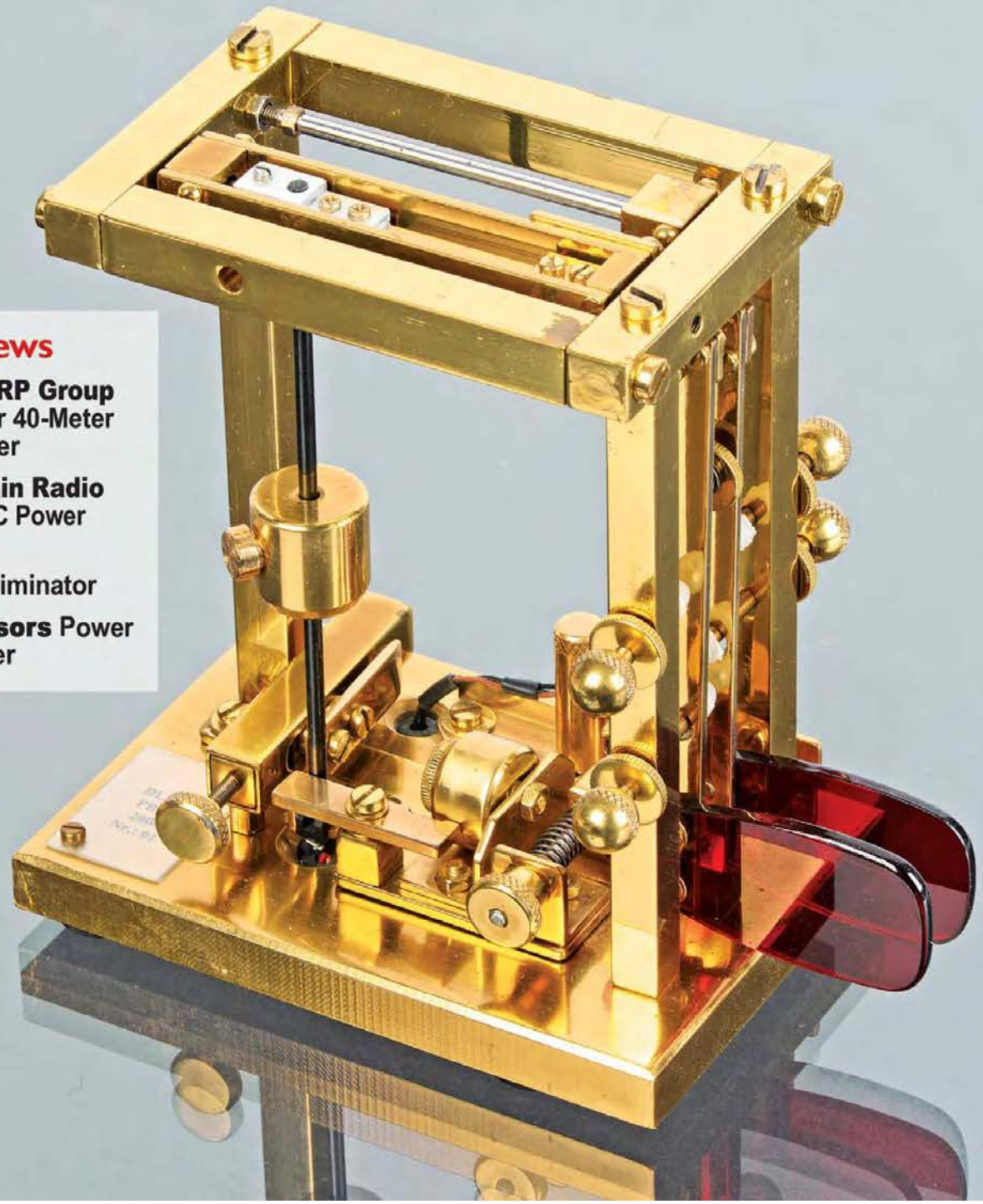
Build a Portable Phased Dipole for 20 Meters | 34

QST

DIGITAL EDITION

ARRL The National Association for Amateur Radio®
March 2022 www.arrl.org
DEVOTED ENTIRELY TO AMATEUR RADIO

The Pendulum Bug



QST Reviews

Four State QRP Group Bayou Jumper 40-Meter CW Transceiver

West Mountain Radio PWRcheck+ DC Power Analyzer

WiMo QRM Eliminator

Monitor Sensors Power and SWR Meter

NEW DEFINITION OF DIGITAL HANDHELD

Meet the Advanced Technologies

《Actual Size》

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

FT5DR

C4FM Digital Clear Voice
Clear and Crisp Voice Technology

AMS Automatic Mode Select

66 ch GPS

WIRES-X

Touch & Go Operation

microSD Card

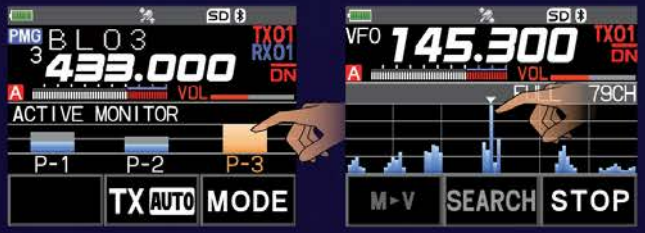
Bluetooth®

- Advanced C4FM Digital / 1W Audio Output
- Robust Tough Body with Rubber Protection
- Worldwide WIRES-X Internet Communications
- Fully Compatible with APRS
- Memory Auto Grouping (MAG) / VFO Band Skip Function

Primary Memory Group Touch & Go operation

Touch & Go Operation

Quick & intuitive Touch and Go PMG key channel monitoring operation, by simply touching a bar on the LCD



Quick Release Holster and Full Flat-Back Case

Comfortable size & form with no protrusions provides excellent grasp, even when wearing gloves for outdoor activities

YAESU
The radio

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The radio

C4FM/FM 144/430MHz Dual Band Mobile

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FM Friendly Digital : AMS (Automatic Mode Select)

System Fusion II Compatible

WIRES-X Portable Digital Node Function

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

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50 W DIGITAL MOBILE TRANSCEIVER

FTM-300DR

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microSD Card
C4FM Clear and Crisp Voice Technology
WIRES-X

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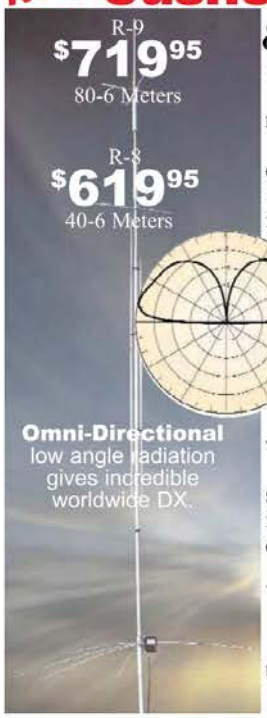
New! Cushcraft R9 . . . *80-6 Meters*



80 Meters . . . No Radials . . . 1500W

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

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

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

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

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.

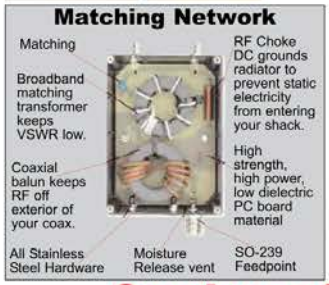
Rugged Construction: Thick fiberglass insulators, all-stainless steel hardware and 6063 aircraft-aluminum tubing is double or triple walled at key stress points to handle anything Mother Nature can dish out.

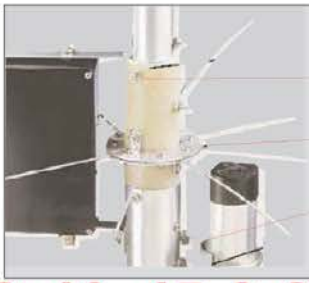
31.5 feet tall, 25 lbs. Mounting mast 1.25 to 2 inches. Wind surface area is 4 square feet.

R8, $619.95. Like R9 antenna but less 75/80 Meters.

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

R-8GK, $89.95. Three-point guy kit for high winds.





MA-5B *5-Band* Beam

Small Footprint -- Big Signal

The MA-5B is one of Cushcraft's most popular HF antennas, delivering solid *signal-boosting directivity* in a bantam-weight package. Mounts on roof using standard TV hardware. Perfect for exploring exciting DX without the high cost and heavy lifting of installing a large tower and 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-5B gives you 5-bands, automatic band switching and easy installation in a compact 26-pound package. On 10, 15 and 20 Meters the end elements become a two-element Yagi that delivers solid power-multiplying gain over a dipole on all three bands. On 12 and 17 Meters, the middle element is a highly efficient trap dipole. When working DX, what really matters are the interfering signals and noise you *don't hear*. That's where the MA-5B's impressive side rejection and front-to-back ratio really shines. *See* ***cushcraftamateur.com*** *for gain figures.*

Cushcraft 10, 15 & 20 Meter Tribander Beams

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

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

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

Cushcraft Dual Band Yagis

One Yagi for Dual-Band FM Radios

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

Cushcraft Famous *Ringo* Compact FM Verticals

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

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Comet's primary tool for any antenna adjustment or diagnostic project...

CAA-500MarkII Antenna Analyzer

1.8-500MHz

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

Functions:
In addition to the display of antenna properties, SWR curves are plotted quickly, easily and accurately!

Auto band-sweep function:
Switch to the amateur band of choice and press "Sweep Center". The chosen band is swept and the SWR graphed in seconds!

Manual band-sweep function:
Select the band, select the center frequency, and select the bandwidth. Manually sweep the chosen frequency range and display the SWR graph.

Multiple Manual Band-Sweeps
Manually graph the user defined bandwidth multiple times and see the results overlaid in 5 selectable colors! Make antenna length, position, height above ground, gamma match adjustments, etc…and graph each adjustment in seconds, in a new color, without losing the previous graph!

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

Features:
Operates on 8-16VDC external power, 6 AA Alkaline or NiMH rechargeable cells • Trickle charger built in (only when using NiMH batteries) • Typical battery life: 9 hours of continuous operation • Battery level indicator • Selectable auto power-off time limit preserves battery capacity • SO-239 connector for 1.8-300MHz range • N-female connector for 300-500MHz range • Optional soft carry case sold separately: CAA-5SC

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QST

Contents

March 2022 ♦ Volume 106 ♦ Number 3

9 **Second Century**
"You think you're Mickey Spillane?"

30 **A Compact 40-Meter Three-Wire Folded Loop**
Jim McLelland, WA6QBU

34 **Portable 20-Meter Phased Dipole Beam**
Bob Rose, KC1DSQ, and Bob Glorioso, W1IS

37 **DL3FF Pendulum Bugs**
Dr. Rudolf Kalocsay, DL3FF

41 **New Challenge Coin Commemorates *NCJ*'s 50th Year of Publication**

42 **Product Review**
Pascal Villeneuve, VA2PV
Four State QRP Group Bayou Jumper 40-Meter CW Transceiver; West Mountain Radio PWRcheck+ DC Power Analyzer; WiMo QRM Eliminator; Monitor Sensors Power and SWR Meter

53 **Meet the New Product Review Editor**
Pascal Villeneuve, VA2PV

59 **OH2BH Looks Back at 60 Years in DXing**
Martti J. Laine, OH2BH/AH3D

63 **The Heartbeat of the Shortwaves**
Jen Glifort, KC1KNL

73 **The 2021 IARU HF World Championship Results**
Bob Raymond, WA1Z

76 **The April 2022 ARRL Rookie Roundup — Phone**

87 **A Look Back: April 1972**

Columns

Ask Dave 54
Celebrating Our Legacy 93
Classic Radio 94
Contest Corral 72
Correspondence 24
Eclectic Technology 58
Happenings 67
Hints & Hacks 56
How's DX? 78
Member Spotlight 13
Public Service 70
Up Front 20
The World Above 50 MHz 80
100, 50, and 25 Years Ago 96

Departments

ARRL Section Managers 16
ARRL Volunteer Examiner Honor Roll 86
Certificate of Code Proficiency Recipients 85
Convention and Hamfest Calendar 83
Feedback 57
Field Organization Reports 71
Guide to ARRL Member Benefits 14
Ham Ads 124
Index of Advertisers 126, 127
Life Members 41
Officers, Division Directors, and Staff 15
QST Cover Plaque Award 66
Silent Keys 97
Special Event Stations 82
Volunteer Monitor Program Report 76
W1AW Qualifying Runs 85
W1AW Schedule 77
W1AW's QSL File 28

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Write for *QST*

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

Our Cover
This beautiful creature is a pendulum bug created by Dr. Rudolf Kalocsay, DL3FF, a ham and telegraphy enthusiast who was looking for a way to solve the problem of contact bounce destroying transceiver PIN diodes that other bugs have. His bounce-free design is dependent on photosensors, and the pendulum design minimizes the bug's footprint. Rudi developed two types (or perhaps we should say "species") of pendulum bug — the main difference being the manner in which the pendulum's oscillation is initiated. One functions by release of the pendulum pre-tensioned with a leaf spring, and the other (shown on our cover) replaces the leaf spring with a torsion spring that's initiated manually. Get the details on both bugs in Rudi's article, "DL3FF Pendulum Bugs." [Guido Flüchter, photo]

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

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

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

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

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

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

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

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

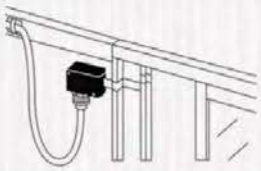
Wavelength: 146MHz 5/8 wave x 2 • 220MHz 5/8 wave x 3• 446MHz 5/8 wave x 5 • Max Pwr: 120W • Length: 10'2" • Weight: 3lbs. 1oz.• Conn: Gold-plated SO-239 • Construction: Fiberglass, 2 Sections

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

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

❼ COMET CTC-50M WINDOW GAP JUMPER

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



CAA-500MarkII

1.8-500MHz Antenna analyzer

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

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

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

CAA-5SC

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

Shoulder strap included.

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COMET®

Happy Belated New Year!

From all of us at SteppIR

We had our holiday party a bit late this year, thanks to an uninvited visit from COVID to our office – but we are back and excited to continue to thrive in 2022! I know we normally like to show off our products in these ads and try to convince folks of the value of our technology, but once in a while I think it's really important to reflect on significant world events, because we are all in this together.

It's been a very difficult stretch of time as we all come into the 2 year anniversary of this current pandemic. Through it all, the human spirit has been illuminated all over the world, and that, to me – is an incredibly moving and powerful thing. We journey forward, never forgetting the past, but ALWAYS hopeful for the future.

What is so unique about the amateur radio community, is that regardless of our location, culture, race or religion, we have for a very long, uninterrupted time, overcome so many world-events to form incredible, lifelong friendships with each other. All while collectively helping others in times of great distress – earthquakes, hurricanes, tsunami's, name all the formidable disasters that have ever happened around the world in modern times, and in the middle of the chaos you will find a group of amateur radio operators offering their assistance, even at great personal risk.

My mother used to say "it is an ill wind that blows no good", and if anything good has happened throughout this historically severe pandemic, it's that much like our amateur radio community, our entire humanity has come together in so many ways to show that compassion, caring and support of your fellow man still rings loudly throughout the world.

John Mertel – WA7IR

SteppIR would like to wish you a very safe, happy and prosperous 2022 – with lots of good DX!

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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

The Standard By Which All Others Are Judged

RF PARTS™ COMPANY

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

Second Century

"You think you're Mickey Spillane?"

"You think you're some kind of writer?" You may recognize these as the noble words of Gunnery Sergeant Hartman in Full Metal Jacket*! That is my question to you this month: do you see yourself as some kind of writer?*

One of the major topics included in the member comments that I receive, month in and month out, is *QST*. It's too thin. It's too technical. It's not technical enough. There are too many ads. Why aren't there more ads with cool stuff? There's not enough content! Over the years, ARRL has expanded its publishing footprint to include four magazines: *QST*, *On the Air*, *QEX*, and *NCJ*. There is a tremendous amount of content to satisfy member needs within those pages. Are you aware that with your membership, you get all four magazines for free digitally? It is remarkably convenient to be able to access the magazines on a timely basis from anywhere by simply going online to read them at **arrl.org/arrl-magazines**. You can even search the full text of *QST* for issues published from January 2012 to present. I also enjoy the ARRL Periodicals Archive (**arrl.org/arrl-periodicals-archive-search**), which lets me search for even older articles that I think back to from early on in my ham radio career.

This blessing is also a curse: our appetite for content is insatiable. We know which articles our members love. It's no surprise that just about any new antenna concept leads to excitement! Kit or construction articles are also very popular. Some of the articles I used to enjoy — that appeared in *QST*, or even in the *Handbook* — had to do with simple transmitter or receiver designs. Doug DeMaw, W1FB (SK), was my hero! Doug was a prolific writer and was on the HQ staff from 1965 to 1983, serving as Senior Technical Editor and Technical Department Manager. My best friend in high school, Mike Conwill, N2MW, loved QRP and built Doug's "Tuna Tin 2" project, which first appeared in the May 1976 issue of *QST*. Along with his Heathkit HW-8, Mike attacked the airwaves, digging for a Worked All States Award — and he was successful! I too built a Tuna Tin 2, which sat next to my homebrew Novice rig (12AT7/6L6GC), and I had a wonderful time with that little radio. Thank you, Doug.

We certainly have our modern-day Doug DeMaws: Steve Ford, WB8IMY; Ward Silver, NØAX, and others who inspire us with their knowledge. But now, we are looking for YOU!

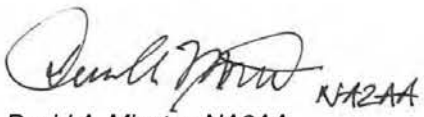
You've probably read our magazines for years. You know the kinds of articles we are looking for. Or maybe you have something innovative we've never thought of or seen before! Go ahead and submit an article to our editorial team. It should be about 1,200 words long and include a "how-to" component, so other hams can reproduce your success. We also like to see three to five high-resolution images that complement the text.

If you're writing up a construction project with step-by-step instructions, your article may exceed 1,200 words, and will likely require additional images — that's fine; send in whatever your project requires. Submissions go to **qst@arrl.org** and are routed to the manuscript evaluation committee that reads and discusses all submissions. We take a broad view of all manuscripts, considering potential use in all of ARRL's publishing outlets. If you'd like more information about what we're looking for, there's an author's guide available at **www.arrl.org/qst-author-guide**.

If you're not a writer, why not *recruit* one! We can't be everywhere. Perhaps you have a friend or someone in your radio club who has written for a newsletter or who is doing/building great things. Encourage them to consider writing something — or sharing something they've already written — with ARRL.

ARRL's current core of authors, editors, and content contributors (thank you all!) already know how rewarding it is to hear from members who tell us that an article they've read or project they've built has inspired them — to try something new, or to become more active in amateur radio. Our editorial mission parallels ARRL's overall mission: To advance the art, science, and enjoyment of Amateur Radio.

Be a writer! Write for ARRL! Get interested and involved in our content. Be radio active. Bring your passion for ham radio to the pages of ARRL magazines.



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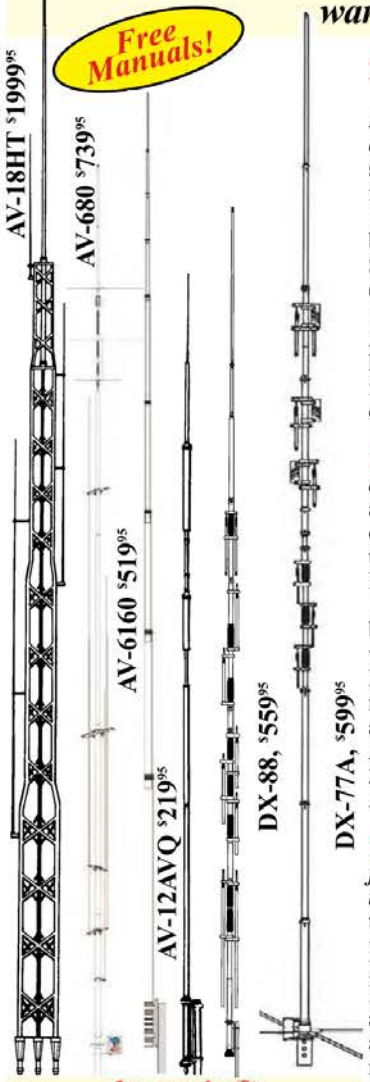

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All hy-gain multi-band vertical antennas are entirely self supporting -- no guys required.

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

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

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

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

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

Two year limited warranty.

AV-18HT, $1999.95. (80,40,20,15,12,10 M, 160, 17 Meters optional). 53 ft., 114 lbs.

Standing 53 feet tall, the famous Hy-Gain HyTower is the world's best performing vertical! Automatic band selection uses unique stub-decoupling which effectively isolates various sections of the antenna so an electrical 1/4 wavelength (or odd multiple) exists on all bands. 250 kHz 80 Meter bandwidth with 2:1 SWR. The addition of a base loading coil (**LC-160Q, $199.95**), provides exceptional 160 Meter performance. **MK-17, $149.95**. Add-on 17M kit. 24 foot tower is all rugged, hot-dip galvanized steel and all hardware is iridited for corrosion resistance. Special tilt-over hinged base for easy raising & lowering.

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AV-640, $659.95. 40/30/20/17/15/12/10/6M. 25.5 ft., 17.5 lbs.

AV-620, $599.95. 20/17/15/12/10/6M. 22.5 ft.

AV-6160, $519.95. (160, 80, 40, 30, 20, 17, 15, 12, 10, 6 Meters). 43 ft., 20 lbs. ***Low profile, self-supporting 43 foot vertical assembles in less than an hour!*** Blends in with sky and trees -- barely visible. Entire length radiates for exceptionally low angle radiation 160-20 Meters with very good performance on 17-6 Meters. A wide range automatic or manual antenna tuner at your rig easily matches this antenna for all bands. No physical adjustments. Includes ATB-65 base mount. Optimized balun design allows direct coax feed with negligible coax loss.

AV-6110, $429.95. 1.5 kW matching network improves efficiency on 160/80 Meters.

AV-12AVQ, $219.95. (20, 15, 10 Meters). 13 ft., 9 lbs. ***Automatic bandswitching, omnidirectional, low angle DX antenna. self-supporting. 1500 Watts.*** *Hy-Q*™ traps give *full* 1/4 wave performance with broadbanding top hat. SWR less than 2:1. Ground or roof mount, requires radials.

AV-14RMQ, $159.95 roof mount.

DX-88, $559.95. (80, 40, 30, 20, 17, 15, 12, 10 Meters, 160 M optional). 25 ft., 18 lbs.

All bands are easily tuned with exclusive adjustable capacitors. 80/40 Meters tuneable from ground without lowering antenna. Super heavy-duty construction. DX-88 OPTIONS: **KIT-160-88, $299.95.**160 Meter add-on kit. **GRK-88, $159.95.** Ground Radial System. **RRK-88, $139.95.** Roof Radial System.

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No ground radials required! Off-center-fed Windom has 55% greater bandwidth than competitive verticals. Heavy-duty tiltable base. Each band independently tunable.

8 Bands!

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$199.95

AV-18AVS

Operate 8 HF bands for $199.95!

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

Also ideal for shortwave listening.

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

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

Automatic Bandswitching AV-14AVQ

40/20/15/10 Meters

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Quickly work DX instantly with automatic bandswitching!

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

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

MK-80, $169.95. 80M add-on kit.

AV-14RMQ, $159.95. Roof mount kit.

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- No HOA Hassels
- Very Low Noise
- Auto Tuned for Best SWR
- 80m* to 10m Models

No Compromises
Mag loops antennas (MLA) are well known for their superior performance. Be it in barren desert, balcony, attic, or just your backyard, this mag loop performs. Retaining all the great features of our HG3 PRO model, the new HG3 QRO high power (1.5 KW*) model (shown here), raises the bar again for MLAs. It covers 80*-10 meters. Adding the optional second radiator loop (two turns), allows high power operation on 80 meters.

Unrivaled Tuning Capability
Shown below is the high Q vacuum capacitor with a 45,000-step resolution stepper motor. This delivers an unprecedented 511 Hz tuning resolution and allows you to set your band preferences spot on. This is very helpful when making QSOs under non-ideal and crowded band conditions.

New HG3 *plus* Controller
It is completely redesigned. It controls both the HG3 PRO and HG3 QRO MLA models and the AR1 Rotator. It remotely tunes 3.5-30 MHz with stepper motor precision and resolution. *RapidTune* automatically scans each band for the lowest SWR and works with most HF radios.

HG3 QRO

- 1.5 KW PEP*
- High Q Vacuum Cap
- 45K Step Resolution
- Auto assist tuning
- 40m-10m standard
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Coaxial , Ladder Line, Single wire, Control Line protection for Rotators, Switches, and Antenna Motors

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

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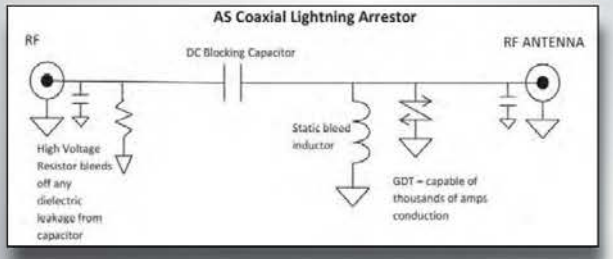
AS-303U



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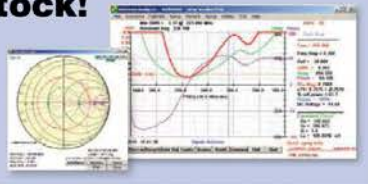
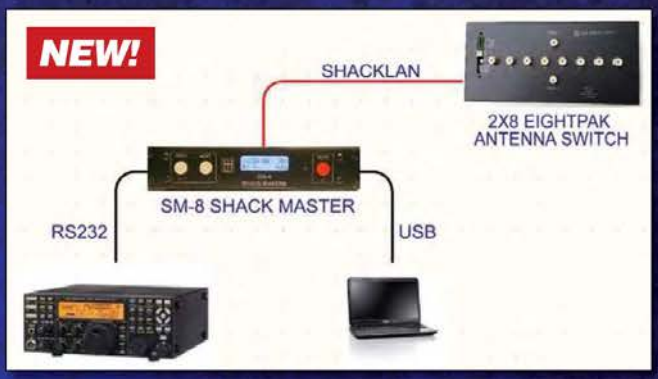


Hamation Station Automation

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

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



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

The Shared Apex Loop Array™!

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

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

Three models to choose from:

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

StackMatch

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

PowerMaster II

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

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Bob Lee, KN6PXS, blee@arrl.org

Member Spotlight

Nella Ludlow, W7LUD

Retired USAF officer and Life Member Nella Ludlow, W7LUD, of Port Townsend, Washington remembers her instrument check flight during her Air Force pilot training in Texas. After she completed the flight, the check pilot told her she had an almost perfect score. The only thing wrong, he explained, was that she failed to check the Morse code identifier of a radio navigation aid by comparing the dits and dahs received against the dots and dashes shown on the chart. A licensed ham since age 12, Nella told the check pilot that she actually knew Morse code and simply read the NAVAID ID by ear. The skeptical instructor called in the chief of the check flight group, who quizzed her on the Morse alphabet. After about eight or nine letters, he realized Nella was the real deal and said, "OK, you pass!" Her score was corrected to 100%.

Nella was introduced to Morse code and electronics at an early age by her father, David Ludlow, W7QHX, an electronics engineer for the US Navy. David even published an article in the January 1975 issue of *QST* on a homebrew test device nicknamed the "Octopus." In her teens, Nella upgraded her license by passing the General-class exam, along with its 13 WPM code test. "When I went away to college in Pullman, Washington, I brought along a Yaesu FT-101 so I could keep in touch with home, 370 miles away. As it was, during freshman year Mt. St. Helens erupted and blanketed the town in volcanic ash, closing local roads, causing power outages, and wreaking havoc on long-distance phone lines. So I jumped on a CW net and helped out by passing messages between fellow students and their anxious parents."

A Technology Career in the Military and Afterwards

After graduation, her commission in the USAF started her career, first as a pilot, and later as an intelligence officer specializing in Soviet fighter craft. In that role she advised a four-star general during Force Reduction talks in Moscow, and was the youngest member of the delegation.

Also while in the Air Force, she earned a PhD in Artificial Intelligence (AI) at the University of Edinburgh in Scotland and later did post-doctoral studies in AI at the University of Cambridge, England. One military assignment was as a Computer Science professor at the Naval Postgraduate School, where many of her students went on to lead IT and communications groups throughout the Department of Defense.

After retiring from the Air Force, she moved back to her home state of Washington. With her spouse, she cofounded a software and wireless company that set up on-vessel-while-at-sea Wi-Fi services for passengers and crew on the Washington State Ferries. This success led to wireless contracts from British Columbia Ferries, the US Navy, and NASA. When she took her company public on the New York Stock Exchange, she was given the honor of ringing the opening bell.

After 13 years leading two wireless companies, she turned her energies toward helping the next generations. She was hired as a Professor of Computer Science at Washington State University (WSU) and later was promoted to Director of Data Analytics. Currently she teaches as an Adjunct Professor of Mathematics at WSU and as a Visiting Professor of Computer Science at Wright State University in Dayton, Ohio, where she created a new and popular course in Quantum Computing.

Ham Radio in the Family

Family gatherings are almost like mini ham conventions; in addition to Nella, her father, grandfather, sister-in-law, brother-in-law, and father-in-law are or were licensed radio amateurs as well.

Nella's favorite radio event each year is ARRL Field Day, when she and her dad take her camper somewhere afield and experiment with new antenna designs, including a 40-meter horizontal loop in 2021. "We dust off equipment, make a few contacts, make a campfire, and tell stories," she said. One highlight was a contact with W1AW and the QSL card that followed. She enjoys VHF, UHF, and microwave operation as well, and she is a member of the Pacific Northwest VHF Society. In 2010 Nella passed the Extra-class exam, and in 2015 she won the Single Operator, Portable category in the ARRL September VHF Contest. She has earned Worked All States (WAS) awards in both Mixed and Phone and is about 35 states into CW WAS status. She can often be found on the KA1ULN CW Net on 7.045 MHz.

One of Nella's current projects is restoring and re-capping her family's old Hallicrafters S-76 receiver, which she learned Morse code on.

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

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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.

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

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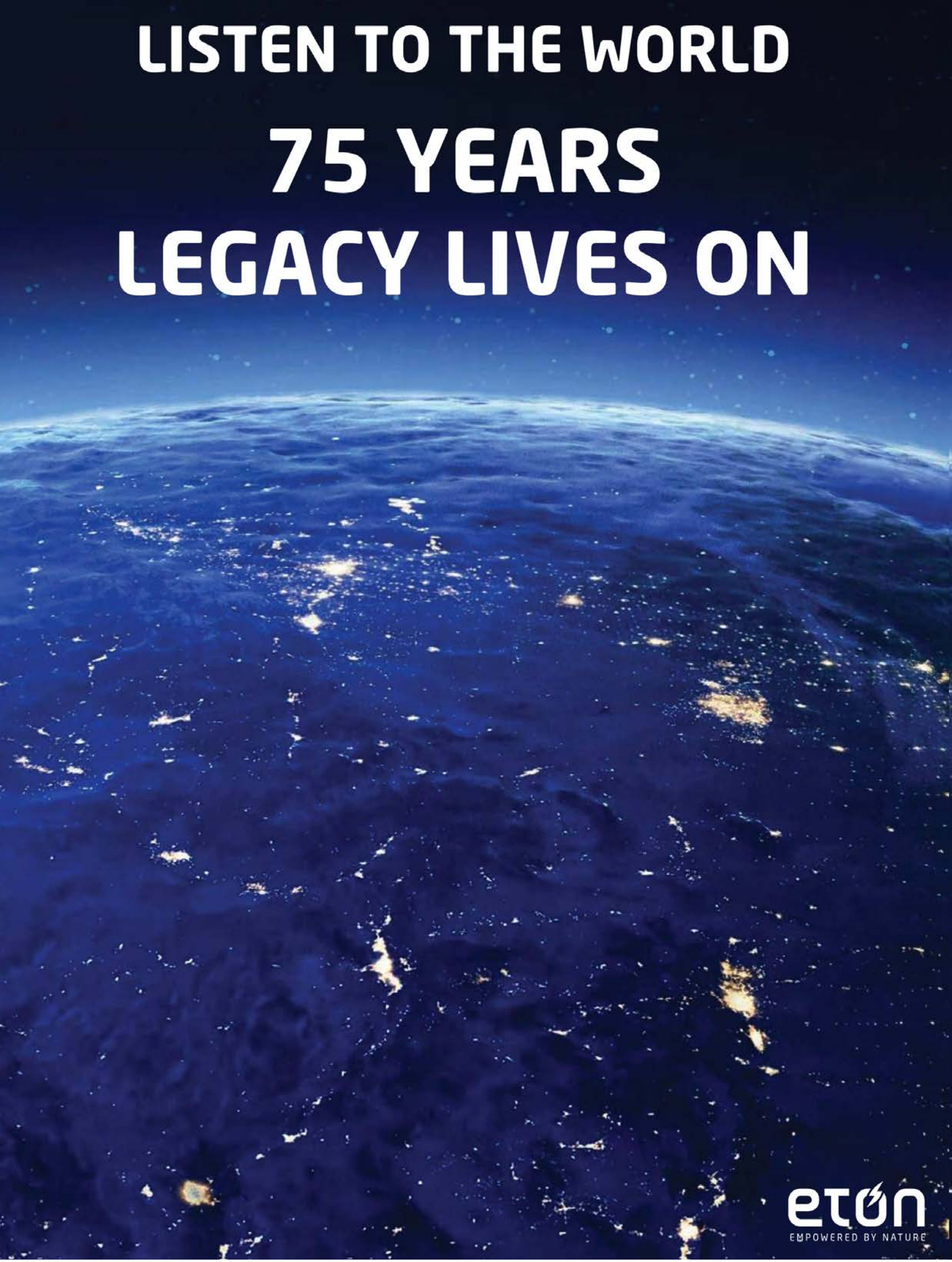

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Up Front

A Third Generation of Hams

In July 2021, at a test session held by the Denver Radio Club VE Team, three sisters passed their Technician-class exams on their first try. Nyobi Sobanski, KFØGHP (age 13), and her sisters, Cora, KFØGHR (age 15), and Anya, KFØGHQ (age 11), are the third generation of hams in their family. The girls' mentor and grandfather, David Cherba, WZ8T, spent the last year helping them study. Their parents Kelly, KB8OGP, and Peter, AB8WN, attended the session and are very proud of their children. Peter even signed up to become a member of the Denver Radio Club VE Team.

The Sobanski sisters showing off their success. From left to right is Nyobi, KFØGHP; Cora, KFØGHR, and Anya, KFØGHQ.

A Nifty Pool Cue Antenna

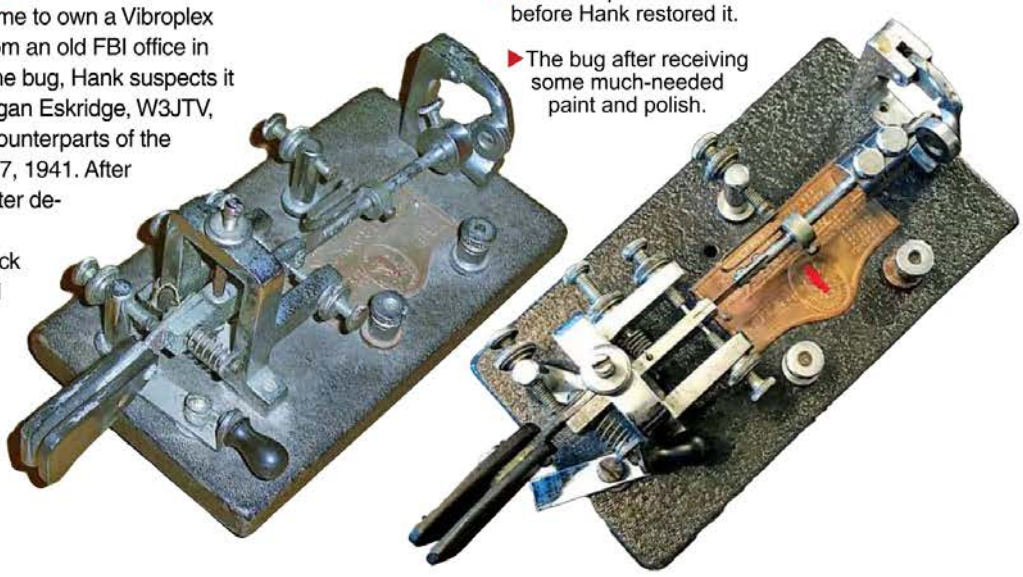
Robert Sisco, K5LYT, designed and built an all-copper antenna on a pool stick. This ¼-wave ground-plane antenna has less than a 1.2 SWR from 144 to 148 MHz. Coax braid covers brass welding rods. The base is a double-sided copper circuit board forming a series isolation capacitor to block static buildup. The antenna also mounts on Robert's fishing magnet mast on his truck, but right now he's mostly using it as a hat rack. (For more detailed instructions, contact Robert Sisco, K5LYT.)

A Historic Honolulu Bug

Henry "Hank" Hanburger, K3YDX, came to own a Vibroplex Original Bug after it was discarded from an old FBI office in Honolulu. Delving into the history of the bug, Hank suspects it could have been used by Dwayne Logan Eskridge, W3JTV, who was in charge of informing FBI counterparts of the attack on Pearl Harbor on December 7, 1941. After being salvaged from the trash, and after decades of disuse, the bug had a badly marred base with remnants of the black crinkle finish and flaking on the plated arm. It was also lacking the typical round finger piece. Hank completely disassembled the bug, repainted the base with a similar crinkle-finish black paint, and polished the chromed metal parts. Hank now has it displayed in his home station.

◀The Vibroplex's condition before Hank restored it.

▶The bug after receiving some much-needed paint and polish.



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Letters from Our Members

Remembering the Doctor

I was very sad to hear about the passing of Joel Hallas, W1ZR. When I was a newly licensed ham a few years ago, I discovered *ARRL The Doctor is In*, a bi-weekly podcast where Joel and former *QST* Editor-in-Chief Steve Ford, WB8IMY, addressed amateur radio questions. Not only were those podcasts entertaining and informative, they were approachable for those who were new to the hobby. I had emailed Joel a question once, and he took the time to write me a lengthy response that was full of helpful suggestions and background information. Indeed, he was as approachable as his podcasts. He will be missed!

The *ARRL The Doctor is In* podcast series ended in 2019, but I encourage everyone to listen (or listen again). Episodes are available at **www.arrl.org/doctor**.

Ken McIntosh, VA7KBM
Vancouver, British Columbia, Canada

Tips for Getting to Know Other Operators

While operating CW, I've engaged in countless variations of the scripted contact that includes your RST (Readability-Signal Strength-Tone), location, name, radio, and age. However, sometimes amateurs are looking for more of a conversation.

Here are some ideas for what you can ask the other operator: what their other hobbies are, what their town is known for, what they like about their radio, how they became interested in ham radio, and if they've tried digital modes. I've had some wonderful chats with hams using these topics.

I hope this helps in your enjoyment of amateur radio and allows you to learn a little more about the operator on the other end. I want to thank my mentor Bert Thornhill, K3HT, for his assistance with this contribution.

Wayne Francis, W3HIZ
Parkville, Maryland

An Outdated US Flag

I really enjoyed the December issue's coverage of the centenary of the first transoceanic amateur radio transmission. Interestingly, the American flag on the "derby" hat that W. W. Burnham gave ARRL Secretary K. B. Warner, W1EH, only has 46 stars. However, when the transmissions occurred, the US flag had 48 stars.

Alan Biddle, WA4SCA
Franklin, Tennessee
Life Member

QST *received several letters about this curious discrepancy in the number of stars. Our best guess is that the UK artisans who painted the hat were unaware that the US gained two more states (New Mexico and Arizona), bringing the total to 48, way back in 1912 — 10 years prior to the hat's creation! Clearly, better communication across the Atlantic was needed — thank goodness the Transatlantic Tests were successful! — Ed.*

Lessons Learned While on the Air

I'd like to share a recent mistake I made on the air to help others avoid my error. Recently, I was tuned in to the Veterans Affairs (VA) Hospital Net on 20 meters. At one point, I heard another Northwest Arkansas ham calling me on the net frequency.

My friend and neighbor Dennis Shirrel, K7DCG, reported that my 2-meter microphone was locked down. Sure enough, it was in constant transmit on the national 2-meter calling frequency. A quick re-press of the button released the radio from transmit.

Several Northwest Arkansas hams had been hearing a carrier on 146.52 MHz since the evening before, and were doing their best to find the signal. When Dennis and other local hams tuned in that morning, they could hear the VA Hospital Net in the background. They quickly scanned 20 meters to find the matching audio feed and realized it was me.

Thankfully, my radio was set for minimum power (5 W), and no harm was done — other than embarrassing spectrum pollution. My best guess was that one of my cats had pressed the switch when they were walking across my operating position the evening before.

After this incident, several lessons came to mind that I thought I should share:

1) Occasionally scan your equipment while operating. Had I looked around when I settled into my shack that morning, I likely would've caught that my microphone button was locked down.

2) Always take a careful look at all of your equipment when shutting it down for the night. If I'd done even a casual scan, I would've found the problem early on.

3) Pay attention to easily pressed transmit/receive switches or microphone buttons. Checking them periodically can help to make sure they haven't become inadvertently engaged.

Because of this experience, I've returned to my previous practice of turning everything off and disconnecting my antennas every evening.

Thanks to Dennis Shirrel, K7DCG; Darrell McKinney, K5ANW, and all of the good-natured amateur radio operators of Northwest Arkansas for their smart work in remedying my error.

Bernie Skoch, K5XS
Elkins, Arkansas

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Advertorial

Building a Crystal Radio Kit Changed My Life, and Now I'm Passing the Torch to The Next Generation!

(5 Minute Read)

When I was younger, I spent a lot of time with my uncle who was very much into analog electronics. I would especially look forward to the winter breaks as I would typically spend them with him and my grandmother. One night after he returned home from work, I remember him bringing home a mysterious box full of parts. I was intrigued to say the least!

When I asked him what was in the box, he said it's called a "Crystal Radio Kit". My mind raced with excitement and I couldn't wait to crack into the box and begin building whatever it was. What happened next changed my life forever!

When we finally finished building the kit, he put the earpiece into my ear, and began turning a dial on the unit. To my amazement I could hear someone's voice. I was stunned, where was this voice coming from? After all, there were no batteries, how could I be hearing anything? What he said next really blew my mind. He said, the voice and the power were coming from radio waves which were invisible to the naked eye.

Not only were those some of the best memories of my life, but from that moment forward, I knew I wanted to study everything I could about electronics. In fact, it led to a successful career as an electrical engineer. Now that I'm older and have nieces and nephews of my own, I knew that I wanted to pass this excitement and knowledge to the next generation. But how? Electronics today are far more complicated than they were when I was starting out decades ago.

After a bit of googling, I ran across something called Arduino. It's a super simple to use electronics platform which allows anyone to build some truly incredible projects. It's coded in a basic form of a language called C.

Now that I've got more time on my hands, I wanted to get my hands on an Arduino based kit so that I could spend some quality time with my nephew and pass the torch to the next generation. Luckily, I keep all my past issues of QST magazine and happened to see a review of a product called the Dr.Duino Explorer which is an Arduino compatible kit. (January 2021, page 48)

After reading this review, I knew that this was exactly what I was looking for. It comes as a DIY style kit accompanied by a superb set of step-by-step online instructions that teach you about the Arduino as you build it. PLUS, for a limited time, when you order your own Explorer Edition from www.DoctorDuino.com, you'll even get access to an Arduino crash course for FREE!

It's perfect for jump starting your Arduino journey, by teaching you what you can and can't do with Arduino, and ends with you creating your very own Morse code machine! I'd hurry though, because ever since it was featured in QST, these kits are hard to get your hands on.

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As seen in QST Magazine January 2021
Page 48 Product Review Section

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Revied by Glen Popiel, KW5GP

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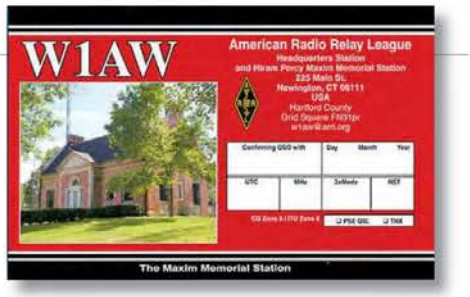
W1AW's QSL File

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



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A Compact 40-Meter Three-Wire Folded Loop

A 0.4 λ loop is a good compromise between size and efficiency.

Jim McLelland, WA6QBU

A standard 40-meter dipole or inverted V is around 65 feet long, which is often too big for a small city lot or townhouse setting. Therefore, many hams miss out on the fun of 40 meters, especially when the higher-frequency bands close for the night. Perhaps you are in this situation, or maybe you want something portable that's easy to set up.

How It Works

The basic design starts as a dipole, but somewhat shorter at 0.4 λ. That may not seem much shorter than 0.5 λ, but it makes a difference when you make it a triangle. The loop is only 22 feet wide and 13 feet high, with the apex as low as 19 feet above ground.

When matching an antenna, there are two critical qualities. The first is feed point resistance. Generally, loops have quite a low input resistance, in this case around 8 Ω. To raise the resistive part of the impedance to be more compatible with modern equipment, the folded dipole concept is incorporated, using three wires instead of the usual two. This gives an impedance multiplier of three squared, or nine, which raises the input resistance to 72 Ω. This is just about perfect for 75 Ω coax. I used 50 Ω cable and got a 1.5:1 SWR, which was good enough to test the system.

Next is the issue of resonance. Consider how the dipole resonance drops somewhat with the ends lowered into an inverted V. This is due to capacitive coupling to ground, and through the ground to the other end of the dipole. Because the ends are near each other in a loop configuration, the dipole end-to-end capacity can be increased with a capacitive stub (see Figure 1), which is used to adjust resonance of the antenna (up or down, depending on length) to the desired frequency.

◀**Figure 1** — The tuning stub.

▼**Figure 2** — An example of how to interlace additional wire into ladder line.

How It's Built

To simplify construction, I used 56 feet of #18 AWG stranded 300 Ω window line and laced a third #16 AWG insulated wire through the windows (see Figure 2). Next time, I'll use #18 AWG, as it is easier to thread and pull. The three wires on the left side are connected together, as are the three on the right side. These two connections are then attached to a capacitive stub made from 2 feet of window line left open at the outer end, with sealed wire nuts for added protection. Halfway around from the stub (or directly across from it), I cut one of the three wires to form a feed point. Using an antenna analyzer at the feed point, the stub length is then trimmed to get exact resonance once the antenna is installed.

The final stub length was 14.5 inches, resonating at 7,160 kHz with a 3:1 standing wave ratio (SWR) bandwidth of 130 kHz. Remember that shape, height, and proximity to other objects affects resonance somewhat. Once tuned, I attached the coax (see Figure 3). Because the antenna is balanced, I put a coax choke at the feed point made from 10 turns of coax with a diameter of 8 inches (see Figure 4).

Figure 3 — Coax feeds one of the three wires.

Figure 4 — The finished balun.

On-Air Tests

With the antenna vertically mounted on a 16-foot pole attached to a 6-foot fence, I worked stations from California to Alabama from my home station in Santa Fe, New Mexico. I was running 100 W SSB and would not recommend much more without more tests, as the stub could overheat, melt, or worse. Using 450 Ω window line would be better for higher power, but the stub will need to be about twice as long. I should also mention that the fence mount was between two stucco houses, which have wire mesh creating some shielding.

Gain and Pattern for the WA6QBU Loop

John Stanley, K4ERO

It is well known that the pattern for a 1-wavelength (λ) circumference loop, such as used in a quad antenna, has a lobe broadside to the plane of the loop with nulls off the sides of the loop. It is also well known that a small magnetic loop has just the opposite — nulls broadside to the loop plane and strong response in the plane of the loop. We might guess, then, that a 0.4 λ loop might have a pattern somewhere in between, with a signal both broadside to, and in the plane of, the loop. NEC studies (see Figures A, B, and C) confirm this and show that at 0.4 λ, the pattern is omnidirectional to within 3 dB, with the strongest signal toward the feed point at the top of the loop.

For nearly all omnidirectional antennas, gain depends on efficiency. A 1 λ loop is nearly 100 percent efficient, and a small loop is quite inefficient (less than 10 percent in some cases). The 0.4λ loop will have an intermediate level of efficiency. Thus, the free space gain will be somewhat less than 0 dBi. A perfect ground reflection would add 6 dB. Any antenna close to the real ground will lose some energy to the soil, and this loop is no different. Feeding at the top instead of the bottom of the WA6QBU loop reduces ground loss, increases the signal at high angles useful for NVIS, and puts the tuning stub near the ground, making adjustments easier.

There are many variations of shape and feed point that an experimenter can try. The shape of the loop will have a slight effect on the tuning and gain, but not so much that mechanical considerations can't dictate what shape, height, and feed point are chosen.

While both full-size (1 λ) loops and small loops have been widely used, the near-half-wave loop is seldom seen. One exception was the once popular halo antenna, which was used on 6- and 2-meter mobile operations when horizontal polarization was desired. Jim's loops are something like the halo stood on edge. When fed at the top, it resembles an inverted-**V** antenna with the ends tucked under to reduce the size. The pattern is much like that of the inverted **V**, making it a great near-vertical incidence skywave (NVIS) antenna. At longer distances, it will have a more omnidirectional pattern compared to a normal dipole, which is weaker off the ends.

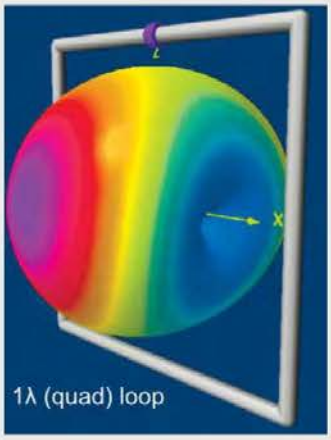

Figure A — A 1 λ quad loop antenna gain pattern.

