Build it Now! Bidirectional Loop Antenna for VHF/UHF Page 35

QST

DIGITAL EDITION

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December 2018 www.arrl.org
DEVOTED ENTIRELY TO AMATEUR RADIO

DIGITAL FEATURE

The radio... YAESU

True RF Legend
True Performance

FT DX 5000MP Limited

RF μ-Tuning Unit
(Optional)

- Provides ultra-high-Q RF preselection selectivity

Congratulations

We congratulate WRTC 2018 Y81N Winning Team from Lithuania

The winners of the World Radio Team Championship 2018
Gedas Lucinskas (LY9A) and Mindis Jukna (LY4L)

Rig used: 2 x FTDX5000MP

YAESU
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WRTC 2018

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The radio

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The radio... YAESU

The Legend Continues

The Transceiver that could only be created by Yaesu Offering New Excitement and Surprises

In homage to Sako Hasegawa

FTDX101MP 200W

HF/50MHz TRANSCEIVER

The Ultimate

FTDX101D 100W

HF/50MHz TRANSCEIVER

- Superb and Astonishing Close-in Dynamic Range
- 9MHz IF Roofing Filter Producing Excellent Shape Factor
- 400MHz HRDDS (High Resolution Direct Digital Synthesizer)
- Hybrid SDR: Direct Sampling & NBW (Narrow Bandwidth) SDR
- Completely Independent Dual Receivers
- High-Q VC Tuning Front-End
- Yaesu Renowned Interference Reduction System
- Large Touch-Panel Precision Color Display
- 3DSS (Three Dimension Spectrum Stream) Waterfall Display
- Active Band Indicator with LED illumination of the operating band, enables rapid band changes
- MPVD (Multi-Purpose VFO Outer Dial) provides Sub VFO dial, Clarifier operation, VC-TUNE adjustment, VFO fine tuning or a CS (custom selection) function

This device has not been approved by the FCC. This device may not be offered for sale or lease or be sold or leased until approval of the FCC has been obtained. The information shown is preliminary and may be subject to change without notice or obligation.

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The radio

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Cushcraft...Keeping You in Touch Around the Globe

MA-6B 6-Band Beam

Small Footprint – Big Signal

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

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

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

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

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

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

***See cushcraftamateur.com** for gain figures.*

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, $499.95,** 12/17 M. **30/40 Meter** *add-on kits* available.

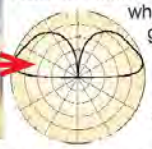
Cushcraft R9...80-6 Meters 80 Meters...No Radials...1500W

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

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

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

Cushcraft Dual-Band Yagis

One Yagi for Dual-Band FM Radios

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

Cushcraft Famous Ringos Compact FM Verticals

W1BX's famous Ringo antenna has been around for a long time and remains unbeaten for solid reliability. The Ringo is broad-banded, 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 2017 Ham Radio Catalog is HERE!

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

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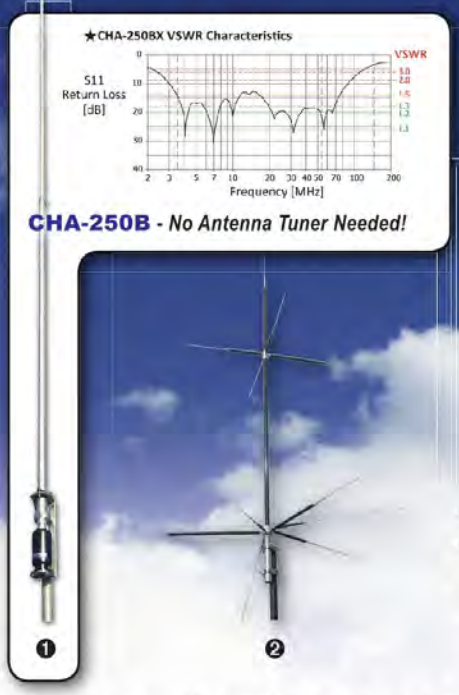
Life is a JOURNEY. Enjoy the ride!



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

Base Antennas

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

NEW
CAA-500MarkII
1.8-500MHz Antenna analyzer

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

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

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

CAA-5SC
Protect your CAA-500MarkII from moisture, shock, dents and dings!
Shoulder strap included.

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QST

Contents

December 2018 ♦ Volume 102 ♦ Number 12

Includes video
Includes audio
Additional content

Cortesia de Virgilio.

Columns

Departments

Our Cover
Our December cover features the antenna of Jack Porayski, SP5AUY. It is a long-boom dual-band Yagi for 21 and 28 MHz installed on his 55-foot tower. Jack lives in the town of Lomianki, about 15 miles north of Warsaw, Poland. [Henryk Kotowski, SM0JHF, photo]

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Ask around and check online; no one beats LDG!

VALUE, QUALITY, SERVICE

In the early days of ham radio around the turn of the 20th century all ham equipment was homebrew. If you wanted to get on the air you had to build your own receiver and transmitter; it would be decades before ham equipment became commercially available. By the 40s and 50s, companies like Collins, Hammarlund and Hallicrafters produced receivers and transmitters to the ham market. While the designs were basic, these radios were of high manufacturing quality, offered good value to the amateur buyer, and were backed by dependable factory warranty service. Many of these radios remain classics and highly valued nearly a millennium later.

These commercial values became hallmarks of many American manufactured products. LDG holds these same principles as our core values. In talking to our customers, we find that their priorities are value, quality, service and warranty; we couldn't agree more.

When LDG introduced the desktop microprocessor-controlled switched-L tuner to the amateur market in 1995, most automatic tuners had variable capacitors and inductors equipped with servo motors and an analog control bridge. Our breakthrough designs operated much more quickly, reliably, repeatably and at a lower cost. American hams, and indeed hams world-wide found great value in this approach, and these products formed the foundation of our business.

All LDG tuners come with a comprehensive, industry-leading two-year warranty. Even after the warranty period expires, your tuner will be repaired for a reasonable price. Full technical support is available by phone and e-mail if you have questions or need guidance in installing or using your tuner. Ask around and check online; no one beats LDG on service and support.

The warranty on your LDG product is fully transferable; if you sell or give away your tuner, simply give the new owner a copy of the receipt and the remaining warranty goes with the tuner. No registration paperwork is required; the copy is all that is needed to obtain warranty repairs.

At a time when our markets are flooded with cheaply made goods of questionable quality and little support, LDG is proud to continue the American tradition of building and marketing high-quality products that our customers find of great value, and providing them with comprehensive support and warranty service.

When you need a new tuner or other related equipment, consider LDG and its wide range of quality products. Visit us on the web at www.ldgelectronics.com

ZERO POWER TUNERS

Z-11ProII

Designed for Battery Operation. Operates from 0.1 to 100 watts SSB or CW, 30 watts digital. Great for both QRP and standard 100 watts transceivers. Matches dipoles, verticals, inverted vees and most coax fed antennas.

DESKTOP TUNERS

AT-100ProII

Our most popular Desktop tuner. Covers all HF frequencies including MARS, 1.8 to 54 MHz. It features a two-position antenna switch to instantly change bands. Work with just about any modern HF radio. The AT-100ProII requires just 1 watt to operate, but will handle 100 watts SSB or 30 watts Digital.

REMOTE TUNERS & MORE

Contact your favorite LDG Dealer TODAY!

& WARRANTY...

LDG ELECTRONICS

Z-100Plus

Low cost and Portable, the Z-100Plus operates from any 7 to 18 volt DC source. AA batteries will run it for a year of normal use. Internal frequency counter stores tuning parameters for fast recall. Handles 100 watts SSB or 30 watts Digital.

Z-817

The ultimate QRP autotuner. Seamless integration to the Yaesu FT-817 and FT-818 provide one button tuning. 2000 memories covers 160 through 6 meters, 20 watts SSB, 5 watts digital.

Don't know which tuner is right for you?

See our Tuner Comparison Chart at ldgelectronics.com

AT-200ProII

The AT-200ProII handles the high powered rigs or that small amp. Includes a two position antenna switch with 2000 memories for each antenna. Handles up to 250 watts SSB on 1.8 to 30 MHz, 100 watts on 6M, 75 watts digital. Rugged and easy to read LDG bar-graphs show RF power and SWR.

AT-600ProII

Perfect for mid-sized amps, the AT-600ProII is a great all-around tuner. 2000 memories store your matches for nearly instant recall. Handles up to 600 watts SSB on 1.8 to 30 MHz, 200 watts on 6M, 200 watts digital.

AT-1000ProII

Our Flagship 1000 watt tuner! Large, easy to read bar-graph meter shows forward power and SWR at the same time. Two position antenna switch; RF sensing; Auto and Semi tuning modes; 5 to 1000 watts SSB/CW, 250 watts digital; 1.8 to 54 MHz, 10:1 tuning range (3:1 on 6M).

IT-100

Matched in size for Icom desktop radios including the IC-7300. Enjoy control from the radio's Tuner button or the Tune button on the tuner. For any Icom radio that are AH-3 or AH-4 compatible.

YT-100

For Yaesu' s FT-100, FT-857 and FT-897 transceivers. The operation is to key the radio in AM/FM/CW then press the tune button on the tuner. The tuner will find the match and you are ready to operate. Includes 3' CAT-DIN-8 cable.

YT-1200

Designed for Yaesu' s FT-991A, FTdx-1200, FTdx-3000, FT-450 and FT-950 for seamless tuner integration. Powered by the radio and controlled by the tuner. With CAT-pass through to allow for computer operation. Use any baud rate. Includes 3' YC-1200 interface cable.

RT-100 and RT-600

RT-100 and RT-600: Remote tuners can reduce feedline loss due to SWR. These tuners are DC powered over the coax to allow operation from your shack. Includes mounting brackets and controller for on/off, Auto mode, Lock and Tune. 1.8 to 54 MHz. RT-100: 100 watts SSB. RT-600: 600 watts SSB.

RBA-1:1 and RBA-4:1

RBA-1:1 and RBA-4:1. Designed to allow easy conversion from ladder line, twin lead, and long wires (with a good ground) to coax cable. Covers 1.8 to 30 MHz. 200 watts SSB.

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DIAMOND ANTENNA

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

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

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

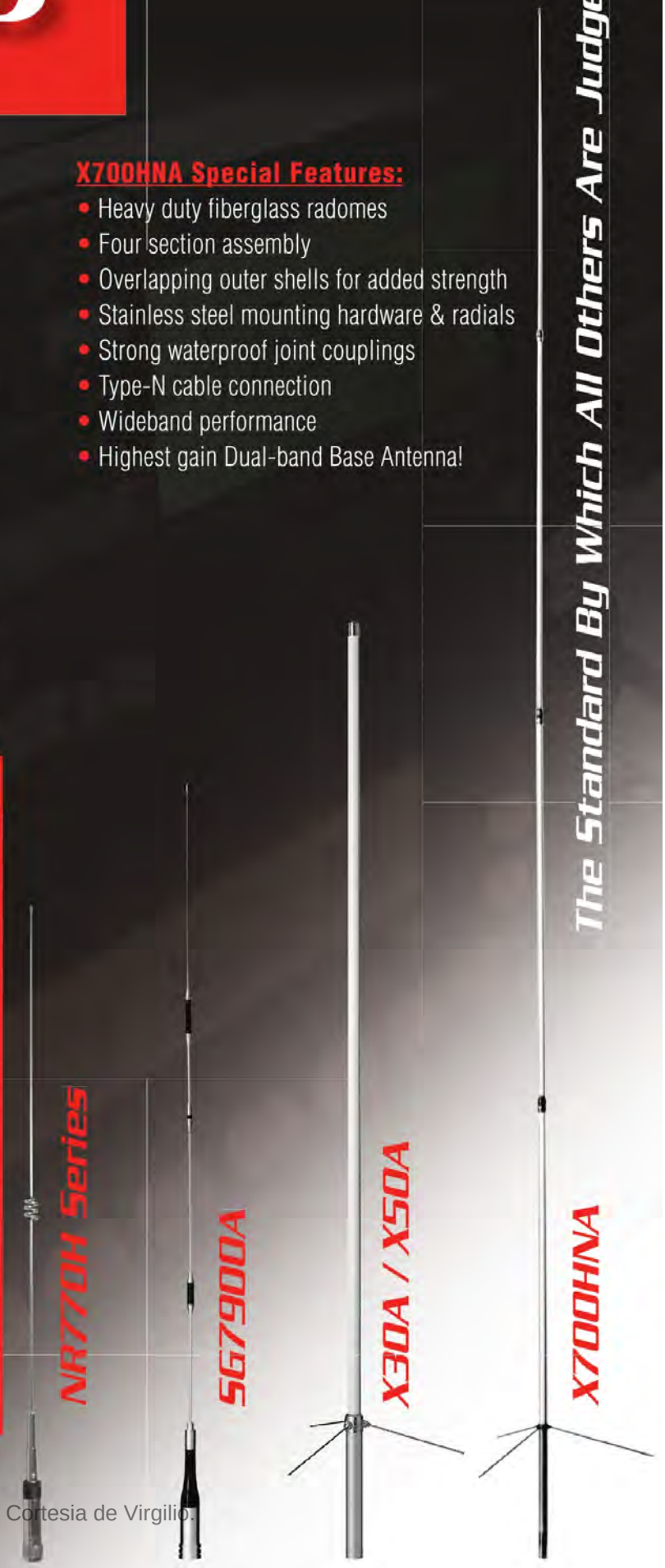
You've tried the rest, now own the best!

X700HNA Special Features:

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

Here is a small sample of our wide variety of antennas

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



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Howard E. Michel, WB2ITX, ARRL Chief Executive Officer, hmichel@arrl.org

Second Century

Starting With a Story

"Those of you who read this column regularly may have noticed that there is a new face at the top of this page. I am Howard E. Michel, WB2ITX, and as I write this, I'm in my second day as ARRL Chief Executive Officer."

First, let me publicly and personally thank Barry Shelley, N1VXY, for stepping up to run ARRL in January. Barry's tenure as CEO caps 29 years of service at ARRL Headquarters. ARRL and Amateur Radio have benefited greatly from his dedication, insight, and management skills. Thanks, Barry!

Secondly, let me thank those of you who are reading this piece. Your interest shows a dedication to ARRL and our hobby that is not shared by all hams. You may be expecting me to make some pronouncement of my views on the hobby, or ARRL. I promise that I will engage you in that dialog in the future. But before I do, I'd like to establish our relationship. I believe that society is best when people communicate, and true communication comes from understanding and respect. And understanding starts with a personal story.

My story starts when I was a young teenager. My father taught me to use a hammer and saw, but he felt electricity was beyond him. We had a friend of the family, who would later be my Elmer, install the electricity in the basement that my father was finishing. I was fascinated by the magic — or logic, or something — in wiring outlets, wall switches, and ceiling lights. Shortly after that, my father and I would go every Friday evening to this friend's workshop, where he repaired radios that were used to alert members of the local volunteer fire department. I wondered how he could understand how the radio worked, and how he knew which piece of test equipment to use. I was hooked on electronics. I wanted to understand.

I made my first major foray into electronics at my seventh-grade science fair. I built — with the help of our family friend and the schematic in the back of the RCA Receiving Tube Manual — a five-tube superheterodyne radio receiver. It was built on a 4 × 8 sheet of pegboard, with sections for the 35W4 rectifier, 50C5 power amplifier, converter, IF, and detector. I wasn't a ham yet. I wasn't even a shortwave listener. But I was learning how radios worked.

That family friend was a ham. I remember him calling CQ, and getting a reply from somewhere far away. I wanted to be a ham too. So our family friend became my Elmer, taking me to a local hamfest, where we bought a shortwave receiver. I've long since forgotten the make and model, but I remember listening, sending reports, and collecting cards from stations around the world. I built a loop antenna, about 4 – 5 feet square, that sat on a tripod in my bedroom. It was highly directional, and with an embedded variable capacitor, highly selective. I loved the challenge of mastering the technology, and using it to do difficult things.

Eventually, when I was about 16, I became WN2ITX. At this point, I had upgraded my receiver and added a Heathkit transmitter. Back in the day, Novices had to operate using crystals to control the transmitter frequency. I bought surplus crystals at hamfests and grinded them with a little abrasive cleaner on a sheet of glass to alter the frequency. The more crystals you had, the more frequencies you could operate on. And for me, making the technology work for me was as important as making the contact. And of course, there were antennas. I had a dipole for 80 and 40 meters (that also worked on 15), squeezed onto a house lot that was too small.

Within a year, I had upgraded to General and then Advanced, and added a secondhand SSB transceiver, an old RTTY machine, a 100 W 2-meter FM base station, and a 40 – 10 meter vertical. A triband beam was a distant dream (I've never had one), but in 1969, sunspots were at their peak, and 10 meters was hot. I was a member of a local club and enjoyed participating in ARRL Field Day and public service events.

But then I went to college and, after that, into the military. Between frequent rounds of packing, moving, and unpacking, along with the difficulty of setting up antennas, and the demands of building my career, ham radio took a back seat. But when I could, I got on the air with equipment that I either built, modified, or repaired.

In the 50 or so years since then, I have not lost the kick I get from using technology that I have mastered. To me, this is the essence of my ham radio hobby. But I also recognize that RCA doesn't make receiving tubes anymore, and not every ham had the same experience as I did. I believe that every ham has a story, and we need to embrace everyone's unique story to move ARRL and Amateur Radio into the future. I welcome your comments at **wb2itx@arrl.org**.

Howard E. Michel WB2ITX

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80-6 Meters

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QST review: Feb. 2010

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$138 to $158

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Part #	Length/Ft
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235-5X-10	10
235-5X-5	5
235-5X-3	3

1ft to 25ft readily available
Custom lengths and Bulk available

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Part #	Length/Ft
233/2-4X-12	12
233/2-4X-10	10
233/2-4X-5	5
233/2-4X-3	3
233/2-4X-1	1

1ft to 25ft readily available
Custom lengths and Bulk available

233/2-G4 Vehicle Ground Braid (PN:233/2-G4) Unique design (Nickel Grommets 4" Spacing) allows for easy attachment to a vehicle's body or truck bed to create a "ground plane" Good option as a buss-bar in the shack ½" wide tinned copper 38x48x8/34 10ga 53 amps

Part#	Length/Ft
233/2-G4-10	10
233/2-G4-5	5
233/2-G4-3	3
233/2-G4-1.5	1.5

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- All Cable Assemblies are Hi-Pot and Continuity Tested.
- Our Cables Have a Sunlight Resistant & Direct Burial Jacket.

Monthly Special

ABR400 (PN: 24400) with N Male connectors

Attenuation per 100ft	Power Rating
1.5dB @ 150 MHz	1.47K
2.7dB @ 450 MHz	0.83K
3.9dB @ 900 MHz	0.58K
4.5dB @ 1200 MHz	0.49K

Cable Length	List	Special
25ft	$44.95	$41.00
50ft	$70.95	$64.00
75ft	$97.95	$88.00
100ft	$124.95	$112.00

ABR213 (PN:2213A) RG213/U MIL-SPEC Non-contaminating Direct-Burial Ultra-Violet Resistant Jacket. W/SILVER-TEFLON PL259 & WEATHERPROOF HST each end.

Attenuation per 100ft	Power Rating
0.6dB @ 10MHz	3.43kW
1.0dB @ 30MHz	1.95kW
1.4dB @ 50MHz	1.5kW
2.4dB @ 150MHz	0.83kW
4.5dB @ 450MHz	0.45kW

Lengths 1.5ft to 150ft readily available
Custom lengths and Bulk available

ABR240-UF (PN:218XA) RG8X (240F) Foil+TC Braid Non-contaminating Direct-Burial Ultra-Violet Resistant Jacket. W/SILVER-TEFLON PL259 & WEATHERPROOF HST each end.

Attenuation per 100ft	Power Rating
0.9dB @ 10MHz	2.16kW
1.6dB @ 30MHz	1.24kW
2.1dB @ 50MHz	0.96kW
3.6dB @ 150MHz	0.55kW
6.3dB @ 450MHz	0.31kW

Lengths 1.5ft to 150ft readily available
Custom lengths and Bulk available

ABR316/U (PN:23316)
Available in standard configurations in 3ft, 6ft, 9ft, and 12ft.

Connector Options
N Male to N Male
SMA Male to SMA Male
SMA Male to SMA Female
SMA Male to SO239
SMA Male to PL259
SMA Female to SO239
SMA Female to PI259
Custom assemblies available

ABR400-UF (PN:24500F) 400-FLEX (RG8/U TYPE) FLEXIBLE LOW LOSS Non-contaminating Direct-Burial Ultra-Violet Resistant Jacket. W/SILVER-TEFLON PL259 & WEATHERPROOF HST each end.

Attenuation per 100ft	Power Rating
0.8dB @ 30MHz	2.77kW
1.1dB @ 50MHz	2.14kW
1.8dB @ 150MHz	1.22kW
3.3dB @ 450MHz	0.69kW

Lengths 1.5ft to 150ft readily available
Custom lengths and Bulk available

ABR400-UF (PN:24500F) 400-FLEX (RG8/U TYPE) FLEXIBLE LOW LOSS w/N Male plugs each end. Complete w/Weatherproof Heat Shrink Tubing (WP-HST)

Attenuation per 100ft	Power Rating
0.8dB @ 30MHz	2.77kW
1.1dB @ 50MHz	2.14kW
1.8dB @ 150MHz	1.22kW
3.3dB @ 450MHz	0.69kW

Lengths 1.5ft to 150ft readily available
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Member Spotlight

Michael Costabile, WD4MGP

Precision Time Inc. is the only time-keeping system trusted by worldwide sports associations, and it was invented by Michael Costabile, WD4MGP, who used ham radio technology as the backbone. Now, his technology is used in every NBA game, has been used in the Olympic games, EuroLeague Basketball games, and many more. Mike, president and founder of Precision Time, says all you have to do to see his technology in action is turn on any basketball game, because "somewhere in the world, that system is used every single night."

Two Passions Collide

Both ham radio and sports have had a huge impact on Mike's life since his formative years. His brother's CB radio sparked an interest that Mike would carry with him through every other aspect of his life and career. He earned his Novice license as a teen in 1977, and his favorite aspects of the hobby are building and testing antennas.

Also inspired by his family's involvement in sports, specifically his father and brother officiating basketball games, he began working as a referee for high school athletics in 1980, then moved on to Division I college athletics, and later became involved with the National Basketball Association in 1989 as a referee. His experience with several time-related issues in the NBA allowed him to explore the ways he could improve the timing system by combining his love of sports with his passion for building and testing ham radio equipment and electronics. Thus, the invention of Precision Time technology.

Michael Costabile, WD4MGP.

No Time to Waste

Founded in 1994, Precision Time developed a sports time tracking system that removed the human error and reaction time from the time-keeping equation. The system, primarily used for basketball, uses a small computer that connects the game clock to the game official's belt pack and whistle, stopping or starting the clock instantly. With players moving constantly and rapidly, a tenth of a second can be critical, and Precision Time makes all the difference.

Mike explained that the fundamental aspect of the Precision Time System is the performance of its radio. He said, "My knowledge of ham radio was directly responsible for how this system was developed and how it survives in the hostile RF environment found in many arenas. Today's arenas are filled with thousands of cell phones, portable radios, wireless devices, and sensors. Any system that is added to that environment is not going to fare well unless it is coordinated into the chaos."

Mike feels that ham radio knowledge goes far beyond the strictly technical aspects of the avocation, especially with developing a creative, inventive, and problem-solving mind. For instance, Mike's company went beyond just the technology itself; Precision Time also developed its own batteries. Mike explained that there was a need for a high-capacity battery with a long life, ideally lasting more than one game. "We were unable to find that in existing batteries, so we went to the drawing board and developed a battery that would provide the capacity our Precision Time customers deserved."

Inspiring New Licensees

Mike is a strong advocate for Amateur Radio, saying, "Our society would benefit from having the skills associated with ham radio, in order to troubleshoot and problem solve today's advanced devices." He added that Amateur Radio allows for many opportunities and helps to overcome a wide range of barriers, from geography and languages to solar environment obstacles.

For this reason, nearly every member of the Precision Time team has, or is in the process of getting, a ham radio license. With Amateur Radio being such an integral part of their work, employees have access to licensing material and hands-on radio experience through the on-site ham shack, and Mike said, "We'll happily help our new licensees obtain their first radios."

The next time you're looking for a little ham radio inspiration, turn on a sports game, keep an eye out for the referee's radio pack, and remember how ham radio played a fundamental role in the development and evolution of this inventive technology.

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The American Radio Relay League, Inc.

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

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

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

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

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

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

Cortesia de Virgilio.

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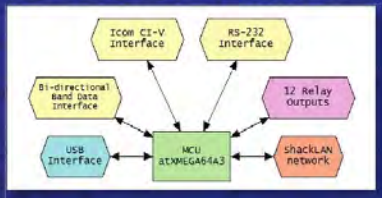

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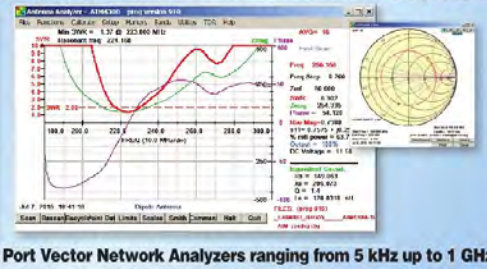

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Up Front

Mother Nature Can be Tough on Antennas

As we slide into December, and the challenges of winter in the Northern Hemisphere, we celebrate those amateurs who persevere, despite the worst that nature can send our way.

Bill Gerhold, K2WH, in Hewitt, New Jersey, captured this image of his 2-meter Yagi, 900 MHz beam, tri-band vertical, and 80-meter dipole antenna all covered in layers of snow and ice.

David McVinnie, N5CFI, offers evidence that it really does snow in Albuquerque, New Mexico. He awoke in mid-December last year to find his Yagi antenna coated in fluff.

Some amateurs refuse to let a few feet of snow stop them from putting up new antennas. Bill LaBell, KD8JAM, in Keweenaw, Michigan, takes advantage of a clear day and prepares to launch wires into the trees. [Don Lafreniere, W8PSP/VA3DJL, photo]

N5CFI also confronted Mother Nature's blustery winds in New Mexico a few years ago and received a valuable education about the importance of antenna guying.

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Letters from Our Members

Attending Amateur Radio Events

I enjoyed the article "Your First Amateur Radio Event" from the September 2018 issue of *QST*. I have had the opportunity through our club, ECARA (Eastern Connecticut Amateur Radio Association), to volunteer for several events and have found them to be very rewarding. I would encourage any ham that is thinking about getting involved to go for it; it is a great way to keep your radio skills sharp, and an excellent opportunity to work with your community and to meet some new people, as well as provide assistance to some very worthy events.

Rusty Lanzit, KC1CVU
Chaplin, Connecticut

Historical Frequencies

Operating on the newly authorized 630-meter band is like traveling on a steam-powered train in the way that you are using a historical vessel. This portion of the radio spectrum just below the AM broadcast band has seen not only the beginnings of radio, but over the last 100 years, has been the site of extreme drama — think of the wireless operators on the *Titanic* and many other disasters at sea. Just a little way up the band from our 472 – 479 kHz allocation was the 500 kHz international maritime frequency used to transmit an "SOS."

The shipboard radio room operators used *Q* signals (created in 1909 by the British to overcome language differences) and many of the same protocols, abbreviations, and shortcuts that hams on CW use today. Indeed, many shipboard operators had ham licenses in addition to commercial Radiotelegraph licenses.

Getting a signal on the air on 630 meters can be a challenge, but most of today's rigs will receive such frequencies. There are beacons to be heard and contacts to be made. For something different, you can tune lower and copy the CW identification of the aviation directional beacons that are still on the air. There are interest groups, retired maritime operators, and hams that are keeping the maritime CW world alive, such as the Maritime Historical Radio Society. See **www.radiomarine.org** for additional info.

Doug McCray, K2QWQ
Southampton, New Jersey
Life Member

Preservation and Promotion

I'm not one who considers myself influenced much by advertisements, but I recently donated to AMSAT-NA in support of the Amateur Radio on the International Space Station (ARISS) program after seeing the Kenwood advertisement on the back page of the July 2018 issue of *QST*. It made me want to support this program in whatever capacity I can.

In part, the ad stated, "The ARISS mission is to provide and operate Amateur Radio systems in space aboard the International Space Station, helping inspire, educate and engage youth and communities worldwide in science, technology, engineering and mathematics."

This struck a chord with me, as I've worked in various capacities in each of those STEM areas over the span of my entire career. The last 11 years of my working life were spent as an adjunct instructor of adult education in my local college's GED program, teaching STEM-related subjects. I spent 20 years in the US Navy working in various meteorological, oceanographic, electronic, and computer maintenance and management capacities. Those activities, plus additional formal education, opened employment opportunities for me in the civilian sector for an additional 30 years.

Exposing school students to the possibilities of careers in STEM via ARISS is nothing short of positive. As stated so many times before, we never know what lesson, activity, or casual statement will open a person's mind and inspire them to greatness.

As I celebrate 47 years in Amateur Radio, I encourage others to reflect upon what it has meant and done for them. I hope that you too will be inspired to "pay it forward" and help preserve and promote an avocation that has meant so much to all of us.

John Carobine, WB8RFB
Waukegan, Illinois
Life Member

Puerto Rico, 1 Year Later

It has been just over 1 year since the team of 22 ham radio operators was deployed to Puerto Rico at the request of the American Red Cross. That mission has ended, but the need still exists. I am still actively involved in preparing my district Emergency Management Agency offices, municipal police departments, and ARES members for the next disaster here in Puerto Rico. I have received radios, antennas, and accessories from many hams on the mainland for use in this ongoing effort of preparedness. Along with that, I have encouraged many in the local municipalities to study and become ham radio operators in the hope that they will also step forward and become active in ARES.

As we look forward to the full implementation of *ARES Connect*, we are all reminded to renew our efforts and commitment to being the best we can be in any situation.

The efforts made by each one of these dedicated operators will be remembered by all here on the island for years to come. They cleared the way for us by demonstrating a dedication to helping at a time when the risk was high. I hold them in the highest regard. We are a force of thousands. We answer the call when needed. Now let's get to work.

Andy Anderson, KP4AAN
Aguadilla, Puerto Rico

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

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DX Engineering's employee radio club, N8DXE, received this QSL card (an All-Time New One) from the 2018 Baker Island KH1/KH7Z DXpedition. Operator Ed, K8IV—a longtime DXer and DX Engineering senior engineering technician—made contact with Baker Island at N8DXE on 20 meter SSB using top equipment available at DX Engineering. From his home station, customer/technical support specialist Mark, W8BBQ scored his own QSL card by working Baker Island on SSB and CW on 17 and 20 meters.

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A Versatile T/R Switch for SDRs and Vintage Radios

This RF-actuated switch can be used with any transmitter and receiver combination, but it is especially well suited for software-defined radios.

Robert Nickels, W9RAN

In my January 2013 *QST* article, "Cheap and Easy SDR," I introduced many hams to the world of software-defined radio (SDR) through inexpensive DVB-T (RTL-SDR) dongles and other SDR receivers like Airspy, SpyVerter, HF+, SDRplay RSPs, HackRF One, and more that have since become part of many ham shacks.

Adding an upconverter like my RANVerter (available at **www.hayseedhamfest.com**) turns inexpensive dongles intended for digital TV reception into usable HF receivers when operated with PC-based software such as *SDR#*. But after some initial fun, many SDR receivers end up in a drawer, because they lack several key communications receiver features needed for use on the air.

I designed my versatile T/R switch with these needed features:

- A provision for muting the speakers when transmitting
- Sidetone to monitor CW keying
- A convenient means of switching the antenna between the transmitter and the SDR receiver
- Protection for the receiver input during transmit
- A way to overcome digital signal processing latency, which makes it impossible to monitor one's own signal, as can be done with a conventional receiver.

With these features, any SDR receiver can be conveniently used as part of a ham station, either as a primary receiver or as a panadapter or DSP second receiver connected to the IF of an existing receiver. Even an inexpensive RTL-SDR can become a very usable receiver when the needed functions are properly integrated. Versa-TR puts everything onto a compact PC board (see the lead photo) using all through-hole construction.

The Versa-TR also works with conventional analog transmitters and receivers or transceivers. Some possible station configurations include a conventional transmitter with an SDR receiver, a conventional transmitter and receiver, a conventional transceiver with an SDR panadapter (or second receiver), and a conventional transmitter with multiple receivers.

The Versa-TR incorporates a versatile RF-sensing relay that can also be used for keying a linear amplifier or lighting an "on air" sign.

Circuit Description

The Versa-TR schematic diagram is shown in Figure 1. It includes four major circuit functions: an RF-actuated switch, antenna relay, muting relay, and sidetone oscillator. A Versa-TR hookup is illustrated in Figure 2. The board requires 5 V at 200 mA, provided by the 5 V USB power supply via a USB Mini-B (five-pin) connector.

RF-Actuated Switch

The RF switch detects RF energy at the transmitter connector and triggers a 555 timer, activating the antenna relay K1 and the muting relay K2.

> *"Even an inexpensive RTL-SDR can become a very usable receiver when the needed functions are properly integrated."*

An adjustable time delay accommodates semi break-in operation. Both relays energize instantly, but the timer provides a delayed release time determined by the setting of the delay trim potentiometer (trimpot). The delay can be up to several seconds to provide VOX-like operation on voice or semi break-in operation in CW.

> *"RF sensing eliminates the need for anything other than an RF connection to the transmitter."*

Antenna Relay

The antenna relay has 8 A contacts to handle antenna switching but should only be used with non-reactive 50 Ω loads. Applied power should not exceed 100 W, and a tuner or resonant antenna should always be used to ensure low SWR. One set of contacts transfers the antenna from receiver to transmitter, and a second set grounds the receiver input to protect against excessive signal levels during transmission.

You will need to provide RG-58/U coaxial cables with RCA connectors for the Versa-TR end, and suitable connectors for the transmitter, receiver, and antenna.

RF sensing eliminates the need for anything other than an RF connection to the transmitter. However, external normally open contacts may be connected to the **KEY** terminals to directly control the Versa-TR, like a conventional T/R relay. No ac or dc voltage should be applied to these terminals.

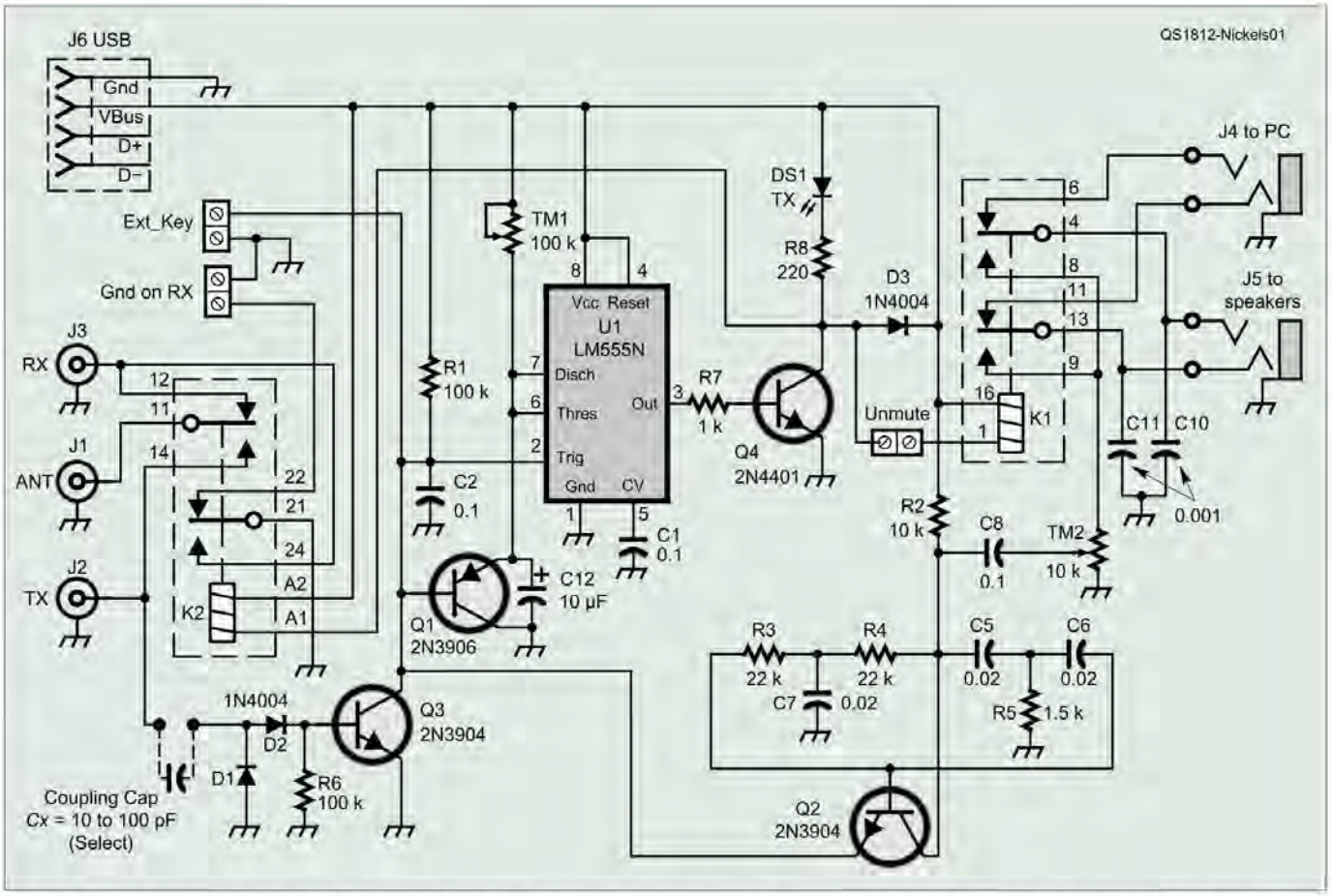


Figure 1 — Schematic of T/R switch. A kit is available at **https://hayseedhamfest.com/products/ran-technology-versa-tr-switch**.

C1, C2, C8 — 0.1 µF, 50 V, ceramic or film capacitor
C5, C6, C7 — 0.02 µF, 50 V, film capacitor
C10, C11 — 0.001 µF, 50 V, ceramic capacitor
C12 — 10 µF, 50 V, electrolytic capacitor
Cx — RF sense capacitor: 10, 47, or 100 pF; use smallest value for reliable keying.
D1, D2, D3 — 1N4004 (or 1N4007) diode
DS1 — T1 LED, red
J1, J2, J3 — RCJ-012, RCA jack, single, right angle, CUI
J4, J5 — 3.5-millimeter stereo jack, flat style
J6 — Mini-B USB connector
K1 — DPDT Signal Relay, V23105A5001A201 TE Connectivity P&B
K2 — DPDT Power Relay, RTE24005F TE Connectivity P&B
Q1 — 2N3906, PNP transistor, TO92 pkg
Q2, Q3 — 2N3904, NPN transistor, TO92 pkg
Q4 — 2N4401, NPN transistor, TO92 pkg
R1, R6 — 100 kΩ, ¼ W, carbon film resistor
R2 — 10 kΩ, ¼ W, carbon film resistor
R3, R4 — 22 kΩ, ¼ W, carbon film resistor
R5 — 1.5 kΩ, ¼ W, carbon film resistor
R7 — 1 kΩ, ¼ W, carbon film resistor
R8 — 220 Ω, ¼ W, carbon film resistor
TM1 — trimpot, 100 kΩ
TM2 — trimpot, 10 kΩ
Misc. — PC board, connector, screw terminal 3.5-millimeter spacing.
U1 — 555 timer IC, eight-pin mini-dip pkg

Muting Relay

A muting relay is designed for switching stereo audio channels to accommodate SDR operation where audio comes through the PC audio system. Both stereo channels are switched so the Versa-TR may be left connected at all times without affecting the quality of music or other PC audio. When no RF is present, PC audio passes through to the amplified PC speakers as usual. The muting relay switches the powered speakers from the line output connector during receive to the output of the sidetone oscillator in transmit.

Muting Disable

For normal muting, the pair of pads marked **UNMUTE** must be jumpered together. Optionally, an external switch can be connected to these pads to disable the muting feature. The **UNMUTE** jumper does not affect antenna relay operation.

Sidetone Oscillator

A sine-wave sidetone oscillator is keyed by the RF signal and sent to the audio output jack for CW monitoring. A volume control is provided to set a pleasant sidetone level.

Muting and Switching

Amplified speakers are required to hear the CW sidetone. The muting relay circuit can be used to mute the audio for any conventional receiver and speaker setup. The audio muting relay can also be wired to provide an SPST normally open or normally closed switching function for any desired purpose. A contact that is grounded on receive is also available.

Optimizing the RF-Sensing Level

A capacitive voltage divider provides a small amount of RF energy for the RF-switching circuit. This circuit works like a volume control to adjust the sensitivity of the RF-sensing circuit but varies with frequency and power level. To compensate for these combined effects, select a capacitor value *Cx* that reliably triggers the RF-switching circuit.

The RF sensing level is set by connecting a suitable capacitor at the **SENSE** screw terminal connector. For low RF power, 47 or 100 pF is needed, but 10 pF will suffice with higher power levels. Temporarily install the smallest value capacitor at the screw terminal location provided and verify that correct RF sensing occurs. Move to the larger values if needed for reliable operation.

Construction

The Versa-TR uses through-hole components to facilitate home construction. Be certain to install the transistors in the correct locations, and observe diode, LED, and capacitor polarity markings.

Typical stereo cables with 3.5-millimeter (⅛-inch) three-circuit miniature phone plugs on each end are used for audio connections. The PC **LINE OUTPUT** goes to J4 and the powered speakers are plugged into J5. In most setups, a 3.5-millimeter stereo jumper cable would go from J4 to the PC **LINE OUTPUT** connector (green), and the speakers would plug direction into J5. Amplified PC speakers are required for SDR receiver use and may be left connected at all times, even without power to the Versa-TR, for normal PC audio operation.

Checkout

Attach a 5 V power supply to the mini-USB jack, temporarily connect short-wire jumpers to the external screw terminals, and touch them together. Both relays should pull in and the LED should light. Remove the short and the relays and the LED should drop out. Adjust the **DELAY** trimpot for the desired delay time consistent with the intended mode of operation. Delay can be set for up to several seconds for operation like semi break-in.

Connect the audio cable to the PC **LINE OUTPUT** connector on the PC, plug in amplified speakers, and verify normal PC sound operation. Insert a jumper plug or wire between the **UNMUTE** pads. Again, short the **KEY** terminals and a pure tone should be heard from the speakers. Adjust the sidetone trimpot for the desired audio

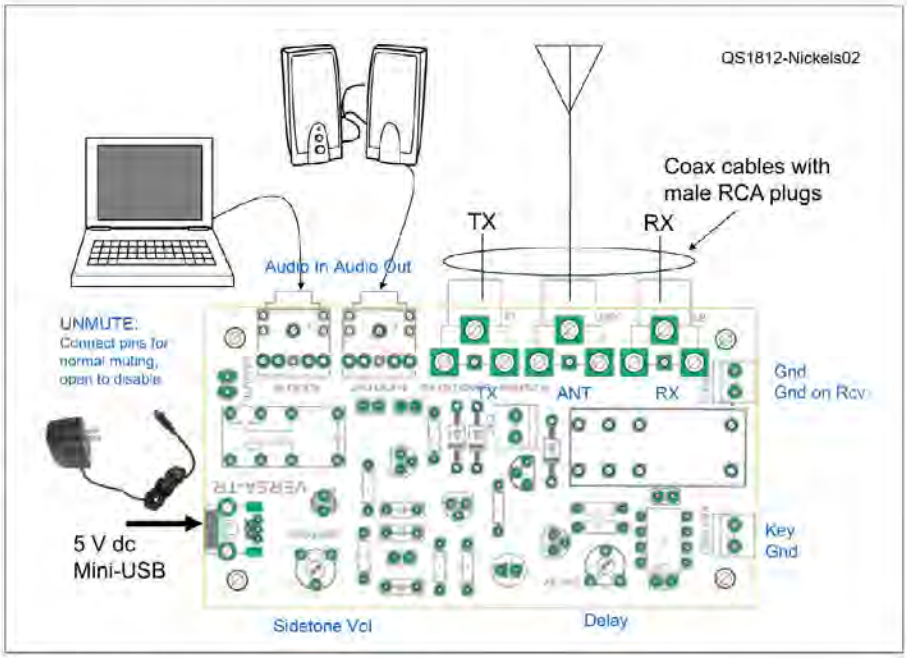


Figure 2 — Typical Versa-TR board connections.

level for CW. Removing the **UNMUTE** jumper will allow receive audio to be heard during transmit for spotting or testing.

Connect the Versa-TR to the station equipment and antenna or dummy load.

Connections

The connections for my board are shown in Figure 2 and in the file on the "*QST* in Depth" web page at **www.arrl.org/qst-in-depth**. Figure 1-QiD shows my PC board layout and location of connectors and controls. The Versa-TR is typically connected as shown in Figure 2-QiD when an SDR receiver is used with a transmitter. Power is provided by a 5 V USB power supply with a Mini-B USB connector. Note that this is not the micro USB used by many phones. PC line output (green) and powered speakers may be left connected for normal PC sound. Standard three-circuit TRS (tip-ring-sleeve) male plug wiring is shown in Figure 3-QiD.

Figure 4-QiD shows a hook-up for a conventional non-SDR receiver using 4 – 8 Ω speakers. Two 3.5-millimeter (⅛-inch) stereo phone plugs should be wired as shown. Connection is made to *either* tip or ring, and sleeve (ground). The unused pin should be left disconnected. Connected this way, audio from the receiver will normally be heard through the speaker and will be muted when RF is present. The CW sidetone will not be heard through a conventional unamplified speaker.

The Versa-TR may be used as a general purpose RF-sensing switch by connecting to the audio output jack as shown in Figure 5-QiD. No connection is made to the audio input jack. The muting relay connects the tip and ring of this jack when RF is present. No connection is made to the sleeve or ground terminal. When using this circuit, the voltage should

Figure 3 — A 1950s vintage Multi-Elmac AF-67 is paired with an Airspy SDR with the SpyVerter for HF reception.

Figure 4 — A simple RTL-SDR is paired up with a Hallicrafters HT-37 transmitter for operation in AM, CW, and SSB modes.

Figure 5 — T/R switch used with an Ameco AC-1 two-tube 15 W CW transmitter and a National NC-98 receiver.

be less than 40 V dc. If control of an ac line powered circuit is needed, use these contacts to control an external slave relay. Under no circumstances should 120 V ac mains ever be wired to this board.

A short interval — I measured 5 ms — is needed for the T/R relay to switch the antenna from the receiver to the transmitter. At 20 WPM, a first "dit" will be shortened by about 10%.

Operation

The **DELAY** trimpot sets the variable drop-out time delay to hold the relays in transmit when a continuous carrier is not present. This provides for semi break-in CW operation, and can be set to mute the audio when using voice modes to mask the slightly delayed sound resulting from digital signal processing latency.

The **SIDETONE** trimpot adjusts the volume of the sine-wave sidetone oscillator for CW operation. First, set the SDR receiver volume to provide adequate volume through the powered speakers, and then adjust the **SIDETONE** trimpot for a comfortable level when transmitting. For voice modes, turn the volume to zero.

Typical Uses of the Versa-TR

Some examples of typical uses include those pictured here — let your imagination and radio inventory be your guide.

Figure 3 shows a 1950s vintage Multi-Elmac AF-67, a popular 60 W dc input power AM transmitter paired with an Airspy SDR with the Spy-Verter for HF reception. *SDR#* software on a Winbook Tablet provides DSP filtering and features like synchronous detection. A stereo patch cable connects between the tablet headphone jack with the input jack on the Versa-TR and the output jack into amplified computer speakers for audio and muting.

Figure 4 shows that even a simple RTL-SDR like my $50 RANVerter can be used to make contacts with the Hallicrafters HT-37 operating in AM, CW, and SSB modes. Wiring up antenna relays and muting the circuit can be tedious, but the Versa-TR makes it easy. For SSB, the sidetone level is turned to zero so no sidetone is heard and the laptop audio output is connected through the Versa-TR for muting on transmit with an amplified speaker. When no RF is present — such as during pauses between words — the Versa-TR will switch back to receive just like in VOX operation. The **DELAY** control can be adjusted to set the length of this delay.

Figure 5 shows the Versa-TR operating with a nostalgic Novice station that includes the classic Ameco AC-1 Novice rig. The AC-1 lacks features like a T/R relay, sidetone monitoring, and muting that make operating more fun. For CW, wiring is according to Figure 2. Audio from the headphone jack of the National NC-98 receiver is routed through the Versa-TR input, and from the output to an amplified speaker, which works for both receive audio and CW keying sidetone monitoring. Unplugging the headphone jack connection returns the NC-98 to normal speaker operation.

Conclusion

Because I like to mix and match various vintage transmitters and receivers, I've used the Versa-TR a lot in my own shack. Once you've wired up a few interconnecting cables, setting up a new station becomes truly a matter of plug and play.

All photos by the author.

ARRL member and Amateur Extra-class licensee Robert Nickels, W9RAN, was first licensed as WN0OHO in 1965 while in high school. He has a BS degree from Fort Hays State University in Kansas and credits Amateur Radio as a major influence during his 40-year-long career in electronics. Bob holds three US patents and is retired from Honeywell. He now heads up RAN Technologies, Inc., a business and technology consulting firm. Bob enjoys cycling, kayaking, and cross-country skiing as well as ham radio history and homebrewing. He also collects, restores, and operates vintage electronics and classic radios from the past 6 decades. You can contact Bob at **w9ran@arrl.net**.

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

The Hourglass Loop Antenna

Build this simple VHF/UHF bidirectional antenna from readily available materials.

John Stanley, K4ERO

This horizontally polarized antenna is an extension of the horizontal loop antenna featured in *The ARRL Antenna Book*.[1] It provides useful gain with very simple construction. The hourglass form factor yields an antenna that is tall but with a tiny footprint and that doesn't look like any other type of antenna, which might make it stealthier in some applications. You could probably use it to support a banner or as a plant trellis, festooned with artificial plants.

How the Loop Works

The loop consists of a 2-wavelength-long wire formed into the shape of an hourglass, as shown in Figure 1. The wires cross in the center but do not touch. Currents travel around the perimeter of the loop and are maximum in the horizontal top wire, the horizontal bottom wire, and at the crossing point. The 50 Ω feed is in the center of the bottom wire.

The voltages are maximum at points about halfway up the sides of each triangle where the currents are minimum. The vertical currents cancel each other while the horizontal currents add in phase. Thus, the loop produces a strong horizontally polarized signal at right angles to the plane of the loop. The crossed wires in the center force the top and bottom wire currents to be in phase, thus producing gain. The horizontal component of the currents at the crossing point is also in phase with each other and adds to the signal.

This antenna can be viewed as two delta loops stacked one on top of the other, with the bottom one inverted and fed in the center of a side instead of at a corner. The top delta is fed from the bottom one. Choosing the correct height-to-width dimensions makes the feed-point impedance 50 Ω.[2]

Gain and Directionality

Compared to the 1-wavelength horizontal loop, which also has a 50 Ω feed-point impedance when the vertical sides are twice the horizontal sides, this antenna has an additional 2.5 dB of gain. Thus, the bidirectional gain is very close to 7 dBi, or about 5 dB more than a dipole. This is as much as a two-element Yagi has while being much easier to build and adjust (see Figure 2). The pattern in azimuth is the same as a dipole or a single-wave loop — that is, the 3 dB points are located at 45° off either side of the main beams. The antenna gets all of its gain by narrowing the vertical pattern, which costs nothing, as signals on these bands arrive at low angles, except for on satellite. The wide azimuthal beam makes aiming less critical and avoids missing some signals that are off the main heading.

Figure 1 — A 432.2 MHz hourglass made from #14 AWG solid bare copper wire. Note the tuning flags and the clamp-on ferrite around the coaxial feed line and taped to the mast.

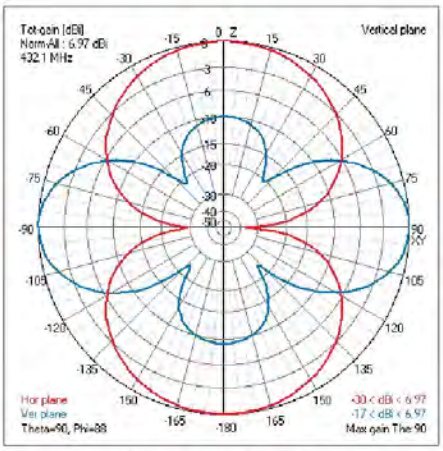


Figure 2 — Vertical (blue) and azimuthal (red) radiation patterns for the hourglass antenna.

As described here, the antenna is bidirectional. It can be made unidirectional by adding a 5% longer second loop behind it, as in a quad antenna, or by placing it in front of a flat conductive screen. Either option will add about 3 dB more gain by eliminating the signal off the back. It will also narrow the beam off the front somewhat. The feed-point impedance will change a bit, but this is not too difficult to compensate for.[3] An omnidirectional version of this antenna could also be made by using any of the methods described for the 6-meter omnidirectional antenna previously published in *QST*.[4]

Figure 3 — From left to right, hourglass antennas for 222, 432, and 144 MHz. Only the 432 MHz antenna is made from bare wire.

Construction

For the bidirectional configuration shown, the antenna requires nothing more than building a simple insulated support frame, measuring the wire to length, and stringing it on the frame (see Figure 3). Since the voltage points are not close to the support frame, wood or PVC can be used without changing the resonant frequency. To observe this, watch an SWR meter while touching the wires at the voltage points, which are between the center crossing point and the top and bottom horizontal sections (note the position of the tuning "flags" on the 432 MHz version). This will change the SWR, but there is little or no effect from touching at the support points. To avoid RF burns, do this test with a very low-power frequency source, such as an impedance meter.

If the dimensions are correct, the antenna impedance should match 50 Ω to better than 1.2 to 1 SWR. If the frequency is not correct, lengthen the wire to lower it or shorten the wire to raise it. Install the crimp lugs on only one end of the loop until you get it right. The use of a single ferrite bead on the feed line is good practice, although two computer models and tests show that even without it, the loop is remarkably free from the effect of feed-line radiation caused by common-mode currents.

The antenna is very forgiving except for having a narrow SWR bandwidth. Once you get it to resonate at the desired frequency, you can be sure that the gain and pattern are as expected. No further adjustments are needed. The bandwidth of this antenna will be about 2% of the center frequency at the 2:1 SWR points (3 MHz at 144 MHz and 9 MHz at 432 MHz). Of course, if you have loss in your feed line, it will broaden the measured SWR bandwidth somewhat. This is a relatively

Table 1
Dimensions for Hourglass Antennas

Resonant Frequency (MHz)	Wire Length (cm)	Loop Height (cm)	Loop Width (cm)
144.2	430*	175	37
222.1	279*	114.5	23
432.1	142**	59	12

*#16 AWG insulated
**#14 AWG bare

narrow-band antenna, but the activity on these bands using horizontal polarization covers only a few hundred kilohertz, so it is sufficient.

Tuning

These antennas are somewhat sensitive to nearby objects, so do the tuning with the antenna mounted in its final position where possible. Otherwise, put it clear of any nearby objects when tuning.

Dimensions for 144, 222, and 432 MHz versions of the hourglass are included in Table 1. The 144 and 222 MHz dimensions are based on use of #16 AWG stranded wire with PVC insulation such as that sold at home improvement stores. The 432 MHz antenna uses #14 AWG bare copper obtained from stripping house wire. Straighten and work-harden the wire by stretching. With the solid wire, no cross arms are needed. For thicker or thinner wire or wire with different insulation, the wire lengths may have to be changed by a few percentage points to move the resonant point back to the desired frequency. Where the wires cross, tape them to the vertical mast so they are held firmly, otherwise wind will cause the SWR to flutter. Of course, they are not connected because of the insulation. For the bare wire version, I added insulation at the crossing point. Varying the wire separation by a few millimeters where they cross provides a fine tuning adjustment to the resonant frequency.

"Varying the flags' location, orientation, and length provides an easily adjustable fine tuning."

Tuning is also done by changing the total wire length. With the solid wire version, I used an alternate fine-tuning method by attaching movable 3-centimeter-long stranded PVC-covered wire "flags" at the high voltage points (see Figure 1). Make the flags by stripping a bit of insulation from one end and wrapping the exposed strands around the solid wire. Varying the flags' location, orientation, and length provides an easily adjustable fine tuning. Once the desired resonance is obtained, the flags are then soldered in place. The dimensions of the 432 MHz antenna are chosen to give a resonance of about 450 MHz without the flags. The flags pull the frequency down to 432 MHz when adjusted outward, as shown in Figure 1, and all the way down to 420 MHz when they are oriented inward. After moving the flags, check the SWR at your frequency.

Other Frequencies

The frequencies listed in Table 1 are those popular for DX work where SSB and CW and horizontal polarization are used. Of course, you could scale the design to any other frequency. Six- and ten-meter versions could also be built but would be quite tall, with a very small footprint. The hourglass could be laid on its side for FM work with vertical polarization, however, the advantage of the wide azimuthal pattern and narrow vertical pattern would be lost. I suppose this would be called a "lazy hourglass antenna."

One could also make one of these for 80, 60, or 40 meters by laying it on its back an eighth wave over the ground for NVIS work. This would be a "very lazy hourglass antenna," and would require a rather long but narrow strip of land. For work out to a few hundred miles, it would have up to 5 dB gain over a dipole, especially in directions at right angles to its long dimension.

Notes

[1] *The ARRL Antenna Book, 23rd Edition*, pp. 9 – 38. ARRL Item no. 0444, available from your ARRL dealer, or from the ARRL Store. Telephone toll-free in the US 888-277-5289, or 860-594-0355, fax 860-594-0303; **www.arrl.org/shop/**; **pubsales@arrl.org**.

[2] J. Stanley, K4ERO, "Some Additional Geometries for Loop Antennas," *QEX*, July/Aug. 2018, pp. 31 – 36.

[3] Experimenters wishing to build a unidirectional or omnidirectional version of this antenna can contact the author for further information.

[4] J. Stanley, K4ERO, "An Omnidirectional 6-Meter Horizontally Polarized Antenna," *QST*, Apr. 2017, pp. 38 – 42.

Photos by the author.

John Stanley, K4ERO, and his wife, Ruth, WB4LUA, retired to Rising Fawn, Georgia, after 45 years in international broadcasting, where they did engineering consulting and training with Christian radio stations in many countries. Working as an ARRL Technical Advisor for the past 27 years, John has contributed to numerous ARRL publications. You can contact John via email at **jnrstanley@alum.mit.edu**.

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

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

Product Review

Yaesu FTM-7250DR Analog and System Fusion Dual-Band Transceiver

Reviewed by Dan Wall, W1ZFG
ARRL Awards and Programs Assistant
w1zfg@arrl.org

The FTM-7250DR is a dual-band (2-meter/70-centimeter) radio with standard analog FM and Yaesu's C4FM System Fusion digital voice capabilities. It has three selectable power levels (50, 25, and 5 W) and extended receive coverage.

The FTM-7250DR comes with a hand microphone with a keypad, a mobile mounting bracket with attachment screws, and a mic clip. The radio has a short pigtail hard-wired to the back of the radio with a standard **T** connector, along with an 8-foot-long dc power cable with a matching **T** connector on one end and bare wires on the other end. The cable also has inline fuse holders, and two spare 15 A glass fuses are included. A USB cable is also provided for doing firmware upgrades. A printed *Operating Manual* is supplied, with an *Advance Manual* available for free download. Optional accessories include a microphone without the keypad, an external speaker, and a 23 A ac supply for home use.

The front panel has a large, easy-to-read LCD screen to show the operating frequency, various operating functions, and parameters for the menu system. A front-mounted speaker plays the audio output nicely. A multi-color, two-section **MODE/STATUS** indicator shows the various combinations of transmitter and receiver modes.

There are only two knobs on the front panel, a volume control and a **DIAL** knob to manually set the frequency and to adjust the parameters in the various menus. There are five buttons below the display to adjust all of the features the radio provides.

- **BAND(SQL)** moves operation to the next highest frequency band. Press and hold to adjust the squelch level.
- **GM(AMS)** activates Group Monitor, one of the many advanced digital mode functions. Press and hold to display the current transmit mode when using the Automatic Mode Select function.
- **MODE(DIG-ID)** selects among the analog FM mode and the two C4FM digital modes. Press and hold to select the DG-ID (digital group ID) number registered in the DG-ID memory.
- **MHz(SETUP)** allows tuning in 1 MHz steps. Press and hold to activate the menu setup mode.
- **V/M(MW)** switches among the VFO mode, the memory mode, and the **HOME** channel. Press and hold to display the memory registration screen.

The rear panel has a standard SO-239 connector for the antenna, a cooling fan, a dc power cable, and a two-contact, 3.5-millimeter external speaker jack. A mini-USB jack labeled **DATA** is for upgrading the radio firmware.

There is no mention of audio input/output for packet radio use. However, a packet TNC could be connected to the front-panel microphone jack and rear-panel external speaker jack, just like it was done in the days before transceivers had dedicated data ports.

Bottom Line

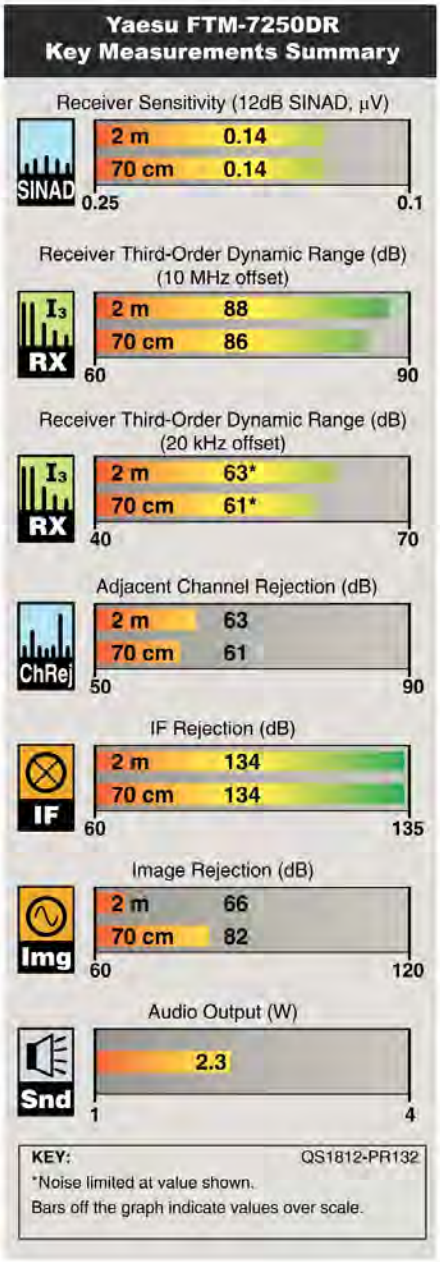
The FTM-7250DR is a full-featured dual-band mobile transceiver for standard analog FM or C4FM digital voice operation with Yaesu's System Fusion. After initial setup, most functions are easily accessed from the microphone keypad.

Table 1
Yaesu FTM-7250DR, serial number 8F020324

Manufacturer's Specifications	Measured in ARRL Lab
Frequency coverage: Receive, 108 – 580 MHz; transmit, 144 – 148, 430 – 450 MHz.	Receive: 108 – 136.995 MHz (AM), 137 – 299.995 MHz (FM), 300 – 335.995 MHz (AM), 336 – 579.995 MHz (FM). Transmit: As specified.
Modes: FM, C4FM digital voice, data.	As specified.
Power requirements: Receive: <500 mA. Transmit 10 A (50 W), 6 A (25 W), 4 A (5 W) at 13.8 V dc ±15%	At 13.8 V dc: Receive, 550 mA (max volume, max lights, no signal, each receiver); 420 mA (max volume, lights off, no signal). Transmit (hi/med/low): 146 MHz, 8.4/5.2/2.8 A. 440 MHz, 9.1/5.2/2.6 A.
Receiver	**Receiver Dynamic Testing**
Sensitivity: FM (12 dB SINAD), 0.16 µV (137 – 174 MHz); 1.0 µV (174 – 222 MHz); 0.5 µV (300 – 350 MHz); 0.2 µV (350 – 400 MHz); 0.18 µV (400 – 470 MHz); 0.35 µV (470 – 580 MHz). AM, 10 dB S/N, 1.5 µV (108 – 137 MHz).	FM (12 dB SINAD): 0.14 µV (144 and 440 MHz); 0.13 µV (162.4 MHz), 0.29 µV (223 MHz). AM (10 dB S+N/N): 0.83 µV (120 MHz), 0.81 µV (312.5 MHz).
FM two-tone, third-order IMD dynamic range: Not specified.	20 kHz offset: 146 MHz, 63 dB;* 440 MHz 61 dB.* 10 MHz offset: 146 MHz, 88 dB; 440 MHz, 86 dB.
FM two-tone, second-order IMD dynamic range: Not specified.	146 MHz, 90 dB, 440 MHz, 104 dB.
Adjacent-channel rejection: Not specified.	20 kHz offset: 146 MHz, 63 dB, 440 MHz, 61 dB.
Spurious response: Not specified.	IF rejection: 146 MHz, 134 dB; 440 MHz, >134 dB. Image rejection: 146 MHz, 66 dB; 440 MHz, 82 dB.
Squelch sensitivity: Not specified.	At threshold: 146 MHz, 0.13 µV, 0.38 µV max. 440 MHz, 0.14 µV, 0.40 µV max.
S-meter sensitivity: Not specified.	S-9 (5 of 8 bars): 1.95 µV (144 MHz); 2.06 µV (440 MHz).
Audio output: 3 W at 10% THD into 4 Ω.	2.3 W at 10% THD into 4 Ω. THD at 1 V_{RMS}, 2.5%.
Transmitter	**Transmitter Dynamic Testing**
Power output: 50, 20, 5 W (hi, med, low).	At 13.8 V dc (hi/med/low): 146 MHz, 45/22/4.2 W; 440 MHz, 43/22/4.6 W.
Power output at minimum operating voltage: Not specified.	At 11.7 V dc (hi/med/low): 144 MHz, 44/21/4.2 W; 440 MHz, 37/21/4.6 W.
Spurious signal and harmonic suppression: >60 dB.	≥70 dB. Meets FCC requirements.
Transmit-receive turnaround time (PTT release to 50% of full audio output): Not specified.	Squelch on, S-9 signal: 146 MHz, 36 ms; 440 MHz, 46 ms.
Receive-transmit turnaround time ("tx delay"): Not specified.	146 MHz, 60 ms; 440 MHz, 45 ms.

Size (height, width, depth): 1.6 × 6.1 × 6.7 inches, incl. protrusions. Weight, 2.9 lbs.

*Measurement was noise limited at the value indicated.



Features

The FTM-7250DR has all of the regular analog FM features expected in a Yaesu radio in this price range. It also offers a multitude of digital features that are compatible with the Yaesu System Fusion II C4FM repeater systems.

This radio has expanded receiver coverage from 108.0 MHz to 579.995 MHz in six bands: 108 – 137 MHz (air band); 137 – 174 MHz; 174 – 222 MHz; 222 – 420 MHz; 420 – 470 MHz, and 470 – 580 MHz.

There are built-in tone encoder/decoder circuits (CTCSS and DCS), a transmit time-out timer, automatic power-off, and automatic repeater shift. Another nice feature is that the squelch can be programmed to open at a specific setting of the S-meter, reducing the guesswork in setting the squelch threshold.

The US version of this radio allows reception of NOAA Weather Radio broadcasts on 10 preprogrammed channels in a special memory bank. You may also enable the severe weather alert feature, which is triggered by a 1,050 Hz tone transmitted by NOAA to signal a severe weather event, such as a hurricane.

The supplied microphone allows access to a large number of the radio's functions directly from the keypad. The **1** through **0** keys allow direct entry of frequencies or channel numbers. The * key switches among the VFO mode, the memory mode, and the **HOME** channel. The # key scans the programmed memory channels. The **A** key changes the tuning to 1 MHz steps. The **B** key changes the operating band. The **C** key adjusts the squelch level. The **D** key changes the transmit power level.

The **P1** and **P2** keys are used for the **DG-ID** memory. The **P3** key activates the WIRES-X internet linking feature, and the **P4** key activates NOAA Weather Radio reception. The **P3** and **P4** keys can be reprogrammed to access other features.

