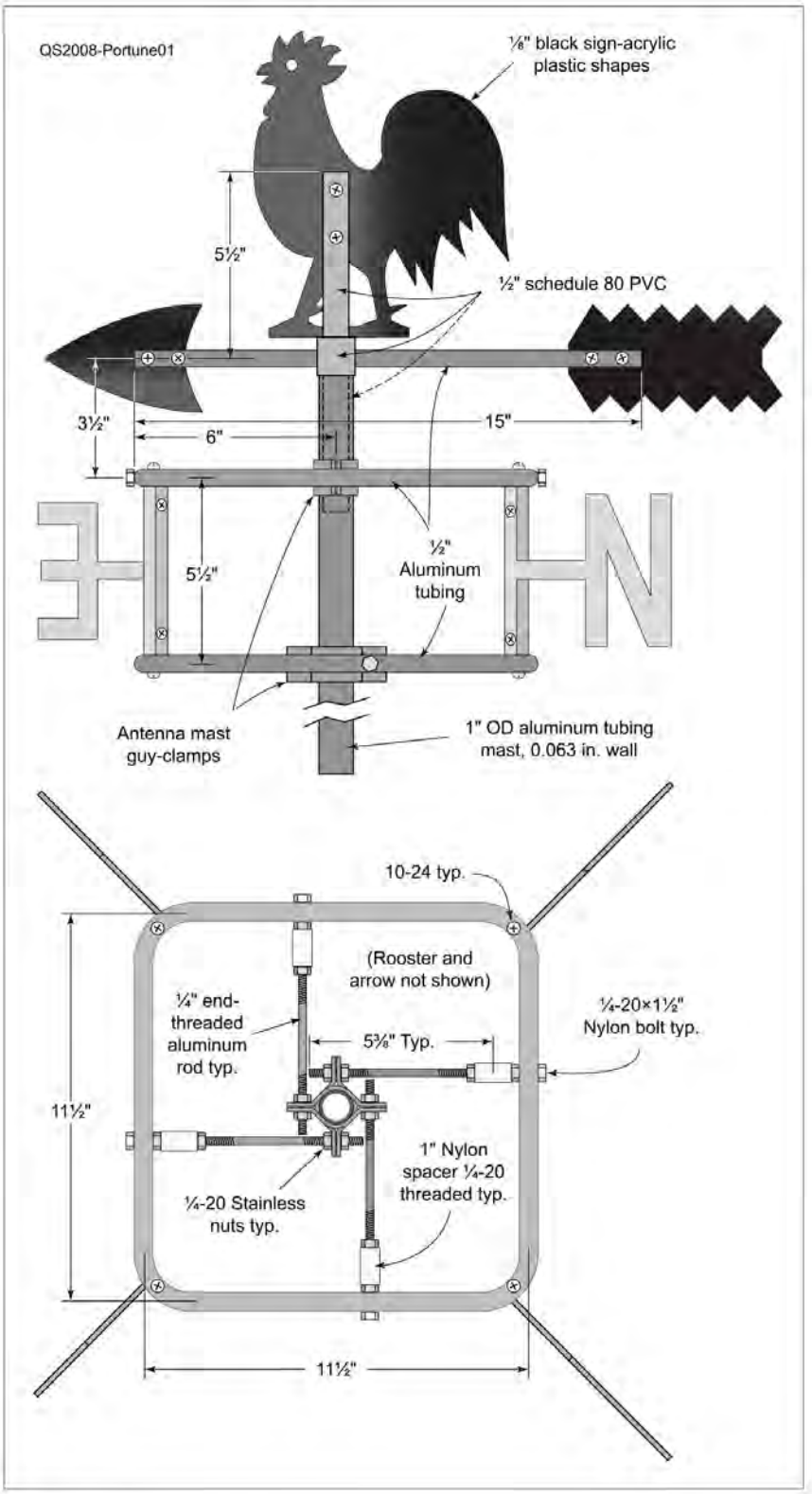


Figure 1 — Essential details.

Mounting

Four ¼-inch partly threaded aluminum rods — two for each ring at 90 degrees — mount the antenna on the mast. The rods attach to the mast by two nuts at the ends of common TV-type antenna guy-cable clamps, available from **RadioShack.com** online, catalog number 1500335, and many local electronics parts stores. One-inch threaded nylon spacers and nylon bolts insulate the rods from the antenna rings. You will need to thread 1½-inch and 1-inch



Figure 2 — Vertical interconnect sections, the frequency adjustment at left, and the SWR adjustment at the feed point at right.

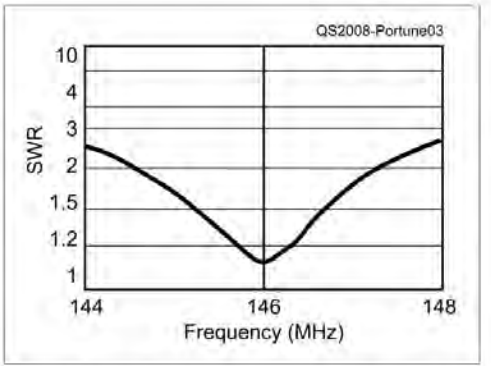


Figure 3 — The SWR from 144 to 148 MHz, measured with a RigExpert A1400.

Rubber-insulated stainless-steel cable clamps provide an easy way to attach the vertical sections to the antenna rings.

Table 1: Materials

Item	Source
10 feet of rigid ½-inch OD aluminum tubing	Local or online metals dealer
18 inches of ¼-inch soft aluminum tubing	Hardware source
Mast: 1-inch OD thin-wall (.063-inch) aluminum tubing	Online antenna tubing supplier
TV antenna guy-cable mast clamps (2 count)	TV antenna hardware source
6-foot coax pigtail with connector	Electronics source
6-32 stainless-steel screws and nuts	Hardware source
10-24 stainless-steel screws	Hardware source
¼-20 stainless-steel hex nuts	Hardware source
¼-20 nylon bolts and nuts	Hardware source
1-inch nylon spaces, ¼-20 threaded	Hardware source
Plastic parts	Craft store or sign-making shop, and 3D printer files at **arrl.org/qst-in-depth**
20 inches of ½-inch-square acrylic or other plastic rod	Internet plastics source
30 inches of ¼-inch aluminum rod	Bicycle safety flag mast
Tie-wraps (UV stable variety)	Hardware/electronics source
1:1 choke balun, ferrite, or coax	Hardware/electronics store, and 3D printer files at **arrl.org/qst-in-depth**
⅜-inch stainless-steel cable clamps (6 count)	Hardware/electronics store

of the rod ends, respectively, with ¼-20 threads. I used an inexpensive common hardware-store threading die. Aluminum all-thread rod may also be used.

The Rotating Rooster and Arrow

The top assembly, with the rotating directional arrow and rooster, is a separate unit that turns inside the 1-inch thin-wall (.063-inch) aluminum tubing mast. The inside diameter of the mast is a close fit for the ½-inch PVC water pipe that mounts the rooster and arrow. White Schedule 40 PVC is acceptable; grey Schedule 80 PVC is stronger and less visible.

Cement the upper and lower PVC pipe sections into a ½-inch, PVC coupling and drill a ½-inch through-hole from the side for the arrow. A second 6-32 screw and nut at 90 degrees secures the arrow. The bottom PVC pipe section should be roughly 12 inches long so that the top assembly will stay in the mast under high wind conditions. Cut a ⅛-inch slot in the top end of the top pipe for mounting the rooster, using 6-32 screws and nuts. Do the same in the ends of the arrow shaft for the arrowhead and feathers. Use stainless-steel or brass fasteners throughout this project.

Making the Antenna Rings

I used a tubing bender (see Figure 5) available on **amazon.com** that makes precise 1½-inch-radius bends in ½-inch tubing. This tool has proven handy for several new antenna designs. Similar models are

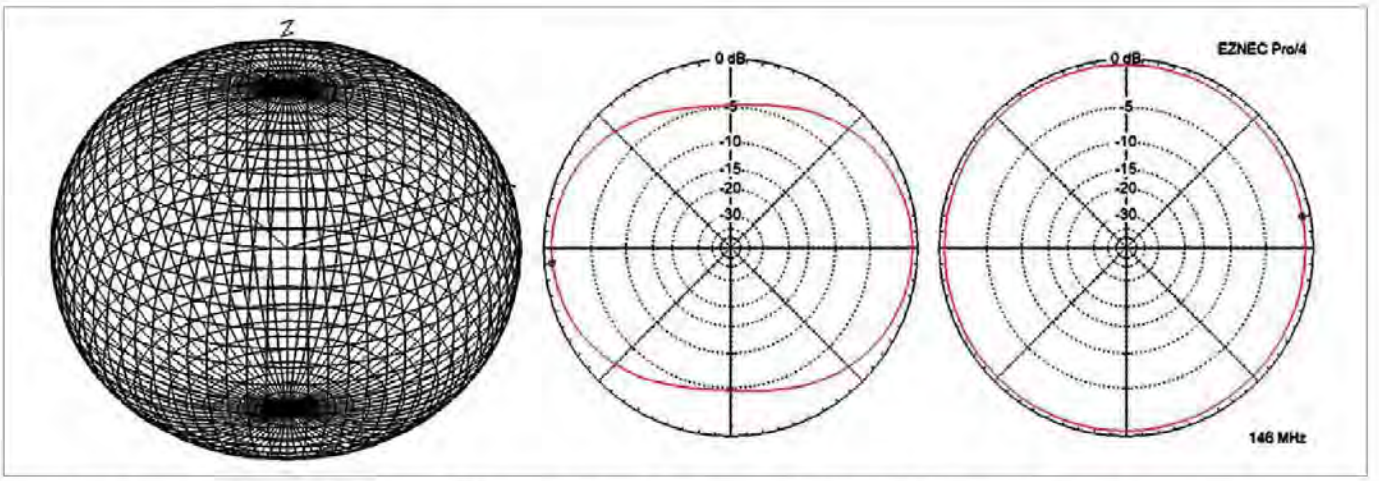


Figure 4 — From left to right is a free-space 3D radiation pattern, vertical elevation pattern, and horizontal azimuth pattern. The gains are in dBi.

available for other tubing sizes. A less-expensive method, suitable for soft aluminum tubing, is to use bending springs. They are readily available on the internet and from local hardware stores. A short length of larger-diameter pipe, held in a vise, provides a bending mandrill for use with the springs.

Alternately, you may make the rings as four separate straight sections. Flatten the ends and drill holes for 10-24 screws, ⅜ inch from the ends. The screws that attach the acrylic posts and N-S-E-W letters will now connect the four ring sections together. The rings should be 11½ inches on a side, tubing measured center to center. The tubing ends should meet in the middle of one of the ring sides. Connect the ends with a short metal link or heavy wire, secured by screws and nuts.

Making the Interconnect Sections

Cut three 4¾-inch lengths of ¼-inch soft aluminum tubing (see Figure 6). Flatten ¾ inch at both ends. Be careful to flatten the ends in the same plane. Then drill 9⁄64-inch holes ⅜ inch from the ends for 6-32 screws.



Figure 5 — A half-inch tubing bender for 3-inch radius bends.

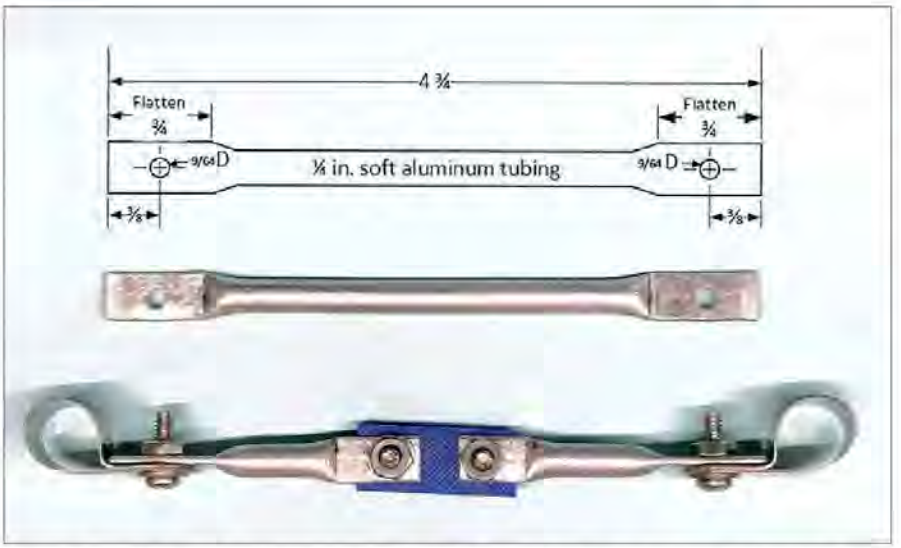


Figure 6 — Vertical interconnect sections. The lower section is shown with clamps. Note the plastic insulator in the lower feed point section.

Next, remove ⅜ inch from the middle of one of the sections for the feed point and flatten the ends. Fabricate a small plastic insulator for the gap and secure it with 6-32 screws and nuts. These screws become the connection terminals for the feed coax.

Rubber-insulated stainless-steel cable clamps provide an easy way to attach the vertical sections to the antenna rings. They also permit adjustment of tuning and matching. Online sources, as well as many local electronic parts stores, offer these clamps. They are, however, a little large to create a good connection to the rings. Therefore, leave roughly ⅜ inch of the rubber insulation on the clamp to ensure a tight connection.

Plastic Antenna Hardware

If you have access to a 3D printer, a complete set of .stl files for printed plastic parts is on the *QST* in Depth web page at **www.arrl.org/qst-in-depth**. ASA filament is best for its UV resistance. The antenna uses conventional home workshop construction methods and materials. Templates for hand cutting the plastic parts are also available on the *QST* in Depth web page, along with *AutoCAD* .dwg files. From these files, a local sign-making shop was able to laser cut the letters, rooster, and arrow parts at a modest cost. Sign acrylic plastic is an excellent material, as it is nearly totally impervious to the UV in sunlight.

Alternately, ready-cut acrylic letters are available on the internet as well as from some craft stores. A further possibility is to cut the shapes from the flat sides of a large rectangular plastic trash can. These are generally made of heavy polyethylene plastic, which is also UV resistant and easily cut with tin snips.

Feed Coax and Balun

For the feed point, separate roughly 2 inches of the center conductor and braid of a 6-foot-long RG-58 or Mini-8 coax pigtail. Weatherproof the ends with heat-shrink tubing. Crimp on #6 ring terminals for the feed point screws. Add a connecter at the other end. Beyond the pigtail, it is best to use larger coax to avoid the high loss of small-diameter coax at VHF.

You should provide the antenna with a 1:1 current choke balun. It



Figure 7 — 3D-printed quick-form for a VHF balun using RG-58 or Mini-8 coax.

may be a small stack of VHF mix ferrite beads on the coax pigtail or a small 4 – 6 turn coil wound with the coax of the pigtail, bundled and secured with zip-ties. Attach the balun to the mast with zip-ties just below the antenna. Included also for 3D printing is a quick-form for a coax balun using small-diameter coax (see Figure 7).

Tuning and Matching

Begin adjustment with the feed point section roughly 1 inch from the middle section and the other roughly 6 inches away. The three sections may also be moved as a group, if required during tuning. For better stealth, the feed point section is best placed near one of the fiberglass supporting rods on the bottom ring. Zip-tie the coax to the rod and main mast.

Adjust the SWR first using an antenna bridge or analyzer. Once the SWR is low, it will change only a little when the frequency is adjusted. Therefore, pay no attention to frequency until you obtain a low SWR. Fine tune both with the antenna mounted in its permanent operating location.

When neighbors or homeowners associations first see this attractive antenna, they are not likely to notice it or see it as unwelcome.

John Portune, W6NBC, is an ARRL member and frequent contributor to *QST*. He has been licensed for 54 years and has held an Amateur Extra-class license since 1972. John has a BS in physics and also holds an FCC Commercial General Radiotelephone Operator license and an FCC Radiotelegraph license. He retired as a broadcast television engineer and technical instructor at KNBC in Burbank and then from Sony Electronics in San Jose, California. You can reach John at **jportune@aol.com** or through his website at **www.w6nbc.com**.

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

- Gene Marcus, W3PM/GM4YRE, builds a project that includes a two-channel VFO, WSPR source, frequency counter, and a clock.
- Steve Franke, K9AN; Bill Somerville, G4WJS, and Joe Taylor, K1JT, describe the FT4 and FT8 digital modes implemented in *WSJT-X*.
- Steve Stearns, K6OIK, explores general uniform transmission lines that have complex characteristic impedance and propagation constant.
- Eric Nichols, KL7AJ, presents Part 2 of his series on double-balanced mixers.
- *QEX* introduces a series of essays on electrical engineering by Eric Nichols, KL7AJ.

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

Product Review

Butane-Powered Soldering Tools

Reviewed by Paul Danzer, N1II
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I have owned an inexpensive RadioShack butane-powered soldering torch for more than 10 years. Mostly, I use it to solder wire antenna connections when it's inconvenient to bring the wire close enough to my home to use a corded electric soldering iron. This review features four butane-powered soldering tools that range in cost from about $25 to $100. These irons all proved useful for soldering tasks inside my station as well as outdoors.



Weller PSI100K Butane Soldering Iron Kit

Let's start with the most expensive unit. The Weller PSI100K comes as a kit in a plastic storage box, and it includes a variety of tips (see Figure 1). There's a ⅛-inch tip for electronic soldering, a larger chisel tip, and a very large 5⁄16-inch-wide tip, which is labeled in the instructions as a cutting tip. Our kit also included a curved hot air deflector tip, although I didn't see this tip included with some of the PSI100K kits currently offered online. Our kit also came with a small metal can with a sponge for cleaning the tip, as well as a protective cover. The 7.2-ounce main body is approximately 3.7 × 11.7 × 1.9 inches. According to Weller, the temperature is adjustable up to 1,076 °F and up to 125 W of power.



Figure 1 — The Weller PSI100K butane soldering kit.

As with all of the tools in this review, butane must be purchased separately. Insert the butane can nozzle into the exposed port on the bottom of the handle, and fill until the observation window near the port shows liquid butane (you won't see it until the reservoir is just about full). If you overfill, some butane liquid will spill out near the port. The online description states that an automatic safety shutoff and butane fuel filter are built in, but the instructions don't elaborate on these features.

To change the tip, unscrew the black retaining nut and the sleeve, and insert the selected tip. Reassembly takes only a few seconds — assuming you are working with a cold iron. To use the iron, first turn the bottom knob counterclockwise (the plus sign indicates full gas flow). Press the igniter button to start the torch. A wire bale swings down to act as a stand. I didn't think the bale put the hot tip far enough from my bench, so I rested the iron in a glass ashtray.



Figure 2 — The Weller PSI100K with the largest tip easily soldered #12 AWG antenna wire.

The three included tips handle a variety of soldering tasks. The smallest tip worked well with PC boards. After a warm-up period of about 1 minute, I used the largest tip to solder the antenna wire shown in Figure 2.

Weller's website offers several short videos on soldering iron selection, maintenance, and usage. If you are new to soldering, you may find some of this material helpful.

Manufacturer: Weller, **www.weller-tools.com**. Price: $100.

Dremel 2000-01 Versa Flame Butane Torch

Dremel's butane-powered multipurpose torch comes as a full kit with a metal storage box (see Figure 3). It's similar to the Weller kit, but the typical selling price is substantially lower. The Dremel kit includes a number of accessory tips for soldering, cutting, heat-shrink tubing, and other applications. Two miniature wrenches are supplied to mount the tips, but I found them to be slightly too small and used pliers instead.

The kit also includes a sponge in a metal can for cleaning the tip, along with a small roll of solder. Finally, a cover is included to protect the iron when not in use and not in the case. The tool is about 9 inches long, 1 inch in diameter, and weighs about 4 ounces. The brief instruction pamphlet includes operating information and explanations for using the supplied accessory tips.

The torch is filled with butane from a port on its bottom. There are two blue buttons on the tool body, to the left of the Dremel label. The button on the right controls the gas supply — rotate it up for maximum heat. The button on the left locks the gas supply on during use.

On the top of the unit, there is something that looks like a rotary thumbwheel, but it doesn't rotate. This controls the igniter. To light the tool, use your thumb to pull back the igniter control and then let it swing forward. This turns on the gas and ignites it; with your other hand, push the left-hand blue button down to lock on the flame. This is actually easier to do than to describe, and the instruction sheet includes three small diagrams to illustrate the procedure. I found



Figure 3 — The Dremel Versa Tip butane soldering kit.

that after doing it once or twice, I had no problem igniting the torch, as long as I remembered to engage the lock button to keep the gas flowing.

The time needed to heat the tip to melt solder varied and was typically about 20 seconds. Once the solder tip is hot, you have the equivalent of a standard bench soldering iron, probably in the vicinity of 40 to 70 W. The small conical tip is thin enough to be used on most PC boards and worked well with standard components.

The hot air and deflector tips can be used to apply heat-shrink tubing. They both worked, but be careful to apply only the heat needed to shrink the tubing, not melt it. I used the cutting knife tip to remove the jacket and dielectric insulation from coaxial cable without nicking the braid or center conductor. A word of caution: after making a cut, allow the coax to cool

for a few seconds to prevent stray wires from the braid from sticking to the cut surfaces.

Using the Dremel soldering tool and the heaviest tip, I was able to install a PL-259 with UG-175 adapter on a piece of RG-58. There was enough heat to melt the solder and have it flow neatly into each of the holes to the exposed braid if I worked on one hole at a time. This tool will not replace your 100 W electric iron with a massive tip, but it is certainly usable for installing PL-259s if an electrical outlet is not available.

Manufacturer: Dremel, **www.dremel.com**. Price: $38.

Iso-Tip SolderPro 50 Butane Soldering Iron

This very basic tool resembles my old RadioShack iron and was the least expensive of this group. I spotted a number of identical-looking units with different brand names, at prices ranging from less than $20 to almost $100. The SolderPro 50 comes with a single 1-millimeter pointed soldering tip (see Figure 4). Other replaceable tips available at extra cost include a larger conical tip, several chisel tips, a hot knife tip, a torch tip, a heat blower, and a deflector tip. I tested only the included soldering tip.

A plastic cap (not shown) protects the tip and heat chamber and includes a flint igniter assembly. Spin the wheel and a spark ignites the gas. If the gas does not appear to ignite with one spin, wait 5 or 10 seconds and see if the tip is getting hot before you try a second spin. Occasionally the butane ignites, but you just don't see it.

Hold the tool upside down to fill the butane reservoir. The transparent window on the end of the handle makes it easy to see the fill level. The SolderPro 50 has a gas flow control; push it all the way up for maximum heat. The manufacturer claims the iron is the equivalent of a 30 to 70 W iron, with a tip temperature of 410 to 750 °F. The time from ignition to use is specified as 20 seconds. In practice, once I ignited the iron, the tip was more than hot enough to melt the solder by the time I unrolled a length to use.



Figure 4 — The Iso-Tip SolderPro 50.



Figure 5 — Soldering a PC board with the SolderPro 50. Any of the units reviewed here do a fine job soldering PC boards and standard electronic components.

The unit is quite small, approximately 5.5 inches long with a maximum handle diameter of 1 inch. It weighs a bit over 2 ounces. The wire bale can be folded down and used as a holder, but I preferred to rest the tool on a glass ashtray.

The included tip size was fine for soldering small pads on a PC board with components such as ¼ W resistors and a 14-pin DIP integrated circuit (see Figure 5). I also tried soldering a PL-259 connector on RG-213 coaxial cable. I was able to tin the braid, but not solder the braid to the connector. The solder would melt, but there was not enough heat to make the solder flow evenly and fill the holes that expose the braid.

Manufacturer: Iso-Tip, **www.iso-tip.com**. Price: $26.

Bernz-O-Matic ST2200T Micro Flame Butane Torch Kit

This butane-powered torch (see Figure 6) resembles a soldering gun rather than a small soldering iron. It is approximately 3 × 6.5 × 9.5 inches and weighs about 6.5 ounces. The soldering tip assembly slides onto the torch body and is secured with a screw and clamp. Without the soldering tip assembly, you can use the tool as a miniature blowtorch for applications requiring direct flame heating.

I needed two hands to start the unit. Pressing the blue button on the right end turns on the gas and keys the igniter. You must also slide down a safety catch (just below the blue button, not visible in the photo). There are two basic modes — continuous and intermittent. For the intermittent mode, you have to keep the blue button depressed; releasing it shuts off the gas. In the continuous mode, start the unit, keep the blue button depressed, and press the locking control. Occasionally, it took two or three tries to ignite the unit. The time to heat up enough to melt the solder varied between about 10 seconds and 30 seconds. (Repeated testing did not give me any clues about the inconsistent warm-up times.)

Once the tool is running, slide the air adjustment button on top of the unit, so that the visible flame disappears. A gas control on the side of the unit (not shown) can be used to reduce the heat if needed. At this point, you are ready to solder.

The included tip is a good size for soldering on small PC boards. I didn't see any other accessory tips listed in the instructions or on the Bernz-O-Matic website. Typically a gun-shaped iron is not used for small soldering jobs on a PC board, and it took some practice to become comfortable with it. I was able to solder twisted antenna wire quickly, but the tool and supplied tip could not provide enough heat to solder a PL-259 body to the shield of RG-213.

Manufacturer: Worthington Industries, **www.bernzomatic.com**. Price: $30.



Figure 6 — The Bernz-O-Matic ST2200T.

In Summary

With the smallest supplied tips, all four tools reviewed here are very good for soldering PC boards and typical electronic components (although the form factor of the Bernz-O-Matic took some getting used to, as mentioned earlier). All of the units tested will solder together two pieces of #12 AWG stranded antenna wire.

Some of the units had temperature specifications for the butane flame. This specification did not seem to be very important; the most important thing for soldering PL-259 connectors was the mass of the tip. Any of the tips get hot enough to melt solder, but when the tip touches the work, the heat is carried away. A small tip loses temperature quickly, and a tip with more mass retains more heat and, therefore, is more likely to be useful for soldering larger objects.

I found that different hand and finger agility is required to ignite each unit. The simplest is the Iso-Tip SolderPro 50 with its separate flint lighter. The others have electronic ignition sequences that may be a convenience to you, or may present an agility problem.

Additional photos of the tools featured in this review are available online from **www.arrl.org/qst-in-depth**.

Hy Power Antenna Company TRI1020 Triband Dipole

Reviewed by Steve Ford, WB8IMY
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The Hy Power TRI1020 is a version of the venerable "fan" dipole antenna. In a fan dipole, several separate dipole antennas are connected at the same central feed point. The legs of the antennas are arranged in parallel, or they may be arrayed orthogonally. Each dipole presents an impedance reasonably close to 50 Ω (actually about 75 Ω) for only the frequency at which it is resonant.

The TRI1020 uses the parallel design, stacking three separate dipoles for 20, 15, and 10 meters. The legs of the dipoles are separated by PVC tubes placed along the legs at either side of the feed point. The feed point itself is another PVC tube with an SO-239 connector for attaching the coaxial feed line (see Figures 7 and 8).

Installation

The TRI1020 is 34 feet long and arrives fully assembled in a surprisingly small box. Your first task is to remove the antenna from the box, cut the twist ties, and unwind the wires. One of the best pieces of advice in the instruction sheet is to tie temporary lines to the end insulators and elevate the antenna about 5 feet above the ground. This makes it much easier to work your way along each leg of the antenna as you straighten the insulated wires and adjust the spreaders.

You'll notice the light gray coloring of the wires and the spreaders. This color scheme makes the TRI1020 blend in more easily with its surroundings, particularly when viewed against the sky. In my test installation, it blended so well with my trees and the overcast sky that obtaining a decent photograph of the entire antenna was impossible. As a result, the accompanying photos were taken when I was straightening the wires near the ground.

Bottom Line

The Hy Power TRI1020 triband dipole works on 20, 15, and 10 meters with a single feed line and arrives assembled and ready to use.



Figure 7 — The legs of the individual dipoles are separated by gray PVC tubes. When setting up the antenna near ground level, you can easily slide the tubes along the wires to achieve consistent spacing.



Figure 8 — The feed point of the TRI1020 dipole antenna.

I installed the TRI1020 between two tree limbs at a height of about 30 feet. You can also install it as an inverted-V antenna if you have only one support.

The individual antennas are designed to present their lowest SWR at the bottom of each band. This makes adjusting the antennas for a frequency higher in the band a matter of simply pulling a couple of inches of wire through the insulators at both ends and wrapping the wire back along the legs. This way, if you change your mind and wish to lower the resonant frequency, you just unwrap the wire.

In my case, no adjustments were necessary because I do most of my operating in the lower-frequency portions of the bands. When I swept the TRI1020 with an antenna analyzer, I was pleased to see 1.2:1 SWR at the lower portions of 20 and 15 meters, rising to about 2:1 at the upper edges of the bands. The

low-SWR point on 10 meters was 1.4:1 at about 28.200 MHz, and it rose to 2:1 at about 28.500 MHz.

On the Air

Although TRI1020 is rated for 1,500 W continuous power, for my tests, I ran just 100 W during the EA RTTY contest in early April. The antenna performed as you'd expect for a dipole, but the convenience of being able to hop from 20 to 15 to 10 meters without having to use an antenna switch was a nice bonus.

Manufacturer: Hy Power Antenna Company, 1843 Renwick St., Bethlehem, PA 18017; **www.hypowerantenna.com**. Price: $71.50, plus $20 shipping and handling.

AlexLoop Premier 40 – 10 Meter Magnetic Loop Antenna with AlexTune

Reviewed by Bob Allison, WB1GCM
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When presented with a majestic view from high atop a Nantucket Island widow's walk, I realized there were no antenna supports on the mid-19th century rooftop structure. I would need a self-supporting antenna system, such as the AlexLoop Premier, a portable magnetic loop antenna with an integrated tuning indicator.



Flexible Setup Options

The AlexLoop Premier can be quickly set up at the beach, in a park, or on a back porch in an antenna-restricted neighborhood. Like the original loop, the AlexLoop Premier is designed for low-power, portable use on 40 through 10 meters. It's rated at 20 W PEP for SSB and CW use, and 10 W for continuous-duty modes, such as FT8, RTTY, or AM/FM voice.

For portability, the loop is made from flexible RG-8 size coaxial cable. With a loop diameter of about 3 feet, the antenna can be used on any

Bottom Line

The AlexLoop Premier is ideal for portable operation in just about any location on 40 through 10 meters. The tuning indicator is simple and effective.



Figure 9 — The AlexLoop Premier tuning unit, with its built-in AlexTune LED tuning indicator in the top-left corner.

Table 1
AlexLoop Bandwidth Without Retuning

Band (meters)	Bandwidth (kHz)	Lowest SWR
40	12	1.7:1
30	23	1.5:1
20	35	1.0:1
17	65	1.0:1
15	75	1.0:1
12	100	1.5:1
10	75	1.9:1

frequency from 6.95 to 30 MHz. Low-loss gold-plated SO-239 and PL-259 type connectors are used at the loop ends and at the manually operated tuning unit to minimize loss. The antenna includes an 8.5-foot-long feed line made from RG-58 type coax. One end is hardwired to the 6-inch-diameter driven loop, and the other end is fitted with a BNC connector for connection to the transceiver.

Three 1.3-foot sections of 1-inch-diameter plastic pipe slide together to provide structural support for the main loop, driven loop, and tuning unit. The antenna is quickly assembled/disassembled and stores neatly in a 16.1 × 10.6 × 3.5 inch carrying bag. At a mere 3.3 pounds, the AlexLoop Premier lends itself to portable operation.

Setup takes only a couple of minutes. The assembled antenna can be handheld, mounted on a user-supplied tripod, or clamped to a balcony railing or other support. Be sure to tether the antenna if it is mounted in a precarious spot, as it will catch the wind. I already own a suitable tripod that accepts the 1-inch-diameter PVC pipe mount. With the tripod, the AlexLoop Premier, and my Elecraft KX2 portable HF transceiver with built-in batteries, I headed off to our backyard picnic table.

Setting Up

In a matter of moments after arriving at my portable operating spot, I had the antenna set up and was tuning the bands. I quickly learned that the bandwidth of the AlexLoop Premier is rather narrow, with careful tuning required (typical of very small magnetic loop antennas). To tune the antenna, I listen carefuly to the background noise level and slowly turn the tuning knob until there is a dramatic increase in noise. Once the background noise is peaked, I make a short carrier transmission (CW or AM) and further adjust the loop tuning for peak LED brightness on the built-in AlexTune LED as the loop reaches resonance (see Figure 9). I found it easier to see peak brighness when tuning with 1.5 to 5 W applied. At my transciever's highest ouput — 10 W — the LED lights brilliantly and is too bright to see the precise point of resonance.

With the loop tuned, I heard plenty of signals on the band. The loop is bidirectional, with maximum signal strength in the plane of the loop and nulls broadside to the loop. It's worth experimenting with loop orientation to peak signals from the desired direction. This characteristic also makes the antenna useful for finding the general direction of a noise or interference source, or locating a hidden transmitter at a club outing. (Use of a variable attenuator is required to reduce signal levels to hear the null when close to a hidden transmitter.)