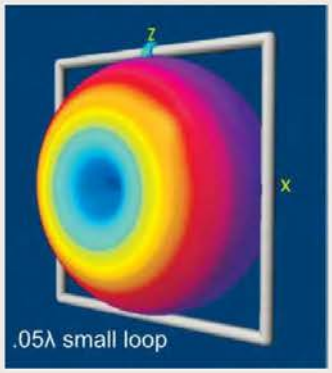

Figure B — A 0.5 λ small loop antenna gain pattern.

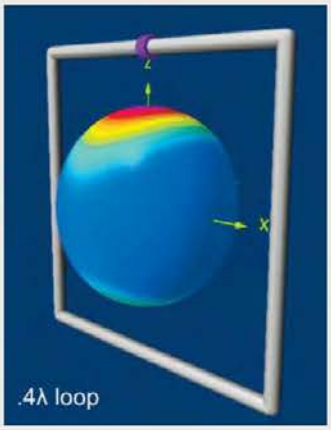

Figure C — A 0.4 λ loop antenna gain pattern.

Because the 40-meter band is 300 kHz wide, I made several tuning stubs with bullet connectors. I could move my SWR band center around easily. I also experimented with an adjustable system using a section of copper pipe. I added some spiral insulation to the stub and inserted it part way into the pipe. This allowed me to tune the antenna; however, this method does require some mechanical work to keep it stable. As mentioned earlier, a somewhat longer stub can also be used if it is split and spread as needed.

Building Instructions

Please refer to Figure 5.

1 Cut a length of stranded #18 AWG, 300 Ω window line (copper-coated steel) to 56 feet. Then strip ¾ inch from the ends, twisting each end together separately (use pliers) and solder.

2 Cut 60 feet of stranded #18 AWG insulated wire (later to be trimmed to the same length as the window line). Weave this wire through every third window. Add shrink tubing, then trim, and solder to the window line ends, connecting all three.

3 Strip the coax jacket 2 inches back, separating the conductors and stripping ¾ inch of insulation from the center conductor.

4 At the center point, cut one of the window line wires or the woven #18 or #16 extra wire. Add shrink sleeve and solder in the coax.

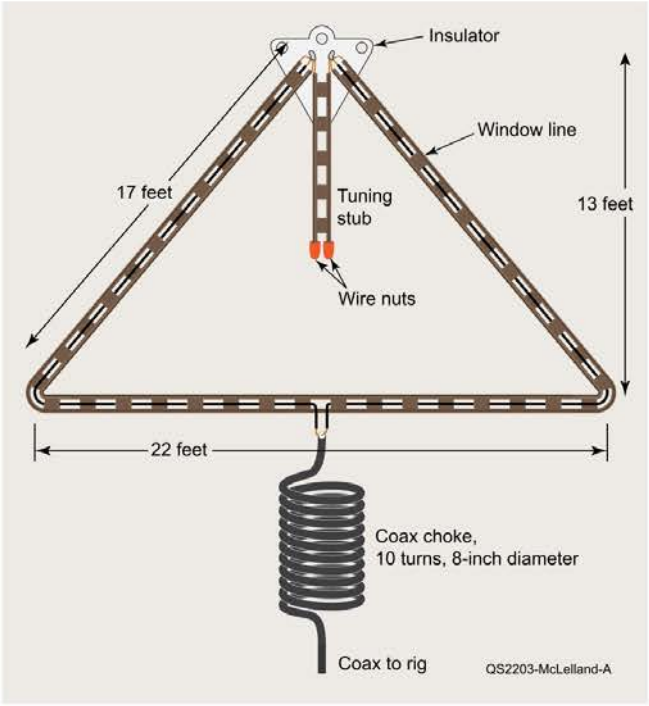

Figure 5 — The antenna's dimensions in feet.

5 Form the coax choke with 10 turns, 8 inches in diameter, of coax (about 20 feet). Secure with tape or ties. Five snap-on ferrite chokes also work well and is lighter, with less wind load.

6 Cut 2 feet of window line, splitting both ends back 2 inches. On one end, strip ¾ inch from both conductors, add shrink sleeve, and solder to the ladder line ends. After tuning, add wire nuts to the opposite unstripped ends and seal.

7 Temporarily mount the antenna, and test with an antenna tuner. Resonance is the point where the impedance (not SWR) is lowest, and it is a sharp dip, so sweep the band slowly. I found my initial resonance point was at 6.7 MHz with an impedance of 67 Ω, using an apex-up triangle configuration. Trim 1 inch at a time — which raises resonance about 65 kHz — until you are in the middle of the band portion of interest. Once at band center, attach wire nuts mentioned in Step 6. This will lower resonance slightly. Splitting the ends a bit more and bending outward will raise resonance slightly. Note that a diamond shape lowered the resonance by about 300 kHz. This would require shortening the stub by about 6 inches to get back to the same resonant frequency as the triangle.

8 Connect the coax to your rig, and using low power at first, confirm frequencies are clear before testing. Check the SWR, sweeping the band to locate SWR minimum and 3:1 SWR points. With 50 Ω coax, this will be about 1.5:1, and 70 Ω coax should be almost a perfect 1:1 SWR match. Most autotuners have no problem touching up SWR within this range, but you can easily use this antenna without a tuner once adjusted. Note that the photos show crimp connectors. This was for experimental purposes only. Be sure to solder and insulate all connections.

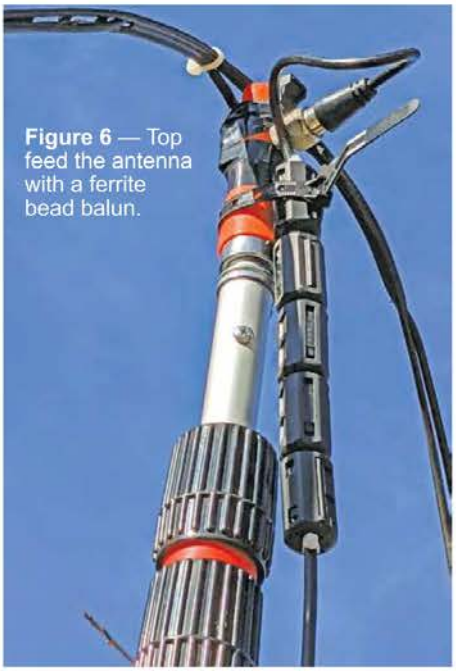

Figure 6 — Top feed the antenna with a ferrite bead balun.

Always Updating

Let me know how it works out. I am still experimenting. I have built a top-fed version using ferrite beads for the balun, which reduces weight and wind load (see Figure 6). The tuning was only slightly changed. Check the *QST* in Depth web page (**www.arrl.org/qst-in-depth**) for updates.

If you can't get on 40 meters, give this project a try. It also makes an easy portable antenna for camping and mountain topping using a telescoping paint pole and umbrella stand, or a couple of ropes and a tree or two.

All photos by the author.

Amateur Extra-class licensee Jim McLelland, WA6QBU, started experimenting with electronics in fifth grade. Jim graduated from San Diego State University with two degrees in electronics, and later continued in graduate school in education, physics, and math, receiving secondary and community college teaching credentials. He also holds a First Class Radiotelephone license. Jim worked in the nuclear industry in radiation monitoring and later became a STEM teacher. Now retired, he also writes articles reporting on various experiments. You can reach Jim at **jmclelland3327@sbcglobal.net**.

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

Portable 20-Meter Phased Dipole Beam

This simple, portable gain antenna has the ability to quickly reverse its pattern by 180 degrees.

Bob Rose, KC1DSQ, and Bob Glorioso, W1IS

This two-element phased dipole beam is designed to be hung between two trees and easily transported. This makes it perfect for ARRL Field Day, Parks On The Air activations, DXpeditions, and more.

Building the Phased Dipoles

Figure 1 shows the layout of the antenna. The 10-foot wooden dowels define the dipole element spacing, which is reduced from the λ/4 spacing normally used for phased dipoles. The phasing line length is increased to compensate. Refer to the *QST* in Depth web page at **www.arrl.org/qst-in-depth** for a detailed theory of operation.

The 32-foot 20-meter dipoles are cut for band center, and are each connected to the combo box with 5 feet, 9 inches of RG-59 coax. Add 4 inches to each dipole leg for tuning purposes. The 75 Ω cables match each dipole to 50 Ω at the combo box. The combo box provides line isolation, dipole phasing, impedance matching, and pattern reversal switching. The components are sized to handle up to 300 W. The dipole wire is #14 THHN or #14 FlexWeave™. Parachute cord is used for the rope harness and the combo box support.

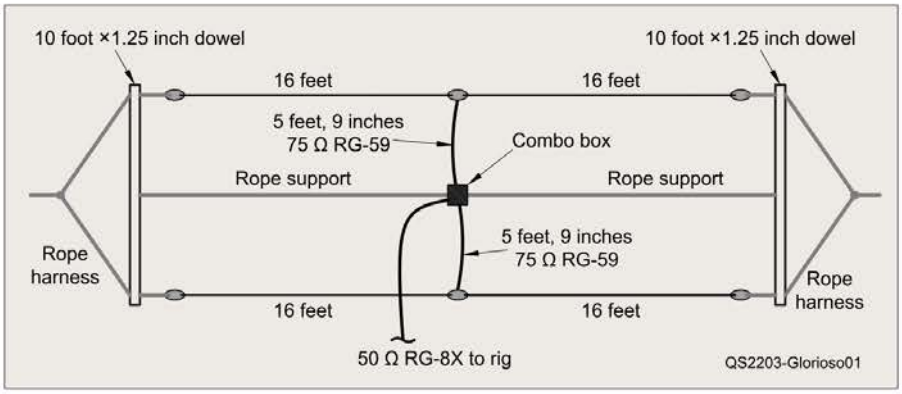

Figure 1 — Top view of 20-meter phased dipoles.

Table 1 — Materials List

Quantity	Material	Source
1	Antenna	
75 feet	#14 THHN wire or #14 FlexWeave™	Hardware store, Davis RF
6	Insulators	
2	1.25-inch × 10-foot wooden dowels	Hardware or lumber store
100 feet	#550 parachute cord	
15 feet	RG-59U 75 Ω coax	
20 feet	RG-316 coax	
1	FT140-43 ferrite toroid for the balun	
1	T37-2 ferrite toroid for matching network inductor	
1	430 pF, 500 V mica capacitor	Mouser (598-CD15FD431J03F)
1	330 pF, 500 V mica capacitor	Mouser (598-CDV16FF331JO3F)
1	4 × 4 × 2-inch waterproof box Carlon A-273	Hardware store
1	Latching relay Potter and Brumfield (RT424A12)	Allied (70288718)
1	Prototype PC board Mouser (854-PAD3U)	
1	Single-sided copper-clad board for matching network	
1 roll	Exterior mounting tape	Hardware store
3	SO-239 coax connectors	

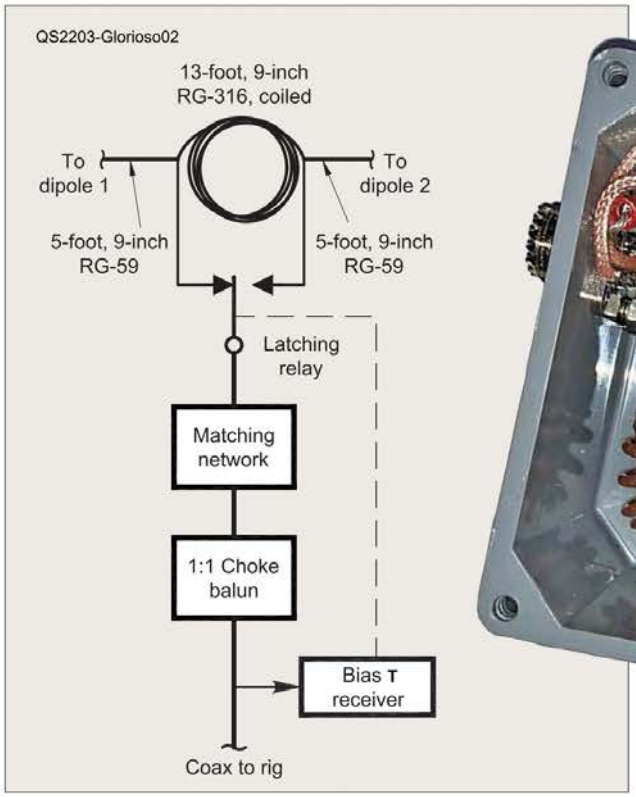

Figure 2 — A diagram of the contents of the combo box.

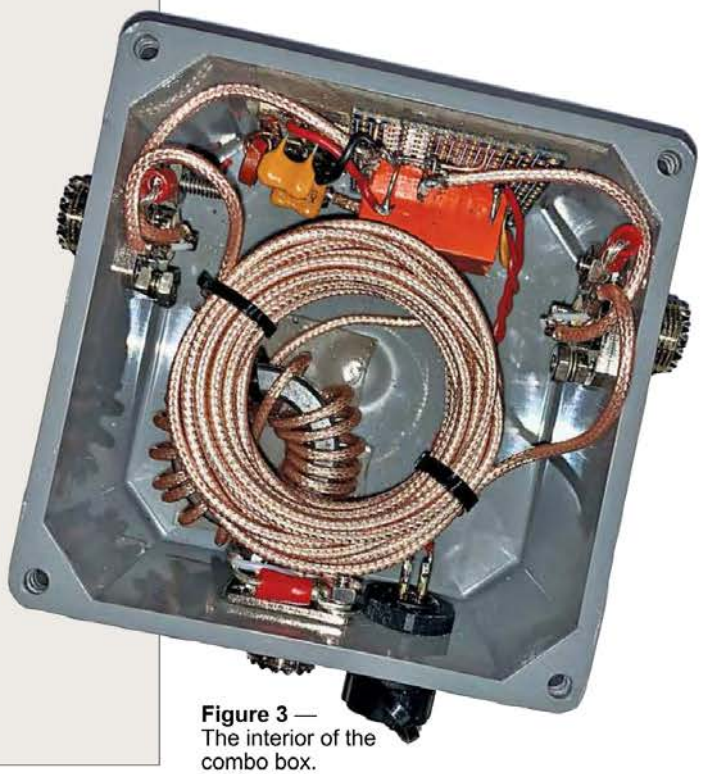

Figure 3 — The interior of the combo box.

Figure 2 is a block diagram of the combo box. A positive pulse latches the relay in one direction, and a negative pulse latches it in the other direction. This reverses the antenna pattern by changing which dipole is fed by the phasing line. The DPDT relay's two sets of 8 A contacts are wired in parallel to double the current capacity. The relay is mounted on a prototype PC board with plated through-holes on 0.1-inch centers. The control signal for the relay is provided through the coax via a bias T circuit.

The interior of the combo box is shown in Figure 3. The relay, matching network, and balun are attached to the box with exterior mounting tape. The balun consists of 16 turns of RG-316 on a FT140-43 core using a cross-over winding.

Due to the near-field interaction of the two dipoles, the impedance of the combined dipoles is about 9 Ω. Figure 4 is a schematic of the matching network. The components are mounted on a single-sided PC board with the dimensions shown in Figure 5. Use a Dremel tool or hobby knife to isolate the lands. The balun connects between the input SO-239 and the 50 Ω side of the matching network. Keep all lead lengths as short as possible. Connect the 9 Ω side of the network to the relay contacts. Use RG-316 coax to attach the relay contacts to the dipole feed line SO-239s. A length of bare wire on the relay PCB permits soldering the

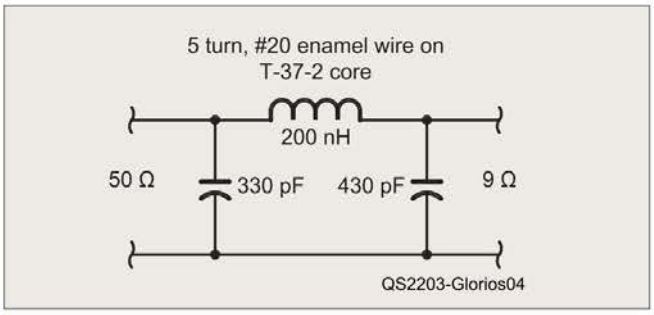

Figure 4 — The matching network.

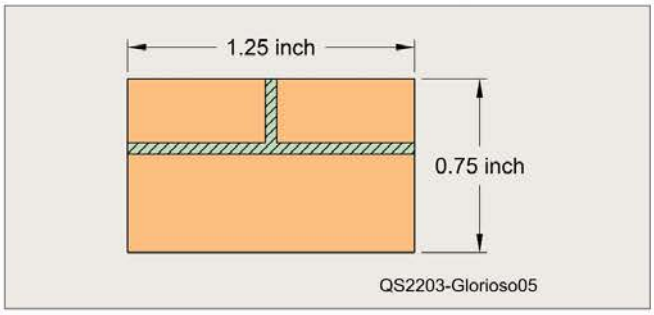

Figure 5 — The PC board dimensions.

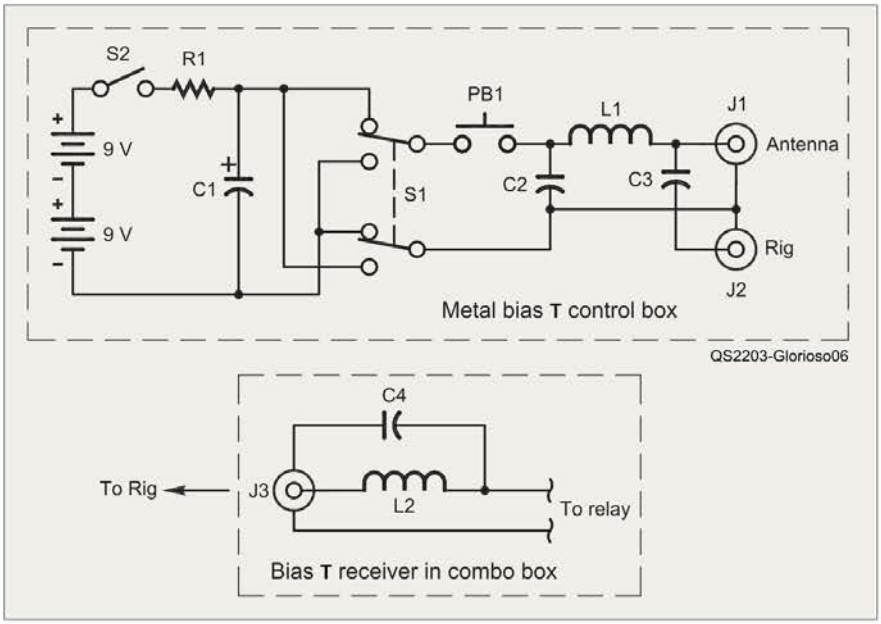

Figure 6 — The control box and bias **T** receiver in combo box.

Metal control box — 4.7 × 3.7 × 2.2 inches, Bud CU234 or Allied 70148694
C2, C4 — ceramic capacitor, 0.01 µF, 100 V disk
C3 — 2 ceramic capacitors in parallel, 0.01 µF, 1 kV disk
C1 — electrolytic capacitor, 500 µF, 25 V
L1, L2 — Choke, 47 µH, 1 A, **rfparts.com** RFC47-1000
R1 — resistor, 2,200 Ω, ¼ W
S2 — SPST switch
S1 — DPDT switch
PB1 — NO (normally open) pushbutton switch
J1 – J3 — SO-239 coax connectors

grounds of the coax shields to the ground side of the matching network. The 13-foot, 9-inch RG-316 phasing line is rolled up and soldered across the SO-239s to connect the two dipoles.

The bias **T** details are shown in Figure 6. Blocking capacitor C3 keeps dc from entering the rig. No blocking capacitor is needed in the combo box. A choke carries dc from the control box and isolates RF from the dc control signal on both ends. The control box uses two 9 V batteries to charge a capacitor that is discharged down the line to switch the latching relay when PB1 is pushed. The double-pole, double-throw switch changes the polarity of the pulse sent to the relay.

Tuning and Performance

Ensure that both dipole wires connected to the RG-59 center conductors are attached to the same spreader and the dipole wires connected to the RG-59 shields are attached to the other spreader. Raise the antenna to 35 or 40 feet, and measure SWR. If needed, drop the array and trim the dipoles for minimum SWR at the band center. All four dipole wires must be the same length.

Simulation results at a height of 40 feet shows gain is equal to 11.3 dBi, front-to-back ratio is 17.3 dB, take-off angle is 25 degrees, elevation beamwidth is 26 degrees, and azimuth beamwidth is 74.8 degrees. The final SWR curve matched the simulated SWR curve quite well.

We tested our antenna using a KX3 at 5 W on SSB. Working both US and European stations, we found that the front-to-back ratio was between 3 and 5 S-units — a bit better than expected.

All photos by the authors.

Amateur Extra-class licensee Bob Glorioso, W1IS, was first licensed in 1955. He has a BSEE, MS, PhD, and he served in the military, managing a computer communications research group. After the military, he was a Professor of Electrical and Computer Engineering at the University of Massachusetts, Amherst. Later, he became Vice President of the Information Systems Business at Digital Equipment Corporation and was founder and CEO of Marathon Technologies Corporation. In 2004, he founded **batteryeliminatorstore.com** with his son, Scott, K1SRG, and Russ, WA1RKO (SK). His ham radio interests include CW, emergency communications, designing antennas, and operating during ARRL Field Day with the PART club of Westford, Massachusetts, where he is on the board. He is a Life Member of ARRL, and a fellow of the IEEE. Bob Glorioso can be reached at **rglorioso@me.com**.

Amateur Extra-class licensee Bob Rose, KC1DSQ, earned a BSEE in 1969 from the University of Maryland. He worked on radar signal processing at Raytheon, then multimedia chips and software at Digital Equipment Corp. He later worked on XEON CPU chips at Intel. He participates in his local ARES net and operates primarily on SSB and FT8 on the HF bands. Bob Rose can be reached at **b.rose@comcast.net**. Bob and Bob have collaborated on a number of antenna design projects. Their website is **www.ocfmasters.com**.

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

DL3FF Pendulum Bugs

These two types of pendulum bug overcome the contact bounce problem.

Dr. Rudolf Kalocsay, DL3FF

Operation of a classical bug can lead to malfunction of the PIN diodes of full-break-in keying power amplifiers as a consequence of extreme contact bouncing. I observed PIN diode destruction within a few minutes of operation. Initial research indicated that a bounce-free contact can be achieved with photo sensors. Construction with a pendulum design minimizes the base area of the bug, thus saving space on the operator's table.

I found two practical solutions to initiate oscillation of the pendulum: (A) by release of the pendulum pre-tensioned with a leaf spring (see Figure 1), and (B) by initiating pendulum oscillation with a manual impulse (see Figure 2).

Torsion spring pendulum bug (front), pendulum bug with oscillation release (back), both made by DL3FF.

Pendulum Bug with Oscillation Release

Figure 3 shows the pendulum bug with oscillation release. The pendulum is attached via a leaf spring to the central column. The lower end of the pre-tensioned pendulum interrupts the path of a light sensor (photoelectric barrier) for telegraphic dit signals (see Figures 1 and 5). To achieve signaling, the height of the flat spring needs to be adjusted in order for the pendulum to freely oscillate in the light path of the photoelectric barrier, leading to interruption and transmission of light to the sensor. The photoelectric barrier for dit signals needs to be positioned below the oscillating pendulum so that we achieve a dit-to-pause ratio of 1:1.

In the resting state, the pendulum rod with the pendulum mass is pushed against a felt damper by the dit lever. This leads to pretension of the leaf spring. Operation of the dit lever with the right thumb pushes the dit lever outside of the oscillation area of the pendulum rod and leads to free pendulum oscillation. Dits are generated through interruptions of the light path at regular intervals (see Figure 5).

Interval length for slower Morse speed can be easily adjusted with an additional weight attached to the side of the pendulum rod, changing its oscillation frequency (see Figure 3). Dahs are generated with an additional photoelectric barrier for both bug models. Light signals are amplified with the circuitry shown in Figure 5 by transistor Q1, with Q2 keying the radio transmitter.

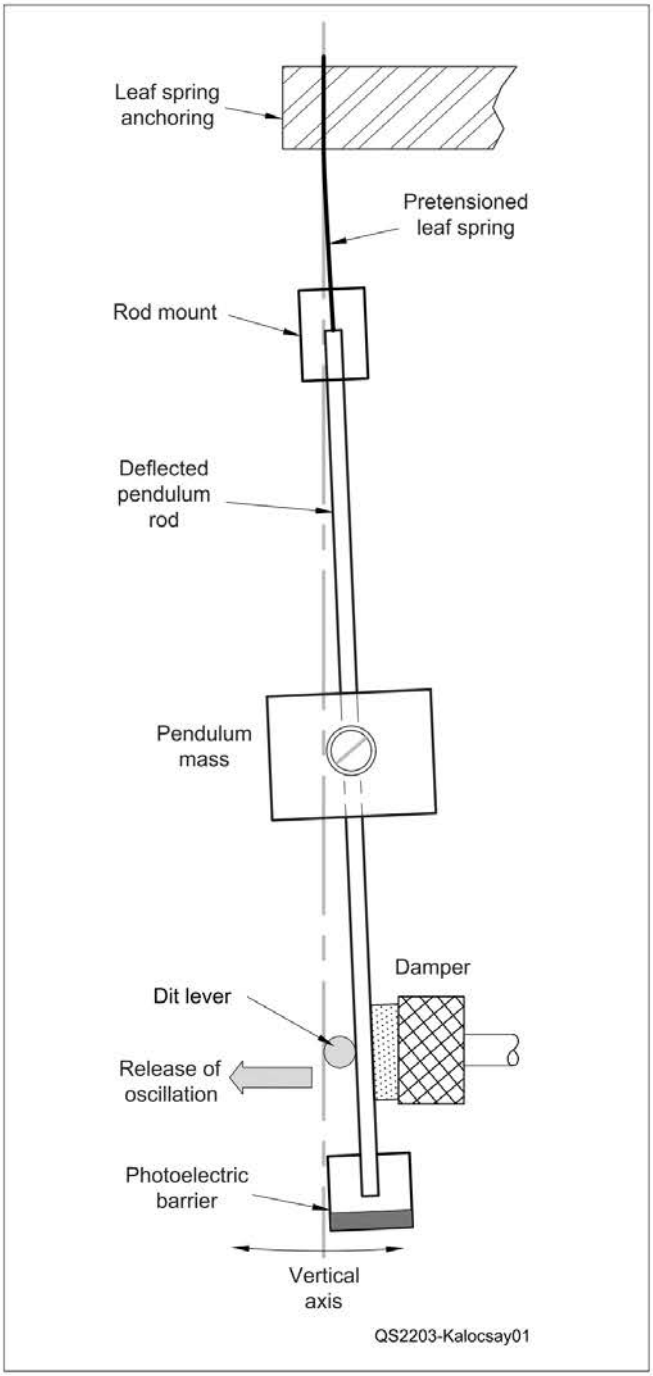

Figure 1 — The operational principle of a pendulum bug with oscillation release.

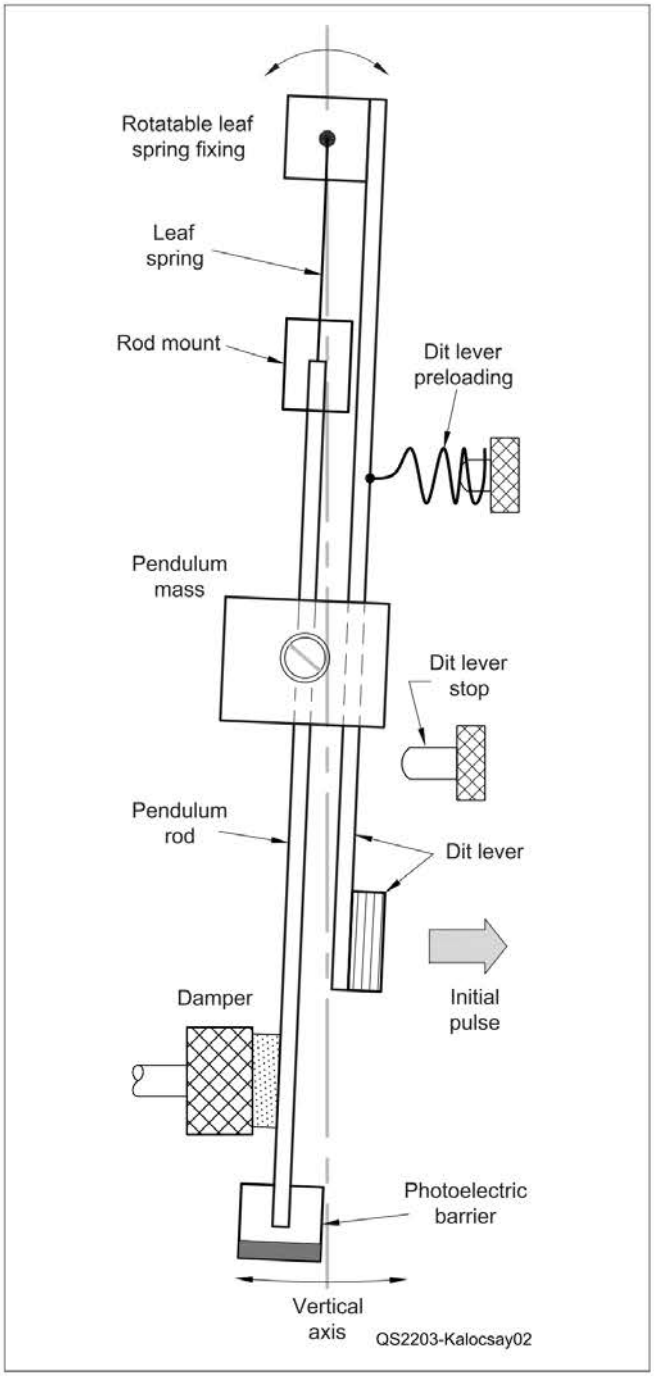

Figure 2 — Operational principle of a torsion spring pendulum bug with initial impulse.

Pendulum Bug with Oscillation Release — Technical Data

- The leaf spring is steel with 0.5 × 8 millimeters dimensions and an active length of 25 millimeters between the anchoring point and the pendulum rod attachmen.
- The pendulum mass is 25.1 grams.
- The pendulum rod is made of carbon fiber with a diameter of 3 millimeters, a length of 130 millimeters (with 10 millimeters for the rod attachment), and a mass of 1.31 grams.
- The Morse speed is 15 – 44 words per minute (75 – 220 letters per minute).
- The power supply is 9 – 13.8 V at 25 mA.
- The output is open collector for voltage testing of up to 50 V.
- The measurements are 78 × 196 × 200 millimeters.
- The mass is 1.35 kilograms.

Figure 3 —The pendulum bug with oscillation release.

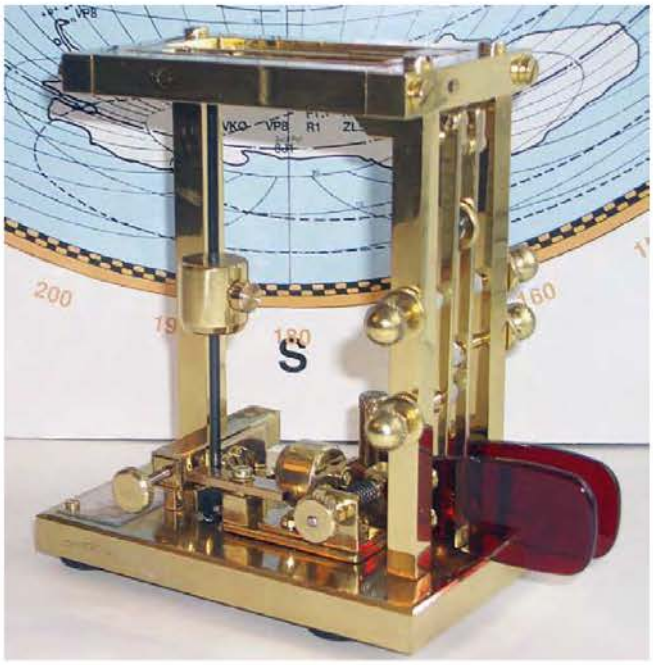

Figure 4 — The torsion spring pendulum bug. The dit-to-pause ratio can be adjusted to 1:1 with the screw on the lower left side. The adjustment screw on the right side calibrates the damper.

Torsion Spring Pendulum Bug with Initial Impulse

The replacement of the leaf spring (see Figure 2) with a torsion spring (see Figure 4) decreases the footprint of the pendulum bug even further. This concept is realized as a torsion spring-operated pendulum bug with initial impulse (see Figure 6).

Asymmetric placement of the three holder columns allows easy access for movement of the adjustable pendulum mass. These columns support the main frame of the bug (see Figure 6). The frame of the cradle is attached to the main frame in a rotatable fashion. The dit lever is attached to the right side of the cradle. The torsion leaf spring is connected to the right side of the cradle frame. On the left side, the spring can be rotated, moved, or tilted in a prismatic bearing with the pendulum rod being attached to the torsion leaf spring. After an initial pulse, the pendulum rod oscillates freely in the path of the light sensor (photoelectric barrier) and generates dits.

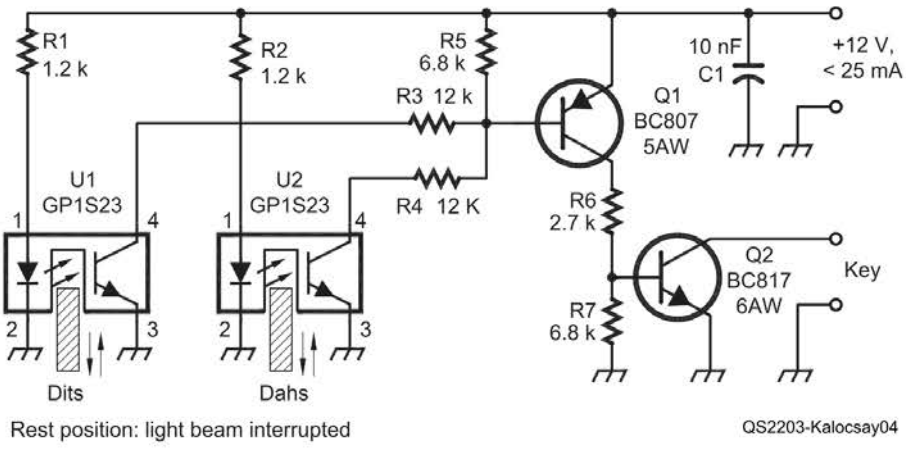

Figure 5 — Circuit for amplification of light signals for generation of dits and dahs.

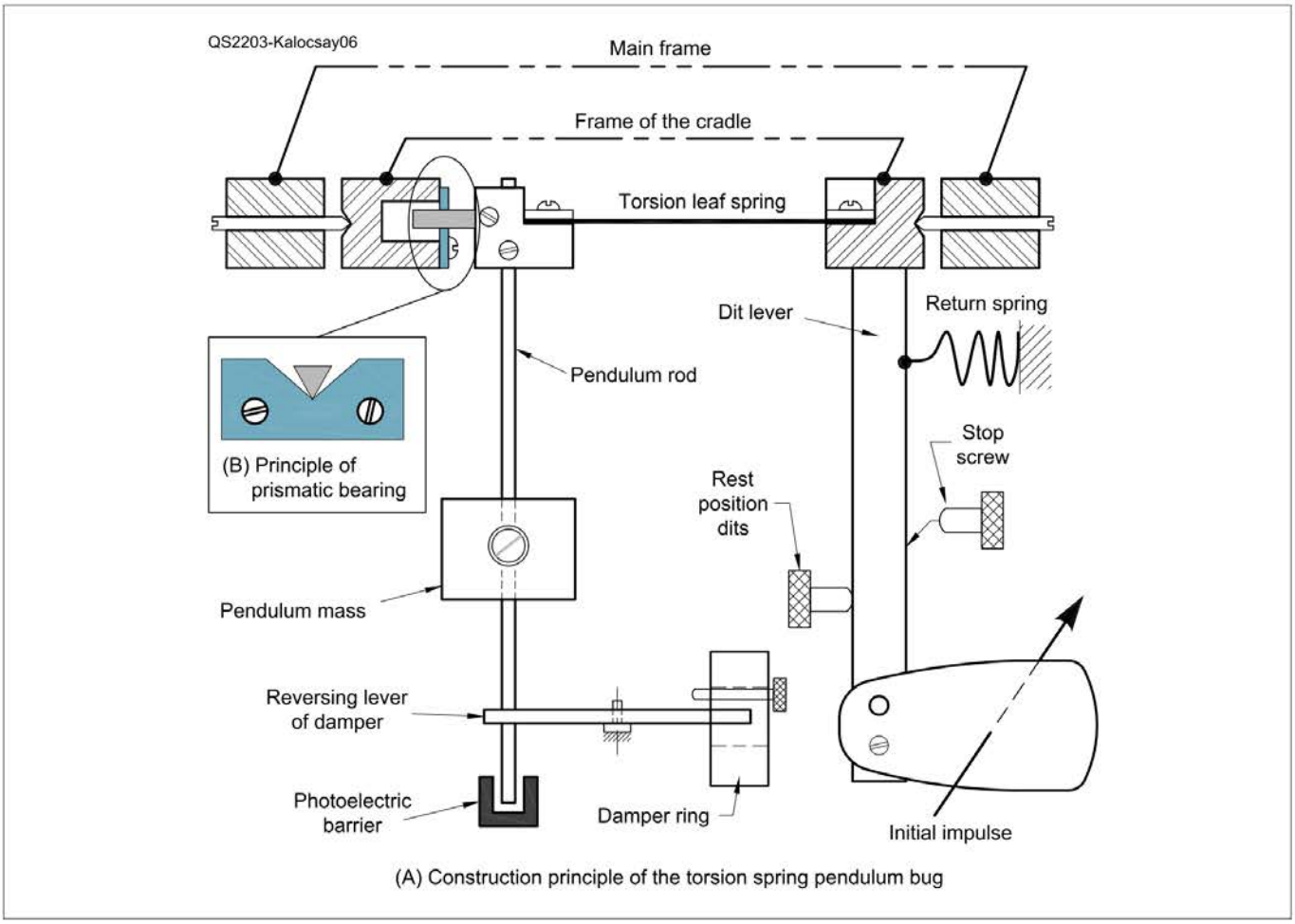

Figure 6 — (A) The construction principle of the torsion spring pendulum bug. (B) The principle of the prismatic bearing.

Pendulum Bug with Torsion Spring — Technical Data

- The torsion leaf spring is stainless steel with a 5 millimeter width and a 0.4 millimeter thickness.
- The pendulum mass is 37 grams.
- Morse speed is 16 – 50 words per minute (80 – 250 letters per minute), with additional mass greater than 62 letters per minute (less than 12.4 words per minute).
- The power supply is 9 – 13.8 V at 25 mA.
- The output is open collector for voltage testing of up to 50 V.
- The measurements are 145 × 77 × 136 millimeters.
- The mass is 1.55 kilograms.

Figure 7 — First-place award in the AGCW-DL October 2021 bug contest, which indicates good practical functionality of the torsion spring bug.

In the resting position, the pendulum rod contacts the reversing lever with its other end contacting the hung-up damper ring. After an initial impulse by the right thumb, the cradle will be twisted. This rotational movement is transferred via the torsion leaf spring to the pendulum rod. This moves the pendulum rod away from the reversing lever of the damper, so it can oscillate freely with the pendulum weight as long as the dit lever remains pushed. With the circuitry shown in Figure 5, this generates Morse dits.

After release of the dit lever, the cradle is returned to its rest position. The pendulum rod gets in contact with the reversing lever of the damper and moves it. This movement is damped by the suspended damper ring. The system then returns to its resting position.

Because dits and dahs can be signaled independently of each other, both bugs allow squeeze operation.

Practical Use

I have been using both pendulum bugs for years during bug competitions in Germany and scored within the top one-third. In 2007, I used the pendulum bug with oscillation release during a competition, reaching third place, and in 2017 and 2021 with the torsion spring bug, I placed first (see Figure 7). This indicates that both bugs operate well. I hope that the concept outlined here encourages and helps you to build similar bugs yourself, overcoming the contact bouncing problem of traditional bugs.

All photos by the author.

Rudi Kalocsay, DL3FF, was born in 1940 and has been a radio ham and telegraphist since the age of 15. He was a CW operator in the 1973 Mount Athos DXpedition SV1DB/A. Including all contests, DXpeditions, and operations under several special call signs, he has logged more than 140,000 contacts, mostly CW. Rudi has authored several publications. He is a member of The Radio Telegraphy High Speed Club (HSC), and The Radio Telegraphy Club (RTC), and others. Rudi can be reached at **dl3ff@darc.de**.

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

New Challenge Coin Commemorates *NCJ*'s 50th Year of Publication

NCJ, ARRL's *National Contest Journal*, is celebrating 50 years of publication in 2022. The celebration kicked off in the January/February issue with the article, "*NCJ* History, Part 1 — Origins and Early Years," by former *NCJ* Editor Scott Wright, KØMD, which all ARRL members can read in the digital edition of *NCJ* at **www.arrl.org/arrl-magazines**.

To commemorate this milestone, ARRL is issuing a new challenge coin that will be available to anyone who subscribes — or renews their subscription — to the print edition of *NCJ* in 2022. For information on how to subscribe and obtain the limited-edition, die-struck commemorative coin, visit **www.arrl.org/ncj**.

Front Back

Design mockup of the *NCJ* challenge coin, commemorating *NCJ*'s 50 years of publication.

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Elected December 13, 2021

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Daniel Johns, KC8DSJ
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Product Review

Four State QRP Group Bayou Jumper 40-Meter CW Transceiver

Reviewed by Steve Ford, WB8IMY
wb8imy@arrl.net

The Four State QRP Group has a reputation for creativity and innovation. Nothing is off limits in their lineup of kits, which encompasses everything from receivers, to transceivers, to accessories. Among their latest offerings is a modernized homage to one of the most famous transceivers of World War II.

When it was developed at the Royal Signal Special Communications workshop, the transceiver was officially known as the Whaddon Mark VII. It earned its familiar moniker "Paraset" because it was dropped by parachute to resistance operatives in France, Norway, Belgium, and the Netherlands. The original Paraset was a tube-based, CW-only transceiver that covered 3.0 to 7.6 MHz and generated 4 to 5 W output. These radios were considered vital components of the war effort and their clandestine operators placed themselves at grave risk. Merely being in possession of a Paraset could be extremely hazardous to one's health.

The 21st-century version of this heroic transceiver is the brainchild of Jim Giammanco, N5IB. Using the same fundamental architecture as the original, Jim, along with David Cripe, NMØS, brought the Paraset up to date with solid-state circuitry while still preserving much of its functionality. Jim christened his creation the Bayou Jumper, a nod to his Louisiana roots, after the popular Knight-Kit Ocean Hopper regenerative receiver that so many Novice licensees built decades ago.

Like the original Paraset, it employs a regenerative receiver, but has updates based on the modern designs of Charles Kitchin, N1TEV. The crystal-controlled CW transmitter section borrows from the Four State QRP Group's NS-40, including its distinctive spiral printed-circuit-board inductors. And like the Paraset, the Bayou Jumper generates about 4 to 5 W output, although the Bayou Jumper is limited to 40 meters only.

The transceiver includes a built-in straight key (again, just like the original Paraset), but adds a ⅛-inch jack for an external key or keyer. Of course, modern transceivers utilize automatic transmit/receive switching, but World War II agents didn't have that luxury. As a result, transmit/receive switching in the Bayou Jumper is performed with a rotary switch, just as was done with the original Paraset.

Bottom Line

For less than $100, you can take a journey into the past and enjoy a uniquely different operating experience — but this time without those annoying midnight visits from the Gestapo.

Building the Bayou Jumper

In an effort to mimic the suitcase-style design of the Paraset (see Figure 1), the Bayou Jumper is designed to be housed within a 7¾ × 5¼ × 3-inch pine box, complete with a handle and clasp. The enclosure is not included with the kit, but must instead be purchased separately. For this review I used a three-box set available from Hobby Lobby, which was selling for just $18 (40% off the regular price) at the time this was written. The smallest of the three boxes becomes the Bayou Jumper enclosure and the remaining two can become whatever you desire (parts storage comes to mind).

The Bayou Jumper front panel and circuit board fit perfectly within this box, after a little necessary woodworking. The transceiver kit includes four wood posts, which must be trimmed to support the front panel in a position ever-so-slightly below the inner lip of the box. I shortened the posts through the vigorous use of coarse sandpaper; after 20 minutes of grinding, I had reduced the lengths of all four by about ⅛ inch each.

I used wood glue to secure the posts in their corners and allowed everything to dry overnight. The following day I carefully drilled ⅛-inch-diameter pilot holes in the tops of each post to accommodate the screws that would later hold the transceiver in place. Resist any urge to skip the pilot holes, lest you risk splitting the posts.

The Bayou Jumper kit doesn't have a large inventory of components, but the circuit board is crowded, so it pays to be careful. Few things in life are more vexing than finding you've inserted the wrong part into the wrong hole, and then realizing you face a tedious removal and replacement exercise.

In building many kits over the years, I've refined the slowpoke habit of attention to detail. The Bayou Jumper makes this easy with one of the best assembly manuals I've seen in ages. The guide — available as a downloadable PDF file — is professionally written and illustrated, and if you follow the instructions to the letter, you'll be rewarded several hours later with a piece of radio nostalgia that is enjoyable to operate.

On the other hand, if you're like the alternative me who sometimes succumbs to hubris, you might skip critical bits of text and end up doing something supremely frustrating — such as mis-winding the only toroid inductor in the kit. This was a toroid core with three separate windings that forms the heart of the regenerative receiver (see Figure 2). How hard is it to construct this component? Not hard at all, unless you miss the author's admonition about paying attention to the directions in which the wires are wound, and you instead wrap them around the ferrite donut any old way you please — like I did. The result was that my finished

Figure 1 — One of the original Parasets on display at the Bletchley Park Museum in the United Kingdom. [Photo by Timitritus]

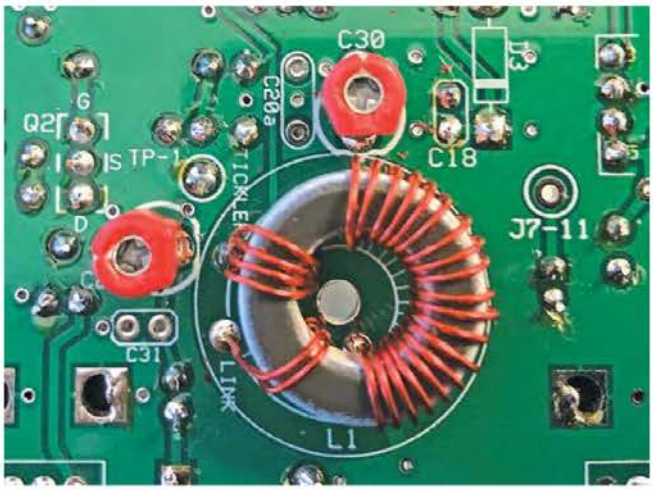


Figure 2 — This triple-winding toroid assembly forms the heart of the Bayou Jumper's regenerative receiver.

Figure 3 — The transceiver's front panel attaches to the circuit board on six metal standoffs.

Table 1
Four State QRP Bayou Jumper

Manufacturer's Specifications	Measured in the ARRL Lab
Frequency coverage: 40-meter CW segment. Receiver tuning range >140 kHz, adjustable. Transmitter, crystal controlled.	Receive, adjusted for 7.0 – 7.160 MHz (see text). Transmit, as specified. Crystals for 7.030 and 7.122 MHz supplied.
Power requirements: 12 – 13.8 V dc at 25 mA receive, 600 mA transmit (5 W RF output).	At 13.8 V dc: Receive, 29 mA; transmit, 616 mA max (5.4 W output).
Modes of operation: CW.	As specified.
Receiver sensitivity: –120 dBm.	Noise floor (MDS): –112 dBm.
Power output: Up to 5 W.	At 13.8 V dc: 5.4 W with 7.030 MHz; crystal; 4.8 W with 7.122 MHz crystal.
Spurious-signal and harmonic suppression: >50 dB.	54 dB (See Figure A.) Complies with FCC emission standards.
CW keying characteristics: Not specified.	See Figures B and C.
Size (height, width, depth): In recommended wooden box, 3.25 × 7.75 × 5.5 inches.	

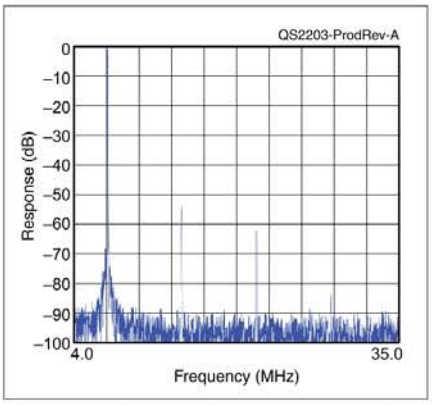


Figure A — Spectral display of the Four State QRP Bayou Jumper. Power output is 5 W on the 7 MHz band. This plot shows the output spectrum from 4 to 35 MHz. The second harmonic is down 54 dB from the carrier, and the third harmonic is down 62 dB. The vertical scale is 10 dB per division.

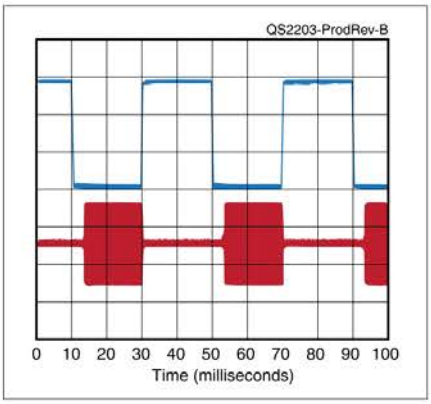


Figure B — CW keying waveform for the Four State QRP Bayou Jumper using external keying. Equivalent keying speed is 60 WPM. The upper trace is the actual key closure; the lower trace is the RF envelope. Horizontal divisions are 10 ms. The transceiver was being operated at 5 W output on the 7 MHz band. Rise time and fall times are 0 ms (no waveshaping). See Lab Notes.