There are also **UP** and **DWN** keys, a **LOCK** switch, a **LAMP** switch, and of course, a **PTT** switch. Once the radio is programmed for your preferences, you may never need to touch the front panel buttons again.

Memory Operation and Scanning

The radio can store basic memory channels numbered 1 through 199. A **HOME** channel can be programmed on each of the six frequency bands. The 10 sets of band-edge memories are also known as "programmable memory scan" channels, and labeled **L0/U0** through **L9/U9**. Memories can store repeater shifts, access tones, and eight-character alphanumeric labels for easy channel recognition.

Programming a memory is easily accomplished from the front panel. Once parameters such as frequency and tone settings are set up in the VFO mode, just press and hold the **V/M (MW)** key. The next available memory channel will appear. Adjust the **DIAL** knob to select the desired channel, and press and hold the **V/M (MW)** key to store the data into the selected channel. The radio may also be programmed through the front-panel microphone jack with the appropriate cable and software (not included).

Scanning of frequencies in the VFO mode or memory channels in the memory mode can be initiated by pressing the **UP** or **DWN** keys on the top of the microphone. There are three different **SCAN RESUME** options detailed in the *Advance Manual*.

C4FM Digital Modes

In addition to standard analog FM, the FTM-7250DR supports Yaesu's System Fusion C4FM digital operation. Voice/data mode — V/D — is the standard mode for C4FM digital operation. It splits the channel into two streams, for simultaneous transmission of voice and data. Voice full rate — Voice FR — uses the entire 12.5 kHz channel for high-quality voice communication. When **AMS** (automatic mode select) is enabled, the transmit mode is set automatically to whichever mode (analog FM, V/D, or Voice FR) is received.

There are several ways to limit communication to select friends or groups. The Group Monitor (GM) function automatically monitors the channel for other stations with the GM function in operation on the same frequency.

The radio also has the Digital Group ID (DG-ID) function. This allows you to set up a two-digit DG-ID number separately for transmit and receive. If both DG-ID numbers are set to 00 (default), you can communicate with all other stations using C4FM. However, by changing the DG-ID number to a unique pair, you will communicate only with other radios set to the same DG-ID numbers. The Digital Personal ID (DP-ID) function allows the individual radio ID transmitted by each transmitter to be registered to another transceiver. This allows communications between radios, regardless of the DG-ID settings.

The FTM-7250DR also supports WIRES-X operation (internet linking) and can connect to WIRES-X nodes. However, it does not support sending/receiving messages, images, audio messages, or location information (this radio does not have GPS built in).

Visit https://youtu.be/Hdfl5CZoxFs to see our review of the Yaesu FTM-7250DR Analog and System Fusion Dual-Band Transceiver on YouTube.

Cortesia de Virgilio.

On-Air Testing

In the analog FM mode, on-the-air tests through area repeaters indicated that receiver sensitivity was excellent, even through repeaters away from the local area. Audio quality was also excellent, with plenty of clear sound through the small built-in front-panel speaker. It was even better with an external speaker. Thanks to Bob Valli, KB1ZBH, manager of the Nutmeg VHF Traffic Net for assisting with the on-the-air testing.

The C4FM digital mode is where the radio really shines. I thought the clarity of the digital signal was almost broadcast quality, with just a tiny amount of digitalization artifacts in the audio signal. That's common with System Fusion and all other digital voice modes. ARRL Lab Assistant Manager Bob Allison, WB1GCM, assisted with the on-the-air testing of the System Fusion digital modes.

A member recently commented that some mobile transceiver displays are difficult to read while wearing polarized sunglasses or viewing the display from some angles other than straight-on. With most LCDs, including this one, viewing the display at high angles to the left and right, or top and bottom, does diminish readability. However, I noticed no issues while viewing the FTM-7250DR's display through polarized sunglasses.

Final Thoughts

The FTM-7250DR packs a lot of features into a small package. The quality and performance of this radio are quite good. If you are looking to upgrade your existing radio to take advantage of the digital features offered by the System Fusion repeater systems, this radio is definitely worth a second look. Even if you are just interested in analog FM, this radio has a lot to offer.

Manufacturer: Yaesu USA, 6125 Phyllis Dr., Cypress, CA 90630; tel. 714-827-7600; **www.yaesu.com**. Price: $275.

Four State QRP Group Hilltopper 20 QRP Transceiver Kit

Reviewed by Paul Danzer, N1II
n1ii@arrl.net

I have always been a fan of building kits that result in a nice piece of equipment for a reasonable price. Assembling a kit is especially fun when the instructions are clear, the parts readily identifiable, and the drawings accurate and helpful. The Hilltopper 20 from Four State QRP Group follows this pattern. Dave Benson, K1SWL, designed the unit and gives credit to others whose successful designs were incorporated in this kit. QRP (low-power) enthusiasts probably recognize Dave's handiwork as the designer of a long list of QRP radios, including the popular RockMite and SW series, among others.

The Hilltopper 20 has a 5 W CW transmitter and superhet receiver with coverage over the full 20-meter band. Features include a narrow four-section crystal filter, a variable speed CW keyer, a selectable tuning rate, and receiver incremental tuning (RIT).

Overview

Figure 1 shows the completed printed circuit board. The PC board is well made, with plated through holes, a solder mask, and silk-screened component placement. The kit uses through-hole parts, except for two surface-mounted components that are preinstalled.

The instruction manual offers complete schematic diagrams and a detailed explanation of the circuitry. The

Bottom Line

Building the Hilltopper 20 is straightforward, thanks to thoughtful packaging and well-illustrated, clear instructions. Upon completion, you have a low-power 20-meter CW transceiver with enough features and performance for many enjoyable contacts.

transmitter uses three BS170 MOSFETs. The digital variable frequency oscillator (VFO) is on a supplied subassembly, and an Atmel ATmega328P microprocessor handles CW keyer and control functions. The receiver is a superhet with an intermediate frequency (IF) of 5.185 MHz.

Tuning is in 100 Hz steps as the default selection, but that can be changed to 20 Hz steps. There is no digital readout. The selected frequency over the range of 14.0 to 14.350 MHz is announced by pressing a control button; an audio tone gives you the current frequency in Morse code.

When power is first applied, the frequency is set to the QRP watering hole at 14.060 MHz. The starting frequency changes to 14.030 MHz if you press the frequency control knob as you power up. As with desktop radios, RIT can be turned on and off, and the kit operates with full break-in keying (QSK). The **SPEED** knob controls the keying speed over a range of approximately 8 to 35 WPM.

The nominal power requirement is 12 V dc at about 60 mA on receive and 900 mA on transmit at 6 W output (as measured in the ARRL Lab with a 13.8 V dc power supply). A reverse-voltage-protection diode is included on the board. Receive audio output is designed to feed headphones (more on this later).

Construction

The kit is supplied in eight plastic envelopes with parts, plus the PC board. Each bag contains the parts for a section of the assembly instructions. The enclosure is made from PC board material, and the front and back panels of the enclosure are snapped off from the edges of the main PC board prior to construction.

As usual, you will need a 20 – 40 W soldering iron with a small tip, a magnifier of some sort for reading component markings, and hand tools, such as needle-nose pliers and small flush cutters. The manual suggests using thin-gauge standard rosin-core 60/40 solder. (I have found that lead-free solder is not a good choice for home construction of PC boards.)

Putting a kit together can be a lot of fun when you do not have to puzzle over where each component goes and hunt to find and identify components. Unlike many kits, most of the part labels on the PC board are not covered by the part after you install it. Therefore, the part numbers are not hidden if you have to troubleshoot the completed kit.

The Hilltopper 20 manual is very well illustrated, and I found the step-by-step instructions to be very clear. You can preview the manual on the Four State QRP Group website to see what's involved in building this kit. The manual is divided into sections, with each section corresponding to one of the plastic envelopes of parts. Each section lists the contents of the corresponding envelope and installation notes for these parts.

What makes construction easier is the layout page included for each envelope. Figure 2 shows part of the illustration for envelope 7. Note that certain components have colored dots. These are the parts that will be installed in this section. I drew black dots on top of the colored dots each time I installed a part. Notice that J1, the antenna connection at the top left, does not have a black dot. When I went back to check that I had completed all the steps for this section, it was obvious that I had forgotten to install J1.

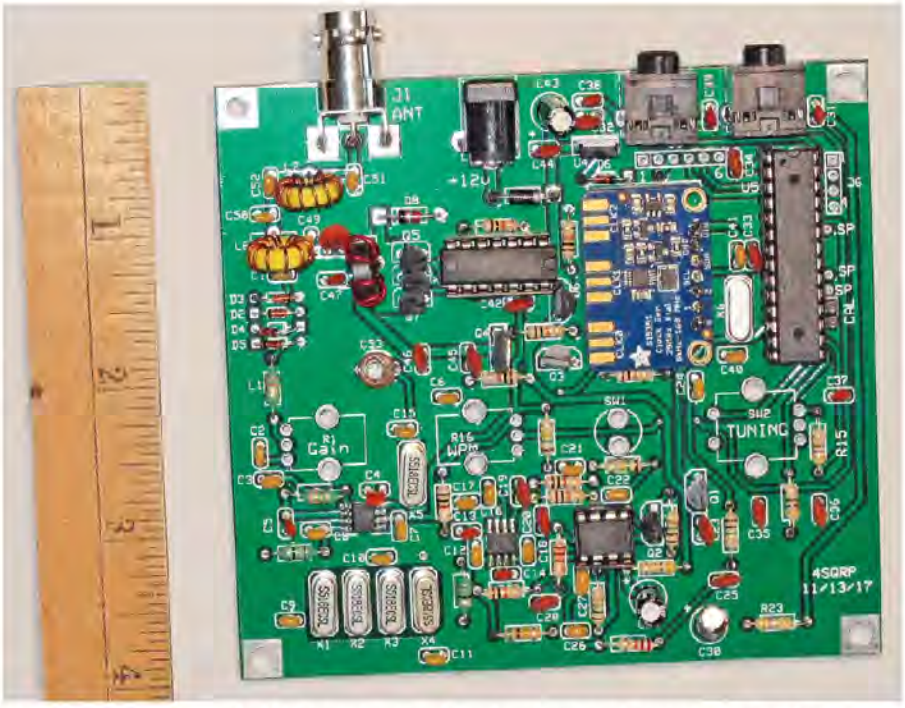


Figure 1 — The completed PC board, without the four top-panel controls that will be mounted later.

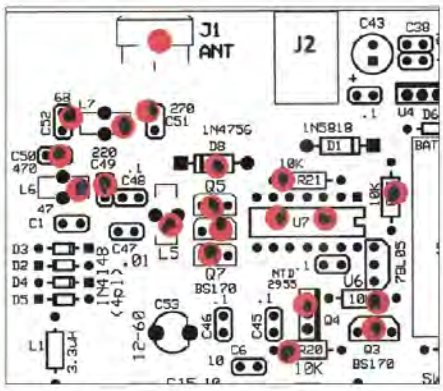


Figure 2 — Part of a drawing from the instruction manual that shows where the parts for Section 7 go. The parts to be inserted in this section are marked with red dots. The author added black dots as he installed each part.

Table 2
Four State QRP Group Hilltopper 20

Measured in the ARRL Lab

Frequency range: Transmit and receive: 14 – 14.35 MHz.

Mode: CW. Internal keyer.

Power consumption: At 13.8 V dc: receive, 61 mA (maximum volume, no signal); transmit, 890 mA. Operable down to 8 V dc.

Receive sensitivity: –107 dBm.*

CW filter bandwidth: 535 – 820 Hz (285 Hz).

RF power output: 6 W at 13.8 V dc; 2 W at 8 V dc.

CW key-down maximum: 5 seconds.

Harmonics and spurious emissions: –55 dBc. Meets FCC spectral purity requirements.

Dimensions (height, width, depth): 1.8 × 4.5 × 4.5 inches, including protrusions. Weight, 7 oz.

*Sensitivity was measured at –126 dBm, but at that level, the signal was inaudible to the human ear. At –107 dBm, the signal was usable for those with normal hearing.

There are three toroidal inductors to be wound. The detailed instructions and pictures are clear, and the turns fit neatly on each of the cores. The instructions remind you that every time the wire goes through the center of a core, it counts as one turn.

When you get to Step 9, be sure to read the entire paragraph before picking up a soldering iron. This is critical to having the controls fit the front panel openings.

For the final assembly, you may need someone to help with enclosure. The enclosure is made from pieces of PC board material, with the side panels soldered to the main PC board, and the top panel attached with spacers and screws. The step to put on the bottom cover can be a bit tricky. You might use a small ball of modeling clay on each of the four spacers to hold them in place while you position the cover and screws. The clay will not be visible after assembly.

The alignment procedure is simple and requires a receiver of known accuracy tuned to 14.060 MHz and a 50 Ω dummy load or matched antenna. As described in the manual, it's a two-part process. First, calibrate the frequency, and then adjust the beat-frequency oscillator (BFO) for the correct pitch.

Controls and Connections

The four controls are mounted on the PC board and protrude thorough the top panel. When you put the knobs on the controls, place the **TUNING** control knob a bit higher off the panel. In addition to rotating, this knob also acts as a pushbutton control for some functions. The **TUNING** control varies the frequency, turns RIT on and off, and can set the tuning step size as well as the initial startup frequency.

The **GAIN** potentiometer is not a volume control in the usual sense. It is a variable resistor acting as a front-end attenuator. A very strong signal may overload the receiver, and signal strength can be reduced by this control.

The keyer **SPEED** control is continuously variable over the 8 to 35 WPM range. You can adjust keyer speed as you send.

To find your frequency, just press the **FUNCTION** pushbutton for an audible readout of the current frequency in Morse code. Other choices selected by this button are explained on a single page in the instruction manual — how to enter the **TUNE** mode for 5 seconds, reverse the keyer paddles, and select iambic mode A or B.

All connections are made on the back panel (see Figure 3). The antenna uses a BNC connector, and 12 V dc power connects through what has become a standard for small transceivers — a 2.1-millimeter coaxial connector.

The 3.5-millimeter **KEY** jack accepts both straight key and paddles. Keyer paddles use a stereo plug. If you want to use a straight key or external keyer, wire it with a mono phone plug (which grounds the ring connection), and the keyer will sense that you are using a straight key rather than paddles.

The **PHONES** jack puts out enough audio for a good pair of headphones. However, as is common with many small radios, there is not enough audio to drive a speaker. Even the audio for headphones could be increased for more comfortable listening. You might consider adding an outboard speaker amplifier.

Operation

ARRL Lab test results are shown in Table 2. The transmitter easily meets FCC spectral purity requirements. The keying waveform and sidebands are good (see Figures 4 and 5), producing a clean signal.

With the default tuning step of 100 Hz, each rotation of the **TUNE** control moves the frequency approximately 3 kHz. To answer a station and hear a clean note takes a little practice and two hands — one for tuning, and one to adjust volume to get a good note at a reasonable level as you tune across signals. Once you have tuned in a station, the frequency is rock solid. If the other station drifts

Figure 3 — Key, headphone, power, and antenna jacks are all on the rear panel.

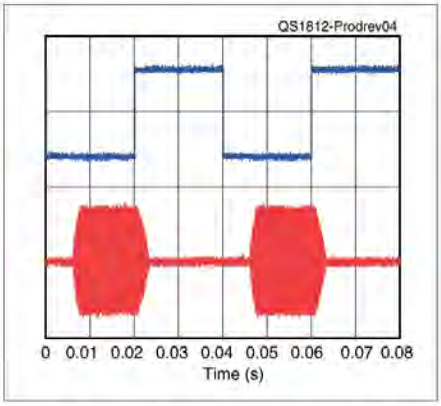


Figure 4 — CW keying waveform for the Hilltopper 20 transmitter showing the first two dits in full-break-in (QSK) mode using external keying. Equivalent keying speed is 60 WPM. The upper trace is the actual key closure; the lower trace is the RF envelope. (Note that the first key closure starts at the left edge of the figure.) Horizontal divisions are 10 ms. The transceiver was being operated at 5 W output on the 14 MHz band.

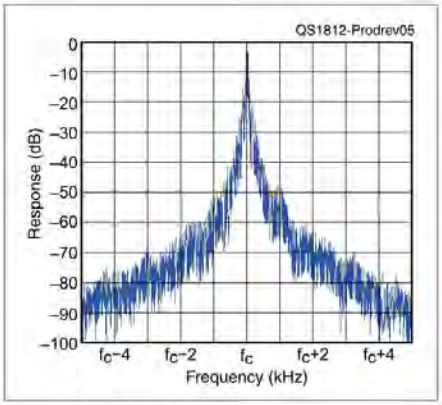


Figure 5 — Spectral display of the Hilltopper 20 transmitter during keying sideband testing. Equivalent keying speed is 60 WPM using external keying. Spectrum analyzer resolution bandwidth is 10 Hz, and the sweep time is 30 seconds. The transmitter was being operated at 5 W output on the 14 MHz band, and this plot shows the transmitter output ±5 kHz from the carrier. The reference level is 0 dBc, and the vertical scale is in dB.

a bit or you want to change the receive tone during a contact, press the **TUNE** control for at least a half-second to engage the RIT. A two-note response indicates that you can now shift the receive frequency without changing your transmit frequency.

Summary

As many QRP enthusiasts will tell you, 5 W is enough to work the world on 20-meter CW. The Hilltopper 20 goes together easily, and as its name implies, it's a good choice for operating in the field (or at home). A 40-meter version is in the works as well.

Manufacturer: Four State QRP Group, P.O. Box 478, Waldport, OR 97394; **www.4sqrp.com**. Price: $90 plus shipping.

West Mountain Radio Epic PWRgate DC Power Manager/Charge Controller

Reviewed by Rick Palm, K1CE
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The West Mountain Radio Epic PWRgate is a high-power, smart battery charge controller and uninterruptible power supply controller designed for hams. It's designed for very low power loss and the flexibility to charge modern 12 V batteries including gel-type sealed lead-acid (SLA), absorbed glass mat (AGM), and lithium-ion phosphate (LiFePO4). Controlling a 12 V backup power system, it's rated to control/transfer up to 40 A continuous duty at 12 V dc, with battery charge rates up to 10 A. It also supports battery charging from a solar panel (30 V maximum).

West Mountain Radio specifies a 0.05 V drop from the power source to the output (load), which is much better than previous PWRgate versions. This unit operates at lower temperatures and, unlike previous versions, no heatsink is needed.

Bottom Line

The Epic PWRgate from West Mountain Radio is a useful power management solution for hams with an interest in emergency backup power at their home station or in the field. It seamlessly controls the components of an uninterruptible 12 V dc power supply and manages charging for several popular battery types from an ac power supply or solar panels.

> *There are a number of advantages to using the Epic PWRgate in my station. My radio will continue to run during ac power outages and dc power supply failures.*

I was eager to try the Epic PWRgate in my station, which includes an Icom IC-7300 HF/6-meter transceiver, LDG IT-100 antenna tuner, Icom ID-4100 VHF/UHF transceiver, and a classic Bird Model 43 wattmeter. For power sources, I have an Astron RM-60A power supply, two Duracell gel-type SLA batteries (12 V, 31 Ah), and two Renogy 100 W solar panels mounted on the roof with cables running into the station.

The Epic PWRgate manages the power sources and output to my radios, and charges the battery from either the solar panels or the power supply. The solar panel charge controller uses maximum power point tracking (MPPT) technology for efficient charging under varying conditions.

It took me a while to get used to the notion of charging batteries from a desktop power supply. The Epic PWRgate eliminates the risk of connecting a power supply directly to a battery, which can damage the power supply, by isolating/managing the connection. It also eliminates much of the hum and RF interference that can be introduced by inexpensive automotive battery chargers.

Basic Operation

The Epic PWRgate has four sets of Anderson Powerpole connectors, plus a micro-USB port for connection to a PC running its companion *Device Diagnostics Utility* software for monitoring the system or programming various charge parameters (more on the software later). The Powerpole connections are for the power supply, solar panels (connected in parallel), battery, and output to the load, which in my case is the radio. There are LED status indicators on the **SOLAR PANEL**, **BATTERY**, and **POWER SUPPLY** ports, and a printed reference card shows the meaning of different indications. The **SUSPEND** pushbutton halts battery charging for 30 minutes if needed to eliminate receiver noise from the MPPT charger. An optional temperature probe can control charging based on battery temperature. (I didn't test this feature.)

With the power supply, battery, and radio connections made, when the Astron power supply is on, it feeds the radio and charges the battery. When the power supply is off, the battery feeds the radio. If the solar panels are connected and the power supply is off, the battery is charged by the panels. When the power supply is on and solar panels (with sufficient voltage) are connected, the battery is charged by the solar panels. After setting up all connections and parameters, you can test the setup by simply turning off the power supply and checking that your radio is still running from the battery.

There are a number of advantages to using the Epic PWRgate in my station. My radio will continue to run during ac power outages and dc power supply failures. During routine maintenance, power supplies and batteries can be changed while my radio is in operation. There is seemingly instantaneous, seamless switching from the power supply to the batteries and back. I was also able to use the Epic PWRgate with batteries and solar panels as my sole ham station power source, without using the ac power supply.

Installation Details

I mounted the Epic PWRgate using cable ties on a low shelf near the floor, where my batteries and power supply are located and solar panel cables come in to the station. I try to keep all wires as short as possible, with the largest gauge wire available to minimize voltage drop. I placed fuses on the wires closest to the battery terminals. West Mountain Radio carries a wide array of premade 12 V cables with various connectors that can make connections easier.

I liked the use of Anderson Powerpole connectors on the Epic PWRgate. All my dc power cords have been terminated with Powerpoles for years, so it was easy to just plug them in. The Epic PWRgate comes with four Powerpole retention clips, which I like to use when possible. I also placed my small inline voltmeters/ammeters at all ports to monitor everything, in addition to using the West Mountain Radio *Device Diagnostics Utility* program to monitor operating parameters, which constantly change as a battery is charged.

To charge my gel SLA battery, I adjusted the variable voltage potentiometer on my big power supply to the recommended 13.9 V and checked the internal jumpers on the Epic PWRgate's circuit board. The jumpers were factory set for gel cells and a 50 Ah rating (the maximum charge current was set to 5 A, or 10% of the battery Ah rating, per protocol). Because my batteries are rated at 31 Ah each, and the fixed jumper choices are 1 A, 5 A, or 10 A, I ended up removing the jumpers. Instead, I used the *Device Diagnostics Utility* software to set custom parameters — in my case, 3 A maximum charge current.

The Epic PWRgate charging circuit is a smart charger, which operates by knowing the battery's voltage. It can change the charging state if the power supply turns on after a power outage, or if there is a heavy current draw when the transmitter is keyed, for example. It provides maximum rated charging current (set to 3 A in my case) if the battery is deeply discharged, and current drops smoothly as the battery nears full charge.

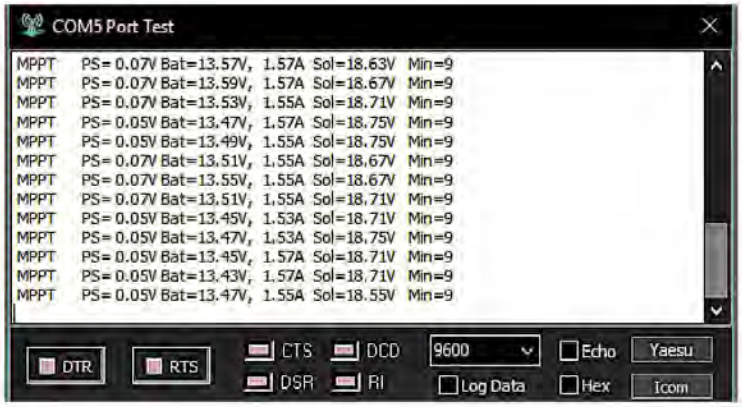

Figure 6 — The *Device Diagnostics Utility* is connected to the COM5 port on my computer. This window shows values for the ports on the Epic PWRgate. For example, the first line shows that the MPPT solar charge controller is active (MPPT); the power supply voltage (PS = 0.07 V, essentially zero because it's off); the battery voltage (Bat = 13.57 V); the current it is drawing from the solar panels to recharge (1.57A), and the voltage the solar panel is supplying (Sol = 18.63 V); and what minute (time) of the current charge cycle the values are taken (Min = 9).

Using the USB Port and the *Device Diagnostics Utility*

Because I have Windows 10, no special drivers were needed. My computer automatically recognized the Epic PWRgate, and the software installed with no issues. (Drivers are also available for earlier Windows versions.) Using the *Device Diagnostics Utility*, I was able to test the system for all operating parameters, including the voltages on each port (solar panels, power supply, battery, charger status, and charge current). A timer gives the number of minutes the battery has been in the charging state (see Figure 6).

While in the *Device Diagnostics Utility* window, type **S** on your PC keyboard to bring up a list of programmable parameters. For my setup, I checked to make sure the **BATTERY TYPE** was set to **2** for gel SLA batteries. You can also choose AGM, LiFePO4, custom, or you can disable the charger altogether. As described earlier, I changed the maximum charging current to 3 A. The maximum charge voltage was already set to 13.5 V for my battery, but can be set to between 9 V and 16 V for other battery types.

Other settable parameters are:

- minimum charge current and trickle charge current;
- recharge voltage (when the voltage drops below this value on a battery that has been fully charged, the charger starts up again);
- maximum charge time in minutes (the battery is considered dead after this time and charging stops);
- retry after abort in minutes; and
- minimum supply voltage for charging.

If you use the optional temperature probe, you can also set the lowest and highest charge temperatures. Charging stops if limits are exceeded. The manual also states that the Epic PWRgate will adjust the charge voltage based on the battery temperature if the temperature probe is used, which allows for optimum battery charging.

LED Status Indicators

As mentioned earlier, a reference card printed on heavy paper stock explains the LED status indicators on the ports. For example, if the **BATTERY** port's LED is solid green, it means the load is being powered by the battery. A quick-flashing green means a battery is detected, but it is not currently charging. A slower flashing green means the battery is supplying less than 12 V. Flashing red means the battery is putting out less than 11.7 V. Solid red means that the battery is dead or the charger is damaged — disconnect the battery. Solid blue means that the battery is fully charged and ready. Flashing blue means the battery is charging, and the flashing increases in rate as the battery nears full charge. Blue with a periodic flicker means the battery is being trickle charged.

There are similar indicators for the **SOLAR** and **POWER SUPPLY** port LEDs.

Conclusions

The Epic PWRgate has a number of features that I really like, including the Powerpole connections, its small footprint on my battery shelf, the LED status indicators for each port, and the unit's high quality. The device would be a useful power management solution for hams with an interest in emergency backup power at their home station, as well as for ARRL Amateur Radio Emergency Service (ARES®) operators in the field. The Epic PWRgate would also be good for use in an uninterruptible power supply at a repeater site or remote station.

The battery charger employs a switching regulator and may generate noise in some instances, but I could not discern any unusual noise on a sweep of the popular HF and VHF bands with my radios. As mentioned earlier, pressing the **SUSPEND** button stops charging for 30 minutes if necessary (and charging resumes with another press of the button).

The *Device Diagnostics Utility* worked smoothly and seamlessly under Windows 10. It was good to be able to monitor all voltages and currents for each port in real time, in a constant rolling feed. Setting the battery charging parameters for my equipment was easily accomplished. And one more small benefit was that I learned a lot about dc power management and 12 V battery charging practices.

Manufacturer: West Mountain Radio, 1020 Spring City Dr., Waukesha, WI 53186; **www.westmountainradio.com**. Price: $179.95.

SOTABEAMS WSPRlite Antenna and Propagation Tester

Reviewed by Mark Wilson, K1RO
QST *Product Review Editor*
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I have two antennas that work on 40 meters — an inverted V cut for that band and fed with RG-58 coax, and a 130-foot inverted V fed with window line and an antenna tuner that can be used on 80 – 10 meters. The apex of the 40-meter inverted V is about 35 feet high, and the apex of the multiband antenna is about 10 feet higher. Both antennas are oriented in approximately the same direction.

Although I normally use the multiband antenna only for 80 and 30 meters, I sometimes wondered if it would be better than the single-band antenna on 40 meters. It was difficult to draw any meaningful conclusions while using an antenna switch to listen to on-air signals while alternating between the two antennas. After reading an interesting *QEX* article about using simultaneous WSPR measurements to compare antennas, I decided to try the WSPRlite system from SOTABEAMS.[1]

Overview

Originally developed by Joe Taylor, K1JT, WSPR (Weak-Signal Propagation Reporter) implements a digital protocol designed for checking propagation paths using low-power transmissions.[2] Transmissions include the station's call sign, Maidenhead grid locator, and transmitter power in dBm (decibels referenced to 1 milliwatt; 0 dBm = 1 mW). Stations around the world receive and decode the transmissions and report the results on the internet.

The WSPRlite system consists of a multiband, low-power WSPR transmitter (up to 200 mW, see Table 3), companion software, and the DXplorer website (**dxplorer.net**) where reception reports are gathered and displayed in several ways. SOTABEAMS offers two versions of the transmitter, the WSPRlite Classic and the WSPRlite Flexi. We ordered one of each.

The WSPRlite Classic covers 630 – 20 meters. Its transmitter output is rich in harmonics, some of which are only 10 to 20 dB below the fundamental level. Spurious emissions and harmonics must be attenuated by at least 43 dB to meet FCC spectral purity requirements for transmitters below 30 MHz. The Classic includes a low-pass filter for 20 and 30 meters. As measured in the ARRL Lab, harmonics and spurious emissions on 20 meters are attenuated at least 53 dB, but on 30 meters, they are down only 35 dB. According to SOTABEAMS, a single filter is used for both bands, so the attenuation of spurious emissions on 30 meters is less than on 20 meters.

The WSPRlite Flexi covers 630 – 6 meters. It includes no filtering for any band and must be used with an external filter to meet FCC requirements. SOTABEAMS offers several low-pass filter kits that can be used to make the WSPRlite transmitters FCC-compliant on all bands (see the sidebar, "Low-Pass Filters").

Bottom Line

The SOTABEAMS WSPRlite system offers an interesting way to compare antennas or check propagation paths.

Setup and Operation

The WSPRlite transmitters are controlled by software. They have an SMA antenna connector, a micro-

Table 3
WSPRlite Transmitter Power Output (mW)

Measured with HP-437B power meter.

WSPRlite Classic

Band (Meters)	Software Setting (mW) 200	100	50	5
160	190	70	33	2.6
80	195	91	41	3.9
60	203	100	47	3.9
40	177	90	45	3.7
30	163	73	32	2.5
20	176	92	45	3.3

WSPRlite Flexi

Band (Meters)	Software Setting (mW) 200	100	50	5
160	212	109	54	5.8
80	212	107	53	5.8
60	207	103	53	5.8
40	197	102	53	5.8
30	198	102	52	5.8
20	190	101	53	5.6
17	185	98	52	5.7
15	185	97	53	5.6
12	184	98	52	6.2
10	183	96	52	6.2
6	n/a	92	50	6.6

Low-Pass Filter Kits

As discussed in the text, except for the Classic on 20 meters, the WSPRlite transmitters require external filtering to comply with FCC spectral purity requirements. SOTABEAMS offers several kits to fix this.

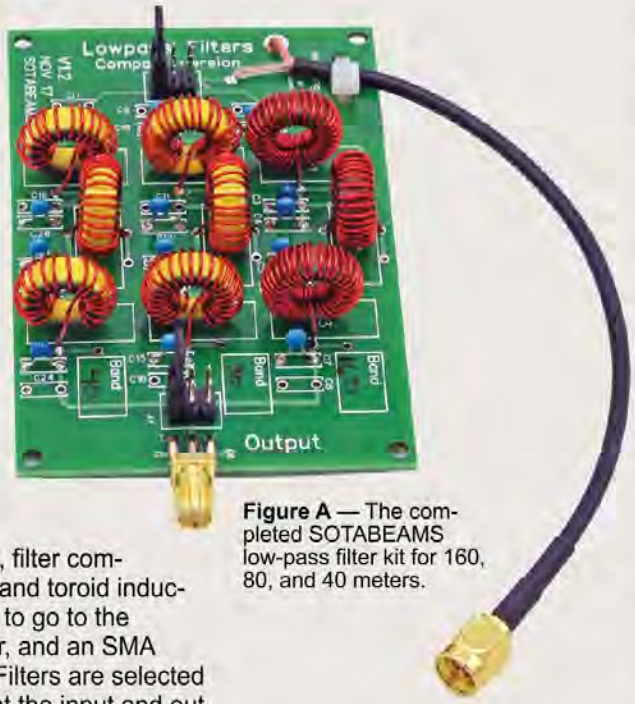

Figure A — The completed SOTABEAMS low-pass filter kit for 160, 80, and 40 meters.

The low-pass filter (LPF) kit for 160, 80, and 40 meters (see Figure A) includes a PC board, filter components (capacitors and toroid inductors), an SMA pigtail to go to the WSPRlite transmitter, and an SMA antenna connector. Filters are selected by moving jumpers at the input and output. The kit is easy to build. You have to wind three toroids for each filter section using the supplied wire and winding instructions. Capacitors are identified in the packaging, but I used a magnifier to double-check the markings. After finishing the build, there's a space on the board to write the band covered by each filter section.

SOTABEAMS also offers a filter PC board kit (the same PC board, connectors, and jumpers), along with individual filter component kits for each band from 160 through 6 meters. I also built one of these with components for 40, 20, and 17 meters.

The ARRL Lab tested the WSPRlite transmitters with and without the filters. In each case, the filters brought the transmitters into FCC compliance without any adjustment (see Figure B).

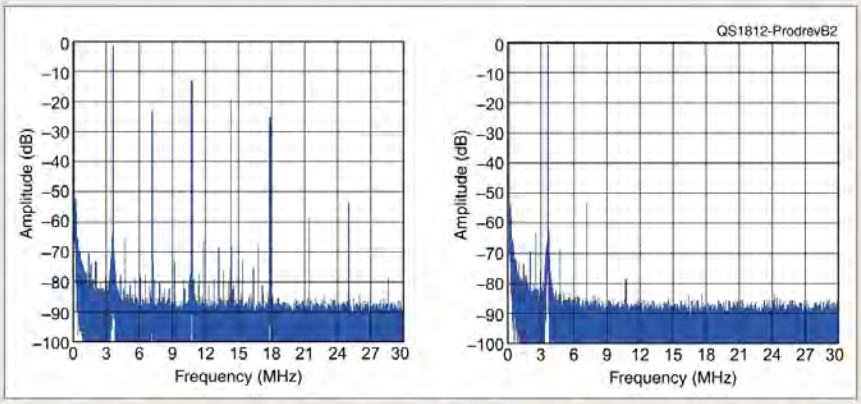

Figure B — Spectral output of the WSPRlite Classic operating on the 80-meter band at 200 mW output. Horizontal divisions are 3 MHz, and vertical divisions are 10 dB. In the plot on the left, without filtering the second through fifth harmonics range from –12 to –25 dBc. With the addition of the SOTABEAMS 80-meter low-pass filter (right), the strongest harmonic is –52 dBc, easily complying with FCC regulations.

USB jack for connection to the host computer (cable not supplied), an LED to indicate status, and a momentary pushbutton switch. Power is supplied via the micro-USB jack as well.

The first step is to visit the DXplorer website and download the configuration software (Windows or Android). Then, if needed, download the appropriate Silicon Labs virtual COM port drivers for your operating system and connect the WSPRlite transmitter. Next, open the WSPRlite application (see Figure 7). Choose the WSPRlite transmitter to set up (if you have more than one) and click **CONNECT**. Other buttons allow you to update firmware and save configuration settings.

Setup is easy. Fill in your WSPR identifier (call sign) and grid locator. Choose a band, and the transmitter will pick a random frequency in the WSPR segment. Select the output power (5, 10, 20, 50, 100, or 200 mW). Select the power level to be reported in your transmission (the same as the WSPRlite output power, unless you are using an external attenuator or amplifier), and indicate if you are using an external filter.

The last two settings control how much you will transmit. A WSPR transmission is 2 minutes long, with 30 time slots per hour. At the default **REPEAT RATE** setting of 20%, you will transmit on six of the 30 available time slots. Maximum repeat rate is 50%. You can also choose how many days (1 – 30) the WSPRlite transmitter will run before shutting off automatically. (You can terminate transmission manually at any time.) After initial setup, the software populates the fields with current settings whenever you **CONNECT** to the WSPRlite transmitter.

The **OPEN IN BROWSER** button at the bottom of the screen is a link to your signal reports on the DXplorer website. I clicked on it and bookmarked the link in my browser.

Cortesia de Virgilio.

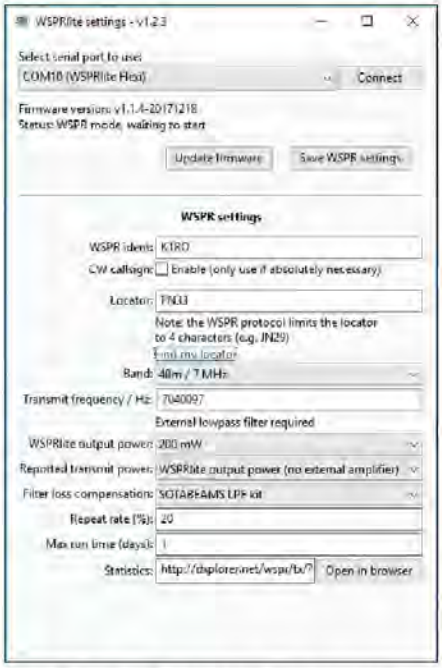

Figure 7 — The WSPRlite configuration screen.

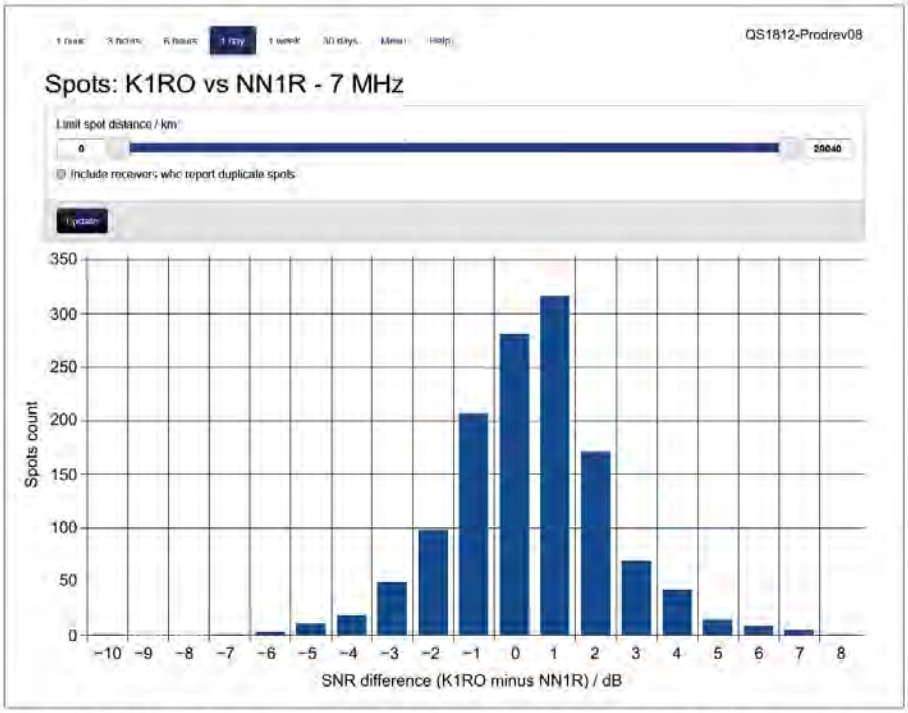

Figure 8 — DXplorer report comparing the strength of the most recent 500 WSPRlite signals received simultaneously from the author's two 40-meter antennas. K1RO used the 40-meter antenna, and NN1R used the multiband dipole tuned to 40 meters. Note that, in this illustration, the axis labels have been enhanced to aid legibility when reproduced at this size.

After you finish configuring the transmitter, the computer connection is no longer required until you want to change a parameter. However, you will need to keep the transmitter connected to an active USB port or USB power supply during operation.

On the Air

When you connect power to the WSPRlite transmitter via the USB port, the LED blinks red. To start transmitting, press the pushbutton at 2 seconds past the start of an even minute (accurate starting time is important). The LED will glow steady red for about 110 seconds while the transmission is in progress, and then turn off until the next transmit time slot. That's it. You can listen in a nearby receiver to confirm that your WSPRlite is transmitting, or just wait a few minutes and check the DXplorer website for reception reports.

Because I was interested in comparing my two antennas for 40 meters, I set up one of the WSPRlite units to transmit as K1RO with my 40-meter antenna, and the other to transmit with a club call sign, NN1R, with my multiband antenna tuned to 40 meters. I started testing at about 1600Z one afternoon and let the WSPRlites run overnight, until about 1300Z the next day.

Several interesting tools are available on the DXplorer website. (Note that WSPRlite owners have access to Premium features on the website that are not available to other users.) Figure 8 compares received signal strength (SNR — signal-to-noise ratio) for two signals as reported by stations receiving both simultaneously. As you can see, for most of the reports, signals are within 1 dB of each other, with a slight preference to K1RO (the 40-meter antenna). Although I was only interested in comparing my own antennas, you can choose to compare simultaneous reports from a list of other active stations.

Figure 9 is a map showing the locations of stations receiving my WSPR signals during the same timeframe, using the same data as the report in Figure 8. The green dots indicate stations receiving both signals, while blue dots indicate stations receiving only NN1R (the multiband antenna) and red dots are for stations receiving only K1RO (the 40-meter antenna). For the most part, coverage was the same, but the 40-meter antenna gathered some additional reports from Europe. You can click on any of the dots for details. In this example, EI3RCW reported that the 40-meter antenna (K1RO) was 1 dB stronger on this 4,834-kilometer path.

I tried another comparison, this time on 20 meters between my two-element beam at 25 feet pointed west (K1RO) and my multband inverted **V** tuned for 20 meters (NN1R). As shown in the map in Figure 10, quite a few stations in the US heard both signals (green dots). Some heard the beam but not the multiband antenna (blue dots). Off the back of the beam, most of the European reports were for only the multiband antenna (red dots). The simultaneous reception report showed that the beam is almost always stronger, with a mean difference of 5.68 dB according to the report.

Figure 9 — DXplorer map showing the locations of stations receiving the signals compared in Figure 8. The green dots indicate stations both signals, while blue dots indicate stations receiving only NN1R (the multiband inverted **V**), and red dots are for stations receiving only K1RO (the 40-meter antenna).

Figure 10 — Another DXplorer map, this time on 20 meters showing WSPRlite signals received from a two-element beam at 25 feet pointed west (K1RO, blue dots) and a multband inverted **V** tuned for 20 meters (NN1R, red dots). Quite a few stations in the US heard both signals (green dots).

Other tools on the DXplorer website show the 10 furthest reception reports for a given band and allow downloading a spreadsheet (CSV format) with details of each reception report. The spreadsheet includes date and time, receiving station's call sign and locator, received SNR, distance and azimuth to the receiving station, and other data. During the 40-meter test, K1RO (the 40-meter antenna) received 1,989 individual reports, while NN1R and the multiband antenna received 1,526 reports during the 21-hour period.

Summary

I was happy to learn that my 40-meter antennas compared well — a modern spin on the old "antenna 1, antenna 2" test with other stations watching S-meters for small differences amid fading and band noise. It would be fun to use WSPRlite to compare signals with other stations in the local area as well, and see the differences over various paths. You could also use the system to make your own personal propagation beacon to look for openings on a quiet band.

Manufacturer: SOTABEAMS, Macclesfield, United Kingdom; **www.sotabeams.co.uk**. Available in the US from DX Engineering (**www.dxengineering.com**). Price (DX Engineering): WSPRlite Classic, $77.99; WSPRlite Flexi, $93.99; 160/80/40 meter low-pass filter kit, $36.99; three-band low-pass filter board and connectors, $22.99; filter component kits for three-band LPF board, $13.59 each.

Notes

[1]C. Preston, K7TAA, "Antenna Comparisons Using Simultaneous WSPR Measurements," *QEX*, July/Aug. 2017, pp. 8 – 14.

[2]WSPR is one of the modes included in the popular *WSJT-X* digital communications software package, and an older standalone version, WSPR 2, is still available. For more information, see **physics.princeton.edu/pulsar/k1jt/wspr.html**.

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

The Doctor is In

When to Change Long Coax to Window Line

Q David, AB1XG, asks: I use a commercial multi-band trap vertical monopole that is hidden in the woods to keep me from running afoul of my homeowners association restrictions. This makes my coax feed line run 150 feet long. I'm using low-loss ultra-flex coax, but I wonder if I would be better off using lower-loss transmission line, such as window line or high-quality transmitting twinlead.

Table 1
Attenuation of 150 feet of two sizes of Ultra-Flex coax compared to Wireman #551 window line.

Frequency (MHz)	LMR-195 UF (dB)	LMR-400 UF (dB)	Window Line (dB)
3.75	1.4	0.5	0.2
7.15	1.9	0.7	0.3
14.15	2.7	0.9	0.4
21.20	3.3	1.1	0.5
28.30	3.8	1.3	0.6

A You don't say which size of flex coax you are using. There is quite a difference between Times Wire LMR-195 UF and LMR-400 UF, or equivalent from other vendors. The numbers in the product name indicate the approximate outside diameter in thousandths of an inch, so the 400 is similar in size to the more common RG-213 coax. Table 1 shows the attenuation of each, compared with a typical 450 Ω window line. All assume matched conditions.

While your coax is reasonably matched to the antenna as delivered, to match to the window line you would need a 9:1 balun at each end, which would add about 0.6 to 1 dB of loss and cost about $100 each. The window line has the additional disadvantage that it must be suspended at least a few inches above ground and can't be easily buried.

If you are using LMR-400UF, I don't think a change is warranted, because the loss in the baluns would negate any benefit of the lower-loss cable. If using thinner cable, I think I would be inclined to change to the larger coax, rather than change to balanced line. If you had a 1,000-foot run, I might have given a different answer.

Q Richard, W1REJ, asks: I have recently received a used commercial tri-band HF Yagi antenna that has a 15-meter trap with mechanical damage. How do I check the trap to see if it is okay? I do have an antenna analyzer and I believe that I should be able to check the trap, but have never done this before. Is this the best way to determine if the trap is electrically sound?

A Depending on the kind of mechanical damage, it may not be worth testing for electrical properties. The trap not only has to act like a parallel-resonant circuit, but also has to keep the weather and insects out, and provide enough strength to keep the outboard end of the element in place. If you think that the mechanical aspects are solid, check for continuity. A proper trap will show 0.0 Ω resistance from one end to the other — just the resistance of the coil wire. Often there can be a connection problem, particularly if the connections are riveted together. While you are at it, check every trap and each joint between tubing sections. On my ancient used tribander, I separated each section, polished the outside and inside at the joints (inside with a rotary grinding tool), applied conductive grease, and used new stainless-steel hose clamps to hold it together. I'm not sure how your Yagi forms the trap's capacitance, but the trap's outer tube should not show connectivity to the element at either end. To measure the resonant frequency, you can connect each end of the trap to your analyzer. It should show a very high impedance at the resonant frequency. Note a few caveats:

- The resonant frequency is usually not actually within the band, perhaps at 20.9 MHz instead of, say, 21.2 MHz. This avoids the very high voltages at resonance, yet still provides a high impedance over the band.

- Both the connecting wires and the chassis of the analyzer will become part of the measured system. Make the leads short, disconnect all cables from the analyzer (power, computer), and place the analyzer on an insulating surface like a wooden stool to avoid excessive loading. The resulting frequency will not be quite the same as the trap by itself, but you can check by comparing to a non-dam-

aged unit on the other side of the same element.

If it needs replacement, for whatever reason, I would bet that the manufacturer would sell you a replacement trap, as well as any other missing or damaged hardware. Make sure you install the antenna (and store it, for that matter) with the trap weep holes facing down to let water out, not in. I hope it works out well for you! My $50 wonder has been adding to my DX count for 10 years now!

Q Fred, KF4FC, asks: I have been doing some reading on the best way to tune my T-network antenna tuner and found some interesting references in a *QST* article.[1]

The author's approach is to keep the antenna-side capacitance (C_{OUT} in Figure 1) as high as possible and to adjust the inductance and transmitter-side capacitor to minimize SWR without moving the antenna-side capacitor, if possible. The argument is that by doing this, we get the most efficient transfer of energy to the antenna and minimize the loss that primarily occurs in the inductor. I followed these steps on my tuning settings and I was able to obtain a match on most bands. I may be imagining things, but it seems that since I have done this, my reception seems better.

Does setting a tuner this way, to maximize "efficiency" on transmit, actually improve the voltage coming to the receiver on receive?

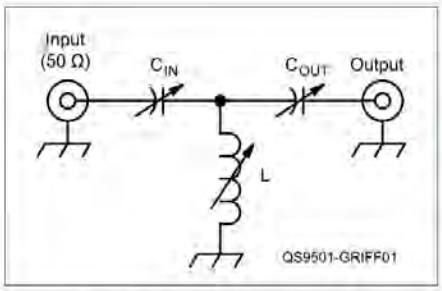

Figure 1 — Schematic diagram of a T-network antenna tuner, frequently used for HF antennas in internal and external tuners.

A It is quite true that the major loss element in an antenna tuner is the copper loss in the inductor wire, especially for tuners that have air dielectric capacitors. Therefore, it follows that the setting with the smallest inductance will have the least loss.

I don't know whether you already use the transmission-line software *TLW* that is included on the CD-ROM at the back of any recent *ARRL Antenna Book*. It is a very useful program that I use constantly. In addition to analyzing transmission lines, it will take the impedance that it calculates at the bottom of the transmission line and design an antenna tuner to match it to 50 Ω. You can pick the configuration, and for the T match, you can pick one of the C values. I used that capability to make a study of a typical load and presented the resulting values in my *Guide to Antenna Tuners* book.[2] My results were very similar to those in your referenced *QST* article, although mine was an example at a particular impedance — not a general proof. So if you use *TLW*, you can evaluate your situation for your actual loads. If you do use *TLW*, make sure you get the update in the code that corrects an error in the loss of balanced lines.[3]

Q Robert, W4SOG, asks: I have a commercial antenna analyzer that is powered by 10 AA dry batteries. Recently, I discovered that three of the batteries come up with reverse polarity. After many years and experience using hundreds of AA batteries, this is something new to me. Is this common, and how can it happen?

A This is a new one to me as well. In all my many years, I don't think I've ever seen that happen. I would have guessed that it would be more likely that you had a meter problem, or that the meter mode switch got bumped to –DC. I then turned to ARRL Senior Lab Engineer Zack Lau, W1VT, who had a better idea. Zack suggested that the batteries weren't matched. If they aren't equal, the stronger batteries will reverse charge the weak ones as they become depleted. It shouldn't happen if you are using new batteries and replace them all in sets from the same package. Ideally, you would monitor each cell's voltage and shut things off before one of the batteries becomes fully discharged, but if you replace them all together with cells from the same batch, it shouldn't happen.

Glenn Schulz, W9IQ, was kind enough to bring to my attention an error in my September 2018 column. It was in the item responding to the question from Keith, KE4TH, regarding possible sources of damage to transceivers and amplifiers due to driving loads with high SWR. I had indicated that with a high SWR, the voltage could be twice that compared to the matched condition. Glenn pointed out that while that is true for the condition of a generator with an output impedance that is matched to the transmission line, that condition rarely exists. In the general case, the voltage (or current) at the transmitter can be as high as the square root of the SWR times the matched voltage, a bigger problem if the SWR is greater than 4:1, as is more often the case.

Notes

[1] A. Griffith, W4ULD, "Getting the Most Out of Your T-Network Antenna Tuner," *QST*, Jan. 1995, pp. 44 – 47.

[2] J. Hallas, W1ZR, *The ARRL Guide to Antenna Tuners*, Table 4-1. Available from your ARRL dealer or the ARRL Store, ARRL Item no. 0984. Telephone 860-594-0355, or toll-free in the US 888-277-5289; **www.arrl.org/shop**; **pubsales@arrl.org**.

[3] J. Hallas, W1ZR, "Introducing an Improved Version of Transmission Line for Windows Software," *QST*, June 2014, pp. 38 – 39.

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

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

Hints & Hacks

A Preamp for Dynamic Mics, An Easy Mobile Support Mount, and More

Copper Wall Plate

I needed an inside wall bulkhead plate for coax that could accommodate several connectors, as well as connect the station grounding conductor to the external ground system. While perusing the local hardware store, I came across a 10 × 4 × 0.025 inch copper plate that seemed like a possibility, especially because it meant there'd be no cutting or bending involved.

For an investment of about $8 and half an hour in my shop, I built a copper wall plate (see Figure 1). I carefully used an 11/16th bi-metal drill bit by clamping the plate between ½-inch plywood, then drilling through the wood, the plate, and into the bottom piece of wood.

Figure 1 — The copper wall plate. [Lionel Booth, N5LB, photo]

Work is ongoing for proper grounding and cable routing, but this is the basic design. A larger ⅜-inch copper plate serves as the outside barrier for cable entrances. I measured the resistance from the inside plate to the coax shield at a few milliohms. — *73, Lionel Booth, N5LB,* **n5lb@outlook.com**

Using Dynamic Microphones with Electret Mic Transceivers

Many popular HF transceivers were designed for use with electret microphones that have 10 – 20 dB higher output levels than typical dynamic microphones. The microphone gain adjustment range on many of those radios is frequently insufficient to accommodate many popular dynamic microphones.

After purchasing one of these radios, I found that the Audio Technica dynamic desk microphone, which performed well with several of my previous transceivers, was unable to provide sufficient output for use with my new transceiver, even with the microphone gain maxed out.

The problem was solved by constructing a simple single-transistor gain-adjustable preamp that fits nicely inside the microphone body, powered by the 8 V present on the microphone positive lead from the transceiver's microphone connector. I used parts I had on hand to build the preamp, all inexpensive and commonly available for less than $5.

Since installing this preamp, I've received numerous compliments on my transmitted audio and I'm able to run the transceiver mic gain between 25 – 30% with proper ALC action. Prior to adding the preamp, I had to speak loudly into the microphone and run the transceiver mic gain at 100% with the compression set at +3 to get close to normal power output.

There is one thing to be aware of when using dynamic microphones with transceivers designed for electret or condenser microphones. If the transceiver powers the microphone element on the positive audio lead, this preamplifier must be connected as shown in Figure 2. If the microphone is powered on a separate

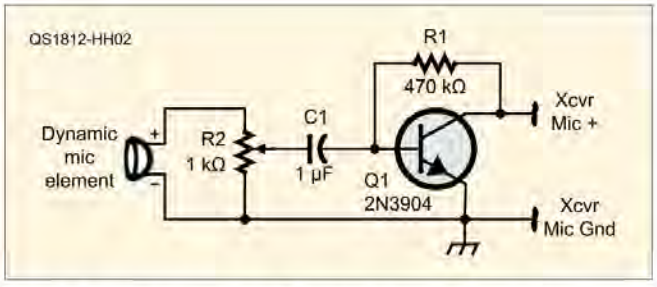

Figure 2 — A schematic with phantom power, for use when the transceiver powers the microphone element on the positive audio lead.

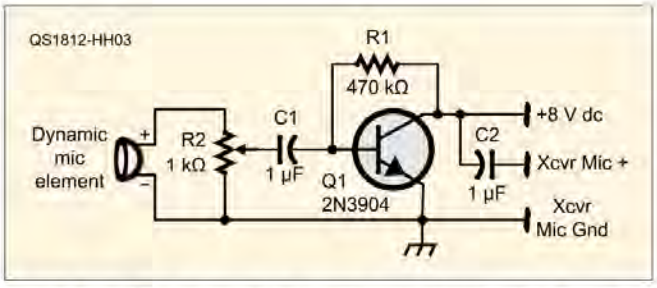

Figure 3 — The schematic without phantom power, for when the microphone is powered on a separate lead.

Figure 4 — The sky-wired assembly before heat shrink. [Paul Dobosz, K8PD, photo]

Figure 5 — The assembly enclosed in heat-shrink tubing. [Paul Dobosz, K8PD, photo]

Figure 6 — The gain potentiometer installation. [Paul Dobosz, K8PD, photo]

lead, it will be necessary to connect to the preamplifier as shown in Figure 3. Most modern transceivers have 8 – 12 V available on the microphone positive pin or a separate pin of the microphone connector, so this circuit should work with pretty much any radio needing extra microphone output from dynamic microphones.

Each physical installation will be unique to the actual microphone. It will depend on the shape and size of internal space available, and your ability to disassemble and reassemble the microphone without damaging it. In my case, I opted to "sky wire" components together with fly leads (see Figure 4) and enclose the assembled circuit in shrink tubing (see Figure 5). I placed a miniature gain adjustment trim potentiometer under the microphone windscreen to allow adjustment without fully disassembling the microphone (see Figure 6). If placement of the circuitry internal to the microphone is not possible, it can also be enclosed in a small inline enclosure or in the base of a microphone stand, or combined with a PTT switch. *— 73, Paul Dobosz, K8PD,* **pjdobosz@gmail.com**

An Inexpensive Mobile Scanner Mount

I needed a cheap and reliable bracket for the Uniden BCD536HP scanner that I keep in my truck. I looked at commercially made ones, but none that suited my needs were able to be installed in the close area between the center seat and my dual-band without obstructions. I also needed it out of the way while driving and needed to be able to see what was being received while parked.

Figure 7 — The finished scanner mobile mount, made from inexpensive plumbing supplies. [Al Wasielewski, WA2VJL, photo]

I decided that plumbing materials were the answer. I went to my local plumbing supply store and purchased two ¾-inch galvanized floor flanges; one ¾ × 6 inch galvanized threaded nipple; four #12 1-inch self-tapping screws, and two ¾-inch locknuts.

I installed the flanges on either side of the pipe, then tightened and mounted it to the transmission hump with the self-tappers. I took the mobile bracket that came with my scanner and drilled a ¾-inch hole in the center of the bracket, installed one of the locknuts onto the pipe, and bolted it to the top of the pipe with the other locknut. Finally, I mounted the scanner to the bracket with the hardware.

After a few adjustments, I had a mobile mount with no obstructions and great visibility for only $4 (see Figure 7). This mount can be used with a variety of radios, using the radio's mobile bracket. *— 73, Al Wasielewski, WA2VJL,* **wa2vjl@yahoo.com**

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Steve Ford, WB8IMY, wb8imy@arrl.org

Eclectic Technology

The Importance of Time

If you're operating any of the so-called "WSJT modes," which include FT8, JT65, JT9, and WSPR, you know that accurate time is critical. Your computer clock must be in sync with the computer clocks at the stations you hope to contact. Synchronization doesn't have to be perfect, but the margin of error is slim. In some instances, a time deviation of 2 seconds is enough to make it impossible to decode signals.

The problem with most computer clocks is that they tend to drift. Modern versions of Windows, which most hams use, communicate with online time servers using Network Time Protocol, or NTP, to keep computer clocks in sync. This works well for ordinary use, but when you're talking about a need for accuracy measured in fractions of a second, that approach can have shortcomings.

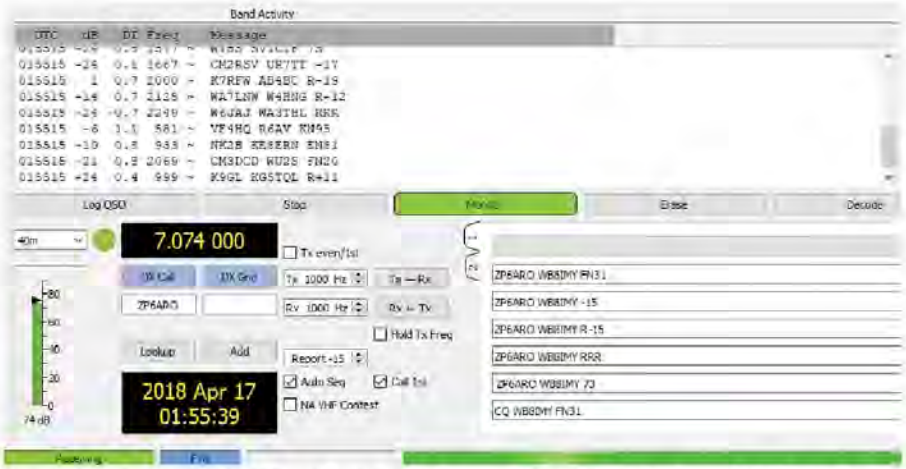


Figure 1 — In the *WSJT-X* Band Activity window, you'll find the DT column (third from the left). The numbers in this column indicate time discrepancies between your computer's clock and the computer clocks at the other stations.

Counting the Seconds

Windows doesn't query the NTP servers constantly, and if there are disruptions in communication (or disruptions in software processes), it will result in lax synchronization. Windows will synchronize the time eventually, but not necessarily according to your operating schedule. At my station, I would occasionally notice that my computer clock had drifted by more than a second.

How could I tell?

I'd look at the "DT" column in my *WSJT-X* software (see Figure 1). The numbers in the DT column indicate the discrepancies — in seconds or fractions of seconds — between your computer's clock and the clocks at the other stations whose signals you've decoded. It is normal to see a few DTs of 1 second or so, but if you notice that nearly every decoded signal is showing such deviations, that's a hint that the problem is at your end. Of course, another strong indicator of a time problem is when you're not decoding signals at all.

Getting in Sync

One fix is to simply force Windows to resynchronize. In Windows 10, open the **SETTINGS** menu, and then click on **TIME & LANGUAGE**. A new menu will appear, and you will see a switch labeled **SET TIME AUTOMATICALLY**. In all likelihood, it will be in the **ON** position. Slide the switch to **OFF**, wait a few seconds, and then slide it back to **ON**. This will force Windows to resynchronize its clock.

The problem with this approach is that you must remember to do it each time you sit down to operate. A more elegant solution is to install a software client that is more vigilant at maintaining the proper time.

Dimension 4 (**www.thinkman.com/dimension4/**) has been a popular free application for many years, but some find it complicated to configure. My favorite software solution is *Network Time Protocol* (*NTP*), available at **www.meinberglobal.com/english/sw/ntp.htm**. This open-source client installs quickly and then sits in the background doing its thing. You'll hardly know it's there, but you will see the effects in the *WSJT-X* DT column right away.

Some amateurs who desire even more precise computer time will use GPS receivers, along with software that taps into the receiver's ultra-accurate time signals. However, this level of precision isn't necessary for *WSJT-X* operating.

Making Digital Contacts Through the ISS

How to use the International Space Station as a digital repeater to make long-distance contacts using packet radio.

[Image courtesy of NASA]

Patrick Stoddard, WD9EWK/VA7EWK

Amateur Radio operators have used satellites with communications in a variety of modes for decades, and packet radio deserves more attention. Along with terminal node controllers (TNCs) and various software packages for packet operations, there are several handheld transceivers (HTs) and FM mobile transceivers that also include packet functionality — without the need for a computer or other hardware.

The International Space Station (see the lead photo) and the NO-84 (PSAT) satellite both have packet radio digipeaters on 145.825 MHz. These digipeaters use the same 1,200 bps packet that is heard on the terrestrial Automatic Packet Reporting System (APRS) network at 144.390 MHz. APRS supports messaging that enables hams to make two-way contacts. The packet path used on 145.825 MHz is different than for the terrestrial APRS network. ARISS should be used for the digipeaters on the ISS and NO-84. The traffic on 145.825 MHz can be seen on websites like **ariss.net** (ISS) and **pcsat.aprs.org** (NO-84), thanks to a network of gateway stations listening on that frequency, and the stations are accessible through other websites like **aprs.fi** and **findu.com**.

Some minor changes must be made to the radios' configuration in order for them to work with the orbiting digipeaters. Figure 1 covers settings for a few handheld and FM mobile transceivers capable of working packet/APRS. Use the GPS module with these radios to set your location, so that can be transmitted through the orbiting digipeaters. Settings also allow for automatically transmitting a position packet every minute.

The ISS and NO-84 pass overhead for approximately 8 to 10 minutes several times a day. To determine when they will be in view of your location, check sources like **amsat.org** and **n2yo.com**. When the digipeaters are on, there's activity over populated areas — look for the call sign RS0ISS from the ISS, or PSAT from NO-84.

Rather than using the radio's DTMF keypad or front panel to create messages, I use the three memory slots for stored messages that can be called up during a pass. Because call signs are already included in the message, I only add the information to complete a contact.

	Kenwood TH-D72A	Kenwood TH-D74A	Kenwood TM-D710GA	Yaesu FT-2DR	Yaesu FTM-400XDR
My call sign	Menu 300	Menu 500	Menu 600 > My Callsign	APRS > 23 CALLSIGN	APRS > 23 CALLSIGN (APRS)
Baud Rate (1200)	Menu 311	Menu 505	Menu 601 > Data Speed	APRS > 4 APRS MODEM	DATA > DATA SPEED > APRS
Beaconing (Automatic)	Menu 3D0	Menu 510	Menu 611 > Method	APRS > 16 BEACON TX	APRS > 15 BEACON TX > AUTO
Beaconing Interval (every minute)	Menu 3D1	Menu 511	Menu 611 > Initial Interval	APRS > 14 BEACON INTERVAL	APRS > 15 BEACON TX > INTERVAL
Packet Path (ARISS)	Menu 3H0 > Others	Menu 504 > (use Others1, Others2, or Others3)	Menu 612 > Others	APRS > 18 DIGI PATH (enter in one space, P5-P8)	APRS > 17 DIGI PATH 1
Predefined messages (phrases), for sending to other stations	Menu 3P0	Menu 560	Menu 621	APRS > 7 APRS MSG TXT	APRS > 4 APRS MSG TXT
Status Text (free-form text about your station)	Menu 390	Menu 503	Menu 608 > TEXT	APRS > 15 BEACON STATUS TXT > TEXT	APRS > 14 BEACON STATUS TXT > TEXT1
Status Text transmit rate (1/1)	Menu 391	Menu 503 > TX Rate	Menu 608 > TX RATE	APRS > 15 BEACON STATUS TXT > TX RATE	APRS > 14 BEACON STATUS TXT > TX RATE

Figure 1 — Settings for making contacts with packet radio and APRS using handheld and FM mobile transceivers.

Operating on 145.825 MHz

The 145.825 MHz digipeaters on the ISS and NO-84 are unique resources for radio amateurs. Some operate on 145.825 MHz as they would on 144.390 MHz, including having stations beacon automatically 24/7. For US hams, unless the stations are at least 50 kilometers above the Earth, automatic operations on 145.825 MHz are not permitted by FCC Part 97. Automatic operations also clog the frequency, preventing other amateurs from using the frequency for making contacts or other interactive experiments.

FCC Part 97 permits automatic operation of amateur stations in a few instances:

- Auxiliary stations, or *remote bases*, can be controlled automatically. However, 97.201(d) does not permit this operation at 145.8 – 146.0 MHz, within the 2-meter satellite subband.
- Beacons are allowed to operate automatically on many amateur bands. In the 2-meter band, beacons may operate automatically only at 144.275 – 144.300 MHz per 97.203(b).
- Repeaters are allowed to operate automatically in parts of the 2-meter band, per 97.205(d). However, repeaters are not allowed at 145.5 – 146.0 MHz, which also includes the 145.8 – 146.0 MHz satellite subband.
- Space stations are allowed to operate automatically and make some one-way transmissions, per 97.207(d) and 97.207(e). Ham stations do not meet the definition of a space station in 97.3(a)(41): "Space station: an amateur station located 50 km or more above the Earth's surface."
- Digital stations under automatic control get their own mention in FCC Part 97 at 97.221. However, one classification of amateur station that is not permitted to be an automatically controlled digital station is an Earth station, which is defined at 97.3(a)(16): "Earth station: An amateur station located on, or within 50 km of, the Earth's surface intended for communications with space stations or with other Earth stations by means of one or more other objects in space." Our stations operating on 145.825 MHz working the ISS or NO-84 digipeaters would be Earth stations.

Radio amateurs in areas governed by the FCC are free to operate on 145.825 MHz, and are subject to their license class and complying with FCC Part 97, but the station must be under control of the radio amateur. If a packet or APRS station needs to operate automatically, please keep it away from 145.825 MHz or anywhere within the 145.8 – 146.0 MHz satellite subband.

If I see a call sign on the screen or in my list of stations that I want to contact, I can use a stored message and add my grid location. Working from there, I don't have to enter that call sign. The radio should display a prompt when it sees the message being retransmitted by the ISS or NO-84. You will either receive an "ACK" — confirmation that the other station received the message you sent — or a message from the other station.

All of this can be done in 10 to 20 seconds, depending on the level of activity on the digipeater. This is just another way to take advantage of our satellites.