On the Air

The narrow bandwidth of the AlexLoop Premier becomes obvious when tuning the transceiver dial — background noise drops quickly while tuning away from the resonant frequency. The loop must be retuned unless frequency changes are small. Some quick measurement with an antenna analyzer determined the 2:1 SWR bandwidth on each band without retuning the loop, as shown in Table 1. Operation on 12 meters is notable because it is possible to operate with a 2:1 or lower SWR without additional tuning

adjustments. I also observed that tuning wasn't as sharp on 10 meters as on other bands. I suspect that is because the loop element is more than than a quarter wavelength on 10 meters, compared to less than one-tenth of a wavelength on 40 meters.

While using the AlexLoop Premier, I disabled my transceiver's internal automatic antenna tuner and used the tuning procedure described above. The built-in AlexTune LED made it easy to fine-tune the antenna as I moved around the band. I did observe SWR fluctuations if the driven loop coax cable changed position on the main loop, and I solved this by using a short length of small-diameter rope to tie the driven loop tight to the base of the PVC loop support.

The antenna worked well outdoors, and I also used it indoors on the top floor of my house. As with all magnetic loop antennas, avoid placing the antenna near large metallic objects. I observed significant detuning if the loop rotated while within a few feet of an automobile, a window screen, or metal ductwork.

I compared the AlexLoop Premier to my station's 20-, 15-, and 10-meter elevated vertical, with three radials per band, up 25 feet. The only band that has been open on a regular basis has been 20 meters. Using an antenna switch for an A/B comparison, I observed that signal levels on 20 meters were typically three S-units stronger on the vertical than the loop, but the loop had a noticable signal-to-noise ratio improvement on weaker signals. I heard S-5 level signals with noise on the vertical and S-2 signals with a nearly quiet background with the loop. The fact that I could null out an unidentified manmade noise source in the neighborhood helped, and it also gave me an approximate bearing of its location.

The day's observations yielded much information about using the antenna. The next day, I was back at my backyard picnic table and made some contacts on 30 and 20 meters. On 40 meters, it was a bit harder to get answers from stations weaker than about S-7 on my transceiver. I did work another QRP enthusiast with an S-4 signal, though.

Unfortunately, 17 through 10 meters were dead and I couldn't raise any contacts there. On the other hand, W1AW is 21 miles to the west, and I could clearly hear W1AW at moderately strong signal levels on 40 through 15 meters. W1AW's 10-meter signal (100 W at the time) was weak but in the clear. Low-power and small portable antennas, such as the AlexLoop Premier, will be a lot more effective when sunspots return and high-band conditions improve.

All in all, I was very satisfied with the performance of the AlexLoop Premier. It is well made, stores away neatly in a closet, and assembles easily in the field. I would recommend using a sandbag on the tripod on windy days. It can tip over in a wind gust while atop a Nantucket widow's walk, or atop a backyard picnic table.

Manufacturer: Alexandre Grimberg, PY1AHD, **www.alexloop.com**. Available in the United States from DX Engineering (**www.dxengineering.com**), Ham Radio Outlet (**www.hamradio.com**), and GigaParts (**www.gigaparts.com**). Price: AlexLoop Premier with built-in AlexTune, $420.



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

The Doctor is In

For DX With a Low Antenna Height, Consider a Vertical

Q Quentin, KC7VOU, asks: From the little reading I have done on antennas, the height of the antenna seems to be the key. I want to try to transport my station on my motorcycle. I can carry a mast or pole system that will get the antenna 12 feet off the ground. I am trying to work 20 and 40 meters and stay within my budget. I have tried dipoles and inverted V antennas and, to date, my communications have been primarily regional, typically only a few states away. I am not sure if there was supposed to be a difference, but I didn't notice any. What's the best option for me?

A A horizontal antenna generally has a main lobe about 6 dB stronger than a vertical, but the horizontal lobe is at high angles until it is about ½ wave high (see Figures 1 to 3). That doesn't mean a low horizontal can't work DX, just that the signal will not be as strong as if it were higher, or from a vertical.

An inverted V, a ½-wave dipole with the center higher than the ends, will work about as well as a horizontal dipole 75% as high as the apex of the V. So, with a 12-foot support, the inverted V at 12 feet will work about as well as the dipole at a height of perhaps 9 – 10 feet (depending on the angle between the wires). That's on the ½-wave resonant frequency. On higher frequency bands, say a 40-meter dipole used on 15 meters, the vertical lobe will be higher than the horizontal dipole's, even at the lower height.

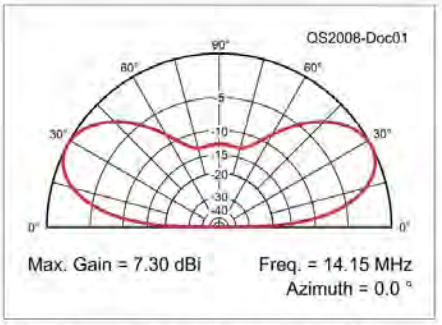


Figure 1 — The elevation pattern of a 20-meter horizontal dipole, ½-wave (34.7 feet) above medium ground (conductivity 0.005 S/m, dielectric constant 13) for reference. The intensity at an elevation angle of 10° is –3.3 dBi.

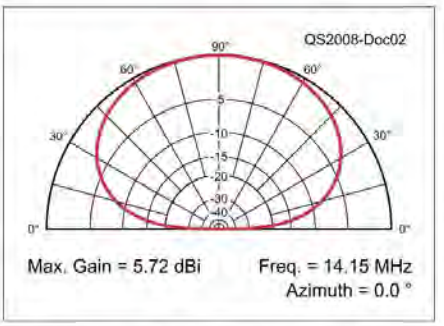


Figure 2 — The elevation pattern of the antenna from Figure 1 at a height of 12 feet above ground. The intensity at an elevation angle of 10° is –5.8 dBi.

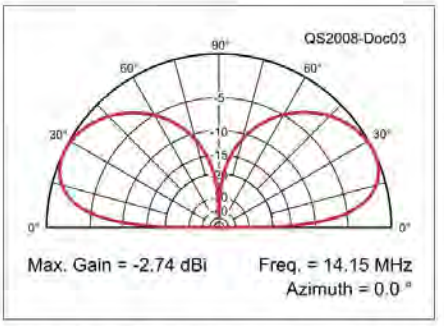


Figure 3 — The elevation pattern of a ¼-wave vertical monopole with 66 ¼-wave-long buried radials, 0.1 feet below the ground described for Figure 1. The intensity at an elevation angle of 10° is –5.5 dBi. While the pattern of this antenna is similar in shape to that of the ½-wave-high horizontal dipole, note that the peak gain is about 10 dB lower. Note also that the 10° intensity is 2.2 dB lower than that from the dipole at a height of a half wavelength, and just 0.3 dB higher than that from the low dipole patterned in Figure 2.

The issue with verticals is that base-fed ¼-wave monopoles require radials. For a portable situation, you will want to use a pair (minimum) of ¼-wave radials per band and they should be insulated and elevated at least 1 – 2 feet off the ground. That makes for a trip hazard if others are around.

If your 12-foot poles could stack to 24 feet, having parallel connected inverted Vs for 40 and 20 meters from the top will work a lot better (especially on 20 meters) than at 12 feet. The antennas can serve as the top guys, while another set at 12 feet will help keep things standing up straight. Both bands can be fed from a single coax — no tuner required.

A vertical monopole has an advantage over horizontal antennas because it doesn't require height to work well at low angles. I've worked all over the world from my mobile rig with a loaded vertical that was less than 12 feet off the ground. At low angles, it suffers about a 6 dB lower-level signal than a horizontal antenna at its optimal height, typically at least ½-wave above ground. Because you aren't going to get that high with your system, a vertical might be your best bet for long-range communication. A 24-foot vertical could be used on both bands with a tuner, but would still require those radials. It will do better for DX, but not as well within 1,000 miles or so. I'll bet you could rig a setup that could be configured either way and try it out to decide for yourself.

Q Bill, WA6SZE, asks: I have a three-element, 20-meter Yagi and a 40-meter shortened rotatable dipole that I would like to stack on a self-supporting tower at a height of 70 feet. How close a spacing between them is too close? I see other builders putting 40- and 20-meter antennas on the same boom. This suggests to me that stacking distance isn't critical. Can they work on the same boom?

A I modeled a half-length 40-meter dipole on the same boom as my *EZNEC* (**www.eznec.com**) model of a typical 20-meter, three-element Yagi. I located the dipole both halfway between the driven element and the reflector and halfway between the driven element and the director and found that neither had any noticeable effect on the gain, front-to-back ratio, nor the SWR of my 20-meter beam model, nor any degradation of the performance of the dipole.

Another consideration is the mechanical one — the added dipole will change the balance point of the Yagi, unless all the elements are moved to compensate. Otherwise, the added unbalanced weight will result in additional stress on the boom mounting arrangement. An alternative is to add the dipole as well as the rotator to the mast. I also modeled the dipole on the mast a foot above and below the Yagi. Both the Yagi and the dipole worked fine there as well.

I didn't check all possible locations for the 40-meter dipole, and I guess it could be different if it were a different length, or if your Yagi dimensions are very different than those of my model.

Q Craig, NA2TY, asks: A recent *QST* article described the use of spark plugs for lightning protection. I don't understand how the spark plug gap helps to secure the shack. Also, I'm not sure how important lightning protection is for safety. Is it a suggestion or a necessity?

A In general, spark gaps (including spark plugs) act like an insulator until a voltage threshold is reached — for the spark plug it might be 10 – 20 kV — at which point they fire and act like a conductor. The usual idea is to have such a gap between your antenna feed and ground, with a very short ground wire. If lightning strikes your antenna, the hope is that a large portion of the lightning current is shunted by the conducting gap to ground, thus helping to protect both the dwelling and equipment.

In my experience, there are four key issues with lightning protection devices:

1) That they fire when the threshold voltage is applied. Spark plugs should be okay here, but gas-filled tubes can be better, I believe.

2) That they *not* fire at voltages below the threshold. This may not be obvious, but there will be some power levels and SWR (line voltage can go up with the square root of SWR) at which they will fire when you key your transmitter, or they might fire on voice peaks. This will put a short on the output of your transmitter, with the result of possible damage to the radio. Although fold-back circuitry is designed to protect it, it may not respond fast enough. My concern with the exposed spark-plug tips is that while there is air in them, they may work fine, but I would think after a wasp builds a nest in the tip, the firing voltage will be reduced considerably. A real lightning arrestor will have a power and SWR rating at which it won't fire, and the gap is usually in a sealed module — even better if easily replaced.

3) Just as with parachutes, lightning arrestors can be tested, but once tested they need to be repacked and then the last test is no longer a good indicator of future performance. With spark gaps, there are only so many times they can fire before they no longer work. The actual number can vary with the intensity. Direct lightning strikes can be severe (90% of them result in a peak current of 200,000 A or less!), but indirect strike effects are much less intense, though much more likely in most circumstances. I don't get a lot of strikes here and my arrestors don't have replaceable gaps, but in retrospect, I think if I redo them, I would use types with replaceable gaps and replace them periodically, just on general principles.

4) In addition to protecting from lightning, many arrestors provide a dc path to ground to eliminate static buildup, which can result in a personal safety problem, particularly in dry climates. The spark plug doesn't do that, but adding a 1 MΩ resistor, or RF choke, across the plug will drain the static without bothering your signal.

Whether such protection is required depends on a number of factors:

- How likely it is that your antenna or nearby objects will be struck by lightning is often a function of your antenna height, as well as frequency of thunderstorms in your area.
- Whether or not you have taken other precautions. I recommend that every station be properly grounded and have some kind of lightning protection. In most cases, a properly designed lightning arrestor is part of a good station design.

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

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Steve Ford, WB8IMY, wb8imy@arrl.org

Eclectic Technology

Meet the Lixie

ARRL book author Glen Popiel, KW5GP, sent a tip that I suppose we might file in the "what's old is new again" category.

If you are of a certain age, you probably remember Nixie tubes. In the October 2019 issue of *QST*, we published an article by Joe Lynch, N6CL, titled "A New Look at an Old Technology," in which he described the history of these unusual devices. To me, a Nixie tube always looked like a tangled bundle of wires that someone had stuffed inside a vacuum tube. Its odd appearance notwithstanding, the Nixie could generate alphanumeric displays that were bright, easy to read, and capable of changing from one character to another very rapidly.

In the days before LED and LCD technologies, Nixies were the go-to solutions for compact displays. In the early 1970s, there were even a few amateur radio transceivers that used Nixies.



A single-digit Lixie display. In this view, you can see several of the acrylic panels that make up the display. [Glen Popiel, KW5GP, photo]

Introducing the Lixie

Hobbyists have resurrected Nixie for the 21st century with an edge-illuminated laser-etched acrylic panel version that they call the Lixie.

These are low-voltage devices that rely on illumination provided by bright LEDs. The LEDs are arranged in such a way that their light is directed lengthwise through the clear panels. The light travels in a straight line through the plastic until it strikes an engraved section or edge. When it does, it scatters and becomes visible.

To display numbers from 0 through 9, you need to create a sandwich comprised of 10 individual acrylic panels, each etched with a number. By using an Arduino or other microcontroller to activate rows of tiny LEDs along the edges of the panels, you can select the digit you want to display. According to Glen, the Arduino library even has a "Nixie" color mode to closely mimic the old orange Nixie.

Some hobbyists are making their own Lixies. Hackaday has a very good article with photos and videos at **hackaday.io/project/18633-lixie-an-led-alternative-to-the-nixie-tube**. There are open-source files available if you have the ability to laser etch your own panels, but you can also purchase Lixie kits on Tindie at **www.tindie.com/products/connornishijima/lixie-ii-the-newnixie-for-arduino-digit-kit/**. With the surge in popularity, however, they've had a difficult time keeping them in stock.

No one is touting Lixies as practical alternatives to LED or LCD displays, but they are awfully fun to play with. It's fair to say that the pleasure of making a Lixie work is enough justification for the time spent!



A row of Lixies used to create a multidigit display. [Glen Popiel, KW5GP, photo]

Hints & Hacks

Dealing with DINs; Bringing Old Meters to Life, and Getting a Grip

Conquering the DIN Plug

Many hams want to use their transceiver accessory jacks for digital operating and other activities, but they find the prospect of wiring a DIN connector intimidating. My transceiver accessory port requires a 13-pin plug, and these are among the more challenging connectors you'll encounter. I started by ordering a few plugs from Digi-Key (**www.digikey.com/product-detail/en/cui-devices/SD-130/CP-1013-ND**) and immediately encountered an issue — trying to connect wires to a DIN connector that lacks solder cups at the ends of the pins.

In an attempt to achieve a secure connection while avoiding shorted pins, I decided to try attaching female connector sockets to the wires then pushing the sockets over the pins.

For the connector sockets, I used Molex 16-02-0103. These sockets are meant for smaller pins, but they can be made to go over the pins on the DIN connector. Sockets like these are very inexpensive, but specialty crimpers like the ones used for this project (**www.digikey.com/products/en?keywords=WM9017-ND**) are often more costly than one might want to spend (you can always try a different socket type that doesn't require this crimper).

The first step is to prepare the cable. Remove about an inch of the outer jacket, remove the foil (if any), and strip the individual wires in preparation for the sockets (see Figure 1). If the cable has a braid or a drain wire, make sure to leave it intact, as the metal shell of the connector often serves as a chassis ground and the braid or drain wire can be connected to the shell in order to preserve this ground connection. The amount of insulation that needs to be removed for the sockets is typically specified by the manufacturer (mine specified a strip length of 0.100 to 0.125 inches). Additionally, don't forget to put the shroud on the cable at this point in the process, especially if the other end of the cable is not available for later assembly.



Figure 1 — The preparation of the cable. [Ken Williams, KC6PUQ, photo]

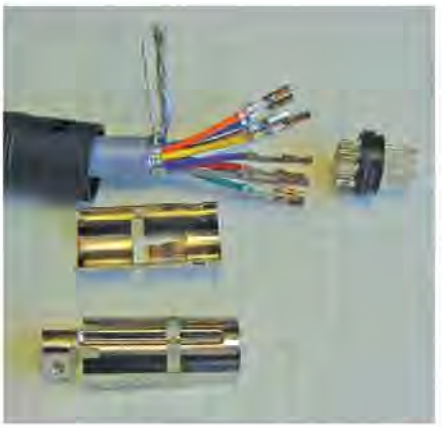


Figure 2 — The sockets attached to the wires. [Ken Williams, KC6PUQ, photo]



Figure 3 — Heat-shrink tubing added to the pins. [Ken Williams, KC6PUQ, photo]

After preparing the cable, attach the sockets to the stripped wires using an appropriate crimper (see Figure 2). This is probably the most important step in the process. Double-check your work when finished.

The next step is to put some heat-shrink tubing over each of the pins, as shown in Figure 3. The tubing should completely cover the ends of the sockets, where the wire is attached. The heat-shrink tubing will add some mechanical strength to the socket-wire connection. Also, these sockets are not meant for this appli-



Figure 4 — The sockets attached to the DIN connector and ready for closure. [Ken Williams, KC6PUQ, photo]

cation, so the sockets will touch each other when the connector is all wrapped up and the tubing will prevent short circuits.

Finally, push the sockets over the ends of the DIN pins and solder the pins. The solder is primarily for mechanical strength, so don't worry if you're unable to access the inner pins of the connector. The final cable-connector assembly ready for closure is shown in Figure 4. *— 73, Ken Williams, KC6PUQ,* **ken@williamsclan.us**

A New Battery for an Old VOM

Many hams still own and use classic volt-ohmmeters (VOMs), like the Simpson 260 or Tripplett 630-PL. The downside of owning a classic VOM is that many of these units require 30 V batteries for their high-range ohmmeters. These batteries have become expensive and difficult to find.

I found a solution in a collection of five "anti-bark dog collar batteries" that are available on Amazon for less than $6 for a set of five. Each 6 V battery is compact, and the terminals take solder easily. This makes it a simple process to wire them together in series to provide 30 V (see Figure 5). A few inches of double-sided tape mounts them inside the meter, and with two soldered connections to the existing wiring, the meter is ready for service. *— 73, Robert Miller, KE6F,* **millerke6f@aol.com**

Gripping Coax Connectors

It's usually best to finger-tighten the threaded shells of coaxial connectors, so they can be easily removed. That's good advice, until you need to unscrew an especially stubborn shell. Even a shell that's been finger-tightened can become difficult to remove over time.

My solution is to use one of those rubber pads that are intended to help open ultra-tightened food jars and bottles. They go by many names and are available at grocery stores. The grippy rubber pads are inexpensive and are ideal for loosening difficult connectors (see Figure 6). They also come in handy when it's time to attach a connector, allowing you to finger-tighten with the best of them. *— 73, Cameron Bailey, KT3A,* **kt3a@arrl.net**



Figure 6 — Inexpensive rubber jar-opening pads are ideal for dealing with overtightened connectors. [Cameron Bailey, KT3A, photo]



Figure 5 — The five 6 V batteries wired in series and installed in the old volt-ohmmeter. [Robert Miller, KE6F, photo]

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

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

Strays

3D Printing a Wouff-Hong?

Tom Porada, W4IEE, is wondering if anyone has created a modeling file (.stl) for making a Wouff-Hong or a Rettysnitch on a 3D printer. If you have such a file, contact Tom at **tom@porada.com**.

Looking for a Tektronix 315

Don Tucker, W7WLL, is looking for a Tektronix Type 315 oscilloscope (manufactured in the early '50s) for loan or sale for the VintageTEK Museum. Email Don at **contactus@vintagetek.org**.



Operating from Tillamook Rock

A look at how one team activated this rare IOTA location in the Graveyard of the Pacific.

Cezar Trifu, VE3LYC

Tillamook Rock is an isolated basaltic sea stack less than 1 acre in size and 1.9 kilometers from the Oregon coast. Located in a stormy area known as the "Graveyard of the Pacific," the lighthouse on Tillamook was built in 1880 and was in operation between 1881 and 1957. Nicknamed "Terrible Tilly" for the weather conditions and difficult commute, it was the most expensive lighthouse to maintain and operate in the US. The island is now privately owned, and the lighthouse has been used as a non-visiting dedicated cemetery since 1981. The rock is home to hundreds of California sea lions, pelicans, and black cormorants.

The island is one of the counters of NA-211 reference for the Islands on the Air (IOTA) program, and was activated only once, 21 years ago. The NA-211 group is now ranked #24 on the most-wanted IOTA list in the world and is in demand by almost 91% of IOTA members. Yuri Sushkin, N3QQ, obtained permission to organize a radio operation on Tillamook Rock from September 6 – 9, 2019, for a team of four. The K7TRI team also included Cezar Trifu, VE3LYC; Sandro Nitoi, VE7NY, and Adrian Ciuperca, KO8SCA.

Arrival and Setup

We traveled on a five-seat helicopter. The pilots flew first to check the landing condition of an old platform before undertaking several flights to transport passengers and materials. While the helicopter scared off hundreds of sea lions, 20 of them remained inside the lighthouse, and it took 4 hours until we were finally able to persuade the last of them to slowly descend the long stairway to the ocean.

We couldn't start installing tents and antennas until the animals were out of the way, so they wouldn't accidentally be harmed by any cables or ropes. A radio team set up the first tent on the reinforced concrete platform in front of the lighthouse and got the first station operational on 30-meter CW using a multiband vertical, in less than an hour and a half. A second tent was then set up, and a CrankIR vertical antenna was installed for operation on 40 meters. The next day, Sandro and Yuri put together the two-element UrbanBeam antenna for 20 meters (see the lead photo), which they installed with the help of the rest of the team, and Adrian set up the third station.

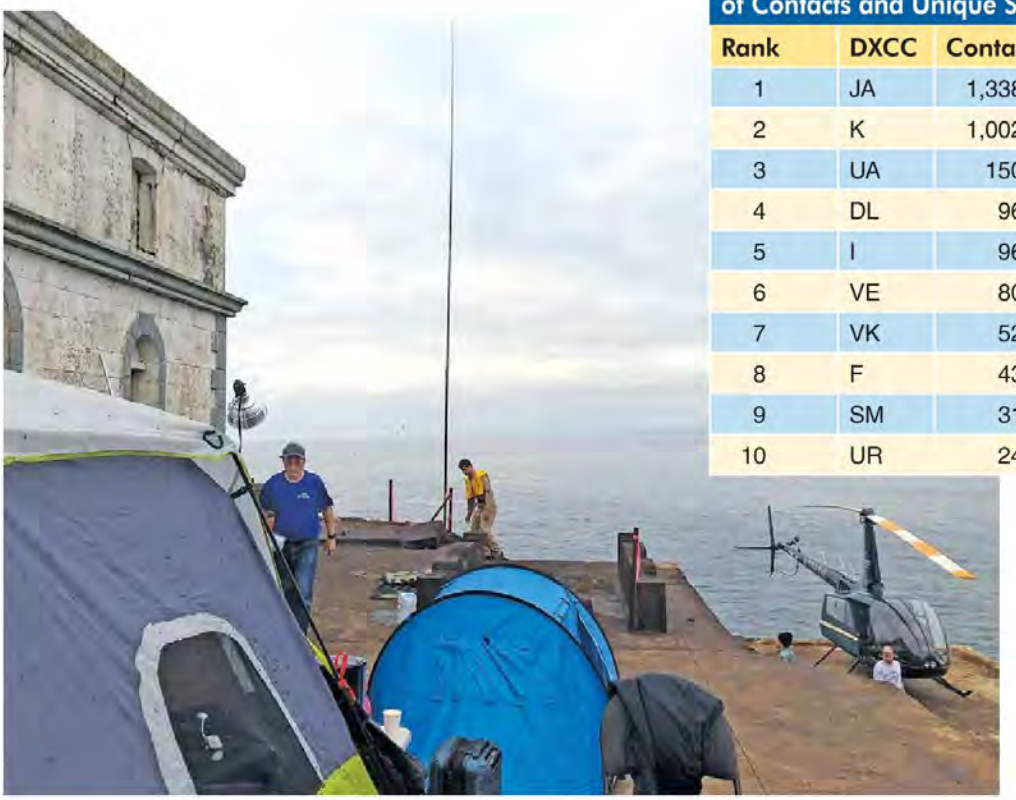


▲ The K7TRI team, pilots, and maintenance crew.

▼ Camp K7TRI was set up quickly.

Table 1
Top Ten DXCCs by Number of Contacts and Unique Stations

Rank	DXCC	Contacts	Stations
1	JA	1,338	767
2	K	1,002	676
3	UA	150	115
4	DL	96	90
5	I	96	84
6	VE	80	60
7	VK	52	31
8	F	43	35
9	SM	31	26
10	UR	24	21





Sandro Nitoi, VE7NY, (left) and Cezar Trifu, VE3LYC, (right) running the pileups from inside the lighthouse.



Hundreds of sea lions, among other wildlife, live on the island.

Operation and Logging

The log includes 3,292 contacts with 2,227 stations, in 64 DXCC locations on six continents. About 32% of contacts were on 20 meters, 30% on 30 meters, 34% on 40 meters, and a few on 17 meters. Over 84% of the contacts were in CW, 7% in SSB, and close to 9% in FT8. Table 1 lists the top ten DXCCs by the number of contacts and unique stations.

Acknowledgments

We wish to thank Mimi Morissette and the Eternity at Sea Columbarium for permitting us to carry out this project; Jerry Trimble Helicopters and their pilots, Craig and Sam; SteppIR, for lending us their UrbanBeam, and our group sponsors: the German DX Foundation, Radio Society of Great Britain (RSGB), International Radio Expedition Foundation, Clipperton DX Club, Swiss DX Foundation (SDXF), CDXC: The UK DX Foundation, Russian Robinson Club, and DX News.

Additionally, we want to acknowledge Mel Nunes, AB6QM, and Max Orr, WB8FLE, for their exceptional support, along with the top donors DL8FL, JA5IU, JJ8DEN, JM1PXG, KF7DS, PT7WA, SM3NXS, VE7QCR, W1JR, W7PDX, WC6DX, WB5JID, as well as many others who provided financial assistance.

A CrankIR vertical antenna was set up at the southeast corner of the lighthouse.



All photos by the author.

Cezar Trifu, VE3LYC, is the IREF 2018 IOTA Expeditioner of the Year and the Russian Robinson Club 2017/2018 Expeditioner of the Year. He can be reached at **ve3lyc@hotmail.com**.

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A Tale of Two Catches

Nothing overshadowed the joy of this beach QRP operation — not even the appearance of an aquatic predator.

Lawrence Paola, KC2EQA

As I prepared for a short vacation to Cape May, New Jersey, in early July 2019, I considered packing a portable QRP transceiver. My wife, Rose, has always supported my hobby and encouraged me to bring it.

The First Catch

On our first full day, Rose and I set out early to find a nice place on the beach and noticed some surf fishermen on the shoreline. I set up my Yaesu FT-817 and Miracle antenna, and attached the radial strung out approximately 14 feet. I tried my luck on 20 meters, and to my surprise and satisfaction, I made my first contact with Lee Trudeau, K2LT, of North Bangor, New York.

The Second Catch — and Then Some

The following day, after some sightseeing (including the Cape May Airport Aviation Museum, which has a fabulous vintage radio room with a Morse code station), I decided to try to snag a 40-meter contact. I went to the beach, reeled out the radial to about 26 feet, and found a quiet frequency. Little did I know, there would be competition from a more traditional type of "catch."

As I called CQ, I noticed about 2 dozen people gathering around a surf fisherman about 200 yards down the beach, their phone cameras held high. Rose made her way to the crowd, curious about the commotion. As I was contemplating whether to join her, Jan "Buck" Buckowski, AA4SN, responded to my signal from New Bern, North Carolina. This was an impressive contact, especially since it was done with a 56-inch whip at low power.

I was basking in the glory of a fine QRP contact when Rose returned with news. The fisherman had reeled in a shark! We later learned it was not uncommon for surf fishermen to catch the small coastal sharks that prey on the plentiful supply of stingrays. The fisherman had brought the shark to shore, and the crowd took pictures. After a couple of minutes, the shark was set free in the ocean, to the delight of the cheering onlookers.

After viewing pictures on Rose's phone, my QRP contact seemed to pale in comparison. She was happy for my success, but clearly the shark catch and release won the evening. As darkness began to set in, we packed our things and returned to the hotel with two "fishing" stories to tell.

Enjoying the Challenge

This brings me to a subject which has been talked about in ham radio media a lot lately: having fun in this period of poor band conditions. I was well aware that conditions are such that making a QRP CW contact on the beach with a whip antenna and 5 W might be difficult. But that didn't stop me from trying — and enjoying — the amateur radio experience.



At home, I enjoy experimenting with wire antennas and different radios. Often Rose will comment that I seem to enjoy the very process of setting everything up just to see if it works. She's not wrong. Like many ham radio operators, I'm thrilled by the challenge of setting up a portable station and making a contact, especially under adverse conditions.



Larry, KC2EQA, having fun in the sun and making those QRP catches.

The fact is that those two contacts on the beach were special because the entire process — preparing the gear, setting up the station, and operating in a beautiful location — made it all worthwhile.

I was glad to get back home to write QSL cards and reminisce about Rose's shark encounter. Though the shark still seems to be the highlight of that evening, I have no regrets about standing firm by my station and landing my own catch.

Larry Paola, KC2EQA, has been a licensed amateur radio operator for 20 years. He primarily operates QRP/CW, and also enjoys SWLing and medium-wave DXing. A retired educator, Larry enjoys spending time with family and friends as well as reading, cooking, enjoying the outdoors, and seeing Broadway plays with his wife, Rose. He can be reached at **larry.paola457@gmail.com**.

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

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May 2020
QST Cover Plaque Award Winner

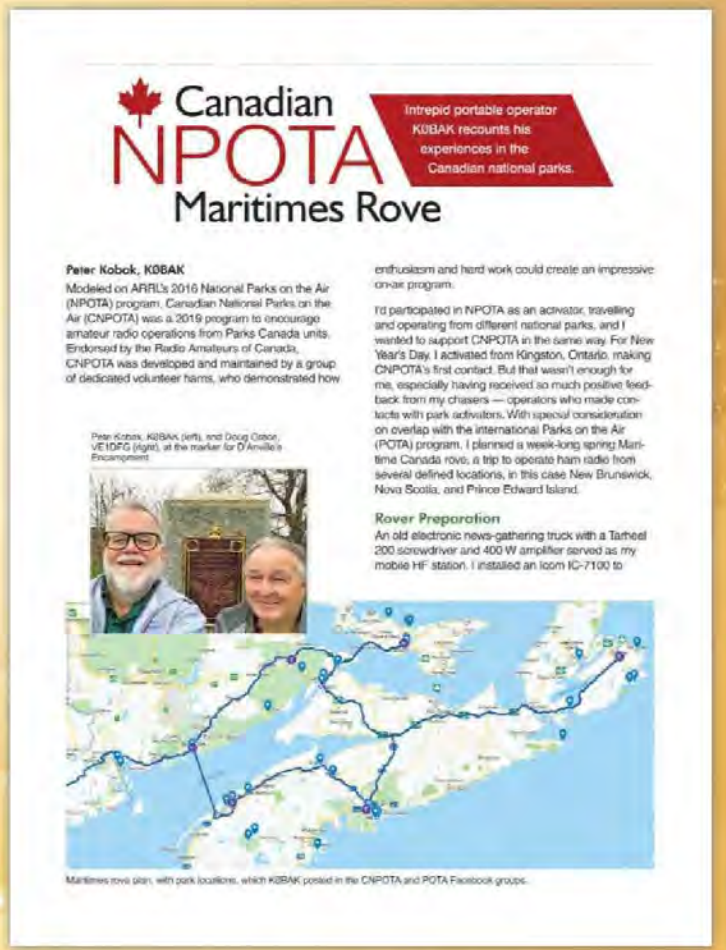
Peter Kobak
KØBAK

Peter's article, "Canadian NPOTA Maritimes Rove," detailed his adventures while operating in several parks in the Canadian Maritime provinces. By the time it was all over, more than 30 parks had been activated!

QST Cover Plaque Awards are given to the author or authors of the most popular article in each issue. *You* choose the winners by casting your vote online at

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Canadian NPOTA Maritimes Rove

Intrepid portable operator KØBAK recounts his experiences in the Canadian national parks.

Peter Kobak, KØBAK

Modeled on ARRL's 2016 National Parks on the Air (NPOTA) program, Canadian National Parks on the Air (CNPOTA) was a 2019 program to encourage amateur radio operations from Parks Canada units. Endorsed by the Radio Amateurs of Canada, CNPOTA was developed and maintained by a group of dedicated volunteer hams, who demonstrated how enthusiasm and hard work could create an impressive on-air program.

I'd participated in NPOTA as an activator, travelling and operating from different national parks, and I wanted to support CNPOTA in the same way. For New Year's Day, I activated from Kingston, Ontario, making CNPOTA's first contact. But that wasn't enough for me, especially having received so much positive feedback from my chasers — operators who made contacts with park activators. With special consideration on overlap with the international Parks on the Air (POTA) program, I planned a week-long spring Maritime Canada rove, a trip to operate ham radio from several defined locations, in this case New Brunswick, Nova Scotia, and Prince Edward Island.

Peter Kobak, KØBAK (left), and Doug Odell, VE1DFG (right), at the marker for D'Anville's Encampment.

Rover Preparation

An old electronic news-gathering truck with a Tarheel 200 screwdriver and 400 W amplifier served as my mobile HF station. I installed an Icom IC-7100 to

Maritimes rove plan, with park locations, which KØBAK posted in the CNPOTA and POTA Facebook groups.

Bicycle Mobile on the HF Bands

An easy way to implement a mobile radio system, for the operator on two wheels.