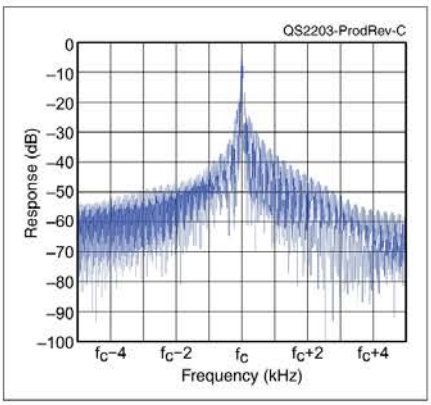


Figure C — Spectral display of the Four State QRP Bayou Jumper transmitter during keying sideband testing. Equivalent keying speed is 60 WPM using external keying. Spectrum analyzer resolution bandwidth is 10 Hz, and the sweep time is 30 seconds. The transmitter was being operated at 5 W PEP output on the 7 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.

Bayou Jumper was as deaf as a proverbial post. Upon discovering my error, I had to completely remove, rewind, and reinstall the toroid. The detour cost about 30 minutes, not including time spent cursing to myself.

No matter how experienced you may be, follow the manual word-for-word and assume nothing. The authors have made it as easy as possible to achieve a result you'll be proud to own.

The transceiver's front panel attaches to the circuit board on six metal standoffs (see Figure 3). All the controls, switches, and jacks are on the circuit board and protrude through holes in the front panel. The front panel is predrilled and features attractive labeling.

With the properly wound toroid, my Bayou Jumper sprang instantly to life when I applied 12 V dc and moved the rotary switch to the **RECEIVE** position. If you've never played with a regenerative receiver, it takes practice to adjust it for optimum performance. It can be surprisingly sensitive and selective once you get the hang of it. My Bayou Jumper needed internal tweaking to get the receive range where I wanted it (from about 7.000 to 7.160 MHz). I also noticed that the receiver frequency drifted at first, but it stabilized after about 10 minutes of warming up.

The kit provides two transmit crystals in HC-49/U holders: one at 7.030 MHz and another at 7.122 MHz. If you are still blessed with old FT-243-type crystals for your favorite 40-meter frequencies, they'll plug directly into the front-panel socket, too. If not, you can also build adapters for HC-49/U crystals using the two small circuit boards supplied (see Figure 4).

I measured 4 W output at my workbench, but the ARRL Laboratory test results shown in Table 1 offer greater detail. Also see the Lab Notes for more information on receiver and transmitter performance.

Taking the Bayou Jumper Out for a Spin

I went for maximum realism for my debut effort and used the built-in straight key. With just a dipole antenna I quickly made contact and didn't embarrass myself too badly in the process. The most difficult aspect of operating the Bayou Jumper is remembering to manually switch between transmit and receive. Receive audio mutes when you switch to transmit mode, but the radio lacks a CW sidetone, which can be disconcerting at first. With the Soup'er Up'er accessory by Dave Martin, NA1MH (also sold by the Four

Figure 4 — HC-49/U crystals mounted on the two small circuit boards supplied with the kit.

Lab Notes: Four State QRP Group Bayou Jumper

The ARRL Lab performed some basic tests on the Bayou Jumper, with the results shown in Table 1. Using the simple regenerative receiver takes a bit of getting used to, and it needed about 10 minutes warm-up time for the frequency to stabilize. Receive sensitivity is a bit lower than typical desktop transceivers, but on 40 meters it's fine and the radio hears plenty of signals.

The transmitter easily meets FCC spectral purity requirements (see Figure A). As seen in Figures B and C, the transmitted signal has no waveshaping (no discernible rise and fall time) and the keying sidebands are broad. Users should be aware that a transmitter with this waveform will generate low-level key clicks that could interfere with nearby stations (the keying sidebands are about 1 milliwatt at 500 Hz from the carrier). A waveform and keying spectrum like this would be unacceptable in a desktop radio intended for regular use on the air.

The Bayou Jumper is a clever novelty radio that reinvents the Parasets of World War II with modern components. — *Paul Cianciolo, W1VLF, ARRL Lab Test Engineer*

State QRP Group), you can add the sidetone, along with several other handy features.

For the rest of my operating tests I used an external keyer, which I'd bet those undercover agents would have loved to own. Despite the low-power signal, I made a number of contacts with the Bayou Jumper, and the other operators often expressed astonishment when they learned what I was using.

When I finished an operating session, I simply unplugged the cable and closed the lid on the handsome little case, which some sandpaper and varnish could make even nicer. You can register your Bayou Jumper online and obtain a decal for the case that instructs users to contact "Her Majesty's Secret Service" for customer support. For details and real-life support, see the Four State QRP website.

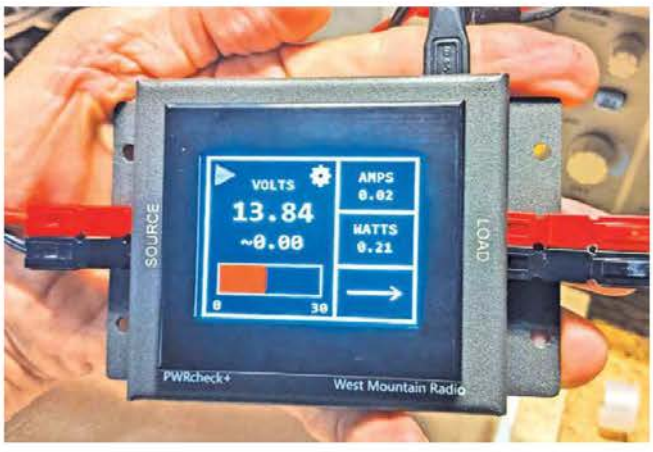
History in a Kit

I wouldn't consider the Bayou Jumper to be a beginner-level kit, but neither is it overly difficult. In total, I spent about 5 hours assembling and adjusting the transceiver. I used my commercial HF radio to calibrate the Jumper's receiver, but if one has access to a frequency counter it would be much easier.

Manufacturer: Four State QRP Group, **www.4sqrp.com/bayoujumper.php**. Price: $98.30 including shipping (US customers only). Wood case: SKU 662536 from **www.hobbylobby.com**. Price: $30 (on sale for $18 when this was written).

West Mountain Radio PWRcheck+ DC Power Analyzer

Reviewed by Phil Salas AD5X
ad5x@arrl.net



West Mountain Radio makes several dc power products, and their new PWRcheck+ looked interesting to me. It is a complete, integrated dc power analyzer for fixed or portable stations. The PWRcheck+ measures voltage up to 60 V dc at up to 40 A continuously, and uses multiple color displays to show voltage, current, watts, amp hours, and even noise — all in either numerical or graphical form. The PWRcheck+ has internal logging of voltage and current events, and it

Table 2
West Mountain Radio PWRcheck+ Electrical Specifications

	Without USB	With USB
Input voltage range	7 – 60 V	0 – 60 V
Input current	0 – 40 A	0 – 40 A
Input current required by PWRcheck+ from Source	0.120 A*	0.0 A

*When PWRcheck+ is powered by the power source, the 120 mA current required for the PWRcheck+ is not included in the current reading.

Table 3
West Mountain Radio PWRcheck+ Measured Current and Voltage Drops

Current	PWRcheck+ In/Out Voltage Drop	Back-to-Back Powerpole Voltage Drop
3 A	0.01 V	0.003 V
7 A	0.02 V	0.005 V
10 A	0.04 V	0.01 V
14 A	0.05 V	0.01 V
17 A	0.06 V	0.01 V
21 A	0.06 V	0.01 V
24 A	0.06 V	0.01 V

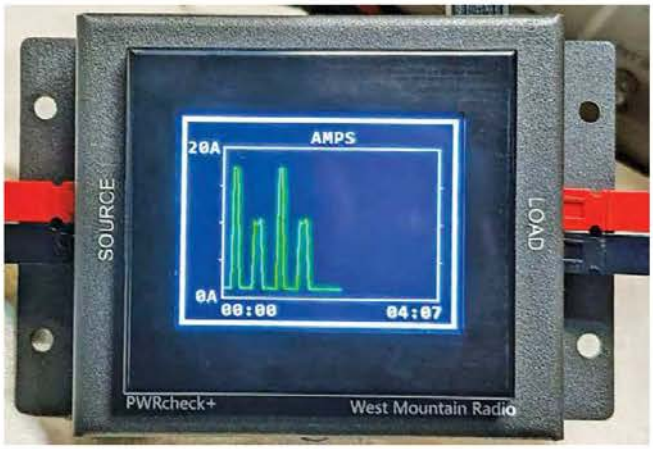


Figure 5 — Key down (tall spikes), and 20 WPM string-of-dits current plot are shown on the PWRcheck+ screen.

also interfaces with your PC for more detailed observations and logging. The 40 A Anderson Powerpole connectors provide the input and output interfaces. The PWRcheck+ specifications are given in Table 2.

PWRcheck+ Overview

The PWRcheck+ comes with an instruction manual, four pairs of Powerpole connectors with 30 A contacts, a USB cable, and PC software on a CD-ROM. You can download the manual and the latest software in the support section of the manufacturer's website, **www.westmountainradio.com**. The PWRcheck+ works well as a standalone device. The color touchscreen interface is extremely easy to navigate. In the standalone mode, the logging interval can be set to off, one second, 30 seconds or 60 seconds. The default is 60 seconds. With the 60 second sampling time, you can record and store data for up to 18 months. The screen displays change easily with the touchscreen. The various screens can be seen in the PWRcheck+ manual.

Bottom Line

The West Mountain Radio PWRcheck+ permits short and long-term evaluation of your system power supply needs.

Testing and Operating

For my initial tests, I wanted to see was if there was any voltage drop through the PWRcheck+. For this I used my dc load box — which I described in an article in the October 2006 issue of *QST* — which permits me to draw from 3 to 24 A at 14 V. I also measured the voltage drop across the Powerpole connectors when the PWRcheck+ was bypassed. Keep in mind that there are two sets of Powerpole connectors when the PWRcheck+ is in line, and only one set when the PWRcheck+ is bypassed. My results are shown in Table 3. As you can see, voltage drop through the PWRcheck+ is negligible.

Next, I looked at a plot of current for key-down and a 20 WPM string of dits from my IC-706MKIIG at 100 W output. You can see this in Figure 5. The sampling is such that you can't display short duration peak current, so the 20 WPM string-of-dits display shows the average current during this event. The data screen showed 1.4 A receive current, 17.5 A transmit current, and 10.2 A average current for the 20 WPM string-of-dits.

While the PWRcheck+ works well as a standalone device, I recommend that you install the PC software, as this gives you additional capabilities, including real-time monitoring, data download and charting, and the ability to display graphs of two items at once, such as voltage and current. Screens can be saved as PNG files, and the data can be output in CSV or Excel format. You can also set over-voltage, under-voltage and over-current alarms, as well as a watt-hour limit alarm. When a limit is exceeded, the PWRcheck+ display flashes red for several seconds. To install the software,

simply run the installation program, then attach the included USB cable and the software will install the necessary driver. As my new workbench laptop doesn't include a CD/DVD drive, I simply downloaded the installation program from West Mountain Radio website. Full installation took just a few minutes.

Figure 6 shows a PC current and voltage plot taken as I switched in the different loads from my load box. As stated earlier, the voltage drop is not due to any losses in the PWRcheck+. Figure 7 is a current and voltage plot of my IC-706MKIIG key down and string-of-dits operation.

The PC software also lets you shorten the logging intervals to 25 milliseconds from the one second minimum on the PWRcheck+ touchscreen. However, I'm not sure what this gives you, as it still doesn't capture short duration current peaks. I was hoping that by shortening the logging time to 25 milliseconds, I could capture a 60 milliseconds dit length at 20 WPM, but that didn't happen.

The West Mountain Radio PWRcheck+ is a useful instrument for monitoring stations power usage. Because it can log long-term power requirements, it is particularly useful for determining battery back-up requirements for fixed, portable and emergency systems. While you can find less expensive imported products, the PWRcheck+ is the top-of-the-line monitor with its color touchscreen and PC software for logging and enhanced monitoring.

Manufacturer: West Mountain Radio, 1020 Spring City Dr., Waukesha, WI 53186; **www.westmountainradio.com**. Price: $185.

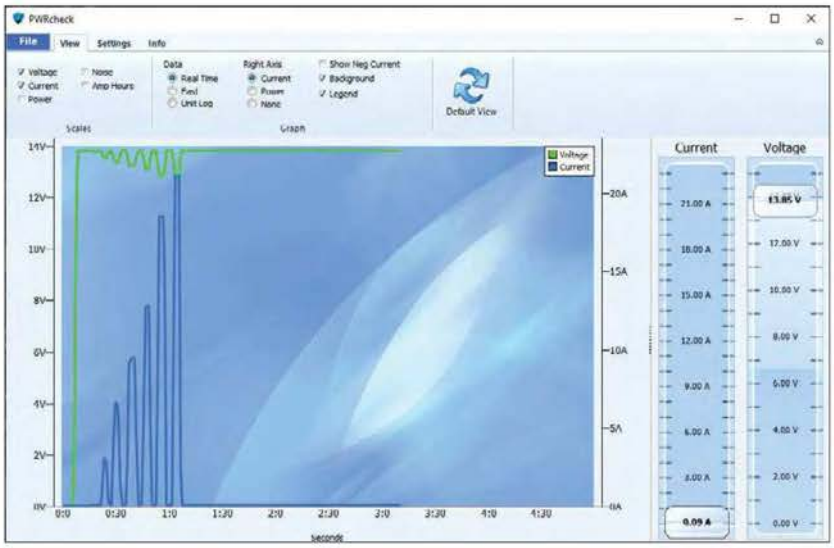


Figure 6 — Voltage and current plots at loads of 3, 7, 10, 14, 21, and 24 A viewed in the PC software.

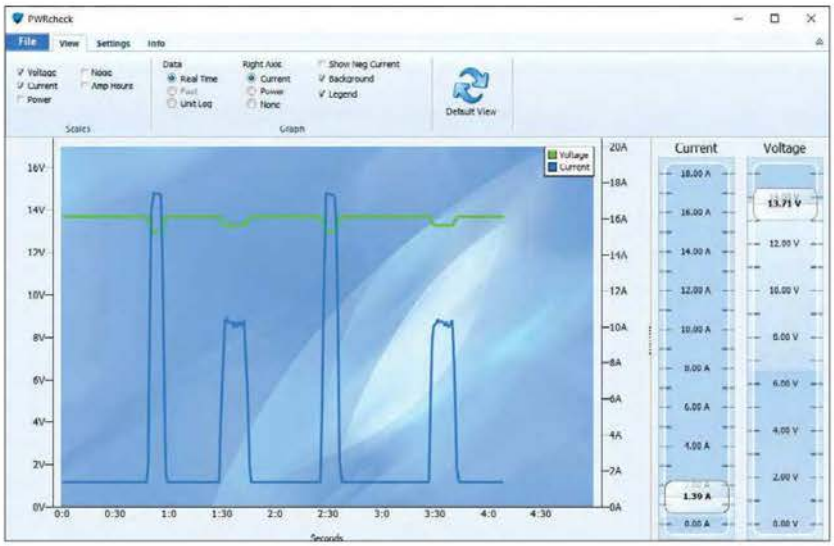


Figure 7 — Key down and 20 WPM string-of-dits voltage and current plots from the PC software.

WiMo QRM Eliminator

Reviewed by Paul Danzer, N1II
n1ii@arrl.net

"If only I could get rid of the noise, I could probably copy that signal!" How often have you said something like that? Depending on your receiver, you may have a number of tools available: noise blanker, noise reduction, DSP filters, and others. The problem with these is that the noise is already in the receiver chain.

The WiMo QRM Eliminator works on a different technique. The 4.33 × 1.81 × 2.72 inch (W×H×D) package has three rotary controls, one labeled **GAIN** and two labeled **PHASE**. The unit requires connection to two antennas, and using very different and diverse antennas is recommended. When the QRM Eliminator is properly adjusted, some or all of the noise from the two antennas though the **MAIN ANT** and **AUX ANT** SO-239 connectors (see Figure 8) should subtract out, leaving only the main signal you wish to hear.

I reviewed a similar unit in the April 1998 issue of *QST*, but it had a different set of controls. While the idea between both of these units is roughly the same, and performance similar, this unit was a bit easier to use.

In the Package

A power cable is included. One end connects to a 13.8 V dc power supply, and the other has a standard 2.1 × 5.5 millimeter dc power connector that matches the socket labeled **12VDC** on the left side of the rear panel. The center conductor of the plug is positive (+) and the maximum current draw is 250 mA.

A second cable is terminated in an RCA phono plug. This is used for push-to-talk (PTT) control.

A one-page instruction sheet is in the box, and has the information needed to connect and operate the unit. The QRM Eliminator is produced by a German company, and the instructions are in English on one side and in German on the other.

Bottom Line

It works, and works well, sometimes. "Sometimes" is not a criticism, but just the result of understanding the advantages and disadvantages of the technique used to suppress noise.

Connections

In addition to the two SO-239 sockets mentioned before, a third SO-239 socket labeled **TRX** on the rear panel is used for connection to your transceiver or receiver. When transmitting, the PTT cable (center pin) must go to ground and thus protect the QRM Eliminator. The operating instructions include a warning to not use the microphone PTT line for this function. Most radios have a PTT connection on the rear panel for keying an amplifier (usually a phono jack or specific pins on an accessory port). That's the connection that should be used to trigger the QRM Eliminator to make sure that it switches safely before the transceiver starts transmitting RF.

According to the manual, transceiver power is limited to 200 W, which is fine for most radios today. If you use a power amplifier, install the QRM Eliminator between the transceiver and amplifier. However, you may damage the QRM Eliminator if high-power RF from the transmit antenna comes back into the receive antenna port. It's feasible to use the QRM Eliminator in a high-power station, but if your antennas are close to each other, consider adding an RF limiter to protect this input (these are typically used with low-noise receive antennas to protect the receiver). Operating frequency range is 3.5 to 60 MHz.

Operating Instructions

In addition to the three knobs, the front panel has a red pushbutton labeled **ON/OFF** and a LED just above the button. When this switch is **OFF**, your transmitter is connected directly to the main antenna connector. When the unit is turned on and you are receiving, the LED glows red/orange. When you transmit and the PTT line input is grounded, the LED glows green. I found that the LED is not very bright in the fluorescent lighting in my station.

Breaking the instructions into steps:

1. Make all connections. (Selection of the second antenna [**AUX ANT**] to be discussed shortly.)
2. Adjust the **GAIN** control so the noise appears to have the same amplitude on both antennas.
3. Adjust the **PHASE** knobs for minimum noise.
4. Continue repeating steps 2 and 3 until you have maximized the noise reduction.

You may have to tune off-frequency to make sure you are eliminating more noise than the desired signal. However, control adjustment did not seem overly critical and I could make larger frequency changes without readjustment than with another unit I previously used.

Antenna Selection and Placement

Suppose your main antenna, some 50 feet up in the air, picks up the signal you want to hear, along with some amount of noise. The second antenna (perhaps a short piece of wire) could pick up the noise as well, but the strength of the desired signal would be much lower. Then the noise in common to the two antennas can be nulled out in the QRM Eliminator, while the desired signal will not null out because its amplitude is much greater on the main antenna.

The included instruction sheet briefly discusses the antenna functions and notes that the second antenna should be far enough from the main one that it does not pick up enough signal when transmitting to damage the QRM Eliminator. The second antenna must be stationary for the noise to null out properly, because the relative amplitude and phase coming from both antennas should stay constant, or else the controls will need to be readjusted. Even so, a stationary truck, for example, could produce noise that can be nulled out, but if it is moving, the noise will not null as well at the same settings. It is also possible that rigidly mounted antennas can pick up noise that can be nulled, but noise picked up by an antenna swinging wildly in the wind might not.

Figure 8 — QRM Eliminator rear panel.

Using the QRM Eliminator

Let's start with the conclusion: The QRM Eliminator works, and works well, sometimes. "Sometimes" is not a criticism, but just the result of understanding the advantages and disadvantages of the technique used to suppress noise.

When testing a receiver or transmitter, if you set the controls and connections one day, shut down, and then come back the next day, you expect to get the same performance day to day. Noise, on the other hand, generally comes from sources that are random or not well defined, that may vary from day-to-day or hour-to-hour or even minute-to-minute.

To test the QRM Eliminator, I used my home station transceiver, an Icom IC-7300, with the AGC turned off and an oscilloscope connected to the audio output. Since human hearing is not linear, I thought monitoring the results on a scope in addition to listening would give more insight to the results.

I used CW and SSB on the 80 to 15 meter bands. On 80 and 20 meters, I found a number of weak carriers outside the ham bands that also served as test signals. My main antenna is an 80 meter horizontal dipole at about 40 feet, supported by two trees. A 10-foot piece of coax in the station feeds a balun mounted on the outside wall of my house. From there, a length of ladder line connects the balun to the dipole. The second antenna (**AUX ANT**) was a VHF/UHF discone, also about 40 feet in the air. I used it in two ways, first as a coax-fed discone to sample noise with a short element, and next by connecting the coax shield and center conductor together in the station to act as a vertically polarized 40-foot wire.

I did get one surprising result. My station is about 300 feet from a major commuter highway (cars only, not trucks). Several years ago, I monitored the noise from passing cars and could see a spike during commuter rush hour. This time, despite heavier traffic, there was no spike, and while the audible noise has gone up, the RF noise has decreased considerably.

Varying Results

As for results, as expected, they varied considerably. When listening to pure noise (tuned away from any desired signal), noise suppression was usually very high. I could bring an S-9 noise level down to perhaps S-1 or S-2. With careful adjustment, when I tuned back to the desired signal, the noise decreased, but not as much. There was no question that in some cases, the noise suppression made a large difference; other times it did not. I could not give any general conclusions about using either of the auxiliary antennas. If you

can't really null the noise out, sometimes it's because there are two noise sources, and you would only get rid of one of the two.

Sometimes, it's hard to null a noise without affecting the desired received signals. This was very apparent when testing using the out-of-band weak carriers, where maximum noise suppression yielded maximum carrier suppression. I did not know the sources of these weak carriers, but this may have been caused by one antenna being vertically polarized and the other, horizontal.

There were two other results worth mentioning. The QRM Eliminator was tolerant of receiver frequency changes without having to readjust its controls. Also, the QRM Eliminator controls are quite tolerant of changes to the settings themselves while adjusting for good suppression.

If your results are disappointing, the manufacturer suggests a great deal of patience. I would second that recommendation. Again, how well it works depends on several factors, including the relative locations of antennas, antenna patterns, noise characteristics and perhaps very (if not most) important, the patience and skill of the operator.

If, however, you are convinced your unit is not working, the instruction sheet has a paragraph on how to test it. The test involves inserting the same signal into the two antenna ports and then adjusting the phasing controls to demonstrate nulling of the signal.

I also tested the QRM Eliminator with approximately 20 feet of wire, running out the window and loosely tied to a tree branch for the **AUX** antenna. I specifically wanted to see if antenna motion affected the nulling capability, and on one windy day, the answer for a small set of tests was definitely yes. The nulled noise went in and out!

Another Application

You can try to use this unit for signal enhancements. By coincidence, as this review was being prepared, a Technical Correspondence by Joe Ostrowsky, KI5FJ, published in the October 2021 issue of *QST*, described using a similar unit for diversity reception. I was not able to get similar results, but this was probably due to the antennas I used and signals I had available when testing. If you have two good HF antennas, one horizontally polarized and the other vertically, it is something to consider.

Manufacturer: WiMo Antennen und Elektronik GmbH, Herxheim, Germany; **www.wimo.com**. Available from DX Engineering, **www.dxengineering.com.** Price: $200.

Monitor Sensors Power and SWR Meter

Reviewed by Phil Salas AD5X
ad5x@arrl.net

The most commonly used accessory in a ham radio station is probably the SWR/power meter. Many hams rely on inexpensive ones for accurate indications of what is really going on in their stations, and while the SWR indication is generally adequate, accuracy of the transmit power measurements can vary, based on the actual power level and the factory calibration accuracy of the meter. Accuracy issues have been addressed by Monitor Sensors, an Australian company, with their Power and SWR Meter.

Overview

The Power and SWR Meter measures power and SWR up to 2000 W from 160 to 10 meters, up to 100 W on 2200 meters (135.7 – 137.8 kHz), and up to

Bottom Line

The Monitor Sensors Power and SWR Meter will accurately read RF power down to 10 mW up to 2000 W, and it will measure SWR at power levels as low as 50 mW.

Table 4
Monitor Sensors Power and SWR Meter Specifications

Auto-selected power ranges: 0.00 to 19.99 W, resolution 0.01 W; 20.0 to 999.9 W, resolution 0.1 W; 1000 to 2000 W, resolution 1 W.
SWR range: 1.00:1 to 99.9:1. Above 99.9:1 the meter reads "infinity."
Power/SWR sampling rate: 2000 readings/second.
Frequency range: 130 kHz to 30 MHz. Each amateur band is individually calibrated.
Accuracy: < 5% power and SWR error.
Peak readings for all modes.
Maximum power: 2000 W 160 – 10 meters, 500 W 630 meters, 100 W 2200 meters.
Alarm contact: Solid state, opto-isolated, 50 V max., 500 mA max., not polarity sensitive. Open resistance > 2 MΩ, closed resistance < 0.01 Ω. Mating connector included.
Power Supply: 6 to 16 V DC (42 mA typical). DC plug and power lead included.
RF Connectors: SO-239 panel mount
Size (height, width, depth): 2¼ × 4⅛ × 5½ inches. Weight: 15 ounces.
Warranty: 1 year.

500 W on 630 meters (472 – 479 kHz). Other features include a solid-state series alarm contact output and accurate peak power measurements. Table 4 lists the Power and SWR Meter specifications.

Using the Power and SWR Meter

When a dc voltage is applied to the unit, it automatically turns on. If your transceiver has a 12 V accessory port, you can use it to turn on the Power and SWR Meter when you turn on your transceiver. You can force off the power meter by pressing and holding the front panel button until the display says GOODBY. A quick tap of this button will turn the unit back on. Incidentally, an internal series diode protects the unit against inadvertent reverse voltage connection.

The Power and SWR Meter powers up in the normal Power/SWR digital readout mode. Besides displaying power and SWR, it automatically senses and displays the band in use when you transmit. The display backlight color is normally light blue. When the SWR rises above 1.50:1, the display turns slightly pink. By the time the SWR reaches 3.00:1 the backlight color will be bright red. And if you exceed the power rating of the unit, the backlight will turn dark blue to tell you to reduce power and prevent damage to the unit.

The Power and SWR Meter always displays peak power based on a 0.5 millisecond sampling rate. As such, it might not always accurately catch the peak power of the first dit, but will with two or more dits. It will accurately show peak envelope power (PEP) when operating SSB. The peak power display is held for about one second, so it is not convenient to use for adjusting an antenna tuner. Tapping the front-panel button changes the display to both a digital power/SWR display and a bar graph SWR display. The bar graph is far more suitable for adjusting a manual antenna tuner.

The single front-panel button also provides access to the menu. Press and hold the button until the **WELCOME TO THE MENU** screen appears. Now, a tap of the button will cycle you through the different menu items: Screen Brightness, High SWR Alarm, SWR Alarm contact state, Auto Reset, and SWR Alarm Threshold. A long press of the button changes the menu item's value. I thought this was quite a clever way to make changes using just a single button.

One valuable feature is the ability to set an SWR threshold and use this to interrupt your transceiver or power amplifier if the SWR gets too high. A two-pin connector on the back of the unit provides a set of opto-isolated, solid-state contacts that can be set to open or close under high SWR conditions. Both the open or close states and the SWR alarm threshold are set in the menu. The selectable SWR thresholds are 1.50:1, 1.70:1, 2.00:1, or 3.00:1. The contacts can be used to inhibit any transceiver with an external inhibit input, or they can be connected in series with your amplifier's amp-key input.

I would have preferred phono jacks for these input and output connections as most amplifiers have a phono jack amp-key input. Because the contacts are just a two-pin series connection, for amplifier inhibiting you

Table 5
Power and SWR Meter Power Measuring Tests

Band (meters)	RF Power Applied/Monitor Sensors Measurement* (key down, W)						
2200	0.01/0.01	2/1.5	—	—	—	—	
630	0.01/0.01	2/1.6	—	—	—	—	
160	0.01/0.01	5/4.6	10/9.7	50/48.5	100/91.6	500/494	
80	0.01/0.01	5/4.6	10/9.7	50/48.3	100/91.6	500/494	
40	0.01/0.01	5/4.7	10/9.7	50/48.3	100/92	500/494	
20	0.01/0.01	5/4.7	10/9.6	50/48.3	100/92	500/497	
10	0.01/0.01	5/4.7	10/9.4	50/47.8	100/91	500/492	
6	0.01/0.01	5/5.4	10/10.8	50/52.1	100/92	500/495	

— = not measured
*RF Power Applied measurements performed with Array Solutions PowerMaster and Mini-Circuits PWR-6GHS+. See text.

will need to wire a cable with the center conductor going through the pin connections, and a separate ground connection. If a high SWR alarm occurs, you must turn off the alarm through the menu in order to re-enable your transceiver or amplifier. However, if you enable Auto Reset in the menu, the alarm will automatically clear after three minutes.

One other feature discussed in the manual is that the Power and SWR Meter screen will flash red during receive if your antenna is picking up strong signals. This can indicate possibly dangerous receive levels from nearby transmitters or nearby lightning strikes.

Figure 9 — Monitor Sensors Power and SWR Meter rear panel.

Some Performance Testing

I first checked the power meter readings at several different bands and power levels. The results are shown in Table 5. Although the unit specs do not cover 6 meters, I also tested it on this band and found it to have adequate performance. For the 630- and 2200-meter bands, I could only generate 2 W of signal with my home test equipment, which I verified with my Tektronix TDS-2022B oscilloscope. On the 160- through 6-meter bands, I used both an Array Solutions PowerMaster and a Mini-Circuits PWR-6GHS+ power sensor with calibrated attenuators for power levels up to 100 W. At the 500 W level (the maximum power available with my Elecraft KPA500 amplifier), I used the Array Solutions PowerMaster. My test equipment is all NIST-calibrated, and therefore should be within ±3% (the "RF Power Applied" values shown in the table). However, as a test engineer once told me: If you have one power meter, you can make a measurement. If you have more than one, you can only make an argument!

Table 6
SWR and Power Meter SWR Resistive Load Testing

SWR/	Measured SWR by Band							
Impedance	2200 m	630 m	160 m	80 m	40 m	20 m	10 m	6 m
10:1/5 Ω	10.5	10.4	9.8	9.7	9.4	9.4	9.5	7.1
8:1/6.25 Ω	7.7	7.7	7.6	7.6	7.4	7.4	7.0	5.9
4:1/12.5 W	4.3	4.1	4.0	3.9	3.9	3.9	3.8	3.6
2:1/25 W	2.0	2.0	1.9	1.9	1.9	2.0	1.9	1.9
1:1/50 W	1.0	1.0	1.0	1.0	1.0	1.0	1.2	1.2
2:1/100 W	2.1	2.1	2.0	2.0	2.0	2.0	2.2	2.3
4:1/200 W	5.0	4.6	4.1	4.1	4.2	4.3	4.4	4.6
8:1/400 W	20	11.5	8.1	8.4	8.4	8.6	8.5	9.3
10:1/500 W	31	13.5	10.4	10.8	10.4	10.9	10.8	13.3

What I found interesting at the 100 W level was that the peak power readings of the Power and SWR Meter were within 2% of the PowerMaster peak power readings. However, the key-down power readings of the Power and SWR Meter were about 8% lower than both the PowerMaster and Mini-Circuits PWR-6GHS+ readings.

For SWR testing, I checked the Power and SWR Meter against my precision SWR test box that I described in an article in the March/April 2021 issue of *QEX*. The results are shown in Table 6. Note that the SWR accuracy on the two lowest frequency bands is poor for high impedance, high SWR conditions. However, as the SWR improves, the accuracy also improves.

Conclusion

The Monitor Sensors Power and SWR Meter is a reasonably priced, accurate instrument. It integrates nicely into any station, and it can also provide high SWR transceiver and amplifier protection should something suddenly goes wrong with your feed system or antenna.

Manufacturer: Monitor Sensors, Caboolture, Queensland, Australia; **www.monitorsensors.com**. Price: about $257 US (AU$360.00).

Meet the New Product Review Editor

Pascal Villeneuve, VA2PV
va2pv@arrl.org

Hello, everyone. I'm Pascal, VA2PV, *QST's* new Product Review Editor. I've been a ham since November 1991, and by February 1992 I had passed all the Canadian amateur radio exams. I went through the process fast, because my love for this hobby practically changed my life. It may sound like a large statement, but that really was the case. At the time I was licensed, I had just completed my college degree in business administration. Five years later, I completed a second degree in electronics, because of ham radio. Since 1997 I've been working in the telecommunication industry in roles that mix business with technology.

I have always been a bit crazy about technology. The availability of new technologies was never fast enough, as I was hungry to learn and make new discoveries. In 2015, I started a YouTube channel (**www.youtube.com/c/LaboenligneCa1**) to share information about a new digital mode, and making videos became another hobby for me. It includes technical challenges, and it was also a good way to access new technology faster.

In 2016, *QST* approached me to write an article about a new multimode digital hotspot that I reviewed on my YouTube channel. *QST's* Editor at that time, Steve Ford, WB8IMY, had *QST* Product Review Editor Mark Wilson, K1RO, contact me. I had been a member of ARRL for a while, and waited for my *QST* every month just like many of you. As you can imagine, I was honored and surprised by that request, considering *QST* is the "major league" of amateur radio product review. Since then, I have written just over 20 reviews, mainly related to digital modes.

I was not done with surprises, as recently *QST's* Editorial Director, Becky Schoenfeld, W1BXY, asked me if I would be interested in replacing Mark Wilson, K1RO, who is taking a well-deserved retirement. Once again, I was honored by this request, and I couldn't refuse the opportunity to increase my contribution to the hobby.

My vision for *QST* Product Review is to have reviews that are done by passionate, objective hams, with different personalities and styles. I insist on the word "objective," as we have to keep in mind that our market is small and we need to support the manufacturers that are willing to invest in new products. At the same time, *QST's* neutrality is as important. Though the readers deserve to know all the good and not-so-good points about the reviewed products, reviewers will need to maintain their objectivity, to prevent negativity and ensure fairness.

The ARRL Lab plays an important part in Product Review. They are amazing, and their expensive, sophisticated testing setup is not possible for many hams. Therefore, their role is crucial and relevant to the industry, and most importantly, to the readers.

The future will be challenging for product reviews due to the semiconductor shortage, but there are still cool things out there to discover, and I will do my best to try to find them. You can help by sending me suggestions at **va2pv@arrl.org**. I answer all my emails. Don't hesitate to send me your suggestions about potential reviewers.

In closing, I would like to thank Mark, K1RO, for his support in the past few years. He's been a great mentor, and working with him closely in the past few weeks has made him a good friend. I sure hope he will still do some reviews for us to enjoy. Mark, have a great retirement, and I wish you a lot of QSOs!

Dave Casler, KEØOG, askdave@arrl.org

Ask Dave

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

Placing Equipment; Crimping vs Soldering; Impossible SWR?

Leave Plenty of Room in Your Shack for Airflow

Q Andrew Moll, KI5AVR, asks: "I am in the process of reorganizing my ham radio space, including building shelves for the radios and additional equipment that I have. How much airflow space should I allow around my radios? Is an inch around the top and sides sufficient?"

A There's no hard and fast rule — some devices create a lot of heat, such as radios and power supplies. Other, such as coax switches, create none. If there are vents on the bottom and the top of an object, allow perhaps an inch below and two inches above for the free flow of cooling air.

A transceiver will dissipate the most heat in most shacks. For example, one that draws around 20 A on transmit at 13.8 V uses 276 W of power from its supply. So, if 100 W goes to the antenna, the remaining 176 W releases into your shack as heat that must convect to the ambient air. Many rigs have a fan on the back that will direct the hot air away from the operator; if so, make sure nothing obstructs it. Also, don't stack anything atop the transceiver.

If you have an amplifier, like I do, it's the same problem. My 500 W amplifier draws 75 A at 16 V dc. That's 1200 W! So 500 W goes to the antenna, and the remaining 700 W makes the amp into a nice little room heater! Of course, these numbers are based on transmitting a continuous tone, which is not a real-world situation. We usually use our radios with a far lower duty cycle and, therefore, less waste heat. But this illustrates the point that you must not box anything in, and you want air to be able to flow into, through, and out of your equipment. Be generous with airflow space!

Persistence or a New Antenna (or Both?)

Q Scott MacKenzie, KBØFHP, asks: "I live on a sloping lot in suburban Philadelphia and am very close to 5BWAS (5-band Worked All States, an award given for working all states on five different bands) but am missing Connecticut, Rhode Island, and Massachusetts on 10 meters and Alaska on 80 meters. I have a G5RV horizontal antenna at 30 feet and a Gap Titan vertical. What can I do?"

A I can sense your frustration, but I congratulate you on what you've already accomplished. 5BWAS is a significant award and represents many hours carefully following propagation, as well as working stations in several states that have few hams.

The key answer is persistence. The last few states for 5BWAS are hard, just like the last few countries for DXCC. They'll take a lot of time and planning. You might try contacting hams in the needed states, perhaps via the local ham radio clubs, and set up schedules to try on the needed bands.

Now let's talk antennas. You can use the GAP vertical on 80 meters for Alaska. The low takeoff angle of a vertical is what you need. You might also try an 80-meter single-band vertical loop hung in the trees, allowing you to steer your signal somewhat. As you correctly noted, your 10-meter signal to New England is going right over their heads. Consider using a single-band 10-meter horizontal dipole at ¼ wavelength height above ground (about 10 feet), which will tend to direct your signal up at higher angles. This approach, called Near Vertical Incidence Skywave (NVIS) is usually useful only on 160, 80, 60, and 40 meters, but there might sometimes be a 10-meter band opening that will do the trick.

I hope this helps you get your 5BWAS. Keep at it!

Coax Connectors: Crimp or Solder?

Q Gene McPherson, NØMHJ, asks: "For years I've resisted the temptation to crimp my coax connectors, in favor of soldering, but it might be time to change. What is your advice on crimping versus soldering, for hams putting on their own connectors?"

A You're asking whether one thing that can lead to problems is better than something else that can lead to problems. When either is done properly, you have a fine connector that you can use for many years. But each approach has its drawbacks.

Connectors on commercial coax cable are crimped — both the inner conductor and the shield — because it's easily done by machine: cut the plastic cover, the braid, the inner dielectric, and the center conductor to exactly the right specifications, pop on the connector, and squeeze in the right places. Copper is a material that once crimped, stays crimped. That's because it's elastic and acts a bit like a spring. Some other materials, when crimped, relax over time

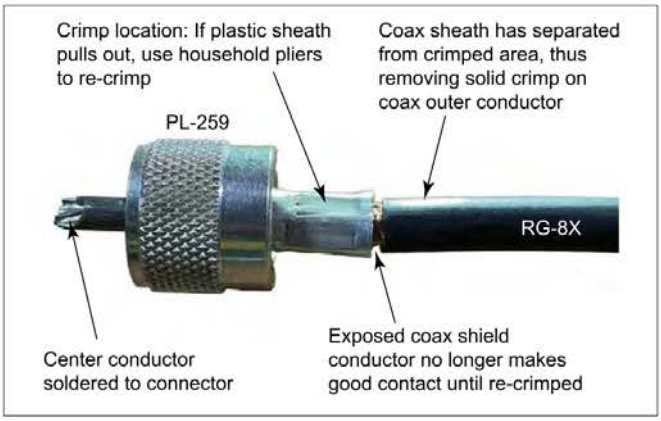


Figure 1 — A common problem with crimped PL-259 connectors is that the coax's plastic sheath can pull away from the crimped area, removing the crimp pressure on the coax braid. Then the connector tends to become intermittent and unreliable. One solution is to squash the connector at the point indicated, using household pliers, to restore the connection between the braid and the connector.

and the crimp pressure lessens. Even in our homes, electrical copper wiring is almost universally crimped or screwed — no solder is used.

Home crimping kits for coax connectors often crimp only the braid and leave you to solder the inner conductor. I find this often works fine, but on a cable that is moved frequently, such as the one between the transceiver and the amplifier, the plastic coax covering tends to slip free of the crimp. This completely removes pressure on the crimp, as shown in Figure 1, and the cable fails. I have a shortcut for at least temporarily getting the cable working again: use household pliers to just squeeze that crimp joint again.

Some specialist crimp kits, such as the ones used for the Times Microwave connectors, are excellent and crimp both the inner and outer conductor. These connectors, and the specialized tools that go with them, are quite expensive.

Now let's have a look at soldering. Soldering the connector to the inner conductor is straightforward, but soldering the shield braid can be an exercise in frustration. A typical solder-type PL-259 UHF connector has four holes where you can see through to the braid. These are where the braid needs to be soldered. This is just plain hard, and if the cable gets twisted much, these tiny solder points can pull loose. If you use a solder station, select the very biggest tip that you have so it will hold enough heat for the connector's outer shaft, the braid, and the inner shaft. It may help to apply a very tiny amount of flux (rosin, not acid) at the joint. At Home Depot, for example, the right type is called "electrical flux." Even a small container can last you a lifetime.

So which approach is best? The answer is *the method that works for you.* If you don't want to mess with it, though — and many hams don't — you can buy coax cables in almost any length with connectors already attached.

Is a 1:1 SWR Even Possible?

Q Stephen Foy, N4FOY, of Florida, says: "A perfect (1:1) SWR is impossible. I cite many reasons for my belief, including temperature, electronic component tolerances, impurities in feed lines, and outside influences, such as trees, buildings, feed line length and stray RF interference. What do you think?"

A I think you're overthinking the problem. SWR is only one measurement of an antenna and its feed line. If you have a dipole antenna that's about ½ wavelength long, there is a frequency at which the reactance is zero, the antenna's resonant point. Assuming a typical ham radio's 50 Ω system: if the antenna's resistance is 50 Ω, fed by 50 Ω coax, the SWR will be 1:1 at that single frequency. That's all it requires. The other factors you mention may contribute to loss, but not SWR. Furthermore, if the antenna is tuned so the 1:1 SWR is at the band center, say, at 7.125 MHz for 40 meters, the SWR will be low enough across the entire band without needing a tuner. (Note that this does not apply on 80 meters, which is too wide for a dipole to work on the entire band.)

Now let's look at the practicalities. It's easy to cut a dipole at, or close to, resonance at a desired frequency. But even though its reactance (jX) is zero, its resistance will seldom be exactly 50 Ω, as antenna height will affect feed point resistance. If the antenna's feed point impedance is 25 Ω + j0 Ω, for example, the best SWR you can have is 2:1, and the feed line, because of the non-50 Ω load, will now act as an impedance transformer. You can use a Smith chart to work out the effect of the feed line.

The dipole can be perfectly resonant at only one frequency, so the farther you operate from that frequency, the more reactive it will be. An antenna tuner will actually tune the combination of the feed line and antenna. Thus, the tuner not only matches the system to an antenna with other than 50 Ω impedance, but with a non-zero reactance as well. If you operate at below the antenna's resonant frequency, the antenna is shorter than optimum and therefore capacitive, and at above its resonant frequency, the antenna is long and inductive. Many modern transceivers feature a built-in tuner, and if the antenna and feed line combined present a 3:1 SWR or lower the rig can usually tune it nicely.

Remember that a 1:1 SWR is not the Holy Grail but keeping your transmitter finals happy is. I don't have a high-power tuner, so when I use my Ameritron ALS-500M amplifier, I use antennas that present a 1.5:1 SWR or less to the radio across the parts of the band I will use.

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

Hints & Hacks

A Flexible Work Light for Mobile Equipment; A Solution for Weed Control

When you need some illumination, particularly when operating mobile, a solution may be as close as the nearest drinking straw (see Figure 1). In my case, I use a plastic flexible drinking straw with an LED on the end. The design allows the straw to slide in and out of an outer tubing to extend and retract the light. The light can be rotated within the outer tubing, and with the combination of flexible portions of the straw assembly, the direction of the light can be adjusted to focus where it needs to be and remain in place. The light is controlled with a linear taper potentiometer equipped with a switch, which provides the ability to turn the light on and off as needed and adjust the intensity of the light.

Coming from the dc power source, a twisted pair of wires scavanged from a Cat 5 network cable seemed to be the best solution for a flexible, yet taut, medium to use for the occasional in-and-out movement of the lamp assembly. The cable is cut to length so there is a minimum of slack when the lamp assembly is not in use, but just enough length when being used.

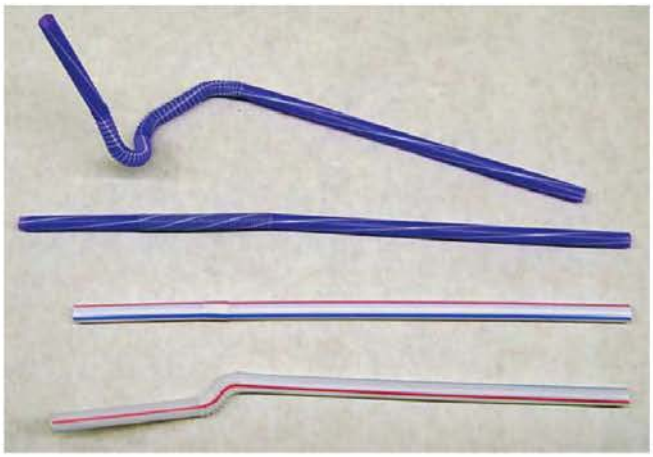


Figure 1 — Ordinary drinking straws can be repurposed to become a flexible mobile lamp.

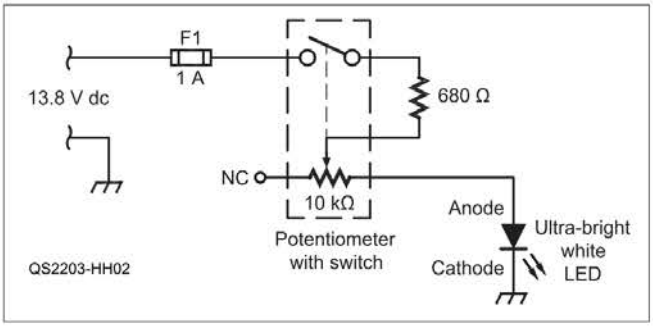


Figure 2 — Schematic diagram of the lamp circuit.

The circuit is shown in Figure 2. The brightness control is a 10 kΩ linear taper potentiometer with a switch. The positive side of the 13.8 V dc from the vehicle is protected by a fuse, and it connects to one side of the switch. A 680 Ω ¼-W current-limiting resistor connects between the other side of the switch and the wiper (center terminal) on the pot. Facing the rear of the pot, the right side of the wiper (right terminal) will connect to the orange wire (B+) of the twisted pair. The other end of the orange wire will connect to the anode (long lead) of the ultra-bright 5 V white LED. The white/orange wire of the twisted pair will connect from the ground bus (–) to the cathode (short lead) of the LED. I built the control components into a power control box of my own creation (Figure 3), but obviously this circuit can fit within a much smaller enclosure.

The outer tubing is a six-inch length of ¼-inch ID plastic tubing, the type typically used for a water faucet feed tube. The end of the tubing where the flexible straw will extend and retract from within the outer tubing was reamed out to a slightly larger diameter down to about a one-inch depth.

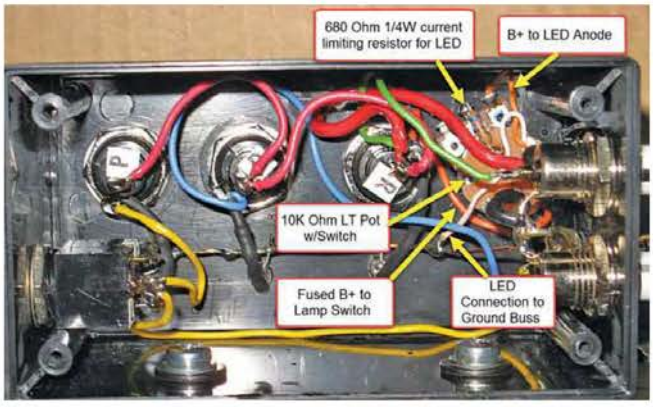


Figure 3 — I built the LED control components into a mobile power-control box of my own design, but any small enclosure will do. All you need is a box that you can mount near the radio so that you can easily adjust the potentiometer.

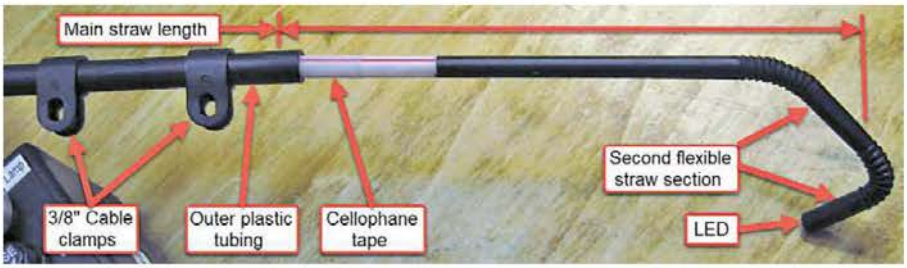


Figure 4 — The finished lamp, with components labelled.

Figure 5 — The lamp at its highest illumination setting.

I also removed a flexible section from a second straw and secured it to the end of the first straw. I used two ⅜-inch cable clamps to secure the outer tubing to the equipment bracket. See Figure 4.