A Life Member of ARRL and AMSAT, Patrick Stoddard, WD9EWK/VA7EWK, was originally licensed in 1977. He holds a US Amateur Extra license and a Canadian license with all three qualifications (Basic, Advanced, Morse). He has worked satellites from over 100 grid locators in locations across the US, Canada, Mexico, and Australia, using portable and QRP equipment. Patrick has achieved WAS and VUCC via satellite, along with WAS, WAC, and DXCC on the HF bands. Patrick has been an IT professional for over 2 decades, focusing on systems, networks, and telecommunications. He may be contacted at **patrick@wd9ewk.net**.

About Cognitive Radio

What it is, how it works, and the technology's implications in the ham radio world.

Ward Silver, N0AX

Along with software-defined radio (SDR), one of the hottest topics in wireless communications is *cognitive radio* (CR). When looking at what "cognitive" means and why it matters to hams, you'll find there is a lot that is surprisingly familiar.

The Meaning of Cognitive

From the perspective of radio, "cognitive" refers to the radio's ability to perform functions usually assigned to a human operator. For example, a CR is programmed to dynamically discover and use available channels that will perform the best, while avoiding interference to other users of the spectrum. Like a human, but automatically, the CR finds available spectrum and then optimizes its receive and transmit behavior accordingly. This is a new type of dynamic spectrum management to accommodate more users.[1]

Three words in that definition are the key to understanding CR: *dynamic*, *automatic*, and *accordingly*. Dynamic — because the radio spectrum is continually changing, and a CR responds to those changes. Automatic — because the CR does this on its own, without human control or even oversight. Accordingly — because the CR observes, learns, and adapts.

The process for CR is similar to what hams are supposed to do on the air. First, tune around and *analyze* what we hear on the band. Second, *decide* how to configure the radio equipment (and maybe a PC). Third, make the contact and *communicate*. Finally, evaluate whether it accomplished what you wanted and *learn* from that. Hams have been doing CR for a century, enabling us to share our spectrum through flexibility and skill — i.e. "radio know-how."

Here's an example of ham radio CR: tune through the lower 100 kHz of the 40-meter band when voice, data, and CW stations are all active. You might hear digital stations exchanging email, voice stations in a net or round table, and CW stations chasing DX or contesting — all at the same time and mixed together. It's relatively easy for a human operator to manage, but it is surprisingly difficult to automate.

No other regulated service offers Amateur Radio's flexibility of continuous tuning, a wide variety of protocols and modulations, self-regulation of operating procedures, and the ability to design and build any part of the station equipment. This allows us to do a lot with our spectrum. That's what CR is about, too — sharing for higher utilization of scarce spectrum. Let's see how a CR approaches the problem.

Analyze

The answer to questions about communications almost always starts with, "It depends…" What is the goal of communicating? What regulatory or operating rules apply? How much is known about other stations? An experienced human operator has a lot of experience with these questions. A CR is limited to what it is programmed to know. Starting with its built-in constraints, the CR begins by observing the spectrum it is authorized to use, typically VHF/UHF/microwave bands but increasingly, the HF bands, too.

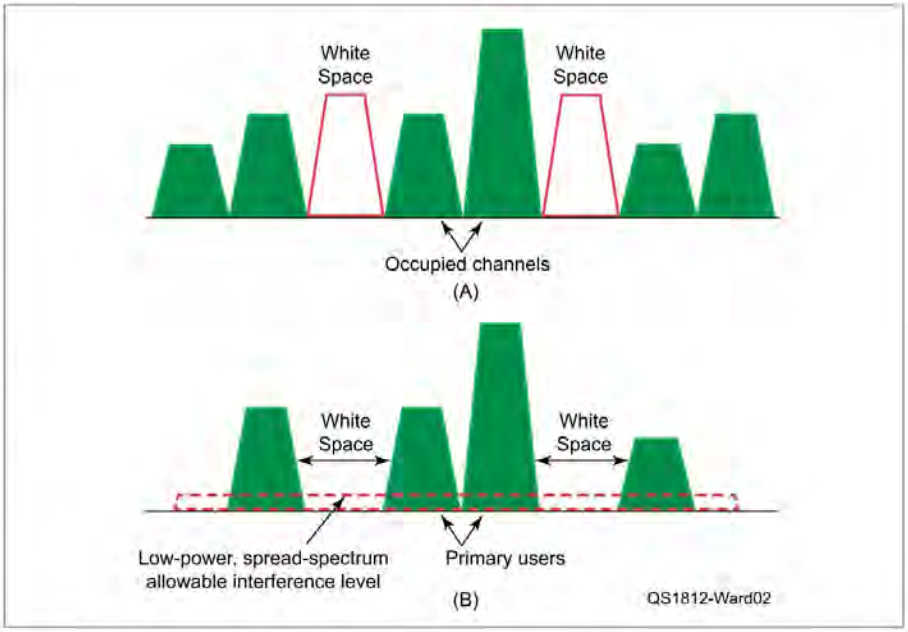


Figure 1 — How a cognitive radio selects an operating frequency — see the text for details.

[1]Visit **en.wikipedia.org/wiki/cognitive_radio** for more links and resources on cognitive radio, such as technical pages and presentations.

Observe

If the CR is operating at VHF or higher frequencies, propagation is usually not a big consideration. As long as precipitation or multi-path are not blocking or corrupting the transmission, choosing a channel is based on what other signals are present.

On HF, sky-wave propagation has a much bigger effect. As hams know well, ionospheric propagation changes dramatically but in broadly predictable ways based on factors like the sunspot cycle, the season, time of day, and the geomagnetic field's stability. Propagation models are available, but these are statistical predictions. Today there are several online sources of near real-time measurements of the ionosphere. These can be used to build models of actual conditions, making it easier to select the right band for the job

Evaluate

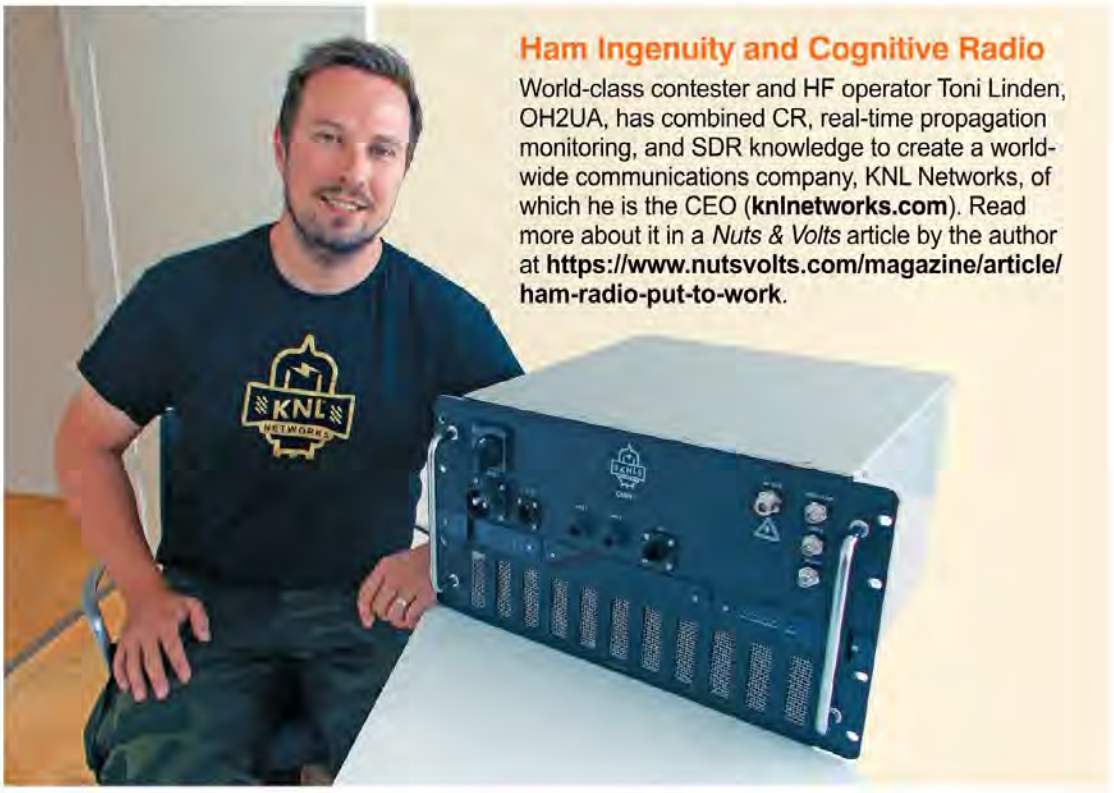
Based on what spectrum is available, the CR has to, in effect, "tune around" to find out what channels are available. This evaluation depends on whether the CR is using *interleave* or *underlay* rules. Interleaving means to only operate on a clear channel so that signals are interleaved across the band, one per channel. Figure 1A shows what the CR would attempt to find: "white space" in which there is no other signal. This is how hams select an operating frequency under normal conditions.

Underlay rules, however, allow a station to transmit on a channel that is occupied as long as the transmission will not exceed a maximum level of interference. This requires the CR to know what constitutes interference to the other user and how much interference they can tolerate. CRs operating this way base decisions on their location and a database of known spectrum users.

Hams know that they are unlikely to get a clear channel most of the time and have to accept some interference. Similarly, hams know when some interference becomes too much. For example, going back to our 40-meter example, if I want to make a CW contact on 7.048 MHz some busy evening and I hear some faint Spanish on that frequency, I know that South or Central American voice stations are there. If I use low power or QRP, I can make my CW contact without bothering them at all — that's an acceptable solution. A CR can transmit a spread-spectrum signal, as illustrated by Figure 1B, and as long as the power is low, that will not cause unacceptable levels of interference to the primary users.

Decide

The CR also has to decide what is signal and what is noise. One way is *energy detection*. The CR measures its receiver output and compares it to a pre-determined level. A modem's "channel busy" light works this way, but it can be fooled; high noise levels can cause "false busy" detections and prevent the CR from making a transmission. Weak signals (like FT8, JT65, or WSPR) might not be much stronger than the noise, so they aren't



Ham Ingenuity and Cognitive Radio

World-class contester and HF operator Toni Linden, OH2UA, has combined CR, real-time propagation monitoring, and SDR knowledge to create a worldwide communications company, KNL Networks, of which he is the CEO (**knlnetworks.com**). Read more about it in a *Nuts & Volts* article by the author at **https://www.nutsvolts.com/magazine/article/ham-radio-put-to-work**.

[Ward Silver, N0AX, photo]

Cortesia de Virgilio.

detected, and the CR causes interference when it transmits.

Some CRs can look for the varying characteristics of a modulated signal. If such a pattern is present, the channel is deemed busy, and the CR stands by or tunes elsewhere. This means the CR does not have to be able to demodulate signal in order to avoid interfering with it.

Finally, sophisticated CRs are able to determine the types and strengths of signals present. They then use stored or online information to determine the appropriate action.

Configure

Having found available spectrum, a CR then configures itself for the job at hand. A *waveform* is selected, meaning a type of modulation, such as a variation of PSK or FSK. The next step is to select an appropriate *protocol*, which sets the rules by which a contact will be established, conducted, and terminated. Antenna patterns can also be configured to select (or reject) signals in certain directions or polarizations.

Communicate

The CR then begins the process of establishing contact. Simple protocols and modulations require little in the way of adjustments. For example, PSK31 only operates with other PSK31 stations. CW operators adjust to a mutually agreeable speed. Basic packet radio (AX.25) operates at 1,200 baud with a standard CONNECT packet to initiate the contact.

CRs negotiate an optimum combination of parameters. You have probably heard this process when two landline modems connect. Simple tones are exchanged, followed by RTTY-like FSK signals at 2,400 baud. The modems then "negotiate" the fastest combination of modulation and protocol. They also transmit *training sequences* so that filtering algorithms can adapt to the channel conditions. A similar sequence occurs when two PACTOR stations connect. They begin with the simple PACTOR-1 exchange, and work their way up to the fastest connection for the conditions.

Once a connection has been established, further negotiations may enable the connecting station to join a network. Packet radio stations, such as APRS, can also digipeat through the connected station in order to send the message.

During the communication, the protocol governs the exchange of data between the stations. Errors can be detected and corrected, and at the end of the transfer, the connection is ended in an orderly way.

If the error rate becomes too high or conditions change, very common on HF, one or both stations may decide to renegotiate the connection between them. This is based on a *bit error rate* (BER) or *signal-to-noise ratio* (SNR). The training sequence is repeated, a new configuration is selected, and contact continues. In severe cases, the connection can be dropped entirely, and the data transfer fails.

Learn

Finally, a CR evaluates the success or failure of the contact. How did that go? Was the selected frequency suitable? Were the configured parameters acceptable or did they have to be renegotiated during the contact? Were the communication system's goals for the contact achieved? Over time, a CR can build up its store of radio know-how, just like a ham does, to know what is likely to work and what doesn't.

The CR can also report its findings to a system-level controller so that the entire system can learn from the experiences of each station — just like hams learn from newsletters, emails, websites, and even magazines.

Amateur CR

Hams can use automated CR in their stations; although on HF, US hams must abide by rules limiting automatic control (§97.221). CR could be used at and above VHF for digital communications through satellites and for mesh network applications. Narrowband (less than 500 Hz) digital signals on HF could be used for emergency communications, scientific experimentation, and propagation beacons.

Amateurs have many tools with which to build CR systems. Automated receivers using *CW Skimmer* or *RTTY Skimmer* are connected to the Reverse Beacon Network (**www.dxatlas.com/cwskimmer** and **reversebeacon.net**). PSK and other digital signals, such as FT8, are monitored by **pskreporter.info**. WSPR receivers are connected into a worldwide network at **wsprnet.org/drupal**.

You can contact Ward Silver, N0AX, at **n0ax@arrl.org**.

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

To Learn More About Cognitive Radio

- "Cognitive-Radio and Antenna Functionalities: A Tutorial," IEEE *Antenna and Propagation Magazine*, Vol. 56, No. 1, Feb. 2014, by Y. Tawk, J. Costantine, and C. G. Christodoulou — includes a detailed list of references and supporting papers.
- "Cognitive Radio Tutorial" at **www.radio-electronics.com/info/rf-technology-design/cognitive-radio-cr/technology-tutorial.php**.
- "Cognitive radio: Making software radios more personal," IEEE Personal Communications, Volume 6, No. 4, 1999, by J. Mitola and G.Q. Maguire — the initial paper on CR.

WINTER FIELD DAY
An Amateur Radio Challenge

Jen Glifort

On January 26 – 27, 2019, hundreds of hams will venture into the cold in an effort to maintain their operating skills year-round.

Most ham radio operators associate Field Day with memories of sunshine, cookouts, and summer fun. "But have you ever tried to set up an antenna with gloves on?" asked Tom Phelps, WD8MBE, one of the founders of the Winter Field Day Association (WFDA). The WFDA believes it's important to participate in winter events to ensure operating skills stay sharp, even when the temperature and weather aren't as cooperative as they are during ARRL's Field Day in summer. Those who take part in this annual January event are eager for the challenges it brings. Participants in Winter Field Day (WFD) have been known to set up in fishing shacks atop frozen lakes, ride snowmobiles to their operating locations, and even cross-country ski to remote parks for the event.

An Icy Field Day

In 2006, the Society for the Preservation of Amateur Radio (SPAR) decided to create a Field Day event set in winter. They had online discussions with their members, held a vote to approve sponsorship of the activity, and established the rules. The first Winter Field Day was held in January 2007. This inaugural event was put together with a lot of help from Charlie Young, KY5U, and Walter Fair, W5ALT, of SPAR.

Over the years, SPAR started winding down, and it seemed like Winter Field Day would fade out with the organization. SPAR is no longer active, but Winter Field Day survived under the care of the Winter Field Day Association. A group of enthusiasts including Tom Phelps, WD8MBE; Bill Nangle, VE3FI; Dave Tabbutt, W3DET; Erik McCord, WX4ET, and Ken Coughlin, N8KC, came together to establish the WFDA and continue organizing and supporting the event. The WFDA is a non-profit organization, run entirely on donations and volunteered time.

Tom said, "Emergencies and disasters can happen at any time… Some hams like the comfort of their home or club stations, but can they function as Amateur Radio operators if those cozy locations are not available?"

The team behind Winter Field Day believes that holding a Field Day-style event in winter allows another opportunity to practice the necessary skills to operate during an emergency, with the potential for added challenges brought on by tough weather conditions.

Tom's advice to participants is to "plan, plan, plan" — especially if you live in an area where the temperature is likely to be freezing or below. "Mother Nature can throw anything at us in January," he said, "so every ham needs to plan ahead for the worst conditions."

Of course, WFD is open to all hams, and some are lucky enough not to face adverse weather. Some operators actually prefer to operate in winter, without the harsh summer conditions common in their area. Tom said, "Those in the south enjoy WFD because the temperature and humidity are lower and it's more bearable to operate outdoors."

Cortesia de Virgilio.

Getting out for a Field Day-style operation in winter can provide different methods of operating, and different views.

Some participants treat WFD like it's a contest, but the organizers still consider the event to be a training exercise meant to prepare for scenarios during difficult weather conditions.

Getting Involved

In addition to the emergency preparedness aspects of Field Day-style events, there are also social benefits (see the sidebar, "More Winter Operating Events"). Hams enjoy connecting in person as well as on the air, even if it means facing winter conditions. Ken said, "Almost all of our entrants love ARRL's summer Field Day, and having another one 6 months later appealed to them. It's a chance to operate as a group and socialize in an off time of year for most club events."

More Winter Operating Events

Winter Field Day isn't the only option available for those who would like to test their skills in adverse winter conditions. Here are a few of the events put on by intrepid hams who venture into the snow and ice to challenge their abilities. Be sure to check the Special Events page (**www.arrl.org/special-event-stations**) for new listings each month.

- Freeze Your Keys Day: Every third Saturday in February, the Kickapoo QRP Amateur Radio Club sponsors an outdoor operating event, which usually takes place in a shelter house in Weston Bend State Park, in Missouri. The next Freeze Your Keys Day will be held on February 16, 2019. Go to W0EBB's page on **QRZ.com** or email **w0ebb@juno.com** for more details.
- Snow Bird Field Day: This winter event is a joint effort from the Sunlife Amateur Radio Club and the Venture Out Amateur Radio Club, both of Mesa, Arizona. The Sunlife Club's website said, "We are a very active group of seniors who, for the most part, are 'snowbirds' and come from various parts of the country, as well as Canada." Snow Bird Field Day is held annually on the last Wednesday of February. The upcoming event will take place on February 27, 2019. For frequencies and more information, visit their website at **www.sunlifearc.org/snow-bird-field-day**.

Some daring Winter Field Day participants reach their operating locations via snowmobile.

Winter Field Day runs during the last full weekend in January. The upcoming event takes place January 26 – 27, 2019, from 1900 UTC (2 PM EST) Saturday to 1900 UTC (2 PM EST) Sunday. Like Field Day, the goal of WFD is to get as many contacts in 24 hours as possible. The rules are similar to those used on Field Day, with three categories — indoor, outdoor, and home. Last year's WFD had over 600 log entries.

Winter Field Day is open to all radio amateurs around the world. The WFDA asks that all participants submit a log, even if they don't want their logs posted. For more information on Winter Field Day, check out their website at **www.winterfieldday.com**, or join their Facebook group (**https://www.facebook.com/groups/winterfieldday**).

Going forward, the WFDA aims to continue stressing the event's value as an exercise in operating under challenging conditions. They also want to keep the event alive for years to come, with newcomers eventually taking up the reins, as the WFDA did when SPAR faded out. Ken said, "We'll need to look into what we need to do to ensure that as the founders grow older, we'll have folks in place to continue Winter Field Day beyond our years."

All photos courtesy of the Winter Field Day Association.

Jen Glifort is an Assistant Editor for *QST*. She can be reached at **jglifort@arrl.org**.

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

Rick Lindquist, WW1ME, ww1me@arrl.org

Happenings

ARRL, FCC Discussing Issue of Uncertified Imported VHF/UHF Transceivers

ARRL has taken exception to the wording of a September 24 FCC *Enforcement Advisory* pertaining to the importation, marketing, and sale of VHF and UHF transceivers, and is in discussions with FCC personnel to resolve the matter. The *Enforcement Advisory* was in response to the importation into the US of certain radio products that are not FCC certified for use in any radio service, but identified as Amateur Radio equipment.

"While much of this equipment is actually usable on amateur bands, the radios are also capable of operation on non-amateur frequencies allocated to radio services that require the use of equipment that has been FCC certified," ARRL said. "Such equipment is being marketed principally to the general public via mass e-marketers and not to Amateur Radio licensees."

ARRL said the result is that the general public has been purchasing these radios in large quantities, and they are being used on the air by unlicensed individuals.

"Radio amateurs have complained of increased, unlicensed use of amateur allocations by people who are clearly unlicensed and unfamiliar with Amateur Radio operating protocols," ARRL said. While it supports the general tenor and intent of the *Enforcement Advisory*, ARRL said it disagrees with the FCC on one point.

"In several places, the *Enforcement Advisory* makes the point that 'anyone importing, advertising, or selling such noncompliant devices should stop immediately, and anyone owning such devices should not use them,'" ARRL pointed out. "The *Advisory* broadly prohibits the 'use' of such radios, but our view is that there is no such prohibition relative to licensed Amateur Radio use — entirely within amateur allocations — of a radio that may be capable of operation in non-amateur spectrum, as long as it is not actually used to *transmit* in non-amateur spectrum."

ARRL has had extensive and ongoing discussions about this issue with FCC Wireless Bureau and Enforcement Bureau staff.

ARRL Emergency Response Team Coordinates with Partners in Hurricane Activations

Twice this fall, the ARRL Headquarters Emergency Response Team has activated as dangerous hurricanes affected the US East and Gulf coasts. The Team coordinated with Field Organization leadership in ARRL Sections affected by the storms, as well as with various partners, including the Hurricane Watch Net (HWN), WX4NHC at the National Hurricane Center, the VoIP Hurricane Net, the Department of Homeland Security Shared Resources (SHARES) HF Radio program, and the US Army Military Auxiliary Radio System (MARS).

Hurricane Florence brought life-threatening storm surge and rainfall to portions of the Carolinas and Mid-Atlantic states in September.

"Watch out, America. Hurricane Florence is so enormous, we could only capture her with a super wide-angle lens from the Space Station, 400 kilometers directly above the eye," Astronaut Alexander Gerst, KF5ONO, tweeted. "Get prepared on the East Coast. This is a no-kidding nightmare coming for you!" [NASA photo]

ARRL shipped seven Ham Aid kits to South Carolina to assist with emergency preparedness needs in advance of Hurricane Florence. The kits were the same ones that ARRL volunteers took to Puerto Rico a year ago to assist with disaster communications following Hurricane Maria. ARRL also staged HF and VHF/UHF equipment in the Maryland/Virginia area for deployment locally or farther down the coast.

The HWN in September found itself closely monitoring three systems — Hurricane Florence, Tropical Storm Isaac, and Hurricane Helene. Hurricane Florence drew considerable concern for its size and strength, as well as for its flooding potential.

The following month, the ARRL Headquarters Emergency Response Team went on alert as powerful Hurricane Michael headed for landfall on the Gulf Coast. The storm struck the Florida Panhandle with devastating 155 MPH winds, the first Category 4 or stronger hurricane to hit the area. In addition to severe wind damage, heavy rainfall and flooding occurred, and power and telecommunications outages were widespread.

Hurricane Michael Anecdotes

During Hurricane Michael, Miller Norton, W4EMN, the Communications Watch Officer at the Duval County Emergency Operations Center (EOC) in Jacksonville, Florida, was monitoring SARnet — a UHF-linked repeater network in Florida — when he heard an urgent call for help that needed to be sent to the State EOC in Tallahassee. All other forms of communication were out, and Norton was able to relay the message via Amateur Radio. He also passed along messages and requests from the Jackson County EOC to the American Red Cross.

According to the *The Washington Post*, Rhonda Lewis, Emergency Management Director of Bristol, Florida, found herself without power, landline, internet, and cell phone use. Even a satellite phone wouldn't work. She was able to locate a radio amateur in the neighboring county and bring him back to Bristol to send out calls for assistance.

Recovery efforts remain under way. After Michael exacted significant destruction in Florida, it moved over the US southeast, causing additional flooding.

Also in September, ARRL deployed seven Ham Aid HF kits to Hawaii in preparation for Hurricane Lane, with plans to leave them there until the hurricane season was over. In that same month, Amateur Radio operators on Guam actively supporting the response to the Super Typhoon Mangkhut, which struck the Philippines.

Dwayne Allen, WY7FD, Resigns as Rocky Mountain Division Director

In a letter to ARRL President Rick Roderick, K5UR, on Friday, October 19, Dwayne Allen, WY7FD, resigned as Director of the Rocky Mountain Division due to time constraints and competing duties with work and family. As such, the Secretary of the Corporation has declared the position vacant. In accordance with Article 7 of the Articles of Association, Vice Director Jeff Ryan, K0RM, will assume the Director position immediately.

US Ham-Astronaut and Russian Cosmonaut Safe in Wake of *Soyuz* Launch Failure

A US astronaut and a Russian cosmonaut returned to Earth after a Russian *Soyuz* spacecraft crew launch to the International Space Station (ISS) suffered a booster failure, requiring an emergency flight abort shortly after liftoff on October 11. On board the *Soyuz* MS-10 were US Astronaut Nick Hague, KG5TMV, and Russian Cosmonaut Aleksey Ovchinin. NASA Administrator Jim Bridenstine promised "a thorough investigation."

"Shortly after launch, there was an anomaly with the booster and the launch ascent was aborted, resulting in a ballistic landing of the spacecraft," Bridenstine said. This was Hague's first launch and Ovchinin's second.

Astronaut Nick Hague, KG5TMV, and his wife, Catie, embrace following the Soyuz launch failure. [NASA photo]

The launch failure followed discovery of a 2-millimeter hole in the wall of the *Soyuz* capsule, now docked to the ISS. The resulting air pressure leak has since been repaired. There is no indication that the launch failure and the mystery hole in the last *Soyuz* are connected. Russian space agency Roscosmos said the hole was not drilled by accident.

In the wake of the *Soyuz* failure, operations to transport ISS crew members were suspended. The current ISS crew of cosmonaut Sergey Prokopyev and astronauts Serena Auñón-Chancellor, KG5TMT, and Alexander Gerst, KF5ONO, is scheduled to return to Earth in December.

Cortesia de Virgilio.

FAA Reauthorization Act of 2018 Overhauls Marking Requirements for Short Rural Towers

Thanks to ARRL efforts on Capitol Hill, language in the 2018 Federal Aviation Administration (FAA) Reauthorization Act resolves the issue of problematic or preclusive rules affecting some rural Amateur Radio towers. The previous FAA Reauthorization Act of 2016 had instructed the FAA to enact tower-marking requirements, similar to those in some state statutes, aimed at improving aircraft safety in the vicinity of meteorological evaluation towers (METs).

These towers are typically between 50 and 200 feet and set up in rural areas, often on short notice. In the wake of fatal crop-dusting aircraft collisions with METs, the National Transportation Safety Board (NTSB) had recommended that states institute laws, sometimes called "crop-duster" statutes, requiring marking and registration of METs. While some state crop-duster laws exempted ham radio towers, federal regulations dating to the 1996 FAA Reauthorization Act did not, and ARRL had expressed its concerns since.

"There is no evidence whatsoever that even one Amateur Radio antenna below 200 feet has ever been involved in an aviation accident," ARRL General Counsel Chris Imlay, W3KD, said. "To impose painting and lighting requirements on Amateur Radio antennas between 50 and 200 feet tall would preclude many, if not most, of the exurban, rural, and, in some cases, suburban Amateur Radio antennas that are, and will be, sited outside incorporated towns and cities. This would ironically defeat the entire reason such antenna facilities are sited in those environments: because rural and exurban areas are where such antennas are permitted, and the few areas where antennas are not precluded entirely by private land use regulations."

After attempting to address the issue through the FAA, ARRL's legislative team met with staff members of Senator Jim Inhofe (R-OK), along with other lawmakers and their staffs associated with the congressional committees of jurisdiction. Senator Inhofe — himself a pilot — was of the view that the 2016 legislation was excessive.

Imlay said Section 576 of the large 2018 FAA reauthorization now requires that the only towers less than 200 feet tall that have to be painted and lighted are meteorological aids and those within the glide slope of an airport or heliport. The remainder of such towers in rural or agricultural areas lower than 200 feet need to only be included in an FAA-maintained database, which will be updated by the owners of such towers.

Imlay credited members of the ARRL Legislative Advocacy team, as well as Senator Inhofe and ARRL's broadcast and land mobile association partners for getting the language revised in the new, 5-year Reauthorization Act. "We consider this a big success for Amateur Radio," Imlay said, "and it would not have been possible but for the visibility that has been achieved for ARRL through our active Capitol Hill advocacy for the Amateur Radio Parity Act."

International Space Station Crew Member Fires Up NA1SS to Seek Random Contacts

On October 6, NASA astronaut Serena Auñón-Chancellor, KG5TMT, MD, spent some time operating NA1SS on 145.800 MHz, making casual, random contacts. The ISS was on a pass that took the spacecraft up the US East Coast at the time. In response to a question, Auñón-Chancellor, who has been on the station since June, told one caller that she's been floating the entire time she's been in space.

"We float every day. Float to work, float back to sleep. It is awesome," she said.

Serena Auñón-Chancellor, KG5TMT, at work on the ISS. [NASA photo]

Scott Chapman, K4KDR, of Montpelier, Virginia, edited a clip of downlink chatter by the 42-year-old flight surgeon and flight engineer.

"During most passes of the ISS where I'm working with the packet digipeater on 145.825, I also monitor 145.800 just in case there is any activity on that frequency," Chapman said in a post to AMSAT-BB. "For the first time in my personal experience, today one of the astronauts was randomly calling to see if anybody was listening. It was a real thrill and, like so much of this hobby, a learning opportunity."

Rick Palm, K1CE, k1ce@arrl.org

Event Operating: Top 20 Training Tips and Techniques

In September, the Larkfield Amateur Radio Club (LARC) in Huntington, New York/Long Island, provided communication assistance for the 41st Northport Great Cow Harbor 10K/2K Run, one of the most prestigious foot races in the country. The 10K Run and 2K Fun Run/Walk are nonprofit events that support Special Olympics Long Island, the Veterans Administration, and local food pantries.

LARC members provided communications between the 10K/2K start positions, and for EMT/PD dispatch, bus transportation, race chairman shadow, course manager shadow, miles 1 – 5, pre-finish line spotter, and the10K/2K finish line. Additionally, there was a LARC operator equipped with a radio who ran the course as a race participant, and an EMT/Amateur Radio operator on a Northport FD vehicle that traveled the course.

A Net Control station with two radio operators was established to monitor and direct all communications, as well as to contact EMTs when needed. Scott Conover, AC2FV, Assistant EC for the Town of Huntington, reported that three medical incidents occurred during the event, and they were swiftly resolved.

Individual amateurs and clubs that support events like this raise the visibility and public perception of Amateur Radio, while garnering experience with event/incident operations and discipline that would be valuable during an emergency or disaster response. This month, we'll consider time-tested tips and techniques for operating events like the Great Cow Harbor foot race.

These tips come from Bruce Pigott, KC1US, a trustee of the Boston area's Minuteman Repeater Association (MMRA). One of the oldest repeater associations in eastern Massachusetts (and one of the first organizations I joined as a new ham in 1976), the MMRA is a nonprofit organization that provides communications infrastructure (22 repeaters) and volunteers for community event and emergency/disaster response communications.

Cow Harbor race participant and course runner Steve Hines, N2PQJ, makes his way past mile 2. [Scott Conover, AC2FV, photo]

Pigott has vast experience to draw from. Here are his 20 most important operating and technical tips for effective communicator best practices.[1]

20) Be concise. Each message should be brief and convey a single piece of information. A great example can be found on the Public Safety Land Mobile bands. Scan for the professional dispatchers and public safety units in the field on your VHF FM radio's extended range (138 – 174 MHz). Also, listen to the traffic on the aircraft communications frequencies, mostly between 118 to 137 MHz, using AM. The professional communicators' messages define brevity, reduced to the absolute minimum words necessary. Their transmissions last a mere 1 – 4 seconds. Emulate them.

Also, save time and promote efficiency by using tactical call signs. Each station identifies its location every time they transmit. Because FCC call signs are needed only every 10 minutes, and at the end of the contact, using the FCC call sign indicates to other stations that the exchange has ended.

19) Dress sharp. On communications assignments, you have to earn respect quickly. Many other volunteers and professionals are observing you and your actions. Dress like professionals in clean khakis and polo shirts, preferably embroidered with your association's name and logo.

[1]See **www.mmra.org/pubserv/index.html** for links to "A Few Hints for Public Service Participants," "Recommended Supplies and Equipment for Public Service Events," and "How Long Will My Battery Last?" by Bruce Pigott, KC1US.

Cortesia de Virgilio.

18) Use plain language. Q signals and Morse code prosigns are unnecessary on voice channels and reduce message integrity and comprehension.

17) Push to talk, wait to talk. All repeaters have built-in delays between transmissions. Some have more transmit delay than others, especially linked systems. Also, talk slowly. Net control and other stations are either out in the open, or in a room full of noise where it is difficult to hear. Wear headphones when appropriate.

Be ready for the eventuality of repeaters failing. The FM simplex mode can, and does, yield wide area, reliable communication links, and independent of other, more vulnerable assets. Test simplex paths prior to the event.

16) Stay calm. Shouting into the mic and not keeping the radio antenna vertical decreases readability. Shouting also ratchets up stress and anxiety in others.

15) Antennas: think long. Use a minimum of a quarter-wave antenna (at least 15 inches for 2 meters) on your handheld radio so you will be heard.

14) Lock mode. Place your radio in lock mode so your assigned channel does not get bumped or changed accidentally. You don't want to miss a critical message.

13) Label your gear. Because situations and sometimes locations change rapidly, keeping track of your gear is easier with labels.

12) Volunteer early. Check the public service list in local section news or club nets, and sign up early. Organizers can then make assignments and return event details to you in a timely manner.

11) Be patient. There will be a lot of waiting for events to happen. Use the waiting periods to get ready for when the peaks hit. Both net control and field operators will get busy with multiple activities.

10) Be aware. Always be assessing your operating environment for hazards while you are performing your communication tasks.

9) Take notes. You will forget the call of the ham you want to talk to later, or what broke on your radio (until the start of the next event).

8) Wear good socks. You will be on your feet for extended periods of time, so take a tip from hikers about supportive footwear and good socks.

7) Eat early. Once the walkers, runners, or cyclists start coming through your checkpoint, the interruptions will be continuous.

6) Be flexible. You will be called on to perform multiple tasks, not limited to your radio.

5) Be specific. If you have limitations on time, transportation, or personal responsibilities or capabilities, include that important information on your sign-up data sheet. Do not wait until you receive your assignment to let your aid station supervisor know. Assignments would then have to be juggled, causing confusion and inefficiency.

4) Take it off your belt. Leaving your handheld transceiver next to your body will cause up to a 15 dB loss in output. Your 2 W are reduced to only 1/16 W.

3) Turn the volume down. The person you are shadowing does not need radio chatter blasting in his or her ear all day long. You should be a filter, so the coordinator can do their job effectively.

2) Carry spares. Carry spares and tools that are appropriate, and that you know how to use.

1) Make a list. Keep a short checklist of equipment needed for the event or incident at hand. This will be a subset of the items in a full ARES go-kit. Update it based on event experience.

Efficiency should be the goal of the day. Keep these tips in mind for safety and success, do your best, and have fun.

Strays

QST Congratulates...

Renner Middle School eighth grader Katherine Forson, KT5KMF, of Plano, Texas, who received the second-place prize in the Physics and Astronomy category, Junior Division, at the 2018 Texas Science and Engineering Fair in San Antonio. Her project was titled "Radio Time" and explored how time of day affects signal propagation on the 20- and 40-meter bands.

Katherine won first place, Junior Division, at the Plano District Science Fair, and then second place along with a special award from the McKinney (Texas) Amateur Radio Club at the Dallas Regional Science and Engineering Fair, which qualified her for state competition. As a result of her second-place finish, she was invited to participate in the Broadcom MASTERS national middle school STEM competition.

Cortesia de Virgilio.

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

Classic Radio

The Pierson-Holt KE-93 Mobile Receiver

The Pierson-Holt KE-93 was a novel receiver aimed at mobile operation, but able to hold its own against many large ham band-only receivers of its era (see the lead photo). It was quite stable, but did not have a product detector or AGC for SSB or CW. The receiver covered the AM broadcast band (so it could substitute for an AM car radio); 160 meters; the low-frequency ship-to-shore band; and the 80-, 40-, 20-, 15-, and 10-meter bands. It covered ship-to-shore frequencies to facilitate its use in boats in the days before small pleasure boats used VHF/FM radios for marine communication. The die-cast front panel gave the receiver a rich look and feel. The receiver was small, but felt very solid. It measured a bit over 5 inches high, 6 inches wide, and about 9 inches deep (not including the knobs).

The radio did not have a built-in power supply, but Pierson-Holt offered an ac power supply with a large S-meter and a station speaker built into a second box the size of the basic receiver (see Figure 1). A vibrator dc power supply was also offered because the KE-93 was built before transistor dc power supplies were commonly available. The unit needed about 225 V dc at 85 mA for high voltage, and 6 or 12 V dc or ac for tube filaments. The mobile supply could be set up for 6 or 12 V dc operation by means of jumper plugs. Internally, the receiver had a ballast regulator for the filament of the 3CB6 local oscillator; it made a source of 300 mA regulated at 3.15 V ac or dc for the local oscillator tube filament power.

The KE-93's Unique Feature

The KE-93 receiver featured some interesting surprises inside (see Figure 2). Its design was unique in that it used a Standard Kollsman TV tuner modified and adapted to serve as the front end of a ham receiver. The tuner had the RF amplifier on all bands, a mixer/local oscillator, and the first conversion and first IF for all ham bands except 160 meters. In its basic form, the KE-93 also covered the AM broadcast band in addition to the 160-, 80-, 40-, 20-, 15-, and 10-meter bands. Other than the tuning air variable capacitor, the tuning components were all mounted on the channel strips in the tuning drum of the modified TV tuner. This made for a mechanically stable structure for the front end of the receiver, and also made it fairly easy to add coverage for any special bands in the HF or VHF spectrum, as only seven bands or tuner strips were consumed covering the bands. The tuner had places for 13 separate channel strips, giving special versions of the receiver the capability of added special narrow bands.

In TV service, the tuner originally used only two tubes — an RF amplifier stage, and a triode-pentode used as a local oscillator (the triode) and mixer (the pentode). As modified for use in the KE-93, three tubes were used in these functions — a 6BZ6 pentode as the RF amplifier stage, a 6BE6 heptode as a mixer, and a 3CB6 pentode as a local oscillator — along with an electronically regulated filament current supply to reduce frequency drift. The filament current regulator ballast was a type 7HTF3 ballast tube. This assembly also included a heptode as a local oscillator/mixer with an input of 2.2 MHz and an output of 265 kHz to make the receiver dual conversion. It used a 2.465 MHz crystal to make a local oscillator for the conversion. This stage was bypassed by a group of microswitches activated by the bandswitch when switching between the AM broadcast band or 160 meters and any of the ham bands.

The 7HTF3 filament current regulator tube may be hard to find now, but was probably not commonly available even when the KE-93 was new. The receiver I own has been modified without any permanent changes to eliminate the ballast tube, and I haven't noticed any difference in stability. When using the radio in a home location on ac power or with a modern car with an alternator to charge the battery, there is probably no actual benefit from the ballast regulator.

Figure 1 — The KE-93 and its optional power pack, featuring an S-meter and built-in station speaker.

Conversion Scheme

The receiver was a dual-conversion design on all ham bands except 160 meters, with a first IF of 2.2 MHz and a second IF of 265 kHz. This gave very good image rejection even at 10 meters, as the image frequency was spaced 4.4 MHz away by the 2.2 MHz first IF. The use of a 265 kHz second IF gave better selectivity than would be achieved with a more conventional second IF of 455 kHz without the use of a mechanical or crystal lattice filter.

For broadcast reception from 540 – 1,600 kHz, 160 meters, and the ship-to-shore band between 160 and 80 meters, the receiver switched to single-conversion design. This was because conventional tuning capacitors and circuit design could not tune the entire broadcast band or 1,650 – 3,500 kHz with a first IF as high as 2.2 MHz. This would require the local oscillator for the AM broadcast band to cover 2.740 – 3.8 MHz while the RF amplifier circuits tuned 0.540 – 1.6 MHz for the AM broadcast band — a difficult thing to do with any conventional two- or three-section tuning capacitor.

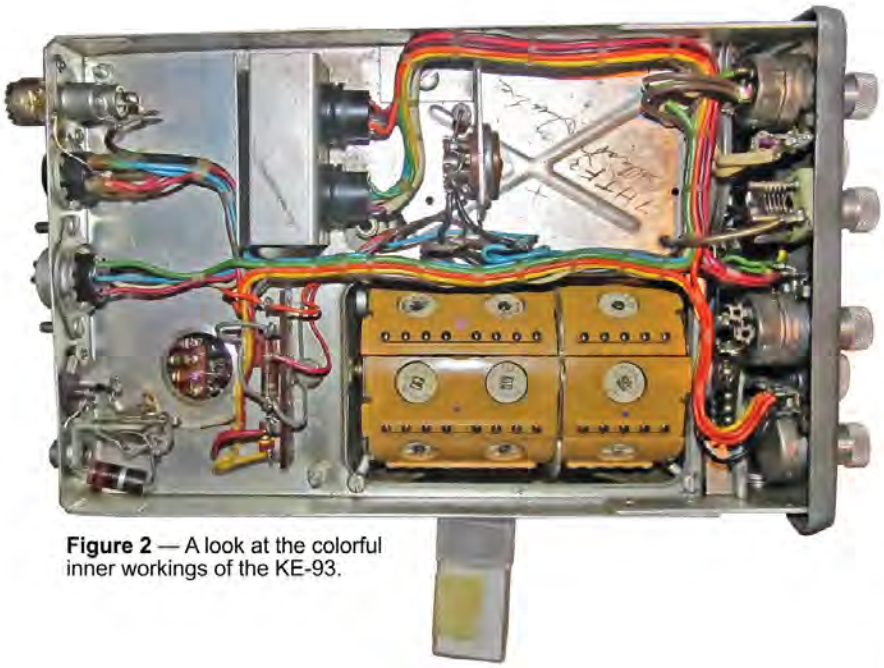


Figure 2 — A look at the colorful inner workings of the KE-93.

The ham bands are narrow in terms of frequency range, especially as a percent of center frequency when compared to the AM broadcast band or the KE-93's coverage for 160 meters. The KE-93 used a group of microswitches operated by the band switch to switch the Pierson-Holt KE-93 to single conversion on the AM broadcast band and 160 meters, and double conversion on all other ham bands. This was an innovative solution to a significant problem.

Dropping Holt

The Pierson-Holt KE-93 was originally manufactured by Pierson-Holt of Venice, California, who earlier built the PR-15, PR-16, and KP-81 receivers. The KE-93 was later manufactured by Automation Electronics, Inc., of Burbank, California. What happened to Holt is a mystery. The die-cast front of the receiver on some versions said "Pierson-Holt" right below the dial on the hood. Later versions said "Pierson KE-93" in the same place. I have a promotional piece of literature printed by Pierson-Holt which called the company Pierson-Holt. However, the copy of the receiver's manual I have only mentions Pierson, and the manufacturing company is identified as Automation Electronics, Inc.

With or without Holt, the Pierson KE-93 was a very good mobile receiver. It featured a clever solution to convert from single conversion to dual conversion and utilized a unique design element in its adapted TV tuner front end. The only issue was the use of a 7HTF3 ballast tube to current regulate the local oscillator filament voltage and current in mobile service, where the applied filament voltage could vary with loads and road speeds of the host automobile. Fortunately, doing without the ballast tube does not impact performance as far as I can tell. All in all, it was a unique and desirable little receiver.

All photos courtesy of the author.

Cortesia de Virgilio.

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Contest Corral December 2018

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

Start - Finish Date-Time		Date-Time		Bands	Contest Name	Mode	Exchange	Sponsor's Website
Nov 30	2200	2	1600	1.8	ARRL 160-Meter Contest	CW	W/VE: RST, section; DX: RST	www.arrl.org/160-meter
1	0600	1	0800	7-14	Wake-Up! QRP Sprint	CW	RST, serial, suffix of previous QSO	qrp.ru/contest/wakeup/333-wakeup-eng
1	1600	2	1559	3.5-28	TOPS Activity Contest	CW	RST, serial, club abbreviation (if any)	procwclub.ro/TAC%20Rules.html
1	2000	2	1959	3.5-28	EPC Ukraine DX Contest	Dig	RSQ, Ukr Admin Region or serial	vinradio.ho.ua/page184.html
2	0000	2	2359	28	Ten-Meter RTTY Contest	Dig	RST, SP or serial	www.rttycontesting.com
4	0200	4	0400	3.5-28	ARS Spartan Sprint	CW	RST, SPC, power	arsqrp.blogspot.com
6	0000	6	0300	1.8	QRP ARCI Topband Sprint	CW Ph	RST, SPC, mbr or power	www.qrparci.org/contests
6	1800	6	2200	28	NRAU 10-Meter Activity Contest	CW Ph Dig	RS(T), 6-char grid square	www.nrau.net/activity-contests
6	2000	6	2200	1.8-28	SKCC Sprint Europe	CW	RST, SPC, name, mbr or power	www.skccgroup.com
8	0000	9	2359	28	ARRL 10-Meter Contest	CW Ph	RST, state/province (DX: serial)	www.arrl.org/10-meter
8	0000	10	2359	1.8-7	PODXS 070 Club Triple Play Low Band Sprint	Dig	RST, SPC	www.podxs070.com
8	1200	9	2359	1.8-50	SKCC Weekend Sprintathon	CW	RST, SPC, name, mbr or "none"	www.skccgroup.com
8	1600	9	1559	3.5-28	International Naval Contest	CW Ph	RS(T), mbr or serial	www.marinefunker.de
9	2000	9	2300	1.8-28	QRP ARCI Holiday Spirits Homebrew Sprint	CW	RST, SPC, mbr or power	www.qrparci.org
9	2100	9	2259	14	CQC Great Colorado Snowshoe Run	CW	RST, SPC	www.coloradoqrpclub.org
10	0100	10	0300	1.8-28	4 States QRP Group Second Sunday Sprint	CW Ph	RS(T), SPC, mbr or power	www.4sqrp.com
12	0130	12	0330	3.5-14	NAQCC CW Sprint	CW	RST, SPC, mbr or power	naqcc.info
14	1400	14	1759	1.8-7	UN DIGI Contest	Dig	RST, serial	kfrr.kz
14	2000	14	2359	1.8	Russian 160-Meter Contest	CW Ph	RS(T), Oblast code or serial	www.qrz.ru/contest
15	0000	15	2359	1.8-50	Feld Hell Sprint	Dig	RST, mbr, SPC, grid	sites.google.com/site/feldhellclub
15	0000	15	2359	3.5-28	OK DX RTTY Contest	Dig	RST, CQ Zone	okrtty.crk.cz/index.php?page=english
15	1400	16	1400	1.8-28	Croatian CW Contest	CW	RST, serial	9acw.org
16	1800	16	2359	3.5-50	ARRL Rookie Roundup, CW	CW	Name, 2-digit year first licensed, SPC	www.arrl.org/rookie-roundup
17	0200	17	0400	1.8-28	Run for the Bacon QRP Contest	CW	RST, SPC, mbr or power	qrpcontest.com/pigrun
19	0130	19	0330	3.5-14	NAQCC CW Sprint	CW	RST, SPC, mbr or power	naqcc.info
21	1600	21	1700	3.5-7	AGB-Party Contest	CW Ph Dig	RST, serial, mbr (if any)	www.ev5agb.com
23	0000	23	1159	3.5-28	RAEM Contest	CW	Serial, latitude, longitude	raem.srr.ru/er/main
26	0000	26	0200	1.8-28	SKCC Sprint	CW	RST, SPC, name, mbr or power	www.skccgroup.com
26	0830	26	1059	3.5-7	DARC Christmas Contest	CW Ph	RS(T), DOK or serial	www.darc.de
29	0000	29	2359	1.8-144	RAC Winter Contest	CW Ph	RS(T), province/territory or serial	wp.rac.ca/rac-canada-winter-contest-rules
29	1500	30	1500	1.8	Stew Perry Topband Challenge	CW	4-char grid square	www.kkn.net/stew
29	1500	30	1500	3.5-14	Original QRP Contest	CW	RST, serial, power category	www.qrpcc.de
31	0900	31	2359	3.5-7	Bogor Old and New Contest	Ph	RS, operator age	www.orari-bogor.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.*

Cortesia de Virgilio.

2018 ARRL Field Day Results

More than 35,000 participants amassed over 1.18 million contacts at this year's Field Day event.

Bart Jahnke, W9JJ
ARRL Contest Branch Manager

Every year, during the fourth full weekend in June, the bands light up with stations calling "CQ Field Day." Now in its 85th year, ARRL's most popular event was last held from June 23 – 24, 2018, with reports from nearly 3,000 groups heralding the largest Amateur Radio social event in North America.

In 2018, more than 35,250 participants were reported by entries from local clubs and individual portable, mobile, and home stations. Several of the portable stations braved the elements of heat and rain, as well as difficult terrain like hills and valleys, turning in respectable contact totals while practicing for a day when their portable stations may be needed after an emergency or disaster. Several groups also reported that their social and direct media efforts paid off, with visits from served agencies and municipal, state, and government officials.

This year's Field Day participants amassed over 1.18 million contacts. Overall attendance was down about 6%, and overall QSO totals down about 9% compared to 2017. These are respectable numbers, considering the lowness of the sunspot cycle and the inclement weather in some areas.

Top Ten Claimed Scores

Call Sign	Score	Class
W3AO	33,942	15A
W4EZ	21,645	9AB
K6EI	19,720	14AB
W4IY	16,988	9A
K4BFT	16,946	4A
K2AA	15,964	7A
W1NVT	14,732	2A
K4JJ	14,562	3A
N4FR	14,290	5F
W1LY	13,928	2A

The Lamorinda Amateur Radio Interest Group, K6ORI, was well represented on ARRL Field Day in 2018. In the back row, from left to right: Ginny Merrifield, KM6QYC; Sandi Gritzer, KK6FTA; Scott Anderson, KW6SA; Alan Wong, KK6WA; Jeff Peacock, KM6NQX, and Eric Dausman, KD7DNM. In the middle row, from left to right: Gene Gottfried, KQ6OL; Dan Lamey, KD6DTL; Keith Riley, K6KWR; Carol Bergren, KJ6MYA; Salahuddin Kamran, K2KK; Jack King, KK6TZL; Mary Solon, KD6MKS, and Todd Gritzer, KK6FSZ. In the front row from left to right: Elizabeth Dausman, KD7PFH, and Patti Young, KE6TJY. [Lamorinda Amateur Radio Interest Group, K6ORI, photo]

Activity by Class

Class A — The most popular operating category, these are Club or Non-Club groups of three or more people who set up a temporary/portable Field Day site away from their usual stations or locations: 1,253 entries (43.2%)

Class B — These are the temporary/portable Club or Non-Club groups of one or two people who set up their Field Day sites away from their usual stations or locations: 352 (12.1%)

Class C — These are the mobile or rover operators from vehicles, and sometimes even bicyclists or hikers that covered miles with an HF/VHF backpack station: 45 (1.6%)

Class D/Class E — Stations operating from home, either with commercial power (Class D) or emergency power (Class E): 1,067 (36.7%)

Class F — Stations operating from or as EOCs: 186 (6.4%)

Checklogs — 22 checklogs were acknowledged (see the list at the bottom of the logs received page at **www.arrl.org/logs-received**).

Geographical Participation and Looking Forward

While contacts are the main draw in this event, tracking how many ARRL Sections and/or DX stations were worked during ARRL Field Day is always exciting for new hams and for sharing with curious visitors. For

2018 Field Day Overall Statistics

Number of Participants:	35,264
Total Entries:	2,903
Checklogs:	22
CW QSOs:	501,223
Digital QSOs:	56,532
Phone QSOs:	622,351
Total QSOs:	1,180,106

Entries by ARRL RAC Section/Prefix

Section	Entries	Section	Entries	Section	Entries	Section	Entries
AZ	63	LA	24	NV	20	SNJ	25
AB	18	LAX	48	NWT	1	STX	70
AK	7	MAR	10	OH	138	SV	48
AL	47	MB	4	OK	29	TN	61
AR	24	MDC	50	ONE	22	UT	31
BC	35	ME	25	ONN	5	VA	101
CO	65	MI	95	ONS	31	VI	2
CT	44	MN	45	OR	39	VT	10
DE	12	MO	56	ORG	52	WCF	32
EB	16	MS	26	PAC	3	WI	56
EMA	38	MT	14	PR	5	WMA	18
ENY	40	NC	74	QC	25	WNY	52
EPA	96	ND	11	RI	13	WPA	42
EWA	24	NE	14	SB	16	WTX	11
GA	59	NFL	56	SC	34	WV	24
GTA	17	NH	31	SCV	40	WWA	73
IA	25	NL	3	SD	12	WY	5
ID	25	NLI	31	SDG	22	DX: CE2 — Chile	1
IL	88	NM	27	SF	13	DX: JA — Japan	2
IN	70	NNJ	39	SFL	31	DX: OK1 — Czech Republic	1
KS	28	NNY	9	SJV	32		
KY	39	NTX	79	SK	4		

Transmitter Count by Class

1A	92	14AB	1	3D	7
2A	282	1AC	18	4D	2
3A	304	2AC	37	5D	1
4A	125	3AC	30	1E	149
5A	68	4AC	16	2E	32
6A	32	5AC	6	3E	20
7A	19	7AC	1	4E	7
8A	8	8AC	1	5E	1
9A	4	1B1	53	7E	1
10A	5	1B1B	191	1EB	199
11A	3	2B1B	4	2EB	7
13A	1	1B1C	16	3EB	3
15A	1	1B2	15	1F	32
20A	1	2B2	7	2F	72
1AB	58	1B2B	39	3F	38
2AB	56	2B2B	18	4F	24
3AB	51	1B2C	6	5F	11
4AB	17	2B2C	3	6F	5
5AB	11	1C	43	7F	2
6AB	2	2C	2	8F	1
7AB	1	1D	616	12F	1
9AB	2	2D	22		

Transmitter Count by Class

Class	Class Definition
A	3 or more person club/non-club portable using emergency power
AB	Per above, with battery or alternate non-generator power source
AC	Per above, but with commercial power
B1	1 person club/non-club portable using emergency power
B1B	1 person per above, with battery or alternate non-generator power source
B1C	1 person per above, but with commercial power
B2	2 person club/non-club portable using emergency power
B2B	2 persons per above, with battery or alternate non-generator power source
B2C	2 persons per above, but with commercial power
C	Mobile stations
D	Home stations using commercial power
E	Home stations using emergency power
F	EOC stations

Count by Class Summary

Class	Entries	Class	Entries	Class	Entries
A	945	B1B	195	C	45
AB	199	B1C	16	D	648
AC	109	B2	22	E	419
B1	53	B2B	57	F	186
		B2C	9		

ARRL Field Day 2018, participants submitted entries from all 83 ARRL/RAC sections, as well as from Chile, the Czech Republic, and Japan.

As far as future ARRL Field Days are concerned, in a world with cell phones and the internet, Amateur Radio is now one of many technologies attracting participants. Aside from assisting after disasters or emergencies — where Amateur Radio may be one of a handful of potential life lines to the world — it is only through in-person demonstration, mentoring, outreach, and publicity that we hope to grow interest in our exciting hobby. Field Day brings focused ham radio education to participants when and where they're most interested.

If you are not already doing so, be sure to share your Field Day experiences with the public (including social media like Facebook, Twitter, and Instagram) to earn a Field Day 100-point bonus. Then share your posts on ARRL's Facebook Page (the 2018 Field Day page can be found at **https://www.facebook.com/groups/fd2018**). Post any community proclamations you received by mail, and for in-person deliveries, don't forget to ask for a photo.

Check out some of the great ARRL Field Day 2018 videos on YouTube at **https://www.youtube.com/results?search_query=ARRL+Field+Day+2018**. Scroll down to see what some individuals, clubs, and groups of clubs were doing to generate excitement.

ARRL Field Day often brings with it an audience of licensed hams and inquisitive visitors. Many groups this year sought out the Educational Activity Bonus. While short training programs were the most popular, some groups offered license classes, license exams, antenna building, coax cutting, installation of connectors, and station accessory assembly and testing. Visit **www.themtnear.com/2018/07/ned-hams-join-national-field-day** to see some examples of youth involvement in Amateur Radio. First Aid and AED training was reported to again be very popular. The Safety Officer bonus is also now a must-have in most group efforts, as a pound of effort brings a ton of rewards in keeping Field Day safe.

Looking ahead to ARRL Field Day 2019, groups are already reserving their public sites; setting goals for their stations, bands, modes, activities, and bonuses; making plans and assigning tasks within their group, and preparing for the day they may be called upon to utilize Amateur Radio in an emergency. Field Day is an annual way to demonstrate our readiness and keep in practice for such occasions. We hope to see you or your group on the air next year, from June 22 – 23, 2019!

Cortesia de Virgilio.

Scores

Score listings are grouped according to the number of transmitters in simultaneous operation and their entry class. The listings show club or group name, call sign(s) used, total number of QSOs, number indicating power output used (5 is less than 5 W, 2 is less than 150 W, 1 is more than 150 W), number of participants, and total score including bonus points and ARRL Section. Entries are listed from highest to lowest claimed score in each class. Class A stations are clubs or groups portable with three or more participants. Class B stations are portables with one or two participants. When there are two operators, the other operator's call is listed in parentheses, if it was supplied. Class C stations are mobiles. Class D stations are home stations using commercial power. Class E stations are home stations using emergency power. Class F stations are EOC stations.

Three or More Person Club/Non-Club Portable

1A

GBoSH FD Gang					
W0FD	1,831	2	5	8,544	CO
Not Case ARC					
W3USA	1,557	2	3	7,222	OH
Blazing Paddles FD Team					
AB9YC	1,516	2	5	7,168	IL
Jessamine Amateur Wrls Soc.					
K4HH	1,474	2	3	7,046	KY
Lafayette DX Assn.					
W9LDX	1,609	2	11	6,104	IN
Batesville ARC & Brock Mtn Contest Grp					
K5UZ	1,100	2	5	5,620	AR
Boomer Contest Club					
K5PX	1,272	2	5	5,338	OK
WWDXC					
N7QT	1,160	2	3	5,272	EWA
Del Mar CERT					
W6DMR	1,148	2	4	5,266	SDG
Federation of AR Operators					
K9ZA	1,228	2	3	5,162	IL
Bedlington Terrier ARC					
WA7NB	1,647	2	3	4,820	AZ
Jelm Mtn WY					
W7C	1,056	2	3	4,774	WY
Berwick Contest Team					
WQ3N	1,451	2	4	4,770	EPA
K6AKW	932	2	4	4,444	SB
West Island ARC					
VE2CWI	932	2	25	4,324	QC
Murphys Law FD Grp					
K5QY	1,141	2	6	4,242	NTX
Dr. Loomis Memorial Junior Mechanics Lge					
W3KDR	1,262	2	11	4,066	MDC
Jupiter Tequesta Rptr Grp					
W4J	1,143	2	50	3,756	SFL
Belews Cove Minions					
N4CWZ	981	2	3	3,536	NC
Page Valley ARC					
K4PMH	966	2	16	3,478	VA
Philips ARC					
W1HP	736	2	10	3,426	EMA
Benton ARS					
K5NE	889	2	16	3,070	AR
Motor City RC					
W8MRM	672	2	25	3,046	MI
New England Radio Discussion Soc.					
N1QX	518	2	14	2,928	ME
Athens Co. ARA					
W8PG	561	2	9	2,892	OH
W0G	1,052	2	4	2,874	MN
Union Metropolitaine des Sans-filistes de Montreal					
VE2UMS	752	2	50	2,750	QC
KD0VHD	664	2	4	2,706	CO
Radio Artisans					
K3NG	551	2	3	2,438	EPA
Montgomery EMA ARC					
N4MGM	500	2	4	2,350	AL
Marshall Co. ARC					
W0GCJ	535	2	8	2,348	KS
N0E (+KD0ZSA)	330	2	39	2,190	MN
Bass Hill Rptr Grp					
W1KX	456	2	7	2,160	ME
Flying Beers Grp					
WY8W	557	2	4	2,158	MI
First State ARC					
K3F	426	2	14	2,156	DE
South Georgian Bay ARC					
VE3SGB	510	2	20	2,096	ONS
RC of Redmond					
N7KE	533	2	5	2,044	EWA
Sam Houston ARK					
AI5M	402	2	20	2,034	STX
Halton ARC					
VE3OD	306	2	7	1,960	GTA
Jefferson Cty ARC & Ancient Modulators					
KB0TLL (+K0AMC)	791	2	22	1,952	MO
The Three Amigos					
KI8R	393	2	8	1,930	OH
Middle Peninsula ARC					
W4HZL	369	2	40	1,896	VA
Breakfast Club					
N6VSS	936	1	3	1,776	EB
Verde Valley ARA					
W7EI	483	2	50	1,772	AZ
Newton ARA					
W0WML	133	2	4	1,760	IA
Fulton ARC & Oswego Co. RACES					
W2CXV	378	2	18	1,730	WNY
Vermilion Range ARC					
K0VRC	261	2	12	1,728	MN
SW MS ARC					
W5WQ	177	2	12	1,726	MS
Motorola ARC					
K9MOT	385	2	7	1,724	WI
The Villages ARC					
K4VRC	864	1	24	1,687	NFL
N0SFF	601	2	10	1,592	IA
Juneau ARC					
KL7JRC	212	2	44	1,542	AK
Club Radio Amateur Laval-Laurentides					
VE2CRL	266	2	22	1,512	QC
North Valley					
W5WHN	128	2	3	1,462	NM
N0FH	82	2	30	1,454	CO
NHRC ARS					
W1CUM	543	2	7	1,436	NH
VE2RMP Radio Grpe					
VE2CUR (+VE2LJV)	583	2	12	1,428	QC
N4SBA	320	2	12	1,410	SC
Keg of Beer Grp					
N7KEG	414	2	12	1,400	AZ
SEMO ARC					
W0QMF	647	1	11	1,397	MO
SCAN & Red Ant Anihillators					
KR6AL	500	2	5	1,350	LAX
Montreal ARC					
VE2ARC	228	2	25	1,334	QC
K3UA	323	2	3	1,328	WPA
North Okanagan Radio Amateur Club					
VE7NOR	237	2	23	1,328	BC
Churchill ARS					
KC7ARS	276	2	4	1,302	NV
PARMA RC					
W8PRC	244	2	29	1,262	OH
VE6NQ	183	2	12	1,256	AB
Point Roberts ARC					
KG7PR	137	2	5	1,246	WWA
Matanuska ARA					
KL7JFU (+KL2IE)	24	2	40	1,218	AK
NC Rptr Assn.					
NC4TX	370	2	3	1,210	NC
Greene Co. Virginia ARC					
K4BRW	145	2	7	1,160	VA
Why Gee ARG					
K2YG	234	2	5	1,126	NNJ
Suburban UHF ARS					
K9SA	231	2	15	1,114	IL
San Juan Co. ARS					
KE7KML	4	2	6	1,066	WWA
BSA Venturing Crew 80					
W3BSA	207	2	6	1,064	VA
KH6CE	497	1	83	1,047	PAC
AA4AG	165	2	5	1,040	VA
Kreuter Family FD					
KD8ZUY	435	2	4	1,020	WPA
Tidelands ARS					
K5BS	144	2	12	988	STX
Ocean State ARG					
K1OS	137	2	6	974	RI
West Kootenay ARC					
VE7CW	209	2	3	952	BC
Saguaro Nights ARC					
NS7F	109	2	3	928	AZ
Niagara RC					
W2QYV	233	2	12	922	WNY
Team Newbies					
N1XRR	333	2	5	916	SC
Lake Chelan Field Day					
W7CH	126	2	3	902	EWA
WA0TTS	123	2	3	900	MO
Garden School ARC					
K2GSG	19	2	25	888	NLI
DeKalb Co. ARC					
KK4ICU	156	2	26	882	AL
Amador Co. ARC					
K6ARC	151	2	13	862	SV
Motor City RC					
W8GTZ	139	2	15	856	MI
Novi ARC					
N8OVI	106	2	4	852	MI
Whitecourt AmRad					
VA6WCT	80	2	15	810	AB
Southern Piedmont ARC					
WD4NHW	113	2	4	802	GA
Renfrew Co. ARC					
VA3NRR	218	2	26	786	ONE
Cleb Radioamateur du Nord					
VE2CVN	243	2	8	760	QC
NASA Glenn ARC					
NA8SA	77	2	15	740	OH
Skyline RC					
K7BSK	207	2	12	728	UT
Aeronautical Center ARC					
W5PAA	19	2	3	726	OK
VE2CLM	127	2	7	718	QC
Mason-Dixon Signal Corp					
KB3DSR	172	2	6	714	EPA
Central Dakota ARC					
W0ZRT	131	2	40	712	ND
W7TT	152	2	4	710	EWA
LOWARS					
VE3JJF	49	2	5	706	ONN
Treaty City ARA					
W8UMD	227	2	4	704	OH
Prescott-Russel ARC					
VE3PRD	318	1	11	668	ONE
KQ7TJ	65	2	6	660	NV
Smokey Mountains AR Team					
N4GSM	151	2	8	652	NC
Three Rivers ARC					
W0BRN	38	2	6	646	MO
DeKalb Co. ARC - Plainview					
AB4RD	33	2	26	636	AL
Atchison Co. AR Svc					
KS0AT	63	2	7	618	KS
Notre Dame Radio Soc.					
ND1U	72	2	3	594	IN
Ether Busters					
W0KU	107	2	3	560	CO
Radio Activity					
K7UWR	2	2	3	558	GA
Northern MI ARES					
KC8NTE	32	2	3	548	MI
Newington ARL					
NA1RL	63	2	7	536	CT
KD8BB	189	2	3	528	IN
Pahrump AR Rptr Assn.					
W7NYK	72	2	19	522	NV
P&J RC					
N5HKA	135	2	3	520	CO
W2BAR	27	2	3	504	NLI
Santa Fe ARES					
W5SAF	20	2	20	490	NM
N0DR	111	2	3	472	SD
Indiana Co. ARC					
W3BMD	85	2	9	466	WPA
Cookin What They Catch					
WR3K	5	2	9	460	SDG
DCT ARC					
WA5DCT	85	2	3	454	NTX
K1KMO	36	2	3	422	LAX
Dow House Grp					
K1ARD	102	2	6	414	ME
Terrace ARC					
VE7RTK	49	2	6	360	BC
K5ARN	47	2	5	344	MS
Jims Farm Grp					
W0BJ	89	2	4	328	MO
Mercury Net					
AC7R	31	2	21	312	AZ
Sandia Vista ARC					
WV5X	76	2	3	302	NM
Halley & HF					
VA2LPQ	38	2	4	226	QC
Spalding Co. ARC					
K4CXS	12	2	6	174	GA
W1BCG	51	2	20	152	CT
San Joaquin Co. ARES/RACES					
W6MSU	1	2	3	54	SJV

1A – Battery

AA6FD	592	5	3	6,230	SV
Ridge Runners RC					
W6BX	514	5	4	5,790	SCV
Chews Ridge Gang					
K6MI	407	5	8	4,785	SCV
Northern OH QRP Club					
KS8M	442	5	6	4,670	OH
The Last dB Club					
WV0H	396	5	7	4,210	CO
New England QRP Grp					
K1DFT	359	5	4	3,890	ME
Hunt Co. Packet Club					
K5T	321	5	3	3,760	NTX
Rochester ARC – QRP					
W0LLN	163	5	10	2,380	MN
Oakville ARC					
VE3HB	256	5	7	2,295	GTA
Maritime Mobile Svc Ntwrk FD Grp					
K4EDX	56	5	5	1,910	NFL
Marconi ARC of Newfoundland					
VO1MRC	86	5	4	1,805	NL
Alberta Clippers					
VE6EX	139	5	5	1,735	AB
Auburn University ARC					
K4RY (+KA4KBX)	75	5	8	1,445	AL
Club Radio Amateur de St-Hyacinthe					
VE2CAM	85	5	5	1,185	QC