Christian Bravo, W4ALF

After experimenting with pedestrian mobile and being active with Summits on the Air (SOTA), I was looking for a new amateur radio challenge. My experiences with portable ham gear led me to the idea of adapting my mobile setup to fit on my bicycle. The two-wheel setup would allow me to be even more mobile, and still be able to communicate on the HF bands.

I've found that most successful bicycle HF implementations were for the VHF/UHF bands. The feature-rich and highly compact low-power operating equipment available makes it easy to implement a practical mobile system on two wheels. In addition to being portable, I wanted my system to be lightweight and compact.

The Radio Setup

My portable operation has had success with the Elecraft KX2 transceiver, however, other low-power radios are also easily adaptable to the bike, such as the Yaesu FT-818 or the Xiegu X5105. Using the Elecraft KX2 meant I could operate on the voice and CW modes when I was stationary. Because my radio has the 10.8 V internal battery and the antenna tuner option, it makes for a compact setup. The radio is mounted directly over the handlebars using a RAM Mount ball and joint mount.

I used the KX2 Mount by Side KX to secure the radio to the RAM Mount system. This plastic radio mount easily attached to the RAM Mount system with a VESA bolt pattern that both products support. I made an easy microphone mount with a plastic clip I found at home, which I zip-tied to the handlebars. I added a second RAM Mount to hold my iPhone, and downloaded the HamLog app, so I could use my phone as a logger. The app also allows you to easily export your log in ADIF format so you can import it into your main logger software.

The Bike

I utilized my 16-inch wheel-folding bike for its compactness and dimensions, allowing me to transport it with minimal hassle. Any bike that can fit a rear bike rack attached to the frame will work. Avoid seat tube-style rear rack carriers, as they don't provide the stability needed to ride with a vertical antenna attached. The



Christian Bravo's, W4ALF, bicycle mobile setup.



Christian Bravo's, W4ALF, bicycle mobile folded to fit in the trunk of his compact vehicle.

side-to-side torque while pedaling can cause this type of rear rack to shift. I recommend using a bike that allows for a fixed rear bike rack, which lets you properly secure an antenna mount. My radio is connected to the rear rack antenna mount via RG-8X coax routed along the bike frame and secured with zip ties.

Mounting the Antenna

The idea for the antenna and mounting system came from my experience with backpack mobile setups. Essentially, I utilize a shortened vertical antenna with a coil that can be tapped for various bands through 20 meters, and a raised counterpoise wire coiled around a 7-foot crappie pole attached to the rear rack of the bike. I decided to use a Buddipole coil, antenna arms, and telescopic whips, because I already had them. Building a bicycle mobile allows a lot of room to homebrew.

The Buddipole pieces I used were four 11-inch arms, one mini coil, and the standard 66-inch telescopic whip, with the last whip section shortened to about 8 inches. This gives an approximate vertical height of about 9 feet (110 inches) when set up for 20 meters.

The counterpoise consists of a fiberglass fishing rod extended 90° in relation to the vertical section and it extends about 87 inches with a 20-foot, 18-gauge wire coiled around it. The fishing rod is then zip-tied to the rear bike rack, allowing the counterpoise to be suspended off the ground, avoiding losses and potential hang-ups of the wire while riding.

For the antenna mount, I used a Super Antenna UM2 SuperMount Universal Portable Antenna Mount for my MP1 portable antenna that pairs well with the Buddipole system, which uses ⅜-24 inch threads to interconnect pieces. I crafted two pieces of metal to use as an attachment for the MP1 portable antenna mount to the rear bike rack. The vertical Buddipole antenna and the counterpoise both connect to the MP1 mount. The whole antenna mount system could also be easily homebrewed.

I found that bringing a small antenna analyzer with me really speeds up antenna adjustments. I also haven't had any problems tuning to at least 1.5:1 voltage standing wave ratio (VSWR) or lower across the 20-meter band with this setup. I adjust for resonance by moving the tap on the coil, adjusting the vertical telescopic whip, and fine-tuning it by adjusting the counterpoise length.

Performance

I've found that my outings always result in plenty of voice and CW contacts, comparable to the wire antenna portable setups I've used. I wanted to test how well the bicycle mobile antenna system was getting out there on 20 meters, so I hooked up the antenna to my SOTABeams WSPRlite for 20 minutes during ARRL Field Day. When I checked the results, I was pleasantly surprised to see a few dozen US and DX hits all over the world!

Conclusion

Operating bicycle mobile is a fun way to get out and operate while getting some exercise. Gear today lends itself well to having a high-performing HF setup on the go with two wheels. My antenna system allows for more bands and radials while operating stopped at a location without having to hang antennas. I hope the ideas presented here spark your own mobile adventures and homebrew modifications.

For a brief video by the author on how to set up your bicycle mobile, visit **https://youtu.be/bC9s6ZqtL4o**.

All photos by the author.

Christian Bravo, W4ALF, earned his Amateur Extra-class license in 2014. He has achieved ARRL DXCC on seven bands and other awards, and is a CW instructor with CWops CW Academy. Summits on the Air (SOTA) and portable CW operations are his favorite styles of operating. He's currently enrolled in a coding bootcamp to become a Java developer. He can be reached at **w4alf@arrl.net**.

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

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Rick Lindquist, WW1ME, ww1me@arrl.org

Happenings

Volunteer Monitor Program Recognizes Good Operators

The Volunteer Monitor Program (**www.arrl.org/volunteer-monitor-program**) has recognized numerous radio amateurs with its first Good Operator Notices.

"One facet of the ARRL and FCC agreement that set up the Volunteer Monitor Program calls for ARRL to recognize especially good amateur radio behavior, in order to encourage compliance with FCC rules and further the efficiency of the Amateur Radio Service," VP Program Coordinator Riley Hollingsworth, K4ZDH, said. "Seventeen operators in 15 states received Good Operator Notices in the first quarter of 2020.



The Good Operator Notices went to veteran operators as well as newcomers, including a 13-year-old in North Carolina for CW operation during the Youth on the Air (YOTA) Special Event and a 14-year-old in Wyoming for SSB operation."

Hollingsworth also said that a 2-meter repeater operator received a Good Operator Report for establishing and managing a COVID-19 net in Pennsylvania, while other operators of various license classes received notices for everyday SSB and CW operation on the HF bands. Recipients were nominated on the basis of operation observed by Volunteer Monitors (VMs).

VMs reported 2,035 hours monitoring on HF and 2,856 hours monitoring on VHF/UHF and other frequencies during May. They referred two cases to the FCC. — *Thanks to Riley Hollingsworth, K4ZDH*

ARISS Established as an Independent Organization

Going forward, the US arm of the Amateur Radio on the International Space Station (ARISS) working group will be known as ARISS-USA, an independent organization. ARISS serves as the intermediary to arrange contacts between schools and organizations on Earth and ISS crew members. ARISS-USA was incorporated as a nonprofit entity in Maryland in late May. The move will allow ARISS-USA to work independently, soliciting grants and donations, while continuing to promote amateur radio and science, technology, engineering, arts, and math (STEAM) goals within schools and educational organizations. ARISS-USA lead Frank Bauer, KA3HDO, noted that the scope and reach of what ARISS accomplishes has grown significantly since its modest start in 1996.

"Our working group status made it cumbersome to establish partnerships, sign agreements, and solicit grants," Bauer said. "These can only be done as an established organization."

ARISS-USA will continue to collaborate with ARISS International as well as with US sponsors, partners, and interest groups, the announcement said.

ARISS-USA can accept tax-deductible contributions via AMSAT-NA through the ARISS website, **www.ariss.org**.

Spring 2020 Section Manager Election Results Announced

In the spring Section Manager (SM) election cycle, three incumbents were returned to office, while one lost to a challenger. Ballots were counted on June 1. Three other incumbent Section Managers were unopposed for new terms of office, while one candidate was elected as the only nominee for the position. New terms began on July 1.

In Illinois, incumbent SM Ron Morgan, AD9I, edged out a win over two challengers. Morgan received 605 votes, while Thomas Beebe, W9RY, garnered 600 votes and Scott DeSantis, KB9VRW, picked up 288 votes. Morgan has been Illinois SM since 2017.

In Indiana, incumbent SM Jimmy Merry, KC9RPX, was re-elected with 515 votes to 384 for his challenger

Brian Jenks, W9BGJ. Merry has been Indiana SM since 2018.

In Oregon, David Kidd, KA7OZO, was re-elected over challenger Kevin Fox, KUØL, 728 to 386. Kidd has served as Oregon SM since 2018.

In Maine, challenger Robert Gould, N1WJO, topped incumbent SM Bill Crowley, K1NIT, 196 to 179. Crowley had served as Maine SM since 2014.

Bill Ashby, AA6FC, of San Jose, California, was the only nominee for Santa Clara Valley SM to succeed Brandon Bianchi, NI6C, who decided not to run for a new term after serving since 2012.

Several sitting SMs were the only nominees in their respective sections and were declared re-elected: Kevin Bess, KK4BFN (Northern Florida); Paul Gayet, AA1SU (Vermont), and Patrick Moretti, KA1RB (Wisconsin).

Richard Budd, WØTF, Appointed as North Dakota ARRL Section Manager

Richard Budd, WØTF, has succeeded Nancy Yoshida, KØYL, as North Dakota Section Manager (SM). Yoshida resigned on June 2 after serving since 2018. She is the new vice president of the YL International Single Sideband System and felt she could not do justice to both leadership roles. In addition to completing the remainder of Yoshida's term, which extends through September 30, Budd was the only nominee for the next term of office, so he will continue in office for an additional 2 years.



Richard Budd, WØTF

A ham since 1980, Budd had served as a North Dakota Assistant SM since 2019, was Section Emergency Coordinator in 2018, and previously served as North Dakota's Official Observer Coordinator.

Rocky Mountain Vice Director Resigns to Accept Appointment as Colorado Section Manager

ARRL Rocky Mountain Division Vice Director Robert Wareham, NØESQ, stepped down in May to accept an appointment as Colorado Section Manager (SM). Wareham succeeds veteran Colorado SM Jack Ciaccia, WMØG, who resigned effective on June 1 after serving since 2011.



Robert Wareham, NØESQ

"Jack will be moving to the East Coast to be closer to family, and I wish him only the best as he transitions to this next phase of his life," ARRL Rocky Mountain Division Director Jeff Ryan, KØRM, said in a message to his Division. Ryan said he was "sorry to lose such an outstanding leader, who has been instrumental in the creation and maintenance of the vibrant amateur radio community that exists across Colorado today." Ciaccia, who is relocating to New Hampshire, said he was proud of the Section's accomplishments over the past 9 years and that his decision to leave was bittersweet.

Wareham will complete Ciaccia's current term, which runs until September 30, 2021. An ARRL Life Member, Wareham served as Colorado Section Emergency Coordinator since 2011, prior to his appointment as Rocky Mountain Vice Director in 2018.

ARRL President Rick Roderick, K5UR, appointed Dan Grady, N2SRK, of Aurora, Colorado, as the new Rocky Mountain Division Vice Director, succeeding Wareham.



Dan Grady, N2SRK

A native of southern New Jersey, Grady was licensed in 1992. In the 1990s, he served in the Amateur Radio Emergency Service (ARES) and Office of Emergency Management communication support teams in southern New Jersey and in the Philadelphia area. After relocating to Colorado in 2014, he helped to found and now serves as president of the Parker Radio Association — a 150-member ARRL-affiliated club.

ARRL/TAPR Digital Communications Conference (DCC) Issues Call for Papers

Technical papers are being solicited for presentation at the 2020 ARRL/TAPR Digital Communications Conference (DCC), September 11 – 13. Due to the coronavirus pandemic, this year's conference will be held online.

Papers will also be published in the *Conference Proceedings*. Authors do not need to participate in the conference to have their papers included in the *Proceedings*.

The submission deadline is August 15, 2020. Submit papers via e-mail to Maty Weinberg, KB1EIB, **maty@arrl.org**. Papers will be published exactly as submitted and authors will retain all rights.

Social Distancing Exam Sessions Demonstrate Pent-Up Demand for Testing

An in-person "social-distancing" amateur radio exam session in Indiana and a "drive-in" session in California earlier this year were representative of those relieving some pent-up demand for testing.

"With in-person sessions starting up again around the country, we are hearing the same story from Volunteer Examiner (VE) teams everywhere," said ARRL Volunteer Examiner Coordinator (VEC) Maria Somma, AB1FM. "Large numbers of candidates who have been waiting to test are contacting teams and are thankful for the opportunity to sit for an exam…VE teams and candidates are following CDC and state guidelines for social distancing."

Anderson (IN) Repeater Club (**www.andersonrepeaterclub.org**) VE Team Liaison Steve Riley, WA9CWE, told ARRL that his club has been conducting test sessions every month since 2011, typically serving four or five candidates each session, but the May 19 session attracted 14 individuals.

VEs and examinees alike wore face masks, and the test room was configured to accommodate the necessary spacing between individuals. "We questioned everyone entering with the usual health questions," Riley explained.

The result for the session was 11 new radio amateurs and three upgrades.

In California, VE Larry Loomer, KI6LNB, told the ARRL VEC that his team conducted a successful drive-in license testing session on May 16 at the Concord Bay Area Rapid Transit Station.

Loomer explained that candidates fill out their paperwork in their cars. Once paperwork is completed, candidates take a test booklet and answer sheet on a clipboard and sit in a chair in front of their cars, taking the test in front of the VEs.

Completed tests go into a box on the VE table, and candidates back their cars into a holding area, to allow other cars to park by the testing chairs. Once a test is scored and signed, the CSCE goes to the waiting candidate, who may then drive away.

Somma said, "Our VE teams are doing a great job! I'm impressed with their attention to safety, their professionalism, and their innovative tactics."



The Madison County, Indiana, exam session.

Section Manager Nomination Notice

To all ARRL members in Eastern Massachusetts, Missouri, Nebraska, New York City-Long Island, Northern New York, South Carolina, Southern New Jersey, Western Pennsylvania, and West Central Florida: You are hereby solicited for nominating petitions pursuant to an election for Section Manager (SM). Incumbents are listed on page 16 of this issue.

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

We suggest the following format:

(Place and Date)

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

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

(Signature ____ Call Sign_____ City ___ ZIP____)

Any candidate for the office of Section Manager must be a resident of the Section, an amateur radio licensee of Technician class or higher, and a full member of ARRL for a continuous term of at least 2 years immediately preceding receipt of a nominating petition. Petitions must be received at Headquarters by 4 PM Eastern Time on September 4, 2020. If more than one member is nominated in a single Section, ballots will be mailed from Headquarters no later than October 1, 2020 to full members of record as of September 4, 2020, which is the closing date for nominations. Returns will be counted November 24, 2020. Section Managers elected as a result of the above procedure will take office October 1, 2020.

If only one valid petition is received from a Section, that nominee shall be declared elected without opposition for a 2-year term beginning January 1, 2021. 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. — *Bart Jahnke, W9JJ, Field Services & Radiosport Department Manager*

Call for Nominations for ARRL Director and Vice Director

Attention to full ARRL members in the Atlantic, Dakota, Delta, Great Lakes, and Midwest Divisions. You have the opportunity to choose a Director and a Vice Director to represent you for 3-year terms beginning January 1, 2021.

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: Fred Hopengarten, KIVR; Michael Ritz, W7VO, 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. 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 **ceo@arrl.org**. The request must reach the ARRL Secretary *no later than noon EDT on Friday, August 14, 2020.* 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 21, 2020.* 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 24, 2020, 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 4, 2020 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, he or she 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, 2020 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, 2020. Completed ballots must be received at the designated PO Box in the envelope provided by noon Eastern Time on Friday, November 20, 2020. The candidate receiving the most votes will be declared the winner.

Absentee Ballots

A full member who is residing temporarily outside his or her home Division, including overseas, may arrange to vote in the home Division by notifying the Secretary prior to September 10, 2020, 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:

Atlantic: Tom Abernethy, W3TOM, Director, and Bob Famiglio, K3RF, Vice Director

Dakota: Matt Holden, KØBBC, Director, and Lynn Nelson, WØND, Vice Director

Delta: David Norris, K5UZ, Director, and Ed Hudgens, WB4RHQ, Vice Director

Great Lakes: Dale Williams, WA8EFK, Director, and Thomas Delaney, W8WTD, Vice Director

Midwest: Rod Blocksome, KØDAS, Director, and Art Zygielbaum, KØAIZ, Vice Director

For the Board of Directors:
May 12, 2020

Barry Shelley, N1VXY, Secretary/Interim Chief Executive Officer

Bob Willey, KD7OWN, kd7own@comcast.net

Public Service

Go-Bags for Short Deployments

The traditional "go-bag" has been a part of amateur radio disaster exercises and deployments for many years. Most of us, however, have a love-hate relationship with them. They're often heavy, bulky, and contain so much stuff we can't even remember what's in all those pockets.

Despite all this, go-bags are very important. Having the supplies you need when you need them is critical. Emergency communication teams train regularly, conducting exercises and drills and participating in community events each year. Go-bags are often mandatory for training exercises and deployments. However, I think the larger go-bags can be left at home or in the trunk of the car, where they'll be safe until they're needed in a disaster. Make building a smaller go-bag fun by taking the Short Deployment Go-Bag Challenge.

Our Amateur Radio Emergency Service (ARES) team in Centralia, Washington, challenged ourselves to create a personal go-bag that weighed 10 pounds or less, was easy to carry, and still had all the supplies necessary for a 2 – 6 hour deployment. Our ARES team trains twice each month and conducts community exercises often. Team members generally know what kind of exercise or deployment they'll be working. Because our response area is fairly small, deployments rarely last more than 6 hours before relief arrives. This made smaller go-bags a viable possibility. For this challenge, we used a flood scenario, because they're by far our most common disasters.

Reducing the Weight

Weight and bulk are the enemy of any go-bag. It's important to plan ahead and carry only the necessities. You probably don't need two handheld radios in your go-bag. One good radio that you know how to use and a spare battery or charging system should be enough. If you're on a nighttime deployment or exercise, you may need multiple flashlights. If not, find something smaller. My favorite is a 5-ounce, 5-inch LED light capable of 300 lumens, which I purchased on sale for $6. Spare batteries for this light weigh 2 ounces. As a backup, consider a small LED headlamp, or one of the many free flashlight apps for your cell phone.

Choose go-bag items carefully, watch the weight, and take only what you need. Introducing it as a team challenge enticed us all to be more creative. For extra incentive, we added a $25 cash prize for the best overall deployment bag.



The Centralia, Washington, ARES group's Short Deployment Go-Bag Challenge winner, Skip Kingmen, K1HEK.

The contest winner for the Centralia, Washington, ARES team's Short Deployment Go-Bag Challenge chose a smaller backpack and added the following items:

- Handheld radio and spare battery
- Headset microphone
- Coax connectors and cables
- Flashlight(s) and spare batteries
- Car charger for the radio
- Headlamp with spare batteries
- GPS, compass, and whistle
- Personal protective equipment
- First-aid kit and rescue blanket
- Personal medication pack
- Multitool, matches, and lighter
- Water bottle and snacks
- 100-foot paracord
- Map and field resource manual
- Tape, zip ties, and bungee cords
- Gloves, sun/rain hat, thermal shirt
- Notepad, pen, pencil, and markers

The Utility Backpack

When putting together a small go-bag, look at the smaller backpacks found at most sporting goods stores. Most come with a handle, and they're lightweight, inexpensive, and leave your hands free to hold a radio. The small backpack I use costs under $20, has four pockets of different sizes, and is water-resistant. As a bonus, it has a built-in, 2-liter hydration bag (water reservoir) and suction tube. Radios easily clip on the shoulder straps, leaving my hands completely free. Unlike deploying to a shelter where you can set your go-bag down in a safe place until needed, volunteering at a parade or fun run usually demands both hands and there's rarely a safe location to temporarily leave your equipment.

Quality in a small backpack doesn't necessarily mean more expense, but prices can range from $10 to over $100, depending on what you buy. Less expensive bags work very well and cost less to replace if they get lost or damaged. Make sure you can easily find the pocket zippers or add something to the zipper to make grabbing it quickly easier. Backpacks with padded shoulder straps are much more comfortable and add little weight.

The Waist Pack

For some exercises or deployments, even a small backpack may prove too much. In that case, try one of the many waist packs, often called fanny packs. As the name implies, this small storage pack uses a belt and attaches around the waist or hip. Weighing in at 10 ounces when empty, the waist pack I use still has four zippered pockets and a place to carry a water bottle. There's plenty of room for a flashlight, extra batteries, a small first aid kit, snacks, and more.

If you're shopping online, be sure to read the reviews. Anything out of the ordinary will show up there. For example, I wanted a waist pack that would hold a water bottle. Some reviews stated an ordinary water bottle wouldn't fit.

Waist packs are easier to carry in hot weather and provide better access to the pockets than a backpack. A wide belt is more comfortable than a thinner belt. Medium-sized waist packs, with multiple pockets and the ability to carry a water bottle, usually cost between $15 – $25.

The Small Equipment Bag

While not hands-free, small equipment bags are convenient and relatively inexpensive. This smaller bag, often found at military surplus stores or online for around $40, weighs just under 2 pounds when empty, yet offers eight or more pockets and one large storage area.

Contents of Smaller Go-Bags

It's important to adjust the contents of a go-bag for short deployments. Weather, the time of year, and the type of exercise or deployment require changes to its contents. Keeping your bag near the 10-pound limit is important. Generally speaking, it shouldn't be difficult to stay within these limits when preparing for a 2 – 6 hour exercise or deployment.

Training exercises are the perfect way to test your team's readiness. Small, well-planned go-bags should be part of every exercise or deployment. Always keep in mind that a go-bag that's too heavy is usually a go-bag left behind.

Field Organization Reports

May 2020

Public Service Honor Roll

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

580
KD8TTE

550
W7PAT

474
KE8BYC

455
WA3EZN

415
N9VC

265
ND8W

250
WS6P

248
AD8CM

240
KD2NMG

236
WA2CCN

230
W9GRG
KT2D

220
KK4PUX

215
WA7PTM

190
W4CMH
WB9WKO
N8SY

174
N2WGF

170
W4DNA

160
W2PH
K9LGU
W8DJG

158
KY2MMM

157
WA2BSS

152
KD2LPM

150
KK3F
N1LL

149
AC8NP

140
W0PZD
WO2H
K4IWW
K0RCJ

135
KC9FXE
W3GWM
K3FAZ
W3YVQ

133
WM2C

130
AC0KQ
K8AMH
WB9QPM
W0LAW
N2JBA
KC8WH
WD8USA
KW1U
NA7G

129
AI9F

128
N3KRX

127
W4INK
K4VWK

125
AG9G

122
K9ILJ
W7EES

120
WA4VGZ
WC4FSU
K2TV
W9RY
K3JL
WK4WC
K0IBS
K2RMF

KY2D
W4NWT
WB4ZIQ
KD8ZCM
KA9OWC
N7IE

118
KE8KOC

116
KA8ZGY

115
K1XFC
N1TF

113
KB8RCR

110
KO4OL
W2PAX
W1KX
WA3QLW
K6HTN
KA5AZK
KE5YTA
KF5IOU
KA9MZJ
KW9EMG
WB8YLO
KD8UUB
KA2ZNZ
N2LJM
K3IN
WF2Y
WB8TQZ
N5MKY
N1IQI
KD2JKV

107
WB7OSC

106
KV8Z

105
N3SW
KD2IWN

103
W1RVY

100
WB4RJW
KZ8Q
KN9P
NX9K
KG5NNA
KB3YRU

W7PHX
AD3J
AC8RV
WB8SIQ
KB0DTI
KB2YAA
AA3SB
KA2GQQ
KB2QO
K8ED
N1LAH
KE1ML

98
N2DW

96
KI7TIG
W9EEU

95
AD4DO
K8MDA

94
KD2GXL
K9DUR

93
K1STM
KC1HHO

92
WS4P
K8RDN

90
KM4WHQ
WD8DHC
K3MIY
AA3N
K8KRA
KB8HJJ
KA1G
WD0BFO
KA2HZP
W3CJD
WB8WKQ
KC1KVY
WA1LPM
AB9ZA

89
KD2GRS
N6IET
W4TTO

88
K6JT
WB8YYS

87
W2CTG
W8IM
N3RB
KB1NMO

86
KF7GC

85
N2TSO
KL7RF
KA0DBK
WB2VUF

84
K2IE

83
NI2W

82
KD2MEN
W9BGJ

81
WB8R

80
KC7ASA
KJ7BHO
N8MRS
K2JPS
AB3WG

79
N3JET

78
N2RQ
WW3S
K2EAG

77
WB6NCT
N8OYY

76
KN4AAG
WB3FTQ

75
AF4NC

74
KT4WX
NV1N

73
K6RAU

70
W3ZR

The following stations qualified for PSHR in previous months but were not reported in this column: (Apr.) WB4ZIQ 120, WF2Y 110. (Mar.) WM2C 318, KT2D 245, WA2BSS 149, N2JBA 130, WO2H 140, N2TSO 90.

Section Traffic Manager Reports

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

Section Emergency Coordinator Reports

The following Section Emergency Coordinators reported: AR, CT, DE, EPA, GA, IA, ID, MDC, MI, MN, MO, NC, NLI, NM, NNJ, NNY, NV, OH, PAC, SFL, SNJ, SV, VI, WCF, WMA, 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 1,580, NX9K 1,326, WB9WKO 953, K6HTN 660.

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

Contest Corral

August 2020

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

Start - Finish Date-Time		Date-Time		Bands	Contest Name	Mode	Exchange	Sponsor's Website
1	0001	2	2359	28	10-10 International Summer Contest, SSB	Ph	Name, mbr or "0," SPC	www.ten-ten.org
1	1200	1	2359	1.8-28	European HF Championship	CW Ph	RS(T), 2-digit year first licensed	lea.hamradio.si/~scc/euhf
1	1400	1	1800	144	WAB 144 MHz Low Power Phone	Ph	RS, serial, WAB square or country	wab.intermip.net
1	1800	2	0559	1.8-28	North American QSO Party, CW	CW	Name, state/DC/province/country	www.ncjweb.com
1	1800	2	1800	222 and up	ARRL 222 MHz and Up Distance Contest	CW Ph Dig	6-char grid square	www.arrl.org/222-mhz-and-up-distance-contest
2	1400	2	1700	3.5-14	SARL HF Phone Contest	Ph	RS, serial	www.sarl.org.za
4	0100	4	0159	1.8-50	Worldwide Sideband Activity Contest	Ph	RS, age group (OM, YL, or youth)	wwsac.com/rules.html
4	0100	4	0300	3.5-28	ARS Spartan Sprint	CW	RST, SPC, power	arsqrp.blogspot.com
5	1700	5	2000	144	VHF-UHF FT8 Activity Contest	Dig	4-char grid square	ft8activity.eu/index.php/en
6	1700	6	2100	28	NRAU 10-Meter Activity Contest	CW Ph Dig	RS(T), 6-char grid square	nrau.net/activity-contests
6	1900	6	2100	1.8-50	SKCC Sprint Europe	CW	RST, SPC, name, mbr or power	www.skccgroup.com
8	0000	9	2359	3.5-28	WAE DX Contest, CW	CW	RST, serial	www.darc.de/der-club/referate/referat-conteste/worked-all-europe-dx-contest/en
8	0800	8	1100	1.8-28	QRP ARCI European Sprint	CW	RST, SPC, mbr or power	qrparci.org
8	1200	9	2359	1.8-50	SKCC Weekend Sprintathon	CW	RST, SPC, name, mbr or "none"	www.skccgroup.com
8	1400	9	0400	1.8-144, 432	Maryland-DC QSO Party	CW Ph Dig	Entry class, county or SPC	w3vpr.org/mdcqsop
10	0000	10	0200	1.8-28	4 States QRP Group Second Sunday Sprint	CW Ph	RS(T), SPC, mbr or power	www.4sqrp.com
10	1200	10	1400	7	SARL Youth Sprint	Ph	RS, age	www.sarl.org.za
11	1500	13	1459	144	MMMonVHF 144 MHz Meteorscatter Sprint Contest	CW Ph Dig	Signal report	mmmonvhf.de/ctestinfo.php
12	0030	12	0230	3.5-14	NAQCC CW Sprint	CW	RST, SPC, mbr or power	naqcc.info/sprint
12	1700	12	2000	432	VHF-UHF FT8 Activity Contest	Dig	4-char grid square	ft8activity.eu/index.php/en
15	0000	16	1600	3.5-28	SARTG WW RTTY Contest	Dig	RST, serial	www.sartg.com
15	0600	16	2359	10 GHz to light	ARRL 10 GHz and Up Contest	CW Ph Dig	6-char Maidenhead locator	www.arrl.org/10-ghz-up
15	0800	16	0800	1.8-28	Russian District Award Contest	CW Ph	RS(T), RU district code or serial	rdaward.org/rdac1.htm
15	1200	16	1200	1.8-50	Keyman's Club of Japan Contest	CW	RST, JA prefecture/district code or continent	kcj-cw.com
15	1600	15	1759	1.8-50	Feld Hell Sprint	Dig	RST, mbr, SPC, 4-char grid	sites.google.com/site/feldhellclub
15	1800	16	0559	1.8-28	North American QSO Party, SSB	Ph	Name, state/DC/province/country	www.ncjweb.com
15	2100	16	2100	3.5-28	CVA DX Contest, CW	CW	RST, category	cvadx.org/regulamento
16	1400	16	1700	3.5-14	SARL HF Digital Contest	Dig	RST, serial	www.sarl.org.za
16	1700	16	2100	3.5-28	NJQRP Skeeter Hunt	CW Ph	RS(T), SPC, Skeeter number or power	www.qsl.net/w2lj
16	1800	16	2359	3.5-28	ARRL Rookie Roundup, RTTY	Dig	Name, 2-digit year first licensed, state/province/XE area/DX	www.arrl.org/rookie-roundup
16	1900	16	2359	1.8-28	Run for the Bacon QRP Contest	CW	RST, SPC, mbr or power	qrpcontest.com/pigrun
22	0400	24	0400	1.8-28	Hawaii QSO Party	CW Ph Dig	RS(T) + HI district or SPC	www.hawaiiqsoparty.org
22	1600	23	0400	3.5-28	Ohio QSO Party	CW Ph	RS(T), county or SPC	www.ohqp.org/index.php/rules
22	2100	23	2100	3.5-28	CVA DX Contest, SSB	Ph	RS, category	cvadx.org/regulamento
22	2300	23	0300	50	50 MHz Fall Sprint	CW Ph Dig	4-char grid square	svhfs.org
26	0000	26	0200	1.8-28	SKCC Sprint	CW	RST, SPC, name, mbr or power	www.skccgroup.com
29	0600	30	0559	3.5-28	ALARA Contest	CW Ph	RS(T), name	alara.org.au/contests
29	1200	30	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
29	1200	30	1159	3.5-28	SCC RTTY Championship	Dig	RST, 4-digit year first licensed	lea.hamradio.si/scc/rtty
29	1200	30	1200	3.5-28	YO DX HF Contest	CW Ph	RS(T), YO county or serial	www.yodx.ro
29	1200	30	1200	1.8-28	World Wide Digi DX Contest	Dig	4-char grid square	ww-digi.com
29	1400	29	2200	3.5-28	Kentucky State Parks on the Air	CW Ph Dig	KY park abbreviation or SPC	k4msu.com/kypota
29	1400	30	2000	3.5-50	Kansas QSO Party	CW Ph Dig	RS(T), county or SPC	ksqsoparty.org/rules/KSQPRules2019.pdf
30	1400	30	1700	3.5-14	SARL HF CW Contest	CW	RST, serial	www.sarl.org.za
31	1300	31	1400	1.8-28	QCX Challenge	CW	RST, name, SPC, rig	www.qrp-labs.com/party.html
31	1900	31	2000	1.8-28	QCX Challenge	CW	RST, name, SPC, rig	www.qrp-labs.com/party.html

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.*

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

2020 ARRL RTTY Roundup Results

This year's ARRL RTTY Roundup was held January 4 – 5, 2020.