I developed a way to keep vehicle motion, vibration, and wire tension from pulling the lamp assembly back into the outer tubing. I used cellophane tape as a shim, so it would apply just enough tightness (or compression) between the plastic straw and the inside diameter of the outer tubing to hold any adjustment that I made to the lamp assembly in place until I adjusted it again. To get just the right amount of compression, I pulled the straw all the way out of the outer tubing, then carefully wrapped cellophane tape on the inner straw near its end. I then inserted the straw back inside the outer tubing and tightened the two cable clamps.

Next, I completed the wiring for the LED. The outer tubing must be secured in place, and the straw needs to be extended to its fullest point, without pulling out of the outer tubing. Make sure the second flexible straw portion is temporarily inserted onto the main straw. Feed the twisted wire pair through the outer tubing and straw and pull just enough of it through the straws to connect the LED, plus about an inch, and then cut the cable. Strip the wire ends just enough for soldering.

Identify the LED anode (the long lead) and cut it short enough that it will not hamper wire movement through the flexible portion when assembly is completed. Slip a short piece of heat-shrink tubing over the orange wire and solder the wire to the LED anode. Repeat this step with the LED cathode and the white/orange wire. Slide the pieces of heat shrink tubing over the solder joints and exposed leads and shrink them in place.

Install the LED ring/lens onto the very end of the straw. I would suggest securing it with a small amount of clear sealant to the lens assembly to keep it in place at the end of the straw. After the sealant had set, I then applied a small amount of E6000 black adhesive to the two mating ends of the two flexible straw sections and let it cure overnight. The result worked perfectly (see Figure 5)! — *73, Mark Kupferschmid, AC9PR,* **mkkupferschmid@gmail.com**

A Solution for Weed Control

At the Skyview Radio Society, K3MJW, we are forever struggling to keep Mother Nature under control when it comes to our antennas. Weeds and vines are always trying to make their way onto our tower bases, and they frequently climb the towers and guy wires. One could use a string trimmer to keep them at bay, but this runs the risk of severing wires. And, yes, you could resort to chemicals, but we prefer a greener solution.

Our answer is to use carpet remnants for weed control. Many carpet outlets will be more than happy to give these to you. Simply cut up the carpet sections to the appropriate sizes and place them over or around the areas you are trying to protect. The carpeting acts as a highly effective weed block and it lasts for years. You can even paint it to blend with the surroundings. — *73, Bob Bastone, WC3O,* **radiofreebob@gmail.com**

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

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

Feedback

The article "NanoWSPR — A Low-Cost Multiband Transmitter," by George R. Steber, WB9LVI, from the January 2022 issue of *QST* contained errors in Figure 3. Connections should be made from Arduino Pin A4 to Si5351 Pin SDA, and Pin A5 to SCL. Also, the unused inputs to U1 should be tied off to ground. *QST* regrets these errors.

Steve Ford, WB8IMY, wb8imy@arrl.net

Eclectic Technology

The Mystery of Static Electricity

On a dry winter day, I vigorously rub my hand across my cat's belly and, before he can punish me with a swipe of his claws, I accumulate a static charge. The next stop is the nearest doorknob where I experience an unpleasant *snap* as I discharge my outstretched fingers to ground.

Based on these rigorous tests, I've concluded that static electricity is generated exclusively by cats. All breeds have the ability to perform this feat, with the possible exception of the Sphynx. No doubt, a Nobel Prize awaits me.

My investigations notwithstanding, however, I was recently astonished to learn that this common electrical phenomenon has no widely accepted scientific explanation. Even my own felidae-centric hypothesis is suspect.

This may be about to change thanks to the work of Alex Lin and Christopher Mizzi, two Northwestern University doctoral students working in the lab of Professor Laurence Marks. According to their research, the true answer lies in microscopic protrusions on a material's surface, combined with two old physics concepts that had been overlooked for decades.

What *Really* Causes Static Electricity?

The first mention of static electricity is credited to Thales of Miletus in 600 BCE. After rubbing a piece of amber (Editor's note: Not coincidentally, the Greek word for "amber" is *elektron*) against fur, he discovered that the fur suddenly attracted copious amounts of dust. Since then, many theories for what causes static electricity followed, but they have all been hotly contested (including my own).

Marks thought the answer might lie in two phenomena we already understand: friction and flexoelectricity. Friction is well understood and clearly crucial to static electricity. The other component (flexoelectricity) is a bit more exotic. The brief description states that all materials have a molecular structure, and when that structure is bent in irregular ways, the bending can create an electric charge. Marks thought that combining these two concepts might create a useful model for static electricity.

Grounded wristbands are standard equipment when working with static-sensitive components.

The idea is that even surfaces that look completely flat are covered with small protrusions at the nanoscale. When these tiny protrusions rub against each other, thanks to friction, they create flexoelectricity, and the charge created by this effect causes what we call static electricity.

To build this hypothesis, Lin and Mizzi had to comb through the scientific record, looking for equations that modeled friction and flexoelectricity. They searched papers online, gathering all the equations they might need, then working through the math by hand, until they finally devised a model that worked in various tests.

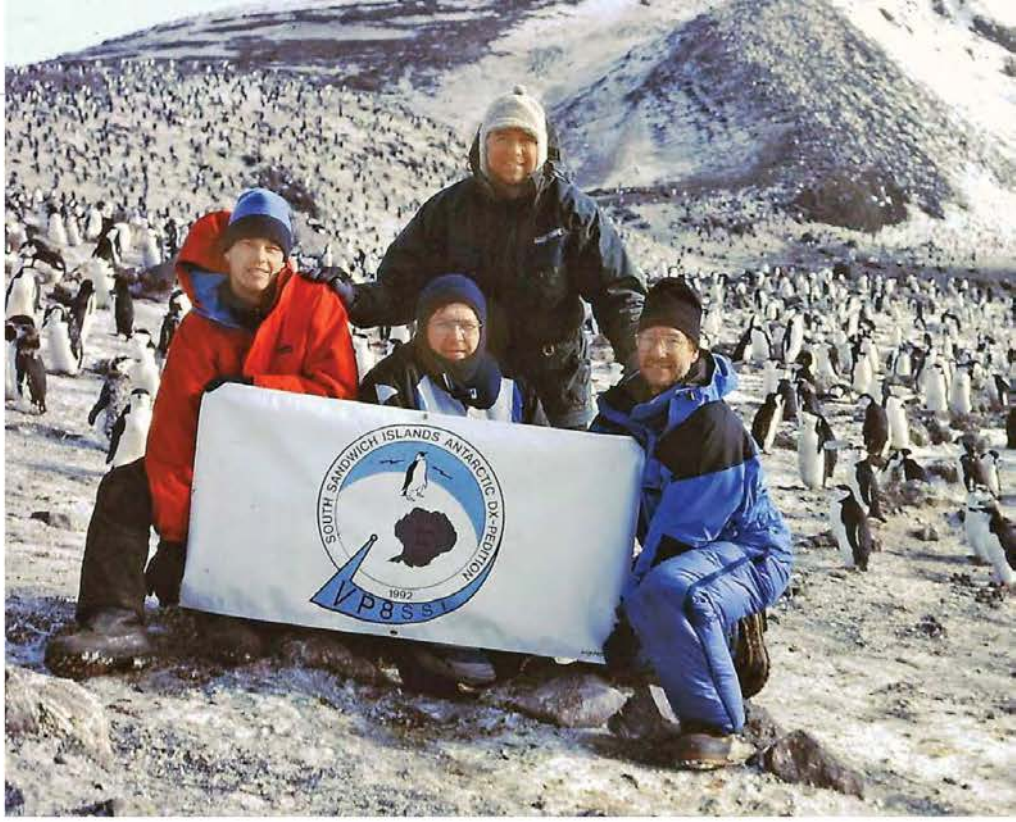
The friction/flexing model provides a convincing explanation for static electricity produced between the same kind of material, but what causes it in other types of material — say, a liquid rubbing against a gas? This will need to be tested against the model, too.

If the model proves accurate, the applications could be broad. Nanogenerators are tiny devices that harvest the surprisingly robust energy of static electricity. It may be possible for nanogenerators to generate power simply from the flexing and friction that occurs when any materials rub together. The body's own movement could be used to power internal medical devices, for example.

The model may also lead to better control, or even elimination, of static electricity in some environments. Many amateurs who have worked with static-sensitive components such as certain types of integrated circuits, are well aware of the need to keep their bodies and work areas discharged at all times. This often includes such measures as wearing grounded wristbands.

Studies have shown, however, that cats tend to resist applications of these bands. Their resistance becomes especially vigorous when one attempts to securely ground all four legs in this fashion. Clearly, more research is necessary.

OH2BH Looks Back at 60 Years in DXing



As a new ham at the age of 15, I admired contest heroes and leading DXpeditioners and desperately wanted to become one of them. Hungry to experience the world, I eventually qualified for world citizenship — along with my entire family. Now, at the age of 75, it's time for me to settle down and reminisce about my passion for amateur radio, which has spanned 60 years and turned into a true way of life.

Martti J. Laine, OH2BH/AH3D

With my fresh amateur radio license in hand, the possibilities seemed endless. I was fortunate to become part of a group of like-minded youngsters, the OH2AM team, who were keen to try out radiosport, which obviously involved being competitive, understanding and building large multi-operator station machinery. All of us progressed so fast, that before the age of 20, the OH2AM team of Kari Leino, OH2BC; Martti Laine, OH2BH; Arto Blomberg, OH2BQ; Markku Heinonen, OH2BS; Erkki Koskinen, OH2BW; Olli Rissanen, OH2BBM; Olavi Lehti, OH2BBR; Osmo Koskenniemi, OH2KH; Anssi Pekkanen, OH2QV, and Leif Eriksson, OH2SB, was ready to win world titles. Because of our desire for maximum learning and results, the original group has remained close to this day on all fronts of life.

Another long-term goal of mine was to work all 340 DXCC countries. It took 17 years, and though I was happy for the increased geographical and political knowledge that working DX can bring, I yearned for some type of renewal of my passion for the hobby.

Early Adventures in Being the DX

I turned my focus to becoming the provider of the DX. With this new approach, my target countries became increasingly rare and further off the beaten track. New cultures and challenges changed my original value set and became a guiding light toward becoming a citizen of the world and feeling at home wherever I hang my hat.

My first real adventure, in 1971, was to Annobon Island (3CØ) out in the Atlantic, with my lifelong friend Ville, OH2MM. We landed in a dense hay field in a small Cessna four-seater, greeted by 1,200 people who had never seen anyone that looked like us. They were soon clearing the field so we would be able to take off and get back to the mainland. The president of Equatorial Guinea, who had signed our operating permission for Annobon, had just sacrificed two missionary workers in

South Sandwich Islands, VP8SSI, March 1992. When spending a week in this type of extreme environment, the experience brings people together as they share something very unique indeed — including their thousands of new penguin friends. Standing: John, W7KNT. Kneeling, from left to right: Dave, KJ9I; Martti, OH2BH, and Ralph, KØIR.

the midst of celebrating their new independence. The experience was horrific, yet eye-opening.

Soon after that, the mysterious dictatorship in Albania (ZA) was on everyone's lips, and the trio of Eric, OH2BW; Ville, OH2MM, and I arrived as some of the first westerners there. We got on the air as OH2BH/ZA with what turned out to be a very special permit, given privately by the Ministry of Communication. Our "guide" was the daughter of the Vice-Minister. Her burning interest in the west, from the perspective of a then-isolated country, made her father bless our advanced operations. The world is small indeed as today, decades later, that then young lady, Liliana Verdha, is the current Consul General of Albania to my country, Finland.

Establishing amateur radio in Albania with the ZA1A activity was followed by an extensive training program at the Technical University of Tirana, in Albania's capital. The fact that amateur radio has set up a presence in Albania is a testament to those early experiences and established relationships.

Goodwill Pays Off

Following these early adventures, the ultimate payback was when the well-known DXpeditioner Lloyd Colvin, W6KG (SK), approached me in 1975 and invited me onto the Yasme Foundation board. The Foundation (**yasme.org**) takes a broader look at amateur radio and its future in the international context, and helps when financial or expert support is needed.

Another interesting 10-year journey (2008-2018) is the story of how the Republic of Kosovo entered the amateur radio scene with their own IARU society (Z60A) and DXCC status, resulting in the current DXCC total of 340 entities. Many Albanians live in Kosovo, and it so happened that the key telecom person from our ZA1A project in Albania, Frederick Kote, headed Kosovo's telecom agency and guided us to another successful project in Kosovo as well.

The OH2AM group was a powerhouse in the 1960s after winning the world title in CQ World Wide. Standing, from left to right: Martti, OH2BH; Olli Rissanen, OH2BBM; Olavi Lehti, OH2BBR (SK); Anssi Pekkanen, OH2QV, and Markku Heinonen, OH2BS. Center: Arto Blomberg, OH2BQ (SK). Front row from left to right: Leif Eriksson, OH2SB (SK); Kari Leino, OH2BC; Osmo Koskenniemi, OH2KH. Missing from the photo is Erkki Koskinen, OH2BW.

With these and other adventures the world became smaller, providing many interesting opportunities in both professional life and amateur radio. Soon, I started feeling more at home on the narrowest of roads. My entire family lived life this way, happy out in the big, wide world. Our homes have been on several continents over the years, in California, Hong Kong, Macau, Beijing, the Madeira Islands, Canary Islands, the Azores, and indeed today in Albania as well. Many of them happen to also be interesting radio locations.

Members of the Amateur Radio Society of Kosovo, Z60A, ready for the IARU Radiosport Championship, together with newly licensed amateurs as well as instructors from overseas.

DX "Missionaries" on Temotu

In California, I had the pleasure to get to know many leading figures in amateur radio, including Jim Maxwell, W6CF (SK). I spent hours in his DX library in the mountains above Santa Cruz. Jim taught me that DXCC countries are constantly moving targets. The world is subject to conflicts and change — even the solid DXCC criteria required distances may change due to the shifting of tectonic plates.

I often spent my time in the Fresno State University Library map room measuring the distance between islands and land masses, desperately looking for the treasure that W6CF suggested I search for — a new DXCC entity. And how sad it was, for example, that the distance between the Solomon Islands main group (H44) and the Temotu Province (H4Ø) was only 4 miles short of qualifying as another DXCC entity. So near, yet so far!

But as Jim had suggested everything can be challenged — maybe even the World War II sea charts. Soon we were on the lookout with Kan-san, JA1BK, for a Japanese satellite to measure the actual distance to Temotu. We found one, and bingo! Temotu easily met the distance rule, and the sea charts were proven wrong.

In no time at all we were out on the Solomon Islands negotiating the license and arranging for transport to Temotu. It was harsh on Temotu, with a lot of malaria, few facilities, and limited hours of electricity serving only the main village of Lata. The islanders were very hospitable and friendly, but we seemed to be running their village dry on supplies. We felt we could not leave them like that.

One of our stations on Temotu was operating from the house of a New Zealand missionary, Dr. Ashley Wilson. We decided to offer a special QSL option, postmarked and mailed from Lata by Dr. Wilson, in exchange for donations toward basic necessities for this remote island, as payback for their hospitality. We also volunteered to donate all surplus funds received with QSL cards.

The donations from the special QSL option included a large check of 20,000 USD, which had us all in tears! It was a personal donation from Lee Shaklee, W6BH (SK), of Los Angeles. On my next visit to LA, I visited Lee to thank him for his support for the Temotu people. I also learned more about the reasons for his generosity.

This large, happy family welcomed Martti, OH2BH, and Leena, OH2BE, into their home along the main street in the village of Lata in Temotu.

As a fighter pilot in World War II, Lee had been shot down over the Temotu jungles and crash-landed there. He had been in the hands of the Temotu locals for a long time. His donation was his personal way of giving back to those caring and hospitable people. The donations for the people of Temotu were used to set up a radio network for the teachers who travel by canoe to fulfill their teaching duties on various islands. The funds also purchased a solid sun cover for the market of Lata, and even brought the first bicycles to the island. This was "DX missionary work" at its best!

A Hop to Asian Adventures

While I was working from Hong Kong and Beijing, several equally exciting discoveries and new DXCC activations, such as Scarborough Reef (BS7) and

Martti, OH2BH, and Ville, OH2MM, endured scorching sun and extreme heat putting South Sudan on the air as ST2FF/STØ in 1980 — the first time the entity was counted for DXCC. It counted again in 2013, when Z81X went on the air.

Activating 12 never-before-heard entities takes a lifetime of effort. In this case, that effort spanned 50 years, from 1969 to 2019. Claiming DXCC status for a new entity often takes a complicated, challenging effort, while organizing an efficient first activation requires an international approach.

A World of Thanks

Making and activating 12 new DXCC entities requires support and encouragement from many lifelong partners, so I must extend thanks to my family — my wife Leena, OH2BE; my son Petri, OH2NB, and my daughter Petrita.

Thanks also to fellow DXers and travel companions such as Pertti, OG2M; Juha, OH8NC; Kan JA1BK; Chip, K7JA; Tim, N4GN; Wayne, N7NG, and Bernie, W3UR.

Pratas Island (BV9) were organized to these militarily sensitive islands in the South China Sea. Dealing with the military and flying into targeted destinations on their C-130s is typically the best and safest way to make these trips of a lifetime. Even mysterious North Korea (P5) was brought into DXCC with multiple visits and small-scale operations.

All in all, these efforts have included 12 new DXCC country activations, as well as activating 207 radio call signs from 107 DXCC countries — and lots of excitement at both ends of the radio circuit. You can read some of these stories in my book *Where Do We Go Next?* Which is downloadable for free at **www.ncdxf.org/pages/oh2bh.html**.

During these years in Asia, my wife Leena, OH2BE, often accompanied me on my travels. She shared her thoughts on how one could simply keep travelling and producing one radio performance after another, using the same script and always generating lots of smiles. Though that practice became my way of life, I believe producing rare and exciting radio contacts is much more than a performance. Radio is all two-way, when you talk to each and every person in the "audience," and hear their excitement.

Continuous Evolution — People and Radio

More recently, amateur radio is going through changes due to evolution and new technologies. The two-way wireless radio is part of everyone's life. It was a magical day for me when I discovered that learning from the next generation of hams was my doorway into the future. Learning from the youth required listening — the very same thing I was taught to do patiently when I began DXing 60 years earlier.

So, supporting young talent became my latest endeavor. Along with many initiatives, the formation of a youth-led group and talent that put me on a new journey, in the form of Radio Arcala, (OH8X/CR2X), out of Finland and the Azores. Radio Arcala has invented a variety of advanced concepts out of the latest technology and made them work for amateur radio and society at large. Just like in the 1960s, we have used competitive amateur radio as the spearhead for connecting people and technology.

Turning traditional transmissions into the latest digital ones, such as FT8, has been mind-boggling. These ongoing technological advances can give us all a new beginning and extended continuity if we embrace them, instead of being stuck on just one concept or activity. Ham radio requires passion and dedication, and it also has certain kind of magical flame that's needed to burn strong through the ages in a changing and evolving world. What a fun journey it has been for me to keep that flame alive for 60 years.

Martti Laine, OH2BH, is a retired telecom executive who was part of the global digital mobile telephony rollout in many countries on multiple continents. In that position he was able to unlock doors for Amateur Radio in many rare entities. Now at the age of 75 he is back home from the world's hotspots and has become just another signal stream on your radio's waterfall.

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

The Heartbeat of the Shortwaves

Shortwave station WWV has operated for over a century, and has broadcast precise time and frequency information for more than 50 years.

Jen Glifort, KC1KNL

Every night, over 50 million devices in the US receive a signal containing time codes through their internal antennas and receivers, which then interpret the codes to ensure near-perfect synchronization. That signal has been coming from WWV in Fort Collins, Colorado, for over half a century.

Among many other things, the National Institute of Standards and Technology (NIST; **www.nist.gov**) is responsible for the maintenance and operation of shortwave stations WWV, WWVB, and WWVH (in Hawaii) through its Time and Frequency Division. Shortwave enthusiast Thomas Witherspoon, K4SWL, called WWV "the heartbeat of the shortwaves." He explained, "The NIST reference signals are ever-present and easily accessible here in North America and other parts of the world."

Vintage Technology

Since 1965, WWV and its companion station, WWVB (often collectively referred to as "WWV"), have broadcast Coordinated Universal Time (UTC) to the exact second to the continental US. WWV is the oldest continuously active radio station in the country (see the sidebar, "The History of WWV"). WWVH, its Hawaiian counterpart, broadcasts the same information for the island state. Using long electromagnetic waves at 60 kHz — a frequency so low it can be received through buildings — WWVB's signal allows millions of timekeeping devices across the country to sync, usually in the middle of the night, when the signal is strongest. These devices contain small, internal antennas and receivers, which interpret the time codes sent by WWVB to maintain accurate readings of the time and the day of the year, as well as adjust for daylight saving time and leap years.

WWVB signals reach all these devices via the 60 kHz longwave band, but WWV and WWVH signals leverage the shortwave bands. There's no official definition of the "shortwave band," but it generally extends from the high end of the medium-frequency (MF) band to the end of the high-frequency (HF) band. Radio waves in the shortwave band are reflected off the ionosphere, which means they can be directed at certain angles that allow them to travel long distances, unlike some radio waves that use line-of-sight propagation and travel in straight

An aerial view of WWV. The station broadcasts six frequencies with their own antennas, which are all surrounded by a white fence. The lowest frequency has the tallest antenna, and it requires a flashing strobe to be visible to passing aircraft.

The History of WWV

1919: NIST (then called the National Bureau of Standards) was assigned the call letters "WWV."

1920: The Bureau started testing the station, broadcasting musical concerts on Friday nights, and later broadcasting market news for the Department of Agriculture.

1922: It was decided that the station would transmit standard frequency signals.

1927: WWV started using quartz oscillators to improve the station's output frequency.

1932: The station moved to a Department of Agriculture site near Beltsville, Maryland, where it began broadcasting on 5, 10, and 15 MHz, which it continues to use today.

1936: Musical organizations suggested WWV add the 440 Hz tone (A above middle C), for the sake of tuning instruments.

1940: WWV was destroyed by a fire, but returned to the air in a nearby building 5 days later, using equipment salvaged from the burned station.

1943: A newly built station went on the air.

1944: WWV added the 2.5 MHz frequency as a way of reaching the nearby population. Over the years, the 20, 25, 30, and 35 MHz frequencies were also added to the station's broadcasts, but only 20 MHz is still used.

1945: Standard time announcements were broadcast using telegraphic code.

1948: WWVH opened on the island of Maui in Hawaii. It wasn't until 1968 that WWVH moved to Kauai, due to damage from the ocean. WWV and WWVH broadcast on the same frequencies, so they use different voices for their announcements to help listeners distinguish between the two stations. WWV uses a man's voice, and WWVH broadcasts a woman's voice.

1950: Voice announcements of time were added to WWV.

1963: WWVB opened in Fort Collins, Colorado.

1966: WWV moved from Beltsville, Maryland, to Fort Collins, where it shares land with WWVB. The new site was closer to NIST's labs in Boulder, Colorado, and improved the transmitted frequency with the use of atomic oscillators at the site.

1967: The station switched from transmitting local time to Greenwich Mean Time (GMT), and began transmitting its current format of Coordinated Universal Time (UTC), 1 year later.

1971: WWV started making time announcements every minute, rather than every 5 minutes.

lines. From the HF bands, WWV puts out 2,500 – 10,000 W on several frequencies (each on separate transmitters) to ensure the best possibility of being heard by its millions of listeners through hindrances like atmospheric conditions — conditions altered by the time of day — and interference caused by the seasons. NIST stations use incredibly precise atomic clocks to keep their time signals accurate.

In addition to broadcasting precise time signals, WWVB broadcasts standard frequencies, UT1 time corrections, geophysical alerts, and more. The time-of-day broadcasts can even be heard by calling a dedicated phone number, which receives around 2,000 calls every day. Musicians can actually listen to WWV to tune their instruments, as the station also broadcasts the 440 Hz tone, which is the musical note A above middle C. WWV's signal is so reliable that NIST maintains a web page (**www.nist.gov/time-distribution/radio-station-WWV/WWV-and-WWVh-broadcast-outages**) dedicated to recording the few incidents that

Timing, signal-generation, and transmitting equipment can be found in the radio station's main building.

Inside of WWV.

The helix house that powers WWV's antenna array.

broadcasting has been interrupted for more than 5 minutes, since the year 2000 (on average, it occurs less than twice per year).

WWV and Ham Radio

Thomas Witherspoon, K4SWL, first heard WWV as a child, when his father tuned to the shortwave station to listen to the time broadcasts and manually set his watch every Sunday. "I found the metronomic ticks hypnotic then," Witherspoon said. "And I still do." He founded the charity Ears to Our World (which closed in 2019), that sent shortwave radios to students and teachers in third-world countries, and is currently a blogger for *The SWLing Post* (**https://swling.com/blog**), a website for fans of shortwave radio. As a kid, Witherspoon was amazed that the signal from WWV could be heard on his father's vintage RCA 6K3 console radio from over 2,000 miles away.

When Witherspoon was a child, many hams discovered the hobby through shortwave. Whether they were building a kit, tuning around the bands, or fixing up an old radio, they could rely on WWV's steady signal to confirm that they were receiving signals, and everything was working correctly. Witherspoon was given a Zenith Trans-Oceanic radio by his great aunt when he was 8 years old, leading him to a lifelong love of shortwave listening and an interest in amateur radio. He said, "WWV has been a constant companion in my radio world."

The era of radios like the Zenith has ended, but as technology has evolved, so has amateur radio. Fewer operators are getting their start through shortwave, or even through kit-building or homebrewing, as their predecessors once did. Many operators today are drawn to modern technology, enjoying the convenience of

WWV Chief Engineer Matt Deutch, NØRGT, checks the equipment.

digital modes like FT8 and JT65. As times change, some fear stations like WWV could get left behind.

Averted Closure

In its 2019 fiscal budget to Congress, the Trump administration proposed cutting NIST's budget, which would have resulted in the closure of WWV, among other branches of NIST. Witherspoon explained at the time, "If WWV and WWVH were to close, those of us who rely on these stations as a point of reference for time, as well as propagation, navigation, astronomy, and receiver calibration, would have to find alternatives."

As technology has advanced, innumerable devices now rely on the internet and Global Positioning System (GPS) signals for timekeeping, making some see WWV as a relic of the past. However, the use of GPS and the internet for timekeeping has downsides. Unlike GPS, WWVB's low-frequency signal can reach clocks and watches inside buildings without issue. The

internet already syncs with millions of devices automatically, but it's dependent on the availability of a signal. Both could fail in times of emergency, whereas WWV would still be functional.

The devices reliant on WWVB are inexpensive, don't require much power, and work without an internet connection. Witherspoon compared these options by explaining that his bedside alarm clock automatically adjusts to WWVB and only requires two AA batteries for around 2 years of functionality, while his GPS-enabled Apple Watch needs to be charged every 2 days and must have an unobstructed signal to satellites in order to work.

The Fate of WWV

Time hasn't run out for WWV just yet. WWV and its companion stations remained open throughout the 2019 fiscal year. Gail Porter, retired Director of Public Affairs for NIST, explained, "The Consolidated Appropriations Act of 2019 provided $724.5 million for NIST's Scientific and Technical Research and Services, the budget category that funds the radio stations." More information about the legislation that funded WWV and related stations for the 2019 fiscal year can be found at **www.congress.gov/congressional-report/116th-congress/house-report/9/1?overview=closed**.

Commenting on the decision to fully fund WWV, Witherspoon said it was "possibly an indication that the radio community's voices were heard by those making budget decisions."

The Northern Colorado Amateur Radio Club (NCARC) worked with NIST to organize WWV's centennial celebration. NIST hosted a small event on October 1, 2019, while NCARC operated special event station WWØWWV on station property. After 100 years, it's clear that whatever WWV's place is in annual budgets, it will always have a place in radio history.

All photos courtesy of NIST.

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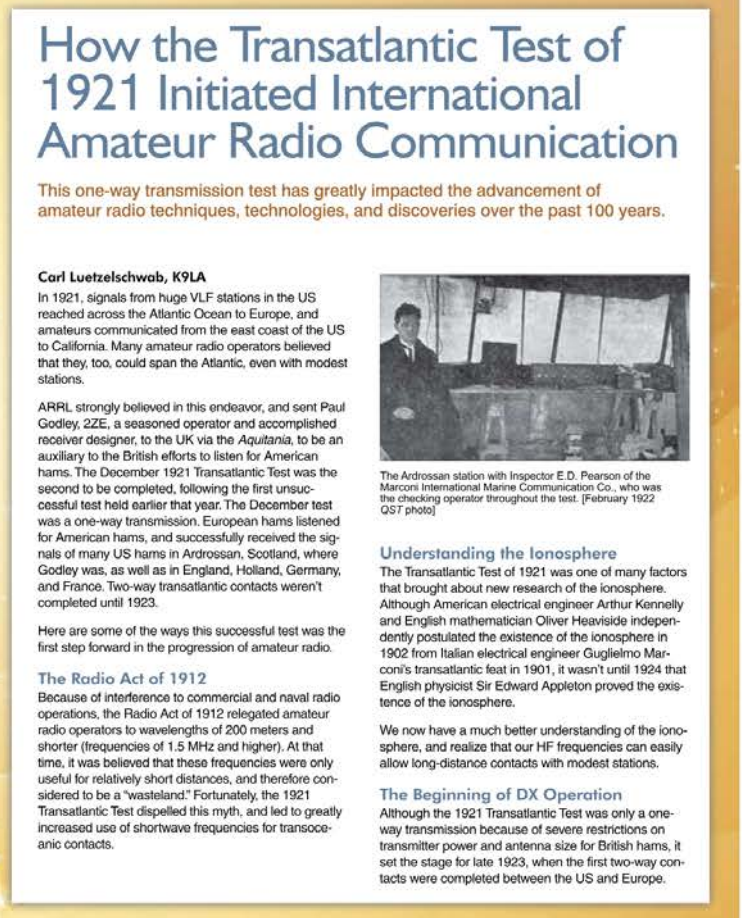
For updates to this article, see the *QST* Feedback page at www.arrl.org/feedback.



How the Transatlantic Test of 1921 Initiated International Amateur Radio Communication

This one-way transmission test has greatly impacted the advancement of amateur radio techniques, technologies, and discoveries over the past 100 years.

Carl Luetzelschwab, K9LA

In 1921, signals from huge VLF stations in the US reached across the Atlantic Ocean to Europe, and amateurs communicated from the east coast of the US to California. Many amateur radio operators believed that they, too, could span the Atlantic, even with modest stations.

ARRL strongly believed in this endeavor, and sent Paul Godley, 2ZE, a seasoned operator and accomplished receiver designer, to the UK via the *Aquitania*, to be an auxiliary to the British efforts to listen for American hams. The December 1921 Transatlantic Test was the second to be completed, following the first unsuccessful test held earlier that year. The December test was a one-way transmission. European hams listened for American hams, and successfully received the signals of many US hams in Ardrossan, Scotland, where Godley was, as well as in England, Holland, Germany, and France. Two-way transatlantic contacts weren't completed until 1923.

Here are some of the ways this successful test was the first step forward in the progression of amateur radio.

The Radio Act of 1912

Because of interference to commercial and naval radio operations, the Radio Act of 1912 relegated amateur radio operators to wavelengths of 200 meters and shorter (frequencies of 1.5 MHz and higher). At that time, it was believed that these frequencies were only useful for relatively short distances, and therefore considered to be a "wasteland." Fortunately, the 1921 Transatlantic Test dispelled this myth, and led to greatly increased use of shortwave frequencies for transoceanic contacts.

The Ardrossan station with Inspector E.D. Pearson of the Marconi International Marine Communication Co., who was the checking operator throughout the test. [February 1922 *QST* photo]

Understanding the Ionosphere

The Transatlantic Test of 1921 was one of many factors that brought about new research of the ionosphere. Although American electrical engineer Arthur Kennelly and English mathematician Oliver Heaviside independently postulated the existence of the ionosphere in 1902 from Italian electrical engineer Guglielmo Marconi's transatlantic feat in 1901, it wasn't until 1924 that English physicist Sir Edward Appleton proved the existence of the ionosphere.

We now have a much better understanding of the ionosphere, and realize that our HF frequencies can easily allow long-distance contacts with modest stations.

The Beginning of DX Operation

Although the 1921 Transatlantic Test was only a one-way transmission because of severe restrictions on transmitter power and antenna size for British hams, it set the stage for late 1923, when the first two-way contacts were completed between the US and Europe.

Rick Lindquist, WW1ME, ww1me@arrl.org

Happenings

ARRL and RSGB Announce Winners of Transatlantic Centenary Cups

ARRL and the Radio Society of Great Britain (RSGB) have announced the winners of the 160-Meter Transatlantic Centenary QSO Party. The December 12 on-air event commemorated the 100th anniversary of the successful Second Transatlantic Tests that contributed to the dawn of international amateur radio communication. Participating stations operating on CW attempted to contact the two official call signs: W1AW at the Hiram Percy Maxim Memorial Station and GB2ZE, activated by a team of stations in Scotland. GB2ZE commemorated the call sign of Paul Godley, 2ZE, who was on the receiving end of the 1921 tests sent by ARRL to Scotland.

The GMDX Group of Scotland announced that it would award a *quaich* — a traditional Scottish drinking cup representing friendship — to the first stations in North America and the UK, including the Crown Dependencies, to complete contacts with both W1AW and GB2ZE during the QSO Party.

ARRL CEO David Minster, NA2AA (left), greets Bruce Godley Littlefield, grandson of Paul Godley, 2ZE, with the original ARRL resolution recognizing Godley for the success of the December 1921 Transatlantic Tests, and the hand-painted derby hat won by ARRL Secretary K. B. Warner, W1EH, who had bet that US signals would be heard in Europe during the tests. Littlefield presented ARRL with a copy of the resolution.

The cup winners were Rick Niswander, K7GM, and Bob Barden, MDØCCE.

Logs from those taking part in the 6-hour event included 496 contacts, of which 261 were from W1AW. Each participant that was recorded in the official W1AW and/or GB2ZE logs is eligible for a commemorative certificate designed by ARRL and RSGB (**https://contests.arrl.org/transatlantic2021.php**). Participants don't have to submit their logs.

During the event, W1AW enjoyed a visit from Bruce Godley Littlefield, Paul Godley's grandson. Littlefield presented ARRL CEO David Minster, NA2AA, with a full-size, gallery-quality copy of the resolution that ARRL awarded to his grandfather in 1922 for his historic achievement of engineering and operating the receiving system installed in Ardrossan, Scotland, where the first amateur signals were successfully heard from North America.

ARRL Welcomes New Director of Emergency Management

ARRL has announced that Josh Johnston, KE5MHV, is the new Director of Emergency Management. Johnston, from Ozone, Arkansas, comes to ARRL with 16 years of experience as the Director of Johnson County (Arkansas) Department of Emergency Management. He holds an Amateur Extra-class license and is an Amateur Radio Emergency Service® (ARES®) Emergency Coordinator, Volunteer Examiner, and ARRL-registered Instructor. Johnston is also certified in the Federal Emergency Management Agency's (FEMA) National Incident Management System (NIMS) and is a Cybersecurity and Infrastructure Security Agency (CISA) AUXCOMM Communications Unit Leader. He holds a bachelor's degree in emergency administration and management from Arkansas Tech University.

Josh Johnston, KE5MHV

"I am happy to welcome Josh to the ARRL staff and to add his talent and knowledge to our team," said ARRL CEO David Minster, NA2AA. "His contribution will help ARRL continue to support our dedicated volunteers of the Amateur Radio Emergency Service, improve opportunities for training, and advance our relationships throughout the EmComm community."

With extensive experience in interagency cooperation and planning, Johnston is well versed in the different aspects of emergency management and leading both professional and volunteer operators. He has experience in communications planning and execution in the field and at the local and state level. As an Arkansas Master Certified Emergency Manager and past Board Member of Arkansas Emergency Management Association, where he served as president for 2 years, Johnston has experience working with government and agency representatives, as well as being boots-on-the-ground in the field.

Johnston will work with ARRL Headquarters staff and member-volunteers, and coordinate with the ARRL Board's new Emergency Communications and Field Services Committee.

Past ARRL Chief Development Officer Mary Hobart, K1MMH, SK

Retired ARRL Chief Development Officer Mary Hobart, K1MMH, of Ardmore, Pennsylvania, died on December 12. An ARRL member, she was 78.

From the time she arrived at ARRL Headquarters, Hobart served enthusiastically as ARRL's Chief Development Officer, developing relationships that helped to grow the ARRL Endowment. One individual she invited into the ARRL fold of regular supporters was Joe Walsh, WB6ACU, of the Eagles.

Born in Washington, DC, she attended the National Cathedral School and Northwestern University in Chicago. After school, she moved to Philadelphia to raise her two sons as a single mother while working in nonprofit development — notably at the Philadelphia Zoo, WHYY, and NJN.

Hobart relocated to New England to work in development at Connecticut Public Television (CPTV) and then at ARRL.

During her 13 years at ARRL Headquarters, she was behind the creation of The Diamond Club, The Diamond Club Terrace, The Maxim Society, and the Second Century Campaign, among other initiatives. She served as secretary of the ARRL Foundation and was a promoter of the ARRL Spectrum Defense Fund.


Mary Hobart, K1MMH

"Because of her efforts and those of her staff, she has raised millions of dollars for ARRL and, ultimately, for the benefit of Amateur Radio," ARRL Chief Operating Officer Harold Kramer, WJ1B, said in the August 2014 issue of *QST*.

She also was one of the founders of the successful ARRL Teachers Institute on Wireless Technology. Funded by voluntary contributions, the annual summer workshops help to better acquaint classroom teachers and educators with wireless technology and the science behind it.

She retired from ARRL in 2014, moving back to the Philadelphia area to be closer to family.

Hurricane Watch Net Recorded 300 On-Air Hours in 2021

Hurricane Watch Net (HWN) Manager Bobby Graves, KB5HAV, says 2021 was the third most-active hurricane season on record in terms of named storms, and was the sixth consecutive above-normal season.

"For the year, we had 21 named storms, seven of which became hurricanes, and four of those became major hurricanes — Category 3 or stronger," Graves said. He noted that 2021 marked the first year on record that two consecutive hurricane seasons exhausted the list of 21 storm names.

Tropical systems that made landfall caused a total estimated damage of $70 billion, as of the end of November, making 2021 the fourth most costly hurricane season on record, behind 2012, 2005, and 2017.

In 2021, the HWN activated for five hurricanes — Elsa, Grace, Henri, Ida, and Larry. Graves said the HWN racked up nearly 300 hours on the air, with 140 of those devoted entirely to Hurricane Ida.

The HWN membership is strategically dispersed across North America, throughout the Caribbean Sea, Central America, and the northern coast of South America. Its primary mission is to disseminate tropical cyclone advisory information to island communities in the Caribbean, Central America, along the Atlantic Seaboard of the US, and throughout the Gulf of Mexico coastal areas. It also gathers observed or measured weather data via amateur radio from operators in storm-affected areas — as well as any post-storm damage — and conveys that information to National Hurricane Center (NHC) forecasters via WX4NHC.

Interim SM Appointments Made

David Benoist, AG4ZR, of Senoia, Georgia, was appointed in December as ARRL Georgia Section Manager (SM). In consultation with ARRL Southeastern Division Director Mickey Baker, N4MB, ARRL Field Services Manager Mike Walters, W8ZY, appointed Benoist to fill the post, which was left vacant after Jim Millsap, K9APD, resigned, effective December 14. He had served since October 1, 2021. Benoist had previously served as Georgia SM from 2016 to 2021, and was the ARRL Georgia Section Emergency Coordinator from March 2014 to 2016.

Joseph M. Grib, Jr., KI3B, was appointed in December to fill the role of Delaware SM on an interim basis. A DuPont retiree, Grib lives in Bear, Delaware, and is active in the local repeater association. Grib is an avid CW operator, but also enjoys other modes. Grib's appointment was effective on December 31, 2021, when the term of now-former SM Mark Stillman, KA3JUJ, ended. Grib will serve in the role at least until July 1, 2022. ARRL is soliciting candidates for Delaware SM, and nominating petitions are due by March 4, 2022.

Carl Clements, W4CAC, was appointed as ARRL Virginia SM by ARRL Field Services Manager Mike Walters, W8ZY, following the death of Joseph Palsa, K3WRY, last fall. The position will be filled on a permanent basis in a Virginia SM election, which is now under way. The winner of the SM election will assume office on April 1, 2022. Clements previously served as Virginia's SM from 2005 to 2006 and 2008 to 2015.

ARRL Foundation Grants First-Year Funding for ARISS *STAR* Keith Pugh Initiative

A $47,533 ARRL Foundation grant will fund the initial phase of the Amateur Radio on the International Space Station (ARISS-USA) *STAR* Keith Pugh Memoriam Project. *STAR*, which stands for Space Telerobotics using Amateur Radio, honors the memory of Keith Pugh, W5IU, a highly respected member of the ARISS team who died in 2019. A long-time and enthusiastic supporter of ARISS, Pugh was a star ARISS technical mentor, assisting schools with ARISS contacts, encouraging interest in ARISS among educators, and visiting schools to teach students about wireless technology.

The ARISS *STAR* Project will enable US junior and senior high school groups to remotely control robots via ham radio through digital APRS (Automatic Packet Reporting System) commands. Year 1 will focus on systems development and initial validation of ARISS *STAR*, and year 2 will focus on evaluation and final validation.

Keith Pugh, W5IU, SK

Systems development and evaluation will be led by university staff and students who will undertake hands-on wireless and telerobotics lesson development, learn about amateur radio, and support *STAR* engineering hardware and software development.

In the process, ARISS will encourage students to prepare for and earn an FCC amateur radio license, enabling them to use ham radio to learn and practice concepts in radio technology and radio communication.

ARISS-USA Executive Director Frank Bauer, KA3HDO, praised the ARRL Foundation for its generosity. "ARISS team member Keith Pugh, W5IU, poured his energy into inspiring, engaging, and educating youth in space and in amateur radio endeavors," Bauer said. "Maybe someday one of our ARISS *STAR* students will use their telerobotics skills to control scientific rovers on the moon or Mars!"

The ARRL Foundation was established in 1973, to advance the art, science, and social benefits of the Amateur Radio Service by awarding financial grants and scholarships to individuals and organizations that support their charitable, educational, and scientific efforts.

Rick Palm, K1CE, k1ce@arrl.net

New England Digital Emergency Communications Network Contributes to Region's Tradition of Service

While Florida, the Gulf Coast, the Atlantic Seaboard, California, and the Great Plains, among others, are regions widely known to be prone to major weather-related disasters, New England is underestimated as a region that experiences severe weather. However, it bears the brunt of nor'easters — horrific (and often historic) blizzards and ice storms.

The New England amateur radio community is proud of its history with the Amateur Radio Emergency Service® (ARES®), as well as SKYWARN® and other National Weather Service (NWS) programs. One of the most well-known is at the WX1BOX SKYWARN station, with its trained operators under the longtime leadership of Rob Macedo, KD1CY, at the NWS Forecast Office in Boston/Norton, Massachusetts, but there are many other programs serving New England. Programs have used Digital Smart Technology for Amateur Radio (D-STAR), *EchoLink*, and Internet Radio Linking Project (IRLP) nodes, along with the more traditional HF and VHF FM and SSB modes for weather-related emergency communications, observations, and reporting.

A New England EmComm Network

Contributing to the region's amateur radio tradition of service that supports weather observation and warning systems, other sectors, and ultimately the public, is the New England Digital Emergency Communications Network (NEDECN). NEDECN created a Digital Mobile Radio (DMR)-based system. There are SKYWARN talkgroups around the country on DMR and System Fusion networks, and several have been running on D-STAR for years. Hotspots (internet gateways to a particular DMR network) offer several advantages for public service, as they are highly portable, consume less power, and are acceptable to most homeowner's associations. Additionally, they increase the coverage for served agencies, are easy to set up, and have a large community of users.

According to its website — **www.nedecn.org** — the NEDECN links almost 100 amateur radio digital repeaters, each with emergency power, facilitating mobile roaming for routine and emergency communications. Communications can be customized for statewide and regional configurations using talkgroups and time slots.

Paul Koplow, WA1VEI, checks into the NEDECN SKYWARN Net via a Boston DMR repeater. [Paul Koplow, WA1VEI, photo]

The NEDECN is an umbrella organization that supports local amateur radio groups throughout the region with the funding needed to expand the network and enhance local communications capabilities. It has served as a platform for radio communications for the Boston Marathon, the Vermont 100, the New Hampshire State Emergency Operations Center (EOC), and the SKYWARN/NWS Forecast Office in Gray/Portland, Maine, among others. It focuses on emergency preparedness by encouraging repeater sites to be powered by backup battery and generator power sources. It also serves as a training ground for technicians and communicators.

Every Thursday from 7:30 – 8 PM local time, the SKYWARN DMR Net convenes on SKY TG 759, where there's timely reporting and discussion of weather events and reporting procedures. The Gray/Portland, Maine, NWS Office forecasters will periodically ask for SKYWARN weather observations from the net check-ins, which usually occurs at the conclusion of a storm event. If any observers have a significant report during a weather event, such as a sighting of a funnel cloud or trees that are down, net members call it in to SKY TG 759. In the event of widespread multiple severe-weather incidents noted by NWS Forecast Offices throughout the region (such as the offices of Gray, Maine; Norton, Massachusetts; Burlington, Vermont, and/or Albany, New York), communications shift to statewide talkgroups, as appropriate.

History of the NEDECN

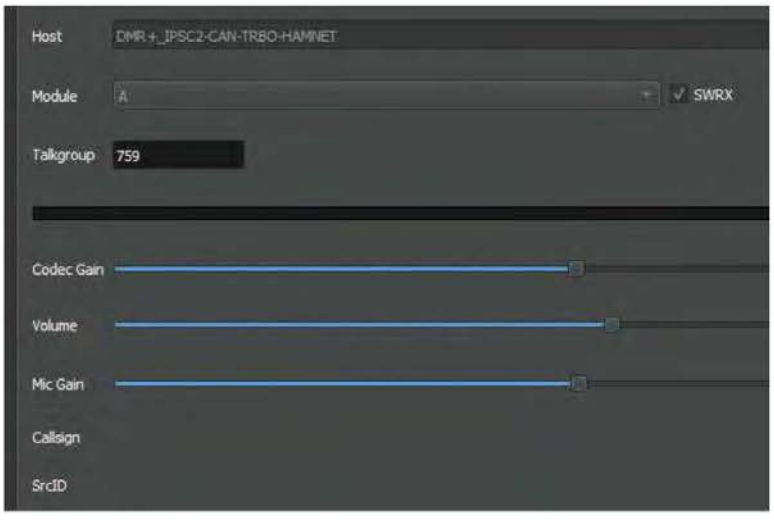
In 2011, one of the founders of the NEDECN, Mike Bernock, N1IW (SK), worked with Bill Barber, NE1B, to experiment with the new amateur radio DMR technology. A retired Motorola Solutions engineer, Barber envisioned putting together the first New England-wide area DMR system. Bernock, who was a communications engineer for The MITRE Corporation, became the sounding board and technical consultant for the network. All of Bernock's ham radio gear was used to fund the expansion of this digital network, per his request prior to his death in 2014. This funding became the resource for building more than 20 repeaters in New Hampshire and Massachusetts.

Accessing DMR Networks

DMR is a Motorola-defined standard for two-way radio that allows other manufacturers to develop radios for use on the global DMR network of repeaters and users. It was designed with low complexity and cost to allow users to choose from a wide array of radios, eliminating a proprietary system that would lock users into a limited catalog of radios and a system that would be costlier to run and maintain.

Operators can communicate with each other directly (regionally and locally) via radio-to-radio or the worldwide network of repeaters connected by the internet. Most activity involves the 70-centimeter band. There are several ways to connect to the network: using a radio to connect to a local repeater in range of the radio, using a radio and RF to connect via a hotspot location and a USB (Universal Serial Bus) device connected to a laptop, or you can even connect without a radio — all you need is computer software. I use *DUDE-Star* (**www.radioamateur.us/dude-star-software**), which was developed by Douglas McLain, AD8DP, to connect to the DMR network. The software connects to D-STAR, System Fusion, NXDN (Next Generation Digital Narrowband), P25, AllStarLink, and, reportedly, even to the new digital mode M17. I found it quick and easy to download, set up, and run.

If you use a hotspot, you'll want to connect and configure the internet (typically Wi-Fi) to a laptop, and use a radio to "talk" to it. Your transmission is sent to the internet by your software and chosen DMR talkgroup or node. The DMR network uses a series of talkgroups (which are numbered) for special interests and regions, large and small, much like checking into a regional HF traffic handling net, or local area VHF FM net.



A screenshot of the *DUDE-Star* program's main operating page. The program connects to reflectors and repeaters via the User Datagram Protocol (UDP).