1A – Commercial

Alpena High School RC					
W5AHS	603	2	5	1,770	AR
Cedar Grove ARC					
WW2G	1,102	1	3	1,498	ENY
VA4PAR	572	2	15	1,494	MB
Bullitt ARS					
KY4KY	139	2	32	1,208	KY
The DIRTS					
K5HO	250	2	3	1,140	NC
Manitoulin ARC					
VE3RMI	631	1	5	981	ONN
Jim Moyer					
WA3WIJ	104	2	4	658	EPA
W0NED	78	2	28	658	CO
Grpe Radio Amateur de Sherbrooke					
VE2KIT	131	2	9	626	QC
NE OH ARC					
K8NEO	139	2	3	528	OH
W AL ARC					
KC4UG	125	2	18	500	AL
N7ORM	124	2	3	468	ID
The Harris Herd & Fletcher Family					
N5VDQ	87	2	8	400	NTX
GREAT Club					
AK4I	170	2	3	392	TN
W4GWD	14	2	28	378	SC
Westside ARC					
W5ABD	32	2	6	314	LA
Fellsmere AR Team					
K4FRT	38	2	3	134	SFL
VE3THN	8	2	3	66	ONN

2A

Radio Amateurs of Northern VT					
W1NVT (+W1PU)	4,615	2	24	14,732	VT
Newport Co. RC Sakonnet 49ers					
W1LY (+W1SYE)	3,817	2	76	13,928	RI
Kansas City Contest Club					
KS0MO (+KC0MO)	2,980	2	11	12,480	KS
Tampa ARC					
N4TP	3,762	2	35	11,972	WCF
Riner FD Grp					
N9NB (+KN4FEB)	3,149	2	7	10,998	VA
Northern OH DXA					
W8DXA	2,546	2	20	9,106	OH

Blue Lake Brothers
N0AT (+K0AUG)
2,095 2 21 9,084 MN
MM Expeditionary Force
N9AU 2,312 2 7 8,924 WI
Salt City DXA
W2ZC (+W2AXR)
2,271 2 12 8,758 WNY
Williamson Co. ARC
N5TT (+N5T)
2,039 2 80 8,320 STX
McHenry Co. Wrls Assn.
K9RN (+KD9M)
2,187 2 21 8,272 IL
Muskogee ARC
K5CM (+K5I)
2,071 2 8 8,240 OK
Falmouth ARA
K1RK (+W1NOB)
2,137 2 59 7,772 EMA
Williamsburg Area ARC
K4RC (+AI4WU)
1,989 2 52 7,292 VA
Albany ARA
K2CT 1,885 2 42 6,984 ENY
Big Bend ARC
K5FD (+W5RSH)
1,767 2 26 6,888 WTX
NA9U Grp
NA9U (+KC9TEW)
1,875 2 16 6,648 IN
K4SV (+W4EEY)
1,765 2 25 6,606 SC
Stamford ARA
W1EE (+K1FC)
1,972 2 29 6,588 CT
St. Louis ARC
K0LIR 1,787 2 17 6,582 MO
BARK
K7CMT (+WA7ODR)
1,752 2 9 6,554 MT
Hattiesburg & Lamar ARC
K5PN (+W5CJR)
1,665 2 64 6,498 MS
Kings Co. & Annapolis Valley ARCs
VE1LD (+VA1AVR)
1,892 2 15 6,448 MAR
Bonac ARC
K2EC 1,827 2 13 6,412 NLI
Cape Fear ARS
K4MN (+K4CFB)
1,582 2 25 6,408 NC
N6MI 1,727 2 4 6,302 SJV
Metro DX Club
W9TY 1,484 2 12 5,782 IL
Murphy's Marauders
N1MM 1,672 2 6 5,510 CT
Berger's Bandits
K3II 1,387 2 5 5,466 EPA
Central OR DX Club
N7LE (+N7XU)
1,380 2 16 5,382 OR
Ft. Madison ARC
WF0RT (+NF5B)
1,339 2 31 5,336 IA
CTRI Contest Grp
KE1S (+W1DX)
1,492 2 20 5,330 RI
Explorer Post 599
WA2DFI (+W7BSA)
1,472 2 22 5,186 AZ
Montrose ARC
K0IIT (+KC0QXX)
1,096 2 24 5,090 CO
Susquehanna Valley ARC
W3VPJ (+KD3MC)
1,170 2 15 4,842 EPA
Franklin Co. ARC
AC1L (+KB1MSU)
1,050 2 27 4,720 WMA
Escondido ARS
N6SD (+N6WB)
1,017 2 50 4,682 SDG
Palatine ARES/RACES/AuxComm
W9P (+WX9PAL)
1,191 2 35 4,624 IL
Nashoba Valley ARC
N1NC 1,128 2 30 4,562 EMA
N1KW 1,314 2 4 4,544 IL
Mid-MO ARC
N0SS 982 2 40 4,456 MO
Tri Co. ARC
W9MQB (+KD9BDL)
918 2 13 4,432 WI
W/K ARC of Greater Milwaukee
N9AW 763 2 10 4,306 WI
Palos Verdes ARC
K6PV 1,094 2 23 4,288 LAX
New Providence ARC
N2XJ (+W2FMI)
1,072 2 46 4,286 NNJ
Harris-Intersil ARC
K4HRS 845 2 15 4,190 SFL
Kankakee Area Radio Soc.
W9AZ (+N9FD)
1,264 2 12 4,176 IL
Minden ARA
N5RD 1,281 2 30 4,160 LA
UT DXA
K7UM 1,057 2 13 4,134 UT
Heart of Texas ARC
W5ZDN (+K5ZDN)
847 2 38 4,106 NTX
KC3ARC (+W3DOV)
1,053 2 20 4,100 DE
Ottawa Valley Mobile RC
VE3JW (+VE3RAM)
782 2 30 4,082 ONE
VE3ORF (+VE3KY)
1,105 2 30 4,008 ONE
NE LA ARC
W5EA 1,277 2 20 4,006 LA
Blossomland ARA
W8MAI (+W8KIT)
808 2 56 3,998 MI
Crawford ARS
W3MIE (+N3QQH)
928 2 25 3,930 WPA
IA Wrls AR Ntwrk
N0IWN 797 2 10 3,924 IA
ARC EmComm Svc
WB2QBP (+K2ARC)
1,153 2 16 3,884 NLI
IL Valley RA
K9AVE 972 2 5 3,852 IL
Scranton-Pocono AR Klub
K3CSG (+W3W)
741 2 20 3,840 EPA
Hanover Area Hamming Assn.
KF3M 1,152 2 13 3,822 EPA
W0MR (+K0AGF)
730 2 50 3,716 MN
Schaumburg ARC
N9RJV (+KD9HIL)
992 2 35 3,694 IL
Anderson RC
N4AW (+AJ4UK)
919 2 36 3,694 SC
Ski Country ARC
K0RV 862 2 35 3,682 CO
Raytown ARC
K0GQ (+K0H)
878 2 16 3,570 MO
AR Transmitting Soc. of Louisville
W4CN 644 2 9 3,536 KY
Morris RC & Hanover Twsp OEM
W2YD 678 2 31 3,532 NNJ
Souris Valley ARC
K0AJW 782 2 10 3,520 ND
MARCA
W7MOT 871 2 12 3,488 AZ
W9ATG (+N9TT)
701 2 39 3,420 IN
Jefferson Co. ARC
W7JCR 629 2 15 3,418 WWA
Ottawa ARC
VE3RC (+VE3SHQ)
737 2 40 3,376 ONE
Anaconda ARC
W7VNE 683 2 7 3,316 MT
Massillon ARC
W8NP 775 2 42 3,212 OH
Canton ARC
W8AL (+NX8J)
679 2 42 3,184 OH
Cacapon S at Cacapon State Park
N8ZR 746 2 3 3,176 WV
Low Country Contest Club
NU4SC 772 2 7 3,176 SC
Gallatin Ham RC
W7ED 797 2 43 3,152 MT
Martin Co. ARES/RACES & MCARA
WX4MC (+K4ZK)
662 2 45 3,124 SFL
Green Valley ARC
WE7GV 751 2 23 3,118 AZ
Pueblo West ARC
NA0PW (+KE0CCJ)
572 2 25 3,102 CO
Edgefield Co. ARC
WR4EC (+KR1Z)
570 2 15 3,098 SC
Littleton Area Radio Klub
K1EME (+KB1TEE)
480 2 19 3,048 NH
The Three Amigos
VE7SS 987 2 3 3,038 BC
PSRG & WSARC & Seattle ACS
W7ACS (+W7AW)
523 2 137 2,940 WWA
Story Co. ARC
W0YL (+W0YR)
675 2 29 2,922 IA
Charleston ARS
WA4USN 582 2 26 2,920 SC
DE Valley Radio Assn.
W2ZQ (+KB2SYB)
504 2 50 2,906 SNJ
Mississippi Valley ARA
W9MVA (+W9FCC)
813 2 9 2,886 WI
Peekskill & Cortlandt ARA
W2NYW 731 2 22 2,886 ENY
Samuel F Morse ARC
W6SFM 451 2 22 2,884 SV
Whitley Co. ARC
WC9AR (+KC9ANF)
560 2 29 2,860 IN
Glenn Valenta Memorial ARC
K0XTR 795 2 6 2,854 CO
Fox Cities ARC
W9ZL (+N9AOT)
561 2 20 2,826 WI
Club Radio Amateur de Quebec
VE2CQ (+VE2CDX)
468 2 64 2,820 QC
CRES ARC
W8ZPF 800 2 18 2,814 OH
Brandon ARS
K4TN (+KC4MMR)
537 2 36 2,780 WCF
Androscoggin ARC
K1A 678 2 15 2,718 ME
Goochland AR Team
N4MI (+N4HOK)
690 2 27 2,708 VA
McHenry Co. Gid Rats
W9VB 699 2 15 2,674 IL
LAFD ACS
N6ACS 732 2 20 2,658 LAX
EPCOM
VE7PCE (+VA7RPC)
735 2 15 2,640 BC
W5NC (+KE5IOV)
518 2 25 2,596 STX
Not Quite Workable Contest Club
K8NQW (+AA8BV)
602 2 4 2,584 OH
Parker Radio Assn.
K0PRA (+N2SRK)
650 2 25 2,570 CO
South Bay ARC
W6SBA 414 2 23 2,554 LAX
Port Lavaca ARC
W5KTC 342 2 6 2,478 STX
Sportsmans Paradise ARC
K4WAK 598 2 6 2,478 NFL
Bankhead ARC
K4K 567 2 8 2,470 AL
Baldwin Co. ARC
N4RT 394 2 12 2,456 AL
K5OUR (+KC5OUR)
336 2 69 2,442 NM
Decatur (AL) ARC
W4ATD (+KD4TGC)
596 2 30 2,440 AL
Butler Co. ARA
W8WRK 531 2 30 2,438 OH
Lenoir ARC & Caldwell ARES
N4LNR 606 2 11 2,362 NC
W9FEZ 472 2 8 2,354 IN
Hidden Valleys ARC & UW-Platteville ARC
KC9KQ (+W9UWP)
453 2 25 2,346 WI
Eastern Shore ARC
K4BW 437 2 20 2,316 VA
Hospital Disaster Support Comms Sys
W6PA (+WW6I)
453 2 36 2,312 ORG
East Greenbush ARA
W2RBJ 589 2 23 2,312 ENY
Garland ARC
K5QHD 441 2 65 2,292 NTX
Central OH Oprs Klub Extra Novice
W8FD 376 2 13 2,282 OH
Hiawatha Valley ARC
AA0RW 496 2 26 2,274 MN
Half Moon Bay ARC
WR6HMB 438 2 10 2,274 SCV
Kings Co. RC
KC2RC 757 2 20 2,270 NLI
NP2VI 504 2 14 2,262 VI
Maple Valley ARC
K7C 519 2 30 2,248 WWA
West Volusia ARS
WV4ARS 456 2 27 2,242 NFL
Santa Barbara ARC
K6TZ (+K6SBZ)
553 2 60 2,236 SB
Suncoast ARC
WA4T 297 2 23 2,228 WCF
W2LI 430 2 29 2,200 NNJ
Penn-Mar RC
W3MUM (+W3WEG)
882 2 29 2,184 EPA
W MI Rptr Assn.
W8GJX 259 2 14 2,172 MI
NEMRA
W5NEM 497 2 11 2,168 MS
Irvine Disaster Emerg Comms
N6IPD (+K6PB)
360 2 40 2,156 ORG
Paso Robles ARC
W6R (+N6KKS)
580 1 47 2,144 SB
W1PBR 268 2 11 2,134 ME
Hot Springs ARC
K0HS 398 2 6 2,132 SD
Emporia ARS
W0EMP 350 2 21 2,124 KS
Barrie ARC
VE3GCB 420 2 44 2,124 ONS
NW2C 415 2 12 2,116 NLI
Arizona ARC
W7IO 644 2 14 2,112 AZ
Sci-Tech ARS
W1OG (+NE1AR)
444 2 45 2,106 EMA
Coastside ARC
WA6TOW 352 2 11 2,094 SCV
The World RC
W3WRC 421 2 6 2,076 SV
South East Metro ARC
W0CGM 389 2 10 2,062 MN
Matagorda Co. ARC
W5WTM 364 2 45 2,060 STX
Delaware Lehigh ARC
W3OK (+WX3MAS)
462 2 30 2,052 EPA
Hambuds ARC
KK5E (+AF5M)
446 2 35 2,046 STX
Independent Radio Crew
K3ODX 523 2 4 2,038 EPA
Sunparlor ARC
VE3SPR 524 2 10 2,036 ONS
Pine State ARC
N1ME 611 2 24 2,024 ME
West Coast ARA
VE7VCC (+VE7EZC)
367 2 12 2,016 BC
W6CUS (+K6BRK)
460 2 15 2,010 EB
Sturdy Memorial Hosp ARC
W1SMH (+W1SMH)
389 2 15 2,004 EMA
LA Delta RC
KC5DR (+WA5WX)
395 2 45 1,982 LA
NN4SA 263 2 16 1,976 AL
Burlington ARC
VE3CJ 390 2 8 1,974 GTA
PALS Rptr Grp
KT9Y 800 2 10 1,970 IL
Warminster ARC
K3DN 499 2 30 1,954 EPA
Ham Assn. of Mesquite
WJ5J 469 2 7 1,952 NTX
Radio Soc. of OH
K8RSO (+KE8BQV)
603 2 5 1,934 WPA
M&M ARC
W8PIF 1,222 1 52 1,933 MI
Bearcat DX Club
W8BXG 688 2 12 1,914 OH
West Sound ARC
N7IG 191 2 38 1,902 WWA
Chicago Suburban Radio Assn.
W9SW (+W9CHI)
449 2 28 1,898 IL
Mora Open Rptr Assn.
KD0CI 212 2 21 1,894 MN
Stillwater ARA
W0JH (+KB0SCE)
342 2 20 1,886 MN
Tamiami ARC
W4AC (+W2XYZ)
371 1 13 1,868 WCF
N9VI (+N9BCP)
454 2 23 1,858 IN
Desert Sands Remote Ops Club
WA7VTM 539 2 3 1,854 NV
Sierra Blanca ARC
KR5NM 255 2 9 1,826 NM
Whatcom Co. EmComm Grp
W7ECG (+W7JIM)
194 2 66 1,820 WWA
Pamlico ARS
N4PRS (+AI4WL)
168 2 29 1,818 NC
K8EP 565 2 10 1,816 WV
W1DDD (+NA1Q)
194 2 56 1,804 RI
Woodchuck ARC
WA8Q 183 2 22 1,780 OH
San Jose ARES/RACES/ACS
W6SJC (+WW6G)
282 2 19 1,776 SCV
Kitsap Co. ARC
KC7Z 359 2 20 1,754 WWA
NAQCC Central TX Chapter
N5A 351 2 9 1,740 STX
W6KAT (+W6KAT)
185 2 20 1,734 LAX
Greenwood ARC
VE1ARC (+VE1WN)
214 2 35 1,728 MAR
K5O (+N5CST)
263 2 7 1,714 OK
North Franklin ARS
N2NNY (+KD2PUP)
336 2 16 1,712 NNY

Frederick ARC
K3ERM (+K3DO) 349 2 18 1,708 MDC
Winona ARC
W0NE 337 2 24 1,698 MN
Central Toronto ARC
VA3CTA 417 2 15 1,668 GTA
Huron ARA
W0NOZ 295 2 12 1,660 SD
South Lake Charles Ham Grp
KI5EE 431 2 4 1,646 LA
Chesapeake Bay Radio Assn.
WD3E 414 2 26 1,644 MDC
Marion Co. Ham RC
KG5HKK (+AG5AB) 145 2 15 1,640 MS
Siskiyou ARA
K6SIS 573 2 4 1,600 SV
Auburn Area EmComms Team
W7A 154 2 20 1,552 WWA
Mesilla Valley RC
N5TMT 178 2 9 1,550 NM
Apple City ARC
W7TD 467 2 39 1,536 EWA
Land of Lakes ARC LLC
K9HD 349 2 8 1,530 IN
Jupiter Lighthouse RC
N4J 163 2 12 1,526 SFL
Old Drum Wrls Grp
K0CIA 384 2 5 1,520 MO
Utica ARC
K2IQ 240 2 8 1,516 WNY
Great Salt Plains ARC
WB0ZWW 220 2 10 1,512 KS
Triangle ARC
K8BLP 286 2 4 1,502 OH
Lake Agassiz RC
N0LAC (+WX0ND) 153 2 10 1,494 ND
Los Alamos ARC
W5PDO 314 2 10 1,482 NM
W6UUS 218 2 27 1,476 SDG
Larkfield ARC
W2LRC 328 2 25 1,474 NLI
Team KI4ITI
KI4ITI 402 2 3 1,470 AL
YARS & MVRC & SARC & UCDARC & Yolo Co. ARES
W6YAR (+W6AK) 210 2 31 1,460 SV
Bryan ARC
W5BCS 202 2 63 1,456 STX
Sachse ARA
K5S 184 2 38 1,446 NTX
Bloomington ARC
K9DIY (+AC9ML) 135 2 44 1,444 IN
Parkersburg AR Klub
W8PAR 235 2 22 1,442 WV
Scott Co. ARC
KF5WNV 134 2 6 1,434 MS
Naturist ARC
NU5DE 581 2 4 1,412 STX
Nwe Mexico High Desert ARC
W5YZ 139 2 20 1,404 NM
N IL Quad Co. ARG
K9T 215 2 8 1,380 IL
Tupelo ARC
K5TUP 335 2 15 1,370 MS
The Chuckanuts
N7AN 283 2 5 1,368 WWA
3 Rivers AmRad
AE7VC 208 2 6 1,366 ID
Riverside Co. ARA
W6TJ 93 2 26 1,364 ORG
Lake Area AR Klub
K5LRK 105 2 14 1,360 NTX
K2FCR 209 2 6 1,358 ENY
Hualapai ARC
WB6RER 216 2 10 1,346 AZ
High Desert ARC
NM5HD 46 2 4 1,334 NM
Winnipeg ARC
VE4BB (+VE4CEM) 276 2 34 1,330 MB
Six Meter Club of Chicago
K9ONA 371 2 18 1,324 IL
Sierra Intermountian Emerg Radio Assn.
NV7CV 155 2 19 1,322 NV
Bitterroot ARC
W7FTX 279 2 8 1,318 MT
Ogden ARC
W7SU 405 2 20 1,312 UT
Jim Bell Wrls Assn.
K4TNS 106 2 4 1,312 AL
VE7NSR (+VE7EMR) 263 2 53 1,292 BC
Lakes Region Rptr Assn.
W1BST 270 2 4 1,290 NH
Mountain ARC
NX0G 241 2 4 1,286 CO
Alhambra High School ARC
K6R 112 2 3 1,274 LAX
Audvain EmComm
AA0RC 158 2 8 1,272 MO
KY4WC 201 2 24 1,272 KY
Hells Gate ARC
K7MM 59 2 3 1,262 EWA
Tri-Lakes ARC
KC0M 147 2 12 1,258 MO
Seaway Valley ARC
VE3VSW 218 2 6 1,248 ONE
West Palm Beach ARG
W4HAW 220 2 49 1,248 SFL
Camp Trouten
K9DJT 489 2 3 1,228 WI
Palouse Hills ARC
KD7PH (+KI7BSW) 101 2 13 1,192 ID
Columbia Co. (NY) ARES
KD2LIL 190 2 11 1,190 ENY
Pella ARC
W0IM 66 2 10 1,184 IA
Orrville ARS
KD8SQ 411 2 14 1,172 OH
Newport Beach Rptr Club
K6NBR 220 2 20 1,154 ORG
High Sierra FD Grp
W6PS 246 2 7 1,142 SV
Moose Pirates
W1IE 269 2 5 1,140 VA
W0W (+W0ZSJ) 321 2 8 1,132 SD
Red Oak Soc.
K2OAK 300 2 5 1,128 NNJ
Richmond Emergency Progams ARS
VA7RER 35 2 9 1,120 BC
Crescenta Valley RC & Glendale Emerg Aux Radio Serv
AD6IZ 182 2 18 1,120 LAX
Friendship ARC
N4FRC (+W1DOH) 111 2 12 1,116 NFL
Clark Co. WA ARES/RACES Team 3
N7BBX 114 2 9 1,110 WWA
Just Havin Fun Contesters
N8IW 302 2 4 1,106 OH
Stanly Co. ARC
K4OGB 14 2 16 1,092 NC
Elkhart ARC
AE9U 121 2 13 1,092 IN
Nanaimo ARA
VE7NA 157 2 20 1,086 BC
W3LP 261 2 4 1,086 EPA
Peconic ARC
W2AMC 303 2 25 1,076 NLI
Huntington Co. ARS
K9HC 185 2 12 1,070 IN
KA3PVM 179 2 3 1,066 MDC
Irving ARC
N5BB 124 2 17 1,066 NTX
Royal Gorge ARC
NC0A 148 2 6 1,040 CO
Bishop ARC
N6OV 80 2 8 1,032 ORG
Powhatan Area RC
N4POW 139 2 15 1,028 VA
N4EAR (+K8ONV) 132 2 12 1,014 WCF
Rich & Rons Field Day
KJ6HRO 187 2 8 1,000 SV
Club Radio Amateur de Portneuf
VE2CSP 224 2 4 998 QC
Williston Basin ARC
K0WSN 124 2 6 998 ND
Hawkins & Hancock AR Team
N2HRT 223 2 21 996 TN
Socorro ARA
W5AQA 146 2 10 988 NM
Scott Co. ARES
NE4ST 17 2 13 984 KY
Capital City ARC
N7RB (+KE7VUX) 97 2 32 984 MT
Great River ARC
W0DBQ 90 2 28 950 IA
Sierra ARC
N6M 29 2 12 940 SJV
Carteret Co. ARS
W4YMI (+NC1NC) 70 2 20 940 NC
Twin City FM Club
W0EF 81 2 10 916 MN
Wexaukee ARC
K8CAD 83 2 15 914 MI
SARA & DCARC
K0TFT 158 2 30 912 IA
Mountain ARC
W6BW 103 2 12 906 SJV
Phillips Co. ARC
W0ZXN 42 2 7 904 KS
Buena Vista Co. ARC
W0A 184 2 6 890 IA
Hall of Science ARC
WB2JSM 19 2 12 888 NLI
Mayerthorpe Flying Tigers
VE6FT 209 1 26 859 AB
LEO-ARC
NW1P 251 2 3 852 ME
The Hellgate ARC
W7PX 234 2 6 852 MT
Metuchen RC
K2YNT 194 2 6 842 NNJ
Radio Amateur Soc. of Norfolk
W4NPS 124 2 6 836 VA
W3UU 239 2 16 828 EPA
VA2NDX 208 2 3 828 QC
Boone & Hamilton Co. ARES
K0CY (+KB0TLM) 136 2 8 824 IA
Eden Prairie RC
K0EPR 123 2 19 816 MN
Low Flying Objects RC
N9MS 146 2 4 796 WI
Pearland ARC
K5PLD 78 2 13 794 STX
Morrow Co. ARES
W8NL 76 2 6 788 OH
K6P 140 2 4 770 SDG
Elko ARC
W7V 81 2 12 762 NV
CAARERT
W9SPI 140 2 8 746 IL
Federal Way ARC
WA7FW 243 2 30 736 WWA
Carbon Co
N7GCR 134 2 14 718 WY
San Juan Co. ARS
N7JN 59 2 22 716 WWA
HARK
W0ABR 159 2 15 708 SD
Limestone ARES
N4SEV 128 2 15 706 AL
Sun Coast ARC
VE7SCA 42 2 10 700 BC
AmRad Pub Svc Corps of Hamilton Co. OH
K8YOJ 22 2 8 694 OH
Maverick Radio Mentors
K5UTA 43 2 5 676 CO
RADOPS of El Jebel Shrine
K0FEZ 97 2 7 654 CO
VE2RVL 144 2 15 648 QC
Martinez ARC
KF6HTE 48 2 11 646 EB
Knox Co. ARC
W9GFD 97 2 10 646 IL
Bothell Stake Hams
K7B (+K7JSG) 30 2 4 644 WWA
Racine Megacycle Club
W9UDU 211 2 15 622 WI
AVRAC & SONRA
VD1A 59 2 18 612 NL
MIT Radio Soc.
W1MX 130 2 11 610 EMA
USC ARC
W6YV 79 2 3 608 LAX
KI6LGW 23 2 4 602 SF
Maury River Rain Dogs
WD8MQN 92 2 8 594 VA
Johnson City ARA
W4ABR 204 2 27 558 TN
KK6JA 32 2 4 514 SCV
Eastern Sierra Travelers FD
K6D 81 2 3 512 ORG
Shingletown ARC
WO6P 85 2 15 490 SV
Meyers Family
KE6LMF 4 2 3 458 SJV
W4JO RC
W6BO 248 1 3 427 SV
Aerospace Employees Assn. ARC
W6AGO 32 2 10 414 LAX
NC4AR 30 2 8 410 NC
Meyers Family
KA6ZMU 4 2 3 360 SJV
Glenn ARS
KJ6HCG 15 2 3 280 SV
Detroit Lakes ARC
W0EMZ 27 2 7 110 MN

2A – Battery

DeKalb Co. ARC & NE Alabama QRP Grp
W4GBR 490 5 26 5,670 AL
Wilsons Wonders
WU7H 353 5 3 4,330 EWA
Gateway ARC
K4GAR 352 5 12 4,160 GA
Wahkiakum ARC
N7WAH (+W7ERY) 289 5 16 3,790 WWA
Barred Owl RC
W4OWL 231 5 5 2,740 VA
SLOCC II
KA5CJJ 259 5 3 2,705 NTX
Boschveldt QRP Club
W3BQC 222 5 4 2,405 EPA
America West ARC
K7AWA 150 5 3 2,250 AZ
Whidbey Radio Friends
WJ7H 66 5 7 860 WWA
The Farm
N4ZAK 75 5 4 725 NC

2A – Commercial

Radio Central ARC & Order of Boiled Owls of NY
W2RC 2,345 2 20 8,358 NLI
Spartanburg ARC
K4II 1,184 2 25 4,212 SC
Candlewood ARA
W1QI 1,069 2 140 4,106 CT
Piedmont ARES
K4PAR (+K4P) 816 2 16 3,492 GA
Sawnee ARA
N4NE (+WX4EOC) 859 2 45 3,266 GA
River Bend Wrls Ops Club
W0QC (+W0BXR) 916 2 61 3,014 IA
The Albemarle ARS
K4WO (+NC4EC) 904 2 35 2,824 NC
Oak Ridge ARC
K4PJ 538 2 27 2,710 TN
NA4CC 671 2 8 2,466 NC
Waupaca Co. ARES
W9WAP 615 2 12 2,160 WI
Cascade RC
W7EK 305 2 22 1,912 WWA
Ottumwa ARC
WA0DX 622 2 10 1,898 IA
SW Dallas Co. ARC
W5WB (+W5AUY) 249 2 29 1,840 NTX
Henry Co. ARC
W9OB 474 2 20 1,650 IN
Clay Co. AuxComm
N9CCA 137 2 6 1,540 IN
Koomer Ridge Contesters
K1CCN 473 2 7 1,510 NH
SE KS ARC
K0SEK 245 2 20 1,500 KS
Lakes Area ARC
W5JAS 177 2 11 1,458 STX
Michigan AR Alliance
W8USA 424 2 25 1,308 MI
W4GL 485 2 15 1,220 SC
Sunnyvale ARES
K6SNY 184 2 80 1,066 SCV
Waterbury ARC
W1LAS 401 2 10 1,066 CT
Tri-States ARC
W4GTA (+W4LMS) 144 2 20 1,058 GA
Columbia River DX Club
AA7CR 940 1 4 990 OR
CW Wings & More ARC
KC5CWW 171 2 10 952 MS
(+KD4VVZ)
NC2PD 161 2 12 932 NLI
Columbia ARA
N7EI 372 2 11 894 OR
Greater NE ARL
K0GNE 175 2 8 868 NE
Grumman ARC
WA2LQO 286 2 10 822 NLI
K8GLC 168 2 4 786 OH
Polk Co. ARA
N9XH 100 2 23 770 WI
Sprow Family
KB9YJH 166 2 3 622 IN
Ft. Pierce ARC & St. Lucie Co. ARES
W4SLC 20 2 11 590 SFL
Sudden Valley ARC
WA7SV 68 2 20 566 WWA
Wantagh ARC
W2VA 99 2 9 516 NLI
St. Mary's ARC
VE3SDF 20 2 5 340 ONS
Suffolk Co. RC
W2DQ 32 2 18 64 NLI

3A

North Fulton ARL
K4JJ (+NF4GA) 4,112 2 159 14,562 GA
Rochester (NY) DX Assn.
W2RDX (+W2AN) 3,479 2 30 12,980 WNY
Indianapolis RC
N9NS (+W9RCA) 3,695 2 56 11,876 IN
Prairie Dog ARC
W0OJY (+W0EJ) 2,895 2 27 10,664 SD
North Shore Radio Assn.
NS1RA 2,920 2 45 10,518 EMA
North Shore RC
K9OR (+WM9Q) 2,745 2 75 10,440 IL
Oakland Co. ARS
W8TNO (+K8O) 3,271 2 26 10,264 MI
Randalistown ARC
N3IC (+K3MZ) 2,824 2 14 10,074 MDC

Providence Radio Assn.
W1OP (+W1PRA)
3,022 2 18 9,788 RI
Hampden Co. Radio Assn.
W1NY 3,089 2 25 9,774 WMA
Lynchburg ARC
K4CQ (+W3CQ)
2,870 2 36 9,770 VA
Port City ARC
K1R 3,078 2 25 9,616 NH
Massanutten & Valley ARA
W4XD (+K4MRA)
2,446 2 53 8,844 VA
Wireless Soc. of Southern ME
WS1SM (+AA1HF)
2,330 2 33 8,698 ME
Old Barney ARC
N2QB (+N2CW)
2,682 2 50 8,608 SNJ
Muscle Shoals ARC
W4JNB (+WX4FC)
2,051 2 25 8,140 AL
Oh-Ky-In ARS
K8SCH (+N8YC)
2,036 2 30 7,744 OH
Dial RC
K8PI (+W8BLV)
1,975 2 34 7,726 OH
Midland ARC
KD5C (+W5QGG)
1,906 2 20 7,638 WTX
Greater Norwalk ARC
N1EV (+W1NLK)
1,671 2 28 7,284 CT
Coconino ARC & Northern AZ DXA
W7YS (+KC7KCN)
1,762 2 87 7,046 AZ
Central WVA Wrls Assn.
K8DF (+WV8HC)
2,212 2 37 6,982 WV
Police AR Team of Westford MA
K1IG (+KB1OIQ)
1,536 2 64 6,684 EMA
Tennessee Valley DXA
W4PL 1,718 2 14 6,642 TN
Columbus ARC
W4CVY (+W4FIZ)
1,622 2 42 6,534 GA
Western WA Contest Club
W7TST 1,964 2 3 6,516 EWA
The QSY Soc.
K2QS (+KD2LEG)
1,684 2 67 6,512 ENY
REDXA/MARS
W6SG 1,959 2 20 6,442 SF
Central Vermont ARC
W1BD 2,087 2 30 6,260 VT
Mountaineer ARA
W8SP 1,470 2 17 6,200 WV
Tallahassee ARS
K4TLH 1,362 2 30 6,160 NFL
ARES of Douglas & Elbert Counties
W0RDR (+WA0DE)
1,479 2 45 6,078 CO
Paducah ARA
W4NJA 1,646 2 20 6,000 KY
Utah ARC
W7SP 1,732 2 53 5,950 UT
York Co. ARS
K4YTZ (+KE4PLT)
1,515 2 14 5,932 SC
K7T (+W7AI)
1,156 2 54 5,896 AZ
Rochester ARC
K0Z (+W0CAY)
1,412 2 62 5,834 MN
Mecklenburg ARS
W4BFB (+NC4DP)
1,490 2 66 5,824 NC
Boulder ARC
W0DK 1,714 2 21 5,456 CO
Reelfoot ARC
K4RFT (+N4MJ)
926 2 18 5,348 TN
UT Valley ARC
K7UVA (+K7GSL)
1,520 2 60 5,212 UT
Clearwater ARS & St. Pete ARC & Upper Pinellas ARC
W4TA 1,253 2 75 5,180 WCF
Blue Ridge ARC
W4YK (+NA4X)
1,296 2 46 5,150 NC
Albemarle ARC
W4DO (+WA4TFZ)
1,519 2 65 5,140 VA
Ellsworth Amateur Wrls Assn.
W1TU (+KB1NEB)
952 2 21 5,052 ME
Boston ARC & Harvard WC
W1BOS 1,227 2 25 5,048 EMA
Seneca RC
W8ID 1,140 2 29 4,916 OH
Peace River Radio Assn.
W4DUX (+KG5RVW)
1,036 2 57 4,870 WCF
Nassau ARC
K2VN (+KD2KZJ)
946 2 41 4,816 NLI
Greater Beloit ARC
K9BY 1,433 2 12 4,770 WI
Central Michigan ARC
W8MAA (+K8CPT)
990 2 60 4,726 MI
Forx ARC
N0GF 993 2 24 4,724 ND
CPARC
W4T (+W8EYU)
929 2 53 4,712 TN
Saint Charles ARC
KO0A 1,186 2 93 4,688 MO
WV8AR 1,209 2 20 4,660 WV
Hazel Park ARC
W8HP (+W8JXU)
1,118 2 43 4,658 MI
Maui ARC
KH6RS 2,345 1 50 4,637 PAC
Davie & Cooper City ARC
NA4DC 1,074 2 20 4,608 SFL
Hughes ARC
W6HA (+AC6RW)
1,402 2 24 4,606 LAX
Surrey ARC
VE7SAR 893 2 25 4,602 BC
Palms West ARC
W4SS 1,681 2 20 4,568 SFL
Rowan ARS
N4UH (+W4EXU)
1,036 2 10 4,522 NC
West Allis RAC
W9FK (+KD9HPS)
1,121 2 17 4,468 WI
XRX & Monroe Co. ARES RCs Joint FD
W2XRX (+W2EOC)
994 2 30 4,436 WNY
Fluvanna ARES Grp
W4XR 1,376 2 12 4,396 VA
Lincoln ARC
K0KKV (+KC0WWR)
1,200 2 65 4,378 NE
North Port ARC
W4NPT 1,095 2 15 4,362 WCF
ARVARF
K5PXP (+KB5FLA)
896 2 8 4,360 AR
Macoupin Co. ARC
K9MCE (+KD9EFO)
1,006 2 13 4,344 IL
Lincoln Co. ARC
K1LX (+KB1TCD)
1,363 2 18 4,316 ME
Stanwood-Camano ARC
W7PIG (+K7UDG)
932 2 64 4,304 WWA
OKC AutoPatch Assn.
W5MEL (+W5TJS)
825 2 45 4,282 OK
RVARC & CARE & JCARES
K7N (+W7DTA)
1,260 2 51 4,264 OR
Union Co. ARC
W8UCO (+N8IG)
805 2 42 4,150 OH
Northern Berkshire ARC
N1WM 844 2 12 4,048 WMA
S Orange ARA
K6SOA (+K6WO)
895 2 79 3,992 ORG
WY3P 1,349 2 4 3,964 EPA
Northeast ARC
N1ERC 1,704 2 10 3,958 EMA
McKinney ARC
W5MRC (+K5CRX)
1,007 2 65 3,954 NTX
721st Mechanized Contest Battalion
WC2FD 1,171 2 20 3,944 NNJ
Michiana ARC
W9AB 911 2 7 3,942 IN
Lake Area Radio Klub
W0WTN 722 2 37 3,930 SD
Ole Virginia Hams
W4OVH 724 2 25 3,836 VA
W4LHS 1,008 2 20 3,798 GA
Columbia-Montour ARC
W3ZR (+N3OMA)
736 2 15 3,782 EPA
Majors Field ARC
W5NNI 855 2 14 3,776 NTX
Kingsport-Bays Mtn ARC
W4TRC 960 2 16 3,764 TN
Sterling Park ARC
K4NVA (+NQ4K)
899 2 20 3,754 VA
San Lorenzo Valley ARC & Santa Cruz Co. ARC & UCSC ARC
K6MMM (+N6OTA)
750 2 68 3,736 SCV
Pamlico ARC
K4BCH (+K4OTH)
767 2 17 3,686 NC
Spark & HPST & PARC
W4QR 874 2 62 3,640 VA
Haywood Co. ARC
KW4P 794 2 50 3,638 NC
Cherryland ARC
W8TCM (+WZ8C)
828 2 37 3,574 MI
TUSCO ARC
W8ZX 766 2 33 3,570 OH
Lowell ARC
W8LRC (+KD8RXD)
1,075 2 12 3,560 MI
San Mateo RC
W6UQ (+AB6D)
712 2 28 3,558 SCV
Clark Co. ARC
W7AIA (+K7JAO)
877 2 157 3,556 WWA
Intercity ARC
W8WE 657 2 12 3,550 AB
Lambton Co. RC
VE3SAR (+VA3OIL)
742 2 15 3,526 ONS
Garrett Co. ARES
K3LNZ 881 2 22 3,514 MDC
Gaston Co. ARS
N4GAS (+K4GNC)
1,012 2 28 3,508 NC
Owensboro ARC
K4HY 797 2 20 3,474 KY
Arrowhead ARC
W0GKP (+KB0YHX)
893 2 45 3,436 MN
Murray State University ARC
K4MSU (+W4GZ)
761 2 70 3,430 KY
Uniontown ARC
W3PIE 927 2 15 3,388 WPA
Redneck Hams
KA3PMW 1,203 2 4 3,374 WPA
HCARC Hill Country ARC
N5HR (+W0HIP)
606 2 40 3,362 STX
Quinte ARC & Prince Edward RC
VE3RL 801 2 18 3,350 ONE
Rip Van Winkle ARS
WD2K 613 2 20 3,338 ENY
West Fork ARC
WQ5A 1,123 2 8 3,336 NTX
Marion ARC
W8GVB 639 2 39 3,290 OH
Shenandoah Valley ARC
W4RKC 826 2 27 3,274 VA
Hampstead Hams
NC4PC (+WA3IRG)
607 2 21 3,266 NC
Springhill Rptr Assn. FD
W4C (+KI4OAS)
497 2 26 3,250 TN
Eastern AZ ARS
K7EAR (+AF7EF)
493 2 11 3,242 AZ
The FPL Grp
K8ESQ 857 2 6 3,230 MI
Putnam Emerg & Amateur Rptr League
K2PUT (+K2PC)
597 2 20 3,220 ENY
Hernando Co. ARA
K4BKV 451 2 10 3,214 NFL
Wilderness Road ARC
W4CDA (+WQ4Z)
537 2 29 3,206 KY
Ocean Monmouth ARC
N2MO 734 2 19 3,188 NNJ
WX4TC 856 2 26 3,152 GA
West River RC
WR1VT (+W1RRC)
700 2 28 3,152 VT
St. Louis & Suburban RC
W0SRC 817 2 62 3,150 MO
N Penn ARC
W3BTN 720 2 7 3,148 EPA
Baton Rouge ARC
W5GIX (+K5LSU)
731 2 60 3,142 LA
Terrie Hill & Friends
W7AU (+W7SST)
612 2 9 3,108 OR
Des Moines Radio Amateurs Assn.
W0AK 680 2 16 3,090 IA
Culpeper ARA
W4CUL (+N4XI)
766 2 21 3,072 VA
Nashville ARC
K4CPO (+N1NUT)
549 2 43 3,070 TN
Coquitlam ARES Soc.
VE7SCC 925 2 9 3,052 BC
Yonkers ARC
W2YRC (+KD2D)
832 2 68 3,036 ENY
Emerald Coast ARA
W8EHH 582 2 20 3,024 NFL
Laguna Mountian WFD
WW6CC 650 2 12 2,978 SDG
Fauquier ARA
W4VA (+KW4VA)
853 2 16 2,956 VA
The Three Cs
N4IQ 787 2 4 2,926 SC
Club de Radio Amateur Outaouais
VE2CRO (+VE3PHV)
683 2 29 2,920 QC
Moore Co. ARS
NC4ML 574 2 50 2,894 NC
Case ARC of CWRU
W8EDU 543 2 49 2,888 OH
Saratoga Co. ARA
K2DLL (+K2LK)
609 2 17 2,888 ENY
Coos Co. RC
K7CCH 453 2 30 2,880 OR
Fond du Lac ARC
W9EBV 578 2 40 2,844 WI
Shelby ARC & ARES of Cleveland Co
KM4C 786 2 15 2,780 NC
Gladwin Area ARC
K8BZ 575 2 8 2,764 MI
Arlington ARC
K5SLD (+W5FJB)
457 2 48 2,764 NTX
Alliance ARC
W8LKY (+KE8FSZ)
477 2 40 2,738 OH
Waldo Co. ARA
N1TN (+W1EMA)
752 2 21 2,730 ME
Newton-McPherson ARC
N0NK 622 2 10 2,722 KS
Green Bay Mike & Key Club
K9EAM 507 2 29 2,680 WI
Splinter Grp ARC
N8ARG (+N8TCP)
543 2 8 2,656 OH
N5BVA (+WB5L)
480 2 40 2,584 AR
W5W (+KE5LIO)
489 2 12 2,582 MS
Antelope Valley ARC
K6OX (+K6A)
373 2 30 2,574 LAX
Okaw Valley ARC
AD9OV (+AD9RR)
391 2 15 2,566 IL
W7Q (+K7BAT)
518 2 25 2,560 OR
Foothills ARS
K6YA (+W6VYC)
619 2 20 2,532 SCV
St. Mary's ARA
K3HKI (+K3NAL)
750 2 13 2,514 MDC
K3EMD 397 2 25 2,500 MDC
Jackson ARC & Hiawatha ARC
K0J (+N0YUP)
470 2 14 2,474 KS
Ruckerville Amateur Transmitting Soc.
N4CVG 531 2 20 2,472 KY
K0NXA 617 2 12 2,468 MO
Heritage Hunt Hams
WA4HH 721 2 15 2,456 VA
Washington Area ARC
W0ARC (+AB0DX)
369 2 28 2,450 IA
Hilltop Transmitter Assn. & Keystone VHF Club
W3HZU (+W3ZGD)
665 2 18 2,442 EPA
The Road Show ARC
WA4TRS 489 2 20 2,424 NC
Red River Radio Amateurs
W0ILO 540 2 21 2,410 ND
Twin Cities Rptr Club
W0BU (+KC0DMF)
499 2 20 2,396 MN
Central ID ARC
K7M (+KG7MFC)
414 2 13 2,348 ID
Mason Co. ARG
KE8COT 221 2 6 2,344 WV
L'Anse Creuse ARC
N8LC 457 2 12 2,328 MI
Chenango Valley ARA
W2RME 625 2 22 2,318 WNY
Santa Fe Trail ARC
KS0KS (+K0NK)
414 2 14 2,304 KS
Coal Country ARC
WV8CCC 430 2 12 2,284 WV
Highline ARC
NC7G (+WA7ST)
347 2 20 2,274 WWA
Two Rivers ARC of McKeesport PA
W3OC (+N3JHB)
641 2 22 2,272 WPA
Central OR Coast ARC
W7FLO (+W7L)
228 2 40 2,264 OR
Eastern PA ARA
N3IS 343 2 20 2,262 EPA

Holmesburg ARC
K3FI 455 2 12 2,260 EPA
Plattsmouth ARC
KB0SMX 519 2 30 2,240 NE
Hamfesters RC
W9AA (+N9JYX) 439 2 54 2,218 IL
Valley of the Moon ARC
W6AJF 428 2 15 2,212 SF
Gold Coast ARA
W4BUG (+N4FL) 798 1 24 2,207 SFL
Hamilton ARC
W8AJT 413 2 25 2,198 OH
Bill Gremillion Memorial RC
K4NRC 385 2 40 2,174 GA
Ft. Smith AR Area ARC
W5ANR 350 2 10 2,158 AR
Ft. Smith Area ARC
W5JE 350 2 10 2,158 AR
Brunswick Shores ARC
N4GM 439 2 23 2,146 NC
KS Antenna Club of Johnson Co.
K0ANT 384 2 13 2,132 KS
Olympia ARS
NT7H 321 2 11 2,116 WWA
Thousand Islands RC
KC2TI 478 2 30 2,106 NNY
Monessen ARC
W3CSL 390 2 21 2,102 WPA
Randolph Co. Emerg RC
K4RAN 442 2 14 2,084 AL
Magnolia DXA
K5MDX 396 2 17 2,058 MS
Marshall Co. ARS
N4MRS (+KM4UII) 439 2 41 2,028 TN
Bedford ARC
K5BED 308 2 18 2,002 NTX
Brownwood ARC
K5BWD (+N5AG) 396 2 5 1,972 NTX
Hardin & Mcnairy ARC
K4A 400 2 25 1,970 TN
Lewis & Clark RC
K9HAM 410 2 25 1,970 IL
Anoka Co. RC
W0YFZ 250 2 21 1,970 MN
Joplin ARC
W0IN 335 2 20 1,966 MO
Border City RC Windsor
VA3XT 608 2 21 1,956 ONS
Cape May Co. ARC
N2CMC 437 2 18 1,948 SNJ
St. Clair ARC
K9GXU 342 2 7 1,938 IL
Warren Co. CERT EmComm
AA4WC (+N4PSS) 252 2 9 1,914 VA
Carroll Co. ARC
K3PZN 318 2 10 1,910 MDC
Montachusett ARA
W1GZ (+W1QED) 431 2 8 1,898 WMA
San Fernando Valley ARC
W6SD 270 2 12 1,882 LAX
Chattanooga ARC
W4AM 388 2 53 1,874 TN
Mich-A-Con ARC
KC8VC (+W8JWN) 342 2 16 1,868 WI
Ellijay ARS
N4M 354 2 12 1,858 GA
Central MO Radio Assn.
K0SI (+N0AXZ) 208 2 34 1,856 MO
Clark Co. ARC
W9WWI (+W9JBQ) 207 2 35 1,850 IN
Gainesville ARS
K4GNV 169 2 23 1,814 NFL
Magic Valley ARC
K7MVA 312 2 14 1,806 ID
Stubblefield Rptr Club & Shelby Co.
K4HJ 302 2 33 1,802 KY
Southern Berkshire ARC
W1BAA 269 2 17 1,796 CT
20/9 RC
K8TKA 238 2 30 1,790 OH
Salem ARC
W7SAA (+K7JLT) 229 2 12 1,788 OR
W3BN 304 2 57 1,786 EPA
Grayson Co. ARC
K5GCC 260 2 15 1,766 NTX
Chickasaw ARA
W5GWD (+AG5FG) 300 2 20 1,764 MS
River City ARCS
N6NA 285 2 12 1,754 SV
Shiawassee ARA
W8QQQ 301 2 7 1,752 MI
San Gorgonio Pass ARC
W6PRC 113 2 27 1,748 ORG
Wyandot Area Ham Operators Org
KE8PX 258 2 10 1,746 OH
River Cities ARA
K4Y 309 2 9 1,744 KY
Club Radioamateur VE2CWQ
VE2CWQ 470 2 13 1,734 QC
Olive Branch ARC
W5OBM (+K5OLV) 363 2 10 1,700 MS
Mercer Island Radio Operators
W7MIR 159 2 25 1,690 WWA
North Hills ARC
K3GT 355 2 10 1,688 WPA
GEARS
W6RHC 135 2 10 1,660 SV
Musselshell ARC
K7Q 220 2 7 1,654 MT
Rowdys
NV8E 462 2 3 1,652 OH
Jamestown ARC
W0FX 194 2 19 1,640 ND
VE7MIR 82 2 25 1,638 BC
Maury ARC
W4GGM 218 2 30 1,632 TN
N4NRV 376 2 35 1,626 VA
Huber Heights ARC
NO8I (+W8GUC) 277 2 24 1,622 OH
Vashon Maury Island RC
W7VMI 237 2 50 1,606 WWA
Fallbrook ARC
N6FQ 346 2 60 1,596 SDG
California City ARC
KE6RN 311 2 18 1,592 SJV
Faulkner Co. ARC
W5AUU 264 2 25 1,574 AR
Genesee Radio Amateurs
W2RCX 444 2 12 1,568 WNY
Lee DeForest ARC
N6CG 82 2 28 1,566 ORG
Los Angeles ARC
W6PCH (+KJ6JQA) 203 2 20 1,564 LAX
NW IL ARC
W9K 181 2 10 1,562 IL
W5E 230 2 20 1,540 NTX
Saskatoon ARC
VE5AA 235 2 27 1,506 SK
Mid-State Rptr Assn.
W9DQA (+K9VER) 157 2 10 1,492 WI
Kay Co. ARC
N5PC (+N5PC) 199 2 23 1,492 OK
CNY Contesters
KD2ETT 195 2 6 1,480 WNY
Wichita ARS
N5WF 131 2 8 1,474 NTX
Ramona Outback ARS
N6ROR 188 2 47 1,472 SDG
W4CHR 357 2 10 1,468 SC
Gateway Technical College ARC
N9GTC 227 2 23 1,468 WI
Mesa ARC
WM7RC 202 2 12 1,460 AZ
Kennehoochee ARC
W4BTI 346 2 61 1,442 GA
Lake of the Ozarks ARC
N0ZS 265 2 30 1,430 MO
Deep South ARC
K4DSR (+K4HDW) 176 2 25 1,422 AL
Beaver Valley ARA
W3SGJ 280 2 25 1,410 WPA
Lincoln Co. ARA
W4BV 317 2 4 1,404 TN
Newark ARA
N8ARA 169 2 28 1,388 OH
Lake Oswego ARES
WA7LO 167 2 15 1,384 OR
Rodeo City RC
K7E 65 2 25 1,380 EWA
Manhattan Area ARS
K0N (+K0A) 238 2 33 1,374 KS
Wyandotte Co. RACES
W0KCK 184 2 18 1,360 KS
West Point Fire CERT
W6WPT 201 2 7 1,352 SJV
Genesis ARS
N1ZIZ 60 2 35 1,330 EMA
Big Sandy ARC
KE0EA 195 2 8 1,326 CO
W9OU 206 2 43 1,326 IN
Bay-Net Grp
K6SRA 86 2 27 1,308 SCV
WARS-Wasco AR Svc
WC7EC 96 2 15 1,302 OR
Indian River ARC
AJ4IR 309 2 10 1,290 SFL
Skyline ARC
K2IWR 211 2 14 1,290 WNY
Milwaukee Rptr Club
WI9MRC (+WA9TXE) 249 2 53 1,288 WI
SVARC
W8BAP 302 2 6 1,256 OH
NC State Univ Student ARS
W4ATC 467 2 5 1,252 NC
Milton ARC
K3FLT (+K3WJH) 190 2 6 1,230 EPA
Aroostook ARA
K1FS 184 2 32 1,218 ME
Ozark Mtn ARC
N0NTC 97 2 20 1,190 MO
Vancouver Emerg Community TeleComms Org
VE7VVC (+VE7BFY) 114 2 40 1,180 BC
Tamaqua Wrls Assn.
W3CMA 80 2 15 1,170 EPA
Key City ARC
KC5OLO 258 2 55 1,164 WTX
Maple Ridge ARC
VE7CMR 150 2 8 1,162 BC
Lakeshore ARC
W9LRC 232 2 5 1,158 WI
Tri-County ARA
K6AGF (+AG6YS) 152 2 33 1,158 LAX
Black River ARC
K8BRC 277 2 16 1,152 MI
Hayward RC
K6EAG 128 2 11 1,152 EB
Sun City Hilton Head ARC
KE4HAM 28 2 19 1,150 SC
Oroville ARS
W6AF 248 2 30 1,142 SV
Santa Clarita ARC
W6JW 52 2 30 1,114 LAX
Sask Alta RC
VE6WP 169 2 9 1,088 AB
The Georgian Bay AR
VE3OSR 150 1 17 1,080 ONS
MEIGS Co. (TN) ARC
KN4LDN 45 2 9 1,080 TN
ARC of Alameda
K6QLF 73 2 39 1,080 EB
W8WSL Grp
W8WSL 307 2 4 1,076 WV
Old Timers Connection
W8OTC 210 2 5 1,076 MI
Southern PA ARC
K3IR 172 2 6 1,070 EPA
Sullivan ARC
K0S 52 2 11 1,060 MO
Lamorinda Area Radio Interest Grp
K6ORI 91 2 15 1,048 EB
Gadsden ARC
K4JMC 197 2 10 1,044 AL
W3VV 195 2 12 1,040 WPA
Ellis Co. ARC
WD5DDH 243 2 10 1,036 NTX
Central IN ARA
N9EOC 91 2 13 1,032 IN
Mt. Magazine ARC
W5MAG 84 2 10 1,018 AR
Community ARC
K2SRV 34 2 3 1,018 WNY
WCARC
W0RRZ 220 2 20 1,012 CO
SEL ARC
K7SEL (+WI7EOC) 161 2 12 1,006 EWA
Bald Rock ARC
N4BRC (+NR4B) 20 2 6 1,000 AL
E NM ARC
KA5B 110 2 12 1,000 NM
Metropolitan ARC
K8NOW 224 2 6 992 MI
Outack Hams
W7B 158 2 7 988 AZ
Big Lake ARC
W4RU 11 2 8 972 SFL
Morongo Basin ARC
W6BA 83 2 27 972 ORG
Lanierland ARC
W4ABP 191 2 25 972 GA
Blue Springs ARC
W5NI 157 2 3 960 MO
Westmoreland ARC
NN4VA 136 2 26 922 VA
Brookings Radio Research Club
W0BXO 180 2 16 910 SD
Elmore Co. ARES
AF7FQ 165 2 6 880 ID
Unreal RC
W0WX 48 2 5 846 MN
Paradise ARS
W6PAR 47 2 4 844 SV
TicBite ARA
N4ENC 77 2 3 838 NC
W7RAG 447 1 3 833 WWA
W5CSY 57 2 5 810 NM
Vintage Comms Museum
W1VCM 123 2 7 796 CT
Shore Points ARC
K2B (+W2HRW) 99 2 15 788 SNJ
W9VCL 115 2 3 780 WI
KD5DX (+AK5FM) 49 2 14 768 STX
Friend & AR Comm Enthusiasts
KF6NNM 55 2 8 764 SV
Buffalo AR Rptr Assn.
W2EUP 135 2 5 720 WNY
Springhill ARC LLC
N5II 240 2 6 698 LA
Columbia Co. ARES/RACES
KC9CZH 74 2 4 698 WI
Cy-Fair CERT
W5CFC 15 2 7 680 STX
Flinthills ARC
KB0VAC 106 2 12 678 KS
Lakewood ARC
KK6NXT 56 2 3 662 LAX
K7UAZ 48 2 11 646 AZ
Elk Grove-Florin ARC & Sacramento Co. ARES
W6EGF 62 2 3 634 SV
Victor Valley ARC
K6QWR 39 2 27 628 ORG
Northern Lakes ARC
K0GPZ 86 2 10 622 MN
Regina ARA
VE5NN 51 2 16 556 SK
Estancia Valley ARA
NM5EV 33 2 3 528 NM
W6CPU 65 2 12 500 SV
Bear Mountain
K7YL 67 2 3 484 OR
Bloomfield ARC
W1CWA 58 2 13 470 CT
Am Red Cross Snohomish Co. EOV
KI7OHH 5 2 8 460 WWA
Anaheim RACES members
W6APD 189 2 9 428 ORG
W7BLR 14 2 6 106 WWA

3A – Battery

Escondido ARC
W5YA (+NN5K) 1,267 5 9 13,745 NM
Zuni Loop Mtn Expeditionary Force
N6GA 736 5 4 7,635 LAX
Colorado QRP Club
W0CQC (+N0CQC) 674 5 15 6,990 CO
South Plainfield ARC
NJ2SP (+KD2FSI) 500 5 14 5,515 NNJ
OH Valley Experimenters Club
KD8LBS 221 5 15 2,640 OH
Cochise ARA
K7RDG 156 5 17 2,210 AZ
Tulsa Digital RC
KT5DIG 155 5 11 1,895 OK
Big Thicket ARC
N5BTC 128 5 6 1,675 STX
Yellowknife ARS
VE8YK 18 5 5 1,230 NWT

3A – Commercial

Splitrock ARA
K2GG 1,136 2 30 4,770 NNJ
W5RIN (+WE5D) 727 2 10 3,620 STX
High Point ARC
W4UA (+KN4JOX) 1,046 2 41 3,528 NC
Wiregrass ARC
W4DHN 823 2 27 3,526 AL
Coshocton Co. ARA
W8CCA 728 2 19 3,508 OH
Macon Co. ARC
N0PR (+AB0C) 464 2 15 2,300 MO
Mobile ARC MARC
NF4J 335 2 8 1,810 AL
Ashtabula Co. ARC
K8CY (+KE8JXW) 370 2 16 1,716 OH
NW FL ARC
KE4FD 365 2 5 1,538 NFL
North Ottawa ARC
W8CSO (+KB8ODB) 286 2 19 1,516 MI
Tishomingo Co. ARC
W5TCR 322 2 16 1,418 MS
Richfield ARC
W0RRC 187 2 53 1,280 MN
DCAR Club
K0DCA 187 2 22 1,132 MO
Voice of ID ARC
W7VOI 205 2 54 1,060 ID
Daviess Co. ARC
KC9SFL 204 2 22 1,058 IN
HP Boise ARC
AB7HP 439 1 12 1,055 ID
Thumb ARC
W8AX 100 2 6 950 MI
Austin ARC
W0AZR 212 2 12 886 MN

Wellesley ARS
W1TKZ (+W1HEB) 195 2 30 846 EMA
ARA of the Southern Tier
W2ZJ 151 2 16 782 WNY
Hoosier Hills Ham Club
W9GUS 79 2 17 722 IN
Sussex ARA
WS3ARA 112 1 27 696 DE
(+WB4FUN)
Hocking Valley ARC
K8LGN 140 2 15 604 OH
SE LA ARC
WM5T 218 2 7 522 LA
NE AR ARC
K5NEA 60 2 16 518 AR
Miller Co. ARES
KB5IOC 73 2 4 496 AR
Barstow ARC
WA6TST 133 2 6 366 ORG
Tri-Country Club
KC9OLF 98 2 4 346 IN
Coon Valley ARC
N0NAF 128 2 5 306 IA
Lowndes Co. ARC
KC5ULN 112 2 14 288 MS

4A

Huntsville ARC
K4BFT (+N7KDT) 4,866 2 63 16,946 AL
Weschester EmComm Assn.
N2SF (+W2ECA) 3,282 2 47 11,982 ENY
Palo Alto ARA
W6ARA (+K6OTA) 3,537 2 129 11,796 SCV
Portage Co. ARS
K8BF (+AC8NT) 3,451 2 87 10,926 OH
Loudoun ARG
K4LRG (+WB8WKU) 3,388 2 19 10,758 VA
ARROW & UMarc
W8UM (+W8RP) 2,245 2 80 9,350 MI
Kaw Valley ARC
W0CET 2,466 2 35 9,094 KS
LARC-FARL
K8UNS (+K8UTT) 2,850 2 51 8,992 MI
Johnson Co. Radio Amateurs Club
W0ERH (+W0AR) 2,705 2 51 8,828 KS
Nittany ARC
W3YA 5,430 1 30 8,681 WPA
Contoocook Valley RC
K1B (+K1DFQ) 2,660 2 47 8,510 NH
N4N FD Grp
N4N 2,225 2 11 8,412 GA
Pasadena RC & S Pasadena ARC & JPL ARC & Caltech ARC
W6KA (+W6JPL) 1,928 2 60 7,556 LAX
Bristol ARC
W4UD 2,135 2 75 7,546 TN
Davis Co. ARC
K7DAV (+N7CN) 2,072 2 55 7,258 UT
Virginia Beach ARC & Virginia DXCC
K4IX (+W4UG) 1,849 2 40 6,982 VA
Fair Lawn ARC
W2NPT (+KD2KLN) 1,714 2 49 6,810 NNJ
Lighthouse Radio Alliance
K4LRA 1,929 2 8 6,570 SFL
Peel ARC
VE3XR 1,434 2 25 6,348 GTA
VE3RB 1,679 2 25 5,802 ONE
South Lyon Area ARC
N8SL (+N8CAL) 1,632 2 62 5,556 MI
Medina 2 Meter Grp
W8HN (+W8EOC) 1,282 2 55 5,490 OH
N7N (+NY7S) 1,152 2 48 5,268 AZ
Lakeland ARC
K4LKL 1,237 2 60 5,154 WCF
OR Tualatin Valley ARC
W7OTV 1,052 2 95 5,092 OR
Kanawha ARC
W8GK 1,335 2 35 4,972 WV
Wrls Assn. of South Hills
W3B 1,418 2 30 4,876 WPA
Mt. Vernon ARC
K8EEN 1,168 2 15 4,832 OH
Sierra Foothills ARC
W6EK 871 2 107 4,550 SV
Green Mtn Wrls Soc.
N1VT (+WA1VT) 902 2 33 4,504 VT
ARC of Butts Co.
WX4BCA (+K3GWK) 899 2 36 4,436 GA
KARC & SMART
W8VY (+K8KZO) 1,107 2 33 4,352 MI
MD Mobileers ARC
W3CU 821 2 24 4,248 MDC
Radio Amateurs of Grtr Syracuse
W2AE 795 2 43 4,060 WNY
Montgomery ARC
W3M (+KV3B) 868 2 45 4,008 MDC
Grand Rapids ARA
W8DC 939 2 27 3,946 MI
KE8RV 1,003 2 34 3,912 OH
Roanoke Valley ARC
W4CA 1,193 2 29 3,908 VA
Acadiana ARA
W5DDL (+W5EXI) 1,365 2 20 3,836 LA
Liverpool Amateur Rptr Club
W2CM 794 2 20 3,836 WNY
Southern PA Comms Grp
K3AE 808 2 37 3,732 EPA
West TN MARS/Tipton ARS
W4ODR 1,228 2 26 3,620 TN
Silvercreek ARA
W8WKY (+WW8TF) 773 2 21 3,408 OH
Rome RC
W2OFQ 531 2 28 3,390 WNY
Union Co. ARS
K4V 720 2 14 3,314 NC
Pilot Knob ARC
W0EBB (+WB0PDR) 643 2 8 3,202 KS
Lakeway ARC
W2IQ 801 2 24 3,098 TN
Washington Amateur Comms
WA3COM 800 2 22 3,050 WPA
Carolina ARC & Lincoln Co. Vol Comms
KT4NC (+NC4LC) 567 2 55 3,020 NC
Cambridge ARA
W8VP 612 2 28 2,974 OH
Snohomish Co. Hams Club
WA7LAW (+KK7M) 541 2 50 2,952 WWA
West Chester ARA
WC8VOA 685 2 13 2,930 OH
Dallas ARC
W5FC 432 2 82 2,896 NTX
Sonoma Co. Radio Amateurs
K6SON 441 2 65 2,892 SF
Chesapeake ARS
W4CAR 698 2 40 2,846 VA
Cherryville Rptr Assn. II
W2CRA 657 2 24 2,802 NNJ
Orange Park ARC
K4BT 432 2 69 2,786 NFL
Maple Grove RC
K0LTC (+K0YTH) 477 2 65 2,742 MN
Rocky Mtn Ham Radio
N0SZ (+W0KVA) 853 2 29 2,736 CO
Cowtown ARC
K5COW 360 2 51 2,664 NTX
DE Valley ARS
W3DE 838 2 20 2,610 DE
Cumberland Valley ARC
W3ACH (+KB3PCA) 604 2 48 2,578 WPA
Great Bay Radio Assn.
W1FZ 401 2 8 2,544 NH
All Amateur RC
W7PU 441 2 4 2,532 WWA
Downey ARC
W6TOI (+KJ6WZW) 592 2 20 2,436 LAX
Toronto ARC
VE3TNC (+VA3RWO) 539 2 20 2,414 ONS
Ft. Herkimer ARA
W2FHA 305 2 15 2,396 WNY
MARC ARC
W3NWA (+WB3JOE) 496 2 32 2,386 EPA
Whitman ARC
NI1X (+WA1NPO) 572 2 37 2,354 EMA
Central NH ARC
W1JY (+W1CNH) 361 2 15 2,334 NH
Milwaukee RAC
W9RH 416 2 20 2,306 WI
AR Radio Emerg Svcs
N5AT 313 2 48 2,302 AR
W7G (+W7YAM) 345 2 59 2,292 OR
Island Co. ARC
W7AVM 296 2 33 2,272 WWA
Denver RC
W0TX 696 2 63 2,266 CO
Middlesex ARS
W1EDH 581 2 13 2,238 CT
Wayne Radio Amateur Emerg Team
KD2KWT 418 2 10 2,202 NNJ
W5R (+N5R) 220 2 64 2,180 NTX
United Radio Amateur Club
K6AA 360 2 20 2,142 LAX
North Shore ARC ON
VE3NSR 269 2 8 2,130 GTA
Hamilton ARC
VE3DC 428 2 20 2,120 ONS
Troy ARA
NY2U 407 2 18 2,106 ENY
Yellow Thunder ARC
WB9FDZ 516 2 11 2,098 WI
Richmond Multi-Club FD Party
W4RAT 572 2 21 2,060 VA
King George AR Operators
K4GVA (+KB4CFP) 224 2 23 2,060 VA
Rancho Cucamonga AuxComms Svc
K6RCR (+KA6D) 239 2 35 2,058 ORG
Onslow ARC
NC4OC 191 2 18 2,044 NC
North Okaloosa ARC
W4AAZ 318 2 48 1,998 NFL
Radio Am Club of Knoxville & Middle E TN Emerg Radio Svc
N4B 350 2 44 1,994 TN
Insurance City Rptr Club
W1DHT 415 2 27 1,950 CT
Coast to Range ARC
WV7CTR (+KB7DAC) 258 2 6 1,904 OR
Basin ARC
W7BAR 367 2 35 1,884 UT
W5AWP (+AK4DI) 249 2 25 1,844 MS
Kitchener Waterloo ARC
VE3IC 380 2 16 1,838 ONS
Morgan Hill ARS & Garlic Valley ARC & San Benito ARA
K7DAA (+W6KRK) 253 2 20 1,802 SCV
Whitewater Valley ARC
N9JM (+KD9JAQ) 336 2 12 1,786 IN
Victoria-Haliburton ARA
VA3LNZ 453 2 22 1,760 ONE
Roane Co. ARC
KE4RX 242 2 25 1,758 TN
Thunder Bay ARC
K8PA 245 2 41 1,740 MI
Dubois Co. ARG
N9A 211 2 34 1,740 IN
East River ARC
W8MOP 275 2 9 1,702 VA
Piscataquis ARC
K1PQ 288 2 11 1,696 ME
ARC of Columbia Co
K4KNS 156 2 27 1,678 GA
ARC of Augusta
W4DV 186 2 22 1,640 GA
National Trail ARC
K9UXZ 373 2 10 1,596 IL
Sierra Chapter of NCCC
K6NV 542 2 6 1,592 SV
AB5UE 216 2 25 1,560 STX
Vaca Valley RC
W6VVR 108 2 15 1,556 EB
Broken Arrow ARC
W5DRZ 176 2 30 1,554 OK
Clallam Co. ARC
W7FEL (+KE7DRT) 293 2 12 1,536 WWA
San Francisco RC
W6PW 277 2 60 1,512 SF
San Antonio RC
W5SC 149 2 10 1,508 STX
Silver Springs RC
K4GSO 111 2 12 1,496 NFL
KS NE RC
K0KSN 223 2 35 1,496 KS
Binghamton ARA
W2OW 110 2 12 1,442 WNY
Calvert ARA
K3CAL 286 2 15 1,434 MDC
Big Bear RC
K6BB 327 2 15 1,412 ORG
Sky Valley ARC
W7SKY 68 2 8 1,378 WWA
Southern Michigan ARS
W8DF (+W8DF) 138 2 30 1,364 MI
Radio Amateurs of Skagit Co
N7GDE 89 2 35 1,328 WWA
Headwaters ARS
VE3TA 152 2 9 1,310 ONS
Cherokee Capital ARS
K4WOC 144 2 15 1,308 GA
Foothills ARS
VE6FAR 70 2 12 1,296 AB
Riverland ARC
WR9ARC 221 2 20 1,292 WI
Boone Co. RACES
KY4TS 349 2 3 1,248 KY
Cambridge ARC
VE3SWA 232 2 4 1,246 ONS
The 220MHz Guys
WM9W 175 2 10 1,100 IL
VE3OKV 187 2 8 1,054 GTA
Cedar Hills Utah LDS Stake
AG7GX 26 2 13 1,048 UT
Elmore Co. ARC
K7ECI 98 2 14 996 ID
NW GA ARC
W4VO (+W4VO) 42 2 14 994 GA
Oak Forest ARC
KE5TRB 75 2 10 910 STX
Disney ARES
WD4WDW 106 2 15 762 NFL
Sequoia ARG
N6KRV 55 2 5 760 SJV
Redlands Area Radio Enthusiasts
N6RAE 17 2 33 704 ORG
N5LEA 42 2 4 574 NM
The Farm
N0OH 57 2 6 564 MN