Top Ten — US and Canada

Single Operator, High Power

AC0C	248,976
W7RN (WK6I, op)	237,600
AA3B	221,844
N6WM	178,556
N1IXF	156,200
K6MR	148,401
AB0RX	135,200
K5XH	127,875
K9WX	111,414
N4CW	103,688

Single Operator, Low Power

W4AAA (KK9A, op)	182,784
WE9V	155,346
AA2MF	144,228
K3AJ	99,500
WA1FCN	97,388
K3RWN	82,305
N0GZ	69,286
N2HMM	66,215
K8ARY	65,751
VA3SB	60,956

Single Operator, QRP

K2YG	39,093
WE6EZ	24,220
NK5G	16,092
K5NZ	12,768
KI4MZC	2,774
W6GMT	2,460
VE3KJQ	1,710
N6HI	1,541
VE3VSM	480
K6GHA	100

Single Operator Unlimited, High Power

K9CT	234,438
VE5MX	222,604
W6YX (N6DE, op)	201,140
W0LSD	188,256
K8IA	178,540
K6LL	173,910
K1MK (@K1TTT)	168,879
KO7SS	168,144
WD6T (@NW6P)	165,342
W7RY	161,928

Single Operator Unlimited, Low Power

AA5AU	197,676
K9OM	157,625
VE4VT	123,785
KI6DY	113,335
WW3S	108,564
VA3DF	94,976
WQ5L	85,258
KE2D	78,750
WT9U	75,055
W5AJ	74,740

Single Operator Unlimited, QRP

N0UR	60,876
W0GJ	44,571
AC8ZU	18,904
N8URE	9,686
VE2NCG	5,170
W4ER	5,002
W7CD	4,032
WB0IWG	3,045
AB7WT	2,720
N1VVV	1,891

Multioperator, Single Transmitter, High Power

N0NI	234,430
W0SD	177,184
W7WW	166,880
K2ADA	148,623
ND2T	147,496
K5RZA	133,878
KM4OQO	133,616
AB5EB	117,990
W3GH	116,085
W4TA	113,730

Multioperator, Single Transmitter, Low Power

K9NR	113,848
N8LRG	89,486
WT0DX	76,930
WD4LBR	69,524
W0PC	68,159
W1QK	49,329
KO0Z	47,432
NJ1F	33,432
W9EAU	30,587
W9AV	26,250

Multioperator, Single Transmitter, QRP

NA5NN	55,272

Top Ten — DX

Single Operator, High Power

P49X (W0YK, op)	323,292
ZF2WF	246,736
F6AGM (FM5CD, op)	150,738
S53X	104,754
EM0I (UT2IZ, op)	95,746
HP3SS	79,488
LY9Y	68,400
KH6ZM	61,790
EA7KI	56,440
DH8BQA	55,742

Single Operator, Low Power

HI3T	116,390
TG9ANF	63,070
IR9D (IW3RUA, op)	61,857
DL3SYA	48,048
RA3Y	46,284
KH6CJJ	42,777
UT5EPP	36,981
CO2AME	34,861
J35X	30,295
IK2RZG	29,960

Single Operator, QRP

F5BEG	49,036
IK1RGK	22,638
TG9ADQ	18,018
YL3FW	8,446
PE2K	4,134
US3EW	3,502
HA7JVV	3,335
DJ3GE	2,475
SN0RVG (SP2UUU, op)	960
EA1GT	897

Single Operator Unlimited, High Power

SN7Q (SP7GIQ, op)	173,696
YO9HP	159,712
UW1M (UR5MW, op)	146,590
IV3SKB	122,694
ER4A (UT5UDX, op)	99,601
SV2BFN	95,041
OH8WW	82,900
ON6NL	72,276
IZ3GFZ	68,600
UR7GO	62,510

Single Operator Unlimited, Low Power

PY2MNL	81,536
LY6A	68,340
CT7AUP	55,853
F4GDI	54,876
IK3TPP	49,797
LX1ER	49,726
UX1UX	46,904
SP9H	45,936
UZ1WW	44,080
8P2K (8P6SH, op)	43,524

Single Operator Unlimited, QRP

YO9BCM	12,656
CO2VE	7,595
EA3FHP	4,128
JG1LFR	3,885
OH2LU	3,848
MM3AWD	2,449
RV3DBK	2,250
YO4BEW	1,326
YO4AAC	1,100
IZ3NVR	1,080

Multioperator, Single Transmitter, High Power

OL7M	147,499
US1Q	142,845
EI7M	135,240
DP7D	121,024
S51A	113,680
YU5R	83,421
SK7K	31,084
9A1CBM	26,550
RK3DXW	25,740
VR2CC	17,766

Multioperator, Single Transmitter, Low Power

9A7T	60,984
J42L	44,080
YO3GNF	14,280
9A7B	8,800
DX3H	5,940
XE2N	2,628
JK2VOC	1,012



Albert Muller, ON5AM, enjoyed coffee while operating during the 2020 ARRL RTTY Roundup. He finished first place in Belgium for the Single Operator, Unlimited, Low Power category, with 286 total contacts. [Albert Muller, ON5AM, photo]

Full Results Online

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

The next ARRL RTTY Roundup will be held January 2 – 3, 2021.

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 plaques 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
P49X (WØYK, op)	DX Single Operator, High Power	Yankee Clipper Contest Club
HI3T	DX Single Operator, Low Power	Rich Cady, N1IXF
AA3B	Atlantic Division Single Operator, High Power	Mike Jacoby, N3MA
K9WX	Central Division Single Operator, High Power	Society of Midwest Contesters
K9CT	Central Division Single Operator Unlimited, High Power	Society of Midwest Contesters
WT9U	Central Division Single Operator Unlimited, Low Power	Society of Midwest Contesters
WDØT	Dakota Division Single Operator, High Power	Minnesota Wireless Assn.
WØPI	Dakota Division Single Operator, Low Power	Minnesota Wireless Assn.
KØTG	Dakota Division Single Operator Unlimited, High Power	Minnesota Wireless Assn.
KØAD	Dakota Division Single Operator Unlimited, Low Power	Minnesota Wireless Assn.
ND2T	Pacific Division Multioperator, High Power	Mother Lode DX/Contest Club
WD4LBR	Roanoke Division Multioperator, Low Power	Sheila Blackley, K4WNW

Continental Winners

Africa		
Single Operator, Low Power	9G2HO (9G5SA, op)	1,247
Single Operator Unlimited, High Power	EA8PT	27,440
Single Operator Unlimited, Low Power	EA8DEG	33,920
Asia		
Single Operator, High Power	JH3FUK	16,848
Single Operator, Low Power	UN7LV	6,052
Single Operator, QRP	JH7UJU	240
Single Operator Unlimited, High Power	JM1XCW	55,794
Single Operator Unlimited, Low Power	JA1BJI	23,030
Single Operator Unlimited, QRP	JG1LFR	3,885
Multioperator, Single Transmitter, High Power	VR2CC	17,766
Multioperator, Single Transmitter, Low Power	JK2VOC	1,012
Europe		
Single Operator, High Power	F6AGM (FM5CD, op)	150,738
Single Operator, Low Power	IR9D (IW3RUA, op)	61,857
Single Operator, QRP	F5BEG	49,036
Single Operator Unlimited, High Power	SN7Q (SP7GIQ, op)	173,696
Single Operator Unlimited, Low Power	LY6A	68,340
Single Operator Unlimited, QRP	YO9BCM	12,656
Multioperator, Single Transmitter, High Power	OL7M	147,499
Multioperator, Single Transmitter, Low Power	9A7T	60,984
North America		
Single Operator, High Power	ZF2WF	246,736
Single Operator, Low Power	HI3T	116,390
Single Operator, QRP	TG9ADQ	18,018
Single Operator Unlimited, High Power	HP1XT	44,190
Single Operator Unlimited, Low Power	8P2K (8P6SH, op)	43,524
Single Operator Unlimited, QRP	CO2VE	7,595
Multioperator, Single Transmitter, Low Power	XE2N	2,628
Oceania		
Single Operator, High Power	KH6ZM	61,790
Single Operator, Low Power	KH6CJJ	42,777
Single Operator Unlimited, High Power	ZM2B (ZL2BR, op)	18,673
Single Operator Unlimited, Low Power	YEØTUR	16,704
Single Operator Unlimited, QRP	YB2BNN	140
Multioperator, Single Transmitter, Low Power	DX3H	5,940
South America		
Single Operator, High Power	P49X (WØYK, op)	323,292
Single Operator, Low Power	PU2WDX	4,180
Single Operator Unlimited, High Power	CX9AU	15,688
Single Operator Unlimited, Low Power	PY2MNL	81,536
Single Operator Unlimited, QRP	PY2MQ	42

Affiliated Club Competition

Club	Score	Entries
Unlimited		
Northern California Contest Club	2,250,767	51
Potomac Valley Radio Club	2,018,034	63
Medium		
Frankford Radio Club	1,592,104	39
Society of Midwest Contesters	1,434,771	42
Yankee Clipper Contest Club	1,141,285	23
Minnesota Wireless Assn.	972,421	44
Arizona Outlaws Contest Club	964,491	19
Florida Contest Group	830,740	22
Contest Club Ontario	531,586	20
Tennessee Contest Group	512,560	13
Western Washington DX Club	457,187	15
Grand Mesa Contesters of Colorado	450,503	9
Central Texas DX and Contest Club	415,074	9
DFW Contest Group	316,947	8
Alabama Contest Group	295,154	7
Kentucky Contest Group	219,416	8
Swamp Fox Contest Group	218,831	7
Southern California Contest Club	211,969	10
North Coast Contesters	205,309	7
Mad River Radio Club	201,469	8
Willamette Valley DX Club	195,231	8
Orca DX and Contest Club	192,462	7
Carolina DX Assn.	181,189	6
Spokane DX Assn.	155,583	7
Valley Amateur Radio Assn.	144,593	4
Northeast Maryland Amateur Radio Contest Society	136,461	5
South East Contest Club	135,157	9
Skyview Radio Society	130,977	3
Great Places Contest Club	122,160	4
Texas DX Society	106,612	4
599 DX Assn.	105,400	3
New Providence ARC	76,103	3
Big Sky Contesters	57,268	3
Granite State ARA	11,723	3
Local		
Orleans County ARC	583,258	10
Niagara Frontier Radiosport	200,372	8
New Mexico Big River Contesters	146,619	3
Metro DX Club	143,428	6
CTRI Contest Group	96,802	4
Bristol (TN) ARC	54,651	4



Iman Arif, YB1IM, worked diligently on his homebrew digital interface in preparation for the 2020 ARRL RTTY Roundup. He enjoyed the event despite rough conditions. [Iman Arif, YB1IM, photo]

Mark Beckwith, N5OT, n5ot@arrl.net

2020 ARRL International DX CW Contest Results



This year's DX CW Contest was held February 15 – 16, 2020.

Matt Strelow, KC1XX, operated the 2020 ARRL International DX CW Contest as HIØLT from Sosúa, Dominican Republic. He constructed a homebrew rooftop tower to support the antennas for the event. Matt finished in second place in the Single Operator Unlimited, High Power category for DX stations. [Matt Strelow, KC1XX, photo]

Full Results Online

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

Continental Winners

Africa

Single Operator, High Power	EA8RM	3,467,178
Single Operator, Low Power	CR3EE (OZ2I, op)	1,223,175
Single Operator Unlimited, High Power	ED8M (EA8DIG, op)	512,316
Single Operator Unlimited, Low Power	EF8O (EA8OM, op)	200,832
Single Operator, 20 Meters	EA8DHV	11,349
Multioperator, Two Transmitter	CR3DX	5,269,005
Multioperator, Multitransmitter	CR3W	4,918,884

Asia

Single Operator, High Power	JH1GBZ (JH5GHM, op)	824,760
Single Operator, Low Power	JH1EAQ	385,182
Single Operator, QRP	JH7UJU	76,146
Single Operator Unlimited, High Power	P33W (5B4AMM, op)	1,234,752
Single Operator Unlimited, Low Power	5B/RN3QO	327,228
Single Operator Unlimited, QRP	JG1LFR	39,060
Single Operator, 160 Meters	JA0QNJ	7,500
Single Operator, 80 Meters	JH1OGC	39,198
Single Operator, 40 Meters	7J1AAI	104,781
Single Operator, 20 Meters	JH3AIU	117,096
Single Operator, 15 Meters	4X1VF	1,596
Multioperator, Single Transmitter, High Power	JH4UYB	1,079,925
Multioperator, Single Transmitter, Low Power	JK2VOC	33,072
Multioperator, Two Transmitter	JH8YOH	830,922
Multioperator, Multitransmitter	JA3YBK	1,476,144

Europe

Single Operator, High Power	CR5E (CT1ILT, op)	3,810,384
Single Operator, Low Power	MU2K	1,155,420
Single Operator, QRP	IZ3NVR	227,799
Single Operator Unlimited, High Power	EA6FO (EA3M, op)	2,721,708
Single Operator Unlimited, Low Power	OR2F	1,215,780
Single Operator Unlimited, QRP	LZ9W (LZ1UQ, op)	767,520
Single Operator, 160 Meters	GW5R (GW3YDX, op)	86,850
Single Operator, 80 Meters	TM6M (F1AKK, op)	195,120
Single Operator, 40 Meters	S52AW	278,070
Single Operator, 20 Meters	S50K	280,356
Single Operator, 15 Meters	HG1S (HA1TJ, op)	14,586
Multioperator, Single Transmitter, High Power	EB5A	2,600,682
Multioperator, Single Transmitter, Low Power	9A7T	831,168
Multioperator, Two Transmitter	EI7M	3,873,945
Multioperator, Multitransmitter	9A1A	3,820,770

North America

Single Operator, High Power	8P5A	6,734,442
Single Operator, Low Power	HQ9X	3,805,110
Single Operator, QRP	V31CO	111,969
Single Operator Unlimited, High Power	KP3DX (NP4Z, op)	4,533,846
Single Operator Unlimited, Low Power	HH2AA (KO7SS, op)	3,493,470
Single Operator, 160 Meters	NP2J (K8RF, op)	129,108
Single Operator, 80 Meters	KP4KE (DK8ZB, op)	225,000
Single Operator, 40 Meters	CO8ZZ	215,232
Single Operator, 20 Meters	AL1G	127,008
Single Operator, 15 Meters	CO8LY	84,315
Multioperator, Single Transmitter, High Power	ZF1A	5,946,675
Multioperator, Single Transmitter, Low Power	ZF5T	4,264,656
Multioperator, Two Transmitter	XE2B	1,636,845

Oceania

Single Operator, High Power	KH6TU (AD6E, op)	1,752,750
Single Operator, Low Power	KH6CJJ	1,002,330
Single Operator, QRP	N7ET/DU7	9,996
Single Operator Unlimited, High Power	KH7M (NA2U, op)	2,861,703
Single Operator Unlimited, Low Power	KH6/W0ZT	185,004
Single Operator Unlimited, QRP	KH6/W7EE	6,936
Single Operator, 80 Meters	DU6/N6SS	13,026
Single Operator, 40 Meters	ZL2AGY	48,000
Single Operator, 20 Meters	ZM1M (ZL1BBW, op)	112,035
Single Operator, 15 Meters	VK4CT	32,265
Multioperator, Two Transmitter	ZL3X	1,311,177
Multioperator, Multitransmitter	KH6/N6DA	4,383,504

South America

Single Operator, High Power	PS2T (PY2ZEA, op)	1,241,100
Single Operator, Low Power	HC2AO	842,697
Single Operator, QRP	PY2VQ	2,673
Single Operator Unlimited, High Power	P44W (W2GD, op)	4,719,999
Single Operator Unlimited, Low Power	9Z4Y	876,096
Single Operator, 80 Meters	PY2PT	90,801
Single Operator, 40 Meters	PY2KJ	46,224
Single Operator, 20 Meters	HK1N	222,300
Single Operator, 15 Meters	PX2A (PY2LSM, op)	277,611
Single Operator, 10 Meters	PY2UDB	20,748
Multioperator, Single Transmitter, High Power	P40L	5,263,608
Multioperator, Single Transmitter, Low Power	FY5KE	1,447,992
Multioperator, Two Transmitter	PJ4A	7,411,875
Multioperator, Multitransmitter	PJ2T	7,888,608

Top Ten — US and Canada

Single Operator, High Power

KC1XX (WA1Z, op)	5,763,204
K1ZZ	4,915,053
VY2TT	4,643,562
KQ2M	4,148,520
K5GN	3,908,124
W9RE	3,757,119
N4AF	3,730,788
VE3AT	3,557,376
N4YDU	3,397,272
N1UR	3,240,576

Single Operator, Low Power

K5KU	1,948,032
N4TZ	1,833,588
N8II	1,755,990
AD5A	1,474,968
W0UO	1,338,564
NT6Q (N5ZO, op)	1,100,655
WJ9B	1,055,604
KD5DD (KG5HVO, op)	1,052,028
K1VUT	902,088
W1VE (VE4EA, op)	834,768

Single Operator, QRP

K2DM	464,607
N1IX	450,882
K3TW	236,649
N7IR	234,600
W6JTI	233,748
K2YAZ	138,408
W6QU (W8QZA, op)	130,074
N7RCS	117,885
W1UU	107,169
ND0C	94,770

Single Operator Unlimited, High Power

KI1G	5,921,280
K5ZD	5,647,674
AA3B	5,562,642
K3WW	5,257,953
AA1K	4,611,960
VA2WA	4,604,046
VE3EJ	4,529,415
N3RD	4,294,320
N3RS	4,215,141
K1RX	4,157,334

Single Operator Unlimited, Low Power

NN1C	2,767,107
VA3DF	1,562,652
N9NC	1,491,504
KS1J	1,403,025
KE3X	1,372,860
VO1HP	1,341,390
W3KB	1,280,988
W9XT	1,245,825
W1QK	1,209,312
K1KNQ	1,178,496

Single Operator Unlimited, QRP

N2WK	390,054
K5NZ	300,906
K8ZT	120,018
W4QO	61,596
KW2A	30,240
W4ER	24,633
KW6G	24,000
KU4A	22,512
VE3HG	17,622
NU4N	2,184
VA3AMX	2,184

Single Operator, 160 Meters

VY2ZM (K1ZM, op)	156,408
W4ZV	73,500
N4XD	64,548
KM1R	24,156
NI0G	23,580
N1QY	12,282
NE0U	12,150
W8WTS	9,315
K1WHS	6,324
KA1J	6,156

Single Operator, 80 Meters

K4ZW	221,880
W3BGN	202,419
W1WEF	171,351
K9ZO	151,470
KV0Q	146,070
K4EA	142,692
N4IJ	111,636
K1DC	74,160
VE3PN	73,236
W0EWD	73,125

Single Operator, 40 Meters

N8OO	532,335
N2MF	501,486
KA1IS	375,417
K2SSS	294,000
N9SE	215,736
K1EA	102,342
KJ4QHL	94,620
K2UF	89,712
W2EG	88,692
K6AR	88,146

Single Operator, 20 Meters

KU2M	510,615
N7TU	373,152
W6YA	307,197
N8BJQ	292,896
K8LX	283,230
W2VJN	252,588
N5CR	238,950
W8WA	206,325
WB4TDH	151,188
N5JJ	140,448

Single Operator, 15 Meters

N4BP	31,506
K4RDU	13,230
VE2NCG	3,402
WU0A	2,550
N6RM	2,394
K0UU	1,575
WB2AMU	1,008
WB7FJG	648
KQ2RP	504
NZ5M	390

Single Operator, 10 Meters

W4DD	3,807
K4WI	3,456

Multioperator, Single Transmitter, High Power

N5DX	5,649,039
K2QMF	4,380,444
K5TR	3,375,735
AA4LS	3,284,400
N1MM	3,244,098
K3PH	3,008,880
AA9A	2,932,056
AA7A	2,784,726
N1RR	2,715,579
W2IRT	2,360,547

Multioperator, Single Transmitter, Low Power

K1XM	1,695,447
K3TD	602,208
W1FM	563,040
W3YI	227,688
NJ1F	102,258
K0UK	63,327

Multioperator, Two Transmitter

W2FU	6,507,396
N4WW	6,377,910
K1IR	5,918,985
K8AZ	5,543,874
VE3JM	5,482,161
K2AX	4,539,969
K4TCG	4,534,920
N0NI	4,478,760
K5KG	3,674,211
N0AX	3,225,672

Multioperator, Multitransmitter

W3LPL	9,706,275
K3LR	9,662,778
NR4M	8,733,054
K1TTT	6,278,370
K1KP	2,703,168
NE3F	2,177,496
W1CSM	1,817,529
NJ3I	1,777,842

Top Ten — DX

Single Operator, High Power

8P5A	6,734,442
V47T	5,901,696
KP2M (KT3Y, op)	5,148,660
TO4A (VE3DZ, op)	4,892,160
CR5E (CT1ILT, op)	3,810,384
EA8RM	3,467,178
ED8W (OM5RW, op)	3,123,651
NP2P (N2TTA, op)	2,850,771
IR2Q (IK2PFL, op)	2,595,546
M6T	2,263,344

Single Operator, Low Power

HQ9X	3,805,110
VP9I	3,618,000
KP2/ND3F	1,906,605
PJ5/KG9N	1,346,169
V47UM (W3UL, op)	1,295,424
CR3EE (OZ2I, op)	1,223,175
MU2K	1,155,420
CO8NMN	1,122,975
DL1IAO	1,037,400
KH6CJJ	1,002,330

Single Operator, QRP

IZ3NVR	227,799
DK7HA	202,917
V31CO	111,969
JH7UJU	76,146
LZ2RS	73,695
HG6C (HA6IAM, op)	62,568
JA6GCE	58,800
IK1RGK	43,596
CO8OH	38,958
JR4DAH	30,420

Single Operator Unlimited, High Power

P44W (W2GD, op)	4,719,999
KP3DX (NP4Z, op)	4,533,846
V26M (N3AD, op)	4,325,148
KH7M (NA2U, op)	2,861,703
EA6FQ (EA3M, op)	2,721,708
NP2X (K9VV, op)	2,618,865
SN7Q	2,399,364
CE2LR	2,301,453
9A4M	2,214,855
OM7M (OM5RM, op)	2,200,122

Single Operator Unlimited, Low Power

HH2AA (KO7SS, op)	3,493,470
HI0LT (KC1XX, op)	3,106,386
OR2F	1,215,780
9Z4Y	876,096
PC3T	827,424
EC4TA	742,050
EW6W	702,372
UZ3A (UX1AA, op)	693,387
DL9EE	651,840
SN7O (SP7IVO, op)	605,280

Single Operator Unlimited, QRP

LZ9W (LZ1UQ, op)	767,520
OK2FD	236,340
OK2AP	55,944
EA2DPA	53,799
JG1LFR	39,060
JA6WFM	29,376
JK7DWD	25,500
JK1TCV	17,673
EA1AER	17,658
HB9TPN	15,900

Single Operator, 160 Meters

NP2J (K8RF, op)	129,108
GW5R (GW3YDX, op)	86,850
S50C (S53RM, op)	61,194
OL1A (OK1CW, op)	59,472
CO2AN	58,800
DR5X (DL8LAS, op)	52,716
SK3GW (SM5IMO, op)	51,747
PI4DX (PD1DX, op)	45,630
F6FYA	43,200
LY7Z	42,504

Single Operator, 80 Meters

KP4KE (DK8ZB, op)	225,000
TM6M (F1AKK, op)	195,120
J35X	141,462
SN2M (SP2XF, op)	140,904
TM6X (F5VHY, op)	139,536
HB9FAP	138,264
RW2F (RA2FA, op)	137,760
HA8JV	134,064
HA5JI	132,495
YR2V (YO5LD, op)	122,430

Single Operator, 40 Meters

S52AW	278,070
TM5EE (FM5CD, op)	276,330
SN3A (SQ2GXO, op)	266,814
YT5A (YU1AU, op)	249,300
9A8M (9A3XU, op)	229,299
S57Q	222,372
EC5K	219,657
CO8ZZ	215,232
Z35T	202,806
YU7U	172,260

Single Operator, 20 Meters

S50K	280,356
II2S (IK2QEI, op)	274,134
F5OGL	250,893
9A5X	242,841
YT3X	223,728
HK1N	222,300
PY2NY	216,123
S51YI	205,560
HG0Y (HA7GN, op)	202,140
OG1D	200,187

Single Operator, 15 Meters

PX2A (PY2LSM, op)	277,611
LU3JVO	250,101
PP5KR	212,976
LW8DQ	196,116
CE2ML	102,795
CO8LY	84,315
LU2EE (LW5EE, op)	70,668
XR2K (CX1EK, op)	62,868
OA4/EA7TN	33,345
LU3MAM	32,853

Single Operator, 10 Meters

PY2UDB	20,748
PU2USL	108

Multioperator, Single Transmitter, High Power

ZF1A	5,946,675
P40L	5,263,608
TI7W	5,189,646
VP5K	5,053,917
VP2MSS	4,858,704
HC5DX	3,525,222
4A7S	2,819,547
EB5A	2,600,682
LZ5R	2,152,080
OK5Z	2,104,674

Multioperator, Single Transmitter, Low Power

ZF5T	4,264,656
V3T	4,016,424
FY5KE	1,447,992
NP4DX	1,304,730
9A7T	831,168
E7CW	541,200
V4/K3VX	333,720
F8KLY	210,600
S53D	73,836
PR1M	69,255

Multioperator, Two Transmitter

PJ4A	7,411,875
CR3DX	5,269,005
EI7M	3,873,945
EA7X	3,526,269
RL3A	1,845,120
HG7T	1,802,640
XE2B	1,636,845
LY4A	1,600,704
ZL3X	1,311,177
AH2R	999,630

Multioperator, Multitransmitter

PJ2T	7,888,608
CR3W	4,918,884
KH6/N6DA	4,383,504
9A1A	3,820,770
E7DX	3,325,455
LN8W	2,577,150
DR4A	2,565,198
JA3YBK	1,476,144
RU1A	1,259,604

The next ARRL International DX CW Contest will be held February 20 – 21, 2021.

The 2020 ARRL September VHF Contest

1800 UTC Saturday, September 12 – 0259 UTC Monday, September 14

Late summer can only mean one thing: the ARRL September VHF Contest is upon us once again! Head to your favorite summit or prominence, or activate a rare grid square. To figure out your grid square, visit **www.arrl.org/grid-squares**.

All legal modes are allowed in this 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**.

Even with a modest station, you can enjoy this event. If you have an HF rig 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 24, 2020.



John Edwards, KB4BKV, and his son operated from grid square FM19 in Pennsylvania during the 2019 September VHF Contest. They used homebrew antennas on the 6-, 2-, and 1.25-meter bands, as well as the 70-centimeter band. [John Edwards, KB4BKV, photo]

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

The 2020 ARRL 10 GHz and Up Contest

Held each year on the third full weekend of August and September.
Weekend 1: August 15 – 16, 2020. *Weekend 2:* September 19 – 20, 2020.
Each weekend begins 6 AM Saturday and runs through midnight Sunday, local time.



Peter Prabucki, VA3ELE, and Hugh Duff, VA3TO, took a break along the northern shore of Lake Ontario after making several 620-kilometer contacts with stations on Block Island, Rhode Island, during the 2019 ARRL 10 GHz and Up Contest. [Hugh Duff, VA3TO, photo]

The microwave bands 10 GHz and above will be exceptionally active in the 2020 ARRL 10 GHz and Up Contest. The object 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 20, 2020.

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

The 2020 ARRL International EME Competition

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

Three weekends of activity for this year's contest:

September 12 – 13: 2.3+ GHz

October 10 – 11: 50 – 1296 MHz

November 28 – 29: 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.

In the ARRL EME Competition, certificates are awarded to all stations who submit a log with at least one contact. 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, December 29, 2020. 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.



During the 2019 ARRL International EME Competition, Roger Rehr, W3SZ, adjusted the feed for his new 10 GHz trailer-mounted dish antenna, while Paul Sokoloff, WA3GFZ, provided assistance. [Russell Lamm, NN3Q, photo]

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

Feedback

In the July 2020 issue of *QST*, the list of Leadership Donors should have included Bill Carpenter, AA8EY, and the list of Legacy Circle donors should have included James M. Galm, W8WTS, and Mario Karcich, K2ZD. *QST* regrets the omissions.

New Products

Talon Power Systems FX-2000 Flex Shield ICS



Talon Power Systems introduces the FX-2000 Flex Shield industrial control system (ICS). The FX-2000 is built on a user-customizable platform, powered by the ATmega2560 micro-controller and easily programmed in the *Arduino IDE* software. Its flexible modular architecture allows rapid assembly of rugged control and monitor solutions for automation components such as motors, relays, and sensors, using FX-2000 series fault-protected, galvanically isolated I/O and data communications modules. To learn more, visit **www.talonpowersystems.com**.

Bernie McClenny, W3UR, w3ur@arrl.org

How's DX?

Updated Top Ten Lists

Beginning in February and peaking in March and April, DXpedition cancellations were at an all-time high due to the COVID-19 pandemic. Every operation announced in the May "How's DX" column was canceled, as well as over 100 other DXpeditions, trips, IOTA activations, and contest operations.

On the plus side, everyone staying home has led to the ham bands being full of activity. Even many hams who have been off the air for a long time are getting involved again. Special call sign suffixes, such as "STAYHOME," have been keeping the bands busy around the world. Contest activity has also increased, as so many people are enjoying the hobby while keeping busy at home. As we take advantage of the extra activity on the bands, here are some DX entities to dream about for the future.

Top Ten Most-Wanted List

Most of the loyal readers of this column are familiar with Club Log's Top Ten Most-Wanted List (**https://clublog.org/mostwanted.php**). It's a listing of the rarest DXCC entities. As of the end of May 2020, the top 10 most-wanted DXCC entities were (in order from 1 – 10):

- P5 — North Korea
- 3Y/B — Bouvet Island
- FT5/W — Crozet Island
- BS7H — Scarborough Reef
- CEØX — San Felix Island
- BV9P — Pratas Island
- KH7K — Kure Island
- KH3 — Johnston Island
- 3Y/P — Peter I Island
- FT5/X — Kerguelen Island

Inactive List

Another list that some like to follow is the top ten most-inactive countries list. This list includes the DXCC entities that have shown no activity for the longest duration. The top ten for this list (in order by years, not time on the air) are:

- CEØX — San Felix Island (18 years)
- KH3 — Johnston Island (17 years)
- BV9P — Pratas Island (16 years)
- KH7K — Kure Island (14 years)
- 3Y/P — Peter I Island (14 years)
- YVØ — Aves Island (13 years)
- EZ — Turkmenistan (13 years)
- BS7H — Scarborough Reef (13 years)
- 3Y/B — Bouvet Island (12 years)
- KP5 — Desecheo Island (11 years)

Activity List

This list may be unfamiliar to most readers. It's the top ten most-wanted countries that have had one or more active amateur radio operators within this year. These countries are:

- SV/A — Mount Athos (SV2RSG/A)
- 4U_UN — United Nations Headquarters (4U1UN)
- 6O — Somalia (6O1OO)
- T30 — Western Kiribati (T3ØTM)



Monk Iakovos Kutlumusian (Jacob), SV2RSG/A, was on the air in May from the Koutloumousiou Monastery. Mount Athos (SV/A) ranks number 19 most-wanted worldwide and number 2 in the western half of North America. [Theodoros Giamtsidis, SV1GRM, photo]



Chris Hannagan, ZL7DX (ZL2DX), and his wife, Catherine Hannagan, ZL7QT (ZL2QT), are living on Chatham Island (ZL7) for the foreseeable future. They plan to build an antenna farm, with antennas on 1.8 through 1296 MHz. Currently, they have a multi-wire vertical with elevated radials for 3.5 – 28 MHz and a seven-element Yagi on 50 MHz. Chris is mostly active on FT8, with plans to be more active on CW and SSB. [Chris Hannagan, ZL7DX, photo]



In early March, Nicolas Sinieokoff, TT8SN (F8FQX), visited Jean-Pierre Berthoumieux, F6ITD, who was vacationing in Guadeloupe. Nicolas is back in N'Djamena, Chad (TT), where he will be operational for the next 3 – 4 years. He can be found mostly on FT8 and some CW on 1.8 through 50 MHz. [Nicolas Sinieokoff, TT8SN, photo]



As soon as it's deemed safe, Akio Taguchi, JE2QIZ, plans to be back in Yangon, Myanmar, and be operational again as XZ2B. Myanmar ranks number 52 on Club Log's most-wanted list. [Akio Taguchi, JE2QIZ, photo]

- KH8 — American Samoa (AH8M)
- ZL7 — Chatham Islands (ZL7DX)
- S2 — Bangladesh (S21ED)
- Z6 — Republic of Kosovo (Z61DX, Z62FB, etc.)
- TT — Chad (TT8SN)
- 5A — Libya (5A1AL and 5AØYL)

It should be noted that there are multiple licensed amateur radio operators in Turkmenistan (EZ), however, they have not been authorized to get on the air since August 2006. Syria (YK) has several licensed operators, but they've said they won't go back on the air until the civil war is over. South Orkney Islands (VP8/O) has an Argentine Naval Base on Laurie Island, LU1ZA, and is occasionally on the air with authorized military operators. Tristan Da Cunha and Gough Islands (ZD9) have Andy Repetto, ZD9BV, but he has not been active for a while.

Operators in Rare Locations

Akio Taguchi, JE2QIZ, was in Myanmar (XZ) until March, when he went back to Japan due to the COVID-19 pandemic. He will return to XZ2B when things settle down. Aboobacker Kunhi Badayi, VU3EBX, is the only licensed ham in Lakshadweep Islands (VU7), however, as of early this year, he only had a VHF transceiver. His license allows 50 W on the HF bands. Warwick Latham, E51WL, is currently stranded in New Zealand waiting to go back home to Penrhyn Atoll, North Cook Islands (E5/N). Satoshi Kawamura, JH2EUV, was in East Timor (4W) up until early March, and active as 4W/JH2EUV. He may have gone back home to Japan. There are two licensed nationals in Tuvalu (T2) — Atufenua Maui, T2AM, and Apinelu Tili, T2AT — but they have not been reported in over a year.

If you're not on the ARRL DXCC Honor Roll, there are still opportunities to work new countries. You just have to know when they're active in order to have your chance at working an all-time new one (ATNO). One of my favorite ways to know a station's habits is to use DX Summit (**http://www.dxsummit.fi/#**) and search for the call sign or name of the country. The site has a powerful database, and you can even choose search filters for band, mode, and date range.