Field Organization Reports

December 2021

Public Service Honor Roll

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

567	177	121	WB8SIQ	85
WA7PTM	KK7GXG	W4TTO	K3RC	KU1U
	KD2LPM		AC8RV	W8GSR
455		120	K3YAK	
N9VC	175	WC4FSU	W3CJD	84
	AI9F	AG9G	AA3SB	KT4WX
450		KA9MZJ	KB1NMO	N3JET
W9GRG	165	WA4VGZ	AK2Z	
	W2PH	KA9QWC	KB2YAA	83
435	WO2H	KB8PGW	W2ZXN	KC1HHO
WA3EZN	K3JL	KY2D	N1LAH	WA1LPM
		NA7G	KD2JKV	
379	160	N7IE		82
KE8BYC	N5MKY		96	KR2HWK
	WD8USA	119	K1HEJ	
365		N1IQI		80
AD8CM	159		95	AJ7B
	WM2C	115	KT5SR	KF7GC
358		N1TF	K1XFC	KR4ST
W7PAT	156			W2ITT
	KM8V	113	92	W9BGJ
322		KB1TCE	KB3IN	KB1NAL
KB3YRU	150		KF0BPN	KC1GSL
	N4CNX	112		
320		WA1URS	90	79
W7EES	147		AA7BM	K0FBS
	W9RY	111	KJ7BHO	KN4AAG
314		K8MDA	AD4DO	K2VTT
AB9ZA	145		KM4WHO	
	W4DNA	110	KB9GO	77
300	N1UMJ	KE4DRF	N2TSO	N3RB
N2LC		K3FAZ	N4ZM	
	142	WA0QLW	WX2DX	76
296	KB5PGY	KO4OL	WB2JNQ	KB0DTI
W0PZD		KC8WH	K0WAV	KD8UOT
	140	AC8NP	AA3N	W3ZR
292	WB9QPM	WB8TQZ	W4KX	N3ARB
KE8KOC	N3KRX	KB2QO	WB4ZDU	
	K4IWW	W2AH	KL7RF	75
285	KD8UUB	K6HTN	K8KRA	K2BNY
ND8W	AB8MW	N3SW	N8MRS	KD2QAR
	KK3F	W1RVY	KB8HJJ	
265			KA1G	74
W3GWM	135	107	K8ED	W5XX
	K9LGU	NI2W	KA2HZP	
245	N2DW		N3XMB	73
KT2D	W8IM	106	K2EAG	K4FHR
	KD8KBX	KC8T	KC1KVY	K3AUX
238	W3YVQ			KE8DON
WA2CCN		105	89	
	130	W9EEU	KA2GQQ	72
220	WM5N	KD2PQP		W4INX
KB3YYC	N2JBA		88	KB3MXK
W8DJG	AC0KQ	100	N9TU	KA2JFU
	WK4WC	W1KX		KC1MSN
210	N1LL	W4CMH	87	
KD2NMG	KD8ZCM	W2PAX	K1STM	70
	KW1U	WB4RJW		K6RAU
192		KZ8Q	86	K7OED
WV5Q	125	KN9P	WB8YYS	W2ARP
	KC9FXE	NX9K	K8RDN	
185	WB9WKO	KA9IKK	N6IET	
N8SY		K5OB		

The following stations qualified for PSHR in November, 2021, but were not listed in this column yet: K1XFC 169, K0RCJ 165, NA7G 120, N7IE 120, WF2Y 110, WS4P 110, KB1NMO 100, K1HEJ 94, KB0DTI 74.

Section Traffic Manager Reports

The following Section Traffic Managers reported: AK, AR, AZ, CO, CT, DE, EMA, ENY, EPA, IL, IN, KS, KY, LA, LAX, MDC, ME, MI, MS, NC, ND, NFL, NLI, NM, NNJ, NV, OH, OR, SD, SFL, SJV, STX, TN, UT, WCF, WI, WMA, WNY, WPA, WV, WWA, WY.

Section Emergency Coordinator Reports

The following Section Emergency Coordinators reported: AR, ENY, EPA, KY, MDC, MI, MO, MS, ND, NFL, NLI, NNJ, NNY, NV, OH, SNJ, STX, UT, VA, VI, WCF, WPA, 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.

KY2D 2,156, KK3F 2,000, NX9K 1,557, WB9WKO 964, N9CK 942, K6HTN 921, KW1U 636, AG9G 544, KB8PGW 511.

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

Contest Corral

March 2022

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

Start - Finish Date-Time		Date-Time		Bands	Contest Name	Mode	Exchange	Sponsor's Website
1	1900	1	2100	3.5	AGCW YL-CW Party	CW	RST, serial, "YL" (if a YL), name	agcw.de/contest/yl-cw-party
2	1300	2	1400	1.8-28	CWops Mini-CWT Test	CW	Name, mbr or SPC	cwops.org/cwops-tests
2	1700	2	2000	144	VHF-UHF FT8 Activity Contest	Dig	4-char grid square	ft8activity.eu/index.php/en
2	1900	2	2000	1.8-28	CWops Mini-CWT Test	CW	Name, mbr or SPC	cwops.org/cwops-tests
2	2000	2	2100	3.5	UKEICC 80-Meter Contest	Ph	6-char grid square	ukeicc.com/80m-rules.php
2	2300	6	2300	3.5-14	AWA Rollins Memorial DX Contest	CW	RST, equipment type and year	antiquewireless.org
3	0000	4	0300	7	Walk for the Bacon QRP Contest	CW	RST, SPC, name, mbr or power	qrpcontest.com/pigwalk40
3	0300	3	0400	1.8-28	CWops Mini-CWT Test	CW	Name, mbr or SPC	cwops.org/cwops-tests
3	0700	3	0800	1.8-28	CWops Mini-CWT Test	CW	Name, mbr or SPC	cwops.org/cwops-tests
3	1800	3	2200	28	NRAU 10-Meter Activity Contest	CW Ph Dig	RS(T), 6-char grid square	nrrlcontest.no
3	2000	3	2200	1.8-50	SKCC Sprint Europe	CW	RST, SPC, name, mbr or "none"	www.skccgroup.com
4	0145	4	0215	1.8-21	NCCC RTTY Sprint	Dig	Serial, name, QTH	www.ncccsprint.com
4	0230	4	0300	1.8-21	NCCC Sprint	CW	Serial, name, QTH	www.ncccsprint.com
4	2000	4	2100	1.8-28	K1USN Slow Speed Test	CW	Name, SPC (max 20 WPM)	www.k1usn.com/sst.html
5	0000	6	2359	1.8-28	ARRL International DX Contest, SSB	Ph	W/VE: RS, SP; DX: RS, power	www.arrl.org/arrl-dx
5	0000	13	2359	Novice bands	Novice Rig Roundup	CW	Name, QTH; Optional: Rig	www.novicerigroundup.org
5	0600	5	0800	7, 14	Wake-Up! QRP Sprint	CW	RST, serial, suffix of previous QSO	qrp.ru/contest/wakeup
5	1800	6	1359	1.8-28	Open Ukraine RTTY Championship	Dig	State/province/canton/etc., serial	krs.ho.ua/openrtty
6	0700	6	1100	3.5	UBA Spring Contest, CW	CW	RST, serial, UBA section (if ON)	www.uba.be
6	1200	6	1400	7	SARL 40-Meter Simulated Emergency Test	Ph	RS, serial	www.sarl.org.za
6	1200	6	2200	3.5	NSARA Contest	CW Ph Dig	RS(T), Nova Scotia county or serial	nsara.ve1cfy.net/?page_id=82
6	1800	6	2200	3.5	WAB 3.5 MHz Phone	Ph	RS, serial, WAB square or country	wab.intermip.net/Contests.php
7	0000	7	0100	1.8-28	K1USN Slow Speed Test	CW	Name, SPC (max 20 WPM)	www.k1usn.com/sst.html
7	1630	7	1729	3.5, 7	OK1WC Memorial (MWC)	CW	RST, serial	memorial-ok1wc.cz
7	2000	7	2130	3.5	RSGB 80-Meter Club Championship, Digital	Dig	RST, serial	www.rsgbcc.org/hf
8	0200	8	0400	3.5-28	ARS Spartan Sprint	CW	RST, SPC, power	arsqrp.blogspot.com
12	0000	12	2359	3.5-28	YB DX RTTY Contest	Dig	RST, serial	rtty.ybdxcontest.com
12	1000	13	1000	3.5-28	RSGB Commonwealth Contest	CW	RST, serial	www.rsgbcc.org/hf
12	1200	13	1200	28	South America 10 Meter Contest	CW Ph	RS(T), CQ zone	sa10m.com.ar/wp/rules
12	1200	13	2359	1.8-50	SKCC Weekend Sprintathon	CW	RST, SPC, name, mbr or "none"	www.skccgroup.com
12	1400	12	2000	3.5-28	AGCW QRP Contest	CW	RST, serial, pwr class, mbr or "NM"	www.agcw.de/contest/qrp
12	1500	13	1500	1.8	Stew Perry Topband Challenge	CW	4-char grid square	www.kkn.net/stew
12	1500	13	2100	3.5-50	Oklahoma QSO Party	CW Ph	RS(T), OK county or SPC	k5cm.com/okqp.htm
12	1600	13	1600	3.5-28	EA PSK63 Contest	Dig	RSQ, EA province or serial	concursos.ure.es/en/eapsk63
12	1800	13	0559	3.5, 7	TESLA Memorial HF CW Contest	CW	RST, serial, 4-char grid square	www.radiosport.org.rs
12	1900	13	1900	1.8-28	Idaho QSO Party	CW Ph	RS(T), ID county or SPC	pocatelloarc.org/idahoqsoparty
12	2300	13	0300	3.5-14	North American Sprint, RTTY	Dig	Other's call, your call, serial, name, SPC	ncjweb.com
13	0700	13	1100	144	UBA Spring Contest, 2 Meters	CW Ph	RST, serial, UBA section (if ON)	www.uba.be
13	0700	13	1700	3.5-28	FIRAC HF Contest	CW	RST, serial, "F" (if a member)	www.firac.de
13	1800	14	0100	All	Wisconsin QSO Party	Ph	WI county or SPC	www.warac.org/wqp
14	0000	14	0200	1.8-28	4 States QRP Second Sunday Sprint	CW Ph	RS(T), SPC, mbr or power	www.4sqrp.com
14	1630	14	1729	3.5, 7	OK1WC Memorial (MWC)	CW	RST, serial	memorial-ok1wc.cz
15	1700	20	1700	3.5-28	CLARA Chatter Party	CW Ph	RS(T), name, SPC	clarayl.ca/chatter-party
16	2000	16	2130	3.5	RSGB 80-Meter Club Championship, CW	CW	RST, serial	www.rsgbcc.org/hf
17	0000	18	0300	14	Walk for the Bacon QRP Contest	CW	RST, SPC, name, mbr or power	qrpcontest.com/pigwalk20
17	0030	17	0230	3.5-14	NAQCC CW Sprint	CW	RST, SPC, mbr or power	naqcc.info
17	1900	17	2059	3.5	BCC QSO Party	CW Ph Dig	RS(T), T-shirt size	bavarian-contest-club.de/contest
19	0200	21	0159	3.5-28	BARTG HF RTTY Contest	Dig	RST, serial, 4-digit UTC time	www.bartg.org.uk
19	1200	20	1200	1.8-28	Russian DX Contest	CW Ph	RS(T), Oblast or serial	www.rdxc.org
19	1200	20	1200	3.5-144	F9AA Cup, SSB	Ph	RST, serial	www.site.urc.asso.fr
19	1400	19	1800	144, 432	AGCW VHF/UHF Contest	CW	RST, serial, power class, 6-char grid	agcw.de/contest/vhf-uhf
19	1400	20	2359	All	Virginia QSO Party	CW Ph Dig	Serial, VA county or SPC	qsl.net/sterling/VA_QSO_Party
19	2000	19	2159	1.8-28	Feld Hell Sprint	Dig	Mbr, SPC, grid	sites.google.com/site/feldhellclub
20	0700	20	1100	3.5	UBA Spring Contest, SSB	Ph	RS, serial, UBA section (if ON)	www.uba.be
20	2300	21	0100	1.8-28	Run for the Bacon QRP Contest	CW	RST, SPC, mbr or power	qrpcontest.com/pigrun
21	1630	21	1729	3.5, 7	OK1WC Memorial (MWC)	CW	RST, serial	memorial-ok1wc.cz
21	1800	21	2059	3.5, 7	Bucharest Digital Contest	Dig	RST, serial	yo3test201x.blogspot.com
23	0000	23	0200	1.8-50	SKCC Sprint	CW	RST, SPC, name, mbr or "none"	skccgroup.com
24	2000	24	2130	3.5	RSGB 80-Meter Club Championship, SSB	Ph	RS, serial	www.rsgbcc.org/hf
26	0000	26	2359	1.8-VHF	FOC QSO Party	CW	RST, name, mbr (if any)	g4foc.org/qsoparty
26	0000	27	2359	1.8-28	CQ WW WPX Contest, SSB	Ph	RS, serial	cqwpx.com/rules.htm
27	0600	27	1000	50	UBA Spring Contest, 6 Meter	CW Ph	RST, serial, UBA section (if ON)	www.uba.be
28	2000	28	2130	3.5-14	RSGB FT4 Contest	Dig	4-char grid square	www.rsgbcc.org/hf
30	2000	30	2100	3.5	UKEICC 80 Meter Contest	CW	6-char grid square	ukeicc.com/80m-rules.php

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

Bob Raymond, WA1Z, bobraymondwa1z@gmail.com

The 2021 IARU HF World Championship Results

5,211 logs from around the world were submitted for this popular contest, held July 10 – 11, 2021.

The DP7D Team logged over 2,200 contacts during the 2021 IARU HF World Championship, earning a second-place finish in the Multioperator, Single Transmitter category for Germany. The team, shown from front to back, included Holger Hammerschlag, DF1QR; Marco Holleyn, DJ4MH, and Holger Wilhelm, DL9EE. [Holger Hammerschlag, DF1QR, photo]

Full Results Online

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

The next IARU HF World Championship will be held the second full weekend of July (July 9 – 10, 2022).

2021 IARU Special Station Scores

Scoring of IARU station logs provided by World Wide Radio Operators Foundation (WWROF).

IARU Headquarters Stations

Call	Score
TM0HQ	25,640,388
DA0HQ	24,593,730
S50HQ	24,055,135
IO0HQ	22,407,660
SN0HQ	21,054,330
OL1HQ	20,973,210
GR2HQ	19,888,896
9A0HQ	19,634,912
YT0HQ	18,581,724
OF1HQ	17,531,830
EF4HQ	17,380,254
LY0HQ	15,663,327
EM5HQ	14,700,303
E7HQ	14,538,802
OP0HQ	14,245,147
OE0HQ	13,955,157
HG0HQ	10,866,746
YR0HQ	10,306,525
OZ1HQ	10,177,160
UN1HQ	10,165,950
YL4HQ	9,970,520
PA6HQ	8,985,480
SK9HQ	8,457,044
NU1AW	6,073,122
EW5HQ	5,482,026
A60HQ	4,778,576
R0HQ	4,745,472
EI0HQ	4,427,480
LX8HQ	3,968,259
W1AW/KL7	3,830,535
8N0HQ	3,584,008
ER7HQ	3,406,023
B0HQ	3,046,694
L21RCA	2,493,972
LZ0HQ	2,267,065
VA2RAC	1,957,648
Z30HQ	1,730,702
DX0HQ	1,717,969
CR5HQ	1,565,840
SX0HQ	1,558,624
OM1HQ	1,472,196
CX1AA	1,439,018
ES9A	941,704
E2HQ	895,856
HZ0HQ	762,840
OY1CT	532,608
9Y4HQ	526,218
T40HQ	479,050
TC3HQ	464,427
OA4O	352,428
7A2HQ	304,048
PX2HQ	253,894
A71HQ	227,556
9M2A	175,010
9H1MRL	150,784
4L0G	145,770
LN2HQ	140,484
Z60A	116,686
BV30HQ	78,457
VK3WIA	32,650
VU2ZH	10,023
EX9HQ	9,724
HI0HQ	8,760
9V1HQ	8,352
YS1YS	8,300
VR2HK	4,290
HC2GRC	930

IARU Administrative Council Stations

G5W	3,016,516
W5ZN	632,337
PB2T	158,935
YB0AZ	140,491
VE6SH	50,813

IARU R1

SM6EAN	633,798
DJ3HW	609,756

IARU R2

VE3YV	10,277

IARU R3

JA1CJP	192,348
HS1FVL	45,594

Top Ten — US and Canada

Single Operator, Mixed Mode, High Power

K5ZD	2,759,350
VE3AT	2,275,254
NR3X (N4YDU, op)	1,279,680
W6YX (N7MH, op)	1,273,993
KØEJ	1,177,256
WØEWD	809,424
AJ6V	437,523
WQ5L	421,502
K6XX	418,125
KR2Q	269,000

Single Operator, Mixed Mode, Low Power

KU2M	386,828
N8II	342,544
VE3TG	230,184
N2EM	178,434
KØEA	116,768
K5XU	110,638
VE5KS	89,280
K5FUV	75,012
KAØPQW	74,718
K6GHA	69,368

Single Operator, Mixed Mode, QRP

NE5TH	17,056
KKØU	3,795
K2GMY	854
VE2SSS	228
N6HI	224
KT3P	119

Single Operator, Phone Only, High Power

W7WA	1,172,696
W6AFA	192,100
N4MM	97,240
AA8DC	80,984
KE8FT	77,616
K9MWM	76,980
VE3BFU	51,680
WW5L	42,624
VA3ZNQ	42,458
ND1X	32,897

Single Operator, Phone Only, Low Power

VA3NW	94,000
WZ8T	67,628
NG1M	53,268
K5DHY	52,622
KS2G	46,371
KJ4UBL	33,516
VA3TPS	32,832
N6OKU	32,643
VE2HIT	27,324
WA4JA	26,740

Single Operator, Phone Only, QRP

WWØWB	3,900
VA3MYC (VE3LJQ, op)	2,093

Single Operator, CW Only, High Power

ND7K (N6MJ, op @N6WIN)	2,414,192
W1KM	2,117,920
K2ZW	1,936,512
N9RV	1,876,350
N3AD	1,734,853
K1KI	1,615,075
KØRF (WØUA, op)	1,559,180
N2IC	1,541,722
NA8V	1,194,184
AD5A	1,147,192

Single Operator, CW Only, Low Power

K7SV	825,286
W1QK	448,818
W7YAQ	428,940
KØAD	378,500
KM6Z	357,750
WJ9B	331,062
W1NN	288,000
VE3TM	269,205
VE3MA	212,238
N8NA	201,695

Single Operator, CW Only, QRP

NX5M	292,740
K8CN	91,471
N4IJ	91,168
N7RCS	67,450
AI9K	20,787
K2EKM	6,372
AC2YD	5,876
VE3HG	5,642
KD8DNS	4,730
KC4IM	3,256

Single Operator Unlimited, Mixed Mode, High Power

K3MM	1,810,728
K4AB	1,419,330
WB9Z	1,414,842
W1GD	1,170,364
VA3DF	874,888
K3WJV	791,536
WO4O	786,546
KK6P	747,648
VE3RZ	648,613
WA3AAN	416,150

Single Operator Unlimited, Mixed Mode, Low Power

VA2EBI	310,536
KA6BIM	306,307
K9OM	273,512
K4IU	209,844
KI2D	147,400
AD1C	147,320
VE3PJ	135,954
VE3GFN	102,144
K1VU	95,370
WT8WV	67,490

Single Operator Unlimited, Mixed Mode, QRP

AC5O	62,988
K8ZT	17,679
KD9LTN	1,236
W1WBB	1,066
AG4CC	440

Single Operator Unlimited, Phone Only, High Power

W3LL	557,842
N8BI	143,472
AEØMO	137,396
N7ZUF	56,414
W9NZ	54,740
K2ANZ	42,039
KC3D	39,185
VA3LR	31,570
VA3WW	29,670
N5GI	28,770

Single Operator Unlimited, Phone Only, Low Power

N3AAA	108,528
VA3IDD	48,545
W4BTW	29,520
VE3HZ	24,616
KM4IAJ	20,475
KA2KON	18,240
KD2JOE	15,635
KØTJT	10,080
KC3RGK	9,744
WS6K	9,010

Single Operator Unlimited, CW Only, High Power

AA3B	3,493,216
KO7SS	2,821,584
K3WW	2,277,330
NY3A	2,057,370
N4AF	2,004,492
VE3NNT	1,801,250
N5RZ	1,708,630
K3JO (AE2W, op)	1,664,230
N3RS	1,450,592
NT6Q (N5ZO, op)	1,407,627

Single Operator Unlimited, CW Only, Low Power

K1XM	876,360
VE3MGY	676,172
K3IE	628,728
KG9X	569,350
W3KB	537,522
N2YO	402,417
N4XL	373,320
WA1FCN	349,408
VE3YT	296,296
VE1ANU	276,374

Single Operator Unlimited, CW Only, QRP

KJ5T	11,359
KU4A	4,495
WB4OMM	4,356
W7JET	3,614
KW2A	364
KC1DVT	168

Multioperator, Single Transmitter, High Power

N5DX	3,443,553
K5TR	2,408,970
W3UA	2,201,670
K1MM	1,824,999
W7RM	1,752,336
K8AZ	1,232,036
W2Z	886,665
WW4XX	788,172
N5LCC	659,018
WØECC	644,680

Top Ten — Worldwide

Single Operator, Mixed Mode, High Power

CR3DX (OM3GI, op)	5,877,186
UW5Y (US2YW, op)	2,960,640
K5ZD	2,759,350
S53MM	2,458,638
VE3AT	2,275,254
TO5GR (UT5UGR, op)	1,757,154
EA4KD	1,423,072
JH4UYB	1,339,502
NR3X (N4YDU, op)	1,279,680
W6YX (N7MH, op)	1,273,993

Single Operator, Mixed Mode, Low Power

IY3A (IZ3EYZ, op)	1,955,573
MU2K (RL5D, op)	1,832,952
RA3Y	1,101,260
4U1A (HB9RB, op)	868,192
RW4WA	622,750
OM5WW	539,903
PY2NY	518,869
EU2F	458,887
UT3SO	438,783
DL3RHN	435,296

Single Operator, Mixed Mode, QRP

LY5G	474,100
HA7UI	308,464
HA5BA	273,792
UR5FEO	196,175
R2PU	193,590
HG6C (HA6IAM, op)	177,177
OK7CM	136,948
PC2F	124,405
9A2EY	80,625
UT5EOX	64,752

Single Operator, Phone Only, High Power

F8KGM (F5USK, op)	1,392,768
EU1W	1,380,730
W7WA	1,172,696
EA3CI	1,141,077
RA3OA	1,099,400
ED3C (EA3IBV, op)	1,026,640
A65BB	664,960
RW9LL	600,903
DF2F (DF2SD, op)	552,948
F5LIW	470,400

Single Operator, Phone Only, Low Power

9A3B (9A2VR, op)	647,942
EA8AM	431,028
PA2TMS	426,312
TA3DE	256,207
EA6AMM	254,016
OE1HHB	251,738
IV3ZYB	220,761
RC7KY	217,128
DM2BR	198,562
CT2IMG	197,284

Single Operator, Phone Only, QRP

DL8LR	137,104
OM3KHT (OM7ANT, op)	67,716
HB9EGA	67,365
TG9ANF	40,491
SP4LVK	37,944
OZ/SO2U (SP2UUU, op)	30,885
HA1TI	28,320
UR7TV	27,579
9A4OP	25,026
DKØBM (DK7CH, op)	21,185

Single Operator, CW Only, High Power

EA8RM	4,949,913
EA6FO (EA3M, op)	3,527,619
RT5Z (RA3CW, op)	2,793,380
KP2M (KT3Y, op)	2,484,075
ND7K (N6MJ, op @N6WIN)	2,414,192
W1KM	2,117,920
K2ZW	1,936,512
N9RV	1,876,350
N3AD	1,734,853
K1KI	1,615,075

Single Operator, CW Only, Low Power

4Z4AK	1,650,068
K7SV	825,286
OM7RU	714,611
YL5W (YL2GN, op)	714,175
OK1CZ	695,019
UF5A	693,966
LB6GG	650,540
HB9ARF	626,628
RA3YDA	592,900
OK2MBP	575,824

Single Operator, CW Only, QRP

DK7HA	400,338
NX5M	292,740
DL8MBS	203,448
LZ2RS	199,100
HG3C (HA3HX, op)	170,800
YL3FW	151,164
OZ7BQ	132,125
K8CN	91,471
N4IJ	91,168
ON6PJ	87,854

Single Operator Unlimited, Mixed Mode, High Power

R2AA	4,287,360
US1Q (UR5IFB, op)	4,088,144
4X6FR	3,898,782
HA5JI	3,631,236
YT5A	2,808,157
K3MM	1,810,728
RW9DX	1,712,430
RA6CA	1,565,550
K4AB	1,419,330
WB9Z	1,414,842

Single Operator Unlimited, Mixed Mode, Low Power

UR6EA	1,659,812
LZ3ZZ	1,581,250
ED1R	832,284
SE4E (SM4DQE, op)	756,674
RW4W	716,870
R5AJ	640,343
HA5PP	590,287
US7IY	587,799
HA6PJ	518,518
DM7EE	502,605

Single Operator Unlimited, Mixed Mode, QRP

DK3WE	804,572
DDØVS	110,387
YU1LM	77,616
AC5O	62,988
IZ3NVR	62,424
DJ3EI	44,100
PC5D	43,363
DKØRPO (DF7IS, op)	29,316
K8ZT	17,679
SP9RQH	10,317

Single Operator Unlimited, Phone Only, High Power

HA3NU	2,447,175
OR1X	1,808,928
SO9I (SQ9ORQ, op)	1,806,931
CR6K (CT1CJJ, op)	1,790,085
LY5W	1,345,508
ED8W (EA8DO, op)	1,205,184
OH6LI	1,149,320
IKØPHY	1,101,600
DL7BC	843,840
OL7T	734,048

Single Operator Unlimited, Phone Only, Low Power

ES6RW	861,039
HGØR (HAØNAR, op)	845,614
UR2Y	680,175
YO7SR	587,664
SV3RPQ	348,096
HI8RD	335,385
SOØN (SQ9CNN, op)	288,708
EW7B	270,930
UA9R	257,920
SO7E	239,259

Single Operator Unlimited, Phone Only, QRP

EA3O	227,532
UZ7M (UT9MZ, op)	227,180
YO8WW	209,032
HG6V (HA6IHA, op)	112,413
LY2BGP	4,263
IW3GST	2,080
SY2COB	1,188
EA5JDG	198

Single Operator Unlimited, CW Only, High Power

EA2W	5,015,544
ES5RR	3,869,383
IR2Q (IK2PFL, op)	3,763,766
AA3B	3,493,216
P44W (W2GD, op)	3,461,120
UW1M	3,396,096
RT9A	3,194,016
YU5R (YT2AAA, op)	2,947,200
P3X (5B4AMM, op)	2,914,051
S53A	2,852,345

Single Operator Unlimited, CW Only, Low Power

R8CT	2,125,508
HG5D (HA8QZ, op)	1,942,500
RG5A	1,795,842
UT4LW	1,761,420
SN7O (SP7IVO, op)	1,684,980
UT5EO	1,665,990
DL3JAN	1,586,410
RC9A	1,578,006
OL5Y	1,572,826
HA6NL	1,079,262

Single Operator Unlimited, CW Only, QRP

RM5F	628,506
LZ6E	543,095
G4ENZ	461,244
HG5O (HA5OB, op)	203,476
JH7VHZ	163,254
PE2K	101,152
US5EFU	57,820
DJ7PRM	48,980
RT4W	38,985
OK2TSG	33,567

Multioperator, Single Transmitter, High Power

RM9A	6,233,612
RU1A	5,578,804
LZ5R	4,875,600
UA4M	4,760,484
HG6N	3,746,580
UA4S	3,583,205
N5DX	3,443,553
IR4M	3,442,069
RT2C	3,377,920
R8IZ	3,189,984

Regional Leaders

Boxes list call sign, score, and class: MSHP = Multioperator, Single Transmitter, High Power; SO-CW-HP = Single Operator, CW Only, High Power; SO-CW-LP = Single Operator, CW Only, Low Power; SO-CW-QRP = Single Operator, CW Only, QRP; SO-MIX-HP = Single Operator, Mixed Mode, High Power; SO-MIX-LP = Single Operator, Mixed Mode, Low Power; SO-MIX-QRP = Single Operator, Mixed Mode, QRP; SO-PH-HP = Single Operator, Phone Only, High Power; SO-PH-LP = Single Operator, Phone Only, Low Power; SO-PH-QRP = Single Operator, Phone Only, QRP; SOU-CW-HP = Single Operator Unlimited, CW Only, High Power; SOU-CW-LP = Single Operator Unlimited, CW Only, Low Power; SOU-CW-QRP = Single Operator Unlimited, CW Only, QRP; SOU-MIX-HP = Single Operator Unlimited, Mixed Mode, High Power; SOU-MIX-LP = Single Operator Unlimited, Mixed Mode, Low Power; SOU-MIX-QRP = Single Operator Unlimited, Mixed Mode, QRP; SOU-PH-HP = Single Operator Unlimited, Phone Only, High Power; SOU-PH-LP = Single Operator Unlimited, Phone Only, Low Power, and SOU-PH-QRP = Single Operator Unlimited, Phone Only, QRP.

West Coast Region

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

W6YX (N7MH, op)		
	1,273,993	SO-MIX-HP
AJ6V	437,523	SO-MIX-HP
K6XX	418,125	SO-MIX-HP
KS7T	73,780	SO-MIX-HP
N7RK	35,496	SO-MIX-HP
K6GHA	69,368	SO-MIX-LP
KA7T	52,982	SO-MIX-LP
WA7BNM	40,690	SO-MIX-LP
WN6W	20,900	SO-MIX-LP
W7WSV	15,510	SO-MIX-LP
K2GMY	854	SO-MIX-QRP
N6HI	224	SO-MIX-QRP
W7WA	1,172,696	SO-PH-HP
W6AFA	192,100	SO-PH-HP
KE8FT	77,616	SO-PH-HP
AI6LY	9,384	SO-PH-HP
N7WS	7,425	SO-PH-HP
WZ8T	67,628	SO-PH-LP
N6OKU	32,643	SO-PH-LP
K7HKR	7,194	SO-PH-LP
N7ESU	2,688	SO-PH-LP
NS7U	1,740	SO-PH-LP
ND7K (N6MJ, op @N6WIN)		
	2,414,192	SO-CW-HP
N9RV	1,876,350	SO-CW-HP
K6NA	806,547	SO-CW-HP
N6AA	687,352	SO-CW-HP
N6TV	412,563	SO-CW-HP
W7YAQ	428,940	SO-CW-LP
WJ9B	331,062	SO-CW-LP
N6ZFO	165,321	SO-CW-LP
WN6K	103,972	SO-CW-LP
VA6WWW	65,440	SO-CW-LP
WO7T	820	SO-CW-QRP
KK6P	747,648	SOU-MIX-HP
N9NA	193,960	SOU-MIX-HP
K2RD	96,048	SOU-MIX-HP
AI6Z	84,537	SOU-MIX-HP
N7UJJ	80,850	SOU-MIX-HP
KA6BIM	306,307	SOU-MIX-LP
WB6JJJ	11,703	SOU-MIX-LP
VE6AX	11,309	SOU-MIX-LP
VA7DXC	6,233	SOU-MIX-LP
KC7SVI	4,608	SOU-MIX-LP
N7ZUF	56,414	SOU-PH-HP
N7GCO	18,154	SOU-PH-HP
K0NG	4,023	SOU-PH-LP
W7NIK	1,037	SOU-PH-LP
VA6AGR	328	SOU-PH-LP
NT6Q (N5ZO, op)		
	1,407,627	SOU-CW-HP
VE7CC	1,221,415	SOU-CW-HP
N7DX	853,335	SOU-CW-HP
K7QA	391,718	SOU-CW-HP
W6SX	262,449	SOU-CW-HP
K7TQ	239,800	SOU-CW-LP
W6TK	165,249	SOU-CW-LP
K6WSC	112,144	SOU-CW-LP
WA0WWW	64,200	SOU-CW-LP
K7JQ	19,610	SOU-CW-LP
W7JET	3,614	SOU-CW-QRP
W7RM	1,752,336	MSHP
NX6T	599,950	MSHP
VE7KW	505,809	MSHP
KT7E	485,072	MSHP
K7BTW	290,280	MSHP

Midwest Region

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

WØEWD	809,424	SO-MIX-HP
KV0I	84,084	SO-MIX-HP
KØNM	43,924	SO-MIX-HP
KØVG	23,896	SO-MIX-HP
WØMAR	8,676	SO-MIX-HP
KØEA	116,768	SO-MIX-LP
VE5KS	89,280	SO-MIX-LP
KAØPQW	74,718	SO-MIX-LP
KA8HDE	42,625	SO-MIX-LP
WA5LFD	32,800	SO-MIX-LP
NE5TH	17,056	SO-MIX-QRP
KKØU	3,795	SO-MIX-QRP
K9MWM	76,980	SO-PH-HP
N5KWD	18,315	SO-PH-HP
W5GFI	15,136	SO-PH-HP
AG5MS	1,512	SO-PH-HP
KDØJLE	848	SO-PH-HP
K5DHY	52,622	SO-PH-LP
KØSCO	5,709	SO-PH-LP
W5JEF	5,394	SO-PH-LP
KØOP	3,810	SO-PH-LP
KF5KWO	3,390	SO-PH-LP
WWØWB	3,900	SO-PH-QRP
KØRF (WØUA, op)		
	1,559,180	SO-CW-HP
N2IC	1,541,722	SO-CW-HP
AD5A	1,147,192	SO-CW-HP
N5AW	999,785	SO-CW-HP
N3BB	145,976	SO-CW-HP
KØAD	378,500	SO-CW-LP
WØTG	109,554	SO-CW-LP
NN5T	89,664	SO-CW-LP
WØZW	85,946	SO-CW-LP
KD2KW	71,328	SO-CW-LP
NX5M	292,740	SO-CW-QRP
KIØG	803	SO-CW-QRP
KEØUI	402,867	SOU-MIX-HP
W7CXX (WA7LNW, op)		
	277,608	SOU-MIX-HP
N5HC	112,710	SOU-MIX-HP
N5WNG	70,983	SOU-MIX-HP
KØTRL	27,352	SOU-MIX-HP
K4IU	209,844	SOU-MIX-LP
AD1C	147,320	SOU-MIX-LP
KE5LQ	34,020	SOU-MIX-LP
KØKX	12,688	SOU-MIX-LP
KØMPH	10,150	SOU-MIX-LP
AEØMO	137,396	SOU-PH-HP
N5GI	28,770	SOU-PH-HP
KSØEGL	12,375	SOU-PH-HP
W5ABA	8,404	SOU-PH-HP
KØTJT	10,080	SOU-PH-LP
AEØLR	8,064	SOU-PH-LP
W5IOH	3,366	SOU-PH-LP
K5LGX	1,080	SOU-PH-LP
NAØED	240	SOU-PH-LP
N5RZ	1,708,630	SOU-CW-HP
NØAV	803,117	SOU-CW-HP
K5CM (W5CW, op)		
	788,865	SOU-CW-HP
K5QR	266,008	SOU-CW-HP
K7UT	265,966	SOU-CW-HP
N5JR	221,650	SOU-CW-LP
KØVBU	189,357	SOU-CW-LP
K8LS	117,481	SOU-CW-LP
N5NAA	60,120	SOU-CW-LP
NØEO (AAØAW, op)		
	57,086	SOU-CW-LP
KJ5T	11,359	SOU-CW-QRP
K5TR	2,408,970	MSHP
WØECC	644,680	MSHP
NØAX	621,920	MSHP
KØG	176,267	MSHP
W7SU	132	MSHP

Central Region

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

VE3AT	2,275,254	SO-MIX-HP
K9ZO	189,975	SO-MIX-HP
KØPJ	98,384	SO-MIX-HP
KW8N	69,760	SO-MIX-HP
VE3BR	37,422	SO-MIX-HP
VE3TG	230,184	SO-MIX-LP
K8RGI	61,490	SO-MIX-LP
N8TFD	32,620	SO-MIX-LP
W8UA	23,424	SO-MIX-LP
AA8OY	19,850	SO-MIX-LP
AA8DC	80,984	SO-PH-HP
VE3BFU	51,680	SO-PH-HP
VA3ZNQ	42,458	SO-PH-HP
W9AMV	22,400	SO-PH-HP
KE8NBC	20,410	SO-PH-HP
VA3NW	94,000	SO-PH-LP
VA3TPS	32,832	SO-PH-LP
N9EAX	25,012	SO-PH-LP
VE3RVZ	21,373	SO-PH-LP
VA3KRT	18,734	SO-PH-LP
VA3MYC (VE3LJQ, op)		
	2,093	SO-PH-QRP
NA8V	1,194,184	SO-CW-HP
K8GL	786,450	SO-CW-HP
K8MP	334,524	SO-CW-HP
VE3VN	313,018	SO-CW-HP
KG9N	285,064	SO-CW-HP
KM6Z	357,750	SO-CW-LP
W1NN	288,000	SO-CW-LP
VE3TM	269,205	SO-CW-LP
VE3MA	212,238	SO-CW-LP
N8VW	164,101	SO-CW-LP
AI9K	20,787	SO-CW-QRP
VE3HG	5,642	SO-CW-QRP
KD8DNS	4,730	SO-CW-QRP
KF4AV	2,352	SO-CW-QRP
WB9AYW	1,530	SO-CW-QRP
WB9Z	1,414,842	SOU-MIX-HP
VA3DF	874,888	SOU-MIX-HP
VE3RZ	648,613	SOU-MIX-HP
N2BJ	223,608	SOU-MIX-HP
VE3TW	169,176	SOU-MIX-HP
K9OM	273,512	SOU-MIX-LP
VE3PJ	135,954	SOU-MIX-LP
VE3GFN	102,144	SOU-MIX-LP
N9SE	17,199	SOU-MIX-LP
W9YK	12,972	SOU-MIX-LP
K8ZT	17,679	SOU-MIX-QRP
KD9LTN	1,236	SOU-MIX-QRP
N8BI	143,472	SOU-PH-HP
W9NZ	54,740	SOU-PH-HP
VA3LR	31,570	SOU-PH-HP
VA3WW	29,670	SOU-PH-HP
N9RMB	1,624	SOU-PH-HP
VA3IDD	48,545	SOU-PH-LP
VE3HZ	24,616	SOU-PH-LP
WS6K	9,010	SOU-PH-LP
W9PI	6,018	SOU-PH-LP
N9VPV	2,134	SOU-PH-LP
VE3NNT	1,801,250	SOU-CW-HP
WI9WI	599,829	SOU-CW-HP
K9NW	496,908	SOU-CW-HP
KE4KY	342,630	SOU-CW-HP
W9PA	236,412	SOU-CW-HP
VE3MGY	676,172	SOU-CW-LP
KG9X	569,350	SOU-CW-LP
VE3YT	296,296	SOU-CW-LP
AB9YC	223,836	SOU-CW-LP
VE3MV	221,652	SOU-CW-LP
KU4A	4,495	SOU-CW-QRP
K8AZ	1,232,036	MSHP
N4QS	220,604	MSHP
KA9VVQ	51,392	MSHP

Southeast Region

(Delta, Roanoke, and Southeastern Divisions)

NR3X (N4YDU, op)		
	1,279,680	SO-MIX-HP
KØEJ	1,177,256	SO-MIX-HP
WQ5L	421,502	SO-MIX-HP
WS7X	203,770	SO-MIX-HP
N4CF	168,099	SO-MIX-HP
N8II	342,544	SO-MIX-LP
K5XU	110,638	SO-MIX-LP
K5FUV	75,012	SO-MIX-LP
KB4CG	61,664	SO-MIX-LP
AC4G	57,165	SO-MIX-LP
N4MM	97,240	SO-PH-HP
WW5L	42,624	SO-PH-HP
WA9TTC	16,236	SO-PH-HP
W4BBT	13,224	SO-PH-HP
N4CZ	3,434	SO-PH-HP
KJ4UBL	33,516	SO-PH-LP
WA4JA	26,740	SO-PH-LP
NC4MI	23,892	SO-PH-LP
KA4FVE	18,496	SO-PH-LP
KB8VND	17,550	SO-PH-LP
KØZR	1,010,988	SO-CW-HP
K4BAI	693,810	SO-CW-HP
K3JT	430,155	SO-CW-HP
NN7CW	385,322	SO-CW-HP
N4OX	274,320	SO-CW-HP
K7SV	825,286	SO-CW-LP
K4EJ	157,344	SO-CW-LP
WN4AFP	148,364	SO-CW-LP
NK4O	131,856	SO-CW-LP
W4YE	112,056	SO-CW-LP
N4IJ	91,168	SO-CW-QRP
N7RCS	67,450	SO-CW-QRP
K2EKM	6,372	SO-CW-QRP
KC4IM	3,256	SO-CW-QRP
AA2MA	1,786	SO-CW-QRP
K4AB	1,419,330	SOU-MIX-HP
WO4O	786,546	SOU-MIX-HP
NF4A	195,517	SOU-MIX-HP
AF4T	54,112	SOU-MIX-HP
NN4NT	39,442	SOU-MIX-HP
WT8WV	67,490	SOU-MIX-LP
WA4IPU	56,280	SOU-MIX-LP
KN4GDX	14,127	SOU-MIX-LP
K4VBM	13,122	SOU-MIX-LP
WN8Y	11,521	SOU-MIX-LP
AC5O	62,988	SOU-MIX-QRP
AG4CC	440	SOU-MIX-QRP
KC3D	39,185	SOU-PH-HP
WJ2D	13,560	SOU-PH-HP
W4KW	13,014	SOU-PH-HP
K4SBZ	7,240	SOU-PH-HP
KE4YOG	6,815	SOU-PH-HP
W4BTW	29,520	SOU-PH-LP
KM4IAJ	20,475	SOU-PH-LP
WA4AH	6,888	SOU-PH-LP
WD4FMG	2,408	SOU-PH-LP
K4LDC	1,444	SOU-PH-LP
N4AF	2,004,492	SOU-CW-HP
AD4EB	1,359,680	SOU-CW-HP
N4UU	1,107,795	SOU-CW-HP
W4NZ	749,612	SOU-CW-HP
K2SX	431,376	SOU-CW-HP
K3IE	628,728	SOU-CW-LP
N2YO	402,417	SOU-CW-LP
N4XL	373,320	SOU-CW-LP
WA1FCN	349,408	SOU-CW-LP
K2MK	144,095	SOU-CW-LP
WB4OMM	4,356	SOU-CW-QRP
K1MM	1,824,999	MSHP
WW4XX	788,172	MSHP
N5LCC	659,018	MSHP
AD4ES	539,645	MSHP
K4RM	419,216	MSHP

Northeast Region

(New England, Hudson, and Atlantic Divisions; Maritime and Québec Sections)

K5ZD	2,759,350	SO-MIX-HP
KR2Q	269,000	SO-MIX-HP
WA2CP (KC2GOW, op)		
	129,584	SO-MIX-HP
N1RR	27,144	SO-MIX-HP
AC3LZ	20,705	SO-MIX-HP
KU2M	386,828	SO-MIX-LP
N2EM	178,434	SO-MIX-LP
WA2JQK	57,148	SO-MIX-LP
KA2FIR	50,687	SO-MIX-LP
W1NU	33,735	SO-MIX-LP
VE2SSS	228	SO-MIX-QRP
KT3P	119	SO-MIX-QRP
ND1X	32,897	SO-PH-HP
AD2BO	30,260	SO-PH-HP
KZ3P	21,294	SO-PH-HP
WO2Y	20,060	SO-PH-HP
K1GMM	10,608	SO-PH-HP
NG1M	53,268	SO-PH-LP
KS2G	46,371	SO-PH-LP
VE2HIT	27,324	SO-PH-LP
K3URT	17,050	SO-PH-LP
AB2TC	13,110	SO-PH-LP
W1KM	2,117,920	SO-CW-HP
K2ZW	1,936,512	SO-CW-HP
N3AD	1,734,853	SO-CW-HP
K1KI	1,615,075	SO-CW-HP
K3ZO	632,052	SO-CW-HP
W1QK	448,818	SO-CW-LP
N8NA	201,695	SO-CW-LP
N1QY	134,351	SO-CW-LP
KB3AAY	122,616	SO-CW-LP
W3WHK	76,285	SO-CW-LP
K8CN	91,471	SO-CW-QRP
AC2YD	5,876	SO-CW-QRP
W1UU	660	SO-CW-QRP
W1TW	400	SO-CW-QRP
W7LG	56	SO-CW-QRP
K3MM	1,810,728	SOU-MIX-HP
W1GD	1,170,364	SOU-MIX-HP
K3WJV	791,536	SOU-MIX-HP
WA3AAN	416,150	SOU-MIX-HP
K3MD	300,321	SOU-MIX-HP
VA2EBI	310,536	SOU-MIX-LP
KI2D	147,400	SOU-MIX-LP
K1VU	95,370	SOU-MIX-LP
K3HW	35,275	SOU-MIX-LP
NN2NN	26,197	SOU-MIX-LP
W1WBB	1,066	SOU-MIX-QRP
W3LL	557,842	SOU-PH-HP
K2ANZ	42,039	SOU-PH-HP
KA2K	26,956	SOU-PH-HP
N2NKX	11,868	SOU-PH-HP
KC2OSR	3,225	SOU-PH-HP
N3AAA	108,528	SOU-PH-LP
KA2KON	18,240	SOU-PH-LP
KD2JOE	15,635	SOU-PH-LP
KC3RGK	9,744	SOU-PH-LP
K3JSJ	4,059	SOU-PH-LP
AA3B	3,493,216	SOU-CW-HP
KO7SS	2,821,584	SOU-CW-HP
K3WW	2,277,330	SOU-CW-HP
NY3A	2,057,370	SOU-CW-HP
K3JO (AE2W, op)		
	1,664,230	SOU-CW-HP
K1XM	876,360	SOU-CW-LP
W3KB	537,522	SOU-CW-LP
VE1ANU	276,374	SOU-CW-LP
KA1YQC	204,546	SOU-CW-LP
WO1N	181,577	SOU-CW-LP
KW2A	364	SOU-CW-QRP
KC1DVT	168	SOU-CW-QRP
N5DX	3,443,553	MSHP
W3UA	2,201,670	MSHP
W2Z	886,665	MSHP
K3AJ	526,889	MSHP
K3CCR	394,476	MSHP

The April 2022 ARRL Rookie Roundup — Phone

1800 UTC – 2359 UTC, Sunday, April 10

The Rookie Roundup is an event meant to encourage newly licensed operators to get on the HF bands and experience competitive amateur radio. This is a great way for clubs to get their newer members on the air, and the perfect opportunity to mentor new licensees.

Rookies make as many contacts as possible during this 6-hour event. Rookies work everyone and non-Rookies work only Rookies. The exchange is your name, call sign, a two-digit year, and state (US or Mexican), Canadian province, or "DX."

You can enter as a Rookie if:

- You made, or will make, your first-ever contact this year or during the previous 3 calendar years (send the last two digits of the year of your first contact in your exchange); or
- You haven't made any contest contacts using the contest mode (Phone) before (send the last two digits of the current year in your exchange).

If you're a non-Rookie, send the last two digits of the year of your first license.

Rookies can enter as a Single Operator, or invite Rookie friends over and operate as Multioperator. Up to five Single Operator Rookies can also enter from their individual stations and submit their total score as a team.

As a non-Rookie, you can join the fun by calling "CQ Rookies," encouraging the Rookie operators to call you.

All scores must be reported within 72 hours after the event. No late entries will be accepted.

David West, W6DMW, participated in the 2021 ARRL Rookie Roundup from Ken Keeler's, N6RO, station in Oakley, California. David received first place in the Single Operator category in US Call Area 6. [David West, W6DMW, photo]

Complete rules, logging sheets, and links for submitting your score can be found at www.arrl.org/rookie-roundup

Volunteer Monitor Program Report

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

- Operators in Center Hill and Coconut Creek, Florida, were issued notices for excessive signal bandwidth on 40 and 75 meters, in violation of Section 97.307(a) of FCC rules. General-class operators in Hudson, Florida; Winterville, Georgia; Provo, Utah, and Bloomfield Hills, Jackson, and Howell, Michigan, received notices for out-of-band SSB operation on frequencies not permitted by their General-class licenses, in violation of Section 97.301 of FCC rules.
- Technician-class operators in Baltimore, Maryland; Divernon, Illinois; Moore, Oklahoma; Bradenton, Florida, and Roseville and Rancho Cordova, California, received notices for FT8 operation on unauthorized 20- and 40-meter frequencies, in violation of Section 97.301 of FCC rules.
- Commendations for exemplary amateur radio operation were issued to licensees in these cities: Dahlonega, Georgia (for managing medical and technical issues during the Six Gap Century bicycle race in October); Riverside, California (for operation during the October Earthquake Situational Emergency Test); Swansea, South Carolina (for operation on the SC HF ARES Net); Springfield, Indiana (for assistance to new operators in message handling); Mims, Florida (for exceptional efforts in correcting wideband issues), and Raymond, Mississippi (for exemplary operation during ARRL Field Day, statewide HF and VHF nets, and assistance to new operators).
- The totals for VM monitoring in November were 1,901 hours on HF frequencies and 2,784 hours on VHF frequencies and above, for a total of 4,685 hours.

There was one referral from the FCC for enforcement assistance. — *Thanks to Volunteer Monitor Program Administrator Riley Hollingsworth, K4ZDH*

W1AW Schedule

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

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

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

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

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

Code bulletins are sent at 18 WPM.