4A – Battery

KnightLites QRP Soc.
WQ4RP 997 5 21 9,020 NC
St. Louis QRP Soc.
N0SA 636 5 24 7,445 MO
Portland ARC
W7LT (+KK7FM) 313 5 40 4,110 OR
Elgin ARS
VE3RSE 91 5 9 1,560 ONS
North GA QRP Club
NO4GA 67 5 11 1,110 GA

4A – Commercial

Pottstown Area ARC
W3U (+K3ZMC) 1,750 2 34 5,408 EPA
Westside RC
W9WRC (+N9EEE) 1,658 2 15 4,128 WI
Central IL RC
W9EX 1,016 2 18 3,840 IL
Cumberland ARC
K3IEC 480 2 16 2,114 EPA
Drake ARC
K8UU 754 2 6 2,058 OH
ARA of NE
W0WWV 411 2 20 1,740 NE
Yadkin Valley ARC
KE4YVF 534 2 8 1,634 VA
Spout Springs Rptr Assn.
WF7S 422 2 16 1,510 EWA
W5KS 266 2 23 1,506 OK
Mississippi Coast ARA
W5SGL 280 2 37 1,498 MS
Radio Assn. of WNY
W2PE 405 2 19 1,454 WNY
Black Diamond ARC
WV8BD 449 2 6 1,298 WV
Jersey Shore ARS
NJ2AR 290 2 26 1,010 SNJ
Pioneer ARC
K0JFN 305 2 27 878 NE
Miami Co. ARC
K9ZEV 285 2 7 620 IN
ToorCamp
N7C 41 2 50 232 WWA

5A

Sussex Co. ARC
W2LV 3,443 2 25 12,556 NNJ
Lake ARA
K4FC 2,840 2 78 10,950 NFL
Ozaukee RC
W9GA (+AE9MY) 2,711 2 60 10,412 WI
N Augusta Belvedere RC
K4NAB (+KK4AMJ) 2,435 2 30 8,876 SC
Vienna Wrls Soc.
K4XY (+K4HTA) 2,381 2 100 8,638 VA
Lorain Co. Wrls Ops
NW8S 2,096 2 18 8,110 OH
Lake Co. ARA
N8BC 2,177 2 21 7,986 OH
Smoky Mountain ARC
W4OLB (+N9KMY) 1,979 2 77 6,662 TN
Bergen ARA
K2BAR 1,946 2 24 6,426 NNJ
Lake Monroe ARS
N4EH (+WR4RW) 1,538 2 58 5,988 NFL
Palomar ARC
W6NWG (+WD6FWE) 1,064 2 74 5,386 SDG

Jim, WX8J, showed off his Field Day colors while casually making over 400 CW contacts operating Class 1E Battery (5 W, with a battery charged by solar cells) from Ohio. [Jim Mayercak, WX8J, photo]

York Region ARC
VE3YRA (+VE3YRK)
1,397 2 51 5,380 GTA
Cuyahoga Falls ARC
W8VPV 1,298 2 33 5,380 OH
Long Island Mobile ARC
W2VL 1,396 2 84 5,248 NLI
Wayne Co. ARA
K4CYP (+W4GOL)
1,239 2 46 4,964 NC
Eastern CT ARA
KZ1M (+K1MUJ)
1,229 2 15 4,876 CT
Holland ARC
K8DAA (+KE8BSL)
1,218 2 37 4,874 MI
CCDXARC
AD1T 1,380 2 28 4,750 NH
RC of Tacoma
W7DK 1,085 2 28 4,522 WWA
MGRA & CGARC
W4R (+N3DJO)
1,004 2 75 4,462 GA
W0GQ 1,265 2 45 4,460 IA
Columbia ARC
W4CAE (+K9DBC)
981 2 41 4,404 SC
Tyler ARC
K5TYR 1,236 2 50 4,294 NTX
Susquehanna Co. ARC
N3SRC (+W3GAA)
957 2 23 4,232 EPA
Bellbrook ARC
W8DGN 718 2 71 3,972 OH
Cherokee ARS
K4R (+KB4MG)
641 2 41 3,900 GA
The Lancaster ARC
W2SO 900 2 15 3,896 WNY
VE3VM 1,251 2 23 3,776 ONS
Delta & MARA & Nashoba & Tri-State
W4EM (+W4BS)
792 2 78 3,714 TN
W4BOC (+ND4AA)
836 2 62 3,704 GA
Phil-Mont Mobile RC
W3EM (+W3AA)
976 2 45 3,702 EPA
Orange Co. (NY) ARC
W2HO (+W2LGB)
679 2 46 3,684 ENY
Hancock AuxComm Team
WV8HAT (+KD8SKZ)
693 2 10 3,590 WV
Anne Arundel RC
W3VPR 616 2 45 3,390 MDC
Twin State RC
W1FN (+AE1H)
745 2 30 3,336 NH
Monongalia Wrls Assn.
W8MWA 623 2 42 3,016 WV
Blackford ARC
K9VND 707 2 44 2,936 IN
Grand Strand ARC
W4GS 449 2 33 2,934 SC
Alexandria RC
W4HFH 645 2 40 2,912 VA
Aero ARC
W3PGA 590 2 35 2,898 MDC
Northern KY ARC
K4CO (+KY4BSA)
567 2 28 2,758 KY
Clinton Co. ARA & Highland Co. ARA
W8O (+W8GO)
590 2 30 2,756 OH
Wood Co. EmComms
WC8EC 430 2 40 2,716 WV
Mohave ARC
K7MPR (+AD7GU)
554 2 25 2,682 AZ
Fulton Co. ARC
K8BXQ 575 2 6 2,668 OH
Wood Co. ARC
K8TIH 476 2 14 2,642 OH
Ft. Myers ARC
W4LX 351 2 20 2,620 SFL
LARA
W2RUI 393 2 20 2,366 WNY
RF Hill ARC
W3AI 754 2 15 2,302 EPA
South Bay ARA
KU6S 994 1 40 2,160 EB
Andrew Johnson ARC
W4WC 499 2 19 1,988 TN
Estero RC
W6JU (+W6SLO)
214 2 26 1,966 SB
Five Flags ARA
W4UC (+KB4HAH)
388 2 50 1,966 NFL
Bear Bait RC
W2JST 232 2 35 1,928 NNY
David Sarnoff ARC
N2RE 257 2 23 1,880 SNJ
Montague Co. ARC
NO5Y 119 2 9 1,878 NTX
Humboldt ARC
NU6O 162 2 25 1,864 SF
Guelph ARC
VE3ZM 484 2 9 1,840 ONS
Altus Area ARA
AJ5Q 140 2 12 1,788 OK
Western Carolina ARS
W4MOE (+W1PTS)
241 2 11 1,742 NC
Citrus Belt ARC
W6JBT 478 2 25 1,730 ORG
Elk Co. ARA
N3NIA 234 2 15 1,602 WPA
Muskegon Area AR Council
W8ZHO 151 2 37 1,570 MI
Norfolk ARC
VE3SME 302 2 20 1,568 ONS
London ARC
VE3LON 372 2 50 1,552 ONS
Stars RC
W9SRC 214 2 26 1,454 IL
Mesabi Wrls Assn.
NT0B 63 2 15 1,438 MN
Kilocycle RC of Ft. Worth
W5SH 113 2 15 1,354 NTX
Henderson ARC
W4KVK 22 2 15 1,330 KY
Yuba-Sutter ARC & Sutter High School ARC
W6KJ 270 2 36 1,250 SV
4th Regiment Comms Team & TN State Guard
W4RGT 128 2 11 1,222 TN
Madison Co. ARES
W8B (+KF5VPD)
35 2 4 1,158 MS
WCARS-Murphy & Cherokee Co. ARES
KN4LIJ 86 2 10 1,148 NC
Atlanta RC
W4DOC 47 2 20 1,056 GA
Skyview Radio Soc.
W3GH 312 2 14 1,036 WPA
Lakes Area ARC
WI9ELK 30 2 12 816 WI
Kachina ARC
W7EH 79 2 5 366 AZ

5A – Battery

Snake River ARC
K7SI 216 5 16 2,700 ID
North Coast ARC
N8NC 296 5 25 2,230 OH

5A – Commercial

Central LA ARC
N5I 1,216 2 35 4,254 LA
Frontenac Radio Grp
VE3FRG 870 2 6 3,496 ONE
Frontenac Radio Grp - Team B
VE3FPN (+VE3CSW)
958 2 6 3,306 ONE
Wisconsin ARC
W9CQ 260 2 15 1,370 WI
Brainerd Area ARC
W0UJ 287 2 12 1,354 MN
Chautauqua ARS
N2MQ 160 2 13 770 WNY

6A

Mike & Key ARC
K7LED (+AE7G)
3,599 2 45 13,038 WWA
Central KY ARS
AJ4A 2,814 2 22 10,500 KY
Rappahannock Valley ARC
K4TS (+NX4Q)
2,479 2 25 8,590 VA
Cuyahoga ARS
W8BM 1,941 2 60 7,586 OH
W2IR (+K2AE)
1,973 2 70 7,210 ENY
Mahoning Valley ARA
W8QLY 1,571 2 31 6,706 OH
Iredell Co. ARS
W4SNC 1,152 2 50 6,214 NC
Central Mass ARA
W1BIM 1,519 2 23 6,038 WMA
San Diego ARES
W6F (+KK6UC)
1,762 1 74 5,240 SDG
Ft. Wayne RC
W9TE (+KB9DEB)
1,041 2 91 5,002 IN
Sun Country ARS
N4EK 1,255 2 27 4,498 NFL
Owatonna Steele Co. ARC
N0UW 897 2 44 4,390 MN
Granite State ARA
N1QC (+KB1NH)
713 2 27 3,846 NH
Wayne Co. ARC
W3ARO (+WA2YLY)
798 2 22 3,820 EPA
Plano AR Klub
K5PRK (+K5F)
651 2 78 3,782 NTX
Kokomo ARC
W9GO 836 2 36 3,768 IN
Sangamon Valley RC
W9DUA 736 2 26 3,284 IL
Four Lakes ARC
W9JZ 541 2 49 3,174 WI
Fort Venango Mike and Key Club
W3ZIC 565 2 25 3,034 WPA
Birmingham ARC
W4CUE (+K4DSO)
444 2 35 2,938 AL
Vero Beach ARC
W4OT (+KC2LXV)
430 2 10 2,840 SFL
Delta ARS
VE7SUN 544 2 19 2,820 BC
Allegan Co. ARC
AC8RC (+W8RMN)
467 2 25 2,672 MI
Starved Rock RC
W9MKS (+K9ZQ)
366 2 32 2,630 IL
Middle TN ARS
W4UOT 424 2 32 2,606 TN
Peak Radio Assn.
W7PRA 360 2 12 2,538 OR
Grande Ronde Radio Amateurs Assn.
W7GRA 404 2 11 2,382 OR
Bonner Co. ARES/RACES
K7BNR 296 2 60 2,300 ID
Wilson ARC
WC4AR 419 2 15 2,236 TN
Red Rose Rptr Assn.
W3RRR (+W3COB)
341 2 15 2,226 EPA
Huntington Beach Races
W6O 211 2 24 2,052 ORG
Crasford Co. ARC
W8BAE (+W8DEL)
359 2 24 2,028 OH
Lancaster & Fairfield Co. ARC
K8QIK 404 2 14 1,920 OH
Saginaw Valley ARA
K8DAC (+KD8KDP)
140 2 20 1,562 MI
Kern Co-Central Valley ARC
W6LIE 83 2 25 1,308 SJV

7A

S Jersey Radio Assn.
K2AA (+W2EA)
4,227 2 66 15,964 SNJ
Orange Co. ARC
W6ZE (+W6NGO)
3,928 2 58 12,746 ORG
Fox River Radio League
W9NE (+W9CEQ)
2,943 2 50 9,822 IL
W6TRW ARA
W6TRW (+K6WMH)
2,144 2 58 7,434 LAX
Butler Co. ARA
W3UDX (+AA3YW)
1,663 2 15 6,658 WPA
Raleigh ARS
W4DW (+W4RAL)
1,820 2 94 6,642 NC
Edmond ARS
K5EOK 1,589 2 94 6,572 OK
Wabash Valley ARA
W9UUU (+W9KT)
1,657 2 41 5,910 IN
DuPage ARC
W9DUP 1,142 2 45 5,456 IL
Genesee Co. RC
W8ACW (+K8HMK)
1,190 2 32 5,348 MI
Toledo Mobile Radio Assn.
W8HHF (+W8ALM)
1,436 2 40 5,290 OH
Antietam Radio Assn.
W3CWC 728 2 36 4,228 MDC
Ak-Sar-Ben ARC
K0USA 985 2 23 3,638 NE
Sierra Nevada ARS
W7TA 593 2 20 3,404 NV
NB3T 800 2 9 3,334 VA
K8BMI 621 2 10 2,884 MI
PENN Wrls Assn.
W3SK 327 2 20 2,782 EPA
TCARES
K6TUO 316 2 20 2,628 SJV
NOARS - LCARA
K8KRG 261 2 24 2,336 OH
SW IA ARC
K0SWI 329 2 43 1,898 IA

7A – Commercial

Rogers Co. Wrls Assn.
WX5RC (+W2ND)
145 2 37 1,186 OK

8A

Gloucester Co. ARC
W2MMD 3,225 2 30 13,016 SNJ
Gwinnett ARS/ARES
W4GR (+KN4CGO)
2,195 2 104 9,404 GA
El Dorado Co. ARC
AG6AU 1,526 2 26 6,178 SV
K3QAC 754 2 11 3,728 MDC
Bluegrass ARS
K4KJQ 551 2 8 3,198 KY
Keuka Lake ARA
N2AAR 412 2 21 2,808 WNY
North Bay ARA
K6LI 354 2 50 2,594 EB
W0AU 270 2 38 2,536 MO

8A – Commercial

Orlando ARC
K1AA 632 2 30 2,598 NFL

9A

Woodbridge Wireless
W4IY (+W4AD)
4,424 2 30 16,988 VA
Forsyth ARC
W4NC (+W4S)
3,541 2 74 13,050 NC
Stanislaus ARA
W6ERE 481 2 33 2,820 SJV
South Wake ARC
N4SWC (+WB4TAL)
767 2 50 2,550 NC
Ventura Co. ARC
K6MEP 262 2 19 2,218 SB

9A – Battery

Orange Co. Radio Amateurs & Durham FM Assn.
W4EZ 2,261 5 53 21,645 NC

10A

BVARC & TDXS & KARS & ECHO
KK5W (+KT5TX)
3,025 2 96 13,154 STX
Nashua Area Radio Soc.
N1FD (+K1DLM)
2,496 2 53 9,620 NH
VCARS & SSARC & SCCC
N6R 2,125 2 136 7,332 SB
Utica Shelby EmComms Assn.
K8UO 1,676 2 47 6,826 MI
Glynn ARA
K4J (+KK4JMW)
663 2 21 3,938 GA

11A

Marple Newtown ARC & Mobile Sixers RC
N3NZ (+W3AWA)
1,614 2 60 5,982 EPA
Mississauga ARC
VE3MIS 1,027 2 18 5,202 GTA
Lodi ARC
N6SJV 282 2 31 2,402 SJV

13A

ARC at IN Univ & Bloomington High School S ARC
K9IU (+K9SOU)
880 2 32 5,644 IN

14A – Battery

West Valley ARA
K6EI (+W6ZZZ)
2,024 5 40 19,720 SCV

15A

Potomac Valley RC & Columbia ARA
W3AO (+K3CUJ)
10,472 2 60 33,942 MDC

20A

Conejo Valley ARC
AA6CV (+K6IDS)
887 2 80 6,018 SB

One or Two Persons Club/ Non-Club Portable

1B – 1 Operator

K5GN	1,806	2	1	7,374	STX
K1LT	1,259	2	1	5,186	OH
W2FU	1,069	2	1	4,616	IA
K8ER	890	2	1	3,810	MI
K8RYU	1,020	2	1	3,780	OH
NB3I	726	2	1	3,052	EPA
N3HCN	672	2	1	2,848	EPA
XL75A	752	2	1	2,636	BC
N8KD	561	2	1	2,580	MI
K7CAR	1,029	2	1	2,308	UT
N4UF	576	2	1	2,114	NFL
KM5VI	1,963	1	1	2,113	STX
W4KAZ	526	2	1	2,042	NC
K8AI	410	2	1	1,790	MI
W4SK	400	2	1	1,650	TN
W0XR	375	2	1	1,650	CO
N3ZP	298	2	1	1,342	EPA
W8KA	570	1	1	1,240	SB
KU7K	268	2	1	1,222	OR
K7A	195	2	1	1,200	MT
N7DLV	318	2	1	1,086	WWA
K5BIU	219	2	1	1,024	LA
N5HDX	197	2	1	1,012	NTX
NK8O	173	2	1	1,000	KS
W7ZRC	212	2	1	898	ID
KG0EW	221	2	1	892	CO
KO5Q	160	2	1	890	GA
AA6MU	175	2	1	814	SJV
K2KR	301	2	1	752	CO
W9KHH	64	2	1	706	WI
N7WY	179	2	1	700	WY
W1RO	92	2	1	696	EMA
KB8UHN	220	2	1	690	OH
VE7DDG	102	2	1	658	BC
WA6RC	98	2	1	646	LAX
VA4CQ	80	2	1	592	MB
N4DL	141	2	1	582	ME
KM4IZZ	207	2	1	564	TN
W6ZH	153	2	1	556	NM
KC1FOZ	102	2	1	554	NH
N6CAM	40	2	1	552	ORG
WD9EWK	38	2	1	544	AZ
KI4CJT	120	2	1	514	KY
K6BLY	100	2	1	500	SDG
WK5N	89	2	1	488	WWA
VE6QO	108	2	1	482	AB
WA5IEK	43	2	1	480	MS
N1XWI	97	2	1	472	NH
N4QX	25	2	1	434	CT
AE6DB	40	2	1	432	ORG
K9EGS	14	2	1	428	IL
KF5JRP	86	2	1	422	OK
K9YNP	35	2	1	420	MT
KG1Q	82	2	1	414	ME
WB0OFR	77	2	1	412	CO
KF3CG	128	2	1	406	WPA
WB2AXF	38	2	1	394	ENY
KD5DLZ	70	2	1	390	OK
N5JSC	118	2	1	386	LA
N7CFO	42	2	1	384	WWA
KD6RMS	115	2	1	380	LAX
KD0HR	65	2	1	380	CO
KJ4MFW	14	2	1	378	MO
W3RA	76	2	1	378	WPA
KG7YBY	59	2	1	368	ID
KM4VEN	58	2	1	366	VA
K6MH	8	2	1	366	LAX
N6VT	62	2	1	356	IL
K6KS	50	2	1	350	SV
AK7MG/6	73	2	1	346	SJV
KG5AUU	35	2	1	324	NTX
AD7DD	44	2	1	324	EWA
KG7HTE	36	2	1	322	OR
W2BXR	46	2	1	314	EPA
VE3HED	31	2	1	312	ONE
VE5YAK	27	2	1	304	SK
KB9GC	76	2	1	302	TN
AE6LA	20	2	1	290	SV
KB3IPZ	15	2	1	280	EPA
W0MBO	13	2	1	276	SF
W9IKU	44	2	1	276	WI
N1EYE	10	2	1	270	RI
N6XDX	57	2	1	264	SDG
WK1J	54	2	1	262	NH
NU4M	40	2	1	260	GA
VO1ZAP	4	2	1	258	NL
KB0YTO	3	2	1	256	NE
W5HLP	47	2	1	244	NTX
K3BYU	45	2	1	240	WWA
K9LA	23	2	1	234	IN
KG2E	40	2	1	230	KY
KI6NAZ	37	2	1	224	LAX
KK3XX	43	2	1	222	ME
VE3LFN	37	2	1	220	ONS
W1KAW	4	1	1	208	EMA
K5TAE	28	2	1	206	LA
KF7WGL	28	2	1	206	UT
K5MLY	28	2	1	206	STX
W4GLK	22	2	1	194	TN
WA2PCN	23	2	1	192	SC
N6OIL	21	2	1	192	ORG
K4MUS	21	2	1	192	TN
N2NGO	16	2	1	182	NLI
KB3NRL	16	2	1	182	EPA
N2NQ	65	2	1	180	VA
KF7ZKA	15	2	1	180	KY
KC3IPF	61	2	1	172	EPA
AC7CJ	7	2	1	164	EWA
KD8KTN	6	2	1	162	MI
VE6ZC	47	2	1	162	AB
K5EBY	5	2	1	160	STX
VE4XM	23	2	1	146	MB
KC5GOI	47	2	1	144	OK
WA7BME	19	2	1	126	UT
KJ7MEB	17	2	1	118	NC
K0FNS	13	1	1	113	CO
K6MCS	30	2	1	110	SV
KQ3Q	3	1	1	106	MDC
N8YRE	23	2	1	96	OH
VA7FFT	17	2	1	84	BC
W9JSP	10	2	1	74	WI
KK4ZUU	10	2	1	70	VA
N6FMD	5	2	1	60	SV
KE0JFG	3	2	1	56	CO
K9BZ	3	2	1	56	SV

1B – 1 Operator Battery

W3TS	501	5	1	5,460	EPA
K5SL	515	5	1	5,400	LA
NR8Z	348	5	1	3,930	OH
KF7MD	324	5	1	3,390	CO
N0EVH	280	5	1	3,350	MO
VE3KON	250	5	1	2,850	ONE
WO9K	243	5	1	2,780	IL
WA4DOX	232	5	1	2,470	VA
W2JLK	202	5	1	2,470	NNJ
W3WT	202	5	1	2,370	EPA
WF2V	195	5	1	2,235	WNY
K9MA	207	5	1	2,220	WI
KD2JC	210	5	1	2,200	NNJ
K9FOH	182	5	1	2,170	IN
KB8PGW	170	5	1	1,950	MI
N3RN	170	5	1	1,850	EPA
WD7Y	159	5	1	1,790	NV
VE3EDX	152	5	1	1,765	ONN
W1PID	110	5	1	1,550	NH
KF0XV	131	5	1	1,460	KS
K0BH	110	5	1	1,445	CO
WB5IUG	112	5	1	1,420	NTX
WA6ARA	106	5	1	1,395	SJV
K1SWL	103	5	1	1,375	NH
W0CZ	92	5	1	1,370	ND
K0RGI	110	5	1	1,350	TN
K0PC	120	5	1	1,350	MN
WB2ATZ	113	5	1	1,195	NLI
N1BYT	206	5	1	1,180	EMA
K9DDS	165	5	1	1,175	IL
K9KJ	100	5	1	1,150	IN
WU0L	75	5	1	1,100	SD
K3TW	71	5	1	1,060	NFL
WB3CEG	78	5	1	1,030	STX
KB5FIO	57	5	1	1,020	NTX
W3ATB	57	5	1	1,015	NH
WA2WMR	91	5	1	1,010	VA
KN3O	84	5	1	990	WPA
K8EG	79	5	1	985	OH
K5QR	70	5	1	950	NTX
KA4HHM	56	5	1	910	NFL
KB7LJP	56	5	1	910	WWA
WA9YEE	75	5	1	900	IL
WD5HNI	65	5	1	900	STX
K5DW	75	5	1	850	CO
K5WI	49	5	1	840	NTX
KC7RAD	128	5	1	790	IL
W0ITT	73	5	1	780	MO
W9FHA	73	5	1	780	IN
WA7ZZB	22	5	1	770	WWA
AA1RB	58	5	1	730	VA
N1UFO	91	5	1	705	NLI
WQ8RP	45	5	1	700	MI
K1PDY	45	5	1	700	NH
KA2BEO	53	5	1	680	SNJ
N0A	51	5	1	660	NE
N2DM	51	5	1	650	WNY
W4DIT	27	5	1	620	TN
K0EAP	57	5	1	615	MN
N9EP/7	35	5	1	595	MT
KB1HXO	46	5	1	580	WMA
W7SAG	43	5	1	580	UT
AG7AA	84	5	1	570	OR
WB4OBF	64	5	1	570	GA
KW7WP	49	5	1	560	OR
KC7FCW	34	5	1	500	WWA
AD0BI	39	5	1	500	MO
VE3DQN	25	5	1	500	ONE
NA4SO	24	5	1	490	GA
WQ2H	14	5	1	490	NH
N8ZVX	47	5	1	485	MI
VE2HEW	5	5	1	475	QC
KA2SJG	27	5	1	470	NNY
KI6TPX	39	5	1	445	LAX
KA2QYA	30	5	1	445	WNY
AD4S	18	5	1	430	GA
K6UZB	16	5	1	410	SCV
WA5DSS	36	5	1	400	STX
KB1HQS	10	5	1	400	VA
WA8MXJ	48	5	1	390	MI
K1DCT	19	5	1	390	CT
AC3BQ	27	5	1	385	SNJ
K4FBI	23	5	1	380	VA
KC9ZGY	33	5	1	375	WI
AC4ZU	45	5	1	375	AL
K0CD	44	5	1	370	WI
N1AIA	21	5	1	365	ME
KR6GG	2	5	1	360	SDG
AC0SR	31	5	1	360	MO
AI6VM	11	5	1	360	ORG
K2MTS	1	5	1	355	ENY
W0JP	20	5	1	350	KS
KI7IOC	54	5	1	340	EWA
KR4GT	37	5	1	335	KY
N4IX	36	5	1	330	GA
KB0LQJ	15	5	1	325	UT
K6GTE	10	5	1	320	ORG
K0TEA	52	5	1	310	MI
N6VNO	18	5	1	280	SCV
WB4MOR	23	5	1	280	TN
KA2YRA	6	5	1	280	ENY
N2HTT	19	5	1	270	ENY
VE2PID	12	5	1	270	QC
VA3FN	22	5	1	270	ONS
KM3K	2	5	1	260	EPA
N4IHS	15	5	1	225	WCF
KA1DTG	14	5	1	220	WMA
KD4NLE	3	5	1	215	WCF
K0NE	6	5	1	210	NE
KK6NVZ	10	5	1	200	SJV
N4OJT	10	5	1	200	KY
WD0BCT	9	5	1	195	CO
AB9MS	8	5	1	190	WI
AF7OS	3	5	1	180	AZ
NF8M	2	5	1	170	MI
K0ARG	2	5	1	160	CO
KG7FDK	1	5	1	155	EWA
AD6QQ	4	5	1	70	SCV
N1GNV	1	5	1	55	CT

1B – 1 Operator Commercial

AD0JA	804	2	1	1,658	MO
K3WR	198	2	1	806	WCF
AD5VM	500	1	1	650	OK
KT6A	81	2	1	574	EPA
W4DHT	239	2	1	528	OH
AE8TF	113	2	1	514	MI
VE3UZ	100	2	1	450	ONS
KC0IEA	54	2	1	358	IA
VE2PUI	58	2	1	254	QC
W1GHD	100	2	1	250	CT
N8VZ/3	49	2	1	168	DE
W9LG	44	2	1	138	NE
W0ND	44	2	1	138	ND
KC3BVR	24	2	1	116	EPA
KA9IVY	16	2	1	82	SC
KC2NYP	8	2	1	16	SNJ

1B – 2 Operator

W9AV	1,070	2	2	4,216	WI
W1MOO	1,000	2	2	3,926	VT
W7SE	600	2	2	2,450	WY
N9EZ	398	2	2	1,742	MI
K6TY	216	2	2	1,338	SJV
W8AWE	300	2	2	1,190	MI
NY6I	159	2	2	954	EB
K0W	33	2	2	762	CO
KA8GFB	200	2	2	750	OH
KK5HT	102	2	2	708	NTX
WD8U	96	2	2	642	WCF
KG7OKY	33	2	2	616	NV
VA3QR	74	2	2	606	ONE
K7SVX	227	2	2	604	ID
WA7SKG	104	2	2	566	OR
KB7XL	122	2	2	494	NV
W7TKE	103	2	2	462	MT
W8AKR	139	2	2	428	OH
AJ6AN	16	2	2	390	SDG
WD8TD	168	2	2	386	MI
KB7MLK	165	2	2	380	NTX
N6IV	152	2	2	378	SJV
WT8P	18	2	2	318	WWA
K5JTB	32	2	2	314	AR
KD9CES	81	2	2	312	IN
K5KWR	29	2	2	308	STX
K7BFL	27	2	2	308	EWA
N6KHO (+KD6MMZ)	103	2	2	306	OR
KG7VUI	98	2	2	296	SV
N0NS	34	2	2	296	IA
WX8C	43	2	2	278	MI
WA2EZG	35	2	2	170	NNJ

1B – 2 Operator Battery

N8PW	560	5	2	5,950	OH
N3CU	470	5	2	4,950	EPA
VA3YV	299	5	2	3,180	ONS
KI4IO (+KC4GIA)	301	5	2	3,110	VA
K0G	226	5	2	2,710	CO
W7EL	219	5	2	2,440	OR
KK2U	225	5	2	2,280	ENY
K6SB	100	5	2	1,345	SJV
KD4EE	119	5	2	1,240	KY
VE3KJQ	32	5	2	955	ONE
KA8GKT	64	5	2	825	IN
VE3HIE (+VE3IDX)	67	5	2	770	ONE
KB8ZUN	21	5	2	675	VA
KE0JWQ	2	5	2	660	CO
KG8YT	50	5	2	650	MI
WB5TXW	40	5	2	550	STX
AG6NS	52	5	2	510	SCV
N3OFR	44	5	2	470	EPA
AE6RF	24	5	2	390	SCV
K4SWL	25	5	2	385	NC
N7BRJ	27	5	2	240	VA
KB7YIV	6	5	2	200	ID

1B – 2 Operator Commercial

K4GU	262	2	2	1,244	AL
W1SEX	238	2	2	726	WMA
W9PNG	151	2	2	544	IL
N3JJT (+KD8ENV)	64	2	2	508	OH
VE6MRF	74	1	2	235	AB
W5TS	14	2	2	106	STX

2B – 1 Operator

W5RIR	30	2	1	112	NTX

2B – 1 Operator Battery

K8ZT	249	5	1	2,825	DE
AI6DO	65	5	1	1,115	LAX
WD8WV	37	5	1	415	WV

2B – 2 Operator

K8BTU	1,849	2	2	6,982	OH
K5ELF	400	2	2	1,756	STX
K0MPH	344	2	2	1,504	WI
WA9JG	202	2	2	1,110	STX
W0DYD	148	2	2	928	MN
W6BIV	126	2	2	876	LAX
KK4DDF	216	2	2	682	VA
WB9QAF	85	2	2	652	SD
W6YUE	40	2	2	630	SJV
NU7DE (+KD7TKQ)	57	2	2	620	AZ
N7QXO	26	2	2	602	OR
K9MAF	217	2	2	584	IN
AI5C	14	2	2	378	SCV
K6CAW	52	2	2	354	ORG

KF5PVT	17	2	2	310	NTX
KD5BBR	54	2	2	290	OK
N6FRG (KM6ELA & N6AXQ)					
	29	2	2	158	SJV
KC0ZIE	39	2	2	128	CO

2B – 2 Operator Battery

W4AMW	536	5	2	5,710	KY
N3A	482	5	2	5,070	WPA
WA4HWT	180	5	2	1,750	GA
VE3GTM	155	5	2	1,595	ONE
KJ4M	61	5	2	1,030	AL
N8M (K8BCI & KC8BPE)					
	41	5	2	760	OH
N0SUW	19	5	2	650	MN

2B – 2 Operator Commercial

NE7D	844	2	2	3,426	OR
K5EC	213	2	2	814	STX
N2DD	77	2	2	204	WNY

Mobile Stations

1C

W8UE	517	2	1	2,248	MI
W1JCW	378	5	1	2,140	NTX
W5NN	268	2	3	1,102	NTX
K4AEN	212	2	3	998	VA
AI9O	367	2	3	962	NTX
W7CGA	151	2	1	854	NM
K2NV/VE3	200	2	1	850	ONS
NC0B	272	2	1	644	CO
K7BWC	232	2	1	614	UT
NA1GB	154	2	2	614	EMA
N4CD	140	2	1	568	NTX
WA9STI	67	2	1	490	NV
K9JK	67	2	1	406	IL
KB8U	89	2	1	404	MI
K9ZU	179	1	1	387	MDC
AI9I	80	2	1	360	IL
NP2N/W0	22	2	5	294	IA
N8TFD	75	2	1	288	OH
AH6EZ	29	2	1	250	EWA
AD7BF	14	2	1	190	WWA
AD6Q	14	2	2	178	SFL
KQ0J	14	2	1	178	WCF
KG6WIK	64	2	1	178	SB
KQ2RP	21	5	1	175	NNJ
KY7K	11	2	1	172	AZ
KD2ABL	7	2	1	164	ENY
K1AP	53	2	1	156	CT
KB7VET	22	2	5	148	NV
KF4LMT	45	2	1	140	GA
W4VG	17	2	2	134	VA
K3SFP	16	2	1	132	VA
KD1TF	15	2	1	130	EMA
KB2YEK	39	2	1	128	NLI
N2NKX	11	2	1	122	WNY
KA1KNW	11	2	1	122	CT
KA3KSP	28	2	1	106	WPA
K9NYO	26	2	1	102	IL
KC9UXC	20	2	1	90	WI
NB3A	13	2	1	76	VA
KF3EI	4	5	1	70	SFL
KK6HWP	8	2	1	66	SCV
KS4FE/KL7	4	2	1	58	AK
N5PNZ	2	2	1	54	NTX

2C

WI7J	63	2	2	376	UT
N0PNT	6	2	1	262	CO

Home Stations Commercial Power

1D

N4BP	1,551	2	1	6,354	SFL
K7KC	1,570	2	4	5,192	UT
AA2BJ	931	2	2	3,358	EPA
K1DJ	699	2	1	2,846	EMA
K5ZD	772	2	1	2,538	WMA
K3WJV	1,209	1	1	2,461	EPA
WB8WKQ	582	2	1	2,432	MI
NW0M	550	2	1	2,250	MO
ND4Y	828	2	1	2,246	KY
VE7KW	526	2	1	2,112	BC
K7RL	1,286	1	1	1,986	WWA
W9PA	477	2	1	1,792	IN
N2UU	420	2	1	1,730	SNJ
K2MK	403	2	1	1,656	WCF
N2RI	374	2	1	1,646	NLI
WA5POK	394	2	2	1,594	TN
N8II	572	2	1	1,592	WV
N0GEF	394	2	1	1,576	MN
K9GDF	364	2	1	1,506	WI
K4BEH	288	2	4	1,502	GA
N4NA	350	2	1	1,450	TN
N2RA	348	2	3	1,442	WNY
KY0Q	331	2	1	1,440	IL
W5JMC	688	2	1	1,426	VA
AB1J	339	2	1	1,406	EMA
NP4AW	338	2	1	1,402	PR
W6SX	711	1	1	1,402	SJV
N8FYL	309	2	1	1,384	MI
K9MMS	300	2	1	1,350	IL
N9NM	325	2	1	1,350	STX
W2RR	486	1	5	1,322	WNY
AI3KS	236	2	1	1,292	EPA
K0AE	311	2	1	1,286	CO
WA0BJR	302	2	1	1,258	MO
N1DC	320	2	1	1,256	EMA
N6JF	283	2	2	1,232	ID
AI7H	262	2	1	1,198	ID
WB2KSP	333	2	1	1,166	ENY
W3CDI	296	2	1	1,146	MDC
W3GIS	266	2	1	1,114	MDC
WC3N	350	2	1	1,100	MDC
W2GPK	232	2	1	1,078	NFL
W8PN	245	2	1	1,030	OH
N9OF	235	2	1	990	STX
KB6UNC	318	2	1	980	UT
W3SOX	965	1	2	965	EPA
WB2FAU	481	2	1	962	SFL
K7XC	594	1	1	960	NV
KU2C	451	1	1	952	EPA
K7ZD	221	2	1	934	AZ
N2CQ	220	2	1	930	SNJ
W6UB	219	2	1	926	TN
N7MZW	437	2	1	924	WY
K4ZM	218	2	1	922	AL
WA3AAN	443	1	1	915	EPA
W1FM	460	1	2	915	EMA
W2LCQ	215	2	1	910	NLI
W5VX	261	2	1	902	STX
K8SAS	212	2	1	898	OH
W3FW	579	1	1	878	EPA
VA3SB	201	2	1	854	ONE
K6WSC	200	2	2	850	AZ
K4MX	203	2	1	812	VA
AA1CA	190	2	1	810	NH
W8ATM	190	2	1	808	OH
K3RWN	377	2	1	804	WPA
N3AM	380	1	1	801	MDC
K3FMF	185	2	1	774	EPA
K1DW	175	2	1	750	LA
AK9D	151	2	3	744	KS
WB9HFK	200	2	1	740	IL
VE3RCN	228	2	1	734	ONS
N4KC	415	1	1	728	AL
W3IUU	219	2	1	726	MDC
VE6JF	173	2	1	726	AB
W4SEC	401	1	2	723	NFL
KW4TO	259	2	2	720	VA
N3CZ	167	2	1	718	NC
WA7NWL	219	2	1	704	AZ
W4YE	175	2	1	700	VA
NY9P	161	2	1	694	IL
K6KQV	145	2	1	680	SCV
KC5YWN	309	2	1	668	AR
KD2IWW	164	2	1	664	ENY
W3NFB	207	2	3	664	MDC
CE2LR	376	1	1	657	DX
WB6FRZ	279	1	1	656	SF
K9UQN	258	1	1	655	TN
KM4VKY	113	2	1	654	NFL
K4JKB	169	2	1	654	VA
KW4VE	300	2	1	650	TN
W4PM	150	2	1	650	VA
W1VEM	530	1	1	641	CT
AA5AU	318	1	1	636	LA
K9GX	315	2	1	630	IN
W0MB	289	2	1	628	MO
KD4ADC	117	2	1	618	AL
WB2NVR	175	2	1	616	ENY
WW6M	146	2	1	614	SV
W1WAB	42	2	1	606	WCF
KF6I	304	1	1	605	ORG
VE6AO	551	1	2	601	AB
N7ESU	135	2	1	590	ID
N2QGV	105	2	1	570	NFL
KD2NSA	210	2	1	570	ENY
N5ZO	259	1	1	568	SDG
K4HQK	252	1	1	554	VA
KI5LR	126	2	1	554	STX
VE2FXL	155	2	1	554	QC
W4NBS	125	2	1	550	AL
K3IN	123	2	1	542	MDC
KB1WLB	211	2	1	540	RI
N4AU	95	2	1	530	AL
VY2DM	106	2	1	524	MAR
WA2QAU	117	2	1	518	WNY
KF3B	361	1	1	517	EPA
VE7WJ	178	2	1	516	BC
WA7YNU	98	2	1	516	MT
KC4TNQ	137	2	1	514	TN
KA5VZG	116	2	1	514	TN
KE2WY	113	2	1	502	WNY
WA0LIF	121	2	1	500	MN
KB6A	90	2	1	498	ORG
WB4P	115	2	1	498	NC
NE8J	112	2	1	498	MI
KF3G	112	2	1	498	EPA
K3PH	221	1	1	492	EPA
N4HAI	110	2	1	490	OH
KE7IZH	100	2	1	472	AZ
VE6WZL	469	1	1	469	AB
K8PJK	207	1	1	464	OH
N9LEO	103	2	1	462	IN
KD8BBK	103	2	1	462	OH
K5BZH	103	2	1	462	WTX
VA3EC	102	2	1	458	GTA
W6DR	204	1	1	457	SCV
K8AO	228	2	1	456	MI
W7WOW	153	2	1	456	NV
N2KDZ	125	2	1	454	NNJ
WA9PYH	100	2	1	450	IN
AK2U	100	2	1	450	WV
N1NN	100	2	1	450	EMA
N5OE	100	2	1	450	NTX
K5EEE	200	2	1	450	SFL
W2BEE	112	2	1	448	ENY
K6EM	112	2	1	448	ORG
KA1VMG	148	2	1	446	CT
K4GM	236	1	1	445	VA
VA6WWW	98	2	1	440	AB
N4EMP	77	2	2	436	AL
KC8R	96	2	1	434	MI
K9UW	183	2	1	432	WI
WA4TAS	95	2	1	430	DE
W8CON	102	2	1	428	MI
N4DBR	138	2	1	426	MI
K4ADB	350	1	1	425	SC
K7JQ	109	2	1	424	AZ
K1VUT	106	2	1	424	EMA
N3XZ	186	2	1	422	EPA
W2DXE	93	2	1	422	WNY
WA6URY	219	1	1	420	LAX
AF2O	174	2	2	418	EPA
WC3A	84	2	1	418	NFL
K4CAE	363	1	1	413	SC
WB4KFO	181	2	1	412	VA
WA5LXS	90	2	1	410	NTX
N9EAX	108	2	2	410	WI
N3MWQ	102	2	1	408	DE
AA2Y	100	2	1	400	ENY
KA4NXP	174	2	1	398	KY
W2VDZ	173	2	1	396	NNJ
VA7JC	74	2	1	392	BC
W6YR	91	2	1	392	ORG
KD8ATF	112	2	1	390	WV
K3JT	85	2	1	386	WV
AK3G	168	2	1	386	WPA
VE3SST	105	2	1	380	GTA
KC2DPF	164	2	1	378	VA
VE3RIA	138	1	1	376	ONS
N5PHT	162	1	1	374	NTX
K4RDU	81	2	1	374	VA
K5URU	81	2	1	374	STX
AI8TA	81	2	1	374	OH
N5QJ	160	2	1	370	AR
KT9X	77	2	1	358	NV
W1CAM	77	2	1	358	NE
AB1ZQ	106	2	1	356	VT
VE9VIC	76	2	1	354	MAR
VA2DLJ	76	2	1	354	QC
KA2FIR	111	2	1	352	NNJ
WO3T	101	2	1	352	WPA
W2GDJ	89	2	1	352	ENY
W6WU	148	2	1	346	MDC
N8RY	293	1	1	346	MI
K0LWC	97	2	1	344	CO
KJ4WD	75	2	1	340	NC
VE3EJ	150	1	1	340	ONS
KE4VA	145	2	1	340	SC
K8NGW	63	2	1	336	MI
K4AVX	71	2	1	334	KY
AI6O	167	1	1	334	SDG
KI7AAY	141	2	1	332	WWA
AC4FS	45	2	2	330	NFL
AD2L	70	2	1	330	EPA
AC5O	70	2	1	330	LA
KC2FYH	97	2	2	324	ENY
K6K	87	2	1	324	SJV
W7QDM	80	2	1	320	ID
AC2KP	135	2	1	320	WNY
KD4BTD	34	2	2	318	SFL
W6MZ	67	2	1	318	SDG
VE3JSO	74	2	1	316	ONS
WS6K	74	2	1	316	OH
N5PA	132	2	1	314	MS
N2NS	130	1	1	310	SJV
K3SV	65	2	1	310	WCF
W0PV	71	2	1	310	WCF
N2ZN	65	2	1	310	WNY
KB1W	223	1	1	310	WMA
KA2AEY	65	2	1	310	WNY
AB7MP	64	2	1	306	EWA
WS2N	53	2	1	306	NLI
W3NTP	69	2	1	306	MDC
W4JDS	64	2	1	306	GA
W8JJ	255	1	1	305	MI
VE3FMK	75	2	1	300	ONE
VE3CNA	125	2	1	300	ONS
W1WIU	223	1	1	300	RI
KS4S	62	2	1	298	NC
N6QQ	225	1	1	294	LAX
AB8VV	36	2	1	294	MI
VE6LB	73	2	1	292	AB
N4BFR	70	2	1	290	GA
WB6W	130	1	1	289	WWA
N4GG	125	1	1	286	GA
K6FW	68	2	1	286	ORG
W7OSU	80	2	1	284	OR
K9CEW	34	2	1	284	IL
K4VBM	115	2	1	280	GA
N0F	120	1	1	280	NFL
KE7A	65	2	1	278	NTX
KF6F	57	2	1	278	SJV
KF7U	113	1	1	276	AZ
KF2XC	112	2	1	274	WNY
W6FGJ	25	2	4	270	AR
KM4IAJ	134	2	1	268	VA
VE3FDZ	53	2	1	268	ONS
AB8RC	108	2	1	266	OH
W6TK	54	2	1	266	SB
AE9LL	100	2	1	264	IN
K5TMH	106	2	1	262	OK
N5VX	106	2	1	262	NC
VA3TPV	28	2	1	262	GTA
K3ZGA	65	2	1	260	NFL
N3TDE	208	1	1	258	EPA
KE8HEA	104	2	1	258	OH
KD2LMW	95	2	1	256	NNY
K2QB	51	2	1	254	WNY
K4HCK	51	2	1	254	TN
WQ6X	102	1	1	254	EB
KM4DJO	51	2	1	254	GA
KG5FPU	65	1	1	252	OK
WP3LR	63	2	1	252	PR
K7ZYV	50	2	1	250	MS
KB1YO	99	2	1	248	CT
KQ9J	127	1	1	247	WI
AC3BS	82	2	1	246	NNJ
KD8YNG	98	2	1	246	OH
AC8WC	98	2	1	246	MI
KO8S	52	2	1	246	MI
AC9PG	49	2	1	246	WI
WV5Y	54	2	1	244	STX
W4ORS	86	2	1	242	AL
KO9A	81	2	1	240	IL
AI9K	59	2	1	236	IL
K9ABR	93	2	1	236	IL
AA0CW	46	2	1	234	CO
W4WNT	21	2	1	234	NC
K7RBT	45	2	1	230	OR
KM2Q	44	2	1	226	SNJ
AI6LY	175	1	1	225	SCV
KF5ZPL	87	2	1	224	AR
WX4NFL	174	1	1	224	NFL
K2RET	209	1	1	223	SNJ
KM4QE	84	2	1	218	SC
KD5COL	84	2	1	218	TN
KN3A	67	2	1	216	EPA
K9DVB	82	2	1	214	WI
K2CYE	41	2	1	214	ENY
K4KGG	81	1	1	212	ENY
VE3SSB	66	2	2	212	GTA
OK1CZ	40	2	1	210	DX
KK4HQT	66	2	1	208	AL
N0RQV	79	2	1	208	CO
N9IO	104	1	1	208	IL
KC3HMY	28	2	1	206	MDC
KG2NI	103	2	1	206	WNY
K3NP	155	1	1	205	NC
W9JUN	76	2	1	202	IN
AD4TJ	38	2	1	202	VA
N2SCJ	101	2	1	202	SNJ
N2CJN	38	2	1	202	SCV
WZ6ZZ	75	2	1	200	EB
K7EFS	75	2	1	200	EPA
NC4MI	72	2	1	200	NC
KA2IWK	25	2	1	200	WNY
AD0RR	74	2	1	198	MO
KU1Q	80	2	2	194	CT
WE6EZ	143	1	1	193	STX
WA3ZMH	71	2	1	192	DE
W7AIT	73	1	1	192	SJV
N1TYH	51	2	1	190	WMA
W4VIC	70	1	1	190	VA
N6REK	19	2	1	188	SB
K0LMD	73	2	1	186	CO
K7DBN	45	2	1	186	UT
KK4BVN	36	2	1	186	NC
KC2PDO	67	2	1	184	NNJ
W4CWM	66	2	1	182	SC
KM6PRP	131	1	1	181	SB
W7KAM	90	2	1	180	MO
WM2Q	64	2	1	178	WNY
K8GT	32	2	1	178	MI
NR9K	54	2	1	178	IL
K7PEO	63	2	1	176	EWA
WA1RIW	58	2	1	176	EMA
K0LAF	52	2	1	176	MO
KC8ZMN	88	2	1	176	MI
K9UO	31	2	1	174	IN
KD5WBW	12	2	1	174	NTX
N5YHF	6	2	1	174	STX
KA2ENE	87	2	1	174	WNY
N7GTE	123	1	1	173	UT
KF5YUB	46	2	1	172	NTX
AE0CM	60	2	3	170	WI
K3JZD	30	2	1	170	WPA
KK6GJM	60	2	2	170	SJV
KA1C	47	2	1	168	ME
KD4QMY	59	2	1	168	GA
WD3H	29	2	1	166	EPA
K6MBD	58	2	1	166	SV
K0UW	8	1	1	166	MN
KD2GYO	58	2	1	166	ENY
K9WPV	57	2	1	164	IN

K2ZP	57	2	1	164	LA	AB8OU	23	2	1	96	OH
N7FAN	6	2	1	162	AZ	N4WQH	29	1	1	95	VA
N0GOS	40	2	1	160	CO	NS9DX	19	2	1	94	IL
WA6HZT	40	2	1	160	SF	KC0FUE	13	2	1	94	KS
N1AK	55	2	1	160	CT	AA4RA	44	2	2	94	SC
N5VWN	38	2	2	160	SJV	K9JDM	22	2	1	94	IL
W8JJB	45	2	1	160	OH	KX4II	47	2	1	94	GA
KE5NJ	79	2	1	158	DE	KD9GOL	21	2	1	92	IL
WM5F	27	2	1	158	ID	K2SAN	23	1	1	92	STX
W3KM	37	2	1	158	EPA	N5RWK	42	1	1	92	STX
WA7PTM	4	2	1	158	WWA	N3VMC	21	2	1	92	EPA
KA9EAK	53	2	1	156	WI	AI6II	19	2	1	90	SF
K7QDX	53	2	1	156	SV	K5NAX	20	2	1	90	LA
N5WVR	106	1	1	156	VT	KD2OMV	10	2	1	90	NNY
KF7ITF	21	2	1	154	AZ	K0APC	14	2	1	90	KS
AC2OC	26	2	1	154	ENY	KD8TNF	28	1	1	90	OH
KI4OXD	26	2	1	154	NFL	KD6OAU	20	2	1	90	ORG
KF6JXM	26	2	1	154	SDG	KC3GYU	20	2	1	90	WPA
VE1BZI	30	2	1	152	MAR	VE7YX	10	2	1	90	BC
WA9YI/0	51	2	1	152	IA	KA7PTW	19	2	1	88	AZ
K1AUS	51	2	1	152	MT	K3QDA	22	2	1	88	EPA
K9BEC	76	2	1	152	IN	W9ABK	19	2	1	88	IL
W1JFF	50	2	1	150	ME	VA2BS	19	2	1	88	QC
K2MFW	100	1	1	150	SNJ	N2BZD	22	2	1	88	SNJ
WB2UFO	100	1	2	150	MO	KD0JLE	36	1	1	86	CO
KB9AFW	74	2	1	148	MI	K5VOP	18	2	1	86	NTX
W8BFX	46	2	1	146	WWA	KF5RUW	18	2	1	86	STX
NE0DB	48	2	2	146	CO	N6DPL	18	2	1	86	ORG
KF8O	29	2	1	146	OH	K3AM	17	2	1	84	SF
KC0QIK	24	2	1	146	MO	KC3KDK	17	2	2	84	WPA
WA7BRL	36	2	1	144	WWA	KM4WYO	9	2	1	82	AL
KG7DAB	47	2	1	144	WWA	N5III	10	2	1	82	MDC
KA2DTH	47	2	1	144	VT	KG5GSI	16	2	1	82	NTX
N3AEA	23	2	1	142	MDC	WB8WUA	12	2	1	82	OH
N7MU	29	2	1	142	WWA	KF4IRC	16	2	1	82	AL
KI6SCT	46	2	1	142	SCV	N1TEN	16	2	1	82	SDG
W5UTW	24	2	1	142	STX	AB5XM	8	2	1	82	STX
KG5GJT	45	2	1	140	LA	K2EIR	16	2	1	82	ENY
K3VED	89	1	1	139	WPA	VE3IL	16	2	2	82	GTA
KB9TIM	40	2	1	138	WI	W7WR	27	1	1	81	WWA
WD6DX	25	2	1	138	SCV	WZ7U	15	2	1	80	OR
AA4MF	86	1	1	136	KY	K6ST	11	2	1	80	NV
KD8OBW	43	2	1	136	OH	AB7WP	14	2	1	78	AZ
W0JTC	67	2	1	134	UT	KK6DOA	14	2	1	78	SV
W3CB	21	2	1	134	MDC	KJ6TLX	14	2	1	78	SCV
WD8JPX	42	2	1	134	SFL	KA7RGW	14	2	1	78	AZ
KI4FH	21	2	1	134	WCF	K9TWW	38	2	1	76	MN
WJ4HCP	39	2	1	134	TN	KB3ZVH	38	2	1	76	WPA
KD5YPH	34	2	1	134	CO	KD2DVW	7	2	1	76	SNJ
KC0CQD	42	2	1	134	MO	KX1I	13	2	1	76	ME
KE4OBT	41	2	1	132	NFL	N6BXO	11	2	1	76	CO
KD8UWF	41	2	1	132	WV	AB9JS	13	2	1	76	AZ
K6AAI	41	2	1	132	SV	KI6WIR	12	2	1	74	LAX
WB9LRK	41	2	1	132	IN	N4AGL	12	2	1	74	NC
K4DSB	40	2	1	130	WCF	KD2KSG	37	2	1	74	WNY
N7QLK	40	2	1	130	VA	N9DIJ	12	2	1	74	WI
WA9ABC	20	2	1	130	IN	KC3HOJ	12	2	1	74	EPA
KD2HFN	39	2	1	128	NLI	N8HWV	8	2	1	74	WI
KD2FN	39	2	1	128	NLI	K7LTF	38	2	1	74	WWA
VE7DZO	32	2	1	128	BC	WS4JP	6	2	1	74	NFL
KA9PHI	39	2	3	128	IL	W7FZY	6	2	1	74	WWA
VA7VF	63	2	1	126	BC	KO6YG	36	2	1	72	SCV
NP4RA	21	2	1	126	PR	KB8SB	22	1	1	72	NFL
K4FU	31	2	1	124	NFL	AI4WM	11	2	1	72	MI
W3SFG	19	2	1	124	MDC	KI7DNO	1	2	1	72	UT
W1AVK	124	1	1	124	CT	AE4NT	11	2	1	72	NFL
KD9EII	37	2	1	124	IL	KE4WUT	11	2	3	72	TN
KB7YSY	37	2	1	124	AZ	VE6CSX	21	1	1	71	AB
KA7NPQ	36	2	1	122	AZ	W3IZ	10	1	1	70	CT
KI0CT	35	2	1	120	MO	VE2HAY	10	2	1	70	QC
K1PH	69	1	1	119	NH	KJ5R	5	2	1	70	NM
WU1N	19	2	1	118	OH	N3MCF	5	2	1	70	MDC
N5AJD	34	2	1	118	NTX	K9ELF	10	2	1	70	IN
KE4TP	34	2	1	118	WCF	KD2FIL	10	2	1	70	WNY
N0UIH	61	1	1	116	MO	K5MKS	10	2	1	70	NTX
N0EHX	33	2	1	116	CO	KA1RFD	5	2	1	70	ME
KC8LKB	33	2	1	116	WTX	KM3GWR	19	1	3	69	AL
KW4LU	32	2	1	114	TN	W2IOC	9	2	1	68	NNJ
KF5WXY	31	2	1	114	AR	K7EAW	9	2	1	68	ID
W1FYG	32	2	1	114	CT	K5JPB	64	1	1	67	NM
W4SOF	63	1	1	113	NM	JA1YNE	4	2	1	66	DX
WB2AOZ	46	2	1	112	NTX	JK2VOC	4	2	1	66	DX
KD0RSX	55	2	1	110	MO	KJ4QAN	8	2	1	66	NFL
N1IBM	29	2	1	110	SNJ	N8LWF	8	2	1	66	OH
K7JKM	30	2	1	110	OR	K1TQ	8	2	1	66	NH
K4QR	29	2	1	108	NFL	WB0NPR	8	2	1	66	IN
VA7XZZ	29	2	1	108	BC	W8IDW	4	2	1	66	WV
N3GD	27	2	1	108	WCF	KG4WNA	8	1	1	66	KY
KM4RTP	29	2	1	108	GA	KE7SW	14	1	1	64	WWA
KG4USN	23	2	1	108	MDC	K0MO	32	2	1	64	SF
KB9GEG	29	2	1	108	IL	W9YM	14	1	1	64	IN
W3RLO	29	2	1	106	DE	KC2TFI	6	2	1	62	WNY
W7LN	31	2	1	106	MO	W2PIX	6	2	1	62	EWA
KJ4LQX	37	1	1	105	SFL	W8FSM	3	2	1	62	MI
K0MIS	22	2	1	104	CO	N0MCW	6	2	1	62	CO
N5US	27	2	1	104	STX	K9KFR	3	2	1	62	IN
WD8BXP	52	2	1	104	MI	KB7HDX	6	2	1	62	EWA
KK9V	26	2	1	104	IN	K9AWM	6	2	1	62	IN
W0PAN	26	2	1	102	AZ	KC1WD	3	2	1	62	EMA
K9RE/8	26	2	1	102	MI	KM6HCD	6	2	1	62	ORG
K0RVB	50	1	1	100	STX	W7SLS	11	1	1	61	WWA
N5PV	14	2	1	100	STX	AG7JQ/6	11	1	1	61	SCV
KI7ELQ	12	2	1	98	WWA	WG7X	44	1	1	61	WWA
K9WWW	24	2	1	98	WWA	WO8M	19	2	2	60	MI
N3VFK	48	2	1	96	ID	AB1OP	5	2	1	60	ME
KC1PUG	23	2	1	96	WMA	WX2DX	3	2	1	60	WPA

Cornwall, Ontario, Community Councillor Bernadette Clement (left) was excited after making her first contact under the guidance of Chris Lauzon, VA3CRR, at the Seaway Valley ARC (VE3VSW) Field Day station. [Art Horovitch, VE3AIH, photo]

KF5NRS	5	2	1	60	NTX
KO4PM	5	2	1	60	WCF
AI6NT	5	2	1	60	SCV
NA6AA	4	2	2	58	SDG
KD6GWH	4	2	1	58	SB
K4SNE	4	2	1	58	AL
AI6ZV	3	2	1	56	ORG
KI7FQT	3	2	1	56	AZ
KF7YRW	3	2	1	56	AZ
W3MY	16	2	1	56	NFL
W5GZ	3	2	1	56	NM
WA5KMH	5	1	1	55	WTX
KB5NJD	1	2	1	54	NTX
K2BCM	2	2	1	54	WNY
AG6YO	2	2	1	54	SCV
K3MF	1	2	1	54	EPA
AB3KC	2	2	2	54	VA
KI0HA	2	2	1	54	MO
KJ6PRH	1	2	1	52	ORG
N1HOB	1	2	1	52	OK
NR6T	1	2	1	52	ORG
WA5VRO	1	2	1	52	STX
VE2GT	1	2	1	52	QC
KC5JRT	1	2	1	52	STX
K0TCM	24	2	1	48	GA
W1UED	24	2	1	48	CT
W8SJB	22	2	1	46	OH
W4LAN	23	2	1	46	VA
K4TSO	21	2	1	42	SC
AJ4ZU	11	2	1	42	VA
KE0ARY	40	1	1	40	MO
KI4KKB	20	2	1	40	SC
K5WRN	37	1	1	39	STX
WA5YNE	39	1	1	39	OK
N7IZM	18	2	2	36	AZ
AF7VC	17	2	1	34	OR
K7YJ	17	2	1	34	AZ
KC2LST	33	1	1	33	NNJ
KA7RON	16	2	1	32	WWA
AG5PP	8	2	1	32	STX
AD6GE	16	2	1	32	ORG
WB4JJJ	8	2	1	32	VA
KM6FEF	16	2	1	32	LAX
KG8IU	14	2	1	28	OH
KN3D	14	2	1	28	MDC
WO2N	7	2	1	28	NLI
KG4GVJ	13	2	1	26	NC
KD2NOP	24	1	1	26	NLI
KC8GTE	12	2	1	24	MI
N2VIG	11	2	1	22	NNJ
KC1EWL	11	2	1	22	WMA
K6DLB	22	1	1	22	LAX
AI6IN	9	2	1	18	SV
K4AKY	17	1	1	17	KY
KE7ZAC	14	1	1	14	WWA
N6TCZ	12	1	1	13	LAX
KM6ERJ	5	2	1	10	LAX
AA6AC	2	2	1	8	SB
KC9BBW	4	2	1	8	VA
KF6FIX	1	2	1	2	ORG

2D

KG5HVO	1,262	2	1	4,338	AL
W4RYZ	684	2	24	3,076	NFL
W9VW	1,811	1	3	2,053	IN
N3COB	620	2	5	1,796	MDC
N2BJ	1,373	1	2	1,423	IL
W4NUN	418	2	9	1,410	GA
W7SA	333	2	15	1,264	AZ
VE3OW	531	2	6	1,254	ONS
VE7RAR	177	2	9	1,234	BC

K8CGE	236	2	2	994	OH
W5CCW	237	2	5	794	MS
KN5S	151	2	4	708	STX
WA4GDN	110	2	35	694	WCF
K5IX	110	2	2	576	STX
K8RJW	172	2	2	566	OH
K4TAK	47	2	1	286	TN
KJ6PWP	65	2	2	206	SV
KK4AND	63	2	1	176	WCF
W6LU	60	2	2	170	ORG
W3LAK	68	2	3	148	EPA
N4YHC	29	2	1	108	KY
KN4DQZ	19	2	1	88	TN

3D

W4HOG	951	2	21	3,284	NC
WD6RAT	263	2	23	990	ORG
W1GLO	169	2	9	674	EMA
W5JDX	201	2	3	458	MS
WA1UKD	94	2	4	326	NE
N9QID	109	2	5	288	MI
W5AW	85	2	3	270	WTX

4D

W7P	517	2	5	1,584	AZ
W0MI	314	2	15	1,054	KS

5D

W9VT	399	2	14	1,990	IL

Home Stations Emergency Power

1E

VE3MGY	1,421	2	1	6,134	ONS
KH7X	1,266	2	1	5,214	AZ
KC3WX	1,214	2	1	4,768	EPA
K9OM	1,103	2	1	4,662	WI
N0TT	993	2	1	4,122	MO
KE0UI	1,045	2	1	3,976	CO
W1AQ	1,438	2	8	3,624	RI
N3JT	806	2	1	3,374	VA
AE5GT	796	2	1	3,334	STX
WT9U	746	2	1	3,034	IN
W9XS	696	2	1	2,872	IL
K1EEE	706	2	3	2,656	NH
KE1IU	528	2	2	2,628	CT
WC4D	1,131	2	1	2,612	KY
KP2XX	1,077	2	1	2,404	VI
K4BSK	562	2	2	2,366	VA
K4WW	565	2	1	2,310	KY
K4RCA	956	2	1	2,262	VA
N6F	1,499	1	18	2,157	SV
NO8C	502	2	1	2,064	OH
N5HC	840	2	1	2,050	NM
WA1ENO	911	2	2	1,972	EMA
N1JD	438	2	1	1,902	ME
W8HH	566	2	19	1,894	OH
N3FJP	803	2	1	1,860	MDC
W6KC	467	2	1	1,848	LAX
K3HW	305	2	3	1,810	EPA
W4TM	583	2	2	1,778	GA
KA5M	406	2	1	1,774	LA
K1KA	1,618	1	1	1,680	NH
N3RC	600	2	1	1,666	SF
VE7JKZ	373	2	1	1,642	BC
K7IA	346	2	1	1,628	NM
NF3R	761	2	1	1,626	EPA
K5AEM	669	2	4	1,582	NTX
W4UT	342	2	1	1,518	TN
N1MHC	325	2	8	1,510	ME