Wrap-Up

That's it for this month, with special thanks to SV1GRM, TT8SN, JE2QIZ, and ZL7DX for helping to make this month's column possible. Don't forget to send your DX news, photos, and club newsletters to **bernie@dailydx.com**. Until next month, see you in the pileups!
— *Bernie, W3UR*

Jon Jones, NØJK, n0jk@arrl.org

The World Above 50 MHz

Large Rates of Unlogged Contacts

Joe Taylor's, K1JT, *WSJT-X* software suite with the amazing FT8 mode has become the predominant mode for sporadic E and tropospheric propagation on the VHF bands. According to the *WSJT-X User Manual*, one reason is "FT8 is an excellent mode for multi-hop E_s on 6 meters, where deep fading may make fast and reliable completion of contacts desirable."

But there are times when it may not be entirely clear that a contact has been completed, or you think you completed a valid contact, but when you check Logbook of The World (LoTW) or Club Log, the other station has not confirmed your contact. For example, I called K7ULS on 6 meters, and Mike answered me with a signal report. I replied "R-13," and Mike received it, but I never received a RRR or RR73, so I considered the contact incomplete. Unconfirmed or incomplete contacts that do not end up in the log occur in daily operation, chasing DXpeditions, and in contests.

Conducting a study of radio contests, the *WSJT-X* team found an "undesirably large rate" of contacts that don't end up in the log during log checking procedures of HF digital contests (see Table 1). This has also been found in VHF contests, and from anecdotal observations in regular VHF operation.

A 5% unlogged contacts rate for these contests is larger than I imagined — higher than SSB or CW contests, which are around 1 – 2%. It may be reasonable to extrapolate a similar occurrence for non-contest contacts that don't end up in the log, particularly during a busy DX opening on 50 MHz with heavy stateside interference in the FT8 passband.

I have found that FT8 requires careful operator attention to what is in the send box, what you see is received, and the context of these messages. For instance, it is important to check that the other station didn't request repeated information. They may also keep sending a report, which could indicate they're waiting for you to confirm or send more information.

These issues occur more often when the band is busy, the frequency not clear, and the other station's signal is weak. The *WSJT-X* team has observed that many of the unlogged contacts are a result of "operators trusting too much in the automated message sequencing and logging features." The team concluded that a human decision to log a contact or not "is always best."

As a general set of guidelines for logging FT4/FT8 contacts, the *WSJT-X* team recommended these steps:

1) In *WSJT-X*, activate and learn to use the Alternate F1 – F6 bindings. These are selectable on the **SETTINGS** tab, in the **GENERAL** window.

2) Always log a contact when you have received "RRR," "RR73," or "73" from the station you are making a contact with.

3) Log a contact when you send "RR73," if you are reasonably confident it will be copied, but be sure to watch for any indication it was not copied. Avoidable human error is often the cause for your contact "not being in the log."

Table 1
Basic Statistics of the HF Digital Contests

Contest	Contacts	Unlogged Contacts	Average Percent Unlogged Contacts
2018 FT8 Roundup	127,340	5,803	4.6%
2019 FT8 Roundup	134,038	6,110	4.6%
2019 WW-Digi	178,906	9,669	5.5%

On the Bands

50 MHz. On May 5, KF2ZQ picked up 4U1UN on ground wave. On May 8, Larry, NØLL, operated portable from grid DN90. He made MSK144 contacts during the Eta Aquarid meteor shower, and sporadic-E contacts on FT8. Danny, KB8W (EN57), made E_s contacts to W7 and VE6. WD4ELG and KØBJ reported working SG6T (JO68).

On May 11, I picked up J68HZ at 2334Z on FT8 received a –24 dB report.

On May 17, Jay, KØGU (DN70), said, "I had a European opening all to myself." Jay logged 21 European stations, including YO3DZZ for his 152nd country. On May 18, Bob, K6QXY, worked HG2DX at 1547Z on FT8.

On May 21, Larry was mobile in EN01 (see Figure 1). He worked UW5EJX/MM at 1900Z in grid EL54. Starting at 2109Z, Larry worked almost ten stations. Larry said, "I started hearing Japanese stations from my home station. I heard JG1TSG working WA5ZFP and JA7WSZ working WA5ZFP." On May 22, Marty, N9OG (EM28), worked



Figure 1 — Larry, NØLL, set up a portable operation from EN01 in Nebraska on May 21, 2020. [Larry Lambert, NØLL, photo]



Figure 2 — Mike, K7ULS, set up a temporary station in Utah. He used a Cushcraft AR-6 vertical on 6 meters to make contacts with stations in Cuba on May 26, 2020. [Mike White, K7ULS, photo]

CO8ZZ using FT8. He uses a three-element Yagi and an Icom IC-7100.

On May 24, Hawaiian stations were logged across North America. Jim Reisert, AD1C (DM79), reported that stations in Wisconsin and Minnesota were able to work Hawaii on 6 meters starting around 2300Z on May 24. This included NH6Y, KH6ZM, and KH6U on FT8. John Sweeney, K9EL, in Illinois, worked three Hawaiian stations from 2240 – 2250Z. According to the *Daily DX*, John called it "the best 6-meter opening to Hawaii from W9 that I have seen."

Bruce, W9XX, also worked the Hawaiians. He worked KH6ZM, KH6U, NH6Y, KH6HI, and KH6TU over 17 minutes. On May 25, Bruce worked KV4HV in rare EL94. He runs 600 W to a six-element LFA Yagi at 50 feet. He was unable to make contacts with Hawaii stations with 200 W. On May 29, Dan, NP2J, worked 185 European stations on CW.

On May 30, Rich, K1HTV (FM18), worked TT8SN at 1202Z on FT8. This is K1HTV's 162nd country on 6 meters. Nicolas, TT8SN, posted that he had low ambient noise, as power was off in his town. At 1330Z, Rich logged 6W1TA. Rich said Tim, WW1L, copied WP4G making a contact with Nodir, EY8MM, at 1142Z. That is some long-haul DX!

Dave, N2SLO, worked many stateside stations on E_S. KF2ZQ found J68HZ (FK93), and FG8OJ (FK96). J68HZ has done an outstanding job this season handing out J6 Dominica. WA2GFN worked K2H, a special event "Heroes Station."

On Saturday, May 31, there was a rare opening from Alaska to the US Midwest and New England states. Mike, N1XK, woke up when JT Alert said "new state." He picked up KL7HBK at –3 dB at 0530Z, while running only 80 W (see Figure 2). This was his last state for the Worked All States award. AAØMZ in EM29 also worked KL7HBK, and said he was on almost an hour.

What's being called "a historic opening" on 6 meters in the Pacific Northwest to Europe occurred on May 31, when David Schaller, W7FN, saw the band open at about 1430Z. W7FN worked 12 DXCC entities on FT8 (on 50.323 MHz). From Illinois, Bruce, W9XX, found the band open to Europe. Going to 50.323 MHz, he ran a string of Europeans in 10 new countries. From Washington State, N7BT worked 34 Europeans in 14 countries.

Paul, K7CW, said, "I worked 83 European stations and 20 entities. Two of the entities were new ones for me, TK (Corsica) and 4O (Montenegro). An initial look at LoTW confirmations has 20 new ones."

The last time an opening like this took place was 10 years ago.

144 MHz. E_S popped up briefly on May 30. Ron, WZ1V (FN31), worked KØTPP and AAØKM in Missouri on SSB with S-9 signals.

222 MHz. N9HF (EL99) worked W7XU (EN13) on May 27 on JT65 EME.

Here and There

From rare Greenland, Bo Christensen, OX3LX, has been showing up on 6 meters on FT8 between 2230 and 0000 UTC.
— *Thanks to* The Daily DX

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

Special Event Stations

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

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

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

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

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

July 17 – July 19, 0400Z – 0400Z, W4W, Gaffney, SC. Cherokee County Coroner's Office. **South Carolina Peach Festival**. 442.500 147.240 145.250 145.190. Certificate & QSL. Dennis Fowler, P.O. Box 1210, Gaffney, SC 29342. **dfowler@cherokeecountycoroner.com**

July 31 – Aug. 2, 1700Z – 0100Z, W9B, Sheboygan, WI. Sheboygan County Amateur Radio Club. **67th Annual Sheboygan Brat Days**. 14.240 7.240. Certificate.* Sheboygan County Amateur Radio Club, c/o Steve Eisold, 4235 N. 29th St., Sheboygan, WI. **www.w9vcl.com**

Aug. 1 – Aug. 9, 0000Z – 2359Z, W8AL, Canton, OH. Canton Amateur Radio Club. **Pro Football Hall of Fame Enshrinement Festival**. 14.300 14.030 7.250 7.030 3.950 3.530; watch for FT8 or other digital modes; BM DMR 313989. Certificate. Canton ARC/W8AL, c/o Justin, W8JKC, P.O. Box 8673, Canton, OH 44711-8673. **www.w8al.org**

Aug. 1 – Aug. 14, 0000Z – 2359Z, W5G, Edmond, OK. KG5JST. **Oklahoma Green Corn Rebellion, 103rd Anniversary**. 14.074 7.078 7.074. QSL. LoTW, QRZ.com, or direct to James M. Branum, KG5JST, P.O. Box 721411, Oklahoma City, OK 73172. *Operating Field Day-style from several locations in Oklahoma, including some Green Corn Rebellion event sites. Primarily on FT8 and JS8Call; will also be doing some voice (SSB and FM). QSL card will be sent to anyone who asks, including SWLs.* **greencorn.org/w5g**

Aug. 2, 1400Z – 2020Z, WØR, Red Wing, MN. Hiawatha Valley Amateur Radio Club. **River City Days**. 14.250 7.250 147.300. Certificate. Bill Eichenlaub, 1966 Launa Ave., Red Wing, MN 55066. **hvamateurradioclub.com**

Aug. 3 – Aug. 8, 1300Z – 2300Z, K2BSA/various, various cities. Boy Scouts of America Order of the Arrow. **National Order of the Arrow Conference**. 21.360 14.290 14.065 7.190. QSL. Per operator's instructions. *The National Order of the Arrow Conference, scheduled for Michigan State University, has been canceled; amateurs who are OA members will be operating K2BSA in many call areas throughout the week.* **www.k2bsa.net**

Aug. 4 – Aug. 5, 1400Z – 0400Z, K1CG, Port Angeles, WA. CG CW Operators Association. **US Coast Guard 230th Birthday**. 21.052 14.052 7.052 3.552. QSL. CG CW Operators Association, Fred Goodwin, 424 N. Bagley Creek Rd., Port Angeles, WA 98362. **www.qrz.com/db/k1cg**

Aug. 11 – Aug. 15, 0000Z – 0000Z, N7C, Window Rock, AZ. Herbert Goodluck, N7HG. **Navajo Code Talkers Special Event**. 18.133 14.265 7.265. Certificate & QSL. Navajo Code Talkers, P.O. Box 06, Chinle, AZ 86503. **www.qrz.com/db/n7c**

Aug. 15, 1400Z – 2100Z, N4F, Franklin, NC. Franklin Amateur Radio Club. **Appalachian Trail 83rd Anniversary**. 14.265 14.045 7.265 7.045. QSL. Franklin Amateur Radio Club,

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**.

K2BHQ, 505 N. Sugar Creek Dr., Franklin, NC 28734. *Event station will be located at the Rock Gap trailhead on the AT.* **k2bhqemail@gmail.com**

Aug. 22 – Aug. 24, 0001Z – 1800Z, W5BMC, Berwick, LA. Bayouland Emergency Amateur Radio Service/BEARS. **Southwest Reef Lighthouse/ILLW/US0176**. 14.275 7.275. QSL. Jackie Price, 708 Front St., Morgan City, LA 70380.

Aug. 22 – Aug. 30, 1200Z – 2300Z, N1P, Canfield, OH. NPS Ranger News. **National Park Service Founders Day**. 14.255 7.290. Certificate. Available online; see website for instructions. **www.qrz.com/db/n1p**

Aug. 27 – Sep. 7, 1200Z – 1200Z, W7B, Gerlach, NV. Mansonian. **Burning Man**. 28.375 21.325 14.250. QSL. George Badger, 4602 Fairway Dr., Soquel, CA 95073. **w7b@w3ab.org**

Aug. 29 – Sep. 7, 0000Z – 2359Z, W3B, Sharon, PA. Mercer County Amateur Radio Club. **Buhl Day, 105th Anniversary of Buhl Farm Park**. 145.350 14.240 7.185 D-STAR Reflector 63C. QSL. Mercer County Amateur Radio Club, P.O. Box 996, Sharon, PA 16146. *Operating at various times as conditions permit. We are also providing communications for a half marathon. Check website for scheduled times of W3B operation.* **www.qrz.com/db/w3b** *or* **www.w3lif.org**

Melissa Stemmer, KA7CLO, mstemmer@arrl.org

At the Foundation

ARRL Foundation Announces The Frankford Radio Club Scholarship

The ARRL Foundation has announced that The Frankford Radio Club Scholarship will join the growing list of scholarships administered by the Foundation. The Frankford Radio Club is "a very active radiosport contesting club centered in Alburtis, Pennsylvania," and is dedicated to increasing operating skill and technical expertise through the medium of radiosport. Their motto is "Proficiency Through Competition." The scholarship will be $1,500, with the first scholarship expected to be awarded in 2020.

The applicant must be a US citizen and must hold a valid US-issued amateur radio license. The scholarship is open to graduating high school seniors, undergraduate students, and US military veterans. The applicant must be pursuing a degree in electronics, electrical engineering, computer science, or related fields at any accredited college, university, or trade school that has established programs in the field of study. Preference will be given to applicants residing within 175 miles of Alburtis, Pennsylvania.

The ARRL Foundation shall determine award recipients and disburse the award funds directly to the chosen institution of higher learning. For more information, visit **www.arrl.org/scholarship-program**.

Certificate of Code Proficiency

Recipients

Sponsored by VIBROPLEX
www.vibroplex.com



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

March 2020

Paul A. Gierow, KN4NVU	10
Richard J. Guerrera, KB1FGC	10
Justin C. Jackson, Jr., WB4ABY	10
Wieslaw Kokoszka, KD8UDU	10
Michael S. Lundy, W4MSL	10
William D. Paul, Sr., KK4LYQ	10
Reiner R. Dieg, N2PEZ	15
Richard J. Guerrera, KB1FGC	15
Thomas F. Miller, W1PDI	15
Randall W. Woessner, KC1NN	15
Robert B. Brown, K6AAQ	20
Cesidio DiBenedetto, Jr., KD8OOB	20
Robert S. Zarges, Jr., K2MZ	20
David R. Otto, KC8ZH	25

April 2020

Daniel L. Allen, Jr., KB4ZVM	10
Teri J. De Leo, K7RBT	10
Robert H. Dickerson, W7VD	10
Daryl J. Garrett, KX4WY	10
David R. Hague, K1DRH	10
Michael J. Love, K8IM	10
Michael L. Marquissee, K9QOO	10
Thomas J. Mozdzen, K7MOZ	10
Jerome F. Palmer, N3KRX	10
Robert E. Rightmire, WA7YNU	10
James N. Wolf, KW4UT	10
Leland R. Bond, N7KC	20
Robert L. Crispin, KM7Q	20
Richard J. Guerrera, KB1FGC	20
Gerald Lemay, VA2GLU	20
William J. Otten, KC9CS	25
David W. Wilkins, W0PF	25

May 2020

James Joseph Goudy, N0JG	10
Randy E. Prescher, AC9WR	10
William A. Riches, WA2DVU	10
Gregory S. Weiler, K3MGQ	10
Benjamin M. Cahill, III, AC2YD	15
Benjamin M. Cahill, III, AC2YD	20
Richard E. DuBroff, W9XW	20
Ralph L. Irons, N4RLI	25
William J. Wrbican, K3QP	30
Philippe Givet, F5IYJ	35
Jay P. Jenkins, WE2KEY	35

June 2020

Ronald J. Hollas, K8RJH	20

Congratulations to all the recipients.

August 2020 W1AW Qualifying Runs

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

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 will be transmitted by K9JM on Wednesday, August 26 at 9 PM PDT (0400 UTC August 27) 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.

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 2020
(All times in Eastern Daylight Time)

Monday	Tuesday	Wednesday	Thursday	Friday
8/3 4 PM – 2000Z 10 – 35 WPM	**8/4** 7 PM – 2300Z 35 – 10 WPM		**8/6** 10 PM – 0200Z (8/7 – UTC) 10 – 40 WPM	**8/7** 9 AM – 1300Z 10 – 35 WPM
	8/11 4 PM – 2000Z 10 – 35 WPM	**8/12** 7 PM – 2300Z 10 – 40 WPM	**8/13** 9 AM – 1300Z 35 – 10 WPM	**8/14** 10 PM – 0200Z (8/15 – UTC) 10 – 35 WPM
	8/18 9 AM – 1300Z 10 – 35 WPM	**8/19** 10 PM – 0200Z (8/20 – UTC) 35 – 10 WPM	**8/20** 7 PM – 2300Z 10 – 35 WPM	**8/21** 4 PM – 2000Z 10 – 40 WPM
8/24 10 PM – 0200Z (8/25 – UTC) 10 – 40 WPM		**8/26** 9 AM – 1300Z 35 – 10 WPM	**8/27** 4 PM – 2000Z 35 – 10 WPM	**8/28** 7 PM – 2300Z 10 – 35 WPM

Convention and Hamfest Calendar

Abbreviations

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

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

Connecticut (Newtown) — Aug. 23 D F H R S T V
8 AM – 1 PM. *Spr:* Candlewood ARA. Edmond Town Hall, 45 Main St. *TI:* 147.3 +600 (100 Hz). *Adm:* $7. **www.cararadioclub.org**

Florida (Fort Pierce) — Aug. 15 D F H Q R S V
8 AM – 1 PM. *Spr:* Fort Pierce ARC. Indian River State College, 3209 Virginia Ave. *TI:* 147.345 (107.2 Hz). *Adm:* $7. **www.fparc.org**

Florida (Tampa) — Aug. 17 F H 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**

Indiana (Winchester) — Aug. 15 D F H Q R S T V
8 AM – 3 PM. *Spr:* Randolph County Amateur Club. Randolph County Fairgrounds, 1885 U.S. 27. *TI:* 147.3 (110.9 Hz). *Adm:* Free.

Kansas (Hutchinson) – Sep. 5 D F R S V
8 AM – 3 PM. *Spr:* Reno County Kansas ARA. Kansas National Guard Armory, 1111 N. Severence. *TI:* 147.12. *Adm:* Donations appreciated. **www.rckara.org**

Massachusetts (Adams) — Aug. 23 D F H R T V
7 AM – noon. *Spr:* Northern Berkshire ARC. Adams Agricultural Fairgrounds, 371 Old Columbia St. *TI:* 149.91 (162.2 Hz). *Adm:* $5. **www.nobarc.org**

Minnesota (Brainerd) — Aug. 22 F H Q T V
9 AM – 1 PM. *Spr:* Brainerd Area ARC. Crow Wing County Fairgrounds, 2000 13th St. SE. *TI:* 147.225. *Adm:* Free. **www.brainerdham.org**

Minnesota (Worthington) — Aug. 22 F H R S V
9 AM – 1 PM. *Spr:* Northern Plains Regional Radio Council. Worthington Regional Airport, 1698 Airport Rd. *TI:* 146.67 (141.3 Hz). *Adm:* Free. **www.facebook.com/groups/NPRRC**

Missouri (Joplin) — Aug. 21 – 22 D F H R V
Friday 1 PM – 7 PM, Saturday 8 AM – 2 PM. *Spr:* Joplin ARC. Jack Lawton Webb Convention Center, 5300 S. Range Line Rd. *TI:* 147.21 (91.5 Hz). *Adm:* Advance $8, door $10. **www.joplinhamfest.org**

Missouri (O'Fallon) — Aug. 9 D F H R V
7 AM – noon (flea market), 8 AM – noon (Vendor Hall). *Spr:* St. Charles ARC. Elks Lodge, 1163 Tom Ginnever Ave. *TI:* 146.67. *Adm:* $5 for one or $20 for 5. **www.wb0hsi.org/hamfest**

New Jersey (Ringwood) — Aug. 15 D F H R T
8 AM. *Spr:* Ramapo Mountain ARC. St. Catherine's Parish Center, 112 Erskine Rd. *TI:* 146.49, 147.49 (107.2 Hz). *Adm:* $5. **www.qsl.net/rmarc**

New Jersey (Spring Lake Heights) — Sept. 5 D F H R T V
7:30 AM – noon. *Spr:* Ocean Monmouth ARC. Spring Lake Heights Independent Fire Company No. 1, 700 Sixth Ave. *TI:* 145.11 (127.3 Hz). *Adm:* $5. **www.n2mo.org**

New Mexico (Alamogordo) — Sept. 5 D F H R S V
7 AM – 3 PM. *Spr:* Alamogordo ARC. Otero County Fairgrounds, 401 Fairgrounds Rd. *TI:* 146.8 (127.3 Hz). *Adm:* Free. **www.qsl.net/k5lrw/hamfest.htm**

New York (Avoca) — Aug. 15 F H R T V
8 AM. *Spr:* Keuka Lake ARA. Howard Community Center, 7481 Hopkins Rd. *TI:* 145.19 (110.9 Hz). *Adm:* Free. **http://klara.us**

New York (Macedon) — Aug. 29 D F H R T V
7 AM. *Spr:* ROC City Net. Log Cabin Family Restaurant, 2445 W. Walworth Rd. *TI:* 145.110 (110.9 Hz). *Adm:* Free. **www.roccityhamfest.com**

New York (Rensselaer) — Aug. 29 F R V
8 AM – 1 PM. *Spr:* East Greenbush ARA. East Greenbush Volunteer Fired Dept., 68 Phillips Rd. *TI:* 147.27 (94.8 Hz). *Adm:* $6. **www.egara.club**

Pennsylvania (New Kensington) — Aug. 30 D F Q R S T
8 AM – 2 PM. *Spr:* Skyview RS. Skyview RS Clubhouse Grounds, 2335 Turkey Ridge Rd. *TI:* 146.64 (131.8 Hz). *Adm:* $5. **www.skyviewradio.net**

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 **July 1** to be listed in the **September** issue. Information in this column is accurate as of our deadline; contact the sponsor or check the sponsor's website for possible late changes, driving directions, and other event details. Please note that postal regulations prohibit mention in *QST* of games of chance, such as raffles or bingo.

Promoting your event is guaranteed to increase attendance. As an approved event sponsor, you are entitled to special discounted rates on *QST* display advertising and ARRL web banner advertising. Call ARRL's toll-free number at 1-800-243-7768, or email **ads@arrl.org**.

WEST VIRGINIA STATE CONVENTION
August 21 – 23, Flatwood, Sutton, WV
D F H Q R S T V
Friday 2 – 9 PM, Saturday 7 AM – 9 PM, Sunday 8 AM. *Spr:* West Virginia State Amateur Radio Council. Days Inn & Suites By Wyndham, Convention Center, 350 Days Dr. *Tl:* 145.39. *Adm:* $5. **www.qsl.net/wvsarc**

Wisconsin (Baraboo) — Aug. 24 D F H R S T V
8 AM – noon. *Spr:* Yellow Thunder ARC. Badger Steam & Gas Engine Club Property, E3347 Sand Rd. *Tl:* 147.315 (123 Hz). *Adm:* $5. **www.yellowthunder.org**

Wisconsin (Cedarburg) — Aug. 29 D F H R T
6 AM – noon. *Spr:* Ozaukee RC. Fireman's Park, 796 Washington Ave. (W65 N796). *Tl:* 146.97 (127.3 Hz). *Adm:* $5. **www.ozaukeeradioclub.org**

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S = SEMINARS / PRESENTATIONS
T = TAILGATING
V = VE SESSIONS

Strays

Owen Garriott Day at Talcott Mountain Science Center

Talcott Mountain Science Center (TMSC) in Avon, Connecticut, successfully petitioned Governor Ned Lamont to declare November 22 "Owen Garriott Day." Owen Garriott, W5LFL, was a NASA astronaut and a pioneer of amateur radio in space. He visited the school in the 1980s to discuss his *Skylab*, *Spacelab-1*, and *Columbia* space shuttle missions. Garriott made the first ham radio contacts from space on the *Columbia* mission, contacting eager hams around the world.

Garriott became a Silent Key in April 2019, at age 88. Owen Garriott Day took place on his birthday. A group of students and teachers at TMSC gathered in the morning to dedicate their radio station, W1TMS, in memory of Garriott. During the ceremony, TMSC Director Jonathan Craig said, "Owen Garriott had a special place in the history of Talcott Mountain, as well as in the history ham radio." Director Craig first met Garriott when he was visiting the school, while Craig was still a teacher. As he showed his class a photo of a cyclone taken from space, Garriott entered the room and commented, "Hey, I took that picture!"

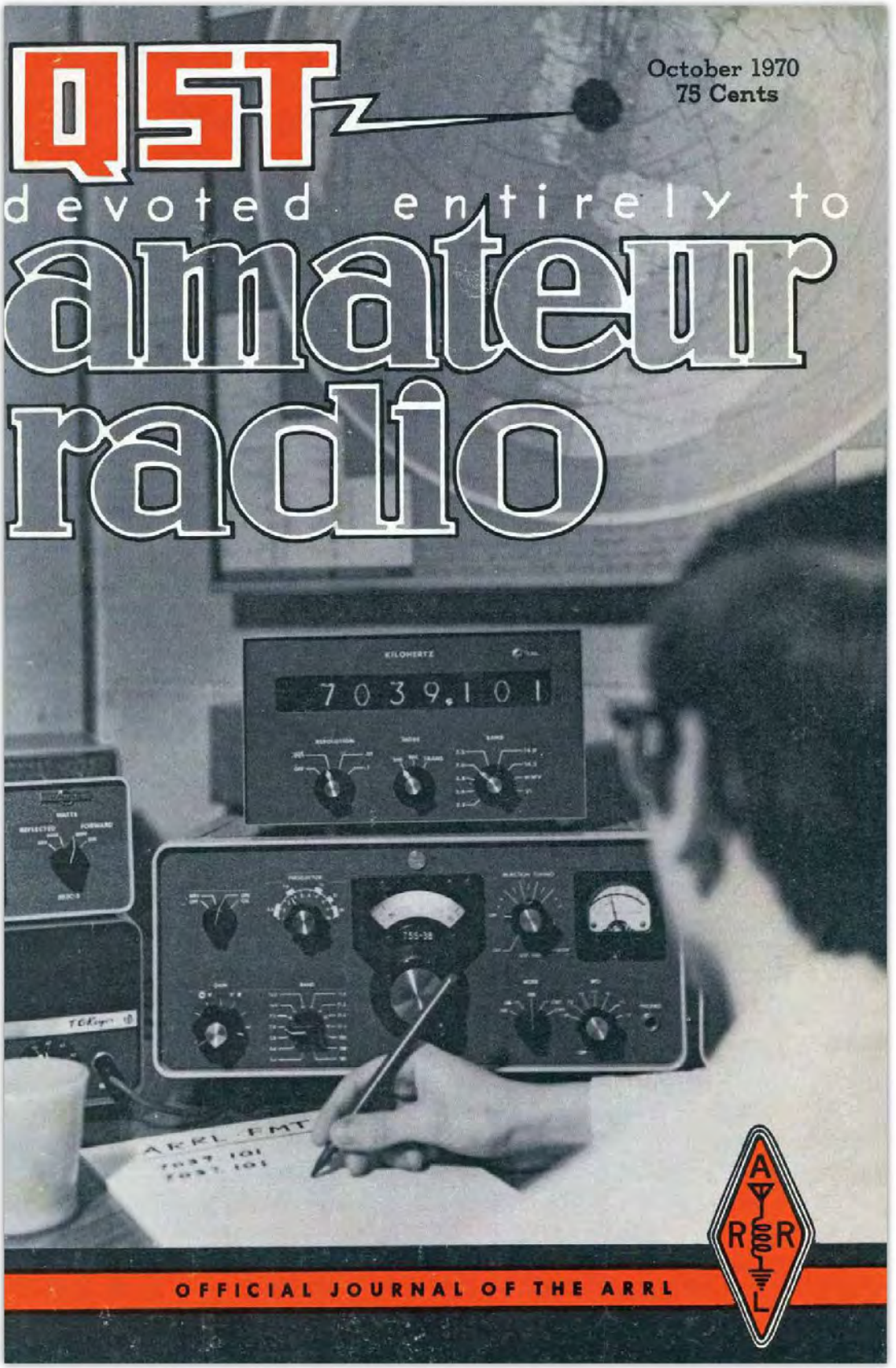
After the station dedication, students operated from their newly renamed station under the guidance of W1TMS Station Trustee and Enrichment Program Teacher Don Wilson, K1IN. The students took turns talking to hams on the air about Owen Garriott and making scheduled contacts with various NASA amateur radio stations, including Kennedy Space Center, N1KSC, in Merritt Island, Florida; Johnson Space Center, W5RRR, in Houston, Texas; Marshall Space Flight Center, NN4SA, in Huntsville, Alabama, and Jet Propulsion Laboratory, W6VIO, in Pasadena, California.

Students asked operators at NASA stations about what it's like to wear a space suit, their favorite foods, and their relationships with Garriott. Scott Vangen, WBØQMZ, at Kennedy Space Center shared that he had worked with Garriott testing space modules and formed a friendship through a shared love of amateur radio.



A group of Talcott Mountain students gathered for their radio station's dedication ceremony, led by school director Jonathan Craig (right). [Leanna Zwiebel, photo]

A Look Back


QST
October 1970
75 Cents
devoted entirely to
amateur radio
OFFICIAL JOURNAL OF THE ARRL

• *Beginner*



At the lower left are the switches, for relay, ac, and plate, in that order. The meter switch is directly above. The band switch is at the upper right, between the tuning and loading controls. A section of the top of the cabinet is removed and perforated aluminum stock installed to allow air flow.

The "Junker" Amplifier

500 Watts – 80 through 10 Meters

BY LEW MCCOY,* W1ICP

A FEW YEARS BACK we described a low-cost amplifier[1] that used a pair of 572Bs operated in grounded-grid fashion. It was evident from the mail received that this was a popular article. Some of the questions concerned substitution of lower-priced tubes, such as 811As, or 813s. In fact, we still receive queries asking for an amplifier design using such surplus tubes because they remain relatively low in cost. The amplifier described in this article is in answer to these requests.

Three types and combinations of tubes were tried. These included a pair of 811As in parallel, a single 813, and a single 803. The 803 tube is a pentode and is rated for operation up to 20 MHz. We found that the 803 worked well on the 21-MHz band but was quite inefficient on 10 meters. However, the 803 is cheap (surplus), and if the builder isn't too concerned about 10-meter operation the tube is a good buy which helps keep the cost of the amplifier down.

Another reason for designing this amplifier was to see how low the cost could be for a 500- to 600-watt unit. Depending on how good a scrounger you are, and how extensive your junk-box stock is (and not overlooking your own ingenuity), the amplifier should be less than $50. As one can see from the photographs, it is strictly a junk-box special. However, the neophyte builder should keep one thing in mind: the watts that come out of this amplifier are just as useful as the watts out of the most expensive amplifier you can buy. A good example of ways to save money is seen in the pi-network tank coil. Our version cost only a few dollars to make, but a suitable commercial assembly would run close to $30.

No newcomer should be afraid to tackle a construction project such as this. There is nothing particularly critical in building the unit. There *are* certain precautions which should be followed, and we'll point those out, but even a beginner in ham radio can easily duplicate this amplifier, and should be able to save money in the process.

Just so no one will think this amplifier is designed for a Prussian officer, the term "Junker" means junk. *If you are a typical ham you should be able to scrounge many of the parts for this amplifier from spare parts boxes – yours and those of other hams.*

Circuit Details

Fig. 1 shows the circuit of the 813 amplifier. Fig. 2 shows the variations for using a pair of 811As or a single 803. Drive from the exciter is coupled to the filaments of the amplifier by means of a .01-μF capacitor. The filaments are isolated from rf chassis ground by RFC1, a bifilar-wound choke. Whenever the term "bifilar" is used, mail comes in asking what the term means. In this case, the bifilar winding consists of two parallel lengths of wire wound with close-spaced turns on a single ferrite core. Two adjacent end leads connect to the tube filaments. The two remaining leads attach to the filament-voltage source – a center-tapped transformer in this instance. RFC1 is a broad-band choke, offering high impedance to rf energy from 80 through 10 meters; thus the rf drive is not shorted out by the low-impedance of the filament transformer. Z1 is a parasitic suppressor.

The tank circuit consists of plate-tuning capacitor C2, L1 and L2, and C5, the loading

*Novice and Beginner

[1] *QST* February 1966.