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

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

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

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

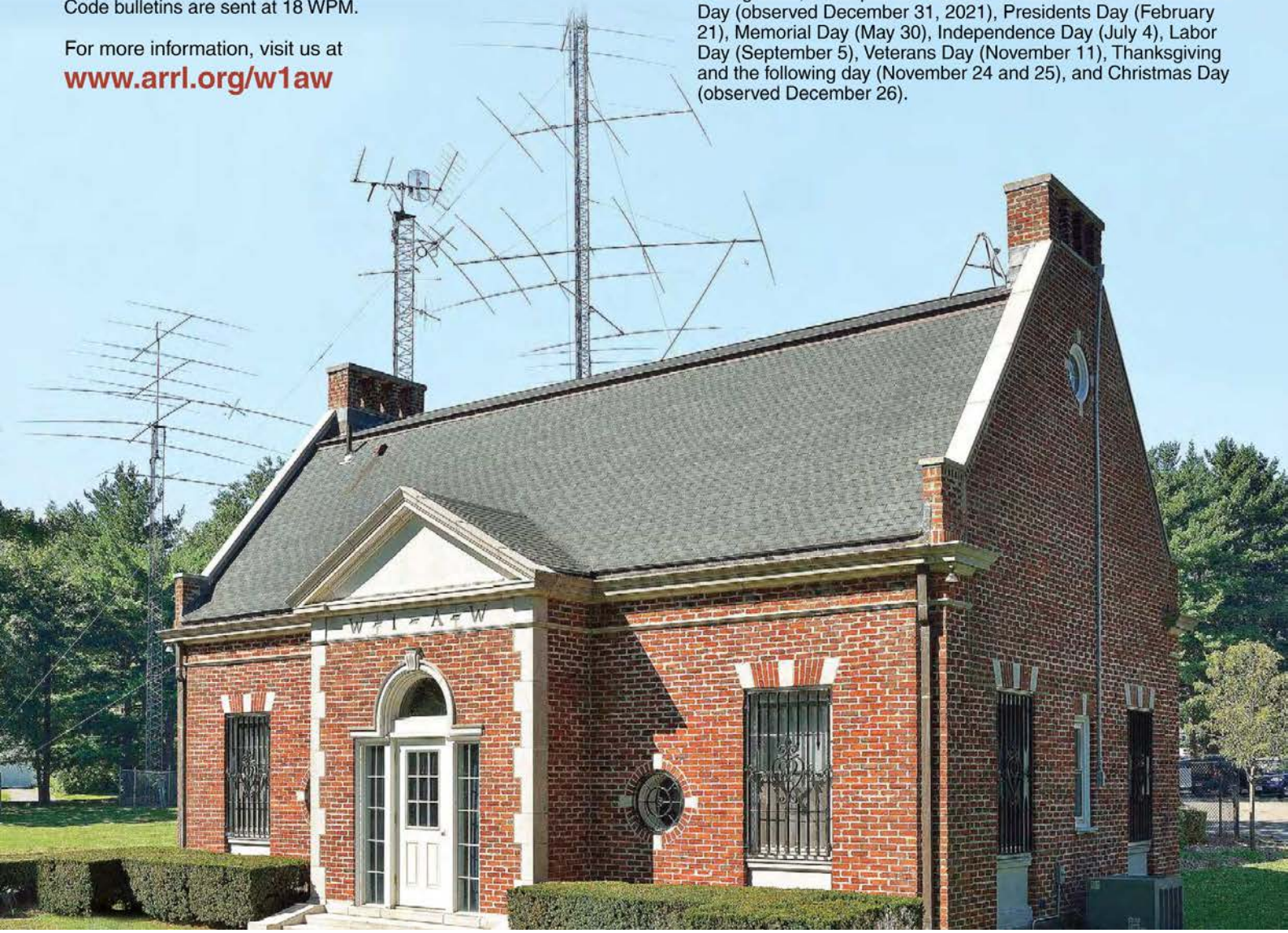
Keplerian elements for many amateur satellites will be sent on the regular digital frequencies on Tuesdays and Fridays at 6:30 PM Eastern time using Baudot and PSK31.

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

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

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

During 2022, Headquarters and W1AW are closed on New Year's Day (observed December 31, 2021), Presidents Day (February 21), Memorial Day (May 30), Independence Day (July 4), Labor Day (September 5), Veterans Day (November 11), Thanksgiving and the following day (November 24 and 25), and Christmas Day (observed December 26).



Bernie McClenny, W3UR, w3ur@arrl.org

How's DX?

Remote Operating By the DXCC Rules

Over the past decade or more, remote operation has become mainstream, and rule 9c in "Section I. Basic Rules" in the DXCC rules states that contacts made using this type of operation are acceptable for credit (**www.arrl.org/dxcc-rules**). However, there is some misunderstanding by a select few in the DX community regarding the rules. In this month's column, I'll address two issues that many of us have noticed.

The first issue is regarding operating a remote station with a legally issued call sign from another country. Remote station operation in ARRL contests (**www.arrl.org/contest-remote-station-operation**) is subject to the rules and regulations of the country in which the station is located. Therefore, if a station is located in the US or its possessions, the FCC allows any FCC-authorized licensee the right to control and operate (from anywhere in the world) a remote station that's located within the US, using the operating privileges of his/her license. For DXCC, the remote station must be located within a specific DXCC entity, and the control operator must be authorized to operate the station in that entity based on their country's regulations. For example, it would be legal for KZ3ZZZ, a call sign issued by the FCC, to operate a US station remotely from anywhere in the world, and the contacts would count for DXCC. However, KZ3ZZZ's station can't be operated by a foreign licensee, unless they have reciprocal or bilateral permission to operate a station in the US **and are physically present/have hands-on control of the station**.

Failure to comply with this policy is a violation of rule 11 of the DXCC program's "Section I. Basic Rules." If you're from another country and are physically present at the station located in the US or its possessions, you must use the prefix modifier "/W," followed by the call area, with your call sign.

PSK Reporter (**https://pskreporter.info**) and the Reverse Beacon Network (**www.reversebeacon.net**) show where digital mode and CW signals are being heard. For example, when a station in Europe is contacted by stations in the Pacific Northwest on 160 meters and isn't heard or decoded by stations in Europe, it's clear that something isn't right. This type of operation also occurred on 6 meters this past summer during a sporadic-E opening. An operator's call sign from Europe was only heard/decoded in the southeastern US (and not in Europe). It was determined that the station was in the US. When your editor switched from using their fixed antenna at 45 degrees to using a rotating antenna set to the south, there was a "eureka" moment. The foreign operator wasn't correctly indicating a proper prefix modifier with their call sign.

The second issue is regarding the use of software to operate 24/7 on FT8 and other digital modes. This allows the operator to go to work, watch TV, etc., all the while their station is making contacts for them. These types of fully automated contacts don't count for any ARRL awards (or ARRL contests), as this type of operation is a violation of rule 6a of the DXCC program's "Section I. Basic Rules." This rule states that "each contact claimed for DXCC credit must include contemporaneous direct initiation by the operator on both sides of the contact. Initiation o f a contact may be locally or by remote." This means that if you contact someone who's using fully automated software to initiate and log a contact, it won't count for ARRL DXCC, even though you followed the rules.

When someone is on the air 24/7 for 3 or more days, it's a red flag. Either there's another operator helping them, or they're using full automation, thus violating the DXCC rules.

In order to maintain the integrity of the ARRL DXCC awards, these issues need to be identified and carefully addressed by the DXCC community and the ARRL DXCC Awards Program.

As a reminder, everyone who makes a DXCC endorsement signs the following statement: "I affirm that I have observed all DXCC rules, as well as all governmental regulations established for Amateur Radio in my country. I understand that ARRL is not responsible for cards handled by DXCC Card Checkers and will not honor any claims. I agree to be bound by the decisions of the ARRL Awards Committee and that all decisions of the ARRL Awards Committee are final."

Global DX News

FO/A — Austral Islands

Jacek Marczewski, SP5EAQ, will be operating a "suitcase-type DXpedition" from Rimatara — Islands On The Air (IOTA) reference number OC-050 — from March 2 – 30. This will be an SSB-only operation, with plans to be on 3.5 through 28 MHz as FO/SP5EAQ. During the CQ World Wide WPX SSB Contest, he'll use special call TX5AQ. QSL via Marek Niedzielski, SP7DQR, either direct or via the bureau, Logbook of The World (LoTW), or SP7DQR's Online QSL Request System (OQRS; **http://sp7dqr.pl/en/oqrs.php**). Visit SP5EAQ's website at **http://australs.sp7dqr.pl/index.html**.

Federación Mexicana de Radioexperimentadores (FMRE) is celebrating their 90th anniversary with a "90 days of radio" award.

Jacek Marczewski, SP5EAQ, will be operating from Rimatara (IOTA reference number OC-050) in the Austral Islands from March 2 – 30.

HC8 — Galápagos Islands

Jim Millner, WB2REM, is co-leading the 7163 Group for their third DXpedition to Santa Cruz Island. Their previous activities were from 2017 and 2019, and the details were published in the August 2019 issue of *CQ* and the April 2020 issue of *QST*. They planned to once again use the special call HD8M to operate from March 2 – 11, 2022. However, the DXpedition has been postponed due to COVID-19. "This decision was made after much discussion and consideration and was made after consulting with persons in Ecuador who are closely attuned to the nature of the [global pandemic] and how it's spreading there, [as well as] the impact it's having on Ecuador and the Galápagos," the team stated.

They planned to operate on CW, SSB, and FT8 (Fox and Hound) on 1.8 through 50 MHz. Other team members include co-leader Chris Hillier, VO1IDX; Mitch Wein, KH6M; Bob Beyer, KE2D, and John Froehler, N4NNY. Mark Robinson, N1UK, was going to act as the DXpedition team's pilot station and planned to be available via email during the operation. Check out the team's website at **www.hd8m.com**.

J8 — Saint Vincent

Brian Price, GW4DVB, is scheduled to head back to Palm Island for a holiday-style operation as J88PI, from February 24 to March 8. He plans to be on CW, SSB, SSTV (slow-scan TV), and FT8, using a Yaesu FT-991A transceiver to transmit on 40, 20, 17, 15, 10, and 6 meters. For antennas, he will have a 10-meter-tall vertical and an MØCVO off-center-fed dipole. QSL direct only to GW4DVB. You can visit his website at **www.g4dvb.co.uk**.

V3 — Belize

The ARRL International DX CW Contest will take place February 19 – 20. A multioperator team from the US and Canada plan to operate as V3T from Cahal Pech. Outside of the contest, John Patterson, WCØW; Robert Brandon, K5PI; Keith Witney, VE7KW; Madison Jones; W5MJ, and possibly other guests, plan to operate with their own calls (V31TP, V31AT, V31WK, and V31IT, respectively) from February 15 – 22. Most of the activity will be on CW and other modes on 1.8 through 28 MHz.

V4 — Saint Kitts and Nevis

Chuck Van Hoorn, KG9N, will be operating from the V47JA rental station in Calypso Bay on Saint Kitts from February 8 to March 1, with an effort in the ARRL International DX CW Contest as V4/KG9N. He also plans to be in the CQ World Wide RTTY WPX Contest, held February 12 – 13. This will be a 100 W operation on all bands and modes, wherever he can "get a pileup." QSL via KG9N, either direct with a SASE or via the bureau, as well as LoTW.

XE — Mexico

Members of the Federación Mexicana de Radioexperimentadores (FMRE) are celebrating their 90th anniversary with a "90 days of radio" award for those operating between January 1 and March 31. The challenge is to communicate with all 32 states of Mexico (including Mexico City), using all bands and modes. Special call 4A90FMRE will be active during this time frame. Visit **http://fmre90.puebladx.org** for more information.

Wrap-Up

Thank you to KG9N, SP5EAQ, and W5MJ for your help making this month's column possible. If you have any DX or IOTA news, or photos or club newsletters, please send them to **bernie@dailydx.com**. Until next month, see you in the pileups! — *Bernie, W3UR*

Jon Jones, NØJK, n0jk@arrl.org

The World Above 50 MHz

Solar Cycle 25 Surges

Solar activity was low during most of December 2021. The solar flux was only around 80 in the ARRL 10 Meter Contest. However, the last week of December had the appearance of multiple large sunspots. The solar flux rose to 140. In the following days, the high solar flux charged the F layer like a battery. This raised the MUF of the F2 layer. It was not as high as it needed to be for direct F2 from North America to the South Pacific, but it was enough that, with some help from sporadic E on both ends, the path opened.

On Christmas Day 2021, stations along the Gulf Coast worked into New Zealand. Dale, WA4CQG (EM72), worked ZL1AKW and ZL1RS. That evening, the opening spread up to Arkansas and Texas. Pat, W5VY (EM34), logged three New Zealand stations and ZL7DX (AE16) on Chatham Island. Chris, ZL7DX, worked many stations, including AA5AM, K5ND, and W5LUA in Texas. Pat said the opening lasted a couple hours. K5VVV (EM10) had E_s to Mexico, suggesting the link. KC4HW (EM71) worked ZL1RS at 0005 UTC, running just 80 W and a five-element Yagi up 10 feet. Steve, VK3OTR (QF02), worked as far as W4DEX (EM70). On December 27, Mike King, KMØT (EN13), in Iowa found ZL7DX on a short opening at 0223 UTC. He noted there was E_s to XE2JS (DL68) and KJ7OG (DM42) at the same time.

The South Pacific opening was back again strong on December 30 (see Figures 1 and 2). This opening started very early around 1900 UTC. There was strong sporadic E across North America that afternoon. Tim, NØTB (EN34), worked ZL7DX at 1902 UTC. ZL7DX and other stations were spotted across the upper Midwestern states. KA9CFD (EN40) worked ZL7DX at 1905 UTC. KØKUK (EN35) went in ZL7DX's log at 1910 UTC. Vince, KØSIX (EN35), worked ZL2WHO (RE79), ZL7DX (AE16), and ZL3RC (RE66) around 1925 UTC. K9MU (EN44) spotted ZL7DX. Dave Quick, KØEKL (EN37), also logged ZL7DX at 1932 UTC. He noted, "FT8 signals were pretty good, strong enough to hear the tones and see clearly on the waterfall. ZL7DX's report was –17, and he gave me –20." Dave used a five-element LFA

Figure 1 — A PSK Reporter map of the 6-meter FT8 flags from ZL7DX Chatham Island to the upper Midwest US at 1915 UTC on December 30, 2021. [**https://pskreporter.info**]

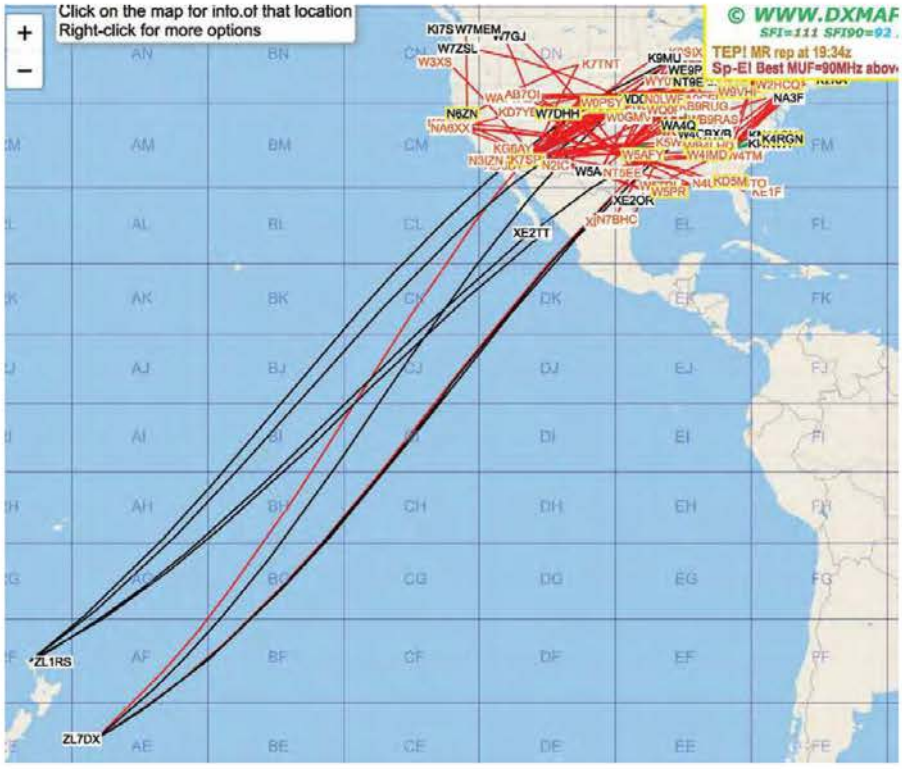


Figure 2 — The DX maps shows the entire opening with paths from New Zealand and Chatham Island to North America on 6 meters on December 30, 2021. [**www.dxmaps.com**]

antenna up 80 feet and 1 kW. Trey, N5KO (CM87), worked ZL3RC at 2032 UTC.

Greg, WQØP (EM19), waited patiently and finally worked ZL2WHO, ZL3NW, and ZL7DX around 2140 UTC. Greg logged XE2JS and XE2K (DM22) earlier, confirming a sporadic-E link out to the South Pacific. The ZL opening extended as far northeast as WW1L (FN54), who had a PSK flag at ZL7DX. Stations in Australia and Rotuma (3D2AG) were closely watching, but there was no propagation to North America. As Solar Cycle 25 progresses, it is likely VK/ZL openings may become more frequent and stronger in the next few years during the magic period between Christmas and the New Year.

A Multiband Grid Expedition

Jeff Townsend, WB8LYJ, went on a road trip, starting in EM82 on December 11, 2021, and going through EM81, EM80, EL89, EL79, EM70, EM60, EM71, EM61 before ending in EM62 on December 17 (see Figure 3). Most of his activity was on 144 and 222 MHz, but he operated on 6 meters from EL79 and EM61 for Fred Fish Memorial Award (FFMA) grid seekers. On 222 MHz, Jeff used a Yaesu FT-818 transceiver with a Q5 signal transverter and a 14-element Yagi. He logged 77 different call signs.

A Strong Tropospheric Opening

Strong tropo set up under a stagnant high-pressure system on Christmas Eve. On December 24, XE2OR (DL98) worked as far as W3XTT (FN01) at 2,534 kilometers on 2-meter FT8. W3XTT also worked N5WS (EL09). Pat, W5VY (EM34), found Mexico openings were strong on December 26. He worked Jorge, XE2X (EL06), on 2-meter FT8, followed by Homero, XE2KK (DL96), on SSB. The highlight was working Rafa, XE2OR, on 432 MHz FT8. Rafa was running just 35 W to a vertical. Rafa worked stations in Texas and as far as Florida station KO4MA (EL88). WA4CQG (EM72) noted XE2OR was in for almost 48 hours. The tropo extended down to 50 MHz. Matt, W3UUM (EL29), worked stations in Louisiana and Florida on 6-meter SSB on December 26.

On the Bands

50 MHz. Larry Lambert, NØLL, was in EN20 again on December 18 and logged eight stations on MSK144. On December 22 and 23, KN4JX and KC4PDN were active from grid EM24. On December 24, Larry activated rare grid EN02, logging 11 stations, including N0JK (EM28) at 1500Z. It took 50 minutes for Larry to work KC7QY (DM64) on MSK144. K3FR (FM18) worked KA1R in rare FN67 on December 30.

Figure 3 — Jeff Townsend, WB8LYJ, set up an operation from Santa Rosa Beach, Forida (EM60vk). [Jeff Townsend, WB8LYJ, photo]

144 MHz. Good activity and lots of meteors were reported in the Geminid meteor shower. Stephen DeVience, N8URE (FM19), reported working Dale, WA4CQG (EM72), on December 14 at 0155 UTC with MSK144 running just 15 W and a four-element Yagi. Stephen had over a dozen PSK flags for his 15 W signal. He noted CM2ESP was monitoring MSK144 on 2 meters from Cuba, and he decoded many North American stations. But Cuba does not allow transmission on MSK144 yet. Ron Klimas, WZ1V (FN31), logged WØLGQ (EN21) at 1,940 kilometers on MSK144. John Lock, KFØM (EM17), decoded W3XTT (FN01), W9WO (EM69), N4OGW (EM53), K5DOG (EM00), and W9RM (DM58) on MSK144.

222 MHz. Dave Olean, K1WHS, worked W5ZN/P in Oklahoma for his 50th state on the 222 MHz band.

James, K7KQA, operated a portable EME station from Oregon on December 12 and worked a number of stations, including Joel Harrison, W5ZN (for his 49th state); N9HF, and K1OR.

Here and There

ARRL Radiosport and Field Services Manager Bart Jahnke, W9JJ, reported, "On December 27, 2021, former ARRL President Joel Harrison, W5ZN, worked and confirmed Tom Worthington, NH6Y, in Hawaii for Joel's 50th 222 MHz state. Joel has been awarded the eleventh Worked All States (WAS). Congratulations to Joel, and to all those VHF+ state chasers (and to the many activators of rare 222 MHz activity states) on their achievements in this continuing quest for 222 MHz Worked All States."

Best dates for EME (Earth-moon-Earth, moonbounce) contacts are March 14 – 18. Sporadic E is rare, but when it occurs, it can link to F2 and TEP to the south. The March equinox is a good time for aurora to occur. High geomagnetic activity associated with aurora can boost the F2 MUF on north-south paths. In mid-April, E_s – TEP openings have taken place in 2020 and 2021. It is a good month for openings to the South Pacific Islands northeast of New Zealand, such as Samoa, Rotuma, and Easter Island.

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

Special Event Stations

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

Feb. 1 – Feb. 28, 0000Z – 2359Z, N9SES, Lake Station, IN. Arab QRZ International. **JY1 Memorial Special Event**. 14.025 14.076 14.250 21.025. QSL. Ayman Azar, 2861 Decatur St., Lake Station, IN 46405. **https://www.n9ses.com/jy1-memorial-special-event-station**

Mar. 1 – Mar. 15, 0000Z – 0000Z, W5T, Cleburne, TX. Club KC5NX. **Battleship *Texas* 108th Birthday**. 7.235 7.240 14.045 14.255. QSL. Club KC5NX, 9200 Summit Ct. W., Cleburne, TX 76033-8212. **www.qrz.com/db/kc5nx**

Mar. 1 – Mar. 28, 0001Z – 2359Z, GB8ØLAN, Luton, United Kingdom. Royal Air Force Amateur Radio Society. **80th Anniversary Avro Lancaster, 1st Operational Sortie**. 3.710 14.055 14.074 14.270. QSL. See website, for QSL information, RAF Waddington, RAF Halton, RAF Cosford, RAF East Kirkby, England. *The call will be active from four different locations at three Royal Air Force Amateur Radio Club Stations: Waddington, Halton, Cosford, and ex-RAF East Kirkby (home of Lancaster "Just Jane"). We plan to be active on all bands and modes 160 m – 70 cm. VK8ØLAN and VE8ØLAN may also be on the air.* **www.qrz.com/db/gb80lan** and **rafars.org**

Mar. 1 – Mar. 31, 0000Z – 2359Z, W5WWL, New Orleans, LA. WWL Amateur Radio Club. **100th Anniversary of WWL 870 AM**. 3.900 7.235 14.285 7.025. QSL. WWL ARC, 127 Highway Dr., New Orleans, LA 70121. **www.qrz.com/db/w5wwl**

Mar. 3 – Mar. 7, 1200Z – 2000Z, K9C, Calumet, MI. Keweenaw County Repeater Association. **CopperDog 150 Dog Sled Race**. 3.825 7.225. QSL. KCRA, 51950 Boston Rd., Hancock, MI 49930. **www.qrz.com/db/k9c** or **https://kcra-mi.net**

Mar. 14, 0000Z – 2359Z, N3P, Burlington, NJ. David Sarnoff Radio Club. **PI Day**. 7.031 7.227 14.031 14.314. QSL. Don Corrington, 7 Pinewald Ln., Burlington, NJ 08016-3421. **www.n2re.org**

Mar. 18, 1800Z – 2200Z, N3TAL, Lanham, MD. American Legion Post 275 ART. **National Vietnam War Veterans Day**. 7.275. QSL. American Legion Post 275 ART, 8201 Martin Luther King Jr. Hwy., Lanham, MD 20706. **wa3dvo@verizon.net**

Mar. 18 – Mar. 20, 1400Z – 0400Z, NN4SA, Huntsville, AL. HamSCI and NASA Marshall Space Flight Center ARC. **HamSCI 2022 Conference**. 7.074 14.074; 7.245 14.245. QSL. NASA MSFC ARC, c/o Matt McDougal, P.O. Box 12804, Huntsville, AL 35815. *HamSCI and NASA MSFC ARC will operate from HamSCI Conference venue near Space and Rocket Center. Will be operating various bands and modes. Check spotting networks for frequencies and modes.* **www.qrz.com/db/nn4sa**, **hamsci.org** and **nn4sa.org**

Mar. 19, 1400Z – 2000Z, W4BKM, Macon, GA. Macon Amateur Radio Club. **Cherry Blossom Special Event Station**. 7.225 14.240. Certificate. Macon Amateur Radio Club, P.O. Box 4862, Macon, GA 31208-4862. **www.w4bkm.org**

Mar. 19, 1400Z – 2000Z, W1M, Russell, MA. Western Massachusetts Council, Scouts BSA. **Scouts BSA WHOA Weekend**. 7.190 10.115 14.060 14.290. QSL. Tom Barker, WA1HRH, 329 Faraway Rd., Whitefield, NH 03598. *Monthly seasonal outdoor activities for Scouts and the general public including "ham radio in the woods." Paper logging. QSL via SASE and eQSL.*

Mar. 19 – Mar. 20, 1400Z – 0200Z, NØQ, Parker, CO. Cynthia Smith. **National Quilting Day**. 7.200 14.250; SSB and FT8. QSL. Cynthia Smith, 23612 Glenmoor Dr., Parker, CO 80138-3112. *Please QSL by May 31, 2022.* **Msgt_smith_cap@hotmail.com**

Mar. 22 – Mar. 24, 1400Z – 2100Z, W4LX, Fort Myers, FL. Fort Myers Amateur Radio Club. **Honoring World War II Gunners at Buckingham Airfield**. 14.270 21.360 28.360 146.685. Certificate & QSL. Fort Myers Amateur Radio Club, P.O. Box 61183, Fort Myers, FL 33906. **https://fmarc.net**

Mar. 26, 1400Z – 2200Z, K4YWE/N4H, Alexander City, AL. Lake Martin Amateur Radio Club. **Commemoration of the Battle of Horseshoe Bend**. 7.240 14.240. QSL. Michael Courtney, KK4AUP, 80 Herren Hill Rd., Ste. F, Tallassee, AL 36078. **mikecourtney@charter.net**

Mar. 29, 1600Z – 2130Z, W5KID, Baton Rouge, LA. Baton Rouge Amateur Radio Club. **National Vietnam War Veterans Day**. 7.040 7.250 14.040 14.250. QSL. USS *Kidd* Amateur Radio Club, 305 S. River Rd., Baton Rouge, LA 70802. *Operation aboard the USS* Kidd *(DD-661).* **qrz.com/db/w5kid**

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

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

Submissions must be received by ARRL HQ no later than the 1st of the second month preceding the publication date; a special event listing for **June** *QST* would have to be received by **April 1**. In addition to being listed in *QST*, your event will be listed on the ARRL Web Special Events page. Note: All received events are acknowledged. If you do not receive an acknowledgment within a few days, please contact us. ARRL reserves the right to exclude events of a commercial or political nature.

You can view all received Special Events at **www.arrl.org/special-event-stations**.

Convention and Hamfest Calendar

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

Abbreviations

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

California (Loomis) — Mar. 19 D F H R S
7 AM – noon. *Spr:* Sierra Foothills ARC. Historic Loomis Train Depot, 5775 Horseshoe Bar Rd. *TI:* 145.430 (162.2 Hz). *Adm:* Free. **w6ek.org**

Florida (Brooksville) — Feb. 26 D H R T V
8 AM – 4 PM. *Spr:* Hernando Co ARA. Sand Hill Scout Reservation, 11210 Cortez Blvd. *TI:* 146.715. *Adm:* $5 Advance, $6 door. **www.hcara.org**

Florida (Fort Walton Beach) — Mar. 18 – 19 D F H Q R T V
Fri. 4 PM – 8 PM, Sat. 8 AM – 2 PM. *Spr:* Playground ARC. Northwest Florida Fairgrounds. 1958 Lewis Turner Blvd. *TI:* 146.790 (100 Hz). *Adm:* $7. **w4zbb.org/w4zbborg/index.php?page=Hamfest**

ARRL SOUTHERN FLORIDA SECTION CONVENTION

March 19, Stuart, Florida
D F H R S T V
7 AM – 1 PM. *Spr:* Martin County ARA. Martin County Fairgrounds, 2616 SE Dixie Hwy. *TI:* 147.060 no tone. *Adm:* Free. **stuarthamfest.com**

Florida (Tampa) — Apr. 9 F H Q R T V
8 AM – 1 PM. *Spr:* Tampa ARC. 7801 N. 22nd St. *TI:* 147.105 (146.2 Hz). *Adm:* $5. **www.hamclub.org**

Georgia (Dalton) — Feb. 26 D F H R S T
8 AM – 2 PM. *Spr:* Dalton ARC. North Georgia Ag Fair, 500 Legion Dr. *TI:* 145.230 (141.3 Hz). *Adm:* $5. **www.facebook.com/events/620912765410079**

Indiana (LaPorte) — Feb. 26 F H R V
7 AM – 1 PM. *Spr:* LaPorte County ARC. LaPorte Civic Auditorium, 1001 Ridge St. *TI:* 146.610 (131.8 Hz). *Adm:* $7. Email: **cabinfeverhamfest@gmail.com**

Iowa (McClelland) — Mar. 5 D F H R
8 AM – noon. *Spr:* Southwest Iowa ARC. McClelland Town Hall, 117 Main St. *TI:* 146.82, 442.225 (136.5 Hz). *Adm:* $4. **swiradio.org**

Iowa (Perry) — Feb. 26 D Q R V
8 AM. *Spr:* Hiawatha ARC. National Guard Armory, 2390 Willis Ave. *TI:* 145.190 (114.8 Hz). *Adm:* $10. **harciowa.org**

Minnesota (Buffalo) — Mar. 19 D F Q V
8 AM – 1 PM. *Spr:* Maple Grove Radio Club. Buffalo Civic Center, 1306 County Road 134. *TI:* 147.00 (114.8 Hz). *Adm:* $10. **k0ltc.org**

Mississippi (Corinth) — Apr. 2 – 3 D F H R V
Sat. 9 AM – 5 PM, Sun. 8 AM – noon. *Spr:* Alcorn County ARES. Crossroads Arena, 2800 South Harper Rd. *TI:* 146.925 no tone. *Adm:* $8, kids free. **acares.reiselt.com**

Missouri (Boonville) — Mar. 26 D F H R S T
8 AM – 1 PM. *Spr:* Boonvillle ARC. Cooper County Youth Fairgrounds, 16899 Dunkles Dr. *TI:* 147.360. *Adm:* $5. **w0brc.org**

OZARKCON

April 8 – 9, Branson, Missouri
F H R S
8 AM – 5 PM. *Spr:* Four States QRP Group. Stone Castle Hotel & Conference Center, 3050 Green Mountain Dr. *TI:* DMR TG 31654, 147.195. **ocon.rleepotter.com/index.html**

Missouri (Mt. Vernon) — Mar. 26 D F H R S V
8 AM – 1 PM. *Spr:* Ozarks ARS. MARC Building, 822 West Mt. Vernon Blvd. *TI:* 146.97 (162.2 Hz). *Adm:* $8 Advance, $10 door. Email: **bhmyer@suddenlink.net**

Nebraska (Bellevue) — Apr. 9 F R
8 AM – 1 PM. *Spr:* Bellevue ARC. Reed Community Center, 1200 Lord Blvd. *TI:* 147.39 (131.8 Hz). *Adm:* $5. **bellevuearc.org**

New Jersey (Belmar) — Feb. 26 F
8 AM – 2 PM. *Spr:* CDL Radio Group. InfoAge Science Learning Center, 2201 Marconi Rd. *TI:* none. *Adm:* Free. **vcfed.org/wp/vcf-swap-meet**

New Jersey (Clinton/Annandale) — Mar. 12 D F H R S T
8 AM. *Spr.* Cherryville Repeater Association. North Hunterdon Regional High School, 1445 Route 31. *TI:* 147.375 (151.4 Hz). *Adm:* $5. **w2cra.org**

New Hampshire (Henniker) — Mar. 20 F H R S V
8 AM – 2 PM. *Spr:* Contoocook Valley Radio Club. The Henniker Community School, 51 Western Ave. *TI:* 146.895 (100 Hz). *Adm:* $4. **k1bke.org**

North Carolina (Concord) — Mar. 11 – 12 D F H R S V
Fri. 3 PM – 7 PM, Sat. 8:30 AM – 4:30 PM. *Spr:* Mecklenburg ARS. Cabarrus Arena and Event Center – Gold Hall, 4751 Highway 49. *TI:* 146.655. *Adm:* $9 Advance, $10 door (cash), $11 door (credit). **charlottehamfest.org**

North Dakota (Bismarck) — Feb. 26 F H R S V
7:30 AM – 12:30 PM. *Spr:* Central Dakota ARC. Bismarck State College Career Academy, 1221 College Dr. *TI:* 146.85 no tone. *Adm:* Free will donation. **www.cdarcnd.com**

Ohio (Cuyahoga Falls) — Apr. 9 D F H F V
8 AM – 1 PM. *Spr:* Cuyahoga Falls ARC. Emidio & Sons Party Center, 48 E. Bath Rd. *TI:* 147.270, 444.850 (both 110.9 Hz). *Adm:* $6 Advance, $7 door. **cfarc.org/hamfest.php**

Ohio (Elyria) — Mar. 13 D H F
9 AM – 1 PM. *Spr:* Northern Ohio ARS, Lorain County Community College, 1005 N. Abbe Rd. *TI:* 146.70 (110.9 Hz). *Adm:* $7. Email: **winterhamfest@noars.net**

Ohio (Irving) — Mar. 12 D F H R T
8 AM – 2 PM. *Spr:* Mid-Ohio Valley ARC. Fellowship of Faith Church Rio Grande, 20344 OH-554. *TI:* 147.060 (74.4 Hz). *Adm:* $5. Email: **docdiesel@hotmail.com**

Ohio (Perrysburg) — Mar. 20 D H R S V
8 AM – 2 PM. *Spr:* Toledo Mobile Radio Association. Owens Community College, 30335 Oregon Rd. *TI:* 147.27 (103.5 Hz). *Adm:* $10. **tmrahamradio.org**

ARRL OKLAHOMA STATE CONVENTION

April 8 – 9, Claremore, Oklahoma

D F H Q S V

Fri. 4 PM – 9 PM, Sat. 8 AM – 3 PM. *Spr:* Green Country Hamfest, Inc. Claremore Expo Center, 400 Veterans Parkway. *Tl:* 147.09 (88.5 Hz), C4FM. *Adm:* $8 Advance; $10 door, kids under 12 free. **greencountryhamfest.org**

Pennsylvania (McKeesport) — Apr. 3 D F H Q R V

8 AM – 2 PM. *Spr:* Two Rivers ARC. The McKeesport Palisades, 100 Fifth Ave. *Tl:* 146.73 no tone. *Adm:* $5. **trarc.net**

Tennessee (Tullahoma) — Mar. 12 D F H R S T V

8 AM – 2 PM. *Spr:* Middle Tennessee ARS. First United Methodist Church, 208 West Lauderdale St. *Tl:* 146.700 (114.8 Hz). *Adm:* $5, children 15 and under free. **qsl.net/mtars**

Texas (Irving) — Mar. 5 F H R V

8 AM – 2 PM. *Spr:* Irving ARC. Betcha Bingo 1, 2420 W. Irving Blvd. *Tl:* 146.720 (110.9 Hz). *Adm:* $5. **irvingarc.org**

ARRL WEST TEXAS SECTION CONVENTION

March 19, Midland, Texas

D F H Q R S V

8 AM – 4 PM. *Spr:* Midland ARC. MLK Community Center, 2300 Butternut Ln. *Tl:* 147.30 (88.5 Hz). *Adm:* Free. **hamfest.w5qgg.org**

UTAH DIGITAL COMMUNICATIONS CONFERENCE

March 26, Sandy, Utah

H S

9 AM – 5 PM. *Spr:* Utah Digital Communications Committee. Salt Lake Community College Conference Center, 9750 South 300 West. *Tl:* 146.62 no tone. *Adm:* Adult $15 advance, Youth free; Adult $20 door, Youth free. **utah-dcc.org**

ARRL VERMONT STATE CONVENTION

February 26, Colchester, Vermont

D F H R S V

8 AM – 2 PM. *Spr:* Radio Amateurs of Northern Vermont. Hampton Inn Conference Center, 42 Lower Mountain Rd. *Tl:* 145.15 (100.0 Hz). *Adm:* $6 Advance, $9 door. **ham-con.org**

ARRL VIRGINIA SECTION CONVENTION

March 27, Annandale, Virginia

H Q R S T V

8 AM – 3 PM. *Spr:* Vienna Wireless Society. Northern Virginia Community College, Annandale Campus, 8333 Little River Turnpike. *Tl:* 146.685 (110.9 Hz) *Adm:* $10. **viennawireless.net/wp/events/winterfest**

Washington (Puyallup) — Mar. 12 D F H R V

8 AM – 2 PM. *Spr:* Mike & Key ARC. Washington State Fairgrounds, 110 9th Avenue SW. *Tl:* 146.82 (103.5 Hz). *Adm:* $10. **mikeandkey.org/SwapMeet.php**

Wisconsin (Jefferson) — Mar. 20 D H R V

8 AM – noon. *Spr:* Tri-County ARC. Jefferson County Fairgrounds – Activity Center, 503 North Jackson Ave. *Tl:* 145.49 (123 Hz). *Adm:* $7. **w9mqb.org**

To All Event Sponsors

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

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

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

Certificate of Code Proficiency

Recipients

Sponsored by
VIBROPLEX
www.vibroplex.com

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

October 2021

Floyd E. Cureton, Jr., WO5S	10
Jay G. Lewis, KA3LNA	10
Harold D. Craft, Jr., AA2JQ	15
David M. Hartley, WQ7F	15
John W. Mellars, WA2MIB	15
Sean Walberg, KN4ZMA	15
Joni Zornes, AA4WA	15
George J. Cosmetis, WA3CCI	20
Dewey L. Edwards, Jr., K4CAB	20
Christopher E. Johnson, WB9FXW	20

November 2021

Timothy S. Jacobson, N9CD	10
James W. Carter. K7IOL	15
Joseph DeMattei, Jr., KD4RXB	15
John Gaynor, N3DNA	15
Joel P. Tilley, KC1PNJ	15
Kirk S. Goddard, AG7YM	20
Russell Rzemien, WA1FCC	20
Michael L. Rohwedder, WU9D	35

December 2021

Andy F. Lach, KD9KHA	10
Dave L. Rawlings, KE7JEL	10
Bruce E. Friedline, N9XAU	15
Martin Hickey, AJ6CL	15
Steven H. Saef, AA2BB/4	15
Ronald A. Weiss, W9OFF	15
Joseph DeMattei, Jr., WA1AAA	20
Gerald L. Foster, WA6BXV	20
Walter J. Schivo, KB6BKN	20
John H. Summers, Jr., WØDY	20
Ronald A. Weiss, W9OFF	20

January 2022

Gregory Dietsche, K9CTS	10
Jonathan M. Graefe, AE3JG	10
Justin T. McKibben, KN4PRB	10
Steve D. Miller, W6SDM	35

Congratulations to all the recipients.

March 2022 W1AW Qualifying Runs

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

March Qualifying Runs will be transmitted by W1AW in Newington, Connecticut at the times shown on 1.802.5, 3.581.5, 7.047.5, 14.047.5, 18.097.5, 21.067.5, 28.067.5, 50.350, and 147.555 MHz. The West Coast Qualifying Runs will be transmitted by K6KPH on Saturday March 26 at 2 PM PDT (2100 UTC) on 3581.5, 7047.5, 14047.5, 18097.5, and 21067.5 kHz. Unless indicated otherwise, sending speeds are from 10 to 35 WPM.

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

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

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

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

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

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

W1AW Qualifying Runs — March 2022
(All times are in Eastern Standard Time; Red denotes Eastern Daylight Time.)

Monday	Tuesday	Wednesday	Thursday	Friday
	3/1 7 PM – 0000Z **(3/2 – UTC)** 35 – 10 WPM	**3/2** 4 PM – 2100Z 10 – 35 WPM	**3/3** 10 PM – 0300Z **(3/4 – UTC)** 10 – 40 WPM	**3/4** 9 AM – 1400Z 10 – 35 WPM
3/7 4 PM – 2100Z 10 – 35 WPM		**3/9** 7 PM – 0000Z **(3/10 – UTC)** 10 – 40 WPM	**3/10** 9 AM – 1400Z 35 – 10 WPM	**3/11** 10 PM – 0300Z **(3/12 – UTC)** 10 – 35 WPM
3/14 7 PM – 2300Z 10 – 35 WPM	**3/15** 9 AM – 1300Z 10 – 35 WPM	**3/16** 10 PM – 0200Z **(3/17 – UTC)** 35 – 10 WPM		**3/18** 4 PM – 2000Z 10 – 40 WPM
3/28 10 PM – 0200Z **(3/29 – UTC)** 10 – 40 WPM	**3/29** 7 PM – 2300Z 10 – 35 WPM	**3/30** 9 AM – 1300Z 35 – 10 WPM	**3/31** 4 PM – 2000Z 35 – 10 WPM	

ARRL VEC Volunteer Examiner Honor Roll

The ARRL VEC Honor Roll recognizes the top 10 Volunteer Examiners in each ARRL Division according to the total number of ARRL exam sessions in which they have participated since their accreditations. Considering each session requires an average time commitment of 2 to 4 hours or more, the thousands of hours these VEs have invested represent extraordinary dedication! Whether you are one of our VE Teams that tests once a week, once a month, or once a year, we want to express our warmest appreciation to all volunteers for your generous contribution to the ARRL VEC program.

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

Examiner	Sessions	Accreditation Date
Atlantic		
Jobst Vandrey, AC0LP	324	23-Jun-08
James McCloskey, NS3K	322	14-Nov-94
Edward Genoino, WA2NDA	298	10-Jul-85
George Brechmann, N3HBT	291	01-Apr-91
William Klepser, Jr., WB2AIV	215	09-Jun-99
Cully Phillips, N3HTZ	205	01-Sep-91
Michael Harla, N2MHO	188	12-Apr-06
Ralph Abbott, WA3ELQ	173	30-May-05
Mark Miller, AK3M	166	20-Jan-03
Jeffrey Jones, ND3Z	164	18-Feb-94
Central		
Ed Wagner, AB9FN	378	01-Jul-02
Allan Bukowski, N9ZD	328	01-Jun-92
Donald Hlinsky, N9IZU	319	01-Mar-91
Eldon Boehm, NK9U	318	21-Nov-86
Brian Eder, WB9UGX	287	01-Jan-92
Robert Begeman, W9KVK	261	01-Jun-92
David Nicolaus, W9DN	250	13-Feb-86
James Rinehart, K9RU	242	01-Aug-91
Frederick Baguhn, W9GOC	241	16-May-02
David Pritchard, W9QL	229	12-Apr-01
Dakota		
Jeffrey Goodnuff, W0KF	320	17-Jun-03
John Schwarz, Jr., AE0AL	309	26-Oct-94
Shep Shepardson, N0NMZ	273	12-Mar-01
Daniel Royer, KE0OR	239	01-Jul-91
Dennis Ackerman, KB0OQQ	221	15-Jul-96
Douglas Nelson, AA0AW	218	01-May-90
James Rice, II, N0OA	209	04-Dec-00
Larry Larson, KR0K	205	16-Mar-09
Robert Tracy, N0TC	184	30-Jul-86
Karl Eriksen, WA2DEE	169	08-Jan-90
Edward Van Cleave, Jr., W0VC	169	01-Jun-92
Delta		
Monvel T. Maskew, Jr.,K9FQ	670	18-Jul-18
Arthur Parry, Jr., WB4BGX	270	01-May-91
Joe Lowenthal, WA4OVO	264	25-May-06
Roger Gray, N5QS	250	01-Mar-93
Bobbie Williams, W1BEW	246	01-Jun-92
Dawn Gray, N5QT	231	01-Mar-93
Loma Westmoreland, KU5J	213	31-Jan-21
Daryl Stout, WX4QZ	210	17-Sep-07
Henry Mitchell, N5SEB	198	10-Nov-94
Robert White, AI4GI	192	18-Jul-05
Great Lakes		
David Potter, KE8OHG	855	03-Jun-20
Charles Tyrrell, KE8PCB	574	03-Sep-20
Charles Hall, W8HF	286	01-Jun-92
Lance Harvala, AB8Y	246	06-Nov-19
Archie Mack, Sr., AF4EB	238	19-Aug-97
Stanley Arnett, II, AC8W	224	06-Sep-84
Dale Pritchett, KC8HJL	223	26-Mar-98
William Bogle, Jr., KE8FZY	222	08-Jul-20
Chris Anderson, K8VJ	220	09-Feb-90
James Viele, W8JV	210	22-Mar-90
Steven Wheatcraft, AA8BN	210	01-May-91

Examiner	Sessions	Accreditation Date
Hudson		
Paul Maytan, AC2T	711	06-Sep-84
Stanley Rothman, WA2NRV	481	01-Mar-85
Alan Crosswell, N2YGK	470	26-Oct-94
Fritz Boigris, KB2O	466	26-Oct-84
Sid Markowitz, K2GG	409	27-Sep-94
Gerald Miller, Jr., AA2ZJ	405	05-Dec-95
Daniel Calabrese, A2HX	305	01-Nov-91
John Kiernan, KE2UN	290	01-Jul-91
Thomas Carrubba, KA2D	280	01-Sep-93
Walter Lesnowich, W2EE	263	06-Mar-08
Midwest		
David Bartholomew, AB0TO	751	22-Mar-02
Kevin Naumann, N0WDG	661	17-Nov-02
Harry Steger, Jr., W0HMS	593	26-Aug-08
Roland Kramer, W0RL	537	21-Jun-01
Jeanette Nordman, AB0YX	460	21-Aug-03
Harold Kunkee, K0KTZ	339	01-Jul-91
Kenneth Simila, KC0VMY	281	18-Feb-07
John Telker, N0TH	272	29-Aug-12
John Mountain, Jr., KJ0MTN	250	28-Sep-09
Ronald Lemons, KB0DIY	209	01-Oct-92
New England		
*Bob Phinney, K5TEC	1,478	20-Jan-14
*Paul Lux, K1PL	1,289	25-Jan-85
Phillip Temples, K9HI	518	12-May-89
Gregory Paul, KC1MND	504	03-Jun-20
Robert Beaudet, W1YRC	399	01-Aug-90
Bruce Anderson, W1LUS	361	11-Feb-88
Lawrence Polowy, KU1L	340	02-Jan-85
James Mullen, KK1W	335	01-Mar-91
Stefan Rodowicz, N1SR	335	20-Nov-84
Barbara Irby, KC1KGS	297	05-Aug-19
Northwestern		
Richard Morgan, KD7GIE	450	11-Aug-00
Scott Robinson, AG7T	382	01-Aug-91
Loren Hole, KK7M	381	06-Sep-84
S. Riley McLean, W7RIL	319	02-Sep-99
David Brooks, N7HT	311	10-Jun-87
John Clarke, AC7WW	308	20-Jan-03
George Ftikas, N7TQZ	302	01-Dec-92
Joseph Barry, K7SQ	279	21-Jun-95
Donald Baune, AC0EX	259	19-Sep-06
Wayne Schuler, AI9Q	255	01-Sep-91
Pacific		
Brian Torr, N6IIY	531	06-Sep-00
Morris Jones, AD6ZH	515	27-Nov-01
Dieter Stussy, KD6LVW	440	27-Jan-94
Gordon Fuller, WB6OVH	361	06-Sep-84
Bill Nichols, NN7K	341	01-Sep-93
Robert Perlman, W6BP	310	26-Aug-08
Jim Brunk, N6BHX	288	13-Jul-95
Larry Loomer, KI6LNB	284	03-Dec-08
Dale Westerterp, WB6TMS	238	16-Jun-00
Joseph Speroni, AH0A	233	20-Nov-84

Examiner	Sessions	Accreditation Date
Roanoke		
Judy Friel, AC4RG	301	01-Feb-91
Alan Ronald Moeck, WA2RPX	264	27-Sep-94
David Snyder, W4SAR	251	01-May-93
Terry Sanner, WV8V	227	06-Sep-84
Larry Withrow, AF4HX	200	17-Dec-98
Henry Wyatt, II, K4YCR	196	28-Jan-98
David Poe, W8IW	194	13-Mar-07
Thomas Lewis, W4SIS	191	14-Nov-97
Edwin Williams, KN4KL	182	01-Jan-92
Maurice Brown, N8VA	181	31-Mar-97
Rocky Mountain		
Robert Hamilton, N0RN	402	19-May-87
Jeffrey Weinberg, W0QO	312	01-Apr-93
David Avery, N0HEQ	302	13-Jan-88
David Sharpe, KI0HG	258	02-Feb-98
Martin Soffran, NM5MS	235	21-Mar-94
Orlin Jenkins, K0OJ	233	01-Mar-85
Peter Brisbine, NM5PB	229	20-Jan-14
Gary Zabriskie, N7ARE	217	20-Nov-84
Gordon Smith, K7HFV	214	06-Sep-84
Michael Blenderman, K7IC	203	30-Apr-96
Southeastern		
***Gary Lee Pike, KA4KBX	4,786	03-Sep-09
***Collin Pike, KJ4AXB	3,469	26-Apr-11
***Justin Lee Pike, KJ4AXF	3,438	12-Nov-12
**Anna Grogan Pike, KD4PCU	2,342	18-Aug-09
*Ryan Krenzischek, W4NTR	1,765	04-Jan-13
*Patrick Wyatt Pike, KJ4AXD	1,416	13-Oct-15
Val Jacyno, AK4MM	388	08-Nov-11
Pablo Soto, KP4SJ	382	01-May-92
Robert Cumming, Sr., W2BZY	368	29-Jan-97
Joseph Patti, N4UMB	325	01-Sep-90
Southwestern		
*Bill Martin, AI0D	1,080	01-Nov-84
Fred Bollinger, AB7JF	544	17-Apr-95
David Morrill, N7TWT	459	20-Jul-00
Bruce Ziemienski, WA6BZ	321	25-Mar-02
Richard Buck, KC7OCT	317	21-May-97
Donald Kramer, Sr., WA6UVW	306	08-May-98
Ali Hassan, AA6WC	288	01-Jun-90
Arthur Hoffman, W7ART	278	20-Feb-98
Norman Pilawski, WT6Y	277	17-Feb-87
Scott Swanson, K6PYP	273	01-Dec-92
West Gulf		
*Franz Laugermann, K3FL	1,047	01-Dec-91
Daniel Quigley, N7HQ	793	24-Apr-20
Tanner Jones, W9TWJ	641	31-Jul-07
Gerald Grant, WB5R	501	04-Jan-85
Adolph Chris Koehler, K5VCR	493	29-Sep-95
Wilbert Cannonier, KK5JJ	469	03-Nov-95
David Fanelli, KB5PGY	461	01-Oct-91
Michael Nault, W5OFT	403	06-Sep-01
Barbara Laugermann, KA5QES	374	24-Aug-11
Janet Crenshaw, WB9ZPH	350	02-Oct-97

*Denotes participation in over 1,000 sessions. **Denotes participation in over 2,000 sessions. ***Denotes participation in over 3,000 sessions.