W7GB	289	2	1	1,506	EWA
W7WSV	285	2	1	1,490	AZ
VE3SB	325	2	1	1,450	GTA
NM5FD	301	2	17	1,440	NM
K3WYC	322	2	1	1,438	AZ
W0UY	278	2	2	1,362	KS
N4UM	275	2	1	1,350	SFL
AF0Z	311	2	1	1,346	MN
N7MO	204	2	1	1,272	EWA
VE7IO	210	2	1	1,190	BC
W7POE	210	2	1	1,188	WWA
K1SEC	261	2	1	1,144	EMA
KJ6TQ	285	2	2	1,140	MO
N2MTG	483	2	1	1,116	ENY
K4QD	883	1	1	1,113	SFL
VE7NI	165	2	1	1,110	BC
W4YG	265	2	1	1,110	VA
K6ODS	855	1	2	1,105	SV
N8BV	525	2	1	1,100	OH
WB5UAA	227	2	1	1,058	NTX
KU4V	274	2	1	1,056	NC
W3KS	335	2	1	1,020	DE
N4DLT	244	2	2	1,016	NC
N5RP	279	2	1	972	IL
NI1Y	100	2	5	970	TN
K7TH	201	2	1	954	MI
W6RKC	241	2	1	940	SV
AD8J	475	1	1	905	NC
KN4FRG	230	2	1	898	MO
KE8USA	300	2	2	850	OH
K0GEO	150	2	1	848	STX
WB8RFB	153	2	1	838	IL
N7DB	182	2	1	832	OR
K2NPN	145	2	1	830	WNY
AD0RW	123	2	1	826	IA
K1IM	336	1	1	822	CT
W7GF	141	2	1	814	OR
W6GMT	120	2	1	808	MN
NN9X	202	2	4	784	IN
K2OGT/3	157	2	1	778	EPA
W4GHV	217	2	1	760	NC
KE4UKX	126	2	7	754	VA
W7RT	229	2	1	738	AZ
W5YM	194	2	10	738	AR
W1GKT	224	2	1	734	AL
K6IJ	339	1	1	728	SV
NS8O	116	2	1	714	OH
KN0WCW/4	87	2	1	698	WCF
W5JVR	108	2	1	682	GA
KC0UXC	104	2	1	666	SD
AC1J	211	2	1	664	NH
KK4HEG	152	2	1	658	NC
NC6V	101	2	1	654	ORG
W8NOR	126	2	1	654	AZ
AA8GP	183	2	1	650	OH
K3URT	196	2	1	644	EPA
KB2MN	100	2	2	636	SNJ
KJ6KCG	142	2	1	634	ORG
W4UAL	575	1	3	625	AL
K8PXR	258	2	1	616	OH
K3CSF	187	2	2	614	WPA
N8PFK	232	2	1	614	MI
N5DD	170	2	1	610	NTX
W6DOJ	152	2	3	596	SV
KX7L	123	2	1	594	WWA
VA7GI	174	1	1	582	BC
KC7O	213	2	1	580	LAX
K4JDF	211	2	1	572	MDC
W9MAP	159	2	3	568	IL
W9WB	135	2	7	560	IL
KB0YH	99	2	1	548	CO
VE1AOE	95	2	1	530	MAR
WA8KBU	94	2	1	526	OH
KE3GK	180	2	1	520	MDC
K0CQ	93	2	1	518	IA
WU6W	99	2	1	510	NV
W7SUA	74	2	1	498	AZ
N6WT	228	1	1	484	SB
W1FJ	108	2	1	482	EMA
AC8UC	60	2	1	482	OH
NP2GG	114	2	1	478	CT
KB4RG	63	2	1	476	WTX
KD7KKC	162	2	1	474	ID
WO3X	111	2	1	472	OH
N3BAL	55	2	1	460	MDC
K3ORS	105	2	1	460	TN
K7EA	77	2	1	458	UT
AE5MM	51	2	1	454	OK
WB3CJU	302	1	1	452	EPA
W4KRN	105	2	1	450	VA
NC6DX	118	2	3	448	SV
KW7DSP	48	2	1	446	OR
NN7NN	110	2	3	438	SV
WA0LJM	104	2	1	434	MN
VA3TPS	113	2	1	432	ONE
N0EMU	86	2	1	422	CO
KF4VXJ	31	2	1	422	NC
NT9F	172	1	1	422	IN
K7FYI	134	2	1	418	NV
KC8BW	67	2	1	418	MI
K9SW	65	2	1	410	IL
WL7CSJ	177	2	1	404	AK
KK5JY	63	2	1	402	OK
W4ZPR	50	2	1	400	VA
W8TV	50	2	1	396	WV
W6RQR	51	2	1	394	SV
N9ZG	36	2	2	394	SC
KR4BW	74	2	1	394	GA
W1HMM	68	2	1	386	NH
K7RFW	48	2	1	384	UT
NA9VY	67	2	1	384	IN
W8AAM	116	2	1	382	MI
N1ILZ	84	1	1	382	EMA
KA0AIG	64	2	1	378	MO
W0MAR	110	2	1	370	CO
KL1JP	7	2	1	366	AK
N4NVG	108	2	1	366	VA
N4JAH	157	2	1	364	GA
AJ4EY	54	2	1	358	VA
K7KXO	54	2	1	358	WWA
VE2CRD	86	2	5	358	QC
WA3SWJ	51	2	1	354	EMA
VE9AV	101	2	2	352	MAR
WM7Y	101	2	1	352	NV
W4LTE	75	2	1	350	NFL
N6NKO	33	2	1	346	WI
N7PR	74	2	3	346	SV
VA3PCJ	48	2	1	342	ONE
AG4YL	45	2	2	340	GA
W6MJS	73	2	1	338	UT
AI4GR	74	2	1	336	NC
W2MRD	42	2	1	334	ENY
W7DBA	40	2	1	330	UT
W7JZE	39	2	2	328	AZ
AC5TU	113	2	1	328	NTX
K1GMM	87	2	1	324	VT
W1OHM	70	2	1	322	NH
KG5GCC	78	2	1	308	MS
KA4ZBN	29	2	1	308	SC
AG6JN	13	2	1	302	ORG
W7ON	100	2	1	300	AZ
AC2BI	60	2	1	290	EPA
W6KYF	35	2	1	290	SCV
KC2WI	69	2	1	288	NNY
N2USM	68	2	1	286	ENY
WA0PFC	66	2	1	282	UT
WY0I	64	2	1	278	KS
K4PH	63	2	1	276	NC
W6DPM	87	2	1	274	LAX
N3C	42	2	4	274	NC
KM4AJ	38	2	1	272	SC
W2F	111	2	2	272	NNY
KJ6RVK	10	2	1	270	ORG
WA7GVT	50	2	2	270	ND
KF6TJR	10	2	1	270	EB
K9YAW	57	2	1	264	IL
KI5FJ	32	2	2	264	VA
W6BUF	53	2	1	262	LAX
KJ4VTH	80	2	1	260	VA
AD6DM	4	2	1	258	SJV
WB2U	51	2	1	254	MDC
W1TFS	51	2	1	252	NH
K0AOM	100	2	1	250	MN
K0MV	25	2	1	250	CO
WJ4E	49	2	1	246	SC
W4CFS	97	2	1	244	SFL
KD0IOE	29	2	1	240	ND
WX8W	94	2	1	238	OH
N6CKV	38	2	1	226	SV
N8YQM	34	2	1	224	OH
N1DOU	57	2	1	220	NH
K9WKD	80	2	1	210	IL
KM4ICE	30	2	1	210	VA
W2ECK	40	2	1	210	GA
W9CDK	29	2	1	208	IL
WZ6P	58	1	1	208	SB
AC2QH	14	2	1	202	ENY
KC9BZL	13	2	1	202	IN
WD9GET	13	2	1	202	STX
N8GGO	25	2	1	200	MI
KB4LHP	23	2	1	196	NFL
KR0RD	46	2	1	192	MO
KL4OB	20	2	1	190	AK
KC3EF	48	2	1	190	NFL
KB8RPO	49	2	1	190	NH
KG5AOP	19	2	1	188	NFL
KI4ENS	18	2	1	186	KY
WB2TVB	18	2	1	186	LAX
KJ4CEG	18	2	1	186	SC
K9RL	17	2	1	184	OR
KE6FNQ	15	2	1	180	VA
KN4DZX	13	2	1	176	TN
K1TDO	12	2	1	174	CT
KD8ORN	60	2	1	170	OH
KH6DH	10	2	1	170	PAC
WB6YYZ	10	2	1	170	EPA
AG6JA	48	2	1	166	EB
KD0VUB	6	2	1	162	NE
W4ES	30	2	1	160	AZ
KB1UMD	4	2	1	158	EMA
N0JK	2	2	1	158	KS
K8WZY	4	2	1	158	OH
K5KMS	55	1	1	155	NTX
VE3EYI	40	2	1	154	GTA
N5CWA	27	2	1	154	STX
AK8T	50	1	1	150	OH
W3WOT/4	46	1	1	146	NC
NT4Z	23	2	1	146	WCF
K1RFD	40	2	1	146	CT
N3FP	47	2	1	144	GA
KV4ZY	46	2	1	142	OH
KI4DHW	90	1	1	140	VA
N8DXC	18	2	1	138	MI
KA4NDY	15	2	2	130	AL
W4UJ	20	2	1	130	SFL
NJ7W	20	2	1	130	WWA
KJ6KK	13	2	1	126	SJV
K7PCB	26	2	1	124	UT
NJ6A	11	2	3	122	ORG
W8BRY	21	1	1	121	VA
AD3Y	15	2	1	110	SNJ
N8PVL	30	2	1	110	MI
KE0JMK	28	2	1	106	OH
WA8WZG	19	2	1	88	AZ
KE4D	18	2	1	86	NFL
KA6ZTO	17	2	1	84	ORG
W5JPT	8	2	1	82	NTX
AD6AF	14	2	1	78	LAX
KD5TKR	11	2	1	72	WTX
KC0QYU	10	2	1	70	CO
K7BIK	4	2	1	58	OR
W8KNO	3	2	1	56	OH
KM4KBS	1	2	1	52	VA

2E

NI5T	3,653	2	3	12,790	NM
AA3B	3,354	2	2	12,206	EPA
W5CT	2,665	2	6	9,404	STX
K5KG	2,565	2	3	8,960	WCF
KQ2F	2,441	2	3	7,932	NLI
W4IZT	2,242	2	10	7,850	GA
KP3Z	1,834	2	2	6,332	PR
K4OO	1,520	2	12	5,814	NC
W0BX	1,242	2	4	4,358	CO
W5ROK	1,157	2	5	3,900	NTX
K3CCR	1,020	2	2	3,752	MDC
VA7MM	509	2	5	2,410	BC
KT1I	474	2	2	2,346	WMA
K6RC	1,269	1	9	2,171	SV
NZ1U	506	2	3	2,022	WMA
VE6FI	1,553	1	4	1,803	AB
W9NXM	344	2	5	1,760	IL
W9AIU	316	2	15	1,514	IL
KC9SNM	317	2	5	1,452	IL
AK7AT	260	2	2	1,322	ID
N3GWZ	334	2	2	1,312	MDC
AA9UF	236	2	2	1,284	IL
W3SW	457	2	2	1,276	WNY
K7JAR	153	2	20	1,256	EWA
W9MXQ	350	2	4	1,250	WI
W0PL	165	2	3	878	MN
K2VER	201	2	10	826	NNJ
KK6JX	142	2	2	790	NC
W6NJB	264	2	2	778	AR
KD0LHI	56	2	2	762	ID
W4MIN	84	2	6	664	WCF
KG5IXI	95	2	2	600	NM
K0AFA	115	2	2	480	CO
VE5SR	58	2	1	466	SK
K6KNR	15	2	1	280	ORG
W8M	229	1	17	279	OH
K7PNX	52	2	8	214	AZ
W8PIX	45	2	4	140	MI

3E

W4CB	2,672	2	6	9,820	VA
N4BRF	1,725	2	57	7,004	SFL
W4GJ	1,316	2	3	5,814	NFL
W1AEC	1,908	2	11	5,758	EMA
N3DUE	1,681	2	3	5,088	MDC
W5GAD	1,085	2	57	4,878	LA
W4GZX	786	2	72	3,320	TN
W1S	772	2	14	3,294	IN
K9ILS	820	2	22	2,854	IL
N1WW	617	2	14	2,496	WMA
W7TBC	421	2	20	2,360	AZ
NI9M	417	2	6	2,318	IL
W8CCI	744	2	15	2,302	OH
WB2ELW	415	2	13	2,268	WNY
W0SV	454	2	12	2,184	MN
W8FT	540	2	10	2,060	OH
K5WPH	506	2	25	1,976	WTX
W4SHL	526	2	10	1,808	AL
W3KWH	276	2	15	1,184	WPA
WG0D	223	2	5	1,074	MN
KB2URI	89	2	1	952	WNY
W4ZBB	108	2	17	926	NFL

4E

K5GDX	1,773	2	14	6,900	MS
K3MJW	1,550	2	17	5,596	WPA
W3GV	1,086	2	18	4,084	WPA
K3WEB	586	2	43	2,462	EPA
K7LWH	220	2	25	1,470	WWA
K6SEE	269	2	11	1,088	SDG
KT7AZ	203	2	6	1,058	AZ

5E

N4SVC	2,721	2	10	7,448	NFL

7E

W0NT	2,500	2	17	8,930	CO

Home Stations Emergency Power – Battery

1EB

KW8N	947	5	1	10,020	OH
KU3X	607	5	2	6,320	EPA
N2CN	467	5	1	4,820	CT
W9TS	430	5	1	4,550	IL
WX8J	403	5	1	4,380	OH
AB7BB	390	5	2	4,350	AZ
N0UR	412	5	1	4,170	MN
AB9CA	363	5	1	3,880	IN
WA8KAN	348	5	1	3,530	WV
N8BB	267	5	1	2,720	MI
W1ECH	263	5	1	2,710	VT
N4CF	256	5	1	2,530	VA
WU9B	242	5	1	2,470	AZ
KU4A	234	5	1	2,315	KY
VE3WZ	200	5	1	2,150	GTA
NC4RT	186	5	1	2,110	NC
NE3R	156	5	4	1,945	MDC
N3MLB	158	5	1	1,830	EPA
NE3I	138	5	1	1,765	EPA
WO8L	161	5	1	1,760	NC
W1JN	137	5	1	1,620	CT
N9ZI	150	5	1	1,550	IN
KA2FHN	153	5	1	1,545	WNY
KX4FR	185	5	1	1,505	TN
K5TSK	109	5	1	1,440	AR
W8NNC	126	5	1	1,410	OH
N5EM	121	5	1	1,360	STX
AB8DF	111	5	1	1,260	MI
KR0U	109	5	1	1,240	CO
KF7WNS	101	5	1	1,160	OR
WB4BIN	100	5	1	1,150	NTX
WG4FOC	73	5	1	1,080	NFL
N7NB	69	5	1	940	WWA
K4FTY	132	5	1	910	AL
W6COW	75	5	1	900	LAX
K1TW	83	5	1	870	EMA
WA4FOM	52	5	1	860	NNJ
AB4EL	71	5	1	715	NC
K6JW	46	5	1	710	LAX
AA5TB	45	5	1	700	NTX
WG5F	42	5	1	665	OK
N3KCM	75	5	1	640	EPA
N4RLI	40	5	1	600	VA
K5HH	15	5	1	580	MS
NV5S	43	5	1	580	STX
N8OQ	65	5	1	575	VA
N9XAU	32	5	1	570	IN
WB7OND	44	5	1	540	NC
N9BT	38	5	1	530	IL
N7NEV	8	5	1	520	AZ
W7CKW	34	5	1	490	OR
W0ENE	31	5	1	460	NFL
VA7ST	40	5	1	450	BC
W4POT	38	5	1	440	NFL
N2JPR	36	5	1	410	NLI
KD9EBS	25	5	1	400	IL
WA4AAK	23	5	1	365	AL
NR8TD	43	5	1	365	OH
WB8ENE	21	5	1	360	OH
N4VSD	20	5	1	350	TN
KC1CNO	40	5	1	350	CT
AA6OC	20	5	1	350	ORG
N3HEE	16	5	1	310	MDC
KB0LF	16	5	1	310	NE
VE3CQH	4	5	1	290	ONS
KG6CUK	26	5	1	280	LAX
WO2B	7	5	1	220	CT
KE4UZL	11	5	1	205	SFL
AF9J	15	5	1	200	WI
N3JIX	16	5	1	175	EPA
N3WXW	12	5	1	160	EPA
KB6DEF	1	5	1	160	EB
KB3USC	11	5	1	155	MDC
K6GPB	7	5	1	120	SV
KC3EYS	8	5	1	90	WPA
KJ0P	1	5	1	55	MN
KE5ZDZ	1	5	2	55	STX

2EB

NA3DX	500	5	6	5,760	MDC

3EB

AB5J	23	5	3	1,165	OK

EOC Stations

1F

Albuquerque DXA					
W5UR	700	2	7	3,696	NM
Parsippany OEM RACES Team					
NI2S	1,016	2	17	3,182	NNJ
Cottonwood Heights ARC					
W7RCH	424	2	20	2,540	UT
West Essex ARC					
W2EF	354	2	8	2,136	NNJ
WX5FWD Skywarn Team					
W5T	187	2	9	1,526	NTX
American Red Cross					
KY4RC	210	2	20	1,510	KY

Amargosa ARC
N7A 153 2 8 1,496 NV
Montvale NJ EOC
K2FJ 209 2 4 1,460 NNJ
Will Co. EMA Amateurs
W9WIL 214 2 5 1,198 IL
Truro ARC
VE1AO 282 2 22 1,168 MAR
Metro ARC Chicago
W9L 198 2 25 1,126 IL
Fayette ARA
K8FAY 350 2 4 1,050 OH
Dartmouth ARC
VE1YO 196 2 1 1,034 MAR
Cedar Creek ARC
K5CCL 147 2 29 944 NTX
El Segundo ARG
WB6VMV 224 2 10 918 LAX
Menlo Park Fire CERT
K6ATH 35 2 8 892 SCV
N5MI 189 2 10 746 WTX
Winchester & Clark Co. EOC
AC4YD 184 2 3 718 KY
Meridian AmRad Op Lauderdale Emerg Mgmt Stn
WX5MEI 85 2 5 672 MS
Princeton Emerg RC
N2ARC 93 2 23 636 SNJ
W7RDR 27 2 3 604 WWA
Old Post ARS
W9EOC 99 2 6 548 IN
City of Cypress RACES
W6CYP 233 2 8 516 ORG
Monterey Moose Lodge 876 ARC
KM0OSE 46 2 10 510 SCV
Morgan Co. ARES
WR4MC 67 2 3 484 GA
Hillsborough Co. ARES/RACES
N4HCA 8 2 6 466 WCF
Corona PD CSV Grp
W6CPD 51 2 5 438 ORG
Highland Lakes ARC
K5HLA 14 2 24 428 STX
Palo Alto ARES
W6PAX 35 2 13 420 SCV
NSWC Corona ARC
KJ6LCP 34 2 4 368 ORG
Central Alberta ARC
VA6RDC 23 2 13 246 AB
Madison Co. ARES / EMA
KD9FHR 18 2 1 86 IL

2F

Platinum Coast ARS
W4MLB (+KA4JRY)
1,539 2 21 6,338 SFL
Orleans Co. ARC
W2ORC (+WA2DOL)
1,538 2 19 5,918 WNY
McHenry Co. RACES/ARES
K9ESV 1,135 2 15 4,894 IL
Point Loma Radio Operators Grp
N6N 1,136 2 6 4,852 SDG
York RC
W9YRC (+N9ZE)
1,422 2 30 4,714 IL
The Richardson Wrls Klub
K5RWK 1,537 2 60 4,680 NTX
Boonville RC
WA0E (+W0BRC)
822 2 15 3,582 MO
Meriden ARC
W1NRG (+W1FD)
747 2 52 3,496 CT
Calhoun Co. EOC
W8RT 858 2 8 3,464 MI
Coventry EMA
KC1CUE (+KC1JWD)
1,035 2 32 3,300 RI
Turkey Heaven Mtn Rptr Assn.
N4THM (+N4IF)
641 2 10 3,274 AL
RICOMU & RIEMA
WA1USA (+WA1LAD)
1,071 2 5 3,100 RI
Imperial Co. ARES/RACES
W6ICR 858 2 7 3,094 SDG
South Canadian ARS
W5NOR (+WB5ULK)
564 2 50 2,952 OK
K2ZV 627 2 6 2,730 NNJ
VA Mtn ARC
W4COV 706 2 10 2,596 VA
Tellico Lake ARC
KN4DUA (+WB4BCS)
558 2 28 2,574 TN
Shelby Co. OH ARES
K8EMA 505 2 14 2,400 OH
Algoma ARC
VE3SOO 448 2 12 2,398 ONN
(+VA3WMC)
Garden State ARA
W2GSA (+K2REM)
480 2 26 2,368 NNJ
Roseland ARC
K2GQ 738 2 6 2,236 NNJ
Providence EMA/RACES Club
KK1PMA (+W1BSN)
248 2 26 2,094 RI
Franklin Co. AuxComms Club & Franklin Co. Ohio ARES
W8THV 393 2 54 2,082 OH
W4K 450 2 13 2,050 AL
Dixie ARC
W7DRC (+NA7UT)
317 2 23 1,842 UT
Benicia ARC EOC
KB6EOC 341 2 56 1,782 EB
Preble ARA
K8YR (+AA8DC)
502 2 12 1,768 OH
Dickson Co. ARC
WC4DC 228 2 13 1,760 TN
Greater Fairfield ARA
N1F 454 2 6 1,746 CT
Franklin Lakes OEM RC
N2FLO 301 2 33 1,730 NNJ
Camp Pouch ARA
WA2CP 1,364 1 6 1,563 NLI
Maritime Lighthouse ARG
VY2CRC 165 2 8 1,480 MAR
Northville ARA
NA1RA (+N1KWV)
267 2 30 1,466 CT
SEMARG & PILGRIM
KA1GG 652 2 5 1,454 EMA
Anchorage ARC
KL7AA 549 1 47 1,441 AK
Rains ARA
W5ENT 120 2 33 1,416 NTX
Langley Emerg Program & EmComms Support Team
VA7LEP 111 2 25 1,392 BC
Great Falls Area ARC
W7ECA 251 2 21 1,340 MT
Charlestown EOC ARES
W1CRI 102 2 7 1,282 RI
Springfield RACES Club
KC1FID 103 2 4 1,266 WMA
NO4Q 74 2 9 1,256 TN
Mohawk Valley ARA
N2MNT 249 2 6 1,256 NNY
Nacogdoches ARC
W5NAC 113 2 21 1,140 NTX
Lisbon Area ARA
K8GQB (+AD8AP)
170 2 26 1,132 OH
Naval Postgraduate School ARC
K6LY 325 2 8 1,096 SCV
Rappahannock ARA
W4NNK 395 2 12 1,088 VA
Kershaw Co. ARC
KC4RC (+KB1ND)
182 1 12 1,053 SC
Issaquah ARC
W7BI 146 2 35 996 WWA
Baytown Area ARC
K5BAY 50 2 6 970 STX
Washington Co. AuxComms Svc
WC5AR 171 2 11 938 AR
Rusk Co. ARC
N5RCA 111 2 12 912 NTX
Charlevoix & Cheboygan & Emmet Co. Public Svc Comms Org
W8CCE 367 1 6 867 MI
Raritan Bay Radio Amateurs
K2GE 40 2 12 830 NNJ
Tri-County (PA) ARC
W3TCA 76 2 11 824 WPA
OKC Emerg Mgmt CERT
WX5EOC 34 2 6 818 OK
Peninsula AR Emergency Team
KA7EOC 136 2 12 742 WWA
Johnson Co. ARES/RACES Unit
KD0MVJ 59 2 6 668 IA
Eastern Jackson Co. EmComm Club
K0EJC 142 2 25 640 MO
Camden Co. (GA) ARS
KB4CC 168 2 7 630 GA
Jefferson Co. ARES
K4E 114 2 8 628 TN
Tri-State ARG
W5AOK 104 2 12 608 OK
Tri-County (TX) ARC
WC5C (+N5ZKA)
90 2 24 596 NTX
OKRA
W5LOC 141 2 2 574 STX
Putnam Co. AuxComm
WB9EOC 33 2 33 536 IN
Cross Co. ARC
WA5CC 56 2 6 512 AR
Bayouland Emergency ARC
W5BMC 12 2 11 474 LA
Navarro ARC
W5NFL 28 2 13 426 NTX
Sandy ARC
W7S 19 2 2 416 UT
Norwood ARC
N1OP 121 2 10 298 EMA
K2H (+KD2LTB)
2 2 6 254 NNJ
Gratiot Co. ARA
AC8HD 42 2 4 234 MI
Chipola ARC
W4BKD 117 1 15 169 NFL

3F

K9IQP (+W9QL)
1,934 2 25 6,348 IL
Mansfield-Johnson AR Svc
KN5TX (+WA5JRS)
1,544 2 68 6,324 NTX
Alamance ARC
K4EG (+W4VGZ)
1,098 2 15 4,766 NC
Southwick RACES
WC1SW 1,551 2 15 4,720 WMA
Murgas ARC
K3YTL 1,319 2 27 4,688 EPA
Daytona Beach CERT AR Team
N4DAB (+KK4JYX)
577 2 13 3,452 NFL
Allen Wylie Lucas ARC & Lucas ARC
W5AWL (+K5LFD)
794 2 35 3,338 NTX
Sioux Empire ARC
W0ZWY (+W0FSD)
661 2 19 3,134 SD
Pikes Peak Radio Amateur Assn.
AF0S 612 2 15 3,050 CO
Franklin Co. (NC) ARC
AA4RV 654 2 34 2,918 NC
Hannibal MO ARC & Western IL ARC
W0KEM (+W0MTL)
520 2 33 2,882 MO
WA3NAN 812 2 20 2,860 MDC
Burlington Co. RC
K2TD 590 2 43 2,812 SNJ
Geauga ARA
K8WHB 802 2 18 2,676 OH
Adams Co. ARS
W3KGN 548 2 20 2,498 EPA
Cass Co. ARC
W9VMW (+W9LVY)
599 2 34 2,206 IN
Salkehatchie ARS
KK4BQ 534 2 38 2,128 SC
Heart of America RC
W0RR 378 2 10 2,102 MO
Radio Operadores Del Este
KP3RE 246 2 17 1,870 PR
Maxim Memorial Station W1AW @ ARRL HQ
W1AW 803 1 8 1,869 CT
Radio Soc. Of Tucson
N7OEM 288 2 30 1,610 AZ
Queen City Emerg Net
W8VVL 579 2 21 1,502 OH
Cupertino ARES
K6KP (+AG6GX)
53 2 20 1,356 SCV
Housatonic ARC & Westport Astro Soc. ARC & Grtr Bridgeport ARC
N1KT 619 1 15 1,302 CT
Boeing Employees ARS
W0MA 974 1 13 1,302 MO
CCARES
K6CCR (+AJ7C)
293 2 16 1,278 LAX
South San Francosco CERT Comms Team
N6SSF 84 2 14 1,218 SCV
Garden City ARC
K8GC 259 2 33 1,002 MI
Metroplex ARC
W2MPX 139 2 5 978 NNJ
Red River Valley ARC
WB5RDD 28 2 30 926 NTX
VE7UT 146 1 17 919 BC
Mid-State ARC
WA9RDF 213 2 23 896 IN
62 Rptr Grp
W4V 189 2 17 848 AL
NM8RC 112 2 20 816 MI
Prince William Co. ARES
W4PWC 175 2 2 700 VA
Manteca ARC
K6MAN 175 2 11 516 SJV
Golden Spike ARC
K7UB 89 2 19 248 UT
Berks ARC
K3TI 35 2 14 124 EPA

4F

Delaware ARA
K8ES (+W8JK)
2,600 2 50 9,864 OH
TriState ARS of Evansville Indiana
W9OG (+W9NRC)
1,925 2 36 7,268 IN
Van Wert ARC
W8FY 1,676 2 13 5,628 OH
Anderson RC
K4TG (+KY4LAW)
1,140 2 18 5,140 KY
Wheaton Radio Community Amateurs & Dupage Co. OEM
W9D 840 2 35 3,350 IL
Southern Counties ARA
K2BR 731 2 40 3,320 SNJ
Tri State ARA
W8VA (+WD8EOP)
563 2 38 3,296 WV
Highlands Co. ARC
K4W (+W4HCA)
524 2 20 3,242 WCF
Watauga ARC
WW4L 561 2 19 2,518 NC
Colquitt Co. ARS & Thomasville ARC
AA4P (+W4UCJ)
232 2 29 2,256 GA
Citrus Co. ARC
W4CRA 246 2 25 2,206 NFL
Woodmont ARA
KC1CIL (+WA1LEI)
458 2 10 2,188 CT
Endless Mtns ARC
N3EP 339 2 28 2,176 EPA
Platte Co. ARG
NR0AD 270 2 26 1,796 MO
W4FWD 303 2 28 1,712 GA
Charlotte ARC
W4CQ 482 2 15 1,652 NC
Broken Arrow Emerg Mgmt ARC
WX5BA 122 2 8 1,464 OK
Eastern OH Amateur Wrls Assn.
W8A 160 2 13 1,342 OH
Bedford Co. ARS
K3NOT (+KB3DFZ)
172 2 9 1,330 WPA
ARASWF
K4YHB 338 2 15 1,318 SFL
Coachella Valley Radio Amateur Club
NR6P 261 2 4 1,292 ORG
KE5FSY 95 2 5 770 AR
Algonquin ARC
N1EM 266 2 17 666 EMA
Orange Co. NY ARES/RACES
KC2OUR 301 2 10 652 ENY

5F

Williamson Co. TN ARES
N4FR (+W4SQA)
1,519 5 88 14,290 TN
Stanford ARC
W6YX (+K6SU)
3,788 2 37 12,926 SCV
KB5TX 656 2 20 3,124 STX
Morehead ARS
KY4HS 189 2 20 1,768 KY
TX Emerg Amateur Communicators
W5SI (+KE5IMW)
363 2 56 1,742 STX
Denton Co. ARA
W5NGU 255 2 50 1,526 NTX
Grundy Co. ARC
W9G 41 2 11 1,172 IL
Sarasota Emergency RC
N4SER 197 2 7 1,068 WCF
Centrlia ARES & Lewis Co. ARES & Chehalis Valley ARS
K7CEM 228 2 20 1,042 WWA
Radio Amateur Downstate Org
W9GH 61 2 6 1,022 IL
Ozone ARC
W5SLA 102 2 25 808 LA

6F

Great South Bay ARC
W2GSB (+W2TOB)
3,446 2 70 11,882 NLI
Warren Co. RC
W2C (+W2WCR)
1,348 2 37 5,708 ENY
SMRA
N3TWT 1,018 2 80 4,914 EPA
Topanga Disaster Radio Team
K6TI 884 2 30 4,628 LAX
CQ Florida
W4F 779 2 86 3,878 NFL

7F

Mercer Co. ARC
W3LIF 2,654 2 50 8,270 WPA
Metro Detroit SATERN
N8SE 233 2 12 952 MI

8F

BEARS of Manchester (CT) ARC
W1BRS 689 2 20 3,370 CT

12F

JSCARC & Clear Lake ARC
W5RRR (+K5HOU)
1,653 2 56 7,166 STX

Bart Jahnke, W9JJ, Contest Branch Manager, w9jj@arrl.org

ARRL International Grid Chase Update

Join the discussion on Facebook at https://www.facebook.com/groups/IGC2018 and check out the #IGC hashtag on Twitter.

Activity and interest remained high as the September portion of the International Grid Chase wrapped up. Portable operations (also called "gridpeditions") remained strong in September.

The remaining weeks of the Grid Chase will be packed with state QSO parties, short-duration special events, and exciting December contests, in addition to the usual casual operating.

September Activity

Per the leader board at **https://igc.arrl.org/leader-board.php**, the month of September saw 20,799 Logbook of The World submissions, which put it just a hair ahead of August, which had 20,767 submissions.

September activity reflected roughly a 15% overall activity decrease from August. It seems this was mainly due to changes in seasonal propagation. The major bands seeing a decrease in activity were 20 meters through 6 meters (down by 25%). The bands seeing an increase in activity were 630 meters through 30 meters (up by 10%), and 2 meters through 3 centimeters (up by 25%).

December numbers, particularly at lower HF, are expected to rise slightly as we engage in December contesting events. At VHF and above, because E-skip and tropospheric propagation have waned, we expect to see a further drop in numbers until the new year.

Remember: You can always find complete Grid Chase information online at **www.arrl.org/international-grid-chase-2018**. See you next month, and on the air!

Amy, AG7GP, activated rare grid square DN01gv from September 30 to October 1 from the Sheldon National Wildlife Refuge in northwestern Nevada. [Amy Haptonstall, AG7GP, photo]

September 2018 ARRL International Grid Chase (IGC) Station Stats (630 meters through 3 centimeters)

Band	630m	160m	80m	40m	30m	20m	17m	15m	12m	10m	6m	2m	1.25m	70cm	33cm	23cm	13cm	3cm	Mode Totals
CW	2	515	1,737	3,817	1,896	4,307	1,274	549	141	156	72	156	10	55	6	13	2	4	14,712
Phone	0	74	1,492	4,168	4	5,382	925	645	68	198	262	928	70	571	15	36	0	5	14,843
Digital	15	2,125	7,352	13,076	7,815	14,902	7,304	5,875	629	1,084	980	449	2	36	0	17	0	0	61,661
Band Totals	17	2,714	10,581	21,061	9,715	24,591	9,503	7,069	838	1,438	1,314	1,533	82	662	21	66	2	9	91,216

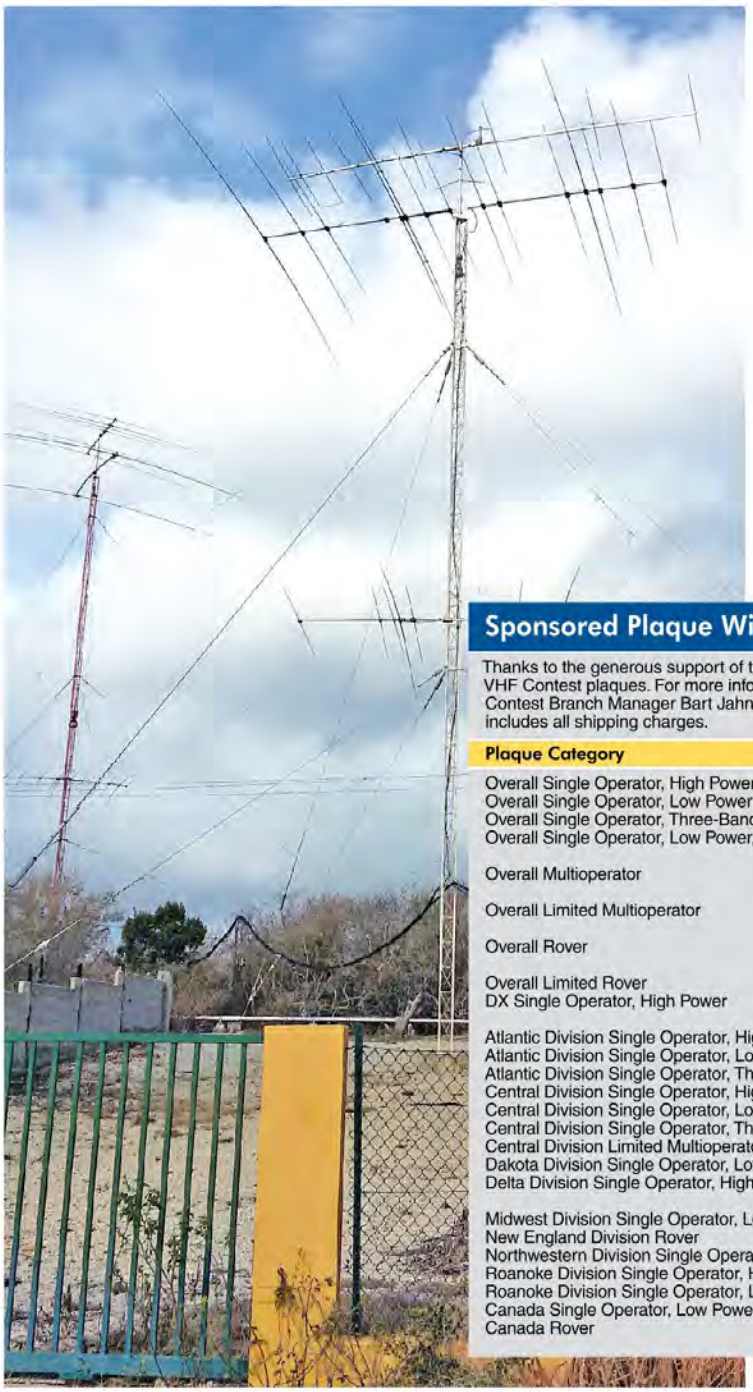
-September submissions: 20,799.
-This report represents all IGC-eligible* QSOs matched in LoTW during September 2018 as uploaded to LoTW by 2359 UTC October 10, 2018.
*IGC-eligible LoTW matches occur only when both stations upload their QSOs to LoTW, and both stations include their grid square in their LoTW TQSL station location(s).
-No contacts were reported to LoTW in September 2018 on 2200 meters, or on most microwave bands above 13 centimeters (except for 3 centimeters).
-30-meter stats may be a log entry typo (30-meter phone is not permitted in the US).

Cortesia de Virgilio.

Phil Koch, K3UA, k3ua1541@me.com

2018 ARRL June VHF Contest Results

This year's ARRL June VHF Contest took place June 9 – 11, 2018.



Lauren, W0LD; Dave, N7BHC, and Jon, N0JK, put PJ4V on the air during the 2018 June VHF Contest, as a Multioperator station from Bonaire. [Jon Jones, N0JK, photo]

Full Results Online

You can read the full results of the contest online at **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 2019 ARRL June VHF Contest will be held June 8 – 10, 2019.

Sponsored Plaque Winners

Thanks to the generous support of the listed clubs, we are pleased to list the winners of the Sponsored June VHF Contest plaques. For more information on plaque sponsorship or to order a duplicate plaque, contact ARRL Contest Branch Manager Bart Jahnke, W9JJ, at 860-594-0232 or **w9jj@arrl.org**. Plaques cost $75, which includes all shipping charges.

Plaque Category	Winner	Plaque Sponsor
Overall Single Operator, High Power	W5ZN	Charles Dietz, W5PR
Overall Single Operator, Low Power	K2DRH	Jeffrey Klein, K1TEO
Overall Single Operator, Three-Band	K2PS	Northern Lights Radio Society
Overall Single Operator, Low Power, Rookie	KC3BVL	W3ZZ First Log Award — Memorial by Tim, K3LR, and Dave, W9PA
Overall Multioperator	W2SZ	Directive Systems and Engineering — in memory of W3ZZ and K3CB
Overall Limited Multioperator	K5QE	Gene Zimmerman, W3ZZ, Memorial — ARRL Contest Branch
Overall Rover	VE3OIL/R	In Memory of Tim Ertl, KE3HT, microwave DX addict
Overall Limited Rover	K2EZ/R	Rochester VHF Group
DX Single Operator, High Power	VP9I (WA4PGM, op)	Bill Tynan, W3XO, Memorial — ARRL Contest Branch
Atlantic Division Single Operator, High Power	K1RZ	Potomac Valley Radio Club
Atlantic Division Single Operator, Low Power	WA3EOQ	Potomac Valley Radio Club
Atlantic Division Single Operator, Three-Band	KR1ST	Rochester VHF Group
Central Division Single Operator, High Power	W0UC	Society of Midwest Contesters
Central Division Single Operator, Low Power	K2DRH	Society of Midwest Contesters
Central Division Single Operator, Three-Band	WB9TFH	Society of Midwest Contesters
Central Division Limited Multioperator	NV9L	Society of Midwest Contesters
Dakota Division Single Operator, Low Power	N0UR	Northern Lights Radio Society
Delta Division Single Operator, High Power	W5ZN	Memorial to Mike Bruck, W5MRB, from his friends
Midwest Division Single Operator, Low Power	N0LL	Northern Lights Radio Society
New England Division Rover	KJ1K/R	North East Weak Signal Group
Northwestern Division Single Operator, Three-Band	N7QOZ	Pacific Northwest VHF Society
Roanoke Division Single Operator, High Power	W3IP	Potomac Valley Radio Club
Roanoke Division Single Operator, Low Power	N9NB (W4FS, op)	Potomac Valley Radio Club
Canada Single Operator, Low Power	VE3DS	Neil Macklem, VE3SST
Canada Rover	VE3OIL/R	Toronto FM Communications Society

Cortesia de Virgilio.

Affiliated Club Competition

Club	Score	Entries
Unlimited		
Society of Midwest Contesters	1,156,768	65
Potomac Valley Radio Club	1,063,771	60
Medium		
Mt. Airy VHF Radio Club	1,547,492	32
Florida Contest Group	673,585	24
North East Weak Signal Group	557,984	16
Yankee Clipper Contest Club	495,396	21
Northern Lights Radio Society	381,176	13
Contest Club Ontario	342,761	16
Rochester VHF Group	310,617	17
Florida Weak Signal Society	307,439	9
Carolina DX Assn.	273,271	6
Badger Contesters	270,046	15
Arizona Outlaws Contest Club	229,146	26
Central Texas DX and Contest Club	180,131	8
Pacific Northwest VHF Society	150,448	31
Alabama Contest Group	142,188	10
New Mexico VHF Society	131,571	16
Michigan VHF-UHF Society	102,630	5
Tennessee Contest Group	100,221	7
Southern California Contest Club	85,190	16
North Coast Contesters	81,581	5
Frankford Radio Club	76,163	13
Texas DX Society	53,682	4
South East Contest Club	53,161	5
Pottstown Area ARC	48,292	3
Minnesota Wireless Assn.	48,182	9
Grand Mesa Contesters of Colorado	46,377	8
Roadrunners Microwave Group	41,224	6
Kentucky Contest Group	35,967	5
Mad River Radio Club	35,429	9
Northern California Contest Club	22,477	19
Hudson Valley Contesters and DXers	18,764	4
Kansas City Contest Club	12,250	3
South Jersey Radio Assn.	11,457	4
DFW Contest Group	10,953	3
Mother Lode DX/Contest Club	3,542	3
Western Washington DX Club	1,485	3
Local		
Eastern Connecticut ARA	99,327	6
Chippewa Valley VHF Contesters	64,832	3
Niagara Frontier Radiosport	60,165	4
CTRI Contest Group	33,868	3
Bergen ARA	26,709	6
Meriden ARC	18,925	4
Bristol (TN) ARC	10,804	5

Division Winners

Classic Rover

Atlantic	KF2MR/R	88,368
Central	W9SNR/R	16,308
Dakota	N0HZO/R	7,191
Delta	AG4V/R	36,994
Great Lakes	KF8QL/R	14,204
Hudson	WB2SIH/R	9,522
New England	KJ1K/R	2,842
Northwestern	KE7MSU/R	6,426
Pacific	KE6QR/R	9,656
Rocky Mountain	KK6MC/R	10,388
Southwestern	WA8WZG/R	26,523
West Gulf	KD5IKG/R	24,938
Canada	VE3OIL/R	110,136

Limited Rover

Atlantic	K2QO/R	46,898
Central	N9GH/R	7,840
Dakota	K0BBC/R	19,656
Delta	AE5P/R	13,860
Great Lakes	W9YOY/R	15,990
Hudson	K2EZ/R	72,334
Midwest	KE0HZX/R	4,785
New England	W1RGA/R	13,980
Northwestern	WW7D/R	31,920
Pacific	K6JS/R	120
Roanoke	W4PH/R	3,450
Rocky Mountain	W3DHJ/R	6,372
Southwestern	N6GP/R	5,004
West Gulf	KA5D/R	22,644
Canada	VA6AN/R	1,160

Unlimited Rover

Atlantic	KD2IRH/R	8,064
Great Lakes	WB8TGY/R	720
New England	K1SIG/R	33,120
Pacific	N6JET/R	19,600
West Gulf	N0LD/R	47,040
Canada	VE3SMA/R	55,110

Single Operator, High Power

Atlantic	K1RZ	267,300
Central	W0UC	186,167
Dakota	W7XU	114,492
Delta	W5ZN	312,075
Great Lakes	W7JW	56,834
Hudson	N2GHR	57,540
Midwest	K0TPP	47,333
New England	K1TR	146,769
Northwestern	KE7SW	16,802
Pacific	N6MI	6,678
Roanoke	W3IP	125,385
Rocky Mountain	K5AM	45,012
Southeastern	K1TO	234,132
Southwestern	W7MRF (KW7MM, op)	36,084
West Gulf	N5RZ	72,874
Canada	VA3ELE	69,917
DX	XE2CQ	9,936

Single Operator, Low Power

Atlantic	WA3EOQ	39,345
Central	K2DRH	283,554
Dakota	N0UR	14,673
Delta	AA5AU	26,166
Great Lakes	K8MR	23,664
Hudson	WB2JAY	45,617
Midwest	N0LL	50,949
New England	AF1T	186,874
Northwestern	AC7MD	9,856
Pacific	KC6ZWT	10,332
Roanoke	N9NB (W4FS, op)	20,020
Rocky Mountain	AI5I	9,954
Southeastern	K5RQ	78,942
Southwestern	W6IT	31,347
West Gulf	K5QB	46,761
Canada	VE3DS	53,298
DX	VP9I (WA4PGM, op)	29,590

Single Operator, Portable

Atlantic	WA2TMC	42,582
Dakota	N0SUW	24
Delta	W4RXR	4,387
Hudson	WB2AMU	2,080
Midwest	N8GOU	6
New England	N1PRW	304
Northwestern	W4DVE	8,670
Pacific	W6KKO	1,560
Roanoke	KC8KSK	378
Rocky Mountain	W0AMT	168
Southwestern	K7CNT	512
Canada	VE2NCG	880

Single Operator, Three-Band

Atlantic	KR1ST	36,295
Central	WB9TFH	21,412
Dakota	N0HJZ	17,316
Delta	N4OGW	42,224
Great Lakes	W8JH	7,137
Hudson	W2JTM	13,197
Midwest	W2FU	42,672
New England	N1ZN	16,016
Northwestern	N7QOZ	2,750
Pacific	AF6SA	3,270
Roanoke	KK4MA	35,775
Rocky Mountain	K0NR	24,831
Southeastern	K2PS	90,440
Southwestern	KE7GRO	14,863
West Gulf	AA5AM	34,181
Canada	VE3SST	16,074

Single Operator, FM Only

Atlantic	K3EO	8
Central	N9SJ	1
Central	WD9CIR	1
Delta	KW4LU	1
Hudson	N2UZQ	396
Northwestern	K7IMA	244
Pacific	W6IA	1,500
Rocky Mountain	KI7FUO	30
Southeastern	K3TW	99
Southwestern	K6QCB	27
Canada	VA2DG	85

Limited Multioperator

Atlantic	W3SO	234,070
Central	NV9L	132,800
Dakota	N0EO	100,130
Delta	K5GDX	26,606
Hudson	N2NT	280,356
Midwest	K0DAS	24,190
New England	K1BX	220,440
Pacific	W6L	3,649
Roanoke	AA4ZZ	246,864
Rocky Mountain	K5LRW	1,519
Southeastern	N4WW	107,984
Southwestern	NN7AZ	69,300
West Gulf	K5QE	394,605
Canada	VA2RC	918
DX	PJ4V	4,644

Unlimited Multioperator

Atlantic	W3CCX	613,600
Central	W9XA	256,470
Great Lakes	N8ZM	120,120
Hudson	WE1P	104,144
Midwest	WQ0P	147,200
New England	W2SZ	752,955
Northwestern	K7TM	910
Pacific	K6HS	13,185
Roanoke	W4IY	186,416
Rocky Mountain	W5UHF	57,876
Southeastern	W4NH	29,526
Southwestern	NI6E	20,164
West Gulf	KC5MVZ	6,336
Canada	VE3WCC	83,053

Cortesia de Virgilio.

Regional Leaders

Boxes list call sign, score, and class: LM = Limited Multioperator; R = Classic Rover; RL = Limited Rover; RU = Unlimited Rover; SO3B = Single Operator, Three-Band; SOFM = Single Operator, FM Only; SOHP = Single Operator, High Power; SOLP = Single Operator, Low Power; SOP = Single Operator, Portable, and UM = Unlimited Multioperator.

West Coast Region
(Pacific, Northwestern, and Southwestern Divisions; Alberta, British Columbia, and NT Sections)

WA8WZG/R	26,523	R
KE6QR/R	9,656	R
KE7MSU/R	6,426	R
AC7SG/R	3,240	R
KF7NP/R	560	R
WW7D/R	31,920	RL
N6GP/R	5,004	RL
K6LMN/R	4,466	RL
K7BDB/R	3,792	RL
VA6AN/R	1,160	RL
N6JET/R	19,600	RU
VE7AFZ/R	816	RU
W7MRF (KW7MM, op)	36,084	SOHP
N1RWY	23,229	SOHP
N7CW	19,240	SOHP
N6VI	16,940	SOHP
KE7SW	16,802	SOHP
W6IT	31,347	SOLP
KC6ZWT	10,332	SOLP
AC7MD	9,856	SOLP
KE6GLA	9,030	SOLP
WJ0F	7,140	SOLP
W4DVE	8,670	SOP
K7ALO	4,648	SOP
K7ATN	3,740	SOP
W6KKO	1,560	SOP
VE7FYC	728	SOP
KE7GRO	14,863	SO3B
N7IR	13,332	SO3B
N7RK	3,304	SO3B
AF6SA	3,270	SO3B
N7AT (K8IA, op)	2,759	SO3B
W6IA	1,500	SOFM
K7IMA	244	SOFM
WB6ETY	224	SOFM
KK6VIX	114	SOFM
N9VM (N1VM, op)	98	SOFM
NN7AZ	69,300	LM
W6L	3,649	LM
N6RPM	1,026	LM
NI6E	20,164	UM
WA7JTM	14,418	UM
K6HS	13,185	UM
K6YK	3,036	UM
WB6HUM	2,358	UM

Midwest Region
(Dakota, Midwest, Rocky Mountain, and West Gulf Divisions; Manitoba and Saskatchewan Sections)

KD5IKG/R	24,938	R
KK6MC/R	10,388	R
N0HZO/R	7,191	R
KC0P/R	6,854	R
KA5D/R	22,644	RL
K0BBC/R	19,656	RL
N6RH/R	12,512	RL
K5ND/R	10,695	RL
KT5TE/R	8,910	RL
N0LD/R	47,040	RU
K5SRT/R	37,291	RU
W7XU	114,492	SOHP
K0SIX	102,135	SOHP
N5RZ	72,874	SOHP
WD5K	64,224	SOHP
WA0CSL	53,055	SOHP
N0LL	50,949	SOLP
K5QB	46,761	SOLP
WQ5S	23,600	SOLP
W5PR	17,575	SOLP
N0UR	14,673	SOLP
W0AMT	168	SOP
KI0G	63	SOP
N0SUW	24	SOP
N8GOU	6	SOP
W2FU	42,672	SO3B
AA5AM	34,181	SO3B
AD5A	27,984	SO3B
WB5TUF	27,060	SO3B
K0NR	24,831	SO3B
KI7FUO	30	SOFM
K5QE	394,605	LM
N0EO	100,130	LM
W5ROK	37,572	LM
K0DAS	24,190	LM
W5KFT	11,692	LM
WQ0P	147,200	UM
W5UHF	57,876	UM
NR7T	18,430	UM
KC5MVZ	6,336	UM

Central Region
(Central and Great Lakes Divisions; Ontario East, Ontario North, Ontario South, and Greater Toronto Area Sections)

VE3OIL/R	110,136	R
W9SNR/R	16,308	R
KF8QL/R	14,204	R
AA9IL/R	5,157	R
K9TMS/R	4,650	R
W9YOY/R	15,990	RL
N9GH/R	7,840	RL
AI9I/R	5,824	RL
WD9HBF/R	4,560	RL
K9JK/R	3,075	RL
VE3SMA/R	55,110	RU
WB8TGY/R	720	RU
W0UC	186,167	SOHP
K9CT	153,300	SOHP
W9EWZ	83,475	SOHP
VA3ELE	69,917	SOHP
N0AKC	61,004	SOHP
K2DRH	283,554	SOLP
W9GA	79,348	SOLP
VE3DS	53,298	SOLP
VE3WY	24,752	SOLP
K8MR	23,664	SOLP
VA3TO/P	126	SOP
WB9TFH	21,412	SO3B
AB9H	20,064	SO3B
N9TF	16,932	SO3B
N9EAT	16,300	SO3B
VE3SST	16,074	SO3B
N9SJ	1	SOFM
WD9CIR	1	SOFM
NV9L	132,800	LM
W9RVG	63,384	LM
KA9CFD	53,186	LM
W9VW	20,928	LM
N2BJ	20,384	LM
W9XA	256,470	UM
N8ZM	120,120	UM
VE3WCC	83,053	UM
K8JH	18,054	UM

Southeast Region
(Delta, Roanoke, and Southeastern Divisions)

AG4V/R	36,994	R
W5VY/R	21,620	R
AE5P/R	13,860	RL
NC5AX/R	4,230	RL
W4PH/R	3,450	RL
W4OWL/R	1,728	RL
WB5RMG/R	650	RL
W5ZN	312,075	SOHP
K1TO	234,132	SOHP
KC4PX	157,356	SOHP
W3IP	125,385	SOHP
N4BP	104,748	SOHP
K5RQ	78,942	SOLP
W4RAA	58,917	SOLP
NF4A	34,093	SOLP
AA5AU	26,166	SOLP
WB4TDH	20,856	SOLP
W4RXR	4,387	SOP
KC8KSK	378	SOP
K2PS	90,440	SO3B
WA4GPM	60,775	SO3B
N4OGW	42,224	SO3B
KK4MA	35,775	SO3B
AJ6T	23,504	SO3B
K3TW	99	SOFM
KW4LU	1	SOFM
W4POT	1	SOFM
AA4ZZ	246,864	LM
N4WW	107,984	LM
WB4WXE	50,978	LM
W6SAI	31,312	LM
K5GDX	26,606	LM
W4IY	186,416	UM
W4NH	29,526	UM
KJ4ZYB	18,067	UM
K4HZ	7,314	UM

Northeast Region
(New England, Hudson, and Atlantic Divisions; Maritime and Quebec Sections)

KF2MR/R	88,368	R
NN3Q/R	40,320	R
K2ET/R	21,758	R
K2LDT/R	18,096	R
KV2X/R	17,907	R
K2EZ/R	72,334	RL
K2QO/R	46,898	RL
N2DXT/R	17,043	RL
W1RGA/R	13,980	RL
KJ2G/R	10,726	RL
K1SIG/R	33,120	RU
KD2IRH/R	8,064	RU
K1RZ	267,300	SOHP
K1TR	146,769	SOHP
K1KG	143,081	SOHP
K3ZO	114,492	SOHP
N3HBX	105,064	SOHP
AF1T	186,874	SOLP
WB1GQR (W1SJ, op)	153,080	SOLP
N8RA	63,772	SOLP
WB2JAY	45,617	SOLP
WA3EOQ	39,345	SOLP
WA2TMC	42,582	SOP
WB2AMU	2,080	SOP
N3KCM	1,184	SOP
KQ2RP	1,148	SOP
VE2NCG	880	SOP
KR1ST	36,295	SO3B
N3ALN	17,226	SO3B
K3SFX	17,100	SO3B
N1ZN	16,016	SO3B
KZ2I	15,925	SO3B
N2UZQ	396	SOFM
VA2DG	85	SOFM
K3EO	8	SOFM
KC3LPC	1	SOFM
N2MH	1	SOFM
KD2MNU	1	SOFM
N2NT	280,356	LM
W3SO	234,070	LM
K1BX	220,440	LM
W2LV	157,780	LM
K2BAR	75,120	LM
W2SZ	752,955	UM
W3CCX	613,600	UM
K2LIM	446,652	UM
WE1P	104,144	UM
KV1J	72,435	UM

Top Ten

Classic Rover

VE3OIL/R	110,136
KF2MR/R	88,368
NN3Q/R	40,320
AG4V/R	36,994
WA8WZG/R	26,523
KD5IKG/R	24,938
K2ET/R	21,758
W5VY/R	21,620
K2LDT/R	18,096
KV2X/R	17,907

Limited Rover

K2EZ/R	72,334
K2QO/R	46,898
WW7D/R	31,920
KA5D/R	22,644
K0BBC/R	19,656
N2DXT/R	17,043
W9YOY/R	15,990
W1RGA/R	13,980
AE5P/R	13,860
N6RH/R	12,512

Unlimited Rover

VE3SMA/R	55,110
N0LD/R	47,040
K5SRT/R	37,291
K1SIG/R	33,120
N6JET/R	19,600
KD2IRH/R	8,064
VE7AFZ/R	816
WB8TGY/R	720

Single Operator, High Power

W5ZN	312,075
K1RZ	267,300
K1TO	234,132
W0UC	186,167
KC4PX	157,356
K9CT	153,300
K1TR	146,769
K1KG	143,081
W3IP	125,385
W7XU	114,492
K3ZO	114,492

Single Operator, Low Power

K2DRH	283,554
AF1T	186,874
WB1GQR (W1SJ, op)	153,080
W9GA	79,348
K5RQ	78,942
N8RA	63,772
W4RAA	58,917
VE3DS	53,298
N0LL	50,949
K5QB	46,761

Single Operator, Portable

WA2TMC	42,582
W4DVE	8,670
K7ALO	4,648
W4RXR	4,387
K7ATN	3,740
WB2AMU	2,080
W6KKO	1,560
N3KCM	1,184
KQ2RP	1,148
VE2NCG	880

Single Operator, Three-Band

K2PS	90,440
WA4GPM	60,775
W2FU	42,672
N4OGW	42,224
KR1ST	36,295
KK4MA	35,775
AA5AM	34,181
AD5A	27,984
WB5TUF	27,060
K0NR	24,831

Single Operator, FM Only

W6IA	1,500
N2UZQ	396
K7IMA	244
WB6ETY	224
KK6VIX	114
K3TW	99
N9VM (N1VM, op)	98
VA2DG	85
N6TCE	85
AA6XA	48

Limited Multioperator

K5QE	394,605
N2NT	280,356
AA4ZZ	246,864
W3SO	234,070
K1BX	220,440
W2LV	157,780
NV9L	132,800
N4WW	107,984
N0EO	100,130
K2BAR	75,120

Unlimited Multioperator

W2SZ	752,955
W3CCX	613,600
K2LIM	446,652
W9XA	256,470
W4IY	186,416
WQ0P	147,200
N8ZM	120,120
WE1P	104,144
VE3WCC	83,053
KV1J	72,435

The 2019 ARRL International DX Contest

CW: 0000 UTC Saturday, February 16 – 2359 UTC Sunday, February 17

SSB: 0000 UTC Saturday, March 2 – 2359 UTC Sunday, March 3

Join thousands of operators worldwide as they compete in this exciting international contest. Whether you're seeking casual DX contacts, testing out the performance of a new rig, or pursuing new countries for awards or to earn your DXCC, this event has something for everyone.

- W/VE stations send signal report and state or province; DX stations send signal report and transmit power.
- Upload your Cabrillo-formatted log to the ARRL web app at **http://contest-log-submission.arrl.org** or send paper logs to ARRL — DX Contest, 225 Main St., Newington, CT 06111.
- Log submission deadlines are 7 days after the event weekends. For this event, the CW deadline is 2359 UTC on February 24, and the SSB deadline is 2359 UTC on March 10.

Complete rules can be found at **www.arrl.org/arrl-dx**

Henning, D44EE (OZ1BII, op), operated from the well-equipped station of Angelo Mendes, D44BS, in the 2018 ARRL DX CW weekend. He took this photo of Angelo, D44BS, with his antennas. [Henning Andresen, OZ1BII, photo]

January 2019 Kids Day

1800 UTC – 2359 UTC Saturday, January 5

The first Saturday in January is the time to get youngsters on the air to share in the joys and fun that Amateur Radio can provide!

Sponsored by the Boring (Oregon) Amateur Radio Club, this event has a simple exchange suitable for younger operators: first name, age, location, and favorite color. After that, the contact can be as long or short as each participant likes.

Kids Day is the perfect opportunity to open your shack doors and invite kids over to see what Amateur Radio is all about!

On Field Day in 2018, 10-year-old General-class licensee Maddie Waltsak, KN4AUC (left), served as control operator for 14-year-old Technician-class licensee Kailey Lamont, KN4DYY (right), for the 40-meter phone position at the Woodbridge Wireless ARC in Woodbridge, Virginia. [Bill Morine, N2COP, photo]

Complete rules can be found at **www.arrl.org/kids-day**

Cortesia de Virgilio.

The 2019 ARRL January VHF Contest

1900 UTC Saturday, January 19 – 0359 UTC Monday, January 21

If the winter doldrums have got you down, brighten things up by operating in the ARRL January VHF Contest! Whether Rover, Single Operator, or Multioperator, there's something for everyone. "Assistance" is available to all entry classes, so stations can coordinate when and where to attempt contacts at home, while portable, or even on the road.

Between meteor scatter, winter E skip, aurora, EME, and tropospheric scatter/ducting, there's no shortage of opportunities for enhanced propagation. And with the newest digital modes (MSK144 and FT8), longer-haul contacts give operators a chance to fill in some extra grid square multipliers.

The contest exchange is simply your Maidenhead grid square. More info on grid squares can be found at **www.arrl.org/grid-squares**.

10-Day Log Deadline: Logs must be uploaded or postmarked no later than 0359 UTC January 31, 2019. Electronic Cabrillo-formatted logs must be uploaded to **http://contest-log-submission.arrl.org**, or paper summary sheets and logs must be mailed to ARRL — January VHF Contest, 225 Main St., Newington, CT 06111.

In the 2018 January VHF Contest, Jim, K5ND/R, experienced the sunrise in EM03, near Wizard Wells, Texas. [Jim Wilson, Jr., K5ND, photo]

Complete rules can be found at
www.arrl.org/jan-vhf

The 2019 ARRL Straight Key Night

0000 UTC – 2359 UTC Sunday, January 1

Ring in the New Year with your favorite straight key or bug!

Straight Key Night (SKN) is not a contest, so there's no need for quick exchanges. Many hams enjoy dusting off vintage rigs and keys for this event, but all gear (new or old) is welcome. Make one, make several — all contacts are fun and the swing of many fists is memorable.

Each year, we invite you to send us your list of stations worked, along with your votes for Best Fist and Most Interesting QSO. Send them to **straightkey@arrl.org** before January 31, 2019. A paper summary of your activity can be mailed to ARRL — Straight Key Night, 225 Main St., Newington, CT 06111. Be sure to post your story and photos of your evening at **www.arrl.org/soapbox**.

Complete rules can be found at
www.arrl.org/straight-key-night

Rev, W1TS, at his bedroom bureau operating position (the amplifier took the night off and was not used). [Willard Revaz, W1TS, photo]

Cortesia de Virgilio.

The 2019 ARRL RTTY Roundup

1800 UTC Saturday, January 5 – 2359 UTC Sunday, January 6

If you're new to digital contesting, the ARRL RTTY Roundup may be for you! Whether your interests are RTTY, modes like JTx, ASCII, AMTOR, PSKxx, Packet, or FT8 (attended operation only), getting on digital modes is easier than ever. All you need is a PC, a transceiver, and a sound card interface (many of the new HF rigs even have built-in interfaces that allow your PC to be connected directly to your transceiver).

If RTTY is your focus, be sure to visit the web page of veteran contester Don Hill, AA5AU, for tips on how to get started, at **www.rttycontesting.com**. If JTx or FT8 is your interest, see **https://physics.princeton.edu/pulsar/k1jt/Quick_Start_WSJT-X_2.0.pdf**.

♦ **Exchange: W/VE stations send signal report and state; DX stations send signal report and consecutive serial number starting with 001.** See the sidebar, "FT8 in the RTTY Roundup," for more information.

♦ Event category consideration: Remember that RTTY Roundup prohibits "automated, multi-channel decoders" for Single Operator category participants. Instead, using software for PSK31 and FT8 in which more than one signal is decoded at a time requires the participant to enter in the Single Operator, Unlimited or Multioperator, Single Transmitter category.

♦ 7-day log deadline: All logs must be received via web app or postmarked no later than 2359 UTC on January 13, 2019. Upload your Cabrillo-formatted logs to **http://contest-log-submission.arrl.org** or mail paper logs to ARRL — RTTY Roundup, 225 Main St., Newington, CT 06111.

Complete rules can be found at
www.arrl.org/rtty-roundup

FT8 in the RTTY Roundup

Here are some important participation requirements for using FT8 in this contest:

- FT8 participants *must* be running *WSJT-X 2.0* (or newer) to ensure they are sending and receiving the exchanges required for this event. (Note: this is not a grid-square exchange event.) The required exchanges are in bold at left.
- FT8's Fox and Hound mode is *not* permitted. Each QSO must be operated in a one-to-one mode manually accepting/logging (unattended QSO macro/automations are prohibited).
- Spread out! With subband congestion, spreading out can increase decode and contact success.
- This is a great opportunity for beginners interested in digital contesting. If you are a first-time contester on RTTY, FT8, or other digital modes, high-power and large antennas are not necessary for successful decodes.

W1AW Schedule

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

PAC	MTN	CENT	EAST	UTC	MON	TUE	WED	THU	FRI
6 AM	7 AM	8 AM	9 AM	1400		FAST CODE	SLOW CODE	FAST CODE	SLOW CODE
7 AM-1 PM	8 AM-2 PM	9 AM-3 PM	10 AM-4 PM	1500-1700 1800-2045	VISITING OPERATOR TIME (12 PM-1 PM CLOSED FOR LUNCH)				
1 PM	2 PM	3 PM	4 PM	2100	FAST CODE	SLOW CODE	FAST CODE	SLOW CODE	FAST CODE
2 PM	3 PM	4 PM	5 PM	2200	CODE BULLETIN				
3 PM	4 PM	5 PM	6 PM	2300	DIGITAL BULLETIN				
4 PM	5 PM	6 PM	7 PM	0000	SLOW CODE	FAST CODE	SLOW CODE	FAST CODE	SLOW CODE
5 PM	6 PM	7 PM	8 PM	0100	CODE BULLETIN				
6 PM	7 PM	8 PM	9 PM	0200	DIGITAL BULLETIN				
6:45 PM	7:45 PM	8:45 PM	9:45 PM	0245	VOICE BULLETIN				
7 PM	8 PM	9 PM	10 PM	0300	FAST CODE	SLOW CODE	FAST CODE	SLOW CODE	FAST CODE
8 PM	9 PM	10 PM	11 PM	0400	CODE BULLETIN				

♦ Morse code transmissions: Frequencies are 1.8025, 3.5815, 7.0475, 14.0475, 18.0975, 21.0675, 28.0675, 50.350, and 147.555 MHz.
Slow Code = practice sent at 5, 7½, 10, 13, and 15 WPM.
Fast Code = practice sent at 35, 30, 25, 20, 15, 13, and 10 WPM.
Code bulletins are sent at 18 WPM.

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

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

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

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

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

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

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

During 2018, Headquarters and W1AW are closed on New Year's Day, Presidents Day (February 19), Good Friday (March 30), Memorial Day (May 28), Independence Day (July 4), Labor Day (September 3), Thanksgiving and the following day (November 22 and 23), Christmas Eve and Christmas (December 24 and 25). For more information, visit us at **www.arrl.org/w1aw**.

Madison Jones, W5MJ, w5mikejuliet@gmail.com

How's DX?

The 2018 CanAm Group's DXpedition to the Central Pacific

Small DXpeditions with up to 10 operators may seem simple and straightforward — you decide on a destination, select a team, make an announcement, get a license, make travel arrangements, and off you go. Having been on quite a few small DXpeditions, I would normally agree with that statement. But sometimes things just don't work out that way.

The TX5T team (from left to right): Bob, K4UEE; Madison, W5MJ; Dr. Bob, K5PI; Robert, W5RF, and Bill, W5SJ.

The CanAm DX Group is a collection of experienced DXers from both large and small projects. Our team included myself; Bob Feldtman, W5RF; Bob Allphin, K4UEE; Bill Priakos, W5SJ, and Robert Brandon, K5PI. We have been to several African destinations and into the Pacific many times together under the general requirements of going to one of the top 100 most-wanted entities that can be reached without a long boat ride. This time, we chose the Central Pacific for about 10 days in mid-August 2018, and let the DX world know. We would be on 160 through 10 meters and would be making the first-ever FT8 contacts on 160 meters from our destination! Not only that — we would be using Elecraft KX3s, capable of running the legal limit through amplifiers.

The team's 160-meter antenna during sunrise on the beach of Raivavae Island.

Cortesia de Virgilio.

Where in the World to Go

Our initial plan was for V6 Ulithi Atoll — the largest anchorage of the US Navy during World War II, with over 800 ships at one time — but there were transportation issues in getting our 600 – 800 pounds of gear there and back quickly and for a reasonable price. We then tried to work out a plan at Majuro V7, Truk V6, Yap V6, Pohnpei V6, Samoa 5W, American Samoa KH8, and Ofu Island KH8, but all of these destinations were found to be unsuitable for one reason or another.

Every time we thought we had our location nailed down, some newly discovered difficulty popped up. Either we couldn't get transportation for us and/or our gear, or the transportation was unacceptable for our equipment or took too long to get there, or we couldn't find an available position. While we found that we could get to some of our intended locations, our equipment would have to go by air freight to a more populous center near our choice, but the last leg would have to be by sea; that would take a long time and could mean that while we would arrive at the destination, our antennas and other items might not. In one instance, the location which we had chosen changed ownership between our initial inquiry and our attempt to finalize everything. The new owners thought our antennas would be an eyesore on their beach and would cause the non-ham tourists to leave.

Our trip was described in "How's DX?" in the August 2018 issue of *QST*, but in the confusion over location, it was reported that we were off to American Samoa. Not only was that embarrassing, but we had to field the usual requests for information about the location and schedules.

Destination Austral Islands

Since we had already announced our intention to go somewhere, and the deadline for action was closing in, we decided to head back to Raivavae Island (OC-114) in the Australs, where we had been 18 months earlier, because we knew it met all the criteria I described. In addition, it was a brand-new destination for three members of our team and would give us all an opportunity to spend a few days in Tahiti.

We obtained licenses from the French Polynesian communications authority in short order, received permission to bring all our equipment without payment of customs duties, and were allowed to use our previous call, TX5T, during our stay in the Australs. In addition, we knew from our previous trip there how to get passage on Air Tahiti Nui and Air Tahiti (two separate airlines) for ourselves and all our gear.

We transited through Los Angeles from our homes and met in Papeete, Tahiti. Because each of us had different activities planned in Tahiti, we arrived there on different dates, but knew we were due at the Air Tahiti gate outbound on August 13, 2018. In the meantime, we had booked several rooms at a hotel in Papeete for our various arrivals. We knew French Polynesia had reciprocal license agreements with the US, so we rigged up an HF antenna on the hotel balcony and made a number of CW contacts using FO/home calls, giving hams another DXCC entity or new band point.

The Best-Laid Plans

As planned, we arrived at the Papeete airport with our equipment on August 13, boarded the plane, and off we went. Unfortunately, the weather did not cooperate, so the pilot turned around at Tubuai Island and returned us to Papeete. Because flights to the Australs are not every day, there were no options other than to return to Tahiti and wait for better flying conditions. We made the best of the situation and did more sightseeing on the idyllic island to pass the time.