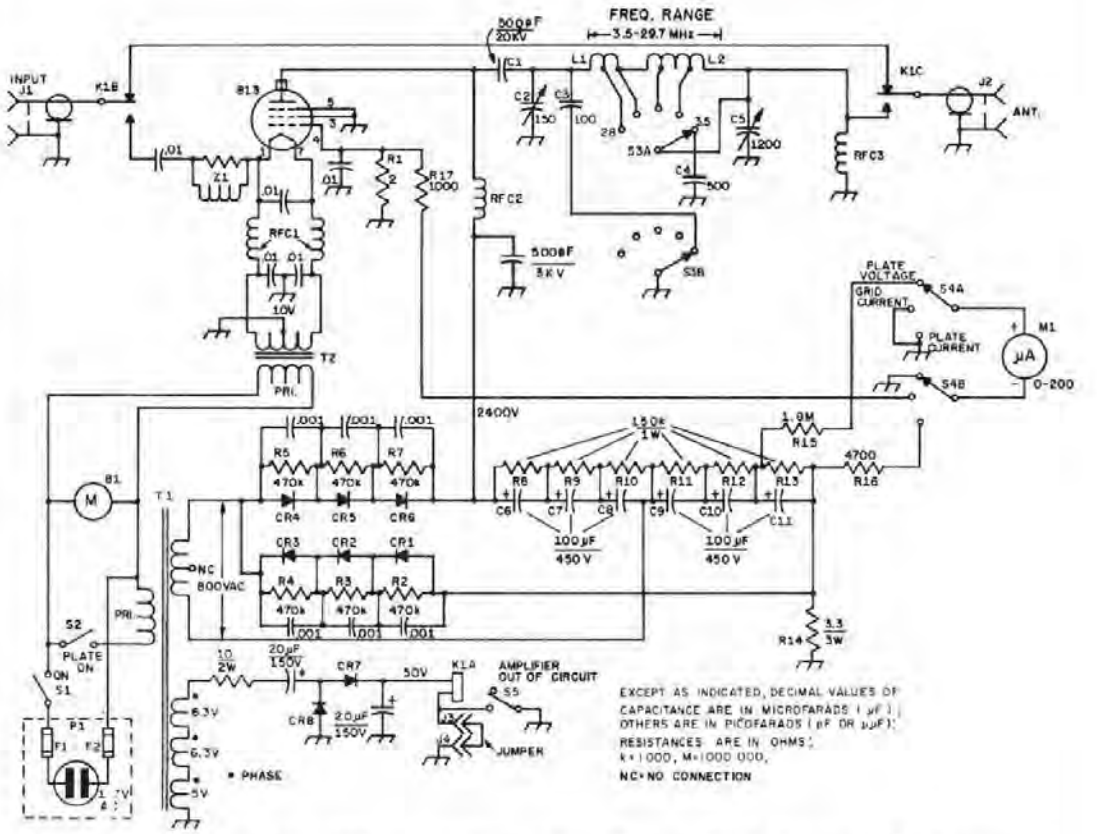


Fig. 1 — Circuit diagram of the 500-watt amplifier. Unless specified, all resistors are one watt composition. All decimal value capacitors are disk ceramic. Labeled components not listed below are for text reference purposes.

B1 — Cooling fan, 117-volt ac motor.
C1 — 500-pF, 20-kV TV-type high-voltage.
C2 — 150-pF variable (E. F. Johnson 154-8, Millen 12515 or equiv.).
C3 — 100-pF mica, transmitting type (see text).
C4 — 500-pF mica, transmitting type, see text.
C5 — 1200-pF variable, trf type, 3-gang, 400-pF per section, stators connected in parallel.
C6-C11, incl — 100-µF, 450-volt electrolytic.
CR1-CR6, incl — 1000-volt piv, 1-ampere diode, see text.
F1, F2 — 10-A fuse.
J1, J2 — Coax chassis fitting, type SO-239.
J3, J4 — Binding post terminals, (jumper can be removed and relay controlled from exciter circuits.)
K1 — Dpdt relay (see text.)
L1 — 10 turns, 2-inch diameter, 1/4-inch copper tubing. Space turns 1/8 inch.
L2 — 15 1/2 turns No. 12 solid wire, 3-inch diameter (see text.) Tap information: Tap points counted from the C5 end of the coil, 40-meter tap 9 3/4 turns; 20-meter tap, 15 turns; 15 meter tap 5 1/4 turns from junction of L1L2; 10-meter tap, 7 1/4 turns from junction of L1L2.
P1 — Fuse-in-plug assembly.
R1 — 2 ohms, 2 watts.
R14 — 3.3 ohms. Three 10 ohm, 1-watt resistors in parallel. jRFC1 — 28 bifilar turns No. 14 Formvar or Nylcad, close-wound on 1/2-inch dia., 7 1/2-inch long ferrite rod (see text.)
RFC2 — 90 µH, 500-mA rf choke (B & W 800 or equiv.).
RFC3 — 2.5 mH rf choke.
S1, S2, S5 — Spst toggle switch.
S3, S4 — Two-pole, 6-position, 2-section rotary (Centralab 2511 or similar).
T1, T2 — See text.
Z1 — 7 turns No. 16 space-wound on 100-ohm, 2-watt resistor.

capacitor. This circuit covers the 80- through 10-meter bands. Fixed-value capacitors are used in combination with C3 and C4 on 80 meters. These capacitors are switched into the circuit by means of S3, the band switch. A double-pole, double-throw relay, K1, can be activated to bypass the amplifier and run only the exciter, if desired.

The power supply is a voltage-doubler type, and with the transformer specified provides a no-load voltage of approximately 2500, which drops to about 2300 volts under load. Filtering is accomplished by a series string of high-capacitance electrolytics, C6 through C11, inclusive. A meter is switched to read grid current, plate voltage or plate current.

Scrounging Parts

One of the more expensive items in any amplifier is the power transformer. One way to reduce this cost to peanuts, is to use a TV set power transformer. Many TV repair shops are loaded with old TV chassis which can be had for the asking, or for only a few dollars. Power transformers from most sets are rated at 300 to 400 watts, continuous duty. In amateur operation, such as ssb or cw, neither of which is continuous duty, it is possible to increase these ratings considerably without any damage to the transformer. The amplifier shown here has been run for long periods without the transformer getting warm to the touch.

In the voltage-doubler circuit you can expect to get 2.8 times the secondary ac voltage. For example, a TV power transformer that has a total secondary ac voltage of 800 will provide about 2300 volts dc in this type of voltage doubler.

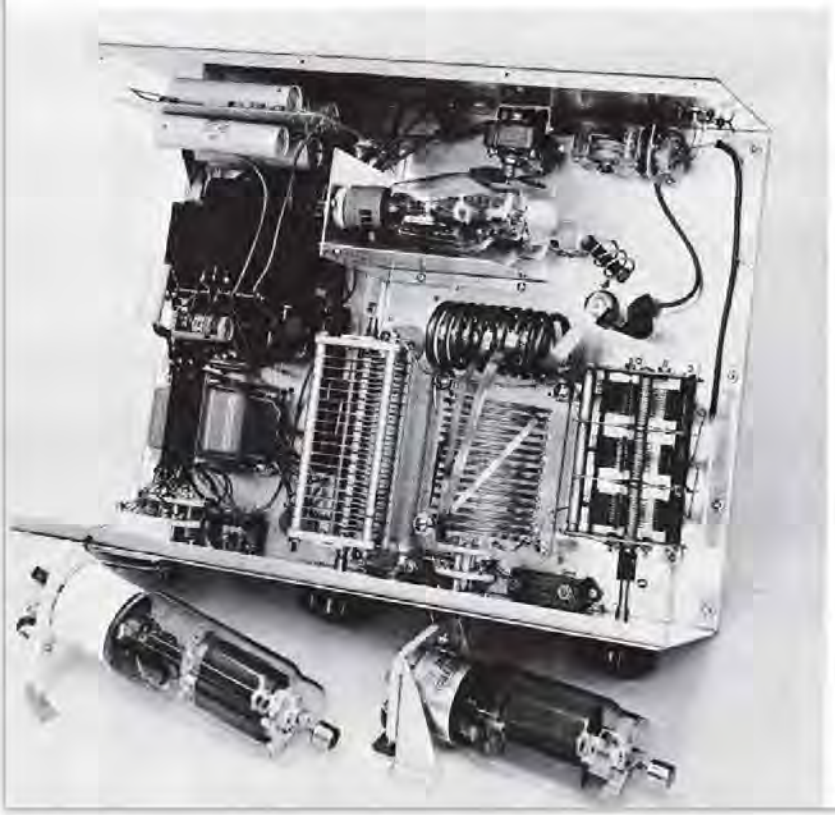
While it didn't occur to us at the time, another large savings could have been effected in obtaining the tank capacitor, C2, and some of the other components. C2 is a relatively expensive unit, but there is one piece of surplus gear that has a suitable capacitor for C2 plus many other useful parts. This is the TU-5B tuning unit that was used in the BC-375 transmitter[2]. This piece of surplus has two variable capacitors capable of handling up to a kW of power input. Also, the unit has the large fixed-value mica capacitors required for C3 and C4. C5 is a 3-gang trf type variable that is available from many surplus houses. Close-spaced capacitor plates can be used at C5 without danger of capacitor arc over.

We used commonly-available tubular electrolytics in the capacitor string of the power supply. These units are obtainable from most radio parts dealers. However, some surplus dealers have high capacitance electrolytics in stock. In order to obtain adequate filtering, one should figure on no less than 15 μF of capacitance. When capacitors are connected in series, and all capacitors have an equal value, the total capacitance is equal to the value of a single capacitor divided by the number of capacitors used in the string. In other words, four 100 μF capacitors connected in series will provide a total of 25 μF of capacitance. The voltage rating of the string is equal to the sum of the working voltages of all the capacitors. For example, four series-connected capacitors having a working voltage of 450 volts each will handle 1800 volts. In figuring your string of capacitors it is a good idea to allow at least 20-percent safety margin on the total working-voltage rating.

As to the tube or tubes you decide to use, 811As, 813s, and 803s can all be purchased as surplus, and you'll save about 40 percent of the cost of new tubes. If you belong to a radio club it is a good idea to ask around among the other hams and see what they might have tucked away. We've found that some hams are like pack rats; they save everything.

The 811A requires 6.3 volts at 4 amperes for the filament. Two tubes will require 8 amperes. The average TV transformer has a 6.3-volt filament winding rated at about 8 amps. It may seem ridiculous, but there is no reason you cannot use

2 These units are available from Fair Radio Sales, Lima, OH. 45802.



In this unit a pair of 811As is used as the amplifier tubes. Note the shield section between the tubes and the tank coil. The shield serves the dual purpose of shielding plus directing the air flow from blower fan directly behind the tubes. The power supply section is along the left side. The tank coil, at the front right, is between the tuning and loading capacitors. Visible directly below the band switch are the two mica capacitors used for 80-meter operation. In front of the unit are the two tubes that were tested in the amplifier, an 803 at the left and an 813 at the right.

QST for

two TV transformers – one for the filaments and the other for plus B. If you find a really rugged transformer, a single unit could be used, for both plate and filament but we recommend a separate filament transformer to ease the power load on the plate transformer. An 813 or 803 filament requires 10 volts at 5 amperes, and again, the surplus market is a good bet for such a transformer. Also, don't overlook club auctions!

The enclosure for the amplifier is a homemade unit, bent up from sheet aluminum. A small piece of perforated aluminum is used over the tube area to permit air flow for cooling of the tubes. The layout of the amplifier is not critical so any enclosure or chassis large enough to hold the parts is suitable. Local sheet-metal shops should have plenty of material for making your own cabinet. Also, the surplus market occasionally yields some good buys in cabinets and enclosures.

Which Transformer?

TV transformers provide from 500 to 750 volts across the entire secondary. The first step you must take is to decide which type of tube or tubes you will use. The 811As will work nicely with 1500 volts on the plates, so a 500- to 600-volt transformer (in a voltage doubler) will give you just about the correct voltage. The 811A unit shown in the photo has a power supply that delivers slightly over 1600 volts with no load. Without negative grid bias on the 811As (zero bias) the resting plate current of the tubes was at a safe level. If you find that the resting current is too high (the plate dissipation rating on the 811As is 65 watts) you may have to use some negative bias. (Usually only a few volts are required, and this can be obtained from batteries.) The point is that you should shoot for a transformer with a 500-volt winding for powering these tubes.

The 813 has a maximum rating of 2500 volts, so a 700- to 800-volt transformer would be best. The 803 has a maximum rating of 2000 volts so the 600-volt range is called for here. In a grounded-grid amplifier it is better to run the tubes at their maximum voltage ratings rather than some lower value. Better efficiency can usually be obtained when using higher plate voltages.

Construction Information

As mentioned, any cabinet and chassis large enough to contain the amplifier will be suitable. The chassis shown was made from a single sheet of aluminum. It is 19 inches wide, 15 inches deep, and 8 inches high.

There is nothing critical in the layout of the components. But be sure that any components carrying high voltage are adequately spaced from the chassis or other ground points. With the tank circuit coil, try to keep the leads for the 15 and 10-meter taps as short as possible.

We made an etched circuit board to hold the electrolytic capacitors, rectifiers, and associated components in the power supply filter section. These components can be mounted on a piece of Plexiglas, or on any similar material. RFC1 can be homemade but we've run into one problem here.

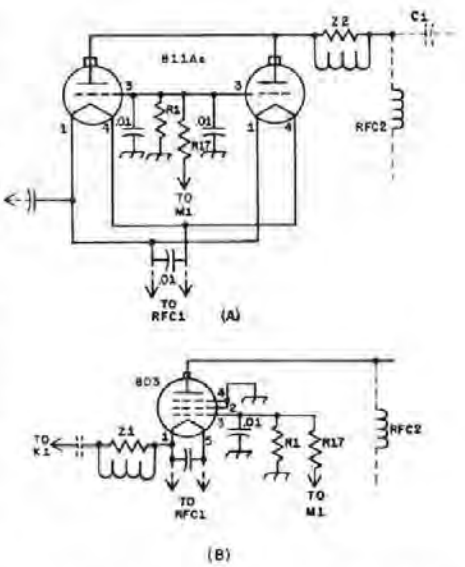


Fig. 2 – At A, the circuit for a pair of 811As. Z2 consists of 3 turns of No. 16 wire 3/4-inch dia., 3/4-inch long, wound on Globar resistor. At B, the circuit for an 803.

The ferrite core we used is a 1/2-inch diameter, 7 1/2-inch-long unit that was available from a mail order house, but they no longer stock the material. However, Amidon Assoc.[3] has a choke kit available. Also, there is another commercially-made choke available[4].

The relay, K1, is a surplus item that required about 30 volts dc to operate it. The voltage was obtained by connecting all of the filament windings on T1 in series, and using a voltage doubler circuit. If you choose this system be sure to have the windings phased correctly so that one winding doesn't buck another.

In figuring the voltage rating for the high-voltage rectifiers (CR1 through CR6) the total required in each leg must be three times that of the *total* secondary winding. In other words, for a 600-volt secondary, you would need a rating of 1800 volts for the rectifiers. It is a good idea to allow a 20-percent safety factor. (Surplus rectifiers are available in the 1000-volt, 1-ampere range.)

A piece of Plexiglas, 4 x 5 x 1/4 inches is used to support L2. We drilled two rows of 1/8-inch diameter holes, 1/8 inch apart. The two rows are three inches apart. There are 15 holes in one row and 16 in the other. Next, we wound 18 turns of No. 12 bare wire on a 3-inch form. You won't need 18 turns but the extra turns will provide some extra lead lengths when the coil is completed. The next step is to carefully thread the coil wire through the holes in the Plexiglas. It took us about

3 Amidon Assoc., 12033 Otsego St., North Hollywood, CA. 91607.
4 William Deane, W6RET, 8831 Sovereign Rd., San Diego, CA. 92103.

an hour to get all the turns on, but the job wasn't a tough one at all. L2 is made of copper tubing wound up on a 2-inch form. The turns are separated 1/8 of an inch. Both end leads of this coil were then flattened in a vise and drilled so they could be mounted along with L1 on the Plexiglas. The entire assembly was then mounted on standoffs which are later mounted on the chassis. All the coil taps are made from strips of copper flashing, about 1/4-inch wide.

For either an 803 or 813, the parasitic suppressor should be installed at the filament side of the tube. If 811As are used, we found that parasitic suppression (Z2) was required in the plate lead (see Fig. 2 at A.) In constructing the unit, the three types of tubes tried were all mounted horizontally. For an 803, pins 2 and 5 should be in a horizontal plane if the tube is to be operated horizontally. For an 813, in a horizontal position, pins 2 and 6 should be in a *vertical* plane. For 811As, pins 1 and 4 should be in a vertical plane.

In testing the amplifier with the various tubes, we found that the 803 and 813 provided stable operation on its own. However, the 811As showed self-oscillation until an aluminum shield was mounted between the tubes and the tank coil.

Tune-Up Procedure

In tuning up a grounded-grid amplifier you don't look for the conventional plate-current dip that is a useful indicator in other types of circuits. What is required here is an output indicator such as most hams use in their feed lines. An SWR bridge can be used in the output position. In grounded-grid operation, the grid and plate current readings are used primarily to check the operating conditions. The ideal instrument to use in tuning up *any* linear amplifier is an oscilloscope, but you can do a good job without one. Also, additional information on adjusting linear amplifiers can be found in considerable detail in the *Handbook*.

Any exciter in the 50-watt or more class will provide adequate driving power for the amplifier. When using an 813 or 803 adjust the driving power plus the tuning and loading controls for maximum output with a grid current of approximately 50 mA and a plate current of 200 mA. With 811As (two tubes), shoot for a grid current reading of 50 to 60 mA and a plate current reading of about 350 mA. This should be done using a cw driving signal. When these conditions are met, reducing the drive slightly should cause the rf output and dc input to drop. With these conditions, the unit should be capable of linear amplication. With the voltages stated earlier, these values of plate current should give about 500-watts dc input on ssb. As general information, the 813 and 803 should show no reddening of the plate under any operating conditions. The 811As, however, can show a barely perceptible red color when operated at their maximum ratings.

We like the performance of this amplifier. It provides an inexpensive method of putting "shoes" on our low-power exciter. QST

Strays

Well, back to the drawing board! (W1MN's tri-band quad after an ice storm last winter).



The Overlook Radio Society of Ulster County, NY, has presented a copy of the 1970 edition of the ARRL *Handbook* to the Kingston city library. Shown making the presentation to Mrs. Mildred Buddington of the library's staff is WB2LZJ. The Overlook Radio Society suggests that other clubs consider presenting amateur publications to their local libraries. Two benefits ensue: Ham radio info becomes available to prospective hams, and good public relations are achieved for amateur radio.



Celebrating Our Legacy

My First Homebrew Receiver

I first became interested in amateur radio in the 1970s, at age 13. My electronics mentor was Bill Kirby, KA1TBQ (SK), a neighbor and radar engineer from World War II. Neither of us were licensed at the time, but he answered my questions with patience and encouragement.

I admired his SCR-522 VHF transceiver, but I didn't know enough to get it working. However, he had given me a 1N21A detector diode in a cool ceramic package and explained slope detection of FM signals. My dad drove me to You-Do-It Electronics Center in Needham, Massachusetts (still my favorite source), and I bought a little variable capacitor and inductor for the tuned circuit. SGS-ATES Semiconductor had an office on my way home from school and I used to bother their salesman for samples, so he gave me an amplifier chip and data sheet.

I wired them all in a little box and connected a 9 V battery, antenna, and headphones. I still remember hearing local TV stations — first the buzz of the video, then the audio. I dismantled the radio long ago, but I still have the capacitor: a 5 – 15 pF air variable that I'm building into another VHF FM receiver. This time, it's a vacuum-tube (in honor of Bill) pulse-counting FM receiver of my own design.

It took 30 more years, but Bill finally gave me the push to get my license when he gave me his radio gear (all transistors now) as he moved out of his home and into assisted living. When he passed away, I took his call sign to honor the man who got me into radio.

Brian T. White, KA1TBQ
Arlington, Massachusetts

Friendship via Satellite

Years ago, I was working toward a Worked All States (WAS) certificate, endorsed for amateur radio satellite operations. I had contacts confirmed with hams in each of the lower 48 states. It took 6 more months after that to work and confirm a contact with Alaska. The last QSL card needed for the endorsement was from KH6, the Hawaiian Islands, and I knew it wasn't going to be easy. The only satellite equipped for amateur radio at the time was OSCAR-6, and it was in a relatively low-Earth orbit. This made it "visible" from Hawaii and my location in Washington, DC, for about 29 seconds every 31 days. I figured the only way I was going to work Hawaii was with a partner.

At the time, I was Awards Manager for AMSAT's Sexagesimal Award. This meant I had access to a list of amateur radio operators in Hawaii who were satellite operational. I sent a letter and began working with Lee Wical, KH6BZF (SK). Lee lived in Kāne'ohe, located on the eastern shore of O'ahu in the Hawaiian district of Ko'olaupoko, which is closer to the US mainland. One of the adjustments we needed to make was to split frequency, because as soon as North American hams on the west coast heard a KH6 signal, the frequency quickly became overloaded. It took a year and a half before Lee and I finally completed our two-way contact and I received that WAS certificate from ARRL.

Many years later, I attended a scientific conference in Honolulu. During one of the breaks, my wife and I took a drive around O'ahu. As we drove through Kāne'ohe, I spotted a house with antennas on the roof. It turned out to be Lee's home, and we finally met in person to celebrate our OSCAR-6 contact.

Earl Skelton, N3ES
Washington, DC

Humorous Help from John Troster, W6ISQ (SK)

During my early days in amateur radio, the chapters on operating a station in *The ARRL Handbook* and *The ARRL Operating Manual for Radio Amateurs* were valuable aids for me. However, another valuable source of operating techniques taught me how *not* to operate — the writings of John G. Troster, W6ISQ (SK).

Beginning in the early 1960s and continuing for several decades, John Troster wrote about humorous events related to real-life amateur radio (all of his writing can be found in the *QST* digital archives at **www.arrl.org/arrl-periodicals-archive-search**). Although his articles were written over 50 years ago, they can still be relevant.

My favorite article of his is "Experience — Technique — Finesse" from the February 1965 issue of *QST*. In it, John hears G6QB in a contest and gives him a call by sending G6QB seven times, followed by W6ISQ eight times. He hears G6QB give out contact number 49. John calls again with five G6QBs followed by seven W6ISQs. He hears G6QB give out contact number 51. This goes on for several attempts, with John shortening the format each time. Finally, John sends "G6QB de W6ISQ." G6QB comes right back to him with contact number 62. He wonders if the short format was what did the trick. John then goes on to work many others using the short format.

The moral of the story is knowing how to operate in a pileup and listening to the other station's technique. Thanks to John's articles, many of us diwdn't have to make the same mistakes.

Carl Luetzelschwab, K9LA
Fort Wayne, Indiana
Life Member

Send reminiscences of your early days in radio to "Celebrating Our Legacy," ARRL, 225 Main St., Newington, CT 06111 or **celebrate@arrl.org**. Submissions selected for publication will be edited for space and clarity. Material published in "Celebrating Our Legacy" may also appear in other ARRL media. The publishers of *QST* assume no responsibility for statements made in this column.

George J. Misic, KE8RN, ke8rn@comcast.net

Classic Radio

The Johnson Invader and Invader 2000 SSB/CW Transmitter

The Johnson Invader and Invader 2000 transmitters covered 80/75, 40, 20, 15, and 10 meters, and provided SSB, AM, and CW signals. Both produced in the early 1960s, the Invader ran 200 W SSB, and the Invader 2000 ran 2,000 W peak envelope power (PEP) input power SSB. The basic Invader had a built-in ac power supply and used a pair of 6146 RF pentodes in the final amplifier. The Invader 2000 replaced the ac power supply with an internal linear amplifier using a pair of PL-175A tubes. The power supply went into an included external power supply for the high-power unit.



The Johnson Invader and Invader 2000 advertised in a February 1962 issue of *73* Magazine. [Photo courtesy of 73 Magazine]

Low-Power Version

The Invader ran 200 W input power PEP on SSB, 200 W on CW, and 90 W input on AM. The final amplifier used a pair of parallel connected 6146 tubes. It was provided with an exciter tuning control to tune the final mixer, driver, and final amplifier grid circuits. The final stage had a plate tuning control, a variable capacitor loading fine adjustment control, and a switch-stepped coarse loading control. No forced air cooling was provided, but the Invader cabinet had a location for a cooling fan if the unit was upgraded to an Invader 2000.

It weighed 53 pounds. The dial tuned in different directions on different bands, as was the case with many rigs of the 1960s. The internal power supply used a 5U4GB for the low-voltage dc source and a 5R4 for the high-voltage source to the 6146s. A 6X4 rectified the bias supply.

High-Power Conversion

Johnson also sold a kit to convert a base Invader into an Invader 2000. The high-power conversion weighed 102 pounds without the base Invader power supply module installed. The linear amplifier portion was the same as the Invader 2000 and used a pair of PL-175A tubes. The package came with a new front panel and all cosmetic pieces. The Invader cabinets all had room for the blower used to cool the PL-175A tubes, so no revision of the wraparound cabinet was needed in the conversion.

The Invader low-power unit cost $619.50 and the high-power conversion package cost $619.50, for a total of $1,239. The Invader 2000 cost $1,229.

Invader 2000 High-Power Transmitter

The Invader 2000 replaced the modular ac power supply with a high-power internal linear amplifier using a pair of PL-175A tetrode tubes. This high-power stage ran 2,000 W PEP, 1,000 W input on CW, and 800 W in the AM mode; AM was a single sideband signal plus an appropriate amount of carrier. The Invader 2000 could be used with the pair of 6146s as the final amplifier and the pair of PL-175A tubes shut down and not operating. The Invader 2000 had two SO-239 RF output fittings on the rear panel. The user had to figure out a way to select the appropriate fitting and provide an antenna relay, because no antenna relay or amplifier bypass relay was provided for either output or the high-power amplifier.

The desktop part weighed about 50 pounds; the separate power supply (including the ac power supply module from inside the low-power version) weighed well over 100 pounds. Several cables were used to connect the power supply to the RF desk unit.

The power supply was a separate unit, about the same size as the transmitter RF unit with the high-power amplifier. The balance of the power supply provided the high voltage to the PL-175A tubes. A pair of 866A mercury-filled high-voltage rectifier tubes were used in the Invader 2000. An 0C3 was used in the bias supply circuitry as a voltage regulator tube. The Invader 2000 did not use a time delay tube to prevent applying high-voltage ac to the rectifier tubes before they warmed up.

Low-Level Stages

The two Invader products were very similar up to the pair of 6146 tubes.

Table 1
The Generation of the Ham Bands

Band	Heterodyne OSC	Internal Frequency	VFO	Output Frequency
80/75	None	9.0 MHz	5.5 – 4.9 MHz	3.5 – 4.1 MHz
40	21.5 MHz	12.5 MHz	5.5 – 4.9 MHz	7.0 – 7.6 MHz
20	None	9.0 MHz	4.9 – 5.5 MHz	14.5 – 13.9 MHz
15	25.0 MHz	16.0 MHz	4.9 – 5.5 MHz	21.5 – 20.9 MHz
10 low	24.5 MHz	33.5 MHz	5.5 – 4.9 MHz	28.0 – 28.6 MHz
10 mid	25.0 MHz	34.0 MHz	5.5 – 4.9 MHz	28.5 – 29 – 1 MHz
10 high	25.6 MHz	34.6 MHz	5.5 – 4.9 MHz	29.1 – 29.7 MHz

The units used a 9.0 MHz first IF. A solid-state balanced modulator provided a double sideband signal with a suppressed carrier. Two carrier oscillators were used, one at 8998.5 kHz and the other at 9001.5 kHz using a 12AT7 dual-triode tube. After the unwanted sideband was removed by the 9.0 MHz crystal lattice filter, it was amplified by a 6AH6 pentode tube and then mixed with a heterodyne oscillator on the 40-, 15-, and 10-meter bands using a 6CX8 tube, where the pentode section was a mixer, and the triode section was the crystal oscillator. On 80/75 meters and 20 meters, the 9.0 MHz signal was passed through the mixer and then mixed with the VFO to create the 20-meter and 80/75-meter frequencies. Only the 40-, 15-, and 10-meter bands had a tunable IF (see Table 1).

A 6AH6 tube was used to mix in the VFO, providing 600 kHz of coverage in each bandswitch position. Following the 6AH6 mixer was a 12BY7 used as a driver tube, which drove a pair of 6146 tubes. The 6146s were used in the Invader 2000 to drive the pair of PL-175As used in the final amplifier. They also drove a separate rear-panel SO-239 output fitting, for operating without the internal linear amplifier. The user selected high or low power by setting the loading capacitor switch to the AMP position when using the high-power amplifier or to the setting needed when operating in the low-power mode.

Invader 2000 Safety Issue

The Invader 2000 connected the 240 V ac power source neutral to the chassis ground, which was mechanically attached to the metal cabinet. Of course, the neutral was at the same ground potential as the safety ground lead in a standard 240 V ac power source. Connecting the neutral to the ground conductor was an electrical code violation and drove a ground-fault interrupted (GFI) power outlet crazy. Johnson likely did not have the Invader 2000 tested and approved when it was new.

There was no issue with the low-power Invader; the power supply operated only from a 120 V ac power line and all power source lines were isolated from the chassis. A three-wire 120 V ac power cord could be used with the ground wire connected to the chassis for a more secure installation.

Strays

QST Congratulates...

Andrew Shecktor, N3OMA, on the publication of his book, *Dark Water: Game Over*. The novel tells the story of a Bulgarian whistleblower and worldwide deep-state corruption. The storyline includes two ham radio operators who are tasked with receiving a coded radio message from Russia. The book is available on Amazon, Google Books, and at select bookstores.

Al Brogdon, W1AB

100, 50, and 25 Years Ago

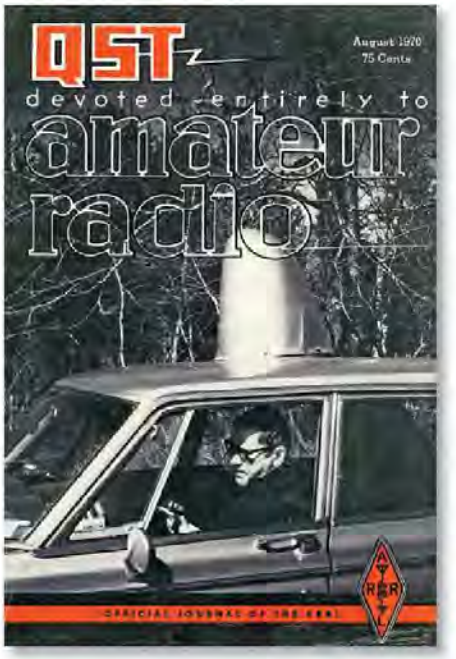
August 1920

- The cover art shows two young hams "tuning the band" on their portable receiver, as they enjoy their lakeside campsite.
- The editorial discusses the tediousness of even slight frequency changes on present-day receivers and looks to a future when a receiver will have only two knobs — one for tuning and one for regeneration.
- In an attempt to learn the "Why?" of fading, "The A.R.R.L. QSS Tests" announces that fading tests are beginning all over the country.
- "The New York Radio Control Station" reports that preliminary engineering studies have been completed for a "super-powered" radio station that will be built by the Radio Corporation of America, for use in intercontinental message handling.
- "A Boardwalk Roller-Chair Radiophone" reports on Harold Warren's integration of a wireless telephone and telegraph station into a roller-chair at the Asbury Park, New Jersey, boardwalk.



August 1970

- The cover photo shows K1KLM in his car, using his MABAV (Mobile All-Band Amateur Vee) antenna, described in this issue.
- The editorial, "Unsung Salesmen," urges all members to sell the idea of League membership to fellow hams.
- Melvin Leibowitz, W3KET, explains how to build "A Complete Solid-State Portable for 40 Meters."
- HQ's own Doug DeMaw, W1CER, provides information on a modern low-power CW transceiver, in "Once More with QRP."
- Bill Bridges, K1KLM, takes an outrageously different approach to mobile antennas with "The MABAV Mobile Antenna."
- Edward Linde, WB2GXF, presents an easy-to-build stacked array, in "5-Over-5 for Six."
- Douglas Blakeslee, W1KLK, provides tips on improving the performance of a popular World War II surplus receiver, in "Updating the SP-600."
- The "Recent Equipment" column reports on the "Heath SB-200 Linear Amplifier."
- Julian Pike, WAØTCU, tells us how to build "The Operational Amplifier."



August 1995

- The cover photo shows "Three Simple Projects to Build This Weekend."
- The editorial, "Service," notes that this is the 50th anniversary of the most destructive war in history, and then segues into a discussion of how amateurs can use our equipment and skills for public service in times of need.
- In "A Rock-Bending Receiver for 7 MHz," Randy Henderson, WI5W, explains how he built a 40-meter direct-conversion receiver with a variable crystal oscillator for frequency control.
- Michael Bryce, WB8VGE, presents "The Battery Sentry," which can be used to continuously monitor the condition of your emergency battery supply.
- William Sabin, WØIYH, discusses "Broadband HF Antenna Matching with ARRL Radio Designer."
- H. Paul Shuch, N6TX, Executive Director of The SETI League (Search for Extra-Terrestrial Intelligence), describes how we can join the effort that is "Searching for Life among the Stars."
- In "Amateur Radio and World War II," Dan Davis, W8LUX, discusses the impact each had on the other. One photo shows Staff Sargeant Jim Marglin, W9THS, and his wife, Mickey, W9ZTU, with their baby, Patricia. Mickey was the first female radio operator in the Signal Corps. Another photo shows Lieutenant Colonel F.E. Handy, W1BDI, serving in Europe with the Army Air Forces.