A Look Back


QST
April 1972
75 Cents
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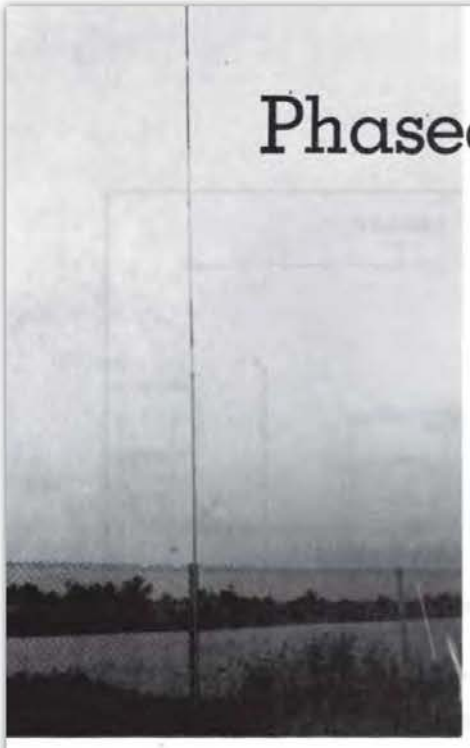
OFFICIAL JOURNAL OF THE ARRL
ARRL



Phased Verticals for 40

BY GARY D. ELLIOTT,* KH6HCM/W7UXP

THE IDEA of using a pair of phased verticals on 40 meters had occurred to me before, but the antenna never materialized since I seemed to get out fairly well with an inverted V up 50 feet. I normally do not work much on 40 meters except during contests, because of the high level of foreign broadcast QRM that is so bothersome on this band in Hawaii. A clear frequency is hard to find and one usually has to duck in between some 40-over-S9 Asian commercial stations.

During the first weekend of the 1971 ARRL DX contest, I used two antennas on 40, an inverted V and a hastily erected sloping dipole directed towards the U.S. Mainland. There was little difference between the antennas, which was disappointing, since the "Sloper" was erected with the hope that it would reduce some of the foreign-broadcast QRM from Asia. Upon conclusion of the first weekend of the contest with a mediocre performance on 40, it was evident that to do well on this band during the second half of the contest, I had to reduce the level of the troublesome QRM, and put a better signal into the East Coast. So I decided to try a pair of phased verticals and then run some comparison checks with the inverted V before round two of the contest commenced.

Theory

Two or more vertical antennas spaced a half wavelength apart can be operated as a single antenna system to obtain additional gain and a directional pattern. There are two practical ways that verticals for 40 meters can be combined, end fire and broadside. In the broadside configuration, the two verticals are fed in phase, producing a figure-eight pattern that is broadside to the plane of the verticals. In an end-fire arrangement, the two verticals are fed out of phase, and a figure-eight pattern is obtained that is in line with the two antennas, Fig. 1. However, an end-fire pair of verticals can be fed 90 degrees out of phase and spaced a quarter wavelength apart, and the resulting pattern will be unidirectional. The direction of maximum radiation is in line with the two verticals, and in the direction of the vertical receiving the lagging excitation; see Fig. 2. The end-fire arrangement fed 90 degrees out of phase was decided upon because it would, I hoped, accomplish my two goals: one, some rejection of foreign broadcast signals off the back of the antenna from Asia and two, increased gain over a dipole.

Construction

Physically, each vertical was constructed out of telescoping aluminum tubing that started off at 1-1/2-inch dia and tapered down to 1/4-inch dia at the top. The length of each vertical was 32 feet 6 inches (234/*f*). Each vertical is supported on two standoff insulators set on a 2 by 4, 6-feet long (as shown in Fig.3) and strapped to a fence. An alternative method of mounting would be a 2 by 4 about 8 feet long and set about 2 feet in the ground. After one vertical was mounted on the 2 X 4 it was raised into position and the resonant frequency was checked with an Omega-T antenna noise bridge. It was found that the vertical resonated too low in frequency, about 6.9 MHz. This was to be expected as the fundamental equation for the quarter-wave vertical is 234/*f*. However, this formula is only reasonably correct for very small dia. tubing or antenna wire. When larger dia.

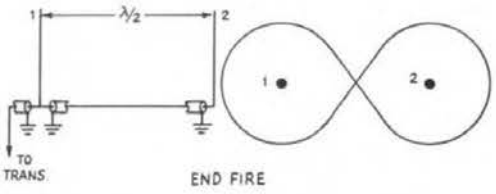


Fig. 1 — Pattern for two verticals spaced one-half wavelength apart fed 180 degrees out of phase.

* 5952 Gannet Ave., Ewa Beach, HI 96706

TABLE I

Total Observations	*Signal Difference* *Inverted "V"*	*Phased Vert's*	*Remarks*
2500 Miles (West Coast) 38	11	–	No difference in sig. strength
	–	14	Phased verticals less then 1 S unit better
	–	7	More than 1 S unit better
	–	6	More than 2 S units better
2500-3500 Miles (Mid West) 35	3	–	No difference in sig. strength
	–	6	Phased verticals less than 1 S unit better
	–	15	More than 1 S unit better
	–	11	More than 2 S units better
Over 3500 Miles (East Coast) 27	–	–	No difference*
	–	2	Phased verticals less than 1 S unit better
	–	15	More than 1 S unit better
	–	10	More than 2 S units better

*All stations past the Midwest reported that the phased verticals were always better than the inverted "V"

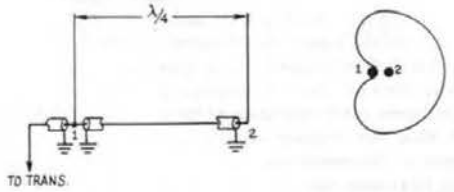


Fig. 2 – Pattern for two verticals spaced 1/4 wavelength apart and fed 90 degrees out of phase.

tubing (1-1/4 inch and larger) is used, the physical length will be shorter than the actual calculated length. Using the antenna noise bridge, an inch at a time was cut off the top until the resonant frequency was 7100 kHz. This resulted in 6 inches being cut off in my particular case, thus making the vertical exactly 32 feet long.

The ground system is very important in the operation of a vertical. The two usual methods of obtaining a ground system with verticals are shown in Fig. 4. In my particular case I used a ground rod at the base of each vertical and used two radials, each a quarter wavelength long at the lowest operating frequency desired. I am fortunate in that there is a salt-water lagoon at the rear of my property and the radials were run into the salt water and anchored. Since most hams will not have a salt-water lagoon in their back yard it is highly recommended that more radials be used.[1]

1 [EDITOR'S NOTE: The importance of a good ground and numerous radials cannot be stressed too strongly. Use as many radials as possible on each vertical. See Sevick, "The Ground-Image Vertical Antenna," *QST*, July 1971.]

Feed System

In order to achieve the unidirectional pattern shown in Fig. 2, the two verticals must be separated by a quarter wavelength and one vertical must be fed 90 degrees behind the other. Two suggested feed methods are shown in Fig. 5. An electrical section of line cannot be used by itself to connect the two verticals together to achieve the 90 degree lag because of the velocity factor of RG8-U. The length of an electrical wavelength of transmission line is based on the calculation:

$$\frac{234 \times 0.66}{7\ \text{MHz}} = 22'6''$$

Obviously, 22 feet, 6 inches of coax cannot be used as the verticals are spaced 34 feet apart. This is overcome and a 90-degree lag is still obtained by using a 3/4-wavelength section of transmission line

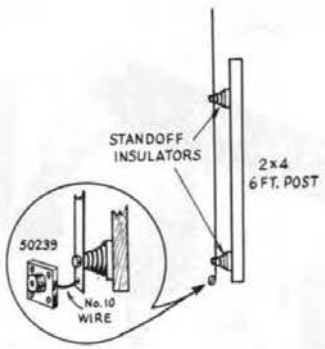


Fig. 3 – Method of mounting the vertical element on a 2 X 4.

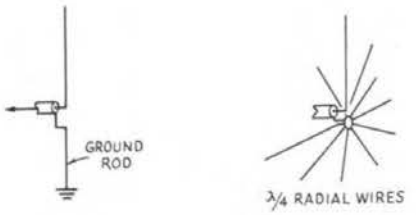


Fig. 4 — An eight- to ten-foot ground rod should be installed at the base of the antenna and as many radials as possible installed.

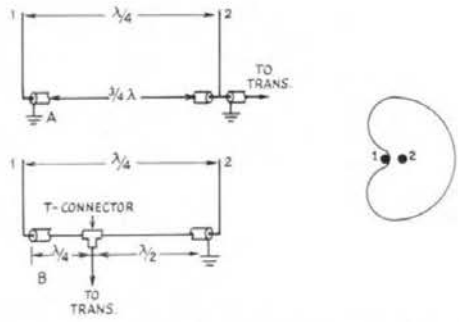


Fig. 5 — Two methods of feeding the phased verticals.

between the two verticals, Fig. 5A.[2] The SWR is less than 1.25 to 1 across the entire band, using 52-ohm coax and no matching network.

Evaluation and Performance

Lacking elaborate test equipment to evaluate the phased verticals, I had to be content with on-the-air comparisons between the verticals and my inverted V. A coaxial relay was utilized in order to have instantaneous antenna transfer and all tests were run with the same power level. A total of 100 different stations on the U.S. Mainland were contacted and participating stations were briefed that I was trying to compare two different antennas and that as accurate as possible comparison reports would be appreciated. Table I shows the results of the comparison. As can be seen, the results were very impressive. In addition there was a noticeable reduction of QRM interference from the Asian commercial stations while on the phased verticals.

The proof of the pudding however, is in the eating. The phased verticals were used extensively during the second weekend of the ARRL DX contest.[3] Band openings to the Mainland on 40 occurred more than 45 minutes earlier when compared to the inverted V. Many stations reported "Loudest KH6 on the band."

I would highly recommend to any ham really interested in putting out a good signal on 40 and who does not have the money to put up a beam, to try some form of phased verticals. An added bonus is that the verticals should load very well on 15 meters. However, since I have a beam for this band no tests were run. QST

2 [EDITOR'S NOTE:] In calculating the phasing-line lengths keep in mind that the velocity factors for solid polyethylene and foamed material used as the insulator between the inner conductor and outer braid are different. Whichever cable you use for the phasing line, be sure to use the correct velocity factor.]

3 None of these contacts was used in tabulating the results shown in Table I.

Strays

For the past few years K1MKV, Needham Heights, Massachusetts, and LU3MAP, Mendoza, Argentina, have maintained an important link in the continuing program of the Moonwatch Division of the Smithsonian Astrophysical Observatory. The Moonwatch Division coordinates a group of amateur astronomers around the world for the tracking of certain artificial satellites. K1MVK and LU3MAP provide communications between the group's tracking station in Argentina and Moonwatch Headquarters in Cambridge, Massachusetts.

The Fine Art of Mobile Radio

BY GEORGE L. FISHER,* WB6MKV

HAVING FINISHED 12,500 miles of mobiling from Los Angeles to Miami, to Athens, Georgia, back to Key West, then to Daytona Beach, to Montreal, Canada, to Bozeman, Montana, then Los Angeles via Las Vegas, I speak with some experience about mobiling – not in a technical atmosphere, but just as an everyday ham wishing the challenge, fun, and excitement of mobile ham radio across the U.S.A.

First, of course, comes the installation of your equipment in the car which is painstaking and exacting if you expect to have a trouble-free trip. My rig operates from a 12-volt power supply and uses a multi-band antenna which can be manually adjusted for 80 through 15 meters, all installed in the cab section of an Alaskan Camper. I also installed another 90-ampere hour battery for additional power.

It may come as a surprise to some of you to learn that, excluding the freeways, U.S. roads are not always very good roads. They are on many occasions narrow, rough, poorly paved, poorly marked, and mismapped. For an experience some day, get off of the freeway, or main arterials, and see how soon you run out of good driving road! Some of the roads to camp areas and sightseeing byways are rough indeed, with gravel washboard and chuck holes which can really vibrate a truck camper and all that is in it. Sound indeed is the rig which can stand 12,500 miles of juggling over bumps and rough pavement to say nothing about the sway, start, stop of a camper traversing all kinds of byways and freeways, tunnels, underpasses, and ferry boats.

A very important item involves notification of FCC of your planned itinerary, your date of visit and other required information. The ARRL will send you a supply of forms (S-43a) for this purpose which substantially reduces the time and paper work for this part of the project. A few spare forms will accommodate one or two changes of plans. Otherwise, write your own notification letters to the District FCC Engineer in charge at the addresses shown in the *ARRL License Manual*. Don't forget also to notify the FCC Engineer in your district of your proposed itinerary and expected time of return.

A must for the mobile trip is a copy of the ARRL WAS (worked all states) Map which is essential for area designations to properly identify your area from 1 through 0 which is necessary to properly identify your station by call sign. Without the map you may have problems identifying the change in radio call districts. Read the newest *License Manual* for the latest station identification regulations.

*Box 1658, San Pedro, CA 90733.

Keeping a Log

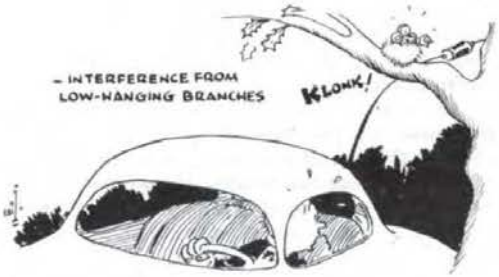
Station logs posed a problem for me. There is a choice of the ARRL Mini log, the standard ARRL Log Book, or any other log book of your choice. The important thing is to carefully enter all calls. This was a new experience for me and was most difficult in a moving vehicle while operating either cw or phone. I devised a system of my own, first because it is difficult to write while driving, and second because the log book was always lost under a pile of maps, clothing, or other miscellany which accompany the passenger on a trip. I used an ordinary clipboard and numbered the sheets on the board which was always stowed on the dashboard. I memorized the log format and scrawled (by feel without looking at the sheet) in large writing all the data necessary for the log on a single large 8 1/2 X 11-inch sheet. This technique permitted me to keep my eyes on the road constantly, never looking at the log page even for a second. Turning your eyes from the road to a log book or to tune is very dangerous. I would set my transceiver for the center of the desired band and then tune only by feel both sides of the center. With a bit of practice you will be surprised at your proficiency. Remember at 60 miles per hour, a second or two can put you off the road.

Time was from a watch set to GMT, another must for the mobiler. The instant a contact is made get the time down, then the call of the other station and your frequency and mode. With the large sheet of paper on the clipboard these notes can be made (without looking) by writing in large letters the information for later entry into the log. After the contact the numbered sheet was removed, folded, and placed on the dashboard for entry into the log at a later time. This makes for a much neater log and a more accurate one. Of course if you have a rule of no driving while hamming the log is kept by the usual process.

Another approach takes advantage of the relatively new reduced logging requirements for mobile work. You can enter the time, band, mode, and power before the beginning of an on-the-road stretch. Then have a grease pencil on the dashboard or hanging perhaps from the rearview mirror; use it to write call signs on the windshield or side window. These can be transferred to the log at the next stopping point (along with a time-out entry), and the window wiped clean for the next stretch. It isn't necessary currently to enter a time in and time out for *each* station when you're mobile.

Other Hints

Getting in and out of service stations, driving along tree-lined streets, and driving under wires across streets are all constant threats. The antenna height becomes critical between the West Coast and the Atlantic coast. Clearance in the West is generally 15 to 16 feet for underpasses and bridges; however, in many places in the East, clearance is limited to 13 or 14 feet. You must be constantly alert for the overhead crossings, low tree branches, and overhead wires. The overall measurement of my antenna was 14', 2" from bottom of the tires to the top of the whip.



Many times when on divided highways or other low-density traffic roads I found that communication could be accomplished with safety; but if you enjoy tailgating, turn off the rig. We stayed way back of the traffic and when we got into heavy traffic we would just stop everything until a rest area or turn-off road became available. Safety has to be the first consideration at all times.

Almost two thirds of my calls were cw while my wife was driving. This was great fun and relieved me from the cares of the road. Most of the other third was voice, both while I was driving and when my wife was driving. I also made a few calls while parked or camped on both cw and phone. Most of these contacts were to show off the rig and ham radio to youngsters. Generally, though, it was early to bed and early to rise with the hamming done on the run. It is most helpful to have a piece of plywood large enough to hold your note paper under a clip and also have room for the key and arm rest when sending or receiving cw. You can purchase clipboard clips separately and affix to the larger boards for use on your lap.

Those who have made the transition from handkey to automatic paddlekey will find that going back to the handkey may be some problem. However, if you will slow down and concentrate on perfect code, the old key will surprise you with very nice readable code in spite of the bumps. With a little practice you will find you can get a compliment or two with the handkey.

It is real easy to get mixed up with call signs so special care must be taken to be certain you have the right call recorded. The unusual distractions of driving and outside noise can cause mistakes in the calls. I used headphones when a passenger, which helped some. Generally I would tune for CQs slowly over the band and contact the CQ caller or listen in and call one of the hams after the other had signed.

Schedules and Nets

A schedule with the family and friends at home is difficult but is a pleasure and is most helpful for special contacts. Schedules are sometimes demanding and most always arrive at the most inconvenient time for your plans. The time difference poses many difficulties. You will soon have different meal times, bed times, and getting up times, and you will soon find you are out of touch with the home pad so don't tie yourself to too tight a schedule. The once-a-week kind are much easier when you can be comfortably located on a nice high spot by a clear stream with a cool drink alongside. From here you can get your business done, make a few social contacts, and enjoy hamming.

One real benefit of mobile is the knowledge that you are always ready to raise help or assistance if needed. Nothing close to an emergency occurred for us – but we were ready. It is interesting to observe the skip in the radio signal and how it changes as you move from place to place. Ham radio won't help you much with hotel reservations at a fifty-mile distant village. However, there are MIDCARS and EASTCARS, companions to WESCARS, across the continent. There are numerous nets on all bands which you might break in for more local assistance. The ARRL Net Directory would be a valuable document to have along if your trip is to be extensive. Another by-product is the ability to keep abreast of weather conditions ahead and plan accordingly. The nets are choice sources of current actual weather conditions.

Repairs and maintenance are very difficult and few small cities have much in the way of ham parts, equipment, or service and, of course, it seems that you make all large cities on Saturday or Sunday or when the stores are closed.

The job of sending QSL cards is a big one when you get home but it is better, I think, than trying to QSL when you are making camp, getting dinner and other things unless your wife does all the work – and mine doesn't.

This article is not for all the old expert mobileers with special equipment but for those who haven't strayed too far from the shack and would like to try mobiling. So many of my contacts expressed a wish that they could do the same that this should be of some interest to those with the heart to make a nice trip with a rig in the car. It is really very simple and with care can be very safe. It is really great fun. I don't think I will ever make a trip again without a rig in the car. QST

ARE YOU LICENSED?

- When joining the League or renewing your membership, it is important that you show whether you have an amateur operator license. Please state your call and/or the class of operator license held, that we may verify your classification.

Celebrating Our Legacy

ARRL's Contribution to My Radio Journey

In the 1950s, my friend loaned me a CONELRAD (Control of Electromagnetic Radiation) crystal radio, which was the first national emergency alert system that covered the AM broadcast band. My dad told me about ham radio after I heard an operator on CONELRAD, and I wanted to learn more. He gave me a crystal radio when I was 11 years old.

One day, I noticed a cubical quad antenna above someone's house as my sister and I walked to the city pool, and I went back later to knock on the door. The man who answered was W5AXV (SK), and he became my mentor. He explained his entire station to me and had patience when teaching me Morse code. I spent the following summer studying my *ARRL Ham Radio License Manual* and earned my Novice-class license in the fall of 1957.

My first radio was a Heathkit DX-20 with an AN/ARC-5 Command Radio receiver, which covered 40 meters with a 72 Ω twinlead dipole. I began to develop code proficiency by listening to ARRL's practice sessions. I continued to study for my General-class license using the *ARRL General Class License Manual*, and I upgraded my license shortly after.

I later entered into a 24-year career in the US Navy. Even though I moved a lot, I knew I had the resources to upgrade my license again. ARRL materials contributed to my success yet again, as I earned my Amateur Extra-class license in 1968. In following my mentor's example, I've helped many other operators obtain their licenses and have kept in contact with many of my friends on 40-meter SSB.

It's been 63 years since my radio journey began. I enjoy portable operations, DXing, wire antenna design and construction, and keeping up with the current technologies of the hobby. It's a pleasure to be part of the amateur radio community!

Stan Sommers, K5OPB
Arlington, Texas
Life Member

Remembering My Mentors

I was introduced to ham radio in 1954, when my father gave me an RCA (Radio Corporation of America) AM/FM shortwave radio. We lived in Augusta, Georgia, and there were about 100 hams in the area. Many of them were associated with the US Army Fort Gordon military base, which had a Signal Corps Training Center. I heard ham radio operators discussing the hobby, and I was fascinated by it. One of my relatives, Dave Freeman, W4EZU, was the engineer at a local radio transmitter site. He taught me basic electronic theory, and I eventually earned my Novice-class license.

I acquired a WRL Globe Trotter transmitter and a Hallicrafters S-85 receiver, and I put up a 40-meter dipole. My first contact was in North Carolina. I borrowed a Morse code practice machine with punched paper that was on a reel, and it took up my entire desktop.

In addition to my Morse code practice machine, one of my mentors, Edgar Mixon, W4DJF, helped me earn my Conditional-class license. Edgar was a blind ham who could copy CW at around 40 WPM, while having a conversation with you at the same time. He was extremely patient. He gave me my code test, while his wife checked my copy. In his basement shack, he was building a 6-foot-tall linear amplifier with all of the components separated, so he could get to them by touch. After receiving my new call sign, I got a Johnson Viking II transmitter and a Hallicrafters SX-96 receiver.

I was fortunate to hear that our local power company was replacing some telephone poles, and they were able to give me two of the older ones (I just had to dig the holes for them). I attached a half-wave 80-meter antenna to the two poles. Thankfully, my parents supported my hobby.

I attended Georgia Tech (Georgia Institute of Technology) and was a member of their ham radio club. I also spent 2 years in the US Naval Security Group in Morocco as a cryptologic technician. Because I already knew Morse code, I only had to learn additional letters in other alphabets. I met several hams in graduate school, and we got together regularly to chat in person and on the air.

My wife and I lived in New York for 9 years and I operated as W2GFC, but I was mostly inactive. When we moved to Texas, I operated as W5VQU, and when we moved to California, I upgraded to my Advanced- and Amateur Extra-class licenses and received my current call sign. One of my prize contacts was with Moscow during the Cold War. The late 1950s were wonderful for DX because we were near a solar maximum.

Ham radio has been a great hobby, and I'm still active. I often think back to the days in my shack when vacuum tubes glowed, and signals came in from around the world.

Claude Hutcheson, K5CH
Greensboro, North Carolina

Stan Sommers's, K5OPB, Heathkit DX-20 transmitter, Heathkit HW-29A transceiver, and Morse code keyer.

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

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

Classic Radio

The Drake 4-Line Family

Several amateur radio equipment retailers, including Drake, set out to duplicate the popular Collins S-Line, which became available in 1958. In 1959 and 1961, Drake released two excellent and popular receivers — the Drake 2-A and the 2-B, respectively. Both receivers were joined by accessory speakers, a 100 kHz crystal calibrator, a 2 LF low-frequency converter, and the 2-AQ and 2-BQ speaker and Q-multiplier combination. In 1963, Drake started building the 4-Line family of separates (see Figure 1) in response to Heathkit's release of their SB-Line.

Drake Introduces the 1-A, 2-B, and TR-3

Starting in 1963, Drake created popular transceivers with the model TR-3 featuring SSB, CW, and AM operation for 80/75, 40, 20, 15, and 10 meters. In 1964, Drake introduced the model TR-4. The 2-B went on as a new product until 1965 and was followed by the model 2-C, which used the same accessories as the 2-A and 2-B, except for the 2-CS speaker and 2-CQ speaker/Q multiplier revised to match the styling and knobs of the 2-C. The 2-C and matching 2-NT CW transmitter was popular in stations for Novice-class licensees.

Drake Emulates the Collins S-Line

The Drake R-4 receiver became available in 1964 and added a built-in calibrator and many other features to the 2-B. The R-4 and 2-B were physically very different. Coverage of 160 meters was built in, except for a single 12.6 MHz plug-in crystal to enable the coverage. Only 28.5 to 29 MHz was included for 10 meters. Three optional crystals were required to cover the rest of 10 meters. Coverage of 80/75 to 15 meters (it was too early for WARC bands) was included in the 500 kHz bands.

Selectivity was provided by Drake's famous and well-liked passband tuning system introduced in the last intermediate frequency (IF) of 50 kHz, except on the R-4C. The R-4, R-4A from 1966 (see Figures 1 and 2), R-4B from 1967 (see Figure 3), and R-4C from 1973 were mixed receivers, employing both vacuum tubes and solid-state devices. They became more solid state as time went on. In 1964, the R-4 used 13 tubes and a few semiconductors. Two years later, in 1966, the R-4A had a reported 12 tubes (but I count 13). By 1967, the R-4B was down to 10 tubes, and in 1978, the well-respected R-4C was down to six tubes.

In 1978, the fully solid-state R-7 receiver came out, replacing the R-4C in a bit over a year. There was a solid-state TR-7 80/75- to 10-meter SSB-CW transceiver and an L7 linear amplifier joined by a single 3-500Z final amplifier tube L-75 linear, but there was no T-7 transmitter to go with the R-7 receiver. The era of the receiver and transmitter transceiving pair was ending with the growth of solid-state transceivers at Swan, Drake, Astro, and the first generation of Atlas transceivers.

Like the Collins S-Line and Heathkit SB-Line, all Drake 4-Line receivers would transceive with all 4-Line transmitters. This was not true of the two Hallicrafters transceiver pairs — the SX-117 and HT-44, and the SX-146 and HT-46.

The R-4C

The earlier R-4, R-4A, and R-4B receivers were quite similar to each other, with only evolutionary changes. They were all double conversion with a 5.645 MHz first IF and 50 kHz second IF. The Drake R-4C was quite different. It was considered a triple-conversion design, which affected the passband tuning. The first conversion was to the 5.645 MHz by the tuning the VFO and the crystals that define the band to be tuned. There was an

Figure 1 — Drake's R-4A receiver. [Ronald Baker, WB4HFN, photo]

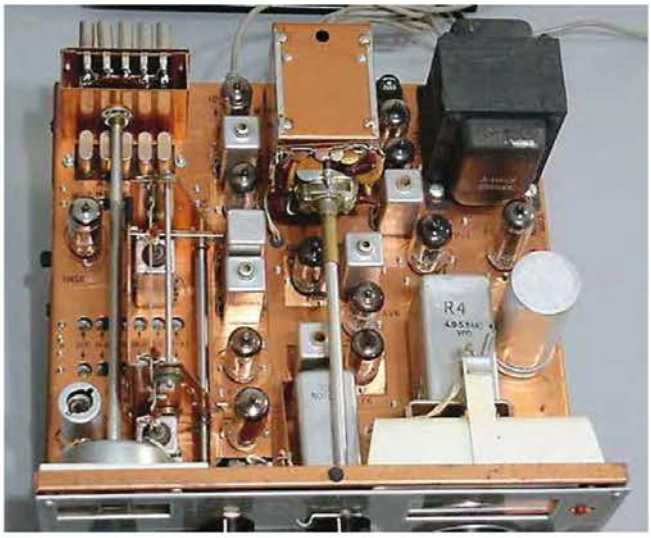


Figure 2 — The top, inside view of the Drake R-4A receiver. [Ronald Baker, WB4HFN, photo]

Figure 3 — The Drake R-4B. [Ronald Baker, WB4HFN, photo]

8 kHz crystal lattice filter to restrict the bit of spectrum coming in. The second conversion was to 5.695 MHz (5695 kHz), using the BFO as the conversion oscillator. The BFO frequency is about 50 kHz, plus or minus about 5 kHz. The third conversion was via a crystal oscillator at 5745 kHz down to the 50.0 MHz. The 50 MHz last IF was characteristic of Drake radios.

The R-4C also offered crystal lattice filters for selectivity. The 5645 kHz IF offered only 8 kHz, and the receiver comes with a 2.4 kHz crystal lattice filter. The optional crystal lattice filters were in the second IF at 5695 kHz. Optional filters had bandwidths of 6, 1.2, and 0.5 kHz, and 250 Hz was offered for sharp CW service.

The front-panel control adjusts the BFO. Shifting the BFO frequency affected the receive frequency slightly and also shifted the position of the BFO relative to the signal to be demodulated by the product detector. The net effect was that the received signal and demodulation both shifted relative to the frequency of the crystal lattice filter, creating very smooth and effective passband tuning about the selected IF filter.

4-Line Compatible Units

Drake marketed several accessories for the Drake 4-Line receivers in addition to the crystals to add band coverage and the crystal lattice filters. The MS-4 matching speaker also housed the AC-4 power supply for the transmitter or transceiver for use with the 4-Line receivers, the 4-NB noise blanker, and the FS-4 frequency synthesizer that replaced all optional crystals, giving the R-4 receivers coverage from 1.5 to 30 MHz (except 5 to 6 MHz) and the T-4 or T-4X family of transmitters to transceive or operate separately from the receiver.

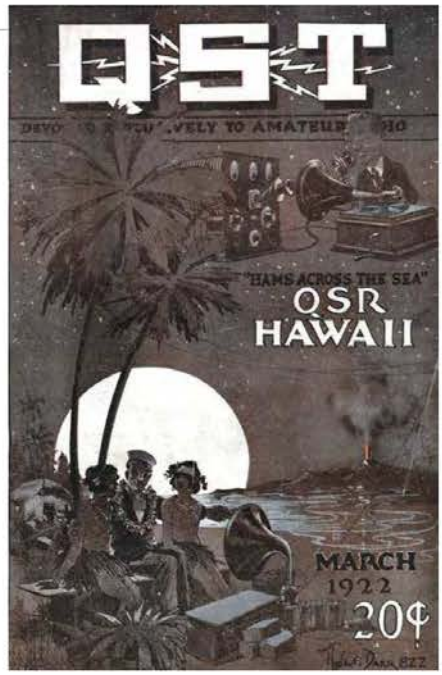
The available transmitters included the T-4, T-4B, and T-4C reciters with no VFO that would only transceive with the 4-Line receivers, the T-4X, T-4XB, and T-4XC transmitters with internal VFOs, so they could transceive or operate on separate frequencies. The receiving converters covered 6 and 2 meters, and the TC-6 and TC-2 transmitting converters helped to put the 4-Line on 6 and 2 meters. The MN-2000 high-power and MN-4 200 W antenna tuners also matched the 4-Line. The C-4 station console complemented the 4-Line styling, colors, and knobs, and the L-4 and L-4B linear amplifiers paired with the other equipment.

End of an Era

Most of the Drake 4-Line equipment was available until 1979, when the solid-state TR-7 80/75- to 10-meter transceiver and the R-7 solid-state receiver were available. By 1980, the reign of separate transmitters and receivers was over for new equipment from manufacturers, including Drake, Swan, Heathkit, Collins, Kenwood, Yaesu, and KW Electronics of England. The SSB-CW transceiver invented by Collins in 1957 and brought down in price by SBE, Drake, Hallicrafters, Swan, Galaxy, and others in England and Japan completely took over the amateur radio market by 1985.

Al Brogdon, W1AB

100, 50, and 25 Years Ago



March 1922

- The cover art shows a moonlit scene in Hawaii.
- The editorial discusses "The 'Phones and Amateur Radio."
- The lead article is "— And Now Transpacifics."
- In "The Improved Reinartz Tuner," readers learn about the advantages of the simple and inexpensive tuner.
- Robert C. Higgy reports on "The Successful Transatlantic Stations."
- "The European Transatlantic Results" discusses the outcomes of the Second Anglo-American Transatlantic Tests.
- S. Kruse presents an argument for co-operation between "The Radiophone and the Code Station."
- Boyd Phelps, 9ZT, discusses "Radio Below 200 Meters."
- Chas. T. Jacobs gives readers "An Improved Primary Condenser Switch."
- Francis L. J. Duffy, 9DDY, describes "A Spark Coil-C.W. Transmitter."

March 1972

- The cover photo shows some of the new power transistors for a "third generation" of sideband gear.
- The editorial discusses "Two Big Jobs" that lie ahead.
- Don V. Watters, VE2HW, presents "An SSB and C.W. Transmitting Converter for 220 MHz."
- Jerry Hall, K1PLP, discusses "High-Frequency Propagation Estimations for the Radio Amateur," using *Telecommunications Research and Engineering Report 13 (OT/TRER 13)*.
- Robert M. Myers, W1FBY, describes "A Dual-Voltage Medium-Current Power Supply for Repeaters."
- Walter J. Stiles, W7NYO, explains his "Dual-Polarization DX Antennas."
- H. H. Rugg, VE2HN, offers Part II of "The VE2HN Digital CQer."
- Roy C. Hejhall, K7QWR, presents his "Broadband Solid-State Power Amplifiers for SSB Service."

March 1997

- The cover photo shows Rick Lindquist, N1RL, trying his hand at portable packet operation.
- The editorial, "Paying Our Dues," discusses how non-profit organizations are funded.
- In "What a Weekend!," Ken Freedman, N1QQV, describes his experience of spending a weekend operating in a QRP contest.
- Mike Agsten, WA8TXT, talks about "The ATL-10 Antenna Tuner."
- Andrew A. Flower, WØZUX, shares some "Tales of Power-Line Noise."
- Anthony McCloskey, WA3CAO, discusses "A Relative-Indication Audible Meter Reader."
- Paul Duell, GØTLG/AE4QC, reports on "73 kHz—A New Band for Great Britain."
- Steve Ford, WB8IMY, and Zack Lau, W1VT, present Part 3 of "Get Ready for Phase 3D!"
- In "Weather Data to Go," Donald Cox, AA3EK, introduces readers to the latest weather information network.
- Farrell Winder, W8ZCF, and Mel Lehmann, KW7E, discuss "APRS via Outer Space."

Silent Keys

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

N1CFG **Vautin**, Claude E., Naples, FL
W1CNI **Arnold**, Daniel M., Bloomfield, CT
WS1D **Roberts**, Warren A., Springvale, ME
AA1DE **Taffe**, William J., Rumney, NH
WA1DOU **Miller**, Sid M., Hamden, CT
N1DPY **Rollinson**, Wilson L., East Providence, RI
•WG1E **Wilson**, John W., Scituate, MA
N1EGO **LaBrie**, Richard N., Winchendon, MA
AB1EL **Riggott**, Orrin W., Jr., Berlin, CT
N1EXY **Taylor**, George T., Milton, VT
♦W1FDR **Ravenstein**, Bob J., Chelmsford, MA
♦K1HTN **Beaman**, Bruce C., Center Ossipee, NH
KT1I **Cayen**, Charles R., Bow, NH
♦•W1IY **McCarron**, Paul F., Wells, ME
KA1JCG **Cutler**, Mary C., Bristol, CT
KA1KPA **Coolbroth**, Dennis S., Lyman, ME
♦•KI1M **Cantara**, Peter A., Hudson, NH
K1MLZ **Coburn**, Louis, Jr., Norton, MA
♦♦K1MMH **Hobart**, Mary M., Ardmore, PA
KA1NIS **Levreault**, Laurent P., Derby, VT
W1QT **Hilton**, Harry A., Brownville, ME
♦KD1R **Stetson**, Ralph T., III, Westford, VT
♦W1STN **Anderson**, Dexter, Mystic, CT
N1TKK **Cintron**, Hector I., Saint Thomas, VI
KB1UJX **Lasky**, Connie D., Fairfield, CT
K1WVU **Shafner**, Robert L., Northborough, MA
♦N2CIS **Imhof**, Maria A., Westampton, NJ
♦N2FS **Sainsbury**, Francis G., Lake Katrine, NY
W2GFM **Moses**, Gerald F., Lee, FL
KC2JGP **Maeder**, Ronald H., San Benito, TX
W2LHD **Placek**, Frank E., Freehold, NJ
WB2OYC **O'Donnell**, Paul V., Jr., Mays Landing, NJ
N2PX **Perry**, Ronnie C. "Ron," Hubbard, OH
WB2TDG **Brockway**, Kenneth B., Cohoes, NY
W2VO **McClain**, Ronald H., Canastota, NY
WA2VZH **Kenien**, Nedeem N., Binghamton, NY
W2WK **Koeth**, William J. "Bill," Piscataway, NJ
K2XF **Miller**, Seymour, East Greenbush, NY
AA2ZJ **Miller**, Gerald E., Jr., Iselin, NJ
•W3CPQ **Hoglund**, Noel O., Concord, NH
AA3FC **Kunz**, Walter F., Ledgedale, PA
♦KB3GN **Roberts**, George L., Jr., Frederick, MD
KA3GRW **Tackish**, Paul M., Pomfret, MD
KT3HC **Lawrence**, Herbert E., Beaver Falls, PA
♦WA3HTS **Caldwell**, Thomas L., Lansdale, PA
KE3IJ **Andersen**, Richard A., New Bloomfield, PA
•WB3JRY **Whitenight**, Raymond E., Berwick, PA
KA3NEN **Pomroy**, Eugene R. "Gene," Philadelphia, PA
K3RLC **Cereghino**, Robert L. "Bob," Stroudsburg, PA
WN3V **Miller**, John R., Liverpool, PA
N3WEN **Olinger**, James F., Jr., Beaver, PA
K3WI **Schwartz**, William M., Seaford, DE
♦K3WRY **Palsa**, Joseph G., Richmond, VA
K4BAK **Keller**, Bruce A., Kissimmee, FL
KE4BMY **Cox**, Glenn M., Wilmington, NC
W4CNN **Burnette**, Charles E., Cleveland, TN
WA4DOU **Lincoln**, Roy D., Sr., Elm City, NC
KN4DSA **Maltbie**, Robert L., Gadsden, AL
♦W4EI **Barron**, Roger L., Stanardsville, VA
WS4J **Lineberry**, Rubin O., Jr., Dublin, VA
♦K4LN **Osborne**, William S., Kingsport, TN
WB4MJE **Shaw**, Rene J., Clermont, FL
♦WB4MUH **Crosier**, Joseph L., Prince George, VA
KJ4OTC **Defilippo**, Robert W., Ridge Manor, FL
KN4PVK **Syphax**, Robert B., Science Hill, KY
♦♦W4QO **Stafford**, James C., Roswell, GA
N4QQM **Scott**, George R., Bluefield, VA
KR4R **Ritter**, Johnnie M., Jr., Dover, FL
♦WB4RLU **Arendell**, James "Lu," West Palm Beach, FL
KD4SUW **Ryckman**, Carol M., Lewiston, MI
KG4TTG **Crane**, Donald W., Rossville, GA
•N4VGY **Smith**, Wayne F., Carthage, TN
KA4WYC **Blythe**, Thomas J. "Jeff," Clover, SC
KI4YZI **Dillard**, Terry L., Alabaster, AL
KG4ZYY **Mars**, Richard A., Hampton, VA
WD5CAE **Simon**, Melvin J., New Iberia, LA
W5CWQ **Motley**, Raymond J., Waxahachie, TX
KF5F **Wyble**, Eugene J., Cherokee Village, AR
KD5FSJ **Shaner**, Merlin E. "Gene," Alvin, TX
W5FUN **Brown**, Terrance L., Pearland, TX
K5HLZ **Nicholas**, Robert H., Jr., Houston, TX
•NC5IR **Barnes**, Richard S., Friendswood, TX
AB5JW **Wright**, Jimmy C., Norman, OK
N5KQL **Leavelle**, Billy R., Lubbock, TX
•WA5LGF **Carter**, Daren D., Pearland, TX
N5LWT **Worth**, Thomas A., Enid, OK
WA5MDN **Thomas**, James A., Ponca City, OK
AD5O **Moore**, Lawrence B., Brandon, MS
WA5OSA **Geick**, Glenn R., Bellville, TX
W5PGZ **Gravett**, William P., Evans, GA
•N5SRC **Heard**, David M., Kingwood, TX
•WW5TX **Hopkins**, Marc E., Alvin, TX
•KC5VAM **Smith**, David L., Pearland, TX
KD5WA **Russell**, Louis M., Norman, OK
•W5YFF **Fowler**, Joe, Pearland, TX
♦K5YPV **Ridge**, Benjamin W., Ripley, MS
WA6DVK **Malory**, Louis P., Lake Arrowhead, CA
♦WA3OPY **Brehm**, Darell F., Oklahoma City, OK
KK6LK **Green**, Jack F., Dinuba, CA
•W6NDA **Kitagaki**, Paul K., South San Francisco, CA
K6SI **Lamson**, Kenneth C., Las Vegas, NV
♦K6SSS **Capossela**, Frederick L., Rancho Cucamonga, CA
AE6WH **Chambers**, Donald R., Menlo Park, CA
KO6XI **Chambers**, John F. "Monte," Glendora, CA
N7AM **Wells**, David E., Pima, AZ
W7ARZ **Smith**, William R. "Bill," Taylor, AZ
NA7AZ **Fitzgerald**, Frederick R., Peoria, AZ
K7BIE **Forsman**, James R., Allegan, MI
♦NU7D **Greeley**, Randy D., Longview, WA
AA7DD **Drayton**, Donald F., Boardman, OR
AA7DR **Rooney**, John T., Elkhorn, NE
KC7EDD **Inman**, Nancy J., Carson City, NV
K7LAZ **Hudson**, Harry W., Federal Way, WA
NJ7M **Lindsay**, Charles B. "Chuck," Boise, ID
WA7ND, •WA6ZYG, •AH6HZ **Conners**, Raymond R. "Rick," Poulsbo, WA
•KC7OGU **Bodine**, Merle W., Sun City West, AZ
K7OVW **Sloan**, Michael T., Cave Junction, OR
W7QJ **Rasmussen**, Stewart A. "Stu," Silverton, OR
W7TRG **Prowitz**, David P. "Dave," Elkhorn, WI
KB7UWV **Roy**, Robert M., Tempe, AZ
KF7UX **Ellis**, Robert L., Sr., Driggs, ID
K7VRU **Saladin**, James H., Reno, NV
KK7VZ **Youngs**, Michael R., Centerville, UT
•W7WQA **Hammond**, Carl E., Portland, OR
KC7YUI **Moore**, Vernard L., Boise, ID
KE8EKT **Ahola**, Dennis U., Otisville, FL
N8FVZ **Zaleski**, Gregory D. "Greg," Burton, MI
KA8IQJ **Powell**, Edsel R., Drummond Island, MI
W8JR **Robertson**, John A., Chillicothe, OH
KE8LBN **Graham**, Jan S., Flushing, MI
K8PFD **Treon**, Ronald C., Dublin, OH
KX8Q **Cook**, Robert A., Jr., Napoleon, OH
KD8SDR **Kluender**, Kenneth A. "Ken," Flint, MI
KE8TAK **Kirkwood**, Timothy A., Franklin, OH
K8TBW **Taylor**, William L., Fremont, OH
KB8YK **Fant**, Claude L., Hamilton, OH
W9AON **Berman**, Joseph H., Athens, OH
WE9C **Kemp**, Gene D., Hobart, IN
♦N9DGK **Miller**, Keith E., Sr., Murfreesboro, TN
K9DNF **Woehrle**, Frank R., Richfield, WI
N9ECY **Fritz**, Dennis B., Jasper, IN
N9FDF **Hoover**, Toby, Valparaiso, IN
•N9IOC **Filipiak**, Jacquelyn R., Sheboygan, WI
AC9JU **Bernhardt**, Robert A., Chippewa Falls, WI
WB9KSK **Scheuerell**, Chris J., Sun Prairie, WI
K9MMW **Husfield**, William G., Benton, KY
K9MRA **Soller**, Stephen W., Cedar Point, NC
KD9MZF **Morrissey**, David M., South Bend, IN
WB9NYG **Fleming**, Russell R., Waunakee, WI
•WB9OLI **Bissell**, Ralph C., Martinsville, IN
KF9PT **Nowak**, Joseph J., Beaver Dam, WI
W9SNS **Craig**, Robert S., McLean, IL
W9SOG **Pickett**, Myron L., Sacramento, CA
N9TMZ **Nichols**, Blakely D. "Blake," La Crescent, MN
W9UIJ **Larson**, Karl A., Rockford, IL
WA9VIQ **Ward**, John M., Tavares, FL
K9WED **Gryder**, Richard E., Kenosha, WI
♦WB9WUN **Larson**, James J., Wisconsin Rapids, WI
N9WXY **LeMay**, Riley A., Westville, IN
N9XXM **Byers**, Jeannie L., Columbia City, IN
•WØEVJ **Sable**, Francis H., Wamego, KS
KØJJV **Brooks**, James R., Hays, KS
KAØLYD **Clay**, Gail L., Jr., Broken Bow, NE
♦WBØNIU **Brom**, Erik W., Winona, MN
•KWØO **Ellis**, Robert O., Marion, IA
•WBØSJL **Wickham**, Raymond J. "Jim," Council Bluffs, IA
♦WØUNM **Price**, Charles N. "Norm," Grand Junction, CO
AAØUZ **Aye**, Jon H., Winona, MN
F6BVD **Pallesco**, Daniel, Longjumeau, France

The January 2022 Silent Keys column listed Richard Wright with the ex-call sign of W1UBC. The call sign should have been W1UC. *QST* regrets the error.

♦ Life Member, ARRL
♦ Maxim Society
♦ Current Diamond Club
• Former call sign

For information on how to list a Silent Key in *QST*, please visit **www.arrl.org/silent-key-submission-guidelines**.

Note: Silent Key reports must confirm the death by one of the following means: a copy of a newspaper obituary notice, a copy of the death certificate, or a letter from the family lawyer or the executor. Please be sure to include the amateur's name, address, and call sign. Allow several months for the listing to appear in this column.

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• Narrow Band and Direct Sampling SDR • Down Conversion, 9MHz IF Roofing Filters Produce Excellent Shape Factor • 5" Full-Color Touch Panel w/3D Spectrum Stream • High Speed Auto Antenna Tuner • Microphone Amplifier w/3-Stage Parametric Equalizer • Remote Operation w/optional LAN Unit (SCU-LAN10)

FT-991A | *HF/VHF/UHF All ModeTransceiver*

Real-time Spectrum Scope with Automatic Scope Control • Multi-color waterfall display • State of the art 32-bit Digital Signal Processing System • 3kHz Roofing Filter for enhanced performance • 3.5 Inch Full Color TFT USB Capable • Internal Automatic Antenna Tuner • High Accuracy TCXO

FTDX101D | *HF + 6M Transceiver*

• Narrow Band SDR & Direct Sampling SDR • Crystal Roofing Filters Phenomenal Multi-Signal Receiving Characteristics • Unparalleled - 70dB Maximum Attenuation VC-Tune • 15 Separate (HAM 10 + GEN 5) Powerful Band Pass Filters • New Generation Scope Displays 3-Dimensional Spectrum Stream

FT-891 | *HF+50 MHz All Mode Mobile Transceiver*

Rugged Construction in an Ultra Compact Body • Stable 100 Watt Output with Efficient Dual Internal Fans • 32-Bit IF DSP Provides Effective and Optimized QRM Rejection • Large Dot Matrix LCD Display with Quick Spectrum Scope • USB Port Allows Connection to a PC with a Single Cable • CAT Control, PTT/RTTY Control

FTM-300DR | *C4FM/FM 144/430MHz Dual Band*

• 50W Reliable Output Power • Real Dual Band Operation (V+V, U+U, V+U, U+V) • 2-inch High-Res Full Color TFT Display • Band Scope • Built-in Bluetooth • WiRES-X Portable Digital Node/Fixed Node with HRI-200

FT-2980R | *Heavy-Duty 80W 2M FM Transceiver*

• Massive heatsink guarantees 80 watts of solid RF power • Loud 3 watts of audio output for noisy environments • Large 6 digit backlit LCD display for excellent visibility • 200 memory channels for serious users

FT-818ND | *HF/6M/2M/440 All Mode Portable Xcvr*

• Ultra-Compact/Portable • Multi-Color Easy to See LCD • 208 Memory Channels/10 Memory Groups • Built-in Electronic Keyer • Internal Battery Operation Capability • Two Antenna Connectors • Built-in High Stability Oscillator ±0.5 ppm

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-5DR *C4FM/FM 144/430 MHz Dual Band*

• High-Res Full-Color Touch Screen TFT LCD Display • Easy Hands-Free Operation w/Built-In Bluetooth© Unit • Built-In High Precision GPS Antenna • 1200/9600bps APRS Data Communications • Supports Simultaneous C4FM Digital • Micro SD Card Slot

FT-65R | *144/430 MHz Transceiver*

Compact Commercial Grade Rugged Design • Large Front Speaker Delivers 1W of Powerful Clear Audio • 5 Watts of Reliable RF Power Within a compact Body • 3.5-Hour Rapid Charger Included • Large White LED Flashlight, Alarm and Quick Home Channel Access

FTM-6000R | *50W VHF/UHF Mobile Transceiver*

• All New User Operating Interface-E2O-III (Easy to Operate-III) • Robust Speaker Delivers 3W of Clear, Crisp Receive Audio • Detachable Front Panel Can Be Mounted in Multiple Positions • Supports Optional Bluetooth® Wireless Operation Using the SSM-BT10 or a Commercially Available Bluetooth® Headset

5 Ways to Shop!

- RETAIL LOCATIONS – Store hours 10:00AM - 5:30PM - Closed Sunday
- PHONE – Toll-free phone hours 9:30AM - 5:30PM
- FAX – All store locations
- ONLINE – WWW.HAMRADIO.COM
- MAIL – All store locations

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ID-52A

2m/70cm Analog/Digital Transceiver

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Quality you can trust

Waterfall Display

See Band Conditions Instantly

- Multi-function Analog/D-STAR 2m/70cm
- 2.3" Color Display with Waterfall band scope
- Dual D-STAR receive
- VV/VU/UU receive capability
- Bluetooth® enabled

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HAM-IV

The most popular rotator in the world!