When the weather cleared, we again headed off to Raivavae and were met by our hosts from our destination. We set up antennas quickly, all verticals on salt water, and got on the air, only about 2 days late. The pileups were fierce. We were indeed able to use FT8 as well as CW and SSB, 160 through 10 meters. Our KX3s loafed along at 3 W or so into our amplifiers, producing 500 W for our signals. Despite predictions of poor propagation, we were able to work North America and Japan with no trouble on all bands, and were even able to get out to Europe. That is a real stretch from the Australs at about 10,000 miles, and very nearly antipodal from our position.

Madison, W5MJ, operating TX5T on 20 meters with CW, using an Elecraft KX3 and Expert Amplifier.

On to the Next One

Because of the weather delaying our arrival at our destination, we were only on the air for 6 days. Nevertheless, we managed about 18,000 contacts during our stay and made good on our goal of reaching many hams through FT8 on 160 meters.

Our trip was a success in every sense of the word. We are already planning the next adventure, so stay tuned!

All photos courtesy of Robert Brandon, K5PI.

Wrap-Up

Thanks to W5MJ and the rest of the CanAm DX group for helping to make this month's column possible. Keep sending your DX news, photos, and club newsletters to **bernie@dailydx.com**. Until next month, see you in the pileups!
— Bernie, W3UR

Jon Jones, N0JK, n0jk@arrl.org

The World Above 50 MHz

Hurricane Tropospheric Propagation from Florence

Hurricane Florence was a major Category 4 hurricane that came ashore along the Carolinas during September. Hurricanes can sometimes block inland weather patterns, causing them to stall. This in turn has the potential to create tropospheric propagation, or tropo, for VHF operators. Hurricane Florence created such a scenario (see Figure 1). This has occurred with past hurricanes. Veteran VHF operator Larry Lambert, N0LL, recalled a similar situation with Hurricane Camille:

> I remember Hurricane Camille back in 1969, when I was on 2-meter AM with just 8 W, using the old Knight Kit TR-108 and a small Yagi. The tropo was on a Friday night. I worked all the way to Ohio from western Kansas. It was difficult to put the microphone down. My dad finally shut off the electricity to my bedroom at midnight.

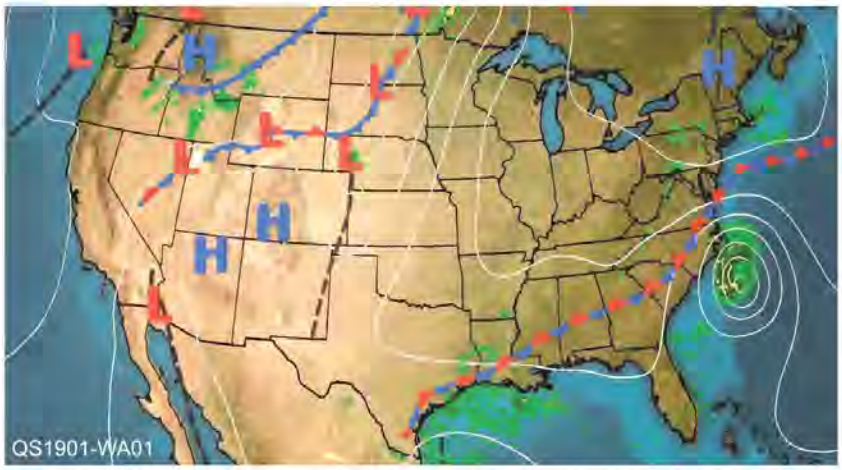


Figure 1 — Hurricane Florence and the high-pressure system that it blocked on September 13, 2018.

Hurricanes can block high-pressure weather systems inland, sometimes well before coming ashore. Florence did not come ashore until September 14, but began blocking a large high-pressure system over the eastern states several days earlier. A stalled high-pressure system sets up a "perfect storm" for VHF propagation. The best days for tropo were September 11 – 15. Gary, KE8FD (EM64), found strong tropo the morning of September 12. On 144 MHz, Gary worked WB8AHT (EN72), W8MIL (EN74), W9MU (EN44), WD9BGA (EN53), W0GHZ (EN34), W0RT (EM27), VE3ZV (EN92), and W0AAT (EN24), with his best DX contact being with K0AWU (EN37) at 1,463 kilometers. That evening, N0LL (EM09) worked K9MRI (EN70) on 2 meters at 2357Z. An hour later, I (N0JK, EM28) worked K9MRI on CW with 559 signals. From Michigan, Stan, W8MIL, had great conditions from September 11 – 14. He logged WA1JAS (FN55) on 2 meters with 25 W and KE8FD (EM64) on 432 MHz with 20 W, along with many other stations. Stations in Iowa, Minnesota, and Illinois worked the east coast and northeast states. On September 14, KF0M (EM17) worked WD0BQM (DN81) on 2 meters on the western side of the high.

High-pressure weather systems create tropospheric refraction by a process known as subsidence. Air in a high-pressure system sinks, and as it does, it warms and becomes drier. Cool, moist air can be trapped underneath. The boundary between the higher warm, dry air and the lower cool, moist air causes an inversion, which is where the tropo occurs. Signals are "trapped" by the inversion in a "duct." Signals can be ducted 1,000 miles or more. Tropospheric propagation affects signals from 28 MHz and up, though frequencies of 144 MHz and higher are of most interest. Usually high-pressure systems advance from west to east across the United States. Many don't linger long enough for stable subsidence to set up.

A hurricane traveling northwest toward the southeast states can "block" the progress of a high-pressure system. Thus, the high-pressure system can stall for up to a week, allowing strong subsidence conditions to grow.

Cortesia de Virgilio.

On the Bands

50 MHz. A surprisingly strong sporadic-E opening took place on September 13 (see Figure 2). It appeared to start around 1800Z and continued for almost 6 hours. It favored the southeast states. KD4ESV (EL87) worked stations in W1, W2, and W3, then west to Oklahoma and Texas. K8LEE spotted some real DX with TI5/N5BEK at 1832Z on 50.313 MHz. This opening would have been a welcome addition to the ARRL September VHF contest the prior weekend. There were almost no sporadic-E openings during the contest. Contestants such as WQ0P found plentiful meteor scatter contacts using MSK144. I (N0JK, EM28) logged K5QE (EM31) via MSK144 on September 9 at 0637Z with 10 W.

Tom Lewis, N4TL, notes he worked Wade, KG4WH, at Guantanamo Bay on FT8 in July. Wade is a civilian working for the US Navy. "Gitmo" has been rare on 6 meters in the last couple of years, and it's great to see the activity there. Wade posts his operating schedule and updates at **https://www.facebook.com/wadehicksjr/**.

Mario, K2ZD, reports working Lance, C21GJ, on JT65A EME on September 29. Lance says Tim, N3XX, was his first US contact on September 29 at 1040Z. This may be a first between Nauru and the US on 6 meters.

144 MHz. Near the end of the September VHF Contest, tropo appeared in the upper midwest. Larry, N0LL, worked W9EWZ (EN52), W8MIL (EN74), and N0URW (EN41) in the last hour.

There was strong regional tropo again in the midwest on September 24 under a slow-moving high-pressure system (see Figure 3). Karl, WD9BGA (EN53), heard the N0YK/b (DM98) and the 12 W from N0LL/b. He worked N0JK (EM28), who was running 50 W, and N0LL (EM09). Larry, N0LL, also worked KC9TNX (EN44), W8MIL (EN74), and W9EWZ (EN52), with 59 signal reports. KF0M (EM17) said remote station AA0F (EN04) was "10 over." The day before, WE7L (DM79) heard the N0YK beacon 30 dB above the noise.

Figure 3 — N0JK's (EM28) portable Yagi used to make contacts on 144 MHz on September 24, 2018.

On September 29, Mike, K7ULS, made 11 EME contacts on 2 meters, including S56P for a new country. Mike uses two 12-element Yagis and 350 W.

432 MHz. N0LL logged W9EWZ (EN52) on September 10 UTC at the end of the VHF Contest.

Figure 2 — A plotting of 2-meter contacts from September 13 UTC (September 12). [**dxmaps.com**]

Meteor Scatter Opportunity in December

The Geminid meteor shower will peak on December 13 – 14, 2018. The radiant — the point in the sky where it appears the meteors originate from — is the constellation Gemini. At the peak, there may be 120 – 160 visible meteors an hour. Astronomers feel this year's shower may be stronger, as Jupiter's gravity has tugged the meteor particle stream closer to Earth. Based on the location of the Geminids radiant, the best radio path is north to south from 10 PM to midnight and 5 to 7 AM local time. The Geminids are plentiful but relatively slow moving at 35 kilometers per seconds, as opposed to the Perseids at 60 kilometers per second. This favors lower frequencies. The Geminids are great on 28 and 50 MHz, good at 144 MHz, but daunting on 222 MHz, compared to the Perseids. At the shower peak, SSB contacts are possible on both 50 and 144 MHz. I recall easily working W5UWB (EL17) on 2-meter SSB at the peak during a past Geminid meteor shower.

Special Event Stations

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

Through Dec. 31, 0000Z – 1259Z, S590RTVS, Cerkno, Slovenia. Radio Club Cerkno (S50E). **90th Anniversary of Radio and Television Corporation of Slovenia**. All bands, all modes. Certificate. Radio Club Cerkno, p.p. 16, 5282 Cerkno, Slovenia. *A special S590RTVS QSL will confirm each contact via the QSL bureau in early 2019. Log will be uploaded on ARRL LoTW and Club Log on a regular basis. See website for complete details.* **www.qrz.com/db/S590RTVS** *or* **www.s50e.si**

Nov. 24 – Nov. 25, 1300Z – 1900Z daily, NI1X, Plymouth, MA. Whitman Amateur Radio Club. **The First Pilgrim Landing at Plymouth**. 18.160 14.260 7.260 3.860; EchoLink: WA1NPO-R, IRLP:8691. Certificate. Whitman ARC, P.O. Box 48, Whitman, MA 02382. **www.wa1npo.org**

Dec. 1, 1400Z – 1900Z, K9P, Green Bay, WI. Green Bay Mike & Key Club. **100th Season of the Green Bay Packers**. 14.270 14.035 7.270 7.035 146.495. QSL. Green Bay Mike & Key Club, P.O. Box 13351, Green Bay, WI 54307. **www.k9eam.org**

Dec. 1, 1400Z – 2100Z, W9VT, Hazel Crest, IL. Tri-Town Radio Amateur Club. **Illinois' 200th Anniversary of Statehood**. 14.340 7.270. Certificate. Tri-Town RAC, P.O. Box 1296, Homewood, IL 60430. **www.w9vt.org**

Dec. 1 – Dec. 2, 1900Z – 0200Z, W2EGB, East Greenbush, NY. East Greenbush Amateur Radio Association. **20th Anniversary**. 28.340 14.340 7.240 3.840. QSL. East Greenbush Amateur Radio Association, Attn: Special Event QSL, P.O. Box 25, East Greenbush, NY 12061. **www.egara.club**

Dec. 1 – Dec. 9, 1300Z – 2200Z, W2W, Baltimore, MD. The Amateur Radio Club of the National Electronics Museum, K3NEM. **Pearl Harbor Day Commemoration**. 14.241 14.041 7.241 7.041. Certificate & QSL. W2W Pearl Harbor Special Event Station, P.O. Box 1693, MS 4015, Baltimore, MD 21203. *Primary operation will be Dec. 1 – Dec. 2, with additional operation possible Dec. 3 – Dec. 9, as operator availability permits.* **www.ww-2.us**

Dec. 5, 1000Z – 1500Z, NB4RC, Deerfield Beach, FL. North Broward Radio Club. **Lost Squadron — Fort Lauderdale**. 14.325. QSL. North Broward Radio Club, 4116 NW 1st St., Deerfield Beach, FL 33442. **joeyjet@bellsouth.net**

Dec. 8, 1400Z – 2200Z, K7T, Tucson, AZ. Oro Valley Amateur Radio Club. **USS *Arizona* at Pearl Harbor Day**. CW: 14.040 7.040; PSK: 14.070 7.070; FT-8: 14.074 7.074 18.100; SSB: 14.250 7.200. Certificate. Email request for certificate to **qsl@tucsonhamradio.org**. *Operating from the USS* Arizona *Memorial on the University of Arizona campus.* **www.tucsonhamradio.org**

Dec. 8, 1600Z – 2200Z, W8VP, Cambridge, OH. Cambridge Amateur Radio Association. **105th Anniversary**. 14.245 7.235. QSL. CARA, P.O. Box 1804, Cambridge, OH 43725. **www.w8vp.org**

Dec. 8, 1700Z – 2359Z, NI6IW, San Diego, CA. USS *Midway* (CV-41) Museum Ship. **Pearl Harbor Remembrance Day**. 14.320 7.250; 14.070 (PSK31); D-STAR on REF001C. QSL. USS *Midway* (CV-41) COMEDTRA, 901 N. Harbor Dr., San Diego, CA 92101.

Dec. 8, 1800Z – 2300Z, W9WWI, New Washington, IN. Clark County Indiana Amateur Radio Club. **Christmas in Bethlehem: Bethlehem On The Air**. 14.245; 40 through 6 meters, as conditions permit. Certificate & QSL. W9WWI CCARC Bethlehem, 4208 Perry Crossing Rd., Sellersburg, IN 47172. *LoTW will be used to log contacts.* **www.clarkcountyarc.org**

Dec. 15 – Dec. 16, 1200Z – 2359Z, W8ZQ, Wheeling, WV. Northern Panhandle Amateur Radio Club. **Oglebay Park Winter Festival of Lights**. 14.245 7.210; 75, 40, and 20 meters; other bands as conditions permit. Certificate. Joe McCready, 29 Clover Ln., Colliers, WV 26035. **www.qrz.com/db/w8zq**

Dec. 15 – Dec. 16, 1400Z-2200Z daily, WX3MAS, Nazareth, PA. Christmas City Amateur Radio Club. **WX3MAS Special Event**. 14.265 7.270 3.850. QSL. WX3MAS, Greystone Building, 14 Gracedale Ave., Nazareth, PA 18064. *See website for details and possible electronic certificate.* **www.dlarc.org**

Dec. 21 – Dec. 27, 0000Z – 2359Z, several calls, numerous areas. NASA Radio Clubs. **Apollo 8 50th Anniversary**. 14.271. Certificate & QSL. See **www.qrz.com** for club contacted. *Several NASA Amateur Radio clubs will be celebrating this event, which marks the end of the year-long NASA On The Air activity. Operation will be on various bands and modes. We will be self-spotting on the DX cluster as well as our Facebook and Twitter feeds. See website for further detail.* **nasaontheair.wordpress.com**

Dec. 26 – Dec. 30, 1400Z – 2200Z, W2T, Trenton, NJ. Delaware Valley Radio Association. **Battle of Trenton**. 14.200 7.200. Certificate & QSL. DVRA/W2T, P.O. Box 7024, Trenton, NJ 08628. *Work both W2T (Battle of Trenton) and W2P (Battle of Princeton in January) and get a certificate of Commission in the Continental Army Signal Corps. See website for details.* **www.w2zq.com**

Certificates and QSL cards: To obtain a certificate from any of the special event stations offering them, send your QSO information along with a 9 × 12 inch self-addressed, stamped envelope to the address listed in the announcement. To receive a special event QSL card (when offered), be sure to include a self-addressed, stamped business envelope along with your QSL card and QSO information.

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**.

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 **February** *QST* would have to be received by **December 1**.

Special Events listed in this issue include current events received through October 10. You can view all received Special Events at **www.arrl.org/special-event-stations**.

December 2018 W1AW Qualifying Runs

Earn your Code Proficiency certificate or endorsements by listening to W1AW Qualifying Runs. Legibly copy at least 1 minute of text by hand and mail the sheet to:

W1AW Qualifying Runs, 225 Main St., Newington, CT USA 06111

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

December Qualifying Runs will be transmitted by W1AW in Newington, Connecticut at 10 PM EST on Thursday, December 6 (0300 UTC on December 7) and at 9 AM EST on Tuesday, December 18 (1400 UTC) at 1.802.5, 3.581.5, 7.047.5, 14.047.5, 18.097.5, 21.067.5, 28.067.5, 50.350, and 147.555 MHz. The West Coast Qualifying Runs will be transmitted by K6KPH on Saturday, December 15 at 2 PM PST (2200 UTC) at 3581.5, 7047.5, 14047.5, 18097.5, and 21067.5 kHz. Unless indicated otherwise, sending speeds are from 10 to 40 WPM.

Life Members

Elected October 20, 2018

Denisse E. Abreu, WP4DA
Lewi Agersten, LA4CIA
Mark Allen, KC7DTE
Richard A. Allnutt, WS8G
Vanessa Bailey, N4NHE
David P. Baxter, WB6LYZ
Daniel R. Beatty, KC1PUG
David A. Begue, K5FOZ
Richard G. Beline, Sr., KA5EZQ
Charles K. Bennett, K8CB
Danette Betz, K8ROK
Michael L. Betz, K8ROX
Kevin J. Biediger, KB5KUK
Jonathan M. Binstock, NK3D
James R. Bledsoe, KI4KEA
Dan Bostick, KG5SSB
Geary A. Bradley III, KG8DH
Kirc A. Breden, N5XJB
Joseph Brennan, W5DPH
Brandon Brinkley, AC4OU
Michael R. Brodeur, N2NSL
Ronald P. Brodeur, W1KDA
Theodore K. Callender, KM4SRO
Robert E. Campbell, KG6HUM
Steve Cerwin, WA5FRF
Mary L. Chambers, WH6FAZ
Wayne Coburn, KK6ZPL
Arnold Cooper, AC2IV
Robert Crago, K0RDC
Brooks M. Crenshaw, K4ATA
Daniel S. Cross, AC2OI
Stephen P. Curry, KD1O
Frederick G. Curtis, KI6GRO
Dennis A. Davidson, NW0V
Dean T. Delpriore, KC2WDQ
Jack Demyan, WM3U
Clay Dixon, KG5PMZ
Francesco Doenz, HB9GUO
Alan R. Ertle, KM6UHJ
Gary L. Eversman, KA0K
James F. Eyrich, KC9IWZ
William Fallon, N1ZV
Cynthia Feuerstein, N7VMO
John S. Fine, KG4ITE
Christopher E. Francis, N8PVL
Kris T. Fredrick, AC0UD
Brian J. Fredricks, KN4BNZ
Bdale Garbee, KB0G
Karen Garbee, N1FED
Dennis Gesker
Scott Ghiz, W3GHZ
Don Goff, WA5DG
Robert G. Graf, K6RGG
Mike Greb, AC2RK
Nick Greed, KE8CZC
Bonnie Greenfeld, KC2JVS
Mark C. Haffner, KC8KHL
Alexander Hagerty, W4JHU
Jacob Hahn, KM4JRL
James C. Hall, WB4YDL
David G. Halliday, K3DGH
Christopher P. Hanson, K8SH
Glenn Hartman, WA3Z
Wesley K. Hearn, KM4COU
Robert T. Helton, KF6CZ
Danny G. Hicks, AB7DH
Susan Hicks, AB7GL
John Hilderbrand, WB3DX
Todd Hoessler, N1GNX
Gary A. Hoffman, N6HDS
William Holden, KM4LOZ
James W. Horman, Jr., W3MMM
David Haney Howell, K2XN
James W. Howland, KJ4LYE
Jefferson J. Hunt, KE0KZH
Randall Jackson, AK4FH
Rennie M. Jacob, KD2JYO
Michael E. Jaggers, WB4TTZ
Ria Jairam, N2RJ
Thomas Jenkins, AD5QA
Don Jones, K6ZO
Alan F. Jovanovich, KA7DAT
Sharon Joyce, KJ4TPQ
James A. Kaup, KK6OQI
Peggy Kennedy, N4PEG
Masafumi Kikuchi, JR7CGF
Steven B. Kindred, AE4US
Steven J. Klein, KC3MAU
David W. Kratz, Jr., WK0R
James P. Langan III, K0QEI
James E. Langston, KI7WQQ
Michael S. Laughlin, KR1MSN
John M. Lento, Jr., AF7AM
John Lockhart, W0DC
Tom Loughney, AJ4XM
Matthew J. Lunati, N7OEI
Casey MacKay, KB9YFW
Jared K. Madsen, KD7ZCR
Tony W. Manino, Jr., KG4VCE
Vincenzo P. Mazzarella, KB1JDX
Matthew S. Medlen, Sr., N9YBK
Kay Meritt, KE5RKB
Duane N. Morrison, K4WAB
Randolph Neals, W3RWN
Bradley A. Nelson, W7LZN
Kenneth E. Norris, KK9N
Carlos M. Osorio, WP4N
Simon G. Outhwaite, AK6J
James D. Pace, K7CEX
James P. Parise, W1UK
Jason R. Parker, KC9NBW
Roger E. Parsons, KK4UDU
Wilbur Pell III, W8WFP
Paula Persons, W0HA
Frank E. Philipp, N0YKA
Elmo W. Piper, KF6LYE
James S. Prihoda, KD7SEW
Joseph B. Puig III, KF6FVD
Carlo Rabino, DG6FFG
Stephen A. Rish, K8SAR
Scott E. Roberts, KB3CBC
Travis S. Robinson, KI6BDJ
Manuel E. Rodriguez, N4JOO
Richard Rosano, Jr., K2RIK
Terry T. Rowe, KN4DLV
Adam J. Royston, W3PAX
Steve Russell, NX0L
Gilbert D. Rymer, W5GLR
Brad B. Sage, K6JPR
Chris R. Schultz, KC0YFX
William R. Semethy, Jr., K3YEB
Leo V. Shebalin, KM6FJF
Jonathan Sherman, WW2JS
Joseph E. Simpson, KK4DZX
River M. Simpson, KF5WBL
Scott C. Souders, KD5ZYZ
Regina W. Spaulding, KC1SR
Lauren M. Speeth, KK6NGE
Lars Spencer, NS3F
Brian M. Spiegel, K2EGL
Kenneth Spiegel, KD2DZZ
Jeff W. Standifer, WB5WAJ
David M. Stein, K0DS
Carsten G. Steinhoefel, G0SYP
Jerry O. Stern, NY2KW
Frederick L. Stiles, WF4LS
Matthew J. Stoops, KM6HET
Douglass C. Sullivan-Gonzalez, K5DSG
Heath W. Sweatman, WA4PFS
Andrew S. Thall, K2OO
John W. Thompson, K3MD
Paul W. Van Dyke, KB9AVO
Rik Van Riel, AB1KW
Michael D. Veltman, W4MDV
Carlos J. Vera, KP4VC
Chad E. Wagoner, KE0RUZ
Charles E. Wallace, KB8DEX
Qingfeng Wang, KC3E
Robert D. Watts, KM4VMZ
Austin B. Williams, AF0OT
Henry Curtis Williamson, W4HCW
Donald C. Winsor, AC8TO
Matthew J. Wolf, N4MTT
Nathan H. Wood, K4NHW
Tim D. Woolever, KJ6OIL
Josef K. Woytowicz, N6COA
David C. Wright, K3DCW
Brad J. Ziegler, KC0CDG

SKYWARN Recognition Day is December 1

The annual SKYWARN Recognition Day (SRD) on-the-air activity will take place Saturday, December 1, 2018, from 0000 until 2400 UTC (starts on the evening of Friday, November 30, in US time zones).

SKYWARN Recognition Day was developed in 1999 by the National Weather Service and ARRL to honor the contributions that SKYWARN volunteers make to the National Weather Service (NWS) mission — the protection of life and property during threatening weather. During the SKYWARN Special Event, hams will operate from several NWS offices.

The object of the event is for all participating Amateur Radio stations to exchange contact information with as many NWS stations as possible on 80, 40, 20, 15, 10, 6, and 2 meters, as well as 70 centimeters. Contacts via repeaters and other modes such as Echolink, IRLP, DMR, D-STAR, and System Fusion, among others, are permitted.

Stations will exchange call signs, signal reports, locations, and a one- or two-word description of the weather at their respective locations (e.g., "sunny," "rainy," "partly cloudy," "windy"). NWS stations will use various modes, including SSB, FM, AM, RTTY, CW, and PSK31. While using digital modes, special event stations will append "NWS" to their call signs (e.g., N0A/NWS).

Details about participating in this event can be found at **hamradio.noaa.gov**. Visit **https://www.skywarn.org** for more information on the National Weather Service SKYWARN program.

Nominations Open for 2018 International Humanitarian Award

Nominations are open for the 2018 ARRL International Humanitarian Award. This award is conferred upon an individual radio amateur or Amateur Radio group that has demonstrated devotion to human welfare, peace, and international understanding through Amateur Radio. ARRL established this annual award to recognize Amateur Radio operators who have used ham radio to provide extraordinary service to others in times of crisis or disaster.

A committee appointed by ARRL's president recommends the award recipient(s) to the ARRL Board of Directors, which makes the final decision. The committee is now accepting nominations until December 31, 2018, from Amateur Radio, governmental, or other organizations that have benefited from extraordinary service rendered by an Amateur Radio operator or group.

Nominations should include a summary of the nominee's actions that qualify the individual (or individuals) for this award, plus verifying statements from at least two people having firsthand knowledge of the events warranting the nomination. These statements may be from an official of a group that benefited from the nominee's Amateur Radio contribution. Nominations should include the names and addresses of all references.

All nominations and supporting material for the 2018 ARRL International Humanitarian Award must be submitted in writing in English to ARRL International Humanitarian Award, 225 Main St., Newington, CT 06111 USA, or via email to **wv1x@arrl.org** by December 31, 2018. As an additional reference, visit **www.arrl.org/international-humanitarian-award**.

ARRL VEC Volunteer Examiner Honor Roll

The ARRL VEC Honor Roll recognizes the top five Volunteer Examiners in each ARRL Division according to the total number of ARRL exam sessions in which they have participated since their accreditations. Considering each session requires an average time commitment of 2 to 4 hours or more, the thousands of hours these VEs have invested represent extraordinary dedication! Whether you are one of our VE Teams that tests once a week, once a month, or once a year, we want to express our warmest appreciation to all volunteers for your generous contribution to the ARRL VEC program.

If you are an ARRL VE, you can view your session stats online at **www.arrl.org/ve-session-counts**. If you are not a VE, become one today! See **www.arrl.org/become-an-arrl-ve**.

Examiner	Sessions	Accreditation Date
Atlantic		
Jobst Vandrey, AC0LP	318	23-Jun-08
James McCloskey, NS3K	300	14-Nov-94
Edward Genoino, WA2NDA	298	10-Jul-85
George Brechmann, N3HBT	264	01-Apr-91
Robert Benna, N3LWP	230	21-May-97
Central		
Ed Wagner, AB9FN	307	01-Jul-02
Eldon Boehm, NK9U	298	21-Nov-86
Allan Bukowski, N9ZD	294	01-Jun-92
Donald Hlinsky, N9IZU	285	01-Mar-91
Timothy Pechtold, AA9BV	266	01-Nov-92
Dakota		
John Schwarz, Jr., AE0AL	291	26-Oct-94
Jeffrey Goodnuff, W0KF	276	17-Jun-03
Daniel Royer, KE0OR	225	01-Jul-91
Shep Shepardson, N0NMZ	219	12-Mar-01
Tom Wilson, NI0I	217	30-Jul-86
Dennis Ackerman, KB0OQQ	217	15-Jul-96
Delta		
Arthur Parry, Jr., WB4BGX	260	01-May-91
Edward Scheufele, AB5RS	224	19-Jan-94
Glenn King, N5GK	220	05-Jun-86
Roger Gray, N5QS	219	01-Mar-93
William Easterday, KB8FU	209	01-Mar-91
Great Lakes		
Charles Hall, W8HF	266	01-Jun-92
David Schmidt, KI4QH	250	15-Feb-85
Dale Pritchett, KC8HJL	223	26-Mar-98
Herbert Blasberg, WA8PBW	216	06-Sep-84
Christian Anderson, K8VJ	215	09-Feb-90

Examiner	Sessions	Accreditation Date
Hudson		
Paul Maytan, AC2T	614	06-Sep-84
E. Drew Moore, W2OU	423	01-Aug-90
Stanley Rothman, WA2NRV	422	01-Mar-85
Gerald Miller, Jr., AA2ZJ	398	05-Dec-95
Fritz Boigris, KB2O	381	26-Oct-84
Midwest		
David Bartholomew, AB0TO	685	22-Mar-02
Kevin Naumann, N0WDG	607	17-Nov-02
Harry Steger, Jr., W0HMS	507	26-Aug-08
Roland Kramer, W0RL	503	21-Jun-01
Jeanette Nordman, AB0YX	459	21-Aug-03
New England		
Robert Beaudet, W1YRC	356	01-Aug-90
Lawrence Polowy, KU1L	327	02-Jan-85
Stefan Rodowicz, N1SR	321	20-Nov-84
Bruce Anderson, W1LUS	320	11-Feb-88
James Mullen, KK1W	319	01-Mar-91
Northwestern		
Richard Morgan, KD7GIE	450	11-Aug-00
Loren Hole, KK7M	367	06-Sep-84
George Ftikas, N7TQZ	291	01-Dec-92
David Brooks, N7HT	275	10-Jun-87
S. Riley McLean, W7RIL	266	02-Sep-99
Pacific		
Morris Jones, AD6ZH	439	27-Nov-01
Dieter Stussy, KD6LVW	372	27-Jan-94
Gordon Fuller, WB6OVH	314	06-Sep-84
Bill Nichols, NN7K	302	01-Sep-93
Jim Brunk, N6BHX	257	13-Jul-95

Examiner	Sessions	Accreditation Date
Roanoke		
Judy Friel, AC4RG	275	01-Feb-91
Alan Moeck, WA2RPX	250	27-Sep-94
David Snyder, W4SAR	231	01-May-93
Sheila Frank, KT4YW	217	30-Oct-96
Thomas Hill, KJ4IV	201	01-Jun-91
Rocky Mountain		
Robert Hamilton, N0RN	364	19-May-87
David Avery, N0HEQ	283	13-Jan-88
Jeffrey Weinberg, W0QO	274	01-Apr-93
Frank Goddard, W0AJY	267	01-Feb-92
Philip O'Kunewick, AB0JR	267	24-Feb-00
David Sharpe, KI0HG	241	02-Feb-98
Southeastern		
Victor Madera, KP4PQ	442	01-Mar-92
Pablo Soto, KP4SJ	369	01-May-92
Val Jacyno, AK4MM	361	08-Nov-11
Robert Cumming, Sr., W2BZY	327	29-Jan-97
Joseph Patti, N4UMB	313	01-Sep-90
Southwestern		
Bill Martin, AI0D	944	01-Nov-84
Fred Bollinger, AB7JF	506	17-Apr-95
Steve Gurley, KY7W	408	19-Apr-96
Joseph Cutitta, W0SLL	394	09-Nov-99
David Morrill, N7TWT	381	20-Jul-00
West Gulf		
Franz Laugermann, K3FL	1,007	01-Dec-91
Wilbert Cannonier, KK5JJ	446	03-Nov-95
Adolph Chris Koehler, K5VCR	433	29-Sep-95
Gerald Grant, WB5R	430	04-Jan-85
David Fanelli, KB5PGY	415	01-Oct-91

Happy Holidays and Peace on Earth

Leona Adams, W1LGA
Mika Aleksandrowicz
Bob Allison, WB1GCM
Katherine Allison, KA1RWY
Ken Bailey, K1FUG
Zoe Belliveau, W1ZOE
Adam Bernard
Kris Bickell, K1BIC
Shelly Bloom, WB1ENT
Stephanie Borden, W2MAU
Kathy Bouchard
Margie Bourgoin, KB1DCO
Matthew Brady
Ann Brinius
Al Brogdon, W1AB
Dennis Budd, K3DGB
Steve Capodicasa
Joe Carcia, NJ1Q
Eric Casey
Lauren Clarke, KB1YDD
Tad Cook, K7RA
Mike Corey, KI1U
Dave Distefano
Bruce Draper, AA5B
Steve Ewald, WW1X
Jon Faasen, KC1ECT
Sue Fagan, KB1OKW
Maureen Farmer
Trish Feeney
Jackie Ferreira, KB1PWB
Gloria Flores
Steve Ford, WB8IMY
Norm Fusaro, W3IZ
Regina Galuppi, W3DGI
Scott Gee, WB9RRU
Jennifer Glifort
Alan Gosselin
Amanda Grimaldi, N1NHL
Mike Gruber, W1MG
Joel Hallas, W1ZR
Doug Haney
Ed Hare, W1RFI
Dan Henderson, N1ND
Gail Iannone
Chris Imlay, W3KD
Bob Inderbitzen, NQ1R
David Isgur, N1RSN
Sabrina Jackson, KC1JMW
Bart Jahnke, W9JJ
Joseph Johnsky
Jon Jones, N0JK
Elizabeth Karpiej, KA1DTU
Michael Keane, K1MK
Caroline Kenney
Greg Kwasowski, W1GJK
Zachary Lau, W1VT
Rose-Anne Lawrence, KB1DMW
Amy Leary, KB1TLM
Monique Levesque
Rick Lindquist, WW1ME
Maryann MacDonald, KB1ZTH
Allison McLellan
Bernie McClenny, W3UR
Kim McNeill, KB1WUX
Howard Michel, WB2ITX
Diane Middleton, W2DLM
Brian Moran, N9ADG
Jodi Morin, KA1JPA
Joshua Nance
Rick Palm, K1CE
Michelle Patnode, W3MVP
Carla Pereira, KC1HSX
Diane Petrilli, KB1RNF
David Pingree, N1NAS
Ann-Marie Pinto
John Proctor, K1JMP
Ally Riedel, KM3ALF
Lisa Riendeau
Janet Rocco, W1JLR
Kim Rochette
Scott St. Onge
Cathy Scharr
Michael Scharr
Becky Schoenfeld, W1BXY
Barry Shackleford, W6YE
Andrew Shefrin, KB1YHB
Barry Shelley, N1VXY
H. Ward Silver, N0AX
Jon Siverling, WB3ERA
Kai Siwiak, KE4PT
Maria Somma, AB1FM
Cathy Stepina
Diane Szlachetka, KB1OKV
Sharon Taratula
Lisa Tardette, KB1MOI
Lou Treglia
Yvette Vinci, KC1AIM
Deborah Voigt
Paul Wade, W1GHZ
Dan Wall, W1ZFG
Maty Weinberg, KB1EIB
Mark Wilson, K1RO

From the ARRL Staff and *QST* Contributing Editors

Convention and Hamfest Calendar

Abbreviations

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

ARKANSAS DX ASSOCIATION CONVENTION

December 1, North Little Rock, AR
S
8 AM – 3 PM. *Spr:* Arkansas DX Assn. Wyndham Riverfront Little Rock Hotel, 2 Riverfront Place. 51st Anniversary Convention. *Registration:* $45. **www.adxa.org**.

Louisiana (Minden) — Dec. 15
D F H R S V
8 AM – 2 PM. *Spr:* Minden ARA. Minden Civic Center, 520 Broadway St. *TI:* 147.3 (186.2 Hz). *Adm:* $5. **n5rd.org**.

NEW YORK CITY/LONG ISLAND SECTION CONVENTION

January 5, Brookville, NY
R S V
7:30 AM (doors open), 9 AM (forums start). *Spr:* Ham Radio University ARC. LIU / Post, Hillwood Commons Student Center, 720 Northern Blvd. Ham Radio University 2019. *TI:* 146.85 (136.5 Hz). *Adm:* $5 (donation). **hamradiouniversity.org**.

North Carolina (Winston-Salem) — Jan. 5
D F H R T
7 AM – noon. *Spr:* Forsyth ARC. Robinhood Road Baptist Church, 5422 Robinhood Rd. *TI:* 145.47 (100 Hz). *Adm:* $5. **w4nc.com**.

Wisconsin (Waukesha) — Jan. 5
D F H R S V
8 AM – 1 PM. *Spr:* West Allis RAC. Waukesha County Expo Center Arena, 1000 Northview Rd. 47th Annual Midwinter Swapfest. *TI:* 147.4 Simplex. *Adm:* Advance $5, door $6. **warac.org**.

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

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 **December 1** to be listed in the **February** 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 the ARRL Advertising Desk at 860-594-0207, or email **ads@arrl.org**.

Write for *QST*

The membership journal of ARRL is always open to manuscript submissions from ham radio operators.

QST looks for material that appeals to a broad cross-section of readers within the diverse Amateur Radio community. Feature articles published in *QST* fall into one of two broad categories: *technical* and *general interest*.

Technical articles outline a construction project or a technical concept. General interest articles are "everything else" that's not technical: recaps of DXpeditions, grid expeditions, or public service activities; personal accounts of trying a new mode or style of operating — anything relating to operating or the ham radio avocation.

Whether your manuscript has a technical or general focus, a strong "how-to" component will make it stand out. Readers should come away from the article with specific ideas for recreating your experience.

Please note that *QST* only considers complete manuscripts — we do not evaluate concepts or ideas for manuscripts. The best way to find out whether the editors of *QST* are interested in your idea is to write the article and send it in for consideration via postal mail or email (no phone calls, please).

For more information on what *QST* is looking for, and how to submit manuscripts, see our Author Guide at **www.arrl.org/qst-author-guide**.

New Products

The MFJ Four-Band Octopus Antenna

Choose your favorite four bands with this new antenna. Using a metal pole or telescopic mast up to 1 inch, it easily secures and tightens with a thumbscrew, and then you can screw in your HamSticks. Rotate it with a small TV rotator or just a ground mount for omnidirectional use. Use eight HamSticks (two of the same for each band). The tough octagonal enclosure has eight ⅜-24 threaded connectors for HamSticks. It has a built-in balun and a super strong base tube insulator made of fiberglass-filled ABS.

This antenna can be put up in minutes. It makes for a great stealth, portable, or permanent base antenna and is super lightweight, with a 14-foot diameter. HamSticks break down to about 4 feet for easy storage.

MFJ-2100: $99.95 (mounting bracket only); MFJ-2104: $249.95 (mounting bracket with your choice of four — two each — 250 W HamSticks saves $20). MFJ-2104H: $479.95 (mounting bracket with your choice of four —two each — high-power 600 W HamSticks saves $20). For more information and to order, visit **https://www.mfjenterprises.com**.

75, 50, and 25 Years Ago

December 1943

- The cover photo shows two young women launching a radiosonde balloon.
- The editorial points out that our hams overseas in the military services would like to get mail from their fellow hams back home.
- In "Aeroanalysis and V.H.F. Techniques," Hollis French, W1JLK, discusses our growing knowledge of conditions in the lower atmosphere and how to take advantage of it with radiosonde equipment.
- Loyal Fox, ex-W2AHB, tutors us on the theory of "Superregeneration" operation in a detector circuit, based on the phenomenon of negative resistance.
- Tech. Sgt. Karl Stello, W3IVZ, reports on the use of Amateur Radio in guiding Coastal Patrol pilots to destroy enemy Axis submarines in "Radio in the Civil Air Patrol."
- In "A Differential Microphone," Cheyney Beekley, W1GS, explains the principles of the new noise-proof lip microphone developed by the Signal Corps.

December 1968

- The cover photo shows W1CW compiling the annual DXCC listing.
- The editorial discusses the debate between commercial phone and radio companies over the legal status of amateur phone patches.
- In "What Is RTTY?" Gerald Hall, K1PLP, provides a simplified explanation to help amateurs acquire the capability.
- Robert Leo, K7KOK, tells how he combined a balun and an L network to produce "An Impedance-Matching Method."
- Lewis McCoy, W1ICP, provides a straightforward definition and explanation of balun use in "Is a Balun Required?"
- W. R. Adey, WB6DEX, and R. T. Kado report on "Synchronous Weak Signal Detection with Real Time Averaging," a technique developed for brain research that was first successfully applied to moon-bounce signal detection over the past year.
- CBS News Vice President Bill Leonard, W2SKE, writes about "The Real Life of W2SKE," describing his own personal ham history as banquet speaker at the Hudson Division Convention.

December 1993

- The cover photo shows the computerized foxhunting system of N1LZD and KA1RBH, described in this issue.
- The editorial, "How to Win the Nobel Prize," summarizes the prize-winning work of K1JT and ex-WB2LAV that led to the discovery and understanding of binary pulsars.
- In "Heroics in the Heartland," Rick Palm, K1CE, reports on the efforts of hams in the Midwest following severe flooding earlier this year.
- Ron Portugal presents Part 1 of "Computer-Controlled Electronic Test Equipment," using your home computer for an inexpensive, completely external build.
- Robert Flanagan, KA1RBH, and Louis Calabrese, N1LZD, explain how they put together "An Automated Mobile Radio-Direction-Finding System" using off-the-shelf high-tech components and good old ham ingenuity.
- Arne Coro, CO2KK, reports on "The First VHF Contest from Cuba" during the first VHF DXpedition in the country, CO0FRC.

Field Organization Reports

September 2018

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**.

1,098
WA7PTM

580
KB2RTZ

496
WB7OSC

449
W7PAT

420
W0KCF

386
WM2C

342
KD8TTE

315
AL0Y

307
KB3YRU

303
KD8UUB

293
WA2CCN

287
WS6P

278
KB1TCE

254
WB8RCR

252
KD2LPM

245
N8SY
WA3EZN

235
WD8MWD

233
KK7TN

225
KT2D
W0PZD

215
WB9WKO

200
KK4PUX
W0DSF

190
AC0KQ

185
K0IBS
WC9CW

180
WD8USA
W4DNA

178
WB8YYS

176
K7WXW

175
W5DY
K8LPC

168
NI2W

165
W2PH

166
KC5ZGG

161
KT5SR
KB3KYH

160
WB9QPM

150
K8RDN

147
WM3G

146
K9DUR
KC8YVF

145
N1LL
W3YVQ

143
KB3LFG

141
N3KRX
KA8ZGY
K3FAZ

140
WB2FTX
W0LAW
KC8WH
WO2H
KK3F
WB6OTS
KW9EMG
WK4WC

139
K1XFC

137
KD2HYA

134
K3JL

133
KC1CIC

131
WB3FTQ

130
NA7G
N2JBA
KW1U
AA7BM
K4IWW

129
W3CB

128
AD5CQ

127
K7OAH

125
AG9G
K9LGU
K2TV

124
KB3IN

120
KI0JO
KA9QWC
WB8YLO
W8DJG
N7IE

119
KV4LY

118
KF4DVF

116
KW4GU

115
W4NWT
KE5YTA
N1IQI
N1TF
W4NWT

114
KB5PGY

111
KD2GXL

110
W1KX
WC4FSU
K6JT

KA5AZK
KC5OZT
KF6IOU
WA3QLW
W8CPG
KY2D
W4CMH
KC2UMX
WB8TQZ
K2KNB
K3IN
K4GK
K1HEJ
KI4UDZ

109
N2WGF

108
WA4VGZ

107
KD2JKV

106
AB9ZA

105
KE4CB

101
KE4AHC

100
WB4RJW
KN9P
N9VC
NX9K
NN7H
KD2MEN
KD2MDV
N8CJS
KB8MAF
AC8RV
WB8SIQ
KA1G
W1RVY
K0VTT
W4TTO

99
N1LAH

98
W9BGJ

95
ND0CW
K3MIY
KB1NMO

93
N3JET

91
WB8QLT

90
KM4VTK
KM4WHO
WD8DHC
KD4EAQ
K8KRA
WD8Q
K8ED
W7PHX
AA3N

88
WA1LPM
WB2ZEX
AA3SB

87
W9EEU
W2CTG

86
N9SE
KA2GQQ
N3RB

84
N2PQJ
WA0UIG

83
AA4XZ
KA2HZP

82
AD3J
W5XX

80
KE5HYW
KA9IKK
KB2QO
KF7GC

79
K3YAK

77
KG5NNA
KD8ZCM

75
K8AMH
W9NXM

74
KL7RF

73
WX4J
KC1HHO

72
K6RAU
K2UNI

70
KC7ASA

The following stations qualified for PSHR in previous months but were not reported in this column: (Aug.) WB4ZIQ 120, WS4P 82, N2JBA 73.

Section Traffic Manager Reports

The following Section Traffic Managers reported: AL, AR, AZ, CO, CT, EMA, ENY, GA, IA, IL, LA, MDC, ME, MN, MS, MT, NC, ND, NFL, NLI, NM, NNJ, NTX, OH, OK, OR, SD, SFL, SJV, SNJ, STX, TN, UT, VA, WI, WMA, WPA, WTX, WV, WY.

Section Emergency Coordinator Reports

The following Section Emergency Coordinators reported: AL, AZ, CT, DE, EB, ENY, EPA, EWA, IA, ID, IL, IN, KY, LA, MDC, MI, MN, MO, MS, ND, NLI, NM, NNJ, NV, OH, OR, PAC, PR, SNJ, SJV, SV, VA, VI, WCF, WPA, WV, WWA.

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 1661, NX9K 1253, WB9WKO 889, WS6P 876, KW1U 646, KI0JO 637.

Silent Keys

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

WA1ABI King, John A., Portsmouth, RI
NF1B Guarino, James J., Dover, DE
KA1CDF Lockhart, Donald G., Charlotte, VT
W1EAW Cressy, Richard W., Jr., Contoocook, NH
KD1FR Stevens, Gene A., Sr., Pownal, VT
W1GAK Trombly, Spencer J., Silver City, NM
KB1GWP Rish, Joseph J., Sr., Wallingford, CT
K1MRC Nates, Joseph F., Taunton, MA
KE1T Bridges, Dean Collier, Raymond, ME
K1ZMB Halpin, John "Jack" E., Patrick Air Force Base, FL
WA2AQH Killmer, Gary E., La Grange, NY
♦WA2CER March, William C., Macedon, NY
W2CNA Annette, Charles N., Warrensburg, NY
N2DRF Fisher, David R., Belfast, NY
♦W2EAL Craig, Robert, Easton, PA
•WA2EWP Brandes, Donald H., Peekskill, NY
W2FIB Colton, Susan, Davenport, FL
KB2FSL Elligott, Patrick J., Jr., Port Charlotte, FL
WB2ICE Amao, Luciano O., Burlington, NJ
•WA2JHD Greene, William C., Belmont, NY
K2JXW Weidner, James H., Merchantville, NJ
KC2MDQ Davis, Charles "Chuck" T., Massena, NY
W2NR Arvay, Frank J., Scotch Plains, NJ
W2OC Fisher, William "Bill," Jr., St. Augustine, FL
KC2QV Zellar, Horace E., Fulton, NY
W2SKP Marshall, Howard, Wetumpka, AL
K2TAE Erway, Elwyn G., Owego, NY
•W2UH Schreiber, Otmar P., Chatham, MA
K2UHV Solomon, Allen, Port Saint Lucie, FL
N2VX Cronin, James D., Pittsford, NY
•KB2WIH Robinson, Dwight C., Utica, NY
WB2WNV Prior, DeLoyce, Verona, NY
N2WVX Sandoli, Samuel C., Oneonta, NY
K2XB Woodlee, Charles R., Burleson, TX
WA2ZWO Reddy, Robert A., East Rochester, NY
KT2ZZ Emmel, Charles Franklin, Sr., Malaga, NJ
KC3AFO Bagley, Keith P., Bedford, PA
W3CWK Kupiec, Christopher W., Spring Brook Township, PA
WB3GOR Frantz, Donald R., Walnutport, PA
•KD3H Judge, George T., Royersford, PA
♦W3IA Chesworth, E. T., Boalsburg, PA
KB3IRF Dyer, Edwin "Ed," Mechanicsburg, PA
K3KO Alsop, Brian, Jacksonville, FL
W3PLP Plants, Paul L., Washington, PA
KA3QHX Levin, John A., Camp Hill, PA
W3TIG Fennell, F. Leighton, Cabot, PA
W3UKX Fullerton, William P., Freeport, PA
W3WES Thompson, Harry B., Hollidaysburg, PA
♦N3WS Supina, Walter R., Redington, FL
AB3YA Flower, John F., Garden Grove, CA
K3ZNB Hankey, William F., Oakdale, PA
WD4AQW Archer, Gene H., Zolfo Springs, FL
W4AWW Satterwhite, Ralph W., Jr., Columbus, GA
WA4BJF Nichols, Earl T., Jr., Elgin, SC
•WA4BWG Brumbelow, Mel, Ashville, AL
KF4CAU Reynolds, James L., Dickson, TN
•AA4CH Hildreth, Cefred K., Cutler Bay, FL
W4CIC Pinegar, Elda "Joe," Brookwood, AL
AE4DY Yarbrough, Dale E., Lyons, GA
♦W4EKB Parker, James R., Springfield, VA
K4FEG Griffin, Frank E., Millington, TN
K4FZM Cranmer, Ray, Anniston, AL
AD4GS Sheets, Gary L., Hogansville, GA
KI4HGO Moniz, Daniel J., Tallahassee, FL
KG4HMP Rush, Ralph R., Union, KY
♦K4KIZ Jackson, Emory L., Mills River, NC
•K4MH Dalton, William R., Gulf Breeze, FL
AK4N Robinson, Grady P., Lancaster, SC
K4OUW Kegley, David R., Rock Hill, SC
♦W4PQ Hendricks, J. R., Cary, NC
N4PYT Nesmith, Idus W., Cochran, GA
NX4Q Steele, James R., Fredericksburg, VA
WD4RDR Crocker, Darrel G., Watertown, SD
W4RFN Johnson, John N., Hillsborough, NC
K4RWA Tew, James A., Fayetteville, NC
•N4SIW Chatham, John B., Norfolk, VA
KI4TDY Reasons, W. E., New Bern, NC
W4TEE Roberts, David, Columbus, GA
W4TKH Collier, Wayne W., Lexington, KY
W4WFA Kilgore, Lawrence H., Birmingham, AL
K4WGB Beyer, William G., Falls Church, VA
KQ4YA Husted, Bill G., Atlanta, GA
WB4YCU West, Bobby G., Thomasville, NC
WA4YID Scott, Fred L., Cocoa, FL
♦WA4YQT Barefoot, Thomas W., New Brockton, AL
K4YZY Watkins, Fred D., Eaststone Gap, VA
♦W4ZEE Burch, Ronald K., Fishersville, VA
N4ZQT Wells, Wilson L., Lexington, KY
N5ASW Brush, Katherine L., Lake Worth, TX
K5AXN Barry, Jerry, Jr., San Antonio, TX
♦W5CML Fowler, Ed L., Jr., Sweetwater, OK
K5CV Jackson, Bruce H., Cordova, TN
KE5GPH Bylander, Ernest G., Bartlesville, OK
K5GYL Adams, Harold W., Chalk Bluff, TX
KB5HVO Detmer, Donna M., Prudenville, MI
K5INZ Gass, Edward W., Phoenix, AZ
N5JWJ Carroll, Larry R., Little Rock, AR
KC5KAZ Kilgore, Norman Douglas, Jr., Huntsville, TX
•KG5KD Roberson, Joel A., Forney, TX
KC5KJ Forbes, Henry P., Hammond, LA
KF5KYO Held, Edward J., El Paso, TX
WA5MPX Cade, Charlie B., Burkeville, TX
W5PKE Swafford, Curtis E., San Antonio, TX
WA5PUA Kimble, John E., Granbury, TX
KB5RJU Moore, Archie B., Waxahachie, TX
AA5SF Gatliff, Robert J., Beavercreek, OH
•W5SMH Richardson, Sam L., Keithville, LA
•KE5VHK Middlebrooks, William C., Burnet, TX
K5WI Warner, William G., Richardson, TX
♦•W5YCY Lindell, John E., Port Arthur, TX
WO6A Thygesen, Dennis L., Ukiah, CA
KT6DX Roberts, Paul S., Milpitas, CA
KJ6FVI Ing, John G., Wildomar, CA
WB6GXW Miller, Steven, Canoga Park, CA
W6GZT Wright, Forest E., Murrieta, CA
KD6IQF Muschinske, Jonathan P., Atascadero, CA
KE6JXV Jones, Daisy M., Anaheim, CA
♦K6LHP McWilliams, James D., Brentwood, CA
N6OPG Olson, Yvonne B., Anacortes, WA
N6PB Bergeron, Philip D., Manhattan Beach, CA
K6REQ Lothrop, Fred H., Lafayette, CA
W6TPT Ross, Lyle A., Lake Havasu City, AZ
W6VPN Ross, Walter J., Los Angeles, CA
KD7BHU Ballo, David R., Chelan, WA
NN7C Skinner, Jeff, Indianapolis, IN
KC7CTB Pinick, Joan M., Bel Aire, KS
AL7EM Dennis, Scott D., Alpine, AK
•K7LNS Behrman, Fred E., Milwaukie, OR
KB7MS Scott, Michael P., Puyallup, WA
W7MSW Walden, Marvin S., Snohomish, WA
W7OTO Fujii, Robert H., Bellevue, WA
KG7OWM Haugen, Floyd M., Auburn, WA
AC7RO Hughes, Gerald D., Tempe, AZ
K7VOR Dreste, Bob, Phoenix, AZ
KD7YSB Senko, Robert L., Boulder City, NV
KC8AHZ Fairfield, Gary L., Tawas City, MI
KE8AJ Neal, Simpson B., Bickmore, WV
•KC8FBY Scott, Norman R., Ann Arbor, MI
•N8FTI Wagner, Robert G., Kalamazoo, MI
KD8GGS Taylor, Marcus A., Mount Gilead, OH
W8HQS Sendelbach, James R., Ottawa, OH
W8HTD McDaniel, Wyatt "Mac" E., Naples, FL
WD8IKI Tenney, Richard E., Akron, OH
W8IYE Giffen, Wallace C., Gahanna, OH
•N8JAV Ezell, Gary P., Jr., Swartz Creek, MI
K8JG Good, James, Cincinnati, OH
•K8GK Marks, Dale E., Jackson, MI
WD8JVS Hollabaugh, Lillian, Harlingen, TX
KG8M Leadingham, E. Ray, Beavercreek, OH
KB8NVK Klein, Paul C., Adrian, MI
N8QBY Bernard, Patrick W., Sault Sainte Marie, MI
W8RJM Martini, Robert J., Columbus, OH
N8SIH McGinn, Betty J., Clinton Township, MI
KB8SJ Thompson, James N., Stow, OH
WA8SKM Miller, Lowell "Al," Bexley, OH
KD8SQD Strobel, Leota M., Dimondale, MI
•KB8TMU Goins, Martin T., Sr., Monroe, MI
K8VOB Miller, Robert E., Newberry, MI
KC8ZU Becker, Richard J., Mansfield, OH
K9FQ Freeburg, Thomas A., Saint Charles, IL
WD9FQO Williamson, William N., East Peoria, IL
WA9FTF Avner, Norman, Huntley, IL
K9JEF Kober, John A., Menasha, WI
•KB9JHB Jones, Dorothy M., Fort Wayne, IN
N9LFG Whipple, Jay N., Jr., Lake Forest, IL
KA9LPC Newman, Ronald A., Aurora, IL
W9NSC Dolezal, Jerome "Jerry," Franklin, WI
W9PI Barchak, John E., Fort Wayne, IN
W9PSE Osterhous, Carl R., Indianapolis, IN
•W9PWO Jones, Lloyd W., Jr., North Aurora, IL
KF9RR Goebel, Ronald R., Evansville, IN
WA9WVX Atwell, Daniel B., Jr., Elgin, IL
♦•WOAFQ Anderson, Lester "Andy," Jr., Olathe, KS
KE0CTZ LaSella, John J., Parkston, SD
K0DJB Blakely, Donald J., Saint Paul, MN
W0FF Glasscock, James A., Union, MO
•W0GNV Gray, James E., Boulder, CO
W0GPE Nelson, Paul H., Willard, MO
•KA0HDP Green, Fred L., Akron, OH
•K0HZI Weihrauch, Jerome M., Circle Pines, MN
K0JYZ Revell, Joseph D., Sr., Newton, IA
•KB0KBE Moeller, Thomas A., Lake Wales, FL
♦W0KT Wilson, Richard D., Bellevue, NE
WA0NDO Pfeiff, Theodore H., Bettendorf, IA
N0NGZ Koppert, Rob, Milford, IA
♦N0NJ Hoffman, Nancy, Florissant, MO
W0RTM Wilson, Robert H., Roland, IA
KD0SVX Gutzmer, Merrill "Eugene," Jr., Pine Island, MN
AB0SX Nordman, Harry S., Saint Louis, MO
N0TGN Augustus, William F., Lawrence, KS
VE7CK Craig, A. R., Kelowna, BC, Canada
VE7WMH Hodson, William M., Kelowna, BC, Canada

♦ Life Member, ARRL
• Former call sign

For information on how to list a Silent Key in *QST*, please visit **www.arrl.org/silent-key-submission-guidelines**.

Note: Silent Key reports must confirm the death by one of the following means: a copy of a newspaper obituary notice, a copy of the death certificate, or a letter from the family lawyer or the executor. Please be sure to include the amateur's name, address, and call sign. Allow several months for the listing to appear in this column.

Many hams remember a Silent Key with a memorial contribution to the ARRL Foundation or to ARRL. If you wish to make a contribution in a friend or relative's memory, you can designate it for an existing youth scholarship, the Jesse A. Bieberman Meritorious Membership Fund, the Victor C. Clark Youth Incentive Program Fund, or the General Fund. Contributions to the Foundation are tax deductible to the extent permitted under current tax law. Our address is: The ARRL Foundation Inc., 225 Main St., Newington, CT 06111.

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Special HRO Holiday Pricing!

FTDX5000MP Limited | *200W HF + 6M Xcvr*

• Internal Power Supply • Two Totally Independent Receivers • Super Sharp "Roofing" Filters • High Performance Yaesu Custom- designed 32-bit Floating Point DSP • True Analog Meter Precision

FTDX3000 | *100W HF + 6M Transceiver*

• 100 Watt HF/6 Meters • Large and wide color LCD display • High Speed Spectrum Scope built-in • 32 bit high speed DSP /Down Conversion 1st IF

FT-991A | *HF/VHF/UHF All ModeTransceiver*

Real-time Spectrum Scope with Automatic Scope Control • Multi-color waterfall display • State of the art 32-bit Digital Signal Processing System • 3kHz Roofing Filter for enhanced performance • 3.5 Inch Full Color TFT USB Capable • Internal Automatic Antenna Tuner • High Accuracy TCXO

FTDX1200 | *100W HF + 6M Transceiver*

• Triple Conversion Receiver With 32-bit Floating Point DSP • 40 MHz 1st IF with selectable 3 kHz, 6kHz & 15 kHz Roofing Filters • Optional FFT-1 Supports AF-FFT Scope, RTTY/PSK31 Encode/Decode, CW Decode/Auto Zero-In • Full Color 4.3" TFT Display

FT-891 | *HF+50 MHz All Mode Mobile Transceiver*

Rugged Construction in an Ultra Compact Body • Stable 100 Watt Output with Efficient Dual Internal Fans • 32-Bit IF DSP Provides Effective and Optimized QRM Rejection • Large Dot Matrix LCD Display with Quick Spectrum Scope • USB Port Allows Connection to a PC with a Single Cable • CAT Control, PTT/RTTY Control

FT-857D | *Ultra Compact HF/VHF/UHF*

• 100w HF/6M, 50W 2M, 20W UHF • DSP included • 32 color display • 200 mems • Detachable front panel (YSK-857 required)

FT-2980R | *Heavy-Duty 80W 2M FM Transceiver*

• Massive heatsink guarantees 80 watts of solid RF power • Loud 3 watts of audio output for noisy environments • Large 6 digit backlit LCD display for excellent visibility • 200 memory channels for serious users

FTM-100DR | *C4FM FDMA/FM 144/430 MHz Xcvr*

• Power Packed System Fusion Transceiver • High Audio Output Power • Rugged Powerful Transmitter • Integrated 66ch High Sensitivity GPS • 1200/9600 APRS Data Communications

FTM-400XD | *2M/440 Mobile*

• Color display-green, blue, orange, purple, gray • GPS/APRS • Packet 1200/9600 bd ready • Spectrum scope • Bluetooth • MicroSD slot • 500 memory per band

FT-70DR *C4FM/FM 144/430MHz Xcvr*

• System Fusion Compatible • Large Front Speaker delivers 700 mW of Loud Audio Output • Automatic Mode Select detects C4FM or Fm Analog and Switches Accordingly • Huge 1,105 Channel Memory Capacity • External DC Jack for DC Supply and Battery Charging

FT-2DR *C4FM/FM 144/430 MHz Xcvr*

• Analog/C4FM Dual Monitor (V+V/U+U/V+U) • System Fusion compatible • 1200/9600 APRS Data Communications • Integrated 66ch High Sensitivity GPS • Wide Band Receiver • Snap-shot Picture Taking Capability With Optional MH-85A11U

FT-65R | *144/430 MHz Transceiver*

Compact Commercial Grade Rugged Design • Large Front Speaker Delivers 1W of Powerful Clear Audio • 5 Watts of Reliable RF Power Within a compact Body • 3.5-Hour Rapid Charger Included • Large White LED Flash-light, Alarm and Quick Home Channel Access

FT-60R | *2M/440 5W HT*

• Wide receiver coverage • AM air band receive • 1000 memory channels w/alpha labels • Huge LCD display • Rugged die-cast, water resistant case • NOAA severe weather alert with alert scan

5 Ways to Shop!

- RETAIL LOCATIONS – Store hours 10:00AM - 5:30PM - Closed Sunday
- PHONE – Toll-free phone hours 9:30AM - 5:30PM
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The radio

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Special HRO Holiday Pricing!

IC-9100 | *The All-Round Transceiver*

• HF/50MHz 144/43vvv0 (440) MHz and 1200MHz*[1] coverage • 100W on HF/50/144MHz, 75W on 430 (440) MHz, 10W on 1200MHz*[1] • Double superheterodyne with image rejection mixer

IC-7851 | *HF/50MHz Transceiver*

• 1.2kHz "Optimum" roofing filter • New local oscillator design • Improved phase noise • Improved spectrum scope • Dual scope function • Enhanced mouse operation for spectrum scope

IC-7700 | *HF/50MHz Transceiver*

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

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

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

IC-7300 | *HF/50MHz Transceiver*

• RF Direct Sampling System • New "IP+" Function • Class Leading RMDR and Phase Noise Characteristics • 15 Discrete Band-Pass Filters • Built-In Automatic Antenna Tuner

IC-7200 | *HF Transceiver*

• 160-10M • 100W • Simple & tough with IF DSP • AGC Loop Management • Digital IF Filter • Digital Twin PBT • Digital Noise Reduction • Digital Noise Blanker • USB Port for PC Control

IC-7100 | *All Mode Transceiver*

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

IC-718 | *HF Transceiver*

• 160-10M** • 100W • 12V operation • Simple to use • CW Keyer Built-in • One touch band switching • Direct frequency input • VOX Built-in • Band stacking register • IF shift • 101 memories

IC-2300H | *VHF FM Transceiver*

• 65W RF Output Power • 4.5W Audio Output • MIL-STD 810 G Specifications • 207 alphanumeric Memory Channels • Built-in CTCSS/DTCS Encode/Decode • DMS

IC-2730A | *VHF/UHF Dual Band Transceiver*

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

IC-R8600 | *Wideband Software Defined Receiver*

• 10 kHz to 3 GHz Super Wideband Coverage • P25, NXDN™, dPMR™, D-STAR Mode • Large Dot Matrix LCD Display w/ Quick Spectrum Scope • SD Card Slot • Remote Control Function

ID-5100A Deluxe

VHF/UHF Dual Band Digital Transceiver

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

ID-4100A | *VHF/UHF Dual Band Digital Xcvr*

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

IC-R30 | *Digital/Analog Wideband Xcvr*

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

ID-51A PLUS2

VHF/UHF D-STAR Portable

• RS-MS1A, free download Android™ application • New modes for extended D-STAR coverage • Terminal Mode & Access Point Mode allow D-STAR operation through Internet • DV & FM repeater search function • Dplus reflector link commands

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**Except 60M Band. ***Frequency coverage may vary. Refer to owner's manual for exact specs. *[1] Optional UX-9100 required. ✦Instant savings and mail-in rebates end 12/31/18. Contact HRO for promotion details. QST DEC 2018. The Icom logo is a registered trademark of Icom Inc. Toll-free including Hawaii, Alaska and Canada. All HRO 800-lines can assist you. If the first line you call is busy, you may call another. Prices, specifications and descriptions subject to change without notice.

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Special HRO Holiday Pricing!

TS-990S | *200W HF + 6M Transceiver*

• World's first dual TFT display • 200W output on all bands • ±0.1ppm TCXO ensures both high stability and reduced power consumption • Triple 32-bit DSP's dedicated to main/sub receivers and band scope • Main receiver employs full down conversion, new mixer & narrow band roofing filters • Third order intercept point (IP3) +40dBm for highest level of RX performance (main receiver)

Call For Special Price!

TS-890S | *HF/50MHz Transceiver*

• Receive performance on a whole other level from narrow bandwidth roofing filters that only full down conversion can provide • CW Morse code decode/encode possible with stand-along unit • 150dB Blocking dynamic range (BDR) • Expanded touch operation scope • Kenwood Sky Command® II Support • Remote operation achieved without host PC Direct remote-control function (KNS)

TS-590SG | *HF/50MHz Transceiver*

• Equipped with 500 Hz/2.7 kHz roofing filter as standard • ALC derived from TS-990S eliminating spike issues • Antenna output function (shared with DRV connector) • CW - morse code decoder function • Improved 1st mixer • New PFB key with multi-function knob • New split function enabling quick setting • LED backlight with selectable color tone

TM-D710G | *2M/440 Dualband*

• V+V/V+U/U+U operation • Built-in GPS • Built-in TNC for APRS & DX-Cluster operation • 50W 2M & UHF • 1,000 memories • Dual receive • Green or amber backlight colors • Latest APRS firmware w/new features • Sky Command II remote functions

Call For Special Price!

TM-V71A | *2M/440 DualBand*

• High RF output (50W) • Multiple Scan • Dual receive on same band (VxV, UxU) • Echolink® memory (auto dialer) • Echolink® Sysop mode for node terminal ops • Invertible front panel • Choice of green/amber for LCD panel • 104 code digital code squelch • "Five in One" programmable memory • 1000 multifunction memory

Call Now For Your Low Price!

TM-281A | *2 Mtr Mobile*

• 65 Watt • 200 Memories • CTCSS/DCS • Mil-Std specs • Hi-quality audio

Call For Special Low Price!

TS-480SAT/HX | *HF + 6M Transceiver*

• 480HX 200W HF & 100W 6M (no tuner) • 480SAT 100W HF & 6M w/AT • Remotable w/front panel/speaker • DSP built-in

Call Now For Low Price!

TH-D72A

2M/440 HT w/extended RX

• 5W TX, RX 118-524 MHz, VxU, VxV, UxU • APRS w/built-in 1200/9600 TNC • Built-in GPS, Built-in USB, digipeater • Echolink® compatible, • Mil-Spec STD810

Call For Special Low Price!

TH-D74A

2M/220/440 HT w/D-STAR!

• D-STAR compatible • APRS ready w/built in GPS • Color weather station information • Built-in KISS mode TNC • High-performance DSP voice processing • Standard compatibility for Bluetooth

Call For Low Price!

TH-K20A | *2M Handheld*

• 2M 5.5W • VOX • CTCSS/DCS/1750 Burst built-in • Weather alert

Call For Special Low Price!

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BURBANK, CA (877) 892-1748	SAN DIEGO, CA (877) 520-9623	DENVER, CO (800) 444-9476	ATLANTA, GA (800) 444-7927	NEW CASTLE, DE (800) 644-4476	SALEM, NH (800) 444-0047	ONLINE STORE WWW.HAMRADIO.COM

✦Instant savings and mail-in rebates expire 12/31/18. Contact HRO for promotion details. Toll-free including Hawaii, Alaska and Canada. All HRO 800 lines are answered by... If the first line you call is busy, you may call another. Prices, specifications and descriptions subject to change without notice.

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ACOM-1000

• HF and 6 Meter 1KW Amplifier • Match 3:1 SWR with No Tuner • User Friendly QSK Operation • LCD Message Display • Single 4CX800a Tube • Vacuum Antenna Relays

Call For Additional ACOM Products!

ABR INDUSTRIES™
American Built & Reliable

218XATC-PL-(length) RG8x (240UF) w/PL259 Connectors Each End. Weather-Proof Heat Shrink Tubing.

- Stranded Center Conductor.
- 95% TC Braid + bonded 100% Foil Shield.
- Very Flexible, Light Weight, and Smaller than RG8 sizes.
- Non-Contaminating-UV Resistant-Direct Burial-Black Jacket.

233/2-G4-(length).