Silent Keys

It is with deep regret that we record the passing of these radio amateurs:

K1AIP **Smallman**, William J., West Haven, CT
•W1BR **Prince**, Roger H., Princeton, MA
W1DHP **Saul**, Michael B., Wallingford, CT
N1DZM **Allard**, Almon R., Billerica, MA
W1FCK **Welch**, Gary J., Chester, NH
W1FLA **Bass**, Jack, West Hartford, CT
WB1GNL **Gish**, Alexander N., III, Chestertown, MD
•N1HBQ **Fasulo**, Jeffrey A., Marlborough, MA
KA1HQE **Torsey**, Allen G., Beverly, MA
♦N1KUK **Lotti**, Robert James, Boston, MA
•WA1NDV **McGrath**, John J., Fitchburg, MA
•KQ1O **Perry**, Arthur J., Jr., "Bud," Waterford, CT
♦W1QLD **Chin**, Robert W., Tyngsboro, MA
K1PAW **Meuse**, James H., Wakefield, MA
ND1Q **Calef**, David S., Spofford, NH
WA1RB **Brown**, Ronald W., South Portland, ME
♦K1THP **Karpiej**, David A., Farmington, CT
•WA1UYR **Connell**, Joseph R., Westford, MA
♦•WA1ZZP **Hecht**, Richard L., Johns Creek, GA
KD2AFC **Haveman**, Frank P., Newton, NJ
•K2BYM **Clinch**, Marvin R., Oneida, NY
K2CDJ **Hanzlik**, Stephen J., Whitney Point, NY
•KB2CS **Abel**, John M., Canandaigua, NY
KB2DBI **LeJuez**, Charlotte A., Bronx, NY
N2DCH **Pivnichny**, John R., Vestal, NY
K2GPM **Nathan**, Donald H., Sun City Center, FL
N2IGU **Bellini**, Robert P., Phoenixville, PA
•W2III **Smith**, Donald J., Bay Shore, NY
KC2JML **DeMott**, Louis F., Jr., Norwich, NY
WB2JOB **LeJuez**, Robert J., Sr., Bronx, NY
N2KYT **Evans**, Charles D. "Dick," Elmira, NY
KJ2P **Jannuzzo**, James T., Red Hook, NY
KC2QNK **Vazquez**, Juan J., Brooklyn, NY
KD2RKX **St. Laurent**, Steven P., East Syracuse, NY
WA2TKR **Head**, Eugene C., Garnerville, NY
WA2TKS **Meyers**, Roger J., Erlanger, KY
•KA2TRM **Moore**, Lenore H., Burlington, NJ
NK2V **Delao**, Steven, Las Vegas, NV
•WA2YLC **Fitch**, Richard O., North Cape May, NJ
WA2YWT **Bond**, Theodore D., New Haven, NY
WA2ZND **Ross**, Emmett W., Audubon, NJ
N3CUY **Petersen**, Solomon B., Jr., "Pete," West Hyattsville, MD
K3GXF **David**, Carey T., Jr., "C.T.," Mascoutah, IL
N3HBD **Muth**, Allen R., DuBois, PA
AC3I **Keim**, William D., Jr., "Bill," Union Dale, PA
•AD3I **Meyer**, Albert L., West Chester, PA
K3QLZ **Long**, Gene M., Lewistown, PA
W3RMM **McClanahan**, Robert M. "Mike," Lewes, DE
♦K3TX **Heller**, David L., Morrisville, PA
W3WSX **Chuprinko**, Emile, Monessen, PA
W3YW **Petrides**, George H., Bethesda, MD
N4BMR **Wiggins**, William F. "Bill," Signal Mountain, TN
K4CYC **Allen**, Gary L., Tampa, FL
♦AF4D **Waring**, Frank, III, Landis, NC
•W4DIB **DiBenedetto**, Anthony G. "Tony," Potomac Falls, VA
KV4FE **Bloomfield**, James W., Mayo, FL
KC4GQ **West**, Robert E., Gainesville, GA
KF4IQN **Duncan**, Constance, Asheville, NC
WA4LTY **Brewer**, George L., Eden, NC
♦W4LVC **Mount**, Charles D., Tucson, AZ
•N4MPI **Bauer**, Cletus P. "Clete," Natchitoches, LA
WD4NMQ **Pierce**, Thomas J., Jr., "Jeff," Kingsport, TN
W4NQP **Preen**, William J. "Bill," Live Oak, FL
WA4NSD **Hedrick**, Ernest E., Lexington, NC
WD4PHF **Kimbrell**, James D. "Don," Fayette, AL
KI4RD **Martin**, George H. "Hal," Asheville, NC
KI4SYU **Mauldin**, Ernest, Hamptonville, NC
WA4VVJ **Anderson**, James B., II, "JB," Leesburg, VA
•KF4WHR **Wallace**, George D., Morganton, NC
KC4WWV **Civils**, Ronald F., Deep Run, NC
W4YF **Winters**, James G., Concord, NC
K5AVT **Riise**, Dennis A., Irving, TX
W5CR **Ready**, Clyde E., Biloxi, MS
K5CUY **Myers**, John R., Kingsland, TX
N5GK **King**, Glenn A., Conway, AR
K5KMH **Holliday**, Kruse M., Oklahoma City, OK
N5KTY **Spence**, J.W., Fort Smith, AR
WB5LBR **McDonald**, Mary L., Baton Rouge, LA
KD5LNU **Pedneau**, Andrew L. "Andy," Jena, LA
WA5NB **Austin**, Elgin W., Saline, LA
N5QNL **Shaw**, Jeana, Abilene, TX
W5SDM **Merrick**, Stephen D., Big Spring, TX
N5TF **Foskey**, Terry E., Biloxi, MS
N5TGW **Hilton**, William A., Richardson, TX
WB5UTV **Hallmark**, Gary T., Decatur, AL
K5UWD **Beis**, Charles R., Garland, TX
WB5VAI **Smith**, Forrest H., Jr., San Antonio, TX
KC5VBX **Ready**, Carol A., Biloxi, MS
•WB5VLG **Shuman**, Frederic L., Colorado Springs, CO
WB5VRT **Reeves**, Fred C., Vernon, AL
KD5WVE **McClain**, James A., Oak Forest, TX
♦•KD6BD **Shannon**, Ronald D., Sequim, WA
K6BWA **Schulman**, Joseph H., Santa Clarita, CA
N6BWS **Millard**, Michael N., Parker, CO
K6DKU **Atmore**, Michael L., Fairmont, NE
K6DPZ **Guretzky**, Harold, Staten Island, NY
W6DQT **Witt**, Herbert M., Hayward, CA
•WB6GDS **Banoczi**, John R., Palm Desert, CA
•KF6HMR **Cooper**, Derek L., Ridgecrest, CA
♦WU6I **Slaughter**, Edward D. "Ed," Highland, CA
♦KQ6KD **Vrabel**, Irene M., Carson City, NV
•WB6NHE **Reifer**, David J., San Gabriel, CA
♦W6PXD **Mort**, Toby D., Hemet, CA
•WW6RQT **Wood**, Joann H., San Jose, CA
♦W6SPS **Blaylock**, Patrick J., Sun City West, AZ
KA6TLY **McLaughlin**, Patrick M., Boise, ID
WA6YPV **Martin**, George M., San Jose, CA
WA6YRB **Lynch**, Thomas R., San Jose, CA
•KA7AFZ **Gee**, John W., Fresno, CA
KB7CH **Hanny**, John H., Jr., Mesa, AZ
K7CJW **Tilman**, Robert J., Chino Valley, AZ
KJ7DFN **Murray**, Dennis A., Reno, NV
WB7DMX **Bailey**, Bobby, Holden, MO
N7DQY **Gilk**, John A., Jr., Salmon, ID
KI7DTL **Norris**, Herbert T. "Tom," Mercer Island, WA
W7GNE **Carli**, Raymond J., Scottsdale, AZ
♦N7GCC **Wiman**, John L., Kingman, AZ
NN7H **Shillinger**, Duane V., Rawlins, WY
•KC7JTI **Oslund**, Richard R., North Muskegon, MI
W7KFN **Pedersen**, Raymond E., Tacoma, WA
AL7KV **Cooper**, Phillip E., Olympia, WA
K7LY **France**, Gerald R., Lake Havasu City, AZ
WA7NBF **Robin**, Neil A., Port Angeles, WA
W7OLU **Robinson**, Richard S., Salt Lake City, UT
AF7PC **Morant**, Frank J., Mercer Island, WA
N7PVA **Avona**, Paul V., Chandler, AZ
•KE7QXT **Stevenson**, Thyra K., Lewiston, ID
W7RQ **Baldassari**, Joseph M. "Jay," Puyallup, WA
KD7TQZ **Darnell**, Michael A., Spring Hill, FL
KY7W **Gurley**, Steve, Tempe, AZ
♦K7YW **Kersheskey**, Leonard J., Littlestown, PA
WD8AFJ **Smith**, Norton P., II, Morgantown, WV
WB8AJR **Prince**, William A., Akron, OH
KC8AW **Hemmye**, Jerome H., Pensacola, FL
W8BAQ **Ward**, David R., Dayton, OH
WD8BMA **Milthaler**, Linden G., Tipp City, OH
N8CCK **Benthall**, John D., Burton, MI
K8EXF **Keesler**, James A., Rives Junction, MI
♦W8FVH **Hoogesteger**, James R., Traverse City, MI
W8GNI **Tippett**, Donnie L., Gainesboro, TN
WG8J **Beverly**, William N., III, Kalamazoo, MI
W8JFQ **Davet**, Robert E., Macedonia, OH
♦WA8MUY **Gruninger**, Ronald H., Lexington, MI
W8PJY **Labermeier**, William C., Sr., Mount Healthy, OH
W8QG **Conklin**, Wayne A., Laredo, TX
WB8RQV **Ludovici**, Kenneth R., Mason, OH
KB8TDC **Anderson**, Charles S., Huber Heights, OH
W8URK **Elliott**, Charles A., Sr., "Chuck," Fairfield, OH
♦K8WMX **Kibler**, William H., Jr., "Jack," Saint Albans, WV
KA8WZO **Sorey**, Arrisia G., Minden, LA
KB8YZV **Triplett**, Peter S., Clay, WV
•KB8ZD **Kimbler**, Lester L., Danville, WV
KB9AMU **Carter**, Kevin R., Shelbyville, IN
W9AY **Peters**, Fredus N., III, "Pete," Fort Wayne, IN
WB9FEA **Ailor**, Robert F., Jr., Winfield, IL
♦W9FJ **Ogle**, William J., Carlinville, IL
KC9FVO **Davis**, Dan E., Lebanon, IN
N9LGV **Williams**, Judith A. "Judy," Viroqua, WI
WA9UIG **Hinnendael**, Jim, Green Bay, WI
KB9MDQ **Stephan**, Michael D., Tippecanoe, IN
W9SR **Stroud**, Richard W. "Dick," Liberty Center, IN
N9TA **Bennett**, John F. "Fred," Crawfordsville, IN
KB9YUB **Pagel**, Michael David, Appleton, WI
•W9YVE **Julius**, Dorwin E., Saint Elmo, IL
N0EZH **Schuchardt**, Gary O., Chesapeake, VA
•KD0IC **Ford**, Warren M., Leonardville, KS
W0JRM **Maruska**, John F., Yuma, AZ
WB0JYB **Dunn**, George E., Sioux Falls, SD
K0KHW **Ferrin**, Frank J., Plymouth, MN
•W0MUG **Meeks**, Archie M., Pittsburg, KS
W0NLF **Schemmel**, Donald E., Dexter, IA
•WA0PTR **White**, Bill, Austin, TX
K0QAF **Tryon**, Warren A., Kansas City, MO
KE0QB **Langston**, Donald E., Nortonville, KS
WA0TTN **Cook**, David E. "Dave," Reno, NV
KD0YLN **Boyd**, Robert H., Hermantown, MN
WB0ZJA **Lenning**, Dennis, Montevideo, MN
VE3AGM **Caldwell**, Douglas Y., Toronto, ON, Canada
VE3GLU **Marquardt**, Paul R., Guelph, ON, Canada
VE7BD **Ewing**, Brent D., Victoria, BC, Canada
VA7VB **McDonald**, Robert F., Prince George, BC, Canada
ZL2UNH **Holland**, Nigel N., Wellington, New Zealand

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• 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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IC-7700 | *HF/50MHz Transceiver*

The Contester's Rig • HF + 6m operation • +40dBm ultra high intercept point • IF DSP, user defined filters • 200W output power full duty cycle • Digital voice recorder



IC-7610 | HF/50 MHz *All Mode Transceiver*

• Large 7-inch color display with high resolution real-time spectrum scope and waterfall • Independent direct sampling receivers capable of receiving two bands/two modes simultaneously



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IC-7100 | *All Mode Transceiver*

• HF/50/144/430/440 MHz Multi-band, Multi-mode, IF DSP • D-STAR DV Mode (Digital Voice + Data) • Intuitive Touch Screen Interface • Built-in RTTY Functions



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• VHF/VHF, UHF/UHF simultaneous receive • 50 watts of output on VHF and UHF • Optional VS-3 Bluetooth® headset • Easy-to-See large white backlight LCD • Controller attachment to the main Unit



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VHF/UHF Dual Band Digital Transceiver

• Analog FM/D-Star DV Mode • SD Card Slot for Voice & Data Storage • 50W Output on VHF/UHF Bands • Integrated GPS Receiver • AM Airband Dualwatch



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• Compact, Detachable Controller for Flexible Installation • DV/FM Near Repeater Search Function • Apps for iOS™ and Android™ devices • Wireless Operation with VS-3 & UT-137 Bluetooth® Headset & Module • MicroSD Card Slot



IC-V86 | *VHF 7W HT*

• 7W OutputPower Plus New Antenna Provides 1.5 Times More Coverage • More Audio, 1500 mW Audio Output • IP54 & MIL-STD 810G–Rugged Design Against Dust & Water • 19 Hours of Long Lasting Battery Life • 200 Memory Channels, 1 Call Channel & 6 Scan Edges



IC-R30 | *Digital/Analog Wideband Xcvr*

• 100 kHz to 3.3 GHz Super Wideband Coverage • P25 (Phase 1), NXDNTM, dPMRTM, D-STAR Mode • 2.3" Large LCD Display & Intuitive User Interface • MicroSD Card Slot for Voice & Data Storage • USB Charging & PC Connection



IC-PW1 | *HF/50 MHz Amplifier*

• Wide freq. coverage - 1 kW from 1.8 MHz to 50 MHz (amateur bands only) • Wide ALC adjustable range • Full duty cycle • Auto antenna tuner built-in • Auto AC input voltage selector is employed



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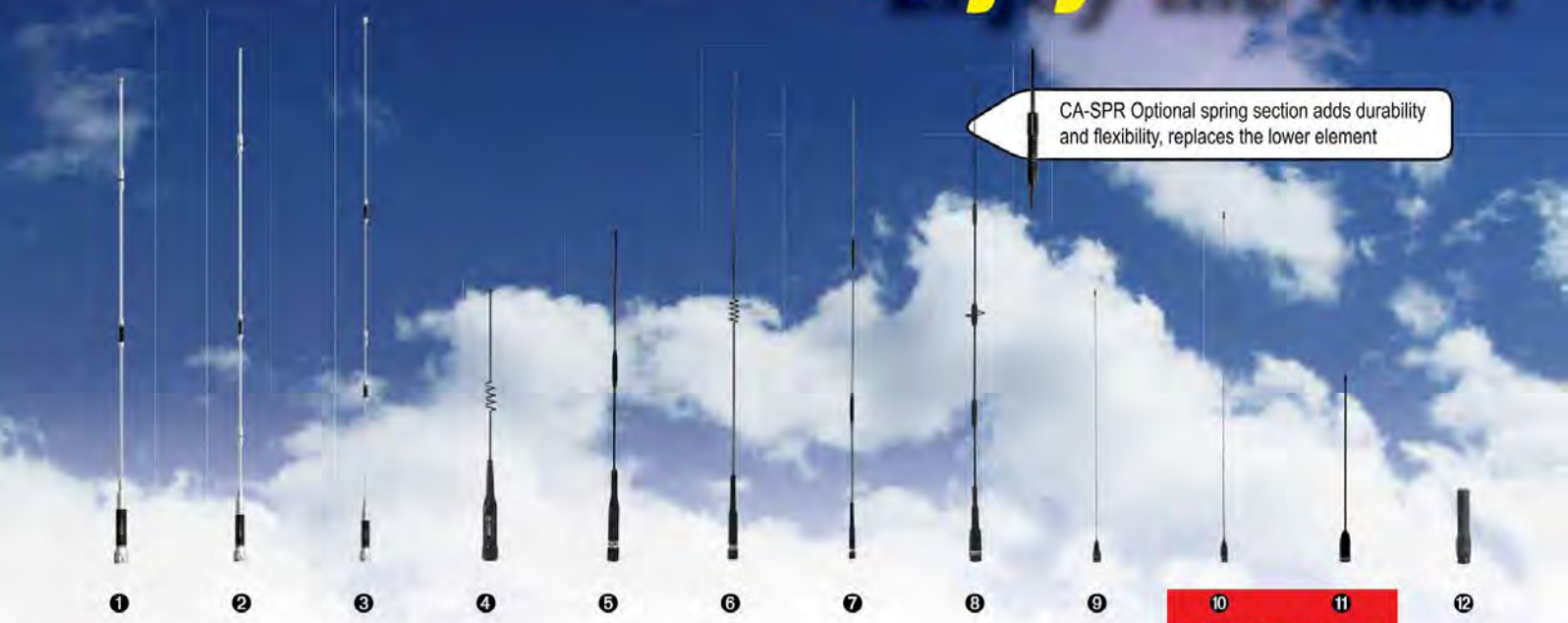
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Mobile Antennas

❶ **COMET CSB-750A** DUAL-BAND 2M/440MHz w/FOLD-OVER
2M: 1/2 wave • 440MHz: 5/8 wave x 2 • VSWR: 1.5:1 or less • Length: 42" • Conn: PL-259 • Max. Pwr: 150W

❷ **COMET CSB-770A** DUAL-BAND 2M/440MHz w/FOLD-OVER
2M: 5/8 wave center load • 440MHz: 5/8 wave x 2 center load • VSWR: 1.5:1 or less • Length: 51" • Conn: PL-259 • Max Pwr: 150W

❸ **COMET CSB-790A** DUAL-BAND 2M/440MHz w/FOLD-OVER
2M: 7/8 wave center load • 440MHz: 5/8 wave x 3 center load • VSWR: 1.5:1 or less • Length: 62" • Conn: PL-259 • Max Pwr: 150W

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

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

❻ **COMET SBB-5/SBB-5NMO** DUAL-BAND 2M/440MHz w/FOLD-OVER
2M: 1/2 wave • 440MHz: 5/8 wave x 2 • Length: 39" • Conn: SBB-5 PL-259, SBB-5NMO - NMO style • Max Pwr: 120W

❼ **COMET SBB-7/SBB-7NMO** DUAL-BAND 2M/440MHz w/FOLD-OVER
2M: 6/8 wave • 440MHz: 5/8 wave x 3 • Length: 58" • Conn: SBB-7 PL-259, SBB-7NMO - NMO style • Max Pwr: 70W

❽ **COMET CA-2X4SR/CA-2X4SRNMO** WIDE-BAND 140-160MHz 435-465MHz w/FOLD-OVER
2M: 5/8 wave • 440MHz: 5/8 wave x 3 • Length: 40" • Conn: CA-2x4S PL-259, CA-2x4SRNMO NMO style • Max Power: 150W

❾ **COMET BNC-24** DUAL BAND 2M/440MHz HT ANTENNA
RX range: 100-1200MHz • Length: 17" • SuperFlex featherweight whip • Conn: BNC

❿ **COMET SMA-24** NEW! **SMA-24J** DUAL BAND 2M/440MHz HT ANTENNA
RX range: 100-1200MHz • Length: 17" • SuperFlex featherweight whip • Conn: SMA-24: SMA-male / SMA-24J: SMA-female

⓫ **COMET SMA-503** NEW! **SMA-503J** DUAL BAND 2M/440MHz HT ANTENNA
RX range: 100-1200MHz • Length: 8.75" • Conn SMA-503: SMA-male, SMA-503J: SMA-female

⓬ ***Maldol* MH-209, MH-209SMA** DUAL BAND 2M/440MHz HT ANTENNA
Length: 3" • Conn: MH-209 BNC, MH-209SMA: SMA-male • Soft rubber cover, good performance in a small package!



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- Clean 5 to 200 W transmit power through the 50 V FET final unit.
- Built-in RTTY and PSK.
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For medium communications arrays up to 15 square feet wind load area. Has 5-second brake delay, Test/Calibrate function. Low temperature grease permits normal operation down to -30 degrees F. Alloy ring gear gives extra strength up to 100,000 PSI for maximum reliability. *Precision* indicator potentiometer. Ferrite beads reduce RF susceptibility. Cinch plug plus 8-pin plug at control box. Dual 98 ball bearing race for load bearing strength and electric locking steel wedge brake prevents wind induced movement. North/South center of rotation scale on meter, low voltage control, max mast $2^{1}/_{16}$".

HAM-VI – $809.95 with DCU-2

HAM-VII – $959.95 with DCU-3

HAM V Rotator Specifications	
Wind Load Capacity (inside tower)	15 square feet
Wind Load (w/mast adapter)	**7.5 square feet**
Turning Power	800 in.-lbs.
Brake Power	**5000 in.-lbs.**
Brake Construction	Electric Wedge
Bearing Assembly	**Dual race/96 ball bearings**
Mounting Hardware	Clamp plate/steel U-bolts
Control Cable Conductors	**8**
Shipping Weight	26 lbs.
Effective Moment (in tower)	**2800 ft.-lbs**

TAILTWISTER SERIES II – $869.95

For Large Medium Antenna Arrays up to 20 sq. ft. wind load.



Has 5-second brake delay, Test/Calibrate functions. Low temp grease, tough alloy ring gear, indicator potentiometer, ferrite beads on potentiometer wires, weatherproof AMP connectors plus 8-pin plug at control box, triple bearing race with 138 ball bearings for large load bearing, electric locking steel wedge brake, North/South center of rotation scale meter, low voltage control, $2^{1}/_{16}$" max mast. **MSHD, $139.95**. Above tower heavy duty mast support. T2X, HAM-IV, HAM-V, HAM-VI. Accepts $1^{7}/_{8}$-$2^{5}/_{8}$" OD.

T-2XD2 – $979.95 with DCU-2

T-2XD3 – $1039.95 with DCU-3

TAILTWISTER Rotator Specifications	
Wind Load Capacity (inside tower)	20 square feet
Wind Load (w/mast adapter)	**10 square feet**
Turning Power	1000 in.-lbs.
Brake Power	**9000 in.-lbs.**
Brake Construction	Electric Wedge
Bearing Assembly	**Triple race/138 ball bearings**
Mounting Hardware	Clamp plate/steel U-bolts
Control Cable Conductors	**8**
Shipping Weight	31 lbs.
Effective Moment (in tower)	**3400 ft.-lbs**

CD-45II – $499.95

For antenna arrays up to 8.5 sq. feet mounted inside tower or 5 sq. ft. with mast adapter.



Low temperature grease good to -30 F degrees. New Test/Calibrate function. Bell rotator design gives total weather protection, dual 58 ball bearing race gives proven support. Die-cast ring gear, stamped steel gear drive, heavy duty, trouble free gear train, North center scale, lighted directional indicator, 8-pin plug/socket on control unit, snap-action control switches, low voltage control, safe operation, takes maximum mast size to $2^{1}/_{16}$ inches. MSLD light duty lower mast support included.

CD-45D2 – $599.95 with DCU-2

CD-45D3 – $659.95 with DCU-3

CD-45II Rotator Specifications	
Wind Load Capacity (inside tower)	8.5 square feet
Wind Load (w/mast adapter)	**5.0 square feet**
Turning Power	600 in.-lbs.
Brake Power	**800 in.-lbs.**
Brake Construction	Disc Brake
Bearing Assembly	**Dual race/48 ball bearings**
Mounting Hardware	Clamp plate/steel U-bolts
Control Cable Conductors	**8**
Shipping Weight	22 lbs.
Effective Moment (in tower)	**1200 ft.-lbs**

New!

Hy-Gain Programmable DCU-3 Digital Rotator Controller

DCU-3 – $499.95



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

Press a memory button or dial in your beam heading or let *Ham Radio Deluxe* (or other) take control. Your antenna auto rotates precisely and safely to your DX.

DCU-3 automatically jogs your antenna free and safely unlocks it before rotating begins (*great for older rotators with "sticky" brakes*) then turns off your motor before reaching its final heading. Your antenna gently coasts to a stop before the brake re-locks -- greatly reducing damaging overshoots and extending rotator life.

Simply press *Left* and *Right* buttons for full manual control and fine tuning.

Bright blue LCD shows current, dialed in and computer controlled beam headings in one degree increments and your call.

Calibrate lets you accurately match your display to your true beam heading. Has USB/RS-232 ports for computer control. Adjustable LCD sleep time. Field upgradeable firmware. 8.5Wx4.3H x9D".

110 VAC. Order DCU-3X for 220 VAC.



DCU-2 Digital Rotator Controller – $459.95
Like DCU-3, but less programmable memories. 110 VAC. Order **DCU-2X**, for 220 VAC.

AR-40 – $399.95

For compact antenna arrays and large FM/TV up to 3.0 square feet wind load area.



Dual 12 ball bearing race. Automatic position sensor never needs resetting. Fully automatic control -- just dial and touch for any desired location. Solid state, low voltage control, safe and silent operation. $2^{1}/_{16}$ inch maximum mast size. MSLD light duty lower mast support included.

AR-40 Rotator Specifications	
Wind Load Capacity (inside tower)	3.0 square feet
Wind Load (w/mast adapter)	**1.5 square feet**
Turning Power	350 in.-lbs.
Brake Power	**450 in.-lbs.**
Brake Construction	Disc Brake
Bearing Assembly	**Dual race/12 ball bearings**
Mounting Hardware	Clamp plate/steel U-bolts
Control Cable Conductors	**5**
Shipping Weight	14 lbs.
Effective Moment (in tower)	**300 ft.-lbs**

Replace your Yaesu Rotator Controller

YRC-1 – $369.95



Hy-gain YRC-1 -- more features, more robust, far less prone to lightning damage. Costs less than repairing!

Easy-to-use -- dial in your beam heading and tap GOTO button. Exclusive 180 degree *AutoReversal*™ for fast longpath operation. All DCU-2 features. Bright blue LCD shows current, dialed-in, computer controlled beam headings, call. USB port for computer control. Extra heavy-duty AC power supply. Fast variable DC motor minimizes overshoot. Intuitive menu. Field upgradeable. For Yaesu G-800/1000/2800/G450/650. AC or DC motors.

YRC-3, $449.95. Like YRC-1 and adds 6 memories.

AR-500 Rotator/Controller – $169.95

UHF/VHF/6-Meter, MFJ-1886 Rotator/Controller and Remote. For use of small VHF/UHF, 6M, TV, FM, the MFJ-1886 wide band receiving loop and other light-weight ham antennas. Rotator is built in a weather-proof one piece cast aluminum housing with precision all metal gears, steel thrust bearings and automatic braking. Includes rotator, controller, remote, clamps, and all hardware.AR-500 remembers up to 12 directions even after a power outage! Use remote control or direct console. Displays location and relative position.



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Null out strong QRM on top of weak rare DX and work him! Null out strong local ham or AM broadcast station to prevent receiver overload.

The MFJ-1026 is an adjustable phasing network that combines two antenna signals to give you various directional patterns. Null out a strong interfering signal or peak a weak signal at a push of a button.

Use external or built-in active noise antenna. RF sense T/R switch bypasses your transceiver. Plugs between antenna and transceiver. 12 VDC, 110 VAC with **MFJ-1312D, $19.95.** 6½ x 1½ x 6¼".



MFJ-1026
$239.95



MFJ-1025, $209.95. Like MFJ-1026 less active antenna, use external noise antenna.

MFJ Morse Code Reader and Keyer Combo

Plug in this MFJ Morse Code Reader with built-in keyer and watch CW turn into solid text messages as they scroll across an easy-to-read LCD

MFJ-464
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(Keyboard, paddles not included)



Built-in keyer makes working high speed CW a breeze. Type-ahead buffer, message memories and adjustable speed lets you compete with the best high speed CW operators – they won't even know you never passed a code test!

Everything you need for ultimate CW: sends/reads 5-99 WPM, automatic speed tracking, large 2-line LCD shows send/receive messages, use single, iambic paddle or computer keyboard, front panel speed, volume controls, 4 message memories, type ahead buffer, read again buffer, adjustable weight & sidetone, RFI proof, easy menu operation, more!

MFJ-551, $29.95. RFI suppressed keyboard.

MFJ-564/B, $109.95. MFJ Iambic paddles, chrome/black.



MFJ Contest Voice Keyer

Makes contesting easy -- Calls CQ, sends your call, does contest exchanges -- in your own natural voice

MFJ-434B
$239.95



MFJ Contest Voice Keyer™ makes contesting easy! Calls CQ, sends your call and does contest exchanges for you in your own natural voice!

Save your voice! Record and play back frequently used phrases like "CQ Contest this is KF5C", "You're 59", "Qth is Mississippi".

Repeat messages continuously. Vary repeat delay 3-500 seconds. Makes a great voice beacon and calling CQ easy.

Record and play back off-the-air signals -- great help if you didn't get it right the first time!

A playing message can be halted by the Stop Button, your microphone's PTT/VOX, remote control or computer.

All audio lines are RF filtered to eliminate RFI, audio feedback and distortion. Audio isolation transformer totally eliminates hum and distortion caused by ground loops.

Five messages, 75 seconds total. Use your mic or built-in mic for recording. Can be remote or computer controlled.

Works with 8 pin round or modular mics. Built-in Speaker amplifier.

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MFJ-73, $44.95. MFJ-434B Remote Control with cable.

MFJ SDR T/R Protection Switch



New!

MFJ-1708SDR, $89.95. An inexpensive wide-band SDR dongle receiver lets you see an entire band on a frequency/waterfall computer display! If you want to know where the activity is, who's generating splatter, what's in the DX window, how wide your audio is or what frequencies are clear, it's all right there! While receiving on your transceiver, MFJ-1708SDR switches your SDR to your antenna showing the entire band. On transmit your SDR is switched out and grounded to protect your SDR. PTT and a failsafe RF sense circuit switches MFJ-1708SDR. For HF/VHF.

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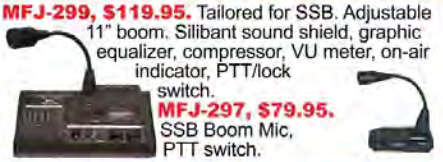
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MFJ Giant SWR/WattMeter



MFJ-868B, $169.95. World's largest 1.8-54 MHz SWR/Wattmeter has giant 6½ inch meter! True active peak/average forward/reflected power. 20/200/2000 Watt ranges.

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MFJ-1702C, $49.95. 2-position coax switch has a new center ground protection!

MFJ-1164B AC Line RFI Filter

MFJ-1164B, $99.95. Multiple Outlet, 119VAC



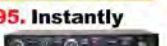
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MFJ-1263, $139.95. **Instantly** switch ragchewing to DX mic to any two transceivers. Use PTT foot switch, boom mic/headset, phones, speaker, audio-in jack.



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MFJ-260C, $49.95. **300 Watts**. SWR below 1.1:1 to 30 MHz. 1.5:1 from 30-650 MHz. **MFJ-264, $89.95.** 1.5kW load.



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DESKTOP



DESKTOP 10W Amplified DSP noise canceling speaker - Easy to use controls - 8 DSP filter levels - Line and speaker level inputs - "Real time" audio adjustment - Suitable for all radios incl' SDR

New NES10-2MK4



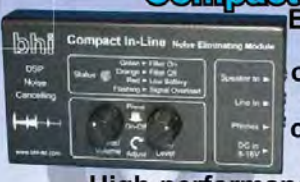
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Fully featured amplified DSP noise canceling in-line module - Separate mono or stereo input and outputs - Headphone socket - Latest bhi DSP noise canceling technology - Suitable for all radios, receivers and SDR - Use with headphones and speakers at the same time



Compact In-Line



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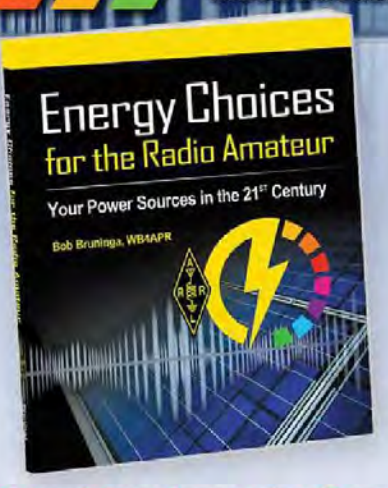


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If you want to know where the activity is, who's generating splatter, what's in the DX window, how wide your audio is or what frequencies are clear, it's all right there! While receiving on your transceiver, MFJ-1708B-SDR switches your SDR to your antenna showing the entire band. On transmit your SDR is switched out and grounded to protect your SDR. PTT and a failsafe RF sense switches MFJ-1708B-SDR. For HF/VHF/UHF. Monitor multiple bands with multiple SDRs and a multi-coupler.

MFJ-1708B-SDR-S, $129.95. SMA connector for your SDR.

MFJ-1708SDR, $99.95. Original model for HF/VHF.

New B series improvements...
The original MFJ-1708 series used one relay and wires to connect the SO-239s. The new B-series uses four relays and connectors on a *single* pc board. This gives you > 50 dB isolation at 300 MHz and > 68 dB at 50 MHz. SWR < 1.16:1 at 50 MHz and < 1.75:1 at 450 MHz at the transmit port. Mute output is a selectable short or open to ground. Use "boat anchors" or modern receivers or key a linear amplifier. Receiver input protection prevents overload from nearby high power signals and from receive to transmit. A hybrid splitter on SDR models reduces loading effect and gives > 15 dB isolation between the SDR REC and XCVR ports to reduce interference. The original MFJ-1708 series is still available.