HAM-IV **$799.95**

For medium communications arrays up to 15 sq. ft. wind load area. 5-second brake delay, Test/Calibrate function. Low temperature grease permits normal operation down to -30° F. Alloy ring gear for extra strength up to 100,000 PSI for maximum reliability. *Precision* indicator potentiometer. Ferrite beads reduce RF susceptibility. Cinch plug + 8-pin plug at control box. Dual 98 ball bearing race for load bearing strength, 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 **$1099.95** with DCU-2

HAM-VII **$1299.95** *with DCU-3*

TAILTWISTER SERIES II

T-2X **$999.95**

T-2XD2 **$1129.95** with DCU-2

T-2XD3 **$1199.95** with DCU-3

For large medium antenna arrays up to 20 sq. ft. wind load. 5-second brake delay, Test/Calibrate functions. Low temp grease, tough alloy ring gear, indicator potentiometer, ferrite beads on potentiometer wires, weatherproof AMP connectors plus 8-pin plug at control, triple bearing race (138 ball bearings) for large load bearing, electric locking steel wedge brake, North/South center of rotation scale meter, low voltage control, 2 1/16" mast.

MSHD, $159.95. Above tower heavy duty mast support. Accepts 1 7/8-2 5/8" OD.

CD-45II

CD-45II **$599.95**

For antenna arrays up to 8.5 sq. feet mounted inside tower or 5 sq. ft. with mast adapter. Low temperature grease good to -30 F degrees. *New* Test/Calibrate function. Bell rotator design gives total weather protection, dual 58 ball bearing race gives proven support. Die-cast ring gear, stamped steel gear drive, heavy duty, trouble free gear train, North center scale, lighted directional indicator, 8-pin plug/socket on control unit, snap-action control switches, low voltage control, safe operation, takes maximum mast size to 2 1/16 inches. MSLD light duty lower mast support included.

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

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

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

Hy-Gain Programmable DCU-3

Digital Rotator Controller

DCU-3 -- $599.95

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 --$519.95
Like DCU-3, but less programmable memories. 110 VAC.
Order DCU-2X, for 220 VAC.

AR-40 -- $499.95

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 desired location. Solid state, low voltage control, safe, silent operation. 2 1/16" max mast. MSLD low mast included.

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

Replace your Yaesu Rotator Controller

YRC-1 - $429.95

Hygain 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 minimises overshoot. Intuitive menu. Field upgradeable. For Yaesu G-800/1000/2800/G450/650. AC or DC motors.

YRC-3, $519.95. Like YRC-1 and adds 6 memories.

AR-500 Rotator/Controller -- $199.95

UHF/VHF/6-Meter, MFJ-1886 Rotator/Controller and Remote. For use of small VHF/UHF/6M, TV, FM, the MFJ-`886 wide band receiving loop and other lightweight ham antennas. Rotator is built in a weather proof one piece cast aluminum housing with precision 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.

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MFJ . . .the World Leader in Ham Radio Accessories!

MFJ G5RV Antennas

Operate all bands 10 thru 160 Meters with a single wire antenna!

MFJ-1778 $89.95

The *famous G5RV antenna is the most popular ham radio antenna in the world!*

It's an efficient, *all band* 102 foot long antenna -- shorter than an 80 Meter dipole. Has 32.5 foot ladder line matching section ending in SO-239 connector for your coax feedline.

Use horizontally or as Inverted Vee or Sloper with just one support. 1500 Watts.

Operate all bands 80-10 Meters with an antenna tuner and even 160M with ground.

Fully assembled with *ceramic* end and fiberglass center insulators. *Hang and Play™* -- add coax, rope to hang and you're on air!

MFJ-1778M, $79.95. *Half-size*, 52 foot *G5RV JUNIOR for limited space*. 40-10 Meters with tuner. Full 1500 Watts.

MFJ All Band Classic Doublet

MFJ-1777 $99.95

MFJ 102 foot *all band* doublet covers 160-6 Meters with balanced line tuner. Super strong custom fiberglass center insulator relieves stress on 100 foot ladder line. *Glazed ceramic* end insulators. 1500 Watts.

RF Isolator

MFJ-915 $59.95

MFJ-915 *RF Isolator* prevents unwanted RF from traveling on the outside of your coax shield into your transceiver. This unwanted RF can cause painful RF "bites" when you touch your microphone or volume control, cause your display or settings to go crazy, lock up your transceiver or turn off your power supply. In mobile installations, stray RF could cause your car to do funny things even blow your car computer. Clear up these problems, plug an MFJ-915 between your antenna and transceiver. 1.8-30 MHz, 1500 Watts. 5x2 inches.

MFJ-919, $74.95. 4:1 current balun,1.5 kW.

MFJ-913, $49.95. 4:1 balun, 300 Watts.

True 1:1 Current Balun & Center Insulator

MFJ-918 $59.95

True *1:1 Current Balun/ Center Insulator* forces equal radiator currents in dipoles for true dipole radiation pattern. Reduces coax radiation and field pattern distortion -- your signal goes where *you* want it. Reduces TVI, RFI and RF hot spots. *Don't build a dipole without one!* 50 hi-permeability ferrite beads on high quality RG-303 *Teflon*(R) coax and *Teflon*(R) SO-239. 1.5kW 1.8-30 MHz. Stainless steel hardware. 14 gauge stranded copper wire is *directly* connected to your antenna. 5x2 inches. Heavy duty weather housing.

2-Position Antenna Switch

MFJ-1702C, $54.95. 2-position antenna switch, lightning surge protection, center ground. SO-239s.

Lightning surge protectors. MFJ-270,

$29.95. 400W. **MFJ-272, $44.95.** 1500 W. Gas discharge tube shunts 5000 amps peak.< 0.1 dB loss. 1 GHz. SO-239s.

MFJ-16C06, $8.95. 6-pack *glazed ceramic* end/center ant. insulators.

MFJ-16B01, $29.95. Molded high-strength center insulator. SO-239.

MFJ-16D01, $11.95. 450 Ohm fiberglass end/center insulator with ladder line stress relief and SO-239 mount.

MFJ-18H100, $49.95. 100 feet, 450 Ohm ladder line, 18 gauge copper clad.

80-10 Meter End-Fed Half Wave antenna

Cover all HF bands with one single wire and no tuner!

MFJ-1982HP, $129.95

No tuner needed!
All band 80-10M EFHW antenna

Get-on-the air on all bands 80-10 Meters with just one wire and one support (pole or tree) and no tuner or long counterpoise.

Installs anywhere in minutes! Rugged *insulated*-wire radiator prevents detuning when contacting limbs/branches. *"No-snag"* end insulator slides over branches, leaves.

Toss over a high limb for inverted-V or sloper or go vertical with an inverted-L.

Dark jacketed wire is virtually invisible -- *don't let antenna restrictions keep you off the air!* Great for emergencies.

EFHWs naturally resonate on the 1/2-wave fundamental frequency and odd/even harmonics. Covers 80/40/30/20/17/15/12/10 Meters without traps, stubs or resonators.

Broad-band matching transformer at feed point gives SWR so low you may never need a tuner. Compensating inductor optimizes SWR. 800 Watts SSB/CW. 132 feet jacketed antenna wire.

MFJ-1984HP, $109.95. 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 $129.95 80/40 Meters

MFJ-17758, $119.95. Operate 80/40 Meters with a short 85 foot dipole. *Full-size* on 40 Meters with ultra-efficient end-loading on 80 Meters. 1500 Watts. Super-strong custom molded center insulator with SO-239 connector and hang hole. Ceramic end insulators. 7-strand, 14 gauge hard copper wire. *No tuner needed!*

MFJ-17754, $89.95. Like MFJ-17758 but is only 42 feet. Operate 40/20 Meters. *Full-size* on 20 Meters, ultra-efficient end-loading on 40 Meters. 1500 Watts.

Single Band Dipoles

MFJ-1779A $99.95 160M, 265 ft.

MFJ-1779B $79.95 80-40M, 135 ft.

MFJ-1779C $59.95 20-6M, 35 ft.

Ultra high quality center fed dipoles give years of trouble-free service. Custom injection-molded UV-resistant center insulator has built-in SO-239 and hanging hole. *Glazed* ceramic end insulators. 7-strand, 14-gauge hard copper antenna wire. 1500 Watts. Use horizontally or as sloper or inverted vee. Simply cut to length with provided cutting chart.

OCFD Dipoles

MFJ-2012 $109.95 1500 Watts

MFJ-2010 $89.95 300Watts

No tuner needed! MFJ ***Off-Center Fed Dipoles*** use MFJ's exclusive *ExactRatio™* RF broadband transformer to give low SWR and maximum bandwidth on 40/20/10/6 Meters. A Guanella current balun kills feedline radiation, pattern distortion, SWR shifts, RFI and noise pickup. Install anywhere and get the same predictable performance regardless of feedline length. You get ground reinforced gain over verticals. Use horizontally, inverted vee, sloper. 98% efficient, 14 gauge, 7-strand copper wire, ceramic end insulators.

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MFJ *Low-Noise Receiving* Loops

Work DX and ragchew even through horrendous noise!

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

Clearly hear signals 50 KHz to 30 MHz you never knew existed. Power line noise and static just disappears.

MFJ-1886 drastically reduces noise and interference by receiving the magnetic field and rejecting the electric field. Rotate MFJ-1886 receiving loop to totally eliminate interfering signals or greatly peak desired signal.

Excellent antenna and preamplifier balance gives deep null.

State-of-the-art push-pull Gali MMICs preamp gives you high dynamic range, low IMD and 25 dB of low noise gain.

Gives excellent strong and weak signal performance without overload.

Fully protected preamplifier -- magnetically coupled voltages up to 40V and capacitively coupled voltages up to 20V will not damage preamplifier.

Output is protected from transmission line surges induced by distant lightning.

Use anywhere, inside or outside. RF signal and power goes through your 50 Ohm coax.

Ruggedly built to withstand extreme weather. 1-inch OD diameter 6061 aluminum tubing. 36-inch diameter. 2½lbs. SO-239. Use masts up to 1¾ inches.

MFJ-1886, $319.95. Includes receive loop and MFJ-4116 bias-tee to power MFJ-1886 through coax.

MFJ-1886TR, $369.95. Includes MFJ-1886 and MFJ-4113TR Bias-Tee/Transmit/Receive switch. MFJ-4113TR powers MFJ-1886 through coax and switches between transmitting antenna and receiving loop. For radios with only one antenna connector.

MFJ-4116, $54.95. Bias-Tee provides RF signal and power through coax transmission line. Send up to 1A DC up to 50 Volts.

MFJ-4113TR, $129.95. Bias-Tee with built-in Transmit/Receive switch. Switches between transmitting and receiving antenna. For radios with only one antenna connector. Provides RF signal and power through coax.

Multi-coupler/Bias-Tee

New! **MFJ-1888MC, $239.95.** Connect four receivers to one antenna. Receivers are fully isolated. Each receiver port has 1-12 dB adjustable gain. IP3 is +15 dB. 2dB noise figure. Built-in Bias-Tee powers receiving loop through coax. SO-239s. Use 12 VDC or 110 VAC with MFJ-1312D, $24.95. RF tight, 7¼Wx1¾Hx5D inches.

Super High Dynamic Range High Gain Receiving Loop

New! **MFJ-1888, $459.95.** 32 dB gain from 50 KHz to 30 MHz. 20 dB gain at 80 MHz. IP3 is + 30 dB, 1 dB compression point is 23 dB, noise figure is 1.7 dB. Built-in BCB input filters to reduce overloading. Includes MFJ-1888MC remote multi-coupler. Can be used with MFJ-4113TR Bias-Tee/T/R switch and/or MFJ-4116 bias tee. 36-inch diameter. 2½ lbs. SO-239. Use masts up to 1¾ inches.

Antenna Rotator

Perfect for MFJ-1886/1786/1788 loop, VHF/UHF, small HF beams, TV, FM antennas.

AR-500 **$199.95** **Weather-proof** one piece cast aluminum housing with precision all metal gears, steel thrust bearings and automatic braking. Includes rotator, controller, remote control, clamps, hardware. Memories for 12 directions! Digitally displays position. 110/220 VAC.

Wipe out RFI

Wipe out RFI, noise, interference from any direction at any frequency with a 60 dB notch before it gets into your receiver!

MFJ-1026 **$269.95**

Eliminate power line noise, fluorescent lamps, light dimmers, computers, TVs, lightning, motors, industrial processes.

Null out QRM on rare DX and work him! Null out local ham or AM station to prevent receiver overload. Works on SSB, AM, CW, FM, digital BCB to lower VHF. Plugs between antenna and transceiver. 12VDC, 110VAC with MFJ-1312D, $19.95.

MFJ *Super High-Q™ Transmitting Loop* Antennas

MFJ 36-inch diameter transmitting loop antenna lets you operate 10-30 MHz continuously including WARC bands!

Ideal for limited space, HOA.

Work DX with low angle radiation and local close-in contacts with high angle radiation when mounted vertically. 150 watts.

Super easy-to-use! MFJ remote control auto tunes to your desired band. Fast/slow tune buttons, Cross-Needle SWR/Watt-meter lets you quickly tune to your exact frequency. No control cable needed.

***World's** most efficient small loop antenna has all welded construction, welded butterfly capacitor with no rotating contacts, large 1.050 inch diameter aluminum radiator for highest efficiency.*

Every capacitor plate is welded for extremely low loss and polished to prevent high voltage arcing. Nylon bearing, anti-backlash mechanism, limit switches, continuous no-step DC motor gives smooth precision tuning. Heavy-duty ABS plastic housing has ultraviolet inhibitor.

Cover 40-15 Meters. MFJ-1788, $699.95. Like MFJ-1786 but covers 40-15 Meters continuous. Includes remote control.

Portable Loop

MFJ-1780, $419.95. *Box fan loop with carrying handle, 24x24x 5¾". 20-10 Meters continuous, 150 Watts. Fast/slow tune remote control. Highly efficient all-welded construction.*

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MFJ Weather-Proof Window Feedthrough Panels

Weather-proof window feedthrough panels bring HF/VHF/UHF antennas, balanced lines, random wire antennas, ground, DC/AC power and Rotator/Antenna Switch Cables into your hamshack without drilling through walls!

made in USA

MFJ Weather-Proof Window Feedthrough Panels mount in your window sill. Lets you bring all your antenna connections into your hamshack without drilling holes through walls.

Simply place in window sill and close window. One cut customizes it for any window up to 48 inches. Use horizontal or vertical. Connectors are mounted on inside/outside stainless steel plates and attached to a 4 ft. long, 3½" high, 3/4" thick pressure-treated wood panel.

Real Western Red Cedar wood is naturally resistant to rot, decay and insects -- lasts longer, maintenance free. Pitch and resin free for a wide range of beautiful finishes or leave it in its naturally beautiful raw finish. Edges sealed by weather-stripping. Seals and insulates against all weather conditions. Includes window locking rod.

Inside/outside stainless steel plates ground all coax shields. Stainless steel ground post brings ground in.

MFJ-4603
$129.95

MFJ-4603 Universal Window Feedthrough Panel

Four 50 Ohm *Teflon*(R) SO-239 coax connectors let you feed HF/VHF/UHF antennas at full legal power limit.

A 50 Ohm *Teflon*(R) coax N-connector lets you use any antenna up to 11 GHz including 450 MHz, UHF, satellite, moon bounce and 2.4/5.8 GHz Wi-Fi antennas.

A 75 Ohm, 1 GHz F-connector makes it easy to bring in telvision, satellite, HFD cable TV and FM radio signals.

A pair of high-voltage ceramic feedthrough insulators lets you bring in 450/300 Ohm balanced lines directly to your antenna tuner.

Has random/longwire antenna ceramic feedthrough insulator.

5-way binding posts let you supply 50 Volts/15 Amps DC/AC power to your outside antenna tuners/relays/switches.

Stainless ground post brings in ground connection, bonds inside/outside stainless steel panels together and drains away static charges.

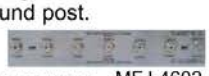
MFJ's exclusive *Adaptive Cable Feedthru*™ lets you bring in rotator/antenna switch cable, etc. without removing connectors (up to 1¼ x 1⅝ in.) Adapts to virtually any cable size. Seals out rain, snow, adverse weather.

3 Coax, Balanced Line, Random Wire

Best Seller! 3 *Teflon*(R) coax connectors for HF/VHF/UHF antennas. Separate high voltage ceramic feed-thru insulators for balanced lines and long wire/random wire. Stainless steel ground post.

MFJ-4601
$89.95

6 Coax



6 high quality *Teflon*(R) coax connectors for HF/VHF/UHF antennas. Stainless steel ground post. Full 1500 Watts.

MFJ-4602
$99.95

4 Balanced Line, 2 Coax

4 pairs of high-voltage ceramic feed-thru insulators for balanced lines and 2 coax connectors.

MFJ-4600
$109.95

5 Cables, any-size

5 Adaptive Cable Feedthrus™. Pass any cable with connector: 2 cables with large connectors up to 1¼x1⅝ inches and 3 cables with UHF/N size coax connectors. Seals out weather.

MFJ-4604
$134.95

All-Purpose FeedThru/CableThru™

Stacks MFJ-4603 and MFJ-4604! Gives you every possible cable connection you'll ever need through your window without drilling holes in wall -- including UHF, N and F coax connectors, balanced lines, random wire, ground, DC/AC power and cables of any size for rotators, antenna switches, etc.

MFJ-4605
$199.95

Bring cables thru eave of your house

MFJ-4616 shown with vent (not included) it replaces. *Six Holes*
$49.95

made in USA

MFJ-4613 shown with vent (not included) it replaces. *Three Holes*
$34.95

Replace standard house eave/sofitt air vents with these *MFJ AdaptiveCable™ Plates*.

Bring in coax, rotator, antenna switch, power cables, etc. of nearly any size up to 1¼x1⅝".

Sliding plates, rubber grommets adjust for virtually any cable size to seal out adverse weather, insects and varmints. Use existing vent hole, mounting screws and screw holes.

MFJ *AdaptiveCable*™ Wall Plates

MFJ-4614 *(Four Holes)*
$69.95

MFJ-4612 *(Two Holes)*
$49.95

MFJ's exclusive weather-sealed *AdaptiveCable™ Wall Plates* let you bring nearly any cable -- rotator, antenna switch, coax, etc. -- through walls without removing connectors. Pass cable connectors up to 1¼x1⅝". Slide plates adjust hole size to weather-seal virtually any cable. Rubber grommet seals out rain, snow, adverse weather. Kit includes 18 gauge *stainless steel* plates for wall side, sliding plates, rubber grommets, weather stripping and hardware. Models for one, two and four cables.

MFJ-4611 *(Single Hole)*
$34.95

made in USA

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MFJ Dummy Loads & SWR/Wattmeters

Dummy Loads

World's most popular Dry 300 Watt HF /VHF Dummy Load

Air-cooled, non-inductive resistor in a perforated metal housing; Has SO-239 connector. Full 300W for 30 seconds. Derating curve to 5 minutes. SWR below 1.1:1 to 30 MHz, 1.5:1 30 to 650 MHz. Compact 2¼x2¼x7 inches. MFJ-260C **$59.95**
MFJ-260CN, $69.95. With type "N" connector.

Dry 1.5 kW HF/VHF/UHF Dummy Load

Ham radio's most versatile 1.5 kW 50 ohm *dry* dummy load covers DC to 650 MHz. SWR 1.1:1 to 30 MHz, 1.3:1 to 650 MHz. Handles 1500W for ten seconds, 100W for 10 minutes. 3Wx 3Hx9D in. SO-239 connector. **MFJ-264N, $119.95.** With type "N" connector. MFJ-264 **$109.95**

Oil-Cooled 1 kW CW, 2 kW SSB 50-Ohm VersaLoad™

Run 1KW CW or 2 KW PEP for 10 minutes. Run *continuous duty* with 200 Watts CW or 400W PEP. Transformer oil included. SWR 1.2:1 to 30 MHz. Low SWR to 400 MHz. SO-239 connector. Safety vent with cap, carrying handle. 7½Hx6⅝D in. **MFJ-250X, $89.95.** No transformer oil. MFJ-250 **$109.95**

500 MHz, 100 Watt Dummy Load

Connects directly with built-in PL-259. Finned aluminum air-cooled heatsink. 15 Watts continuous, 100W peak. SWR < 1.5:1, DC-500 MHz. 1⅝ inch round by 3 inches long. **MFJ-262B, $74.95.** PL-259. 35 Watts continuous, 200W for 5-seconds. SWR< 1.2;1 DC-1 GHz. MFJ-261 **$39.95** *With PL-259* DC to 500 MHz

MFJ 2500W fan-cooled Dry Load

MFJ's 2500 Watt *fan cooled* load handles legal limit amps, 2500W average one minute on, ten minutes off, 300W continuous. DC- 6 Meters. SWR <1.25, 30 MHz; <1.4, 30-60 MHz. Detailed power curve. 12 VDC or 110 VAC. 8¼Wx4Hx 9½D in. SO-239s. 5 pounds. MFJ-265 **$279.95**

Switchable RF Dummy Load

Select 16.6, 25, 50, 100, 150 Ohm dummy loads. Test/calibrate your wattmeters, SWR accuracy. At 50 Ohms it handles 300 Watts for 30 seconds with SWR < 1.1, 60 MHz. SO-239. 4½Wx2¼Hx6½D in. Optional 12 VDC/110 VAC adaptor, MFJ-1312D, $24.95. MFJ-251 **$189.95**

3 GHz, 300 Watts Dry Dummy Load

New high-tech metal film resistor on large heavy-duty air-cooled heatsink. 300 Watts for ten seconds and 125W *continuously.* SWR < 1.1, 1 GHz; <1.2, 1.5 GHz; <1.5, 3 GHz. N-connector. 10¾Wx2¼Hx5¼D inches. MFJ-263 **$169.95**

1.5kW Dry DummyLoad/SWR/Wattmeter

Tune up your transceiver, linear amplifier or antenna tuner into a safe 50 Ohm dummy load at *full power*. Then instantly switch to your antenna and monitor SWR, forward and reflected power on lighted cross-needle meter. 300/3000 Watt ranges. DC-60 MHz.Test/tune Xceivers, amps, tuners, baluns, filters, coax, stubs. MFJ-267 **$219.95**

SWR/Wattmeters

Compact Cross-Needle SWR/Wattmeters

Large 3-inch *lighted* Cross-Needle meter covers 1.8-200 MHz in 30/300W power ranges. Read forward, reflected power, SWR *simultaneously*. 3¼Wx3¼H x3¼D in. SO-239 connectors. MFJ-822 **$79.95**
MFJ-842, $79.95. 140-525 MHz, 15/150W.

High-accuracy 1.8-60 MHz Digital SWR/Wattmeter

Highly accurate! Auto-ranging select 25W, 250W, 1500W ranges with *full 10-bit* resolution. Frequency compensated data insures highest accuracy. *True* peak/average forward/reflected power, SWR and frequency are *simultaneously* displayed on backlit LCD and large 3-inch lighted cross needle meter. Peak hold. LED, buzzer, amplifier-bypass alerts and protects your amplifier when SWR is high and toggles extra relay. 6½Wx2⅝Hx6D". MFJ-828 **$299.95**
MFJ-826B, $229.95. No meter, ampr bypass, control relay.

MFJ GrandMaster™ SWR/Wattmeters

GrandMaster™ SWR/Power Meters are *the Cadillacs of ham radio!* Large 3¼x1¼ inch precision illuminated meter gives easy wide-angle viewing of SWR, forward or reflected power. 7½Wx3⅛Hx4¼D in. SO-239s. MFJ-870 **$119.95**
MFJ-870, $119.95. 1.6-60 MHz. 30/300/3000 Watt ranges.
MFJ-874, $159.95. 1.8-525 MHz. 5/20/200 Watt ranges.

MFJ *giant* 6.5 inch SWR/Wattmeter

World's *largest* HF+6M SWR/Wattmeter has *giant* 6½ inch meter! Extra-long scales gives highly accurate SWR/power 1.8-54 MHz. Huge numbers make reading easy. *True* peak or average forward and reflected power. 20/200/2000 Watt ranges. 9 Volt battery, 12 VDC or 110 VAC with MFJ-1312D, $24.95. 7Wx5½Hx5D in. SO-239s. MFJ-868B **$199.95**

VHF SWR/Wattmeter plus Field Strength

World's most popular -- and most affordable -- VHF SWR/Wattmeter. Read SWR, forward and reflected power over 144-220 MHz in two ranges, 30/300W. Built-in field strength meter for 1-220 MHz. 4½Wx2¼Hx3D". MFJ-812B **$64.95**

Compact Digital SWR/Wattmeters

Displays forward, refelected power, SWR (1.6-60 MHz) and battery *all in a single glance!* Large 1/2" forward power digits and 5/8" reflected/SWR digits! 0-200W. Power/backlight on/off. SO-239s. MFJ-845 **$139.95**
MFJ-847, $139.95. 125-525 MHz, 0-120W.

MFJ-849, $219.95. Large 3.5" bright orange LCD displays SWR, forward/reflected power. 1.5-525 MHz, 200W, HF/VHF-UHF switch.

MFJ HF QRP SWR/Wattmeter

Read forward, reflected power 1.8-50 MHz, 0-5W. Also reads SWR, relative power 100 mW to 50W. SO-239s. 4½Wx 2¼ H x3D in. MFJ-813 **$64.95**

VHF/UHF SWR/Wattmeter

Lighted Cross-Needle,SWR/Watts, 144/220/440 MHz, 30/300W Forward power, 6/60W Reflected power. MFJ-862 **$99.95**

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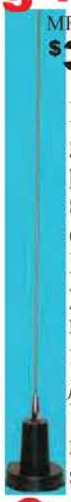
MFJ-1724B **$39.95** **MFJ-1724B** 2-Meter/440 MHz antenna is perfect for your dual band mobile or HT. Powerful 3½ inch magnet holds firm at highway speeds, rubber guard, 19" black stainless steel whip, low SWR, excellent gain, 300 Watts PEP, 12 feet coax with PL-259. *Free* BNC adapter.

MFJ-1729 **$54.95** **MFJ-1729** ***Power*Gain***™ Ham Radio's most powerful dual band antenna gives whopping gain on 440 MHz and 2-Meters! Low SWR. 27½" stainless steel *Slimline*™ radiator minimizes wind vibration for less SWR flutter for longer range, better readability. 12' coax, PL-259, Heavy duty magnet mount.



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MFJ *Super-Strong* Magnet Mounts with Coax/PL-259

MFJ 5-inch Magnet

MFJ-335BS SO-239
MFJ-335BM NMO
MFJ-335BT 3/8 - 24 For HF sticks
$29.95 Each

Best Seller! **These** jet-black ***5-inch*** *super strong* magnet mounts have 17' coaxial line terminated with PL-259 connectors. SO-239 (BS) or NMO (BM) for your VHF/UHF antennas or 3/8-24 threaded (BT) for your HF hamstick antennas with a 3/8-24 threaded connector.

MFJ 3-inch Magnet

MFJ-333BS pictured **$24.95 Each**

3-inch black magnet antenna mounts. 17 foot coax is terminated with PL-259 connector. Choose SO-239 (**BS**) or NMO (**BM**). For VHF/UHF lightweight antennas.

MFJ SMA/BNC Cables, $24.95

Release strain on your HT's antenna connector! 3 ft. flexible, mini coax with SO-239 connector.

A.MFJ-5612S SMA Male.
B.MFJ-5612SF SMA Female Wouxun/Baofeng.
C.MFJ-5612B BNC Male.

MFJ Triple 5" Magnets

$49.95 Each
MFJ-336S SO-239
MFJ-336M NMO
MFJ-336T 3/8x24

Three super-strong 5-Inch Magnets make up this MFJ *Goliath*™ Tri-Magnet Mount. 1/4" thick steel triangle base. 17' coax. Select SO-239, NMO, 3/8-24 antennas. **Caution:** once on, it's difficult to get off!

HF/VHF/UHF 200 Watt Duplexers

MFJ-916B **$39.95** **Use** separate HF/VHF and 440 MHz UHF antennas with single transceiver ***OR*** use two separate HF/VHF and 440 MHz UHF transceivers with a single HF/VHF/UHF antenna. Heavy-duty diecast enclosure houses low/high pass networks that separate/combine HF/VHF/UHF signals. Low loss SO-239s. 50 Ohm ports. **MFJ-916BC, $79.95** 3 ft. coax pigtails on 2-port side.

1.8-200 MHz SWR/Wattmeter

MFJ-822 1.8-200 MHz **$79.95** MFJ-842, 140-525

Compact 1.8-200 MHz SWR/Wattmeter has HUGE 3" *Cross-Needle* meter. Read forward/reflected power and SWR simultaneously. Perfect for mobile/portable. 30/300 Watt ranges. Built-in meter light. SO-239s. 3¼Wx3¼Hx3¼D". **MFJ-842, $79.95** covers 140-525 MHz, 15/150 Watts.

VHF/UHF Hi-Gain Antennas

A. MFJ-1402, $44.95. ***VHF/UHF RuffRiderJunior***™. Premium, short 16½" antenna fits in any garage on any auto. ¼ Wave on 2 Meters, ½ Wave, gain on 440 MHz. 100W. No foldover. B or C.

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C. MFJ-1422, $49.95. ***VHF/UHF RuffRider High Gain***™. 41½ inch long antenna gives extra gain with little height increase. Handles 150 Watts. ½ wave with good gain on 2 Meters, ⅝ wave, excellent gain on 440 MHz. Black or chrome.

D. MFJ-1432, $74.95. ***VHF/UHF RuffRider Hyper Gain***™. 62½" brute gives whopping gain on ⅞ Wave 2-Meters, ⅝ Wave and a *MONSTER* gain on 440 MHz. MFJ will rock your ham radio world! 150 Watts. Use tri-magnet. Black or Chrome.

MFJ Mobile HF *Ham Sticks*

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MFJ-1660T - 60 Meters
MFJ-1640T - 40 Meters
MFJ-1630T - 30 Meters
MFJ-1620T - 20 Meters
MFJ-1617T - 17 Meters
MFJ-1615T - 15 Meters
MFJ-1612T - 12 Meters
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Each is ruggedly constructed. A heavy duty 4', ⅜ inch diameter fiberglass rod; a nearly indestructible .125 inch diameter PH-17-7 stainless steel whip and chrome plated brass fittings will give you years of service. It's sleek, low profile construction has low wind loading and its semi-rigid fiberglass eliminates the need for springs or guys.

Black anti-static jacket protects loading coil, blends with any vehicle. Stainless steel whip is adjustable for lowest SWR. Push it down to park in the garage or fully extend it for maximum efficiency during mobile operation.

Includes allen wrench and complete tuning and matching instructions. Handle 250 Watts PEP. Whips are 7 feet fully extended, and collapse to about 4 feet for easy storage. **Simply** screws into any 3/8 x 24 female mount for quick band-changing. Get them all for great band coverage!

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MFJ-343, $19.95. Tough 3/8-24 hard mount for permanent installation.

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Read Complex Impedance as series resistance and reactance (R+jX) or as magnitude (Z) and phase (degrees).

Determine velocity factor, coax cable loss in dB, length of coax and distance to short/open.

Read SWR, return loss and reflection coefficient at any frequency simultaneously.

Read inductance (uH) and capacitance (pF) at RF frequencies.

Large easy-to-read two line LCD screen and side-by-side meters clearly display your information.

Built-in frequency counter, Ni-MH/Ni-CD charger circuit, battery saver, low battery warning, smooth reduction drive tuning.

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MFJ-249D does everything MFJ-259D does with digital display only.

MFJ-269D . . . 280 KHz - 230 MHz plus 415-470 MHz, 12-bit A/D

New and improved. Now covers 280 KHz to 230 MHz and 415 to 470 MHz and 2200 Meter band!

Instantly gives you a complete picture of your antenna.

Read SWR, return loss, reflect-ion coefficient, match efficiency at any frequency simultaneously.

Read Complex Impedance (100 KHz to 230 MHz) as series equivalent resistance and reactance (Rs+jXs) or as magnitude (Z) and phase (degrees). Also reads parallel equivalent resistance and reactance (Rp+jXp).

Determine velocity factor, coax loss in dB, length of coax and *distance to short or open in feet (it's like a built-in TDR).*

New!

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Coax Calculator™ calculates coax line length in feet given degrees and vice versa for any frequency, velocity factor.

Measure SWR and loss of coax with *any* characteristic impedance (280 KHz to 230 MHz) from 10 to over 600 Ohms.

Measures inductance in uH and capacitance in pF at RF frequencies, 100 KHz to 230 MHz.

High contrast LCD gives precision readings and two side-by-side analog meters make antenna adjustments smooth and easy.

12-bit A/D converter gives much better accuracy and resolution than common 8-bits -- *MFJ-269D exclusive!*

Built-in frequency counter, battery saver, low battery warning, Ni-Mh/NiCd charge circuit. 4Wx2Dx6¾", 2 lbs. Use ten aA batteries or 110 VAC with MFJ-1312D, $26.95.

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MFJ-223 1-60 MHz Color Graphic VNA Analyzer

MFJ-223 **$349.95**

This *pocket-sized wonder* breaks the mold for analyzer design with user-friendly convenience, top notch accuracy, and a vivid TFT multi-color display. Don't let the size fool you, it's packed with VNA features and performance you need!

- **Single-frequency** and *swept-frequency* operation
- **Truly accurate** SWR, R, X, and Z measurements
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- **Powerful +5-dBm** stimulus generator
- **Field-strength meter**
- **DDS generator** precision signal source
- **Vivid 1600-pixel/inch** color graphics on a 2x2 inch non-glare TFT screen

MFJ-225 1.5-180 MHz *continuous* Two-Port Graphic Analyzer

MFJ-225 **$349.95**

Out in the field, the MFJ-225 is a compact completely *self-contained handheld graphing analyzer.* On the bench it becomes a full-fledged two-port (S21) desktop machine when teamed up with your PC. Using powerful IG-miniVNA freeware, you'll run de-tailed data analysis and print out stunning color-graphic plots to document your work! Built-in back-lighted *3-inch LCD graphic* display. Make fine adjustments using full-screen easy-to-view SWR bargraph, capture vivid swept displays for SWR, impedance, re-turn loss, phase angle, more. DDS generator.

SWR Analyzer Accessories

A. MFJ-29D/MFJ-39D, $44.95. Carrying Pouch for MFJ-259D/269D.

B. MFJ-92AA10, $44.95. 10-Pk 2500 mAh Ni-MH Supercells.

C. MFJ-66, $44.95. Dip coils, set of two covers 1.8-230 MHz.

D. MFJ-731, $134.95. Tunable Analyzer Filter, 1.8-30 MHz, for strong RF fields.

E. MFJ-917, $54.95. 1:1 Current balun for SWR Analyzers to test balanced line antennas, other loads.

F. MFJ-7737, $8.95. PL-259 to BNC Female.

G. MFJ-7727, $8.95. PL-259 to SMA Female.

H. MFJ-5510C, $19.95. 12VDC cigarette lighter adapter.

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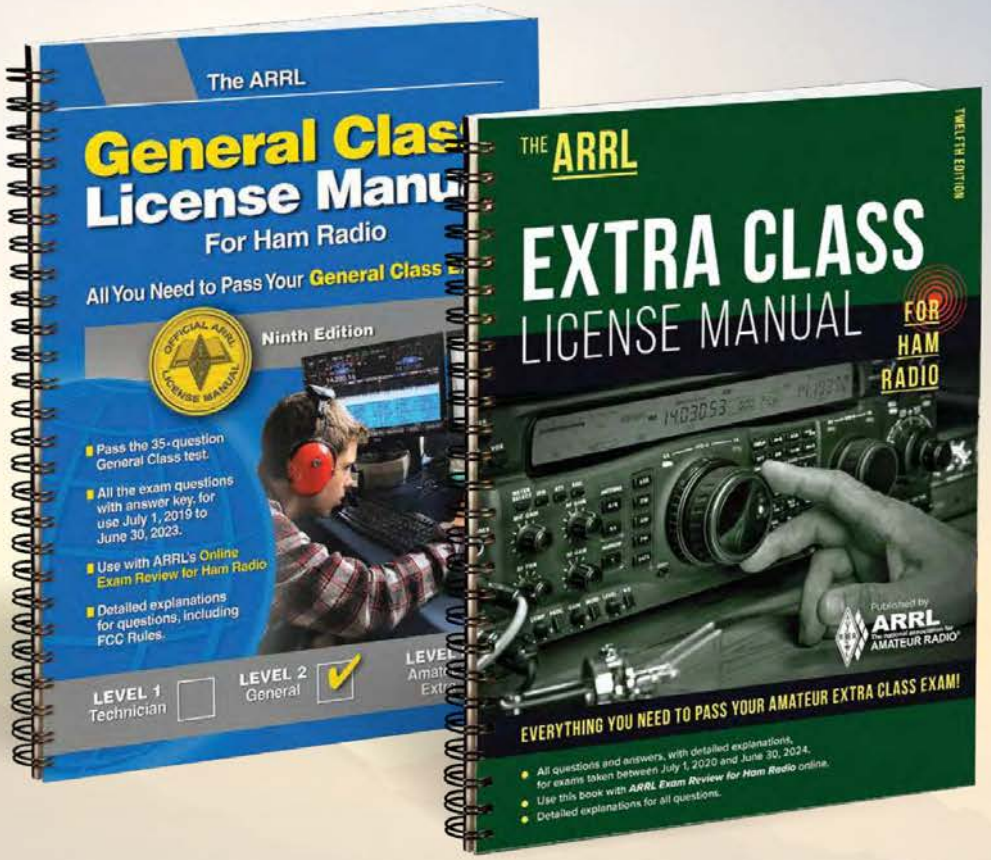

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600 Watt MFJ Automatic Antenna Tuner

MFJ-994B, $409.95. Like MFJ-993B but handles 600 Watts SSB/ CW/Digital, matches 12-800 Ohms. 10,000 memories. Doesn't have LCD, antenna switch, balun, audio SWR meter. 10Wx2¾Hx9D inches.

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Extra *wide matching range at less cost.* MFJ's *exclusive* dual power level: 300 Watts for 6-1600 Ohms; 150Watts for 6-3200 Ohms. Cross-Needle SWR/Wattmeter.

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200 Watt ...Compact

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Matches IC-706, FT-857D, TS-50S

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1200/9600 bps AX.25 Packet
Available with USB or RS-232 connection

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Proven FTDI Chip. 9 and 25 pins for all radios, TNCs, Rotor Controllers & more!

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MFJ Antenna Tuners

New, Improved MFJ-989D 1500 Watt Legal Limit Antenna Tuner

World's most popular 1500W Legal Limit Tuner just got better -- *much better* -- gives you more for your money!

New, Improved MFJ-989D legal limit antenna tuner gives you beter efficiency, lower losses and a new true peak reading meter. It easily handles full 1500 Watts SSB/CW, 1.8 to 30 MHz, including MARS/WARC bands.

New, dual 500 pF air variable capacitors give you twice the capacitance for more efficient operation on 160/80 Meters.

New, improved *AirCore*™ Roller Inductor gives you lower losses, higher Q and handles more power more efficiently.

New, *TrueActive*™ peak reading Cross-Needle SWR/Wattmeter lets you read true peak power on all modes.

MFJ-989D, $499.95

New, high voltage current balun lets you tune balanced lines at high power with no worries.

New, crank knob lets you reset your roller inductor quickly, smoothly and accurately.

New, larger 2-inch diameter capacitor knobs with easy-to-see dials make tuning much easier.

New, cabinet maintains components' high-Q. Generous air vents keep components cool.

12⅞Wx6Hx11⅝D inches.

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

The MFJ-989D uses the superb time-tested T-Network. It has the widest matching range and is the easiest to use of all matching networks. Now with MFJ's new 500 pF air variable capacitors and new low loss roller inductor, it easily handles higher power much more efficiently.

***No Matter What*™ Warranty**

Every MFJ tuner is protected by MFJ's famous one year *No Matter What*™ limited warranty. We will repair or replace your MFJ tuner (at our option) for a full year.

MFJ-986 Two Knob *Differential-T*™

MFJ-986, $449.95

Two knob tuning (differential capacitor and *AirCore*™ roller inductor) makes tuning fooolproof and easier than ever. Gives minimum SWR at only one setting. Handles 3 kW PEP SSB amplifier input power (1.5 kW output). Gear-driven turns counter, lighted peak/average Cross-Needle SWR/Wattmeter, antenna switch, balun, 1.8 to 30 MHz. 15Wx4½Hx10¾D".

MFJ-962D compact kW Tuner

MFJ-962D, $399.95

A few more dollars steps you up to a kW tuner for an amp later. Handles 1.5 kW PEP/SSB amplifier input power (800W output). Ideal for Ameritron's AL-811H. *AirCore*™ roller inductor, gear-driven turns counter, peak/avg lighted Cross-needle SWR/Wattmeter, antenna switch, balun, Lexan front, 1.8 to 30 MHz. 10⅞Wx14½Hx10¾D".

MFJ-969 300W Roller Inductor Tuner

MFJ-969, $299.95

Superb, *AirCore*™ roller inductor. Covers 6 Meters through 160 Meters! 300 Watts PEP SSB. Active true peak reading lighted Cross-Needle SWR/WAttmeter, *QRM-Free PreTune*™ antenna switch, dummy load, 4:1 balun, Lexan front. 10½Wx3½Hx9½D".

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More hams use MFJ-949s than any other antenna tuner in the world! Handles 300 Watts, full 1.8-30 MHz coverage, custom inductor switch, 1000V tuning capacitors, full size peak/average lighted Cross-Needle SWR/Wattmeter, 8 position antenna switch, dummy load, *QRM-Free PreTune*™, scratch proof Lexan front panel. 10⅝Wx3½Hx7D".

MFJ-949E, $249.95

MFJ-948, $219.95. Econ-omy version of MFJ-949E, less dummy load.

MFJ-941E Super Value Tuner

Most for your money! 300 Watts PEP, 1.8-30 MHz, lighted Cross-Needle SWR/Wattmeter, 8-position antenna switch, 4:1 balun, 1000 Volt capacitors, Lexan front panel. 10½Wx2½Hx7D". **MFJ-941EK, $159.95.** Tuner Kit -- *Build your own!*

MFJ-941E, $199.95

MFJ-945E HF/6M mobile Tuner

Extends your mobile antenna bandwidth so you don't have to stop, go outside and adjust your antenna. Tiny 8Wx2Hx6D". Lighted Cross-Needle SWR/Wattmeter, Lamp and Bypass switches. Covers 1.8-30 MHz and 6-Meters. 300 Watts PEP. **MFJ-20, $13.95**, mobile mount.

MFJ-945E, $189.95

MFJ-971 portable/QRP Tuner

Tunes coax, balanced lines, random wire, 1.8-30 MHz. Cross-Needle Meter, SWR, 30/300 or 6 Watt QRP ranges. Matches popular MFJ rigs. Tiny 6½Wx2½Hx6D".

MFJ-971, $179.95

MFJ-901B smallest Versa Tuner

MFJ's smallest (5Wx2Hx6D") and most affordable wide range 200 Watt PEP Versa Tuner. Covers 1.8 to 30 MHz. Great for matching solid state rigs to linear amps.

MFJ-901B, $149.95

MFJ-902B Tiny Travel Tuner

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MFJ-902B, $149.95

MFJ-16010 random wire Tuner

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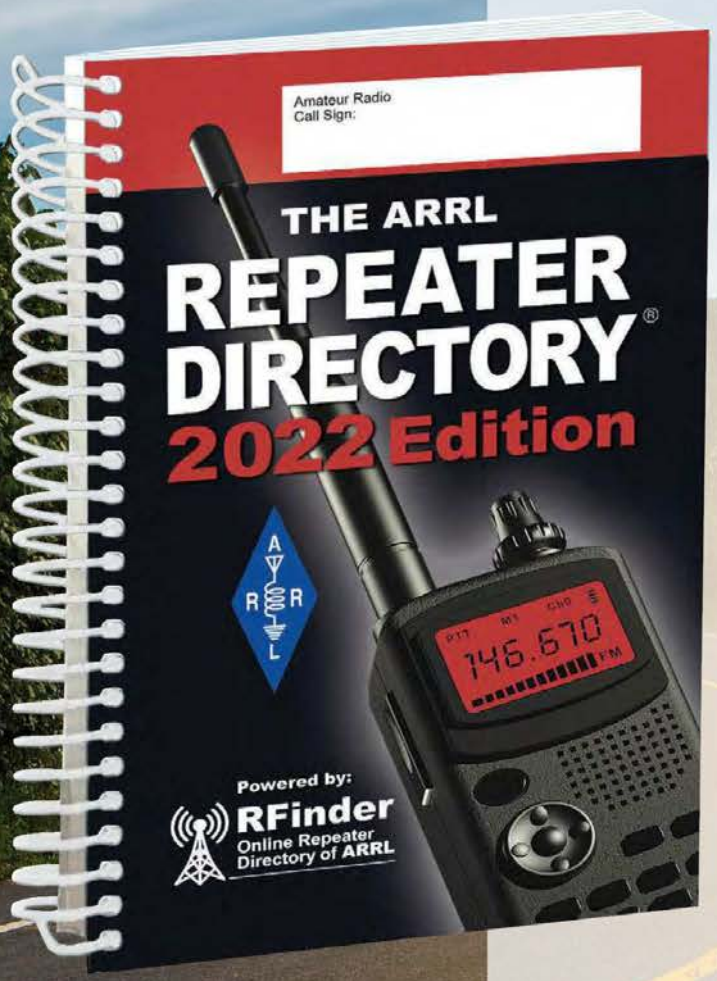

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QST Index of

Advanced Specialties – www.advancedspecialties.net 100
Air Boss/Olah Technologies– www.olahtechnologies.com 104
Alfa Radio Ltd – www.alfaradio.ca 102
Alinco - www.alinco.com..... 104
Alpha Delta Radio Communications, LLC – www.alphadeltaradio.com 125
Ameritron – www.ameritron.com 17
Arcom Communications – www.arcomcontrollers.com 102
Array Solutions – www.arraysolutions.com 12
ARISS – www.ariss-usa.org/donate... 104
ARRL – www.arrl.org 100, 110, 116, 120, 122
BeLoud.US – www.beloud.us..... 100
Bioenno Power – www.bioennopower.com 126
BridgeCom Systems – www.BridgeComSystems.com ..... 22, 23, Cover III
Buckmaster International LLC – www.hamcall.net 127
Cable X-Perts, Inc. – www.CableXperts.com 114
California Peripherals & Components, Inc. – www.Californiapc.com 126
Cushcraft – www.cushcraftamateur.com 2
Dr.Duino – www.drduino.com 26, 27
Diamond Antenna – www.diamondantenna.net 8
DX Engineering – www.DXEngineering.com 25
Elecraft – www.elecraft.com 19
Elk Antennas – www.ElkAntennas.com 126
Expert Linears America, LLC – www.ExpertLinears.com 125
FlexRadio Systems – www.flex-radio.com 21
Geochron® – www.geochron.com/ham-radio-4k/ 102
Global TSCM Group, Inc. – www.kn2c.us 110
Green Heron – www.greenheronengineering.com 110
Ham Ads – www.arrl.org/ham-ad-listing 124
Ham Radio Outlet – www.hamradio.com 98, 99
Hammond Mfg. Co. – www.hammondmfg.com 106
Heathkit: A Guide to the Amateur Radio products – www.www.wa7zze.com 114
Hy-Gain – www.hy-gain.com 10, 103
ICOM America – www.icomamerica.com 101
Island Amplifier USA – www.islandampliflier.com 100

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K6IOK – www.k6iok.com 126
Kenwood Communications – www.kenwood.com/usa/ ..... Cover IV, 29
LDG Electronics – www.ldgelectronics.com 102
MFJ Enterprises – www.mfjenterprises.com ..... 105, 107 ,109, 111, 113, 115, 117, 119, 121, 123
Mosley Electronics – www.mosley-electronics.com 104
NCG Company – www.natcommgroup.com 3, 6
OCI-Olds Communications Inc. – www.ocicom.com 127
Pacific Antenna – www.qrpkits.com 104
Palomar Engineers – www.Palomar-Engineers.com 114
Penta Laboratories – www.pentalabs.com 100
PreciseRF – http://preciserf.com 11
PreppComm – www.preppcomm.com 106
Quicksilver Radio Products – www.qsradio.com 112
RF Parts Company – www.rfparts.com 127
RT Systems – www.rtsystems.com 104
SteppIR Communications Systems – www.steppir.com 7
Tac-Comm – www.tac-comm.com 106
Ten-Ten International Net, Inc. – www.ten-ten.org 104
Tigertronics – www.tigertronics.com 114
Timewave Technology, Inc. – www.timewave.com 118
VHQ Hex Antenna Products – www.vhqhex.com 110
W5SWL Electronics – www.w5swl.com 114
WA3RNC – www.wa3rnc.com 100
Warren Gregoire & Associates – www.superbheadsets.com 126
West Mountain Radio – http://www.westmountainradio.com 18
Wireman – www.coaxman.com 104
Yaesu USA – www.yaesu.com ..... Cover II, 1

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