- Unique design **(Nickel Grommets 4" Spacing)** allows for easy attachment to a vehicle's body or truck bed to create a "ground-plane".
- Good option as a "buss-bar" in the shack.
- ½" wide tinned copper 38x48x8/384 10ga 53 Amps.
- Stocked in 1.5', 3', 5', and 10' foot lengths.

The SDRplay RSP FAMILY

THE WORLD'S FAVORITE SDR RECEIVERS

- Continuous SDR coverage from 1kHz to 2GHz (NO GAPS!)
- Now includes the new RSPduo 14-bit Dual-Tuner SDR
- RSPduo can simultaneously receive on 2 totally independent 2MHz spectrum windows, anywhere between 1kHz & 2GHz
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- Visualise all the signals in multiple bands simultaneously
- S/W pre-sets for all the bands from the new LF2200m to 23cm
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- Only needs a computer and an antenna
- Backed by the biggest and best SDR support community

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MA-40

• 40' Tubular Tower

Call For Latest Pricing!

MA-550

• 55' Tubular Tower • Handles 10 sq. ft. at 50 mph • Pleases neighbors with tubular streamlined look

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All US Towers shipped by truck; freight charges additional.

BUY FROM HRO. The World's Largest US Tower Dealer

TX-455

• 55' freestanding crank-up • Handles 18 sq. ft. @ 50 mph • No guying required • Extra-strength construction • Can add raising and motor drive accessory • Towers rated to EIA specifications • Other models available at great prices!

REMOTE RIG

RRC-1258 MkII-S-Set

This set of interfaces allows remote control of your Amateur Radio Station via Internet in a user-friendly and cost effective way! RemoteRig gives you control of the radio coupled with crystal clear TX & RX audio and sending CW with your own Paddle!

New! Now Stereo Version for Dual Receiver radios.

Works with all Computer-controllable radios from: ***Alinco - Elecraft - ICOM - Kenwood - Yaesu***

For radios with detachable front panels no PC is required for: TS-480HX/SAT; TS-2000 (RC-2000 req'd); IC-703/Plus; IC-706 series; DX-SR8T; IC-2820H; IC-R2500

Just simply insert your control box in place of your front panel interconnect cable, place the body of the radio on the remote end and you are on the air as if you are there! Extra Controller and Remote interface units sold individually for multiple sites/users.

Now includes 12V power supply, $12.95 value!

Available exclusively from all HRO locations!

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- RETAIL LOCATIONS – Store hours 10:00AM - 5:30PM - Closed Sunday
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- ONLINE – WWW.HAMRADIO.COM
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Enjoy a noise free Christmas with... ...a bhi DSP noise cancelling product!

bhi

NES10-2 MK3

Amplified DSP speaker:

- 8 DSP filter levels 9 to 35dB
- 5W input & 2.7W audio out
- 3.5 mm mono headphone socket
- On/off audio bypass switch
- 12 to 24VDC (500mA)

Simply plug in the audio and connect the power!

DSPKR

10W amplified DSP noise cancelling speaker

- Easy control of DSP filter
- 7 filter levels - Mounting bracket
- Sleep mode - 4in loudspeaker
- Filter select & store function
- Separate volume control
- Input overload LED
- Headphone socket
- Supplied with user manual

Compact In-Line

Compact handheld DSP noise cancelling unit

- Easy to use rotary controls
- Use with a mono or stereo inputs
- 8 filter levels
- Ideal for portable use & DXing
- Use with headphones or speakers
- 12V DC power or 2 x AA batteries
- Over 40 hours battery life
- Size: 121mm x 70mm x 33mm
- Suitable for use with SDR, Elecraft K3 & KX3 plus FlexRadio products

Dual In-Line

Fully featured in-Line DSP noise eliminating module - Uses latest bhi DSP noise cancelling technology - 8 Filter levels 8 to 40dB - 3.5mm Mono or stereo inputs and outputs - Separate line level input and output sockets - 7 watt mono speaker output - 3.5mm stereo headphone socket - 3.5mm mono and stereo audio leads supplied - Can be used with many radios and receivers incl' the Elecraft K3, KX3 & FlexRadio products

- Replaces bhi NEIM1031MKII

Check out our DSP noise cancelling modules for your radio, receiver and extension speaker on our website!

Happy Holidays from all at bhi Ltd

DESKTOP

- 10W amplified DSP noise cancelling base station speaker
- Rotary volume & filter level controls
- 8 filter levels
- Speaker and line level audio inputs
- Headphone socket
- Size 200(H)x150(D) x160(W)mm, Wt 1.9 Kg
- For use with most radios, receivers & SDR including Elecraft & FlexRadio

ParaPro EQ20 Audio DSP Range

Boost the sound of your receive audio!

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- 4 versions available: EQ20, EQ20-DSP EQ20B, EQ20B-DSP
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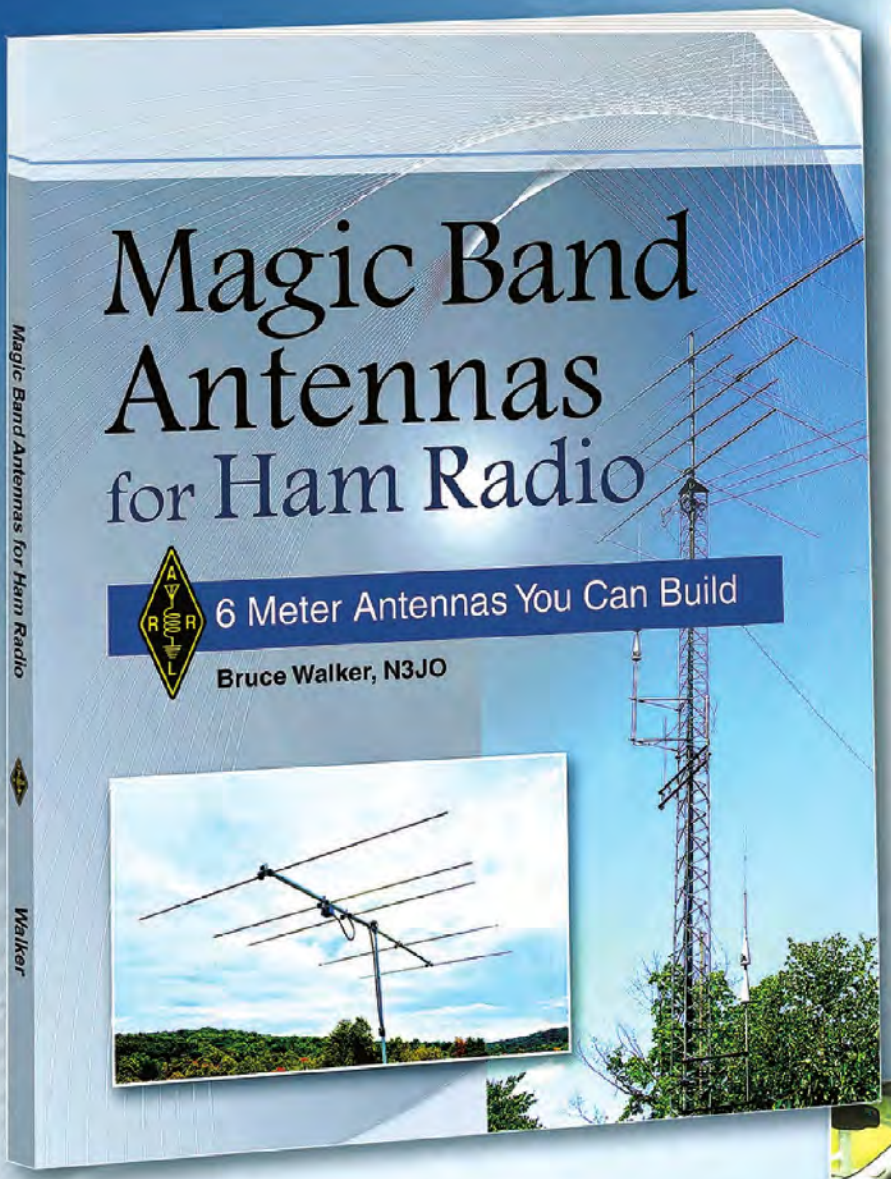
The Magic of Six Meters...



NEW!

Magic Band Antennas for Ham Radio is designed for radio amateurs who want to discover the mysteries of the "magic band." Six meters is a band full of surprises. When you least expect it, 6 meters can suddenly open for contacts over hundreds and even thousands of miles. And when the HF bands are suffering during a solar minimum, 6 meters is unaffected and just as amazing as ever.

If you're looking for new pursuits in Amateur Radio, the world above 50 MHz is the territory you should explore. You'll quickly learn 6 meters is exciting and fun!

Includes:

- Insight into the unpredictable behavior of the 6-meter band.
- 6-meter operating and the quirks of 6-meter propagation.
- Build your own 6-meter antennas — includes detailed designs for everything from simple antennas to high-gain band busters.

Bruce Walker, N3JO, author, ARRL Life Member, and volunteer VHF Awards Manager.

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Happy Holidays From Your Friends at Quicksilver Radio

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HAMMO-CAN™ Go Box

Ready to go, a complete VHF-UHF station in a box. Now also available without radios installed, for most FM mobiles & several HF rigs as well. Powerpoles, USB, lighter socket & voltmeter included!

Ultimate Crimp Kit™

Ultimate Anderson Powerpole & Coax prep, strip & crimp kit. Crimp 15, 30, 45, 50 & 75A Powerpoles. Works with all popular coax types like RG-213, LMR-400 & 240, RG-8X, etc.

Powerpole Mounts

EZ install, just drill a 1-1/8" hole. Great for go-kits, power supplies, and other projects in the shack or on the bench.

USB Microscopes

Up to 1000X magnification. Capture still images and record live video. Built in LED Lighting. New models available!

Powerpole Connectors

The standard for DC power connections. Power distribution, pre-built cables, mounts & more.

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Check out our new Play-Series™ USB modules. New body & LED colors & styles. Aluminum body available. Spruce up your Ham shack, car, etc.

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The First Choice of Hams Around the World!

hy-gain® HF Rotators

HAM-IV – $649.95

The Most Popular Rotator in the World!

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

HAM-VI – $749.95 with DCU-2

HAM-VII – $799.95 with DCU-3

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

TAILTWISTER SERIES II – $799.95

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, $109.95**. Above tower heavy duty mast support. T2X, HAM-IV, HAM-V, HAM-VI. Accepts $1^{7}/_{8}$-$2^{5}/_{8}$" OD.

T-2XD2 – $899.95 with DCU-2

T-2XD3 – $949.95 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 – $449.95

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-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**

AR-40 – $349.95

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**

New!

Hy-Gain Programmable DCU-3 Digital Rotator Controller

DCU-3 – $449.95

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 – $399.95
Like DCU-3, but less programmable memories. 110 VAC. Order **DCU-2X**, for 220 VAC.

Replace your Yaesu Rotator Controller

YRC-1 – $329.95

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, $399.95. Like YRC-1 and adds 6 memories.

AR-500 Rotator/Controller – $129.95

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

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

Add shipping. Prices and specifications subject to change. ©2016 Hy-Gain.

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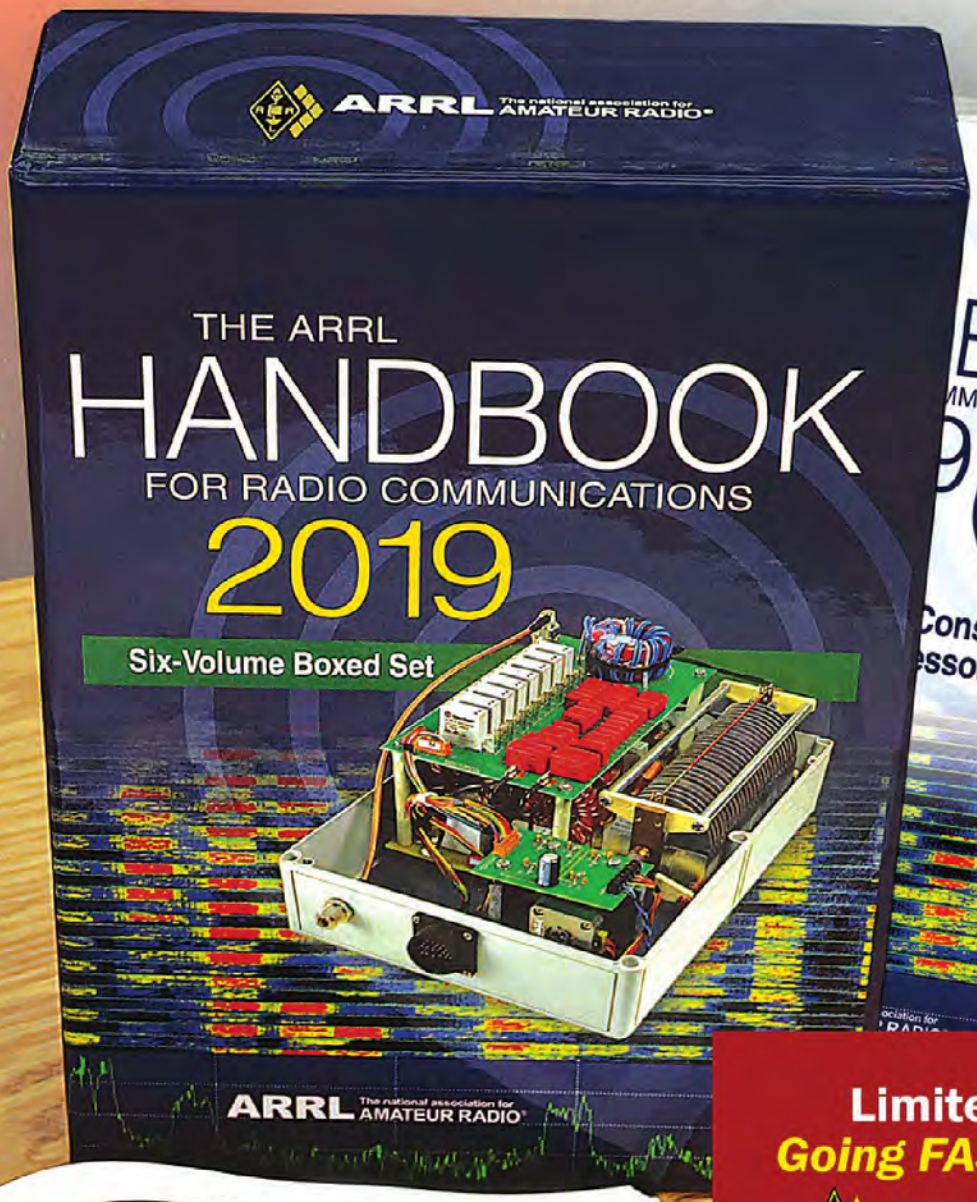

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MFJ 4-Band Octopus Antenna

Choose any 4 bands: HF/VHF/UHF

Octopus antenna hub turns your hamsticks into four fully balanced dipoles in minutes!

Mix and match any four HF/VHF/UHF bands.

Example: screw-in 80, 40, 20 Meter hamsticks and a dual band 2M/440 MHz whip (two on each band) on opposite sides. Now you have an automatic bandswitching 5-band dipole! Rotate it for maximum signal and minimum QRM and noise with a small rotator like Hy-Gain AR-500, $129.95.

Works at any height, low for local NVIS and high for DX. At a fixed height, (say 20-30 feet) use 80-Meters for NVIS and 20-Meters for low-angle DX.

Mounts on any mast up to 1-inch diameter. Use a fiberglass pole on a tripod and you're on the air!

Perfect for casual portable operation, limited space, HOAs, field day, camping, ARES during disasters.

Single coax feed, built-in balun.

Interaction between bands is minimized because the ends are spaced apart at a large angle.

You don't need an antenna tuner if you carefully tune each dipole. An easier way is to just set each dipole approximately on frequency and use an antenna tuner to operate and widen the bandwidth.

Hamsticks break down to about four feet for easy storage.

Tough Octopus Hub

Eight 3/8 x 24 threaded connectors for hamsticks. Super strong fiberglass filled ABS base insulator. Your Octopus hub will give you years of trouble-free service!
Based on Geoff Haines, N1GY, award-winning *December 2007 QST* article.

Super Octopus Deals

MFJ-2104, $249.95 Octopus hub with your choice of four (2 each) 250W *HamSticks™. Saves $20!*

MFJ-2104H, $479.95 Octopus hub with your choice of four (2 each) 600W *HamSticks™. Saves $20!*

MFJ 250W & 600W *HamSticks*

MFJ *HamSticks* are ruggedly constructed. They have a sleek, low profile construction with low wind loading. Semi-rigid fiberglass eliminates the need for springs or guys while mobile.

Black anti-static jacket protects loading coil and blends with any vehicle. Nearly indestructible 4 foot, 0.125 inch diameter PH-17-7 stainless steel whips are adjustable for lowest SWR. Chrome plated brass fittings will give you years of reliable service.

Screws into any 3/8 x 24 female mount.

Includes allen wrench, tuning/matching instructions.

MFJ-16XXT *HamSticks* handle 250 Watts PEP. About 7 feet fully extended, 4 feet collapsed.

MFJ-26XXT *Hi-Q HamSticks* handle 600 Watts PEP. Much larger diameter loading coil and wire gauge gives you *higher*-Q. Lower losses let you dramatically talk further and hear better. 101 inches fully extended, 53 inches collapsed.

Band	600W	Price	250W	Price
75-M	MFJ-2675T	$59.95	MFJ-1675T	$24.95
60-M	N/A	N/A	MFJ-1660T	$24.95
40-M	MFJ-2640T	$49.95	MFJ-1640T	$18.95
30-M	N/A	N/A	MFJ-1630T	$18.95
20-M	MFJ-2620T	$49.95	MFJ-1620T	$18.95
17-M	MFJ-2617T	$39.95	MFJ-1617T	$16.95
15-M	MFJ-2615T	$39.95	MFJ-1615T	$16.95
12-M	N/A	N/A	MFJ-1612T	$16.95
10-M	MFJ-2610T	$39.95	MFJ-1610T	$16.95
6-M	N/A	N/A	MFJ-1606T	$16.95
2M/440MHz	N/A	N/A	MFJ-1414	$19.95

Antenna Rotator

AR-500/X
$129.95

Rotate your Octopus dipoles for maximum gain and minimum QRM/noise!

Weatherproof one piece cast aluminum housing with precision all metal gears, steel thrust bearings and automatic braking. Includes rotator, controller, remote control, clamps, hardware. Remembers up to 12 directions!

Digitally displays position.

Order AR-500X for 220VAC.

Portable Tripod with 18-foot mast

MFJ-1919EX
$159.95
w/18' ext. mast

Black *steel* base forms strong braced equilateral triangles on a side. Non-skid feet and strong base and mast locks. Stays in place! Telescopic fiberglass mast with *QuickClamps™* for instant *no-tool* set-up. 18 feet extended. 5 feet collapsed. Strong 1/8" wall fiberglass, 3/4" diameter top section, 1 1/2" diameter bottom section. 15 lbs. **MFJ-1905, $24.95.** Tripod anchor foot braces. 3-pack stainless hardware set.

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Phone: (662) 323-5869 ■ **Tech Help:** (662) 323-0549 ■ **FAX:** (662) 323-6551 8-4:30 CST, Mon.-Fri.

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MFJ-259C Analyzer, $299.95

World's best selling antenna analyzer covers 530 KHz to 230 MHz, LCD, SWR and impedance or SWR bargraph, analog meters, signal generator, freq counter.

MFJ-269C Analyzer, $399.95

Upgraded MFJ-269C has all features of MFJ-259C plus 415-470 MHz, 12-bit A/D converter, characteristic impedance 0-600 Ohms, coax calculator, parallel equivalent R/X.

MFJ-226 VNA Analyzer, $339.95

1-230 MHz. Plots *SWR, Impedance, Resistance, Reactance, Phase Angle, Complex Return Loss, Smith Chart.* Open-Short-Load calibration. Memories download to PC via USB.

MFJ-949E Tuner $189.95

More hams use MFJ-949E tuners than all others in the world! Large 3" cross-needle SWR/Wattmeter, 8 position antenna switch, dummy load, Match any antenna 1.8-30 MHz.

MFJ-969 Tuner $229.95

World's only 6 -160 Meters 300 Watt *AirCore*™ Roller Inductor antenna tuner gives you absolute minimum SWR. 3" cross-needle meter, true peak reading meter, dummy load, 8 pos. antenna switch.

MFJ-962D Tuner $319.95

Compact *roller inductor* antenna tuner handles popular Ameritron AL-811H/811 amps. *AirCore*™ inductor, 3" Cross-Needle meter, 6-position antenna switch, 800W SSB PEP output.

MFJ-989D Tuner $409.95

Legal-limit antenna tuner has *Air-Core*™ inductor, 500pF air variable capacitors, fast-tune crank, high voltage balun, 3" meter, dummy load, ant. switch.

MFJ-929 AutoTuner $229.95

Compact 200 Watt *IntelliTuner*™ tunes any unbalanced antenna *ultra-fast!* 20,000 Virtual Memories, Antenna Switch, Efficient L-network, Matches 6-1600 Ohms from 1.8-30 MHz.

MFJ-993B AutoTuner $269.95

Select 300 Watts (6-1600 Ohms) or 150 Watts (6-3200 Ohms) with the *world's only dual power* automatic tuner. 1.8-30 MHz, 4:1 current balun, LED lighted cross meter, backlit LCD, more!

MFJ-998 AutoTuner $699.95

Full 1500 Watts SSB/CW. Digital and analog SWR/Wattmeter, 12-1600 Ohms from 1.8-30 MHz, built-in antenna switch, auto amp bypass.

MFJ-1778 G5RV $49.95

Efficient, *all band* G5RV antenna is only 102' long, has 32.5' ladder line matching section ending in an SO-239 for feedline. Operate 80-10 Meters with tuner. 1500 Watts.

MFJ-16XX HF Sticks $16.95

Rugged, sleek **6-40M** mobile *HamTenna*™ antennas, **$14.95** each band. 250 Watts, 7' extended, collapse to about 4 feet for storage. Quickly screws into any 3/8-24 female mount for quick band changing. **60-75M, $24.95.**

MFJ-2286 BigStick $99.95

7.0-55 MHz *Big Stick*™ antenna with adjustable *high-Q* air-wound coil. 17 feet extended, 28" collapsed. 2 lbs. Backpack portable, fast set-up/tune, 1 KW PEP SSB/CW. Ruggedly built. Mast mount with SO-239, radial kit included.

MFJ-1786 HQ Loop $449.95

10-30 MHz Super Hi-Q loop, remote control. 36" dia. all welded construction, butterfly tuning capacitor. ABS plastic housing. **MFJ-1788, $499.95.** 7-22 MHz.

MFJ-260C Dry Load $39.95

300W VHF/HF Dry Dummy Load handles full load for 30 seconds. Derating curve to 5 minutes. SWR below 1.1:1 to 30 MHz. 1.5:1 from 30-650 MHz. **MFJ-264, $74.95.** 1.5kW load.

MFJ-1702C Ant Switch $39.95

2-position antenna switch has center ground, auto grounding of unused position, 2.5 kW PEP and works to over 500 MHz. Lightning surge protection. SO-239 Connectors. **MFJ-1704, $89.95.** 4 positions.

MFJ-915 RFI Isolator $29.95

Prevents unwanted RF from traveling on your coax shield into your expensive transceiver. Prevents stray RF that cause painful RF "bites" and eratic operation. Heavy duty weather protected PVC is 2Wx5H inches. 1.5 kW. 1.8-30 MHz.

MFJ-918 4:1 Balun $29.95

High-permeability ferrite beads on high-quality RG-303 *Teflon*® coax. True 1:1 current balun/center insulator. 2" diameter by 6" long. 14 gauge stranded copper wire. Handles 1.5 kW 1.8-30 MHz.

MFJ-270 Surge Protect $19.95

Safeguard your expensive equipment. Shunts to 5000 Amps of peak impulse current harmlessly to ground. SWR less than 1.1:1, less than 0.1 dB loss. Use to 1000 MHz, 400W PEP.

MFJ-392B Headphones $29.95

Perfect for Ham Radio and shortwave listening -- SSB, FM, AM, data and CW. Super lightweight (8 oz.) padded headband and ear cushioned design. Each earphone has own volume control. 3.5mm/1/4" plugs, 9' cord.

MFJ-4230MV 30A PS $89.95

World's most compact 30A switching power supply. V/A meter. 4-16 Volts, adjustable. 5Wx2½Hx6D inches, 3 pounds! Selectable input voltage 120/240 VAC.

MFJ-4035MV 30A PS $149.95

19.2 lb. transformer delivers 35A maximum, 30A continuous. 1-14 VDC out, 110 VAC in. Highly regulated, 1% load regulation. 1 mV Ripple. 5-way binding posts, quick connects.

MFJ-4245MV 45A PS $149.95

Switching power supply. 45A surge/40A continuous. 9-15 VDC out. 85-260 VAC in. Low ripple, highly regulated. 5-way posts, cig lighter, quick connects. 5 lbs., 7½Wx4¾Hx9D".

MFJ-4275MV 75A PS $259.95

Switching power supply. 75A max/70A cont. Great for ALS-500M solid state amp. Adjustable 4-16 VDC. Input 110/220 VAC. Battery charger. 10.5 lbs.

Antenna Window Feedthrough Panels

Bring your antenna cables into your hamshack without drilling holes through walls! Place in window sill, close window. *Real* western cedar 3/4" thick wood naturally resistant to rot, decay and insects, weather edge foam tape included. *Teflon*® SO-239s for HF/VHF/UHF antennas, *ceramic* feed-thrus for balanced line/random wire, ground post. Stainless steel in/out plates.

MFJ-4602, $69.95

MFJ-868B Giant Meter $149.95

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Practice sending Morse code. Telegraph key, code oscillator, speaker on heavy non-skid steel base. Volume/tone controls. Use 9V battery.

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MFJ-4245MV Switching power supply gives 45A surge/40A continuous. 9-15 VDC out. 85-260 VAC in. Low ripple, highly regulated. 5-way posts, cig lighter, quick connects. 5 lbs., 7½W x 4¾H x 9D",

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MFJ-4235MV switching power supply gives 35A surge and 30A continuous. 4-16 VDC with 1% voltage regulation. < 9 mV peak-to-peak ripple. AC input 90-125 or 200-240V. 7W x 4¼H x 8¾D", 4 lbs.

35-Amps, $149.95

MFJ-4035MV 19.2 lb. transformer delivers 35A max, 30A continuous. 1-14 VDC out, 110 VAC in. Highly regulated, 1% load regulation. 1 mV ripple. 5-way binding posts, quick connects. 9½W x 6H x 9¾".

28-Amps, $84.95

MFJ-4128 switching power supply delivers 28A surge, 25A continuously at 13.8 VDC. Selectable AC input voltage 85-135 and 170-260 VAC. 5-way binding posts, cigarette lighter socket, fan "on" LED, 7W x 2¼H x 7½D", 4 lbs.

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25-Amps, $84.95

MFJ-4125 gives 25A surge, 22A continuous. 13.8 VDC switching power supply has 5-way binding posts on front panel and quick connects on back. 3.5 lbs. Super compact 5½W x 2½H x 5¾D inches fits anywhere.

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Operate all bands 10 through 160 Meters with a single wire antenna!

***The famous** G5RV antenna is the most popular ham radio antenna in the world!*

It's an efficient, *all* band 102 foot long antenna – shorter than an 80 Meter dipole. Has 32.5 foot ladder line matching section ending in SO-239 connector for your coax feedline.

MFJ-1778
$49.95

Use horizontally or as Inverted Vee or Sloper with just one support. 1500 Watts.

Operate all bands 80-10 Meters with an antenna tuner and even 160M with ground.

Fully assembled with *ceramic* end and fiberglass center insulators. *Hang and Play*™ – add coax, rope to hang and you're on air!

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MFJ 102 foot *all band* doublet covers 160-6 Meters with balanced line tuner. Super strong custom fiberglass center insulator relieves stress on 100 foot ladder line.

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Glazed ceramic end insulators. 1500 Watts.

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$29.95

MFJ-919, $59.95. 4:1 current balun,1.5 kW.
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True 1:1 *Current Balun/Center Insulator* forces equal radiator currents in dipoles for true dipole radiation pattern. Reduces coax radiation and field pattern distortion – your signal goes where *you* want it. Reduces TVI, RFI and RF hot spots. *Don't build a dipole without one!* 50 hi-permeability ferrite beads on high quality RG-303 *Teflon®* coax and *Teflon®* SO-239. 1.5kW 1.8-30 MHz. Stainless steel hardware. 14 gauge stranded copper wire is *directly* connected to your antenna. 5 x 2 inches. Heavy duty weather housing.

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$29.95

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MFJ-1702C, $39.95. 2-position antenna switch, lightning surge protection, center ground. SO-239s.

Lightning surge protectors

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80-10 Meter End-Fed Half Wave antenna

Cover all bands with one single wire and no tuner!

MFJ-1982HP
$89.95

No tuner needed!
All band 80-10M EFHW antenna

Get-on-the air on all bands 80-10 Meters with just one wire and one support (pole or tree) and no tuner or long counterpoise.

Installs anywhere in minutes! Rugged *insulated*-wire radiator prevents detuning when contacting limbs/branches. "*No-snag*" end insulator slides over branches, leaves.

Toss over a high limb for inverted-V or sloper or go vertical with an inverted-L.

Dark jacketed wire is virtually invisible – *don't let antenna restrictions keep you off the air!* Great for emergencies.

EFHWs naturally resonate on the 1/2-wave fundamental frequency and odd/even harmonics. Covers 80/40/30/20/17/15/12/10 Meters without traps, stubs or resonators.

Broad-band matching transformer at feed point gives SWR so low you may never need a tuner. Compensating inductor optimizes SWR. 800 Watts SSB/CW. 132 feet jacketed antenna wire.

MFJ-1984HP, $79.95. Like MFJ-1982HP but 40-10M. 66 feet jacketed wire.

See www.mfjenterprises.com for 30 Watt QRP and 300 Watt models.

Dual Band Dipoles

MFJ-17758, $89.95. Operate 80/40 Meters with a short 85 foot dipole. Full-size on 40 Meters with ultra-efficient end-loading on 80 Meters. 1500 Watts. Super-strong custom molded center insulator with SO-239 connector and hang hole. Ceramic end insulators. 7-strand, 14 gauge hard copper wire. No tuner needed!

MFJ-17758
$89.95
80/40 Meters

MFJ-17754, $59.95. Like MFJ-17758 but is only 42 feet. Operate 40/20 Meters. Full-size on 20 Meters, ultra-efficient endloading on 40 Meters. 1500 Watts.

Single Band Dipoles

Ultra high quality center fed dipoles give years of troublefree service. Custom injection-molded UV resistant center insulator has built-in SO-239 and hanging hole. Glazed ceramic end insulators. 7-strand, 14-gauge hard copper antenna wire. 1500 Watts. Use horizontally or as sloper or inverted vee. Simply cut to length with provided cutting chart.

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$69.95
160M, 265 ft.

MFJ-1779B
$49.95
80-40M, 135 ft

MFJ-1779C
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20-6M, 35 ft.

OCFD Dipoles

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Low in cost, but big on performance. MFJ *Cobweb Antenna* turns your space problem into a stack of QSL cards from far away places.

MFJ-1836HK34, $119.95. Add-on kit adds 40/30 Meters to MFJ-1835/1835H and MFJ-1836/MFJ-1836H cobweb antennas.

MFJ-1838
$399.95

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MFJ 20/17/15/12/10/6 Meter *Hexbeam*

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MFJ uses an updated G3TXQ element configuration for excellent gain, improved bandwidth, superior front-to-back ratio and low SWR!

MFJ takes the HexBeam`s unique balanced-tension framework to a new level with rugged mounting hardware, exceptionally durable spreaders and sliding antenna-wire guides – designed to ensure years of reliable service.

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MFJ-1848, $699.95. 8 Bands: 20/17/15/12/10/ 6M, 2-elements per band; 40/30M, single elements, full 1500W. 28 lbs. 14 ft. turning radius.

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3-Element Hexbeam

MFJ-1856 is ***six*** individually stacked monoband yagis!

6 Bands: 20/17/15/12/10/6M. Full 1500 Watts.

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MFJ-1704, $79.95. Like MFJ-1702C but has 4 positions.

MFJ G5RV Antenna

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High contrast LCD gives precision readings and two side-by-side analog meters make antenna adjustments smooth and easy.

12-bit A/D converter gives much better accuracy and resolution than common 8-bit A/D converters – *MFJ-269C exclusive!*

Built-in frequency counter, battery saver, low battery warning, Ni-Mh/NiCd charge circuit. 4W x 2D x 6¾ inches, 2 lbs. Use ten double A batteries or 110 VAC with MFJ-1312D, $15.95.

MFJ-269C
$399.95

MFJ-269CPRO™ Analyzer

MFJ-269CPro, $429.95. Like MFJ- 269C, but UHF range covers ***430 to 520 MHz*** to include commercial industrial frequencies. Rugged protective shell protects knobs, switches, meters, LCD for industrial/lab work.

MFJ No Matter What™ Warranty
Every MFJ Analyzer is protected by MFJ's famous one year **No Matter What**™ limited warranty. We will repair or replace your MFJ analyzer (at our option) for a full year.

More hams use MFJ analyzers than all others in the world!

MFJ-259C

530 KHz - 230 MHz, World's most popular analyzers

New and improved. Now covers 530 KHz to 230 MHz!.

All-In-one ham radio test set...

Includes frequency counter, RF Generator, *SWR Analyzer*™, RF Resistance and Reactance Analyzer, Coax Analyzer, Capacitance and Inductance Meter and more!

Large easy-to-read two line LCD screen and side-by-side meters clearly display your information.

MFJ-259C
$299.95

Here's what you can do...

Super easy-to-use – Read antenna SWR, complex impedance, return loss, reflection coefficient. Determine velocity factor, coax cable loss in dB, length of coax and distance to short or open in feet. Read inductance in uH, capacitance in pF at RF frequencies. Large easy-to-see two line LCD screen and side-by-side meters clearly display your information. Built-in frequency counter, signal generator, Ni-Cad charger circuit, battery saver, low battery warning and smooth reduction drive tuning. *More!*

Maritime and 600 Meter Coverage

MFJ-259CM, $299.95. Like MFJ-259C except the bottom band covers 470-940 KHz for Maritime and 600 Meter bands.

MFJ-223

1-60 MHz Color Graphic VNA Analyzer

MFJ-223
$299.95

This *pocket-sized* wonder breaks the mold for analyzer design with user-friendly convenience, top notch accuracy, and a vivid TFT multi-color display. Don't let the size fool you, MFJ-223 is packed with all the VNA features and performance you need!

- **Single-frequency** and *swept-frequency* operating modes
- **Truly accurate** SWR, R, X, and Z measurements
- **Seamless DDS** coverage with 100-Hz resolution from 1-60 MHz
- **Smooth "skip-free"** encoder tunes fast or slow without missing a step
- **Powerful +5-dBm** stimulus generator overrides local interference
- **Field-strength meter** measures local signals, detects potential interference
- **DDS generator** precision signal source
- **Vivid 1600-pixel/inch** color graphics on a 2x2 inch non-glare TFT screen

MFJ-225

1.5-180 MHz *continuous* Two-Port Graphic Analyzer

Out in the field, MFJ-225 is a compact completely *self-contained hand-held graphing analyzer.* On the bench it becomes a full-fledged two-port (S21) desktop machine when teamed up with your PC. Using powerful IG-miniVNA freeware, you'll run detailed data analysis and print out stunning color-graphic plots to document your work!

MFJ-225
$299.95

Built-in back-lighted *3-inch LCD graphic* display. Make fine adjustments using fullscreen easy-to-view SWR bargraph, capture vivid swept displays for SWR, impedance, return loss, phase angle, more. DDS generator.

MFJ-249C Analyzer

MFJ-249C, $279.95

If digital display is all you need MFJ-249C does everything MFJ-259C does without analog meters.

Visit: www.mfjenterprises.com or call toll-free 800-647-1800

MFJ VNA Antenna Analyzer

MFJ VNA Antenna Analyzer covers 1 to 230 MHz, 1Hz resolution.

·Frequency sweep plots: *SWR, Impedance, Resistance, Reactance, Phase Angle, Complex Return Loss, Smith Chart* ***·Sign of reactance*** positively identifies inductive or capacitive reactance ***·Amazing accuracy with OSL (Open-Short-Load) calibration*** – calibrate through feedline/test cable at different frequencies and store in memory. Measure directly or through feedline with exceptional accuracy, correcting for line loss/phase angle. ***Smith Chart*** plots S11 magnitude/phase over any frequency span. ***Capture screens*** in 32 memories to download to PC via USB.

MFJ-226
$339.95

MFJ SWR Analyzer Accessories

- **A. MFJ-29D/MFJ-39D, $24.95.** Carrying Pouch for MFJ-259C/269C.
- **B. MFJ-92AA10, $29.95.** 10-Pack 2500 mAh Ni-MH Supercells.
- **C. MFJ-66, $24.95.** Dip coils, set of two covers 1.8-230 MHz.
- **D. MFJ-731, $99.95.** Tunable Analyzer Filter, 1.8-30 MHz, for strong RF fields.
- **E. MFJ-917, $29.95.** 1:1 Current balun for SWR Analyzers to test balanced line antennas, other loads.
- **F. MFJ-5510, $9.95.** 12VDC cigarette lighter adapter.
- **G. MFJ-7737, $5.95.** PL-259 to BNC Female.
- **H. MFJ-7727, $5.95.** PL-259 to SMA Female.
- **I. MFJ-633, $29.95.** Ultra-fast intelligent charger.

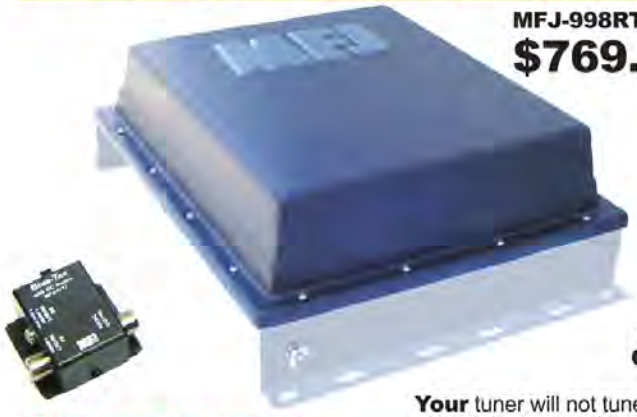
MFJ Enterprises, Inc. 300 Industrial Pk Rd, Starkville, MS 39759
Phone: (662) 323-5869 ■ **Tech Help:** (662) 323-0549 ■ **FAX:** (662) 323-6551 8-4:30 CST, Mon.-Fri.

MFJ...the World Leader in Ham Radio Accessories!

MFJ 1500 Watt Remote Auto Tuner

Place this MFJ-998RT remote tuner at your antenna to match high SWR antennas/long coaxes -- greatly reduce losses for high efficiency

. . . Match 12-1600 Ohms, 1.5 kW, SSB/CW, 1.8-30 MHz . . . Match coax/wire antennas . . . Weather-sealed . . . Remotely powered thru coax . . . Amplifier, radio, tuner protection . . . Output static/lightning protection . . . StickyTune™ always tunes when power folds back . . . DC power jack . . .



MFJ-998RT
$769.95

Bottom Chassis

Inside View

Tune your antenna at your antenna

Get greatly reduced losses and high efficiencies with long coax runs and high SWR antennas with this new MFJ-998RT 1.5 kW Remote Antenna Tuner.

Weather-Sealed

A tough, durable weather-sealed ABS cabinet with over-lapping lips, sealing gasket and stainless steel chassis protects the MFJ-998RT from all kinds of weather.

No Power Cable Needed!

No power cable needed -- remotely powered through coax. Includes MFJ-4117 Bias-Tee with on/off switch for station end of coax. Has 12 VDC jack for power cable, if desired.

Fully Protected

MFJ exclusive algorithms protect your tuner, radio and RF power amplifier from damage.

Automatic inductor and capacitor limiting prevents tuning extreme loads which can destroy your tuner.

Your tuner will not tune if more than 75 Watts with SWR greater than 3:1 is applied or if more than 125 Watts is applied.

Tuner output is static electricity and lightning induced surge protected.

MFJ exclusive StickyTune™

Very high SWR can fold back transmitter power and prevent tuning caused by extreme differences in loads (example: changing bands and other conditions).

But MFJ exclusive StickyTune™ always tunes with a simple on/off power cycle and re-transmit.

Tunes Coax fed and Wire Antennas

Tunes both coax fed and wire antennas. Has ceramic feed-through insulator for wire antennas. 2 kV Teflon® insulated SO-239 – prevents arcing from high SWR.

High Power, Highly Efficient

A highly efficient L-network matches 6-1600 Ohms at full 1500 Watts legal limit SSB/CW 1.8 to 30 MHz with Hi-Q Ls, Cs.

MFJ-998RT Learns as you Operate

As you operate, the MFJ-998RT automatically tunes for minimum SWR and remembers your frequency and tuner settings. The next time you operate on that frequency and antenna, its tuner solution is restored in milliseconds and you're ready to operate!

Highly Intelligent, Ultra-fast Tuning

MFJ InstantRecall™ recalls stored tuning solutions from 10,000 memories. For new frequencies, MFJ Intelli-Tune™ measures your antenna impedance and instantly determines the correct matching components. If antenna impedances cannot be measured, MFJ AdaptiveSearch™ searches only the relevant components that can match your antenna giving you ultra-fast tuning.

Field upgradeable firmware. Requires 12-15 VDC at 1.4 Amps maximum or 110 VAC with optional MFJ-1316, $21.95. Weighs 9.5 lbs. 13 1/4W x 6 3/4H x 17 1/2D inches.

600W Remote IntelliTuner™

MFJ-994BRT – perfect for 600 Watt SSB/CW amplifiers like Ameritron's AL-811/ ALS-600/ALS-500M. Matches 12-800 Ohms. Coax/wire antennas, 1.8-30 MHz. Fully weather-sealed for outdoor use. Remotely powered through coax. Tough, durable, built-to-last cabinet, 9 1/4W x 3H x 14 1/4D inches, 4 lbs. Includes MFJ-4117 BiasTee Power Injector.

MFJ-994BRT
$399.95

300W Remote IntelliTuner™

MFJ-993BRT handles 300 Watts SSB/CW and matches an extra-wide 6-1600 Ohm impedances. Coax/ wire antennas, 1.8-30 MHz. Fully weather-sealed for remote outdoor or marine use. Remotely powered through coax. Tough, durable, built-to-last cabinet measures 9 1/4W x 3H x 14 1/4D inches. Weighs just 4 pounds. Includes MFJ-4117 BiasTee Power Injector.

MFJ-993BRT
$299.95

200W Remote IntelliTuner™

MFJ-926B, 200 Watts SSB/CW, matches 6-1600 Ohms, Coax/wire antennas, 1.8-30 MHz. Includes BiasTee.

MFJ-926B $279.95

MFJ No Matter What™ Warranty

One year **No Matter What**™ Warranty
30 Day Money Back Guarentee
(less s/h) on orders direct from MFJ.

160-6 Meters 43 foot Vertical Antenna

Operate all bands 160-6 Meters at full 1500 Watts with this self-supporting, 43 foot high performance vertical! Assembles in less than an hour. Low profile blends in with sky and trees -- barely see it. Entire length radiates. Exceptional low angle DX performance on 160-20 Meters and very good performance on 17-6 Meters. Telescope it shorter for more effective low angle radiation on 17-6 M if desired. One of these wide range MFJ automatic tuners at the antenna easily matches all bands 160-6 Meters. There's no physical tuning adjustments on the antenna -- you simply put it up! Requires ground system, at least one radial, more the better. Includes balun and base mount. **MFJ-1932, $34.95**. All band ground radial system.

MFJ-2990
$359.95

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QST QuickStats

sta·tis·tics (stuh-tis-tiks) noun.
1. (used with a singular verb) The mathematics of the collection, organization, and interpretation of numerical data, especially the analysis of population characteristics by inference from sampling.
2. (used with a plural verb) Numerical data.

www.arrl.org/QuickStats

Online QuickStats Poll Results for September 1, 2018 through October 1, 2018.
Get on the web and vote today at **www.arrl.org/quickstats**!

Will you be participating in the 2018 ARRL 10 Meter contest, December 8-9?

Yes. **35%**

No. **32%**

It is too early to say. **33%**

Will you be participating in the 2018 ARRL 160 Meter contest, November 30 – December 2?

Yes. **22%**

No. **63%**

It is too early to say. **15%**

When was the last time you sold equipment at a hamfest flea market?

Within the last several months. **10%**

Last year. **11%**

Within the last several years. **14%**

Many years ago. **25%**

Never. **40%**

When was the last time you purchased equipment at a hamfest flea market?

Within the last several months. **30%**

Last year. **16%**

Within the last several years. **21%**

Many years ago. **20%**

Never. **13%**

Cortesia de Virgilio.

Free Dealer/Catalog/Manuals/Instructions – Visit: www.mfjenterprises.com or call toll-free 800-647-1800

MFJ...the World Leader in Ham Radio Tuners!

MFJ Tuners

New, Improved MFJ-989D 1500 Watt legal limit Antenna Tuner

World's most popular 1500 Watt Legal Limit Tuner just got better -- much better -- gives you more for your money!

New, improved MFJ-989D legal limit antenna tuner gives you better efficiency, lower losses and a new true peak reading meter. It easily handles full 1500 Watts SSB/CW, 1.8 to 30 MHz, including MARS/WARC bands.

New, dual 500 pF air variable capacitors give you twice the capacitance for more efficient operation on 160 and 80 Meters.

New, improved AirCore™ Roller Inductor gives you lower losses, higher Q and handles more power more efficiently.

New, TrueActive™ peak reading Cross-Needle SWR/Wattmeter lets you read true peak power on all modes.

MFJ-989D $409.95

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

The MFJ-989D uses the superb time-tested T-Network. It has the widest matching range and is the easiest to use of all matching networks. Now with MFJ's new 500 pF air variable capacitors and new low loss roller inductor, it easily handles higher power much more efficiently.

New, high voltage current balun lets you tune balanced lines at high power with no worries.

New, crank knob lets you reset your roller inductor quickly, smoothly and accurately.

New, larger 2-inch diameter capacitor knobs with easy-to-see dials make tuning much easier.

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

No Matter What™ Warranty

Every MFJ tuner is protected by MFJ's famous one year **No Matter What™** limited warranty. We will repair or replace your MFJ tuner (at our option) for a full year.

More hams use MFJ tuners than all other tuners in the world!

MFJ-986 Two knob Differential-T™

MFJ-986 $369.95

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

MFJ-962D compact kW Tuner

MFJ-962D $319.95

A few more dollars steps you up to a KW tuner for an amp later. Handles 1.5 kW PEP SSB amplifier input power (800W output). Ideal for Ameritron's AL-811H! AirCore™ roller inductor, gear-driven turns counter, pk/avg lighted Cross-Needle SWR/Wattmeter, antenna switch, balun, Lexan front, 1.8-30MHz. $10^{7}/_{8}$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 $229.95

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, $159.95. Economy version of MFJ-949E, less dummy load, Lexan front panel.

MFJ-949E $189.95

MFJ-941E super value Tuner

The most for your money! Handles 300 Watts PEP, covers 1.8-30 MHz, lighted Cross-Needle SWR/ Wattmeter, 8 position antenna switch, 4:1 balun, 1000 volt capacitors, Lexan front panel. Sleek $10^{1}/_{2}$W x $2^{1}/_{2}$H x 7D in.

MFJ-941E $149.95

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, $6.95, mobile mount.

MFJ-945E $139.95

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 $129.95

MFJ-901B smallest Versa Tuner

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

MFJ-901B $99.95

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, $149.95**. 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 $109.95

MFJ-16010 random wire Tuner

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

MFJ-16010 $69.95

MFJ-906/903 6 Meter Tuners

MFJ-906 has lighted Cross-Needle SWR/ Wattmeter, bypass switch. Handles 100 W FM, 200W SSB. **MFJ-903, $69.95**, Like MFJ-906, less SWR/Wattmeter, bypass switch.

MFJ-906 $99.95

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 $89.95

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, $209.95**, Artificial ground/300 Watt Tuner/Cross-Needle SWR/Wattmeter.

MFJ-931 $109.95

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MFJ *Telescopic* Fiberglass Masts

Portable, telescoping high-strength fiberglass masts extend way up into the sky! Just pull out sections and lock.

Choose Lightweight-Light-Duty or Super-Strong Thick-Wall models – 10 to 50 feet long. Each collapses to an easy-to-carry size for true portability.

For quick put-up and take-down, light-duty models have Twist & Lock sections and heavy-duty thick wall models use military style *QuickClamps*™ or stainless steel hose clamps.

Use them for traveling, camping, at hotels, hamfests, field day, DX-peditions. Put up full size full performance inverted Vee, dipole or vertical antenna in minutes at heights that will snag you real DX.

Use multiple telescoping masts to make loops, quads, rotatable dipoles even beams.

← *Light Duty Lightweight Fiberglass Masts*

So lightweight you can take them anywhere!

MFJ's most popular MFJ-1910 is 33 feet long, 3.3 lbs.

MFJ-1910, $79.95. 33 ft., light duty w/top tie ring.
MFJ-1911, $89.95. 20 ft., light duty w/top tie ring.
MFJ-1913, $89.95. 28 ft., lightweight w/top tie ring.
MFJ-1915, $139.95. 25 ft., for heavier duty use.
MFJ-1916, $159.95. 34 ft., for heavier duty use.
MFJ-1917, $169.95. 43 ft., heavier duty w/top tie ring.

Super-strong .125" Thick-Wall Fiberglass Masts

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

Heavy Duty Models: All have QuickClamps™ →

MFJ-1908HD, $259.95 is 50' ext., 8 feet collapsed, has 2 1/2" OD bottom, 1" OD top, seven 8-foot sections, 26 lbs.
MFJ-1906HD, $219.95 is 38' extended, 6 feet collapsed, has 2 1/2" OD bottom, 1" OD top, seven 6-foot sections, 24 lbs.
MFJ-1904HD, $159.95 is 25' extended, 4 feet collapsed, has 2 1/2" OD bottom, 1" OD top, seven 4-foot sections, 14 lbs.
MFJ-1904H, $139.95. 22' ext., 5' collapsed, 9 lbs. 2 1/2" OD.
MFJ-1902H, $119.95, 10' ext., 38" collapsed, 5 lbs. 2 1/2" OD

Standard Models: H models have QuickClamps™

MFJ-1906, $139.95/MFJ-1906H, $189.95, 33 feet, ext., 6 ft. collapsed, six 6-ft. sections, 13 lbs. 2" bottom, 3/4" top OD.
MFJ-1908, $179.95/MFJ-1908H, $229.95, 43 feet ext., 8 ft. collapsed, six 8-ft. sections, 16 lbs. 2" bottom, 3/4" top OD.

Mast Accessories

MFJ-1900, $69.95. Mount clamps mast to mounting pipe.
MFJ-14, $59.95. 5 Military *QuickClamps*™. Fit 3/4" to 2" OD.
MFJ-14HD, $69.95. Extra set clamps, 1- 2 1/2" masts.

Mast Guy Ring Sets

Fits masts 3/4" to 1 1/4" dia OD. **MFJ-2830X, $6.95,** *fiberglass*; **MFJ-2840X, $8.25,** *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, $159.95.
Put your antennas up high anywhere with this super-strong* 18 foot telescoping fiberglass mast and MFJ-1919 heavy duty steel tripod. *QuickClamps*™ *lower mast to 5 feet. Mast has thick 1/8 in. wall, .75" top, 1.5" bottom dia. 15 lbs. Steel tripod has braced triangle base, non-skid feet, mast lock.

MFJ-1918EX, $89.95.
MFJ-1918 tripod has super strong 9.5 foot telescoping fiberglass mast. 3.8 feet collapsed. *QuickClamps*™. Thick 1/8 inch wall, .75" top, 1" bottom diameters. 6.5 lbs.

Tripods Only

MFJ-1921, $169.95, Giant tripod base spreads to 8 feet! Supports massive antennas. Adjustable length non-skid legs accommodates uneven ground surfaces. Optional foot anchors **MFJ-1905, $24.95**, see **Tripod Anchors** bottom right. 5.75Hx7D feet collapsed. 14 lbs.
MFJ-1919, $89.95, *Large tripod* base spreads to 4.8 feet. Supports 100 pounds. 7.8 feet, 1.4 inch diameter mast. 4.5H x .5D feet collapsed. 9.75 lbs.
MFJ-1918, $49.95, Smaller tripod base spreads to 2.75 ft. Support 66 lbs. 6 foot, 1" dia. mast. 3.2H x .3D ft. collapsed. 6.75 lbs.

80-6 Meter Antenna

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

MFJ-2980
$99.95
40-6 Meters

MFJ-2982
$149.95
80-6 Meters

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

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

Includes four 12 foot radials. Current balun reduces feedline radiation and pattern distortion.

MFJ "HamStick" Isolated Dipole

Build your own 80-6 Meter *mini*-dipole using two HF mobile whips! Only MFJ-347 mount *isolates* dipole elements and lets you use a balun to give a true *balanced dipole*. Prevents pattern distortion, noise pickup and RFI radiation from RF on coax shield. Solid aluminum. Use mast up to 1 1/4" OD.

MFJ-347
$19.95

3/8-24 Hamstick

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

MFJ-342T
$9.95

MFJ Balcony Mount

MFJ-1907
$39.95

Mount *multiple* HF/VHF hamsticks, verticals, dipoles vertically and/or horizontally on your apartment/condo balcony. High-strength aircraft aluminum extends out 14". Two U-bolts mount up to 1 1/2" diameter.

Tripod Anchors

Securely anchor tripod to ground with these 3 stainless steel foot braces and your stakes. For high winds, unlevel ground, tall antennas. Fits legs to 1 1/2"OD.

MFJ-1905
$24.95

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New from COMET!

CAA-500MarkII Antenna Analyzer

1.8-500MHz

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

Functions:
In addition to the display of antenna properties, SWR curves are plotted quickly, easily and accurately!

Auto band-sweep function:
Switch to the amateur band of choice and press "Sweep Center". The chosen band is swept and the SWR graphed in seconds!

Manual band-sweep function:
Select the band, select the center frequency, and select the bandwidth. Manually sweep the chosen frequency range and display the SWR graph.

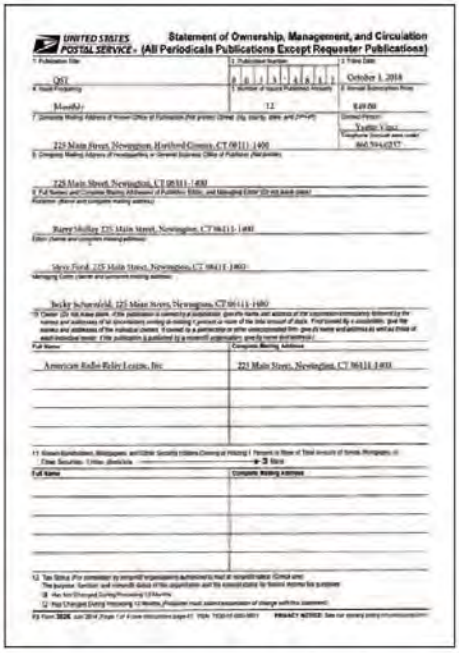
Multiple Manual Band-Sweeps
Manually graph the user defined bandwidth multiple times and see the results overlaid in 5 selectable colors! Make antenna length, position, height above ground, gamma match adjustments, etc…and graph each adjustment in seconds, in a new color, without losing the previous graph!

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

Features:
Operates on 8-16VDC external power, 6 AA Alkaline or NiMH rechargeable cells • Trickle charger built in (only when using NiMH batteries) • Typical battery life: 9 hours of continuous operation • Battery level indicator • Selectable auto power-off time limit preserves battery capacity • SO-239 connector for 1.8-300MHz range • N-female connector for 300-500MHz range • Optional soft carry case sold separately: CAA-5SC

Call or visit your local dealer today!
www.natcommgroup.com | 800-962-2611

COMET®



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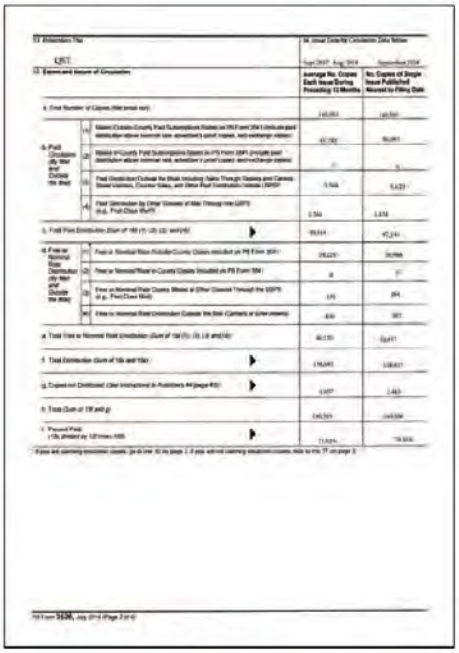

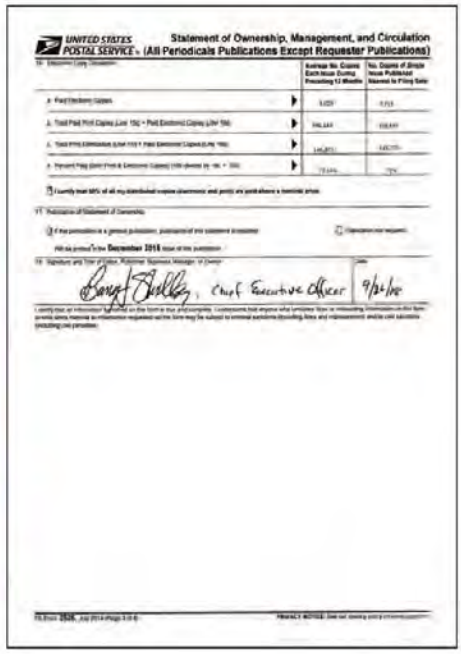

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Ham Ads

Please contact the Advertising Department at 860-594-0255 or hamads@arrl.org for further information or to submit your ad.

Before considering a ham ad please read.

1. Advertising must pertain to products and services which are related to Amateur Radio.

2. The Ham-Ad rate for commercial firms offering products or services for sale is $2.25 per word. Individuals selling or buying personal equipment: ARRL member 1.00 per word. Non-ARRL member $1.50 per word. **Bolding** is available for $2.50 a word. Prices subject to change without notice. You may pay by check payable to the ARRL and sent to: Ham-Ads, ARRL, 225 Main St., Newington, CT 06111. Or, you may pay by credit card sending the information by fax to 860-594-4285 or via e-mail to hamads@arrl.org. The credit card information we need is: the type of credit card, the exact name that appears on the credit card, the credit card number, the expiration date and the credit card billing address.

3. Remittance in full must accompany copy since Ham-Ads are not carried on our books. Each word, abbreviation, model number and group of numbers counts as one word. Entire telephone numbers count as one word. No charge for postal Zip code. No cash or contract discounts or agency commission will be allowed. Tear sheets or proofs of Ham-Ads cannot be supplied. Ads submitted in writing should be typed or printed clearly on an 8 1/2" X 11" sheet of paper.

4. Closing date for Ham-Ads is the 15th of the second month preceding publication date. No cancellations or changes will be accepted after this closing date. Example: Ads received December 16th through January 15th will appear in March *QST*. If the 15th falls on a weekend or holiday, the Ham-Ad deadline is the previous working day. Please contact the Advertising Department at 860-594-0255 or hamads@arrl.org for further information or to submit your ad.

5. No Ham-Ad may use more than 200 words. No advertiser may use more than three ads in one issue. Mention of lotteries, prize drawings, games of chance etc is not permitted in *QST* advertising.

6. New firms or individuals offering products or services for sale must check with us to determine if a production sample (which will be returned) should be submitted for examination. Dealers are exempted, unless the product is unknown to us. Check with us if you are in doubt. You must stand by and support all claims and specifications mentioned in your advertising.

The publisher of *QST* will vouch for the integrity of advertisers who are obviously commercial in character and for the grade or character of their products and services. Individual advertisers are not subject to scrutiny.

The American Radio Relay League does not discriminate in its advertising on the basis of race, color, religion, age, sex, sexual orientation, marital status or national origin. The League reserves the right to decline or discontinue advertising for any other reason.

7. AN IMPORTANT NOTICE TO ALL HAM AD POSTERS AND RESPONDERS, FROM THE ARRL ADVERTISING DEPARTMENT Greetings from ARRL HQ! Please note that we have received reports from many ARRL members who have placed classified ads in these listings, and have received responses from individuals proposing "creative" payment schemes. These particular instances involved offers of overpayments for goods by bank check, followed by instructions to deduct the cost of your item from the overpayment, and to transfer the overage back or to another individual. This is a well-known scam. Unfortunately, we have no control over this and other scams of this type. Once your email address is posted, you are vulnerable to those individuals seeking to provide you with questionable information.

QST Ham Ads on the Web
Updated Monthly!

www.arrl.org/ham-ad-listing

Club/Hamfests/Nets

CW INSTRUCTION via internet classes. VISIT longislandcwclub.org

FRIEND OF BILL W?? http://www.qsl.net/haam HF Net 12:30 Eastern Sat 14.290, Sun 14.340 Mon-Fri 14.316 QSO Net 11:30 Eastern 21:350

MARCO Medical Amateur Radio Council. Professionals enjoying ham radio. Free newsletter & info: secretary@marco-ltd.org

Property/Vacation/Rentals

A DX Apartment available in VP9 with rigs and antennas. Email: ed@vp9ge.com for details.

AL7HG helps hams buy/sell a QTH anywhere in Florida. Now with Pebble Pointe Realty. Email: Kaiserdr@yahoo.com, (352)321-0364

COLORADO CHALET with ham gear for weekly rental, www.lostcreekcabin.com. WØLSD, Buena Vista, CO.

HAWAII DX RENTAL STEPP-IRs KH6RC. 808-929-7101 info@leilanibedandbreakfast.com

Need a NEW QTH on Florida's east coast? Contact Greg Bowman, N4EN, Realtor Associate, Pioneer Properties USA, Melbourne FL. 321-305-9142

Operate N4USA in Virginia's high Blue Ridge Mountains www.n4usa.com

Timeshare for sale at the Occidental Grand Hotel in Aruba. One-bedroom deluxe, floating week availability from September through November. Call Patrick, KD2DGX (631) 979-8198.

Welcome to Finland, to OH73ELK! The new rental QTH on the small island, where you can combine a family vacation and Ham radio! No QRM/NO STRESS. https://OH73EIK.net or QRZ.com

www.peidxlodge.com

Antique/Vintage/Classic

ANTIQUE WIRELESS ASSOCIATION - the largest international organization for historic radio enthusiasts. Publishes the quarterly AWA Journal and annual AWA Review on all aspects of collecting and history of communications. AWA produces the famous annual AWA Convention and sponsors the world renowned Antique Wireless Museum. Only $35/year USA, $40/year elsewhere. Antique Wireless Association, PO Box 421, Bloomfield, NY 14469. Website: http://www.antiquewireless.org

Six Decades of Amateur Radio www.kk4ww.com

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General

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ISOTRON ANTENNAS FOR 160 - 6 METERS! Efficient, rugged and resonant. Please visit www.isotronantennas.com wd0eja@isotronantennas.com 719/687-0650.

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MicroLog-By-WA0H .. Easy to use logging program .. Free download .. **www.wa0h.com**

PRINTED CIRCUIT BOARDS for projects shown in QST, QEX, HR, ARRL HB, 73 and more. Custom boards available. FAR Circuits, 18N640 Field Ct, Dundee, IL 60118; fax/phone 847-836-9148; www.farcircuits.net; mail@farcircuits.net

QSK Your Amp http://QSK2500.myfreesites.net/

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Rohn Tower, telescoping poles, tripods and antenna parts delivered to your door. **www.antennapartsoutlet.com**

ROPE: All kinds: antenna, hauling, ginpole. FREE Consultation. www.DavisRopeAndCable.com Veteran Owned, K1PEK 978-369-1738

Station Sale - W3BZN. Call evenings WPA 814-942-7334. Cash - Pick-up only

SuperBertha "World's Strongest Antenna Tower" Legendary monopole rotates from ground level carrying your custom, stacked antenna load, no guy wires, TIA-G compliant, hurricane zone option. LittleBertha 40-79ft, BigBertha 80-109ft., SuperBertha 110-200+ft. Visit **www.SuperBertha.com** for W3TX's "Ultimate Antenna Towers(tm)

Tactical Portable Accessories for Yaesu 817ND, 857D, 897D, 891, 991A, ICOM 7300, 7000, 706/703. W0MSN www.portablezero.com

We are putting FUN back into ham radio! http://HamRadioFun.com

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Advertising Department Staff:

Janet Rocco, W1JLR, Advertising Sales Manager
Lisa Tardette, KB1MOI, Account Executive
Diane Szlachetka, KB1OKV, Advertising Graphic Design

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Your Customers are Reading...QST!

If your company provides products or services of interest to our Members, please contact the ARRL Advertising Department today for information on building your business.

Support those who support ARRL! Please patronize our ARRL Advertisers.

Contact Information:

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Direct Line: 860-594-0207
Fax: 860-594-4285
E-mail: ads@arrl.org
Web: www.arrl.org/ads

Additional advertising information is available on the web at:
www.arrl.org/ads

Advertisers

QST Advertising Deadlines:

Issue	Reservation Date	Materials Due Date
January 2019	Friday, November 9, 2018	Wednesday, November 14, 2018
February 2018	Tuesday, December 11, 2018	Friday, December 14, 2018

For links to the Web sites of all ARRL advertisers, visit www.arrl.org/shop-our-advertisers

Fa La La La…Lots of ARRL Diamond Club Benefits!

All members of the ARRL Diamond Club receive annual ARRL membership – including *QST* – plus the additional benefits listed below:

Diamond Club—Basic **$85-$249 annually**
(Special Note: ARRL Life Members can participate at this level for only $50!)
- Diamond Club pin
- Personalized Diamond Club certificate
- Diamond Club car window decal (2)
- ARRL Calendar (mailed in November)

Diamond Club—Brass **$250-$499 annually**
- Diamond Club Brass pin
- Personalized Diamond Club Brass certificate
- Diamond Club car window decal (2)
- Diamond Terrace recognition
- 10% discount on publication purchases direct from ARRL

Diamond Club—Silver **$500-$999 annually**
- Diamond Club Silver pin
- Personalized Diamond Club Silver certificate
- Diamond Club car window decal (2)
- Diamond Terrace recognition
- 10% discount on publication purchases direct from ARRL
- First Class Delivery of *QST*

Diamond Club—Gold **$1,000-$2,499 annually**
- Diamond Club Gold pin
- Personalized and framed Diamond Club Gold certificate
- Diamond Club car window decal (2)
- Diamond Terrace recognition
- 10% discount on publication purchases direct from ARRL
- First Class Delivery of *QST*
- Invitation to ARRL Annual Donor Recognition Event
- Recognition in ARRL Annual Report and on ARRL website
- Unlimited free use of DXCC, QSL Service and Awards
- Diamond Club Call-Sign Badge

Diamond Club—Platinum **$2,500-$4,999 annually**
- Diamond Club Platinum pin
- Personalized and framed Diamond Club Platinum certificate
- Diamond Club car window decal (2)
- Diamond Terrace recognition
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- First Class Delivery of *QST*
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- Recognition in ARRL Annual Report and on ARRL website
- Unlimited free use of DXCC, QSL Service and Awards
- Specially designed and personalized ARRL Diamond Club QSL cards
- Most recent Edition of the *ARRL Handbook*
- Diamond Club Call-Sign Badge

Diamond Club—Director **$5,000-or more annually**
- Diamond Club Director pin
- Personalized and framed Diamond Club Director certificate
- Diamond Club car window decal (2)
- Diamond Terrace recognition
- 15% discount on publication purchases direct from ARRL
- Priority Delivery of *QST*
- Invitation to ARRL Annual Donor Recognition Event
- Recognition in ARRL Annual Report and on ARRL website
- Unlimited free use of DXCC, QSL Service and Awards
- Specially designed and personalized ARRL Diamond Club QSL cards
- Most recent Edition of the *ARRL Handbook*
- ARRL Periodicals DVD with *QST*, *QEX* and *NCJ*
- Two ARRL passes to annual Dayton Hamvention® and an ARRL shirt
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For additional information on the Diamond Club, please contact us at 1-888-277-5289 and ask for the Development Office or development@arrl.org.

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