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Pull weak signals out of static crashes, atmospheric, man-made and power line noise!

Hear signals 500 KHz to 30 MHz cleaner, quieter than ever before! Power line noise disappears. Rotate its figure 8 pattern and its extremely deep null to completely eliminate an interfering signal or greatly peak a desired one. Fully protected state of-the-art Gali MMICs in push-pull gives you a preamp with extremely high dynamic range, low IMD and 25 dB of low noise gain. Excellent performance on strong and weak signals without overload. 36-inch dia. loop. 1-in. OD 6061 aluminum.



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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.

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RSS is a Raspberry PiTM computer running Linux and RigPi Keyer and Audio boards. RigPi Keyer uses K1EL WinKeyer3 integrated circuit for keyboard/paddle input. RigPi Audio is used for VoIP for remote, digital modes and I/Q spectral display (Panadaptor).

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TECH HELP

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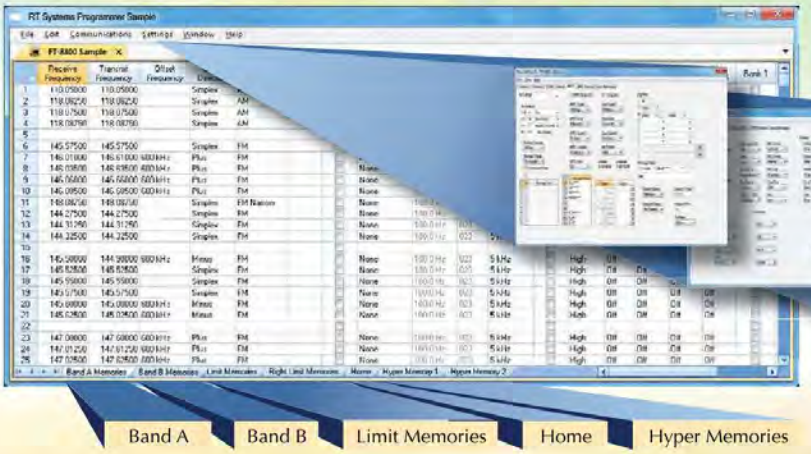
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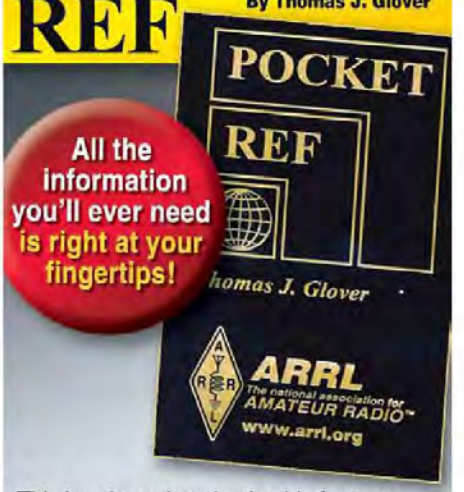
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MFJ-2289, $209.95. 7-55 MHz portable, 34' ext., 28" collapsed, balun, 1kW, 30/40M coil.

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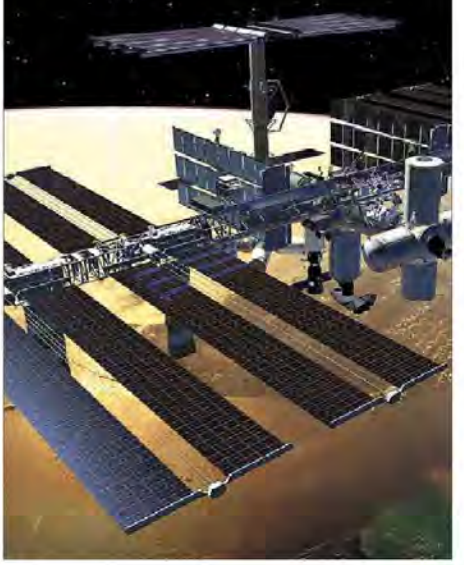
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Use for temporary or permanent wire antennas, small beams or verticals. **Best seller** is 50 ft. long, just 26 lbs.

Heavy Duty Models: All have QuickClamps™ →

MFJ-1908HD, $289.95 is 48 ext., 7.75-ft. collapsed, has 2 1/2" OD bottom, 1" OD top, seven 7.75-ft. sections, 24 lbs.
MFJ-1906HD, $249.95 is 38' extended, 6 feet collapsed, has 2 1/2" OD bottom, 1" OD top, seven 6-foot sections, 24 lbs.
MFJ-1904HD, $179.95 is 25' extended, 4 feet collapsed, has 2 1/2" OD bottom, 1" OD top, seven 4-foot sections, 14 lbs.
MFJ-1904H, $159.95. 22' ext., 5' collapsed, 9 lbs. 2 1/2" OD.
MFJ-1902H, $139.95, 10' ext., 38" collapsed, 5 lbs. 2 1/2" OD

Standard Models: H models have QuickClamps™

MFJ-1906, $159.95/MFJ-1906H, $219.95, 33 feet, ext., 6 ft. collapsed, six 6-ft. sections, 13 lbs. 2" bottom, 3/4" top OD.
MFJ-1908, $199.95/MFJ-1908H, $259.95, 41' ext., 7.75 ft. collapsed, six 7.75-ft. sect., 16 lbs. 2" bottom, 3/4" top OD.

Mast Accessories

MFJ-1900, $79.95. Mount clamps mast to mounting pipe.
MFJ-13S, $69.95. 5 Military *QuickClamps*™. Fit 3/4" to 2" OD.
MFJ-13HD, $69.95. Extra set clamps, 1- 2 1/2" masts.

Mast Guy Ring Sets

Fits masts 3/4" to 1 1/4" dia OD. **MFJ-2830X, $9.95,** *fiberglass*; **MFJ-2840X, $12.95**, *aluminum.*



Left: *Stainless Steel Hose Clamps* recommended for permanent installations. Fiberglass is slotted.

Right: UV protected Military grade *QuickClamps*.Guy 2 levels when fully extended.





18' Telescopic Mast & Tripod

MFJ-1919EX, $179.95.
Put your antennas up high anywhere with this super-strong* 18 foot telescoping fiberglass mast and MFJ-1919 heavy duty steel tripod. *QuickClamps™ lower mast to 5 feet. Mast has thick 1/8 in. wall, .75" top, 1.5" bottom dia. 15 lbs. Steel tripod has braced triangle base, non-skid feet, mast lock.

MFJ-1918EX, $109.95.
MFJ-1918 tripod has super strong 9.5 foot telescoping fiberglass mast. 3.8 feet collapsed. *QuickClamps*™. Thick 1/8 inch wall, .75" top, 1" bottom diameters. 6.5 lbs.



Tripods Only

MFJ-1921, $199.95, Giant tripod base spreads to 8 feet! Supports massive antennas. Adjustable length non-skid legs accommodates uneven ground surfaces. Optional foot anchors **MFJ-1905, $34.95**, see **Tripod Anchors** bottom right. 5.75Hx7D feet collapsed. 14 lbs.

MFJ-1919, $109.95, *Large tripod* base spreads to 4.8 feet. Supports 100 pounds. 7.8 feet, 1.4 inch diameter mast. 4.5H x .5D feet collapsed. 9.75 lbs.

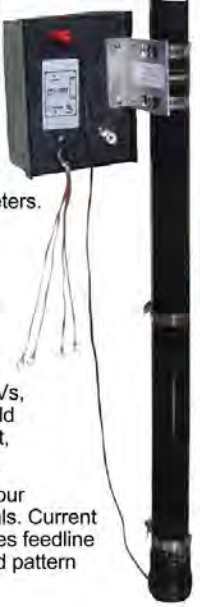
MFJ-1918, $69.95, Smaller tripod base spreads to 2.75 ft. Support 66 lbs. 6 foot, 1" dia. mast. 3.2H x .3D ft. collapsed. 6.75 lbs.

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3.8 foot fiberglass mast telescopes to a 31 foot self-supporting high performance 80-6 Meter vertical antenna in minutes!

MFJ-2980 **$115.95** 40-6 Meters

MFJ-2982 **$169.95** 80-6 Meters



Quarter wave performance on 40 Meters, halfwave on 20M. High-Q air wound loading coil. Use antenna tuner for 30, 20, 15, 12, 10, 6 Meters. 600 Watts SSB/CW.

Use as temporary, portable or permanent antenna for home, RVs, camping, field day, hamfest, DX-pedition.

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MFJ-347 **$24.95**



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Mount 3/8-24 HF/VHF hamsticks vertically or horizontally on masts up to 1 inch. Built-in SO239 connector.

MFJ-342T **$15.95**

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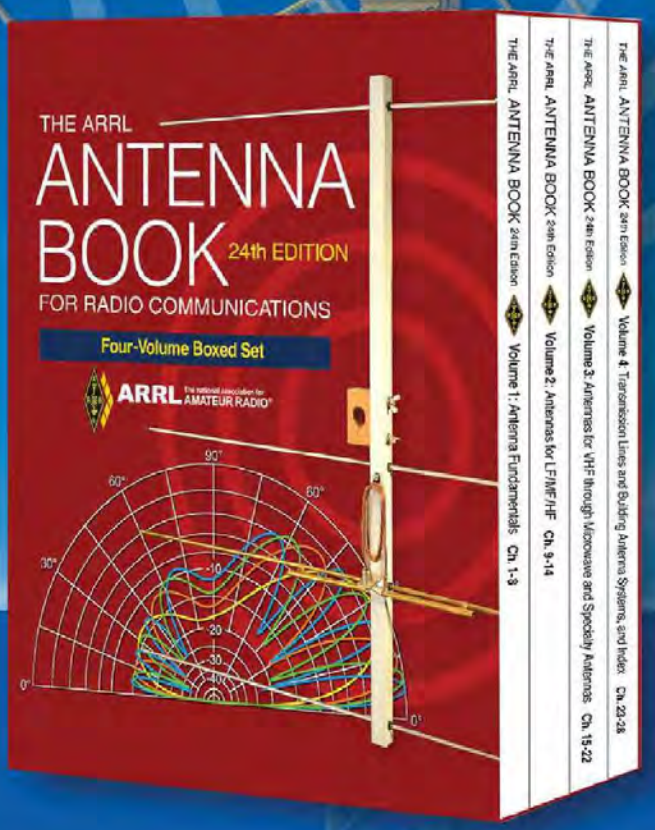
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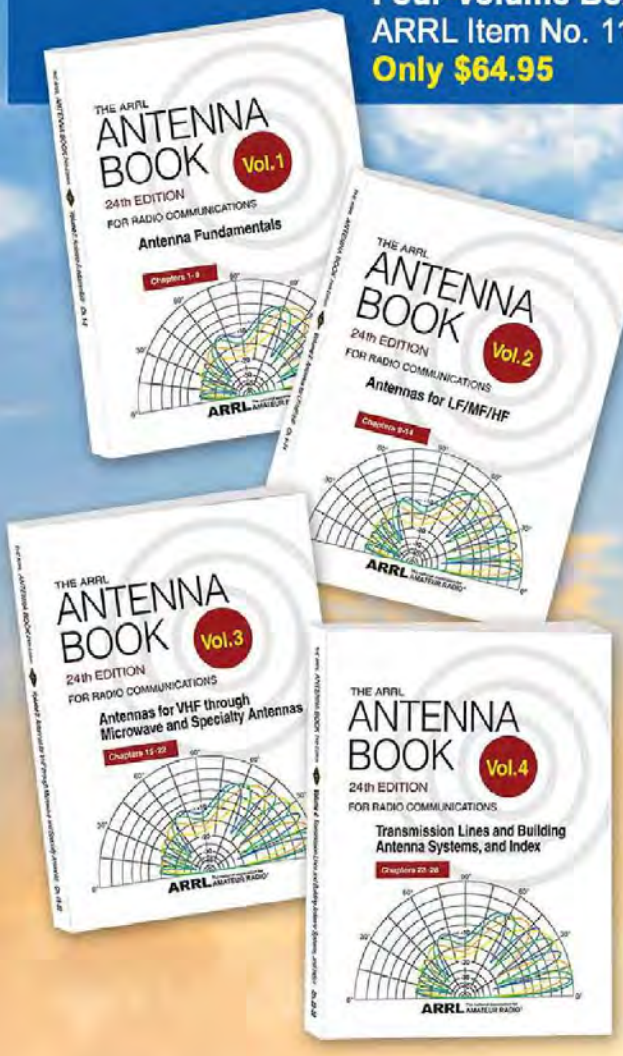
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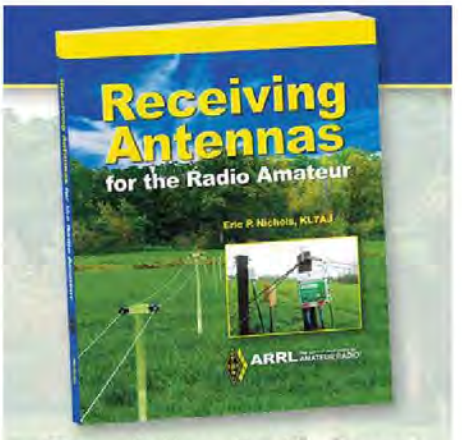


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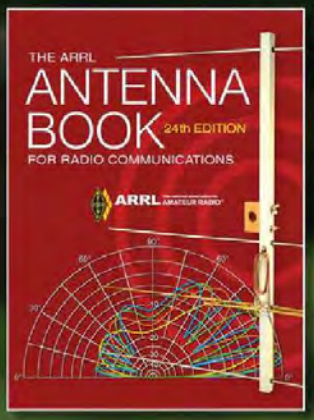
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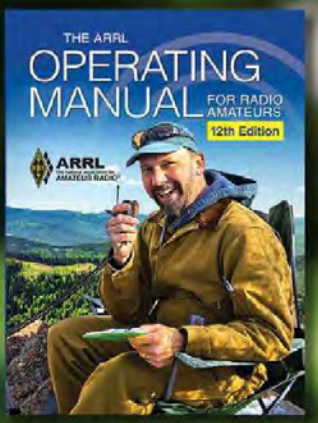
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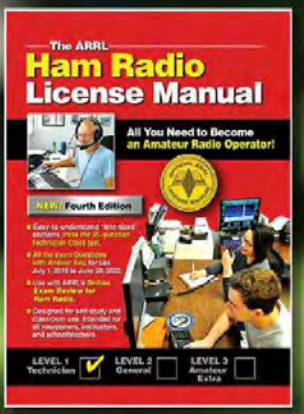
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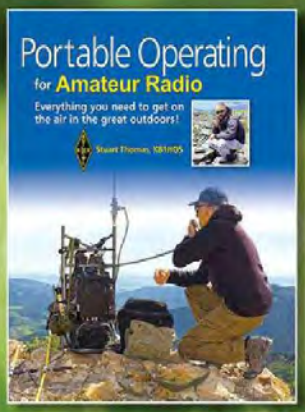
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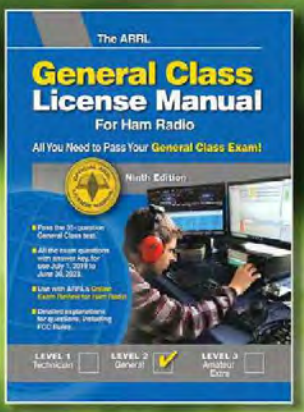


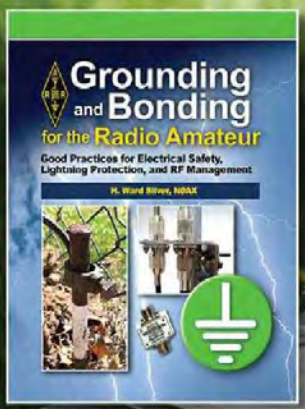


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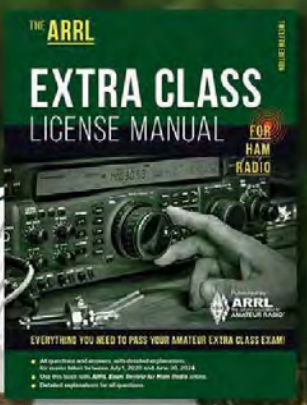
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New, cabinet maintains components' high-Q. Generous air vents keep components cool. $12^{7}/_{8}$W x 6H x $11^{5}/_{8}$D inches.

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Includes six position ceramic antenna switch, 50 Ohm dummy load, indestructible multi-color Lexan front panel with detailed logging scales and legends.

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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.

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Two knob tuning (differential capacitor and AirCore™ roller inductor) makes tuning foolproof and easier than ever. Gives minimum SWR at only one setting. Handles 3 kW PEP SSB amplifier input power (1.5 KW output). Gear-driven turns counter, lighted peak/average Cross- Needle SWR/Wattmeter, antenna switch, balun. 1.8 to 30 MHz. 15W x $4^{1}/_{2}$H x $10^{3}/_{4}$D in.

MFJ-962D compact kW Tuner



MFJ-962D $359.95

A few more dollars steps you up to a KW tuner for an amp later. Handles 1.5 kW PEP SSB amplifier input power (800W output). Ideal for Ameritron's AL-811H! AirCore™ roller inductor, gear-driven turns counter, pk/avg lighted Cross-Needle SWR/Wattmeter, antenna switch, balun, Lexan front, 1.8-30MHz. $10^{7}/_{8}$W x $10^{3}/_{4}$H x $4^{1}/_{2}$D in.

MFJ-969 300W Roller Inductor Tuner



Superb, AirCore™ Roller Inductor tuning. Covers 6 Meters thru 160 Meters! 300 Watts PEP SSB. Active true peak reading lighted Cross-Needle SWR Wattmeter, QRM-Free PreTune™, antenna switch, dummy load, 4:1 balun, Lexan front panel. $10^{1}/_{2}$W x $3^{1}/_{2}$H x $9^{1}/_{2}$D inches.

MFJ-969 $259.95

MFJ-949E deluxe 300 Watt Tuner



More hams use MFJ-949s than any other antenna tuner in the world! Handles 300 Watts Full 1.8 to 30 MHz coverage, custom inductor switch, 1000 Volt tuning capacitors, full size peak/average lighted Cross-Needle SWR/Wattmeter, 8 position antenna switch, dummy load, QRM-Free PreTune™, scratch proof Lexan front panel. $10^{5}/_{8}$W x $3^{1}/_{2}$H x 7D inches. **MFJ-948, $179.95.** Economy version of MFJ-949E, less dummy load, Lexan front panel.

MFJ-949E $219.95

MFJ-941E Super Value Tuner



Most for your money! 300 Watts PEP, 1.8-30 MHZ, lighted Cross-Needle SWR/Wattmeter, 8 position antenna switch, 4:1 balun, 1000 volt capacitors, Lexan front panel. $10^{1}/_{2}$W x $2^{1}/_{2}$H x 7D in. **MFJ-941EK, $139.95.** Tuner Kit -- Build your own!

MFJ-941E $169.95

MFJ-945E HF/6M mobile Tuner



Extends your mobile antenna bandwidth so you don't have to stop, go outside and adjust your antenna. Tiny 8W x 2H x 6D in. Lighted Cross-Needle SWR/Wattmeter. Lamp and bypass switches. Covers 1.8-30 MHz and 6 Meters. 300 Watts PEP. **MFJ-20, $9.95**, mobile mount.

MFJ-945E $159.95

MFJ-971 portable/QRP Tuner



Tunes coax, balanced lines, random wire 1.8-30 MHz. Cross-Needle Meter. SWR, 30/300 or 6 Watt QRP ranges. Matches popular MFJ transceivers. Tiny $6^{1}/_{2}$W x $2^{1}/_{2}$H x 6D in.

MFJ-971 $149.95

MFJ-901B smallest Versa Tuner



MFJ's smallest (5W x 2H x 6D in.) and most affordable wide range 200 Watt PEP Versa tuner. Covers 1.8 to 30 MHz. Great for matching solid state rigs to linear amps.

MFJ-901B $119.95

MFJ-902B Tiny Travel Tuner



Tiny $4^{1}/_{2}$W x $2^{1}/_{4}$H x 3D inches, full 150 Watts, 80-6 Meters, has tuner bypass switch, for coax/random wire. **MFJ-904H, $169.95**. Same but adds Cross-needle SWR/Wattmeter and 4:1 balun for balanced lines. $7^{1}/_{4}$W x $2^{3}/_{4}$H x $2^{3}/_{4}$D inches.

MFJ-902B $129.95

MFJ-16010 random wire Tuner



Operate all bands anywhere with MFJ's reversible L-network. Turns random wire into powerful transmitting antenna. 1.8-30 MHz. 200 Watts PEP. Tiny 4W x 2H x 3D in.

MFJ-16010 $79.95

MFJ-9201 QRPocket™ Tuner



80-10 Meters, 25 Watts. 12 position inductor, tune/bypass switch, wide-range T-network, BNCs. 4W x $2^{5}/_{8}$H x $1^{1}/_{2}$D inches. **MFJ-9201, $49.95**

MFJ-9201 $54.95

MFJ-921/924 VHF/UHF Tuners



MFJ-921 covers 2 Meters/220 MHz. **MFJ-924** covers 440 MHz. SWR/Wattmeter. 8W x $2^{1}/_{2}$H x 3D in.

MFJ-921/924 $109.95

MFJ-931 Artificial RF Ground



Eliminates RF hot spots, RF feedback, TVI/RFI, weak signals caused by poor RF grounding. Creates artificial RF ground or electrically places far away RF ground directly at rig. **MFJ-934, $249.95**, Artificial ground/300 Watt Tuner/Cross-Needle SWR/Wattmeter.

MFJ-931 $129.95

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2-Meter/440 MHz

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This antenna is perfect for your dual band mobile or HT. Powerful 3 1/2 inch magnet holds firm at highway speeds, rubber guard, 19" black stainless steel whip, low SWR, excellent gain, 300 Watts PEP, 12 feet coax with PL-259. Free BNC adapter.



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MFJ-281

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Ham Radio's most powerful dual band antenna gives whopping gain on 440 MHz and 2-Meters! Low SWR. 27 1/2" stainless steel Slimline™ radiator minimizes wind vibration for less SWR flutter for longer range, better readability. 12' coax, PL-259, Heavy duty magnet mount.



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MFJ-1728B **$34.95**

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MFJ Super-Strong Magnet Mounts with Coax/PL-259

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These jetblack 5-inch super strong magnet mounts have 17' coaxial line terminated with PL-259 connectors. SO-239 (BS) or NMO (BM) for your VHF/UHF antennas or 3/8-24 threaded (BT) for your HF hamstick antennas with a 3/8-24 threaded connector.

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MFJ-335BM – NMO
MFJ-335BT – 3/8 - 24 For HF sticks

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Compact 1.8-200 MHz SWR/Wattmeter has HUGE 3" Cross-Needle meter. Read forward/reflected power and SWR simultaneously. Perfect for mobile/portable. 30/300 Watt ranges. Built-in meter light. SO-239s. 3 1/4W x 3 1/4H x 3 1/4D". **MFJ-842, $69.95** covers 140-525 MHz, 15/150 Watts.

MFJ-822 **1.8-200 MHz $69.95**
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VHF/UHF Hi-Gain Antennas



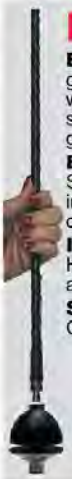
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C. MFJ-1422, $44.95.
VHF/UHF RuffRider High Gain™. 41 1/2 inch long antenna gives extra gain with little height increase. Handles 150 Watts. 1/2 wave with good gain on 2 Meters, 5/8 wave, excellent gain on 440 MHz. Black or chrome.

D. MFJ-1432, $64.95.
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Each is ruggedly constructed. A heavy duty 4 foot, 3/8 inch diameter fiberglass rod; a nearly indestructible .125 inch diameter PH-17-7 stainless steel whip and chrome plated brass fittings will give you years of service. It's sleek, low profile construction has low wind loading and its semi-rigid fiberglass eliminates the need for springs or guys.

Black anti-static jacket protects loading coil, blends with any vehicle. Stainless steel whip is adjustable for lowest SWR. Push it down to park in the garage or fully extend it for maximum efficiency during mobile operation.

Includes allen wrench and complete tuning and matching instructions. Handle 250 Watts PEP. Whips are 7 feet fully extended, and collapse to about 4 feet for easy storage.

Simply screws into any 3/8 x 24 female mount for quick bandchanging. Get them all for great band coverage!

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MFJ-1617T - 17 Meters
MFJ-1615T - 15 Meters
MFJ-1612T - 12 Meters
MFJ-1610T - 10 Meters
MFJ-1606T - 6 Meters

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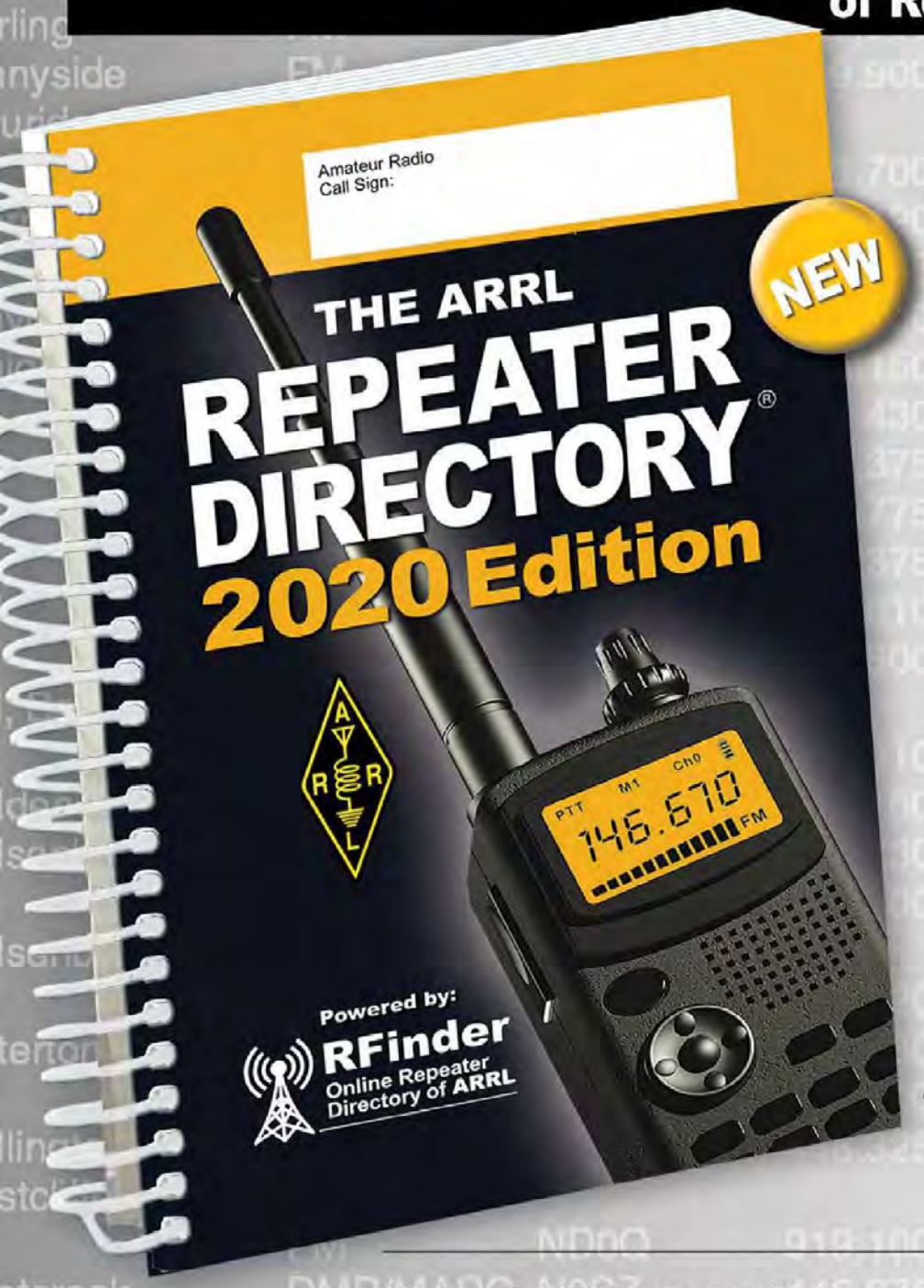


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Ham radio's most versatile 1.5 kW 50 ohm *dry* dummy load covers DC through 650 MHz. SWR 1.1:1 to 30 MHz and 1.3:1 to 650 MHz. Handles 1500 Watts for ten seconds, 100 Watts for 10 minutes. 3W x 3H x 9D in. SO-239 connector. **MFJ-264N, $109.95.** With type "N" connector.

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Run 1kW CW or 2 kW PEP for 10 minutes. Run *continuous duty* with 200 Watts CW or 400W PEP. Transformer oil included. SWR 1.2:1 to 30 MHz. Low SWR to 400 MHz. SO-239 connector. Safety vent with cap, carrying handle. 7½H x 6⅝D in. **MFJ-250X, $69.95.** No transformer oil.

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Connects directly with built-in PL-259. Finned aluminum air-cooled heatsink. 15 Watts continuous, 100W peak. SWR <1.5:1, DC-500 MHz. 15/8 inch round by 3 inches long. **MFJ-262B, $69.95.** PL-259. 35 Watts continuous, 200W for 5-seconds. SWR< 1.2;1 DC-1 GHz.

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MFJ's 2500 Watt *fan cooled* load handles legal limit amps, 2500W average one minute on, ten minutes off, 300W continuous. DC- 6 Meters. SWR <1.25, 30 MHz; <1.4, 30-60 MHz. Detailed power curve. 12 VDC or 110 VAC. 8¼W x 4H x 9½D in. SO-239s. 5 pounds.

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GrandMaster™ SWR/Power Meters are the *Cadillacs of ham radio!* Large 3¼ x 1¼ inch precision illuminated meter gives easy wide-angle viewing of SWR, forward or reflected power. 7½W x 3⅛H x 4¼D in. SO-239s. **MFJ-870, $89.95.** 1.6-60 MHz. 30/300/3000 Watt ranges. **MFJ-874, $129.95.** 1.8-525 MHz. 5/20/200 Watt ranges.

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Compact Digital SWR/Wattmeters



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MFJ-845 $114.95



MFJ-849 $189.95

MFJ HF *QRP* SWR/Wattmeter

Read forward, reflected power 1.8- 50 MHz, 0-5W. Also reads SWR, relative power 100 mW to 50W. SO-239s. 4½W x 2¼ H x 3D in.

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VHF/UHF SWR/Wattmeter

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The Ultimate

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1. Advertising must pertain to products and services which are related to Amateur Radio.

2. The Ham-Ad rate for commercial firms offering products or services for sale is $2.25 per word. Individuals selling or buying personal equipment: ARRL member 1.00 per word. Non-ARRL member $1.50 per word. **Bolding** is available for $2.50 a word. Prices subject to change without notice. You may pay by check payable to the ARRL and sent to: Ham-Ads, ARRL, 225 Main St., Newington, CT 06111. Or, you may pay by credit card sending the information by fax to 860-594-4285 or via e-mail to hamads@arrl.org. The credit card information we need is: the type of credit card, the exact name that appears on the credit card, the credit card number, the expiration date and the credit card billing address.

3. Remittance in full must accompany copy since Ham-Ads are not carried on our books. Each word, abbreviation, model number and group of numbers counts as one word. Entire telephone numbers count as one word. No charge for postal Zip code. No cash or contract discounts or agency commission will be allowed. Tear sheets or proofs of Ham-Ads cannot be supplied. Ads submitted in writing should be typed or printed clearly on an 8 1/2" X 11" sheet of paper.

4. Closing date for Ham-Ads is the 15th of the second month preceding publication date. No cancellations or changes will be accepted after this closing date. Example: Ads received December 16th through January 15th will appear in March *QST*. If the 15th falls on a weekend or holiday, the Ham-Ad deadline is the previous working day. Please contact the Advertising Department at 860-594-0255 or hamads@arrl.org for further information or to submit your ad.

5. No Ham-Ad may use more than 200 words. No advertiser may use more than three ads in one issue. Mention of lotteries, prize drawings, games of chance etc is not permitted in *QST* advertising.

6. New firms or individuals offering products or services for sale must check with us to determine if a production sample (which will be returned) should be submitted for examination. Dealers are exempted, unless the product is unknown to us. Check with us if you are in doubt. You must stand by and support all claims and specifications mentioned in your advertising.

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7. AN IMPORTANT NOTICE TO ALL HAM AD POSTERS AND RESPONDERS, FROM THE ARRL ADVERTISING DEPARTMENT Greetings from ARRL HQ! Please note that we have received reports from many ARRL members who have placed classified ads in these listings, and have received responses from individuals proposing "creative" payment schemes. These particular instances involved offers of overpayments for goods by bank check, followed by instructions to deduct the cost of your item from the overpayment, and to transfer the overage back or to another individual. This is a well-known scam. Unfortunately, we have no control over this and other scams of this type. Once your email address is posted, you are vulnerable to those individuals seeking to provide you with questionable information.

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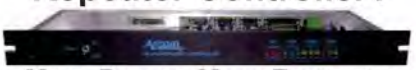
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